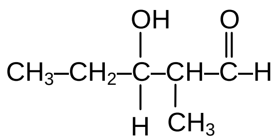
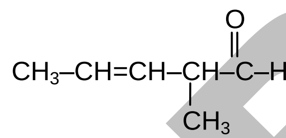
IIT-JEE CHEMISTRY BY N.J. SIR ORGANIC CHEMISTRY

DAILY PROBLEM PRACTICE SHEET

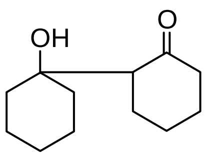
Q.1 Name reactions

(I) 

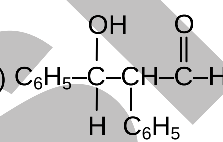
(A)



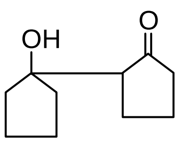
(B)

(II) 

(C)

(III) 

(D)

(IV) 

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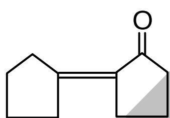
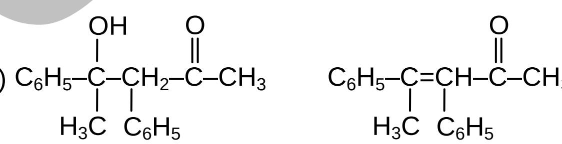
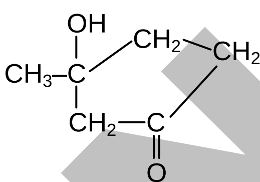


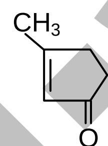
(F)

(V) 

(G)

Q.2 (I) 

(A)



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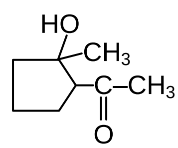
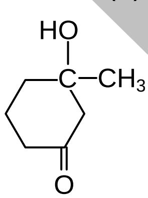
(II) 

(III) 

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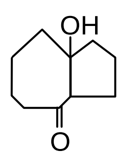
(IV) 

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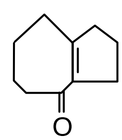
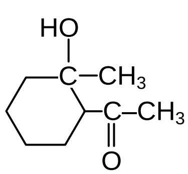


(F)

(V) 

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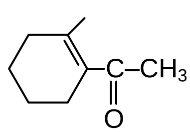

(H)

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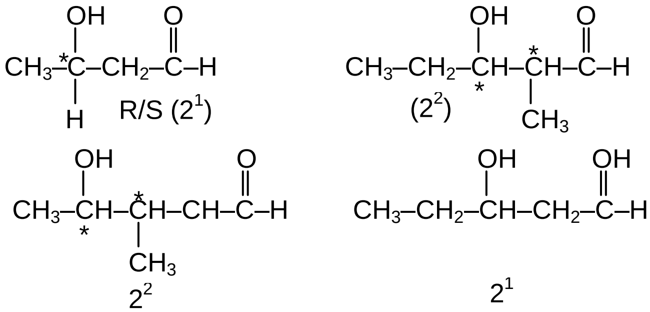
Q.3 (I)



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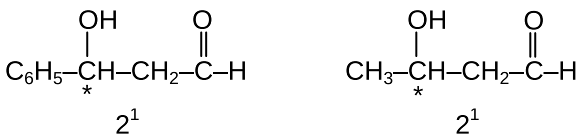

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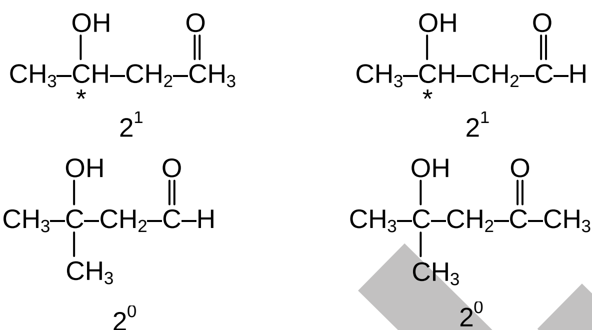

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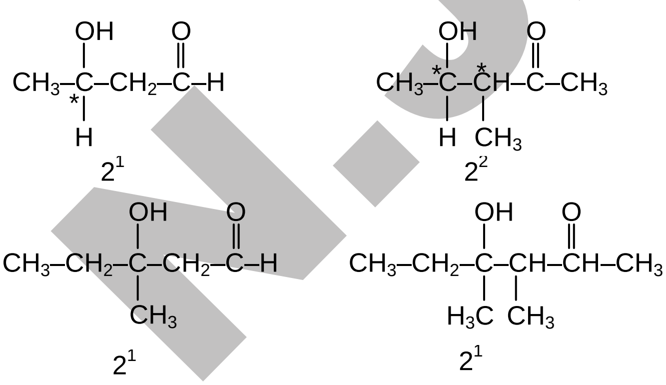

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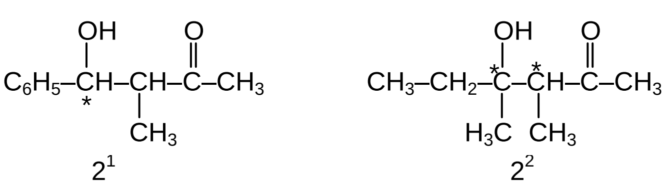
(V)



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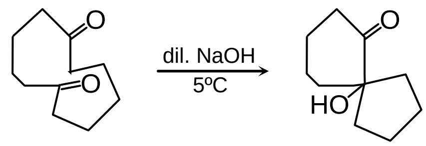
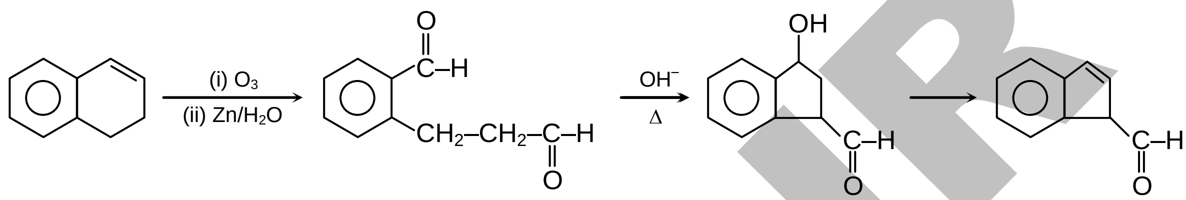
Q.4 (I)



(A) (B)

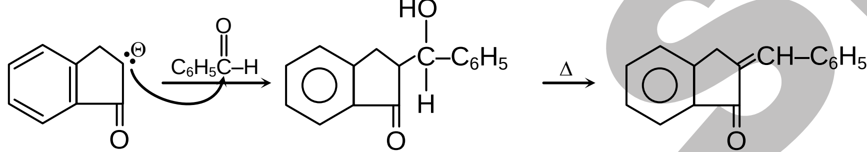
(II) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[5^oC]{\text{dil. NaOH}} CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\underset{CH_3}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-CH_3$

Q.5 (a)



(A) (B)

(b)



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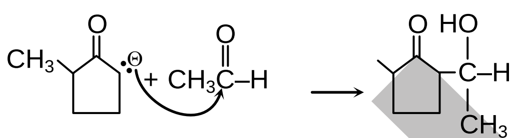

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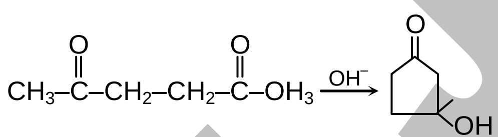

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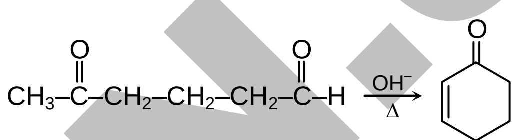
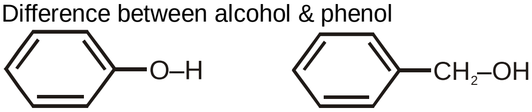


Alcohol and Phenol

Alcohol

$\longrightarrow$ 1. Lewis Base
2. Nucleophiles
3. Polar protic solvents

→ Difference between alcohol & phenol



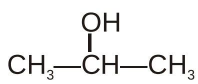
Phenol alcohol

partial double bond character between C & O

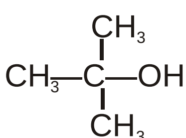
→ high boiling point & water solubility due to Hydrogen bonding.

Classification →

→ $CH_2 — CH_2 — OH$
1° – alcohol
(primary alcohol)



2°– alcohol
(Secondary alcohol)



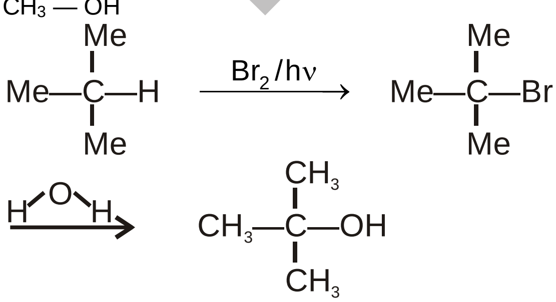
3°– alcohol
(tertiary alcohol)

→ $CH_2 = CH – OH$ (vinylic alcohol)
$CH_2 = CH – CH_2 – OH$ (allylic alcohol)

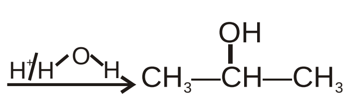
<u>General Methods of preparation</u>

(1) from alkanes

$CH_4 \xrightarrow{Cl_2/h\nu} CH_3 — Cl \xrightarrow{aq.KOH}$
$CH_3 — OH$

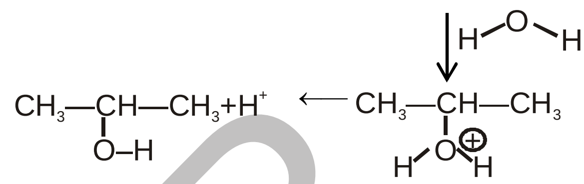


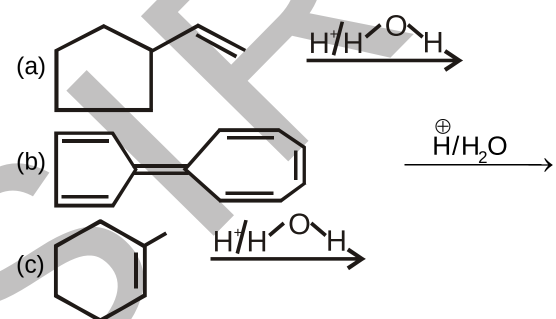
(2) from alkenes

(i) $CH_3 — CH = CH_2$ 

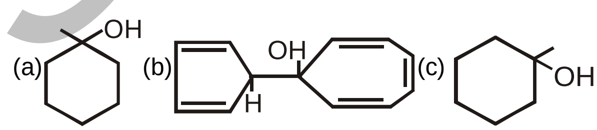
acid catalysed hydration

$CH_3 – CH = CH_2 + H^+ \longrightarrow CH_3 + \overset{+}{C}H – CH_2 – H$

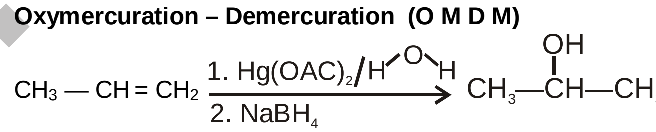




Ans.

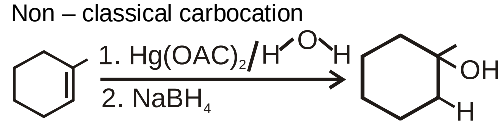


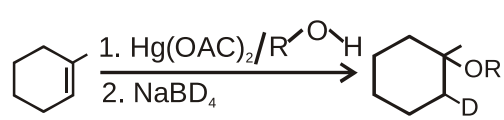
Oxymercuration – Demercuration (O M D M)

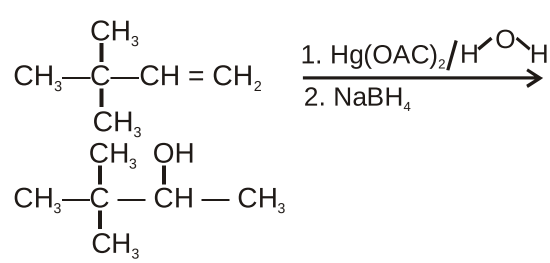


(n – hexane or paraffin solvent)

Features:–
(1) Markownikoff addition
(2) No. Rearrangement
(3) Non – classical carbocation

(1) 

(2) 

(3) 

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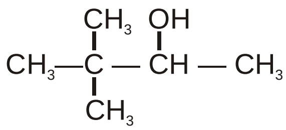
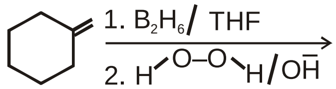
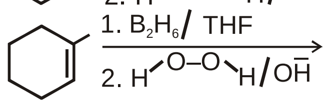
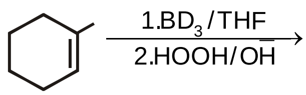
Ans. **(3)** 

Hydroboration – oxidation

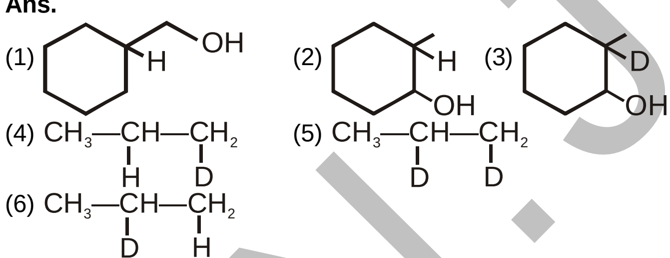
$$CH_3-CH=CH_2 \xrightarrow[2.\ H-O-O-H/\overline{O}H]{1.\ BH_3/THF} CH_3-CH_2-CH_2-OH$$

Features
1. anti markownikoff addition
2. No. Rearrangement

Ex:–

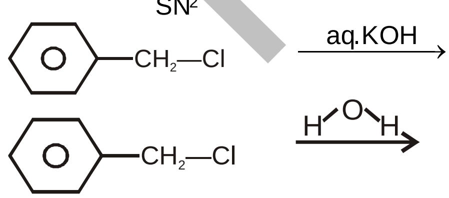
1. 
2. 
3. 
4. $CH_3-CH=CH_2 \xrightarrow[2.CH_3-COOD]{1.B_2H_6/THF}$
5. $CH_3-CH=CH_2 \xrightarrow[2.CH_3-COOD]{1.B_2D_6/THF}$
6. $CH_3-CH=CH_2 \xrightarrow[2.CH_3-COOH]{1.B_2H_6/THF}$

Ans.



(3) from alkyl halides

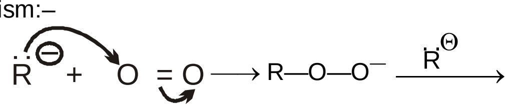
$$R-X \xrightarrow[SN^2]{aq.KOH} R-OH$$



(4) from grignard reagent

$$2\ R\ mg \times \xrightarrow[2.H^+/H_2O]{1.\ O_2} 2\ R-OH$$

Mechanism:–



$$R-O^{\ominus} + RO^{-} \xrightarrow{H^+/H_2O} R-OH + R-OH$$

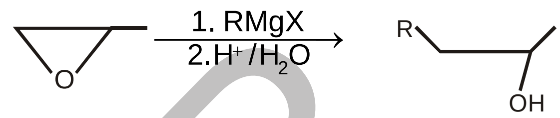
(5) Conversion of lower alcohol into higher alcohol

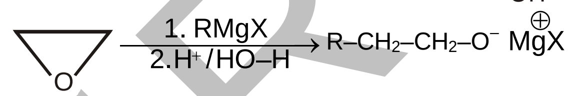
$$CH_3-OH \xrightarrow{HI} CH_3-I \xrightarrow{CH_3-MgBr} CH_3-CH_3$$

$$\xrightarrow{SO_2Cl_2/h\nu} CH_3-\underset{Cl}{\underset{|}{C}}H_2 \rightarrow KOH(aq.)CH_3-CH_2-OH$$

$$CH_3OH \longrightarrow CH_3-CH_2-OH$$

(6) from epoxy compounds

1. 

2. 

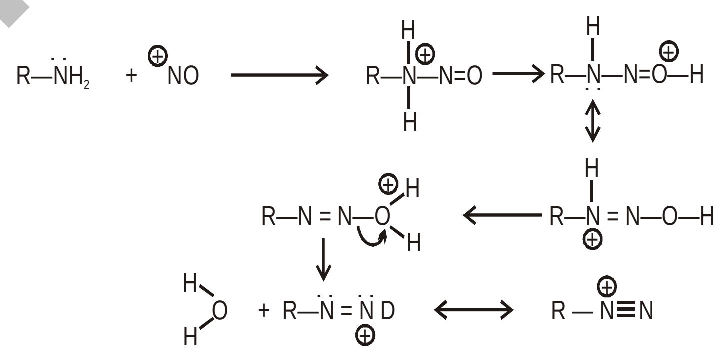
$$\xrightarrow{H^+} R-CH_2-CH_2-OH$$

(7) from primary amines

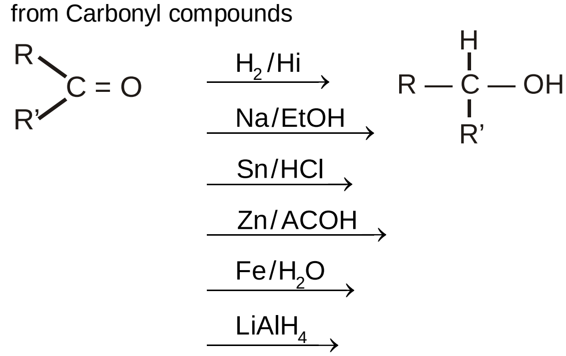
$$R-NH_2 \xrightarrow[HCl]{NaNO_2} R-OH$$

$$R-NH_2 \xrightarrow[HCl]{NaNO_2} R-N_2^+Cl^- \text{ (diazotisation)}$$

Mechanism:–

1\. 

(8) from Carbonyl compounds



(9) MPV – Reduction:–

Meerwain pondorf werley reduction)

$$\underset{R'}{\overset{R}{}}\!\!>C=O \xrightarrow[2.\ H_3O^+]{1.\ \left((CH_3)_2CH-O\right)_3Al} \underset{R}{\overset{R}{}}\!\!>CH-OH + Al(OH)_3 + 3\ (CH_3)_2C=O$$

(10) Oppenaur Oxidation

$$R_2CH-OH \xrightarrow{((CH_3)_3CO)Al} 3.\ R_2C=O$$

(11) from Carboxylic acid

$$R-COOH \xrightarrow{LiAlH_4} R-CH_2OH$$

(12) from Carboxylic acid derivatives

(a) $R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{LiAlH_4} R-CH_2-OH$

(b) $R-\overset{O}{\overset{\|}{C}}-OR \xrightarrow{LiAlH_4} R-CH_2OH$

(c) $R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R \xrightarrow{LiAlH_4} R-CH_2-OH$

(d) $R-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow{LiAlH_4} R-CH_2-NH_2$

(13) from hydrolysis of ester.

(a) $R-\overset{O}{\overset{\|}{C}}-OR' \xrightarrow{H_2SO_4(dil)} R-\overset{O}{\overset{\|}{C}}-OH + R'OH$

(b) $Me-\overset{O}{\overset{\|}{C}}-\overset{18}{O}Me \xrightarrow{dil\ H_2SO_4} CH_3-\overset{O}{\overset{\|}{C}}-OH + Me\overset{18}{O}H$

General Reaction of alcohols

(a) Reactions sue to O — H bond Cleavage

$R-O-\!\!\mid\!\!-H$

(1) $R-O-H \xrightarrow{Na} R-O^- Na^+ + \frac{1}{2} H_2$

(acidic nature)

(2) $R-O-H$ + Blue litmus ⟶ Red litmus

(Alcohols are weak acids)

(3) $R-O-H$ + NaOH ⟶ ✕

(4) $R-O-H$ + $NaHCO_3$ ⟶ ✕

(5) $R-O-H + CH_2N_2 \longrightarrow R-O-CH_3$

(6) $R-O-H + CH_3MgBr \longrightarrow CH_4 + R-O^- \overset{\oplus}{Mg}Br$

(7)

$$CH_2=C=O \xrightarrow{H-\ddot{O}-H} CH_2=\underset{\underset{H}{\oplus O-R}}{C}-O^- \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-OR$$

(8) $R-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{R'-OH/H^+} R-CH(OR')_2$ (acetal)

(9) $R-\overset{O}{\overset{\|}{C}}-H \xrightarrow{R'OH} R-\overset{O}{\overset{\|}{C}}-OR' + H-O-H$

Reaction due to C — O bond Cleavage

$R-\!\!\mid\!\!-O-H$

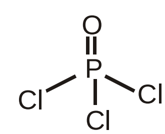
(1) $R-OH \xrightarrow[Red\ P]{HI} R-H$

(2) $R-OH \xrightarrow[SN^1\ or\ SN^2]{HCl/ZnCl_2} R-Cl$.(Lucas Test)

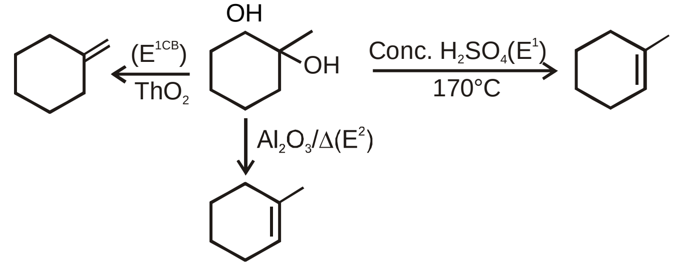
(3) $R-OH \xrightarrow[SN^1]{SOCl_2} R-Cl + HCl + SO_2\uparrow$

(4) $3R-OH \xrightarrow[SN^2]{PCl_3} 3\,R-Cl + H_3PO_3$

(5) $R-O-H \xrightarrow[SN^1\ \&\ SN^2]{PCl_5} R-Cl + HCl +$



(6) $CH_3-CH_2-\underset{OH}{CH} \xrightarrow[170°C]{Conc.H_2SO_4} CH_3-CH=CH_2$



Oxidation of alcohol

1. $R_1-\underset{OH}{CH}-R_2 \xrightarrow[Cu\ Tube]{Red\ hot} R_1-\overset{O}{\overset{\|}{C}}-R_2$

$$R - \underset{\large H}{\underset{|}{C}}H - OH \xrightarrow[\text{Cu Tube}]{\text{Red hot}} R - \overset{O}{\overset{\|}{C}} - H$$

(1° – alcohol to aldehydes)

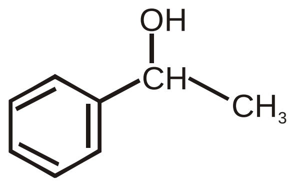
$$R - \underset{\large OH}{\underset{|}{C}}H - CH_3 \xrightarrow[\text{Cu Tube}]{\text{Red hot}} R - \overset{O}{\overset{\|}{C}} - CH_3$$

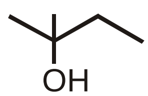
(2° – alcohol to ketones)

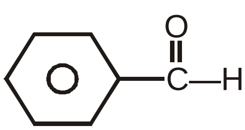
$$R - \underset{\large OH}{\underset{|}{\overset{\large CH_3}{\overset{|}{C}}}}H - CH_3 \xrightarrow[\text{Cu Tube}]{\text{Red hot}} R - \overset{CH_3}{\overset{|}{C}} = CH_2$$

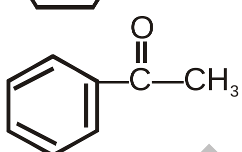
(3° – alcohol – dehydration to alkenes)

Q.1 $Ph - \underset{2}{CH} - OH \xrightarrow{\text{Red hot Cu}}$

Q.2  $\xrightarrow{\text{Red hot Cu}}$

Q.3  $\xrightarrow{\text{Red hot Cu}}$

Ans. **1.** 

2.  **3.** 

Oxidation of alcohol

(2) Oxidising agent $KMnO_4$ / H^+ or $K_2Cr_2O_7/H^+$

1. $R - CH_2 - OH \xrightarrow{KMnO_4/H^+} R - \overset{O}{\overset{\|}{C}} - H$

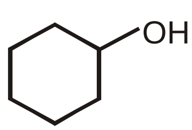
(1° – alcohol → acid)

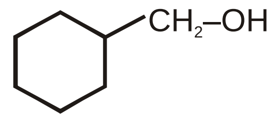
2. $R_1 - \underset{\large OH}{\underset{|}{C}}H - R_2 \xrightarrow{KMnO_4/H^+} R_1 - \underset{\large O}{\underset{\|}{C}} - R_2$

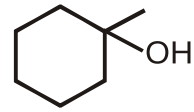
(2° – alcohol → ketone)

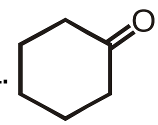
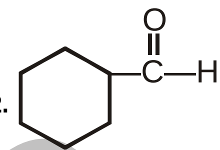
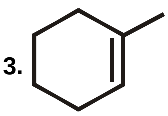
3. $R_1 - \underset{\large OH}{\underset{|}{\overset{\large CH_3}{\overset{|}{C}}}}H - CH_3 \xrightarrow{KMnO_4/H^+} R_1 - \overset{CH_3}{\overset{|}{C}} = CH_2$

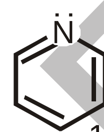
(3° – alcohol → alkenes)

Q.1  $\xrightarrow{KMnO_4/H^+}$

Q.2  $\xrightarrow[H^+]{KMnO_4}$

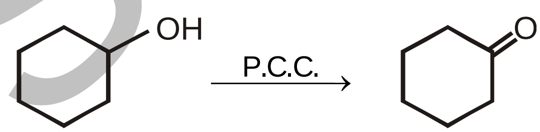
Q.3  $\xrightarrow{KMnO_4/H^+}$

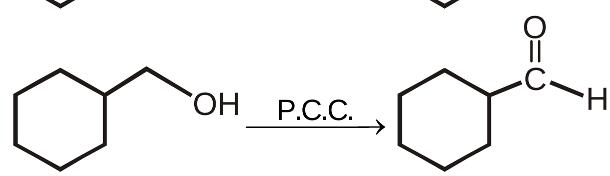
Ans. **1.**  **2.**  **3.** 

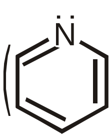
(3) P.C.C.  $/CrO_3/HCl$

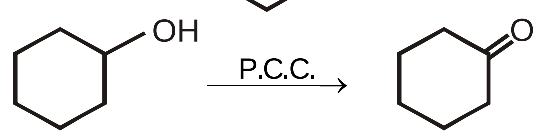
1 : 2 : 3

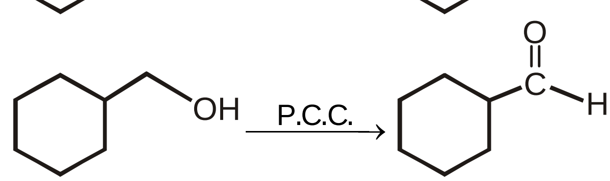
1° ⟶ aldehyde
2° ⟶ ketone
3° ⟶ no.effect)

1. 

2. 

4. Collin's Reagent ( : CrO_3 : CH_2Cl_2)

1. 

2. 

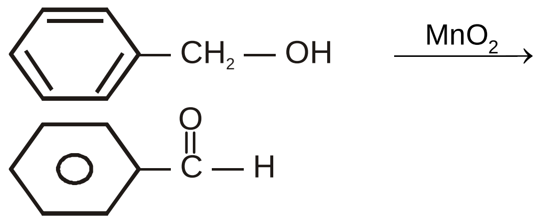
5. John's Reagent (H_2CrO_4 in anhydrous acetone)

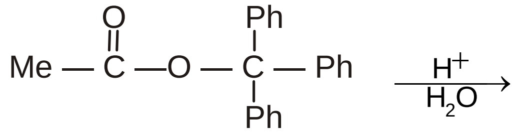
1° ⟶ aldehydes 2° ⟶ ketones
3° ⟶ alkenes

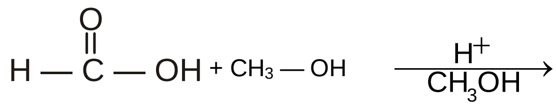
6. MnO_2 ⟶ Weak oxidizing agent

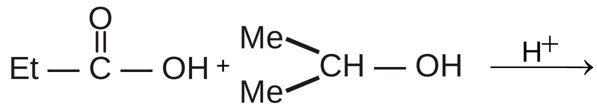
$CH_2 = CH - CH_2 - OH \xrightarrow{MnO_2}$

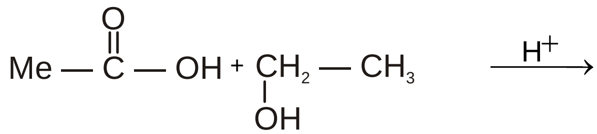
$CH_2 = CH - \overset{O}{\overset{\|}{C}} - H$

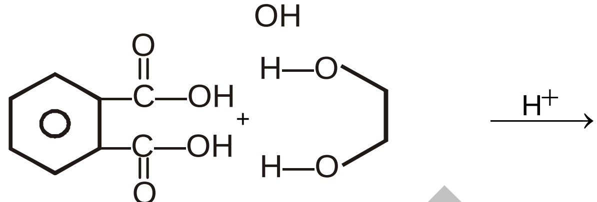


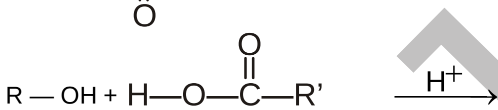
Q.1 

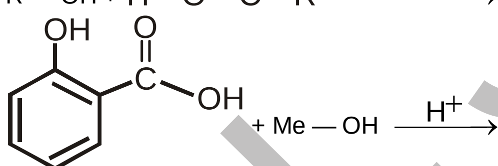
Q.2 

Q.3 

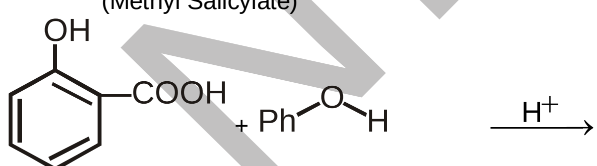
Q.4 

Q.5 

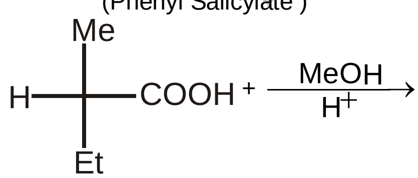
Q.6 

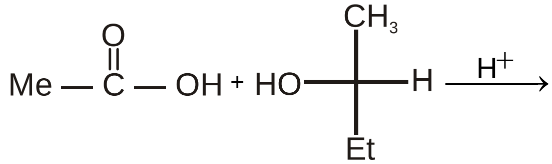
Q.7 

(Methyl Salicylate)

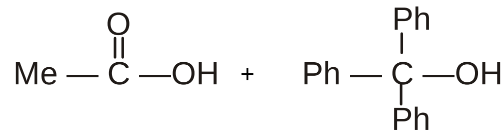
Q.8 

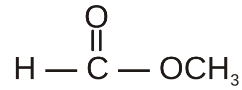
(Phenyl Salicylate)

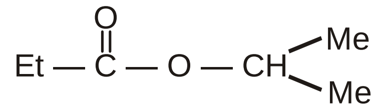
Q.9 

Q.10 

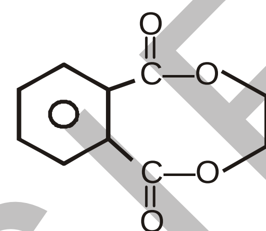
Ans.

Q.1 

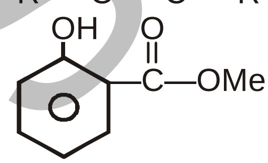
Q.2 

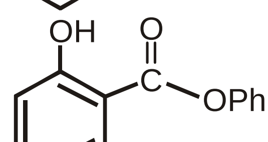
Q.3 

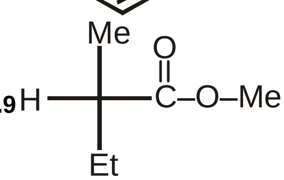
Q.4 

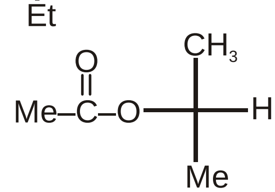
Q.5 

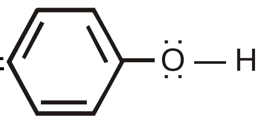
Q.6 

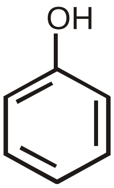
Q.7 

Q.8 

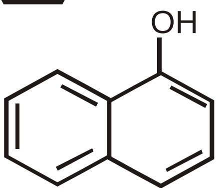
Q.9 

Q.10 

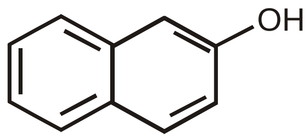
Phenol:- 



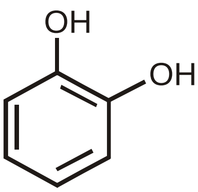
Phenol



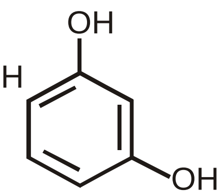
1-Napthol
α-Napthol



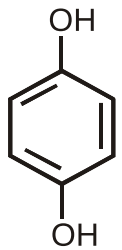
2- Napthol
β - Napthol



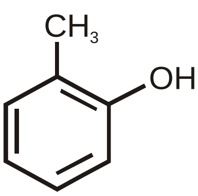
Catechol



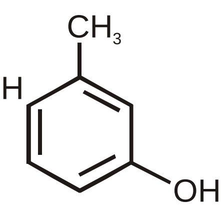
Resorchinol



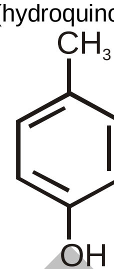
Quinol (hydroquinone)



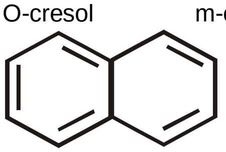
O-cresol



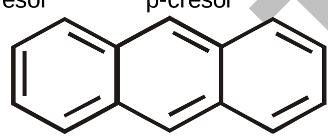
m-cresol



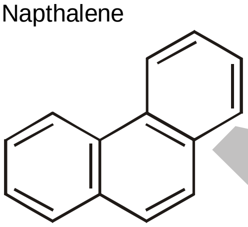
p-cresol



Napthalene



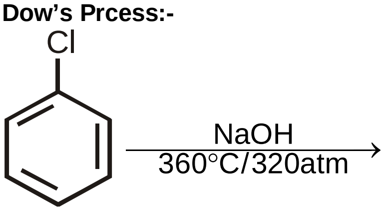
Anthracene



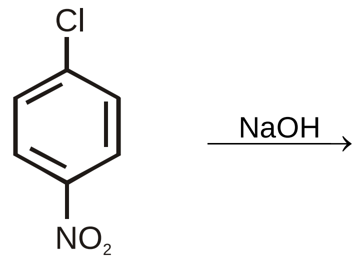
Phenanthrene

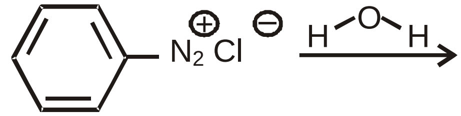
Methods of preparation:-

1. Dow's Prcess:-

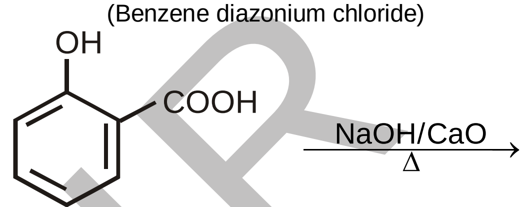


(Follow's Benzyne Mechanism)

2. 

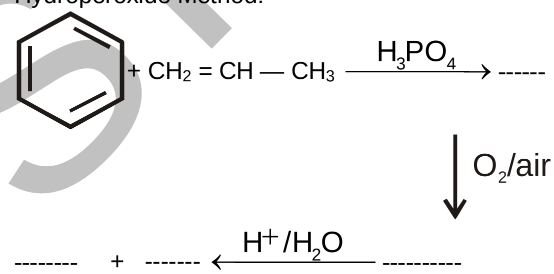
3. 

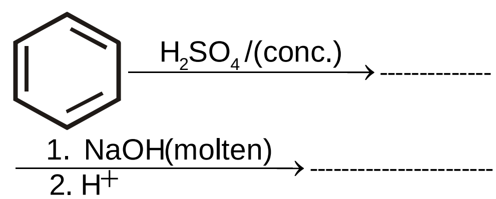
(Benzene diazonium chloride)

4. 

(Soda lime decarboxylation)

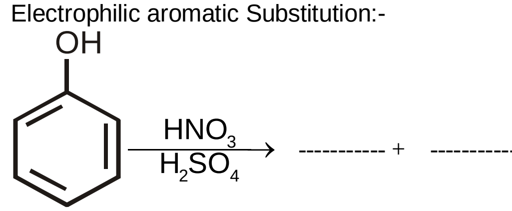
5. Hydroperoxide Method:-

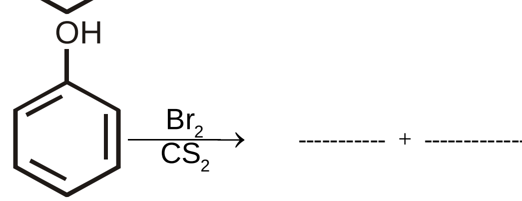


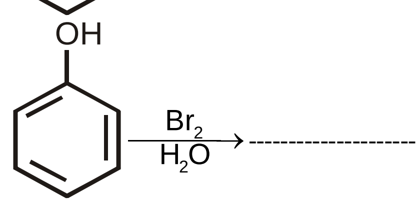
6. 

Reaction of Phenol:-

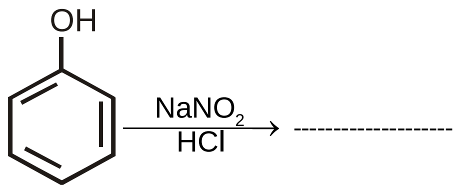
(1) Electrophilic aromatic Substitution:-

(a) 

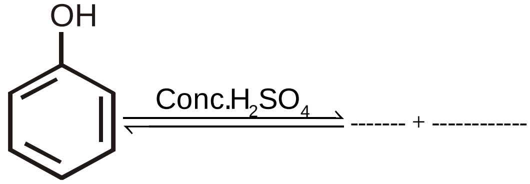
(b) 

(c) 

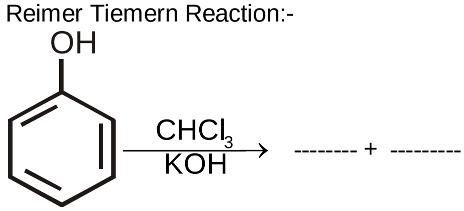
(d)



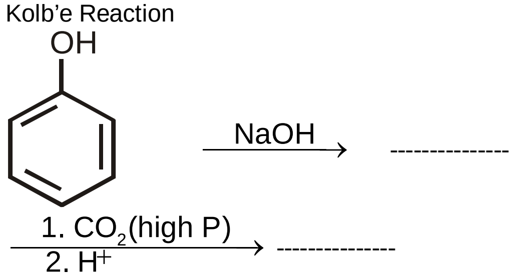
(e)



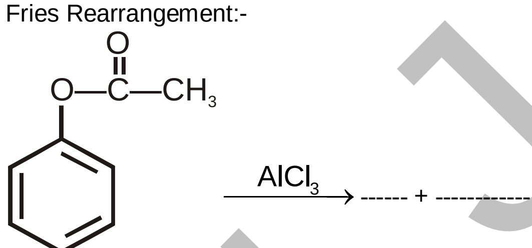
(f) Reimer Tiemern Reaction:-



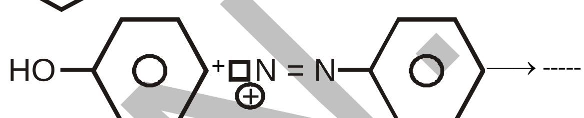
(g) Kolb'e Reaction



(h) Fries Rearrangement:-

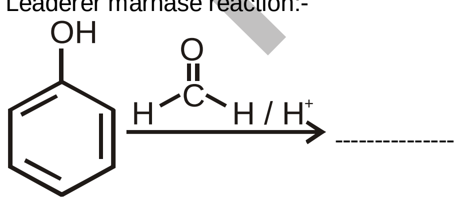


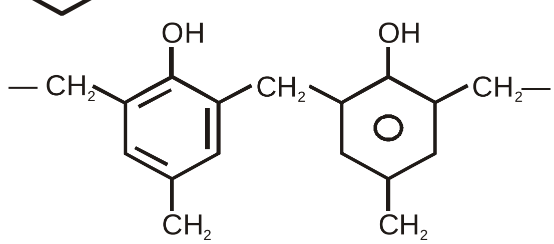
(i)



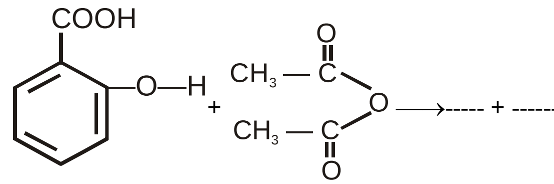
Coupling Reaction:-

(j) Leaderer marnase reaction:-

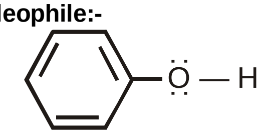




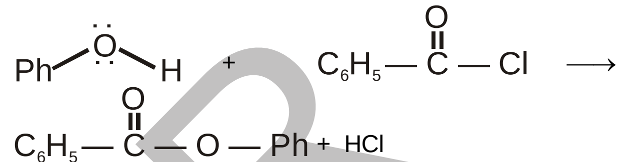
B alkaline— polymer



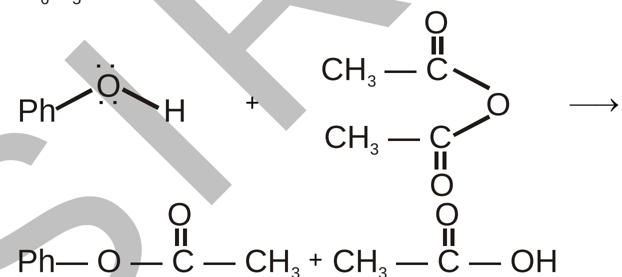
Phenol as Nucleophile:-



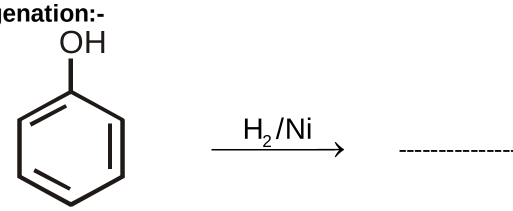
1.



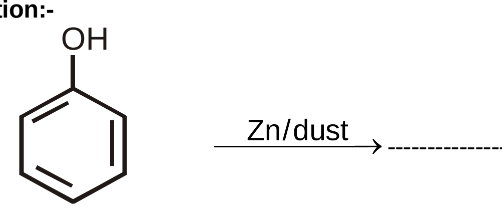
2.



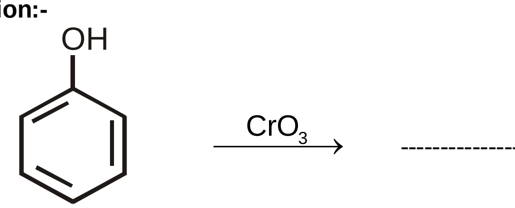
Hydrogenation:-



Reduction:-



Oxidation:-



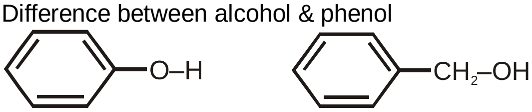
(Quinone)

Alcohol and Phenol

Alcohol

$R-\ddot{O}-H$ ⟶ 1. Lewis Base
2. Nucleophiles
3. Polar protic solvents

→ Difference between alcohol & phenol



Phenol alcohol

partial double bond character between C & O

→ high boiling point & water solubility due to Hydrogen bonding.

Classification →

→ CH_2-CH_2-OH 1° – alcohol (primary alcohol)

$CH_3-\underset{|}{\overset{OH}{CH}}-CH_3$ 2°– alcohol (Secondary alcohol)

$CH_3-\underset{CH_3}{\overset{CH_3}{C}}-OH$ 3°– alcohol (tertiary alcohol)

→ $CH_2 = CH - OH$ (vinylic alcohol)
$CH_2 = CH - CH_2 - OH$ (allylic alcohol)

<u>General Methods of preparation</u>

(1) from alkanes

$CH_4 \xrightarrow{Cl_2/h\nu} CH_3-Cl \xrightarrow{aq.KOH} CH_3-OH$

$Me-\underset{Me}{\overset{Me}{C}}-H \xrightarrow{Br_2/h\nu} Me-\underset{Me}{\overset{Me}{C}}-Br \xrightarrow{H-O-H} CH_3-\underset{CH_3}{\overset{CH_3}{C}}-OH$

(2) from alkenes

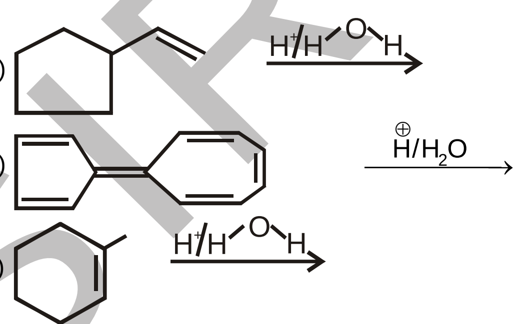
(i) $CH_3-CH=CH_2 \xrightarrow{H^+/H-O-H} CH_3-\underset{|}{\overset{OH}{CH}}-CH_3$

acid catalysed hydration

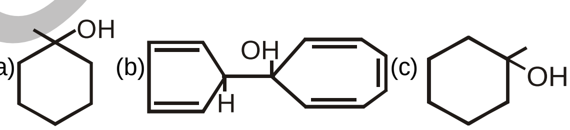
$CH_3-CH=CH_2+H^+ \longrightarrow CH_3-\overset{+}{CH}-CH_2-H$

$\downarrow H-O-H$

$CH_3-\underset{O-H}{CH}-CH_3+H^+ \longleftarrow CH_3-\underset{H-\overset{\oplus}{O}-H}{CH}-CH_3$



Ans.

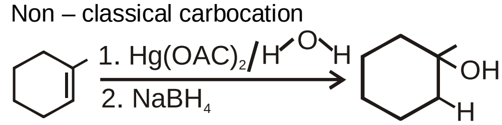


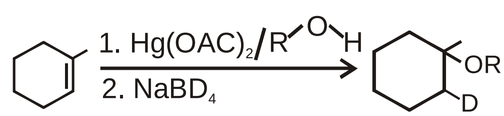
Oxymercuration – Demercuration (O M D M)

$CH_3-CH=CH_2 \xrightarrow[2.\ NaBH_4]{1.\ Hg(OAC)_2/H-O-H} CH_3-\underset{|}{\overset{OH}{CH}}-CH_3$

(n – hexane or paraffin solvent)

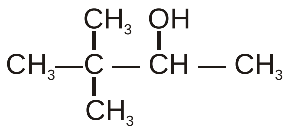
Features:–
(1) Markownikoff addition
(2) No. Rearrangement
(3) Non – classical carbocation

(1) 

(2) 

(3) $CH_3-\underset{CH_3}{\overset{CH_3}{C}}-CH=CH_2 \xrightarrow[2.\ NaBH_4]{1.\ Hg(OAC)_2/H-O-H}$

$CH_3-\underset{CH_3}{\overset{CH_3}{C}}-\overset{OH}{CH}-CH_3$

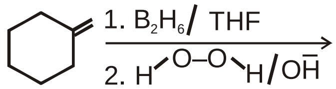
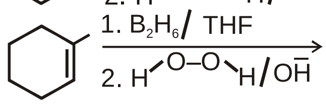
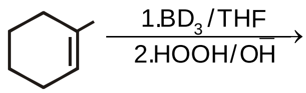
Ans. **(3)** 

Hydroboration – oxidation

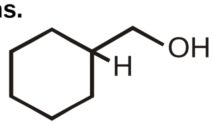
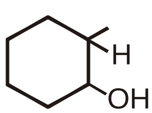
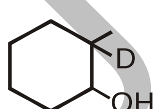
$$CH_3-CH=CH_2 \xrightarrow[2.\ H-O-O-H/\bar{O}H]{1.\ BH_3/THF} CH_3-CH_2-CH_2-OH$$

Features
1. anti markownikoff addition
2. No. Rearrangement

Ex:–

1. 
2. 
3. 
4. $CH_3-CH=CH_2 \xrightarrow[2.CH_3-COOD]{1.B_2H_6/THF}$
5. $CH_3-CH=CH_2 \xrightarrow[2.CH_3-COOD]{1.B_2D_6/THF}$
6. $CH_3-CH=CH_2 \xrightarrow[2.CH_3-COOH]{1.B_2H_6/THF}$

Ans.

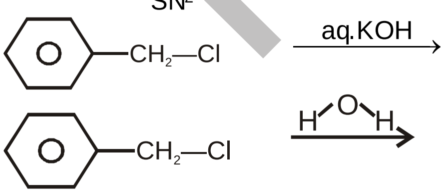
(1)  (2)  (3) 

(4) $CH_3-\underset{H}{CH}-\underset{D}{CH_2}$ (5) $CH_3-\underset{D}{CH}-\underset{D}{CH_2}$

(6) $CH_3-\underset{D}{CH}-\underset{H}{CH_2}$

(3) from alkyl halides

$$R-X \xrightarrow[SN^2]{aq.KOH} R-OH$$



(4) from grignard reagent

$$2\ R\ mg\ \times \xrightarrow[2.H^+/H_2O]{1.\ O_2} 2\ R-OH$$

Mechanism:–

$$\ddot{R}^{\ominus} + O=O \longrightarrow R-O-O^- \xrightarrow{R^{\Theta}}$$

$$R-O^{\Theta} + RO^- \xrightarrow{H^+/H_2O} R-OH + R-OH$$

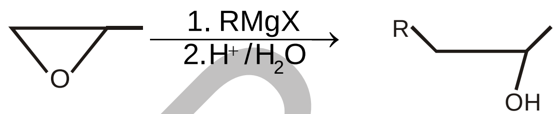
(5) Conversion of lower alcohol into higher alcohol

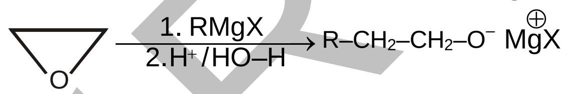
$$CH_3-OH \xrightarrow{HI} CH_3-I \xrightarrow{CH_3-MgBr} CH_3-CH_3$$

$$\xrightarrow{SO_2Cl_2/h\nu} CH_3-\underset{Cl}{CH_2} \rightarrow KOH(aq.)CH_3-CH_2-OH$$

$$CH_3OH \longrightarrow CH_3-CH_2-OH$$

(6) from epoxy compounds

1. 

2. 

$$\xrightarrow{H^+} R-CH_2-CH_2-OH$$

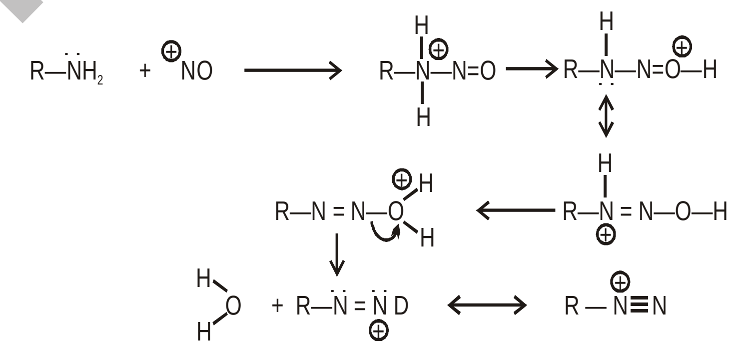
(7) from primary amines

$$R-\overset{H}{\underset{H}{N}}: \xrightarrow[HCl]{NaNO_2} R-OH$$

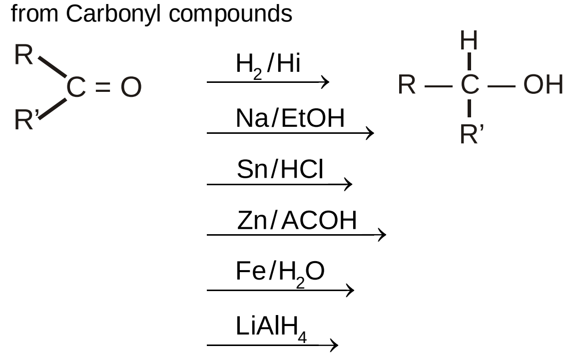
$$R-\overset{H}{\underset{H}{N}}: \xrightarrow[HCl]{NaNO_2} R-N_2^+Cl^- \text{ (diazotisation)}$$

Mechanism:–

1.



(8) from Carbonyl compounds



(9) MPV – Reduction:–

Meerwain pondorf werley reduction)

$$\begin{matrix}R\\R'\end{matrix}\!\!>C=O \xrightarrow[2.\ H_3O^+]{1.\ ((CH_3)_2CH-O)_3Al} \begin{matrix}R\\R\end{matrix}\!\!>CH-OH + Al(OH)_3 + 3\ (CH_3)_2C=O$$

(10) Oppenaur Oxidation

$$\begin{matrix}R\\R\end{matrix}\!\!>CH-OH \xrightarrow{((CH_3)_3CO)Al} 3.\ \begin{matrix}R\\R\end{matrix}\!\!>C=O$$

(11) from Carboxylic acid

$$R-COOH \xrightarrow{LiAlH_4} R-CH_2OH$$

(12) from Carboxylic acid derivatives

(a) $R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{LiAlH_4} R-CH_2-OH$

(b) $R-\overset{O}{\overset{\|}{C}}-OR \xrightarrow{LiAlH_4} R-CH_2OH$

(c) $R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R \xrightarrow{LiAlH_4} R-CH_2-OH$

(d) $R-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow{LiAlH_4} R-CH_2-NH_2$

(13) from hydrolysis of ester.

(a) $R-\overset{O}{\overset{\|}{C}}-OR' \xrightarrow{H_2SO_4(dil)} R-\overset{O}{\overset{\|}{C}}-OH + R'OH$

(b) $Me-\overset{O}{\overset{\|}{C}}-\overset{18}{O}Me \xrightarrow{dil\ H_2SO_4} CH_3-\overset{O}{\overset{\|}{C}}-OH + Me\overset{18}{O}H$

General Reaction of alcohols

(a) Reactions sue to O — H bond Cleavage

$R-O \,\vdots\, H$

(1) $R-O-H \xrightarrow{Na} R-O^- Na^+ + \frac{1}{2} H_2$

(acidic nature)

(2) $R-O-H$ + Blue litmus $\longrightarrow$ Red litmus

(Alcohols are weak acids)

(3) $R-O-H$ + NaOH $\longrightarrow$ ✕

(4) $R-O-H$ + $NaHCO_3 \longrightarrow$ ✕

(5) $R-O-H + CH_2N_2 \longrightarrow R-O-CH_3$

(6) $R-O-H + CH_3MgBr \longrightarrow CH_4 + R-O^- \overset{\oplus}{Mg}Br$

(7)

$$CH_2=C=O \xrightarrow{H-\ddot{O}-H} CH_2=\underset{\underset{H}{|}}{\underset{\overset{\oplus}{O}-R}{|}}{C}-O^- \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-OR$$

(8) $R-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{R'-OH/H^+} R-CH\begin{matrix}OR'\\OR'\end{matrix}$ (acetal)

(9) $R-\overset{O}{\overset{\|}{C}}-H \xrightarrow{R'OH} R-\overset{O}{\overset{\|}{C}}-OR' + H-O-H$

Reaction due to C — O bond Cleavage

$R \,\vdots\, O-H$

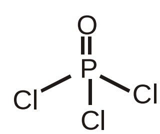
(1) $R-OH \xrightarrow[Red\ P]{HI} R-H$

(2) $R-OH \xrightarrow[SN^1\ or\ SN^2]{HCl/ZnCl_2} R-Cl$.(Lucas Test)

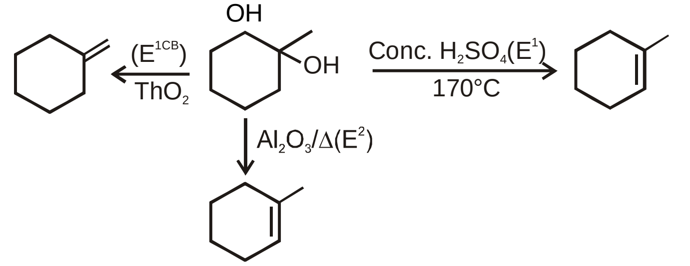
(3) $R-OH \xrightarrow[SN^1]{SOCl_2} R-Cl + HCl + SO_2\uparrow$

(4) $3R-OH \xrightarrow[SN^2]{PCl_3} 3\ R-Cl + H_3PO_3$

(5) $R-O-H \xrightarrow[SN^1\ \&\ SN^2]{PCl_5} R-Cl + HCl +$



(6) $CH_3-CH_2-\underset{OH}{\underset{|}{CH}} \xrightarrow[170°C]{Conc.H_2SO_4} CH_3-CH=CH_2$



Oxidation of alcohol

1. $R_1-\underset{OH}{\underset{|}{CH}}-R_2 \xrightarrow[Cu\ Tube]{Red\ hot} R_1-\overset{O}{\overset{\|}{C}}-R_2$

$$R-\underset{\underset{H}{|}}{CH}-OH \xrightarrow[\text{Cu Tube}]{\text{Red hot}} R-\overset{\overset{O}{\|}}{C}-H$$

(1° – alcohol to aldehydes)

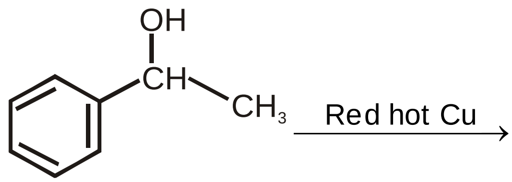
$$R-\underset{\underset{OH}{|}}{CH}-CH_3 \xrightarrow[\text{Cu Tube}]{\text{Red hot}} R-\overset{\overset{O}{\|}}{C}-CH_3$$

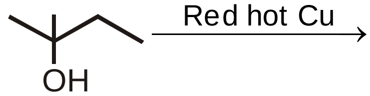
(2° – alcohol to ketones)

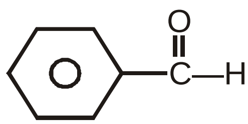
$$R-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{CH}}-CH_3 \xrightarrow[\text{Cu Tube}]{\text{Red hot}} R-\overset{\overset{CH_3}{|}}{C}=CH_2$$

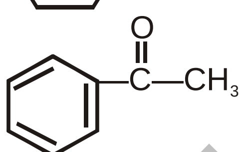
(3° – alcohol – dehydration to alkenes)

Q.1 $Ph-CH_2-OH \xrightarrow{\text{Red hot Cu}}$

Q.2 

Q.3 

Ans. **1.** 

2. 

3. 

Oxidation of alcohol

(2) Oxidising agent $KMnO_4/H^+$ or $K_2Cr_2O_7/H^+$

1. $R-CH_2-OH \xrightarrow{KMnO_4/H^+} R-\overset{\overset{O}{\|}}{C}-H$

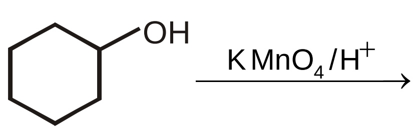
(1° – alcohol → acid)

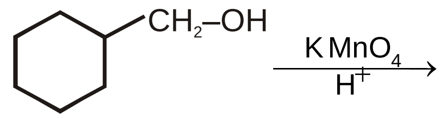
2. $R_1-\underset{\underset{OH}{|}}{CH}-R_2 \xrightarrow{KMnO_4/H^+} R_1-\underset{\underset{O}{\|}}{C}-R_2$

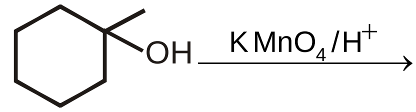
(2° – alcohol → ketone)

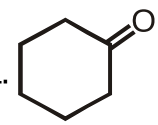
3. $R_1-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{CH}}-CH_3 \xrightarrow{KMnO_4/H^+} R_1-\overset{\overset{CH_3}{|}}{C}=CH_2$

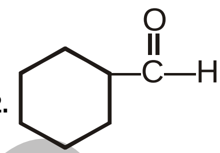
(3° – alcohol → alkenes)

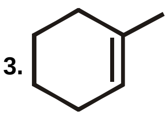
Q.1 

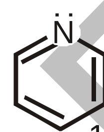
Q.2 

Q.3 

Ans. **1.** 

2. 

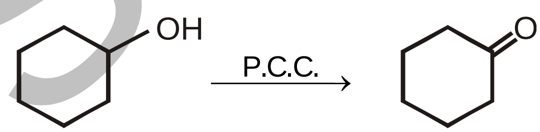
3. 

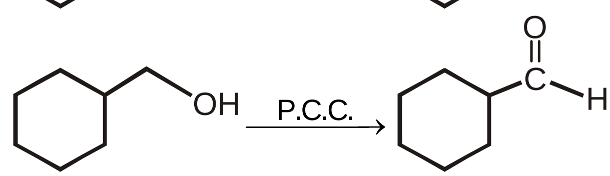
(3) P.C.C. 

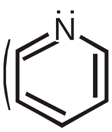
$/CrO_3/HCl$

1 : 2 : 3

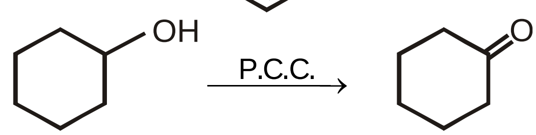
- 1° ⟶ aldehyde
- 2° ⟶ ketone
- 3° ⟶ no.effect)

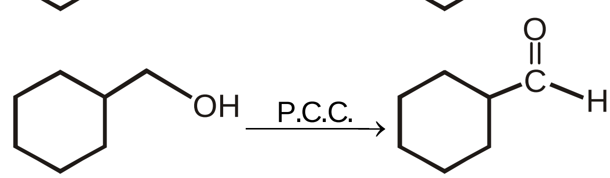
1. 

2. 

4. **Collin's Reagent** (

$: CrO_3 : CH_2Cl_2$)

1. 

2. 

5. **John's Reagent** (H_2CrO_4 in anhydrous acetone)

1° ⟶ aldehydes 2° ⟶ ketones

3° ⟶ alkenes

6. **MnO_2** ⟶ Weak oxidizing agent

$$CH_2=CH-CH_2-OH \xrightarrow{MnO_2}$$

$$CH_2=CH-\overset{\overset{O}{\|}}{C}-H$$

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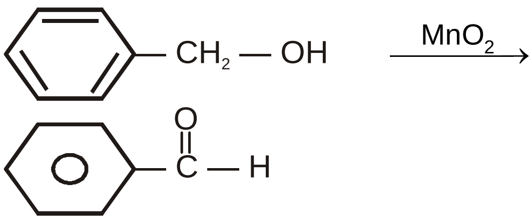
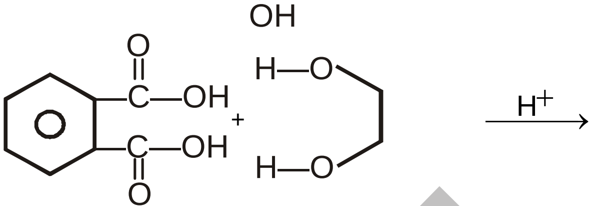


Q.1 $Me-\overset{O}{\overset{\|}{C}}-O-CPh_3 \xrightarrow[H_2O]{H^+}$

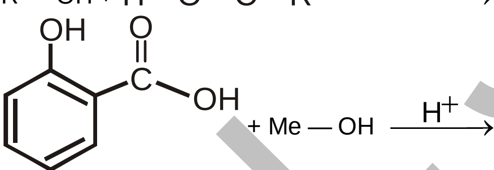
Q.2 $H-\overset{O}{\overset{\|}{C}}-OH + CH_3-OH \xrightarrow[CH_3OH]{H^+}$

Q.3 $Et-\overset{O}{\overset{\|}{C}}-OH + (Me)_2CH-OH \xrightarrow{H^+}$

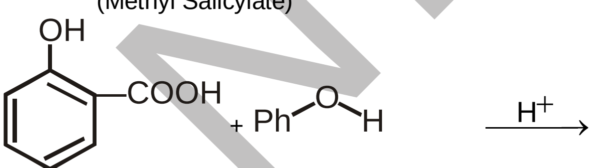
Q.4 $Me-\overset{O}{\overset{\|}{C}}-OH + CH_2(OH)-CH_3 \xrightarrow{H^+}$

Q.5 

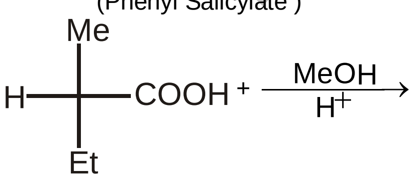
Q.6 $R-OH + H-O-\overset{O}{\overset{\|}{C}}-R' \xrightarrow{H^+}$

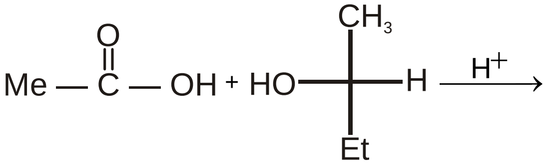
Q.7 

(Methyl Salicylate)

Q.8 

(Phenyl Salicylate)

Q.9 

Q.10 

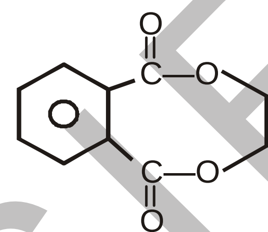
Ans.

Q.1 $Me-\overset{O}{\overset{\|}{C}}-OH + Ph-\underset{Ph}{\overset{Ph}{C}}-OH$

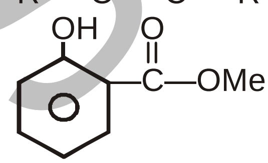
Q.2 $H-\overset{O}{\overset{\|}{C}}-OCH_3$

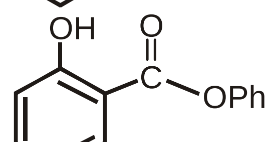
Q.3 $Et-\overset{O}{\overset{\|}{C}}-O-CH(Me)_2$

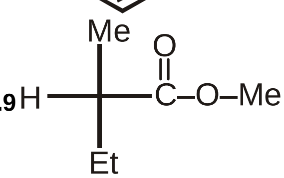
Q.4 $Me-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$

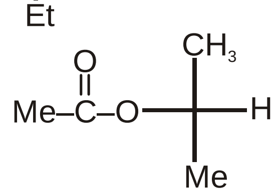
Q.5 

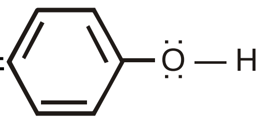
Q.6 $R-O-\overset{O}{\overset{\|}{C}}-R'$

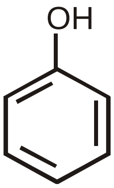
Q.7 

Q.8 

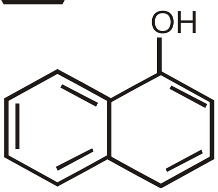
Q.9 

Q.10 

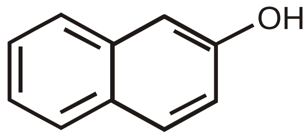
Phenol:- 



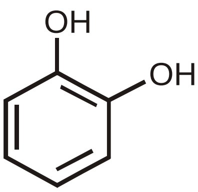
Phenol



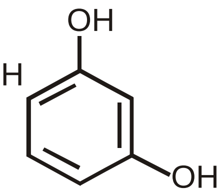
1-Napthol
α-Napthol



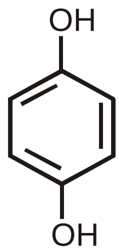
2- Napthol
β - Napthol



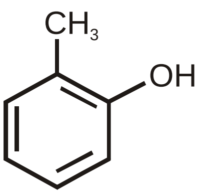
Catechol



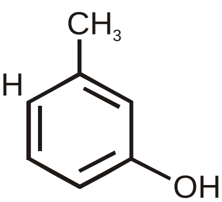
Resorchinol



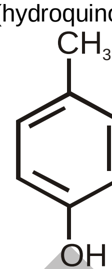
Quinol (hydroquinone)



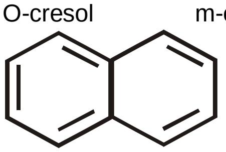
O-cresol



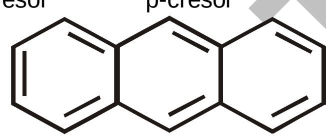
m-cresol



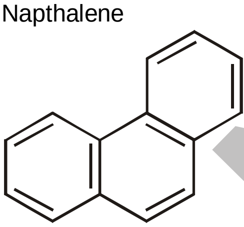
p-cresol



Napthalene



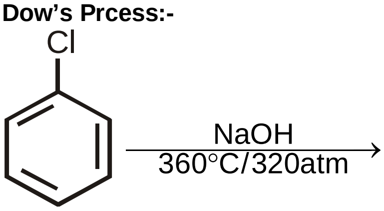
Anthracene



Phenanthrene

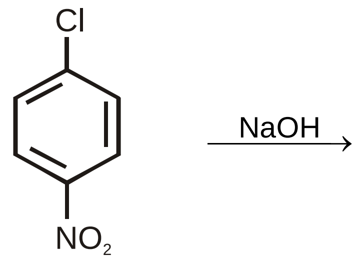
Methods of preparation:-

1. Dow's Prcess:-

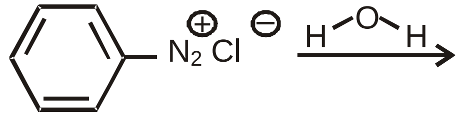


(Follow's Benzyne Mechanism)

2.

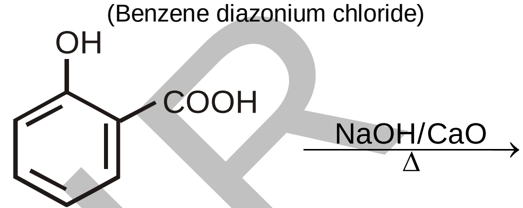


3.



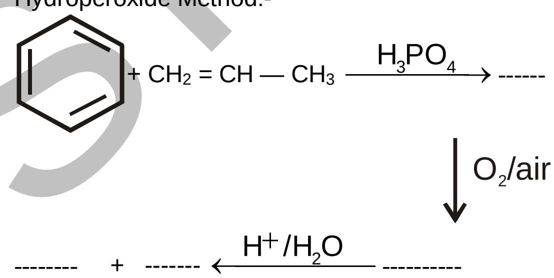
(Benzene diazonium chloride)

4.

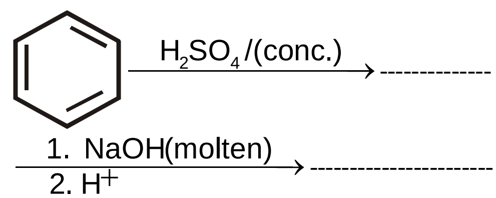


(Soda lime decarboxylation)

5. Hydroperoxide Method:-



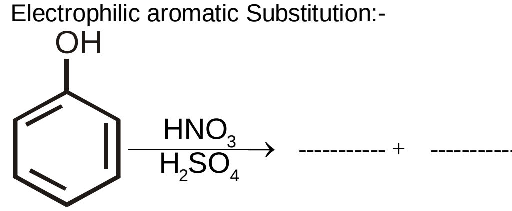
6.



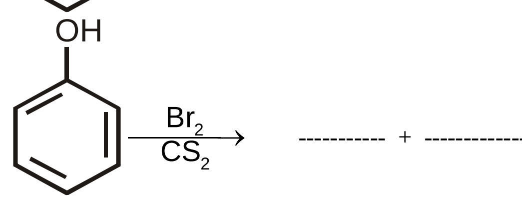
Reaction of Phenol:-

(1) Electrophilic aromatic Substitution:-

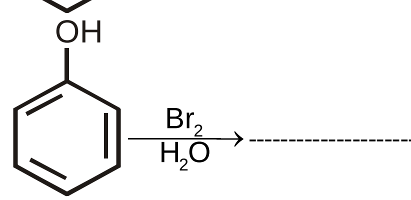
(a)



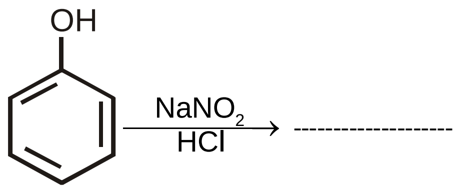
(b)



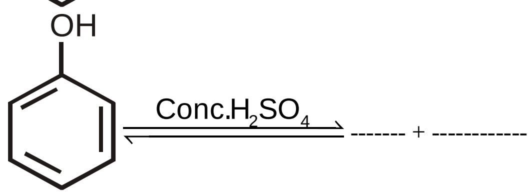
(c)



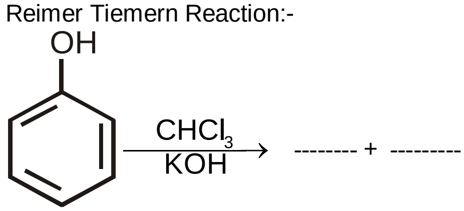
(d)



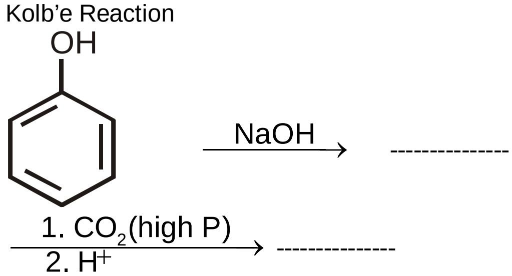
(e)



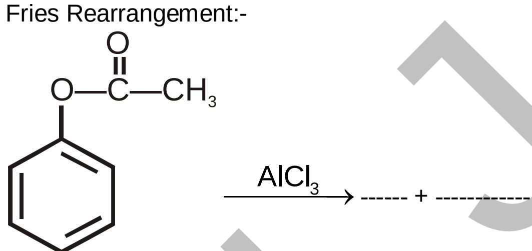
(f) Reimer Tiemern Reaction:-



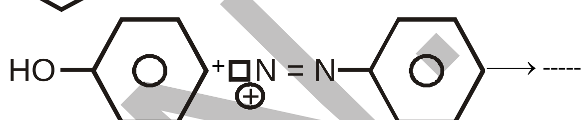
(g) Kolb'e Reaction



(h) Fries Rearrangement:-

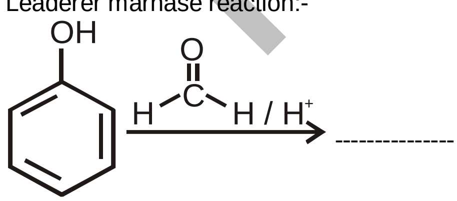


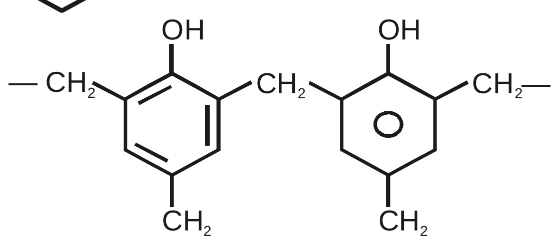
(i)



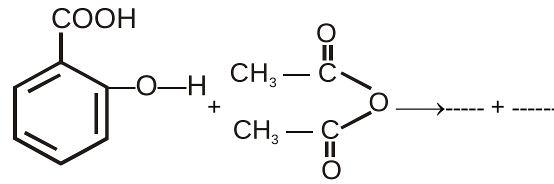
Coupling Reaction:-

(j) Leaderer marnase reaction:-

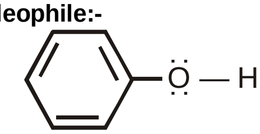




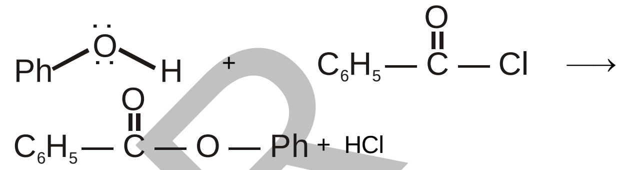
B alkaline⁻ polymer



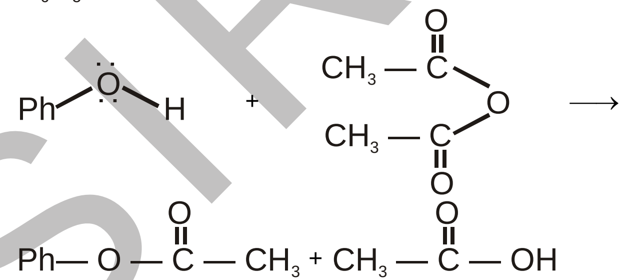
Phenol as Nucleophile:-



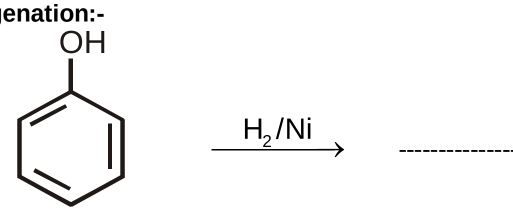
1.



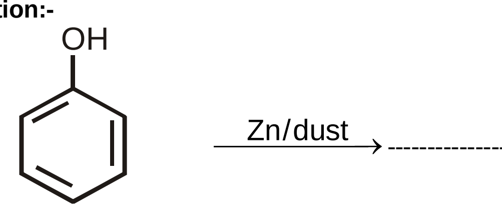
2.



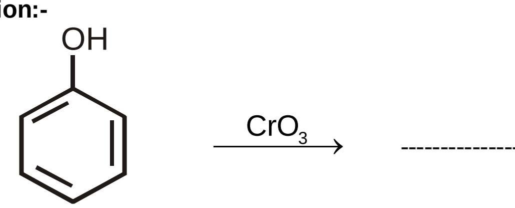
Hydrogenation:-



Reduction:-



Oxidation:-



(Quinone)

Alcohol, Ether & Phenol

EXERCISE –1

Q.1 The products of combustion of an aliphatic thiol (RSH) at 298 K are: **[JEE 1992]**

(A) $CO_2(\ell)$, H_2O (g) and SO_2(g) (B) CO_2(g), H_2O (g) and SO_2(g)

(C) $CO_2(\ell)$, H_2O (ℓ) and SO_2(g) (D) CO_2 (g), H_2O (ℓ) and $SO_2(\ell)$

Q.2 An organic compound C_3H_6O does not give a precipitate with 2,4- dinitrophenyl hydrazine reagent and does not react with sodium metal. It could be: **[JEE 1993]**

(A) $CH_3– CH_2 – CHO$ (B) $CH_3 – CO – CH_3$

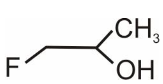
(C) $CH_2 = CH – CH_2OH$ (D) $CH_2 = CH – OCH_3$

Q.3 The reaction products of $C_6H_5OCH_3 + HI \xrightarrow{\Delta}$ are: **[JEE 1995]**

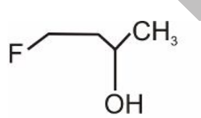
(A) $C_6H_5OH + CH_3I$ (B) $C_6H_5I + CH_3OH$

(C) $C_6H_5CH_3 + HOI$ (D) $C_6H_6 + CH_3OI$

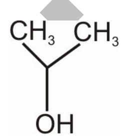
Q.4 The order of reactivity of the following alcohols: **[JEE 1997]**



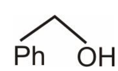
(I)



(II)



(III)



(IV)

towards conc. HCl is

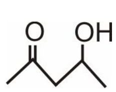
(A) I > II > III > IV (B) I > III > II > IV

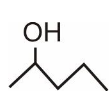
(C) IV > III > II > I (D) IV > II > III > I

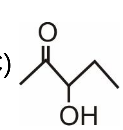
Q.5 Among the following compounds, the strongest acid is: **[JEE 1998]**

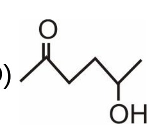
(A) $HC \equiv CH$ (B) C_6H_6 (C) C_2H_6 (D) CH_3OH

Q.6 Which one of the following will most readily be dehydrated in acidic condition: **[JEE 2000]**

(A) 

(B) 

(C) 

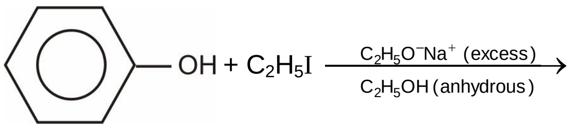
(D) 

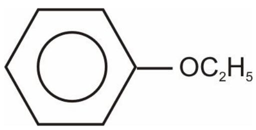
Q.7 Identify the correct order of boiling point of the following compounds: **[JEE 2002]**

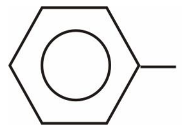
$CH_3CH_2CH_2CH_2OH$ $CH_3CH_2CH_2CHO$ $CH_3CH_2CH_2COOH$

1.   2.   3.

(A) 1 > 2 > 3   (B) 3 > 1 > 2   (C) 1 > 3 > 2   (D) 3 > 2 > 1

Q.8  **[JEE 2003]**

(A) 

(B) 

(C) $C_6H_5OC_6H_5$

(D) $C_2H_5OC_2H_5$

Q.9 Reaction of entainomerically pure acid with 1 chiral carbon and racemic alcohol with 1 chiral carbon gives an ester which is **[JEE 2003]**

(A) Meso

(B) Optically active mixture

(C) Racemic mixture (D) Enantionmerically pure

Q.10 On acid catalysed hydration, 2- phenyl propene gives: **[JEE 2004]**

(A) 3- phenyl-2- propanol

(B) 2-phenyl-1- propanol

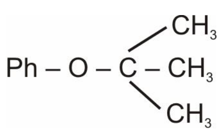
(C) 1- phenyl-3- propanol

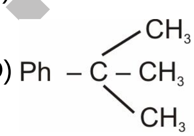
(D) 2- phenyl -2- propanol

Q.11 Phenyl magnesium bromide reacting with t- Butyl alcohol gives: **[JEE 2005]**

(A) Ph – OH

(B) Ph – H

(C) 

(D) 

Q.12 **Statement-1:** p- Hydroxybenzoic acid has a lower boiling point than o-hydroxybenzoic acid. **[JEE 2007]**

Because

Statement-2: o- Hydroxybenzoic acid has intramolecular hydrogen bonding.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

EXERCISE –2

Q.1 When t-butanol and n- butanol are separately treated with a few drops of dilute $KMnO_4$ in one case only, purple colour disappears and a brown precipitate is formed. Which of the two alcohols gives the above reaction and what is the brown precipitate? **[JEE 1994]**

Q.2 3,3-Dimethylbutan-2-ol losses a molecule of water in the presence of a concentrated sulphuric acid to give tetramethyl ethylene as a major product. Suggest a suitable mechanism. **[JEE 1996]**

Q.3 A compound $D(C_8H_{10}O)$ upon treatment with alkaline solution of iodine gives a yellow precipitate. The filtrate on acidification gives a white solid (E) $(C_7H_6O_2)$. Write the structures of (D) and (E) and explain the formation of (E). **[JEE 1996]**

Q.4 Which of the following is the correct method for synthesising methyl-t-butyl ether and why ?

(i) $(CH_3)_3CBr + NaOMe \longrightarrow$

(ii) CH_3Br + tert-BuOna $\longrightarrow$ **[JEE 1997]**

Q.5
$$\begin{array}{c} O=C-OH \\ | \\ O=C-OH \end{array} + \begin{array}{c} HOCH_2 \\ | \\ HOCH_2 \end{array} \xrightarrow{\text{Conc.}H_2SO_4} (A)$$
[JEE 1997]

Q.6 Discuss why o-hydroxy benzaldehyde is a liquid at room temperature while p- hydroxy benzaldehyde is a high melting solid? **[JEE 1999]**

Q.7 Write the structures of the product A and B. **[JEE 2000]**

$$\begin{array}{l} CH_3-\underset{\underset{O}{\|}}{C}-\overset{18}{O}C_2H_5 \xrightarrow{H_3O^{\oplus}} A + B \end{array}$$

Q.8 Cyclobutyl bromide on treatment with magnesium in dry ether forms an organometallic A. The organometallic reacts with ethanol to give an alcohol B after mild acidification. Prolonged treatment of alcohol B with an equivalent amount of HBr gives 1- bromo-1- methylcyclopentane (C). Write the structures of A, B and explain how C is obtained from B. **[JEE 2001]**

Q.9 Identify X, Y and Z in the following synthetic scheme and write their structure. Explain the formation of labelled formaldehyde (H_2C^*O) as one of the products when compound Z is treated with HBr and subsequently ozonolysed. Mark the C* carbon in the entire scheme. **[JEE 2001]**

$$BaC^*O_3 + H_2SO_4 \rightarrow X \text{ (gas) [C* denotes } C^{14}]$$

$$CH_2 = CH - Br \xrightarrow[\text{(ii)X, (iii)}H_3O^+]{\text{(i)Mg / ether}} Y \xrightarrow{LiAlH_4} Z$$

Q.10 Mention two esters produced when a racemic mixture of 2- phenyl propanoic acid is treated with (+) 2-butanol. What is the stereochemical relationship between these esters? **[JEE 2003]**

Q.11 An organic compound P($C_5H_{10}O$) Reacts 10^{15} times faster then ethylene with dil. H_2SO_4 to give two products Q and R. Both Q and R give positive iodoform test. Identify P, Q and R and also give reason for very high reactivity of P. **[JEE 2004]**

Q.12 (X) $C_5H_{13}N \xrightarrow[-N_2]{NaNO_2,\ HCl}$ (Y) (Tertiary alcohol + other products)

(Optically active)

Find X and Y. Is y optically active? Write the intermediate steps. **[JEE 2005]**

EXERCISE-1

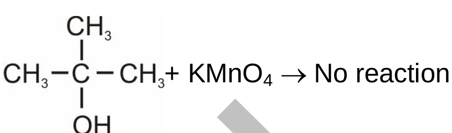
Q.1	**B**	**Q.2**	**D**	**Q.3**	**A**	**Q.4**	**C**	**Q.5**	**D**	**Q.6**	**A**
Q.7	**B**	**Q.8**	**D**	**Q.9**	**B**	**Q.10**	**D**	**Q.11**	**B**	**Q.12**	**D**

EXERCISE-2

Q.1 n- butanol is oxidised by KMnO4 and not t- butanol as the latter does not contain H atom attached to carbinol carbon atom.

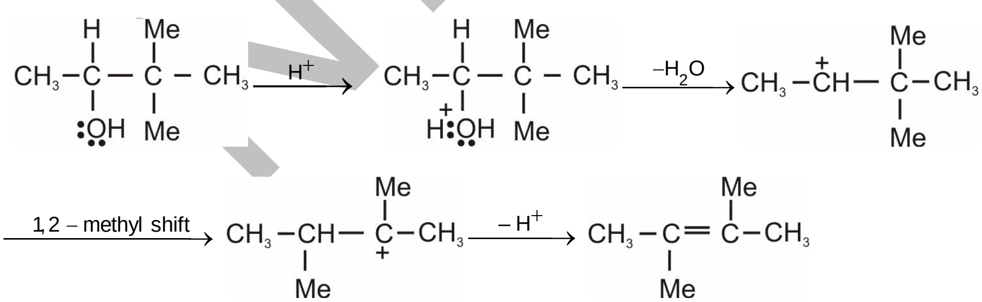
$CH_3CH_2CH_2CH_2OH + KMnO_4 \rightarrow CH_3CH_2CH_2COO\overset{-}{O}\overset{+}{K} + MnO_2 + KOH$

n- Butanol Brown

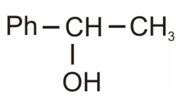


t- Butanol

Q.2



Q.3 (D)



(E) C_6H_5COOH

Q.4 The ether formation involves nucleophilic substitution of alkoxide ion for halide ion.

$R'O^- + R - X \quad R'O^- + R - X \xrightarrow{\text{Slow}} R'\overset{\delta^-}{O} \text{--------} R \text{------} \overset{\delta^-}{X} \xrightarrow{\text{Fast}} R' - O - R + X^-$

3° alkyl halide can also involve elimination of HX to give alkene in the presence of a base. So, it is better to start with 3° alkoxide and 1° alkyl halide, i.e., equation (b).

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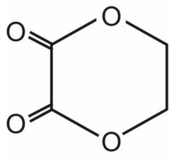
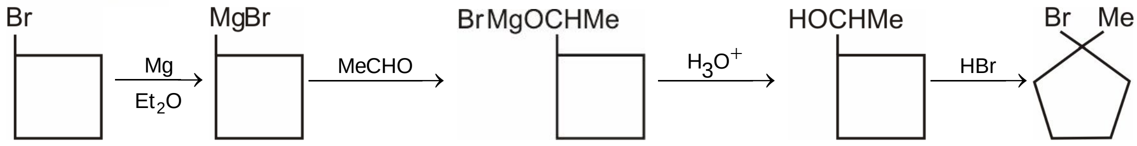
Q.5 

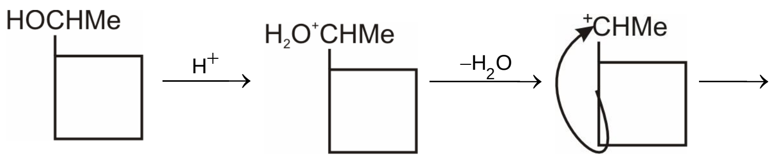
Q.6 Due to intermolecular H-Bonding.

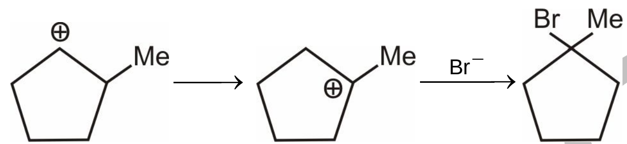
Q.7 A = $CH_3-\overset{\overset{\large O}{||}}{C}-OH$ (i.e. $CH_3-C(=O)-OH$), B = $C_2H_5O^{18}H$

Q.8 

(A) (B) (C)

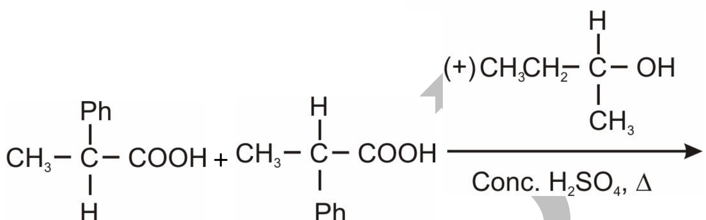
Mechanism



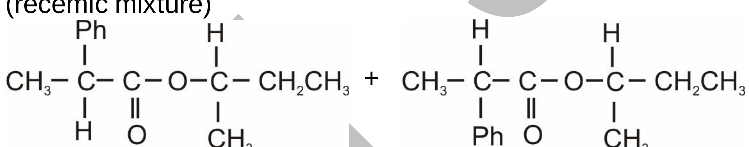


2°carbonium 3° carbonium

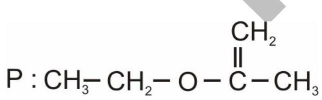
Q.9 X : $\dot{C}O_2$; Y : $CH_2=CH-\dot{C}OOH$; Z : $CH_2=CH\,\dot{C}H_2OH$; $\dot{C}H_2O$ $R'O^- + R-X$

Q.10 

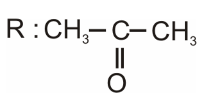
(recemic mixture)



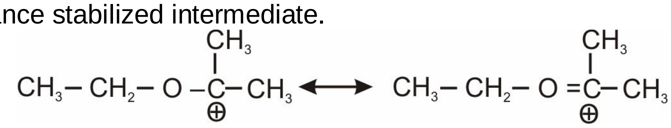
during esterification reaction only –COOH and – OH participates. There is no effect on structure of configuration of carbon adjacent of these groups. So when (±) acid reacts with pure (+) alcohol two esters are produced which are diastereoisomers of each other.

Q.11 

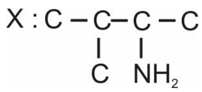
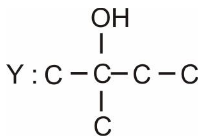
Q : CH_3CH_2OH



When ethylene reacts with dil. $H_2SO_4CH_3CH_2^{\oplus}$ is produced during rate determining step, whereas P gives resonance stabilized intermediate.



due to extra stability of intermediate the rate of reaction is very fast.

Q.12  

Y is optically inactive.

Alcohol, Ether & Phenol

EXERCISE –1

Q.1 The products of combustion of an aliphatic thiol (RSH) at 298 K are: **[JEE 1992]**

(A) $CO_2(\ell)$, H_2O (g) and SO_2(g) (B) CO_2(g), H_2O (g) and SO_2(g)

(C) $CO_2(\ell)$, H_2O (ℓ) and SO_2(g) (D) CO_2 (g), H_2O (ℓ) and $SO_2(\ell)$

Q.2 An organic compound C_3H_6O does not give a precipitate with 2,4- dinitrophenyl hydrazine reagent and does not react with sodium metal. It could be: **[JEE 1993]**

(A) $CH_3– CH_2 – CHO$ (B) $CH_3 – CO – CH_3$

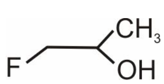
(C) $CH_2 = CH – CH_2OH$ (D) $CH_2 = CH – OCH_3$

Q.3 The reaction products of $C_6H_5OCH_3 + HI \xrightarrow{\Delta}$ are: **[JEE 1995]**

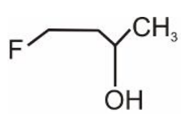
(A) $C_6H_5OH + CH_3I$ (B) $C_6H_5I + CH_3OH$

(C) $C_6H_5CH_3 + HOI$ (D) $C_6H_6 + CH_3OI$

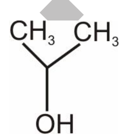
Q.4 The order of reactivity of the following alcohols: **[JEE 1997]**



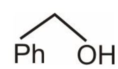
(I)



(II)



(III)



(IV)

towards conc. HCl is

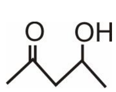
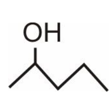
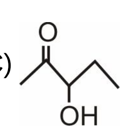
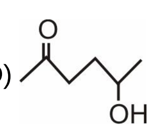
(A) I > II > III > IV (B) I > III > II > IV

(C) IV > III > II > I (D) IV > II > III > I

Q.5 Among the following compounds, the strongest acid is: **[JEE 1998]**

(A) $HC \equiv CH$ (B) C_6H_6 (C) C_2H_6 (D) CH_3OH

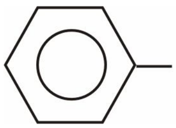
Q.6 Which one of the following will most readily be dehydrated in acidic condition: **[JEE 2000]**

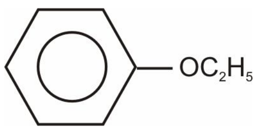
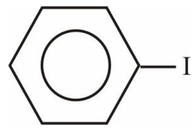
(A)  (B)  (C)  (D) 

Q.7 Identify the correct order of boiling point of the following compounds: **[JEE 2002]**

$CH_3CH_2CH_2CH_2OH$ (1.) $CH_3CH_2CH_2CHO$ (2.) $CH_3CH_2CH_2COOH$ (3.)

(A) 1 > 2 > 3   (B) 3 > 1 > 2   (C) 1 > 3 > 2   (D) 3 > 2 > 1

Q.8  $-OH + C_2H_5I \xrightarrow[C_2H_5OH\,(\text{anhydrous})]{C_2H_5O^-Na^+\,(\text{excess})}$ **[JEE 2003]**

(A)    (B) 

(C) $C_6H_5OC_6H_5$ (D) $C_2H_5OC_2H_5$

Q.9 Reaction of entainomerically pure acid with 1 chiral carbon and racemic alcohol with 1 chiral carbon gives an ester which is **[JEE 2003]**

(A) Meso   (B) Optically active mixture

(C) Racemic mixture (D) Enantionmerically pure

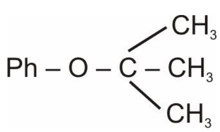
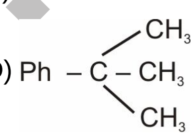
Q.10 On acid catalysed hydration, 2- phenyl propene gives: **[JEE 2004]**

(A) 3- phenyl-2- propanol   (B) 2-phenyl-1- propanol

(C) 1- phenyl-3- propanol   (D) 2- phenyl -2- propanol

Q.11 Phenyl magnesium bromide reacting with t- Butyl alcohol gives: **[JEE 2005]**

(A) Ph – OH   (B) Ph – H

(C)    (D) 

Q.12 **Statement-1:** p- Hydroxybenzoic acid has a lower boiling point than o-hydroxybenzoic acid. **[JEE 2007]**

Because

Statement-2: o- Hydroxybenzoic acid has intramolecular hydrogen bonding.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

EXERCISE –2

Q.1 When t-butanol and n- butanol are separately treated with a few drops of dilute $KMnO_4$ in one case only, purple colour disappears and a brown precipitate is formed. Which of the two alcohols gives the above reaction and what is the brown precipitate? **[JEE 1994]**

Q.2 3,3-Dimethylbutan-2-ol losses a molecule of water in the presence of a concentrated sulphuric acid to give tetramethyl ethylene as a major product. Suggest a suitable mechanism. **[JEE 1996]**

Q.3 A compound $D(C_8H_{10}O)$ upon treatment with alkaline solution of iodine gives a yellow precipitate. The filtrate on acidification gives a white solid (E) $(C_7H_6O_2)$. Write the structures of (D) and (E) and explain the formation of (E). **[JEE 1996]**

Q.4 Which of the following is the correct method for synthesising methyl-t-butyl ether and why ?

(i) $(CH_3)_3CBr + NaOMe \longrightarrow$

(ii) CH_3Br + tert-BuOna $\longrightarrow$ **[JEE 1997]**

Q.5

$$\begin{array}{l} O=C-OH \\ \quad\ \ | \\ O=C-OH \end{array} + \begin{array}{l} HOCH_2 \\ \quad\ | \\ HOCH_2 \end{array} \xrightarrow{\text{Conc.}H_2SO_4} (A)$$

[JEE 1997]

Q.6 Discuss why o-hydroxy benzaldehyde is a liquid at room temperature while p- hydroxy benzaldehyde is a high melting solid? **[JEE 1999]**

Q.7 Write the structures of the product A and B. **[JEE 2000]**

$$\begin{array}{c} CH_3-C-\overset{18}{O}C_2H_5 \\ \| \\ O \end{array} \xrightarrow{H_3O^{\oplus}} A + B$$

Q.8 Cyclobutyl bromide on treatment with magnesium in dry ether forms an organometallic A. The organometallic reacts with ethanol to give an alcohol B after mild acidification. Prolonged treatment of alcohol B with an equivalent amount of HBr gives 1- bromo-1- methylcyclopentane (C). Write the structures of A, B and explain how C is obtained from B. **[JEE 2001]**

Q.9 Identify X, Y and Z in the following synthetic scheme and write their structure. Explain the formation of labelled formaldehyde (H_2C^*O) as one of the products when compound Z is treated with HBr and subsequently ozonolysed. Mark the C* carbon in the entire scheme. **[JEE 2001]**

$$BaC^*O_3 + H_2SO_4 \rightarrow X \text{ (gas) [C* denotes } C^{14}]$$

$$CH_2=CH-Br \xrightarrow[\text{(ii)X, (iii)}H_3O^+]{\text{(i)Mg / ether}} Y \xrightarrow{LiAlH_4} Z$$

Q.10 Mention two esters produced when a racemic mixture of 2- phenyl propanoic acid is treated with (+) 2-butanol. What is the stereochemical relationship between these esters? **[JEE 2003]**

Q.11 An organic compound P($C_5H_{10}O$) Reacts 10^{15} times faster then ethylene with dil. H_2SO_4 to give two products Q and R. Both Q and R give positive iodoform test. Identify P, Q and R and also give reason for very high reactivity of P. **[JEE 2004]**

Q.12 (X) $C_5H_{13}N \xrightarrow[-N_2]{NaNO_2,\ HCl}$ (Y) (Tertiary alcohol + other products)

(Optically active)

Find X and Y. Is y optically active? Write the intermediate steps. **[JEE 2005]**

EXERCISE-1

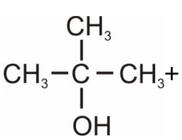
Q.1	**B**	**Q.2**	**D**	**Q.3**	**A**	**Q.4**	**C**	**Q.5**	**D**	**Q.6**	**A**
Q.7	**B**	**Q.8**	**D**	**Q.9**	**B**	**Q.10**	**D**	**Q.11**	**B**	**Q.12**	**D**

EXERCISE-2

Q.1 n- butanol is oxidised by KMnO4 and not t- butanol as the latter does not contain H atom attached to carbinol carbon atom.

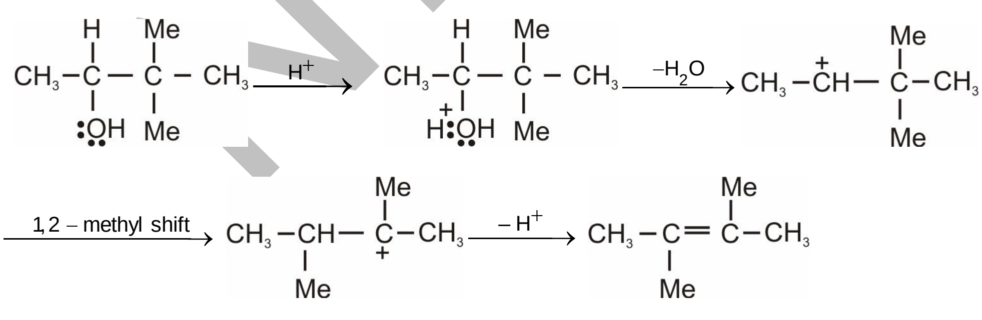
$CH_3CH_2CH_2CH_2OH + KMnO_4 \rightarrow CH_3CH_2CH_2COO\overset{-}{O}\overset{+}{K} + MnO_2 + KOH$

n- Butanol Brown

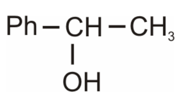


t- Butanol

Q.2



Q.3 (D)

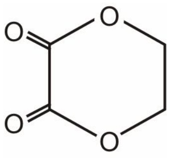


(E) C_6H_5COOH

Q.4 The ether formation involves nucleophilic substitution of alkoxide ion for halide ion.

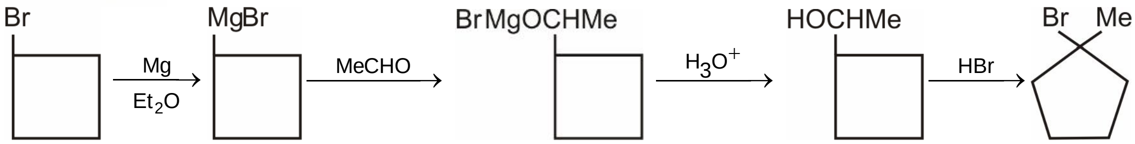
$R'O^- + R - X \quad R'O^- + R - X \xrightarrow{Slow} R'\overset{\delta^-}{O} \text{--------} R \text{------} \overset{\delta^-}{X} \xrightarrow{Fast} R' - O - R + X^-$

3° alkyl halide can also involve elimination of HX to give alkene in the presence of a base. So, it is better to start with 3° alkoxide and 1° alkyl halide, i.e., equation (b).

Q.5 

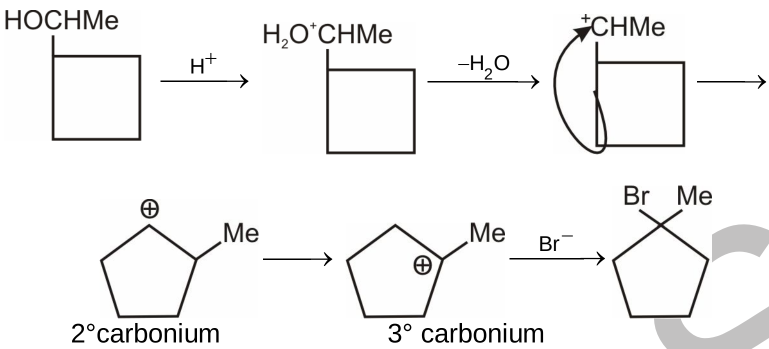
Q.6 Due to intermolecular H-Bonding.

Q.7 $A = CH_3-\underset{\underset{O}{\|}}{C}-OH$, $B = C_2H_5O^{18}H$

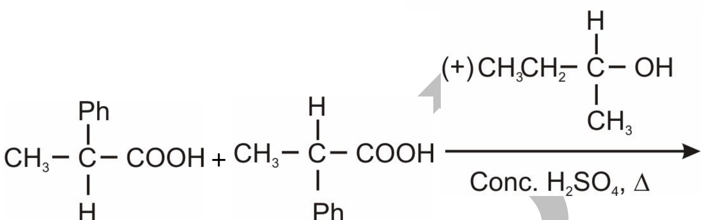
Q.8 

(A) (B) (C)

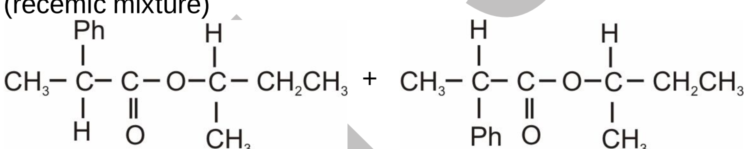
Mechanism



Q.9 X : $\dot{C}O_2$; Y : $CH_2 = CH - \dot{C}OOH$; Z : $CH_2 = CH\ \dot{C}H_2OH$; $\dot{C}H_2O$ $R'O^- + R - X$

Q.10 

(recemic mixture)



during esterification reaction only –COOH and – OH participates. There is no effect on structure of configuration of carbon adjacent of these groups. So when (±) acid reacts with pure (+) alcohol two esters are produced which are diastereoisomers of each other.

Q.11 P : $CH_3-CH_2-O-\overset{\overset{CH_2}{\|}}{C}-CH_3$

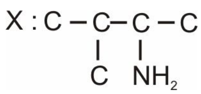
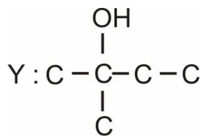
Q : CH_3CH_2OH

R : $CH_3-\underset{\underset{O}{\|}}{C}-CH_3$

When ethylene reacts with dil. $H_2SO_4CH_3CH_2^{\oplus}$ is produced during rate determining step, whereas P gives resonance stabilized intermediate.

$$CH_3-CH_2-O-\underset{\oplus}{\overset{\overset{CH_3}{|}}{C}}-CH_3 \longleftrightarrow CH_3-CH_2-O=\underset{\oplus}{\overset{\overset{CH_3}{|}}{C}}-CH_3$$

due to extra stability of intermediate the rate of reaction is very fast.

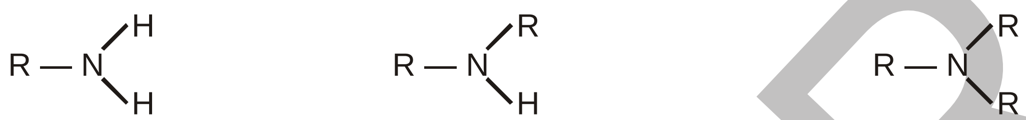
Q.12  

Y is optically inactive.

AMINES

Nitrogen Containing Compounds

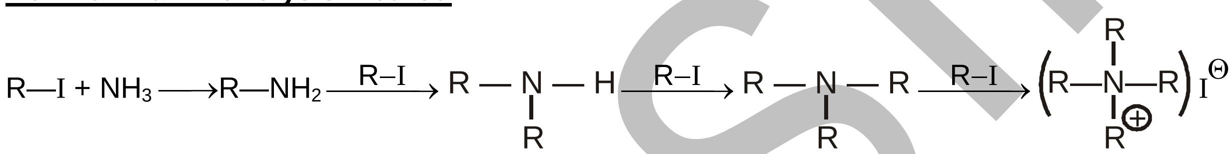
Amines:-



(1° - amine) (primary amine) (2° - amine) (Secondary amine) (3°- amine) (Tertiary amine)

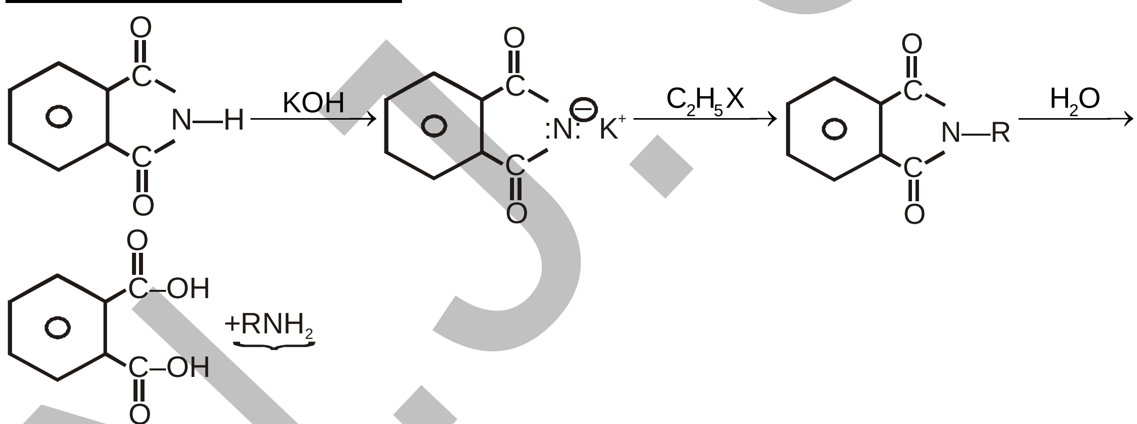
Methods of preparation

(1) Hoffmann ammonolysis method



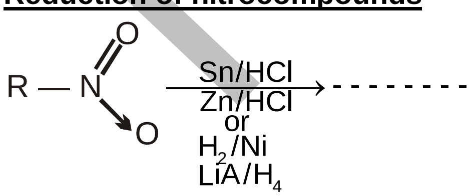
Not a good method of prepare primary amines

(2) Gabriel phthalimide reaction



Very good method to generate primary amines

(3) Reduction of nitrocompounds

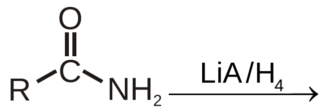


(4) Reduction of cyanides

$R - C \equiv N \xrightarrow{H_2/Ni}$

$\quad\quad\;\; \xrightarrow{Na\,/\,EtOH}$

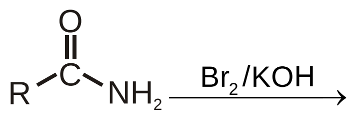
(5) **<u>Reduction of amides</u>**



(6) **<u>Reduction of oximes</u>**

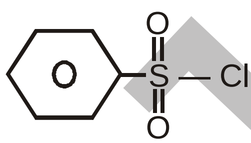
$R - CH = NOH \xrightarrow[LiA/H_4]{H_2/Ni}$

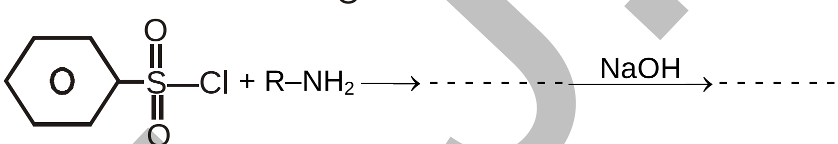
(7) **<u>Hoffmann Bromamide Reaction</u>**



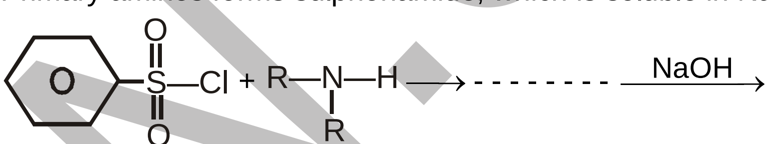
(8) $RMgX + ClNH_2 \longrightarrow$

(9) $R - N \equiv C + H-O-H \xrightarrow{H^+}$

<u>Hinsberg Test:-</u>  (Hinsberg Reagant)

1. 

Primary amines forms sulphonamide; which is soluble in NaOH.

2.  (Insoluble)

(Teitiary amines do not react)

<u>Chemical Properties of amines</u>

1. Basic Nature

2. $R - NH_2 \xrightarrow{Na}$ - - - - - - - -

3. $R - NH_2 \xrightarrow[KOH]{CHCl_3}$ - - - - - - - - (foulsmell) [Carbyl amine reaction]

4. **<u>Libermann's Nitroso Test</u>**

1. $R - NH_2 \xrightarrow{HONO}$ - - - - - - - -

2. $R-\underset{\underset{R}{|}}{N}-H \xrightarrow{HONO}$ - - - - - - - - [yellow oily liquids insoluble in H_2O]

3. $R-\underset{\underset{R}{|}}{N}-R \xrightarrow{HONO}$ - - - - - - - -

5. Hoffmann Mustard oil Reaction

$R - \ddot{N}H_2 + CS_2 + HgCl_2 \longrightarrow$ - - - - - - - -

$R - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{N}}: + S = C = S \longrightarrow$ - - - - - - - - $\xrightarrow{HgCl_2}$ - - - - - - - -

6. Reactions with Carbonyl Compounds

$R - NH_2 \longrightarrow$ imines - - - - - - - -

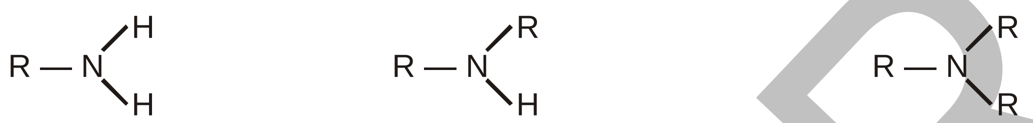
$R - \underset{\underset{H}{|}}{N}-R \longrightarrow$ enamines - - - - - - - -

$R-\underset{\underset{R}{|}}{N}-R \longrightarrow$ No. Reaction - - - - - - - -

AMINES

Nitrogen Containing Compounds

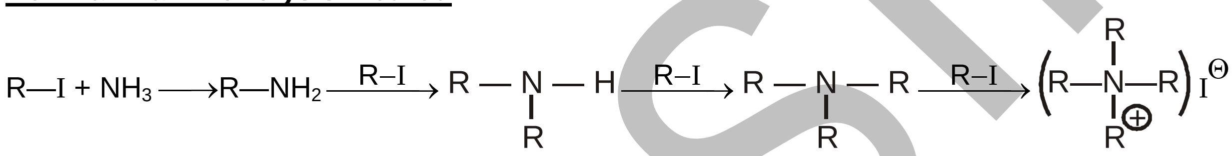
Amines:-



(1° - amine) (primary amine) (2° - amine) (Secondary amine) (3°- amine) (Tertiary amine)

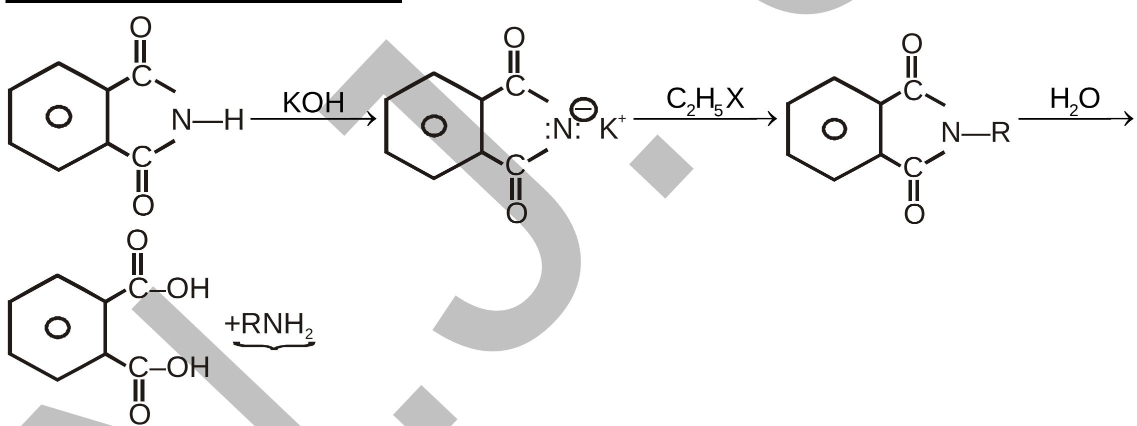
Methods of preparation

(1) Hoffmann ammonolysis method



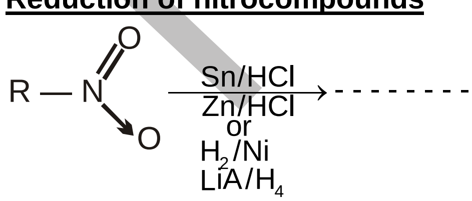
Not a good method of prepare primary amines

(2) Gabriel phthalimide reaction



Very good method to generate primary amines

(3) Reduction of nitrocompounds

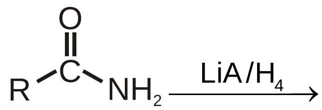


(4) Reduction of cyanides

$R-C\equiv N \xrightarrow{H_2/Ni}$

$\quad\quad \xrightarrow{Na\ /\ EtOH}$

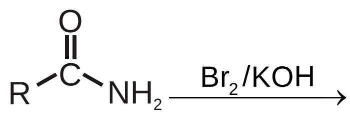
(5) **Reduction of amides**



(6) **Reduction of oximes**

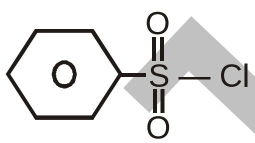
$R-CH=NOH \xrightarrow[LiA/H_4]{H_2/Ni}$

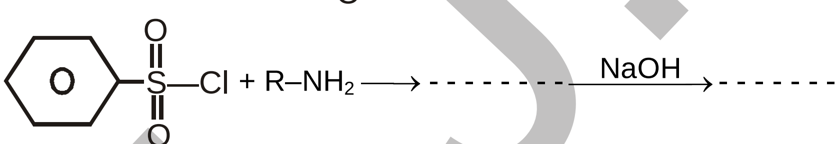
(7) **Hoffmann Bromamide Reaction**



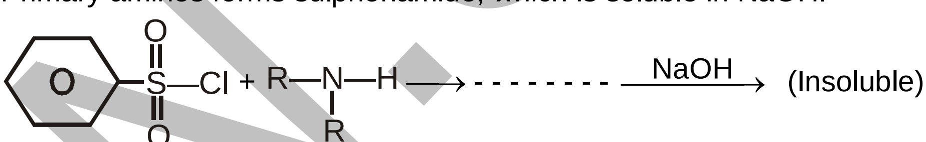
(8) $RMgX + ClNH_2 \longrightarrow$

(9) $R-N\equiv C + H-O-H \xrightarrow{H^+}$

Hinsberg Test:-  (Hinsberg Reagant)

1. 

Primary amines forms sulphonamide; which is soluble in NaOH.

2. 

(Teitiary amines do not react)

Chemical Properties of amines

1. Basic Nature

2. $R-NH_2 \xrightarrow{Na}$ - - - - - - - -

3. $R-NH_2 \xrightarrow[KOH]{CHCl_3}$ - - - - - - - - (foulsmell) [Carbyl amine reaction]

4. **Libermann's Nitroso Test**

1. $R-NH_2 \xrightarrow{HONO}$ - - - - - - - -

2. $R-\underset{\underset{R}{|}}{N}-H \xrightarrow{HONO}$ - - - - - - - - [yellow oily liquids insoluble in H_2O]

3. $R-\underset{\underset{R}{|}}{N}-R \xrightarrow{HONO}$ - - - - - - - -

5. <u>Hoffmann Mustard oil Reaction</u>

$R-\ddot{N}H_2 + CS_2 + HgCl_2 \longrightarrow$ - - - - - - - -

$R-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{N}}\!: + S=C=S \longrightarrow$ - - - - - - - - $\xrightarrow{HgCl_2}$ - - - - - - - -

6. <u>Reactions with Carbonyl Compounds</u>

$R-NH_2 \longrightarrow$ imines - - - - - - - -

$R-\underset{\underset{H}{|}}{N}-R \longrightarrow$ enamines - - - - - - - -

$R-\underset{\underset{R}{|}}{N}-R \longrightarrow$ No. Reaction - - - - - - - -

AROMATIC CHEMISTRY

AROMATIC CHEMISTRY

Directive Influence in substituted Benzene

e– donating groups activating

1) Strong E.D.G. (O/P- directing)

$-\ddot{\underset{\cdot\cdot}{O}}{:}^{\ominus}$, $-\ddot{N}(CH_3)_2$, $-\ddot{N}H-CH_3$

$-\ddot{N}H_2$, $-OH$, $-OCH_3$

2) Moderately E.D.G. (O/P- directing)

$-O-\overset{O}{\overset{\|}{C}}-CH_3$, $-NH-\overset{O}{\overset{\|}{C}}-CH_3$,

$-O-CH=CH_2$, $-NH-CH-CH_2$

3) Weakly E.D.G. (O/P- directing)

$-R$, $-\overset{O}{\overset{\|}{C}}-O^-$, $-Ph$

e– with drawing groups deactivating

1) Strong EWG. (Meta- directing)

$-NO_2$, $-C\equiv N$, $-SO_3H$,

$-\overset{\oplus}{N}F_3$, $-\overset{\oplus}{N}H_3$, CF_3

2) Moderately EWG. (Meta- directing)

$-\underset{O}{\underset{\|}{C}}-H$, $-\underset{O}{\underset{\|}{C}}-R$, $-\underset{O}{\underset{\|}{C}}-OR$,

$-\underset{O}{\underset{\|}{C}}-NH_2$, $-\underset{O}{\underset{\|}{C}}-O-\underset{O}{\underset{\|}{C}}-R$,

3) Weakly EWG. (O/P- directing)

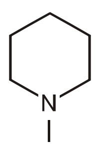
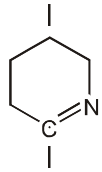
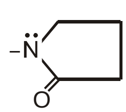
$-F$

$-C\ell$ $-NO$

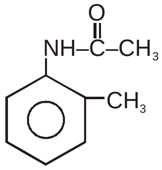
$-Br$

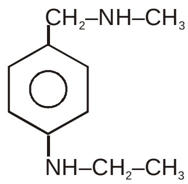
$-I$

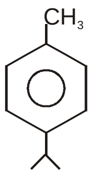
Fill in the blanks :

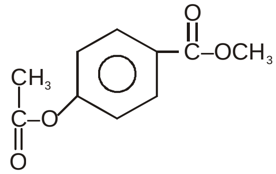
Substitute on Ph ring o/p	Meta	Activating	deactivating
1. 			
2. 			
3. $-\underset{O}{\underset{\|}{C}}-CH_3$			
4. $-O-\underset{O}{\underset{\|}{C}}-CH_3$			
5. $-SO_3H$			
6. $-CH_3$			
7. $-\ddot{N}=O$			
8. 			
9. $-CH=CH-NO_2$			
10. $-NH-CH_3$			

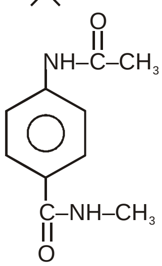
1. Identify the position where electrophilic substitution is favourable :

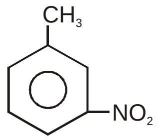
(1) 

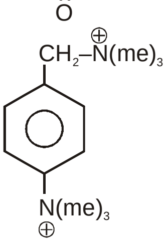
(2) 

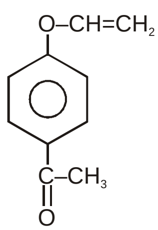
(3) 

(4) 

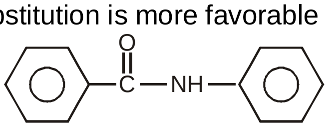
(5) 

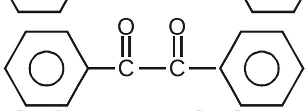
(6) 

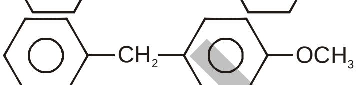
(7) 

(8) 

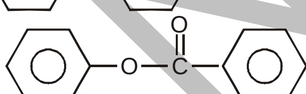
2. Identify the ring on which electrophilic substitution is more favorable :

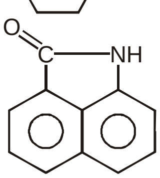
(1) 

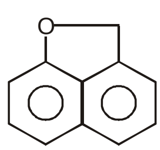
(2) 

(3) 

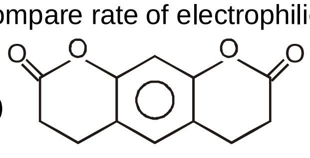
(4) 

(5) 

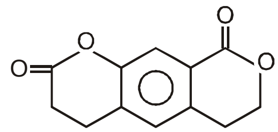
(6) 

(7) 

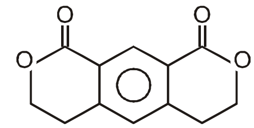
3. Compare rate of electrophilic substitution :

(1) 

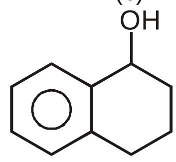
(a)



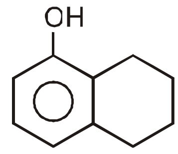
(b)



(c)

(2) 

(a)



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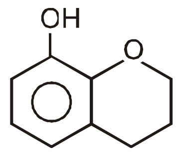
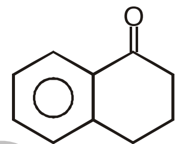


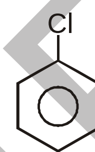
(c)



(d)

(3) 

(a)



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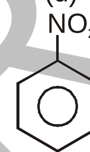

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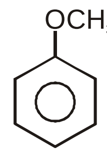
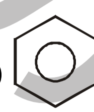
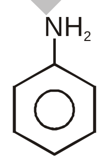


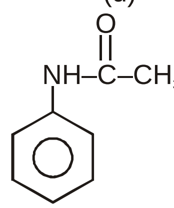
(d)

(4) 

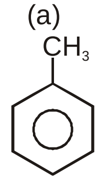
(a)



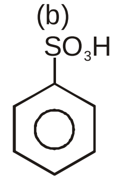
(b)



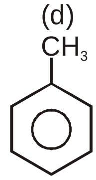
(c)



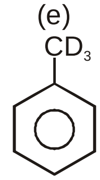
(d)



(e)

(5) 

(a)



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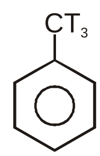
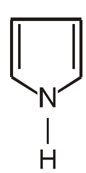
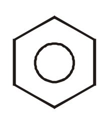
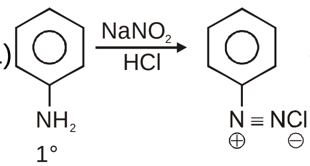


(c)

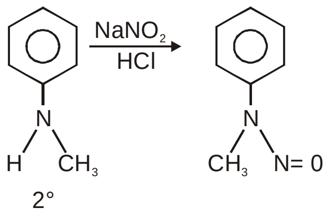
(6) 



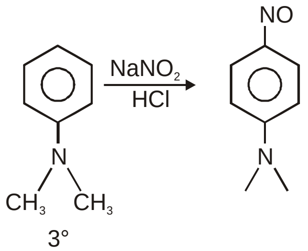
4. **Diazotisation of amines**

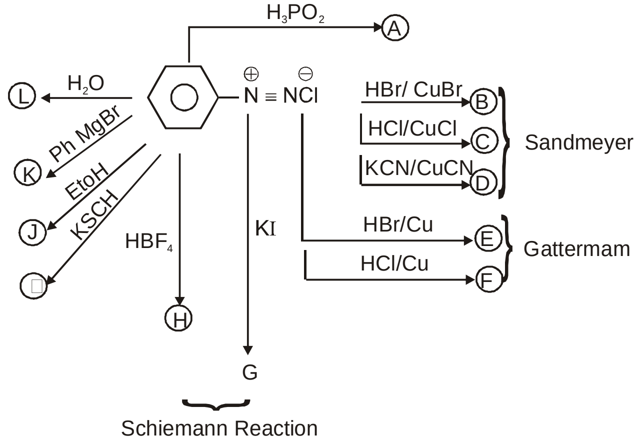
(1)  diazonium chloride

ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

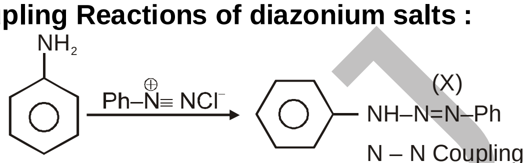
(2) 

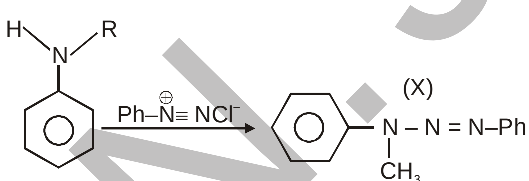
(Nitroso amine)

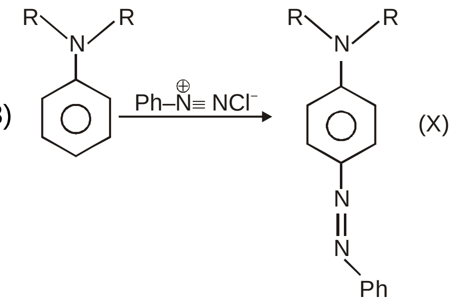
(3) 

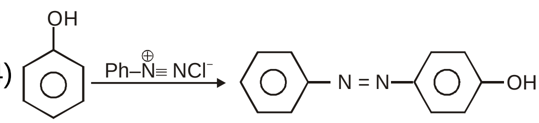


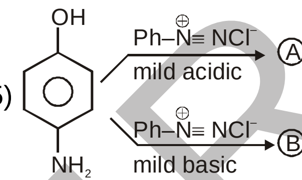
5. Cupling Reactions of diazonium salts :

(1) 

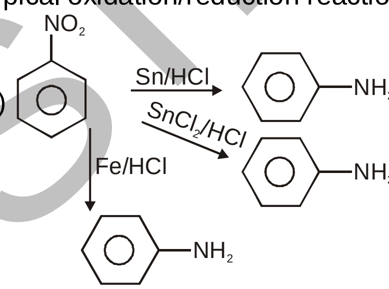
(2) 

(3) 

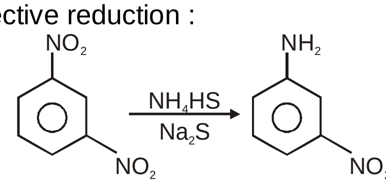
(4) 

(5) 

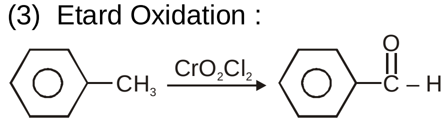
6. Typical oxidation/reduction reactions :

(1) 

(2) Selective reduction :

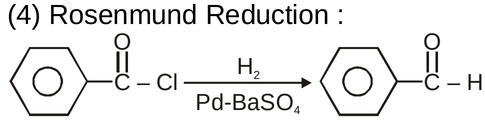


(3) Etard Oxidation :



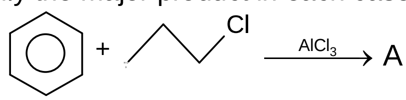
($CrO_2Cl_2 \rightarrow$ etard reagent)

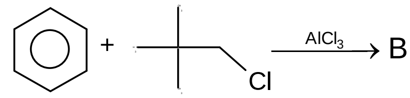
(4) Rosenmund Reduction :

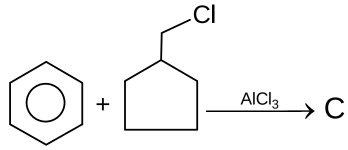


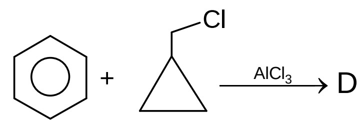
DPP-01 Time: 20 Minutes

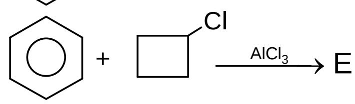
Q.1 Write only the major product in each case:

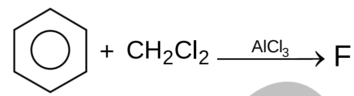
(a) 

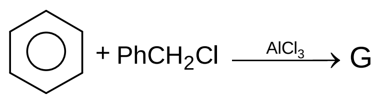
(b) 

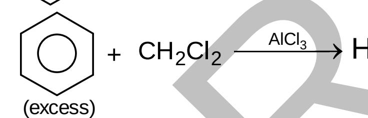
(c) 

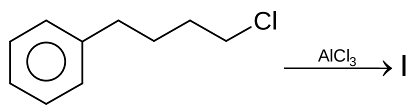
(d) 

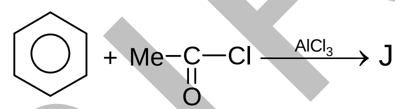
(e) 

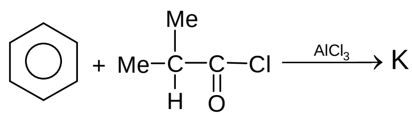
(f) 

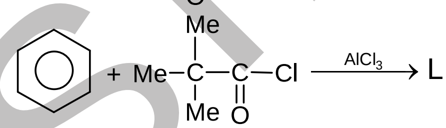
(g) 

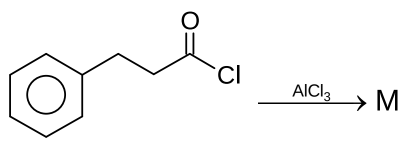
(h) 

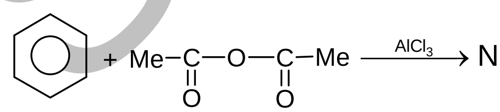
(i) 

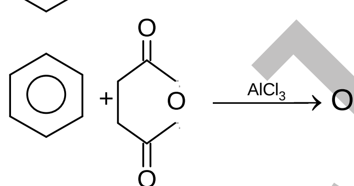
(j) 

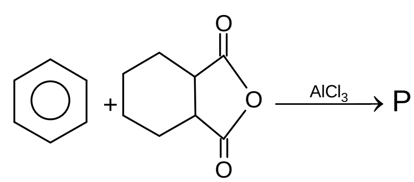
(k) 

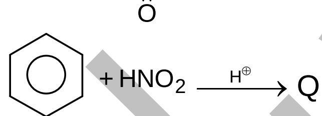
(l) 

(m) 

(n) 

(o) 

(p) 

(q) 

Q.2. Give structure and names of the priccipal organic products expected from mononitration of

(a) o-nitrotoluene (b) m-dibromobenzene

(c) m-dinitrobenzene (d) o-cresol

(e) p-cresol (f) m-nitrotoluene

(g) p-xylene (p-$C_6H_4(CH_3)_2$)

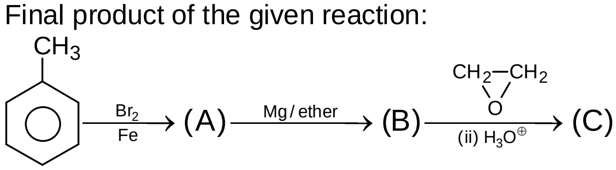
(h) terephthalic acid (p-$C_6H_4(COOH)_2$)

(i) anilinium hydrogen sulfate ($C_6H_5NH_3^+HSO_4^-$)

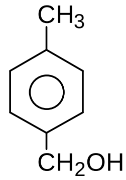
(j) m-cresol (m-$CH_3C_6H_4OH$)

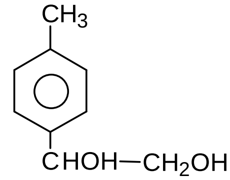
(k) p-nitroacetanilide (p-$O_2NC_6H_4NHCOCH_3$)

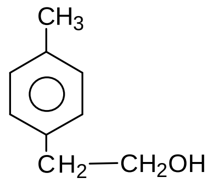
Q.3 Final product of the given reaction:

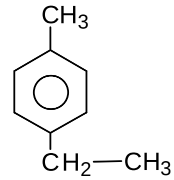


(C) is:

(A) 

(B) 

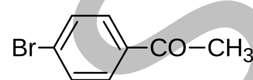
(C) 

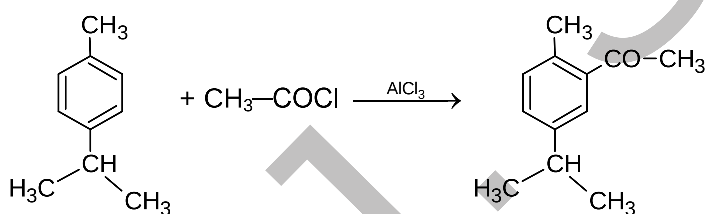
(D) 

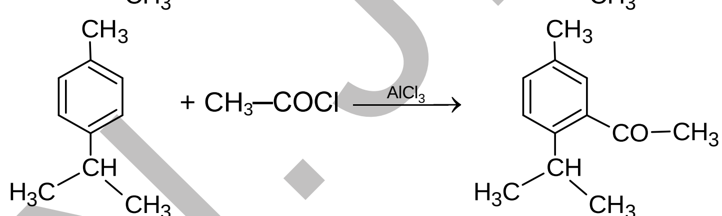
Q.4 For chlorination of benzene which of the following reagent should be used?
(A) BrCl (B) ICl (C) $HOCl + H^+$ (D) All

Q.5 Which of the following statement is not correct regarding desulfonation?
(A) All steps are reversible
(B) it exhibits kinetic isotope effect.
(C) Phenol when reacts with SO_3 at low temperature o-product is formed and at high temperature p-product is formed as mojor product.
(D) none

Q.6 Point out the wrong formulation.

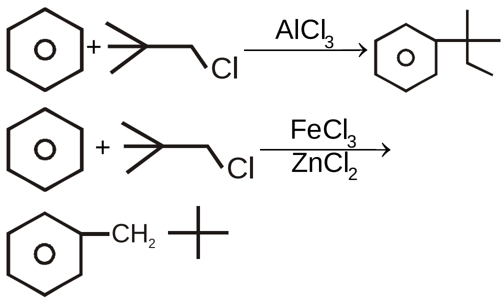
(A) $C_6H_5\text{—}Br + (CH_3\text{—}CO)_2\,O \xrightarrow{AlCl_3}$ 

(B) 

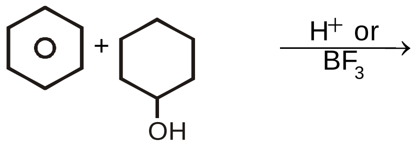
(C) 

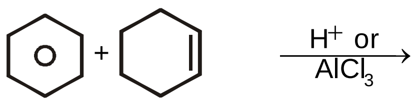
(D) $C_6H_5\text{—}NO_2 + EtCl \xrightarrow{AlCl_3}$ no reaction

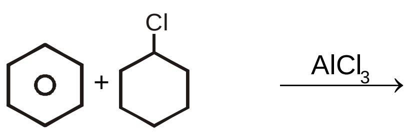
DPP NO-02 Time: 15 minutes

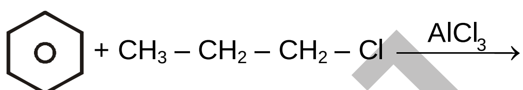
Q.1 

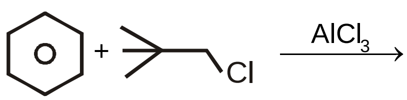
Explain

Q.2 

Q.3 

Q.4 

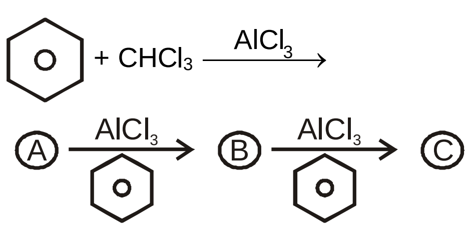
Q.5 

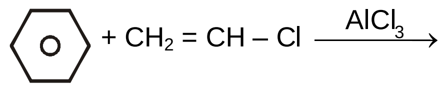
Q.6 

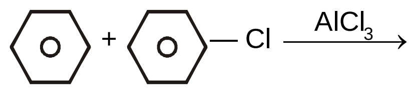
Q.7 

Q.8 

Q.9 

Q.10 

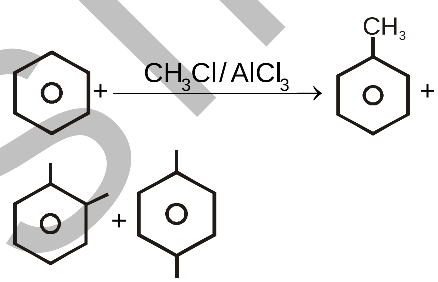
Q.11 

Q.12 

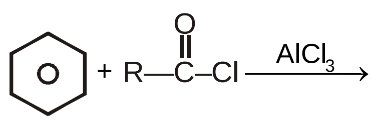
Q.13 Strong e^- with drawing groups like.

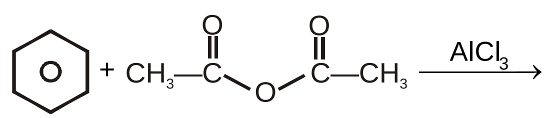
— NO_2, — C ≡ N, —$\overset{\overset{O}{\|}}{C}$–OH, — SO_3H give poor yield in friedel craft alkylation. Explain.

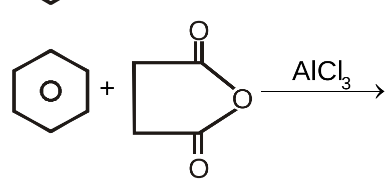
Q.14 Strong e^- releasing group — NH_2 donot not give friedel craft alkylation. Explain

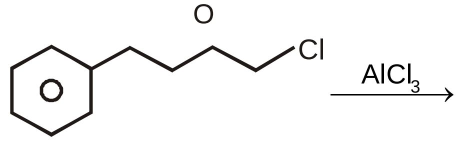
Q.15 

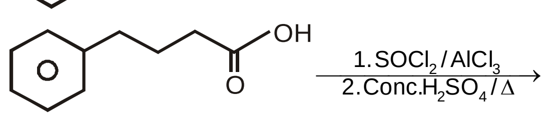
Write the major product for these reactions.

Q.16 

Q.17 

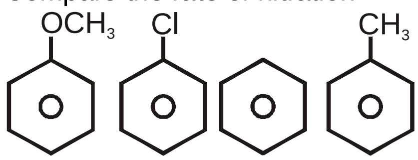
Q.18 

Q.19 

Q.20 

DPP NO -03 Time: 15 minutes

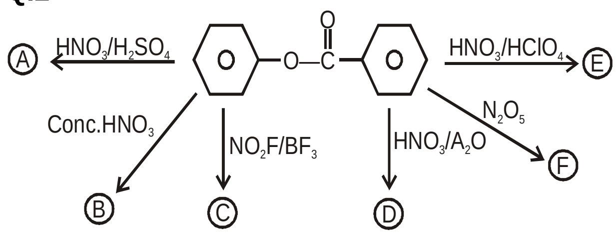
Q.1 Compare the rate of nitration



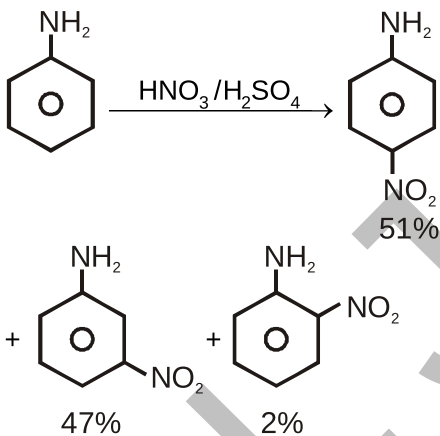
(a) (b) (c) (d)

C_6D_6 (e) C_6T_6 (f)

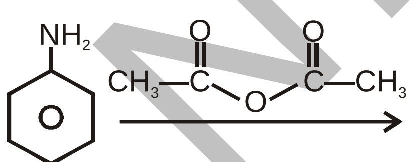
Q.2



Q.3
Explain

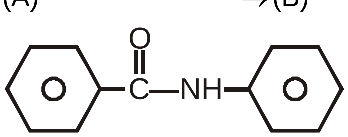


Q.4



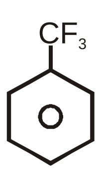
(A) $\xrightarrow{HNO_3/H_2SO_4}$ (B) $\xrightarrow{H_3O^+}$ (D)+(C

Q.5



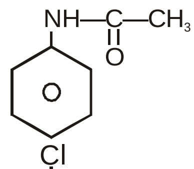
$\xrightarrow{HNO_3/H_2SO_4}$

Q.6



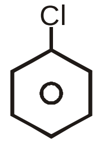
$\xrightarrow{HNO_3/H_2SO_4}$

Q.7



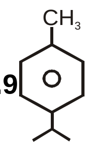
$\xrightarrow[H_2SO_4]{HNO_3}$

Q.8



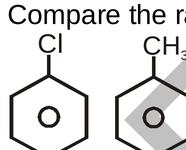
$\xrightarrow[H_2SO_4]{HNO_3}$

Q.9



$\xrightarrow[H_2SO_4]{HNO_3}$

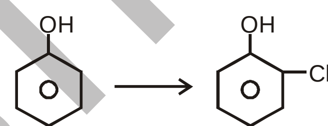
Q.10 Compare the rate of sulphonation:–



C_6H_6 C_6D_6 C_6T_6

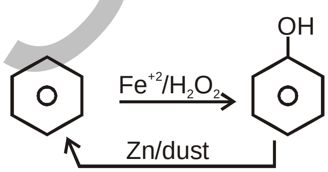
(a) (b) (c) (d) (e)

Q.11 Convert

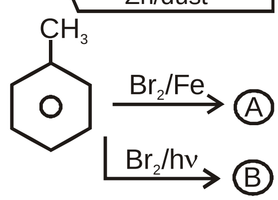


(hint:– protection of para position)

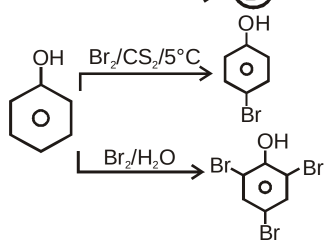
Q.12



Q.13



Q.14



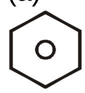
Q.15

$\xrightarrow[HNO_3]{I_2}$ (A)

Q.16 Compare rate of iodination of

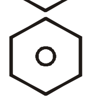
C_6H_6 (a) C_6D_6 (b) C_6T_6 (c)

Q.17



$\xrightarrow{ICl/AlCl_3}$

Q.18

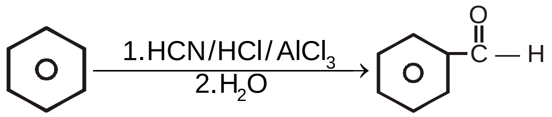


$\xrightarrow[AlCl_3]{Br–Cl}$

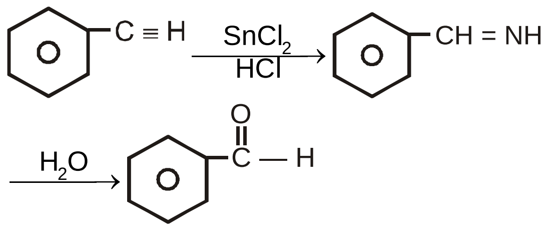
DPP NO-04 Time: 15 minutes

Q.1 Write mechanism of following reactins:–

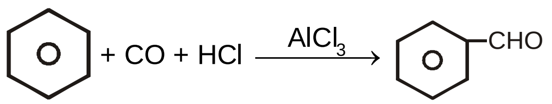
(a) Gatterrnann aldehyde synthesis:–



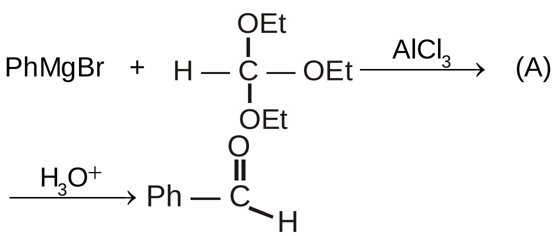
(b) Stephen Reduction



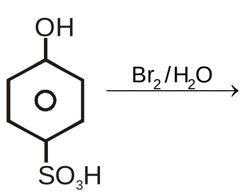
(c)



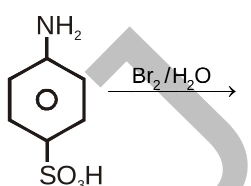
(d)



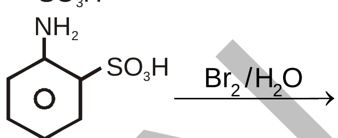
Q.2



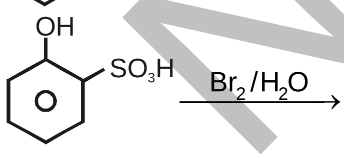
Q.3



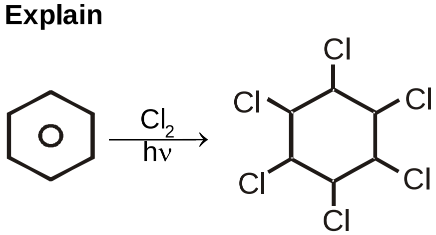
Q.4



Q.5



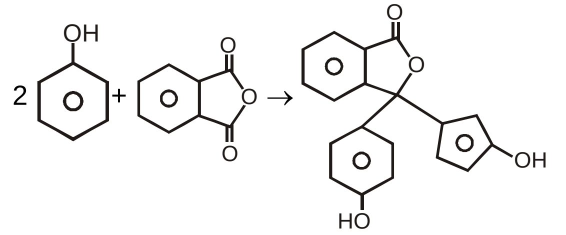
Q. Explain



Lindane /666/ $C_6H_6Cl_6$ /Gammaxene /BHC

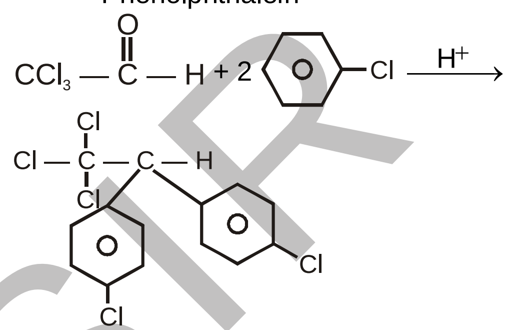
Q. Write mechanism

1.

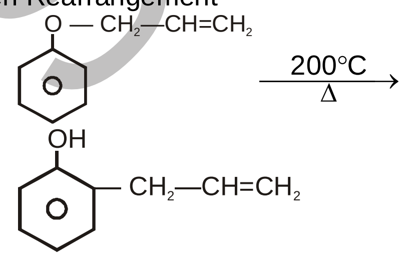


Phenolphthalein

2.

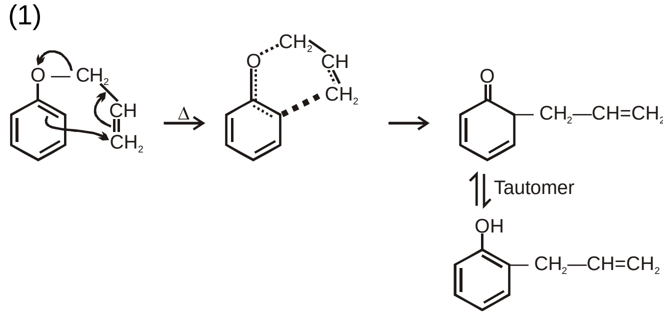


Claisen Rearrangement



Mechanism:–

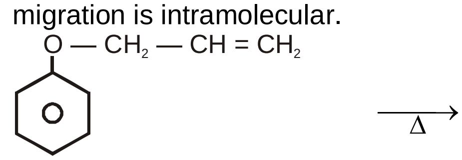
(1)

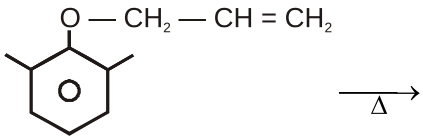


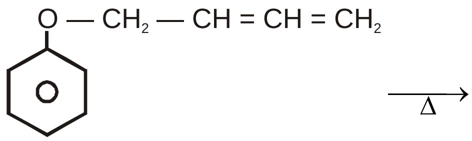
Characteristics

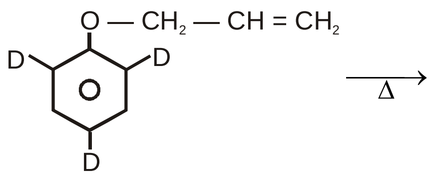
1. first order reaction
2. migration is intramolecular.

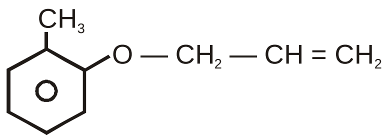
Q.1



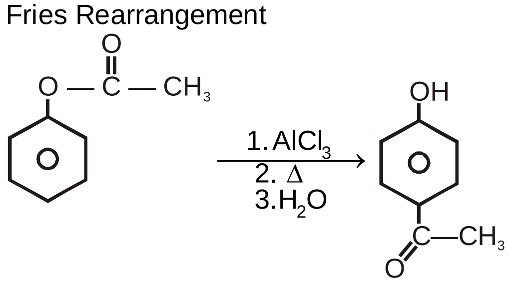
Q.2 

Q.3 

Q.4 

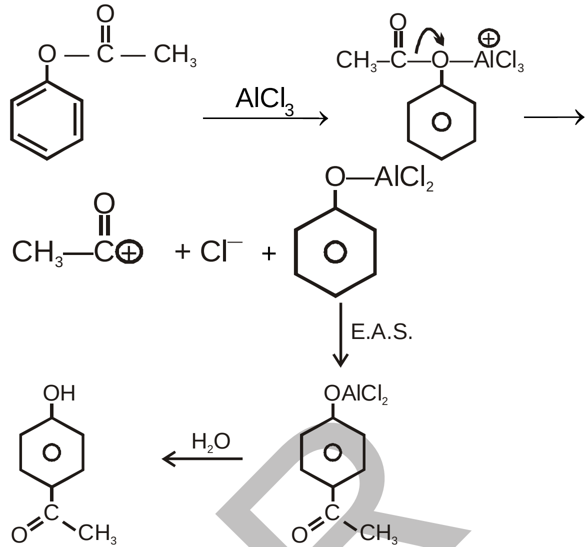
Q.5 

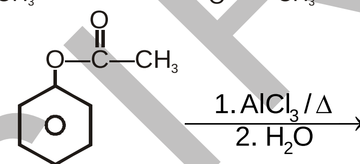
Fries Rearrangement

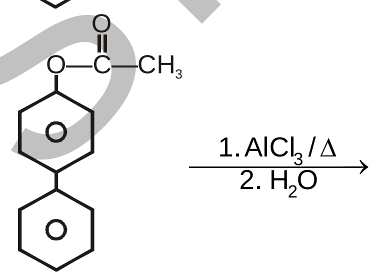


Mechanism:–

1.

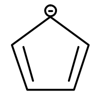


Q.1 

Q.2 

EXERCISE – I

Q.1 How many π electron are there in the following species :



(A) 2 (B) 4 (C) 6 (D) 8

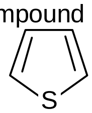
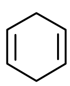
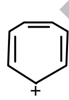
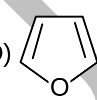
Q.2 Benzene is a resonance hybrid mainly of two Kekule structures. Hence
(A) Half of the molecules correspond to one structure, and half of the second structure
(B) At low temperatures benzene can be separated into two structures
(C) Two structures make equal contribution to resonance hybrid
(D) An individual benzene molecule changes back and forth between two structures

Q.3 Which one of the following is the most basic compound :
(A) $C_6H_5-NH_2$ (B) $C_6H_5-NHCH_3$
(C) $C_6H_5-N(CH_3)_2$ (D) $C_6H_5N(C_2H_5)_2$

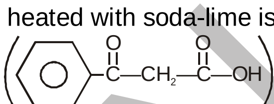
Q.4 Which of the following groups is divalent :
(A) Benzoyl (B) Benzyl
(C) Benzal (D) p-Tolyl

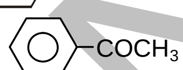
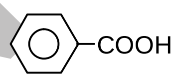
Q.5 The number of benzylic hydrogen atoms in ethylbenzene is :
(A) 3 (B) 5 (C) 2 (D) 7

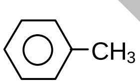
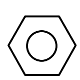
Q.6 Which of the following is not an aromatic compound :

(A)  (B)  (C)  (D) 

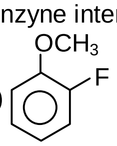
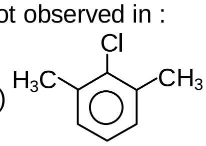
Q.7 Product obtained when benzoyl acetic acid is heated with soda-lime is :

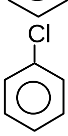
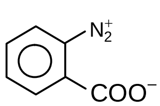
 (Benzoyl acetic acid)

(A)  (B) 

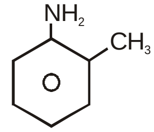
(C)  (D) 

Q.8 Benzyne intermediate is not observed in :

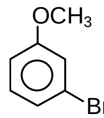
(A)  (B) 

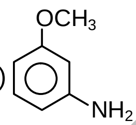
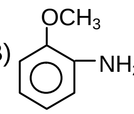
(C)  (D) 

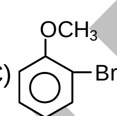
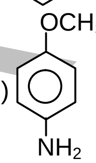
Q.9 In the reaction of p-chlorotoluene with KNH_2 in liquid NH_3, the major product is :

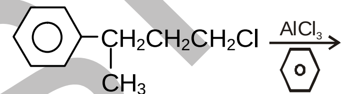
 (o-Toluidine)

(A) o-Toluidine (B) m-Toluidine
(C) p-Toluidine (D) p-Chloroaniline

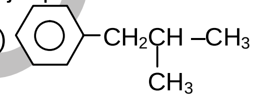
Q.10  $\xrightarrow{NaNH_2}$ A, major product A and reaction R are :

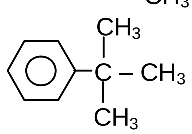
(A)  (B) 

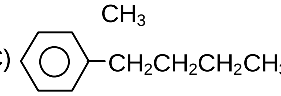
(C)  (D) 

Q.11  hydrocarbon (X)

major product X is :

(A) 

(B) 

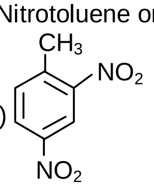
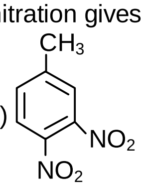
(C) 

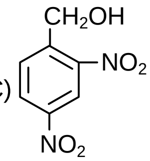
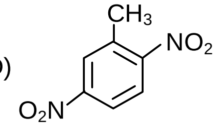
(D) None of these

Q.12 $C_6H_6 + A \xrightarrow{AlCl_3} C_6H_5CONH_2$
A in the above reaction is :
(A) NH_2CONH_2 (B) $ClCONH_2$
(C) CH_3CONH_2 (D) $CH_2(Cl)CONH_2$

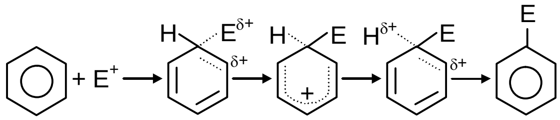
Q.13 In the sulphonation, acetylation and formylation of benzene the group of effective electrophiles would be :
(A) $SO_3^+, CH_3\equiv\overset{+}{O}, H\overset{+}{C}O$
(B) $SO_3, CH_3-C\equiv\overset{+}{O}, H\overset{+}{C}O$
(C) SO_3, CH_3CHO, CO + HCl
(D) HSO_3, CH_3CO, HCO

Q.14 p-Nitrotoluene on further nitration gives :

(A)  (B) 

(C)  (D) 

Q.15 Which of the following species is expected to have maximum enthalpy in an electrophilic aromatic substitution reaction ?



(I) (II) (III) (IV) (V)

(A) Species (II) (B) Species (III)
(C) Species (IV) (D) Species (V)

Q.16 For the electrophilic substitution reaction involving nitration, which of the following sequence regarding the rate of reaction is true ?

(A) $k_{C_6H_6} > k_{C_6D_6} > k_{C_6T_6}$

(B) $k_{C_6H_6} < k_{C_6D_6} < k_{C_6T_6}$

(C) $k_{C_6H_6} = k_{C_6D_6} = k_{C_6T_6}$

(D) $k_{C_6H_6} > k_{C_6D_6} < k_{C_6T_6}$

Q.17 For the electrophilic substitution reaction involving sulphonation, which of the following sequence regarding the rate of reaction is true ?

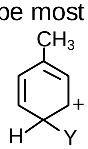
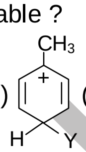
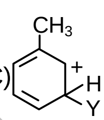
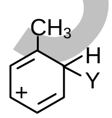
(A) $k_{C_6H_6} > k_{C_6D_6} > k_{C_6T_6}$

(B) $k_{C_6H_6} < k_{C_6D_6} < k_{C_6T_6}$

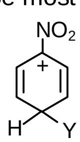
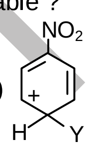
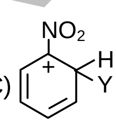
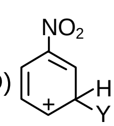
(C) $k_{C_6H_6} = k_{C_6D_6} = k_{C_6T_6}$

(D) $k_{C_6H_6} > k_{C_6D_6} < k_{C_6T_6}$

Q.18 Which of the following carbocations is expected to be most stable ?

(A)  (B)  (C)  (D) 

Q.19 Which of the following carbocations is expected to be most stable ?

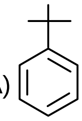
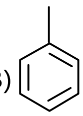
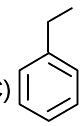
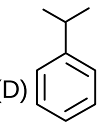
(A)  (B)  (C)  (D) 

Q.20 Reaction of SO_3 is easier in :
(A) Benzene (B) Toluene
(C) Nitrobenzene (D) Chlorobenzene

Q.21 Which order is correct for the decreasing reactivity to ring monobromination of the following compounds :
(I) $C_6H_5CH_3$ (II) C_6H_5COOH
(III) C_6H_6 (IV) $C_6H_5NO_2$
(A) I > II > III > IV (B) I > III > II > IV
(C) II > III > IV > I (D) III > I > II > IV

Q.22 In a reaction of C_6H_5Y, the major product (>60%) is m-isomer, so the group Y is :
(A) – COOH (B) – Cl
(C) –OH (D) – NH_2

Q.23 Which of the following will undergo sulphonation of fastest rate ?

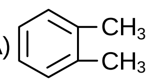
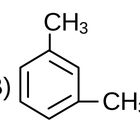
(A)  (B)  (C)  (D) 

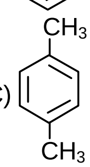
Q.24 Aniline under acidic medium, when chlorinated, produces :
(A) o-chloro aniline (B) m-chloro aniline
(C) p-chloro aniline
(D) Mixture of ortho and para-chloro aniline

Q.25 Which of the following is most reactive towards sulphonation ?
(A) m-Xylene (B) o-Xylene
(C) Toluene (D) p-Xylene

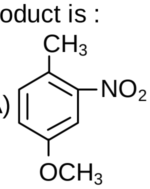
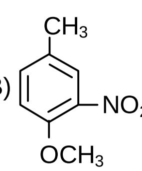
Q.26 When sulphonilic acid (p-$H_2NC_6H_4SO_3H$) is treated with excess of bromine, the product is
(A) tribromo product (B) dibromo product
(C) monobromo product (D) tetrabromo product

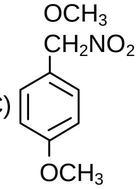
Q.27 Ring nitration of dimethyl benzene results in the formation of only one nitro dimethyl benzene. The dimethyl benzene is :

(A)  (B) 

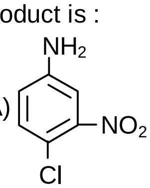
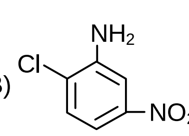
(C)  (D) None of these

Q.28 If p-methoxy toluene is nitrated, the major product is :

(A)  (B) 

(C)  (D) No reaction

Q.29 If meta-nitroaniline is chlorinated, the major product is :

(A)  (B) 

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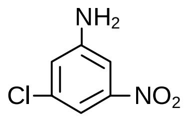
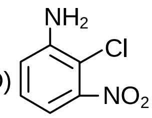
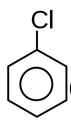
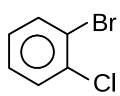
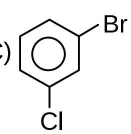
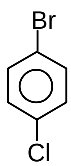
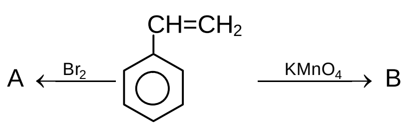
(C)  (D) 

Q.30 An aromatic compound of molecular formula $C_6H_4Br_2$ was nitrated then three isomers of formula $C_6H_3Br_2NO_2$ were obtained. The original compound is :

(A)o-dibromobenzene (B) m-dibromobenzene
(C) p-dibromobenzene (D) Both A & C

Q.31 Which of the following substituted benzene derivatives would furnish only three isomers in significant amount when one more substituent is introduced :

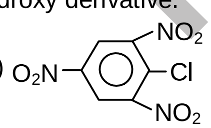
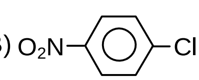
(A)  (B)  (C)  (D) 

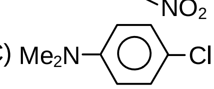
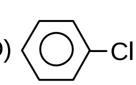
Q.32 

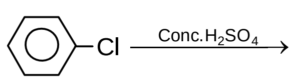
Compound A and B respectively are :
(A) o-Bromostyrene, benzoic acid
(B) p-Bromostyrene, benzaldehyde
(C) m-Bromostyrene, benzaldehyde
(D) Styrene dibromide, benzoic acid

Q.33 m-Bromotoluene is prepared by :
(A) Bromination of toluene
(B) Friedel Craft's reaction of bromobenzene with CH_3Cl
(C) Bromination of nitrobenzene and subsequent replacement of $-NO_2$ group with methyl group
(D) Bromination of aceto-p-toluidine followed by hydrolysis and deamination

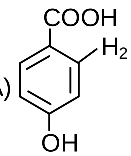
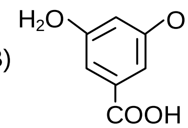
Q.34 Which chloroderivative of benzene among the following would undergo-hydrolysis most readily with aq. NaOH to furnish the corresponding hydroxy derivative.

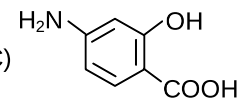
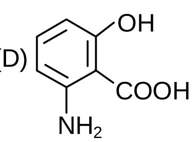
(A)  (B) 

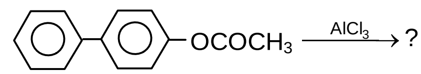
(C)  (D) 

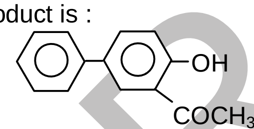
Q.35 Chloral +  product. The product is :
(A) Lindane (B) DDT
(C) Tefflon (D) Ethaneperchlorate

Q.36 m-Aminophenol on treatment with NaOH and CO_2 gives which of the following as major product ?

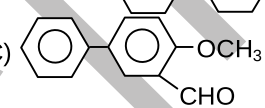
(A)  (B) 

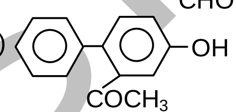
(C)  (D) 

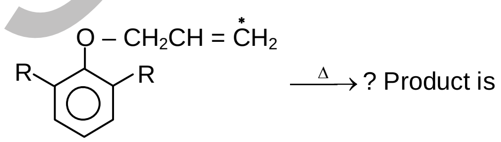
Q.37  Major Product is :

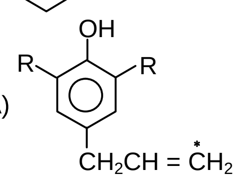
(A) 

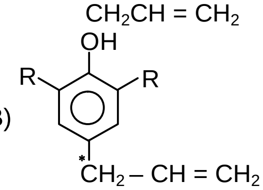
(B) 

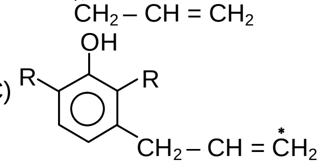
(C) 

(D) 

Q.38 

(A) 

(B) 

(C) 

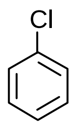
(D) no reaction

EXERCISE – II

Q.1 Benzene reacts with n-propyl chloride in the presence of anhydrous $AlCl_3$ to give predominantly :
(A) n-Propylbenzene (B) Isopropylbenzene
(C) 3-Propyl-1-chlorobenzene
(D) Cumene

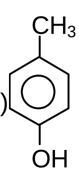
Q.2 In which of the following reaction t-butylbenzene is formed :
(A) Benzene + iso-butyl chloride, $AlCl_3$
(B) Benzene + $(CH_3)_2C = CH_2 \xrightarrow{BF_3.HF}$
(C) Benzene + t-butyl alcohol $\xrightarrow{H_2SO_4}$
(D) Benzene + $(CH_3)_2C = CH_2 \xrightarrow{AlCl_3}$

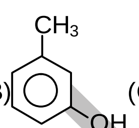
Q.3 The replacement of a hydrogen atom in benzene by alkyl group can be brought about with the following reagents :
(A) Alkyl chloride and $AlCl_3$
(B) Alkene and $AlCl_3$
(C) Alkanol and alkali
(D) Alkanol and acid

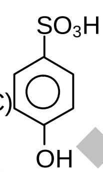
Q.4 Which of the following can be used in Friedel Crafts reaction ?
(A) 

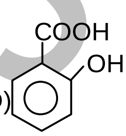
(B) $CH_2 = CH - Cl$
(C) CH_3CH_2Cl
(D) $CH_2 = CH - CH_2 - Cl$

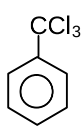
Q.5 The good method for converting benzene into propyl benzene is :
(A) $C_6H_6 + CH_3CH_2CH_2Cl$ + Anhyd. $AlCl_3$
(B) $C_6H_6 + CH_3CH_2COCl$ + Anhyd. $AlCl_3$ and then treatment with Zn/Hg/HCl
(C) $C_6H_6 + CH_3CH_2COCl$ + Anhyd. $AlCl_3$ and then treatment with H_2Ni
(D) C_6H_6 + Anhyd. $AlCl_3$ + cyclopropane

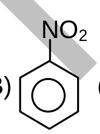
Q.6 The structure of the compound that gives a tribromo derivative on treatment with bromine water is :
(A) 

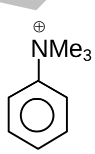
(B) 

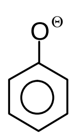
(C) 

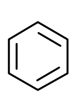
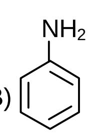
(D) 

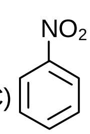
Q.7 Electrophilic attack of $NO_2^{\oplus}$ at meta position is observed in :
(A) 

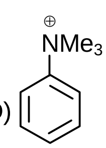
(B) 

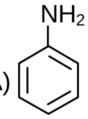
(C) 

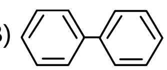
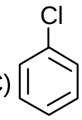
(D) 

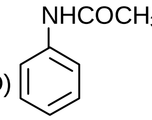
Q.8 Which of the following does not gives Friedel-Crafts reaction ?
(A) 
(B) 

(C) 

(D) 

Q.9 Which of the following will undergo nitration faster than benzene ?
(A) 

(B) 
(C) 

(D) 

Q.10 Of the species PhSH, $PhS(=O)R$, $PhS(=O)_2R$ and $Ph - S(=O)_2 - OR$ the meta-substituted product is obtained from
(A) PhSR
(B) $PhS(=O)R$
(C) $PhS(=O)_2R$
(D) $Ph - S(=O)_2 - OR$

Q.11 Which of the following is not an ortho-para directing group ?
(A) CF_3
(B) CCl_3
(C) – CH = CH – COOH
(D) $-N \overset{\rightarrow}{\equiv} C$

Q.12 Which of the following statement is incorrect for electrophilic substitution
(A) Ortho-and para-directing groups increase electron density at ortho-and para-position
(B) Meta-directing group increase electron density at meta-position
(C) Meta-directing groups decrease electron density at meta-position
(D) Ortho-and para-directing groups decrease electron density at meta-position

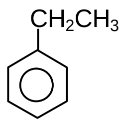
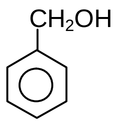
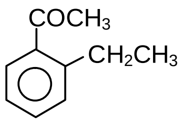
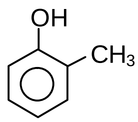
Q.13 Which of the following statement is/are not true ?
(A) All ortho-para directing group activates the ring
(B) All ortho-para directing groups excepting halogens activate the ring
(C) All meta-directing groups have π-bond on the atom directly attached to the ring
(D) All meta directing groups are deactivating

Q.14 Amongst the following, the moderately activating group is
(A) – NHR
(B) – $NHCOCH_3$
(C) $-O-\overset{R}{\overset{\|}{C}}-R$
(D) – CH_3

Q.15 False statement is/are :
(A) Although benzene contains three double bonds, normally it does not undergo addition reaction
(B) m-chlorobromobenzene is an isomer of m-bromochlorobenzene

(C) In benzene, carbon uses all the three p orbitals for hybridization
(D) An electron donating substitutent in benzene orients the incoming electrophilic group to the meta position

Q.16 Benzoic acid may be prepared by the oxidation of :

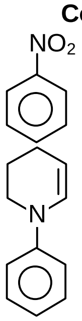
(A) 
(B) 
(C) 
(D) 

Q.17 Which of the following reactions of benzene proves the presence of three carbon-carbon double bonds in it :
(A) Formation of a triozonide
(B) Hydrogenation of benzene to cyclohexane
(C) Formation of $C_6H_6Cl_6$ by addition of chorine
(D) Formation of nitrobenzene on heating benzene with a mixture of concentrated nitric acid and sulphuric acid

Q.18 Which of the following are classified as aromatic?
(A) 1,2, 3-Triphenylcyclopropenium cation
(B) Cyclooctatetraenyl dianion
(C) Azulene
(D) Annulene

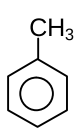
Q.19 Match the column :

Column I **Column II**

(A), (B) 

(P) Group attached with phenyl ring is +M

(Q) Rate of electrophilic aromatic substitution is less than benzene ring

(C) 

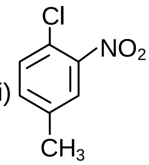
(R) Group attached with phenyl ring will show (+H) (Hyperconjugation)

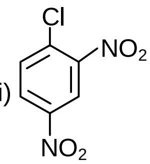
(S) Group attached with phenyl ring will show (–H) effect (Hyperconjugation)

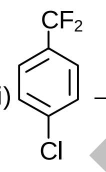
EXERCISE – III

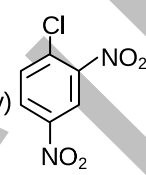
Q.1 Write the most stable resonating structure for the cyclohexadienyl anion formed by reaction of methoxide ion with o-fluoronitrobenzene.

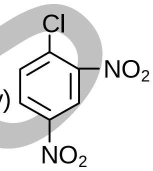
Q.2 Write the principal organic product in each of the following reactions :

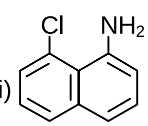
(i)  $+ C_6H_5CH_2SK \rightarrow A$

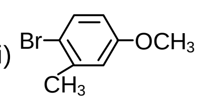
(ii)  $\xrightarrow[\text{triethylene glycol}]{H_2NNH_2} B$

(iii)  $\xrightarrow[\text{(ii) NaOCH}_3\text{, CH}_3\text{OH}]{\text{(i) HNO}_3\text{, H}_2\text{SO}_4} C$

(iv)  $+ CH_3CH_2ONa \rightarrow D$

(v)  $+ C_6H_5CH_2SNa \rightarrow E$

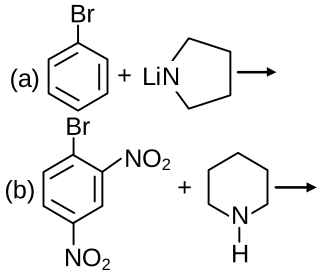
Q.3 (i)  $\xrightarrow[\text{(ii) CuBr}]{\text{(i) NaNO}_2\text{, HBr}} E$

(ii)  $\xrightarrow[\text{(ii) NaSCH}_3]{\text{(i) NBS, Benzoylperoxide CCl}_4\text{, heat}} F$

Q.4 Reaction of 1, 2, 3-tribromo-5-nitrobenzene with sodium ethoxide in ethanol gave a single product $C_8H_7Br_2NO_3$, in quantitative yield. Suggest a reasonable structure for this compound.

Q.5 2-Bromo-1,3-dimethylbenzene is inert to nucleophilic aromatic substitution on treatment with sodium amide in liquid ammonia. It is recovered unchanged even after extended contact with the reagent. Suggest an explanation for this lack of reactivity.

Q.6 In each of the following reactions, an amine or a lithium amide derivative reacts with an aryl halide. Give the structure of the expected product and specify the mechanism by which it is formed.



Q.7 1,2,3,4,5-Pentalfluoro-6-nitrobenzene reacts readily with sodium methoxide in methanol at room temperature to yield two major products, each having the molecular formula $C_7H_3F_4NO_3$. Suggest reasonable structures for these two compounds.

EXERCISE – IV(A)

Q.1 The chlorination of toluene in presence of ferric chloride gives predominatly : **[JEE 1986]**
(A) Benzyl chloride (B) m-chlorotoluene
(C) Benzal chloride
(D) o-and p-chlorotoluene

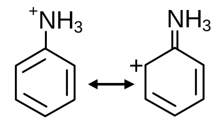
Q.2 Aryl halides are less reactive towards nucleophilic substitution reaction as compared to alkyl halide due to **[JEE 1990]**
(A) The formation of less stable carbonium ion
(B) Resonance stabilization
(C) Longer carbon-halogen bond
(D) The inductive effect

Q.3 The most basic compound among the following is : **[JEE 1990]**
(A) Benzylamine (B) Aniline
(C) Acetaniline (D) p-nitro aniline

Q.4 Chlorination of toluene in the presence of light and heat followed by treatment with aqueous NaOH gives : **[JEE 1990]**
(A) o-cresol (B) p-cresol
(C) 2,4-dihydroxytoluene (D) Bezoic acid

Q.5 When nitrobenzene is treated with Br_2 in presence of $FeBr_3$ the major product formed is m-bromonitrobenzene. Statements which are related obtain the m-isomer are : **[JEE 1992]**
(A) The electron density on meta carbon is more than on ortho and para position
(B) The intermediate carbonium ion formed after initial attack of Br^+ attack the meta position is least destabilized
(C) Loss of aromaticity when Br^+ attacks at the ortho and para positions and not at meta position
(D) Easier loss of H^+ to region aromaticity form the meta position than from ortho and para position

Q.6 Choose the correct statement from the ones given below for two aniline in : **[JEE 1993]**



(I) (II)

(A) II is not an acceptable canonical structure because carbonium ions are less stable than ammonium ions
(B) II is not an aceptable canonical structure because it is non aromatic
(C) II is not an acceptable canonical structure because the nitrogen has 10 valence electrons
(D) II is an acceptable canonical structure

Q.7 Most stable cabonium ion is : **[JEE 1995]**
(A) p – NO_2 – C_6H_4 – $^+CH_2$
(B) C_6H_5 $^+CH_2$
(C) p– Cl – C_6H_4 – $^+CH_2$
(D) p– CH_3O – C_6H_4 – $^+CH_2$

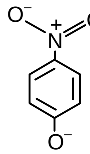
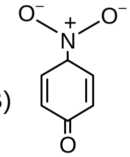
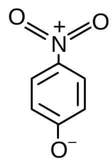
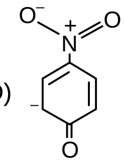
Q.8 Arrange in order of decreasing trend towards S_E reactions : **[JEE 1995]**
(I) Chlorobenzene (II) Benzene
(III) Anilinium chloride (IV) Toluene
(A) II > I > III > IV (B) III > I > II > IV
(C) IV > II > I > III (D) I > II > III > IV

Q.9 Among the following statements on the nitration of aromatic compounds, the false one is : **[JEE 1997]**
(A) The rate of benzene is almost the same as that of hexadeuterobenzene
(B) The rate of nitration of toluene is greater than that of benzene
(C) The rate of nitration of benzene is greater than that of hexadeuterobenzene
(D) Nitration is an electrophilic substitution reaction

Q.10 Nirtobenzene can be prepared from benzene by using a mixture of conc. HNO_3 and conc. H_2SO_4. In the nitrating mixture HNO_3 acts as a : **[JEE 1997]**
(A) Base (B) Acid
(C) Reducing agent (D) Catalyst

Q.11 Benzyl chloride ($C_6H_5CH_2Cl$) can be prepared from toluene by chlorination with : **[JEE 1998]**
(A) $SO_2Cl_2h\nu$ (B) $SOCl_2$
(C) $Cl_2h\nu$ (D) NaOCl

Q.12 The most unlikely representation of resonance structure of p-nitrophenoxide ion is : **[JEE 1998]**

(A) 
(B) 
(C) 
(D) 

Q.13 Benzenediazonium chloride on reaction with phenol in weakly basic medium gives : **[JEE 1998]**

(A) Diphenyl ether
(B) p-hydroxyazobenzene
(C) Chlorobenzene
(D) Benzene

Q.14 A solution of (+) –1-chloro-1-phenylethane in toluene racemises slowly in the presence of small amount of $SbCl_5$, due to the formation of : **[JEE 1999]**

(A) Carbanion (B) Carbene
(C) Free-radical (D) Carbocation

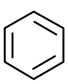
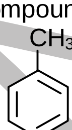
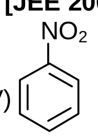
Q.15 Toluene, when treated with Br_2/Fe, gives p-bromotoluene as the major product, because the CH_3 group : **[JEE 1999]**

(A) is para directing (B) is meta directing
(C) activates the ring by hyperconjugation
(D) deactivates the ring

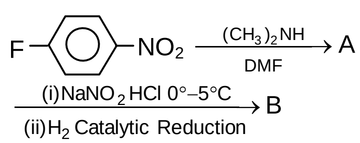
Q.16 Amongst the following the strongest base is : **[JEE 2000]**

(A) $C_6H_5NH_2$ (B) p-$O_2NC_6H_4NH_2$
(C) m-$O_2NC_6H_4NH_2$ (D) $C_6H_5CH_2NH_2$

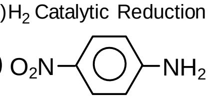
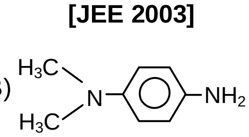
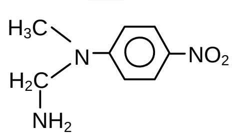
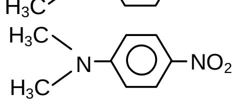
Q.17 Identify the correct order of reactivity in electrophilic substitution reactions of the following compounds **[JEE 2002]**

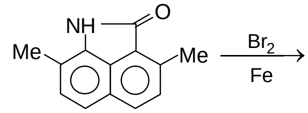
(I)  (II)  (III)  (IV) 

(A) I > II > III > IV (B) IV > III > II > I
(C) II > I > III > IV (D) II > III > I > IV

Q.18 

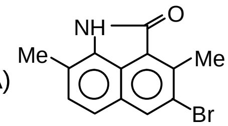
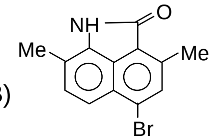
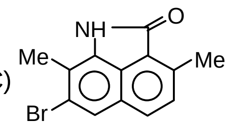
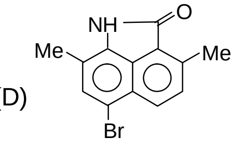
[JEE 2003]

(A) 
(B) 
(C) 
(D) 

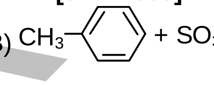
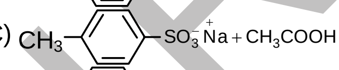
Q.19 

[JEE 2004]

Major product of above reaction is :

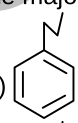
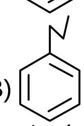
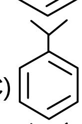
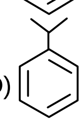
(A) 
(B) 
(C) 
(D) 

Q.20 Which of the following is obtained when 4-Methylbenzenesulphonic acid is hydrolysed with excess of sodium acetate? **[JEE 2005]**

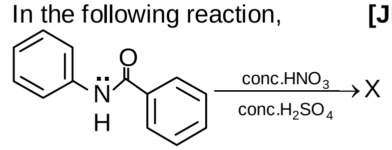
(A) 
(B) 
(C) 
(D) 

Q.21  + Cl – CH_2CH_2 – CH_3 $\xrightarrow{AlCl_3}$ P $\xrightarrow[(ii)\, H_3O^+]{(i)\, O_2 / \Delta}$ Q + Phenol **[JEE 2006]**

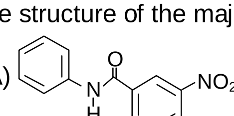
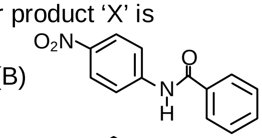
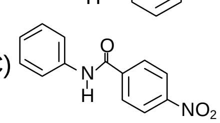
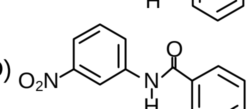
The major products P and Q are

(A)  and CH_3CH_2CHO
(B)  and CH_3COCH_3
(C)  and CH_3COCH_3
(D)  and CH_3CH_2CHO

Q.22 In the following reaction, **[JEE 2007]**



the structure of the major product 'X' is

(A) 
(B) 
(C) 
(D) 

Q.23 Statement – 1: Bromobenzene upon reaction with Br_2/Fe gives 1,4-dibromobenzene as the major product. **[JEE 2008]**

and

Statement - 2 : In bromobenzene, the inductive effect of the bromo group is more dominant than the mesomeric effect in directing the incoming electrophile.

(A) SATEMENT -1 is True, SATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1
(B) SATEMENT -1 is True, SATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1
(C) SATEMENT -1 is True, SATEMENT-2 is False.
(D) SATEMENT -1 is False, SATEMENT-2 is True.

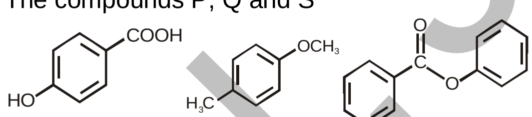
Q.24 Statement – 1 : Aniline on reaction with $NaNO_2$/HCl at 0°C followed by coupling with β-naphthol gives a dark blue coloured precipitate. **[JEE 2008]**

and

Statement – 2 : The colour of the compound formed in the reaction of aniline with $NaNO_2$/HCl at 0° followed by coupling with β-naphthol is due to the extended conjugation.

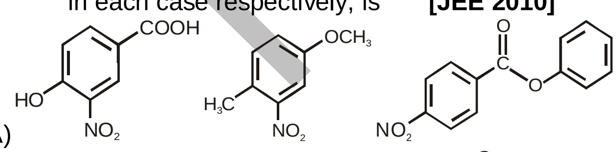
(A) SATEMENT -1 is True, SATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1
(B) SATEMENT -1 is True, SATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1
(C) SATEMENT -1 is True, SATEMENT-2 is False.
(D) SATEMENT -1 is False, SATEMENT-2 is True.

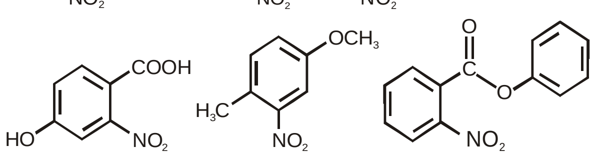
Q.25 The compounds P, Q and S

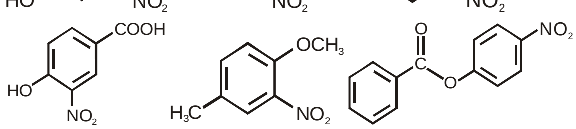


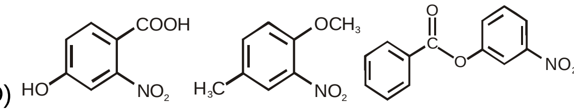
P Q S

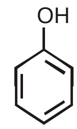
were separately subjected to nitration using HNO_3/H_2SO_4 mixture. The major product formed in each case respectively, is **[JEE 2010]**

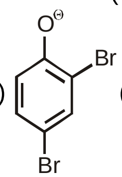
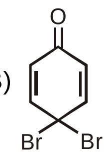
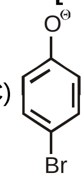
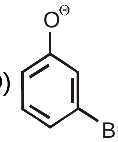
(A) 

(B) 

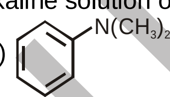
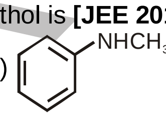
(C) 

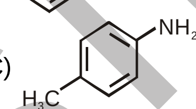
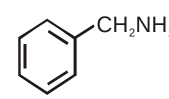
(D) 

Q.26 In the reaction  $\xrightarrow{NaOH\,(aq.)/Br_2}$ the intermediate(s) is(are) **[JEE 2010]**

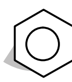
(A)  (B)  (C)  (D) 

Q.27 Amongst the compounds given, the one that would form a brilliant colored dye on treatment with $NaNO_2$ is dil. HCl followed by addition to an alkaline solution of β-naphthol is **[JEE 2011]**

(A)  (B) 

(C)  (D) 

EXERCISE – IV(B)

Q.1  + $(CH_3)_2CH.CH_2Cl \xrightarrow{AlCl_3} (A)$

[JEE 1992]

Q.2 $C_6H_5C_2H_5 \xrightarrow[\text{(ii)NaCN}]{\text{(i)}Br_2\text{,Heat,light}}$ **[JEE 1994]**

Q.3 An organic compound (A), C_8H_6 on treatment with dilute sulphuric acid containing mercuric sulphate gives a compound (B), which can also be obtained from a reaction of benzene with an acid chloride in the presence of anhydrous aluminium chloride. The compound (B), when treated with iodine in aqueous KOH, yields (C) and a yellow compound (D). Identify (A), (B), (C) and (D) with justification. Show how (B) is formed from (A) ? **[JEE 1994]**

Q.4 Toluene reacts with bromine in the presence of light to give benzyl bromine while in presence of $FeBr_3$ it gives p-bromotoluene. Give explanation for the above observations. **[JEE 1996]**

Q.5 Show the steps the carry out the following transformations: **[JEE 1998]**
(a) Ethylbenzene → benzene
(b) Ethylbenzene → 2-phenylpropionic acid

Q.6 $C_6H_5CH_2CHClC_6H_5 \xrightarrow{\text{alcoholic KOH, heat}} (A) + (B)$
[JEE 1998]

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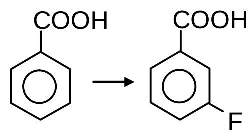
Q.7 Normally, benzene gives electrophilic substitution reaction rather than thus electrophilic addition reaction although it has double bonds. **[JEE 2000]**

Q.8 How would you synthesis 4 methoxyphenol from bromobenzene in NOT more than five steps ? State clearly the reagents used in each step and show the structures of the intermediate compounds in your synthetic scheme. **[JEE 2001]**

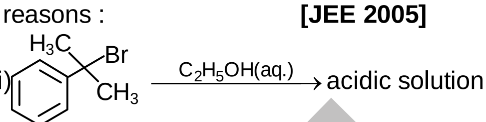
Q.9 Carry out following conversions in 3 or less steps. **[JEE 2003]**

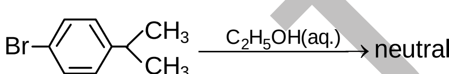


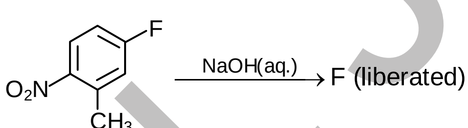
Q.10 A compound $C_9H_7O_2Cl$ exists in keto form A and enolic form B. Enolic form B predominates at equilibrium. On oxidation with $KMnO_4$ it gives m-chlorobenzoic acid. Give structures of A and B. **[JEE 2003]**

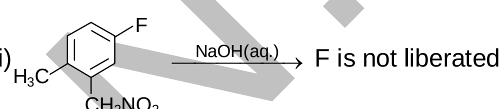
Q.11 7-bromo-1,3,5-cycloheptatriene is ionic compound, whereas 5-bromo-1,3-cyclopentadiene can't ionise even in the presence of $Ag^{\oplus}$, Explain why? **[JEE 2004]**

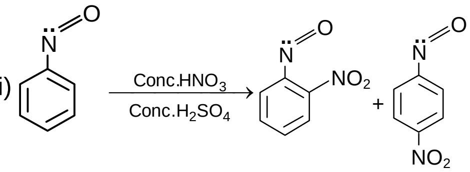
Q.12 Give reasons : **[JEE 2005]**

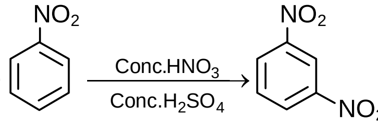
(a) (i) 

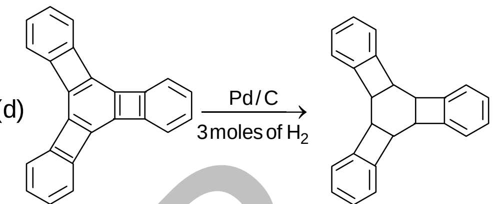
(ii) 

(b) (i) 

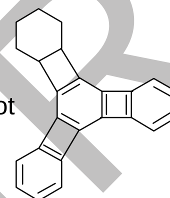
(ii) 

(c) (i) 

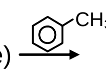
(ii) 

(d) 

is

formed but not 

Q.13 $\left(\begin{array}{l}\text{Brown fumes and} \\ \text{pungent smell}\end{array}\right) B \xleftarrow{NaBr + MnO_2} A$

$\xrightarrow{\text{Conc.}HNO_3}$ C(intermediate)  D

(Explosive product)

Find A, B, C and D. Also write equations A to B and A to C. **[JEE 2005]**

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ANSWER KEY

EXERCISE - I

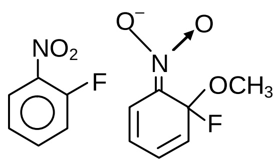
Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	C	D	C	C	B	A	B	B	A	D	B	B	A	A	C	A	B	D	B
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38		
Ans.	B	A	B	B	A	A	C	B	B	B	C	D	D	A	B	C	A	A		

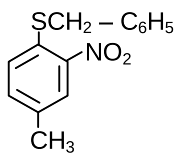
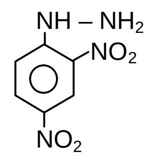
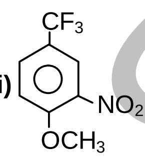
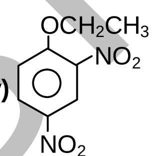
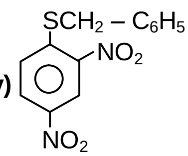
EXERCISE – II

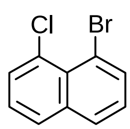
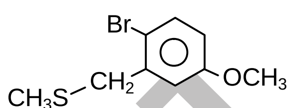
Ques.	1	2	3	4	5	6	7	8
Ans.	B,D	A,B,C,D	A,B,D	C,D	B,D	B,C,D	A,B,C	B,C,D
Ques.	9	10	11	12	13	14	15	16
Ans.	A,B,D	C,D	A,B,D	B,C,D	A,C	B,C	B,C,D	A,B
Ques.	17	18						
Ans.	A,B,C	A,B,C						

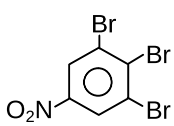
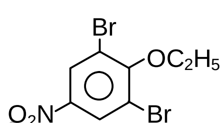
Q.19 (A) Q ; (B) P ; (C) R

EXERCISE – III

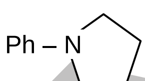
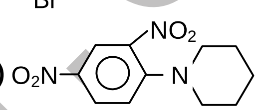
Q.1 

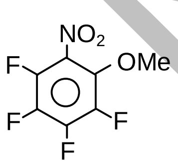
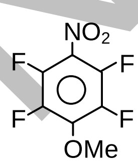
Q.2 **(i)**  **(ii)**  **(iii)**  **(iv)**  **(v)** 

Q.3 **(i)**  **(ii)** 

Q.4  

Q.5

Q.6 **(a)**  **(b)** 

Q.7  

EXERCISE – IV(A)

Ques.	1	2	3	4	5	6	7	8
Ans.	D	B	A	D	A,B	C	D	C
Ques.	9	10	11	12	13	14	15	16
Ans.	C	A	A,C	C	B	D	A,C	D
Ques.	17	18	19	20	21	22	23	24
Ans.	C	B	D	C	C	B	C	D
Ques.	25	26	27					
Ans.	C	A,C,D	C					

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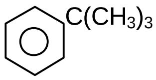
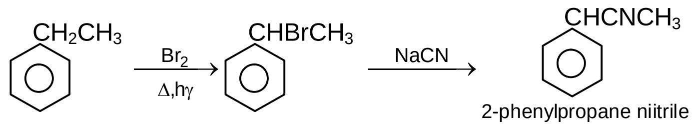
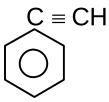
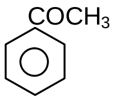
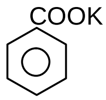
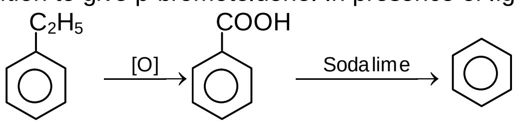
EXERCISE – IV(B)

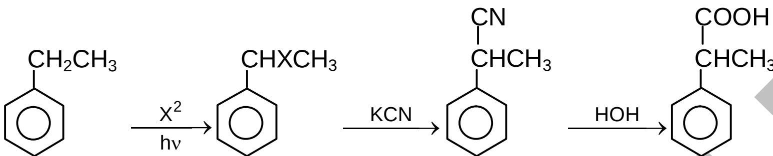
Q.1  **Q.2** 

2-phenylpropane niitrile

Q.3 (A)  (B)  (C) 

Q.4 In presence of $FeBr_3$, Br_2 Produces Br+ (an electrophile) which attacks the benzene ring at o-, p-position to give p-bromotoluene. In presence of light, side chain is attacked to produce benzyl bromide.

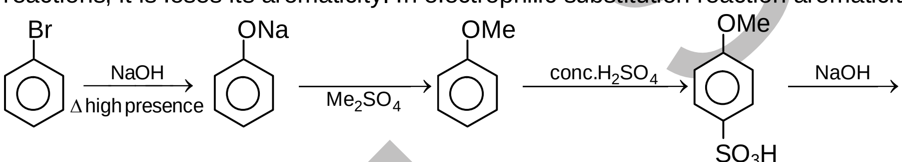
Q.5 (b) (i) 

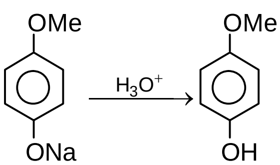
(ii) 

Q.6 $C_6H_5CH_2CHClC_6H_5 \xrightarrow[\Delta]{KOH(alc.)} C_6H_5CH = CHC_6H_5$

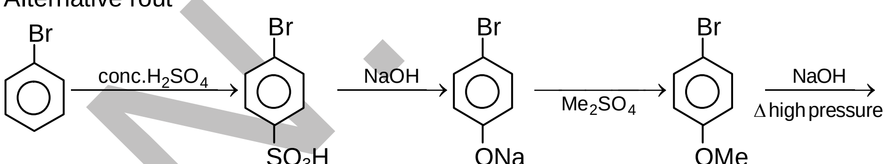
(Cis and trans forms)

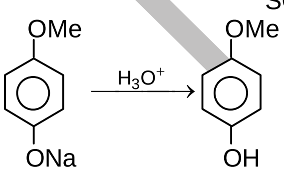
Q.7 Benzene has resonance stabilization due to delocalization of π-electrons. Also during electrophilic addition reactions, it is loses its aromaticity. In electrophilic substitution reaction aromaticity is retained.

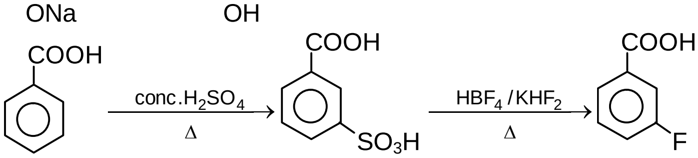
Q.8 



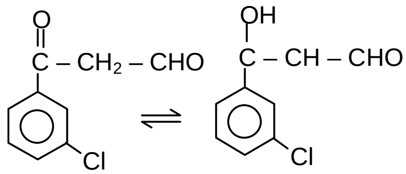
Alternative rout





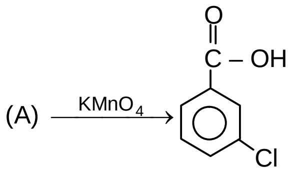
Q.9 

Q.10

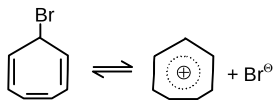


(A) Keto (B) Enol

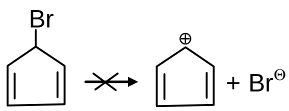
Enol form is more stable due to extended conjugation.



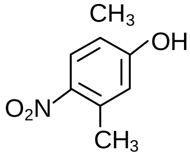
Q.11 On ionization 7-bromo-1,3,4-cycloheptatriene gives tropolium ion which is aromatic with 6π electrons.



5-bromo-1,3-cyclopentadiene can't ionize as it will in that case give highly unstable antiaromatic cation with 4π electrons.



Q.12 (a) (i) $H_5C_6 - \underset{CH_3}{\overset{CH_3}{C}} - OC_2H_5 + HBr$ (acid) ; (i) no reaction due to partial double bond character

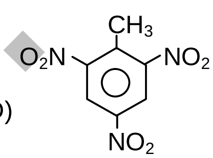
(b) (i) 

+ F$^-$ is liberated ; (ii) Bimomecular mechanism is not possible in (ii) case

(c) (i) due to presence of lone pair of nitrogen atom NO group is electron donating and ortho, para directing

(ii) NO_2 group is electron withdrawing and meta directing

(d) Due to reduction of central ring, three four membered antiaromatic rings become stable while on reduction of terminal ring only one antiaromatic ring can be stabilized.

Q.13 (A) H_2SO_4, (B) Br_2, (C) $NO_2^{\oplus}$, (D) 

AROMATIC CHEMISTRY

AROMATIC CHEMISTRY

Directive Influence in substituted Benzene

e– donating groups activating

1) Strong E.D.G. (O/P- directing)

$-\ddot{\underset{\cdot\cdot}{O}}:^{\ominus}$, $-\ddot{N}(CH_3)_2$, $-\ddot{N}H-CH_3$

$-\ddot{N}H_2$, $-OH$, $-OCH_3$

2) Moderately E.D.G. (O/P- directing)

$-O-\overset{O}{\overset{||}{C}}-CH_3$, $-NH-\overset{O}{\overset{||}{C}}-CH_3$,

$-O-CH=CH_2$, $-NH-CH-CH_2$

3) Weakly E.D.G. (O/P- directing)

$-R$, $-\overset{O}{\overset{||}{C}}-O^-$, $-Ph$

e– with drawing groups deactivating

1) Strong EWG. (Meta- directing)

$-NO_2$, $-C\equiv N$, $-SO_3H$,

$-\overset{\oplus}{N}F_3$, $-\overset{\oplus}{N}H_3$, CF_3

2) Moderately EWG. (Meta- directing)

$-\underset{O}{\underset{||}{C}}-H$, $-\underset{O}{\underset{||}{C}}-R$, $-\underset{O}{\underset{||}{C}}-OR$,

$-\underset{O}{\underset{||}{C}}-NH_2$, $-\underset{O}{\underset{||}{C}}-O-\underset{O}{\underset{||}{C}}-R$,

3) Weakly EWG. (O/P- directing)

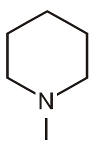
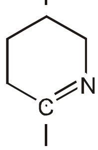
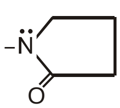
$-F$

$-C\ell$ $-NO$

$-Br$

$-I$

Fill in the blanks :

Substitute on Ph ring o/p	Meta	Activating	deactivating
1. 			
2. 			
3. $-\underset{O}{\underset{||}{C}}-CH_3$			
4. $-O-\underset{O}{\underset{||}{C}}-CH_3$			
5. $-SO_3H$			
6. $-CH_3$			
7. $-\ddot{N}=O$			
8. 			
9. $-CH=CH-NO_2$			
10. $-NH-CH_3$			

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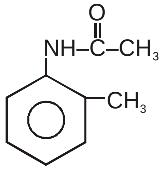
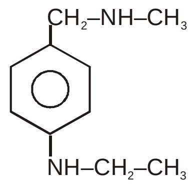
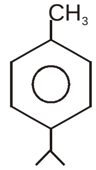
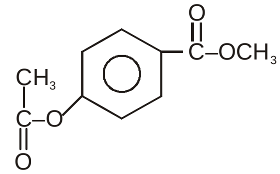
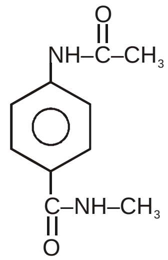
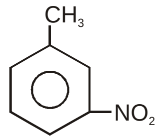
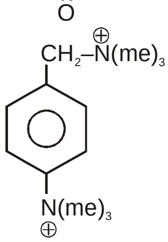
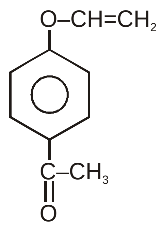
1. Identify the position where electrophilic substitution is favourable :

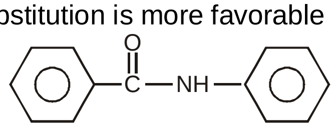
(1) 
(2) 

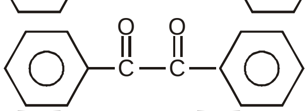
(3) 
(4) 

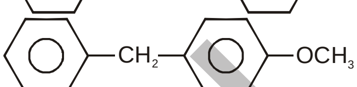
(5) 
(6) 

(7) 
(8) 

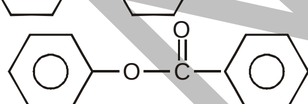
2. Identify the ring on which electrophilic substitution is more favorable :

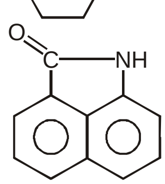
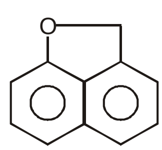
(1) 

(2) 

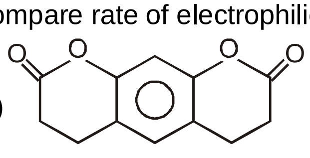
(3) 

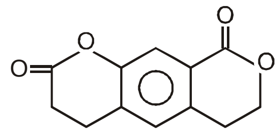
(4) 

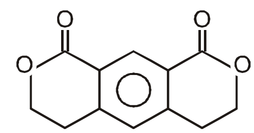
(5) 

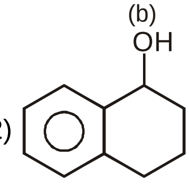
(6) 
(7) 

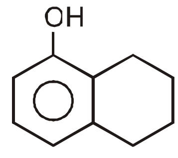
3. Compare rate of electrophilic substitution :

(1) 
(a)


(b)


(c)

(2) 
(a)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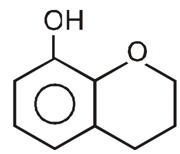
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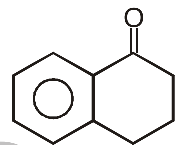
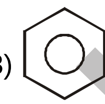
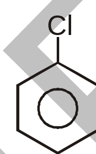

(d)

(3) 
(a)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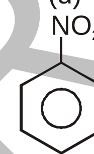
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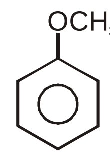
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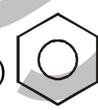
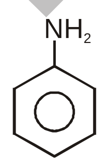
(4) 
(a)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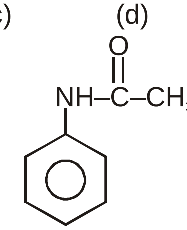
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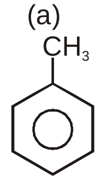
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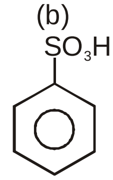
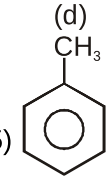
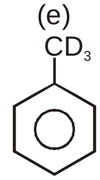

(e)

(5) 
(a)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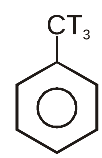
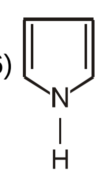
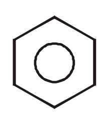
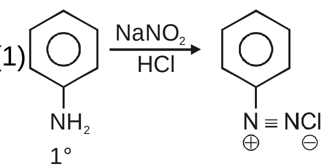
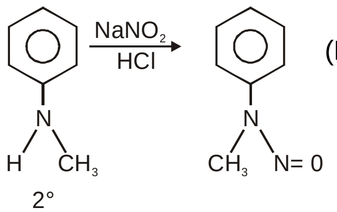

(c)

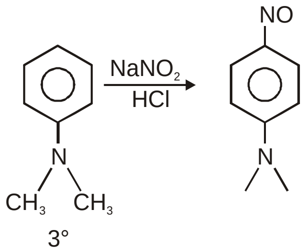
(6) 


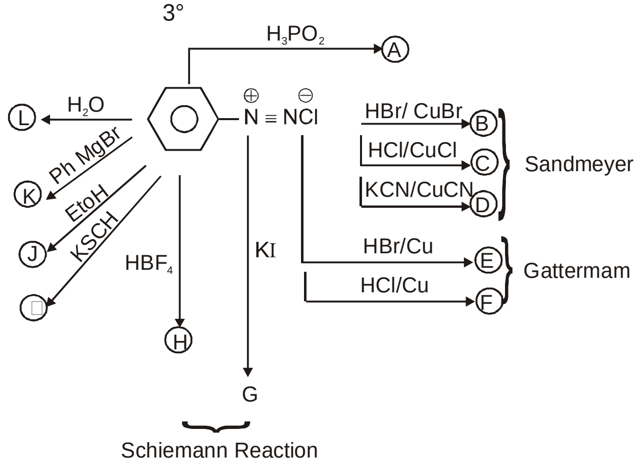
4. **Diazotisation of amines**

(1) 
diazonium chloride

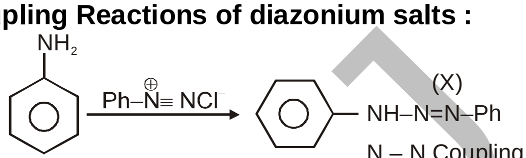
(2) 

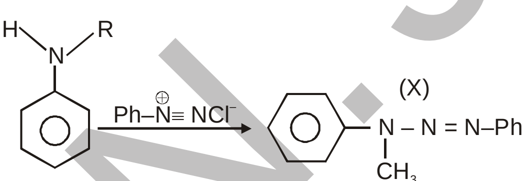
(Nitroso amine)

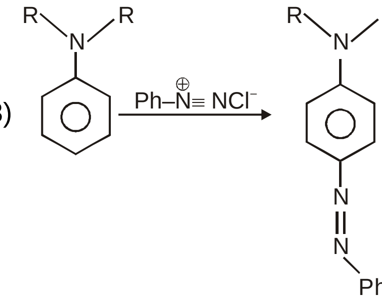
(3) 



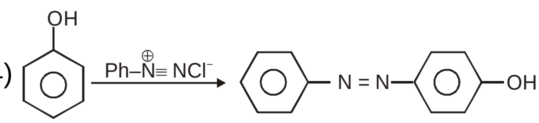
5. Cupling Reactions of diazonium salts :

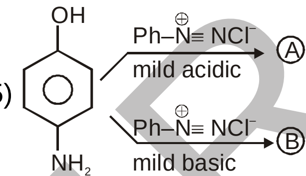
(1) 

(2) 

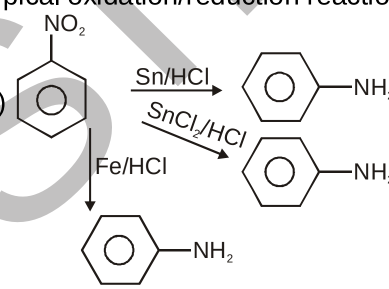
(3) 

(X)

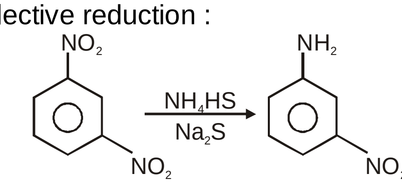
(4) 

(5) 

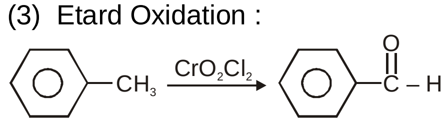
6. Typical oxidation/reduction reactions :

(1) 

(2) Selective reduction :

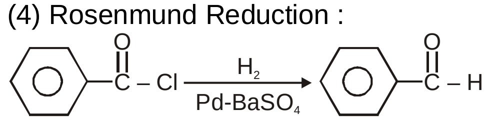


(3) Etard Oxidation :



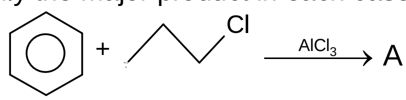
($CrO_2Cl_2 \rightarrow$ etard reagent)

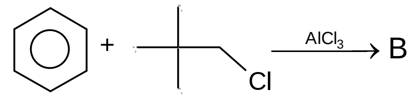
(4) Rosenmund Reduction :

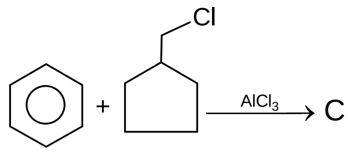


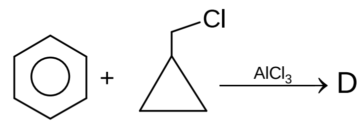
DPP-01 Time: 20 Minutes

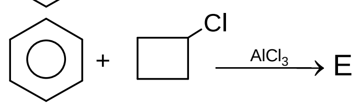
Q.1 Write only the major product in each case:

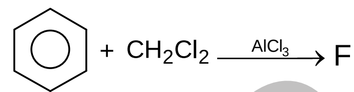
(a) 

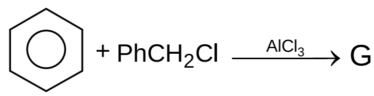
(b) 

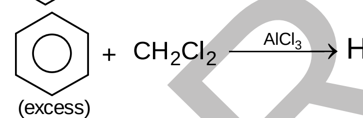
(c) 

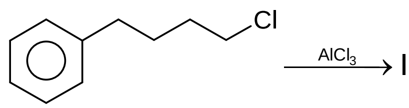
(d) 

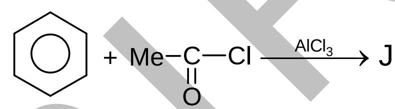
(e) 

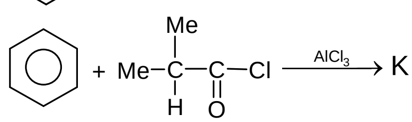
(f) 

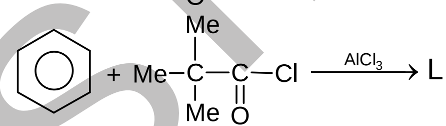
(g) 

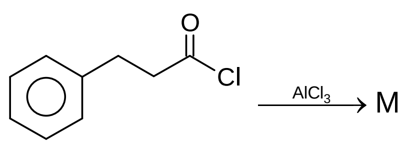
(h) 

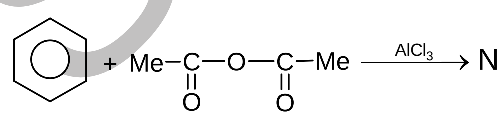
(i) 

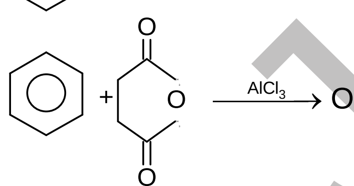
(j) 

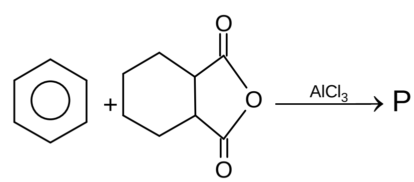
(k) 

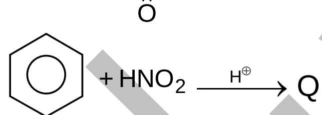
(l) 

(m) 

(n) 

(o) 

(p) 

(q) 

Q.2. Give structure and names of the priccipal organic products expected from mononitration of

(a) o-nitrotoluene (b) m-dibromobenzene

(c) m-dinitrobenzene (d) o-cresol

(e) p-cresol (f) m-nitrotoluene

(g) p-xylene (p-$C_6H_4(CH_3)_2$)

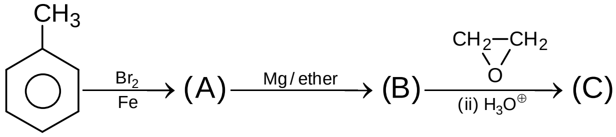
(h) terephthalic acid (p-$C_6H_4(COOH)_2$)

(i) anilinium hydrogen sulfate ($C_6H_5NH_3^+HSO_4^-$)

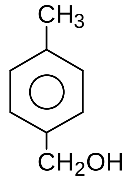
(j) m-cresol (m-$CH_3C_6H_4OH$)

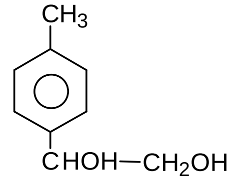
(k) p-nitroacetanilide (p-$O_2NC_6H_4NHCOCH_3$)

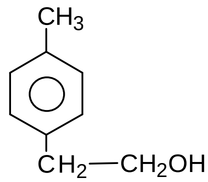
Q.3 Final product of the given reaction:

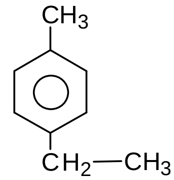


(C) is:

(A) 

(B) 

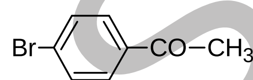
(C) 

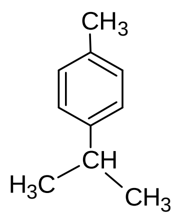
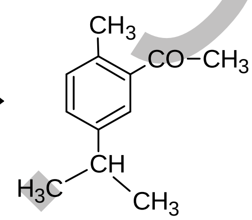
(D) 

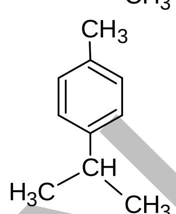
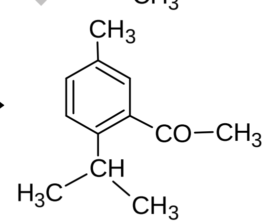
Q.4 For chlorination of benzene which of the following reagent should be used?
(A) BrCl (B) ICl (C) $HOCl + H^+$ (D) All

Q.5 Which of the following statement is not correct regarding desulfonation?
(A) All steps are reversible
(B) it exhibits kinetic isotope effect.
(C) Phenol when reacts with SO_3 at low temperature o-product is formed and at high temperature p-product is formed as mojor product.
(D) none

Q.6 Point out the wrong formulation.

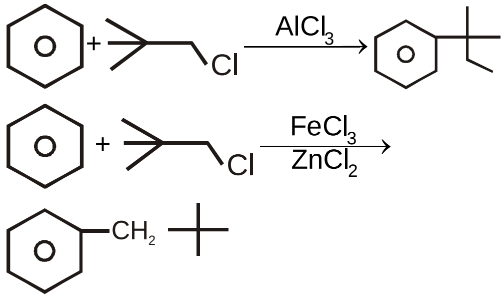
(A) $C_6H_5{-}Br + (CH_3{-}CO)_2O \xrightarrow{AlCl_3}$ 

(B)  $+ CH_3{-}COCl \xrightarrow{AlCl_3}$ 

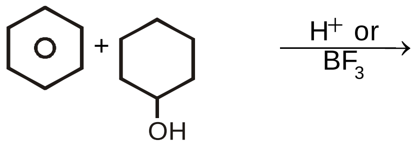
(C)  $+ CH_3{-}COCl \xrightarrow{AlCl_3}$ 

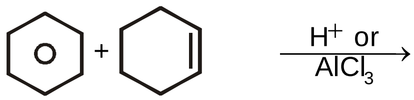
(D) $C_6H_5{-}NO_2 + EtCl \xrightarrow{AlCl_3}$ no reaction

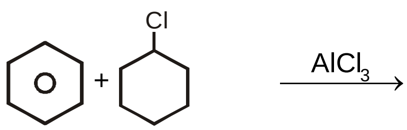
DPP NO-02 Time: 15 minutes

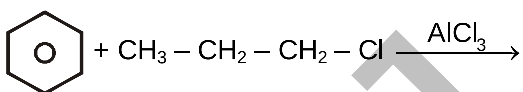
Q.1 

Explain

Q.2 

Q.3 

Q.4 

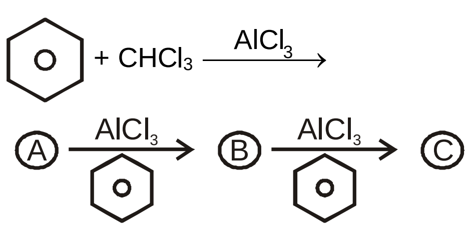
Q.5 

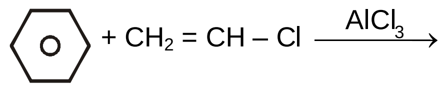
Q.6 

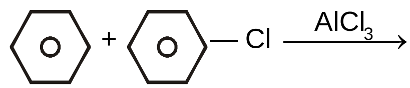
Q.7 

Q.8 

Q.9 

Q.10 

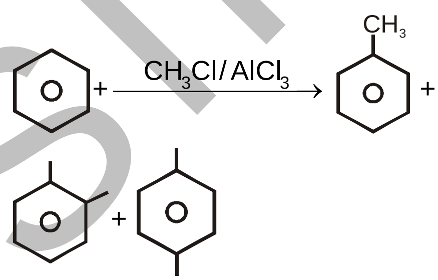
Q.11 

Q.12 

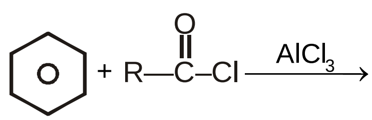
Q.13 Strong e^- with drawing groups like.

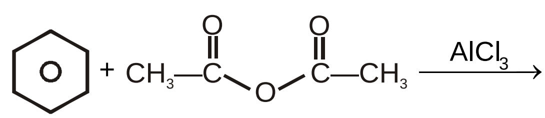
$-NO_2$, $-C\equiv N$, $-\overset{O}{\overset{\|}{C}}-OH$, $-SO_3H$ give poor yield in friedel craft alkylation. Explain.

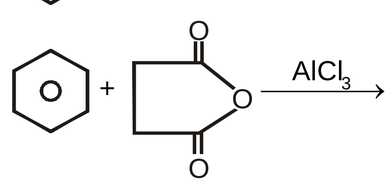
Q.14 Strong e^- releasing group $-NH_2$ donot not give friedel craft alkylation. Explain

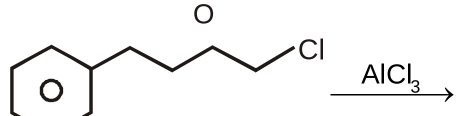
Q.15 

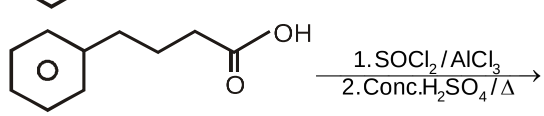
Write the major product for these reactions.

Q.16 

Q.17 

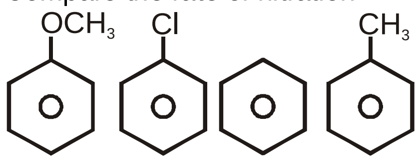
Q.18 

Q.19 

Q.20 

DPP NO -03 Time: 15 minutes

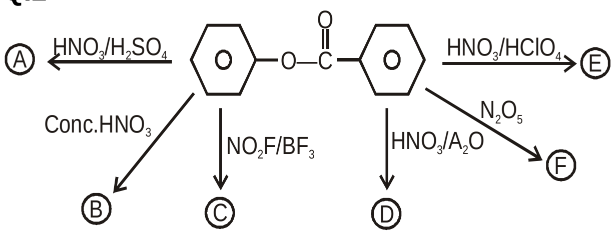
Q.1 Compare the rate of nitration



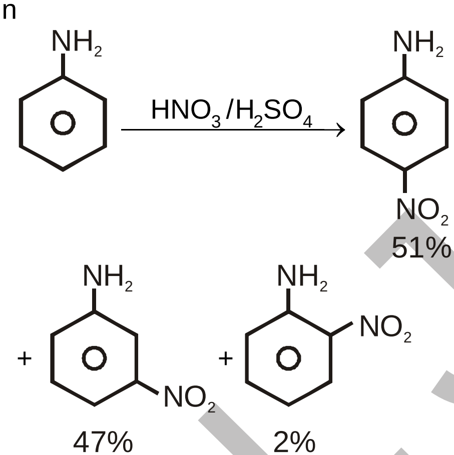
(a) (b) (c) (d)

C_6D_6 (e) C_6T_6 (f)

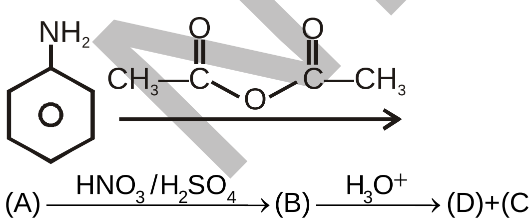
Q.2



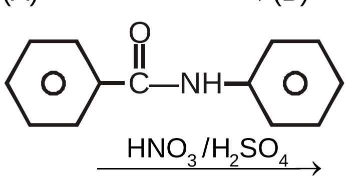
Q.3
Explain



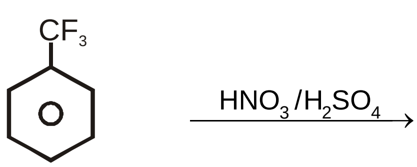
Q.4



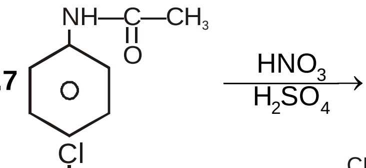
Q.5



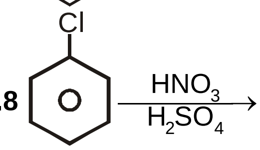
Q.6



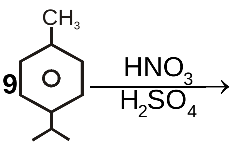
Q.7



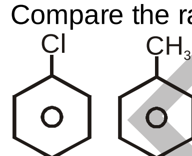
Q.8



Q.9



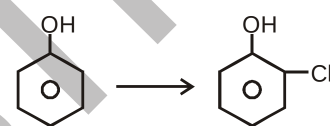
Q.10 Compare the rate of sulphonation:–



C_6H_6 C_6D_6 C_6T_6

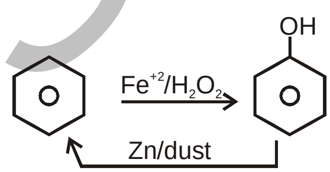
(a) (b) (c) (d) (e)

Q.11 Convert

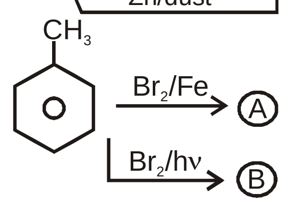


(hint:– protection of para position)

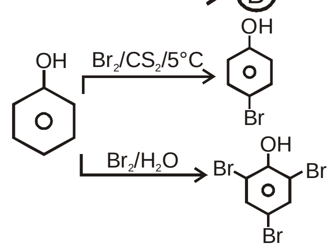
Q.12



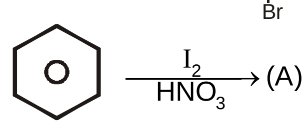
Q.13



Q.14



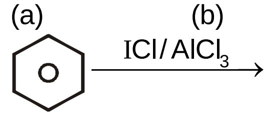
Q.15



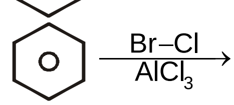
Q.16 Compare rate of iodination of

C_6H_6 (a) C_6D_6 (b) C_6T_6 (c)

Q.17



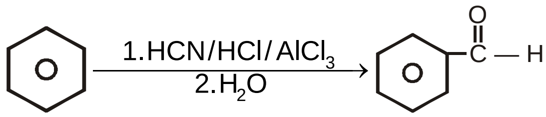
Q.18



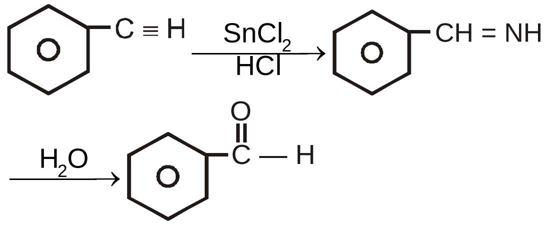
DPP NO-04 Time: 15 minutes

Q.1 Write mechanism of following reactins:–

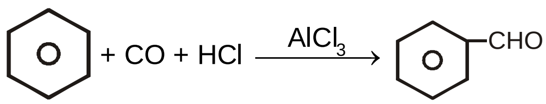
(a) Gatterrnann aldehyde synthesis:–



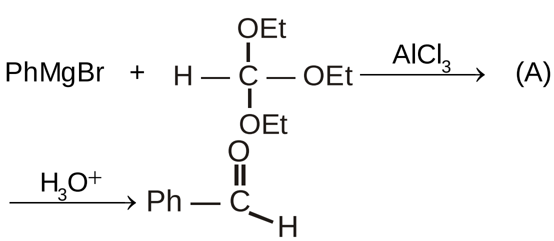
(b) Stephen Reduction



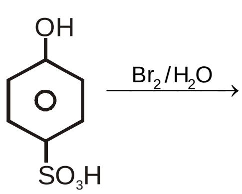
(c)



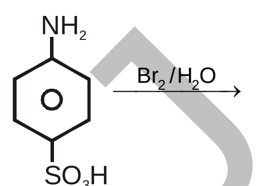
(d)



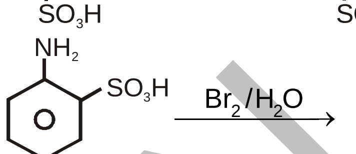
Q.2



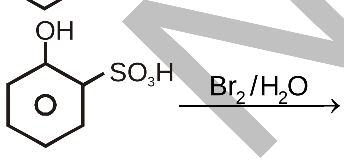
Q.3



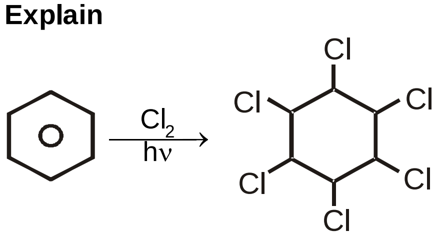
Q.4



Q.5



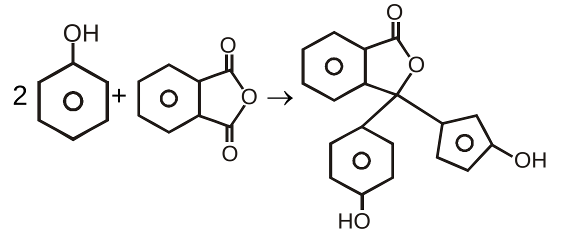
Q. Explain



Lindane /666/ $C_6H_6Cl_6$ /Gammaxene /BHC

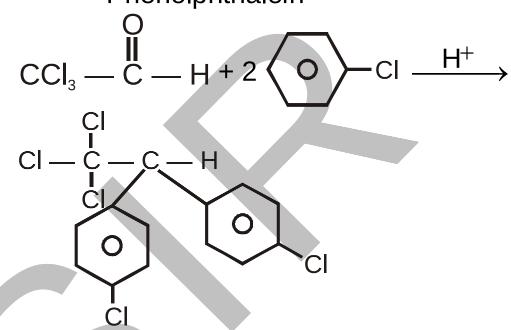
Q. Write mechanism

1.

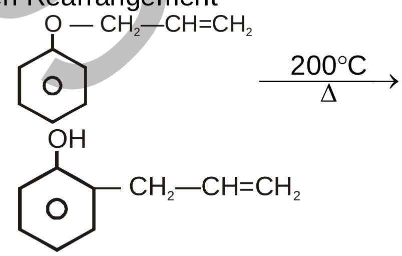


Phenolphthalein

2.

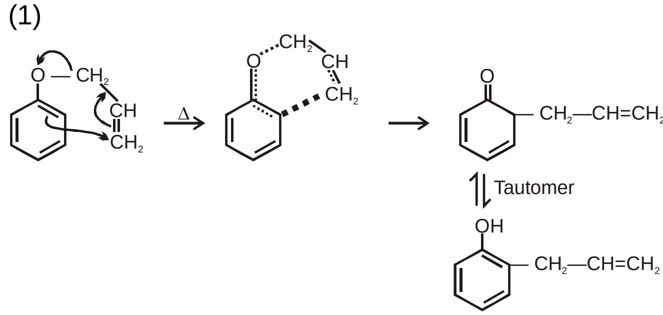


Claisen Rearrangement



Mechanism:–

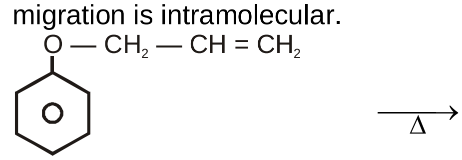
(1)



Characteristics

1. first order reaction
2. migration is intramolecular.

Q.1



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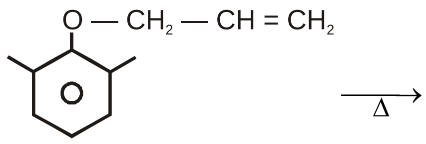
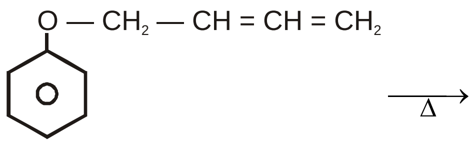
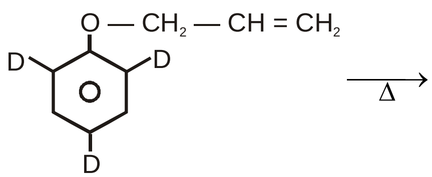
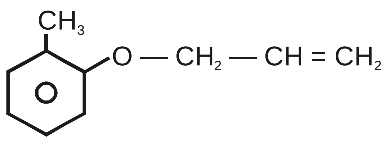
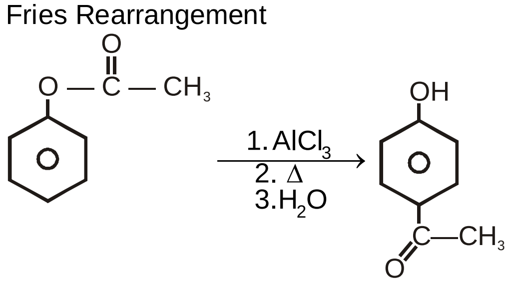
Q.2 

Q.3 

Q.4 

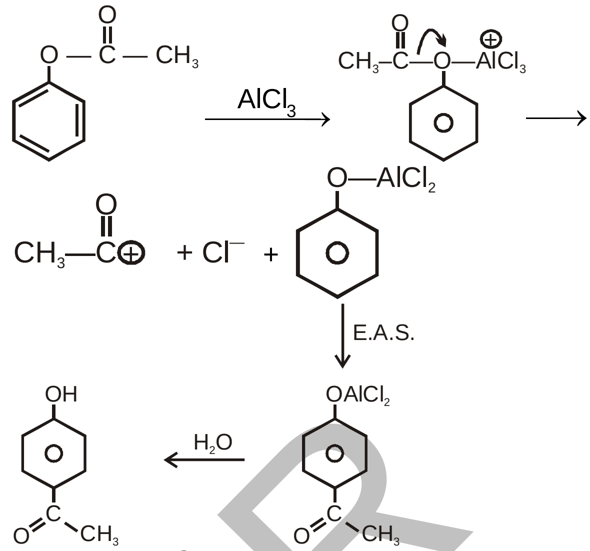
Q.5 

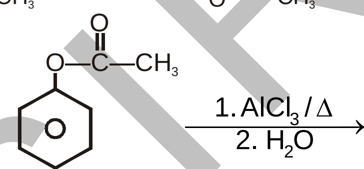
Fries Rearrangement

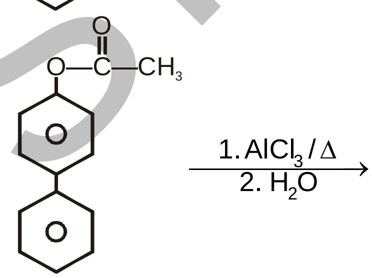


Mechanism:–

1.

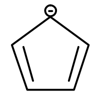


Q.1 

Q.2 

EXERCISE – I

Q.1 How many π electron are there in the following species :



(A) 2 (B) 4 (C) 6 (D) 8

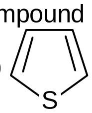
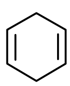
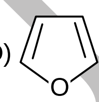
Q.2 Benzene is a resonance hybrid mainly of two Kekule structures. Hence
(A) Half of the molecules correspond to one structure, and half of the second structure
(B) At low temperatures benzene can be separated into two structures
(C) Two structures make equal contribution to resonance hybrid
(D) An individual benzene molecule changes back and forth between two structures

Q.3 Which one of the following is the most basic compound :
(A) $C_6H_5 - NH_2$ (B) $C_6H_5 - NHCH_3$
(C) $C_6H_5 - N(CH_3)_2$ (D) $C_6H_5N(C_2H_5)_2$

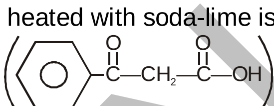
Q.4 Which of the following groups is divalent :
(A) Benzoyl (B) Benzyl
(C) Benzal (D) p-Tolyl

Q.5 The number of benzylic hydrogen atoms in ethylbenzene is :
(A) 3 (B) 5 (C) 2 (D) 7

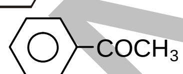
Q.6 Which of the following is not an aromatic compound :

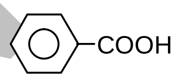
(A)  (B)  (C)  (D) 

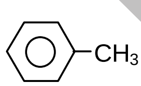
Q.7 Product obtained when benzoyl acetic acid is heated with soda-lime is :

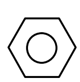


(Benzoyl acetic acid)

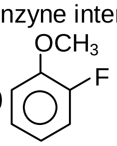
(A) 

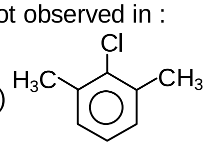
(B) 

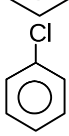
(C) 

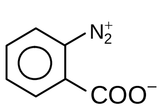
(D) 

Q.8 Benzyne intermediate is not observed in :

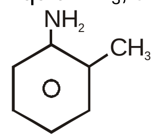
(A) 

(B) 

(C) 

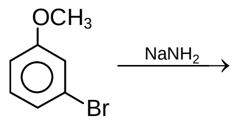
(D) 

Q.9 In the reaction of p-chlorotoluene with KNH_2 in liquid NH_3, the major product is :

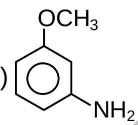


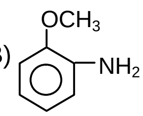
(o-Toluidine)

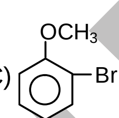
(A) o-Toluidine (B) m-Toluidine
(C) p-Toluidine (D) p-Chloroaniline

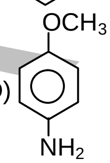
Q.10 

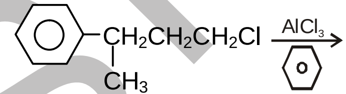
A, major product A and reaction R are :

(A) 

(B) 

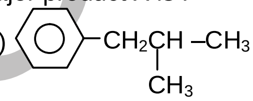
(C) 

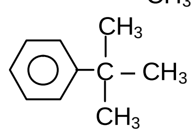
(D) 

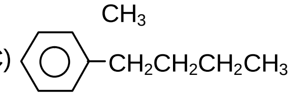
Q.11 

(X)

major product X is :

(A) 

(B) 

(C) 

(D) None of these

Q.12 $C_6H_6 + A \xrightarrow{AlCl_3} C_6H_5CONH_2$
A in the above reaction is :
(A) NH_2CONH_2 (B) $ClCONH_2$
(C) CH_3CONH_2 (D) $CH_2(Cl)CONH_2$

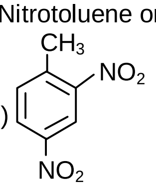
Q.13 In the sulphonation, acetylation and formylation of benzene the group of effective electrophiles would be :

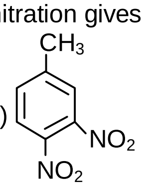
(A) $SO_3^+, CH_3 \equiv \overset{+}{O}, H\overset{+}{C}O$

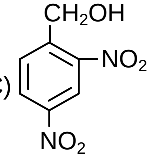
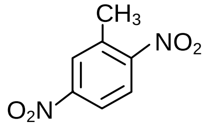
(B) $SO_3, CH_3 - C \equiv \overset{+}{O}, H\overset{+}{C}O$

(C) SO_3, CH_3CHO, $CO + HCl$
(D) HSO_3, CH_3CO, HCO

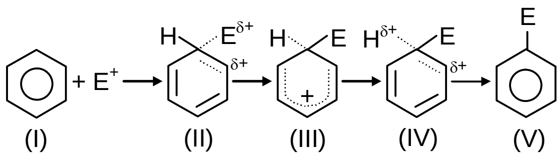
Q.14 p-Nitrotoluene on further nitration gives :

(A) 

(B) 

(C)  (D) 

Q.15 Which of the following species is expected to have maximum enthalpy in an electrophilic aromatic substitution reaction ?



(A) Species (II) (B) Species (III)
(C) Species (IV) (D) Species (V)

Q.16 For the electrophilic substitution reaction involving nitration, which of the following sequence regarding the rate of reaction is true ?

(A) $k_{C_6H_6} > k_{C_6D_6} > k_{C_6T_6}$

(B) $k_{C_6H_6} < k_{C_6D_6} < k_{C_6T_6}$

(C) $k_{C_6H_6} = k_{C_6D_6} = k_{C_6T_6}$

(D) $k_{C_6H_6} > k_{C_6D_6} < k_{C_6T_6}$

Q.17 For the electrophilic substitution reaction involving sulphonation, which of the following sequence regarding the rate of reaction is true ?

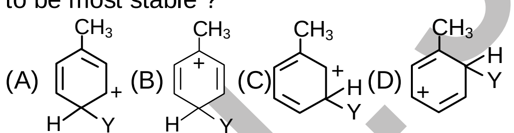
(A) $k_{C_6H_6} > k_{C_6D_6} > k_{C_6T_6}$

(B) $k_{C_6H_6} < k_{C_6D_6} < k_{C_6T_6}$

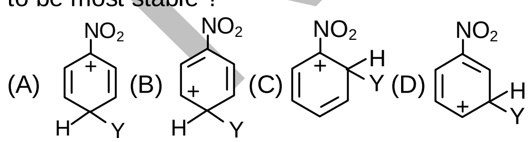
(C) $k_{C_6H_6} = k_{C_6D_6} = k_{C_6T_6}$

(D) $k_{C_6H_6} > k_{C_6D_6} < k_{C_6T_6}$

Q.18 Which of the following carbocations is expected to be most stable ?



Q.19 Which of the following carbocations is expected to be most stable ?

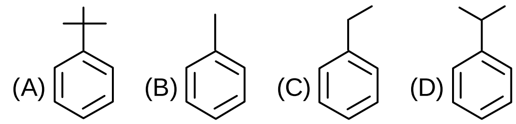


Q.20 Reaction of SO_3 is easier in :
(A) Benzene (B) Toluene
(C) Nitrobenzene (D) Chlorobenzene

Q.21 Which order is correct for the decreasing reactivity to ring monobromination of the following compounds :
(I) $C_6H_5CH_3$ (II) C_6H_5COOH
(III) C_6H_6 (IV) $C_6H_5NO_2$
(A) I > II > III > IV (B) I > III > II > IV
(C) II > III > IV > I (D) III > I > II > IV

Q.22 In a reaction of C_6H_5Y, the major product (>60%) is m-isomer, so the group Y is :
(A) – COOH (B) – Cl
(C) –OH (D) – NH_2

Q.23 Which of the following will undergo sulphonation of fastest rate ?

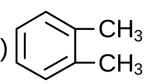
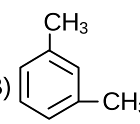


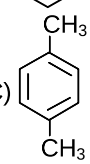
Q.24 Aniline under acidic medium, when chlorinated, produces :
(A) o-chloro aniline (B) m-chloro aniline
(C) p-chloro aniline
(D) Mixture of ortho and para-chloro aniline

Q.25 Which of the following is most reactive towards sulphonation ?
(A) m-Xylene (B) o-Xylene
(C) Toluene (D) p-Xylene

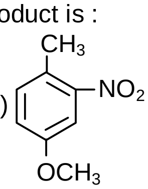
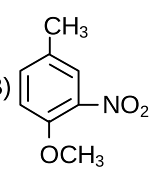
Q.26 When sulphonilic acid (p-$H_2NC_6H_4SO_3H$) is treated with excess of bromine, the product is
(A) tribromo product (B) dibromo product
(C) monobromo product (D) tetrabromo product

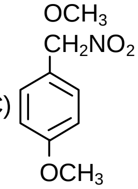
Q.27 Ring nitration of dimethyl benzene results in the formation of only one nitro dimethyl benzene. The dimethyl benzene is :

(A)  (B) 

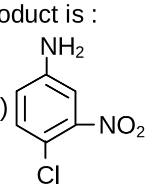
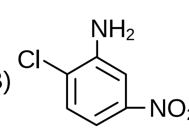
(C)  (D) None of these

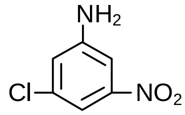
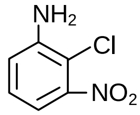
Q.28 If p-methoxy toluene is nitrated, the major product is :

(A)  (B) 

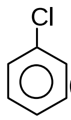
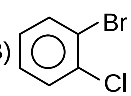
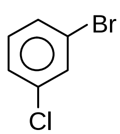
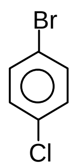
(C)  (D) No reaction

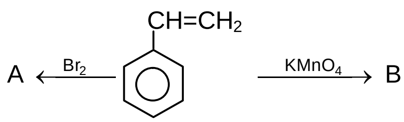
Q.29 If meta-nitroaniline is chlorinated, the major product is :

(A)  (B) 

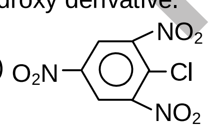
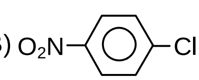
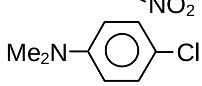
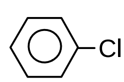
(C)  (D) 

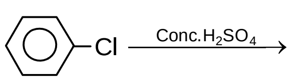
Q.30 An aromatic compound of molecular formula $C_6H_4Br_2$ was nitrated then three isomers of formula $C_6H_3Br_2NO_2$ were obtained. The original compound is :
(A)o-dibromobenzene (B) m-dibromobenzene
(C) p-dibromobenzene (D) Both A & C

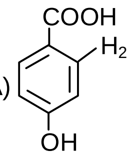
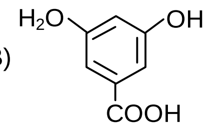
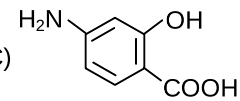
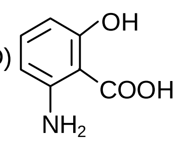
Q.31 Which of the following substituted benzene derivatives would furnish only three isomers in significant amount when one more substituent is introduced :
(A)  (B)  (C)  (D) 

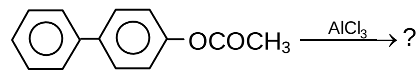
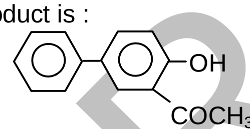
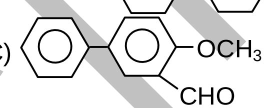
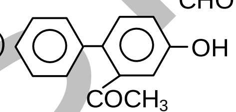
Q.32 
Compound A and B respectively are :
(A) o-Bromostyrene, benzoic acid
(B) p-Bromostyrene, benzaldehyde
(C) m-Bromostyrene, benzaldehyde
(D) Styrene dibromide, benzoic acid

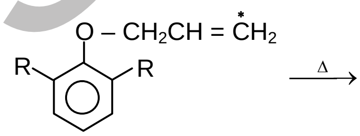
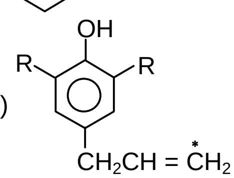
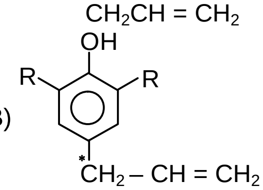
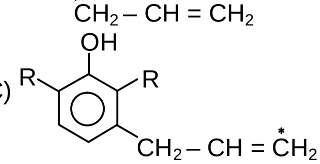
Q.33 m-Bromotoluene is prepared by :
(A) Bromination of toluene
(B) Friedel Craft's reaction of bromobenzene with CH_3Cl
(C) Bromination of nitrobenzene and subsequent replacement of $-NO_2$ group with methyl group
(D) Bromination of aceto-p-toluidine followed by hydrolysis and deamination

Q.34 Which chloroderivative of benzene among the following would undergo-hydrolysis most readily with aq. NaOH to furnish the corresponding hydroxy derivative.
(A)  (B) 
(C)  (D) 

Q.35 Chloral +  product. The product is :
(A) Lindane (B) DDT
(C) Tefflon (D) Ethaneperchlorate

Q.36 m-Aminophenol on treatment with NaOH and CO_2 gives which of the following as major product ?
(A)  (B) 
(C)  (D) 

Q.37  Major Product is :
(A) 
(B) 
(C) 
(D) 

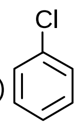
Q.38  ? Product is :
(A) 
(B) 
(C) 
(D) no reaction

EXERCISE – II

Q.1 Benzene reacts with n-propyl chloride in the presence of anhydrous $AlCl_3$ to give predominantly :
(A) n-Propylbenzene (B) Isopropylbenzene
(C) 3-Propyl-1-chlorobenzene
(D) Cumene

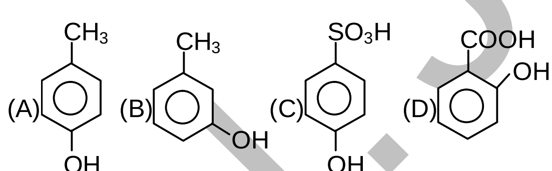
Q.2 In which of the following reaction t-butylbenzene is formed :
(A) Benzene + iso-butyl chloride, $AlCl_3$
(B) Benzene + $(CH_3)_2C = CH_2 \xrightarrow{BF_3.HF}$
(C) Benzene + t-butyl alcohol $\xrightarrow{H_2SO_4}$
(D) Benzene + $(CH_3)_2C = CH_2 \xrightarrow{AlCl_3}$

Q.3 The replacement of a hydrogen atom in benzene by alkyl group can be brought about with the following reagents :
(A) Alkyl chloride and $AlCl_3$
(B) Alkene and $AlCl_3$
(C) Alkanol and alkali
(D) Alkanol and acid

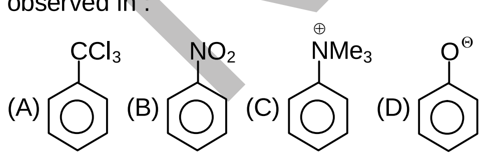
Q.4 Which of the following can be used in Friedel Crafts reaction ?
(A) 
(B) $CH_2 = CH - Cl$
(C) CH_3CH_2Cl
(D) $CH_2 = CH - CH_2 - Cl$

Q.5 The good method for converting benzene into propyl benzene is :
(A) $C_6H_6 + CH_3CH_2CH_2Cl$ + Anhyd. $AlCl_3$
(B) $C_6H_6 + CH_3CH_2COCl$ + Anhyd. $AlCl_3$ and then treatment with Zn/Hg/HCl
(C) $C_6H_6 + CH_3CH_2COCl$ + Anhyd. $AlCl_3$ and then treatment with H_2Ni
(D) C_6H_6 + Anhyd. $AlCl_3$ + cyclopropane

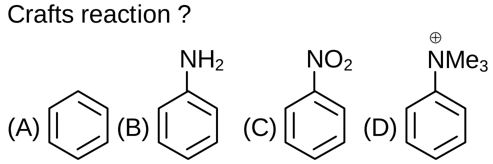
Q.6 The structure of the compound that gives a tribromo derivative on treatment with bromine water is :



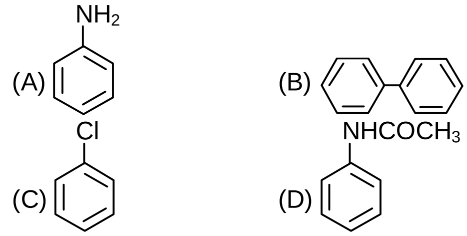
Q.7 Electrophilic attack of $NO_2^{\oplus}$ at meta position is observed in :



Q.8 Which of the following does not gives Friedel-Crafts reaction ?



Q.9 Which of the following will undergo nitration faster than benzene ?



Q.10 Of the species PhSH, $PhS(=O)R$, $PhS(=O)_2R$ and $Ph - S(=O)_2 - OR$ the meta-substituted product is obtained from
(A) PhSR
(B) $PhS(=O)R$
(C) $PhS(=O)_2R$
(D) $Ph - S(=O)_2 - OR$

Q.11 Which of the following is not an ortho-para directing group ?
(A) CF_3
(B) CCl_3
(C) – CH = CH – COOH
(D) $- N \equiv C$

Q.12 Which of the following statement is incorrect for electrophilic substitution
(A) Ortho-and para-directing groups increase electron density at ortho-and para-position
(B) Meta-directing group increase electron density at meta-position
(C) Meta-directing groups decrease electron density at meta-position
(D) Ortho-and para-directing groups decrease electron density at meta-position

Q.13 Which of the following statement is/are not true ?
(A) All ortho-para directing group activates the ring
(B) All ortho-para directing groups excepting halogens activate the ring
(C) All meta-directing groups have π-bond on the atom directly attached to the ring
(D) All meta directing groups are deactivating

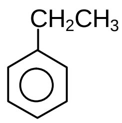
Q.14 Amongst the following, the moderately activating group is
(A) – NHR
(B) – $NHCOCH_3$
(C) $- O - C(=R) - R$
(D) – CH_3

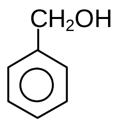
Q.15 False statement is/are :
(A) Although benzene contains three double bonds, normally it does not undergo addition reaction
(B) m-chlorobromobenzene is an isomer of m-bromochlorobenzene

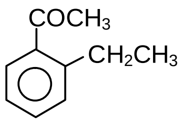
(C) In benzene, carbon uses all the three p orbitals for hybridization

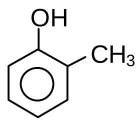
(D) An electron donating substitutent in benzene orients the incoming electrophilic group to the meta position

Q.16 Benzoic acid may be prepared by the oxidation of :

(A) 

(B) 

(C) 

(D) 

Q.17 Which of the following reactions of benzene proves the presence of three carbon-carbon double bonds in it :

(A) Formation of a triozonide

(B) Hydrogenation of benzene to cyclohexane

(C) Formation of $C_6H_6Cl_6$ by addition of chorine

(D) Formation of nitrobenzene on heating benzene with a mixture of concentrated nitric acid and sulphuric acid

Q.18 Which of the following are classified as aromatic?

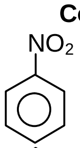
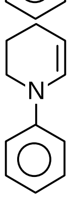
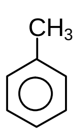
(A) 1,2, 3-Triphenylcyclopropenium cation

(B) Cyclooctatetraenyl dianion

(C) Azulene

(D) Annulene

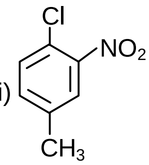
Q.19 Match the column :

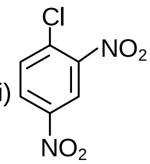
Column I	Column II
(A) 	(P)Group attached with phenyl ring is +M
(B) 	(Q) Rate of electrophilic aromatic substitution is less than benzene ring
(C) 	(R) Group attached with phenyl ring will show (+H) (Hyperconjugation)
	(S) Group attached with phenyl ring will show (–H) effect (Hyperconjugation)

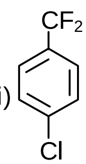
EXERCISE – III

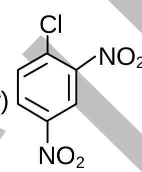
Q.1 Write the most stable resonating structure for the cyclohexadienyl anion formed by reaction of methoxide ion with o-fluoronitrobenzene.

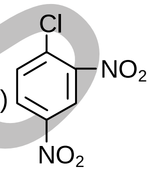
Q.2 Write the principal organic product in each of the following reactions :

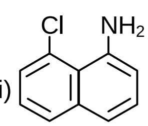
(i)  $+ C_6H_5CH_2SK \rightarrow A$

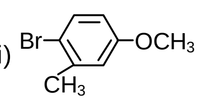
(ii)  $\xrightarrow[\text{triethylene glycol}]{H_2NNH_2} B$

(iii)  $\xrightarrow[\text{(ii)}NaOCH_3, CH_3OH]{\text{(i)}HNO_3, H_2SO_4} C$

(iv)  $+ CH_3CH_2ONa \rightarrow D$

(v)  $+ C_6H_5CH_2SNa \rightarrow E$

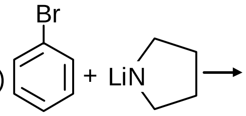
Q.3 (i)  $\xrightarrow[\text{(ii)}CuBr]{\text{(i)}NaNO_2, HBr} E$

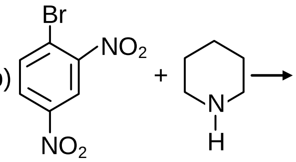
(ii)  $\xrightarrow[\text{(ii)}NaSCH_3]{\text{(i)}NBS, \text{Benzoylperoxide } CCl_4, \text{heat}} F$

Q.4 Reaction of 1, 2, 3-tribromo-5-nitrobenzene with sodium ethoxide in ethanol gave a single product $C_8H_7Br_2NO_3$, in quantitative yield. Suggest a reasonable structure for this compound.

Q.5 2-Bromo-1,3-dimethylbenzene is inert to nucleophilic aromatic substitution on treatment with sodium amide in liquid ammonia. It is recovered unchanged even after extended contact with the reagent. Suggest an explanation for this lack of reactivity.

Q.6 In each of the following reactions, an amine or a lithium amide derivative reacts with an aryl halide. Give the structure of the expected product and specify the mechanism by which it is formed.

(a) 

(b) 

Q.7 1,2,3,4,5-Pentalfluoro-6-nitrobenzene reacts readily with sodium methoxide in methanol at room temperature to yield two major products, each having the molecular formula $C_7H_3F_4NO_3$. Suggest reasonable structures for these two compounds.

EXERCISE – IV(A)

Q.1 The chlorination of toluene in presence of ferric chloride gives predominatly : **[JEE 1986]**
(A) Benzyl chloride (B) m-chlorotoluene
(C) Benzal chloride
(D) o-and p-chlorotoluene

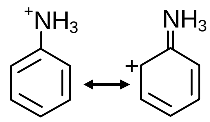
Q.2 Aryl halides are less reactive towards nucleophilic substitution reaction as compared to alkyl halide due to **[JEE 1990]**
(A) The formation of less stable carbonium ion
(B) Resonance stabilization
(C) Longer carbon-halogen bond
(D) The inductive effect

Q.3 The most basic compound among the following is : **[JEE 1990]**
(A) Benzylamine (B) Aniline
(C) Acetaniline (D) p-nitro aniline

Q.4 Chlorination of toluene in the presence of light and heat followed by treatment with aqueous NaOH gives : **[JEE 1990]**
(A) o-cresol (B) p-cresol
(C) 2,4-dihydroxytoluene (D) Bezoic acid

Q.5 When nitrobenzene is treated with Br_2 in presence of $FeBr_3$ the major product formed is m-bromonitrobenzene. Statements which are related obtain the m-isomer are : **[JEE 1992]**
(A) The electron density on meta carbon is more than on ortho and para position
(B) The intermediate carbonium ion formed after initial attack of Br^+ attack the meta position is least destabilized
(C) Loss of aromaticity when Br^+ attacks at the ortho and para positions and not at meta position
(D) Easier loss of H^+ to region aromaticity form the meta position than from ortho and para position

Q.6 Choose the correct statement from the ones given below for two aniline in : **[JEE 1993]**



(I) (II)

(A) II is not an acceptable canonical structure because carbonium ions are less stable than ammonium ions
(B) II is not an aceptable canonical structure because it is non aromatic
(C) II is not an acceptable canonical structure because the nitrogen has 10 valence electrons
(D) II is an acceptable canonical structure

Q.7 Most stable cabonium ion is : **[JEE 1995]**
(A) p – NO_2 – C_6H_4 – $^+CH_2$
(B) C_6H_5 $^+CH_2$
(C) p– Cl – C_6H_4 – $^+CH_2$
(D) p– CH_3O – C_6H_4 – $^+CH_2$

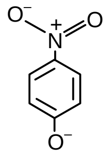
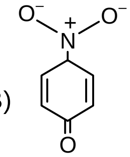
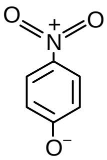
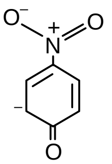
Q.8 Arrange in order of decreasing trend towards S_E reactions : **[JEE 1995]**
(I) Chlorobenzene (II) Benzene
(III) Anilinium chloride (IV) Toluene
(A) II > I > III > IV (B) III > I > II > IV
(C) IV > II > I > III (D) I > II > III > IV

Q.9 Among the following statements on the nitration of aromatic compounds, the false one is : **[JEE 1997]**
(A) The rate of benzene is almost the same as that of hexadeuterobenzene
(B) The rate of nitration of toluene is greater than that of benzene
(C) The rate of nitration of benzene is greater than that of hexadeuterobenzene
(D) Nitration is an electrophilic substitution reaction

Q.10 Nirtobenzene can be prepared from benzene by using a mixture of conc. HNO_3 and conc. H_2SO_4. In the nitrating mixture HNO_3 acts as a : **[JEE 1997]**
(A) Base (B) Acid
(C) Reducing agent (D) Catalyst

Q.11 Benzyl chloride ($C_6H_5CH_2Cl$) can be prepared from toluene by chlorination with : **[JEE 1998]**
(A) $SO_2Cl_2h\nu$ (B) $SOCl_2$
(C) $Cl_2h\nu$ (D) NaOCl

Q.12 The most unlikely representation of resonance structure of p-nitrophenoxide ion is :**[JEE 1998]**

(A) 
(B) 
(C) 
(D) 

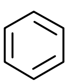
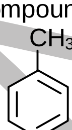
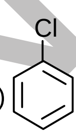
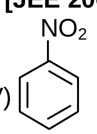
Q.13 Benzenediazonium chloride on reaction with phenol in weakly basic medium gives : **[JEE 1998]**
(A) Diphenyl ether
(B) p-hydroxyazobenzene
(C) Chlorobenzene
(D) Benzene

Q.14 A solution of (+) –1-chloro-1-phenylethane in toluene racemises slowly in the presence of small amount of $SbCl_5$, due to the formation of : **[JEE 1999]**
(A) Carbanion (B) Carbene
(C) Free-radical (D) Carbocation

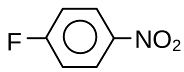
Q.15 Toluene, when treated with Br_2/Fe, gives p-bromotoluene as the major product, because the CH_3 group : **[JEE 1999]**
(A) is para directing (B) is meta directing
(C) activates the ring by hyperconjugation
(D) deactivates the ring

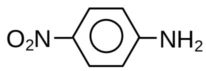
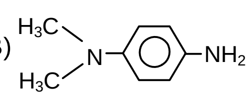
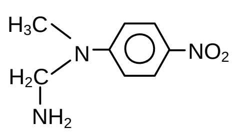
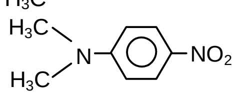
Q.16 Amongst the following the strongest base is : **[JEE 2000]**
(A) $C_6H_5NH_2$ (B) p-$O_2NC_6H_4NH_2$
(C) m-$O_2NC_6H_4NH_2$ (D) $C_6H_5CH_2NH_2$

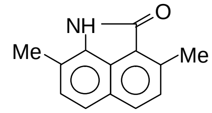
Q.17 Identify the correct order of reactivity in electrophilic substitution reactions of the following compounds **[JEE 2002]**

(I)  (II)  (III)  (IV) 

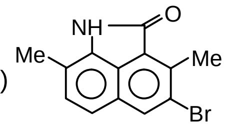
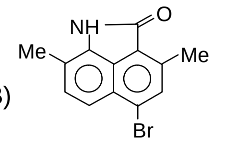
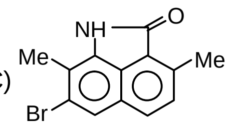
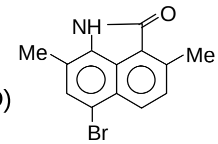
(A) I > II > III > IV (B) IV > III > II > I
(C) II > I > III > IV (D) II > III > I > IV

Q.18  $\xrightarrow[\text{DMF}]{(CH_3)_2NH}$ A $\xrightarrow[\text{(ii)} H_2 \text{ Catalytic Reduction}]{\text{(i)} NaNO_2\ HCl\ 0°\text{–}5°C}$ B **[JEE 2003]**

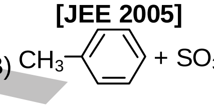
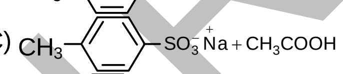
(A)  (B) 
(C)  (D) 

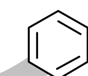
Q.19  $\xrightarrow[\text{Fe}]{Br_2}$ **[JEE 2004]**

Major product of above reaction is :

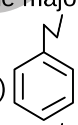
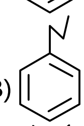
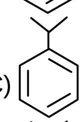
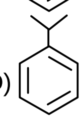
(A)  (B) 
(C)  (D) 

Q.20 Which of the following is obtained when 4-Methylbenzenesulphonic acid is hydrolysed with excess of sodium acetate? **[JEE 2005]**

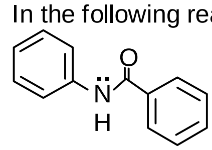
(A)  (B) 
(C) 
(D) 

Q.21  + Cl – CH_2CH_2 – CH_3 $\xrightarrow{AlCl_3}$ P $\xrightarrow[\text{(ii)} H_3O^+]{\text{(i)} O_2/\Delta}$ Q + Phenol **[JEE 2006]**

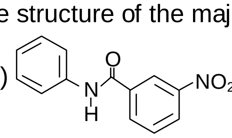
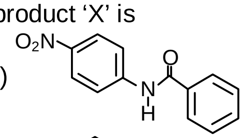
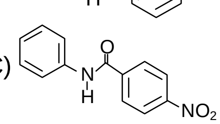
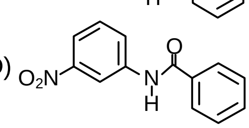
The major products P and Q are

(A)  and CH_3CH_2CHO
(B)  and CH_3COCH_3
(C)  and CH_3COCH_3
(D)  and CH_3CH_2CHO

Q.22 In the following reaction, **[JEE 2007]**

 $\xrightarrow[\text{conc.} H_2SO_4]{\text{conc.} HNO_3}$ X

the structure of the major product 'X' is

(A)  (B) 
(C)  (D) 

Q.23 Statement – 1: Bromobenzene upon reaction with Br_2/Fe gives 1,4-dibromobenzene as the major product. **[JEE 2008]**

and

Statement - 2 : In bromobenzene, the inductive effect of the bromo group is more dominant than the mesomeric effect in directing the incoming electrophile.

(A) SATEMENT -1 is True, SATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1
(B) SATEMENT -1 is True, SATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1
(C) SATEMENT -1 is True, SATEMENT-2 is False.
(D) SATEMENT -1 is False, SATEMENT-2 is True.

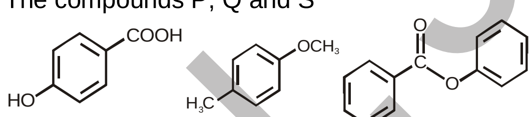
Q.24 Statement – 1 : Aniline on reaction with $NaNO_2$/HCl at 0°C followed by coupling with β-naphthol gives a dark blue coloured precipitate. **[JEE 2008]**

and

Statement – 2 : The colour of the compound formed in the reaction of aniline with $NaNO_2$/HCl at 0° followed by coupling with β-naphthol is due to the extended conjugation.

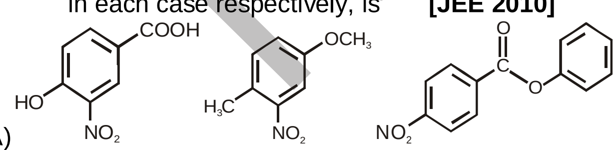
(A) SATEMENT -1 is True, SATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1
(B) SATEMENT -1 is True, SATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1
(C) SATEMENT -1 is True, SATEMENT-2 is False.
(D) SATEMENT -1 is False, SATEMENT-2 is True.

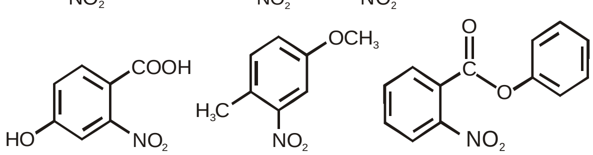
Q.25 The compounds P, Q and S

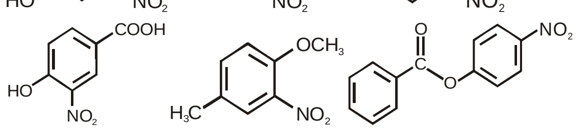


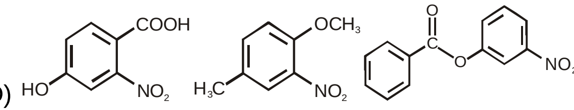
P Q S

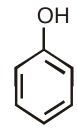
were separately subjected to nitration using HNO_3/H_2SO_4 mixture. The major product formed in each case respectively, is **[JEE 2010]**

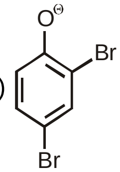
(A)


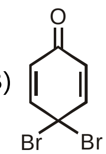
(B)


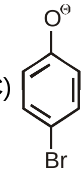
(C)


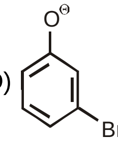
(D)


Q.26 In the reaction  $\xrightarrow{NaOH(aq.)/Br_2}$ the intermediate(s) is(are) **[JEE 2010]**

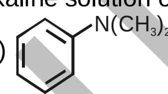
(A)


(B)


(C)


(D)


Q.27 Amongst the compounds given, the one that would form a brilliant colored dye on treatment with $NaNO_2$ is dil. HCl followed by addition to an alkaline solution of β-naphthol is **[JEE 2011]**

(A)


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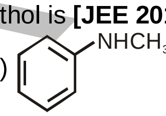
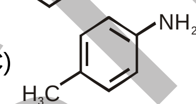
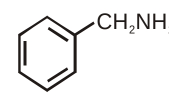
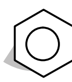


(C)


(D)


EXERCISE – IV(B)

Q.1  + $(CH_3)_2CH.CH_2Cl \xrightarrow{AlCl_3}$ (A)

[JEE 1992]

Q.2 $C_6H_5C_2H_5 \xrightarrow[\text{(ii)NaCN}]{\text{(i)}Br_2\text{,Heat,light}}$ **[JEE 1994]**

Q.3 An organic compound (A), C_8H_6 on treatment with dilute sulphuric acid containing mercuric sulphate gives a compound (B), which can also be obtained from a reaction of benzene with an acid chloride in the presence of anhydrous aluminium chloride. The compound (B), when treated with iodine in aqueous KOH, yields (C) and a yellow compound (D). Identify (A), (B), (C) and (D) with justification. Show how (B) is formed from (A) ? **[JEE 1994]**

Q.4 Toluene reacts with bromine in the presence of light to give benzyl bromine while in presence of $FeBr_3$ it gives p-bromotoluene. Give explanation for the above observations. **[JEE 1996]**

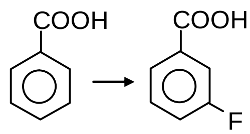
Q.5 Show the steps the carry out the following transformations: **[JEE 1998]**
(a) Ethylbenzene → benzene
(b) Ethylbenzene → 2-phenylpropionic acid

Q.6 $C_6H_5CH_2CHClC_6H_5 \xrightarrow{\text{alcoholic KOH, heat}}$ (A)+ (B)
[JEE 1998]

Q.7 Normally, benzene gives electrophilic substitution reaction rather than thus electrophilic addition reaction although it has double bonds. **[JEE 2000]**

Q.8 How would you synthesis 4 methoxyphenol from bromobenzene in NOT more than five steps ? State clearly the reagents used in each step and show the structures of the intermediate compounds in your synthetic scheme. **[JEE 2001]**

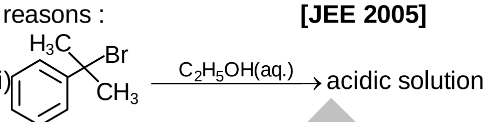
Q.9 Carry out following conversions in 3 or less steps. **[JEE 2003]**

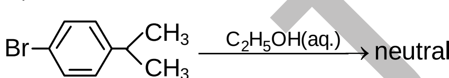


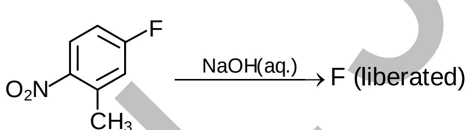
Q.10 A compound $C_9H_7O_2Cl$ exists in keto form A and enolic form B. Enolic form B predominates at equilibrium. On oxidation with $KMnO_4$ it gives m-chlorobenzoic acid. Give structures of A and B. **[JEE 2003]**

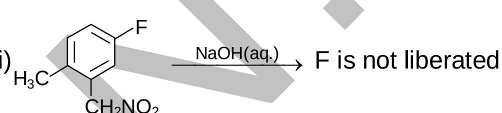
Q.11 7-bromo-1,3,5-cycloheptatriene is ionic compound, whereas 5-bromo-1,3-cyclopentadiene can't ionise even in the presence of $Ag^{\oplus}$, Explain why? **[JEE 2004]**

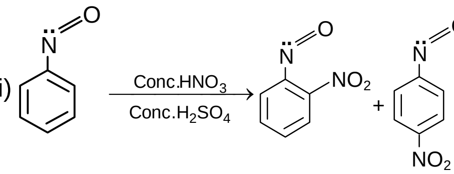
Q.12 Give reasons : **[JEE 2005]**

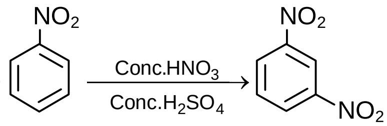
(a) (i) 

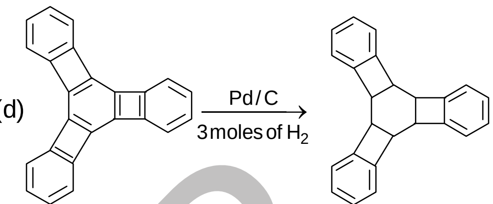
(ii) 

(b) (i) 

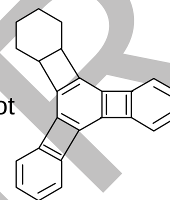
(ii) 

(c) (i) 

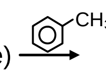
(ii) 

(d) 

is

formed but not 

Q.13 $\begin{pmatrix}\text{Brown fumes and} \\ \text{pungent smell}\end{pmatrix}$ B $\xleftarrow{NaBr + MnO_2}$ A

$\xrightarrow{Conc.HNO_3}$ C(intermediate)  D

(Explosive product)

Find A, B, C and D. Also write equations A to B and A to C. **[JEE 2005]**

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ANSWER KEY

EXERCISE - I

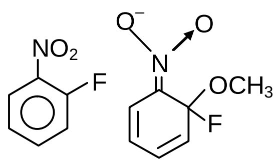
Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	C	D	C	C	B	A	B	B	A	D	B	B	A	A	C	A	B	D	B
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38		
Ans.	B	A	B	B	A	A	C	B	B	B	C	D	D	A	B	C	A	A		

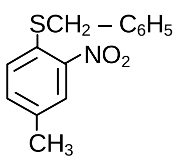
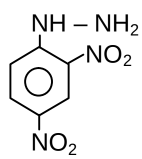
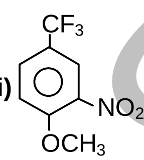
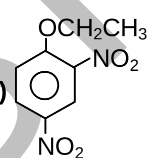
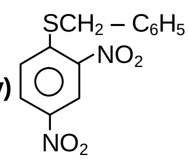
EXERCISE – II

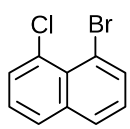
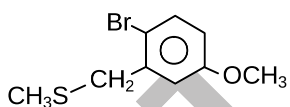
Ques.	1	2	3	4	5	6	7	8
Ans.	B,D	A,B,C,D	A,B,D	C,D	B,D	B,C,D	A,B,C	B,C,D
Ques.	9	10	11	12	13	14	15	16
Ans.	A,B,D	C,D	A,B,D	B,C,D	A,C	B,C	B,C,D	A,B
Ques.	17	18						
Ans.	A,B,C	A,B,C						

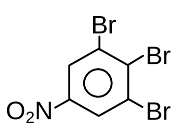
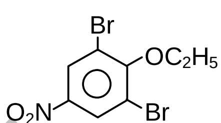
Q.19 (A) Q ; (B) P ; (C) R

EXERCISE – III

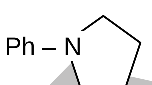
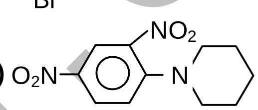
Q.1 

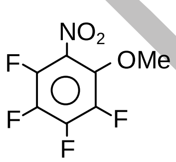
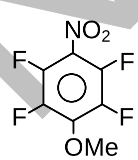
Q.2 (i)  (ii)  (iii)  (iv)  (v) 

Q.3 (i)  (ii) 

Q.4  

Q.5

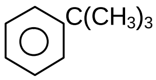
Q.6 (a)  (b) 

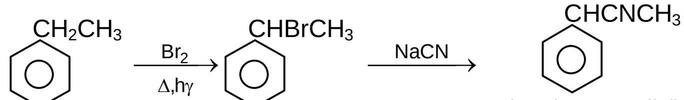
Q.7  

EXERCISE – IV(A)

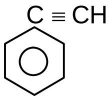
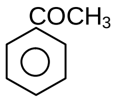
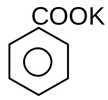
Ques.	1	2	3	4	5	6	7	8
Ans.	D	B	A	D	A,B	C	D	C
Ques.	9	10	11	12	13	14	15	16
Ans.	C	A	A,C	C	B	D	A,C	D
Ques.	17	18	19	20	21	22	23	24
Ans.	C	B	D	C	C	B	C	D
Ques.	25	26	27					
Ans.	C	A,C,D	C					

EXERCISE – IV(B)

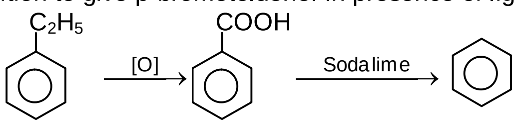
Q.1 

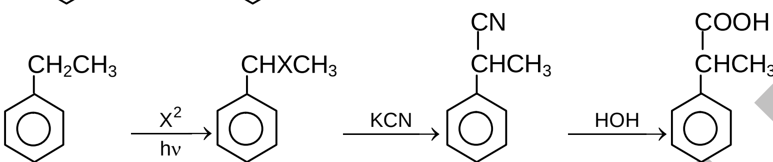
Q.2 

2-phenylpropane niitrile

Q.3 (A)  (B)  (C) 

Q.4 In presence of $FeBr_3$, Br_2 Produces Br+ (an electrophile) which attacks the benzene ring at o-, p-position to give p-bromotoluene. In presence of light, side chain is attacked to produce benzyl bromide.

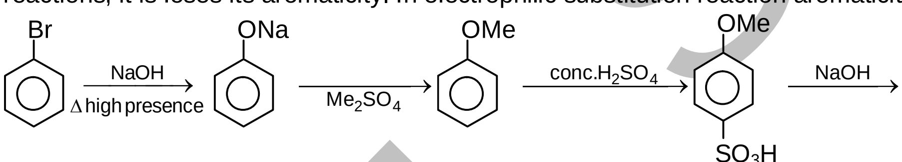
Q.5 (b) (i) 

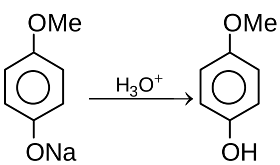
(ii) 

Q.6 $C_6H_5CH_2CHClC_6H_5 \xrightarrow[\Delta]{KOH(alc.)} C_6H_5CH = CHC_6H_5$

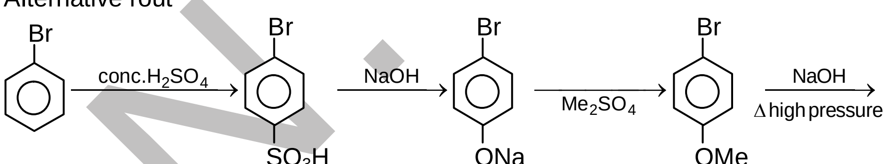
(Cis and trans forms)

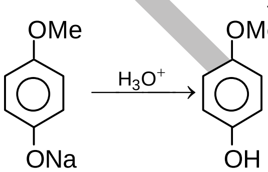
Q.7 Benzene has resonance stabilization due to delocalization of π-electrons. Also during electrophilic addition reactions, it is loses its aromaticity. In electrophilic substitution reaction aromaticity is retained.

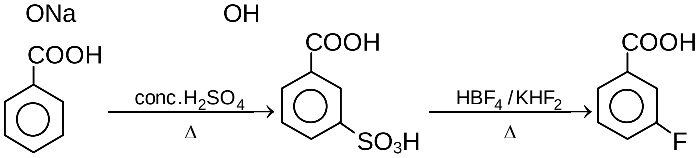
Q.8 



Alternative rout





Q.9 

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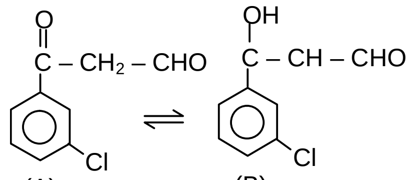
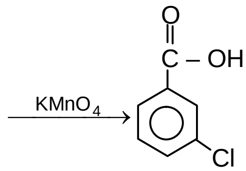
Q.10

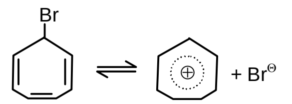


(A) Keto (B) Enol

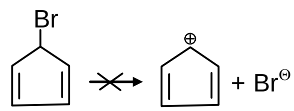
Enol form is more stable due to extended conjugation.

(A) 

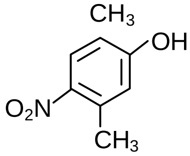
Q.11 On ionization 7-bromo-1,3,4-cycloheptatriene gives tropolium ion which is aromatic with 6π electrons.



5-bromo-1,3-cyclopentadiene can't ionize as it will in that case give highly unstable antiaromatic cation with 4π electrons.



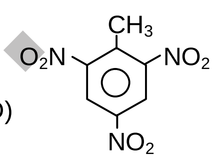
Q.12 (a) (i) $H_5C_6 - C(CH_3)_2 - OC_2H_5 + HBr$ (acid) ; (i) no reaction due to partial double bond character

(b) (i)  + F^- is liberated ; (ii) Bimomecular mechanism is not possible in (ii) case

(c) (i) due to presence of lone pair of nitrogen atom NO group is electron donating and ortho, para directing

(ii) NO_2 group is electron withdrawing and meta directing

(d) Due to reduction of central ring, three four membered antiaromatic rings become stable while on reduction of terminal ring only one antiaromatic ring can be stabilized.

Q.13 (A) H_2SO_4, (B) Br_2, (C) $NO_2^{\oplus}$, (D) 

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Biomolecules

Polymers

&

Practical Organic Chemistry

1. IIT-JEE Syllabus

Carbohydrates: Classification – mono, di and polysaccharides (Glucose, Sucrose and Starch only); hydrolysis of sucrose. Amino acids and Peptides: General structure and physical properties. Properties and uses of some important polymers (natural rubber, cellulose, nylon, teflon, PVC), Dyes and their application.

8.1
2. Carbohydrates

8.2

8.3
2.1 Introduction

8.4 ***Old Definition:*** The group of compounds known as carbohydrates received their general name because of early observations that they often have the formula $C_x(H_2O)_y$ - that is, they appear to be hydrates of carbon.

Limitations of the old definition: The above definition could not survive long due to the following reasons:

i) A number of compounds such as rhamnose, ($C_6H_{12}O_5$) and deoxyribose ($C_5H_{10}O_4$) are known which are carbohydrates by their chemical behaviour but cannot be represented as hydrates of carbon.

ii) There are other substances like formaldehyde (HCHO, CH_2O) and acetic acid [CH_3COOH, $C_2(H_2O)_2$] which do not behave like carbohydrates but can be represented by the general formula, $C_x(H_2O)_y$.

New definition: Carbohydrates are defined as polyhydroxy aldehydes or polyhydroxy ketones or substances which give these on hydrolysis and contain at least one chiral carbon atom. It may be noted here that aldehydic and ketonic groups in carbohydrates are not present as such but usually exist in combination with one of the hydroxyl group of the molecule in the form of hemiacetals and hemiketals respectively.

8.5
2.2 Classification

The carbohydrates are divided into three major classes depending upon whether or not they undergo hydrolysis, and if they do, on the number of products formed.

i) ***Monosaccharides:*** The monosaccharides are polyhydroxy aldehydes or polyhydroxy ketones which cannot be decomposed by hydrolysis to give simpler carbohydrates. Examples are glucose and fructose, both of which have molecular formula, $C_6H_{12}O_6$.

$$\underset{\text{glucose or fructose}}{C_6H_{12}O_6} + H_2O \xrightarrow{H^+} \text{No reaction}$$

ii) ***Oligosaccharides:*** The oligosaccharides (Greek, oligo, few) are carbohydrates which yield a definite number (2-9) of monosaccharide molecules on hydrolysis. They include,

a) Disaccharides, which yield two monosaccharide molecules on hydrolysis. Examples are sucrose and maltose, both of which have molecular formula, $C_{12}H_{22}O_{11}$.

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{glucose}}{2C_6H_{12}O_6}$$

b) Trisaccharides, which yield three monosaccharide molecules on hydrolysis. Example is, raffinose, which has molecular formula, $C_{18}H_{32}O_{16}$.

$$\underset{\text{raffinose}}{C_{18}H_{32}O_{16}} + 2H_2O \xrightarrow{H^+} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6} + \underset{\text{galactose}}{C_6H_{22}O_6}$$

c) Tetrasaccharides, etc.

iii) ***Polysaccharides:*** The polysaccahrides are carbohydrates of high molecular weight which yield many monosaccharide molecules on hydrolysis. Examples are starch and cellulose, both of which have molecular formula, $(C_6H_{10}O_5)_n$.

$$\underset{\text{starch}}{(C_6H_{10}O_5)_n} + nH_2O \xrightarrow{H^+} \underset{\text{glucose}}{nC_6H_{12}O_6}$$

In general, the monosaccharides and oligosaccharides are crystalline solids, soluble in water and sweet to taste. They are collectively known as sugars. The polysaccharides, on the other hand, are amorphous, insoluble in water and tasteless. They are called non-sugars.

The carbohydrates may also be classified as either reducing or non-reducing sugars. All those carbohydrates which have the ability to reduce Fehling's solution and Tollen's reagent are referred to as reducing sugars, while others are non-reducing sugars. All monosaccharides and the disaccharides other than sucrose are reducing sugars.

8.6 3. Monosaccharides

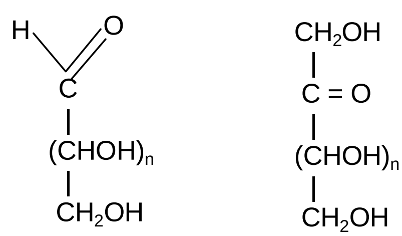
The monosaccharides are the basis of carbohydrate chemistry since all carbohydrates are either monosaccharides or are converted into monosaccharides on hydrolysis. The monosaccharides are polyhydroxy aldehydes or polyhydroxy ketones. There are, therefore, two main classes of monosaccharides.

1. The Aldoses, which contain an aldehyde group $(-\overset{\overset{\displaystyle O}{\|}}{C}-H)$

2. The Ketoses, which contain a ketone group $(-\overset{\overset{\displaystyle O}{\|}}{C}-)$

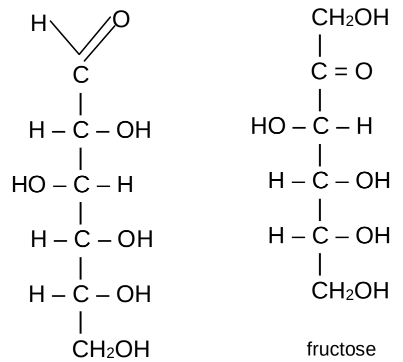
The aldoses and ketoses are further divided into sub-groups on the basis of the number of carbon atoms in their molecules, as trioses, tetroses, pentoses, hexoses, etc. To classify a monosaccharide completely, it is necessary to specify both, the type of the carbonyl group and the number of carbon atoms present in the molecule. Thus monosaccharides are generally referred to as aldotrioses, aldotetroses, aldopentoses, aldohexoses, ketohexoses, etc.

The aldoses and ketoses may be represented by the following general formulas.



Aldoses (n = 1, 2, 3, 4, 5)   Ketoses (n = 0, 1, 2, 3, 4)

Glucose and fructose are specific examples of an aldose and a ketose.

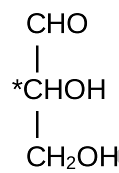


Glucose (an aldohexose)

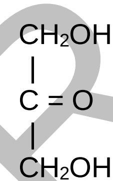
fructose (a ketohexose)

3.1 Trioses

D and L Terminology: The simplest of all carbohydrates that fit the definition we have given for carbohydrates are the trioses, glyceraldehyde and dihydroxyacetone. Glyceraldehyde is aldotriose, and dihydroxyacetone is a ketotriose.

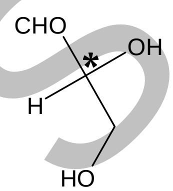


Glyceraldehyde (an aldotriose)

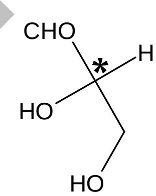


Dihydroxyacetone (a ketotriose)

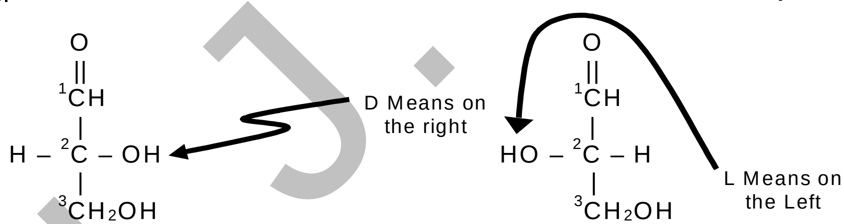
Glyceraldehyde contains one asymmetric carbon atom (marked by an asterisk) and can thus exist in two optically active forms, called the D-form and the L-form. Clearly, *the two forms are mirror images that cannot be superimposed,* that is they are ***enantiomers***.



D-Glyceraldehyde



L-Glyceraldehyde



D-Glyceraldehyde

L-Glyceraldehyde

The two forms of glyceraldehyde are especially important because the more complex monosaccharides may be considered to be derived from them. They serve as a reference point for designating and drawing all other monosaccharides. In carbohydrate chemistry, the Fischer projection formulas are always written with the aldehyde or ketone groups at the top of the structure. By definition, *if the hydroxyl group on the asymmetric carbon atom farthest from aldehyde or ketone group projects to the right, the compound is a member of the D-family. If the hydroxyl group on the farthest asymmetric carbon projects to the left, the compound is a member of the L-family.* The maximum number of optical isomers of a sugar is related to the number of asymmetric carbon atoms in the molecule and may be calculated by the following simple equation.

Maximum Number of Optical Isomers = 2^n, where n = the number of asymmetric carbon atoms.

Since glyceraldehyde contains only one asymmetric carbon atom, the number of optical isomer is 2^1. We know that 2^1 is = 2, and we have seen that there are indeed two different glyceraldehydes.

3.2 Aldotetroses

If we examine the general formula of an aldotetrose, we see that they contain two asymmetric carbon atoms (marked by asterisks).

This means that 2^2 or 4 optical isomers are possible. They may be represented as the following two pairs:

```
1.   CHO
      |
2.  *CHOH
      |
3.  *CHOH
      |
4.   CH2OH     an aldotetrose
```

```
     CHO             CHO              CHO             CHO
      |               |                |               |
 H – C – OH      HO – C – H       HO – C – H       H – C – OH
      |               |                |               |
 H – C – OH      HO – C – H        H – C – OH     HO – C – H
      |               |                |               |
     CH2OH           CH2OH            CH2OH           CH2OH
   Mirror images (recemic pair)     Mirror images (recemic pair)
 D (–)-erythrose  L (+)-erythrose  D (–)-threose   L (+)-threose
```

All four isomers have been prepared synthetically. The D- and L-erythrose are mirror images, that is, they are enantiomers. They have exactly the same degree of rotation but in opposite directions. Equal amounts of the two would constitute a racemic mixture, that is, a mixture that would allow a plane-polarised light to pass through the solution unchanged but could be separated into detrorotatory and laevorotatory isomers. The same comments hold for D- and L-threose. However, D-erythrose and L-threose are not images, that is, they are diastereomers *(optical isomers that are not mirror images are called diastereomers),* and the degree of rotation of each would probably differ.

3.3 Aldopentoses

If we examine the general formula of an aldopentose, we see that they contain three asymmetric carbon atoms.

This means that 2^3 or 8 optical isomers are possible. These are: - D(–) lyxose, L(+)-lyxose, D(–) xylose, L(–)xylose, D(–) arabinose, L(+)-arabinose, D(–)-ribose, L(+)-ribose

```
1.   CHO
      |
2.  *CHOH
      |
3.  *CHOH
      |
4.  *CHOH
      |
5.   CH2OH
  an aldopentose
```

3.4 Aldohexoses

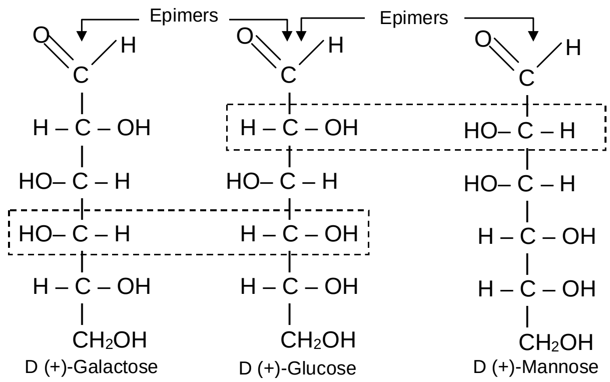
If we examine the general formula of aldohexose, we see that it contains four asymmetric carbon atoms. This means that 2^4 or 16 optical isomers are possible. D and L forms of altrose, allose glucose, mannose, galactose, talose, arabinose and idose

Only three of the sixteen possible aldohexoses are found in nature (all sixteen isomers have been prepared synthetically). They are D-glucose, D-mannose, and D-galactose. No one of these three optical iosmers is a mirror image of any of the others, so all three are diastereomers of each other.

```
1.   CHO
      |
2.  *CHOH
      |
3.  *CHOH
      |
4.  *CHOH
      |
5.  *CHOH
      |
6.   CH2OH
  an aldohexose
```

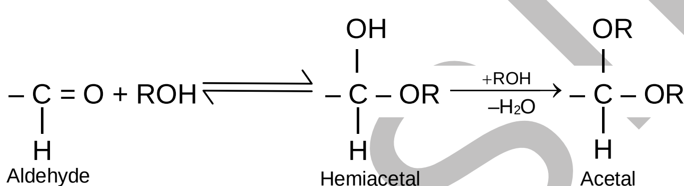
3.5 Epimers

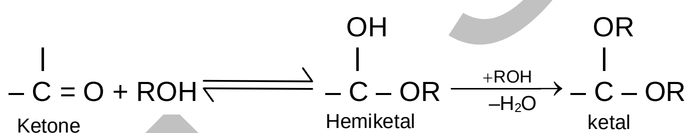
8.7 A pair of diastereomers that differ only in the configuration about of a single carbon atom are said to be epimers. e.g D(+)- glucose is epimeric with D(+) -mannose and D(+) -galactose as shown below:



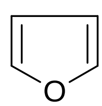
3.6 Cyclic structure of monosaccharides

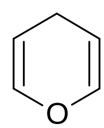
We know that aldoses (and ketoses) react with alcohols to give first hemiacetals (and hemiketals) and then acetals (and ketals), i.e.,





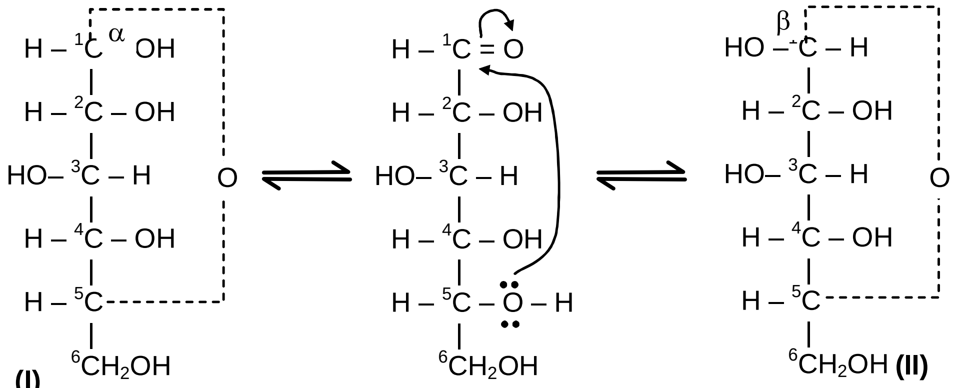
Since monosaccharides contain a number of hydroxyl groups and an aldehyde or a keto group, therefore, any one of the –OH groups (usually C_4 or C_5 in aldohexoses and C_5 or C_6 in ketohexoses) may combine with the aldehyde or the keto group to form intramolecular hemiacetal or hemiketal.


furan


pyran

As a result, the open chain formulae do not represent the actual structures of the monosaccharides. Their actual structures are cyclic involving five or six membered rings containing an oxygen atom. The five membered ring containing one oxygen atom because of its similarity with furan is called the furanose form and the six membered ring containing one oxygen atom because of its resemblance with pyran is called the pyranose form. In nut shell, all the monosaccharides (pentoses and hexoses) in the free state always exist in the pyranose form. However, in the combined state some monosaccharides such as ribose, 2-deoxyribose, fructose etc., usually exist in the furanose form.

3.7 Cyclic structure of Glucose – Anomers



(I) α-D(+)-Glucose or α-D(+)-Glucopyranose

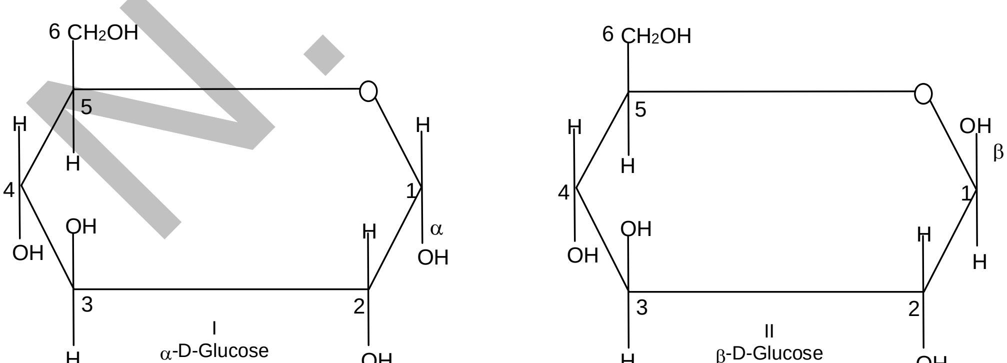
D(+)-Glucose (Open chain form)

(II) β-D(+)-Glucose or β-D(+)-Glucopyranose

We have discussed above that monosaccharides have cyclic hemiacetal or hemiketal structures. To illustrate, let us first consider the example of D-glucose. During hemiacetal formation C_5 – OH of glucose combines with the C_1 – aldehydic group. As a result, C_1 becomes chiral or asymmetric and thus has two possible arrangements of H and OH groups around it. In other words, D-glucose exists in two stereoisomeric forms, i.e., α-D-glucose and β-D-glucose as shown below:

In α-D-glucose, the OH group at C_1 is towards right while in β-D-glucose, the OH group at C_1 is towards left. *Such a pair of stereoisomers which differ in configuration only around C_1 are called* ***anomers*** and the C_1 carbon is called Anomeric carbon (or glycosidic carbon. The cyclic structures of monosaccharides can be better represented by *Haworth Projection formulae*. To get such a formula for any monosaccharide (say α-and β-D-glucose), draw a hexagon with its oxygen atom at the upper right hand corner. Place all the groups (on C_1, C_2, C_3 and C_4) which are present on left hand side in structures I and II, above the plane of the ring and all those groups on the right hand side below the plane of the ring.

The terminal – CH_2OH group is always placed above the plane of the hexagon ring (in D-series). Following the above procedure, Haworth Projection Formulae for α-D-glucose (I) and β-D-glucose (II) are obtained as shown below:

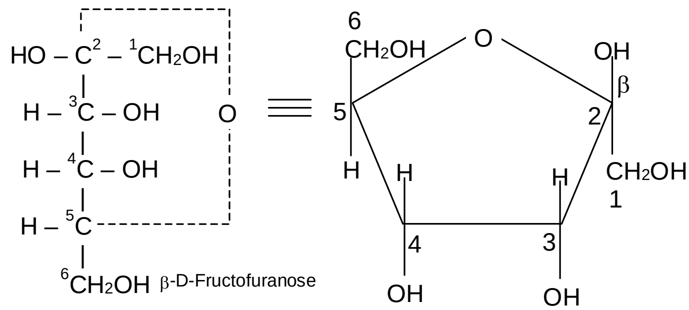


I α-D-Glucose or α-D(+)-Glucopyranose

II β-D-Glucose or β-D(+)-Glucopyranose

3.8 Cyclic structure of Fructose

Like glucose, fructose also has a cyclic structure. Since fructose contains a keto group, it forms an intramolecular hemiketal. In the hemiketal formation, C_5– OH of the fructose combines with C_2-keto group. As a result, C_2 becomes chiral and thus has two possible arrangements of CH_2OH and OH group around it. Thus, D-fructose exists in two stereoisomeric forms, i.e., α-D-fructopyranose and β-D fructopyranose. However in the combined state (such as sucrose), fructose exists in furanose form as shown below:



3.9 Mutarotation

The two stereoisomeric forms of glucose, i.e., α-D-glucose and β-D-glucose exist in separate crystalline forms and thus have different melting points and specific roations. For example α-D-glucose has a m.p. of 419 K with a specific rotation of +112° while β-D-glucose has a m.p. of 424 K and has a specific rotation of +19°. However, when either of these two forms is dissolved in water and allowed to stand, it gets converted into an equilibrium mixture of α-and β-forms through a small amount of the open chain form.

$$\underset{(36\%)}{\alpha\text{-D-Glucose}} \rightleftharpoons \underset{(0.02\%)}{\text{Open chain form}} \rightleftharpoons \underset{(64\%)}{\beta\text{-D-Glucose}}$$

As a result of this equilibrium, the specific rotation of a freshly prepared solution of α-D-glucose gradually decreases from of +112° to +52.7° and that of β-D-glucose gradually increases from +19° to +52.7°.

$$\underset{[\alpha]_D = +112°}{\alpha\text{-D-Glucose}} \rightleftharpoons \underset{[\alpha]_D = +52.7°}{\text{Equilibrium mixture}} \rightleftharpoons \underset{[\alpha]_D = +19°}{\beta\text{-D-Glucose}}$$

Where $[\alpha]_D$ = specific rotation

*This change in specific rotation of an optically active compound in solution with time, to an equilibrium value, is called **mutarotation**.* During mutarotation, the ring opens and then recloses either in the inverted position or in the original position giving a mixture of α-and-β-forms. All reducing carbohydrates, i.e., monosaccharides and disacchardies (maltose, lactose etc.) undergo mutarotation in aqueous solution.

3.10 Reactions of Glucose

a) With HI/P: It undergoes reduction to form n-hexane while with sodium amalgam it forms sorbitol.

$$\text{Glucose} \xrightarrow{\text{HI / P}} \underset{\text{n-hexane}}{CH_3 - (CH_2)_4 - CH_3}$$

$$\text{Glucose} \xrightarrow{\text{Na / Hg}} \underset{\text{s-orbitol}}{CH_2OH - (CHOH)_4 - CH_2OH}$$

b) With H_2O: It forms neutral solution

c) With Hydroxylamine (NH_2OH)

$$\text{Glucose} \xrightarrow{NH_2OH} \begin{array}{c} HC=NOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose oxime} \end{array}$$

d) With HCN: It form addition product cyanohydrin

$$\text{Glucose} \xrightarrow{HCN} \begin{array}{c} CN \\ | \\ (CHOH)_5 \\ | \\ CH_2OH \\ \text{Glucose cyanohydrin} \end{array}$$

e) Oxidation: Glucose on oxidation with Br_2 gives gluconic acid which on further oxidation with HNO_3 gives glucaric acid

$$\text{Glucose} \xrightarrow{Br_2/H_2O} \begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Gluconic acid} \end{array} \xrightarrow[\text{Strong oxidation}]{HNO_3} \begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ COOH \\ \text{Glucaric acid} \end{array}$$

f) With Tollen reagent and Fehling solution. Glucose forms silver mirror and red ppt. of Cu_2O respectively.

g) With acetic anhydride. In presence of pyridine glucose forms pentaacetate.

$$\text{Glucose} \xrightarrow[C_5H_5N]{5(CH_3CO)_2O} \begin{array}{c} CHO \\ | \\ (CHOCOCH_3)_4 \\ | \\ CH_2OCOCH_3 \\ \text{Glucose pentaacetate} \end{array}$$

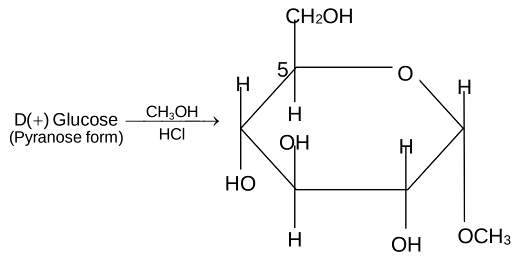
h) With phenylhydrazine: it forms glucosazone

$$\text{Glucose} \xrightarrow[C_5H_5N]{C_6H_5NHNH_2} \begin{array}{c} CH_2OH \\ | \\ (CHOH)_3 \\ | \\ C=NNHC_6H_5 \\ | \\ CH=NNHC_6H_5 \\ \text{(Glucosazone)} \end{array}$$

i) With conc. HCl acid: Glucose gives laevulinic acid

$$\text{Glucose} \xrightarrow{\text{Conc. HCl}} \underset{\text{Laevulinic acid}}{CH_3CO \cdot CH_2CH_2 \cdot COOH} + HCOOH + H_2O$$

j) Glycoside formation: When a small amount of gaseous HCl is passed into a solution of D (+) glucose in methanol , a reaction takes place that results in the formation of amomeric methyl acetals.



Methyl α-D-glucopyranoside
+
Methyl β-D-glucopyranoside

Carbolydrate acetals, genrally are called glycosides and an acetal of glucose is called glucoside.

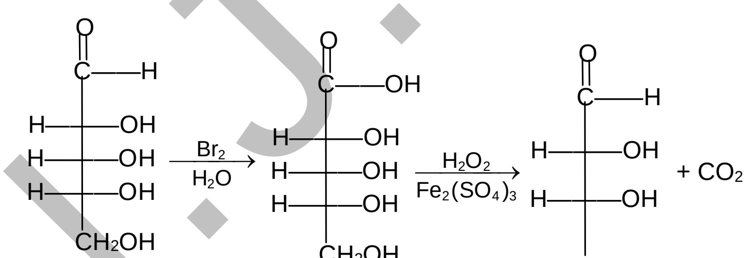
Other reactions

a) *Kiliani - Fischer Synthesis*: - This is a method of lengthening the carbon chain of an aldose. To illustrate, we take synthesis of D-threose and D-erythrose (Aldotetroses) from D-glyceraldehyde (an aldotriose).

Addition to HCN to glyceraldehyde produces two epimeric cyanohydrins because reaction creates a new stereoicenter. The cyanohydrins can be separated easily (since they are diastereomers) and each can be converted to an aldose through hydrolysis, acidification and lactonisation, and reduction with Na—Hg. One cyanohydrin ultimately yields D-erythrose and D-threose.

Here we can see that both sugars are D-sugars because starting compound is D-glyceraldehyde and its stereocentrer is unaffected by its synthesis.

b) *Ruff Degradation:* It is opposite to Kiliani Fischer synthesis that can be used to shorten the chain by a similar unit. The ruff degradation involves (i) Oxidation of the aldose to an aldonic acid using Bromine water. (ii)Oxidative decarboxylation of the aldonic acid to the next lower aldose using H_2O_2 and $Fe_2(SO_4)_3$. D-ribose for example can be reduced to D-erythrose.



D(–) Ribose D–Ribonic acid D(–) -Erythrose

Exercise 1: ***Treatment of (+)– glucose with HIO_4 gives results that confirm its aldohexose structure. What product should be formed, and how much HIO_4 should be consumed.***

8.8 4. Disaccharides

Carbohydrates which upon hydrolysis give two molecules of the same or different monosaccharides are called disaccharides. Their general formula is $C_{12}H_{22}O_{11}$. The three most important disaccharides are sucrose, maltose, and lactose. Each one of these on hydrolysis with either an acid or an enzyme gives two molecules of the same or different monosaccharides as shown below:

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{or Invertase}]{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{or Maltase}]{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Glucose}}{C_6H_{12}O_6}$$

$$\underset{\text{Lactose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{or Lactase}]{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Galactose}}{C_6H_{12}O_6}$$

Disaccharides may also be considered to be formed by a condensation reaction between two molecules of the same or different monosaccharides with the eliminatioin of a molecule of water. This reaction involves the formation of an acetal from a hemiacetal and an alcohol – in which one of the monosaccharides acts as the hemiacetal while the other acts as the alcohol.

4.1 Sucrose

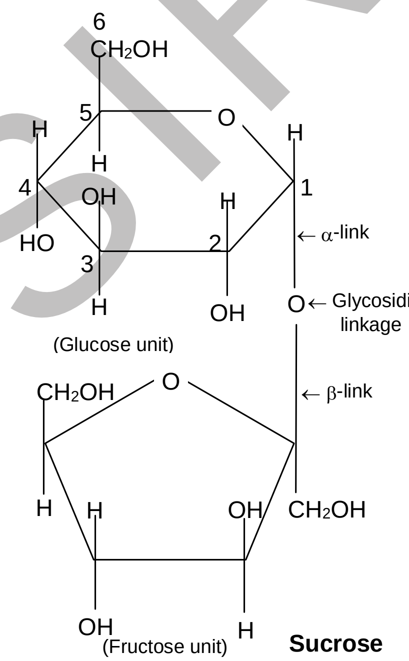
It is formed by condensation of one molecule of glucose and one molecule of fructose. Unlike maltose and lactose, it is non-reducing sugar since both glucose (C_1 - α) and fructose (C_2 - β) are connected to each other through their reducing centres. Its structure is shown below:

***Hydrolysis**:* (Invert Sugar or Invertose). Hydrolysis of sucrose with hot dilute acid yields D-glucose and D-fructose.

$$\underset{\substack{\text{Sucrose} \\ [\alpha]_D = +66.5°}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underbrace{\underset{\substack{\text{D-glucose} \\ [\alpha]_D = +53°}}{C_6H_{12}O_6} + \underset{\substack{\text{D-fructose} \\ [\alpha]_D = -92°}}{C_6H_{12}O_6}}_{\text{Invert Sugar}}$$

$$[\alpha]_D = (+53°) - (-92°) = -39°$$

Sucrose is dextrorotatory, its specific rotation being +66.5%, D-glucose is also dextrorotatory, $[\alpha]_D$ = +53°, but D-fructose has a large negative rotation, $[\alpha]_D$ = -92°. Since D-fructose has a greater specific rotation than D-glucose, the resulting mixture is laevorotatory. Because of this the hydrolysis of sucrose is known as the inversion of sucrose, and the equimolecular mixture of glucose and fructose is known is invert sugar or invertose.



Sucrose

8.9 5. Polysaccharides

Polysaccharides are formed when a large number (hundreds to even thousands) of monosaccharide molecules join together with the elimination of water molecule. Thus, polysaccharides may be regarded as condensation polymers in which the monosaccharides are joined together by glycosidic linkages. Some important polysaccharides are:

1. Cellulose
2. Starch
3. Glycogen
4. Gums and
5. Pectins

8.10 5.1 Starch

It is a polymer of glucose. Its molecular formula is $(C_6H_{10}O_5)_n$ where the value of n (200 – 1000) varies from source to source. It is the chief food reserve material or storage polysaccharide of plants and is found mainly in seeds, roots, tubers, etc. Wheat, rice, potatoes, corn, bananas etc., are rich sources of starch.

Starch is not a single compound but is a mixture of two components – a water soluble component called amylose (20%) and a water insoluble component called amylopectin (80%). Both amylose and amylopectin are polymers of α-D-glucose.

Amylose is a linear polymer of α-D-glucose. It contains about 200 glucose units which are linked to one another through α-linkage involving C_1 of one glucose unit with C_4 of the other as shown below:

$C_1 – C_4 – \alpha$-linkage

(– Glucose – Glucose – Glucose – Glucose –)$_n$

Linear Polymer

Amylopectin, on the other hand, is a highly branched polymer. It consists of a large number (several branches) of short chains each containing 20-25 glucose units which are joined together through α-linkages involving C_1 of one glucose unit with C_4 of the other. The C_1 of terminal glucose unit in each chain is further linked to C_6 of the other glucose unit in the next chain through $C_1 – C_6$ α-linkage. This gives amylopectin a highly branched structure as shown below.-

C_1 — C_4 α-linkage

Glucose — Glucose — Glucose

← C_1 — C_6 α-linkage

Glucose — Glucose — Glucose

← C_1 — C_6 α-linkage

Glucose — Glucose — Glucose

Hydrolysis: Hydrolysis of starch with hot dilute acids or by enzymes gives dextrins of varying complexity, maltose and finally D-glucose. Starch does not reduce Tollen's reagent and Fehling's solution.

Uses: It is used as a food. It is encountered daily in the form of potatoes, bread, cakes, rice etc. It is used in coating and sizing paper to improve the writing qualities. Starch is used to treat textile fibres before they are woven into cloth so that they can be woven without breaking. It is used in manufacture of dextrins, glucose and ethyl alcohol. Starch is also used in manufacture of starch nitrate, which is used as an explosive.

8.11 6. Amino Acids

6.1 Introduction and Nomenclature

Amino acids are molecules, which contain two functional groups, one is carboxylic group and another is amino group. Amino acids are derivatives of carboxylic acids in which one hydrogen atom of carbon chain is substituted by Amino group.

Amino group may be at α, β, γ position with respect to carboxylic group

$H_2N — CH_2 — COOH$ Amino acetic acid, or Glycine

$CH_3 — CH\ (NH_2) — COOH$ α - Amino propionic acid or Alanine

$H_2N — CH_2 — CH_2 — COOH$ β - Amino propionic acid

$H_2N — CH_2 — (CH_2)_2 — COOH$ γ - Amino butyric acid

Some amino acids contain a second carboxyl group or a potential carboxyl group in the form of carboxamide: these are called ***acidic amino acid*** some contain a second basic group which may be an amino group these are called ***basic amino acids***.

$$\underset{\text{Aspartic acid (Acidic amino acid)}}{HOOC-CH_2-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH} \qquad \underset{\text{Lysine (Basic amino acid)}}{H_2N-CH_2-CH_2-CH_2-CH_2-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH}$$

6.2 Physical Properties and Structure

Although the amino acids are commonly shown as containing an amino group and a carboxyl group, certain properties are not consistent with this structure.

1. In contrast to amines and carboxylic acids, the amino acids are nonvolatile solids, which melt at fairly high temperatures.
2. They are insoluble in organic solvents [i.e. non polar solvents] and are highly soluble in water.
3. Their aqueous solution is neutral.
4. Their aqueous solutions behave like solutions of substances of high dipole moment.
5. Acidity and basicity constants are ridiculously low for - COOH and – NH_2 groups

All these properties are quite consistent with a dipolar ion structure for the amino acids (I)

$$^{+}H_3N-CHR-COO^{-}$$

(I)

Amino acid : dipolar ions

In the physical properties melting points, solubility, and high dipole moment are just what would be expected of such a salt.

The acid base properties also become understandable when it is realized that the measured Ka actually refers to the acidity of an ammonium ion, RNH_3^+

$$^{+}H_3NCHRCOO^{-} + H_2O \rightleftharpoons H_3O^{+} + H_2NCHRCOO^{-}$$

$$K_a = \frac{[H_3O^+][H_2NCHRCOO^-]}{[^+H_3N-CH-RCOO^-]}$$

and K_b actually refers to the basicity of a carboxylate ion, $RCOO^-$

$$^{+}H_3N-CH-RCOO^{-} + H_2O \rightleftharpoons {}^{+}H_3N-CHR-COOH + OH^{-}$$

$$K_b = \frac{[^+H_3N-CHR-COOH][OH^-]}{[^+H_3NCHRCOO^-]}$$

When the solution of an amino acid is made alkaline, the dipolar ion(I) is converted to the anion (II); the stronger base, hydroxide ion, removes a proton from the ammonium ion and displaces the weaker base, the amine

$$^{+}H_3N — CHRCOO^{-} + OH^{-} \rightleftharpoons H_2N\ CHRCOO^{-} + H_2O$$

(I)		(II)	
Stronger acid	Stronger base	Weaker base	Weaker acid

When the solution of an amino acid is made acidic; the dipolar ion I is converted into the cation (III); the stronger acid H_3^+O, gives up a proton to the carboxylate ion, and displaces the weaker carboxylic acid.

$$^{+}H_3N\ \ CHRCOO^{-} + H_3O^{+} \rightleftharpoons {}^{+}H_3N\ CHRCOOH + H_2O$$

(I)		(III)	
Stronger base	Stronger acid	Weaker acid	Weaker base

In summary, the acidic group of a simple amino acid like glycine is $-NH_3^+$ not –COOH, and basic group is –COO$^-$ not –NH$_2$.

Exercise 2: The amino acids in water acts as ampholyte. Explain?

6.3 Iso Electric Point

What happens when a solution of an amino acid is placed in an electric field depends upon the acidity or basicity of solution. In quite alkaline solution.

$$\underset{(II)}{H_2N\text{-}CHRCOO^{-}} \underset{OH^{-}}{\overset{H^{+}}{\rightleftharpoons}} \underset{(I)}{{}^{+}H_3N.CHRCOO^{-}} \underset{OH^{-}}{\overset{H^{+}}{\rightleftharpoons}} \underset{(III)}{{}^{+}H_3N.CHRCOOH}$$

Anions (II) exceed cations (III), and there is a net migration of amino acid toward the anode. In quite acidic solution cations (III) are in excess, and there is a net migration of amino acid towards the cathode. If (II) and (III) are exactly balanced, there is no net migration; under such conditions any one molecule exists as a positive ion and as a negative ion for exactly the same amount of time and any small movement in the direction of one electrode is subsequently cancelled by an equal movement back towards the other electrode. The hydrogen ion concentration of the solution in which a particular amino acid does not migrate under the influence of an electric field is called the ***isoelectric point*** of that amino acid.

An amino acid shows its lowest solubility in a solution at the isoelectric point, since here there is the highest concentration of the dipolar ion. As the solution is made more alkaline or more acidic, the concentration of one of the more soluble ions, II or III increases.

If an amino acid has amino group and one carboxyl group, it has two pK values. The isoelectric point (PI) of this amino acid has the average value of the both pK values.

We take example of glycine.

$$\underset{\text{Conjugated acid (CA)}}{H_3{}^{+}N — CH_2 — COOH} \rightleftharpoons \underset{\text{Dipolar Ion (DI)}}{H_3N^{+} — CH_2 — COO^{-}} + H^{+} \qquad \ldots(1)$$

At equilibrium $K_1 = \dfrac{[DI][H^+]}{[CA]}$

$$\underset{\text{DI}}{H_3N^{+} — CH_2 — COO^{-}} \rightleftharpoons \underset{\text{Conjugated Base (CB)}}{H_2N — CH_2 — COO^{-}} + H^{+} \qquad \ldots(2)$$

At equilibrium $K_2 = \dfrac{[CB][H^+]}{[DI]}$

$$[CA] = \frac{[DI][H^+]}{K_1}$$

$$[CB] = \frac{K_2[DI]}{[H^+]}$$

At isoelectric point [CA] = [CB]

$$\frac{[DI][H_i^+]}{K_1} = \frac{K_2[DI]}{[H_i^+]}$$ Where $[H_i^+]$ = conc. of $[H^+]$ at isoelectric point.

or, $[H_i^+]^2 = K_1 K_2$

or, $2\log [H_i^+] = \log K_1 + \log K_2$

or $-2 \log (H_i^+] = -\log k_1 - \log K_2$

or $2pH_i = pK_1 + pK_2$

or $pH_i = \dfrac{pK_1 + pK_2}{2}$

8.12 7. Peptides

As the amino acid molecules contain both basic as well as acidic group it might be expected that an intermolecular reaction may take place between the carboxyl group of one amino acid and the amino group of another amino acid, with the elimination of a molecule of water.

$$H_2N-\underset{\displaystyle |}{\overset{\displaystyle R}{CH}}-COOH + H_2N-\overset{\displaystyle R'}{\underset{}{CH}}-COOH \longrightarrow H_2N-\overset{\displaystyle R}{CH}CO-NH-\overset{\displaystyle R'}{CH}COOH$$

Since the resulting molecule still has a free amino and a carboxyl group, it may react with other amino acids at either of the ends to give a higher molecular weight linear or condensation product. Every two amino acids are linked by means of a –CO-NH group, which is commonly referred as ***peptide bond***. So now we can define ***a peptides as the amides formed by interaction between amino groups and carboxyl groups of amino acids.***

Depending upon the number of amino acid residues per molecule, they are known as dipeptides, tripeptides and so on and finally polypeptides.

8.13 7.1 Naming of Polypeptide

A convenient way of representing peptide structures by use of standard abbreviations. According to convention the N-terminal amino acid residue [having the free amino group] is written as the left and the C terminal amino acid residue (having the free carboxyl group) at the right end.

A peptide is named by indicating its sequence of amino acids beginning with the N-terminal residue.

$$H_2N-\underset{CH_3}{CH}-CONH-\underset{CH_2\text{-}OH}{CH}-CONH-\underset{CH_2\text{-}C_6H_5}{CH}-CONH-\underset{CH_2\text{-}CONH_2}{CH}-CONHCH_2\,COOH$$

Alanine Serine Phenylalamine Asparagine glycine

This pentapeptide is called alanyl-sery-phenylalanyl-asparaginyl-glycine or using the common abbreviations as H-Ala-Ser-phe-Asn-gly-OH. All naturally occurring important peptides, however, posses a shorter individual name.

7.2 Structure of Poly peptides

To identify the structure of a peptide, the peptide in question is first hydrolysed to its constituent amino acids, which are separated and identified. The amount of each amino acid is measured, and hence the number of each kind of amino acid can be calculated.

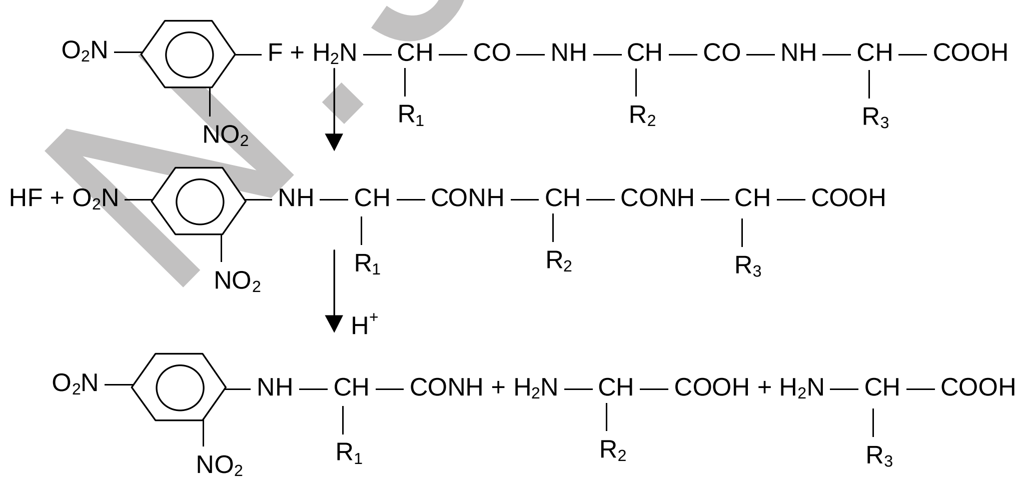
The next problem is to determine the sequence of the various amino acids constituting the peptide. This is very difficult task, because there is a large number of possibilities in which the constituent amino acids may be linked in the peptide, e.g. even is a dipeptide, having glycine and alanine, the two amino-acids may be present in either of the two ways.

$$\underset{\text{Glycylalanine}}{H_2N - CH_2 - CO - NH - \overset{\overset{\large CH_3}{|}}{CH} - COOH} \qquad \underset{\text{Alanylaglycine}}{H_2N - \overset{\overset{\large CH_3}{|}}{CH} - CO - NH - CH_2 - COOH}$$

The two structures differ in the respect that in the first the N-terminal amino acid is glycine (i.e. the amino group of glycine is free) and C-terminal amino acid is alanine, while in the latter the N-terminal amino acid is alanine and C-terminal acid is glycine. Various chemical methods have been developed to remove either of the two terminal amino acid residues of a polypeptide in a stepwise manner and hence the arrangement of the various amino acids in a polypeptide can be established.

7.3 Sanger's Method

Sanger reagent, 1-fluoro-2, 4-dinitrobenzene (FDNB) was first used to determine that which amino acid constituted the amino end of the polypeptide. The method consists in treating the polypeptide with the reagent in the presence of sodium-hydrogen-carbonate solution at room temperature to form a 2, 4-dinitrophenyl (DNP) derivative of the polypeptide. The product is hydrolysed be means of acid (which causes the cleavage of the peptide bond connecting the N-terminal amino acid to the rest of the polypeptide molecule) to form dinitrophenyl (DNP) derivative of the N-terminal amino acid and the rest of the polypeptide molecule or amino acid residues.



2, 4 – DNP derivative　　　　Aminoacid mixture

8.14 8. Dyes

8.1 Definition

The chemical substances which are used to impart colour to fabrics, foods and other objects for their beautification and distinction are called dyes.

These chemical substances used as dyes are capable of getting fixed to the fabrics permanently and are resistant to the action of water, soap, light, acid and alkalies.

The colour of dyes is attributed to their ability to absorb some wavelengths of visible region of electromagnetic spectrum (380 nm to 760 nm). The part of the colour which reflected back gives the colour of the dye i.e. complementary to the colour absorbed. The colour of visible light absorbed and the complementary colour reflected are listed in table.

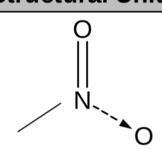
Wave length (nm)	Colour absorbed	Complementary colour
400 – 435	Violet	Yellow, Green
435 – 480	Blue	Yellow
480 – 490	Greenish Blue	Orange
490 – 500	Bluish Green	Red
500 – 560	Green	Purple
560 – 580	Yellowish Green	Violet
580 – 595	Yellow	Blue
595 – 605	Orange	Greenish Blue
605 – 750	Red	Blue, Green

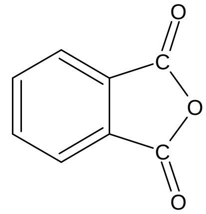
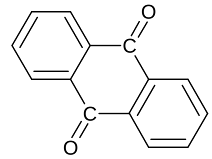
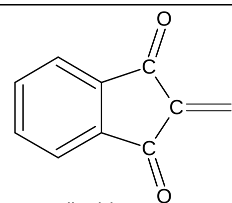
In the earlier days fabrics were coloured by the dyes mainly from Alizarin (red dye) and indigo (blue dye). But now a days, many natural dyes have been synthesized in the laboratory. This helped us to produce dyes of desired shades which otherwise are not available in natural dyes.

8.2 Classification

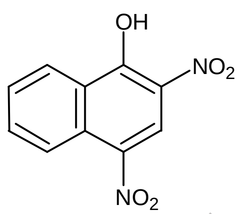
These dyes have been classified into two categories

a) ***Classification based on constitution:*** Depending upon the characteristic structural units the dyes are classified as follows.

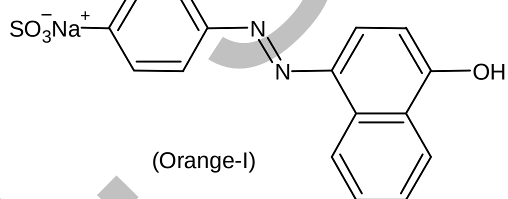
Sl. No.	Type of Dye	Structural Unit	Examples
1.	Nitro dyes	 (Nitro group)	Martius yellow, Naphthol yellow
2.	Azo dyes	– N = N – (azo group)	Orange-I, Orange-II, Congo red
3.	Triphenyl methane dyes	$(C_6H_5)_3C$ –	Malachite green, Rosaniline

4.	Phthalein dyes	 (Phthalein group)	Phenolphthalein, Mercurochrome
5.	Anthraquinone dyes	 (anthraquinone group)	Alizarin
6.	Indigoid dyes	 Indigoid group	Indigo, Tyrian purple

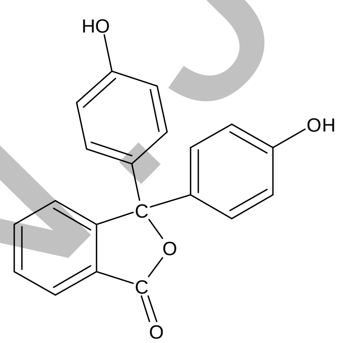
Structures



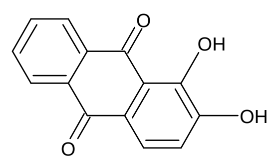
(Martius yellow)



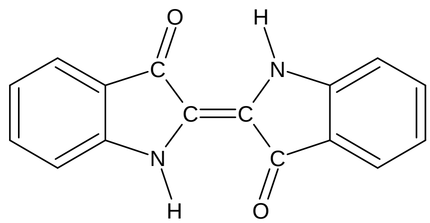
(Orange-I)



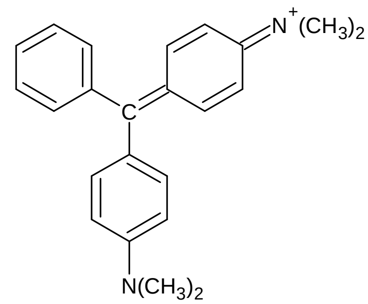
(Phenolphthalein)



(Alizarine)

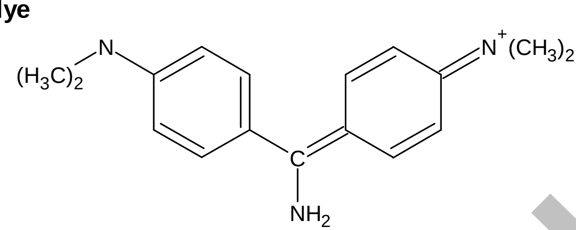


(Indigo)



(Malachite green)

Diphenyl methane dye



Auromine – 0

8.3 Classification Based on Application

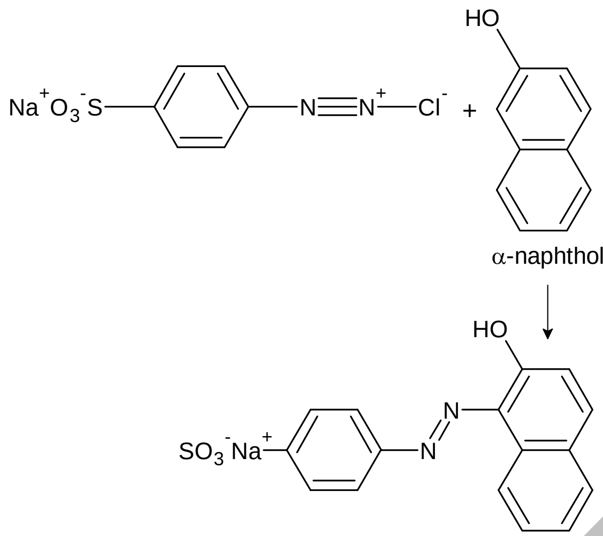
A particular dye may be suitable for one kind of fibre and may be unsuitable for the other. For example, a dye suitable for wool and silk may not be applied or used for dyeing cotton or rayon. Thus based on the class, shade and other properties like resistance to acids, alkalies, and fastness to light a classification of dyes is done, as given below:

a) Acid dyes	b) Basic dyes
c) Direct dyes	d) Disperse dyes
e) Fibre reactive dyes	f) Vat dyes
g) Insoluble azodyes	h) Mordant dyes

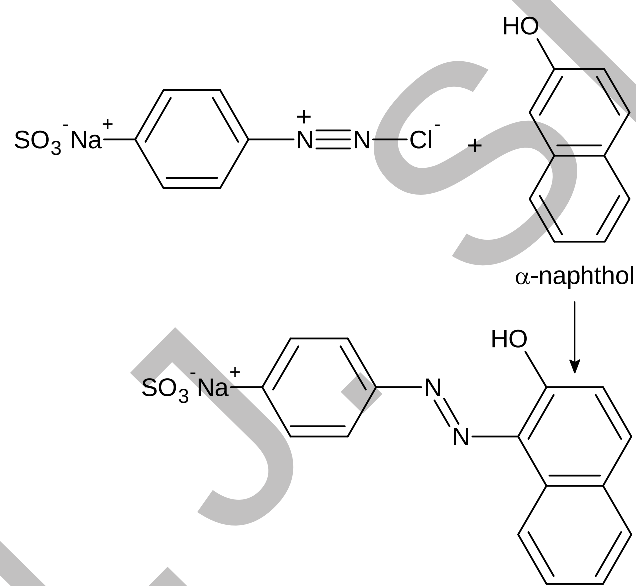
a) ***Acid dyes:*** These dyes are characterised by the presence of acid group like sulphonic acid (– SO_3H), carboxylic acid (– COOH) and phenolic group. The presence of such groups make the dyes more soluble and also serve as the reactive points for fixing the dye to the fibre.

Application: These dyes are applied to wool, silk and nylon. These have no affinity for cotton.

Examples: Orange-I and Orange-II can be obtained by the action of sulphonic compounds with naphthols or by coupling sulphonic compounds with naphthols.



Orange-I



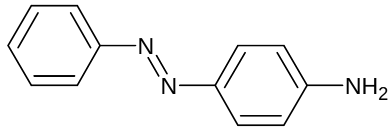
Orange-II

b) ***Basic Dyes:*** These dyes contain (–NH_2) group or (–NR_2) group as chromophore (colour bearing group) or auxochrome (colour enhancing group). In acidic solutions these form water soluble cations. These dyes use the anionic side on the fabric to get themselves attached.

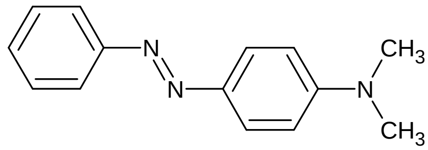
Application: This type of dyes is used to dye nylon, polyester, wool, cotton, leather, paper, etc.

Example

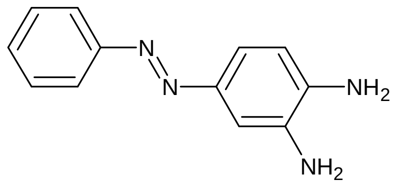
1. Aniline yellow



2. Butter yellow



3. Crysodine G

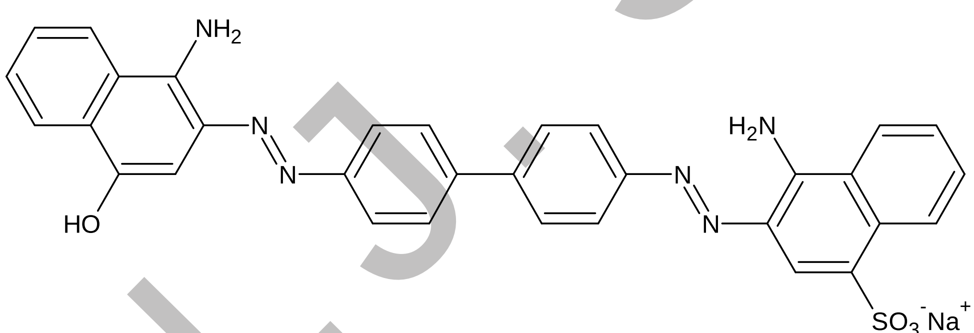


c) **Direct Dyes:** These dyes also belong to the class of azo dyes and are used to dye the fabrics directly by placing it in aqueous solution of the dye. The direct dyes attack the fibre by means of hydrogen bonding.

Application: These are very effective for dying cotton, wool and rayon

Example:

1. Martius yellow
2. Congo Red

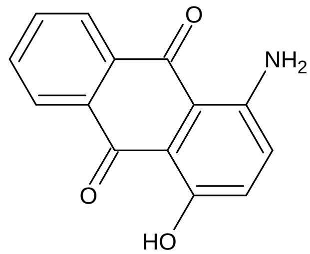


c) ***Disperse Dyes:*** These dyes, as the name signifies, are usually applied in the form of a dispersion of finely divided dye in a soap solution in the presence of phenol, cresol or benzoic acid.

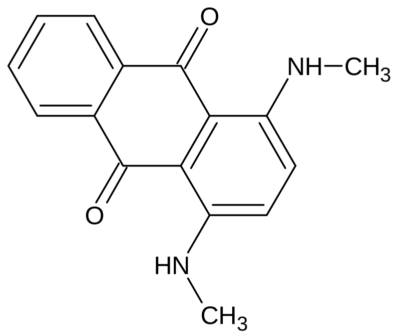
Application*:* These are mainly used to dye rayon, dacron nylon, synthetic fibres, polysters and poly acrylonitrile.

Examples*:*

1. Celliton fast pink B



2. Cellition fast blue B

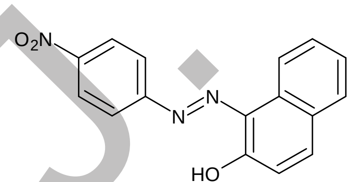


d) **Fibre Reactive Dyes:** These dyes are used to dye fibres like cotton, wool or silk. These are linked to the fibre by virtue of the hydroxy or amino group present on the fibre. These dyes induce fast colour on fibres which is retained for a longer time.

e) ***Insoluble azo dyes:*** The dyes belonging to this class are directly synthesised on the fibre. The fabric to be coloured is soaked in an alkaline solution of phenol or naphthol and is than treated with a solution of diazotised amine to produced the azo dye on the surface of the fabric.

Application: These dyes can be used to dye cotton silk, polyester, nylon, etc.

Example:



(Nitroaniline red)

f) ***Vat Dyes:*** Before being introduced on to fabric these dyes are first reduced to colourless leuco compounds in wooden vats by alkaline reducing agent. The fibre is then soaked in the solution of the dye. After proper absorption of the dye, the fibre is then exposed to air or to an oxidising agent. By doing so the dye gets oxidised to yield insoluble coloured dye on the fabric.

Example: Indigo dye

g) ***Mordant Dyes:*** A dye which imparts different colours to the fabric in the presence of different metal ions (called mordants) is referred to as mordant dye. Nowadays it is rarely used

Application: These dyes are used for dyeing of wool. The method involves the precipitation of certain substances on the fabrics which then combine with the dye with the dye to form an insoluble coloured complex called lake. Depending on the kind of mordant used different colours. For example, Alizarin, a mordant dye, gives red colour with aluminium and tin salts, where as brownish red colour chromium mordant and black violet with iron mordant.

8.15 9. Polymers

9.1 Introduction

Sit quietly and think about your activities today from the morning. You wake up in the morning, You want to brush your teeth. You fetch your toothpaste. The tube is made up of a polymer. Your brush is made up of a polymer. When you want to rinse your mouth, you open your plastic(polymer) tap. The pipe lines used to bring water to your tap is made of PVC(polymer). Skip it. You start preparing your break fast. You take a non-stick tawa. Non-stick? What does that mean? What is it made of? It is poly tetrafluoro ethylene abbreviated as teflon, a polymer. See, how polymers play an important role in our daily life from dawn to dusk. The molded chair in which you are sitting is a polymer. The pen with which I'm writing this is a polymer. Want to know more about polymers? Read further.

Polymers can be called as macromolecules. Macromolecules can be considered as an association of small molecules to give a big molecule. Macromolecules can be man-made, too. The first syntheses were aimed at making substitutes for the natural macromolecules, rubber and silk; but a vast technology has grown up that now produces hundreds of substances that have no natural counterparts. Synthetic macromolecular compounds include: **elastomers,** which have the particular kind of elasticity characteristic of rubber; **fibers**, long, thin and threadlike, with the great strength along the fiber that characterizes cotton, wool, and silk; and **plastics,** which can be extruded as sheets or pipes, painted on surfaces, or molded to form countless objects. We wear these manmade materials, eat and drink from them, sleep between them, sit and stand on them; turn knobs, pull switches, and grasp handles made of them; with their help we hear sounds and see sights remote from us in time and space; we live in houses and move about in vehicles that are increasingly made of them.

8.16 9.2 Polymers and polymerization

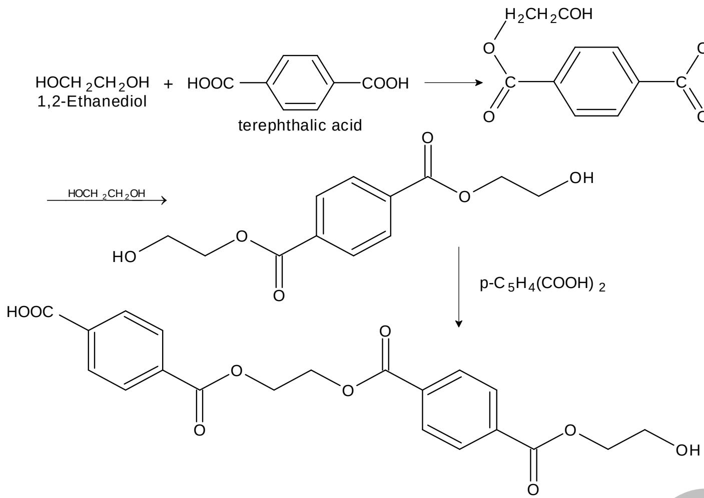
Macromolecules, both natural and man-made, owe their great size to the fact that they are polymers (Greek: many parts); that is, each one is made up of a great many simpler units — identical to each other or at least chemically similar — joined together in a regular way. They are formed by a process we touched on earlier: **polymerization**, the joining together of many small molecules to form very large molecules. The simple compounds from which polymers are made are called monomers.

Polymers are formed in two general ways.

a) ***In chain-reaction polymerization,*** there is a series of reactions each of which consumes a reactive particle and produces another, similar particle; each individual reaction thus depends upon the previous one. The reactive particles can be free radicals, cations, or anions. A typical example is the polymerization of ethylene. Here the chain-carrying particles are free radicals, each of which adds to a monomer molecule to form a new, bigger free radical.

$$\text{Rad.} + CH_2 = CH_2 \longrightarrow \text{Rad}CH_2CH_2\cdot \xrightarrow{CH_2=CH_2} \text{Rad}CH_2CH_2CH_2CH_2\cdot \longrightarrow \text{etc.}$$

b) ***In step reaction polymerization, t***here is a series of reactions each of which is essentially independent of the preceding one; a polymer is formed simply because the monomer happens to undergo reaction at more than one functional group. A diol, for example, reacts with a dicarboxylic acid to form an ester; but each moiety of the simple ester still contains a group that can react to generate another ester linkage and hence a larger molecule, which itself can react further, and so on.



8.17 **a) Free-radical vinyl polymerization:** In we discussed briefly the polymerization of ethylene and substituted ethylenes under conditions where free radicals are generated — typically in the presence of small amounts of an initiator, such as a peroxide. Reaction occurs.

$$\underset{\text{Vinyl monomer}}{nCH_2=\underset{\substack{|\\ G}}{CH}} \xrightarrow{\text{initiator}} -CH_2\underset{\substack{|\\ G}}{CH}CH_2\underset{\substack{|\\ G}}{CH}CH_2\underset{\substack{|\\ G}}{CH}CH_2\underset{\substack{|\\ G}}{CH}- \quad \text{or } \underset{\text{Polymer}}{(-CH_2\underset{\substack{|\\ G}}{CH}-)_n}$$

At the doubly bonded carbons — the vinyl groups — and is called *vinyl polymerization*. A wide variety of unsaturated monomers may be used, to yield polymers with different *pendant groups* (G) attached to the polymer backbone. For example.

$$\underset{\text{Vinyl chloride}}{CH_2=\underset{\substack{|\\ Cl}}{CH}} \longrightarrow \underset{\text{Poly (vinyl chloride) (PVC)}}{-CH_2-\underset{\substack{|\\ Cl}}{CH}-CH_2-\underset{\substack{|\\ Cl}}{CH}-CH_2-\underset{\substack{|\\ Cl}}{CH}-}$$

$$\underset{\text{Acrylonitrile}}{CH_2=\underset{\substack{|\\ CN}}{CH}} \longrightarrow \underset{\text{Polyacrylonitrile (Orlon)}}{CH_2-\underset{\substack{|\\ CN}}{CH}-CH_2-\underset{\substack{|\\ CN}}{CH}-CH_2-\underset{\substack{|\\ CN}}{CH}-CH_2-\underset{\substack{|\\ CN}}{CH}-}$$

$$\underset{\text{Styrene}}{CH_2=\underset{\substack{|\\ C_6H_5}}{CH}} \longrightarrow \underset{\text{Polystyrene}}{CH_2-\underset{\substack{|\\ C_6H_5}}{CH}-CH_2-\underset{\substack{|\\ C_6H_5}}{CH}-CH_2-\underset{\substack{|\\ C_6H_5}}{CH}-}$$

b) Copolymerization: So far, we have discussed only polymerisation of a single monomeric compound to form a *homopolymer,* a polymer made up — except, of course, at the two ends of the long molecule — of identical units.

Now, if a mixture of two (or more) monomers is allowed to undergo polymerization, there is obtained a **copolymer** a polymer that contains two (or more) kinds of monomeric units in the same molecule. For example:

$$\underset{\text{Styrene}}{\underset{\substack{|\\ Ph}}{CH_2 = CH}} + \underset{\text{Methyl methacrylate}}{\overset{\substack{CH_3\\ |}}{\underset{\substack{|\\ COOCH_3}}{CH_2 = C}}} \xrightarrow{\text{initiator}} \underset{\text{Polystyrene (co-methyl methacrylate)}}{– CH_2 – \underset{\substack{|\\ Ph}}{CH} – CH_2 – \overset{\substack{CH_3\\ |}}{\underset{\substack{|\\ COOCH_3}}{C}} –}$$

Through copolymerization there can be made materials with different properties than those of either homopolymer, and thus another dimension is added to the technology. Consider, for example, styrene. Polymerized alone, it gives a good electric insulator that is molded into parts for radios, television sets, and automobiles. Copolymerization with butadiene (30%) adds toughness; with acrylonitrile (20-30%) increases resistance to impact and to hydrocarbon; with maleic anhyride yeilds a material that, on hydrolysis, is water-soluble, and is used as a dispersant and sizing agent. The copolymer in which butadiene predominates (75%) butadiene, 25% styrene) is an elastomer, and since World War II has been the principal rubber substitute manufactured in the United States.

Copolymers can be made not just from two different monomers but from three, four, or even more. They can be made not only by free-radical chain reactions, but by any of the polymerization methods we shall take up; ionic, coordination, or step-reaction. The monomer units may be distributed in various ways, depending on the technique used. As we have seen, they may alternate along a chain, either randomly or with varying degrees of regularity. In block copolymers sections made up of one monomer alternate with sections of another:

$$— M_1M_1M_1M_1M_1 – M_2M_2M_2M_2 — \qquad \text{Block copolymer}$$

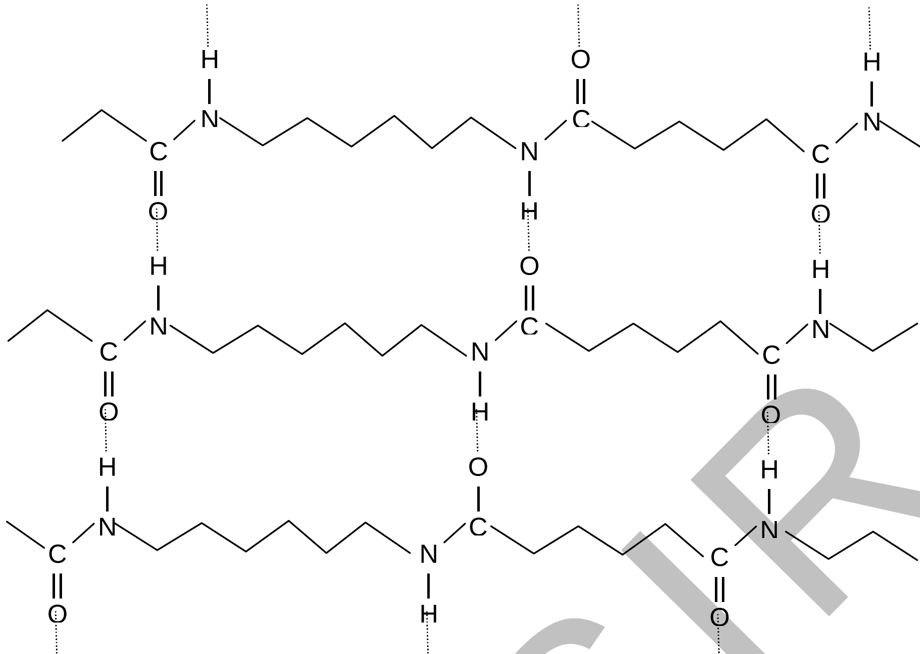
If graft copolymers, a branch of one kind is grafted to a chain of another kind:

$$\begin{array}{l} — M_1M_1M_1M_1M_1M_1M_1 — \\ \quad\; | \\ \quad M_2M_2M_2M_2 \end{array}$$

Fibres are long thin, threadlike bits of material that are characterized by great tensile (pulling) strength in the direction of the fiber. The natural fibres – cotton, wool, silk – are typical. Fibres are twisted into threads, which can then be woven into cloth, or embedded in plastic material to impart strength. The tensile strength can be enormous, some synthetic fibres rivaling – on a weight basis – steel.

The gross characteristics of fibres are reflected on the molecular level – the molecules, too, are long, thin, and threadlike. Furthermore, and most essential, they lie stretched out alongside each other, lined up in the direction of the fiber. The strength of the fiber resides, ultimately, in the strength of the chemical bonds of the polymer chains. The lining-up is brought about by drawing – stretching — the return to random looping and coiling is overcome by strong intermolecular attractions. In a fiber, enthalpy wins out over entropy. This high degree of molecular orientation is usually — although not always — accompanied by appreciable crystallinity.

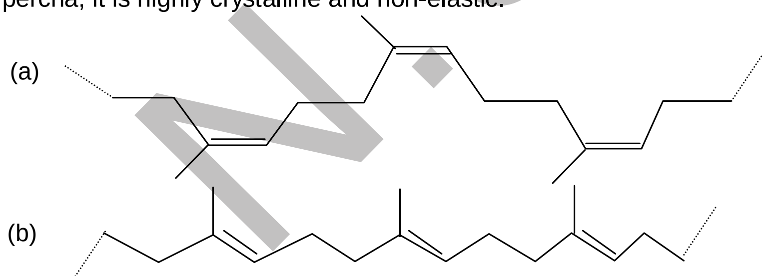
An **elastomer** possesses the high degree of elasticity that is characteristic of rubber: it can be greatly deformed — stretched to eight times its original length, for example — and yet return to its original shape. Here, as in fibres, the molecules are long and thin; as in fibres, they become lined up when the material is stretched. The big difference is this: when the stretching force is removed, the molecular chains of an elastomer do not remain extended and aligned but return to their original random conformations favored by entropy. They do not remain aligned because the intermolecular forces necessary to hold them that way are weaker than in a fiber. In general, elastomers do not contain highly polar groups or sites for hydrogen bonding; the extended chains do not fit together well enough for Vander Waals forces to do the job. In an elastomer entropy beats enthalpy.



Hydrogen bonding in crystallites of nylon-6,6

One further requirement the long chains of an elastomer must be connected to each other by occasional cross – links: enough of them to prevent slipping of molecules past one another; not so many as to deprive the chains of the flexibility that is need for ready extension and return to randomness.

Natural rubber illustrates these structural requirements of an elastomer; long flexible chains; weak intermoecular forces and occasional cross – linking. Rubber is cis 1,4-polyisoprene . With no highly polar substituents, intermolecular attraction is largely limited to van der Waals forces. But these are weak because of the all – cis configuration about the double bond. Figure below compares the extended chains of rubber with those of its trans stereoisomer. As we can see, the trans configuration permits highly regular zig – zags that fit together well; the cis configuration does not. The all-trans stereoisomer occurs naturally as gutta percha; it is highly crystalline and non-elastic.



Extended chains of (a) natural rubber, cis-1,4 –polyisoprene, and of (b) gutta percha, its trans stereoiosmer.

Chief among the synthetic elastomers is SBR, a copolymer of butadiene (75%) and styrene (25%) produced under free-radical conditions; it competes with natural rubber in the main use of elastomers, the making of automobile tires. All-cis polybutadiene and polyisoprene can be made by Ziegler – Natta polymerization.

An elastomer that is entirely or mostly polydiene is, of course, highly unsaturated. All that is required of an elastomer, however, is enough unsaturation to permit cross-linking. In making butyl rubber for example, only 5% of isoprene is copolymerized with isobutylene.

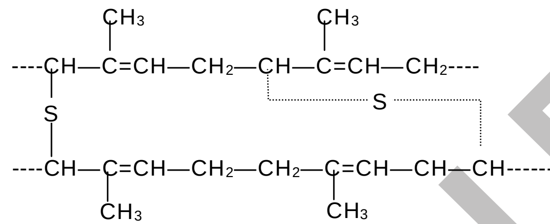
Exercise 3: ***What is the difference between addition and condensation polymersiation give an examples.***

Some Important Polymers:

a) *Natural Rubber:* Natural rubber is an addition polymer of isoprene (2-methyl-1,3-butadiene)

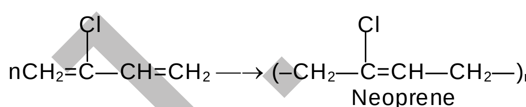
Rubber has an average chain length of 5000 monomer units of isoprene.

The rubber in which the arrangement of carbon chain is trans with respect to the double bond is known as ***Gutta Percha*** and this is the natural rubber obtained from bark of various trees. Natural rubber is sticky material. This disadvantage is removed by 'VULCANISATION' which involves addition of sulphur to rubber and heating the mixture. sulphur forms short chains of sulphur atoms that link two hydrocarbon (isoprene) units together.



When tension is applied the chains can strengthen out but they cannot slip past each other because of sulphur bridges. Thus rubber can be stretched only to a certain extent and hydrocarbon chains have the tendency to regain their shape when tension is removed. Vulcanised rubber is thus stronger and less sticky than the natural rubber.

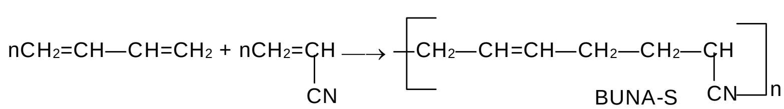
b) *Synthetic rubber*: (Polychloroprene) or Neoprene) It is obtained by free radical polymerisation of chloroprene in



it is a thermoplastic and need not to be vulcanised. It is a good general purpose rubber and superior to natural rubber as it is resistant to the reaction of aire, heat, light chemicals, alkalis and acids below 50% strength. It is used for making transmission belts, printing rolls and flexible tubing employed for conveyence of oil and petrol.

c) *Buna rubbers*: Butadiene polymerises in the presence of sodium to give a rubber substitute viz. BuNa. It is of two types

i) Buna - N or GRA: it is synthetic rubber obtained by copolymerisation of one part of acryl nitrile and two parts of butadiene.



It is more rigid responds less to heat and very resistant to swelling action of petorol, oils and other organic solvents.

ii) Buna -S or GRS (General purpose Styrene rubber): It is a copolymer of three moles of butadiene and one mole of styrene\ and is an elastomer. It is obtained as a result of free radical copolymerisation of its monomers.

$$nC_6H_5CH{=}CH_2 + nCH_2{=}CH{-}CH{=}CH_2 \rightarrow [-CH_2-CH{=}CH-CH_2-\underset{\substack{|\\ C_6H_5}}{CH}-CH_2-]_n$$

BUNA-S

It is generally compounded with carbon black and vulcanised with sulphur. It is extremely resistant to wear and tear and finds use in manufacture of tyres and other mechanical rubber goods.

d) Teflon: It is polymer of tetrafluorethylene ($F_2C{=}CF_2$) which on polymerisation gives Telfon.

$$nCF_2{=}CF_2 \xrightarrow{(NH_4)_2S_2O_8 \;\; 870-1020K} (-CF_2-CF_2-)_n$$

It is thermoplastic polymer with a high softening point (600K). It is very tough and difficult to work. It is inert to most chemicals except fluorine and molten alkali metals. It withstands high temperatures. Its electrical properties make it an ideal insulating material for high frequency installation.

e) Nylon -66: It is a polymer resin. It is a condensation polymer formed by reaction between adipic acid and hexamethylene diamine. Both monomer units consist of 6 carbon atoms and therefore named nylon -66.

$$HO-\overset{\overset{\displaystyle O}{\|}}{C}-(CH_2)_4-\overset{\overset{\displaystyle O}{\|}}{C}-OH + H-\overset{\overset{\displaystyle H}{|}}{N}-(CH_2)_6-NH_2 \xrightarrow{-H_2O}$$

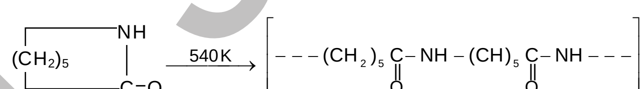
$$\left[--\overset{\overset{\displaystyle O}{\|}}{C}-(CH_2)_4-\overset{\overset{\displaystyle O}{\|}}{C}-\overset{\overset{\displaystyle H}{|}}{N}-(CH_2)_6-NH---\right]$$

Nylon – 66

(A condensation copolymer)

It is thermoplastic polymer when extruded above its melting point (536 K) through spinneret, it gives nylon fiber which is extremely tough and resistant to friction. It possess greater tensile strength, elasticity and lusture than any natural fiber. It is chemically inert and is fabricated into sheet, bristles and textile fibres.

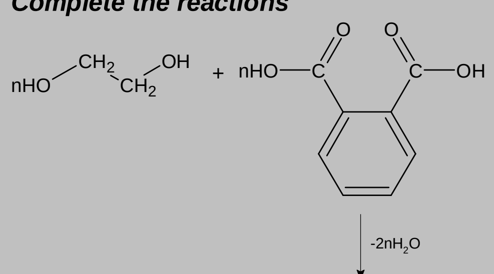
f) Nylon 6 or Perolon - L: A polyamide is prepared by prolonged heating of caprolactam at 530 - 540 K.



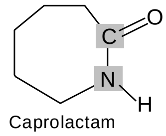
Nylon – 6

The fiber is practically identical to Nylon in properties

Exercise 4: ***Complete the reactions***



Exercise 5: ***a) What is the structure of nylon-6, made by alkaline polymerisation of caprolactom?***



Caprolactam

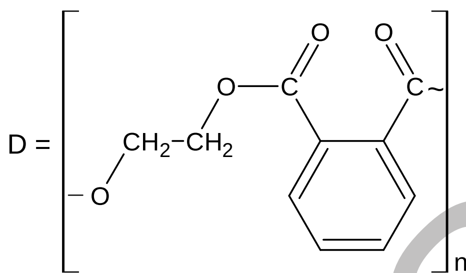
b) Suggest a mechanism for the process. Is polymerisation of the chain reaction or step reaction type?

8. Solutions to Exercise

Exercise 1: Since in glucose there are five –OH groups so five moles of HIO_4 are consumed giving main product formic acid and formaldehyde as shown below :

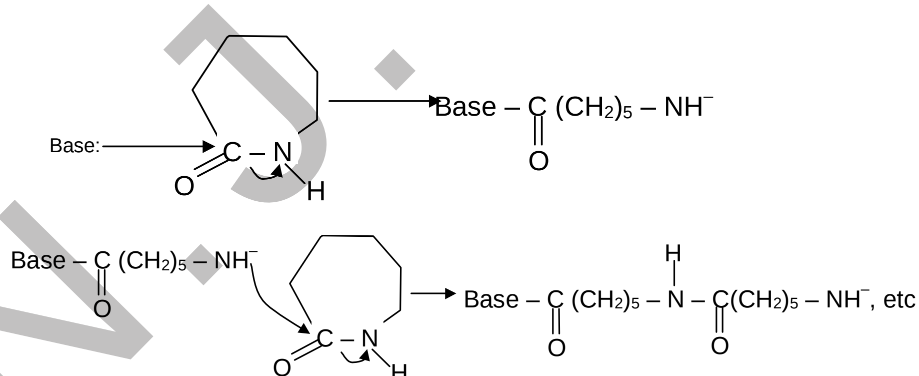
$$\text{Glucose} + 5HIO_4 \longrightarrow 5HCOOH + HCHO$$

Exercise 4:



Exercise 5: a) $\sim\sim \underset{\text{H}}{\text{N}}(CH_2)_5\underset{\text{O}}{\text{C}}-\underset{\text{H}}{\text{N}}(CH_2)_5\underset{\text{O}}{\text{C}}\sim\sim$

b)



The reaction is anionic chain reaction polymerization, involving nucleophilic substitution at the acyl group of the cyclic amide. The base could be OH^- itself or the anion formed by abstraction of the –NH proton from a molecule of lactam.

9. Solved Problems (Subjective)

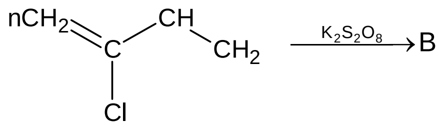
9.1 Subjective

Complete the reactions (Question 1 to 3)

Problem 1: $nCF_2 = CF_2 \xrightarrow[\text{heat, high pressure}]{A} (-CF_2 - CF_2 -)_n$ ***Teflon***

Solution: A = $(NH_4)_2S_2O_8$

Problem 2:

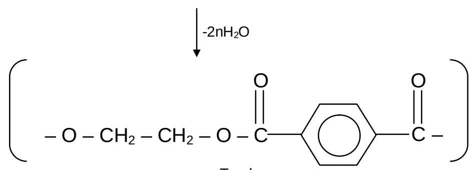


Solution:

$$B = \left(-CH_2 - \underset{\substack{| \\ Cl}}{C} = CH = CH_2 - \right)_n$$

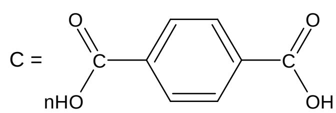
neprene

Problem 3: $nH_O - CH_2 - CH_2 - OH + C$



Terelene

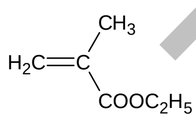
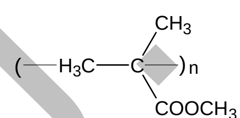
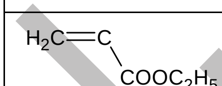
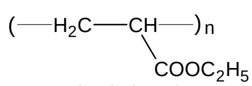
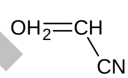
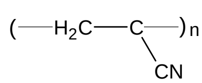
Solution:



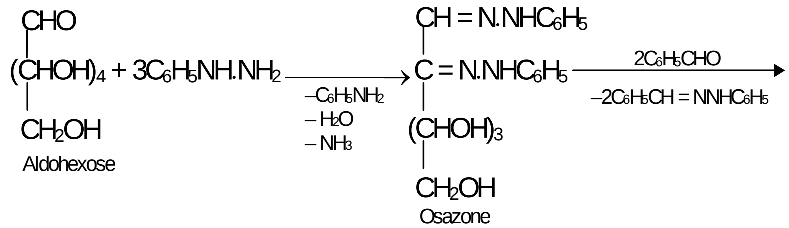
Terephathalic acid

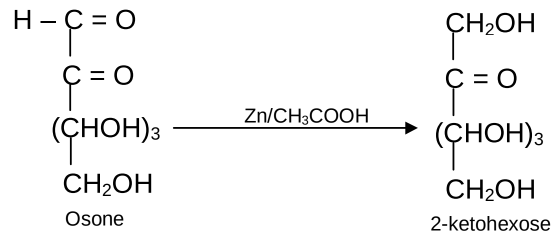
Problem 3: ***Give the classification of polymers obtained from esters of acrylic acid (CH_2 = CH.COOH)***

Solution:

Formula of monomer	***Polymer***	***Characteristics***	***Uses***
 methylacrylate	 Polymethylacrylate	***Hard transparent, high optical clarity. It is capable of acquiring different colours and tints***	***Lenses, transparent object domes and skylights plastic jewellery***
 ethyl acrylate	 Polyethylacrylate	***Tough and rubbery polymer***	***Similar to above***
 acrylonitrile	 Polyacrylonitrile	***Hard, horney and high melting material***	***Used in preparing cloth, carpets and blankets***

Problem 4: ***a) Show how an aldohexose can be used to synthesize 2-ketohexose. (b) Since glucose is converted to fructose by this method, what can you say about the configurations of C^3, C^4 and C^5 in the sugars.***





Here aldohexose reacts with one molecule of phenylhyrazine which condenses with the aldehyde group to give phenylhydrazone. When warmed with excess of phenyl hydrazine, the secondary alcoholic group adjacent to the aldehyde group is oxidised by another molecule of phenylhydrazine, to a ketonic group. With this ketonic group, the third molecule of phenylhydrazine condenses to give osazone. The phenylhydrazinyl group is transferred from osazone to C_6H_5CHO giving $C_6H_5CH = N{\cdot}NHC_6H_5$ and a dicarbonyl compound called an osone. The more reactive aldehyde group of the osone is reduced, not the less reactive keto group and it gives the 2-ketohexose.

b) The configurations of these carbons which are unchanged in the reactions, must be identical in order to get the same osazone.

Problem 5: ***a) Supply structures for H through K. Given:***

An aldohexose $\xrightarrow{NH_2OH\ /\ base} H \xrightarrow{Ac_2O\ /\ NaOAc} I \xrightarrow{-HOAC} J \xrightarrow{NaOMe\ /\ MeOH}$ ***K.***

b) Explain the last step (c). What is net structural change (d) Name this overall method. (e) Discuss the possibility of epimer formation.

Solution: a) H is an oxime $HOCH_2(CHOH)_4CH = NOH$; I is the completely acetylated oxime, $AcOCH_2(CHOAc)_4CH = NOAc$ that loses 1 mole of HOAc to form J, $AcOCH_2(CHOAc)_4\,C{\equiv}N$; K is an aldopentose, $HOCH_2(CHOH)_3CHO$.

b) The acetates undergo transesterification to give methyl acetate freeing all the sugar OH's. This is followed by reversal of HCN addition.

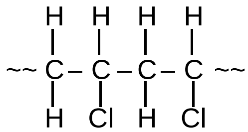
c) There is loss of one C from the carbon chain.

d) Wohl degradation

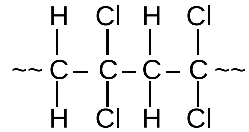
e) The α-CHOH becomes the –CH = O without any configurational changes of the other chiral carbons. Thus no epimers are formed.

Problem 6: ***Although both polymers are prepared by free radical processes, poly (vinyl chloride) is amorphous and poly (vinylidene chloride) (saran) is highly crystallilne. How do you account for the different? (vinylidene chloride is 1,1-dichloroethene).***

Solution:



Poly (vinyl chloride) PVC



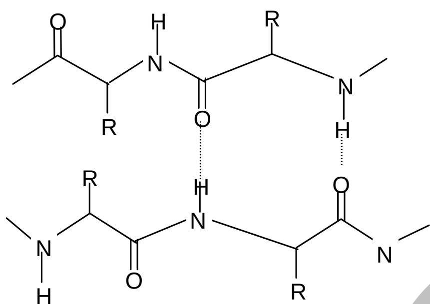
Poly (vinylidene chloride) saran

As poly (vinyl chloride) is able to show stereoisomerism and further it is formed by a free radical process, it is atactic (chlorine atoms distributed randomly), the molecules fit together poorly.

Poly (vinylidene chlroide) has two identical substituents on each carbon and the chains fit together well.

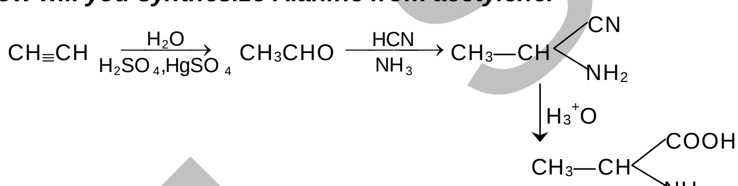
Problem 7: ***Show the fundamental unit of structure common to all polypeptides and proteins and show how cross linking occurs between two chains by H - bonding.***

Solution:



Problem 8: ***How will you synthesize Alanine from acetylene.***

Solution:



Alanine

8.18 ***Problem 9:*** ***Glycine exists as ($H_3N^+CH_2COO^-$) while anthranilic acid ($P–NH_2–C_6H_4$ – COOH) does not exist as dipolar ion.***

Solution: –COOH is too weakly acidic to transfer H^+ to the weakly basic $–NH_2$ attached to the electron withdrawing benzene ring. When attached to an aliphatic carbon, the $–NH_2$ is sufficiently basic to accept H^+ form –COOH group.

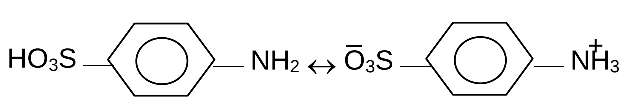
Problem 10:

i) Sulphanilic acid although has acidic as well as basic group, it is soluble in alkali but insoluble in mineral acid

ii) Sulphanilic acid is not soluble in organic solvents.

Solution:

i) Sulphanilic acid exist as Zwitterion

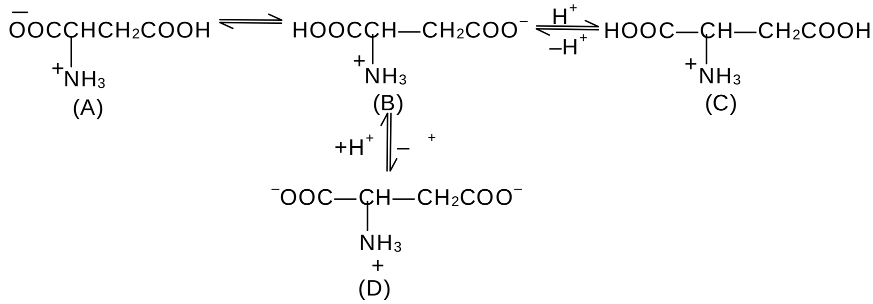


The weakly acidic $–{}^+NH_3$ transfers H^+ to OH^- to form a soluble salt, $P–NH_2–C_6H_4–SO_3^-Na^+$ on the other hand $-SO_3^-$ is too weakly basic to accept H^+ from strong acids.

ii) Due to its ionic character it is insoluble in organic solvents.

Problem 11: ***Why should isoelectric point for Aspartic acid (2.98) be so much lower than that of leucine?***

Solution: This may be explained by considering following ion equilibria



It is apparent that ions (A) and (B) are neutral, while (C) is a cation and (D) is dianion. In species (D), the anion is derived from the second —COOH group present in aspartic acid and is not possible in leucine. At neutral pH a significant concentration of (D), will be present in aqueous solution. It will therefore, be necessary to decrease the pH of such a solution if the formation of (D) is to be suppressed to a stage where anions and cations are present in equal concentration (the isoelectric point).

9.2 Objective

Problem 1: ***Nylon-66 is a polyamide of***

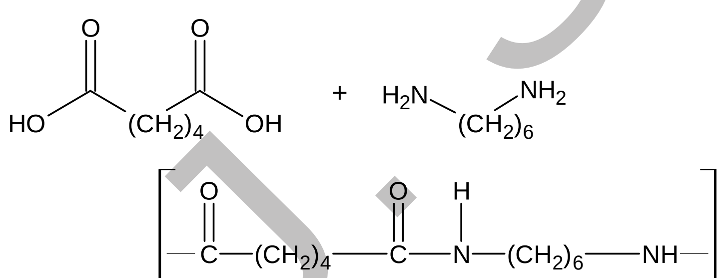
(A) Vinylchloride and formaldehyde

(B) Adipic acid and methyl amine

(C) Adipic acid and hexamethylene diamine

(D) Formaldehyde and melamine

Solution:



Nylong-66

$\therefore$ **(C)**

Problem 2: ***Which of the following is not a condensation polymer?***

(A) Glyptal ***(B) Nylon-66***

(C) Dacron ***(D) PTFE***

Solution: Others are condensed polymer

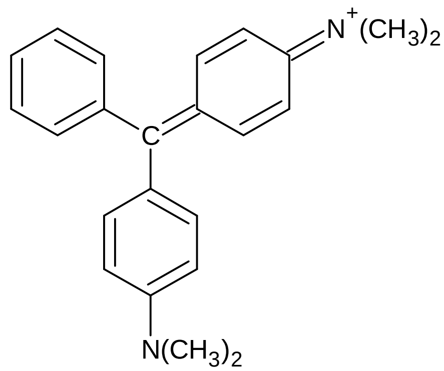
$\therefore$ **(C)**

Problem 3: ***Which of the following is an example of basic dye?***

(A) Alizarine ***(B) Indigo***

(C) Malachite ***(D) Orange – I***

Solution:



$\therefore$ **(C)**

Problem 4: ***Which of the following is not a chromophone?***

(A) – NH_2 ***(B) – NO***

(C) – NO_2 ***(D) – N = N –***

Solution: Chromophore is colour bearing group

$\therefore$ **(A)**

Problem 5: ***Which of the following is a natural fibre?***

(A) Starch ***(B) Cellulose***

(C) Rubber ***(D) Nylon-6***

Solution: **(B)**

EXERCISE – I

Q.1 Which of the following statement is not correct for maltose.

(A) It is a disaccharide

(B) It undergoes mutarotation

(C) It is a reducing sugar

(D) It does not have hemiacetal group

Q.2 Identify the correct statement about lactose.

(A) It consists of one galactose and one glucose unit

(B) Mutarotation is not possible

(C) Anomeric carbon of galactose is attached to 4′ carbon of glucose which is β-1, 4′-glycoside bond.

(D) Lactose is used to cleave the β-1, 4′-glycoside bond

Q.3 Which of the following carbohydrates would be most abundant in the diet of strict vegetarian?

(A) Amylose (B) Glycogen (C) Cellulose (D) Maltose

Q.4 Which of the following statements about the structure of glycogen is true.

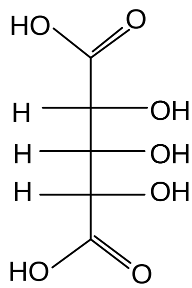
(A) Glycogen is a copolymer of glucose and galactose

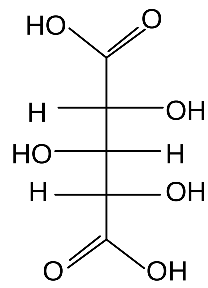
(B) There are more branch residues than residues in straight chains.

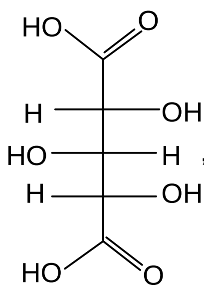
(C) The monosaccharide residue alternate between D and L-glucose

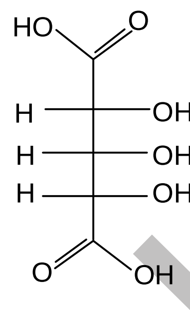
(D) New glucose molecules are added to the C-2 aldehyde group of chain termini forming a hemiacetal.

Q.5 D-Ribose when treated with dilute HNO_3 forms

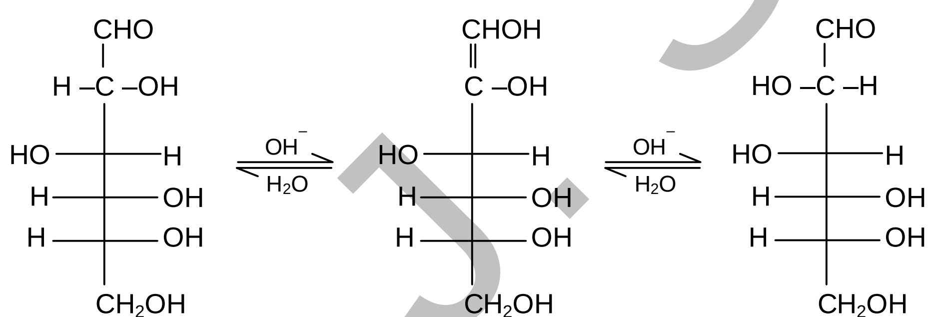
(A)  , Achiral

(B)  , Chiral

(C)  , Achiral

(D)  , Chiral

Q.6 Consider the given process.



(I) (II) (III)

and identify the incorrect statement.

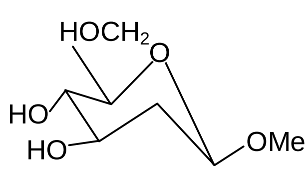
(A) Configuration at C-2 is lost on enolisation

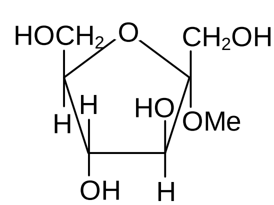
(B) I and III are epimers

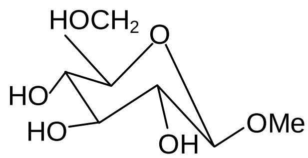
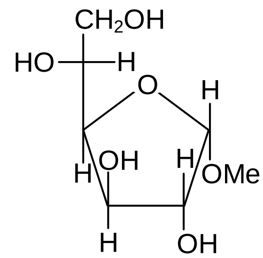
(C) Proton transfer from water to C-1 converts ene diol to an aldose

(D) D-glucose can isomerise to D-fructose through enol intermediate.

Q.7 Consider the given structure and select the incorrect statement:





(A) (I) Hydrolyse much faster than (III)
(B) (III) Hydrolyse much faster than (I)
(C) (II) Hydrolyse much faster than (IV) in acidic medium
(D) Compound (IV) is methyl-α-D-glucofuranoside

Q.8 Select the **incorrect** statement:
(A) Starch is a homopolymer of glucose forming an α-glycosidic chain
(B) Maltose and Lactose are disaccharides
(C) Cellulose has only β-D-glucose unit which are joined by glycosidic linkage between C_1 of one glucose unit and C_4 of another glucose unit
(D) The structure of glycogen is similar to amylose

Q.9 When methyl D-glucopyranaside is treated with HIO_4 its number of mole consumed per mole of the sugar is :
(A) 2 (B) 3 (C) 4 (D) 5

Q.10 α- amino acid when heated with BaO forms.
(A) α,β-unsaturated acid(B) α, β-unsaturated amine
(C) Carboxylic acid (D) Amine

Q.11 The configuration of the C-2 epimer of D-glucose is:
(A) 2R, 3S, 4R, 5S (B) 2S, 3S, 4R, 5R
(C) 2S, 3R, 4S, 5R (D) 2R, 3S, 4R, 5R

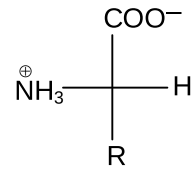
Q.12 Mutaratation involve:
(A) Racemisation
(B) Diastereomerisation
(C)Optical resolution
(D) Conformational inversion

Q.13 Consider the reaction sequence-

$$\text{Glucose} \xrightarrow[\text{excess}]{\text{PhNHNH}_2} P \xrightarrow[\Delta]{H_3O^+} Q \xrightarrow[\text{AcOH}]{\text{Zn}} R$$

The product R is-
(A) Arbinose (B) Sorbitol (C) Fructose (D) Mannose

Q.14 The pH of the solution containing following zwitter ion species is



(A) 4 (B) 5 (C) 7 (D) 9

Q.15 Peptide linkage is:

(A) $-\overset{\overset{O}{\|}}{C}-O-$ (B) $-\overset{\overset{O}{\|}}{C}-NH_2$ (C) $-\overset{\overset{O}{\|}}{C}-NH-$ (D) $-\overset{\overset{O}{\|}}{C}-NH-NH_2$

Q.16 Same osazone derivative is obtained in case of D-glucose, D-Mannose and D-Fructose due to:

(A) the same configuration at C-5

(B) the same constitution

(C) the same constitution at C-1 and C-2

(D) The same constitution and acid configuration at C-3, C-4, C-5 and C-6 but different constitution and configuration at C-1 and C-2 which becomes identical by osazone formation

Q.17 D(–) –Erythrose $\xrightarrow{NaBH_4}$ (P)

D(–) – Threose $\xrightarrow{NaBH_4}$ (R)

Which of the following statement is correct about P and R?

(A) Both are optically active

(B) Both are optically inactive

(C) P is optically inactive and R is optically active

(D) Neither P nor R has asymmetric carbon

Q.18 The monomer of nucleic acids are held together by

(A) Phosphoester linkage (B) Amide linkage

(C) Glycosidic linkage (D) Ester linkage

Q.19 Select the incorrect statement:

(A) Manufacture of paints require glyptal (B) Water pipes are made up of PVC

(C) Bakelite has free carbonyl group (D) Polystyrene is $\left(CH_2-\underset{}{\overset{C_6H_5}{\overset{|}{C}H}}\right)_n$

Q.20 Select incorrect statement about Nylon 2- nylon-6.

(A) It is a copolymer

(B) It is biodegradable

(C) It is an alternating polyamide

(D) It is made up of $CH_3-\underset{\underset{NH_2}{|}}{CH}-COOH$ and $H_2N(CH_2)_5COOH$.

Q.21 Which of the following cannot be used as drying agent for a liquid organic compound

(A) Anhydrous $CaCl_2$ (B) Anhydrous K_2CO_3

(C) Metallic sodium in the form of wires (D) Anhydrous H_2SO_4

Q.22 The ferrox reagent used for detection of oxygen present in a given compound contains:

(A) $K_4[Fe(CNS)_6]$ (B) $K_3[Fe(NCS)_6]$

(C) $Fe[Fe(CNS)_6]$ (D) $Fe[Fe(NCS)_6]$

Q.23 When N and S both present the Lassaignes test is sometimes incomplete due to formation of

(A) Na(CNS) (B) Na(NCS)

(C) NaCN (D) Na_2S

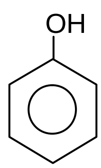
Q.24 The polymer formed as a result of following sequence of reaction is:

$$2HC \equiv CH \xrightarrow{CuCl} HC \equiv CH - CH = CH_2 \xrightarrow[NH_4Cl]{1.\ HCl \quad 2.\ Cu_2Cl_2} CH_2 = \underset{\substack{|\\Cl}}{C} - CH = CH_2$$

$$\xrightarrow{\text{polymerisation}} \left[CH_2 - \underset{\substack{|\\Cl}}{C} = CH = CH_2 \right]$$

(A) Saran (B) PVC (C) Neoprene (D) Chloroprene

Q.25 Consider the reaction-



$$\xrightarrow[(ii)H_3O^+]{(i)CHCl_3 + NaOH} P(\text{major}) + Q(\text{minor})$$

Mixture of A and B can be best separated by-

(A) Steam distillation (B) Vacuum distillation

(C) Fractional distillation (D) Crystallisation

Q.26 Select the incorrect statement-

(A) The Lassaigne's filtrate must be clear and colourless solution

(B) Presence of colour in Lassaigne's filtrate indicates incomplete fusion

(C) The Lassaigne's filtrate solution is alkaline

(D) The Lassaigne's filtrate solution must be neutral

Q.27 When Na-extract is added to small amount of freshly prepared $FeSO_4$ solution and small amount of NaOH a green coloured precipitated is obtained. This indicates.

(A) Presence of SN (B) Presence of $Fe(OH)_2]$

(C) Presence of $Fe(CN)_2$ (D) Presence of $Na_4[Fe(CN)_6]$

Q.28 Consider the following sequence

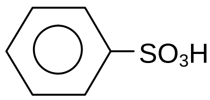
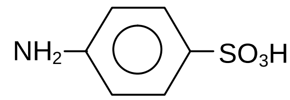
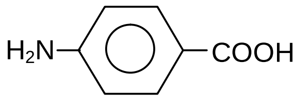
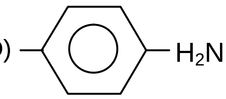
$$\underset{\text{Freshly prepared sol}^n.}{\text{Na (extract)} + FeSO_4} \xrightarrow{NaOH} \underset{\text{Solution (Filtrate)}}{(A)} \xrightarrow[H_2SO_4]{Dil.HCl/} \text{Green colour}$$

The presence of green colour confirm the presence of

(A) N (B) S

(C) O (D) N and S both

Q.29 When solidum extract is treated with $FeCl_3$ solution a blood red coloured is obtained due to the presence of :

(A) 
(B) 
(C) 
(D) 

Q.30 The monomer that undergo radical polymerization most easily is
(A) $CH_2 = CH_2$
(B) $C_6H_5CH = CH_2$
(C) $CH_2 = C(Me)(Me)$
(D) $CH_3 – CH = CH_2$

Q.31 The monomer that can undergo radical, cationic and anionic polymerization with equal case :
(A) $Me – C(Me) = CH_2$
(B) $Ph–CH = CH_2$
(C) $CH_2 = CH_2$
(D) $CH_2 = CH –CN$

Q.32 Select the incorrect statement about polymer
(A) Polymers do not carry any charge
(B) Polymers have high viscosity
(C) Polymers scattered light
(D) Polymers have multiple bond

EXERCISE – II

Q.1 Carbohydrates may be:
(A) Sugars
(B) Starch
(C) Polyhydroxy aldehyde/ketones
(D) Compounds that can be hydrolysed to sugar

Q.2 Select the correct statement:
(A) S-glyceraldehyde is also known as L-glyceraldehyde
(B) The configuration of the stereocenter most distant from the carbonyl group determines whether a monosaccharide is D or L.
(C) Glucose and all naturally occurring sugars are D-sugars
(D) D-erythrose and D-threose are diastereomers

Q.3 Select the incorrect statement.
(A) Monosaccharide are insoluble in organic solvents like diethyl ether.
(B) Anomers of a cyclic monosaccharides differ in the position of the OH group at the hemiacetal carbon.
(C) D-ribose the OH group used to form the five membered furanose ring is located on C_4
(D) Aldopentoses and ketohexoses form pyranose rings in solution.

Q.4 Select the correct statement.
(A) Glycosides do not undergo mutarotation
(B) All OH groups of a cyclic monosaccharides are converted to ethers by treatment with base and an alkyl halide
(C) α- D glucose reacts with Ag_2O and excess CH_3I to form tetramethyl ether
(D) D-glucose upon treatment with warm HNO_3 forms D-glucaric acid

Q.5 All disaccharides may have
(A) One acetal
(B) Two acetal

(C) One acetal and One hemiacetal (D) Two hemiacetal

Q.6 Starch molecules are polymer with repeating glucose units. Select the correct statement(s).
(A) Glucose units are joined through α-glycosidic linkage
(B) The branches of amylopectin are linked to the chain with α-1,6′-glycosidic linkages
(C) The linear linkages of amylopectin are formed by α-1,6′-glycosidic bond
(D) Amylose has an unbranched skeleton of glucose molecules with α-1, 4′-glycosidic linkages.

Q.7 Select the correct statement:
(A) Proteins upon hydrolysis gives α-amio acid only
(B) Except glycine, all other naturally occurring α-amino acids are optically active.
(C) In fibrous proteins polypeptide chains are held together by hydrogen and disulphide bonds
(D) Keratine is insoluble in water

Q.8 Select the correct statement:
(A) Coiling of polypeptide chain form fibrous protein
(B) Quarternary structure of protein also exist
(C) Lysine is an amino acid with basic side chain
(D) The absolute configuration of $H_3\overset{+}{N}-CH(CH_2OH)COO^-$ (L-serine) is S.

Q.9 Select the correct statement:
(A) All proteins are polyamides formed by joining amino acids together.
(B) All L-amino acids except cysteine have the S-configuration.
(C) All amino acids are 1° amines except praline.
(D) Proline is a 2° amine consisting of five membered ring.

Q.10 Select the correct option:
(A) Isoelectric point is the pH at which an amino acid exists primarily in its neutral form.
(B) Isoelectric point is the average of pK_a values of α-COOH amino α-NH_3^+ groups [valid only for neutral amino acid].
(C) Glycine is characterised by two pK_a values.
(D) For neutral amino acid the concentration of zwitter ion is maximum at its isoelectric point.

Q.11 Amino acids are synthesised from:
(A) α-Halo acids by reaction with NH_3.
(B) Aldehydes by reaction with NH_3 and cyanide ion followed by hydrolysis.
(C) Alkyl halides by reaction with the enolate anion derived from diethyl acetamidomalonate and hydrolysis.
(D) Alcohols by reaction with NH_3 and CN^- ion followed by hydrolysis.

Q.12 Which of the following carbohydrates developes blue colour on treatment with iodine solution?
(A) Glucose (B) Amylose (C) Starch (D) Fructose

Q.13 Select the correct statement:
(A) High density polythene is a linear polymer.
(B) Low density polythene is a branched chain polymer.
(C) Chain growth polymers are also known as addition polymer.
(D) Step growth polymer is also known condensation polymer.

Q.14 Select the correct statement:
(A) Chain growth polymerisation takes place through radical, cation or anion intermediate.
(B) A synthetic polymer is polydisperse
(C) $\overline{M}n$ is given by $\frac{1}{N}\sum_i M_iN_i$, where N_i in the number of molecules with molar mass M_i and there are N molecules.
(D) Weight average molar mass is inversely proportional to the mean square molar mass

Q.15 Select the correct statement:

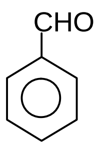
(A) Elastomers have the weakest intermolecular forces
(B) Buna-N is an elastomer with crosslinks
(C) Some fibres have crystalline nature
(D) Thermoplastic polymers have stronger intermolecular forces than fibres

Q.16 Consider the given sequence of reaction

$$\text{Na(extract)} + \text{Dil. } HNO_3 \xrightarrow[\Delta]{} \text{Filtrate (A)} + \underset{\text{Violet}}{(B)\uparrow}$$

$$\text{Filtrate (A)} \xrightarrow{\text{Cool } AgNO_3} \underset{\text{(white)}}{(C)\downarrow} \xrightarrow{NH_4OH} \text{Clear solution}$$

Select the correct statement:
(A) Na extract contains Br^- and I^- together
(B) B is vapour of I_2
(C) The clear solution contains AgCl
(D) The clear solution contains $[Ag(NH_3)_2]^+$

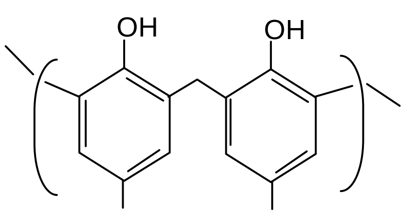
Q.17  $+ AC_2O \xrightarrow{AcONa} (P)$

Before isolating (P) unreacted Ph–CHO is removed first. Select the correct statement:
(A) P is cinnamaldehyde
(B) Removal of PhCHO is done by passing steam into the mixture
(C) Removal is done by simple distillation
(D) P is cinnamic acid

Q.18 Match the column:

Column-I		Column-II
(A) Sucrose	(P)	Two acetals
(B) Maltose	(Q)	No hemiacetal
(C) Lactose	(R)	β-1,4′-glycosidic bond
(D) Cellulose	(S)	Hydrolysis product is glucose

Q.19 Match the column:

Column-I		Column-II
(A) $-\!\!(CH_2 - \underset{\underset{Cl}{\vert}}{C} = CH - CH_2)\!\!-_n$	(P)	Thermoplastic polymer
(B) $-\!\!(\overset{\overset{H}{\vert}}{N} - (CH_2)_6 - \overset{\overset{H}{\vert}}{N} - \overset{\overset{O}{\Vert}}{C} - (CH_2)_4 - \overset{\overset{O}{\Vert}}{C})\!\!-_n$	(Q)	Thermosetting polymers
(C) $-\!\!(CH_2 - \overset{\overset{Cl}{\vert}}{CH})\!\!-_n$	(R)	Fibres
(D) 	(S)	Elastomer

Q.20 Match the column:

Column-I (Component of mixture)	**Column-II (Reagent)**
(A) Crystalline Na_2CO_3 + Sodium citrate + $CuSO_4$(aq. sol.)	(P) Fehling solution
(B) $CuSO_4$ + Rochelle Salt + NaOH (Aq. sol.)	(Q) Nesseler's Reagent
(C) 10% α-naphthol in alcohol	(R) Bennedict's solution
(D) HgCl + KI + KOH (aq. sol.)	(S) Molisch's Reagent

EXERCISE – III

Assertion Reason:

Q.1 **Statement I :** Furanose ring. like pyranose rings are not planar.
Statement II : The most stable conformation of furanose is envelope form.
(A) Statement- I is true, statement- II is true and statement- II is correct explanation for statement- I
(B) Statement- I is true, statement- II is true and statement- II is NOT correct explanation for statement- I
(C) Statement- I is true, statement- II is false.
(D) Statement- I is false, statement- II is true.

Q.2 **Statement I :** Bromine water changes glucose to gluconic acid
Statement II : Bromine water acts as oxidising agent
(A) Statement- I is true, statement- II is true and statement- II is correct explanation for statement- I
(B) Statement- I is true, statement- II is true and statement- II is NOT correct explanation for statement- I
(C) Statement- I is true, statement- II is false.
(D) Statement- I is false, statement- II is true.

Q.3 **Statement I :** All monosaccharide ketoses are reducing sugars.
Statement II : Monosaccharide ketose give positive Tollen's and Fehling's test
(A) Statement- I is true, statement- II is true and statement- II is correct explanation for statement- I
(B) Statement- I is true, statement- II is true and statement- II is NOT correct explanation for statement- I
(C) Statement- I is true, statement- II is false.
(D) Statement- I is false, statement- II is true.

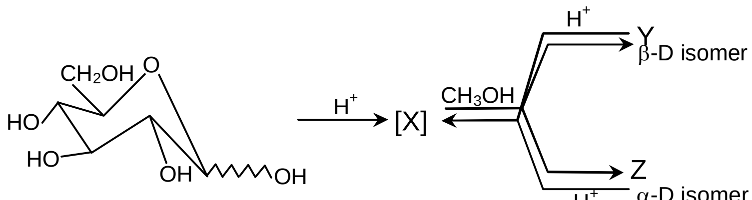
Q.4 **Statement I :** Amylose chain adopts a helical arrangement
Statement II : Presence of α-1,4′-glycosidic bonds force to adopt a helical shape.
(A) Statement- I is true, statement- II is true and statement- II is correct explanation for statement- I
(B) Statement- I is true, statement- II is true and statement- II is NOT correct explanation for statement- I
(C) Statement- I is true, statement- II is false.
(D) Statement- I is false, statement- II is true.

Q.5 **Statement I :** PHBV is a biodegradable polymer.
Statement II : PHBV undergoes bacterial degradation in the environment.
(A) Statement- I is true, statement- II is true and statement- II is correct explanation for statement- I

(B) Statement- I is true, statement- II is true and statement- II is NOT correct explanation for statement- I
(C) Statement- I is true, statement- II is false.
(D) Statement- I is false, statement- II is true.

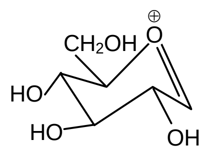
Comprehension (6 to 8)

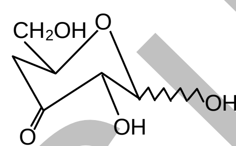
Consider the following reversible process for a reaction of D-glucose.

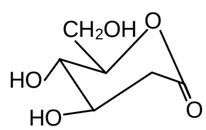


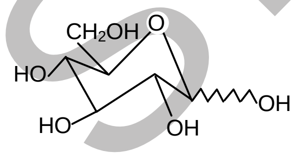
D-glucose
(α or β form)

Q.6 The structure of intermediate [X] is:

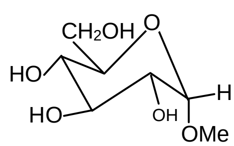
(A) 

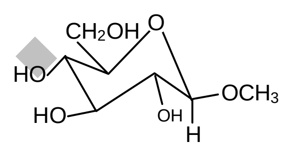
(B) 

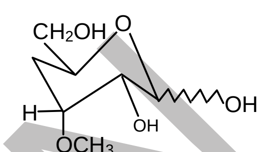
(C) 

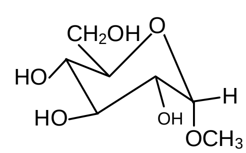
(D) 

Q.7 Select the correct option:

(A) Y is 

(B) Z is 

(C) Y is 

(D) Z is 

Q.8 Select the correct statement.
(A) Y is more stable than Z due to H-bond
(B) Y is less stable than Z due to anomeric effect
(C) Y is more stable than Z due to anomeric effect
(D) Y is less stable than Z due to H-bond

Comprehension (9 to 11)
Consider the given data for a given sample of.

Molar mass Interval/Kg mol^{-1}	Average molar mass within Internal/Kg mol^{-1}	Mass of sample within Interval/g
5-10	7.5	9.60
10-15	12.5	8.70
15-20	17.5	8.75

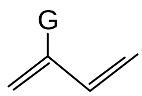
20-25 22.5 5.6

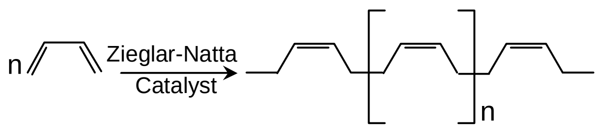
Q.9 The number average molar mass in kg mol^{-1} is:
(A) 10.25 (B) 11.91 (C) 12.87 (D) 13.65

Q.10 The weight average molar mass in kg mol^{-1} is:
(A) 8.76 (B) 10.36 (C) 12.06 (D) 14.16

Q.11 The polydispersity index of the polymer is:
(A) 0.29 (B) 0.84 (C) 1.18 (D) 2.1

Comprehension (Q.No.12 to Q. 14)

The monomer  (G = Me or Cl) when treated with Zieglar-Natta catalyst undergo polymerisation in the manner given below-



cis-poly-1,3-butadiene

Q.12 The Zieglar-Natta catalyst is:
(A) $TiCl_4$ (B) R_3Al (C) $R_3Al/TiCl_4$ (D) $R_3B/TiCl_4$

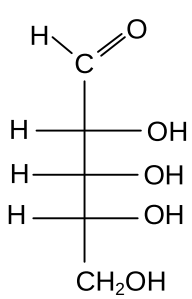
Q.13 The polymer obtained when monomeric unit used is $CH_2 = \underset{}{\overset{Cl}{\overset{|}{C}}} - CH = CH_2$
(A) Neoprene (B) Stilbene (C) Styrene (D) Chlopropicrin

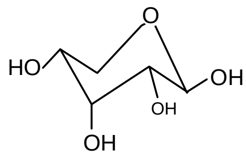
Q.14 Which of the following statement is not true considering the process given above:
(A) The general class of polymer formed is known as homopolymer
(B) The polymer obtained is stereoregular
(C) Buna-N can be prepared using above process
(D) Synthetic rubber can be formed by above process using 1,3-butadiene.

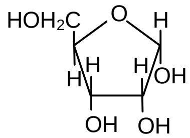
Q.15 Match the column

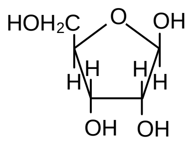
Column-I	**Column-II**
(A) α- anomer of a D-monosaccharide	(P) CH_2OH at C-5 and OH at C-1 are cis to each other
(B) β- anomer of a D-monosaccharide	(Q) OH at C-1 and CH_2OH at C-5 are trans to each other
(C) Haworth projection of α- anomer	(R) OH group is drawn down at C-1
(D) Haworth projection of β-D-anomer	(S) Major isomer at equilibrium

Q.16 Match the compounds given below existing in equilibrium mixture with their percentage given in the right hand side.

Column-I	**Column-II**
(A) 	(P) 6%

(B)  (Q) 18%

(C)  (R) < 1%

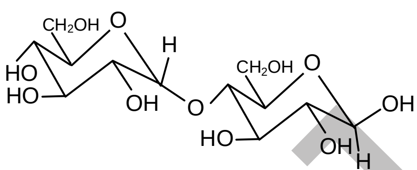
(D)  (S) 56%

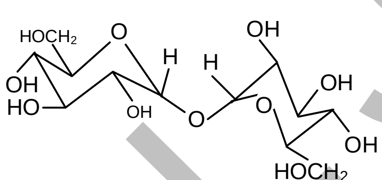
Q.17 Match the column:

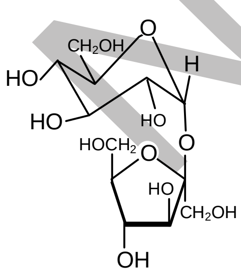
Column-I (Carbohydrate)	**Column-II (Properties)**
(A) Starch	(P) Mutarotation
(B) Sucrose	(Q) Non reducing sugar
(C) Lactose	(R) β-glycosidic bond
(D) Maltose	(S) α-glycosidic bond
	(T) Reducing sugar
	(U) Hemiacetal

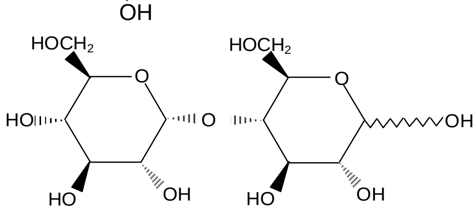
Q.18 Match the column:

Column-I **Column-II**

(A)  (P) α-glycoside bonds

(B)  (Q) Reducing sugar

(C)  (R) Forms enediol intermediate

(D)  (S) β-glycoside bond

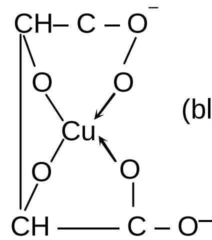
Q.19 Match the column:

Column-I **Column-II**

(Functional group) (Test used or complex during confirmatory test)

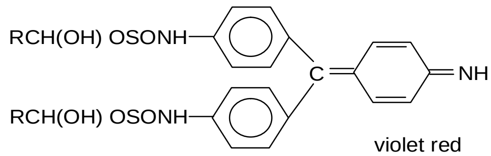
(A) Aldehydic — (P) $[(C_6H_5O)_6Fe]^{-3}$ (Violet)

(B) Phenolic — (Q)



(blue)

(C) Alcohol — (R)



violet red

(S) $(ROH)_2\ Ce(NO_3)_4$ (Red)

(T) Molisch's Test

Q.20 Match the column:

Column-I	**Column-II**
(A) Addition polymer	(P) Buna-S
(B) Condensation polymer	(Q) Buna-N
(C) Homopolymer	(R) Polythene
(D) Copolymers	(S) Nylon 6,6

Q.21 Match the column :

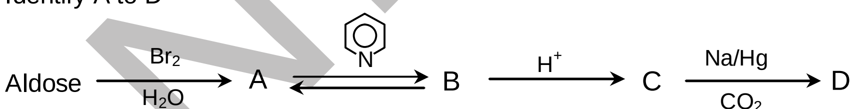
Monomer	**Catalyst**	**Polymer**
(A) $CH_2 = CH_2$	(1) Peroxide	(P) Teflon
(B) $CF_2 = CF_2$	(2) Persulphate & high P	(Q) LDP
(C) $CH_2 = CHCN$	(3) Ziegler-Natta Catalyst P=6, 7 atm	(R) HDP
		(S) Polyacrylonitrite

Q.22 Match the column :

Presence of the element in Na-extract	Complex formed in one of the test	Colour of the complex
(A) N	(P) $Na_4[Fe(CN)_5NOS]$	(W) Prussian Blue
(B) S	(Q) $Fe(CNS)_3$	(X) Black
(C) N and S together	(R) PbS	(Y) Violet
	(S) $Fe_4[Fe(CN)_6]$	(Z) Blood Red

Subjective

Q.23 Identify A to D



Q.24 The pKa values for the three acidic group P, Q, R are 4.3, 9.7 and 2.2 respectively

$$\underset{(R)}{HOOC}–\underset{\underset{(Q)}{\overset{\oplus|}{NH_3}}}{CH}–CH_2–\underset{(P)}{COOH}$$

Calculate the isoelectric point of the amino acid?

Q.25 How will you separate?

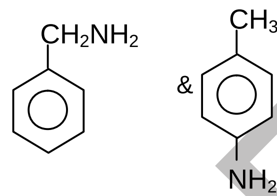
(a) Ethane, Ethene & Ethyne

(b) 1-Butyne and 2-Butyne

(c) 2-hexyne and 3-hyxyne

(d) Phenol & Propanol

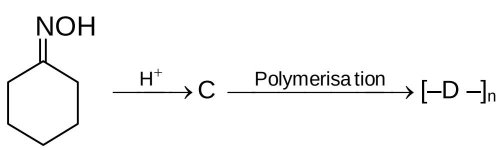
(e) 2-Propanol and Propanone
(f) CH_3COOH & $HCOOCH_3$
(g) PhOH & PhCOOH
(h) EtOH & $EtNH_2$
(i) $EtNH_2$ & Me_2NH
(j) EtOH & Et– O –Et

Q.26 How will you differentiate?
(a) Propane and Propene
(b) 1-Butyne and 2-Butyne
(c) 2- Hexyne and 3-hexyne
(d) 1,1-Dichloroethane and 1,2-Dichloroethane
(e) Chloroethane and Chloroethene
(f) Pure and Oxidized $CHCl_3$
(g) p-chlorotoluene and benzylchloride
(h) n- propylchloride and isopropylchloride
(i) Methanol and ethanol(j) Isobutanol and tert-butanol
(k) 2- Pentanol and 3-pentanol
(l) O-cresol and benzylalcohol
(m) Ethanol and Propanol
(n) Propanone and Ethanol
(o) HCHO and PhCHO (p) Glucose and Fructose
(q) HCOOH & CH_3COOH
(r) HCOOH & HCHO
(s) $MeNH_2$ & Me_2NH
(t) 

EXERCISE IV

Q.1 Give the structures of the products in each of the following reactions. **[JEE 2000]**

(i) Sucrose $\xrightarrow{H^+}$ A + B

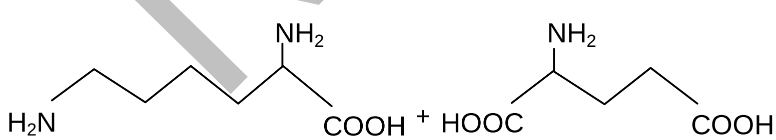
(ii) 

Q.2 Aspartame, an artificial sweetener, is a peptide and has the following structure:**[JEE 2001]**

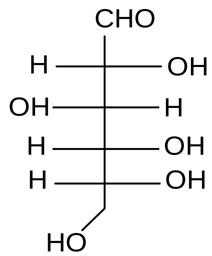
$$H_2N-\underset{\underset{CH_2-COOH}{|}}{CH}-CONH-\overset{\overset{CH_2-C_6H_5}{|}}{CH}-COOCH_3$$

(i) Identify the four functional groups.
(ii) Write the zwitterionic structure
(iii) Write the structures of the amino acids obtained from the hydrolysis of aspartame.
(iv) Which of the two amino acids is more hydrophobic?

Q.3 Following two amino acids lysine and glutamine form dipeptide linkage. What are two possible dipeptides? **[JEE 2003]**



Q.4 The structure of D-Glucose is as follows- **[JEE 2004]**
(a) Draw the structure of L-Glucose
(b) Give the reaction of L-Glucose with Tollen's reagent



Q.5 Which of the following pairs give positive Tollen's test? **[JEE 2004]**
(A) Glucose, sucrose (B) Glucose, fructose
(C) Hexanal, Acetophenone (D) Fructose, sucrose

Q.6 Two forms of D-glucopyranose, are called
(A) Enantiomers (B) Anomers
(C) Epimers (D) Diastereomers

Q.7 Monomer A of a polymer on ozonolysis yields two moles of HCHO and one mole of CH_3COCHO
[JEE 2005]
(a) Deduce the structure of A
(b) Write the structure of "all cis"-forms of polymer of compound A.

Q.8 When benzene sulfonic acid and p-nitrophenol are treated with $NaHCO_3$, the gases released respectively are-
[JEE 2006]
(A) SO_2, NO_2 (B) SO_2, NO
(C) SO_2, CO_2 (D) CO_2, CO_2

Q.9 **Statement-I** : Glucose gives a reddish-brown precipitate with Fehling's solution.
because **[JEE 2007]**
Statement-II : Reaction of glucose with Fehling's solution gives CuO and gluconic acid.
(A) Statement- I is true, Statement- II is true and Statement- II is correct explanation for Statement- I
(B) Statement- I is true, Statement- II is true and Statement- II is NOT a correct explanation for Statement- I
(C) Statement- I is true, Statement- II is false.
(D) Statement- I is false, Statement- II is true.

Q.10 **Statement-I** : p-ydroxybenzoic acid has a lower boiling point than o-hydroxybenzoic acid.
because **[JEE 2007]**
Statement-II : o-Hydroxybenzoic acid has Intramolecular hydrogen bonding.
(A) Statement- I is true, Statement- II is true and Statement- II is correct explanation for Statement- I
(B) Statement- I is true, Statement- II is true and Statement- II is NOT a correct explanation for Statement- I
(C) Statement- I is true, Statement- II is false.
(D) Statement- I is false, Statement- II is true.

Q.11 Match the chemical substances in Column I with type of polymers/type of bonds in Column-II. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.
[JEE 2007]

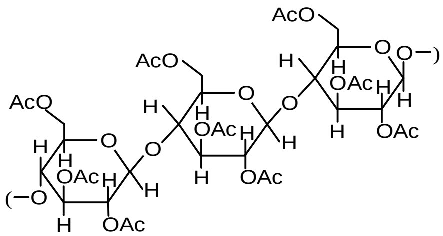
Column-I	**Column-II**
(A) Cellulose	(P) Natural polymer
(B) Nylon-6,6	(Q) Synthetic polymer
(C) Protein	(R) amide linkage
(D) Sucrose	(S) Glycoside linkage

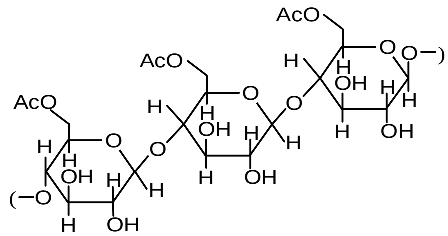
Q.12 Match the compounds/ion in column I with their properties/reaction in Column-II. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.
[JEE 2007]

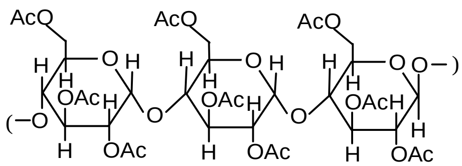
Column-I	**Column-II**
(A) C_6H_5CHO	(P) gives precipitate with 2,4-dinitrophenylhydrazine

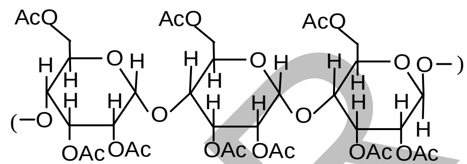
(B) $CH_3C \equiv CH$ (Q) gives precipitate with $AgNO_3$
(C) CN^- (R) is a nucleophile
(D) I^- (S) is involved in cyanohydrin formation

Q.13 Cellulose upon acetylation with excess acetic anhydride/H_2SO_4 (catalytic) gives cellulose triacetate whose structure is **[JEE 2008]**

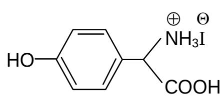
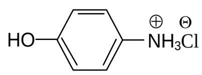
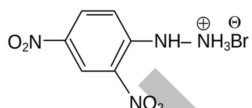
(A) 

(B) 

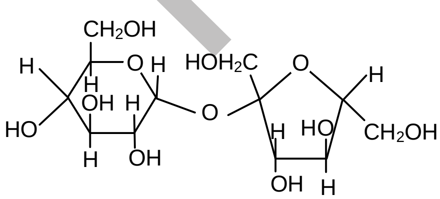
(C) 

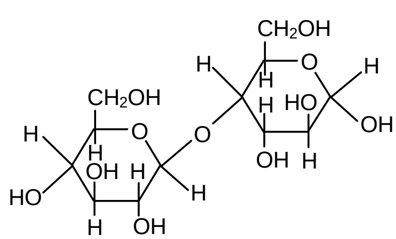
(D) 

Q.14 Match the compounds in Column I with their characteristic test(s)/reaction(s) given in Column II. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS. **[JEE 2008]**

Column-I	**Column II**
(A) $H_2N - \overset{\oplus}{N}H_3\overset{\ominus}{Cl}$	(P) Sodium fusion extract of the compound gives Prussian blue colour with $FeSO_4$
(B) 	(Q) gives positive $FeCl_3$ test
(C) 	(R) gives white precipitate with $AgNO_3$
(D) 	(S) reacts with aldehydes to form the corresponding hydrazine derivative

Q.15 The correct statement(s) about the following sugars X and Y is(are)- **[JEE 2009]**


(X)

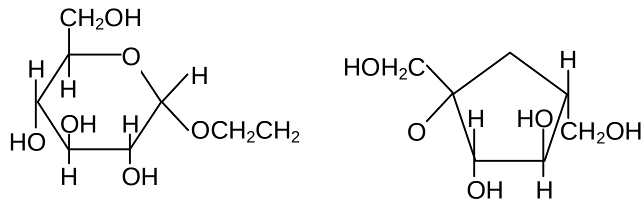

(Y)

(A) X is a reducing sugar and Y is a non-reducing sugar
(B) X is a non-reducing sugar and Y is a reducing sugar
(C) The glucosidic linkages in X and Y are α and β, respectively
(D) The glucosidic linkages in X and Y are β and α, respectively

Q.16 Among cellulose, poly(vinyl chloride), nylon and natural rubber, the polymer in which the intermolecular force of attraction is weakest is **[JEE 2009]**

(A) Nylon
(B) Poly (vinyl chloride)
(C) Cellulose
(D) Natural Rubber

Q.17 The correct statement about the following disaccharide is – **(JEE2010)**



(A) Ring (a) is pyranonse with α-glycosidic link

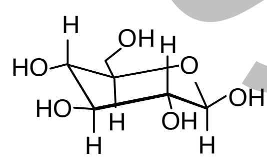
(B) Ring (a) is furanonse with α-glycosidic link

(C) Ring (b) is furanonse with α-glycosidic link

(D) Ring (b) is pyranonse with β-glycosidic link

Q.18 A decapeptide (Mol. Wt. 796) on complete hydrolysis gives glycine (Mol. wt. 75), alanine and phenylalanine. Glycine contributes 47.0% to the total weight of the hydrolysed products. The number of glycine units present in the decapeptide is – **(JEE2011)**

Q.19 The following carbohydrate is -



(A) ketohexose
(B) an aldohexose
(C) an α-furanose
(D) an α-pyranose

ANSWER KEY

EXERCISE-1

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ans.	D	A	C	D	A	C	B	D	A	D	A	B	C	C	C	D
Q.No.	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Ans.	C	A	C	D	D	C	A	C	C	D	B	A	B	B	B	D

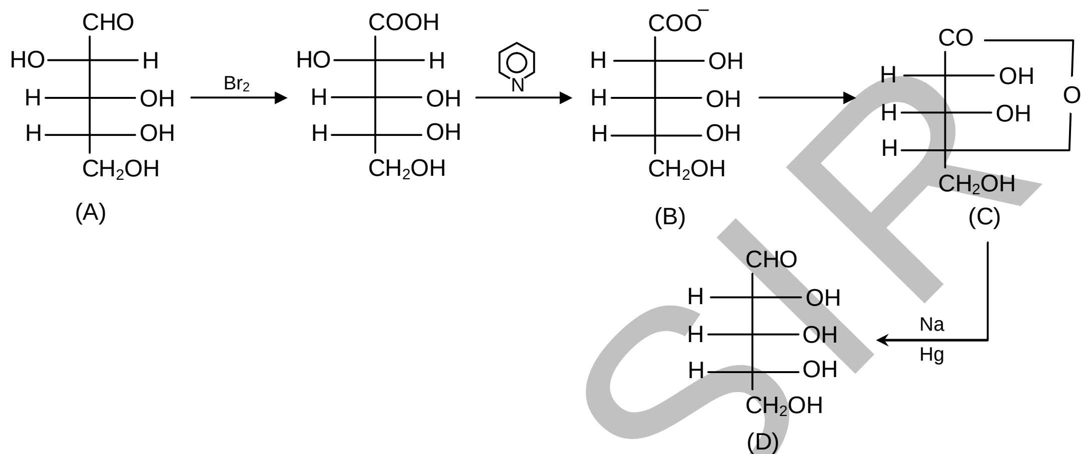
EXERCISE-II

Q.No.	1	2	3	4	5	6	7	8	9	10	11
Ans.	A,B,C	A,B,C,D	A,B,C	A,B,D	A,B,C	A,B,D	A,B,C,D	B,C,D	A,B,C	A,C,D	A,B,C
Q.No.	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**A**	**B**	**C**	**D**
Ans.	B,C	A,B,C,D	A,B,C	A,B,C	B,D	B,D		P,Q,S	S	R	R
Q.No.	**19**	**A**	**B**	**C**	**D**	**20**	**A**	**B**	**C**	**D**	
Ans.		S	R	P	Q		Q	P	R	S	

EXERCISE-III

Q.No.	1	2	3	4	5	6	7	8	9	10	11
Ans.	A	A	A	A	A	A	D	B	B	D	C
Q.No.	**12**	**13**	**14**	**15**	**A**	**B**	**C**	**D**			
Ans.	C	A	C		Q,R	P,S	R	S			
16	**A**	**B**	**C**	**D**	**17**	**A**	**B**	**C**	**D**		
	R	S	P	Q		Q,S	Q,S	P,R,T,U	P,S,T,U		
18	**A**	**B**	**C**	**D**	**19**	**A**	**B**	**C**	**D**		
	P,Q,R	P	P	P,Q,R		Q,P	P	S	T		
20	**A**	**B**	**C**	**D**	**21**	**A**	**B**	**C**	**D**		
	P,Q,R	S	R	P,Q,S		1-Q	1,2-P	1-S	3-R		
22	**A**	**B**	**C**								
	S-X	P-Y,R-X	Q-Z								

Q.23

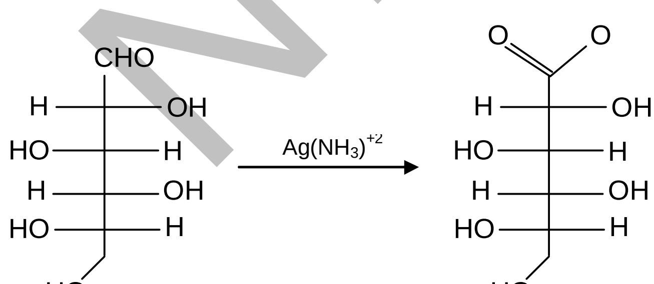


Q.24 3.25

EXERCISE IV

Q.2 (i) Amine, carboxylic acid, Amide, Ester

Q.4

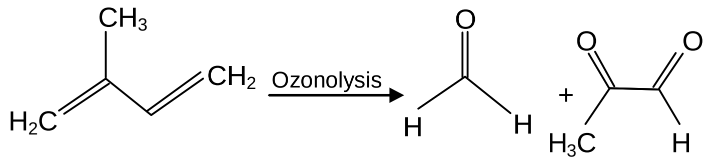


(L-glucose)

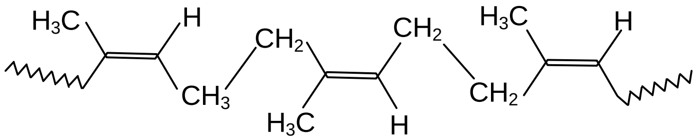
Q.5 B

Q.6 B

Q.7 (a)



(b)



Q.8 D

Q.9 C

Q.10 D

Q.11 (A) P, S; (B) Q, R; (C) P, R; (D) S

Q.12 (A) P, S ; (B) Q; (C) Q, R, S ; (D) Q, R

Q.13 A

Q.14 (A) R, S (B) P,Q (C) P, Q, R (D) P, S

Q.15 B, C

Q.16 D

Q.17. (A)

Q.18. (6)

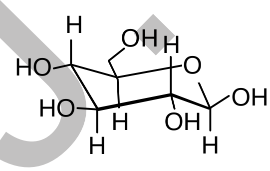
Sol. For n-units of glycine,

$$\frac{n\times 75}{(796+9\times 18)}\times 100=47$$

$\Rightarrow$ n = 6

Q.19. (B)

Sol.



β-pyranose
(Aldohexose)

Biomolecules

Polymers

&

Practical Organic Chemistry

ETOOS Academy Pvt. Ltd.
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1. IIT-JEE Syllabus

Carbohydrates: Classification – mono, di and polysaccharides (Glucose, Sucrose and Starch only); hydrolysis of sucrose. Amino acids and Peptides: General structure and physical properties. Properties and uses of some important polymers (natural rubber, cellulose, nylon, teflon, PVC), Dyes and their application.

8.1 2. Carbohydrates

8.2

8.3 2.1 Introduction

8.4 ***Old Definition:*** The group of compounds known as carbohydrates received their general name because of early observations that they often have the formula $C_x(H_2O)_y$ - that is, they appear to be hydrates of carbon.

Limitations of the old definition: The above definition could not survive long due to the following reasons:

i) A number of compounds such as rhamnose, ($C_6H_{12}O_5$) and deoxyribose ($C_5H_{10}O_4$) are known which are carbohydrates by their chemical behaviour but cannot be represented as hydrates of carbon.

ii) There are other substances like formaldehyde (HCHO, CH_2O) and acetic acid [CH_3COOH, C_2 $(H_2O)_2$] which do not behave like carbohydrates but can be represented by the general formula, $C_x(H_2O)_y$.

New definition: Carbohydrates are defined as polyhydroxy aldehydes or polyhydroxy ketones or substances which give these on hydrolysis and contain at least one chiral carbon atom. It may be noted here that aldehydic and ketonic groups in carbohydrates are not present as such but usually exist in combination with one of the hydroxyl group of the molecule in the form of hemiacetals and hemiketals respectively.

8.5 2.2 Classification

The carbohydrates are divided into three major classes depending upon whether or not they undergo hydrolysis, and if they do, on the number of products formed.

i) ***Monosaccharides:*** The monosaccharides are polyhydroxy aldehydes or polyhydroxy ketones which cannot be decomposed by hydrolysis to give simpler carbohydrates. Examples are glucose and fructose, both of which have molecular formula, $C_6H_{12}O_6$.

$$\underset{\text{glucose or fructose}}{C_6H_{12}O_6} + H_2O \xrightarrow{H^+} \text{No reaction}$$

ii) ***Oligosaccharides:*** The oligosaccharides (Greek, oligo, few) are carbohydrates which yield a definite number (2-9) of monosaccharide molecules on hydrolysis. They include,

a) Disaccharides, which yield two monosaccharide molecules on hydrolysis. Examples are sucrose and maltose, both of which have molecular formula, $C_{12}H_{22}O_{11}$.

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{glucose}}{2C_6H_{12}O_6}$$

b) Trisaccharides, which yield three monosaccharide molecules on hydrolysis. Example is, raffinose, which has molecular formula, $C_{18}H_{32}O_{16}$.

$$\underset{\text{raffinose}}{C_{18}H_{32}O_{16}} + 2H_2O \xrightarrow{H^+} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6} + \underset{\text{galactose}}{C_6H_{22}O_6}$$

c) Tetrasaccharides, etc.

iii) ***Polysaccharides:*** The polysaccahrides are carbohydrates of high molecular weight which yield many monosaccharide molecules on hydrolysis. Examples are starch and cellulose, both of which have molecular formula, $(C_6H_{10}O_5)_n$.

$$\underset{\text{starch}}{(C_6H_{10}O_5)_n} + nH_2O \xrightarrow{H^+} \underset{\text{glucose}}{nC_6H_{12}O_6}$$

In general, the monosaccharides and oligosaccharides are crystalline solids, soluble in water and sweet to taste. They are collectively known as sugars. The polysaccharides, on the other hand, are amorphous, insoluble in water and tasteless. They are called non-sugars.

The carbohydrates may also be classified as either reducing or non-reducing sugars. All those carbohydrates which have the ability to reduce Fehling’s solution and Tollen’s reagent are referred to as reducing sugars, while others are non-reducing sugars. All monosaccharides and the disaccharides other than sucrose are reducing sugars.

8.6 3. Monosaccharides

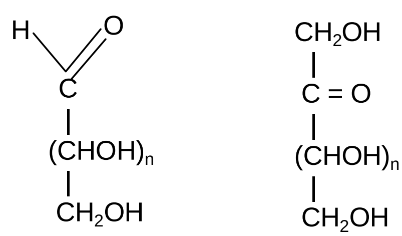
The monosaccharides are the basis of carbohydrate chemistry since all carbohydrates are either monosaccharides or are converted into monosaccharides on hydrolysis. The monosaccharides are polyhydroxy aldehydes or polyhydroxy ketones. There are, therefore, two main classes of monosaccharides.

1. The Aldoses, which contain an aldehyde group $(-\overset{\overset{\displaystyle O}{\|}}{C}-H)$

2. The Ketoses, which contain a ketone group $(-\overset{\overset{\displaystyle O}{\|}}{C}-)$

The aldoses and ketoses are further divided into sub-groups on the basis of the number of carbon atoms in their molecules, as trioses, tetroses, pentoses, hexoses, etc. To classify a monosaccharide completely, it is necessary to specify both, the type of the carbonyl group and the number of carbon atoms present in the molecule. Thus monosaccharides are generally referred to as aldotrioses, aldotetroses, aldopentoses, aldohexoses, ketohexoses, etc.

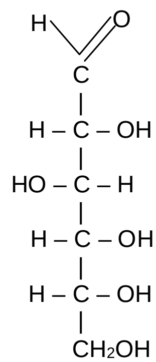
The aldoses and ketoses may be represented by the following general formulas.



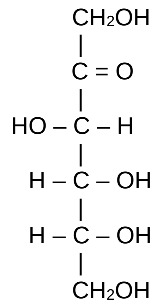
Aldoses (n = 1, 2, 3, 4, 5)

Ketoses (n = 0, 1, 2, 3, 4)

Glucose and fructose are specific examples of an aldose and a ketose.



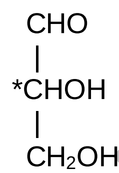
Glucose (an aldohexose)



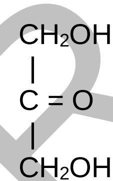
fructose
(a ketohexose)

3.1 Trioses

D and L Terminology: The simplest of all carbohydrates that fit the definition we have given for carbohydrates are the trioses, glyceraldehyde and dihydroxyacetone. Glyceraldehyde is aldotriose, and dihydroxyacetone is a ketotriose.

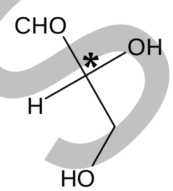


Glyceraldehyde
(an aldotriose)

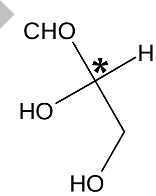


Dihydroxyacetone
(a ketotriose)

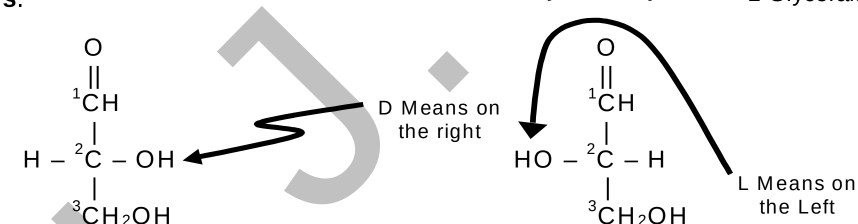
Glyceraldehyde contains one asymmetric carbon atom (marked by an asterisk) and can thus exist in two optically active forms, called the D-form and the L-form. Clearly, *the two forms are mirror images that cannot be superimposed,* that is they are ***enantiomers***.



D-Glyceraldehyde



L-Glyceraldehyde



D-Glyceraldehyde L-Glyceraldehyde

The two forms of glyceraldehyde are especially important because the more complex monosaccharides may be considered to be derived from them. They serve as a reference point for designating and drawing all other monosaccharides. In carbohydrate chemistry, the Fischer projection formulas are always written with the aldehyde or ketone groups at the top of the structure. By definition, *if the hydroxyl group on the asymmetric carbon atom farthest from aldehyde or ketone group projects to the right, the compound is a member of the D-family. If the hydroxyl group on the farthest asymmetric carbon projects to the left, the compound is a member of the L-family.* The maximum number of optical isomers of a sugar is related to the number of asymmetric carbon atoms in the molecule and may be calculated by the following simple equation.

Maximum Number of Optical Isomers = 2^n, where n = the number of asymmetric carbon atoms.

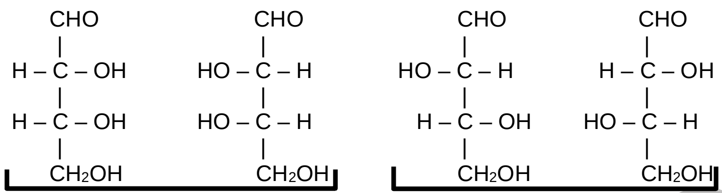
Since glyceraldehyde contains only one asymmetric carbon atom, the number of optical isomer is 2^1. We know that 2^1 is = 2, and we have seen that there are indeed two different glyceraldehydes.

3.2 Aldotetroses

If we examine the general formula of an aldotetrose, we see that they contain two asymmetric carbon atoms (marked by asterisks).

This means that 2^2 or 4 optical isomers are possible. They may be represented as the following two pairs:

1. CHO
   |
2. *CHOH
   |
3. *CHOH
   |
4. CH_2OH an aldotetrose



Mirror images (recemic pair) Mirror images (recemic pair)

D (–)-erythrose L (+)-erythrose D (–)-threose L (+)-threose

All four isomers have been prepared synthetically. The D- and L-erythrose are mirror images, that is, they are enantiomers. They have exactly the same degree of rotation but in opposite directions. Equal amounts of the two would constitute a racemic mixture, that is, a mixture that would allow a plane-polarised light to pass through the solution unchanged but could be separated into detrorotatory and laevorotatory isomers. The same comments hold for D- and L-threose. However, D-erythrose and L-threose are not images, that is, they are diastereomers *(optical isomers that are not mirror images are called diastereomers),* and the degree of rotation of each would probably differ.

3.3 Aldopentoses

If we examine the general formula of an aldopentose, we see that they contain three asymmetric carbon atoms.

This means that 2^3 or 8 optical isomers are possible. These are: - D(–) lyxose, L(+)-lyxose, D(–) xylose, L(–)xylose, D(–) arabinose, L(+)-arabinose, D(–)-ribose, L(+)-ribose

1. CHO
   |
2. *CHOH
   |
3. *CHOH
   |
4. *CHOH
   |
5. CH_2OH

an aldopentose

3.4 Aldohexoses

If we examine the general formula of aldohexose, we see that it contains four asymmetric carbon atoms. This means that 2^4 or 16 optical isomers are possible. D and L forms of altrose, allose glucose, mannose, galactose, talose, arabinose and idose

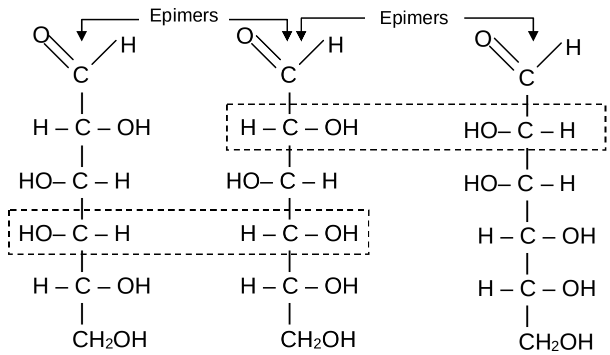
Only three of the sixteen possible aldohexoses are found in nature (all sixteen isomers have been prepared synthetically). They are D-glucose, D-mannose, and D-galactose. No one of these three optical iosmers is a mirror image of any of the others, so all three are diastereomers of each other.

1. CHO
   |
2. *CHOH
   |
3. *CHOH
   |
4. *CHOH
   |
5. *CHOH
   |
6. CH_2OH

an aldohexose

3.5 Epimers

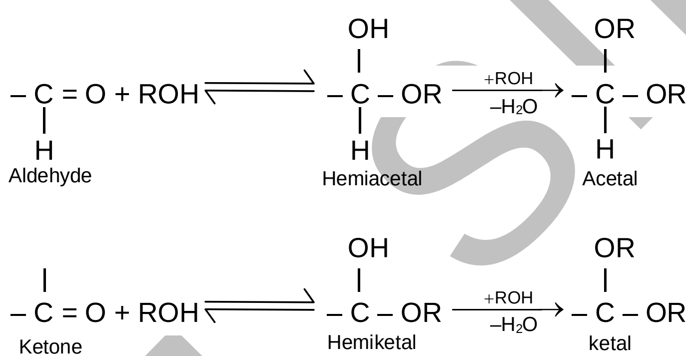
8.7 A pair of diastereomers that differ only in the configuration about of a single carbon atom are said to be epimers. e.g D(+)- glucose is epimeric with D(+) -mannose and D(+) -galactose as shown below:



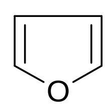
D (+)-Galactose D (+)-Glucose D (+)-Mannose

3.6 Cyclic structure of monosaccharides

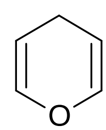
We know that aldoses (and ketoses) react with alcohols to give first hemiacetals (and hemiketals) and then acetals (and ketals), i.e.,



Since monosaccharides contain a number of hydroxyl groups and an aldehyde or a keto group, therefore, any one of the –OH groups (usually C_4 or C_5 in aldohexoses and C_5 or C_6 in ketohexoses) may combine with the aldehyde or the keto group to form intramolecular hemiacetal or hemiketal.



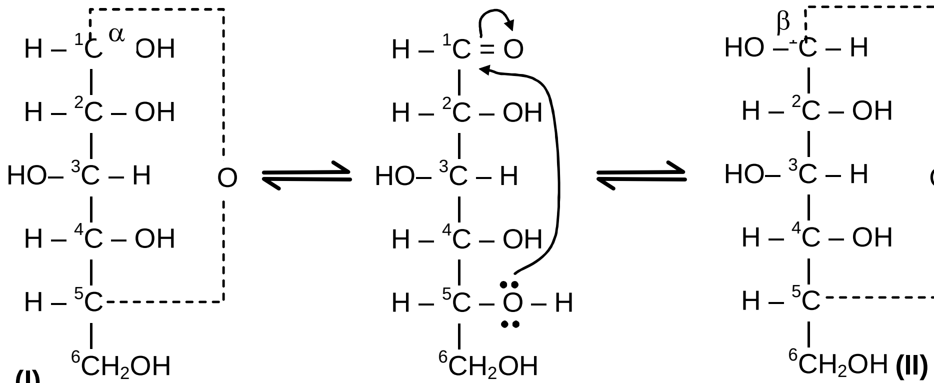
furan



pyran

As a result, the open chain formulae do not represent the actual structures of the monosaccharides. Their actual structures are cyclic involving five or six membered rings containing an oxygen atom. The five membered ring containing one oxygen atom because of its similarity with furan is called the furanose form and the six membered ring containing one oxygen atom because of its resemblance with pyran is called the pyranose form. In nut shell, all the monosaccharides (pentoses and hexoses) in the free state always exist in the pyranose form. However, in the combined state some monosaccharides such as ribose, 2-deoxyribose, fructose etc., usually exist in the furanose form.

3.7 Cyclic structure of Glucose – Anomers



(I) α-D(+)-Glucose or α-D(+)-Glucopyranose

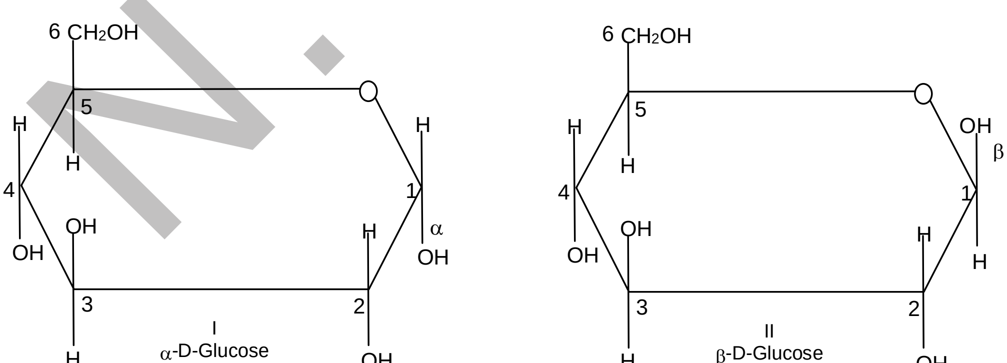
D(+)-Glucose (Open chain form)

(II) β-D(+)-Glucose or β-D(+)-Glucopyranose

We have discussed above that monosaccharides have cyclic hemiacetal or hemiketal structures. To illustrate, let us first consider the example of D-glucose. During hemiacetal formation C_5 – OH of glucose combines with the C_1 – aldehydic group. As a result, C_1 becomes chiral or asymmetric and thus has two possible arrangements of H and OH groups around it. In other words, D-glucose exists in two stereoisomeric forms, i.e., α-D-glucose and β-D-glucose as shown below:

In α-D-glucose, the OH group at C_1 is towards right while in β-D-glucose, the OH group at C_1 is towards left. *Such a pair of stereoisomers which differ in configuration only around C_1 are called* ***anomers*** and the C_1 carbon is called Anomeric carbon (or glycosidic carbon. The cyclic structures of monosaccharides can be better represented by *Haworth Projection formulae*. To get such a formula for any monosaccharide (say α-and β-D-glucose), draw a hexagon with its oxygen atom at the upper right hand corner. Place all the groups (on C_1, C_2, C_3 and C_4) which are present on left hand side in structures I and II, above the plane of the ring and all those groups on the right hand side below the plane of the ring.

The terminal – CH_2OH group is always placed above the plane of the hexagon ring (in D-series). Following the above procedure, Haworth Projection Formulae for α-D-glucose (I) and β-D-glucose (II) are obtained as shown below:

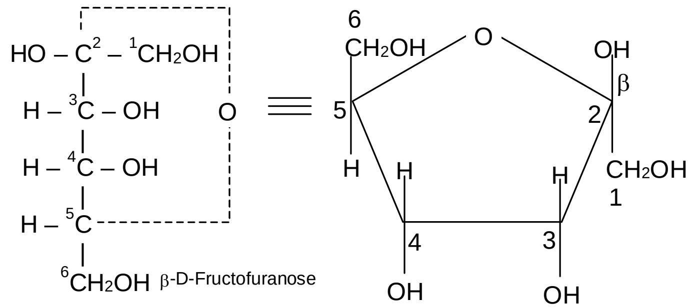


I
α-D-Glucose
or α-D(+)-Glucopyranose

II
β-D-Glucose
or β-D(+)-Glucopyranose

3.8 Cyclic structure of Fructose

Like glucose, fructose also has a cyclic structure. Since fructose contains a keto group, it forms an intramolecular hemiketal. In the hemiketal formation, C_5– OH of the fructose combines with C_2-keto group. As a result, C_2 becomes chiral and thus has two possible arrangements of CH_2OH and OH group around it. Thus, D-fructose exists in two stereoisomeric forms, i.e., α-D-fructopyranose and β-D fructopyranose. However in the combined state (such as sucrose), fructose exists in furanose form as shown below:



β-D-Fructofuranose

3.9 Mutarotation

The two stereoisomeric forms of glucose, i.e., α-D-glucose and β-D-glucose exist in separate crystalline forms and thus have different melting points and specific roations. For example α-D-glucose has a m.p. of 419 K with a specific rotation of +112° while β-D-glucose has a m.p. of 424 K and has a specific rotation of +19°. However, when either of these two forms is dissolved in water and allowed to stand, it gets converted into an equilibrium mixture of α-and β-forms through a small amount of the open chain form.

$$\underset{(36\%)}{\alpha\text{-D-Glucose}} \rightleftharpoons \underset{(0.02\%)}{\text{Open chain form}} \rightleftharpoons \underset{(64\%)}{\beta\text{-D-Glucose}}$$

As a result of this equilibrium, the specific rotation of a freshly prepared solution of α-D-glucose gradually decreases from of +112° to +52.7° and that of β-D-glucose gradually increases from +19° to +52.7°.

$$\underset{[\alpha]_D = +112^\circ}{\alpha\text{-D-Glucose}} \rightleftharpoons \underset{[\alpha]_D = +52.7^\circ}{\text{Equilibrium mixture}} \rightleftharpoons \underset{[\alpha]_D = +19^\circ}{\beta\text{-D-Glucose}}$$

Where $[\alpha]_D$ = specific rotation

This change in specific rotation of an optically active compound in solution with time, to an equilibrium value, is called ***mutarotation****.* During mutarotation, the ring opens and then recloses either in the inverted position or in the original position giving a mixture of α-and-β-forms. All reducing carbohydrates, i.e., monosaccharides and disacchardies (maltose, lactose etc.) undergo mutarotation in aqueous solution.

3.10 Reactions of Glucose

a) With HI/P: It undergoes reduction to form n-hexane while with sodium amalgam it forms sorbitol.

$$\text{Glucose} \xrightarrow{HI/P} \underset{\text{n-hexane}}{CH_3-(CH_2)_4-CH_3}$$

$$\text{Glucose} \xrightarrow{Na/Hg} \underset{\text{s-orbitol}}{CH_2OH-(CHOH)_4-CH_2OH}$$

b) With H_2O: It forms neutral solution

c) With Hydroxylamine (NH_2OH)

$$\text{Glucose} \xrightarrow{NH_2OH} \begin{array}{c} HC = NOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose oxime} \end{array}$$

d) With HCN: It form addition product cyanohydrin

$$\text{Glucose} \xrightarrow{HCN} \begin{array}{c} CN \\ | \\ (CHOH)_5 \\ | \\ CH_2OH \\ \text{Glucose cyanohydrin} \end{array}$$

e) Oxidation: Glucose on oxidation with Br_2 gives gluconic acid which on further oxidation with HNO_3 gives glucaric acid

$$\text{Glucose} \xrightarrow{Br_2/H_2O} \begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Gluconic acid} \end{array} \xrightarrow[\text{Strong oxidation}]{HNO_3} \begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ COOH \\ \text{Glucaric acid} \end{array}$$

f) With Tollen reagent and Fehling solution. Glucose forms silver mirror and red ppt. of Cu_2O respectively.

g) With acetic anhydride. In presence of pyridine glucose forms pentaacetate.

$$\text{Glucose} \xrightarrow[C_5H_5N]{5(CH_3CO)_2O} \begin{array}{c} CHO \\ | \\ (CHOCOCH_3)_4 \\ | \\ CH_2OCOCH_3 \\ \text{Glucose pentaacetate} \end{array}$$

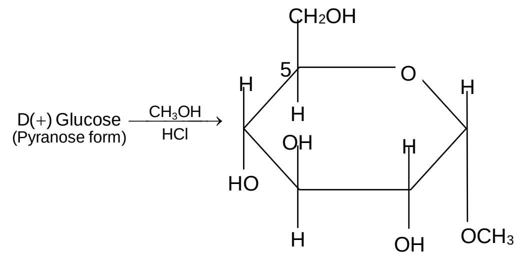
h) With phenylhydrazine: it forms glucosazone

$$\text{Glucose} \xrightarrow[C_5H_5N]{C_6H_5NHNH_2} \begin{array}{c} CH_2OH \\ | \\ (CHOH)_3 \\ | \\ C = NNHC_6H_5 \\ | \\ CH = NNHC_6H_5 \\ \text{(Glucosazone)} \end{array}$$

i) With conc. HCl acid: Glucose gives laevulinic acid

$$\text{Glucose} \xrightarrow{\text{Conc. HCl}} \underset{\text{Laevulinic acid}}{CH_3CO \cdot CH_2CH_2 \cdot COOH} + HCOOH + H_2O$$

j) Glycoside formation: When a small amount of gaseous HCl is passed into a solution of D (+) glucose in methanol , a reaction takes place that results in the formation of amomeric methyl acetals.



Methyl α-D-glucopyranoside
+
Methyl β-D-glucopyranoside

Carbolydrate acetals, genrally are called glycosides and an acetal of glucose is called glucoside.

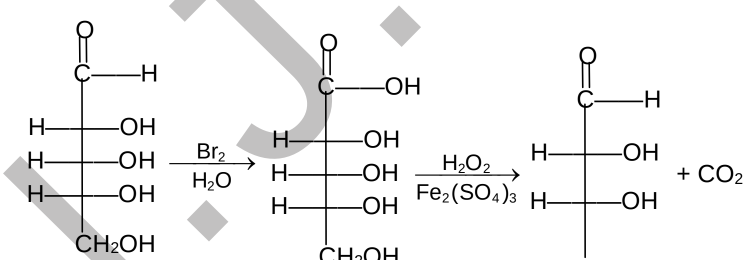
Other reactions

a) *Kiliani - Fischer Synthesis*: - This is a method of lengthening the carbon chain of an aldose. To illustrate, we take synthesis of D-threose and D-erythrose (Aldotetroses) from D-glyceraldehyde (an aldotriose).

Addition to HCN to glyceraldehyde produces two epimeric cyanohydrins because reaction creates a new stereoicenter. The cyanohydrins can be separated easily (since they are diastereomers) and each can be converted to an aldose through hydrolysis, acidification and lactonisation, and reduction with Na—Hg. One cyanohydrin ultimately yields D-erythrose and D-threose.

Here we can see that both sugars are D-sugars because starting compound is D-glyceraldehyde and its stereocentrer is unaffected by its synthesis.

b) *Ruff Degradation:* It is opposite to Kiliani Fischer synthesis that can be used to shorten the chain by a similar unit. The ruff degradation involves (i) Oxidation of the aldose to an aldonic acid using Bromine water. (ii)Oxidative decarboxylation of the aldonic acid to the next lower aldose using H_2O_2 and $Fe_2(SO_4)_3$. D-ribose for example can be reduced to D-erythrose.



D(–) Ribose D–Ribonic acid D(–) -Erythrose

Exercise 1: ***Treatment of (+)– glucose with HIO_4 gives results that confirm its aldohexose structure. What product should be formed, and how much HIO_4 should be consumed.***

8.8 4. Disaccharides

Carbohydrates which upon hydrolysis give two molecules of the same or different monosaccharides are called disaccharides. Their general formula is $C_{12}H_{22}O_{11}$. The three most important disaccharides are sucrose, maltose, and lactose. Each one of these on hydrolysis with either an acid or an enzyme gives two molecules of the same or different monosaccharides as shown below:

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{or Invertase}]{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{or Maltase}]{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Glucose}}{C_6H_{12}O_6}$$

$$\underset{\text{Lactose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{or Lactase}]{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Galactose}}{C_6H_{12}O_6}$$

Disaccharides may also be considered to be formed by a condensation reaction between two molecules of the same or different monosaccharides with the eliminatioin of a molecule of water. This reaction involves the formation of an acetal from a hemiacetal and an alcohol – in which one of the monosaccharides acts as the hemiacetal while the other acts as the alcohol.

4.1 Sucrose

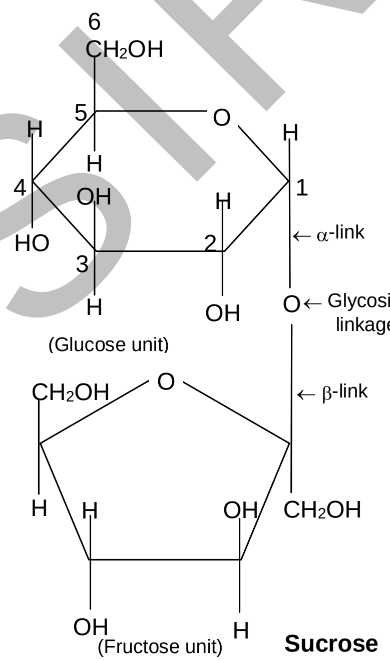
It is formed by condensation of one molecule of glucose and one molecule of fructose. Unlike maltose and lactose, it is non-reducing sugar since both glucose (C_1 - α) and fructose (C_2 - β) are connected to each other through their reducing centres. Its structure is shown below:

Hydrolysis*:* (Invert Sugar or Invertose). Hydrolysis of sucrose with hot dilute acid yields D-glucose and D-fructose.

$$\underset{\substack{\text{Sucrose} \\ [\alpha]_D = +66.5°}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underbrace{\underset{\substack{\text{D-glucose} \\ [\alpha]_D = +53°}}{C_6H_{12}O_6} + \underset{\substack{\text{D-fructose} \\ [\alpha]_D = –92°}}{C_6H_{12}O_6}}_{\text{Invert Sugar}}$$

$$[\alpha]_D = (+53°) – (–92°) = –39°$$

Sucrose is dextrorotatory, its specific rotation being +66.5%, D-glucose is also dextrorotatory, $[\alpha]_D$ = +53°, but D-fructose has a large negative rotation, $[\alpha]_D$ = -92°. Since D-fructose has a greater specific rotation than D-glucose, the resulting mixture is laevorotatory. Because of this the hydrolysis of sucrose is known as the inversion of sucrose, and the equimolecular mixture of glucose and fructose is known is invert sugar or invertose.



Sucrose

8.9 5. Polysaccharides

Polysaccharides are formed when a large number (hundreds to even thousands) of monosaccharide molecules join together with the elimination of water molecule. Thus, polysaccharides may be regarded as condensation polymers in which the monosaccharides are joined together by glycosidic linkages. Some important polysaccharides are:

1. Cellulose
2. Starch
3. Glycogen
4. Gums and
5. Pectins

8.10 5.1 Starch

It is a polymer of glucose. Its molecular formula is $(C_6H_{10}O_5)_n$ where the value of n (200 – 1000) varies from source to source. It is the chief food reserve material or storage polysaccharide of plants and is found mainly in seeds, roots, tubers, etc. Wheat, rice, potatoes, corn, bananas etc., are rich sources of starch.

Starch is not a single compound but is a mixture of two components – a water soluble component called amylose (20%) and a water insoluble component called amylopectin (80%). Both amylose and amylopectin are polymers of α-D-glucose.

Amylose is a linear polymer of α-D-glucose. It contains about 200 glucose units which are linked to one another through α-linkage involving C_1 of one glucose unit with C_4 of the other as shown below:

$$(\text{– Glucose – Glucose – Glucose} \overset{C_1 - C_4 - \alpha\text{-linkage}}{\downarrow\!\text{–}} \text{Glucose –})_n$$

Linear Polymer

Amylopectin, on the other hand, is a highly branched polymer. It consists of a large number (several branches) of short chains each containing 20-25 glucose units which are joined together through α-linkages involving C_1 of one glucose unit with C_4 of the other. The C_1 of terminal glucose unit in each chain is further linked to C_6 of the other glucose unit in the next chain through $C_1 – C_6$ α-linkage. This gives amylopectin a highly branched structure as shown below.-

C_1 — C_4 α-linkage

Glucose — Glucose — Glucose

$\leftarrow C_1$ — C_6 α-linkage

Glucose — Glucose — Glucose

$\leftarrow C_1$ — C_6 α-linkage

Glucose — Glucose — Glucose

Hydrolysis: Hydrolysis of starch with hot dilute acids or by enzymes gives dextrins of varying complexity, maltose and finally D-glucose. Starch does not reduce Tollen's reagent and Fehling's solution.

Uses: It is used as a food. It is encountered daily in the form of potatoes, bread, cakes, rice etc. It is used in coating and sizing paper to improve the writing qualities. Starch is used to treat textile fibres before they are woven into cloth so that they can be woven without breaking. It is used in manufacture of dextrins, glucose and ethyl alcohol. Starch is also used in manufacture of starch nitrate, which is used as an explosive.

8.11 6. Amino Acids

6.1 Introduction and Nomenclature

Amino acids are molecules, which contain two functional groups, one is carboxylic group and another is amino group. Amino acids are derivatives of carboxylic acids in which one hydrogen atom of carbon chain is substituted by Amino group.

Amino group may be at α, β, γ position with respect to carboxylic group

$H_2N — CH_2 — COOH$ Amino acetic acid, or Glycine

$CH_3 — CH\ (NH_2) — COOH$ α - Amino propionic acid or Alanine

$H_2N — CH_2 — CH_2 — COOH$ β - Amino propionic acid

$H_2N — CH_2 — (CH_2)_2 — COOH$ γ - Amino butyric acid

Some amino acids contain a second carboxyl group or a potential carboxyl group in the form of carboxamide: these are called ***acidic amino acid*** some contain a second basic group which may be an amino group these are called ***basic amino acids***.

$$\underset{\displaystyle NH_2}{HOOC - CH_2 - \underset{|}{CH} - COOH}$$

Aspartic acid
(Acidic amino acid)

$$\underset{\displaystyle NH_2}{H_2N - CH_2 - CH_2 - CH_2 - CH_2 - \underset{|}{CH} - COOH}$$

Lysine
(Basic amino acid)

6.2 Physical Properties and Structure

Although the amino acids are commonly shown as containing an amino group and a carboxyl group, certain properties are not consistent with this structure.

1. In contrast to amines and carboxylic acids, the amino acids are nonvolatile solids, which melt at fairly high temperatures.
2. They are insoluble in organic solvents [i.e. non polar solvents] and are highly soluble in water.
3. Their aqueous solution is neutral.
4. Their aqueous solutions behave like solutions of substances of high dipole moment.
5. Acidity and basicity constants are ridiculously low for - COOH and – NH_2 groups

All these properties are quite consistent with a dipolar ion structure for the amino acids (I)

$$^{+}H_3N - CHR - COO^{-}$$

(I)

Amino acid : dipolar ions

In the physical properties melting points, solubility, and high dipole moment are just what would be expected of such a salt.

The acid base properties also become understandable when it is realized that the measured Ka actually refers to the acidity of an ammonium ion, RNH_3^+

$$^{+}H_3NCHRCOO^{-} + H_2O \rightleftharpoons H_3O^{+} + H_2NCHRCOO^{-}$$

$$K_a = \frac{[H_3O^+][H_2NCHRCOO^-]}{[^+H_3N - CH - RCOO^-]}$$

and K_b actually refers to the basicity of a carboxylate ion, $RCOO^-$

$$^{+}H_3N - CH - RCOO^{-} + H_2O \rightleftharpoons {}^{+}H_3N - CHR - COOH + OH^{-}$$

$$K_b = \frac{[^+H_3N - CHR - COOH][OH^-]}{[^+H_3NCHRCOO^-]}$$

When the solution of an amino acid is made alkaline, the dipolar ion(I) is converted to the anion (II); the stronger base, hydroxide ion, removes a proton from the ammonium ion and displaces the weaker base, the amine

$$^{+}H_3N - CHRCOO^{-} + OH^{-} \rightleftharpoons H_2N\ CHRCOO^{-} + H_2O$$

(I)		(II)	
Stronger acid	Stronger base	Weaker base	Weaker acid

When the solution of an amino acid is made acidic; the dipolar ion I is converted into the cation (III); the stronger acid H_3^+O, gives up a proton to the carboxylate ion, and displaces the weaker carboxylic acid.

$$^{+}H_3N\ \ CHRCOO^{-} + H_3O^{+} \rightleftharpoons {}^{+}H_3N\ CHRCOOH + H_2O$$

(I)		(III)	
Stronger base	Stronger acid	Weaker acid	Weaker base

In summary, the acidic group of a simple amino acid like glycine is $-NH_3^+$ not –COOH, and basic group is –COO$^-$ not –NH_2.

Exercise 2: The amino acids in water acts as ampholyte. Explain?

6.3 Iso Electric Point

What happens when a solution of an amino acid is placed in an electric field depends upon the acidity or basicity of solution. In quite alkaline solution.

$$\underset{(II)}{H_2N\text{-}CHRCOO^{-}} \underset{OH^{-}}{\overset{H^{+}}{\rightleftharpoons}} \underset{(I)}{^{+}H_3N.CHRCOO^{-}} \underset{OH^{-}}{\overset{H^{+}}{\rightleftharpoons}} \underset{(III)}{^{+}H_3N.CHRCOOH}$$

Anions (II) exceed cations (III), and there is a net migration of amino acid toward the anode. In quite acidic solution cations (III) are in excess, and there is a net migration of amino acid towards the cathode. If (II) and (III) are exactly balanced, there is no net migration; under such conditions any one molecule exists as a positive ion and as a negative ion for exactly the same amount of time and any small movement in the direction of one electrode is subsequently cancelled by an equal movement back towards the other electrode. The hydrogen ion concentration of the solution in which a particular amino acid does not migrate under the influence of an electric field is called the ***isoelectric point*** of that amino acid.

An amino acid shows its lowest solubility in a solution at the isoelectric point, since here there is the highest concentration of the dipolar ion. As the solution is made more alkaline or more acidic, the concentration of one of the more soluble ions, II or III increases.

If an amino acid has amino group and one carboxyl group, it has two pK values. The isoelectric point (PI) of this amino acid has the average value of the both pK values.

We take example of glycine.

$$\underset{\text{Conjugated acid (CA)}}{H_3^{+}N - CH_2 - COOH} \rightleftharpoons \underset{\text{Dipolar Ion (DI)}}{H_3N^{+} - CH_2 - COO^{-}} + H^{+} \qquad \ldots(1)$$

At equilibrium $K_1 = \dfrac{[DI][H^+]}{[CA]}$

$$\underset{DI}{H_3N^{+} - CH_2 - COO^{-}} \rightleftharpoons \underset{\text{Conjugated Base (CB)}}{H_2N - CH_2 - COO^{-}} + H^{+} \qquad \ldots(2)$$

At equilibrium $K_2 = \dfrac{[CB][H^+]}{[DI]}$

$$[CA] = \frac{[DI][H^+]}{K_1}$$

$$[CB] = \frac{K_2[DI]}{[H^+]}$$

At isoelectric point [CA] = [CB]

$$\frac{[DI][[H_i^+]}{K_1} = \frac{K_2[DI]}{[H_i^+]}$$ Where $[H_i^+]$ = conc. of $[H^+]$ at isoelectric point.

or, $[H_i^+]^2 = K_1\,K_2$

or, $2\log[H_i^+] = \log K_1 + \log K_2$

or $-2\log(H_i^+] = -\log k_1 - \log K_2$

or $2pH_i = pK_1 + pK_2$

or $pH_i = \dfrac{pK_1 + pK_2}{2}$

8.12 7. Peptides

As the amino acid molecules contain both basic as well as acidic group it might be expected that an intermolecular reaction may take place between the carboxyl group of one amino acid and the amino group of another amino acid, with the elimination of a molecule of water.

$$H_2N-\underset{}{\overset{R}{\overset{|}{C}H}}-COOH + H_2N-\overset{R'}{\overset{|}{C}H}-COOH \longrightarrow H_2N-\overset{R}{\overset{|}{C}H}CO-NH-\overset{R'}{\overset{|}{C}H}COOH$$

Since the resulting molecule still has a free amino and a carboxyl group, it may react with other amino acids at either of the ends to give a higher molecular weight linear or condensation product. Every two amino acids are linked by means of a –CO-NH group, which is commonly referred as ***peptide bond***. So now we can define ***a peptides as the amides formed by interaction between amino groups and carboxyl groups of amino acids.***

Depending upon the number of amino acid residues per molecule, they are known as dipeptides, tripeptides and so on and finally polypeptides.

8.13 7.1 Naming of Polypeptide

A convenient way of representing peptide structures by use of standard abbreviations. According to convention the N-terminal amino acid residue [having the free amino group] is written as the left and the C terminal amino acid residue (having the free carboxyl group) at the right end.

A peptide is named by indicating its sequence of amino acids beginning with the N-terminal residue.

$$H_2N-\underset{CH_3}{\underset{|}{C}H}-CONH-\underset{CH_2\text{-}OH}{\underset{|}{C}H}-CONH-\underset{CH_2\text{-}C_6H_5}{\underset{|}{C}H}-CONH-\underset{CH_2\text{-}CONH_2}{\underset{|}{C}H}-CONHCH_2\,COOH$$

Alanine Serine Phenylalamine Asparagine glycine

This pentapeptide is called alanyl-sery-phenylalanyl-asparaginyl-glycine or using the common abbreviations as H-Ala-Ser-phe-Asn-gly-OH. All naturally occurring important peptides, however, posses a shorter individual name.

7.2 Structure of Poly peptides

To identify the structure of a peptide, the peptide in question is first hydrolysed to its constituent amino acids, which are separated and identified. The amount of each amino acid is measured, and hence the number of each kind of amino acid can be calculated.

The next problem is to determine the sequence of the various amino acids constituting the peptide. This is very difficult task, because there is a large number of possibilities in which the constituent amino acids may be linked in the peptide, e.g. even is a dipeptide, having glycine and alanine, the two amino-acids may be present in either of the two ways.

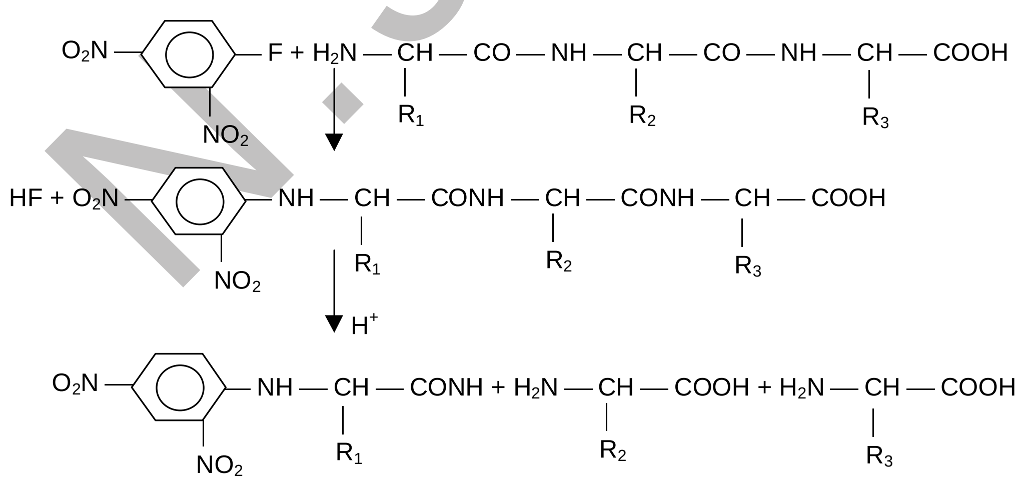
$$H_2N - CH_2 - CO - NH - \underset{\displaystyle |}{\overset{\displaystyle CH_3}{\overset{|}{C}}}H - COOH \qquad H_2N - \overset{\displaystyle CH_3}{\overset{|}{C}}H - CO - NH - CH_2 - COOH$$

Glycylalanine Alanylaglycine

The two structures differ in the respect that in the first the N-terminal amino acid is glycine (i.e. the amino group of glycine is free) and C-terminal amino acid is alanine, while in the latter the N-terminal amino acid is alanine and C-terminal acid is glycine. Various chemical methods have been developed to remove either of the two terminal amino acid residues of a polypeptide in a stepwise manner and hence the arrangement of the various amino acids in a polypeptide can be established.

7.3 Sanger's Method

Sanger reagent, 1-fluoro-2, 4-dinitrobenzene (FDNB) was first used to determine that which amino acid constituted the amino end of the polypeptide. The method consists in treating the polypeptide with the reagent in the presence of sodium-hydrogen-carbonate solution at room temperature to form a 2, 4-dinitrophenyl (DNP) derivative of the polypeptide. The product is hydrolysed be means of acid (which causes the cleavage of the peptide bond connecting the N-terminal amino acid to the rest of the polypeptide molecule) to form dinitrophenyl (DNP) derivative of the N-terminal amino acid and the rest of the polypeptide molecule or amino acid residues.



2, 4 – DNP derivative Aminoacid mixture

8.14 8. Dyes

8.1 Definition

The chemical substances which are used to impart colour to fabrics, foods and other objects for their beautification and distinction are called dyes.

These chemical substances used as dyes are capable of getting fixed to the fabrics permanently and are resistant to the action of water, soap, light, acid and alkalies.

The colour of dyes is attributed to their ability to absorb some wavelengths of visible region of electromagnetic spectrum (380 nm to 760 nm). The part of the colour which reflected back gives the colour of the dye i.e. complementary to the colour absorbed. The colour of visible light absorbed and the complementary colour reflected are listed in table.

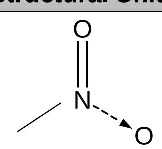
Wave length (nm)	Colour absorbed	Complementary colour
400 – 435	Violet	Yellow, Green
435 – 480	Blue	Yellow
480 – 490	Greenish Blue	Orange
490 – 500	Bluish Green	Red
500 – 560	Green	Purple
560 – 580	Yellowish Green	Violet
580 – 595	Yellow	Blue
595 – 605	Orange	Greenish Blue
605 – 750	Red	Blue, Green

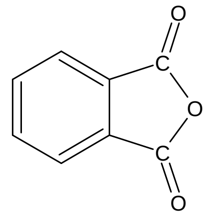
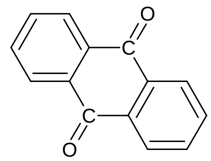
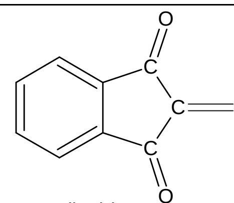
In the earlier days fabrics were coloured by the dyes mainly from Alizarin (red dye) and indigo (blue dye). But now a days, many natural dyes have been synthesized in the laboratory. This helped us to produce dyes of desired shades which otherwise are not available in natural dyes.

8.2 Classification

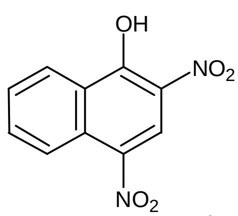
These dyes have been classified into two categories

a) ***Classification based on constitution:*** Depending upon the characteristic structural units the dyes are classified as follows.

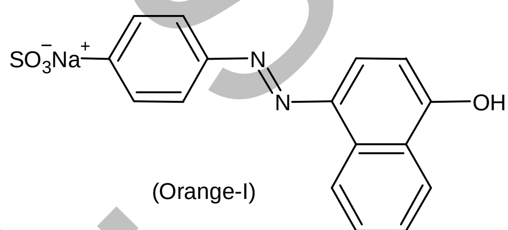
Sl. No.	Type of Dye	Structural Unit	Examples
1.	Nitro dyes	 (Nitro group)	Martius yellow, Naphthol yellow
2.	Azo dyes	– N = N – (azo group)	Orange-I, Orange-II, Congo red
3.	Triphenyl methane dyes	$(C_6H_5)_3C$ –	Malachite green, Rosaniline

4.	Phthalein dyes	 (Phthalein group)	Phenolphthalein, Mercurochrome
5.	Anthraquinone dyes	 (anthraquinone group)	Alizarin
6.	Indigoid dyes	 Indigoid group	Indigo, Tyrian purple

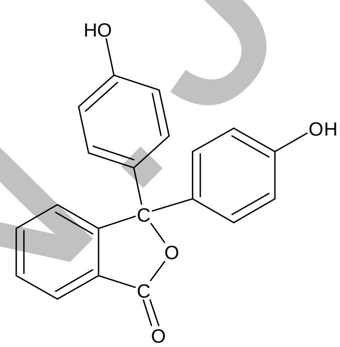
Structures



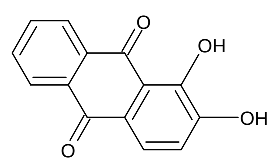
(Martius yellow)



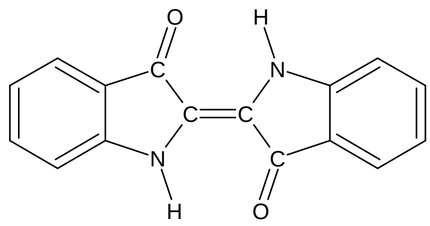
(Orange-I)



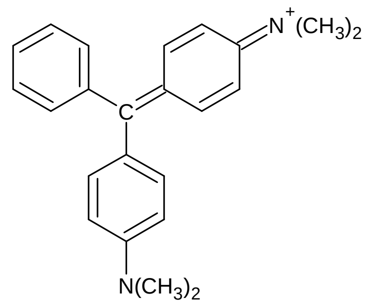
(Phenolphthalein)



(Alizarine)

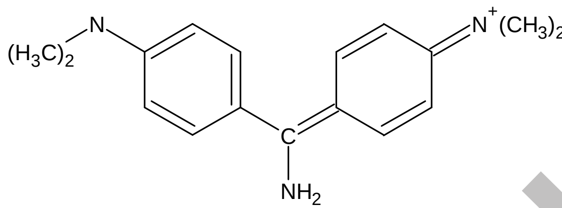


(Indigo)



(Malachite green)

Diphenyl methane dye



Auromine – 0

8.3 Classification Based on Application

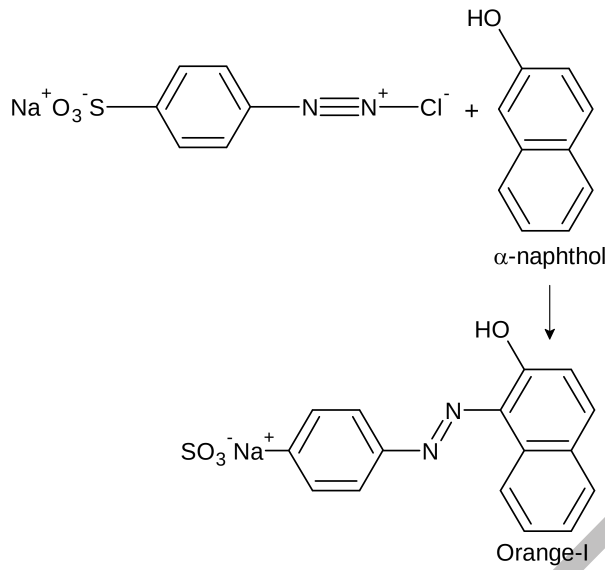
A particular dye may be suitable for one kind of fibre and may be unsuitable for the other. For example, a dye suitable for wool and silk may not be applied or used for dyeing cotton or rayon. Thus based on the class, shade and other properties like resistance to acids, alkalies, and fastness to light a classification of dyes is done, as given below:

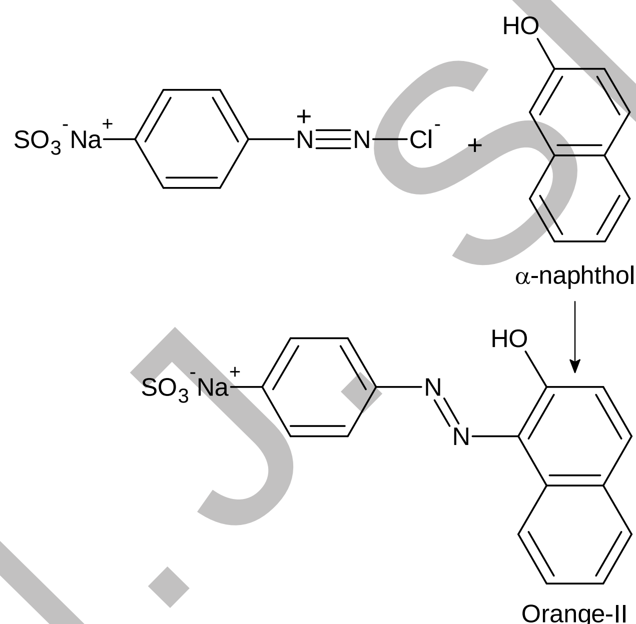
a) Acid dyes
b) Basic dyes
c) Direct dyes
d) Disperse dyes
e) Fibre reactive dyes
f) Vat dyes
g) Insoluble azodyes
h) Mordant dyes

a) ***Acid dyes:*** These dyes are characterised by the presence of acid group like sulphonic acid (– SO_3H), carboxylic acid (– COOH) and phenolic group. The presence of such groups make the dyes more soluble and also serve as the reactive points for fixing the dye to the fibre.

Application: These dyes are applied to wool, silk and nylon. These have no affinity for cotton.

Examples: Orange-I and Orange-II can be obtained by the action of sulphonic compounds with naphthols or by coupling sulphonic compounds with naphthols.



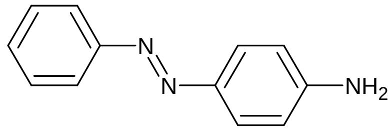


b) ***Basic Dyes:*** These dyes contain ($–NH_2$) group or ($–NR_2$) group as chromophore (colour bearing group) or auxochrome (colour enhancing group). In acidic solutions these form water soluble cations. These dyes use the anionic side on the fabric to get themselves attached.

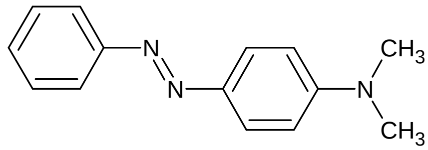
Application: This type of dyes is used to dye nylon, polyester, wool, cotton, leather, paper, etc.

Example

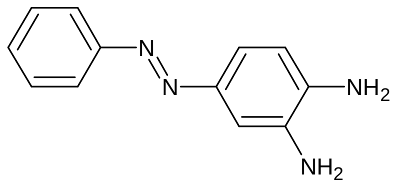
1. Aniline yellow



2. Butter yellow



3. Crysodine G



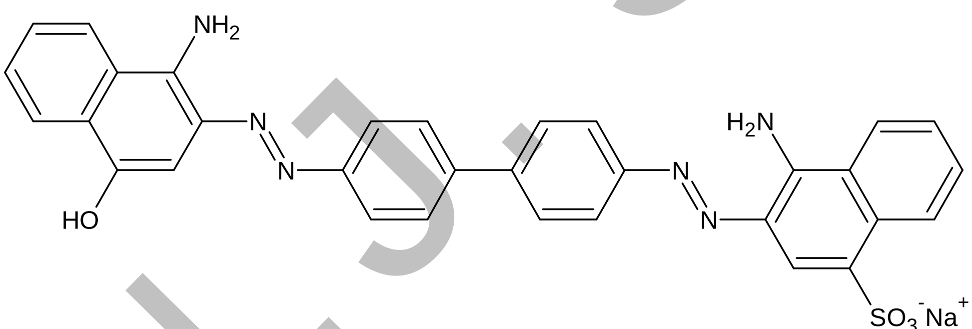
c) **Direct Dyes:** These dyes also belong to the class of azo dyes and are used to dye the fabrics directly by placing it in aqueous solution of the dye. The direct dyes attack the fibre by means of hydrogen bonding.

Application: These are very effective for dying cotton, wool and rayon

Example:

1. Martius yellow

2. Congo Red

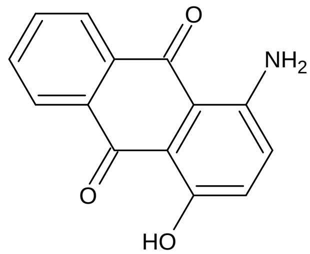


c) ***Disperse Dyes:*** These dyes, as the name signifies, are usually applied in the form of a dispersion of finely divided dye in a soap solution in the presence of phenol, cresol or benzoic acid.

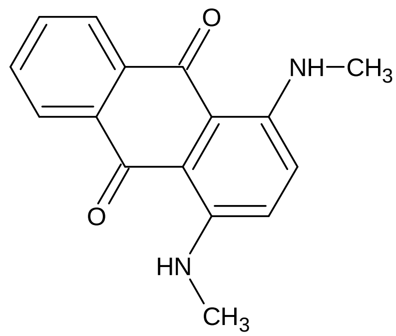
Application*:* These are mainly used to dye rayon, dacron nylon, synthetic fibres, polysters and poly acrylonitrile.

Examples*:*

1. Celliton fast pink B



2. Cellition fast blue B

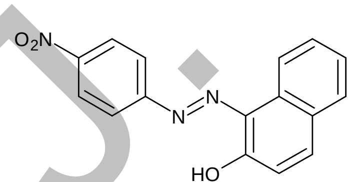


d) **Fibre Reactive Dyes:** These dyes are used to dye fibres like cotton, wool or silk. These are linked to the fibre by virtue of the hydroxy or amino group present on the fibre. These dyes induce fast colour on fibres which is retained for a longer time.

e) ***Insoluble azo dyes:*** The dyes belonging to this class are directly synthesised on the fibre. The fabric to be coloured is soaked in an alkaline solution of phenol or naphthol and is than treated with a solution of diazotised amine to produced the azo dye on the surface of the fabric.

Application: These dyes can be used to dye cotton silk, polyester, nylon, etc.

Example:



(Nitroaniline red)

f) ***Vat Dyes:*** Before being introduced on to fabric these dyes are first reduced to colourless leuco compounds in wooden vats by alkaline reducing agent. The fibre is then soaked in the solution of the dye. After proper absorption of the dye, the fibre is then exposed to air or to an oxidising agent. By doing so the dye gets oxidised to yield insoluble coloured dye on the fabric.

Example: Indigo dye

g) ***Mordant Dyes:*** A dye which imparts different colours to the fabric in the presence of different metal ions (called mordants) is referred to as mordant dye. Nowadays it is rarely used

Application: These dyes are used for dyeing of wool. The method involves the precipitation of certain substances on the fabrics which then combine with the dye with the dye to form an insoluble coloured complex called lake. Depending on the kind of mordant used different colours. For example, Alizarin, a mordant dye, gives red colour with aluminium and tin salts, where as brownish red colour chromium mordant and black violet with iron mordant.

8.15 9. Polymers

9.1 Introduction

Sit quietly and think about your activities today from the morning. You wake up in the morning, You want to brush your teeth. You fetch your toothpaste. The tube is made up of a polymer. Your brush is made up of a polymer. When you want to rinse your mouth, you open your plastic(polymer) tap. The pipe lines used to bring water to your tap is made of PVC(polymer). Skip it. You start preparing your break fast. You take a non-stick tawa. Non-stick? What does that mean? What is it made of? It is poly tetrafluoro ethylene abbreviated as teflon, a polymer. See, how polymers play an important role in our daily life from dawn to dusk. The molded chair in which you are sitting is a polymer. The pen with which I'm writing this is a polymer. Want to know more about polymers? Read further.

Polymers can be called as macromolecules. Macromolecules can be considered as an association of small molecules to give a big molecule. Macromolecules can be man-made, too. The first syntheses were aimed at making substitutes for the natural macromolecules, rubber and silk; but a vast technology has grown up that now produces hundreds of substances that have no natural counterparts. Synthetic macromolecular compounds include: **elastomers,** which have the particular kind of elasticity characteristic of rubber; **fibers**, long, thin and threadlike, with the great strength along the fiber that characterizes cotton, wool, and silk; and **plastics,** which can be extruded as sheets or pipes, painted on surfaces, or molded to form countless objects. We wear these manmade materials, eat and drink from them, sleep between them, sit and stand on them; turn knobs, pull switches, and grasp handles made of them; with their help we hear sounds and see sights remote from us in time and space; we live in houses and move about in vehicles that are increasingly made of them.

8.16 9.2 Polymers and polymerization

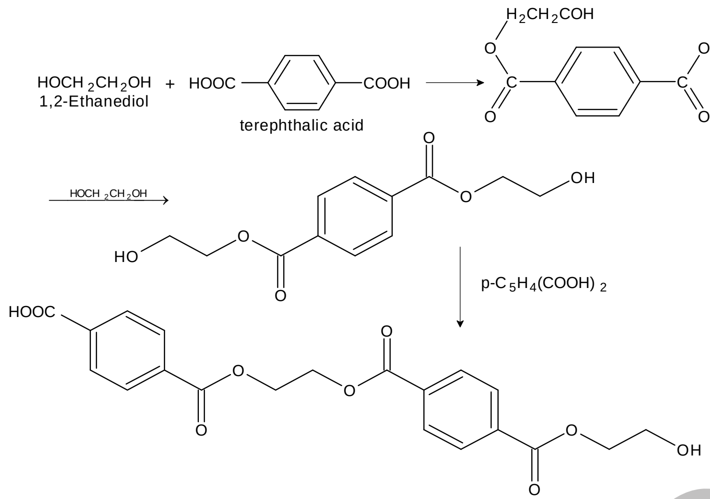
Macromolecules, both natural and man-made, owe their great size to the fact that they are polymers (Greek: many parts); that is, each one is made up of a great many simpler units — identical to each other or at least chemically similar — joined together in a regular way. They are formed by a process we touched on earlier: **polymerization**, the joining together of many small molecules to form very large molecules. The simple compounds from which polymers are made are called monomers.

Polymers are formed in two general ways.

a) ***In chain-reaction polymerization,*** there is a series of reactions each of which consumes a reactive particle and produces another, similar particle; each individual reaction thus depends upon the previous one. The reactive particles can be free radicals, cations, or anions. A typical example is the polymerization of ethylene. Here the chain-carrying particles are free radicals, each of which adds to a monomer molecule to form a new, bigger free radical.

$$\text{Rad.} + CH_2 = CH_2 \longrightarrow RadCH_2CH_2\cdot \xrightarrow{CH_2=CH_2} RadCH_2CH_2CH_2CH_2\cdot \longrightarrow \text{etc.}$$

b) ***In step reaction polymerization, t***here is a series of reactions each of which is essentially independent of the preceding one; a polymer is formed simply because the monomer happens to undergo reaction at more than one functional group. A diol, for example, reacts with a dicarboxylic acid to form an ester; but each moiety of the simple ester still contains a group that can react to generate another ester linkage and hence a larger molecule, which itself can react further, and so on.



8.17 a) Free-radical vinyl polymerization: In we discussed briefly the polymerization of ethylene and substituted ethylenes under conditions where free radicals are generated — typically in the presence of small amounts of an initiator, such as a peroxide. Reaction occurs.

$$nCH_2=\underset{G}{\underset{|}{CH}} \xrightarrow{\text{initiator}} -CH_2\underset{G}{\underset{|}{CH}}CH_2\underset{G}{\underset{|}{CH}}CH_2\underset{G}{\underset{|}{CH}}CH_2\underset{G}{\underset{|}{CH}}-$$

Vinyl monomer

$$\text{or } (-CH_2\underset{G}{\underset{|}{CH}}-)_n$$

Polymer

At the doubly bonded carbons — the vinyl groups — and is called *vinyl polymerization*. A wide variety of unsaturated monomers may be used, to yield polymers with different *pendant groups* (G) attached to the polymer backbone. For example.

$$CH_2=\underset{Cl}{\underset{|}{CH}} \longrightarrow -CH_2-\underset{Cl}{\underset{|}{CH}}-CH_2-\underset{Cl}{\underset{|}{CH}}-CH_2-\underset{Cl}{\underset{|}{CH}}-$$

Vinyl chloride   Poly (vinyl chloride) (PVC)

$$CH_2=\underset{CN}{\underset{|}{CH}} \longrightarrow CH_2-\underset{CN}{\underset{|}{CH}}-CH_2-\underset{CN}{\underset{|}{CH}}-CH_2-\underset{CN}{\underset{|}{CH}}-CH_2-\underset{CN}{\underset{|}{CH}}-$$

Acrylonitrile   Polyacrylonitrile (Orlon)

$$CH_2=\underset{C_6H_5}{\underset{|}{CH}} \longrightarrow CH_2-\underset{C_6H_5}{\underset{|}{CH}}-CH_2-\underset{C_6H_5}{\underset{|}{CH}}-CH_2-\underset{C_6H_5}{\underset{|}{CH}}-$$

Styrene   Polystyrene

b) Copolymerization: So far, we have discussed only polymerisation of a single monomeric compound to form a *homopolymer,* a polymer made up — except, of course, at the two ends of the long molecule — of identical units.

Now, if a mixture of two (or more) monomers is allowed to undergo polymerization, there is obtained a **copolymer** a polymer that contains two (or more) kinds of monomeric units in the same molecule. For example:

$$\underset{\text{Styrene}}{\underset{\underset{Ph}{|}}{CH_2 = CH}} + \underset{\text{Methyl methacrylate}}{CH_2 = \overset{\overset{CH_3}{|}}{\underset{\underset{COOCH_3}{|}}{C}}} \xrightarrow{\text{initiator}} \underset{\text{Polystyrene (co-methyl methacrylate)}}{- CH_2 - \underset{\underset{Ph}{|}}{CH} - CH_2 - \overset{\overset{CH_3}{|}}{\underset{\underset{COOCH_3}{|}}{C}} -}$$

Through copolymerization there can be made materials with different properties than those of either homopolymer, and thus another dimension is added to the technology. Consider, for example, styrene. Polymerized alone, it gives a good electric insulator that is molded into parts for radios, television sets, and automobiles. Copolymerization with butadiene (30%) adds toughness; with acrylonitrile (20-30%) increases resistance to impact and to hydrocarbon; with maleic anhydride yeilds a material that, on hydrolysis, is water-soluble, and is used as a dispersant and sizing agent. The copolymer in which butadiene predominates (75%) butadiene, 25% styrene) is an elastomer, and since World War II has been the principal rubber substitute manufactured in the United States.

Copolymers can be made not just from two different monomers but from three, four, or even more. They can be made not only by free-radical chain reactions, but by any of the polymerization methods we shall take up; ionic, coordination, or step-reaction. The monomer units may be distributed in various ways, depending on the technique used. As we have seen, they may alternate along a chain, either randomly or with varying degrees of regularity. In block copolymers sections made up of one monomer alternate with sections of another:

$$— M_1M_1M_1M_1M_1 – M_2M_2M_2M_2 — \qquad \text{Block copolymer}$$

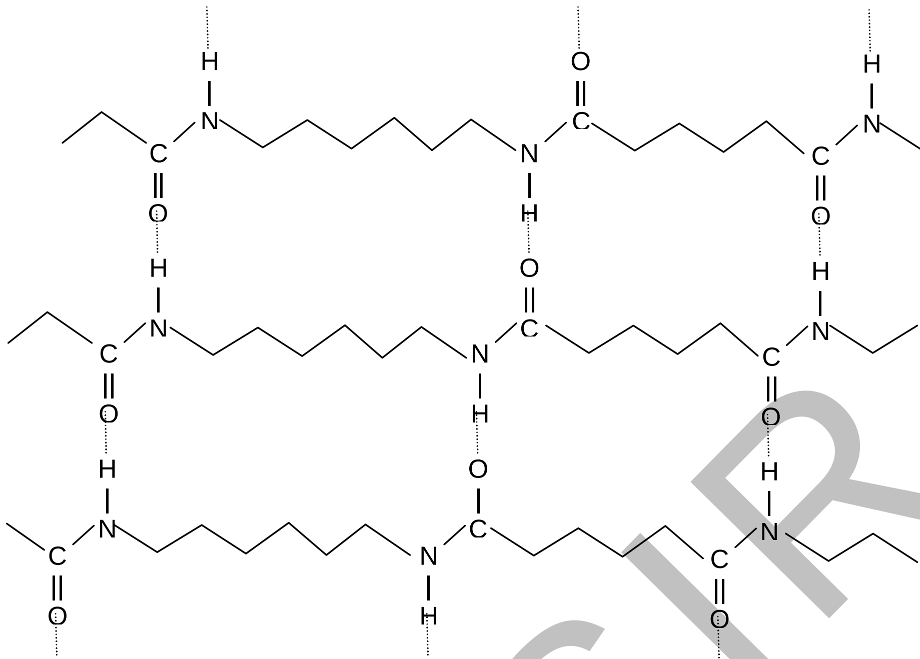
If graft copolymers, a branch of one kind is grafted to a chain of another kind:

$$— \underset{\underset{M_2M_2M_2M_2}{|}}{M_1}M_1M_1M_1M_1M_1M_1 —$$

Fibres are long thin, threadlike bits of material that are characterized by great tensile (pulling) strength in the direction of the fiber. The natural fibres – cotton, wool, silk – are typical. Fibres are twisted into threads, which can then be woven into cloth, or embedded in plastic material to impart strength. The tensile strength can be enormous, some synthetic fibres rivaling – on a weight basis – steel.

The gross characteristics of fibres are reflected on the molecular level – the molecules, too, are long, thin, and threadlike. Furthermore, and most essential, they lie stretched out alongside each other, lined up in the direction of the fiber. The strength of the fiber resides, ultimately, in the strength of the chemical bonds of the polymer chains. The lining-up is brought about by drawing – stretching — the return to random looping and coiling is overcome by strong intermolecular attractions. In a fiber, enthalpy wins out over entropy. This high degree of molecular orientation is usually — although not always — accompanied by appreciable crystallinity.

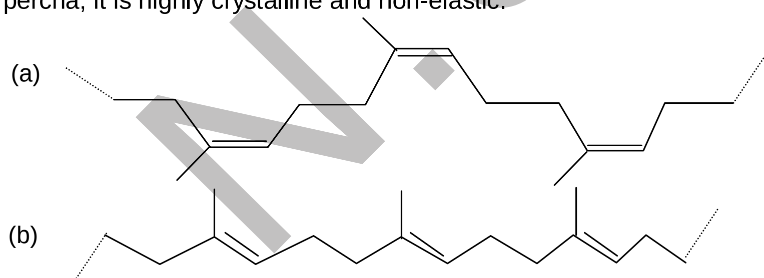
An **elastomer** possesses the high degree of elasticity that is characteristic of rubber: it can be greatly deformed — stretched to eight times its original length, for example — and yet return to its original shape. Here, as in fibres, the molecules are long and thin; as in fibres, they become lined up when the material is stretched. The big difference is this: when the stretching force is removed, the molecular chains of an elastomer do not remain extended and aligned but return to their original random conformations favored by entropy. They do not remain aligned because the intermolecular forces necessary to hold them that way are weaker than in a fiber. In general, elastomers do not contain highly polar groups or sites for hydrogen bonding; the extended chains do not fit together well enough for Vander Waals forces to do the job. In an elastomer entropy beats enthalpy.



Hydrogen bonding in crystallites of nylon-6,6

One further requirement the long chains of an elastomer must be connected to each other by occasional cross – links: enough of them to prevent slipping of molecules past one another; not so many as to deprive the chains of the flexibility that is need for ready extension and return to randomness.

Natural rubber illustrates these structural requirements of an elastomer; long flexible chains; weak intermoecular forces and occasional cross – linking. Rubber is cis 1,4-polyisoprene . With no highly polar substituents, intermolecular attraction is largely limited to van der Waals forces. But these are weak because of the all – cis configuration about the double bond. Figure below compares the extended chains of rubber with those of its trans stereoisomer. As we can see, the trans configuration permits highly regular zig – zags that fit together well; the cis configuration does not. The all-trans stereoisomer occurs naturally as gutta percha; it is highly crystalline and non-elastic.



Extended chains of (a) natural rubber, cis-1,4 –polyisoprene, and of (b) gutta percha, its trans stereoiosmer.

Chief among the synthetic elastomers is SBR, a copolymer of butadiene (75%) and styrene (25%) produced under free-radical conditions; it competes with natural rubber in the main use of elastomers, the making of automobile tires. All-cis polybutadiene and polyisoprene can be made by Ziegler – Natta polymerization.

An elastomer that is entirely or mostly polydiene is, of course, highly unsaturated. All that is required of an elastomer, however, is enough unsaturation to permit cross-linking. In making butyl rubber for example, only 5% of isoprene is copolymerized with isobutylene.

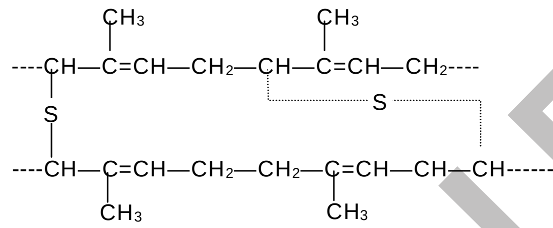
Exercise 3: What is the difference between addition and condensation polymersiation give an examples.

Some Important Polymers:

a) *Natural Rubber:* Natural rubber is an addition polymer of isoprene (2-methyl-1,3-butadiene)

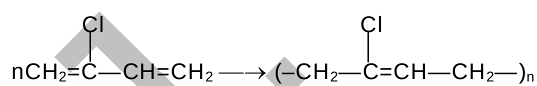
Rubber has an average chain length of 5000 monomer units of isoprene.

The rubber in which the arrangement of carbon chain is trans with respect to the double bond is known as ***Gutta Percha*** and this is the natural rubber obtained from bark of various trees. Natural rubber is sticky material. This disadvantage is removed by 'VULCANISATION' which involves addition of sulphur to rubber and heating the mixture. sulphur forms short chains of sulphur atoms that link two hydrocarbon (isoprene) units together.



When tension is applied the chains can strengthen out but they cannot slip past each other because of sulphur bridges. Thus rubber can be stretched only to a certain extent and hydrocarbon chains have the tendency to regain their shape when tension is removed. Vulcanised rubber is thus stronger and less sticky than the natural rubber.

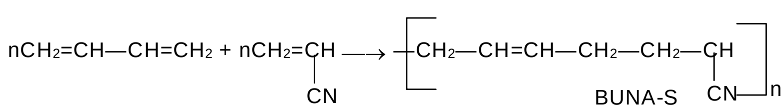
b) *Synthetic rubber*: (Polychloroprene) or Neoprene) It is obtained by free radical polymerisation of chloroprene in



it is a thermoplastic and need not to be vulcanised. It is a good general purpose rubber and superior to natural rubber as it is resistant to the reaction of aire, heat, light chemicals, alkalis and acids below 50% strength. It is used for making transmission belts, printing rolls and flexible tubing employed for conveyence of oil and petrol.

c) *Buna rubbers*: Butadiene polymerises in the presence of sodium to give a rubber substitute viz. BuNa. It is of two types

i) Buna - N or GRA: it is synthetic rubber obtained by copolymerisation of one part of acryl nitrile and two parts of butadiene.



It is more rigid responds less to heat and very resistant to swelling action of petorol, oils and other organic solvents.

ii) Buna -S or GRS (General purpose Styrene rubber): It is a copolymer of three moles of butadiene and one mole of styrene\ and is an elastomer. It is obtained as a result of free radical copolymerisation of its monomers.

$$nC_6H_5CH{=}CH_2 + nCH_2{=}CH{-}CH{=}CH_2 \rightarrow [-CH_2{-}CH{=}CH{-}CH_2{-}\underset{\displaystyle C_6H_5}{\underset{|}{C}H}{-}CH_2{-}]_n$$

BUNA-S

It is generally compounded with carbon black and vulcanised with sulphur. It is extremely resistant to wear and tear and finds use in manufacture of tyres and other mechanical rubber goods.

d) Teflon: It is polymer of tetrafluorethylene ($F_2C{=}CF_2$) which on polymerisation gives Telfon.

$$nCF_2{=}CF_2 \xrightarrow{(NH_4)_2S_2O_8\ \ 870-1020K} (-CF_2-CF_2-)_n$$

It is thermoplastic polymer with a high softening point (600K). It is very tough and difficult to work. It is inert to most chemicals except fluorine and molten alkali metals. It withstands high temperatures. Its electrical properties make it an ideal insulating material for high frequency installation.

e) Nylon -66: It is a polymer resin. It is a condensation polymer formed by reaction between adipic acid and hexamethylene diamine. Both monomer units consist of 6 carbon atoms and therefore named nylon -66.

$$HO-\overset{\displaystyle O}{\overset{\|}{C}}-(CH_2)_4-\overset{\displaystyle O}{\overset{\|}{C}}-OH + H-\overset{\displaystyle H}{\overset{|}{N}}-(CH_2)_6-NH_2 \xrightarrow{-H_2O}$$

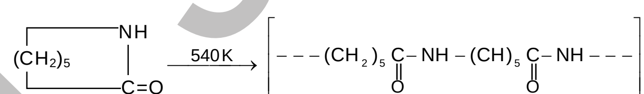
$$\left[--\overset{\displaystyle O}{\overset{\|}{C}}-(CH_2)_4-\overset{\displaystyle O}{\overset{\|}{C}}-\overset{\displaystyle H}{\overset{|}{N}}-(CH_2)_6-NH---\right]$$

Nylon−66

(A condensation copolymer)

It is thermoplastic polymer when extruded above its melting point (536 K) through spinneret, it gives nylon fiber which is extremely tough and resistant to friction. It possess greater tensile strength, elasticity and lusture than any natural fiber. It is chemically inert and is fabricated into sheet, bristles and textile fibres.

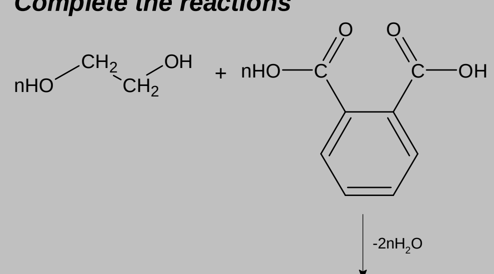
f) Nylon 6 or Perolon - L: A polyamide is prepared by prolonged heating of caprolactam at 530 - 540 K.



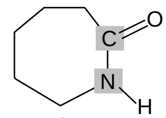
Nylon – 6

The fiber is practically identical to Nylon in properties

Exercise 4: ***Complete the reactions***



Exercise 5: ***a) What is the structure of nylon-6, made by alkaline polymerisation of caprolactom?***



Caprolactam

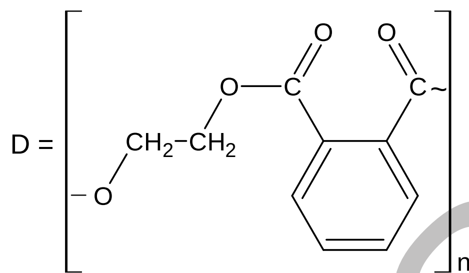
b) Suggest a mechanism for the process. Is polymerisation of the chain reaction or step reaction type?

8. Solutions to Exercise

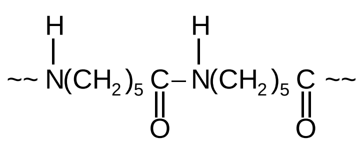
Exercise 1: Since in glucose there are five –OH groups so five moles of HIO_4 are consumed giving main product formic acid and formaldehyde as shown below :

$$\text{Glucose} + 5HIO_4 \longrightarrow 5HCOOH + HCHO$$

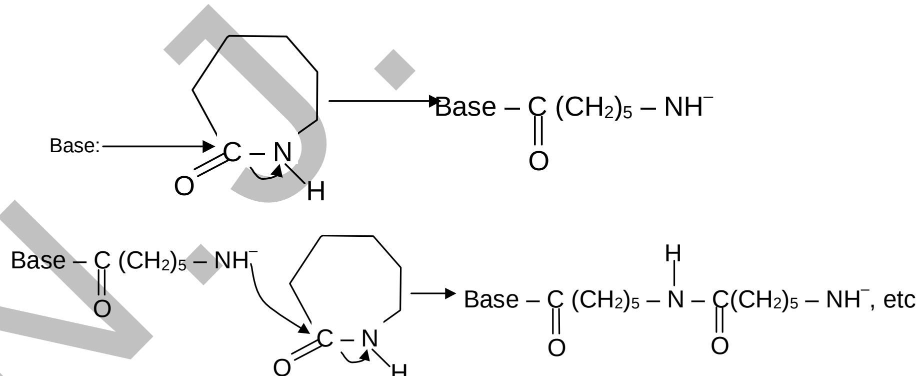
Exercise 4:



Exercise 5: a)



b)



The reaction is anionic chain reaction polymerization, involving nucleophilic substitution at the acyl group of the cyclic amide. The base could be OH^- itself or the anion formed by abstraction of the –NH proton from a molecule of lactam.

9. Solved Problems (Subjective)

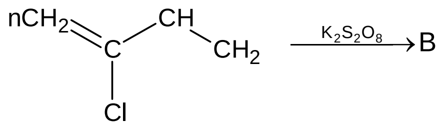
9.1 Subjective

Complete the reactions (Question 1 to 3)

Problem 1: $nCF_2 = CF_2 \xrightarrow[\text{heat, high pressure}]{A} (–CF_2 – CF_2 –)_n$ ***Teflon***

Solution: $A = (NH_4)_2S_2O_8$

Problem 2:

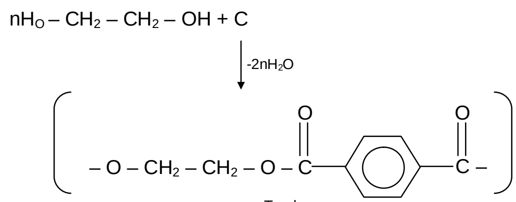


Solution:

$$B = \left(-CH_2 - \underset{\displaystyle |\atop Cl}{C} = CH = CH_2 - \right)_n$$

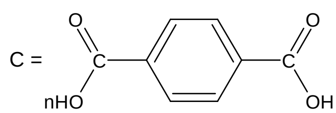
neprene

Problem 3:



Terelene

Solution:



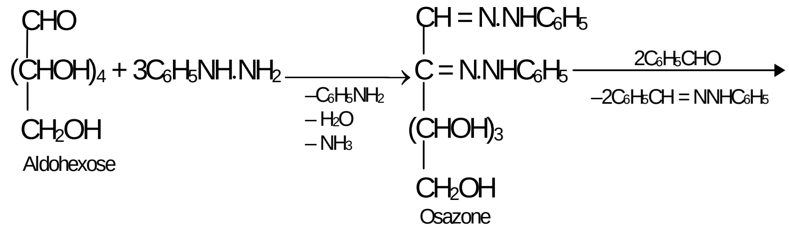
Terephathalic acid

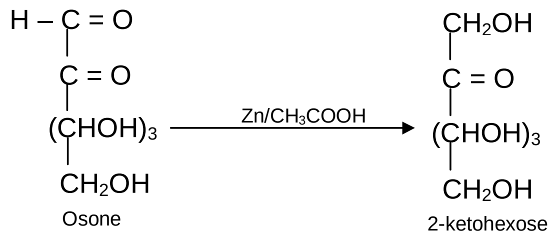
Problem 3: ***Give the classification of polymers obtained from esters of acrylic acid (CH_2 = CH.COOH)***

Solution:

Formula of monomer	***Polymer***	***Characteristics***	***Uses***
$H_2C{=}C(CH_3)COOC_2H_5$ methylacrylate	$(-H_3C-C(CH_3)(COOCH_3)-)_n$ Polymethylacrylate	***Hard transparent, high optical clarity. It is capable of acquiring different colours and tints***	***Lenses, transparent object domes and skylights plastic jewellery***
$H_2C{=}C-COOC_2H_5$ ethyl acrylate	$(-H_2C-CH(COOC_2H_5)-)_n$ Polyethylacrylate	***Tough and rubbery polymer***	***Similar to above***
$OH_2{=}CH-CN$ acrylonitrile	$(-H_2C-C(CN)-)_n$ Polyacrylonitrile	***Hard, horney and high melting material***	***Used in preparing cloth, carpets and blankets***

Problem 4: ***a) Show how an aldohexose can be used to synthesize 2-ketohexose. (b) Since glucose is converted to fructose by this method, what can you say about the configurations of C^3, C^4 and C^5 in the sugars.***





Here aldohexose reacts with one molecule of phenylhyrazine which condenses with the aldehyde group to give phenylhydrazone. When warmed with excess of phenyl hydrazine, the secondary alcoholic group adjacent to the aldehyde group is oxidised by another molecule of phenylhydrazine, to a ketonic group. With this ketonic group, the third molecule of phenylhydrazine condenses to give osazone. The phenylhydrazinyl group is transferred from osazone to C_6H_5CHO giving $C_6H_5CH = N{\cdot}NHC_6H_5$ and a dicarbonyl compound called an osone. The more reactive aldehyde group of the osone is reduced, not the less reactive keto group and it gives the 2-ketohexose.

b) The configurations of these carbons which are unchanged in the reactions, must be identical in order to get the same osazone.

Problem 5: ***a) Supply structures for H through K. Given:***

An aldohexose $\xrightarrow{NH_2OH\ /\ base} H \xrightarrow{Ac_2O\ /\ NaOAc} I \xrightarrow{-HOAC} J \xrightarrow{NaOMe\ /\ MeOH}$ ***K.***

b) Explain the last step (c). What is net structural change (d) Name this overall method. (e) Discuss the possibility of epimer formation.

Solution:

a) H is an oxime $HOCH_2(CHOH)_4CH = NOH$; I is the completely acetylated oxime, $AcOCH_2(CHOAc)_4CH = NOAc$ that loses 1 mole of HOAc to form J, $AcOCH_2(CHOAc)_4\,C{\equiv}N$; K is an aldopentose, $HOCH_2(CHOH)_3CHO$.

b) The acetates undergo transesterification to give methyl acetate freeing all the sugar OH's. This is followed by reversal of HCN addition.

c) There is loss of one C from the carbon chain.

d) Wohl degradation

e) The α-CHOH becomes the –CH = O without any configurational changes of the other chiral carbons. Thus no epimers are formed.

Problem 6: ***Although both polymers are prepared by free radical processes, poly (vinyl chloride) is amorphous and poly (vinylidene chloride) (saran) is highly crystallilne. How do you account for the different? (vinylidene chloride is 1,1-dichloroethene).***

Solution:

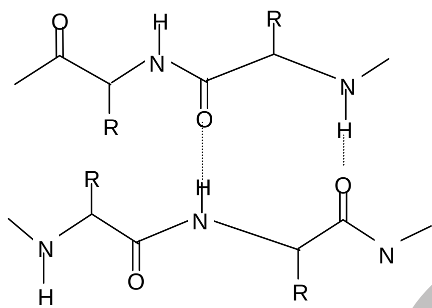
Poly (vinyl chloride) PVC   Poly (vinylidene chloride) saran

As poly (vinyl chloride) is able to show stereoisomerism and further it is formed by a free radical process, it is atactic (chlorine atoms distributed randomly), the molecules fit together poorly.

Poly (vinylidene chlroide) has two identical substituents on each carbon and the chains fit together well.

Problem 7: ***Show the fundamental unit of structure common to all polypeptides and proteins and show how cross linking occurs between two chains by H - bonding.***

Solution:



Problem 8: ***How will you synthesize Alanine from acetylene.***

Solution:

$$CH\equiv CH \xrightarrow[H_2SO_4,HgSO_4]{H_2O} CH_3CHO \xrightarrow[NH_3]{HCN} CH_3-CH\begin{matrix}CN\\NH_2\end{matrix} \xrightarrow{H_3^+O} CH_3-CH\begin{matrix}COOH\\NH_2\end{matrix}$$

Alanine

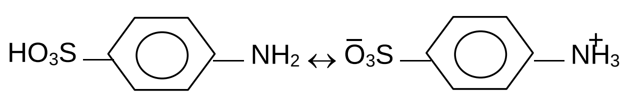
8.18 ***Problem 9:*** ***Glycine exists as ($H_3N^+CH_2COO^-$) while anthranilic acid (P–NH_2–C_6H_4 – COOH) does not exist as dipolar ion.***

Solution: –COOH is too weakly acidic to transfer H^+ to the weakly basic –NH_2 attached to the electron withdrawing benzene ring. When attached to an aliphatic carbon, the –NH_2 is sufficiently basic to accept H^+ form –COOH group.

Problem 10:
i) Sulphanilic acid although has acidic as well as basic group, it is soluble in alkali but insoluble in mineral acid

ii) Sulphanilic acid is not soluble in organic solvents.

Solution:
i) Sulphanilic acid exist as Zwitterion

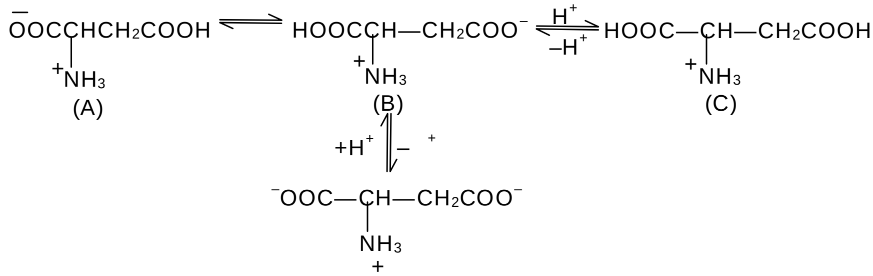


The weakly acidic –$^+NH_3$ transfers H^+ to OH^- to form a soluble salt, P–NH_2–C_6H_4–$SO_3^-Na^+$ on the other hand $-SO_3^-$ is too weakly basic to accept H^+ from strong acids.

ii) Due to its ionic character it is insoluble in organic solvents.

Problem 11: ***Why should isoelectric point for Aspartic acid (2.98) be so much lower than that of leucine?***

Solution: This may be explained by considering following ion equilibria



It is apparent that ions (A) and (B) are neutral, while (C) is a cation and (D) is dianion. In species (D), the anion is derived from the second —COOH group present in aspartic acid and is not possible in leucine. At neutral pH a significant concentration of (D), will be present in aqueous solution. It will therefore, be necessary to decrease the pH of such a solution if the formation of (D) is to be suppressed to a stage where anions and cations are present in equal concentration (the isoelectric point).

9.2 Objective

Problem 1: ***Nylon-66 is a polyamide of***

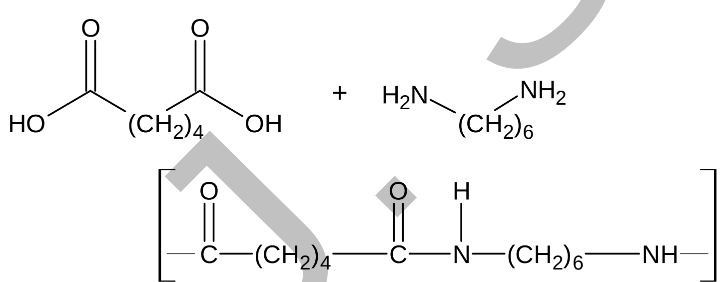
(A) Vinylchloride and formaldehyde

(B) Adipic acid and methyl amine

(C) Adipic acid and hexamethylene diamine

(D) Formaldehyde and melamine

Solution:



$\therefore$ **(C)**

Problem 2: ***Which of the following is not a condensation polymer?***

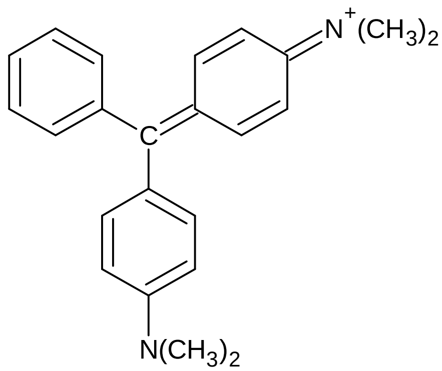
(A) Glyptal ***(B) Nylon-66***
(C) Dacron ***(D) PTFE***

Solution: Others are condensed polymer
$\therefore$ **(C)**

Problem 3: ***Which of the following is an example of basic dye?***

(A) Alizarine ***(B) Indigo***
(C) Malachite ***(D) Orange – I***

Solution:



$\therefore$ **(C)**

Problem 4: ***Which of the following is not a chromophone?***

(A) – NH_2 ***(B) – NO***

(C) – NO_2 ***(D) – N = N –***

Solution: Chromophore is colour bearing group

$\therefore$ **(A)**

Problem 5: ***Which of the following is a natural fibre?***

(A) Starch ***(B) Cellulose***

(C) Rubber ***(D) Nylon-6***

Solution: **(B)**

EXERCISE – I

Q.1 Which of the following statement is not correct for maltose.

(A) It is a disaccharide

(B) It undergoes mutarotation

(C) It is a reducing sugar

(D) It does not have hemiacetal group

Q.2 Identify the correct statement about lactose.

(A) It consists of one galactose and one glucose unit

(B) Mutarotation is not possible

(C) Anomeric carbon of galactose is attached to 4′ carbon of glucose which is β-1, 4′-glycoside bond.

(D) Lactose is used to cleave the β-1, 4′-glycoside bond

Q.3 Which of the following carbohydrates would be most abundant in the diet of strict vegetarian?

(A) Amylose (B) Glycogen (C) Cellulose (D) Maltose

Q.4 Which of the following statements about the structure of glycogen is true.

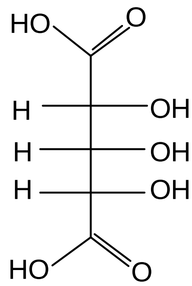
(A) Glycogen is a copolymer of glucose and galactose

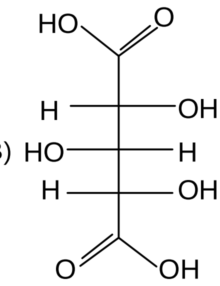
(B) There are more branch residues than residues in straight chains.

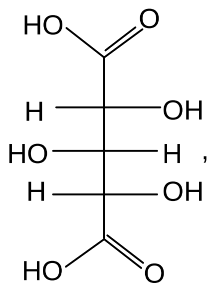
(C) The monosaccharide residue alternate between D and L-glucose

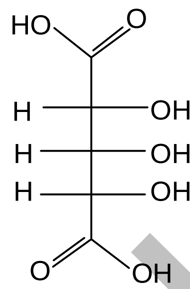
(D) New glucose molecules are added to the C-2 aldehyde group of chain termini forming a hemiacetal.

Q.5 D-Ribose when treated with dilute HNO_3 forms

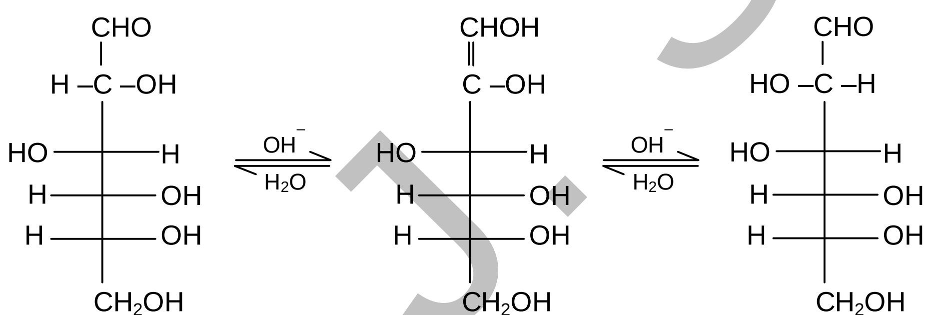
(A)  , Achiral

(B)  , Chiral

(C)  , Achiral

(D)  , Chiral

Q.6 Consider the given process.



(I) (II) (III)

and identify the incorrect statement.

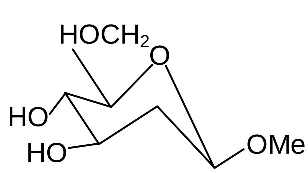
(A) Configuration at C-2 is lost on enolisation

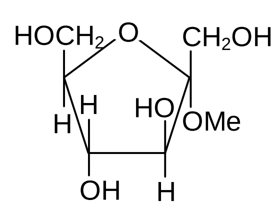
(B) I and III are epimers

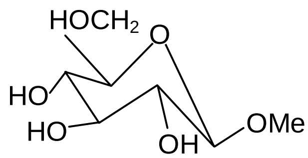
(C) Proton transfer from water to C-1 converts ene diol to an aldose

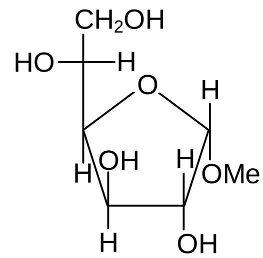
(D) D-glucose can isomerise to D-fructose through enol intermediate.

Q.7 Consider the given structure and select the incorrect statement:









(A) (I) Hydrolyse much faster than (III)

(B) (III) Hydrolyse much faster than (I)

(C) (II) Hydrolyse much faster than (IV) in acidic medium

(D) Compound (IV) is methyl-α-D-glucofuranoside

Q.8 Select the **incorrect** statement:

(A) Starch is a homopolymer of glucose forming an α-glycosidic chain

(B) Maltose and Lactose are disaccharides

(C) Cellulose has only β-D-glucose unit which are joined by glycosidic linkage between C_1 of one glucose unit and C_4 of another glucose unit

(D) The structure of glycogen is similar to amylose

Q.9 When methyl D-glucopyranaside is treated with HIO_4 its number of mole consumed per mole of the sugar is :

(A) 2 (B) 3 (C) 4 (D) 5

Q.10 α- amino acid when heated with BaO forms.

(A) α,β-unsaturated acid(B) α, β-unsaturated amine

(C) Carboxylic acid (D) Amine

Q.11 The configuration of the C-2 epimer of D-glucose is:

(A) 2R, 3S, 4R, 5S (B) 2S, 3S, 4R, 5R

(C) 2S, 3R, 4S, 5R (D) 2R, 3S, 4R, 5R

Q.12 Mutaratation involve:

(A) Racemisation

(B) Diastereomerisation

(C)Optical resolution

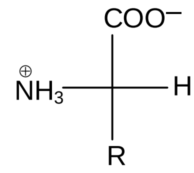
(D) Conformational inversion

Q.13 Consider the reaction sequence-

$$\text{Glucose} \xrightarrow[\text{excess}]{PhNHNH_2} P \xrightarrow[\Delta]{H_3O^+} Q \xrightarrow[\text{AcOH}]{\text{Zn}} R$$

The product R is-

(A) Arbinose (B) Sorbitol (C) Fructose (D) Mannose

Q.14 The pH of the solution containing following zwitter ion species is 

(A) 4 (B) 5 (C) 7 (D) 9

Q.15 Peptide linkage is:

(A) $-\overset{\overset{\displaystyle O}{\|}}{C}-O-$ (B) $-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2$ (C) $-\overset{\overset{\displaystyle O}{\|}}{C}-NH-$ (D) $-\overset{\overset{\displaystyle O}{\|}}{C}-NH-NH_2$

Q.16 Same osazone derivative is obtained in case of D-glucose, D-Mannose and D-Fructose due to:

(A) the same configuration at C-5

(B) the same constitution

(C) the same constitution at C-1 and C-2

(D) The same constitution and acid configuration at C-3, C-4, C-5 and C-6 but different constitution and configuration at C-1 and C-2 which becomes identical by osazone formation

Q.17 D(–) –Erythrose $\xrightarrow{NaBH_4}$ (P)

D(–) – Threose $\xrightarrow{NaBH_4}$ (R)

Which of the following statement is correct about P and R?

(A) Both are optically active

(B) Both are optically inactive

(C) P is optically inactive and R is optically active

(D) Neither P nor R has asymmetric carbon

Q.18 The monomer of nucleic acids are held together by

(A) Phosphoester linkage (B) Amide linkage

(C) Glycosidic linkage (D) Ester linkage

Q.19 Select the incorrect statement:

(A) Manufacture of paints require glyptal (B) Water pipes are made up of PVC

(C) Bakelite has free carbonyl group (D) Polystyrene is $\left(CH_2-\underset{}{\overset{\overset{\displaystyle C_6H_5}{|}}{C}}H\right)_n$

Q.20 Select incorrect statement about Nylon 2- nylon-6.

(A) It is a copolymer

(B) It is biodegradable

(C) It is an alternating polyamide

(D) It is made up of $CH_3-\underset{\underset{\displaystyle NH_2}{|}}{C}H-COOH$ and $H_2N(CH_2)_5COOH$.

Q.21 Which of the following cannot be used as drying agent for a liquid organic compound

(A) Anhydrous $CaCl_2$ (B) Anhydrous K_2CO_3

(C) Metallic sodium in the form of wires (D) Anhydrous H_2SO_4

Q.22 The ferrox reagent used for detection of oxygen present in a given compound contains:

(A) $K_4[Fe(CNS)_6]$ (B) $K_3[Fe(NCS)_6]$

(C) $Fe[Fe(CNS)_6]$ (D) $Fe[Fe(NCS)_6]$

Q.23 When N and S both present the Lassaignes test is sometimes incomplete due to formation of

(A) Na(CNS) (B) Na(NCS)

(C) NaCN (D) Na_2S

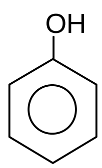
Q.24 The polymer formed as a result of following sequence of reaction is:

$$2HC \equiv CH \xrightarrow{CuCl} HC \equiv CH - CH = CH_2 \xrightarrow[NH_4Cl]{1.\ HCl \quad 2.\ Cu_2Cl_2} CH_2 = \underset{\displaystyle Cl}{\underset{|}{C}} - CH = CH_2$$

$$\xrightarrow{\text{polymerisation}} -\!\!\left[CH_2 - \underset{\displaystyle Cl}{\underset{|}{C}} = CH = CH_2 \right]$$

(A) Saran (B) PVC (C) Neoprene (D) Chloroprene

Q.25 Consider the reaction-



$$\xrightarrow[(ii) H_3O^+]{(i) CHCl_3 + NaOH} P(\text{major}) + Q(\text{minor})$$

Mixture of A and B can be best separated by-

(A) Steam distillation (B) Vacuum distillation

(C) Fractional distillation (D) Crystallisation

Q.26 Select the incorrect statement-

(A) The Lassaigne's filtrate must be clear and colourless solution

(B) Presence of colour in Lassaigne's filtrate indicates incomplete fusion

(C) The Lassaigne's filtrate solution is alkaline

(D) The Lassaigne's filtrate solution must be neutral

Q.27 When Na-extract is added to small amount of freshly prepared $FeSO_4$ solution and small amount of NaOH a green coloured precipitated is obtained. This indicates.

(A) Presence of SN (B) Presence of $Fe(OH)_2]$

(C) Presence of $Fe(CN)_2$ (D) Presence of $Na_4[Fe(CN)_6]$

Q.28 Consider the following sequence

$$\underset{\text{Freshly prepared sol}^n.}{Na\ (\text{extract}) + FeSO_4} \xrightarrow{NaOH} \underset{\text{Solution (Filtrate)}}{(A)} \xrightarrow[H_2SO_4]{Dil.HCl/} \text{Green colour}$$

The presence of green colour confirm the presence of

(A) N (B) S

(C) O (D) N and S both

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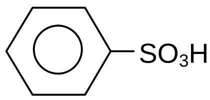
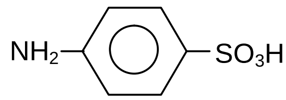
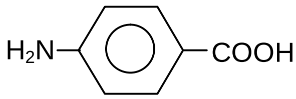
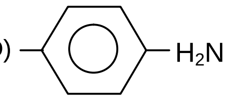
Q.29 When solidum extract is treated with $FeCl_3$ solution a blood red coloured is obtained due to the presence of :

(A) 

(B) 

(C) 

(D) 

Q.30 The monomer that undergo radical polymerization most easily is
(A) $CH_2 = CH_2$
(B) $C_6H_5CH = CH_2$
(C) $CH_2 = C(Me)Me$
(D) $CH_3 - CH = CH_2$

Q.31 The monomer that can undergo radical, cationic and anionic polymerization with equal case :
(A) $Me - C(Me) = CH_2$
(B) Ph–CH = CH_2
(C) $CH_2 = CH_2$
(D) CH_2 = CH –CN

Q.32 Select the incorrect statement about polymer
(A) Polymers do not carry any charge
(B) Polymers have high viscosity
(C) Polymers scattered light
(D) Polymers have multiple bond

EXERCISE – II

Q.1 Carbohydrates may be:
(A) Sugars
(B) Starch
(C) Polyhydroxy aldehyde/ketones
(D) Compounds that can be hydrolysed to sugar

Q.2 Select the correct statement:
(A) S-glyceraldehyde is also known as L-glyceraldehyde
(B) The configuration of the stereocenter most distant from the carbonyl group determines whether a monosaccharide is D or L.
(C) Glucose and all naturally occurring sugars are D-sugars
(D) D-erythrose and D-threose are diastereomers

Q.3 Select the incorrect statement.
(A) Monosaccharide are insoluble in organic solvents like diethyl ether.
(B) Anomers of a cyclic monosaccharides differ in the position of the OH group at the hemiacetal carbon.
(C) D-ribose the OH group used to form the five membered furanose ring is located on C_4
(D) Aldopentoses and ketohexoses form pyranose rings in solution.

Q.4 Select the correct statement.
(A) Glycosides do not undergo mutarotation
(B) All OH groups of a cyclic monosaccharides are converted to ethers by treatment with base and an alkyl halide
(C) α- D glucose reacts with Ag_2O and excess CH_3I to form tetramethyl ether
(D) D-glucose upon treatment with warm HNO_3 forms D-glucaric acid

Q.5 All disaccharides may have
(A) One acetal
(B) Two acetal

(C) One acetal and One hemiacetal (D) Two hemiacetal

Q.6 Starch molecules are polymer with repeating glucose units. Select the correct statement(s).
(A) Glucose units are joined through α-glycosidic linkage
(B) The branches of amylopectin are linked to the chain with α-1,6′-glycosidic linkages
(C) The linear linkages of amylopectin are formed by α-1,6′-glycosidic bond
(D) Amylose has an unbranched skeleton of glucose molecules with α-1, 4′-glycosidic linkages.

Q.7 Select the correct statement:
(A) Proteins upon hydrolysis gives α-amio acid only
(B) Except glycine, all other naturally occurring α-amino acids are optically active.
(C) In fibrous proteins polypeptide chains are held together by hydrogen and disulphide bonds
(D) Keratine is insoluble in water

Q.8 Select the correct statement:
(A) Coiling of polypeptide chain form fibrous protein
(B) Quarternary structure of protein also exist
(C) Lysine is an amino acid with basic side chain
(D) The absolute configuration of $H_3\overset{+}{N}-CH(CH_2OH)COO^-$ (L-serine) is S.

Q.9 Select the correct statement:
(A) All proteins are polyamides formed by joining amino acids together.
(B) All L-amino acids except cysteine have the S-configuration.
(C) All amino acids are 1° amines except praline.
(D) Proline is a 2° amine consisting of five membered ring.

Q.10 Select the correct option:
(A) Isoelectric point is the pH at which an amino acid exists primarily in its neutral form.
(B) Isoelectric point is the average of pK_a values of α-COOH amino α-NH_3^+ groups [valid only for neutral amino acid].
(C) Glycine is characterised by two pK_a values.
(D) For neutral amino acid the concentration of zwitter ion is maximum at its isoelectric point.

Q.11 Amino acids are synthesised from:
(A) α-Halo acids by reaction with NH_3.
(B) Aldehydes by reaction with NH_3 and cyanide ion followed by hydrolysis.
(C) Alkyl halides by reaction with the enolate anion derived from diethyl acetamidomalonate and hydrolysis.
(D) Alcohols by reaction with NH_3 and CN^- ion followed by hydrolysis.

Q.12 Which of the following carbohydrates developes blue colour on treatment with iodine solution?
(A) Glucose (B) Amylose (C) Starch (D) Fructose

Q.13 Select the correct statement:
(A) High density polythene is a linear polymer.
(B) Low density polythene is a branched chain polymer.
(C) Chain growth polymers are also known as addition polymer.
(D) Step growth polymer is also known condensation polymer.

Q.14 Select the correct statement:
(A) Chain growth polymerisation takes place through radical, cation or anion intermediate.
(B) A synthetic polymer is polydisperse
(C) $\overline{M}n$ is given by $\frac{1}{N}\sum_i M_iN_i$, where N_i in the number of molecules with molar mass M_i and there are N molecules.
(D) Weight average molar mass is inversely proportional to the mean square molar mass

Q.15 Select the correct statement:

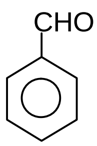
(A) Elastomers have the weakest intermolecular forces
(B) Buna-N is an elastomer with crosslinks
(C) Some fibres have crystalline nature
(D) Thermoplastic polymers have stronger intermolecular forces than fibres

Q.16 Consider the given sequence of reaction

$$\text{Na(extract)} + \text{Dil. } HNO_3 \xrightarrow{\Delta} \text{Filtrate (A)} + \underset{\text{Violet}}{(B)\uparrow}$$

$$\text{Filtrate} \xrightarrow{\text{Cool } AgNO_3} \underset{\text{(white)}}{(C)\downarrow} \xrightarrow{NH_4OH} \text{Clear solution}$$

Select the correct statement:
(A) Na extract contains Br^- and I^- together
(B) B is vapour of I_2
(C) The clear solution contains AgCl
(D) The clear solution contains $[Ag(NH_3)_2]^+$

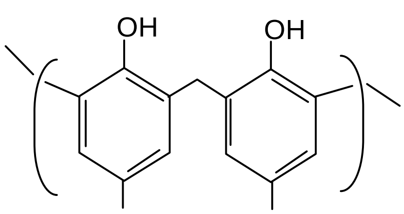
Q.17  $+ AC_2O \xrightarrow{AcONa} (P)$

Before isolating (P) unreacted Ph–CHO is removed first. Select the correct statement:
(A) P is cinnamaldehyde
(B) Removal of PhCHO is done by passing steam into the mixture
(C) Removal is done by simple distillation
(D) P is cinnamic acid

Q.18 Match the column:

Column-I		Column-II
(A) Sucrose	(P)	Two acetals
(B) Maltose	(Q)	No hemiacetal
(C) Lactose	(R)	β-1,4′-glycosidic bond
(D) Cellulose	(S)	Hydrolysis product is glucose

Q.19 Match the column:

Column-I		Column-II
(A) $-\!\!\left(CH_2 - \underset{\underset{Cl}{\mid}}{C} = CH - CH_2\right)\!\!-_n$	(P)	Thermoplastic polymer
(B) $-\!\!\left(\overset{\overset{H}{\mid}}{N} - (CH_2)_6 - \overset{\overset{H}{\mid}}{N} - \overset{\overset{O}{\parallel}}{C} - (CH_2)_4 - \overset{\overset{O}{\parallel}}{C}\right)\!\!-_n$	(Q)	Thermosetting polymers
(C) $-\!\!\left(CH_2 - \overset{\overset{Cl}{\mid}}{CH}\right)\!\!-_n$	(R)	Fibres
(D) 	(S)	Elastomer

Q.20 Match the column:

Column-I (Component of mixture)	**Column-II (Reagent)**
(A) Crystalline Na_2CO_3 + Sodium citrate + $CuSO_4$(aq. sol.)	(P) Fehling solution
(B) $CuSO_4$ + Rochelle Salt + NaOH (Aq. sol.)	(Q) Nesseler's Reagent
(C) 10% α-naphthol in alcohol	(R) Bennedict's solution
(D) HgCl + KI + KOH (aq. sol.)	(S) Molisch's Reagent

EXERCISE – III

Assertion Reason:

Q.1 **Statement I :** Furanose ring. like pyranose rings are not planar.
Statement II : The most stable conformation of furanose is envelope form.
(A) Statement- I is true, statement- II is true and statement- II is correct explanation for statement- I
(B) Statement- I is true, statement- II is true and statement- II is NOT correct explanation for statement- I
(C) Statement- I is true, statement- II is false.
(D) Statement- I is false, statement- II is true.

Q.2 **Statement I :** Bromine water changes glucose to gluconic acid
Statement II : Bromine water acts as oxidising agent
(A) Statement- I is true, statement- II is true and statement- II is correct explanation for statement- I
(B) Statement- I is true, statement- II is true and statement- II is NOT correct explanation for statement- I
(C) Statement- I is true, statement- II is false.
(D) Statement- I is false, statement- II is true.

Q.3 **Statement I :** All monosaccharide ketoses are reducing sugars.
Statement II : Monosaccharide ketose give positive Tollen's and Fehling's test
(A) Statement- I is true, statement- II is true and statement- II is correct explanation for statement- I
(B) Statement- I is true, statement- II is true and statement- II is NOT correct explanation for statement- I
(C) Statement- I is true, statement- II is false.
(D) Statement- I is false, statement- II is true.

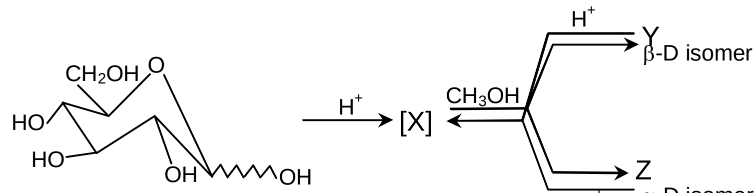
Q.4 **Statement I :** Amylose chain adopts a helical arrangement
Statement II : Presence of α-1,4′-glycosidic bonds force to adopt a helical shape.
(A) Statement- I is true, statement- II is true and statement- II is correct explanation for statement- I
(B) Statement- I is true, statement- II is true and statement- II is NOT correct explanation for statement- I
(C) Statement- I is true, statement- II is false.
(D) Statement- I is false, statement- II is true.

Q.5 **Statement I :** PHBV is a biodegradable polymer.
Statement II : PHBV undergoes bacterial degradation in the environment.
(A) Statement- I is true, statement- II is true and statement- II is correct explanation for statement- I

(B) Statement- I is true, statement- II is true and statement- II is NOT correct explanation for statement- I
(C) Statement- I is true, statement- II is false.
(D) Statement- I is false, statement- II is true.

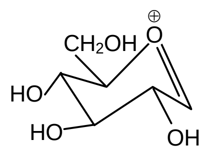
Comprehension (6 to 8)

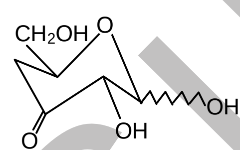
Consider the following reversible process for a reaction of D-glucose.

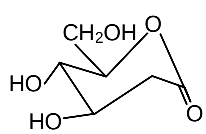


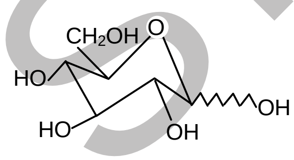
D-glucose
(α or β form)

Q.6 The structure of intermediate [X] is:

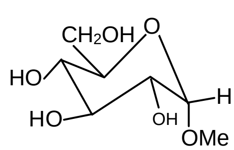
(A) 

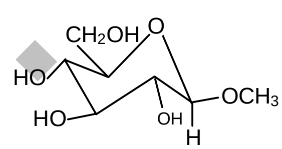
(B) 

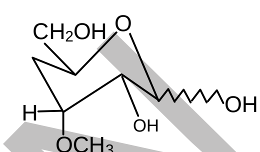
(C) 

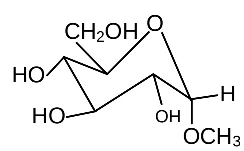
(D) 

Q.7 Select the correct option:

(A) Y is 

(B) Z is 

(C) Y is 

(D) Z is 

Q.8 Select the correct statement.
(A) Y is more stable than Z due to H-bond
(B) Y is less stable than Z due to anomeric effect
(C) Y is more stable than Z due to anomeric effect
(D) Y is less stable than Z due to H-bond

Comprehension (9 to 11)
Consider the given data for a given sample of.

Molar mass Interval/Kg mol^{-1}	Average molar mass within Internal/Kg mol^{-1}	Mass of sample within Interval/g
5-10	7.5	9.60
10-15	12.5	8.70
15-20	17.5	8.75

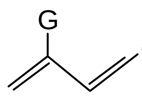
20-25	22.5	5.6

Q.9 The number average molar mass in kg mol^{-1} is:
(A) 10.25 (B) 11.91 (C) 12.87 (D) 13.65

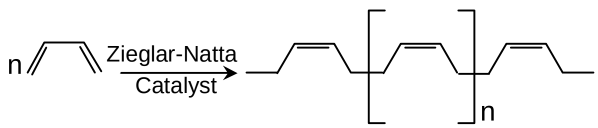
Q.10 The weight average molar mass in kg mol^{-1} is:
(A) 8.76 (B) 10.36 (C) 12.06 (D) 14.16

Q.11 The polydispersity index of the polymer is:
(A) 0.29 (B) 0.84 (C) 1.18 (D) 2.1

Comprehension (Q.No.12 to Q. 14)

The monomer 

(G = Me or Cl) when treated with Zieglar-Natta catalyst undergo polymerisation in the manner given below-



cis-poly-1,3-butadiene

Q.12 The Zieglar-Natta catalyst is:
(A) $TiCl_4$ (B) R_3Al (C) $R_3Al/TiCl_4$ (D) $R_3B/TiCl_4$

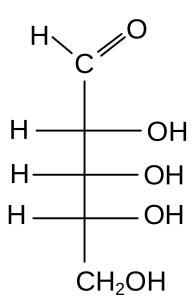
Q.13 The polymer obtained when monomeric unit used is $CH_2 = \underset{}{\overset{Cl}{\overset{|}{C}}} -CH = CH_2$
(A) Neoprene (B) Stilbene (C) Styrene (D) Chlopropicrin

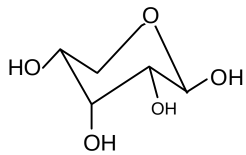
Q.14 Which of the following statement is not true considering the process given above:
(A) The general class of polymer formed is known as homopolymer
(B) The polymer obtained is stereoregular
(C) Buna-N can be prepared using above process
(D) Synthetic rubber can be formed by above process using 1,3-butadiene.

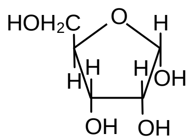
Q.15 Match the column

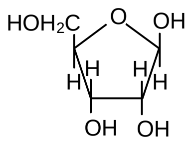
Column-I	**Column-II**
(A) α- anomer of a D-monosaccharide	(P) CH_2OH at C-5 and OH at C-1 are cis to each other
(B) β- anomer of a D-monosaccharide	(Q) OH at C-1 and CH_2OH at C-5 are trans to each other
(C) Haworth projection of α- anomer	(R) OH group is drawn down at C-1
(D) Haworth projection of β-D-anomer	(S) Major isomer at equilibrium

Q.16 Match the compounds given below existing in equilibrium mixture with their percentage given in the right hand side.

Column-I	**Column-II**
(A) 	(P) 6%

(B)  (Q) 18%

(C)  (R) < 1%

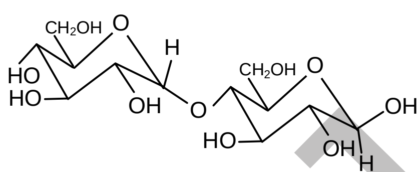
(D)  (S) 56%

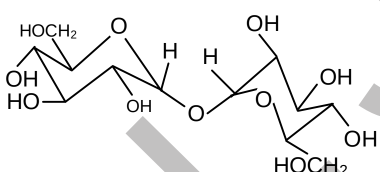
Q.17 Match the column:

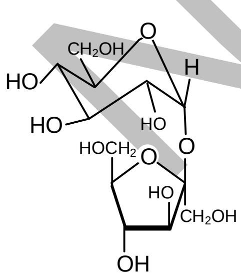
Column-I (Carbohydrate)	**Column-II (Properties)**
(A) Starch	(P) Mutarotation
(B) Sucrose	(Q) Non reducing sugar
(C) Lactose	(R) β-glycosidic bond
(D) Maltose	(S) α-glycosidic bond
	(T) Reducing sugar
	(U) Hemiacetal

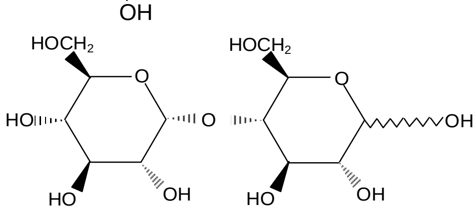
Q.18 Match the column:

Column-I **Column-II**

(A)  (P) α-glycoside bonds

(B)  (Q) Reducing sugar

(C)  (R) Forms enediol intermediate

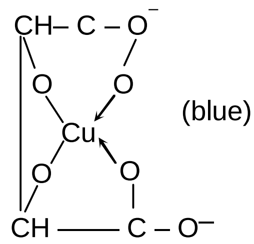
(D)  (S) β-glycoside bond

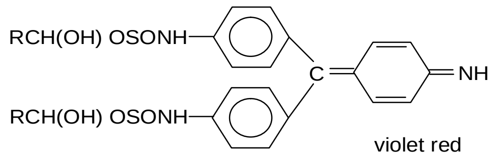
Q.19 Match the column:

Column-I **Column-II**

(Functional group) — (Test used or complex during confirmatory test)

(A) Aldehydic — (P) $[(C_6H_5O)_6Fe]^{-3}$ (Violet)

(B) Phenolic — (Q) 

(C) Alcohol — (R) 

violet red

(S) $(ROH)_2\ Ce(NO_3)_4$ (Red)

(T) Molisch's Test

Q.20 Match the column:

Column-I	**Column-II**
(A) Addition polymer	(P) Buna-S
(B) Condensation polymer	(Q) Buna-N
(C) Homopolymer	(R) Polythene
(D) Copolymers	(S) Nylon 6,6

Q.21 Match the column :

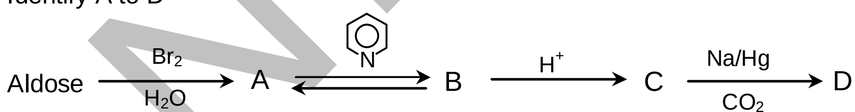
Monomer	**Catalyst**	**Polymer**
(A) $CH_2 = CH_2$	(1) Peroxide	(P) Teflon
(B) $CF_2 = CF_2$	(2) Persulphate & high P	(Q) LDP
(C) CH_2= CHCN	(3) Ziegler-Natta Catalyst P=6, 7 atm	(R) HDP
		(S) Polyacrylonitrite

Q.22 Match the column :

Presence of the element in Na-extract	Complex formed in one of the test	Colour of the complex
(A) N	(P) $Na_4[Fe(CN)_5NOS]$	(W) Prussian Blue
(B) S	(Q) $Fe(CNS)_3$	(X) Black
(C) N and S together	(R) PbS	(Y) Violet
	(S) $Fe_4[Fe(CN)_6]$	(Z) Blood Red

Subjective

Q.23 Identify A to D



Q.24 The pKa values for the three acidic group P, Q, R are 4.3, 9.7 and 2.2 respectively

$$\underset{(R)}{HOOC}–\underset{\underset{(Q)}{\overset{\oplus}{N}H_3}}{CH}–CH_2–\underset{(P)}{COOH}$$

Calculate the isoelectric point of the amino acid?

Q.25 How will you separate?

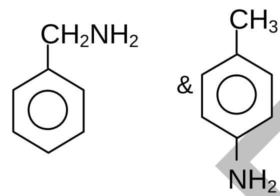
(a) Ethane, Ethene & Ethyne

(b) 1-Butyne and 2-Butyne

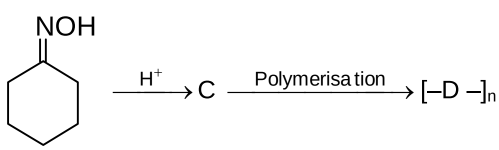
(c) 2-hexyne and 3-hyxyne

(d) Phenol & Propanol

(e) 2-Propanol and Propanone
(f) CH_3COOH & $HCOOCH_3$
(g) PhOH & PhCOOH
(h) EtOH & $EtNH_2$
(i) $EtNH_2$ & Me_2NH
(j) EtOH & Et– O –Et

Q.26 How will you differentiate?
(a) Propane and Propene
(b) 1-Butyne and 2-Butyne
(c) 2- Hexyne and 3-hexyne
(d) 1,1-Dichloroethane and 1,2-Dichloroethane
(e) Chloroethane and Chloroethene
(f) Pure and Oxidized $CHCl_3$
(g) p-chlorotoluene and benzylchloride
(h) n- propylchloride and isopropylchloride
(i) Methanol and ethanol(j) Isobutanol and tert-butanol
(k) 2- Pentanol and 3-pentanol
(l) O-cresol and benzylalcohol
(m) Ethanol and Propanol
(n) Propanone and Ethanol
(o) HCHO and PhCHO (p) Glucose and Fructose
(q) HCOOH & CH_3COOH
(r) HCOOH & HCHO
(s) $MeNH_2$ & Me_2NH
(t) 

EXERCISE IV

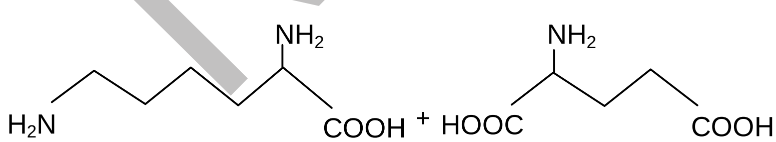
Q.1 Give the structures of the products in each of the following reactions. **[JEE 2000]**
(i) Sucrose $\xrightarrow{H^+}$ A + B
(ii) 

Q.2 Aspartame, an artificial sweetener, is a peptide and has the following structure:**[JEE 2001]**

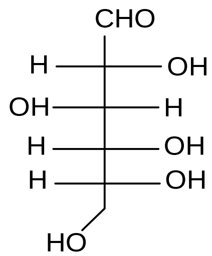
$$\begin{array}{c} \qquad\qquad\qquad\qquad\qquad CH_2-C_6H_5 \\ \qquad\qquad\qquad\qquad\qquad | \\ H_2N-CH-CONH-CH-COOCH_3 \\ | \qquad\qquad\qquad\qquad \\ CH_2-COOH \qquad\qquad \end{array}$$

(i) Identify the four functional groups.
(ii) Write the zwitterionic structure
(iii) Write the structures of the amino acids obtained from the hydrolysis of aspartame.
(iv) Which of the two amino acids is more hydrophobic?

Q.3 Following two amino acids lysine and glutamine form dipeptide linkage. What are two possible dipeptides? **[JEE 2003]**



Q.4 The structure of D-Glucose is as follows- **[JEE 2004]**
(a) Draw the structure of L-Glucose
(b) Give the reaction of L-Glucose with Tollen's reagent



Q.5 Which of the following pairs give positive Tollen's test? **[JEE 2004]**
(A) Glucose, sucrose (B) Glucose, fructose
(C) Hexanal, Acetophenone (D) Fructose, sucrose

Q.6 Two forms of D-glucopyranose, are called
(A) Enantiomers (B) Anomers
(C) Epimers (D) Diastereomers

Q.7 Monomer A of a polymer on ozonolysis yields two moles of HCHO and one mole of CH_3COCHO
[JEE 2005]
(a) Deduce the structure of A
(b) Write the structure of "all cis"-forms of polymer of compound A.

Q.8 When benzene sulfonic acid and p-nitrophenol are treated with $NaHCO_3$, the gases released respectively are-
[JEE 2006]
(A) SO_2, NO_2 (B) SO_2, NO
(C) SO_2, CO_2 (D) CO_2, CO_2

Q.9 **Statement-I** : Glucose gives a reddish-brown precipitate with Fehling's solution.
because **[JEE 2007]**
Statement-II : Reaction of glucose with Fehling's solution gives CuO and gluconic acid.
(A) Statement- I is true, Statement- II is true and Statement- II is correct explanation for Statement- I
(B) Statement- I is true, Statement- II is true and Statement- II is NOT a correct explanation for Statement- I
(C) Statement- I is true, Statement- II is false.
(D) Statement- I is false, Statement- II is true.

Q.10 **Statement-I** : p-ydroxybenzoic acid has a lower boiling point than o-hydroxybenzoic acid.
because **[JEE 2007]**
Statement-II : o-Hydroxybenzoic acid has Intramolecular hydrogen bonding.
(A) Statement- I is true, Statement- II is true and Statement- II is correct explanation for Statement- I
(B) Statement- I is true, Statement- II is true and Statement- II is NOT a correct explanation for Statement- I
(C) Statement- I is true, Statement- II is false.
(D) Statement- I is false, Statement- II is true.

Q.11 Match the chemical substances in Column I with type of polymers/type of bonds in Column-II. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.
[JEE 2007]

Column-I	Column-II
(A) Cellulose	(P) Natural polymer
(B) Nylon-6,6	(Q) Synthetic polymer
(C) Protein	(R) amide linkage
(D) Sucrose	(S) Glycoside linkage

Q.12 Match the compounds/ion in column I with their properties/reaction in Column-II. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.
[JEE 2007]

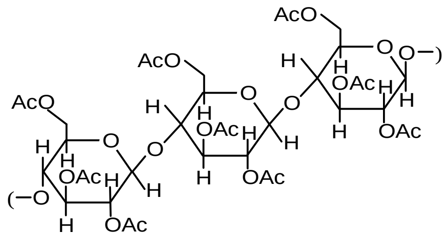
Column-I	Column-II
(A) C_6H_5CHO	(P) gives precipitate with 2,4-dinitrophenylhydrazine

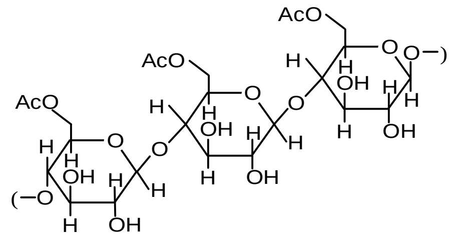
(B) $CH_3C \equiv CH$ — (Q) gives precipitate with $AgNO_3$

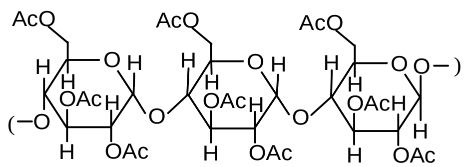
(C) CN^- — (R) is a nucleophile

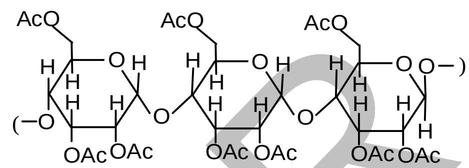
(D) I^- — (S) is involved in cyanohydrin formation

Q.13 Cellulose upon acetylation with excess acetic anhydride/H_2SO_4 (catalytic) gives cellulose triacetate whose structure is **[JEE 2008]**

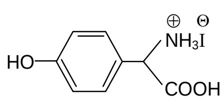
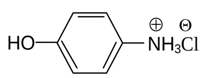
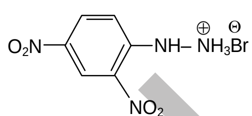
(A) 

(B) 

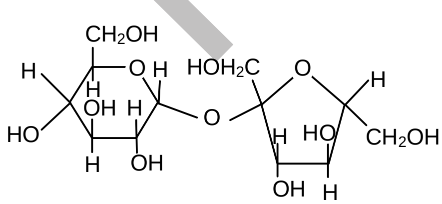
(C) 

(D) 

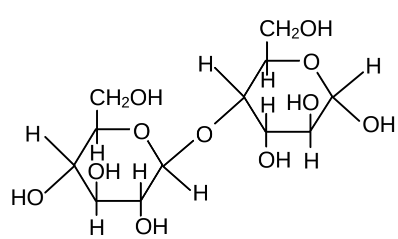
Q.14 Match the compounds in Column I with their characteristic test(s)/reaction(s) given in Column II. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS. **[JEE 2008]**

Column-I	**Column II**
(A) $H_2N - \overset{\oplus}{N}H_3\overset{\ominus}{Cl}$	(P) Sodium fusion extract of the compound gives Prussian blue colour with $FeSO_4$
(B) 	(Q) gives positive $FeCl_3$ test
(C) 	(R) gives white precipitate with $AgNO_3$
(D) 	(S) reacts with aldehydes to form the corresponding hydrazine derivative

Q.15 The correct statement(s) about the following sugars X and Y is(are)- **[JEE 2009]**



(X)



(Y)

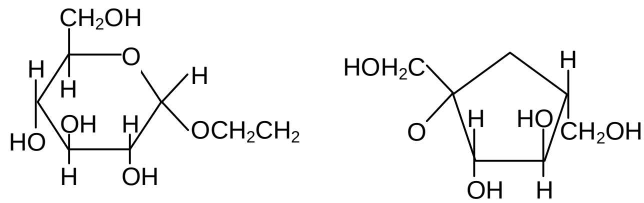
(A) X is a reducing sugar and Y is a non-reducing sugar
(B) X is a non-reducing sugar and Y is a reducing sugar
(C) The glucosidic linkages in X and Y are α and β, respectively
(D) The glucosidic linkages in X and Y are β and α, respectively

Q.16 Among cellulose, poly(vinyl chloride), nylon and natural rubber, the polymer in which the intermolecular force of attraction is weakest is **[JEE 2009]**

(A) Nylon (B) Poly (vinyl chloride)

(C) Cellulose (D) Natural Rubber

Q.17 The correct statement about the following disaccharide is – **(JEE2010)**



(A) Ring (a) is pyranonse with α-glycosidic link

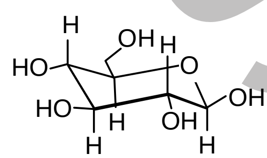
(B) Ring (a) is furanonse with α-glycosidic link

(C) Ring (b) is furanonse with α-glycosidic link

(D) Ring (b) is pyranonse with β-glycosidic link

Q.18 A decapeptide (Mol. Wt. 796) on complete hydrolysis gives glycine (Mol. wt. 75), alanine and phenylalanine. Glycine contributes 47.0% to the total weight of the hydrolysed products. The number of glycine units present in the decapeptide is – **(JEE2011)**

Q.19 The following carbohydrate is -



(A) ketohexose (B) an aldohexose

(C) an α-furanose (D) an α-pyranose

ANSWER KEY

EXERCISE-1

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ans.	D	A	C	D	A	C	B	D	A	D	A	B	C	C	C	D
Q.No.	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Ans.	C	A	C	D	D	C	A	C	C	D	B	A	B	B	B	D

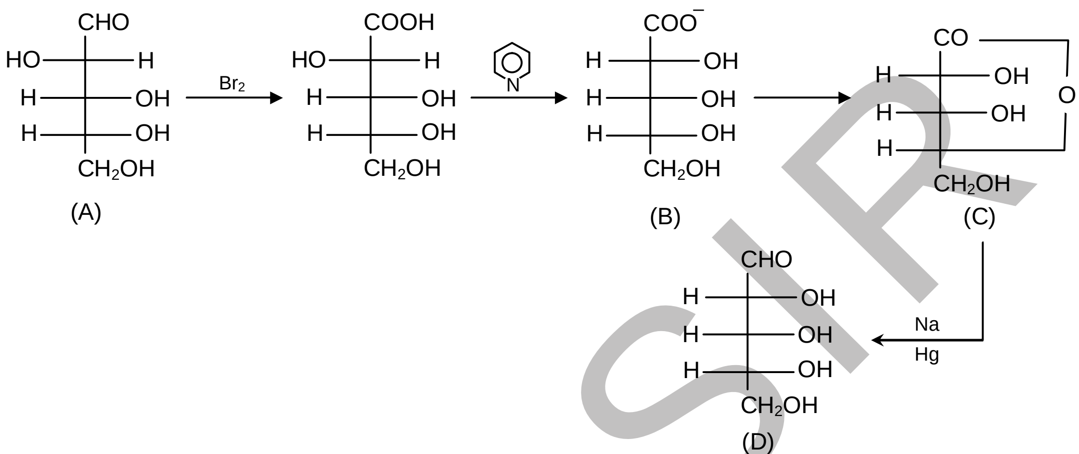
EXERCISE-II

Q.No.	1	2	3	4	5	6	7	8	9	10	11
Ans.	A,B,C	A,B,C,D	A,B,C	A,B,D	A,B,C	A,B,D	A,B,C,D	B,C,D	A,B,C	A,C,D	A,B,C
Q.No.	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**A**	**B**	**C**	**D**
Ans.	B,C	A,B,C,D	A,B,C	A,B,C	B,D	B,D		P,Q,S	S	R	R
Q.No.	**19**	**A**	**B**	**C**	**D**	**20**	**A**	**B**	**C**	**D**	
Ans.		S	R	P	Q		Q	P	R	S	

EXERCISE-III

Q.No.	1	2	3	4	5	6	7	8	9	10	11
Ans.	A	A	A	A	A	A	D	B	B	D	C
Q.No.	**12**	**13**	**14**	**15**	**A**	**B**	**C**	**D**			
Ans.	C	A	C		Q,R	P,S	R	S			
16	**A**	**B**	**C**	**D**	**17**	**A**	**B**	**C**	**D**		
	R	S	P	Q		Q,S	Q,S	P,R,T,U	P,S,T,U		
18	**A**	**B**	**C**	**D**	**19**	**A**	**B**	**C**	**D**		
	P,Q,R	P	P	P,Q,R		Q,P	P	S	T		
20	**A**	**B**	**C**	**D**	**21**	**A**	**B**	**C**	**D**		
	P,Q,R	S	R	P,Q,S		1-Q	1,2-P	1-S	3-R		
22	**A**	**B**	**C**								
	S-X	P-Y,R-X	Q-Z								

Q.23

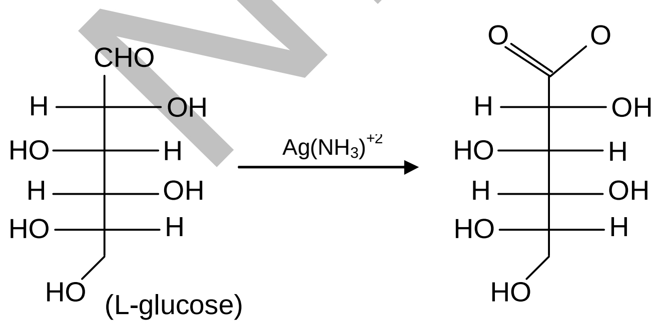


Q.24 3.25

EXERCISE IV

Q.2 (i) Amine, carboxylic acid, Amide, Ester

Q.4



Q.5 B

Q.6 B

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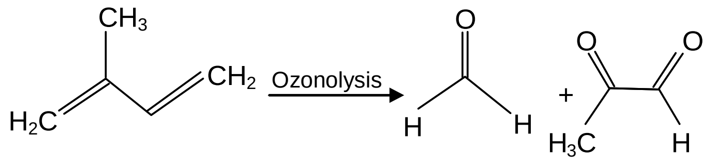
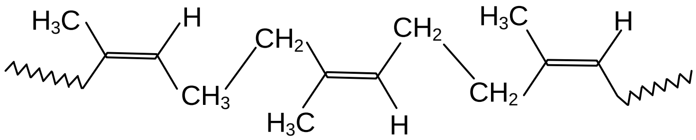
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

Q.7 (a) 

(b) 

Q.8 D

Q.9 C

Q.10 D

Q.11 (A) P, S; (B) Q, R; (C) P, R; (D) S

Q.12 (A) P, S ; (B) Q; (C) Q, R, S ; (D) Q, R

Q.13 A

Q.14 (A) R, S (B) P,Q (C) P, Q, R (D) P, S

Q.15 B, C

Q.16 D

Q.17. (A)

Q.18. (6)

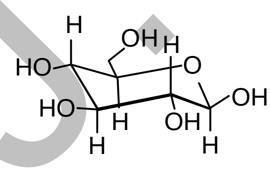
Sol. For n-units of glycine,

$$\frac{n \times 75}{(796 + 9 \times 18)} \times 100 = 47$$

$\Rightarrow n = 6$

Q.19. (B)

Sol.



β-pyranose
(Aldohexose)

Aldehydes and Ketones

Exercise:1

Q. 1 **The formation of cynohydrin from a ketone is an example of (1990)**

(A) Electrophilic addition (B) Nucleophilic addition
(C) Nucleophilic substitution (D) Electrophilic substitution

Q.2 The enolic form of acetone contains : **[IIT 1990]**

(A) 9 sigma bonds, 1 pi bond and 2 lone pairs
(B) 8 sigma bonds, 2 pi bonds and 2 lone pairs
(C) 10 sigma bonds, 1 pi bond and 1 lone pair
(D) 9 sigma bonds, 2 pi bonds and 1 lone pair

Q.3 m-chlorobenzaldehyde on reaction with conc. KOH at room temperature gives:

(A) Potassium m-chlorobenzoate and m-hydroxybenzaldehyde **[IIT 1991]**
(B) m- hydroxybenzaldehyde and m- chlorobenzyl alcohol
(C) m-chlorobenzyl and m-hydroxybenzyl alcohol
(D) Potassium m-chlorobenzoate and m-chlorobenzyl alcohol

Q.4 Hydrogenation of benzoyl chloride in the presence of Pd and $BaSO_4$ gives:

(A) Benzyl alcohol (B) Benzaldehyde **[IIT 1992]**
(C) Benzoic acid (D) Phenol

Q.5 An organic compound C_3H_6O does not give a precipitate with 2,4-Dinitrophenyl hydrazine reagent and does not react with metallic sodium. It could be: **[IIT 1993]**

(A) CH_3CH_2CHO (B) CH_3COCH_3
(C) $CH_2=CH–CH_2OH$ (D) $CH_2=CH–O–CH_3$

Q.6 Under Wolff Kishner reduction conditions, the conversions which may be brought about is? **[IIT 1995]**

(A) Benzaldehyde into Benzyl alcohol
(B) Cyclohexanol into Cyclohexane
(C) Cyclohexanone into Cyclohexanol
(D) Benzophenone into Diphenylmethane

Q.7 In the reaction, P is **[IIT 1995]**

$$\begin{matrix}CH_3 \\ CH_3\end{matrix}\!\!>CO \xrightarrow{SeO_2} P + Se + H_2O$$

(A) CH_3COCHO (B) CH_3COOCH_3
(C) CH_3COCH_2OH (D) None

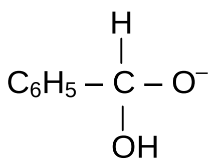
Q.8 In the Cannizzaro reaction given below, $2Ph-CHO \xrightarrow{OH^-} Ph-CH_2OH + PhCO_2^-$ the slowest step is :

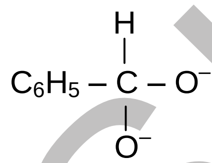
(A) the attack of OH^- at the carbonyl group
(B) the transfer of hydride to the carbonyl group
(C) the abstraction of proton from the carboxylic acid
(D) the deprotonation of $Ph-CH_2OH$ **[IIT 1996]**

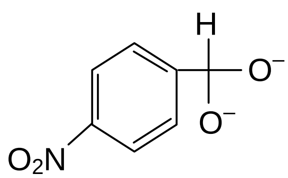
Q.9 Among the given compounds, the most susceptible to nucleophilic attack at the carbonyl group is- **[IIT 1997]**

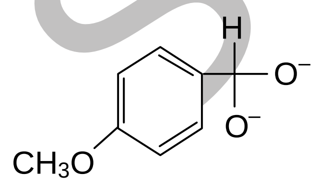
(A) MeCOCl (B) MeCHO
(C) MeCOOMe (D) MeCOOCOMe

Q.10 In a Cannizzaro reaction the intermediate which is the best hydride donor is: **[IIT 1997]**

(A) 

(B) 

(C) 

(D) 

Q.11 $CH_3CHO + H_2NOH \rightarrow CH_3-CH=N-OH$. The above reaction occurs at :

(A) pH = 1 (B) pH = 4.5 **[IIT 1997]**
(C) Any value of pH (D) pH = 12

Q.12 Among the following compounds, which will react acetone to give a product containing > C = N –

(A) $C_6H_5NH_2$ (B) $(CH_3)_3N$ **[IIT 1998]**
(C) $C_6H_5NHC_6H_5$ (D) $C_6H_5NHNH_2$

Q.13 The product obtained via oxymercuration ($HgSO_4 - H_2SO_4$) of 1- butyne would be

(A) $CH_3CH_2-\overset{\overset{\displaystyle O}{||}}{C}-CH_3$ (B) $CH_3CH_2CH_2CHO$ **[IIT 1998]**
(C) $CH_3CH_2CHO + HCHO$ (D) $CH_3CH_2COOH + HCOOH$

Q.14 Which of the following will undergo aldol condensation: **[IIT 1998]**

(A) Acetaldehyde (B) Propanaldehyde
(C) Benzaldehyde (D) Trideutero acetaldehyde

Q.15 Which of the following will react with water: **[IIT 1998]**

(A) $CHCl_3$ (B) Cl_3CCHO
(C) CCl_4 (D) $ClCH_2CH_2Cl$

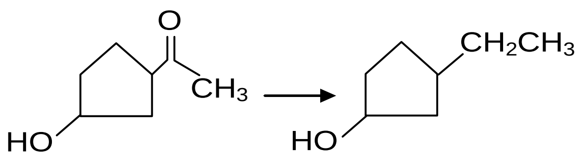
Q.16 A new carbon-carbon bond formation is possible in: **[IIT 1998]**

(A) Cannizzaro reaction
(B) Friedel-Crafts alkylation
(C) Clemmensen reduction
(D) Reimer-Tiemann reaction

Q.17 Which of the following has the most acidic hydrogen: **[IIT 2000]**

(A) 3-hexanone
(B) 2, 4-hexanedione
(C) 2,5-hexanedione
(D) 2, 3-hexandione

Q.18 The appropriate reagent for the following transformation: **[IIT 2000]**



(A) Zn (Hg), HCl (B) NH_2NH_2, OH^-
(C) H_2/Ni
(D) $NaBH_4$

Q.19 A mixture of benzaldehyde and formaldehyde on heating with aqueous NaOH solution gives: **[IIT 2001]**

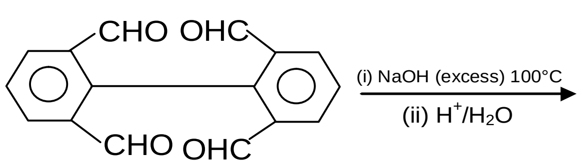
(A) benzyl alcohol and sodium formate
(B) sodium benzoate and methyl alcohol
(C) sodium benzoate and sodium formate
(D) benzyl alcohol and methyl alcohol

Q.20 Compound A (molecular formula C_3H_8O) is treated with acidified potassium dichromate to form a product B(molecular formula C_3H_6O). B forms a shining silver mirror on warming with ammonical silver nitrate. B when treated with an aqueous solution of $H_2NCONHNH_2$. HCl and sodium acetate gives a product C. Identify the structure of C. **[IIT 2002]**

(A) $CH_3CH_2CH{=}\,NNHCONH_2$
(B) $CH_3 - \underset{\underset{CH_3}{|}}{C} = NNHCONH_2$
(C) $CH_3 - \underset{\underset{CH_3}{|}}{C} = NCONHNH_2$
(D) $CH_3CH_2CH{=}\,NCONHNH_2$

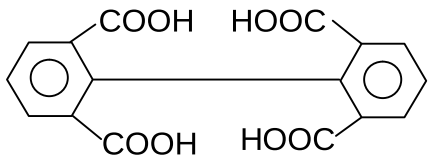
Q.21 1- propanol and 2- propanol can be best distinguished by: **[JEE 2001]**

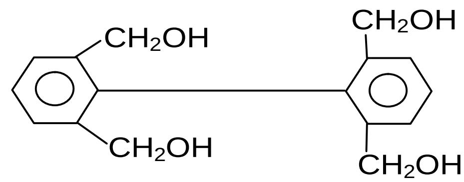
(A) Oxidation with alkaline $KMnO_4$ followed by reaction with Fehling solution
(B) Oxidation with acedic dichromate followed by reaction with Fehling solution
(C) Oxidation by heating with copper followed by reaction with Fehling solution
(D) Oxidation with concentrated H_2SO_4 followed by reaction with Fehling

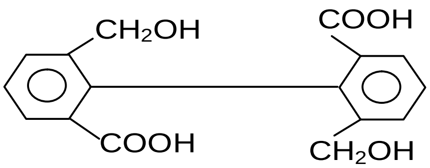
Q.22 

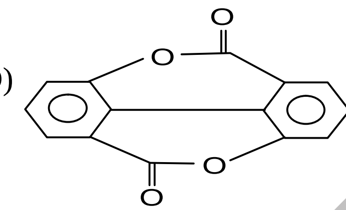
[IIT 2003]

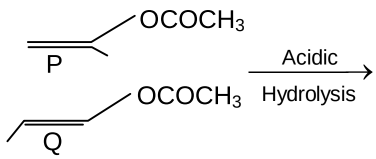
any one of the products formed is:

(A) 

(B) 

(C) 

(D) 

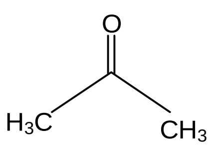
Q.23 

Products formed by P & Q can be differentiated by :

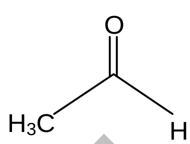
[IIT 2003]

(A) 2,4 DNP
(B) Lucas reagent ($ZnCl_2$) conc. HCl
(C) $NaHSO_3$
(D) Fehlings solution

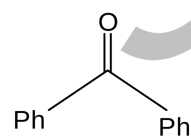
Q.24 The order of reactivity of phenyl Magnesium Bromide with the following compounds is :
[IIT 2004]



(I)

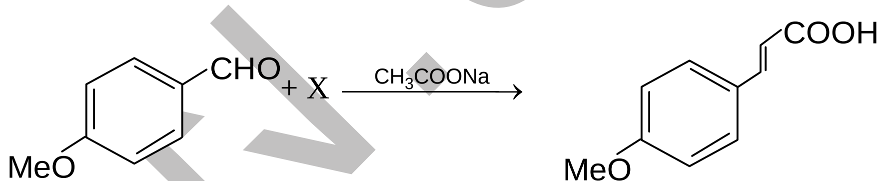


(II)



(III)

(A) II > III > I
(B) I > III > II
(C) II > I > III
(D) All react with the same rate

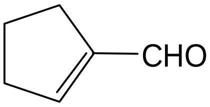
Q.25 

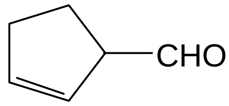
[IIT 2005]

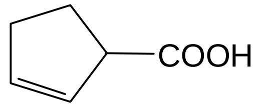
What is X?
(A) CH_3COOH
(B) $BrCH_2$, COOH
(C) $(CH_3CO)_2O$
(D) CHO –COOH

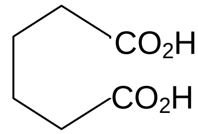
Q.26 The smallest ketone and its next homologue are reacted with NH_2OH to form oxime.
(A) Two different oximes are formed
(B) Three different oximes are formed
(C) Two oximes are optically active
(D) All oximes are optically active
[JEE 2006]

Q.27 Cyclohexene on ozonolysis followed by reaction with zinc dust and water gives compound E. Compound E on further treatment with aqueous KOH yields compound F. Compound F is:
[JEE 2007]

(A) 

(B) 

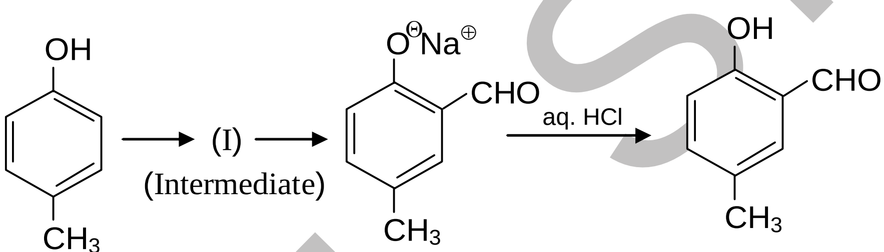
(C) 

(D) 

Q.28 **Statement-1 :** Glucose gives a reddish-brown precipitate with Fehling's solution.
because
Statement-2 : Reaction of glucose with Fehling's solution gives CuO and gluconic acid.
(A) Statement-1 is true, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True. **[JEE 2007]**

Paragraph for Question Nos. 29 to 31(3 questions)

Reimer-Tiemann reaction introduces an aldehyde group, on to the aromatic ring of phenol, ortho to the hydroxyl group. This reaction involves electrophilic aromatic substitution. This is a general method for the synthesis of substituted salicylaldehydes as depicted below:

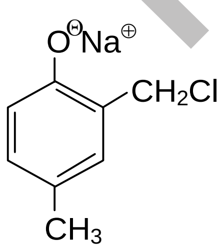


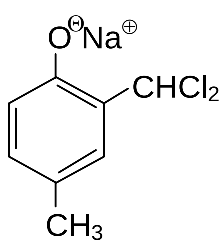
(I) (II) (III)

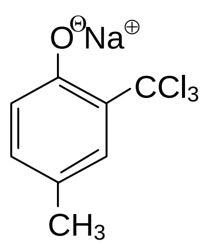
Q.29 Which one of the following reagents is used in the above reaction? **[JEE 2007]**
(A) aq.NaOH + CH_3Cl (B) aq. NaOH +CH_2Cl_2
(C) aq. NaOH + $CHCl_3$ (D) aq. NaOH + CCl_4

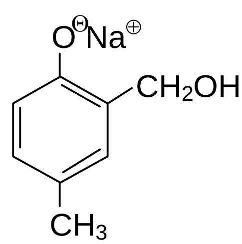
Q.30 The electrophile in this reaction is: **[JEE 2007]**
(A) $:CHCl$ (B) $^{+}CHCl_2$
(C) $:CCl_2$ (D) $:CCl_3$

Q.31 The structure of the intermediate I is: **[JEE 2007]**

(A) 

(B) 

(C) 

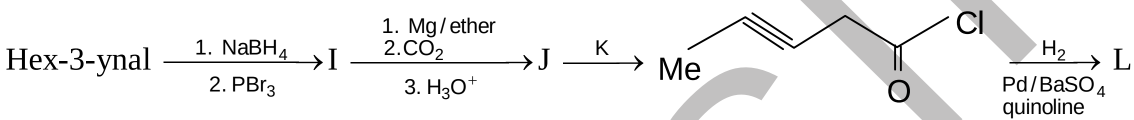
(D) 

Q.32 Match the compounds/ion in column-I with their properties/reaction in Column- II. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS. **[JEE 2007]**

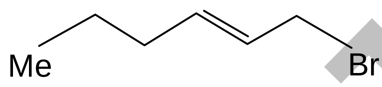
Column-I	Column-II
(A) C_6H_5CHO	(P) gives precipitate with 2,4- dinitrophenylhydrazine
(B) $CH_3C \equiv CH$	(Q) gives precipitate with $AgNO_3$
(C) CN^-	(R) is a nucleophile
(D) I^-	(S) is involved in cyanohydrin formation

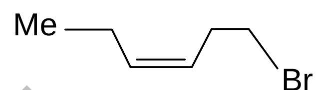
Paragraph for Question No.33 to 35

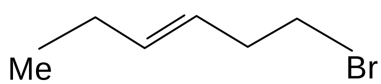
In the following reaction sequence, products **I**, **J** and **L** are formed. **K** represents a reagent.

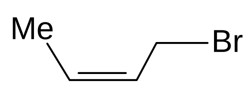


Q.33 The structure of the product **I** is: **[JEE 2008]**

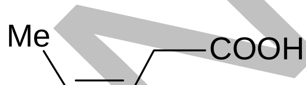
(A) 

(B) 

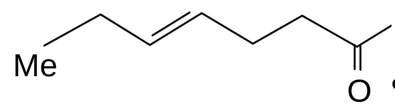
(C) 

(D) 

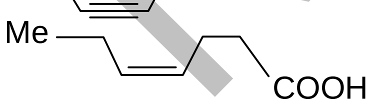
Q.34 The structures of compounds **J** and **K**, respectively, are: **[JEE 2008]**

(A) 

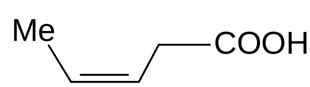
& $SOCl_2$

(B) 

& SO_2Cl_2

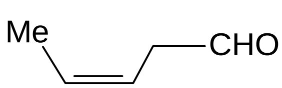
(C) 

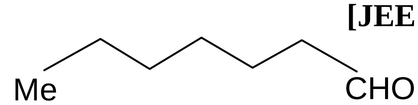
& $SOCl_2$

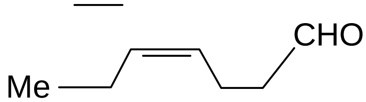
(D) 

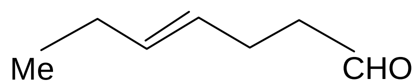
& CH_3SO_2Cl

Q.35 The structure of product **L** is: **[JEE 2008]**

(A) 

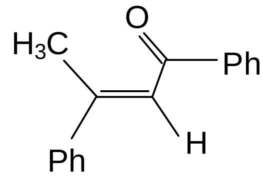
(B) 

(C) 

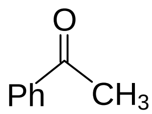
(D) 

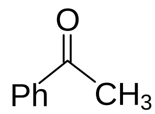
Paragraph for Question No.36 to 38

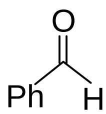
A tertiary alcohol **H** upon acid catalysed dehydration gives a product I. Ozonolysis of **I** leads to compounds **J** and **K**. Compound **J** upon reaction with KOH gives benzyl alcohol and a compound **L**, whereas **K** on reaction with KOH gives only **M**.

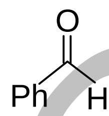
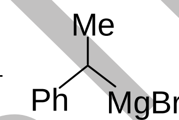
M = 

Q.36 Compound **H** is formed by the reaction of : **[JEE 2008]**

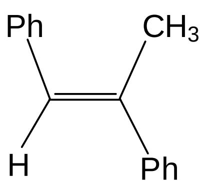
(A)  + PhMgBr

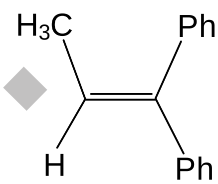
(C)  + $PhCH_2MgBr$

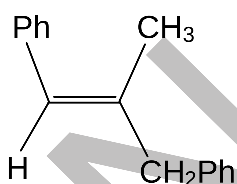
(C)  + $PhCH_2MgBr$

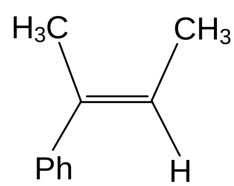
(D)  + 

Q.37 The structure of compound **I** is: **[JEE 2008]**

(A) 

(B) 

(C) 

(D) 

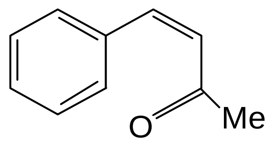
Q.38 The structures of compounds **J**, **K** and **L**, respectively are : **[JEE 2008]**
(A) $PhCOCH_3$, $PhCH_2COCH_3$ and $PhCH_2COO^-K^+$
(B) PhCHO, $PhCH_2CHO$ and $PhCOO^-K^+$
(C) $PhCOCH_3$, $PhCH_2CHO$ and $CH_3COO^-K^+$
(D) PhCHO, $PhCOCH_3$ and $PhCOO^-K^+$

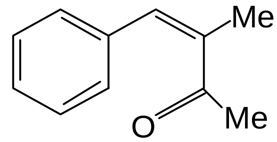
Paragraph for Question Nos. 39 to 41

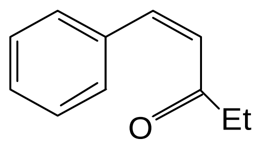
A carbonyl compound **P**, which gives positive iodoform test, undergoes reaction with MeMgBr followed by dehydration to give an olefin **Q**. Ozonolysis of **Q** leads to a dicarbonyl compound **R**, which undergoes Intramolecular aldol reaction to give predominantly **S**.

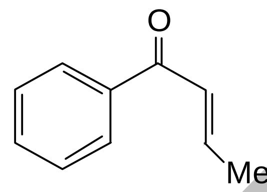
$$P \xrightarrow[\substack{2.\ H^+,\ H_2O \\ 3.\ H_2SO_4,\ \Delta}]{1.\ MeMgBr} Q \xrightarrow[2.\ Zn, H_2O]{1.\ O_3} R \xrightarrow[2.\ \Delta]{1.\ OH^-} S$$

Q.39 The structure of the carbonyl compound P is: **[JEE 2009]**

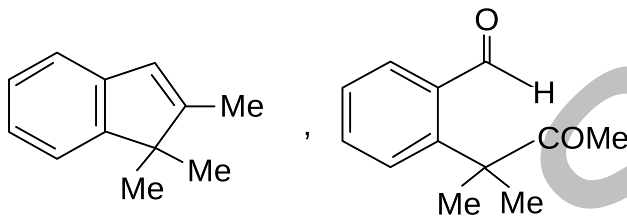
(A) 

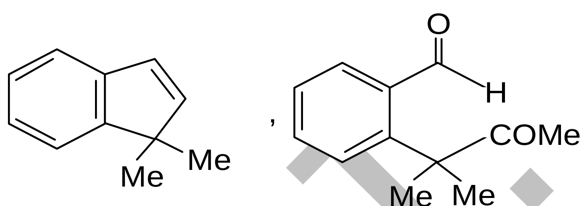
(B) 

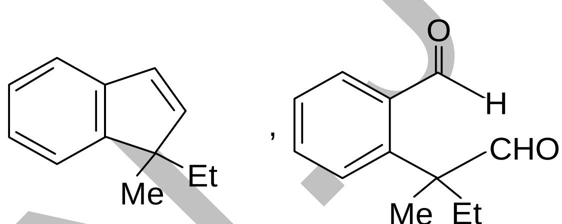
(C) 

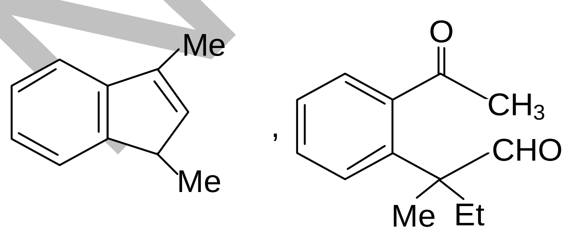
(D) 

Q.40 The structure of the products **Q** and **R**, respectively, are **[JEE 2009]**

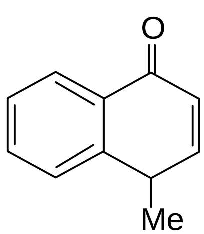
(A) 

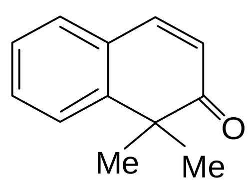
(B) 

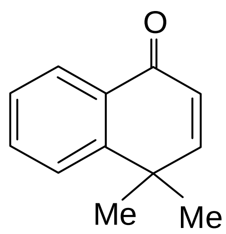
(C) 

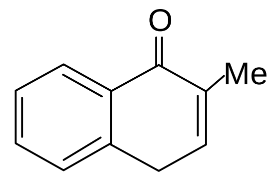
(D) 

Q.41 The structure of the product **S** is : **[JEE 2009]**

(A) 

(B) 

(C) 

(D) 

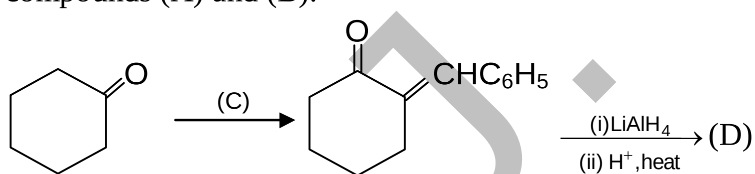
EXERCISE-2

Q.1 $C_6H_5-CHO + CH_3-COOC_2H_5 \xrightarrow[C_2H_5OH \text{ and heat}]{NaOC_2H_5}$ (D). **[IIT 1995]**

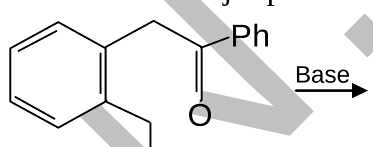
Q.2 $CH_3CH_2(H)C=O \xrightarrow[\text{(ii) } LiAlH_4]{\text{(i) } KCN/H_2SO_4} D$ **[IIT 1996]**

Q.3 Acetophenone on reaction with hydroxylamine- hydrochloride can produce two isomeric oximes. Write structure of the oximes. **[IIT 1997]**

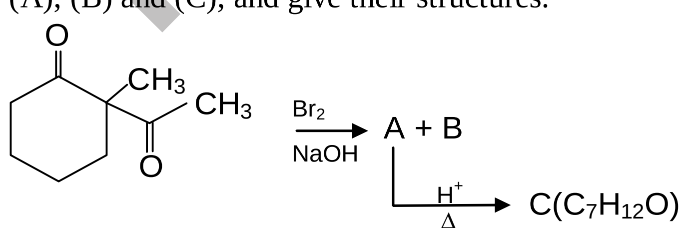
Q.4 An aldehyde (A) ($C_{11}H_8O$), which does not undergo self aldol condensation, gives benzaldehyde and two mole of (B) on ozonolysis. Compound (B), on oxidation with silver ion, gives oxalic acid. Identify the compounds (A) and (B). **[IIT 1998]**

Q.5  **[IIT 1998]**

Q.6 What would be the major product in each of the following reaction? **[IIT 2000]**



Q.7 Identify (A), (B) and (C), and give their structures. **[IIT 2000]**

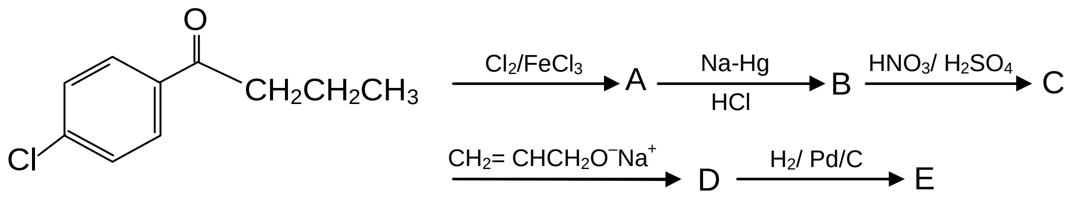


Q.8 Five isomeric para-disubstituted aromatic compounds A to E with molecular formula $C_8H_8O_2$ were given for identification. Based on the following observations, give structure of the compounds.
(i) Both A and B form a silver mirror with Tollen's reagent; also, B gives a positive test with $FeCl_3$ solution
(ii) C gives positive iodoform test.
(iii)D is readily extracted in aqueous $NaHCO_3$solution.

(iv) E on acid hydrolysis gives 1,4-dihydroxybenzene. **[IIT 2002]**

Q.9 Write structures of the products A, B, C, D and e in the following scheme.

[IIT 2002]



Q.10 $C_6H_{12} \xrightarrow{HCl} \underset{(B)}{C_6H_{13}Cl} + (C)$

(B) $\longrightarrow$ (D) $\xrightarrow{\text{ozonolysis}}$ (E)

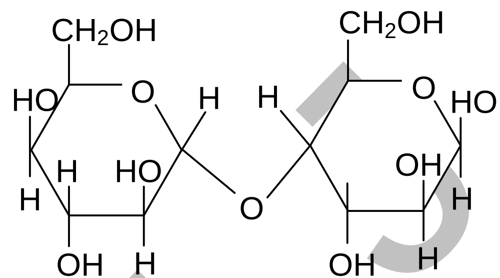
(A) $\xrightarrow{\text{ozonolysis}}$ (F) + (G) $\xrightarrow{NaOH}$ NCOONa + 1°alcohol

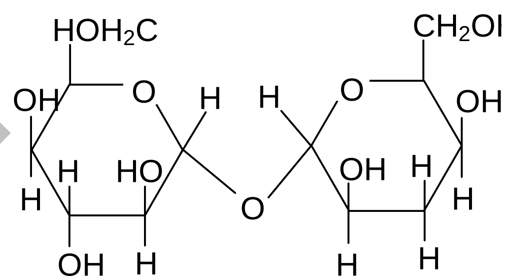
(D) is isomer A. E gives negative test with Fehling solution but gives iodoform test. F and G gives Tollen's test but do not give iodoform test. Identify A to G.

[IIT 2003]

Q.11 Which of the following disaccharide will not reduce. Tollen's reagent?

[IIT 2005]

(A) 

(B) 

(Q) (P)

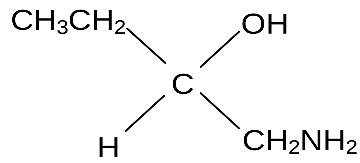
EXERCISE-1

Q.No.	1	2	3	4	5	6	7	8	9	10
Ans.	B	A	D	B	D	D	A	B	A	D
Q.No.	11	12	13	14	15	16	17	18	19	20
Ans.	B	A,D	A	A,B,D	B	B, D	B	B	A	A
Q.No.	21	22	23	24	25	26	27	28	29	30
Ans.	C	C	D	C	C	B	A	C	C	C
Q.No.	31	32	A	B	C	D	33	34	35	36
Ans.	B		P, S	Q	Q,R, S	Q,R	D	A	C	B
Q.No.	37	38	39	40	41					
Ans.	A	D	B	A	B					

EXERCISE-2

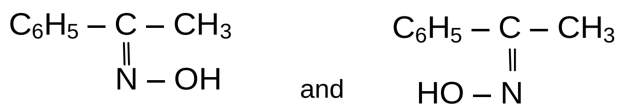
Q. 1 $C_6H_5CH = CHCOOC_2H_5$
(D)

Q.2



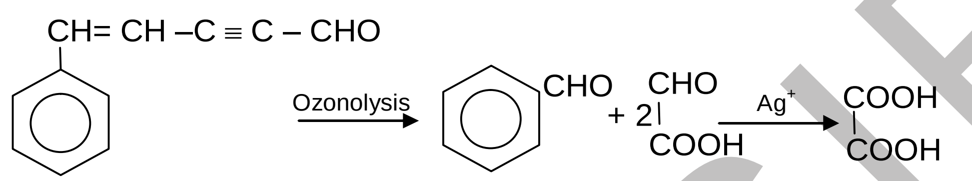
(a racemic mixture)

Q.3



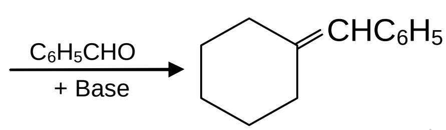
syn anti (isomers)

Q.4



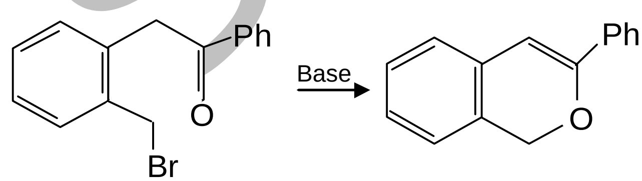
(A) (B) (Oxalic acid)

Q.5

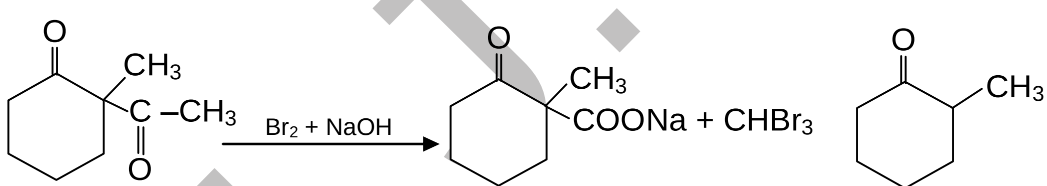


(C) (D)

Q.6

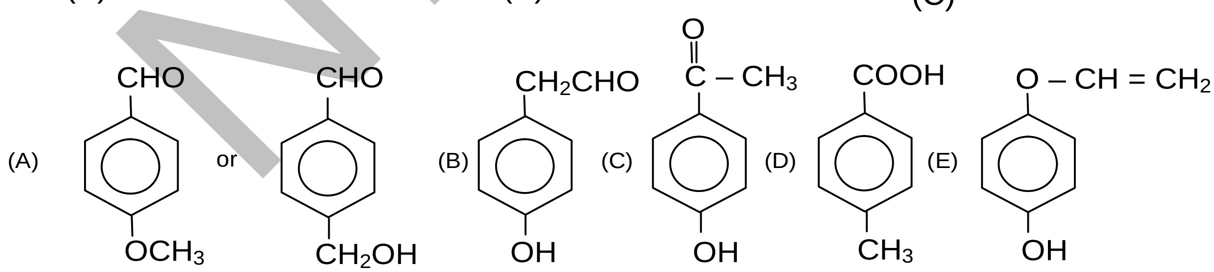


Q.7

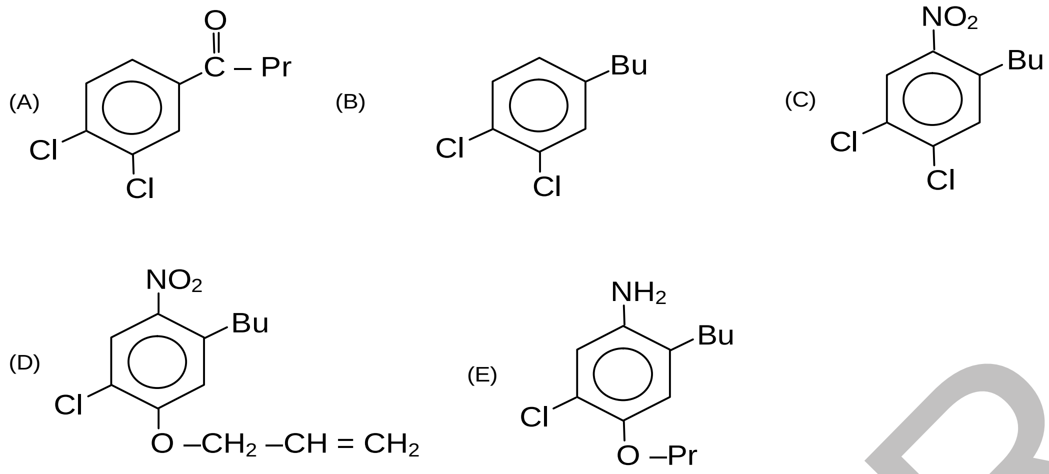


(A) (B) (C)

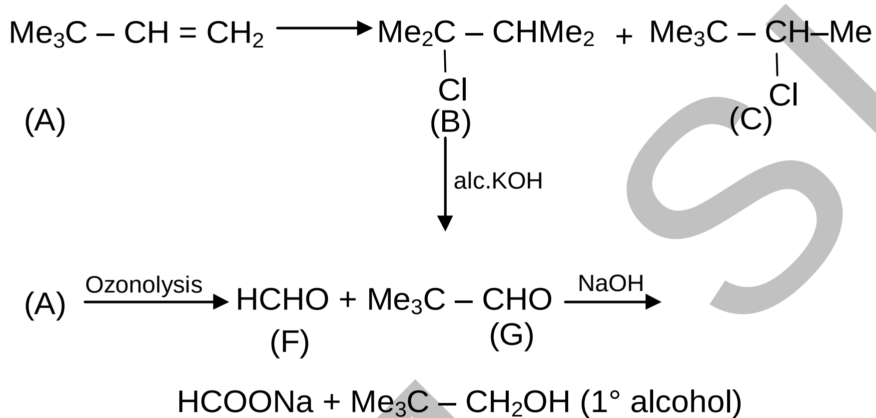
Q.8



Q.9



Q.10



Q.11 In structure (P) both the rings are present in acetyl form therefore it will not hydrolyse in solution that's why Fehling solution cannot react with this.
In structure (Q) one ring present in the form of hemiacetal. This will hydrolysed in solution it can reduce Fehling solution.

Aldehydes and Ketones

Exercise:1

Q. 1 **The formation of cynohydrin from a ketone is an example of (1990)**
(A) Electrophilic addition (B) Nucleophilic addition
(C) Nucleophilic substitution (D) Electrophilic substitution

Q.2 The enolic form of acetone contains : **[IIT 1990]**
(A) 9 sigma bonds, 1 pi bond and 2 lone pairs
(B) 8 sigma bonds, 2 pi bonds and 2 lone pairs
(C) 10 sigma bonds, 1 pi bond and 1 lone pair
(D) 9 sigma bonds, 2 pi bonds and 1 lone pair

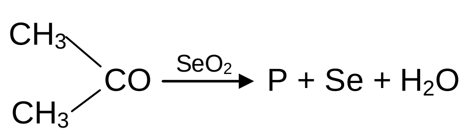
Q.3 m-chlorobenzaldehyde on reaction with conc. KOH at room temperature gives:
(A) Potassium m-chlorobenzoate and m-hydroxybenzaldehyde **[IIT 1991]**
(B) m- hydroxybenzaldehyde and m- chlorobenzyl alcohol
(C) m-chlorobenzyl and m-hydroxybenzyl alcohol
(D) Potassium m-chlorobenzoate and m-chlorobenzyl alcohol

Q.4 Hydrogenation of benzoyl chloride in the presence of Pd and $BaSO_4$ gives:
(A) Benzyl alcohol (B) Benzaldehyde **[IIT 1992]**
(C) Benzoic acid (D) Phenol

Q.5 An organic compound C_3H_6O does not give a precipitate with 2,4-Dinitrophenyl hydrazine reagent and does not react with metallic sodium. It could be: **[IIT 1993]**
(A) CH_3CH_2CHO (B) CH_3COCH_3
(C) $CH_2=CH–CH_2OH$ (D) $CH_2=CH–O–CH_3$

Q.6 Under Wolff Kishner reduction conditions, the conversions which may be brought about is?
[IIT 1995]
(A) Benzaldehyde into Benzyl alcohol
(B) Cyclohexanol into Cyclohexane
(C) Cyclohexanone into Cyclohexanol
(D) Benzophenone into Diphenylmethane

Q.7 In the reaction, P is **[IIT 1995]**



(A) CH_3COCHO (B) CH_3COOCH_3
(C) CH_3COCH_2OH (D) None

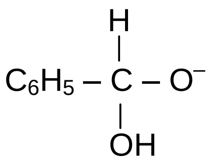
Q.8 In the Cannizzaro reaction given below, $2Ph-CHO \xrightarrow{OH^-} Ph-CH_2OH + PhCO_2^-$ the slowest step is :

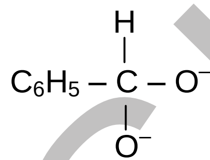
(A) the attack of OH^- at the carbonyl group
(B) the transfer of hydride to the carbonyl group
(C) the abstraction of proton from the carboxylic acid
(D) the deprotonation of $Ph-CH_2OH$ **[IIT 1996]**

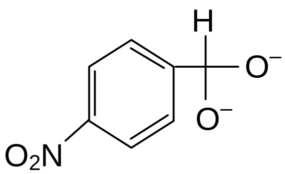
Q.9 Among the given compounds, the most susceptible to nucleophilic attack at the carbonyl group is- **[IIT 1997]**

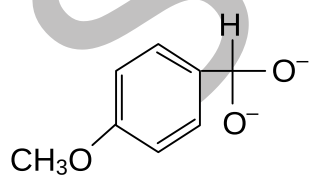
(A) MeCOCl (B) MeCHO
(C) MeCOOMe (D) MeCOOCOMe

Q.10 In a Cannizzaro reaction the intermediate which is the best hydride donor is: **[IIT 1997]**

(A) 

(B) 

(C) 

(D) 

Q.11 $CH_3CHO + H_2NOH \rightarrow CH_3 - CH = N - OH$. The above reaction occurs at : **[IIT 1997]**

(A) pH = 1 (B) pH = 4.5
(C) Any value of pH (D) pH = 12

Q.12 Among the following compounds, which will react acetone to give a product containing > C = N – **[IIT 1998]**

(A) $C_6H_5NH_2$ (B) $(CH_3)_3N$
(C) $C_6H_5NHC_6H_5$ (D) $C_6H_5NHNH_2$

Q.13 The product obtained via oxymercuration ($HgSO_4 - H_2SO_4$) of 1- butyne would be **[IIT 1998]**

(A) $CH_3CH_2-\overset{\overset{\displaystyle O}{||}}{C}-CH_3$ (B) $CH_3CH_2CH_2CHO$
(C) $CH_3CH_2CHO + HCHO$ (D) $CH_3CH_2COOH + HCOOH$

Q.14 Which of the following will undergo aldol condensation: **[IIT 1998]**

(A) Acetaldehyde (B) Propanaldehyde
(C) Benzaldehyde (D) Trideutero acetaldehyde

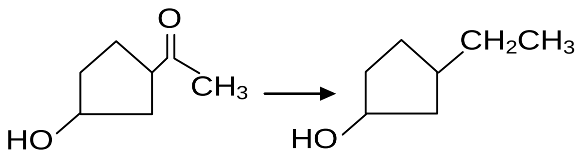
Q.15 Which of the following will react with water: **[IIT 1998]**

(A) $CHCl_3$ (B) Cl_3CCHO
(C) CCl_4 (D) $ClCH_2CH_2Cl$

Q.16 A new carbon-carbon bond formation is possible in: **[IIT 1998]**
(A) Cannizzaro reaction (B) Friedel-Crafts alkylation
(C) Clemmensen reduction (D) Reimer-Tiemann reaction

Q.17 Which of the following has the most acidic hydrogen: **[IIT 2000]**
(A) 3-hexanone (B) 2, 4-hexanedione
(C) 2,5-hexanedione (D) 2, 3-hexandione

Q.18 The appropriate reagent for the following transformation: **[IIT 2000]**



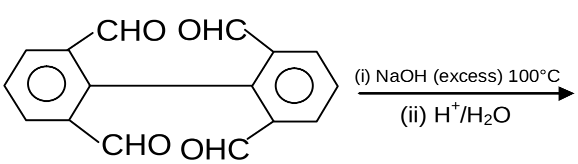
(A) Zn (Hg), HCl (B) NH_2NH_2, OH^-
(C) H_2/Ni (D) $NaBH_4$

Q.19 A mixture of benzaldehyde and formaldehyde on heating with aqueous NaOH solution gives: **[IIT 2001]**
(A) benzyl alcohol and sodium formate
(B) sodium benzoate and methyl alcohol
(C) sodium benzoate and sodium formate
(D) benzyl alcohol and methyl alcohol

Q.20 Compound A (molecular formula C_3H_8O) is treated with acidified potassium dichromate to form a product B(molecular formula C_3H_6O). B forms a shining silver mirror on warming with ammonical silver nitrate. B when treated with an aqueous solution of $H_2NCONHNH_2$. HCl and sodium acetate gives a product C. Identify the structure of C. **[IIT 2002]**
(A) $CH_3CH_2CH=NNHCONH_2$ (B) $CH_3-\underset{\substack{|\\CH_3}}{C}=NNHCONH_2$

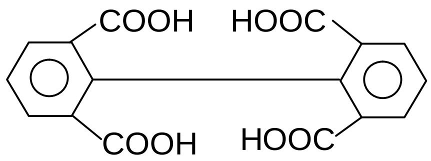
(C) $CH_3-\underset{\substack{|\\CH_3}}{C}=NCONHNH_2$ (D) $CH_3CH_2CH=NCONHNH_2$

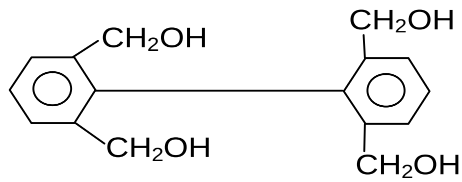
Q.21 1- propanol and 2- propanol can be best distinguished by: **[JEE 2001]**
(A) Oxidation with alkaline $KMnO_4$ followed by reaction with Fehling solution
(B) Oxidation with acedic dichromate followed by reaction with Fehling solution
(C) Oxidation by heating with copper followed by reaction with Fehling solution
(D) Oxidation with concentrated H_2SO_4 followed by reaction with Fehling

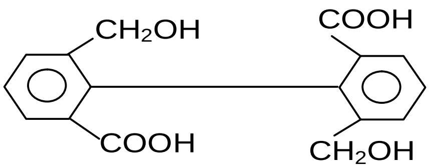
Q.22 

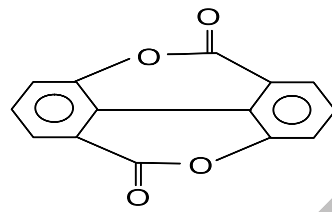
[IIT 2003]

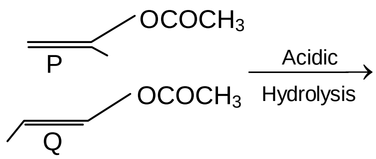
any one of the products formed is:

(A) 

(B) 

(C) 

(D) 

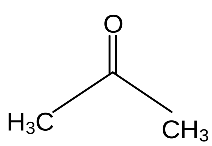
Q.23  Products formed by P & Q can be differentiated by :

[IIT 2003]

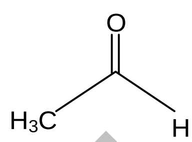
(A) 2,4 DNP
(B) Lucas reagent ($ZnCl_2$) conc. HCl
(C) $NaHSO_3$
(D) Fehlings solution

Q.24 The order of reactivity of phenyl Magnesium Bromide with the following compounds is :

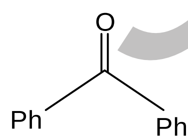
[IIT 2004]



(I)

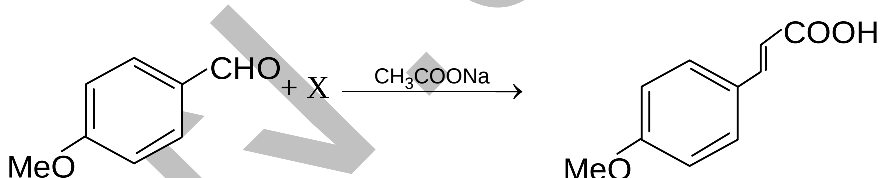


(II)



(III)

(A) II > III > I
(B) I > III > II
(C) II > I > III
(D) All react with the same rate

Q.25  **[IIT 2005]**

What is X?

(A) CH_3COOH
(B) $BrCH_2$, COOH
(C) $(CH_3CO)_2O$
(D) CHO –COOH

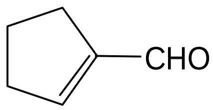
Q.26 The smallest ketone and its next homologue are reacted with NH_2OH to form oxime.

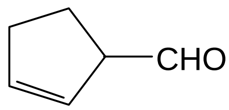
(A) Two different oximes are formed
(B) Three different oximes are formed
(C) Two oximes are optically active
(D) All oximes are optically active

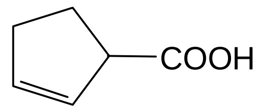
[JEE 2006]

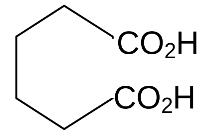
Q.27 Cyclohexene on ozonolysis followed by reaction with zinc dust and water gives compound E. Compound E on further treatment with aqueous KOH yields compound F. Compound F is:

[JEE 2007]

(A) 

(B) 

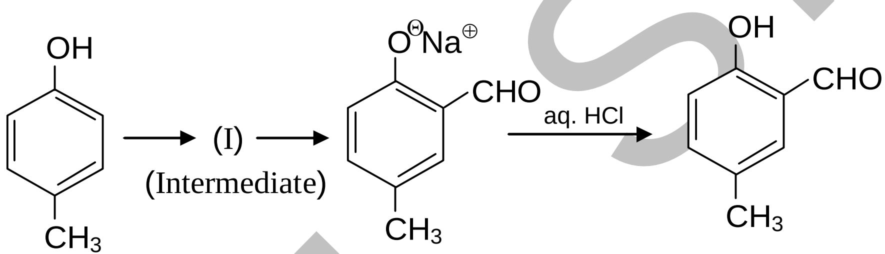
(C) 

(D) 

Q.28 **Statement-1 :** Glucose gives a reddish-brown precipitate with Fehling's solution.
because
Statement-2 : Reaction of glucose with Fehling's solution gives CuO and gluconic acid.
(A) Statement-1 is true, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True. **[JEE 2007]**

Paragraph for Question Nos. 29 to 31(3 questions)

Reimer-Tiemann reaction introduces an aldehyde group, on to the aromatic ring of phenol, ortho to the hydroxyl group. This reaction involves electrophilic aromatic substitution. This is a general method for the synthesis of substituted salicylaldehydes as depicted below:

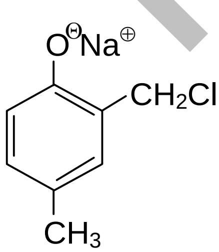


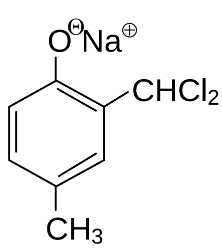
(I) (II) (III)

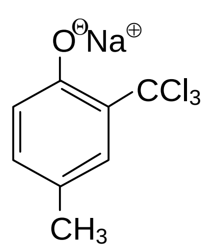
Q.29 Which one of the following reagents is used in the above reaction? **[JEE 2007]**
(A) aq.NaOH + CH_3Cl (B) aq. NaOH +CH_2Cl_2
(C) aq. NaOH + $CHCl_3$ (D) aq. NaOH + CCl_4

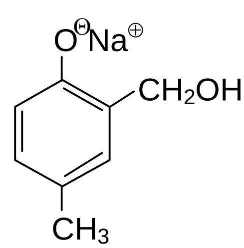
Q.30 The electrophile in this reaction is: **[JEE 2007]**
(A) $:CHCl$ (B) $^+CHCl_2$
(C) $:CCl_2$ (D) $:CCl_3$

Q.31 The structure of the intermediate I is: **[JEE 2007]**

(A) 

(B) 

(C) 

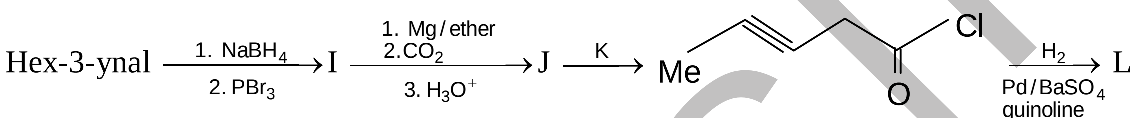
(D) 

Q.32 Match the compounds/ion in column-I with their properties/reaction in Column- II. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS. **[JEE 2007]**

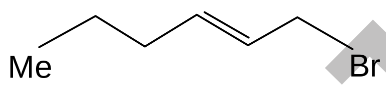
Column-I	**Column-II**
(A) C_6H_5CHO	(P) gives precipitate with 2,4- dinitrophenylhydrazine
(B) $CH_3C \equiv CH$	(Q) gives precipitate with $AgNO_3$
(C) CN^-	(R) is a nucleophile
(D) I^-	(S) is involved in cyanohydrin formation

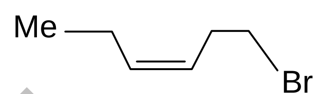
Paragraph for Question No.33 to 35

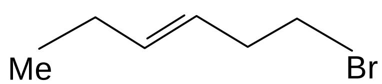
In the following reaction sequence, products **I**, **J** and **L** are formed. **K** represents a reagent.

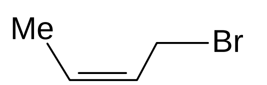


Q.33 The structure of the product **I** is: **[JEE 2008]**

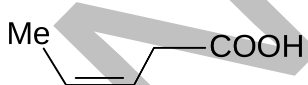
(A) 

(B) 

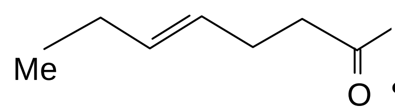
(C) 

(D) 

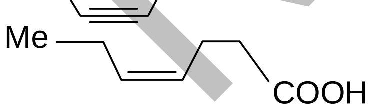
Q.34 The structures of compounds **J** and **K**, respectively, are: **[JEE 2008]**

(A) 

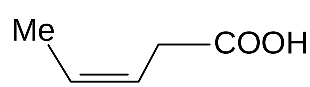
& $SOCl_2$

(B) 

& SO_2Cl_2

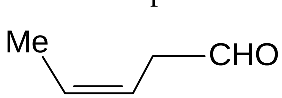
(C) 

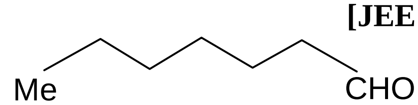
& $SOCl_2$

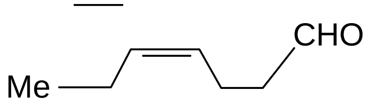
(D) 

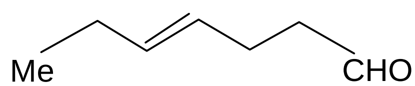
& CH_3SO_2Cl

Q.35 The structure of product **L** is: **[JEE 2008]**

(A) 

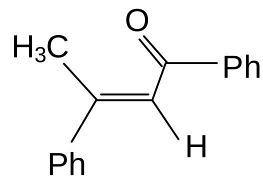
(B) 

(C) 

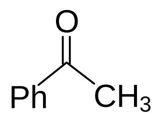
(D) 

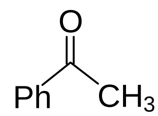
Paragraph for Question No.36 to 38

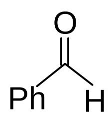
A tertiary alcohol **H** upon acid catalysed dehydration gives a product I. Ozonolysis of **I** leads to compounds **J** and **K**. Compound **J** upon reaction with KOH gives benzyl alcohol and a compound **L**, whereas **K** on reaction with KOH gives only **M**.

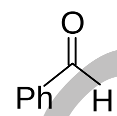
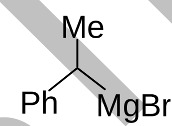
M = 

Q.36 Compound **H** is formed by the reaction of : **[JEE 2008]**

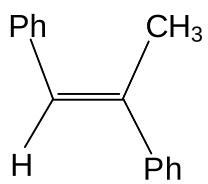
(A)  + PhMgBr

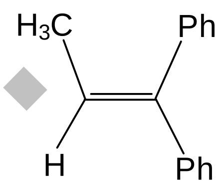
(C)  + $PhCH_2MgBr$

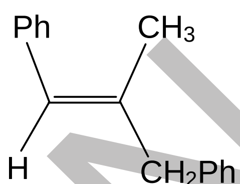
(C)  + $PhCH_2MgBr$

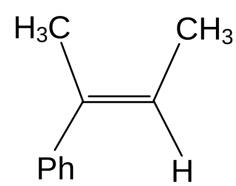
(D)  + 

Q.37 The structure of compound **I** is: **[JEE 2008]**

(A) 

(B) 

(C) 

(D) 

Q.38 The structures of compounds **J**, **K** and **L**, respectively are : **[JEE 2008]**

(A) $PhCOCH_3$, $PhCH_2COCH_3$ and $PhCH_2COO^-K^+$

(B) PhCHO, $PhCH_2CHO$ and $PhCOO^-K^+$

(C) $PhCOCH_3$, $PhCH_2CHO$ and $CH_3COO^-K^+$

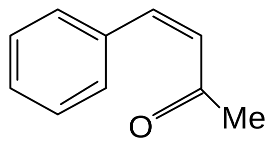
(D) PhCHO, $PhCOCH_3$ and $PhCOO^-K^+$

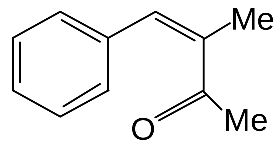
Paragraph for Question Nos. 39 to 41

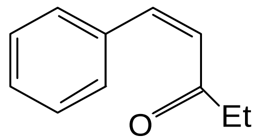
A carbonyl compound **P**, which gives positive iodoform test, undergoes reaction with MeMgBr followed by dehydration to give an olefin **Q**. Ozonolysis of **Q** leads to a dicarbonyl compound **R**, which undergoes Intramolecular aldol reaction to give predominantly **S**.

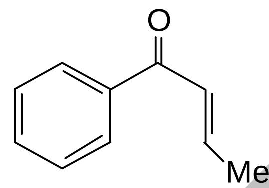
$$P \xrightarrow[\text{2. } H^+,\ H_2O \quad \text{3. } H_2SO_4,\ \Delta]{\text{1. MeMgBr}} Q \xrightarrow[\text{2. Zn, } H_2O]{\text{1. } O_3} R \xrightarrow[\text{2. } \Delta]{\text{1. } OH^-} S$$

Q.39 The structure of the carbonyl compound P is: **[JEE 2009]**

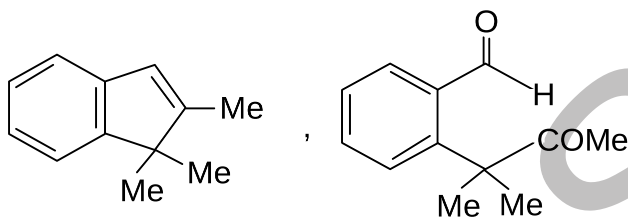
(A) 

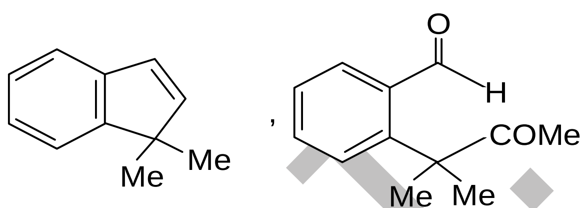
(B) 

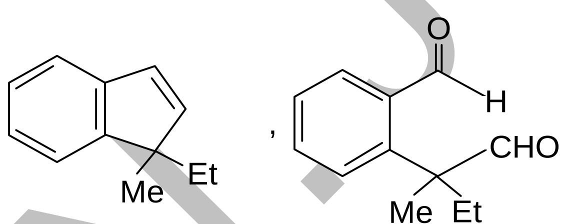
(C) 

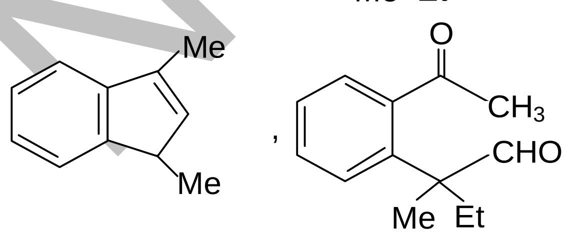
(D) 

Q.40 The structure of the products **Q** and **R**, respectively, are **[JEE 2009]**

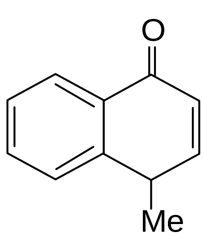
(A) 

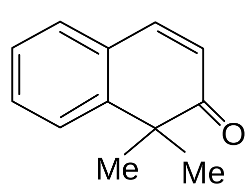
(B) 

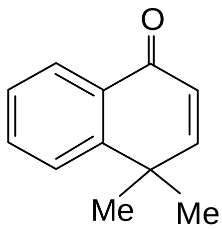
(C) 

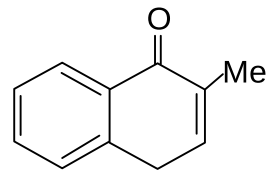
(D) 

Q.41 The structure of the product **S** is : **[JEE 2009]**

(A) 

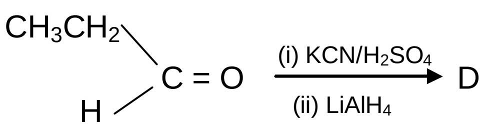
(B) 

(C) 

(D) 

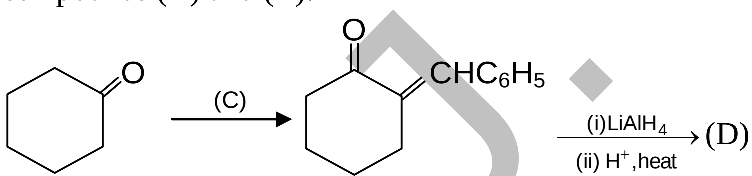
EXERCISE-2

Q.1 $C_6H_5-CHO + CH_3-COOC_2H_5 \xrightarrow[C_2H_5OH \text{ and heat}]{NaOC_2H_5}$ (D). **[IIT 1995]**

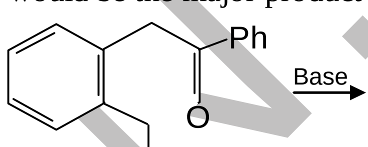
Q.2  **[IIT 1996]**

Q.3 Acetophenone on reaction with hydroxylamine- hydrochloride can produce two isomeric oximes. Write structure of the oximes. **[IIT 1997]**

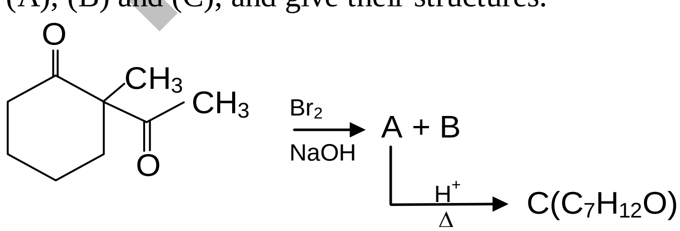
Q.4 An aldehyde (A) ($C_{11}H_8O$), which does not undergo self aldol condensation, gives benzaldehyde and two mole of (B) on ozonolysis. Compound (B), on oxidation with silver ion, gives oxalic acid. Identify the compounds (A) and (B). **[IIT 1998]**

Q.5  **[IIT 1998]**

Q.6 What would be the major product in each of the following reaction? **[IIT 2000]**



Q.7 Identify (A), (B) and (C), and give their structures. **[IIT 2000]**



Q.8 Five isomeric para-disubstituted aromatic compounds A to E with molecular formula $C_8H_8O_2$ were given for identification. Based on the following observations, give structure of the compounds.

(i) Both A and B form a silver mirror with Tollen's reagent; also, B gives a positive test with $FeCl_3$ solution

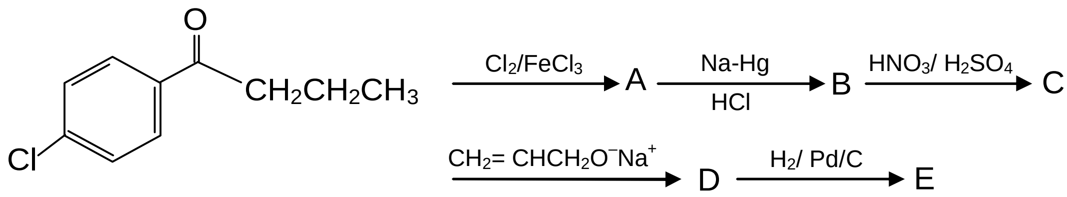
(ii) C gives positive iodoform test.

(iii)D is readily extracted in aqueous $NaHCO_3$solution.

(iv)E on acid hydrolysis gives 1,4-dihydroxybenzene. **[IIT 2002]**

Q.9 Write structures of the products A, B, C, D and e in the following scheme.

[IIT 2002]



Q.10 $C_6H_{12} \xrightarrow{HCl} \underset{(B)}{C_6H_{13}Cl} + (C)$

$(B) \longrightarrow (D) \xrightarrow{\text{ozonolysis}} (E)$

$(A) \xrightarrow{\text{ozonolysis}} (F) + (G) \xrightarrow{NaOH}$ NCOONa + 1°alcohol

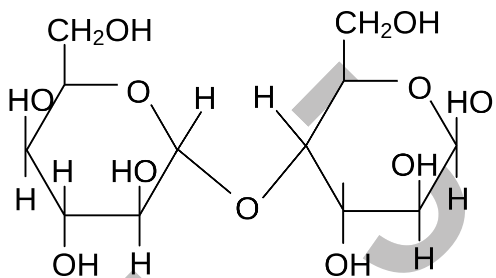
(D) is isomer A. E gives negative test with Fehling solution but gives iodoform test. F and G gives Tollen's test but do not give iodoform test. Identify A to G.

[IIT 2003]

Q.11 Which of the following disaccharide will not reduce. Tollen's reagent?

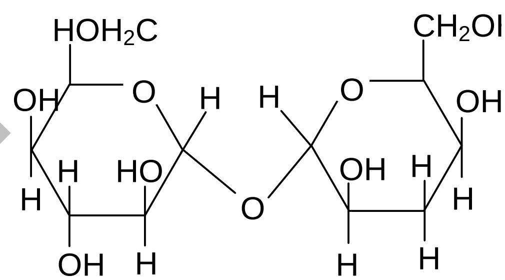
[IIT 2005]

(A)



(Q)

(B)



(P)

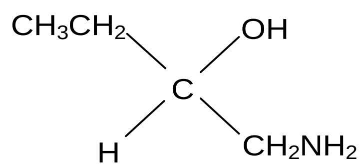
EXERCISE-1

Q.No.	1	2	3	4	5	6	7	8	9	10
Ans.	B	A	D	B	D	D	A	B	A	D
Q.No.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.	B	A,D	A	A,B,D	B	B, D	B	B	A	A
Q.No.	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	C	C	D	C	C	B	A	C	C	C
Q.No.	**31**	**32**	**A**	**B**	**C**	**D**	**33**	**34**	**35**	**36**
Ans.	B		P, S	Q	Q,R, S	Q,R	D	A	C	B
Q.No.	**37**	**38**	**39**	**40**	**41**					
Ans.	A	D	B	A	B					

EXERCISE-2

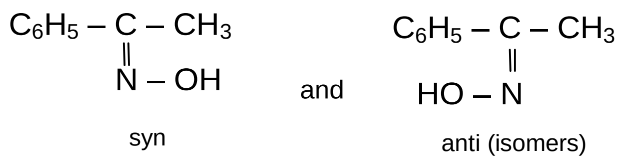
Q. 1 $C_6H_5CH = CHCOOC_2H_5$
(D)

Q.2

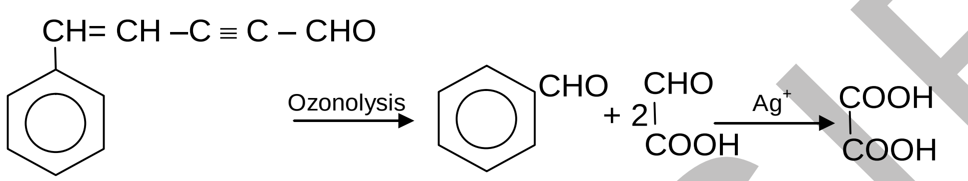


(a racemic mixture)

Q.3

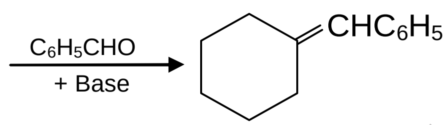


Q.4



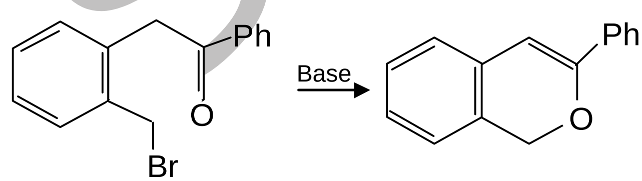
(A) (B) (Oxalic acid)

Q.5

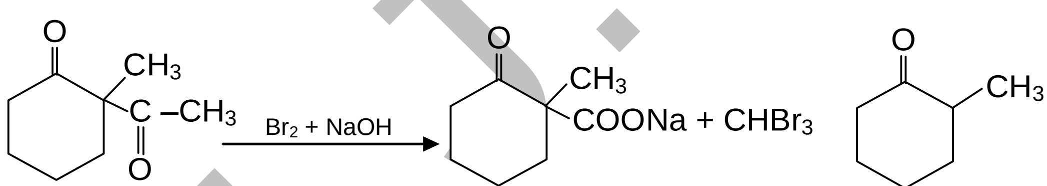


(C) (D)

Q.6

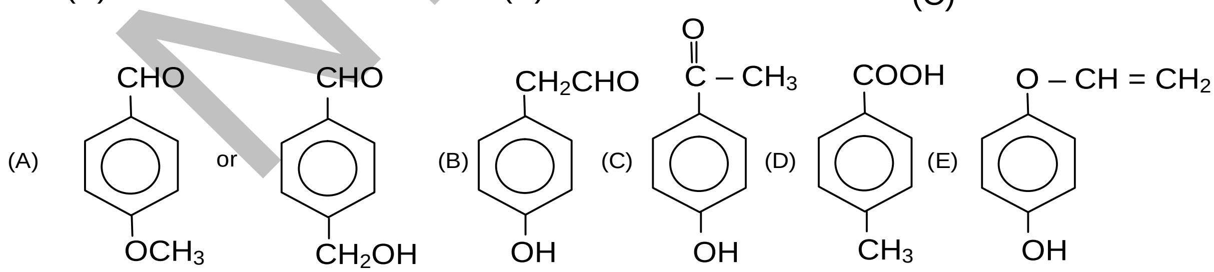


Q.7



(A) (B) (C)

Q.8



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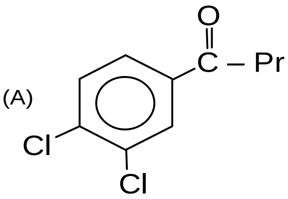
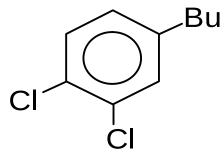
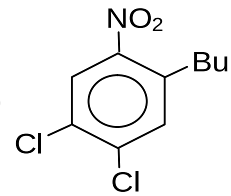
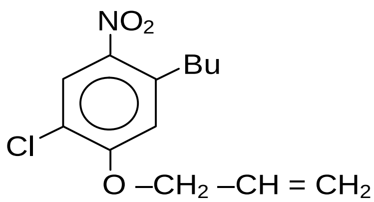
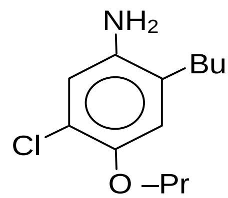
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

Q.9 (A)  (B)  (C) 

(D)  (E) 

Q.10

$$\underset{(A)}{Me_3C-CH=CH_2} \longrightarrow \underset{(B)}{Me_2\underset{|}{\overset{}{C}}(Cl)-CHMe_2} + \underset{(C)}{Me_3C-CH(Cl)-Me}$$

(B) $\xrightarrow{\text{alc.KOH}}$ (A)

$$\text{(A)} \xrightarrow{\text{Ozonolysis}} \underset{(F)}{HCHO} + \underset{(G)}{Me_3C-CHO} \xrightarrow{\text{NaOH}}$$

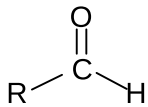
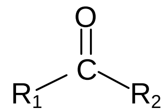
$HCOONa + Me_3C-CH_2OH$ (1° alcohol)

Q.11 In structure (P) both the rings are present in acetyl form therefore it will not hydrolyse in solution that's why Fehling solution cannot react with this.
In structure (Q) one ring present in the form of hemiacetal. This will hydrolysed in solution it can reduce Fehling solution.

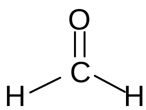
ALDEHYDES AND KETONES

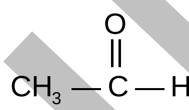
Carbonyl Compounds

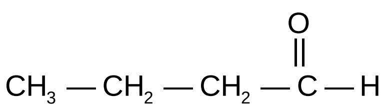
Both aldehydes & ketones are known as carbonyl compounds.

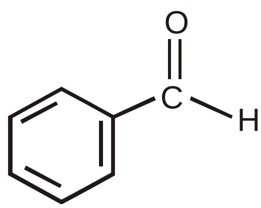
Aldehydes  Ketones 

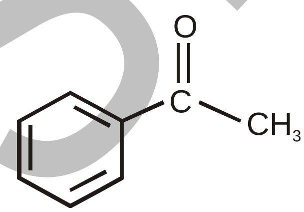
Common Name :-

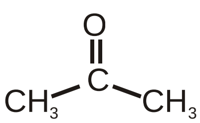
1.  formaldehyde

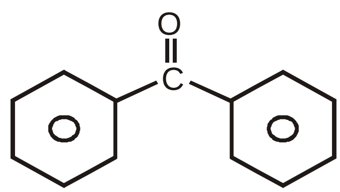
2.  acetaldehyde

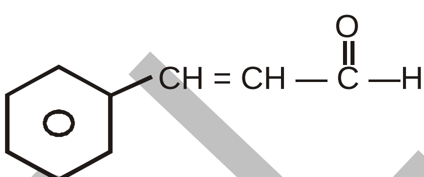
3. butyraldehyde 

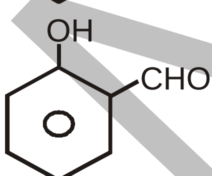
4.  Benzaldehyde

5.  acetophenone

6.  (acetone)

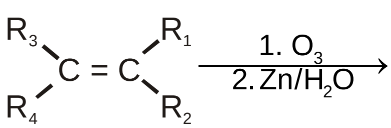
7.  (Benzophenone)

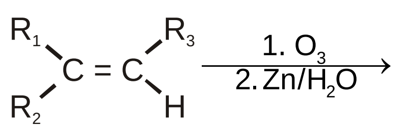
8.  (Cinnamaldehyde)

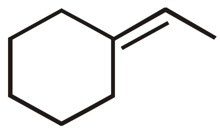
9.  (salicyldehyde)

Preparation of aldehydes & ketones

1. From alkenes

 ,



Q.1  $\xrightarrow[2.\ Zn/H_2O]{1.\ O_3}$

Q.2  $\xrightarrow[2.\ Zn/H_2O]{1.\ O_3}$

2. From alkynes

$R_1 - C \equiv C - H \xrightarrow[dil.H_2SO_4]{HgSO_4}$

1 $R_1 - CH_2 - C \equiv CH \xrightarrow[2.\ dil\ H_2SO_4]{1.\ HgSO_4}$

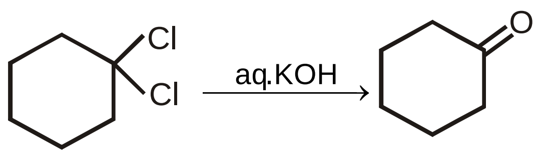
2  $\xrightarrow[2.\ dil\ H_2SO_4]{1.\ HgSO_4}$

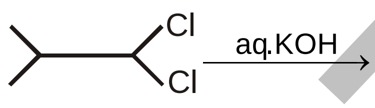
3 $CH_3 - C \equiv C - CH_3 \xrightarrow[2.\ dil.\ H_2SO_4]{1.\ HgSO_4}$

Hydration of alkynes

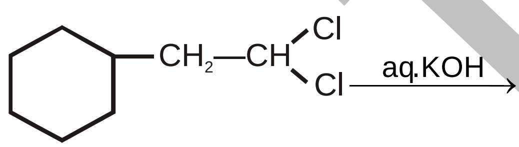
$$R - C \equiv CH \xrightarrow[2.\ H_2O_2/\overline{O}H]{1.\ 9\text{–}BBN} R - CH = \underset{\displaystyle OH}{\underset{|}{CH}} \rightleftharpoons R - CH_2 - \overset{\displaystyle O}{\overset{\|}{C}} - H$$

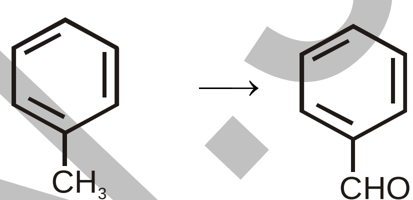
3. **Hydrolysis of Gem dihalides**



Q.1 

Q.2 $CH_3 - CHCl_2 \xrightarrow{aq.KOH}$

Q.3 

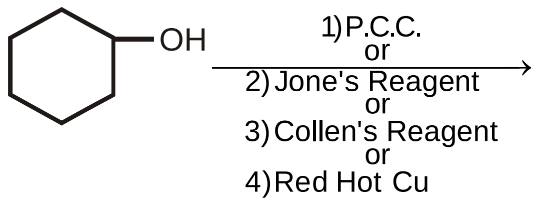
Q.4 Convert 

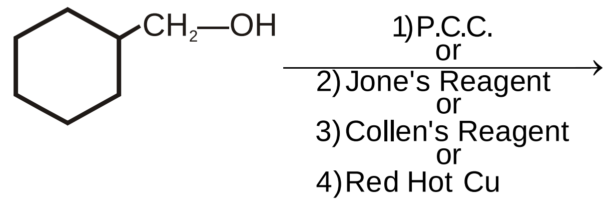
4. **By oxidation of alcohols**

1. $R - CH_2 - OH \xrightarrow{P.C.C.}$

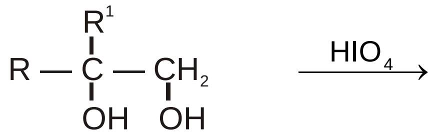
2. $R_1 - \underset{\displaystyle OH}{\underset{|}{CH}} - R_2 \xrightarrow{P.C.C.}$

Other oxidizing agents which can be used Collen's reagent; Jone's Reagent, Red Hot Cu Tube

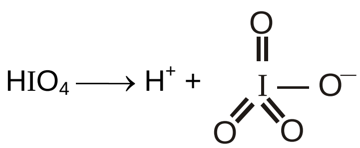
Q.1 

Q.2 

5. **From diols Via HIO_4**



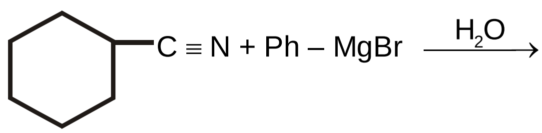
Mechanism:-



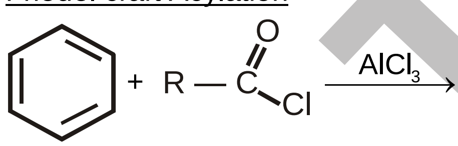
Methods of Preparation (Conta.)

6. From cyanides

$R — C \equiv N + CH_3MgBr \xrightarrow{H_2O}$

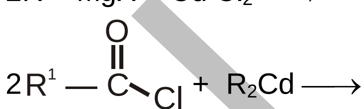


7. Friedel craft Acylation

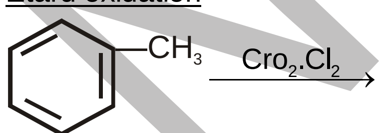


8. From acid Chlorides

$2R – MgX + Cd\,Cl_2 \longrightarrow$



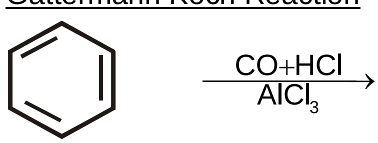
9. Etard oxidation



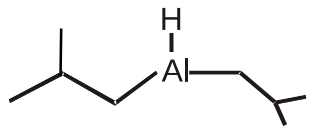
10. Rosenmund Reduction

$R — CN \xrightarrow[HCl]{SnCl_2}$

11. Gattermann Koch Reaction



Diisobutyl aluminium hydride DIBAL-H:-



AlH (i-Bu)$_2$

$R-\overset{\overset{\displaystyle O}{||}}{C}-O-R^1 \xrightarrow{\text{DIBAL–H}}$

$R-C\equiv N \xrightarrow[\text{2. } H_2O]{\text{1.DIBAL–H}}$

<u>Polymerisation Reaction</u>

1. $n\ H-\overset{\overset{\displaystyle O}{||}}{C}-H \xrightarrow{H_2O}$

2. <u>Polymerisationm in presence of H_2SO_4</u>

(a) 3 $H-\overset{\overset{\displaystyle O}{||}}{C}-H \xrightarrow{H_2SO_4}$

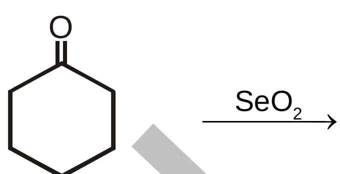
(b) 3 $CH_3-\overset{\overset{\displaystyle O}{||}}{C}-H \xrightarrow{H_2SO_4}$

(c) 4 $CH_3-\overset{\overset{\displaystyle O}{||}}{C}-H \xrightarrow{SO_2/HCl}$

$NaHSO_3$

$R-\overset{\overset{\displaystyle O}{||}}{C}-H \xrightarrow{HSO_3^{\ominus}}$

SeO_2

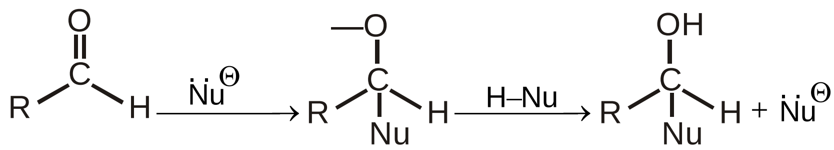


Imp

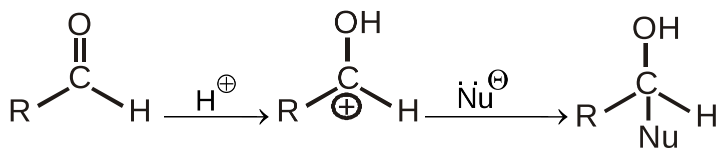
6 $H-\overset{\overset{\displaystyle O}{||}}{C}-H \xrightarrow{4NH_3}$

Nucleophilic addition Reaction:-

Base catalysed

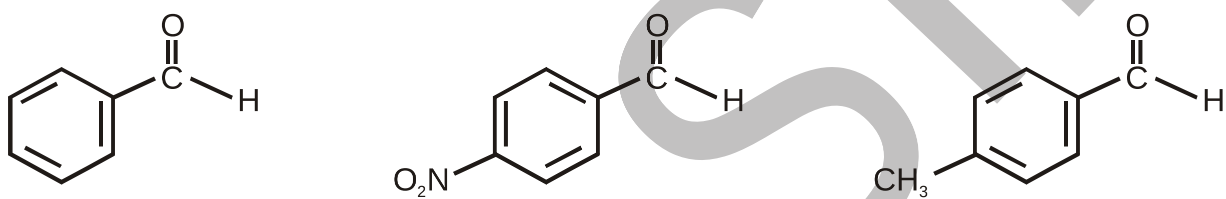


Acid catalysed



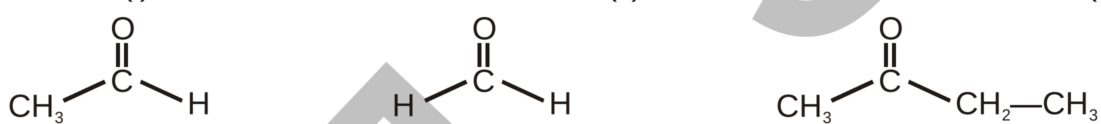
Q.1 Compare rate of $\ddot{N}u^{\ominus}$ additions on following:-

(a)



(i) (ii) (iii)

(b)

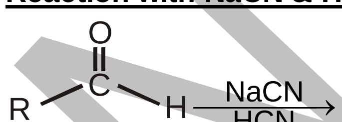


(i) (ii) (iii)

(c)

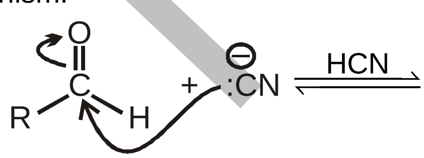
(i) (ii)

(1) Reaction with NaCN & HCN

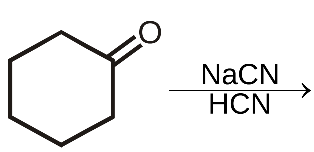


Mechanism:-

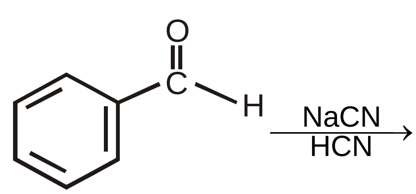
1.

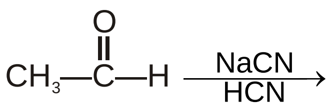


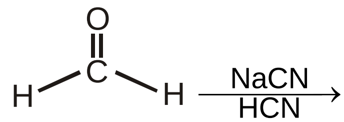
Q.1



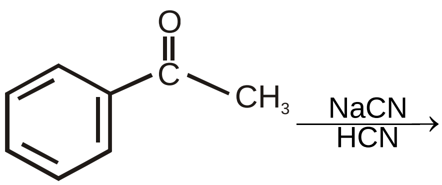
Q.2



Q.3 

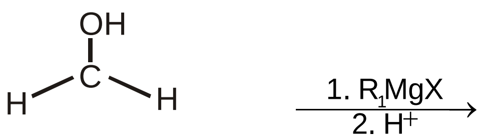
Q.4 

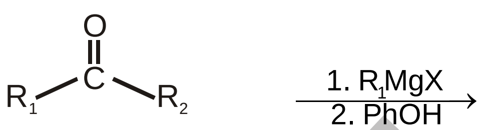
Guess during Reaction

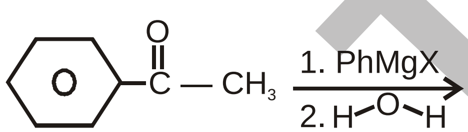
Q.5 

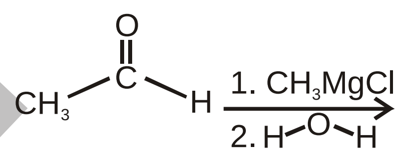
Q.6 $\frac{d(H^+)}{dt} > O$ or $\frac{d(H^+)}{dt} = O$ or $\frac{d(H^+)}{dt} = O$

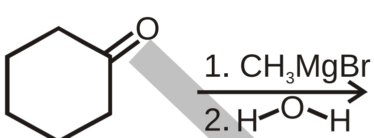
2. <u>Reaction with Grignard Reagent (RMgX)</u>



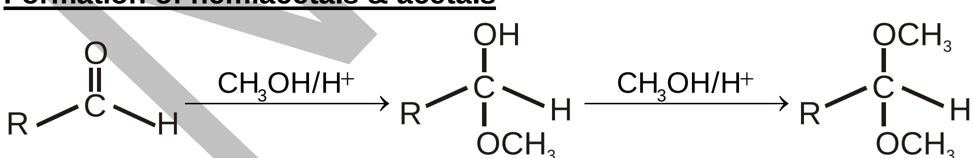


Q.1 

Q.2 

Q.3 

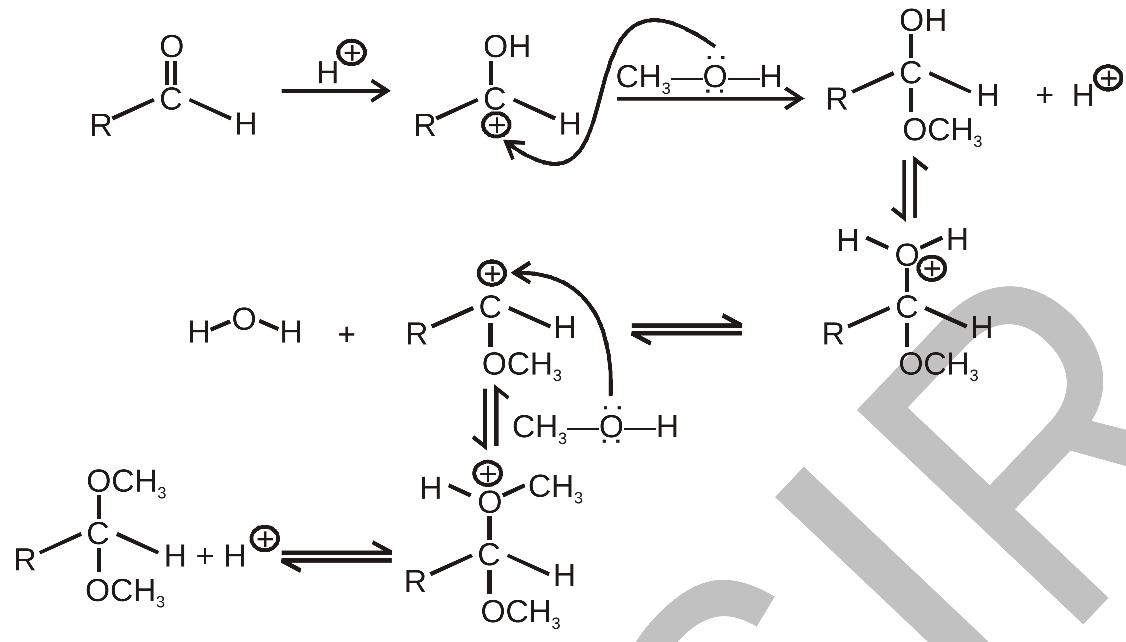
3. <u>Formation of hemiacetals & acetals</u>

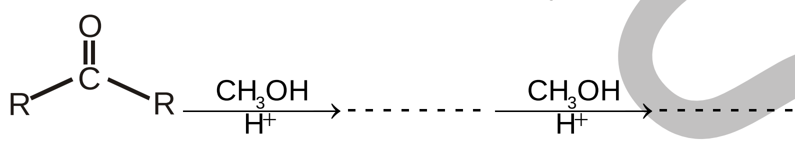


Hemiacetal acetal

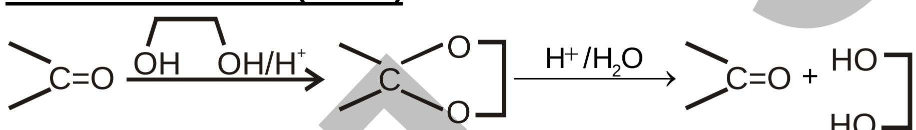
Mechanism

1.

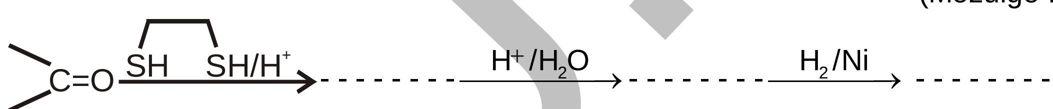




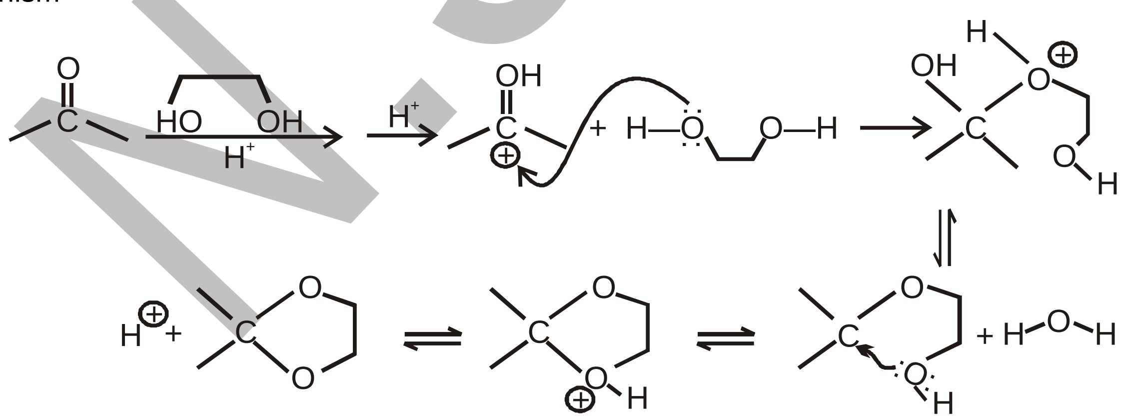
(4) Reactions with diols (Thiols)

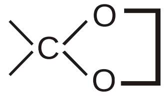
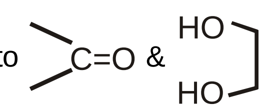


(Mozuigo Reduction)

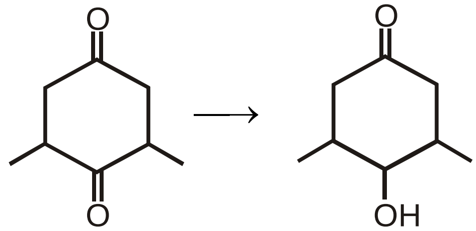


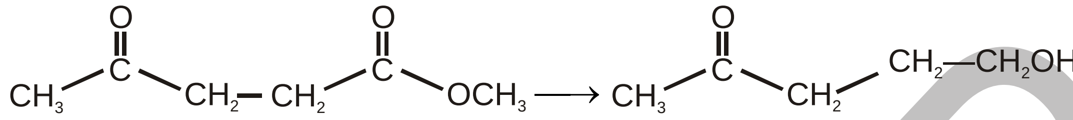
Mechanism

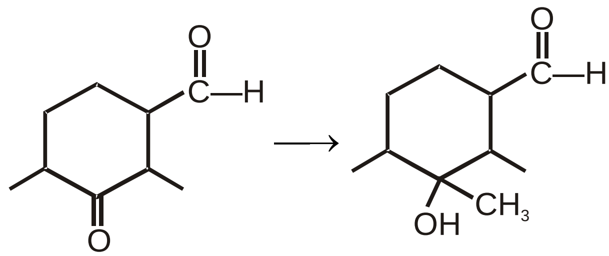


 is stable in basic medium but in aqueous acidic medium it converts to 

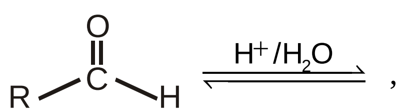
Convert

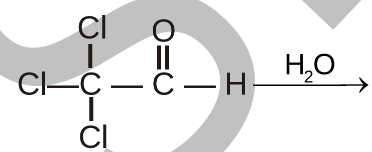
Q.1 

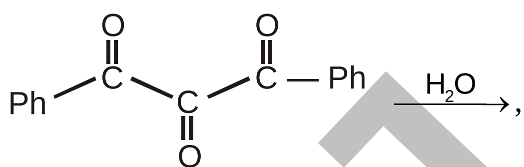
Q.2 

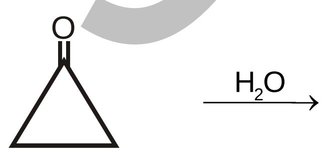
Q.3 

(4) Reaction with $H-O-H$ (hydration)



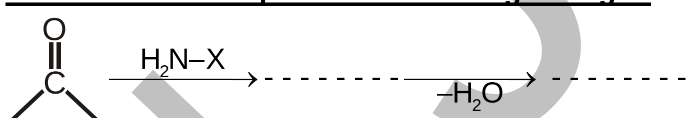




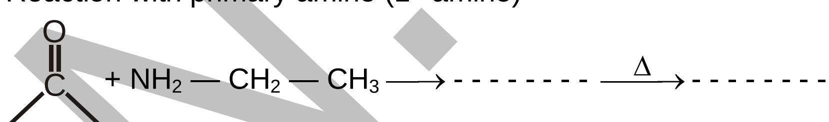


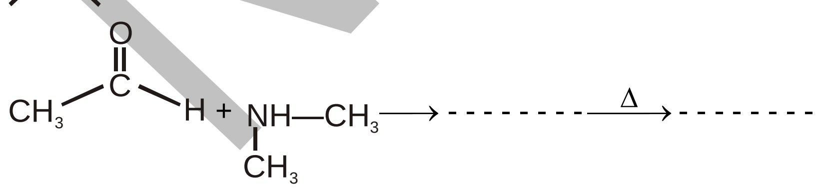
(Stable hydrate)

(5) Addition with compounds containing Nitrogen



1. Reaction with primary amine (1°-amine)





Imp. Note:-

1° amines (primary amines) give $\longrightarrow$ imine

2° amines give $\longrightarrow$ enamine

1. $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=O \xrightarrow[\text{hydrazine}]{NH_2-NH_2}$

2. $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=O \xrightarrow[\text{Phenylhydrazine}]{NH_2-NH-Ph}$

3. $(CH_3)_2C=O \xrightarrow[\text{hydroxyl amine}]{NH_2OH}$

4. $(CH_3)_2C=O \xrightarrow[\text{Semicarbazide}]{NH_2-NH-\overset{\displaystyle O}{\overset{||}{C}}-NH_2}$

Oxidation of Carbonyl Compounds

1. $R-\overset{\displaystyle O}{\overset{||}{C}}-H \xrightarrow[\Delta]{[Ag(NH_3)_2]OH}$

Aldehydes are easily oxidized hence they act as reducing agent.

Silver mirror Test

$AgNO_3 + NH_4OH \longrightarrow$ ammonical $AgNO_3$ is tollen's Reagent.

$2\ AgOH \longrightarrow Ag_2O + H-O-H$

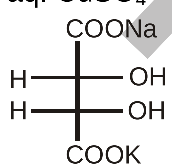
$R-\overset{\displaystyle O}{\overset{||}{C}}-H + Ag_2O \longrightarrow$ - - - - - - - -

Imp.

Ketones do not give this test.

2. Fehling solution

Fehling A $\longrightarrow$ aq. $CuSO_4$

Fehling B $\longrightarrow$ 

(Sodium potassium Tartorate or Roscheue Salt)

$Cu(OH)_2 \longrightarrow Cu\,O + H_2O$

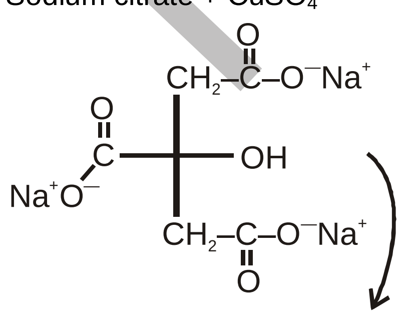
$R-\overset{\displaystyle O}{\overset{||}{C}}-H + 2Cu\,O \longrightarrow R-\overset{\displaystyle O}{\overset{||}{C}}-OH + Cu_2\,O$ (Red ppt.)

Imp.

Aldehydes give (red ppt.) with Fehling solution but ketones do not give this test.

(3) Benedict's Solution

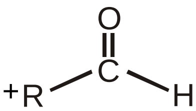
Sodium citrate + $CuSO_4$



(I am a salt of weak acid & strong base. I will make the solution basic)

Sodium citrate

$Cu(OH)_2 \xrightarrow[\Delta]{} CuO + $ H–O–H

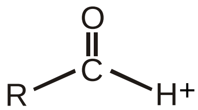
2 Cu O +  $\longrightarrow$

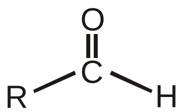
<u>Acidified potassium dichromate (VI) solution</u>

$K_2Cr_2O_7/H^+$

$Cr_2O_7^{2-} + 14\,H^+ + 6e^- \longrightarrow 2\,Cr^{+3} + 7H_2O$

Orange (Cr^{+6}) green (Cr^{+3})

1.  + H–O–H $\longrightarrow$ - - - - - - - -

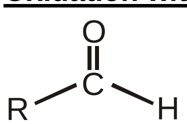
2.  $\longrightarrow$ X

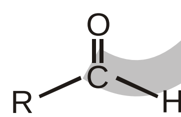
Note:

With the reaction of $K_2Cr_2O_7$ in dil. Acidic medium

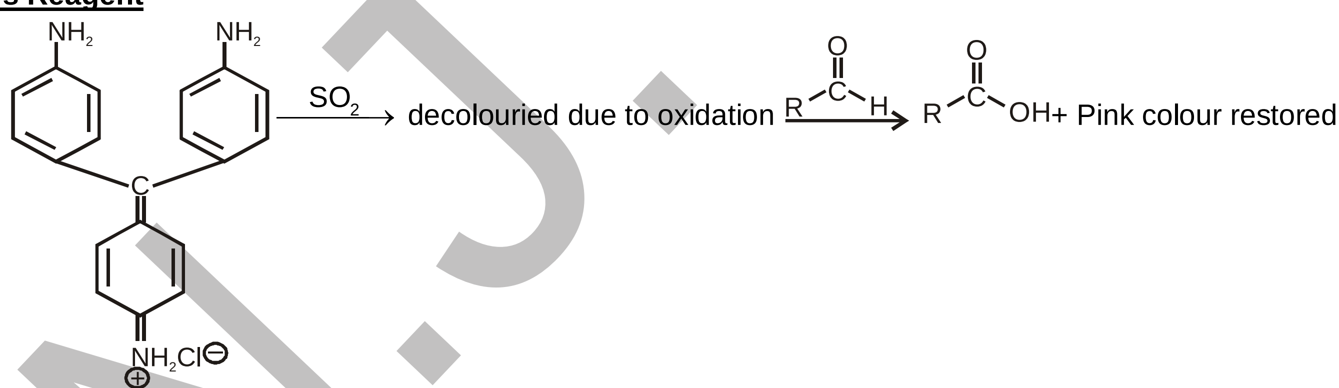
Ketone	No change in orange solution
Aldehyde	Orange colour $\longrightarrow$ green

(5) <u>Oxidation with $HgCl_2$</u>

1.  $+ 2HgCl_2 + H_2O \longrightarrow$

2.  $+ Hg_2Cl_2 + H_2O \longrightarrow$

<u>Schiff's Reagent</u>



P – Rosaaniline hydrochloride magenta colour

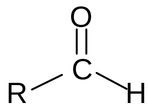
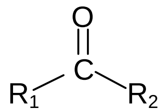
Imp.

Aldehydes restore the pink colour of rosaaniline hydrochloride but ketones do not.

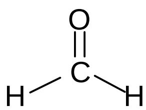
ALDEHYDES AND KETONES

Carbonyl Compounds

Both aldehydes & ketones are known as carbonyl compounds.

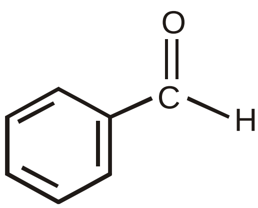
Aldehydes  Ketones 

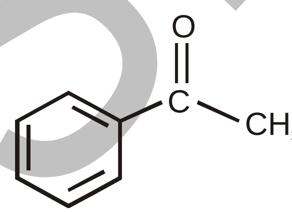
Common Name :-

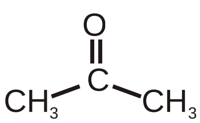
1.  formaldehyde

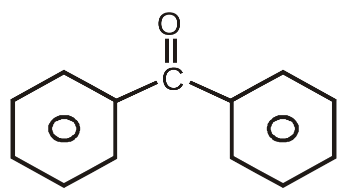
2. $CH_3-\overset{\overset{O}{||}}{C}-H$ acetaldehyde

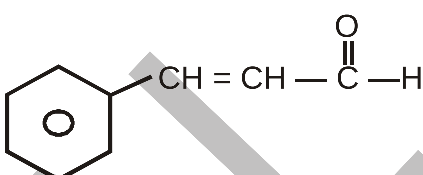
3. butyraldehyde $CH_3-CH_2-CH_2-\overset{\overset{O}{||}}{C}-H$

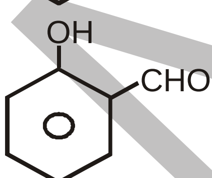
4.  Benzaldehyde

5.  acetophenone

6.  (acetone)

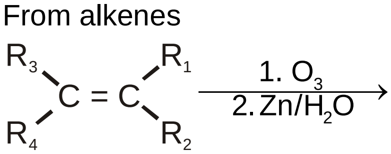
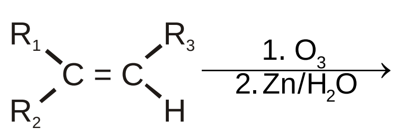
7.  (Benzophenone)

8.  (Cinnamaldehyde)

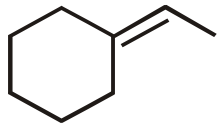
9.  (salicyldehyde)

Preparation of aldehydes & ketones

1. From alkenes

 , 

ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

Q.1  $\xrightarrow[2.\ Zn/H_2O]{1.\ O_3}$ Q.2  $\xrightarrow[2.\ Zn/H_2O]{1.\ O_3}$

2. From alkynes

$R_1 - C \equiv C - H \xrightarrow[\text{dil.}H_2SO_4]{HgSO_4}$

1 $R_1 - CH_2 - C \equiv CH \xrightarrow[2.\ \text{dil}\ H_2SO_4]{1.\ HgSO_4}$

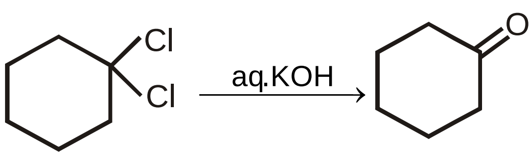
2  $\xrightarrow[2.\ \text{dil}\ H_2SO_4]{1.\ HgSO_4}$

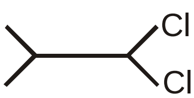
3 $CH_3 - C \equiv C - CH_3 \xrightarrow[2.\ \text{dil.}\ H_2SO_4]{1.\ HgSO_4}$

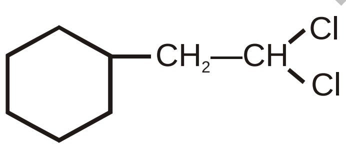
Hydration of alkynes

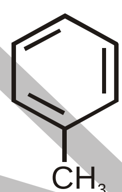
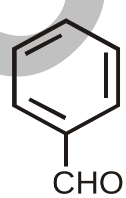
$$R - C \equiv CH \xrightarrow[2.\ H_2O_2/\overline{O}H]{1.\ 9\text{–}BBN} R - CH = \underset{\displaystyle OH}{\underset{|}{CH}} \rightleftharpoons R - CH_2 - \overset{\displaystyle O}{\overset{\|}{C}} - H$$

3. **Hydrolysis of Gem dihalides**



Q.1  $\xrightarrow{aq.KOH}$ Q.2 $CH_3-CH\langle^{Cl}_{Cl} \xrightarrow{aq.KOH}$

Q.3  $\xrightarrow{aq.KOH}$

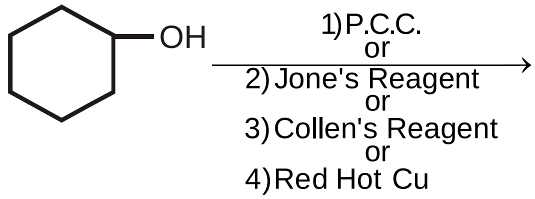
Q.4 Convert  $\longrightarrow$ 

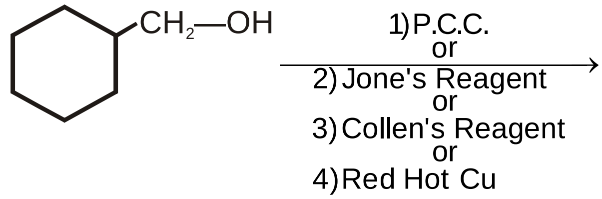
4. **By oxidation of alcohols**

1. $R - CH_2 - OH \xrightarrow{P.C.C.}$

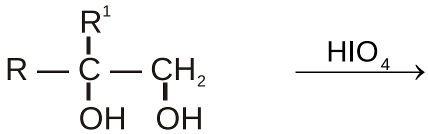
2. $R_1 - \underset{\displaystyle OH}{\underset{|}{CH}} - R_2 \xrightarrow{P.C.C.}$

Other oxidizing agents which can be used Collen's reagent; Jone's Reagent, Red Hot Cu Tube

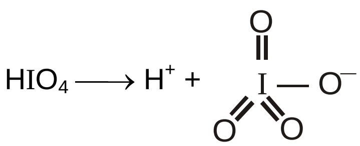
Q.1 

Q.2 

5. **<u>From diols Via HIO_4</u>**



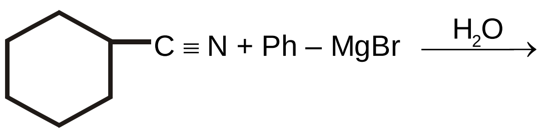
<u>Mechanism:-</u>



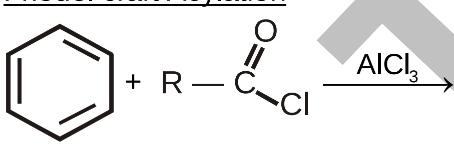
<u>Methods of Preparation (Conta.)</u>

6. <u>From cyanides</u>

$R - C \equiv N + CH_3MgBr \xrightarrow{H_2O}$

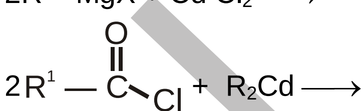


7. <u>Friedel craft Acylation</u>

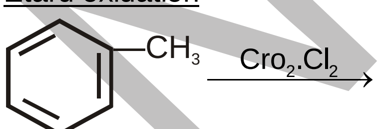


8. <u>From acid Chlorides</u>

$2R - MgX + Cd\,Cl_2 \longrightarrow$



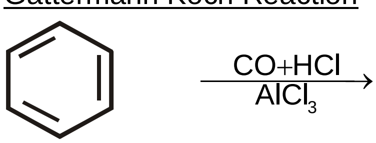
9. <u>Etard oxidation</u>



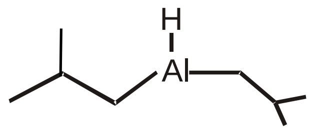
10. <u>Rosenmund Reduction</u>

$R - CN \xrightarrow[HCl]{SnCl_2}$

11. <u>Gattermann Koch Reaction</u>



<u>Diisobutyl aluminium hydride DIBAL-H</u>:-



$AlH\ (i\text{-}Bu)_2$

$R-\overset{\overset{\displaystyle O}{\|}}{C}-O-R^1 \xrightarrow{\text{DIBAL–H}}$

$R-C\equiv N \xrightarrow[\text{2. } H_2O]{\text{1.DIBAL–H}}$

<u>Polymerisation Reaction</u>

1. $n\ H-\overset{\overset{\displaystyle O}{\|}}{C}-H \xrightarrow{H_2O}$

2. <u>Polymerisationm in presence of H_2SO_4</u>

(a) 3 $H-\overset{\overset{\displaystyle O}{\|}}{C}-H \xrightarrow{H_2SO_4}$

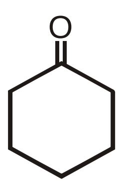
(b) 3 $CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-H \xrightarrow{H_2SO_4}$

(c) 4 $CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-H \xrightarrow{SO_2/HCl}$

$NaHSO_3$

$R-\overset{\overset{\displaystyle O}{\|}}{C}-H \xrightarrow{HSO_3^{\ominus}}$

SeO_2

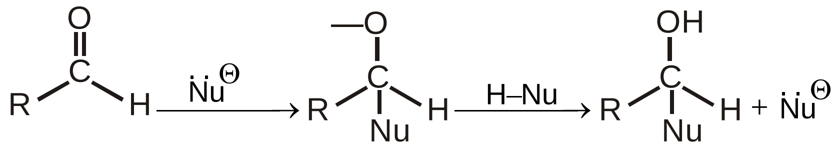
 $\xrightarrow{SeO_2}$

Imp

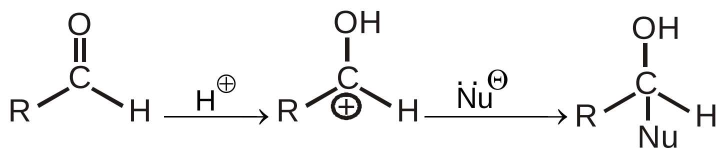
$6\ H-\overset{\overset{\displaystyle O}{\|}}{C}-H \xrightarrow{4NH_3}$

Nucleophilic addition Reaction:-

Base catalysed

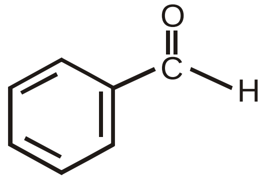


<u>Acid catalysed</u>

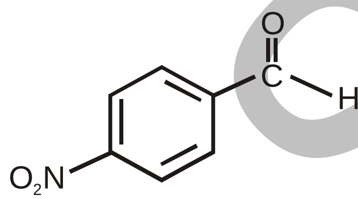


Q.1 Compare rate of $\dot{N}u^{\ominus}$ additions on following:-

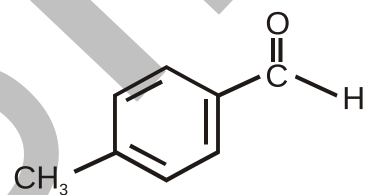
(a)



(i)

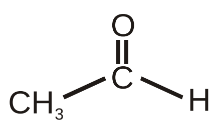


(ii)

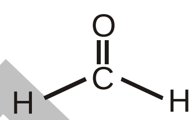


(iii)

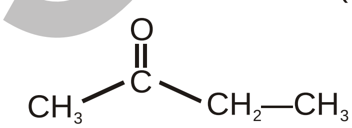
(b)



(i)

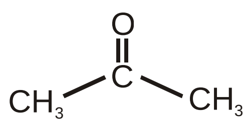


(ii)

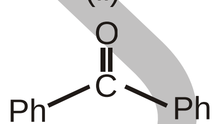


(iii)

(c)

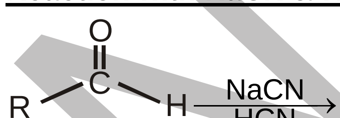


(i)



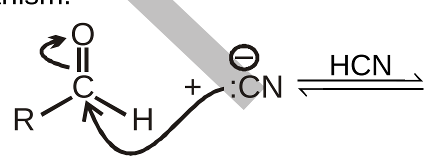
(ii)

(1) <u>Reaction with NaCN & HCN</u>

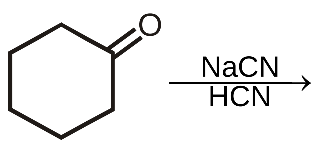


Mechanism:-

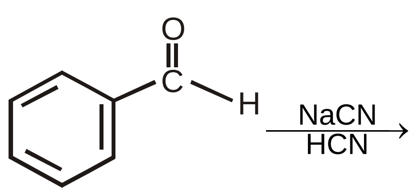
1.

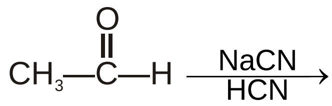


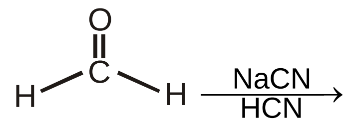
Q.1



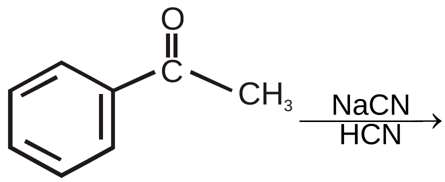
Q.2



Q.3 

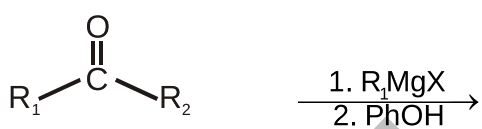
Q.4 

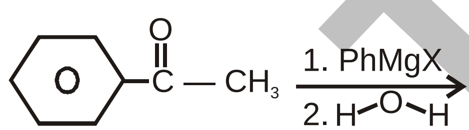
Guess during Reaction

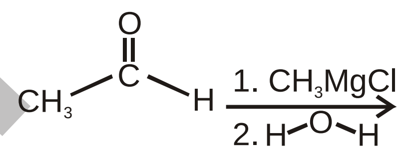
Q.5 

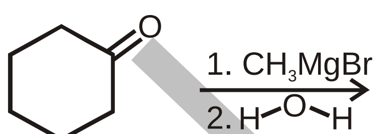
Q.6 $\frac{d(H^+)}{dt} > O$ or $\frac{d(H^+)}{dt} = O$ or $\frac{d(H^+)}{dt} = O$

2. Reaction with Grignard Reagent (RMgX)

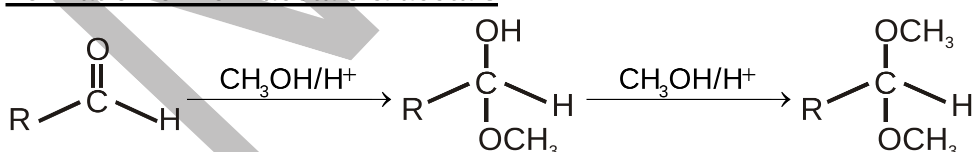


Q.1 

Q.2 

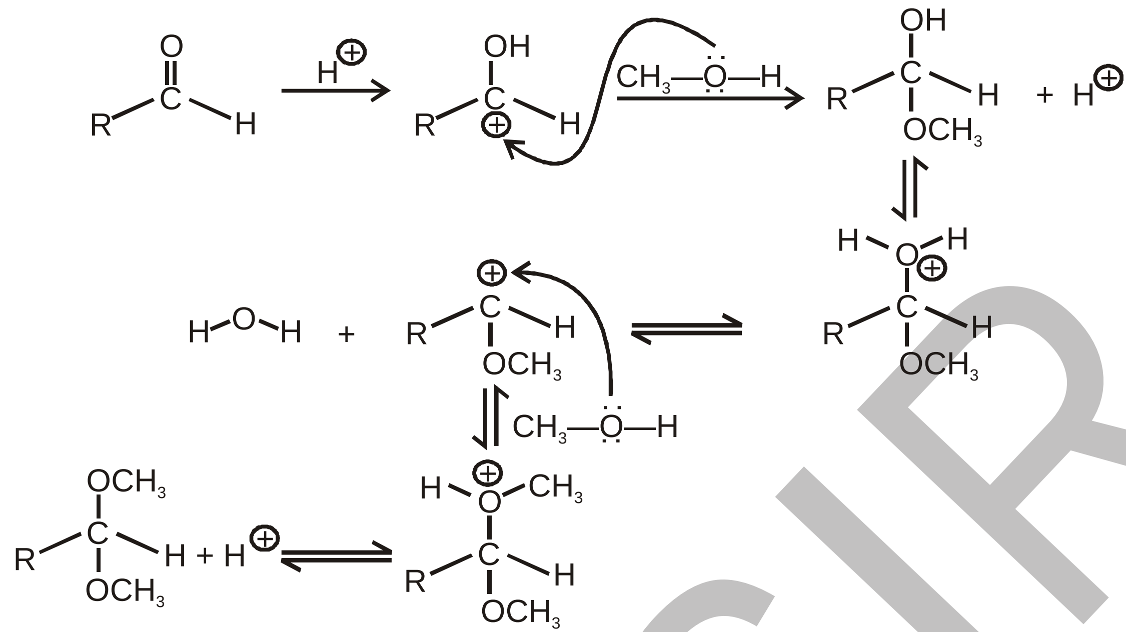
Q.3 

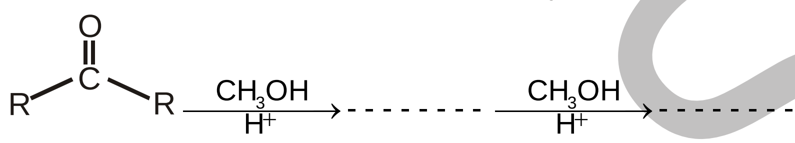
3. Formation of hemiacetals & acetals



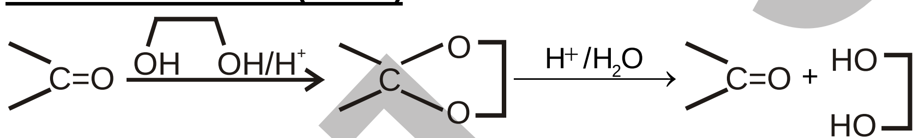
Hemiacetal acetal

Mechanism

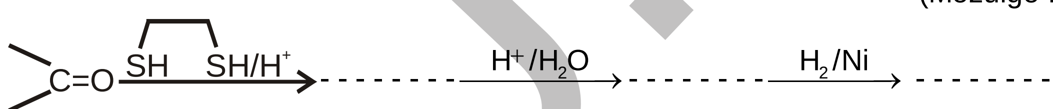
1. 



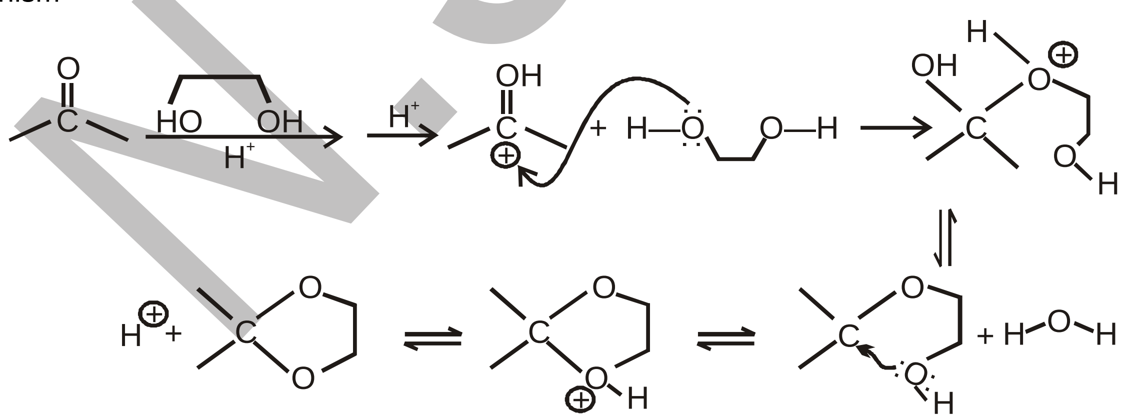
(4) **Reactions with diols (Thiols)**

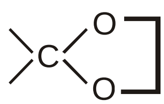
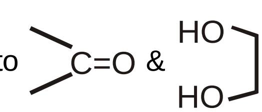


(Mozuigo Reduction)

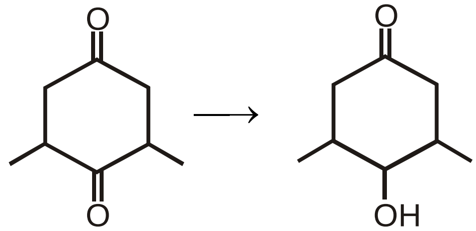


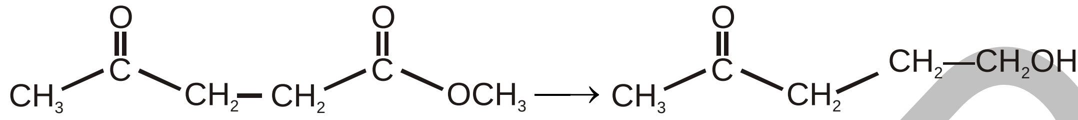
Mechanism

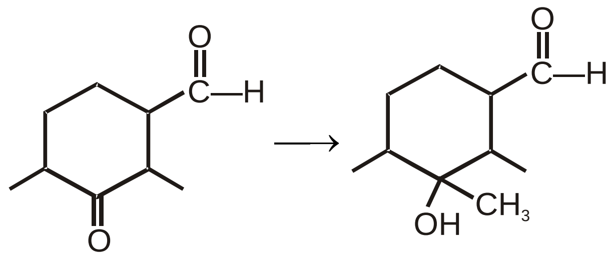


 is stable in basic medium but in aqueous acidic medium it converts to 

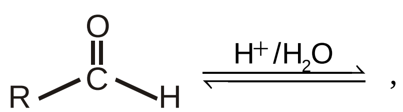
Convert

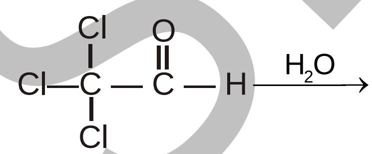
Q.1 

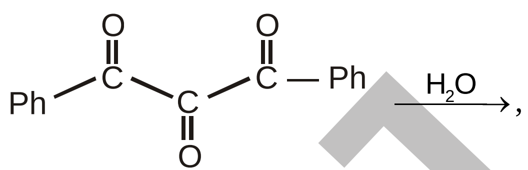
Q.2 

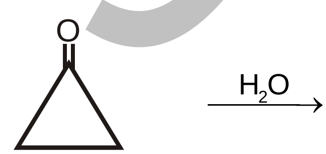
Q.3 

(4) Reaction with $H-O-H$ (hydration)



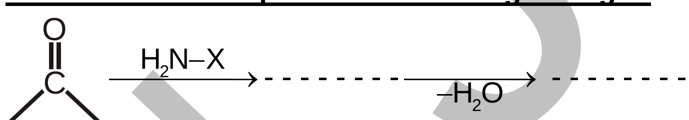




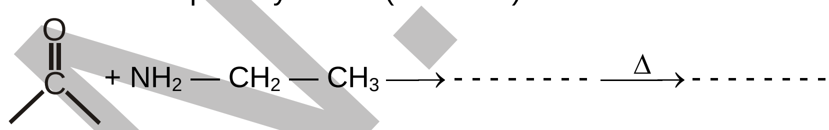


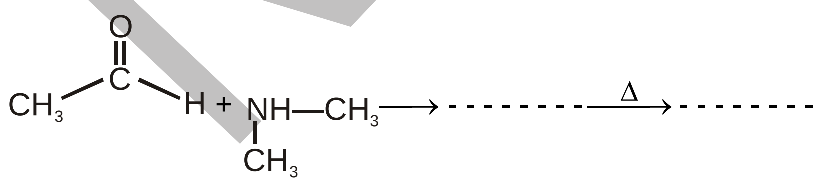
(Stable hydrate)

(5) Addition with compounds containing Nitrogen



1. Reaction with primary amine (1°-amine)





Imp. Note:-

1° amines (primary amines) give $\longrightarrow$ imine

2° amines give $\longrightarrow$ enamine

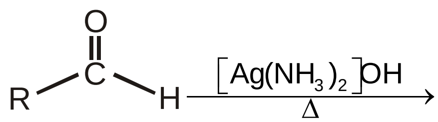
1. $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=O \xrightarrow[\text{hydrazine}]{NH_2-NH_2}$

2. $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=O \xrightarrow[\text{Phenylhydrazine}]{NH_2-NH-Ph}$

3. $(CH_3)_2C=O \xrightarrow[\text{hydroxyl amine}]{NH_2OH}$

4. $(CH_3)_2C=O \xrightarrow[\text{Semicarbazide}]{NH_2-NH-\overset{\displaystyle O}{\overset{\|}{C}}-NH_2}$

<u>Oxidation of Carbonyl Compounds</u>

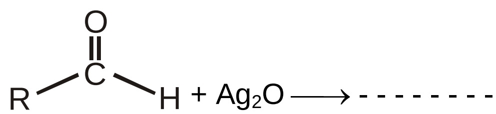
1. 

Aldehydes are easily oxidized hence they act as reducing agent.

<u>Silver mirror Test</u>

$AgNO_3 + NH_4OH \longrightarrow$ ammonical $AgNO_3$ is tollen's Reagent.

$2\ AgOH \longrightarrow Ag_2O + H-O-H$

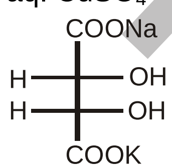


Imp.

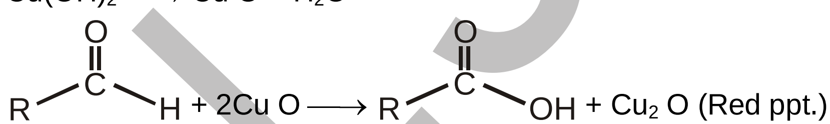
Ketones do not give this test.

2. <u>Fehling solution</u>

Fehling A $\longrightarrow$ aq. $CuSO_4$

Fehling B $\longrightarrow$  (Sodium potassium Tartorate or Roscheue Salt)

$Cu(OH)_2 \longrightarrow Cu\,O + H_2O$

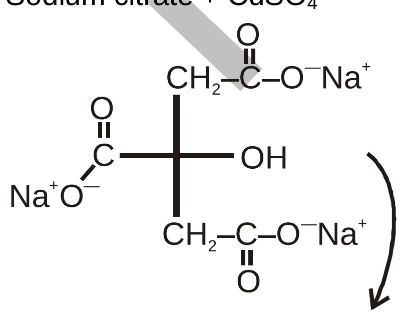


Imp.

Aldehydes give (red ppt.) with Fehling solution but ketones do not give this test.

(3) <u>Benedict's Solution</u>

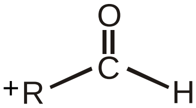
Sodium citrate + $CuSO_4$



(I am a salt of weak acid & strong base. I will make the solution basic)

Sodium citrate

$Cu(OH)_2 \xrightarrow[\Delta]{} CuO + H{-}O{-}H$

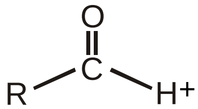
2 Cu O +  $\longrightarrow$

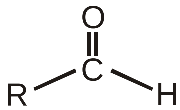
Acidified potassium dichromate (VI) solution

$K_2Cr_2O_7/H^+$

$Cr_2O_7^{2-} + 14\,H^+ + 6e^- \longrightarrow 2\,Cr^{+3} + 7H_2O$

Orange (Cr^{+6})   green (Cr^{+3})

1.  + $H{-}O{-}H \longrightarrow$ - - - - - - - -

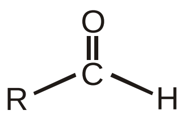
2.  $\longrightarrow$ X

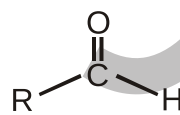
Note:

With the reaction of $K_2Cr_2O_7$ in dil. Acidic medium

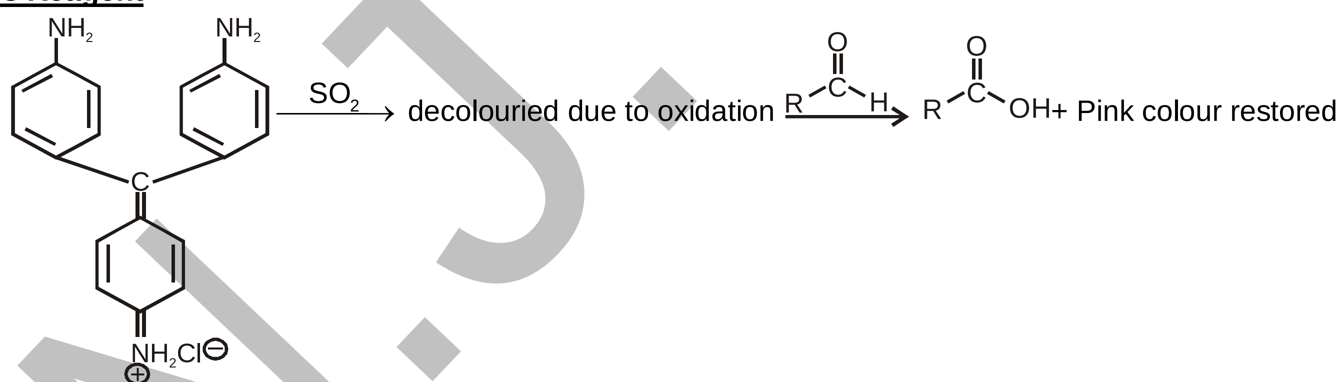
Ketone	No change in orange solution
Aldehyde	Orange colour $\longrightarrow$ green

(5) Oxidation with $HgCl_2$

1.  $+ 2HgCl_2 + H_2O \longrightarrow$

2.  $+ Hg_2Cl_2 + H_2O \longrightarrow$

Schiff's Reagent



P – Rosaaniline hydrochloride magenta colour

Imp.

Aldehydes restore the pink colour of rosaaniline hydrochloride but ketones do not.

Carboxylic acids and Amines

EXERCISE – 1

Q.1 The reaction of $R-\overset{\overset{O}{||}}{C}-NH_2$ with a mixture of Br_2 and KOH gives $R-NH_2$ as a product. The intermediates involved in this reaction are : **[IIT 1992]**

(A) $R-\overset{\overset{O}{||}}{C}-NHBr$ (B) $R-N=C=O$ (C) $R-NHBr$ (D) $R-\overset{\overset{OH}{||}}{C}-N\begin{smallmatrix}Br\\Br\end{smallmatrix}$

Q.2 Which of the following carboxylic acids undergo decarboxylation easily : **[IIT 1995]**

(A) $C_6H_5CO-CH_2COOH$ (B) $C_6H_5COCOOH$

(C) $C_6H_5\underset{\underset{OH}{|}}{C}H_2-COOH$ (D) $C_6H_5\underset{\underset{NH_2}{|}}{C}H_2-COOH$

Q.3 The molecular weight of benzoic acid in benzene as determined by depression in freezing point method corresponds to : **[IIT 1996]**

(A) Ionization of benzoic acid (B) Dimerisation of benzoic acid

(C) Trimerisation of benzoic acid (D) Solvation of benzoic acid

Q.4 When propionic acid is treated with aqueous $NaHCO_3$, CO_2 is liberated. The 'C' of CO_2 comes from

(A) Methyl group (B) Carboxylic acid group **[IIT 1999]**

(C) methylene group (D) bicarbonate

Q.5 Benzoyl chloride is prepared from benzoic acid by **[IIT 2000]**

(A) Cl_2, $h\nu$ (B) SO_2Cl_2 (C) $SOCl_2$ (D) Cl_2, H_2O

Q.6 Which of the following acids has the smallest dissociation constant ? **[IIT 2002]**

(A) $CH_3CHFCOOH$ (B) FCH_2CH_2COOH (C) $BrCH_2CH_2COOH$ (D) $CH_3CHBrCOOH$

Q.7 When benzamide is treated with $POCl_3$, the product is : **[IIT 2004]**

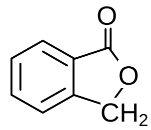
(A) Benzonitrile (B) Aniline (C) Chlorobenzene (D) Benzylamine

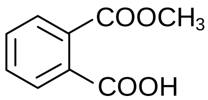
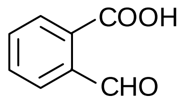
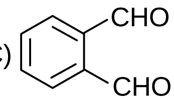
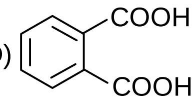
Q.8 The correct IUPAC name of C_6H_5COCl is **[IIT 2006]**

(A) Benzoyl chloride (B) Benzene chloro ketone

(C) Benzene carbonyl chloride (D) Chloro phenyl ketone

Q.9 Which of the following reactants on reaction with conc. NaOH followed by acidification gives the following lactone as the only product ? **[IIT 2006]**

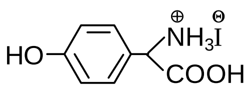


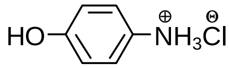
(A)  (B)  (C)  (D) 

Q.10 Match the compounds in **Column I** with their characteristic test(s)/reaction(s) given in **Column II.** Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.

Column I | **Column II** | **[IIT 2008]**

(A) $H_2N - \overset{\oplus}{N}H_3\overset{\ominus}{Cl}$

(B) 

(C) 

(D) 

(P) sodium fusion extract of the compound gives Prussian blue colour with $FeSO_4$

(Q) gives positive $FeCl_3$ test

(R) gives white precipitate with $AgNO_3$

(S) reacts with aldehydes to form the corresponding hydrazone derivative

Q.11 Match each of the compound in Column I with its characteristic reaction (s) in Column II.

Column I | **Column II** | **[IIT 2009]**

(A) $CH_3CH_2CH_2CN$

(B) $CH_3CH_2OCOCH_3$

(C) $CH_3 - CH = CH - CH_2OH$

(D) $CH_3CH_2CH_2CH_2NH_2$

(P) Reduction with Pd–C/H_2

(Q) Reduction with $SnCl_2$/HCl

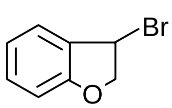
(R) Development of foul smell on treatment with chloroform and alcoholic KOH

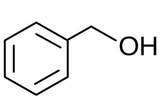
(S) Reduction with diisobutylaluminium hydride (DIBAL-H)

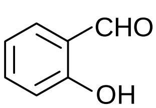
(T) Alkaline hydrolysis

Q.12 Match each of the compounds given in Column I with the reaction(s), that they can undergo, given in Column II.

[IIT 2009]

(A) 

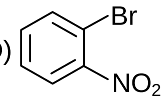
(B) 

(C) 

(P) Nucleophilic substitution

(Q) Elimination

(R) Nucleophilic addition

(D) 

(S) Esterification with acetic anhydride

(T) Dehydrogenation

EXERCISE – 2

Q.1 Compound (A) ($C_6H_{12}O_2$) on reduction with $LiAlH_4$ yielded two compounds (B) and (C). The compound (B) on oxidation gave (D) which on treatment with aqueous alkali and subsequent heating furnished (E). The latter on catalytic hydrogenation gave(C). The compound (D) was oxidised further to give (F) which was found to be monobasic acid (molecular mass = 60.0). Deduce the structure of (A), (B), (C), (D) and (E).
[IIT 1990]

Q.2 In the following reactions, identify the compounds (A), (B), (C) and (D) **[IIT 1994]**

$PCl_5 + SO_2 \rightarrow (A) + (B)$

$(A) + CH_3COOH \rightarrow (C) + SO_2 + HCl$

$2(C) + b(CH_3)_2Cd \rightarrow 2(D) + CdCl_2$

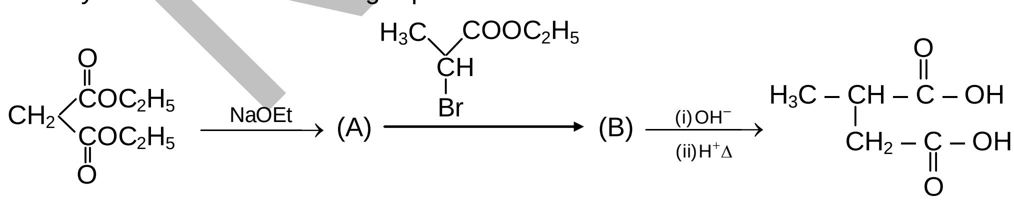
Q.3 Complete the following equations by writing the missing A and B **[IIT 1995]**

(i) $CH_3CH_2COOH \xrightarrow{P/Br_2} (A) \xrightarrow[(ii)H^+]{(i)\,Alc.KOH(excess)} (B)$

(ii) $C_4H_8O_3(A) \xrightarrow{CrO_3} (B) \xrightarrow{Warm} CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - CH_3 + CO_2$

Q.4 A mixture of an acid anhydride (A) and a monobasic acid (B) on heating produces another monobasic acid (C) of equivalent weight 74 and an anhydride (D). The acids and anhydrides remain in equilibrium. The anhydride (D) contains two identical fluoro-alkyl groups. The acid (B) contains a trifluoromethyl group and has an equivalent weight of 128. Give structures of (A) to (D) with proper reasoning. (Atomic weight of fluorine = 19)
[IIT 1998]

Q.5 Identify A and B in the following equations : **[IIT 1999]**



Q.6 Write the structure of product A & B **[IIT 2000]**

$CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - O^{18}C_2H_5 \xrightarrow{H_3O^+} A + B$

Q.7 Identify X, Y and Z in the following synthetic scheme and write their structure. Explain the formation of labelled formaldehyde (H_2C^*O) as one of the products when compound Z is treated with HBr and

$BaC^*O_3 + H_2SO_4 \rightarrow C(gas)$ [C* denotes C_{14}] **[IIT 2001]**

$$CH_2 = CH-Br \xrightarrow[\substack{(ii)\,X \\ (iii)\,H_3O^+}]{(i)\,Mg\,/\,ether} Y \xrightarrow{LiAH_4} Z$$

Q.8 Mention two esters produced when a racemic mixture of 2-phenyl propanoic acid is treated with (+) 2-butanol. What is the stereochemical relationship between these esters? **[IIT 2003]**

EXERCISE – 1

Ques.	1	2	3	4	5	6	7	8	9
Ans.	A,B	A	B	D	C	C	A	C	C

Q.10 (A) R,S ; (B) P,Q; (C) P,Q,R ; (D) P,S

Q.11 (A) P,Q,S,T ; (B) P,S,T ; (C) P ; (D) R

Q.12 (A) P,Q,T ; (B) P,S,T ; (C) R,S ; (D) P

EXERCISE – 2

Q.1 (A) $CH_3CH_2CH_2COOCH_2CH_3$; (B) CH_3CH_2OH

(C) $CH_3CH_2CH_2CH_2OH$: (D) CH_3CHO

(E) $CH_3CH = CHCHO$

Q.2 (A) $SOCl_2$; (B) $POCl_3$; (C) CH_3COCl; (D) CH_3COCH_3

Q.3 (i) (A) $CH_3CHBrCOOH$; (B) $CH_2 = CHCOOH$;

(ii) (A) $CH_3CH(OH)\ CH_2COOH$; (B) CH_3COCH_2COOH

Q.4 (A) $(CH_3CH_3CO)_2O$; (B) CF_3CH_2COOH; (C) CH_3CH_2COOH ; (D) $(CF_3CH_2CO)_2O$

Q.5 (A) $NaCH(COC_2H_5)_2$; (B) $CH_3-\overset{HC-(COOC_2H_5)_2}{\overset{|}{HC}}-COOC_2H_5$

Q.6 (A) CH_3COOH ; (B) $C_2H_5O^{18}H$

Q.7 $BaC^*O_3 + H_2SO_4 \longrightarrow C^*O_2(X) + BaSO_4$

$$CH_2 = CH-Br \xrightarrow[(iii)\,H_3O^+]{(i)\,Mg,(ii)\,C^*O_2}$$

$$CH_2 = CH-C^*OOH(Y) \xrightarrow{LiAlH_4}$$

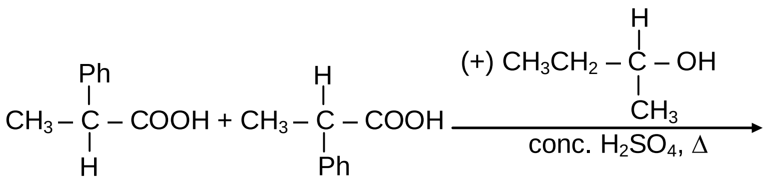
$$CH_2 = CHC^*H_2OH(Z) \xrightarrow{H^+}$$

$CH_2 = H - C^*\ H_2^+ \leftrightarrow C^*\ H_2^+ CH = C^*H_2$

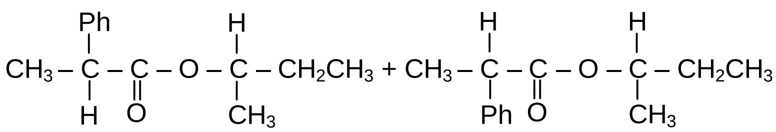
$\downarrow Br-$ $\qquad\qquad\qquad\qquad \downarrow Br^-$

$CH_2 = CH - C^*H_2\ Br\ BrCH_2 - CH = C^*H_2$

$\downarrow O_3ZnH_2O$ $\qquad\qquad\qquad \downarrow O_3ZnH_2O$ $Br - C^*H_2CHO + HCHO$ $Br - CH_2CHO + HC^*HO$

Q.8 

(recemic mixture)



during esterification reaction only – COOH and – OH participates. There is no effect on structure or configuration of carbon adjacent to these groups. So when (±) acid reacts with pure (+) alcohol two esters are produced which are diastereoisomers of each other.

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Carboxylic acids and Amines

EXERCISE – 1

Q.1 The reaction of $R-\overset{\overset{\large O}{\|}}{C}-NH_2$ with a mixture of Br_2 and KOH gives $R-NH_2$ as a product. The intermediates involved in this reaction are : **[IIT 1992]**

(A) $R-\overset{\overset{\large O}{\|}}{C}-NHBr$ (B) $R-N=C=O$ (C) $R-NHBr$ (D) $R-\overset{\overset{\large OH}{\|}}{C}-N\begin{smallmatrix}\diagup Br\\ \diagdown Br\end{smallmatrix}$

Q.2 Which of the following carboxylic acids undergo decarboxylation easily : **[IIT 1995]**

(A) $C_6H_5CO-CH_2COOH$ (B) $C_6H_5COCOOH$

(C) $C_6H_5\underset{\underset{\large OH}{|}}{C}H_2-COOH$ (D) $C_6H_5\underset{\underset{\large NH_2}{|}}{C}H_2-COOH$

Q.3 The molecular weight of benzoic acid in benzene as determined by depression in freezing point method corresponds to : **[IIT 1996]**

(A) Ionization of benzoic acid (B) Dimerisation of benzoic acid

(C) Trimerisation of benzoic acid (D) Solvation of benzoic acid

Q.4 When propionic acid is treated with aqueous $NaHCO_3$, CO_2 is liberated. The 'C' of CO_2 comes from

(A) Methyl group (B) Carboxylic acid group **[IIT 1999]**

(C) methylene group (D) bicarbonate

Q.5 Benzoyl chloride is prepared from benzoic acid by **[IIT 2000]**

(A) Cl_2, $h\nu$ (B) SO_2Cl_2 (C) $SOCl_2$ (D) Cl_2,H_2O

Q.6 Which of the following acids has the smallest dissociation constant ? **[IIT 2002]**

(A) $CH_3CHFCOOH$ (B) FCH_2CH_2COOH (C) $BrCH_2CH_2COOH$ (D) $CH_3CHBrCOOH$

Q.7 When benzamide is treated with $POCl_3$, the product is : **[IIT 2004]**

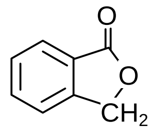
(A) Benzonitrile (B) Aniline (C) Chlorobenzene (D) Benzylamine

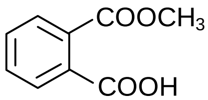
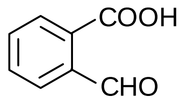
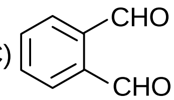
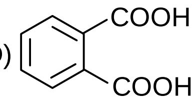
Q.8 The correct IUPAC name of C_6H_5COCl is **[IIT 2006]**

(A) Benzoyl chloride (B) Benzene chloro ketone

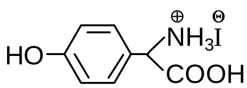
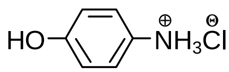
(C) Benzene carbonyl chloride (D) Chloro phenyl ketone

Q.9 Which of the following reactants on reaction with conc. NaOH followed by acidification gives the following lactone as the only product ? **[IIT 2006]**



(A)  (B)  (C)  (D) 

Q.10 Match the compounds in **Column I** with their characteristic test(s)/reaction(s) given in **Column II.** Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.

Column I	**Column II**
(A) $H_2N - \overset{\oplus}{N}H_3\overset{\ominus}{Cl}$	(P) sodium fusion extract of the compound gives Prussian blue colour with $FeSO_4$
(B) 	(Q) gives positive $FeCl_3$ test
(C) 	(R) gives white precipitate with $AgNO_3$
(D) 	(S) reacts with aldehydes to form the corresponding hydrazone derivative

[IIT 2008]

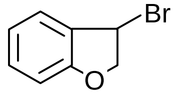
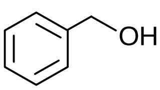
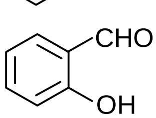
Q.11 Match each of the compound in Column I with its characteristic reaction (s) in Column II.

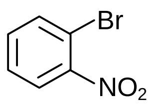
[IIT 2009]

Column I	**Column II**
(A) $CH_3CH_2CH_2CN$	(P) Reduction with Pd–C/H_2
(B) $CH_3CH_2OCOCH_3$	(Q) Reduction with $SnCl_2$/HCl
(C) $CH_3 - CH = CH - CH_2OH$	(R) Development of foul smell on treatment with chloroform and alcoholic KOH
(D) $CH_3CH_2CH_2CH_2NH_2$	(S) Reduction with diisobutylaluminium hydride (DIBAL-H)
	(T) Alkaline hydrolysis

Q.12 Match each of the compounds given in Column I with the reaction(s), that they can undergo, given in Column II.

[IIT 2009]

(A) 	(P) Nucleophilic substitution
(B) 	(Q) Elimination
(C) 	(R) Nucleophilic addition

(D) 

(S) Esterification with acetic anhydride

(T) Dehydrogenation

EXERCISE – 2

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[IIT 1990]

Q.2 In the following reactions, identify the compounds (A), (B), (C) and (D) **[IIT 1994]**

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$(A) + CH_3COOH \rightarrow (C) + SO_2 + HCl$

$2(C) + b(CH_3)_2Cd \rightarrow 2(D) + CdCl_2$

Q.3 Complete the following equations by writing the missing A and B **[IIT 1995]**

(i) $CH_3CH_2COOH \xrightarrow{P/Br_2} (A) \xrightarrow[(ii)H^+]{(i)\,Alc.KOH(excess)} (B)$

(ii) $C_4H_8O_3(A) \xrightarrow{CrO_3} (B) \xrightarrow{Warm} CH_3 - \overset{O}{\overset{||}{C}} - CH_3 + CO_2$

Q.4 A mixture of an acid anhydride (A) and a monobasic acid (B) on heating produces another monobasic acid (C) of equivalent weight 74 and an anhydride (D). The acids and anhydrides remain in equilibrium. The anhydride (D) contains two identical fluoro-alkyl groups. The acid (B) contains a trifluoromethyl group and has an equivalent weight of 128. Give structures of (A) to (D) with proper reasoning. (Atomic weight of fluorine = 19)

[IIT 1998]

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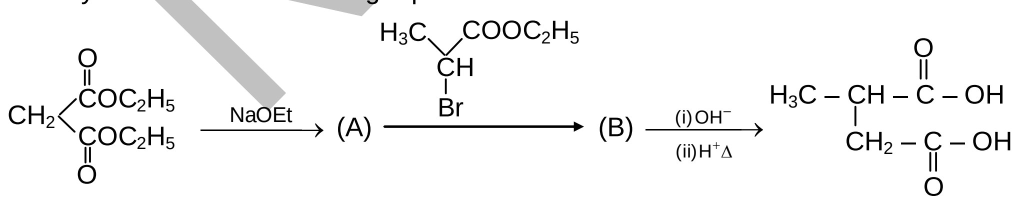


Q.6 Write the structure of product A & B **[IIT 2000]**

$CH_3 - \overset{O}{\overset{||}{C}} - O^{18}C_2H_5 \xrightarrow{H_3O^+} A + B$

Q.7 Identify X, Y and Z in the following synthetic scheme and write their structure. Explain the formation of labelled formaldehyde (H_2C^*O) as one of the products when compound Z is treated with HBr and

$BaC^*O_3 + H_2SO_4 \rightarrow C(gas)$ [C* denotes C_{14}] **[IIT 2001]**

$$CH_2 = CH - Br \xrightarrow[\text{(ii) X}\ \text{(iii)} H_3O^+]{\text{(i) Mg / ether}} Y \xrightarrow{LiAH_4} Z$$

Q.8 Mention two esters produced when a racemic mixture of 2-phenyl propanoic acid is treated with (+) 2-butanol. What is the stereochemical relationship between these esters? **[IIT 2003]**

EXERCISE – 1

Ques.	1	2	3	4	5	6	7	8	9
Ans.	A,B	A	B	D	C	C	A	C	C

Q.10 (A) R,S ; (B) P,Q; (C) P,Q,R ; (D) P,S

Q.11 (A) P,Q,S,T ; (B) P,S,T ; (C) P ; (D) R

Q.12 (A) P,Q,T ; (B) P,S,T ; (C) R,S ; (D) P

EXERCISE – 2

Q.1 (A) $CH_3CH_2CH_2COOCH_2CH_3$; (B) CH_3CH_2OH

(C) $CH_3CH_2CH_2CH_2OH$: (D) CH_3CHO

(E) $CH_3CH = CHCHO$

Q.2 (A) $SOCl_2$; (B) $POCl_3$; (C) CH_3COCl; (D) CH_3COCH_3

Q.3 (i) (A) $CH_3CHBrCOOH$; (B) $CH_2 = CHCOOH$;

(ii) (A) $CH_3CH(OH)\ CH_2COOH$; (B) CH_3COCH_2COOH

Q.4 (A) $(CH_3CH_3CO)_2O$; (B) CF_3CH_2COOH; (C) CH_3CH_2COOH ; (D) $(CF_3CH_2CO)_2O$

Q.5 (A) $NaCH(COC_2H_5)_2$; (B) $\begin{array}{l} \ \ \ \ \ \ \ \ \ \ HC-(COOC_2H_5)_2 \\ \ \ \ \ \ \ \ \ \ \ \ | \\ CH_3-HC-COOC_2H_5 \end{array}$

Q.6 (A) CH_3COOH ; (B) $C_2H_5O^{18}H$

Q.7 $BaC^*O_3 + H_2SO_4 \longrightarrow C^*O_2(X) + BaSO_4$

$CH_2 = CH - Br \xrightarrow[\text{(iii)} H_3O^+]{\text{(i) Mg, (ii)} C^*O_2}$

$CH_2 = CH - C^*OOH(Y) \xrightarrow{LiAlH_4}$

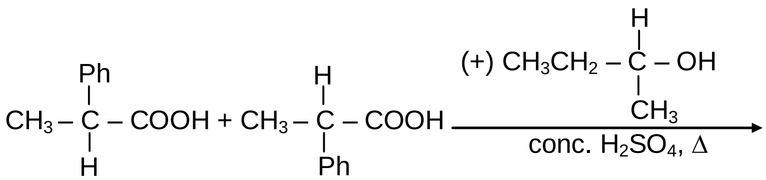
$CH_2 = CHC^*H_2OH(Z) \xrightarrow{H^+}$

$CH_2 = H - C^*\ H_2^+ \leftrightarrow C^*\ H_2^+ CH = C^*H_2$

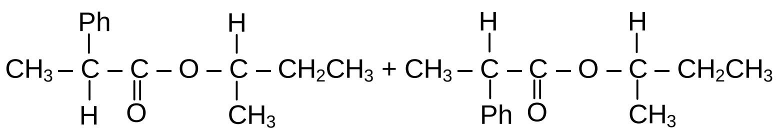
$\downarrow Br-$ $\qquad\qquad\qquad\qquad \downarrow Br^-$

$CH_2 = CH - C^*H_2\ Br\ BrCH_2 - CH = C^*H_2$

$\downarrow O_3ZnH_2O$ $\qquad\qquad\qquad\qquad \downarrow O_3ZnH_2O$ $\ Br - C^*H_2CHO + HCHO\ \ Br - CH_2CHO + HC^*HO$

Q.8 

(recemic mixture)



during esterification reaction only – COOH and – OH participates. There is no effect on structure or configuration of carbon adjacent to these groups. So when (±) acid reacts with pure (+) alcohol two esters are produced which are diastereoisomers of each other.

CONCEPTUAL IMPROVEMENT OF G.O.C.

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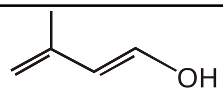
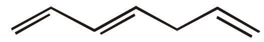
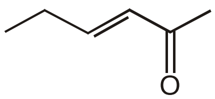
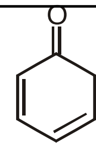
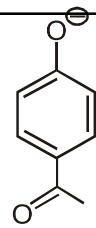
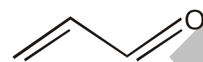
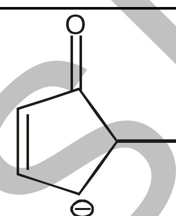
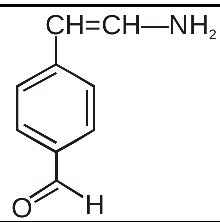
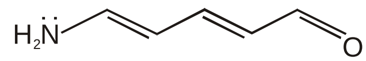
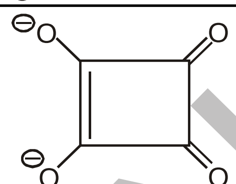
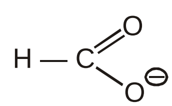
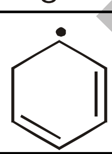
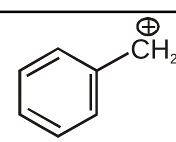
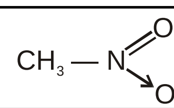
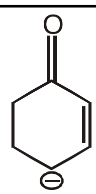
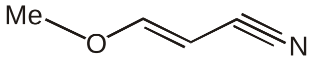
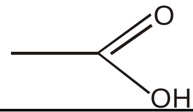
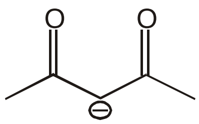
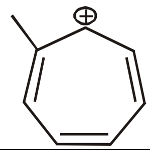
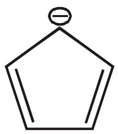
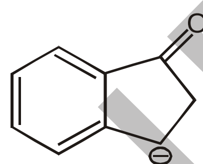
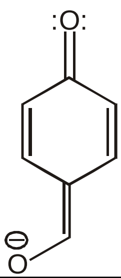
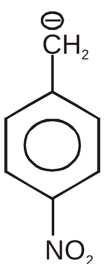
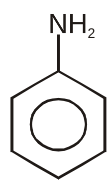
DPP NO- 1 Time: 15 minutes

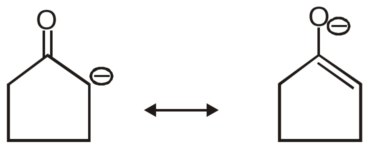
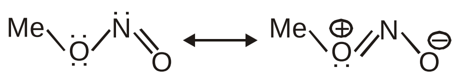
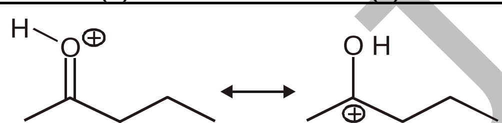
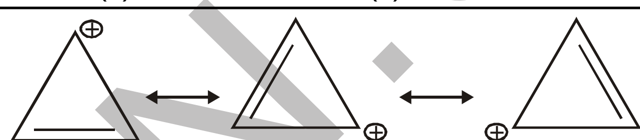
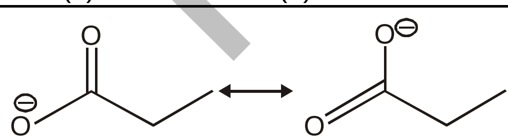
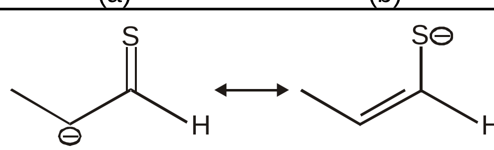
1. Draw Resonance hybrid of the following compounds:-

(1) 	(2) 
(3) 	(4) 
(5) 	(6) 
(7) $H_2C = C - NH - CH_3$	(8) 
(9) 	(10) 
(11) 	(12) 
(13) 	(14) 
(15) Me — S — $\overset{\oplus}{CH_2}$	(16) 
(17) 	(18) $H_2\ddot{N} — C \equiv N:$

(19) $NO_3^{\ominus}$	(20) O = C = O
(21) 	(22) $H_2N-\underset{\underset{\ddot{N}H}{\parallel}}{C}-NH_2$
(23) 	(24) 
(25) 	(26) 
(27) 	(28) 
(29) 	(30) $\overset{\ominus}{O}-C=O$ with $O^{\ominus}$ on C
(31) 	(32) 

DPP NO- 2 Time: 15 minutes

1. Compare relative stability of following resonating strutures

S.No.	Resonanting structures	Order of stability	Reason
(1)	$H_2C = CH — Cl \longleftrightarrow H_2\overset{\ominus}{C} — CH = Cl^{\oplus}$ (a) (b)		
(2)	 (a) (b)		
(3)	$\overset{\ominus}{C}H_2 — CH = NH \longleftrightarrow H_2C = CH — \overset{\ominus}{N}H$ (a) (b)		
(4)	$CH_3 — O — \overset{\oplus}{C}H_2 \longleftrightarrow CH_3 — \overset{\oplus}{O} = CH_2$ (a) (b)		
(5)	$H — N = C = O \longleftrightarrow H — \overset{\oplus}{N} \equiv C — \overset{\ominus}{O} \longleftrightarrow H — \overset{\ominus}{N} — C \equiv \overset{\oplus}{O}$ (a) (b) (c)		
(6)	 (a) (b)		
(7)	 (a) (b)		
(8)	 (a) (b) (c)		
(9)	 (a) (b)		
(10)	 (a) (b)		

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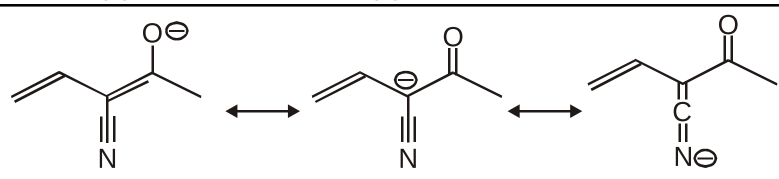
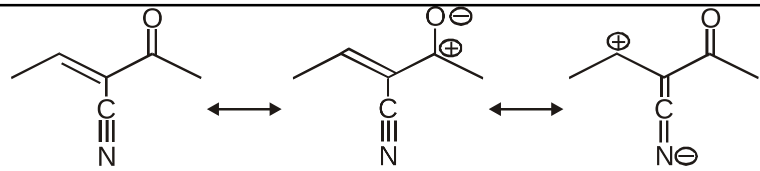
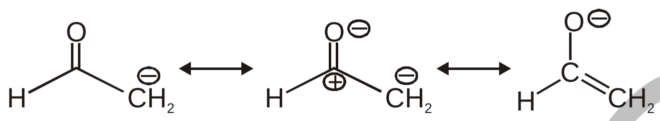
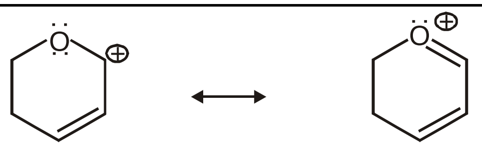
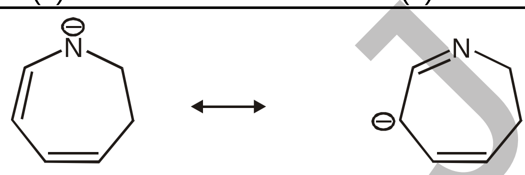
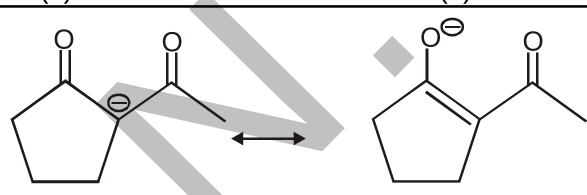
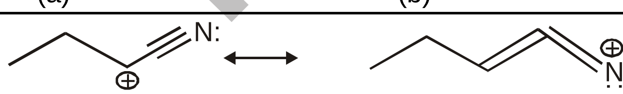
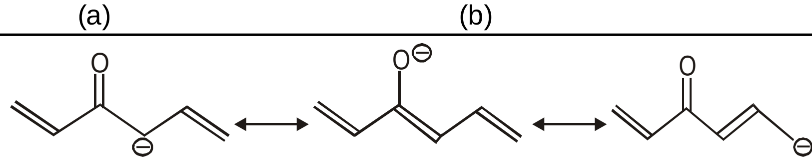
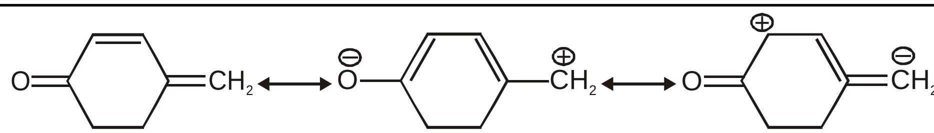
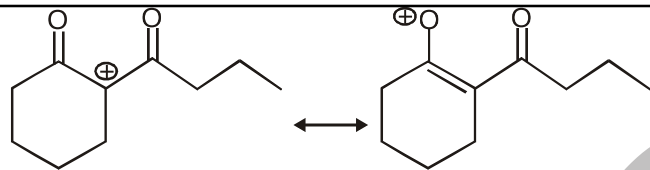
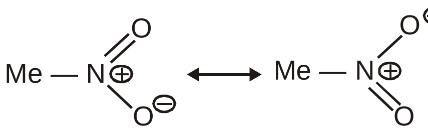
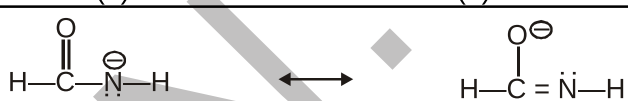
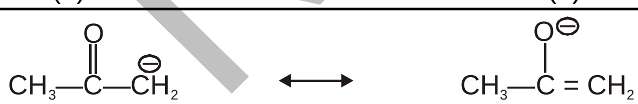
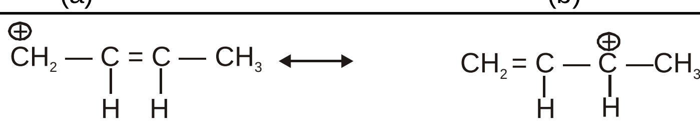
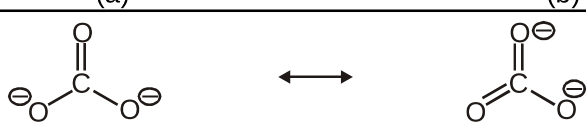
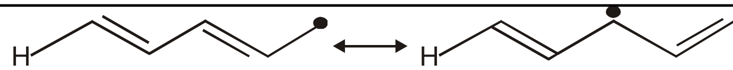
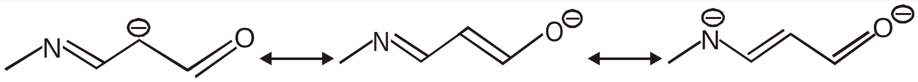
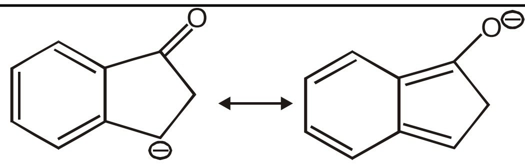
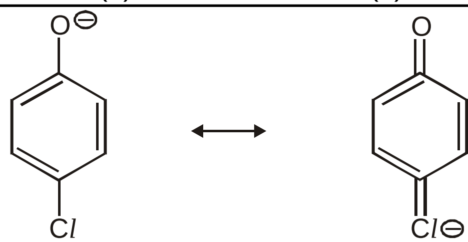
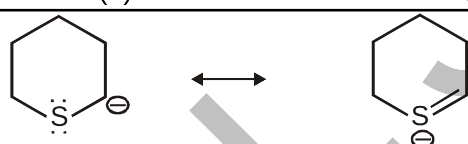
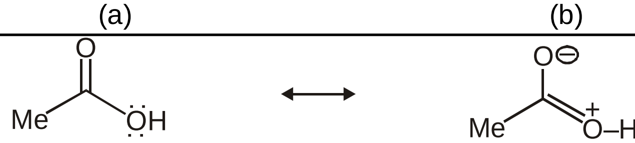
S.No.	Resonanting structures	Order of stability	Reason
(11)	$H-\overset{+}{\ddot{O}}=C=\overset{\ominus}{\ddot{N}}: \longleftrightarrow H-\ddot{O}-C\equiv N:$ (a) (b)		
(12)	 (a) (b) (c)		
(13)	 (a) (b) (c)		
(14)	 (a) (b) (c)		
(15)	 (a) (b)		
(16)	 (a) (b)		
(17)	 (a) (b)		
(18)	 (a) (b)		
(19)	 (a) (b) (c)		

DPP NO- 3 Time: 15 minutes

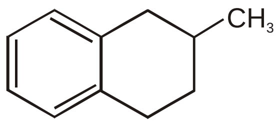
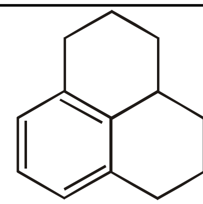
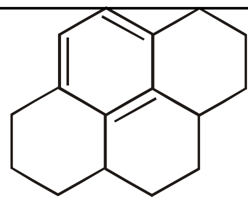
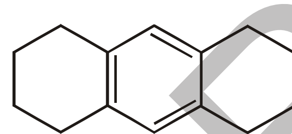
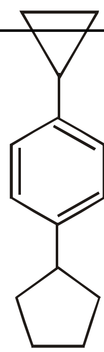
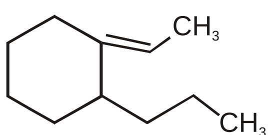
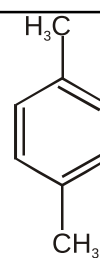
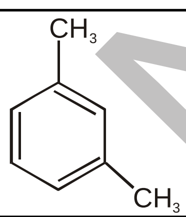
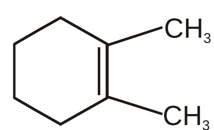
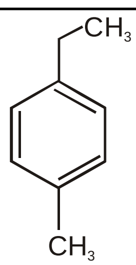
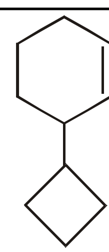
1. Compare relative stability of following resonating strutures

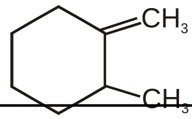
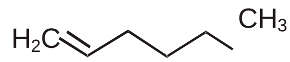
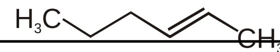
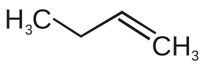
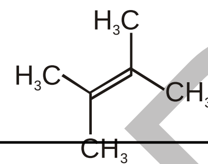
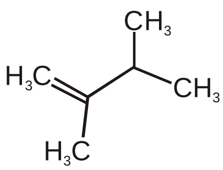
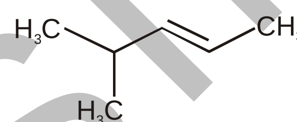
S.No.	Resonanting structures	Order of stability	Reason
(1)	 (a) (b) (c)		
(2)	$H_2\ddot{N}-CH=\overset{+}{N}H_2 \longleftrightarrow H_2\overset{+}{N}=CH-\ddot{N}H_2$ (a) (b)		
(3)	 (a) (b)		
(4)	 (a) (b)		
(5)	$H-\overset{\ominus}{C}=\overset{\oplus}{N}=\ddot{N}-H \longleftrightarrow H-C\equiv\overset{\oplus}{N}-\underset{\ominus}{\ddot{N}}-H$ (a) (b)		
(6)	$H_3C-HC=C=O \longleftrightarrow Me-\overset{\ominus}{C}H-C\equiv O^{\oplus}$ (a) (b)		
(7)	 (a) (b)		
(8)	 (a) (b)		
(9)	 (a) (b)		
(10)	 (a) (b)		

S.No.	Resonanting structures	Order of stability	Reason
(11)	 (a) (b)		
(12)	 (a) (b) (c)		
(13)	 (a) (b)		
(14)	 (a) (b)		
(15)	$Me - CH = C = \overset{\ominus}{C}H \longleftrightarrow Me - \overset{\ominus}{C}H - C \equiv CH$ (a) (b)		
(16)	$Me - \ddot{O} - CH = CH - \overset{+}{C}H_2 \longleftrightarrow Me - \overset{+}{O} = CH - CH = CH_2$ (a) (b)		
(17)	 (a) (b)		
(18)	$O = C = O \longleftrightarrow \overset{\ominus}{O} - C \equiv \overset{\oplus}{O} \longleftrightarrow \overset{\oplus}{O} = C - \overset{\ominus}{O}$ (a) (b) (c)		
(19)	$H_2\ddot{N} - C = N: \longleftrightarrow H_2\overset{\oplus}{N} = C = \overset{\ominus}{N}:$ (a) (b)		
(20)	 (a) (b)		

DPP NO-4 Time: 15 minutes

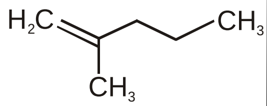
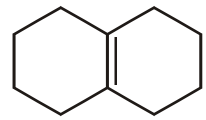
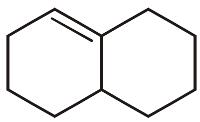
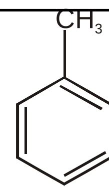
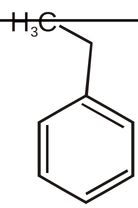
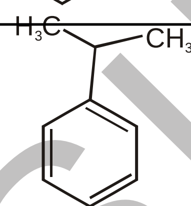
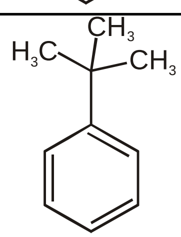
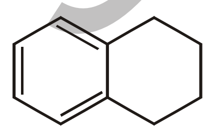
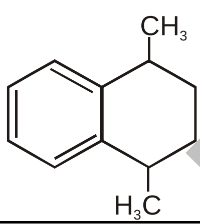
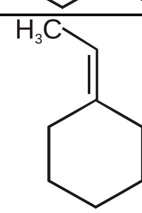
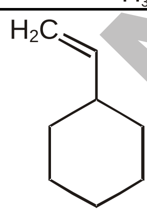
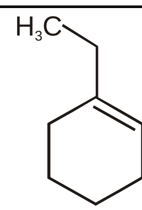
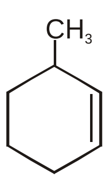
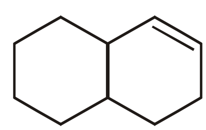
1. Identify no. of α-hydrogen in the following compounds

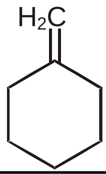
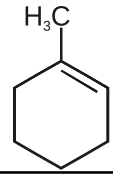
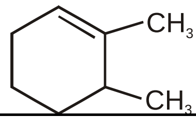
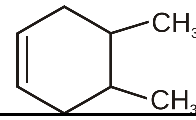
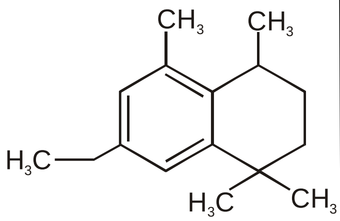
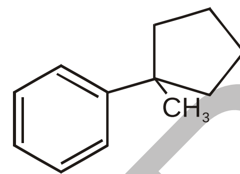
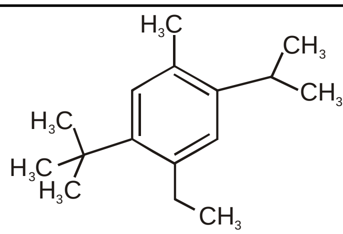
	No of α-hydrogen		**No. of α-hydrogen**
(1) 		(2) 	
(3) 		(4) 	
(5) 		(6) 	
(7) 		(8) 	
(9) 		(10) 	
(11) 		(12) 	

	No of α-hydrogen		No. of α-hydrogen
(13) 		(14) 	
(15) 		(16) 	
(17) 		(18) 	
(19) 		(20) 	

DPP NO- 5 Time: 15 minutes

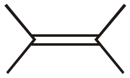
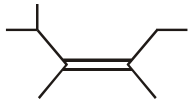
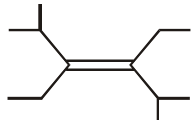
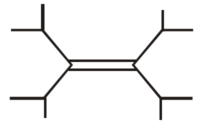
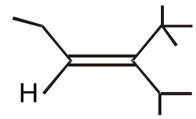
1. Identify no. of α-hydrogen in the following compounds

	No of α-hydrogen		**No. of α-hydrogen**
(1) 		(2) 	
(3) 		(4) 	
(5) 		(6) 	
(7) 		(8) 	
(9) 		(10) 	
(11) 		(12) 	
(13) 		(14) 	

	No of α-hydrogen		No. of α-hydrogen
(15) 		(16) 	
(17) 		(18) 	
(19) 		(20) 	
(20) 			

DPP NO- 6 Time: 15 minutes

Q.1 Given the relative Stability of the following compound

1.  (i)  ii)  (iii)  (iv)  (v)

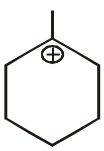
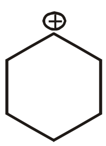
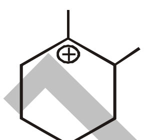
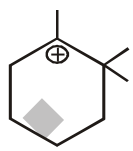
2. (i) $Ph - CH_2 - CH = CH - C(Me)_2 - Me$

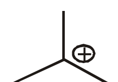
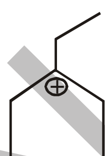
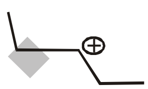
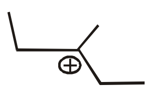
(ii) $Me - CH(Me) - CH = CH - C(Me)_2 - Me$

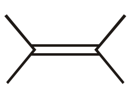
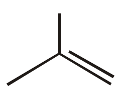
(iii) $PH - CH = CH - C(Me)_2 - Me$

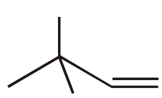
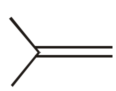
(iv) $Me - C(Me)_2 - HC = CH - C(Me)_2 - Me$

3. (i) $Me - CH(Me) - \overset{\oplus}{C}H - CH_3$ (ii) $Me - \overset{\oplus}{C}H_2$ (iii) $\overset{\oplus}{C}H_3$ (iv) $Me - C(Me)_2 - \overset{\oplus}{C}H_2$

4.  (i)  (ii)  (iii)  (iv)

5.  (i)  (ii)  (iii)  (iv)

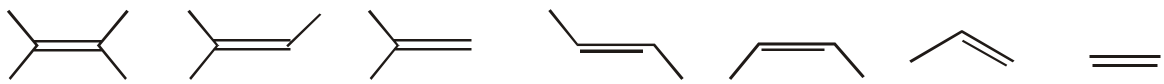
6.  (i)  (ii)  (iii) (iv)

7. (i) $H_2C = C = CH_2$ (ii) $Me - CH = CH_2$  (iii)  (iv)

DPP NO- 7 Time: 15 minutes

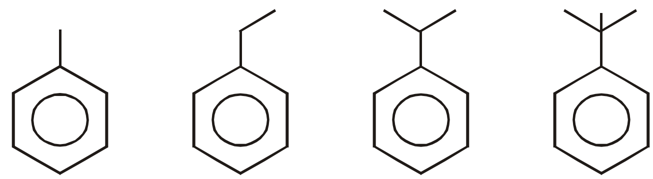
Q.1 Given the relative Stability of the following compound

1.



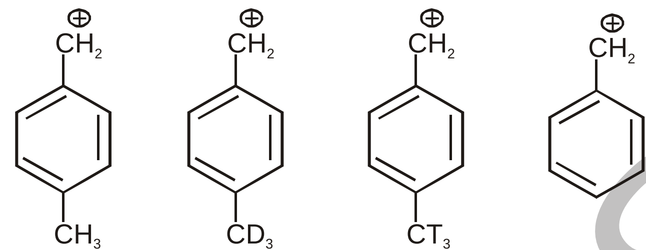
(i) (ii) (iii) (iv) (v) (vi) (vii)

2.



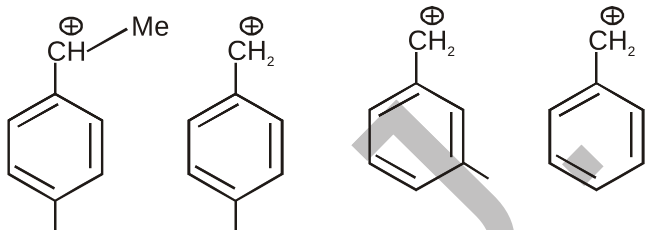
(i) (ii) (iii) (iv)

3.



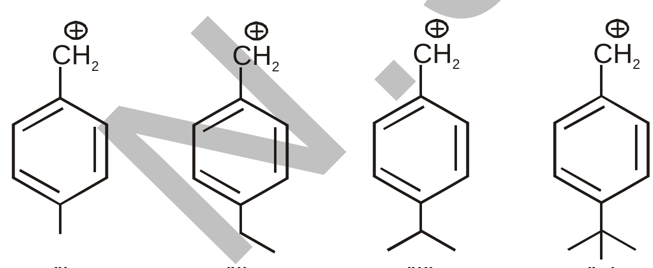
(i) (ii) (iii) (iv)

4.



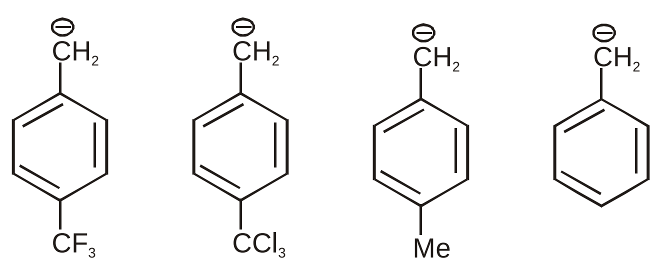
(i) (ii) (iii) (iv)

5.



(i) (ii) (iii) (iv)

6.



(i) (ii) (iii) (iv)

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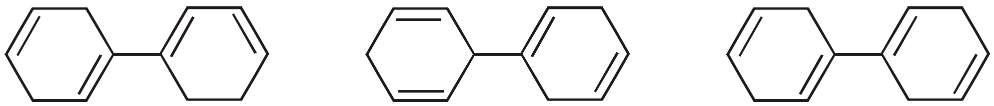
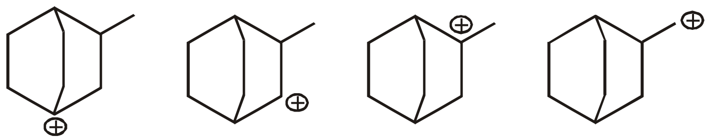
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

DPP NO- 8 Time: 15 minutes

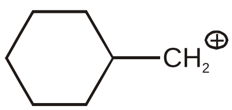
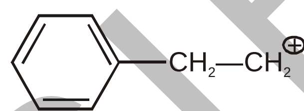
Q.1 Given the relative Stability of the following compound

1. 

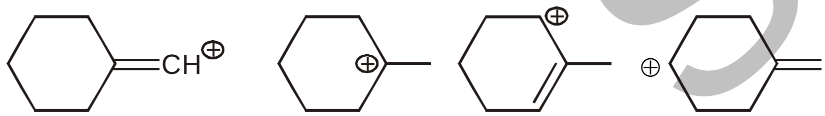
(i) (ii) (iii)

2. 

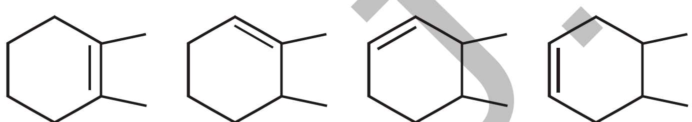
(i) (ii) (iii) (iv)

3.  $(Et)_2CH^{\oplus}$ $(Et)_3C^{\oplus}$ 

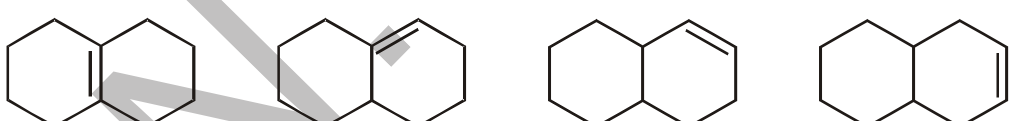
(i) (ii) (iii) (iv)

4. 

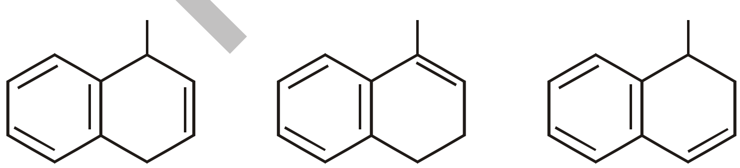
(i) (ii) (iii) (iv)

5. 

(i) (ii) (iii) (iv)

6. 

(i) (ii) (iii) (iv)

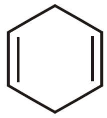
7. 

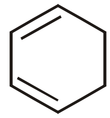
(i) (ii) (iii)

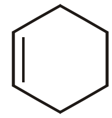
DPP NO- 9 Time: 15 minutes

Q.1 Given the relative Stability of the following compound

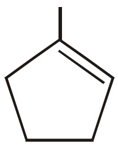
1.

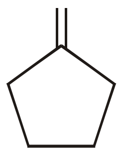

(i)

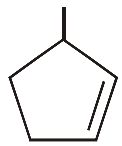

(ii)


(iii)

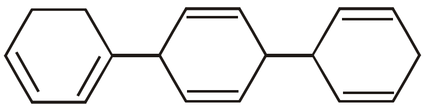
2.

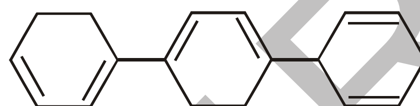

(i)

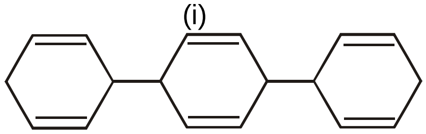

(ii)


(iii)

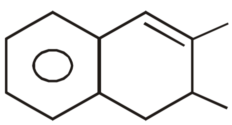
3.

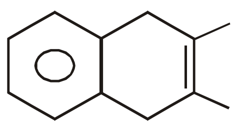

(i)

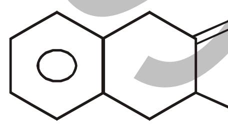

(ii)


(iii)

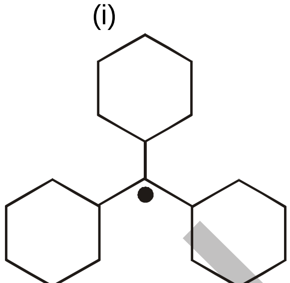
4.

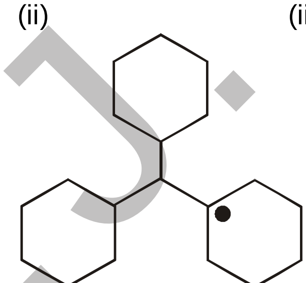

(i)

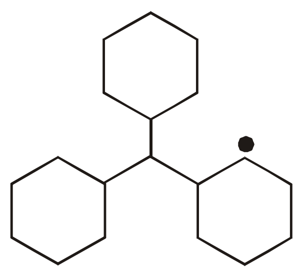

(ii)


(iii)

5.

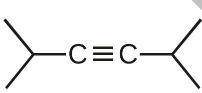

(i)


(ii)

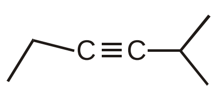

(iii)

6. $CH_3 — C \equiv C — CH_3$ (i) $H_3C — CH_2 — C \equiv CH$ (ii)

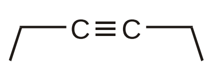
7.



(i)



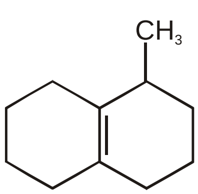
(ii)



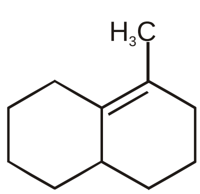
(iii)

$H_3C — C \equiv C — CH_3$
(iv)

8.



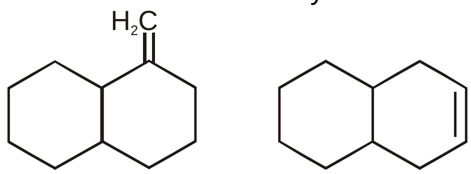
(i)



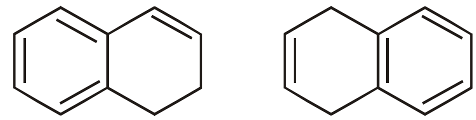
(ii)

DPP NO- 10 Time: 15 minutes

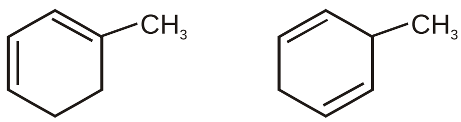
Q.1 Given the relative Stability of the following compound

1. 

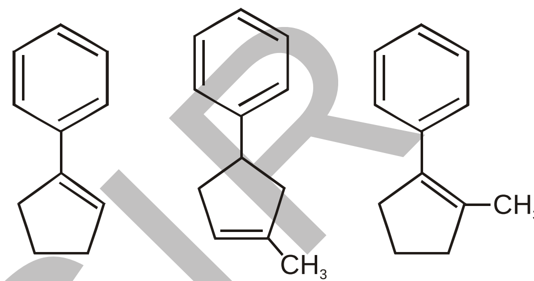
(i) (ii)

2. 

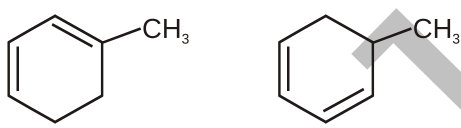
(i) (ii)

3. 

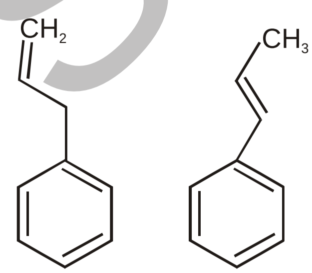
(i) (ii)

4. 

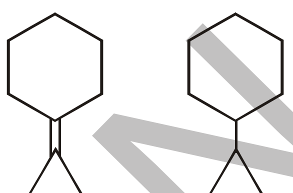
(i) (ii) (iii)

5. 

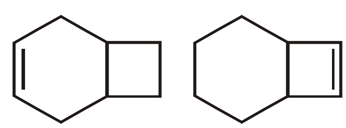
(i) (ii)

6. 

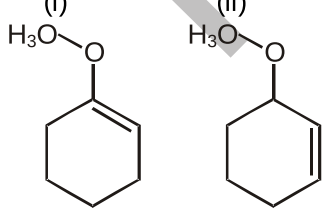
(i) (ii)

7. 

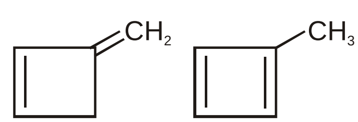
(i) (ii)

8. 

(i) (ii)

9. 

(i) (ii)

10. 

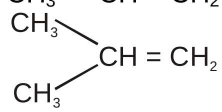
(i) (ii)

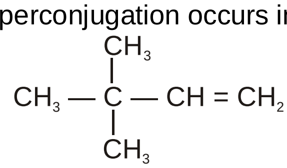
Q.2 Hyperconjugation involves
(A) Delocalization of s-electrons into an adjacent p-bond.
(B) Delocalization of n-electrons into an adjacent double bond.
(C) Delocalization of π-electrons into an adjacent double bond.
(D) All are true

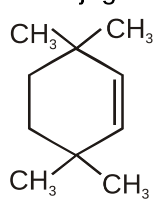
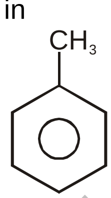
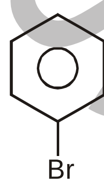
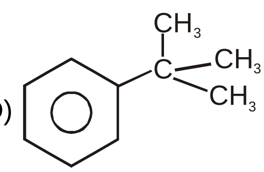
DPP NO- 11 Time: 15 minutes

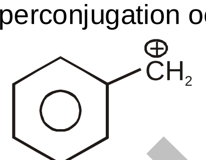
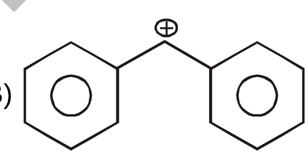
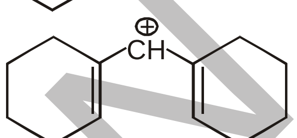
Q.1 Hyperconjugation is possible in
(A) alkenes (B) alkynes (C) carbocations (D) all of these

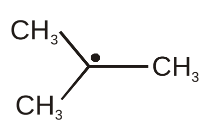
Q.2 Hyperconjugation is possible in
(A) Free radicals (B) Carbanions (C) Alcohols (D) Amines

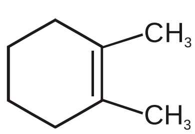
Q.3 Hyperconjugation occurs in
(A) $CH_3 — CH = CH_2$ (B) $CH_3 — CH_2 — CH = CH_2$
(C) 
(D) all ot these

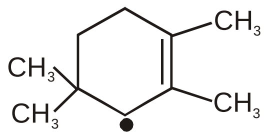
Q.4 Hyperconjugation occurs in
(A) 
(B) $CH_3 — CH = CH — CH_3$
(C) $Ph — CH = CH_2$ (D) $\overset{\oplus}{C}H_3$

Q.5 Hyperconjugation occurs in
(A) 
(B) 
(C) 
(D) 

Q.6 Hyperconjugation occurs in
(A) 
(B) 
(C) 
(D) all of these

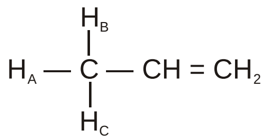
Q.7 Hyperconjugation occurs in
(A) $\dot{C}H_3$ (B) $CH_3 - \dot{C}H_2$ (C)  (D) both (B) and (C)

Q.8 
How many hyperconjugable H-atoms does this cation has?
(A) 10 (B) 6 (C) 12 (D) 15

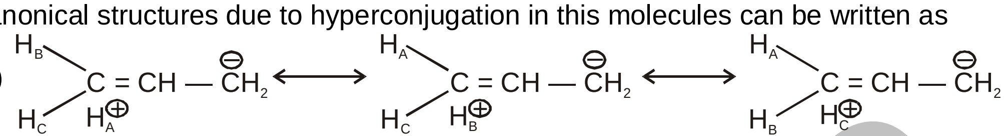
Q.9 

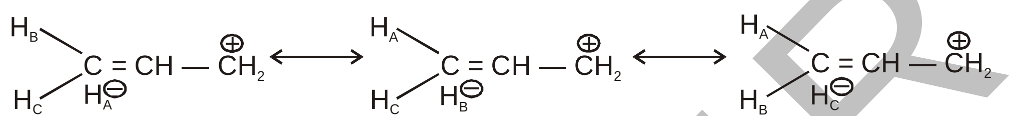
How many hyperconjugable H-atoms does this cation has?

(A) 5 (B) 6 (C) 12 (D) 8

Q.10 

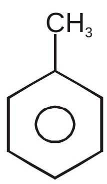
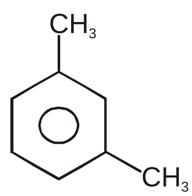
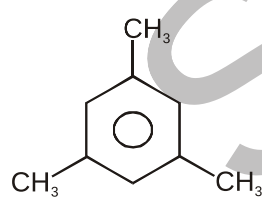
Canonical structures due to hyperconjugation in this molecules can be written as

(A) 

(B) 

(C) both (A) and (B)

(D) none of these

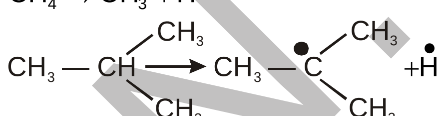
Q.11   

I II III

Among these compounds, which of the following orders is correct for their nobond-resonance energy?

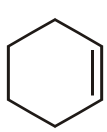
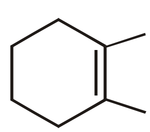
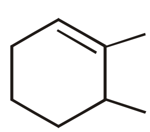
(A) III > II > I (B) I > II > III (C) I > III > II (D) II > III > I

Q.12

Compound	Homolytic bond dissociation energy
$CH_4 \rightarrow \dot{C}H_3 + \dot{H}$	104 Kcal/mol
	92 Kcal/mol

Notice the hemolytic bond-dissociation energy of the alkanes. Now, ignoring the contribution of inductive effect, no-bond-resonance energy of tert-butyl radical can be calculated to be

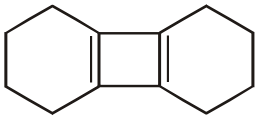
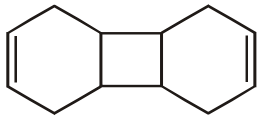
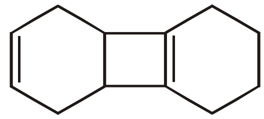
(A) 6 Kcal/mol (B) 10 Kcal/mol (C) 12 Kcal/mol (D) 14 Kcal/mol

Q.13   

I II III

Among these cycloalkenes, which of the following orders of stability is correct?

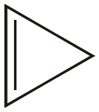
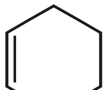
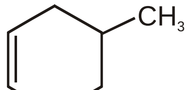
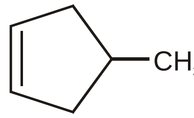
(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.14   

I II III

Among these dienes, which of the following orders of stability is correct?

(A) I > II > III (B) III > II > I (C) II > III > I (D) II > I > III

Q.15    

I II III IV

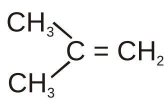
Which of the following statements is correct, about these cycloalkenes?

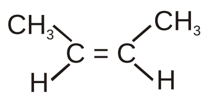
(A) Stability difference between I and II is more than that between III and IV

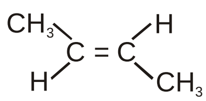
(B) Stability difference between I and II is less than that between III and IV

(C) Overall, stability order is I > II > III > IV

(D) None of these

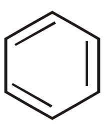
Q.16 I 

II 

III 

Which of the following orders is correct for heat of combustion of these isomeric alkenes?

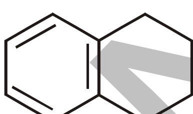
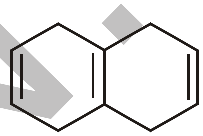
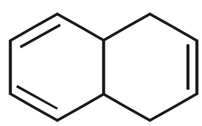
(A) I > II > III (B) III > II > I (C) III > I > II (D) II > III > I

Q.17  $CH_2 = CH — C \equiv C — CH = CH_2$

I II

Which of the following orders is correct for heat of combustion of these isomers?

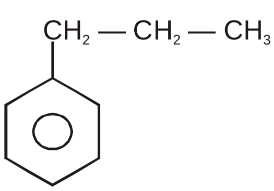
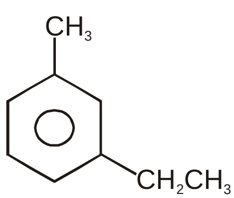
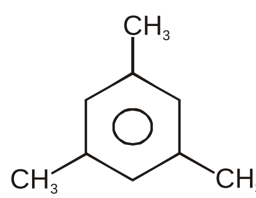
(A) I > II (B) II > I (C) I = II (D) Not predictable

Q.18   

I II III

Which of the following order is correct for heat of combustion of these isomers?

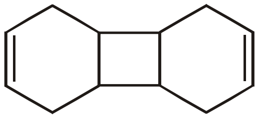
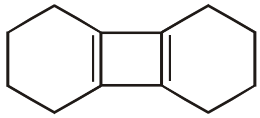
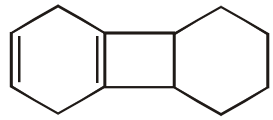
(A) I > II > III (B) III > II > I (C) II > III > I (D) I > III > II

Q.19   

I II III

Which of the following orders is correct for heat of hydrogenation of these compounds?

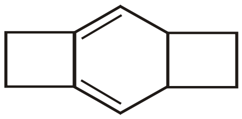
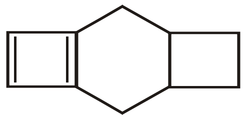
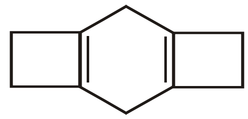
(A) I > II > III (B) III > II > I (C) II > I > III (D) I > III > II

Q.20   

I II III

Which of the following orders is correct for heat of hydrogenation of these compounds?

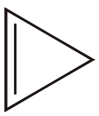
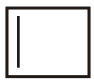
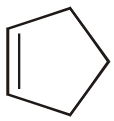
(A) I > II > III (B) III > II > I (C) III > I > II (D) II > III > I

Q.21   

I II III

Which of the following orders is correct for heat of hydrogenation of these compounds?

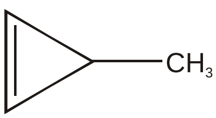
(A) I > II > III (B) III > II > I (C) II > I > III (D) I > III > II

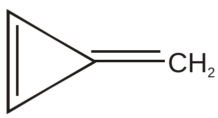
Q.22   

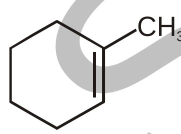
I II III

Which of the following orders is correct for heat of hydrogenation of these compounds?

(A) I > II > III (B) III > II > I (C) II > I > III (D) III > I > II

Q.23 

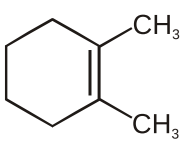


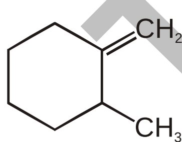


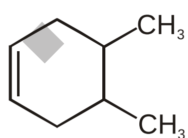
I II III

Which of the following orders is correct for heat of hydrogenation of these compounds?

(A) I > II > III (B) III > II > I (C) III > I > II (D) II > I > III

Q.24 

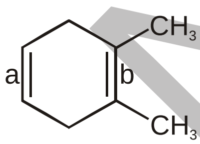




I II III

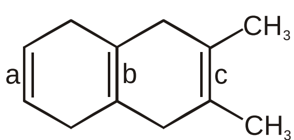
Which of the following order is correct for heat of hydrogenation of these compounds?

(A) I > II > III (B) III > II > I (C) II > III > I (D) III > I > II

Q.25 

a and b are the length of these two C = C bonds. Now, which of the following orders is correct?

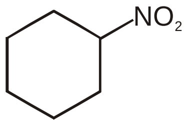
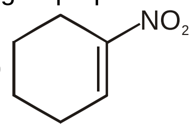
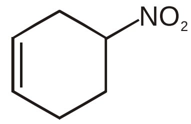
(A) a = b (B) a < b (C) b > a (D) Not predictable

Q.26 

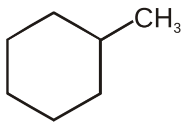
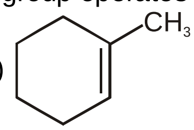
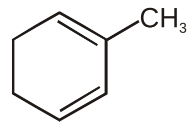
a, b and c are the length of these C = C bonds. Now, which of the following orders is correct?

(A) a = b = c (B) a > b > c (C) c > b > a (D) b > c > a

Q.27 Inductive effect of – NO_2 group operates in

(A)  (B)  (C)  (D) all of these

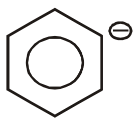
Q.28 Inductive effect of – CH_3 group operates in

(A)  (B)  (C)  (D) both (B) and (C)

Q.29 $-CH_3$ (I) $-\overset{\overset{\large O}{\|}}{C}-O^{\ominus}$ (II) $-O^{\Theta}$ (III)

Which of these groups has + I effect?

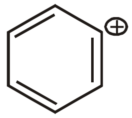
(A) I (B) II (C) III (D) all of these

Q.30 

Hybridization of the negatively charged C-atom of this anion is

(A) sp^3 (B) sp^2 (C) sp (D) unhybridized

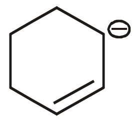
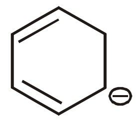
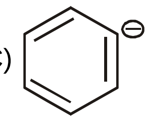
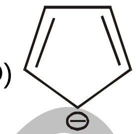
DPP NO- 12 Time: 15 minutes

Q.1 

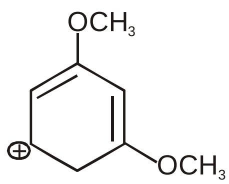
Empty orbital of this carbocation is

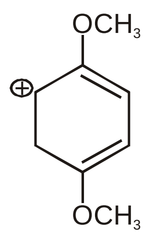
(A) 2p (B) sp^3 (C) sp^2 (D) sp

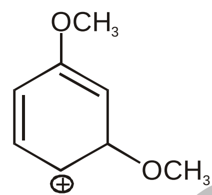
Q.2 Negative charge of which the following carbanions is not resonance – stabilized?

(A)  (B)  (C)  (D) 

Q.3



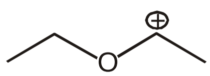


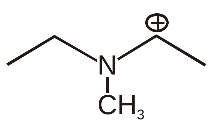


I II III

Which of the following orders is correct for the stability of these carbocations?

(A) I > II > III (B) III > II > I (C) I > III > II (D) II > III > I

Q.4 I 

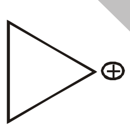
II 

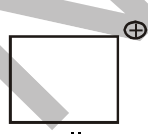
II 

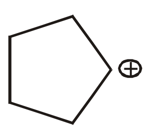
Which of the following orders is correct for the stability of these carbocations?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.5





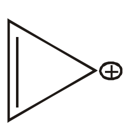


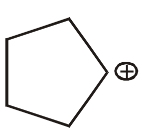
I II III

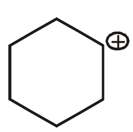
Which of the following orders is correct for the stability of these carbocations?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.6



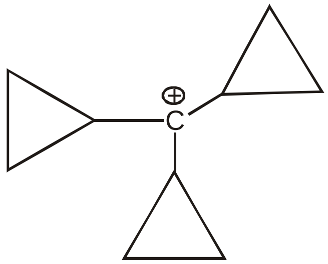


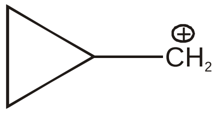


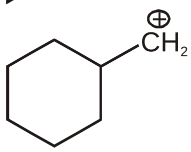
I II III

Which of the following orders is correct for the stability of these carbocations?

(A) I > II > III (B) III > II > I (C) I > III > II (D) II > I > III

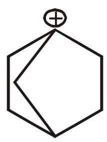
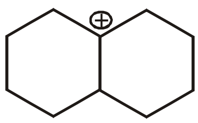
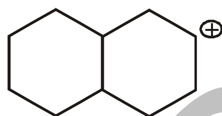
Q.7 I 

II 

III 

Which of the following orders is correct for the stability of these carbocations?

(A) I > II > III (B) III > II > I (C) II > I > III (D) III > I > II

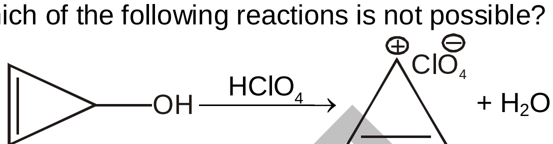
Q.8   

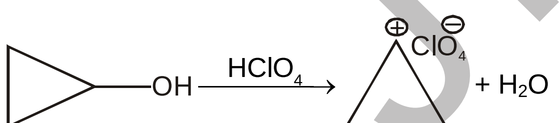
I II III

Which of the following orders is correct for the stability of these carbocations?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.9 Which of the following reactions is not possible?

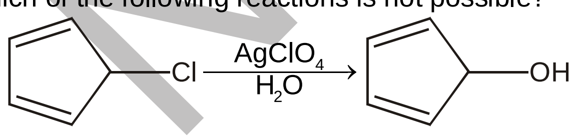
(A) 

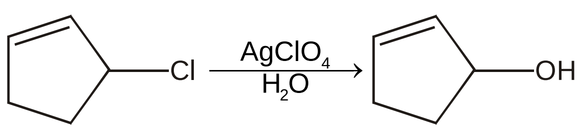
(B) 

(C) both (A) and (B)

(D) none of these

Q.10 Which of the following reactions is not possible?

(A) 

(B) 

(C) both (A) and (B)

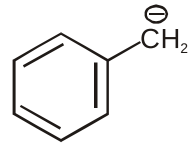
(D) none of these

Q.11 $CH_3-\overset{\ominus}{C}H_2$ $\quad$ $CH_3-\overset{\ominus}{C}H-CH_3$ $\quad$ $CH_3-\overset{\ominus}{C}(CH_3)-CH_3$

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

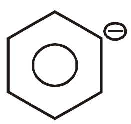
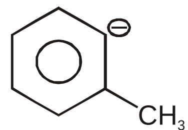
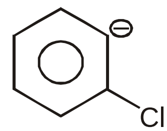
(A) I > II > III (B) III > II > I (C) II > I > III (D) I > II > III

Q.12 $CH_3-\overset{\ominus}{C}H_2$ $\quad$ $CH_2=CH-\overset{\ominus}{C}H_2$ $\quad$ 

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

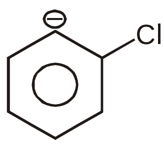
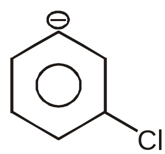
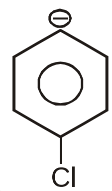
(A) I > II > III (B) III > II > I (C) II > III > I (D) II > I > III

Q.13   

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

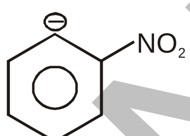
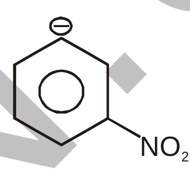
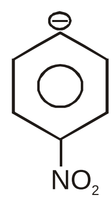
(A) I > II > III (B) III > II > I (C) III > I > II (D) II > III > II

Q.14   

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

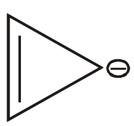
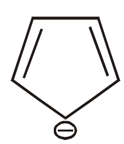
(A) I > II > III (B) III > II > I (C) II > I > III (D) II > I > III

Q.15   

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.16  $\quad$ $CH_2=CH-\overset{\Theta}{C}H_2$ $\quad$ 

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

(A) I > II > III (B) III > II > I (C) I > III > II (D) II > III > I

Q.17 I $\overset{\ominus}{C}H_2 - CH = CH_2$

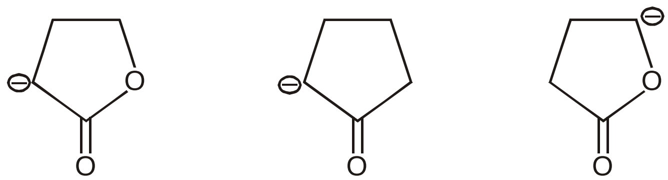
II $\overset{\ominus}{C}H_2 - CH = O$

III $\overset{\ominus}{C}H_2 - CH_2 - CH_3$

Which of the following orders is correct for the stability of these carbanions?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.18

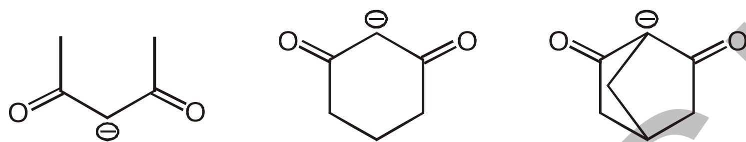


I II III

Which of the following orders is correct for the stability of these carbanions?

(A) I > II > III (B) III > II > I (C) II > III > I (D) II > I > III

Q.19



I II III

Which of these carbanions is sp^3 hybridized?

(A) I (B) II (C) III (D) nonw of these

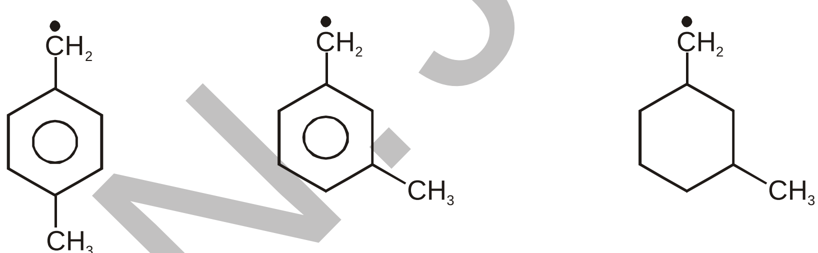
Q.20 $CH_2 = CH - \dot{C}H_2$ $CH_3 - \dot{C}H_2$ $CH_3 - \dot{C}(CH_3)_2$

I II III

Which of the following orders is correct for the stability of these radicals?

(A) I > II > III (B) III > II > I (C) I > III > II (D) III > I > II

Q.21

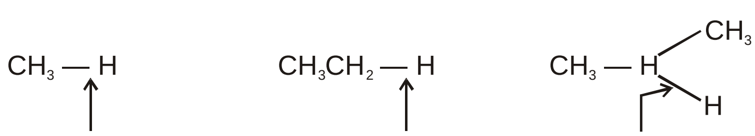


I II III

Which of the following orders is correct for the stability of these radicals?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

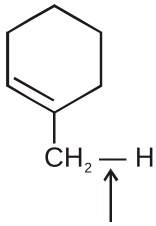
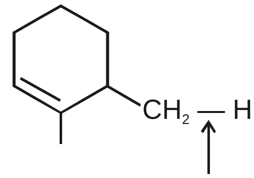
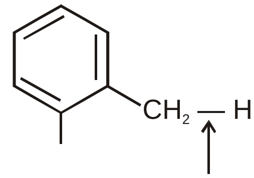
Q.22



I II III

Which of the following orders is correct for the energy required for homolytic cleavage of indicated C – H bonds?

(A) I > II > III (B) III > II > I (C) III > I > II (D) II > III > I

Q.23 I  II  III 

Which of the following orders is correct for energy required for homolytic cleavage of indicated C – H bonds?

(A) I > II > III (B) III > II > I (C) II > I > III (D) III > I > II

Q.24

I $Cl - CH_2 - COOH$

II $Br - CH_2 - COOH$

III $I - CH_2 - COOH$

Which of the following order is correct for the acidic strength of these carboxylic acids?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.25

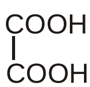
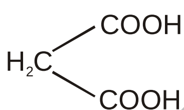
I $Cl - CH_2 - COOH$

II $O_2N - CH_2 - COOH$

III $CH_3 - COOH$

Which of the following order is correct for the acidic strength of these carboxylic acids?

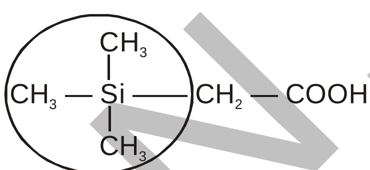
(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.26   HCOOH

I II III

Which of the following order is correct for the acidic strength of these carboxylic acids?

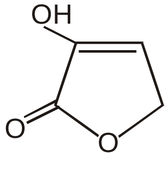
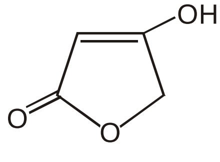
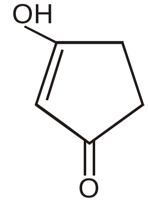
(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.27 

In this molecule, the effect of trimethylsilyl group (encircled) on the acidity of – COOH group is of

(A) strong electron donating nature (B) strong electron withdrawing nature

(C) weak electron withdrawing nature (D) both (A) and (C)

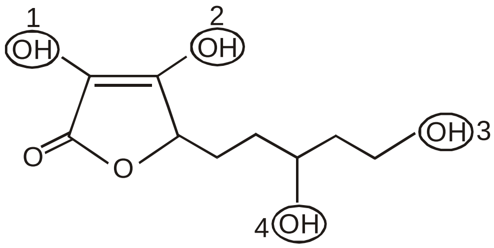
Q.28   

I II III

Which of the following order is correct for the acidic strength of these compounds?

(A) I > II > III (B) III > II > I (C) II > I > III (D) III > I > II

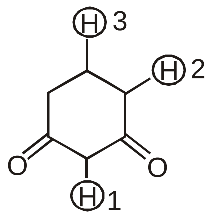
Q.29



Which of these – OH groups is most acidic?

(A) 1 (B) 2 (C) 3 (D) 4

Q.30

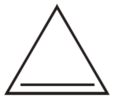
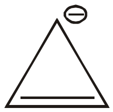
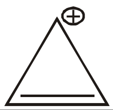
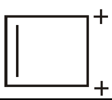
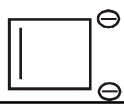
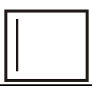
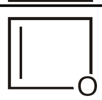
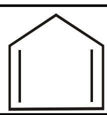
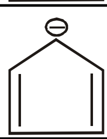
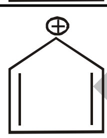
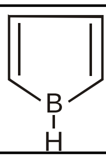
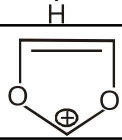
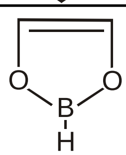


Which of the following orders is correct for the acidity of these indicated H-atoms?

(A) 1 > 2 > 3 (B) 3 > 2 > 1 (C) 2 > 1 > 3 (D) 1 > 3 > 2

DPP NO- 13 Time: 15 minutes

1. Identify the Nature of compound

S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				
(10)				
(11)				
(12)				
(13)				

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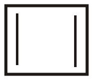
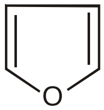
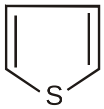
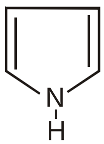
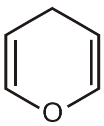
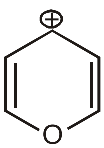
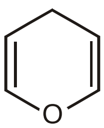
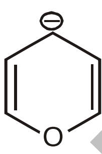
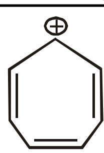
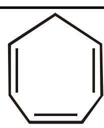
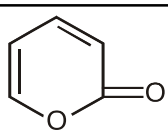
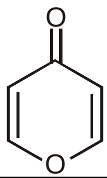
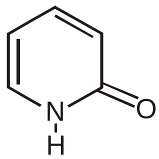
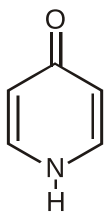
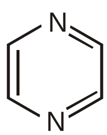
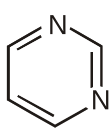
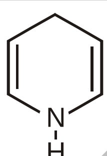
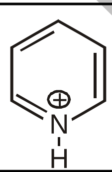
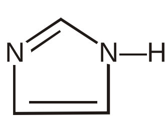
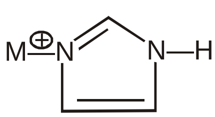
DPP NO- 14 Time: 15 minutes

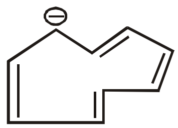
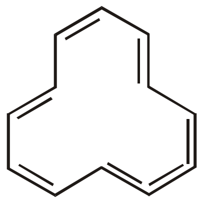
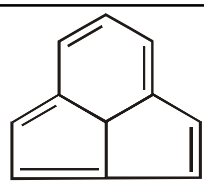
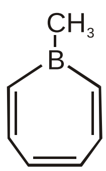
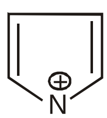
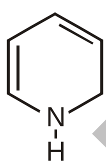
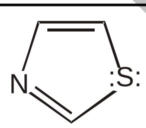
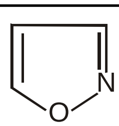
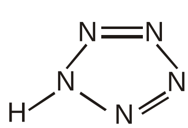
S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				
(10)				
(11)				

DPP NO- 15 Time: 15 minutes

S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				

DPP NO- 16 Time: 15 minutes

1. Identify the Nature of compound

S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				

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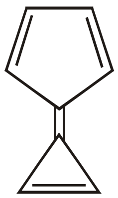
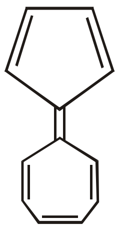
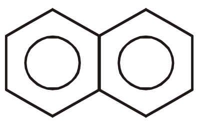
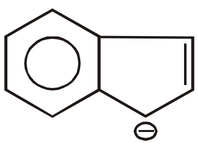
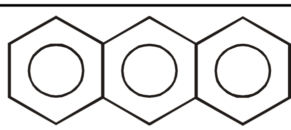
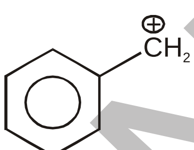
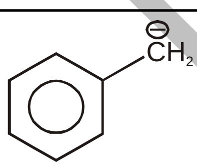
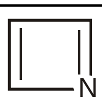
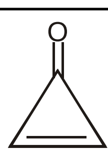
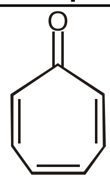
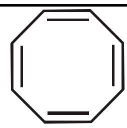
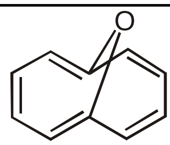
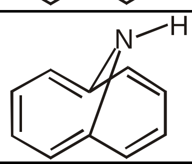
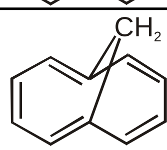
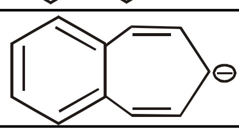
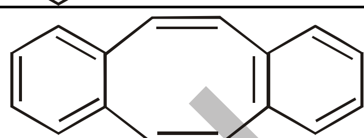
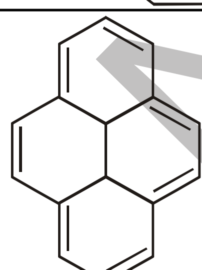
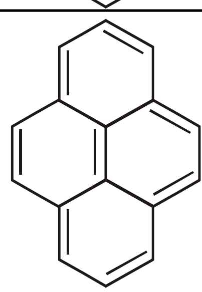
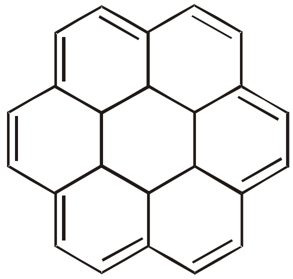
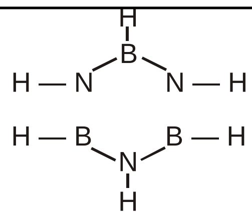
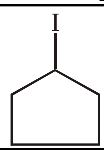
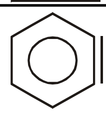
DPP NO- 17 Time: 15 minutes

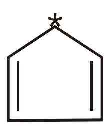
S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				

DPP NO- 18 Time: 15 minutes

S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				

DPP NO- 19 Time: 15 minutes

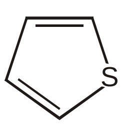
S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)	 Borazole			
(3)				
(4)				

(2)  (C* = C^{14}) $\xrightarrow{KH}$ (A) + gas (Identify A, B, C, D)

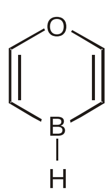
$\downarrow H^+$

B + C + D

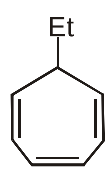
(3) Determine the number of π electrons for each compound below, then indicate whether they are aromatic, antiaromatic, or neither. Assume the molecules are neutral and planar unless otherwise indicated.



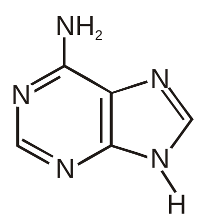
Number of π electrons:_____ Aromatic, Antiaromatic, or Neither ?



Number of π electrons:_____ Aromatic, Antiaromatic, or Neither ?



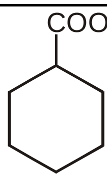
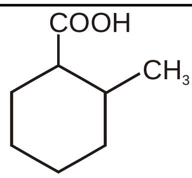
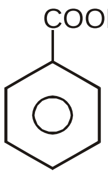
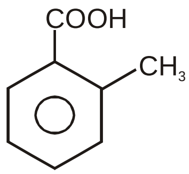
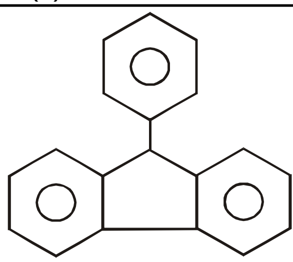
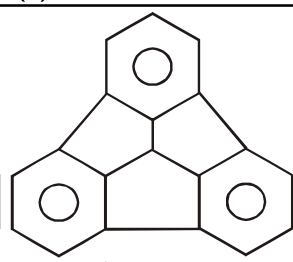
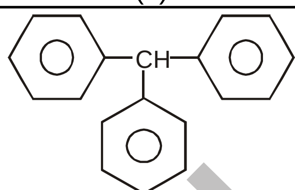
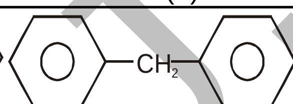
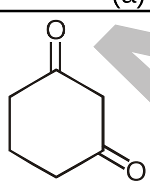
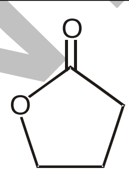
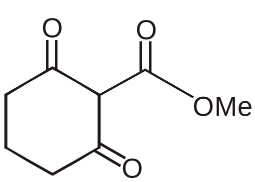
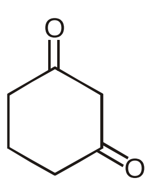
Number of π electrons:_____ Aromatic, Antiaromatic, or Neither ?



Number of π electrons:_____ Aromatic, Antiaromatic, or Neither ?

DPP NO- 20 Time: 15 minutes

1. Compare Acidic Strength

S.No.	**Compound**	**Compare Ka value**		**Compare pKa value**	
		a	**b**	**a**	**b**
(1)	 (a)  (b)				
(2)	 (a)  (b)				
(3)	 (a)  (b)				
(4)	 (a)  (b)				
(5)	 (a)  (b)				
(6)	 (a)  (b)				

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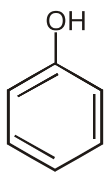
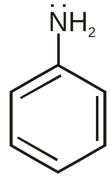
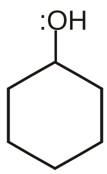
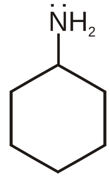
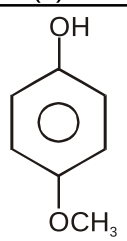
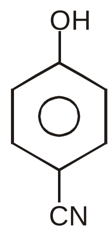
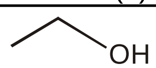
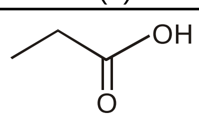
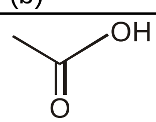
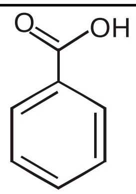
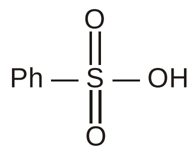
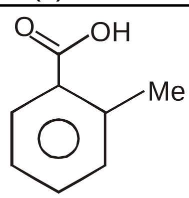
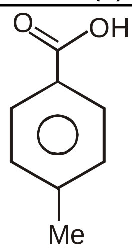
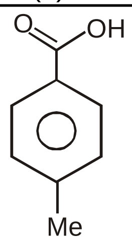
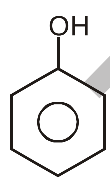
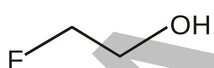
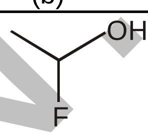
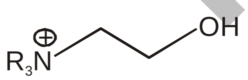
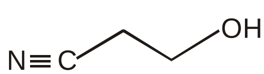
S.No.	Compound	Compare Ka value		Compare pKa value	
		a	b	a	b
(7)	 (a)  (b)				
(8)	 (a)  (b)				
(9)	 (a)  (b)				
(10)	Cl—CH_2—CH_2—COOH (a) CH_3—CH(Cl)—COOH (b)				
(11)	 (a)  (b)				
(12)	HF (a) NH_3 (b)				
(13)	HC ≡ CH (a) $\ddot{N}H_3$ (b)				
(14)	CH_4 (a) NH_3 (b)				
(15)	HC ≡ N (a) $\ddot{N}H_3$ (b)				
(16)	 (a)  (b)				

DPP NO-21 Time: 15 minutes

1. Compare Acidic Strength

S.No.	Compound	Compare Ka value		Compare pKa value	
		a	b	a	b
(1)	 (a)  (b)				
(2)	R — OH (a) $R-\overset{\overset{\displaystyle O}{||}}{C}-OH$ (b)				
(3)	 (a)  (b)				
(4)	 (a)  (b)				
(5)	 (a)  (b)				
(6)	 (a)  (b)				
(7)	CH_4 (a) HF (b)				
(8)	HF (a) HI (b)				
(9)	H_2S (a) H_2O (b)				

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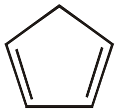
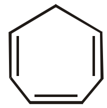
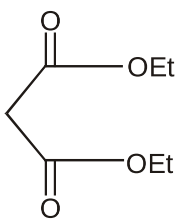
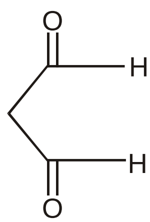
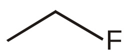
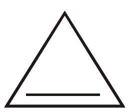
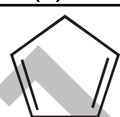
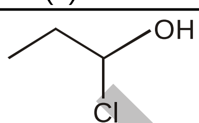
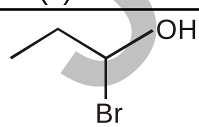
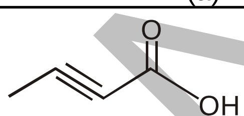
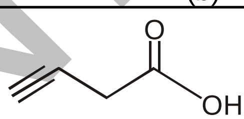
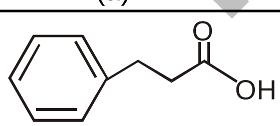
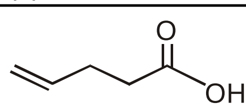
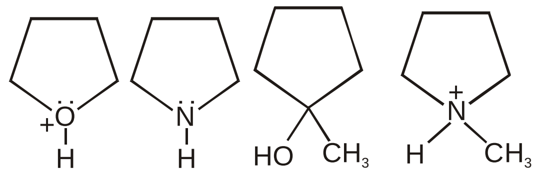
S.No.	Compound	Compare Ka value		Compare pKa value	
		a	b	a	b
(10)	 (a)  (b)				
(11)	 (a)  (b)				
(12)	 (a)  (b)				
(13)	 (a)  (b)				
(14)	 (a)  (b)				
(15)	CCl_3OH (a) CF_3OH (b)				
(16)	 (a)  (b)				
(17)	 (a)  (b)				
(18)	 (a)  (b)				
(19)	 (a)  (b)				
(20)	$CHCl_3$ (a) HCF_3 (b)				

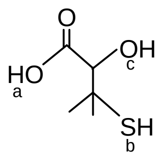
DPP NO- 22 Time: 15 minutes

Q.1 Rank the following in order of decreasing acidity.

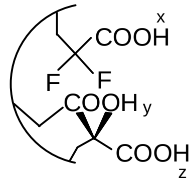


Q.2 Consider the following compound. Rank the labeled proton in increasing order of acidity

(a)

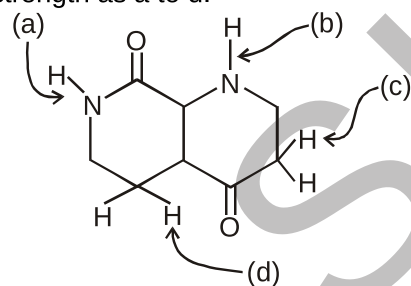


(b)

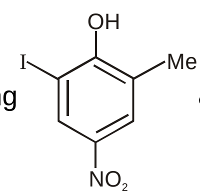


Write the stepwise ionization of acid

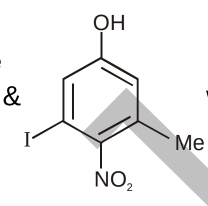
Q.3 Write correct order of acidic strength as a to d.



Q.4 Among

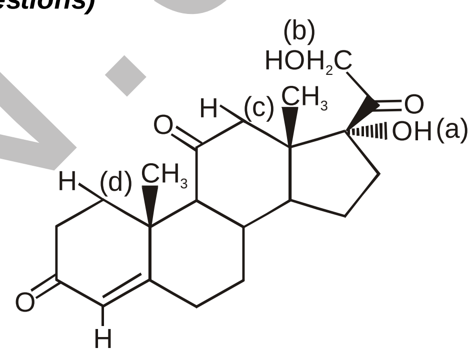


&



which is more acidic & why? Explain through canonical forms.

Questions No. 5 to 7 (3 questions)



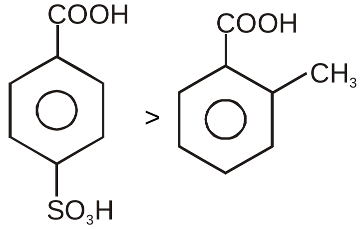
Cortisone

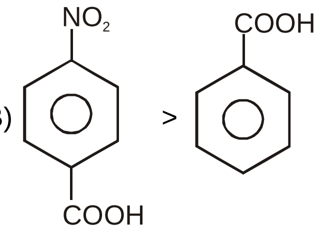
Q.5 Cortisone contains which functional groups?
(A) Ether, alkene, alcohol (B) Alcohol, ketone, amine
(C) Alcohol, ketone, alkene (D) Ether, amine, ketone

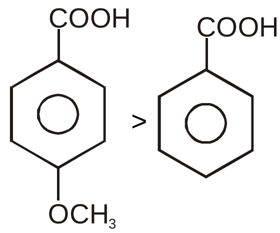
Q.6 Total stereoisomer of the compound Cortisone is
(A) 32 (B) 64 (C) 66 (D) 128

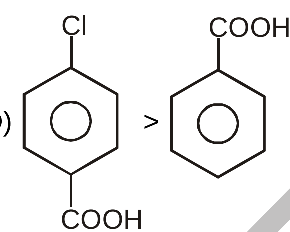
Q.7 Total number of chiral center in Cortisone:
(A) 4 (B) 5 (C) 6 (D) 7

Q.8 Which order of acid strength is wrong

(A) 

(B) 

(C) 

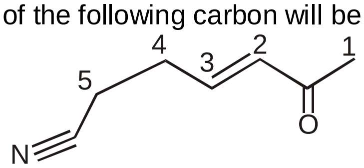
(D) 

Q.9 Which is the order of acidity of the following compounds?

$EtCO_2H$	CH_3CO_2H	CH_3SO_3H	CF_3SO_3H
a	b	c	d

(A) b > a > d > c (B) d > c > a > b (C) d > c > b > a (D) d > a > b > c

Q.10 Which of the following carbon will be deprotonatated first on treatment with base.



(A) 4 (B) 5 (C) 2 (D) 3

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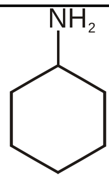
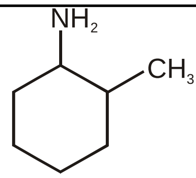
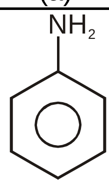
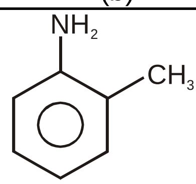
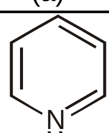
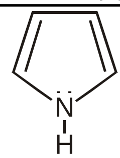
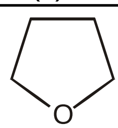
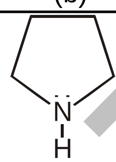
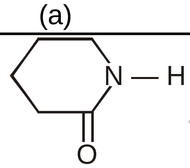
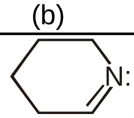
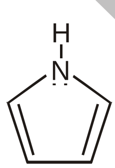
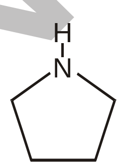
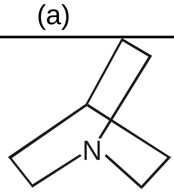
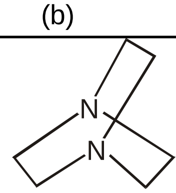
DPP NO-23 Time: 15 minutes

1. Compare which is more basic in nature

S.No.	**Compounds**	**Compare Kb value**		**Compare pKb value**	
		a	**b**	**a**	**b**
(1)	 (a)  (b)				
(2)	 (a)  (b)				
(3)	 (a)  (b)				
(4)	 (a)  (b)				
(5)	 (a)  (b)				
(6)	 (a)  (b)				
(7)	 (a)  (b)				

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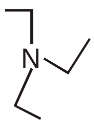
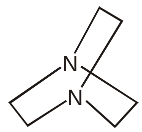
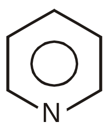
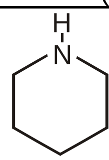
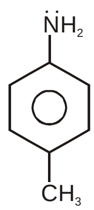
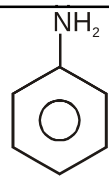
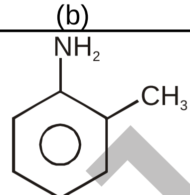
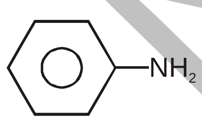
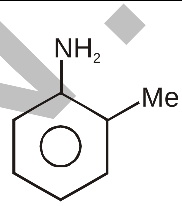
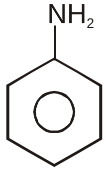
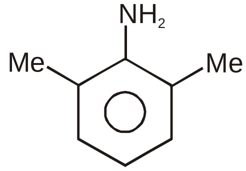
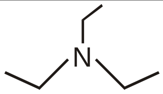
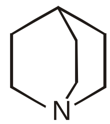
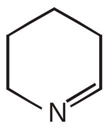
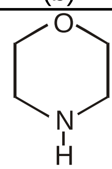
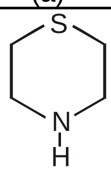
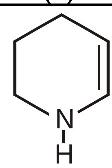
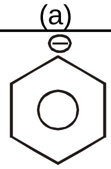
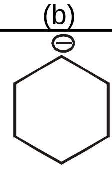
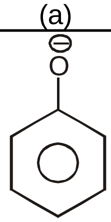
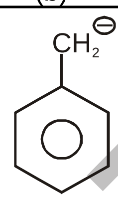
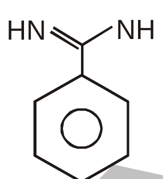
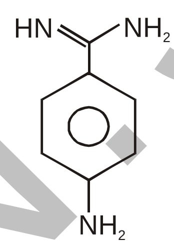
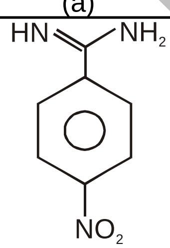
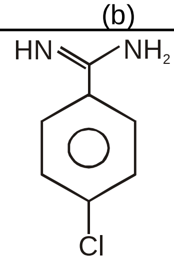
DPP NO- 24 Time: 15 minutes

1. Compare which is more basic in nature

S.No.	Compounds	Compare Kb value		Compare pKb value	
		a	**b**	**a**	**b**
(1)	 (a)  (b)				
(2)	 (a)  (b)				
(3)	 (a)  (b)				
(4)	Ph — NH — Me (a)  (b)				
(5)	Ph — NH — Me (a); Ph — N(Me) — Me (b)				
(6)	 (a)  (b)				
(7)	$H_2N-C(NH_2)=NH$ (a); $H_2N-C(CH_3)=NH$ (b)				
(8)	 (a)  (b)				

S.No.	Compounds	Compare Kb value		Compare pKb value	
		a	b	a	b
(9)	 (a)  (b)				
(10)	 (a)  (b)				
(11)	 (a)  (b)				
(12)	 (a)  (b)				
(13)	 (a)  (b)				
(14)	 (a)  (b)				
(15)	 (a)  (b)				

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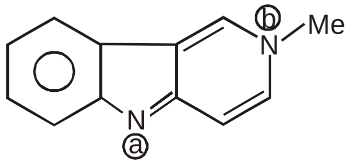
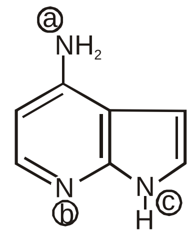
DPP NO- 25 Time: 15 minutes

Q.1 Which Nitrogen is most basic

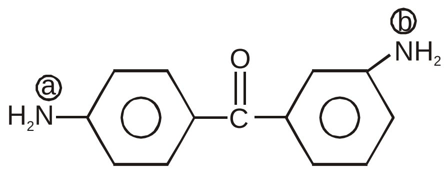
(i)



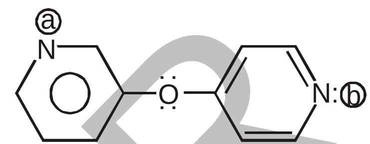
(ii)



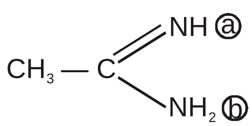
(iii)



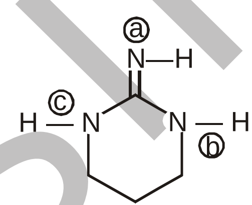
(iv)



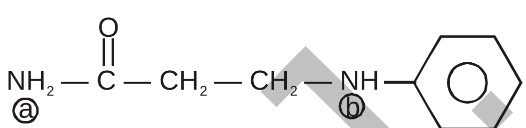
(v)



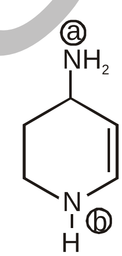
(vi)



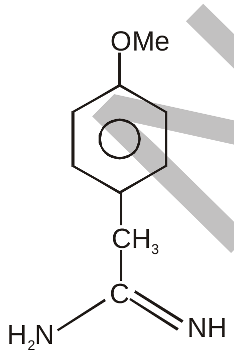
(vii)



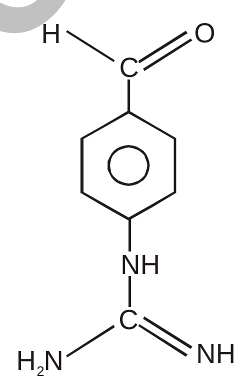
(viii)



2. Which is more basic & why?



(i)



(ii)

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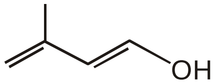
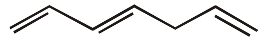
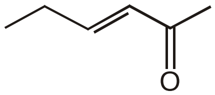
CONCEPTUAL IMPROVEMENT OF G.O.C.

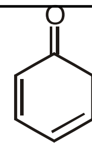
DPP NO- 1 Time: 15 minutes

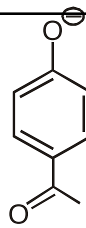
1. Draw Resonance hybrid of the following compounds:-

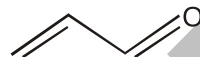
(1) 

(2) 

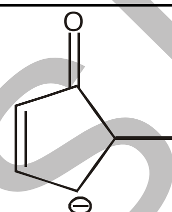
(3) 

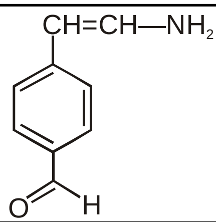
(4) 

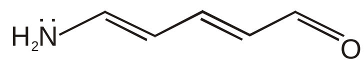
(5) 

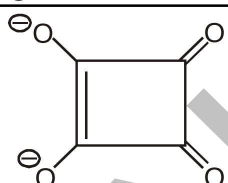
(6) 

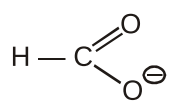
(7) $H_2C = C - NH - CH_3$

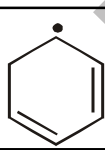
(8) 

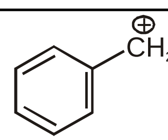
(9) 

(10) 

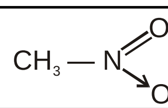
(11) 

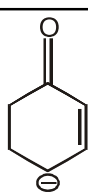
(12) 

(13) 

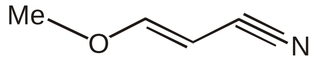
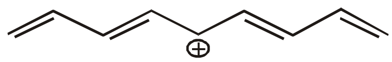
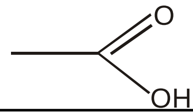
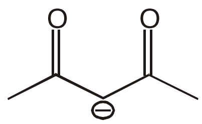
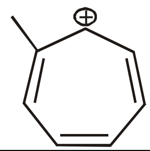
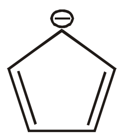
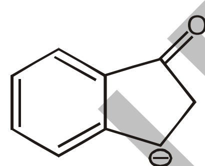
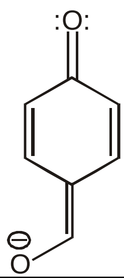
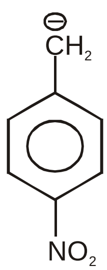
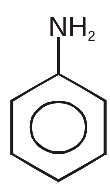
(14) 

(15) $Me - S - \overset{\oplus}{C}H_2$

(16) 

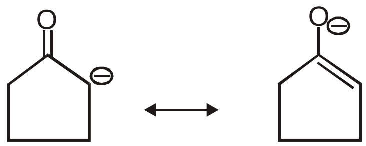
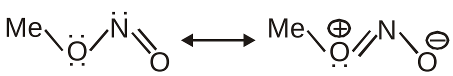
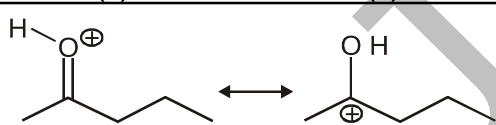
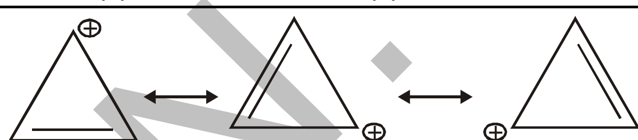
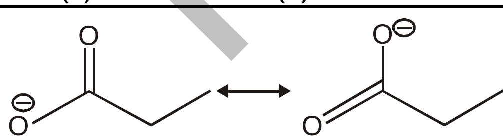
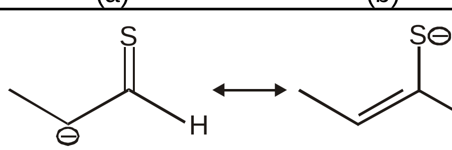
(17) 

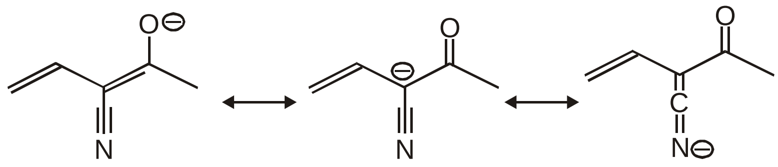
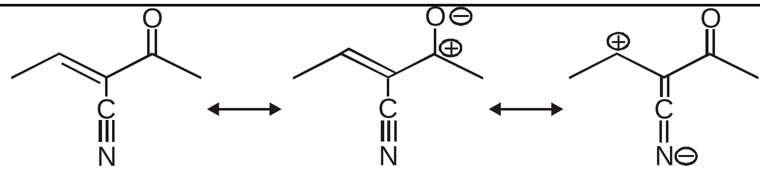
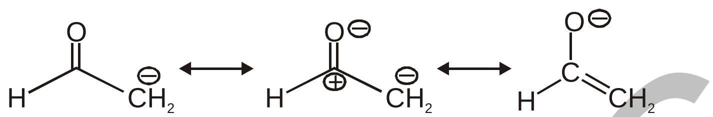
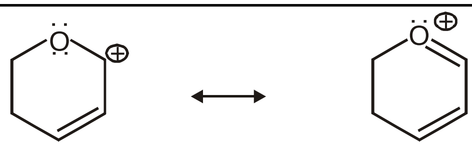
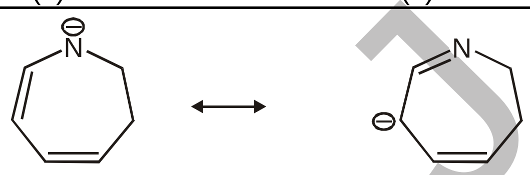
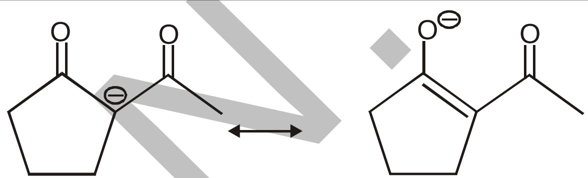
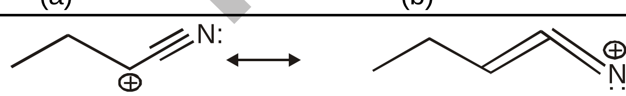
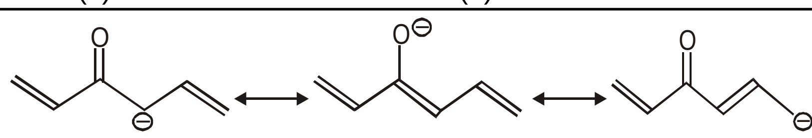
(18) $H_2\ddot{N} - C \equiv N:$

(19) $NO_3^{\ominus}$	(20) O = C = O
(21) 	(22) $H_2N - \underset{\underset{\ddot{N}H}{\|\|}}{C} - NH_2$
(23) 	(24) 
(25) 	(26) 
(27) 	(28) 
(29) 	(30) $\overset{\ominus}{O} - \underset{\underset{O^{\ominus}}{\|}}{C} = O$
(31) 	(32) 

DPP NO- 2 Time: 15 minutes

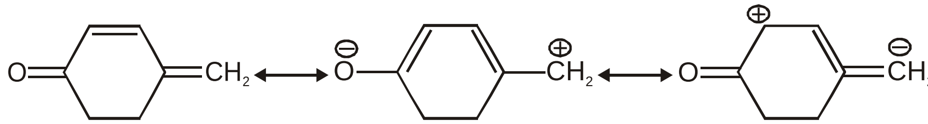
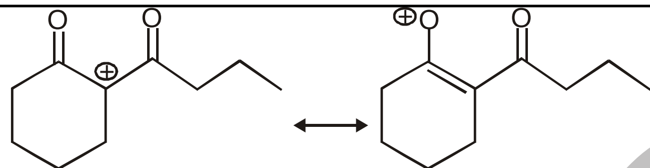
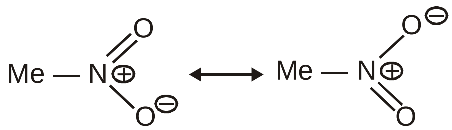
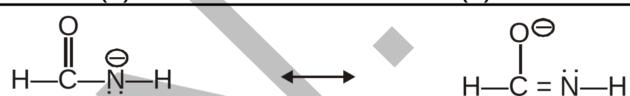
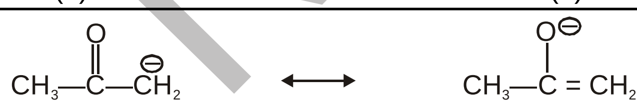
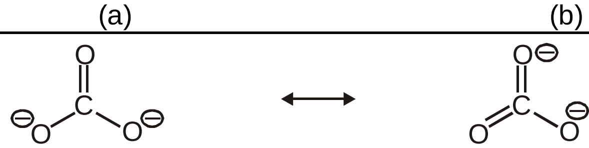
1. Compare relative stability of following resonating strutures

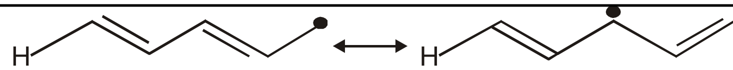
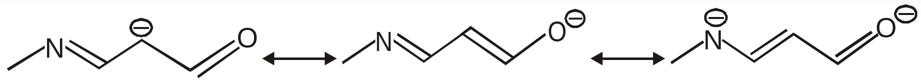
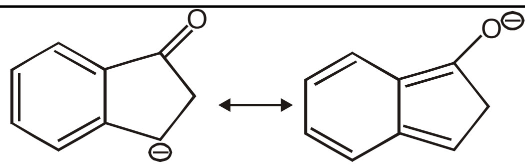
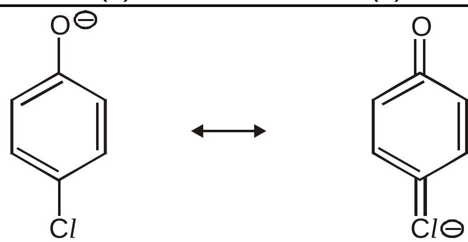
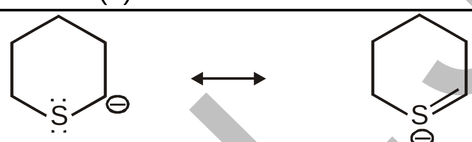
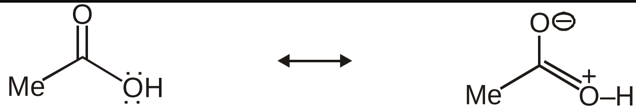
S.No.	Resonanting structures	Order of stability	Reason
(1)	$H_2C = CH - Cl \longleftrightarrow H_2\overset{\ominus}{C} - CH = \overset{\oplus}{Cl}$ (a) (b)		
(2)	 (a) (b)		
(3)	$\overset{\ominus}{C}H_2 - CH = NH \longleftrightarrow H_2C = CH - \overset{\ominus}{N}H$ (a) (b)		
(4)	$CH_3 - O - \overset{\oplus}{C}H_2 \longleftrightarrow CH_3 - \overset{\oplus}{O} = CH_2$ (a) (b)		
(5)	$H - N = C = O \longleftrightarrow H - \overset{\oplus}{N} \equiv C - \overset{\ominus}{O} \longleftrightarrow H - \overset{\ominus}{N} - C \equiv \overset{\oplus}{O}$ (a) (b) (c)		
(6)	 (a) (b)		
(7)	 (a) (b)		
(8)	 (a) (b) (c)		
(9)	 (a) (b)		
(10)	 (a) (b)		

S.No.	Resonanting structures	Order of stability	Reason
(11)	$H-\overset{+}{\underset{\cdot\cdot}{O}}=C=\overset{\ominus}{N}: \longleftrightarrow H-\underset{\cdot\cdot}{\ddot{O}}-C\equiv N:$ (a) (b)		
(12)	 (a) (b) (c)		
(13)	 (a) (b) (c)		
(14)	 (a) (b) (c)		
(15)	 (a) (b)		
(16)	 (a) (b)		
(17)	 (a) (b)		
(18)	 (a) (b)		
(19)	 (a) (b) (c)		

DPP NO- 3 Time: 15 minutes

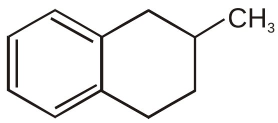
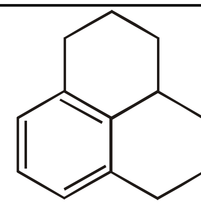
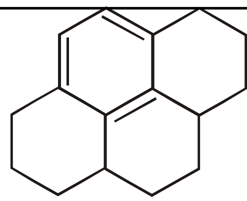
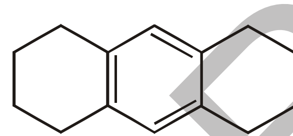
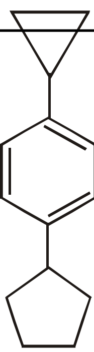
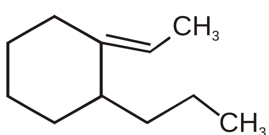
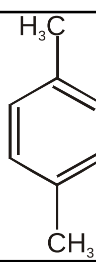
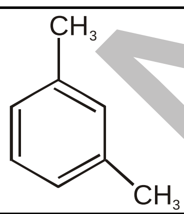
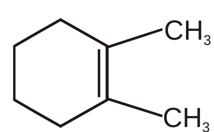
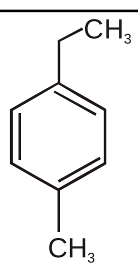
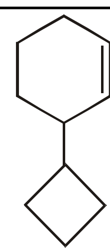
1. Compare relative stability of following resonating strutures

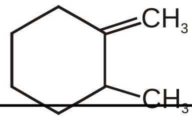
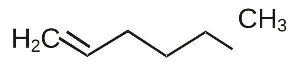
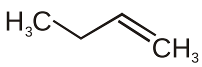
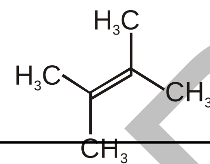
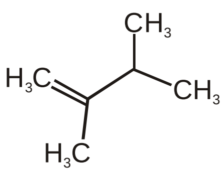
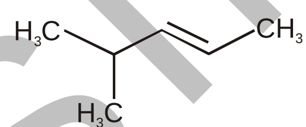
S.No.	Resonanting structures	Order of stability	Reason
(1)	 (a) (b) (c)		
(2)	$H_2\ddot{N}-CH=\overset{+}{N}H_2 \longleftrightarrow H_2\overset{+}{N}=CH-\ddot{N}H_2$ (a) (b)		
(3)	 (a) (b)		
(4)	 (a) (b)		
(5)	$H-\overset{\ominus}{C}=\overset{\oplus}{N}=\ddot{N}-H \longleftrightarrow H-C\equiv\overset{\oplus}{N}-\underset{\ominus}{\ddot{N}}-H$ (a) (b)		
(6)	$H_3C-HC=C=O \longleftrightarrow Me-\overset{\ominus}{C}H-C\equiv O^{\oplus}$ (a) (b)		
(7)	 (a) (b)		
(8)	 (a) (b)		
(9)	$\overset{\oplus}{C}H_2-\underset{H}{C}=\underset{H}{C}-CH_3 \longleftrightarrow CH_2=\underset{H}{C}-\underset{H}{\overset{\oplus}{C}}-CH_3$ (a) (b)		
(10)	 (a) (b)		

S.No.	Resonanting structures	Order of stability	Reason
(11)	 (a) ↔ (b)		
(12)	 (a) ↔ (b) ↔ (c)		
(13)	 (a) ↔ (b)		
(14)	 (a) ↔ (b)		
(15)	Me — CH = C = $\overset{\Theta}{C}H$ ⟷ Me — $\overset{\Theta}{C}H$ — C ≡ CH (a) (b)		
(16)	Me — $\ddot{O}$ — CH = CH — $\overset{+}{C}H_2$ ⟷ Me — $\overset{+}{O}$ = CH — CH = CH_2 (a) (b)		
(17)	 (a) ↔ (b)		
(18)	O = C = O ⟷ $\overset{\ominus}{O}$ — C ≡ $\overset{\oplus}{O}$ ⟷ $\overset{\oplus}{O}$ = C — $\overset{\ominus}{O}$ (a) (b) (c)		
(19)	$H_2\dot{N}$ — C = N: ⟷ $H_2\overset{\oplus}{N}$ = C = $\overset{\ominus}{N}$: (a) (b)		
(20)	 (a) ↔ (b)		

DPP NO-4 Time: 15 minutes

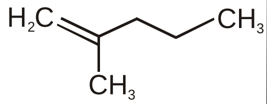
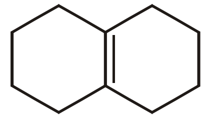
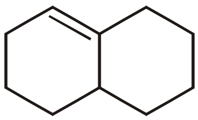
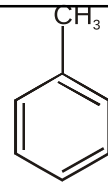
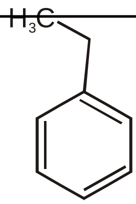
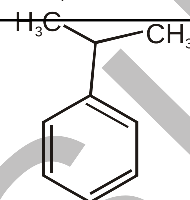
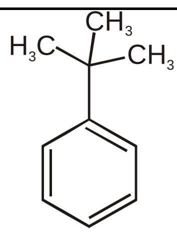
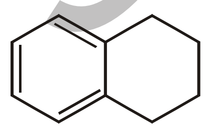
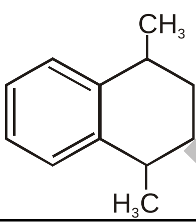
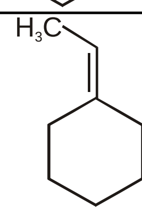
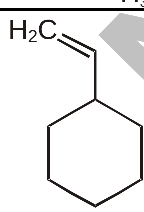
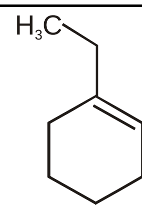
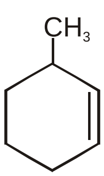
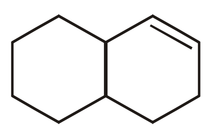
1. Identify no. of α-hydrogen in the following compounds

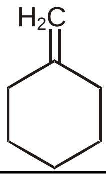
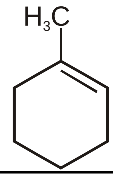
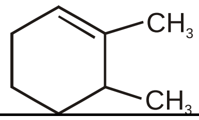
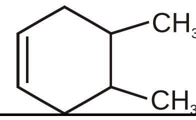
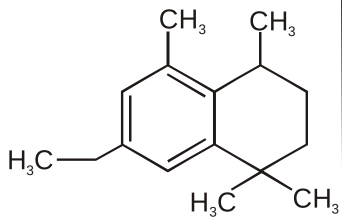
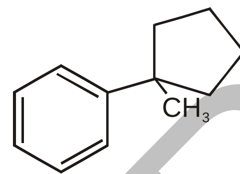
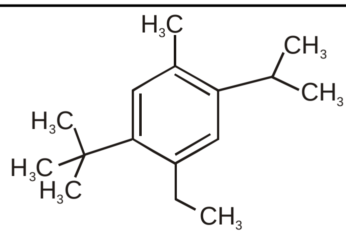
	No of α-hydrogen		**No. of α-hydrogen**
(1) 		(2) 	
(3) 		(4) 	
(5) 		(6) 	
(7) 		(8) 	
(9) 		(10) 	
(11) 		(12) 	

	No of α-hydrogen		No. of α-hydrogen
(13) 		(14) 	
(15) 		(16) 	
(17) 		(18) 	
(19) 		(20) 	

DPP NO- 5 Time: 15 minutes

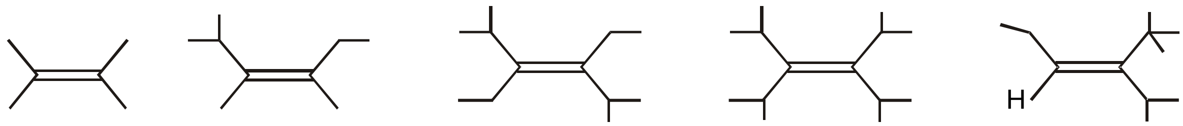
1. Identify no. of α-hydrogen in the following compounds

	No of α-hydrogen		**No. of α-hydrogen**
(1) 		(2) 	
(3) 		(4) 	
(5) 		(6) 	
(7) 		(8) 	
(9) 		(10) 	
(11) 		(12) 	
(13) 		(14) 	

	No of α-hydrogen		No. of α-hydrogen
(15) 		(16) 	
(17) 		(18) 	
(19) 		(20) 	
(20) 			

DPP NO- 6 Time: 15 minutes

Q.1 Given the relative Stability of the following compound

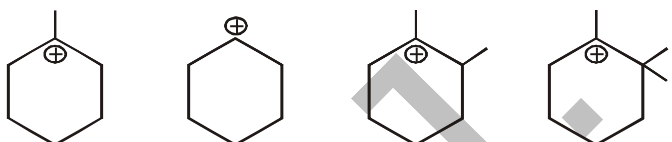
1. 

(i) ii) (iii) (iv) (v)

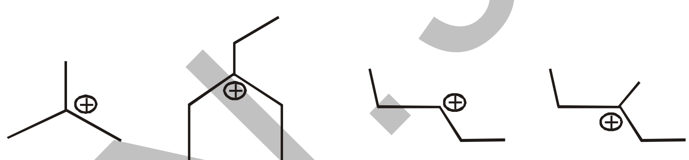
2. $Ph-CH_2-CH=CH-C(Me)_2-Me$ (i) $Me-CH(Me)-CH=CH-C(Me)_2-Me$ (ii)

$PH-CH=CH-C(Me)_2-Me$ (iii) $Me-C(Me)_2-HC=CH-C(Me)_2-Me$ (iv)

3. $Me-CH(Me)-\overset{\oplus}{C}H-CH_3$ (i) $Me-\overset{\oplus}{C}H_2$ (ii) $\overset{\oplus}{C}H_3$ (iii) $Me-C(Me)_2-\overset{\oplus}{C}H_2$ (iv)

4. 

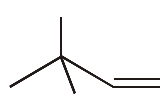
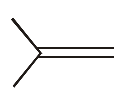
(i) (ii) (iii) (iv)

5. 

(i) (ii) (iii) (iv)

6. 

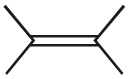
(i) (ii) (iii) (iv)

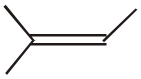
7. $H_2C=C=CH_2$ (i) $Me-CH=CH_2$ (ii)  (iii)  (iv)

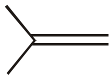
DPP NO- 7 Time: 15 minutes

Q.1 Given the relative Stability of the following compound

1.

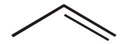

(i)


(ii)


(iii)

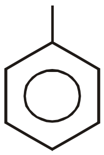

(iv)

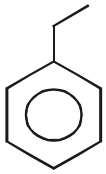

(v)

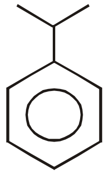

(vi)

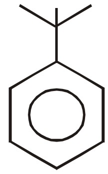
(vii)

2.

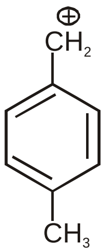

(i)

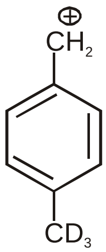

(ii)

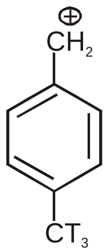

(iii)

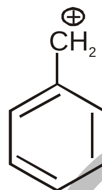

(iv)

3.

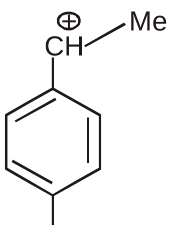

(i)

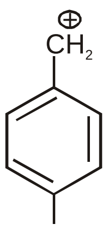

(ii)

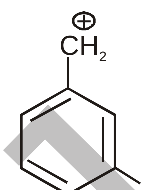

(iii)

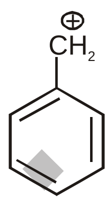

(iv)

4.

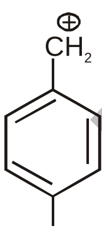

(i)

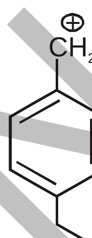

(ii)

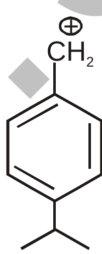

(iii)

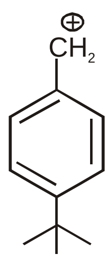

(iv)

5.

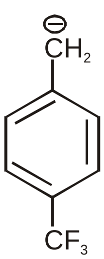

(i)

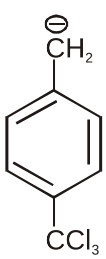

(ii)

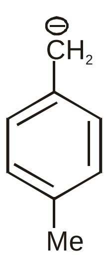

(iii)

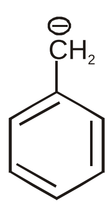

(iv)

6.


(i)


(ii)

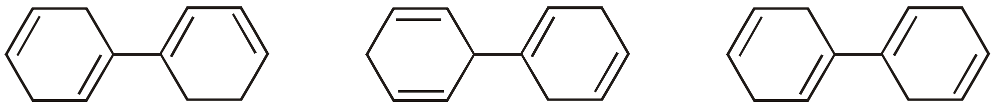

(iii)


(iv)

DPP NO- 8 Time: 15 minutes

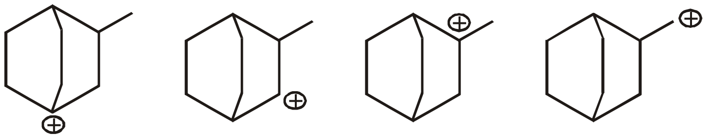
Q.1 Given the relative Stability of the following compound

1.



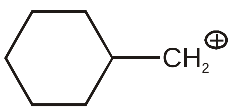
(i) (ii) (iii)

2.



(i) (ii) (iii) (iv)

3.



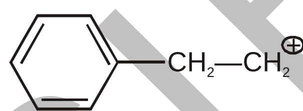
(i)

$(Et)_2CH^{\oplus}$

(ii)

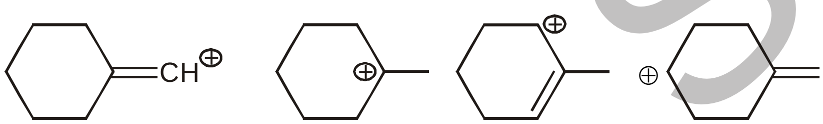
$(Et)_3C^{\oplus}$

(iii)



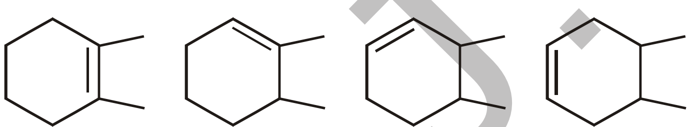
(iv)

4.



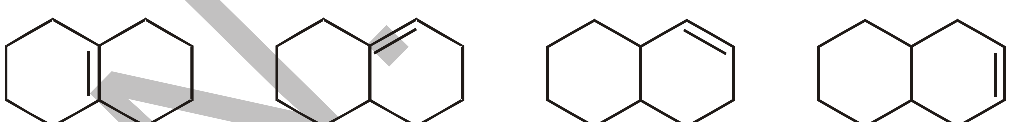
(i) (ii) (iii) (iv)

5.



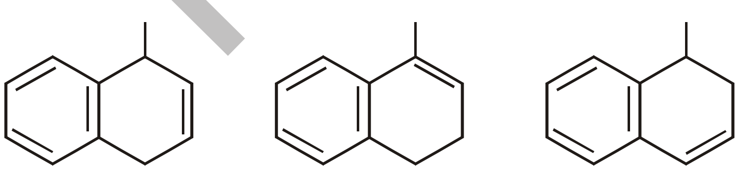
(i) (ii) (iii) (iv)

6.



(i) (ii) (iii) (iv)

7.

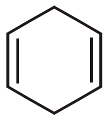


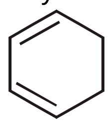
(i) (ii) (iii)

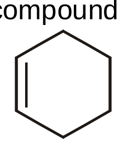
DPP NO- 9 Time: 15 minutes

Q.1 Given the relative Stability of the following compound

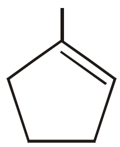
1.

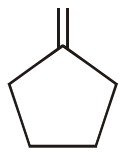

(i)

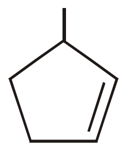

(ii)


(iii)

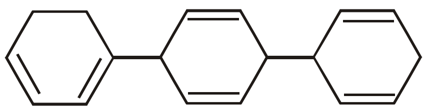
2.

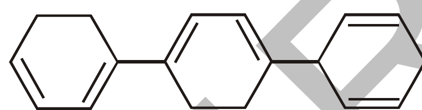

(i)

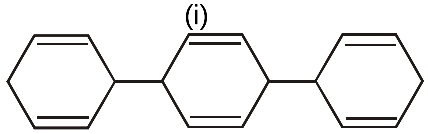

(ii)


(iii)

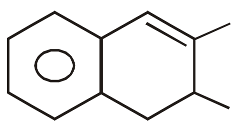
3.

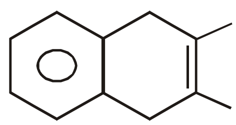

(i)

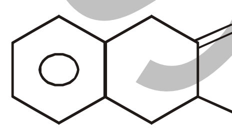

(ii)


(iii)

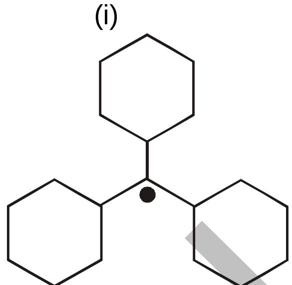
4.

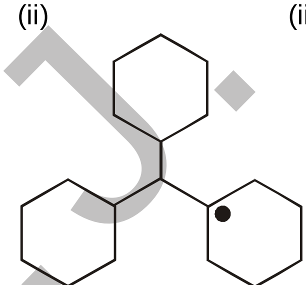

(i)

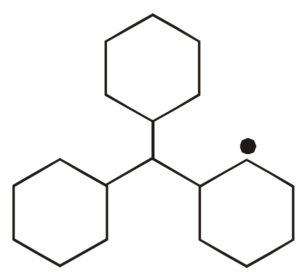

(ii)


(iii)

5.

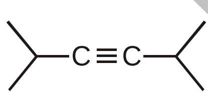

(i)


(ii)

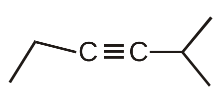

(iii)

6. $CH_3 - C \equiv C - CH_3$ (i) $H_3C - CH_2 - C \equiv CH$ (ii)

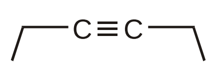
7.



(i)



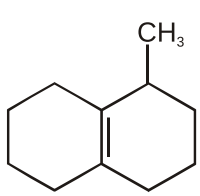
(ii)



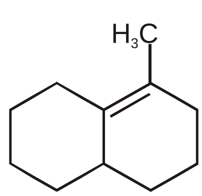
(iii)

$H_3C - C \equiv C - CH_3$
(iv)

8.



(i)



(ii)

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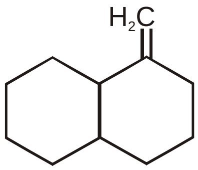
Q.1 Given the relative Stability of the following compound

1. 

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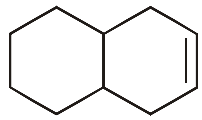
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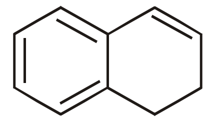
2. 
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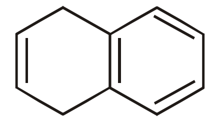
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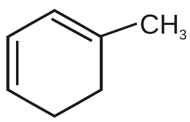
3. 

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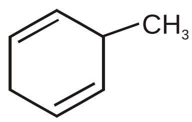

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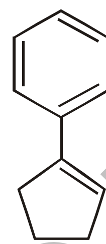
4. 
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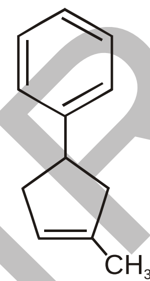

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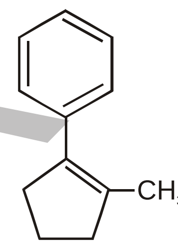

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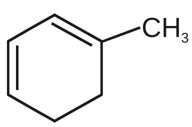
5. 

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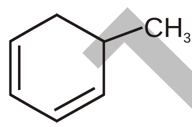

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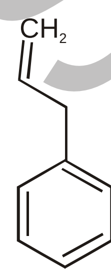
6. 

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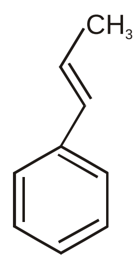
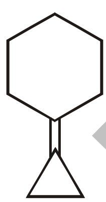


(ii)

7. 
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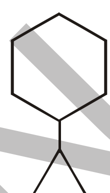
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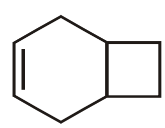
8. 
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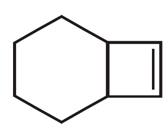
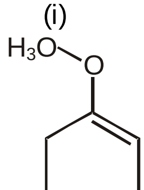
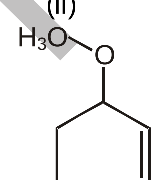
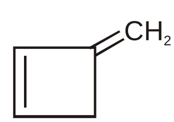
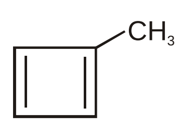

(ii)

9. 

(i)


(ii)

10. 

(i)


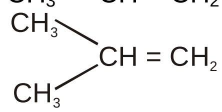
(ii)

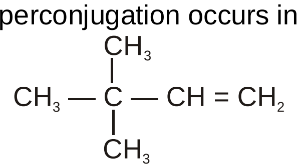
Q.2 Hyperconjugation involves
(A) Delocalization of s-electrons into an adjacent p-bond.
(B) Delocalization of n-electrons into an adjacent double bond.
(C) Delocalization of π-electrons into an adjacent double bond.
(D) All are true

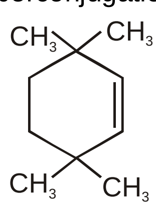
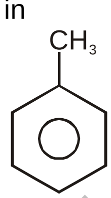
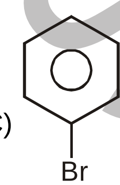
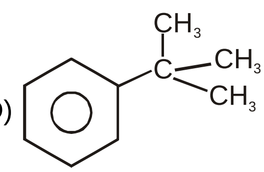
DPP NO- 11 Time: 15 minutes

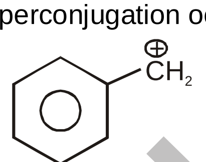
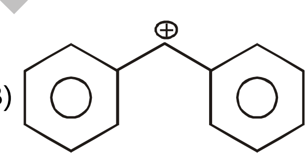
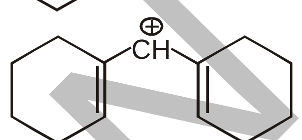
Q.1 Hyperconjugation is possible in
(A) alkenes (B) alkynes (C) carbocations (D) all of these

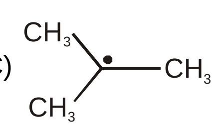
Q.2 Hyperconjugation is possible in
(A) Free radicals (B) Carbanions (C) Alcohols (D) Amines

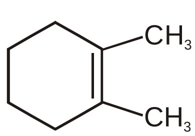
Q.3 Hyperconjugation occurs in
(A) $CH_3 — CH = CH_2$ (B) $CH_3 — CH_2 — CH = CH_2$
(C) 
(D) all ot these

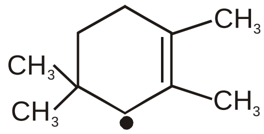
Q.4 Hyperconjugation occurs in
(A) 
(B) $CH_3 — CH = CH — CH_3$
(C) $Ph — CH = CH_2$ (D) $\overset{\oplus}{C}H_3$

Q.5 Hyperconjugation occurs in
(A) 
(B) 
(C) 
(D) 

Q.6 Hyperconjugation occurs in
(A) 
(B) 
(C) 
(D) all of these

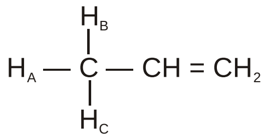
Q.7 Hyperconjugation occurs in
(A) $\dot{C}H_3$ (B) $CH_3 - \dot{C}H_2$ (C) 
(D) both (B) and (C)

Q.8 
How many hyperconjugable H-atoms does this cation has?
(A) 10 (B) 6 (C) 12 (D) 15

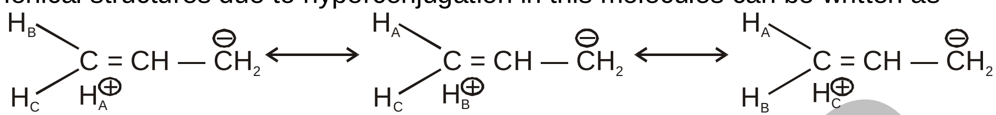
Q.9 

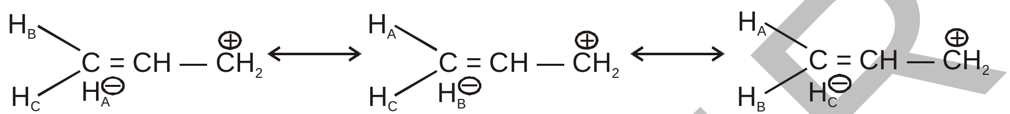
How many hyperconjugable H-atoms does this cation has?

(A) 5 (B) 6 (C) 12 (D) 8

Q.10 

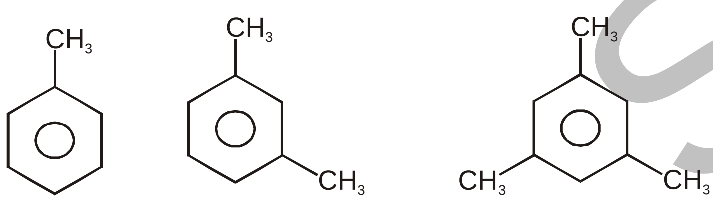
Canonical structures due to hyperconjugation in this molecules can be written as

(A) 

(B) 

(C) both (A) and (B)

(D) none of these

Q.11 

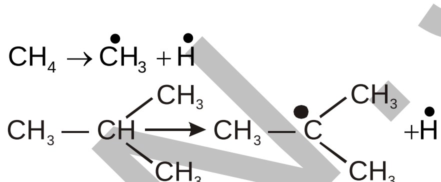
I II III

Among these compounds, which of the following orders is correct for their nobond-resonance energy?

(A) III > II > I (B) I > II > III (C) I > III > II (D) II > III > I

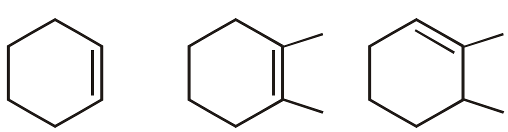
Q.12 Compound — Homolytic bond dissociation energy

$CH_4 \rightarrow \dot{C}H_3 + \dot{H}$ 104 Kcal/mol

 92 Kcal/mol

Notice the hemolytic bond-dissociation energy of the alkanes. Now, ignoring the contribution of inductive effect, no-bond-resonance energy of tert-butyl radical can be calculated to be

(A) 6 Kcal/mol (B) 10 Kcal/mol (C) 12 Kcal/mol (D) 14 Kcal/mol

Q.13 

I II III

Among these cycloalkenes, which of the following orders of stability is correct?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

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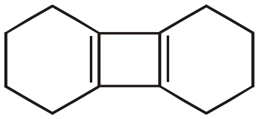
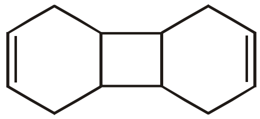
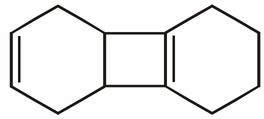
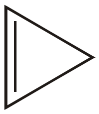
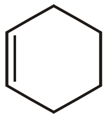
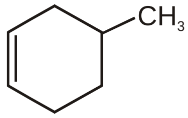
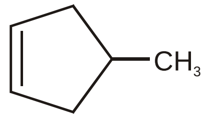
Q.14   

I II III

Among these dienes, which of the following orders of stability is correct?

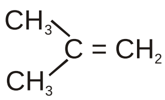
(A) I > II > III (B) III > II > I (C) II > III > I (D) II > I > III

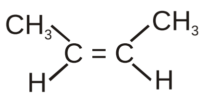
Q.15    

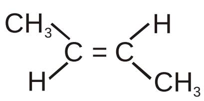
I II III IV

Which of the following statements is correct, about these cycloalkenes?

(A) Stability difference between I and II is more than that between III and IV
(B) Stability difference between I and II is less than that between III and IV
(C) Overall, stability order is I > II > III > IV
(D) None of these

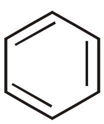
Q.16 I 

II 

III 

Which of the following orders is correct for heat of combustion of these isomeric alkenes?

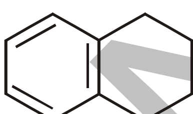
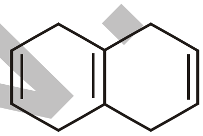
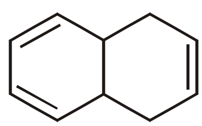
(A) I > II > III (B) III > II > I (C) III > I > II (D) II > III > I

Q.17  $CH_2 = CH — C \equiv C — CH = CH_2$

I II

Which of the following orders is correct for heat of combustion of these isomers?

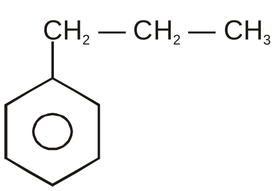
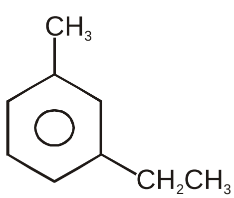
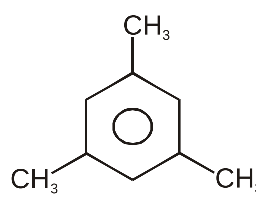
(A) I > II (B) II > I (C) I = II (D) Not predictable

Q.18   

I II III

Which of the following order is correct for heat of combustion of these isomers?

(A) I > II > III (B) III > II > I (C) II > III > I (D) I > III > II

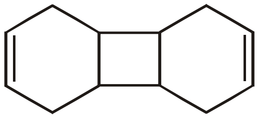
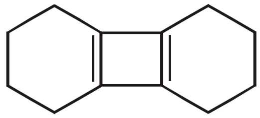
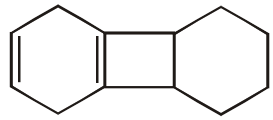
Q.19   

I II III

Which of the following orders is correct for heat of hydrogenation of these compounds?

(A) I > II > III (B) III > II > I (C) II > I > III (D) I > III > II

Q.20

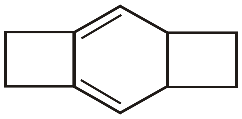
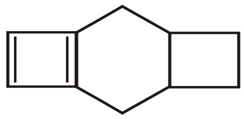
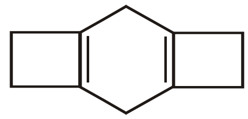
  

I II III

Which of the following orders is correct for heat of hydrogenation of these compounds?

(A) I > II > III (B) III > II > I (C) III > I > II (D) II > III > I

Q.21

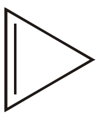
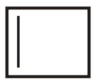
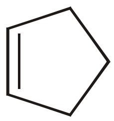
  

I II III

Which of the following orders is correct for heat of hydrogenation of these compounds?

(A) I > II > III (B) III > II > I (C) II > I > III (D) I > III > II

Q.22

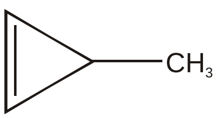
  

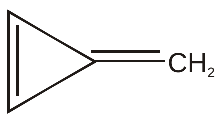
I II III

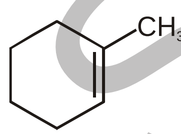
Which of the following orders is correct for heat of hydrogenation of these compounds?

(A) I > II > III (B) III > II > I (C) II > I > III (D) III > I > II

Q.23





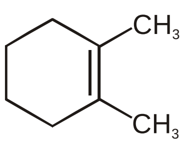


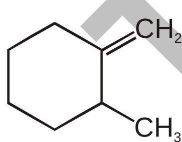
I II III

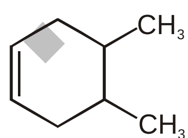
Which of the following orders is correct for heat of hydrogenation of these compounds?

(A) I > II > III (B) III > II > I (C) III > I > II (D) II > I > III

Q.24





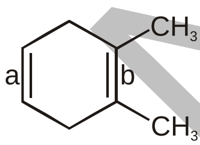


I II III

Which of the following order is correct for heat of hydrogenation of these compounds?

(A) I > II > III (B) III > II > I (C) II > III > I (D) III > I > II

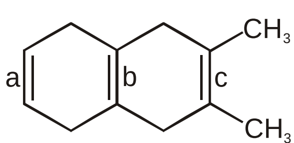
Q.25



a and b are the length of these two C = C bonds. Now, which of the following orders is correct?

(A) a = b (B) a < b (C) b > a (D) Not predictable

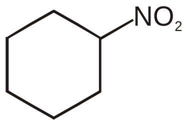
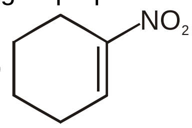
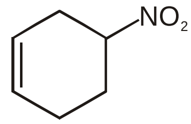
Q.26



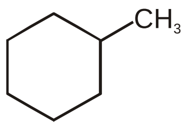
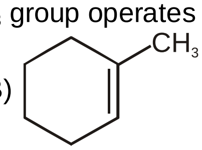
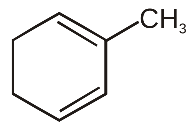
a, b and c are the length of these C = C bonds. Now, which of the following orders is correct?

(A) a = b = c (B) a > b > c (C) c > b > a (D) b > c > a

Q.27 Inductive effect of – NO_2 group operates in

(A)  (B)  (C)  (D) all of these

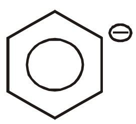
Q.28 Inductive effect of – CH_3 group operates in

(A)  (B)  (C)  (D) both (B) and (C)

Q.29 — CH_3 (I) $\quad -\overset{\overset{\displaystyle O}{\|}}{C}-O^{\ominus}$ (II) $\quad -O^{\ominus}$ (III)

Which of these groups has + I effect?

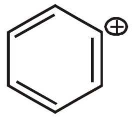
(A) I (B) II (C) III (D) all of these

Q.30 

Hybridization of the negatively charged C-atom of this anion is

(A) sp^3 (B) sp^2 (C) sp (D) unhybridized

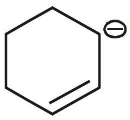
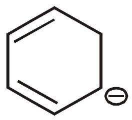
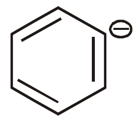
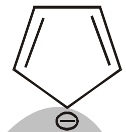
DPP NO- 12 Time: 15 minutes

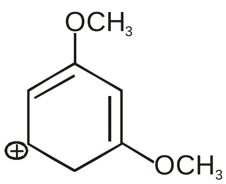
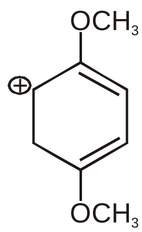
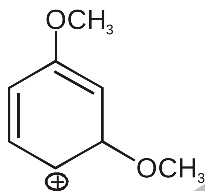
Q.1 

Empty orbital of this carbocation is

(A) 2p (B) sp^3 (C) sp^2 (D) sp

Q.2 Negative charge of which the following carbanions is not resonance – stabilized?

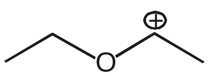
(A)  (B)  (C)  (D) 

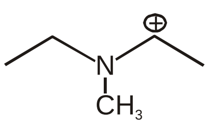
Q.3   

I II III

Which of the following orders is correct for the stability of these carbocations?

(A) I > II > III (B) III > II > I (C) I > III > II (D) II > III > I

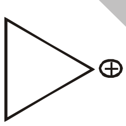
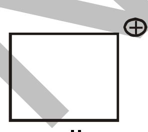
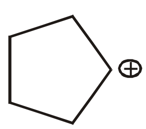
Q.4 I 

II 

II 

Which of the following orders is correct for the stability of these carbocations?

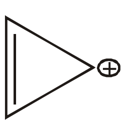
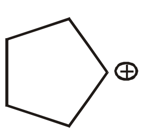
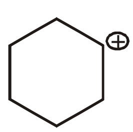
(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.5   

I II III

Which of the following orders is correct for the stability of these carbocations?

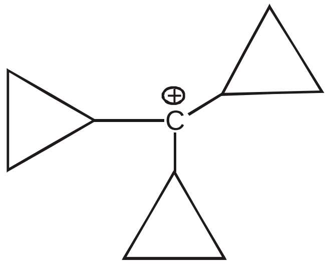
(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

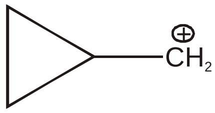
Q.6   

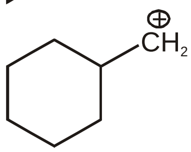
I II III

Which of the following orders is correct for the stability of these carbocations?

(A) I > II > III (B) III > II > I (C) I > III > II (D) II > I > III

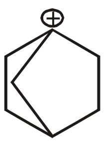
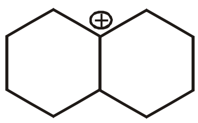
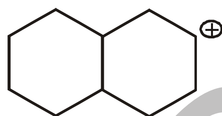
Q.7 I 

II 

III 

Which of the following orders is correct for the stability of these carbocations?

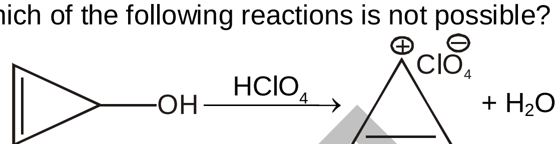
(A) I > II > III (B) III > II > I (C) II > I > III (D) III > I > II

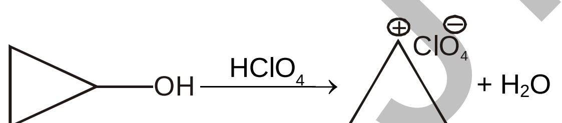
Q.8  I  II  III

Which of the following orders is correct for the stability of these carbocations?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.9 Which of the following reactions is not possible?

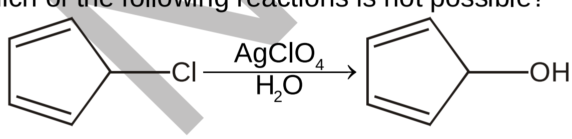
(A) 

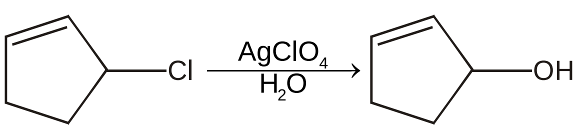
(B) 

(C) both (A) and (B)

(D) none of these

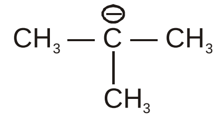
Q.10 Which of the following reactions is not possible?

(A) 

(B) 

(C) both (A) and (B)

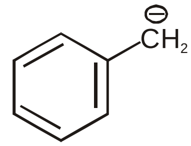
(D) none of these

Q.11 $CH_3 - \overset{\ominus}{C}H_2$ $\quad$ $CH_3 - \overset{\ominus}{C}H - CH_3$ $\quad$ 

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

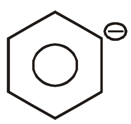
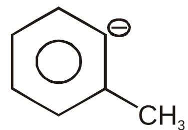
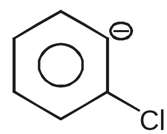
(A) I > II > III $\quad$ (B) III > II > I $\quad$ (C) II > I > III $\quad$ (D) I > II > III

Q.12 $CH_3 - \overset{\ominus}{C}H_2$ $\quad$ $CH_2 = CH - \overset{\ominus}{C}H_2$ $\quad$ 

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

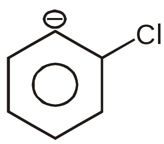
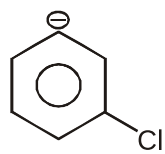
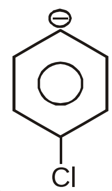
(A) I > II > III $\quad$ (B) III > II > I $\quad$ (C) II > III > I $\quad$ (D) II > I > III

Q.13   

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

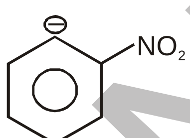
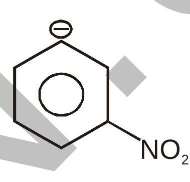
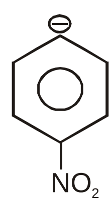
(A) I > II > III $\quad$ (B) III > II > I $\quad$ (C) III > I > II $\quad$ (D) II > III > II

Q.14   

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

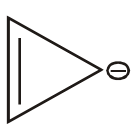
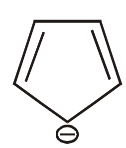
(A) I > II > III $\quad$ (B) III > II > I $\quad$ (C) II > I > III $\quad$ (D) II > I > III

Q.15   

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

(A) I > II > III $\quad$ (B) III > II > I $\quad$ (C) II > I > III $\quad$ (D) II > III > I

Q.16  $\quad$ $CH_2 = CH - \overset{\Theta}{C}H_2$ $\quad$ 

I $\quad$ II $\quad$ III

Which of the following orders is correct for the stability of these carbanions?

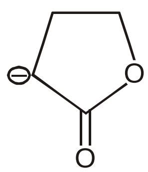
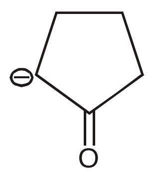
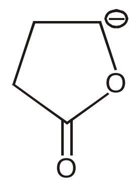
(A) I > II > III $\quad$ (B) III > II > I $\quad$ (C) I > III > II $\quad$ (D) II > III > I

Q.17 I $\overset{\ominus}{C}H_2 - CH = CH_2$

II $\overset{\ominus}{C}H_2 - CH = O$

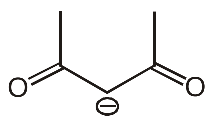
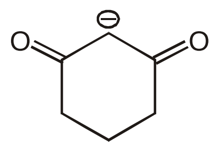
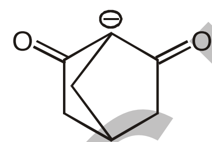
III $\overset{\ominus}{C}H_2 - CH_2 - CH_3$

Which of the following orders is correct for the stability of these carbanions?
(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.18   

I II III

Which of the following orders is correct for the stability of these carbanions?
(A) I > II > III (B) III > II > I (C) II > III > I (D) II > I > III

Q.19   

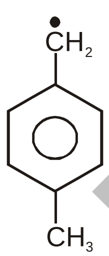
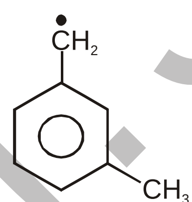
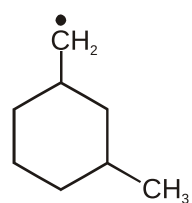
I II III

Which of these carbanions is sp^3 hybridized?
(A) I (B) II (C) III (D) nonw of these

Q.20 $CH_2 = CH - \dot{C}H_2$ $CH_3 - \dot{C}H_2$ $CH_3 - \dot{C}(CH_3)_2$

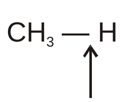
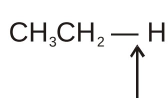
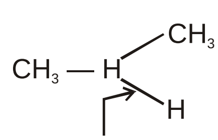
I II III

Which of the following orders is correct for the stability of these radicals?
(A) I > II > III (B) III > II > I (C) I > III > II (D) III > I > II

Q.21   

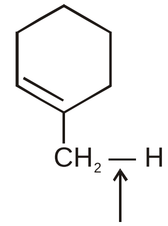
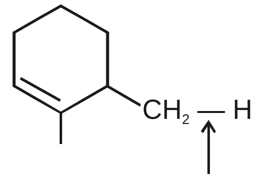
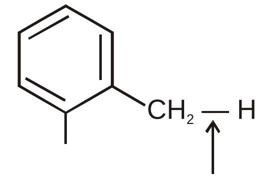
I II III

Which of the following orders is correct for the stability of these radicals?
(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.22   

I II III

Which of the following orders is correct for the energy required for homolytic cleavage of indicated C – H bonds?
(A) I > II > III (B) III > II > I (C) III > I > II (D) II > III > I

Q.23 I  II  III 

Which of the following orders is correct for energy required for homolytic cleavage of indicated C – H bonds?

(A) I > II > III (B) III > II > I (C) II > I > III (D) III > I > II

Q.24 I $Cl-CH_2-COOH$

II $Br-CH_2-COOH$

III $I-CH_2-COOH$

Which of the following order is correct for the acidic strength of these carboxylic acids?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.25 I $Cl-CH_2-COOH$

II O_2N-CH_2-COOH

III CH_3-COOH

Which of the following order is correct for the acidic strength of these carboxylic acids?

(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.26 $\underset{\text{COOH}}{\overset{\text{COOH}}{|}}$ $H_2C\begin{matrix} \nearrow COOH \\ \searrow COOH \end{matrix}$ HCOOH

I II III

Which of the following order is correct for the acidic strength of these carboxylic acids?

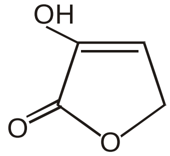
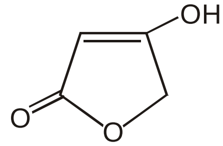
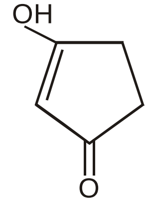
(A) I > II > III (B) III > II > I (C) II > I > III (D) II > III > I

Q.27 $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{Si}}-CH_2-COOH$

In this molecule, the effect of trimethylsilyl group (encircled) on the acidity of – COOH group is of

(A) strong electron donating nature (B) strong electron withdrawing nature

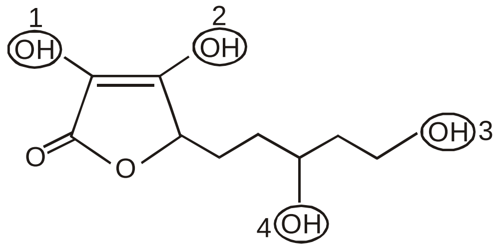
(C) weak electron withdrawing nature (D) both (A) and (C)

Q.28   

I II III

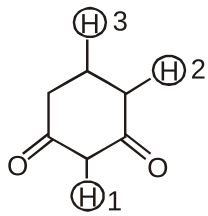
Which of the following order is correct for the acidic strength of these compounds?

(A) I > II > III (B) III > II > I (C) II > I > III (D) III > I > II

Q.29 

Which of these – OH groups is most acidic?

(A) 1 (B) 2 (C) 3 (D) 4

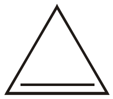
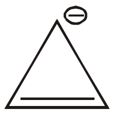
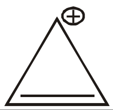
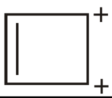
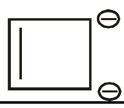
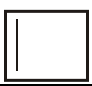
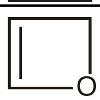
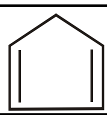
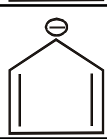
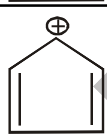
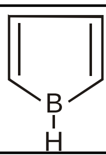
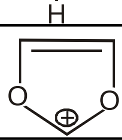
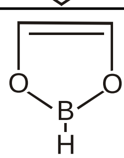
Q.30 

Which of the following orders is correct for the acidity of these indicated H-atoms?

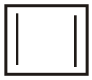
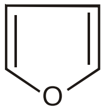
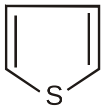
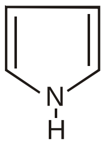
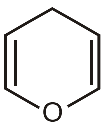
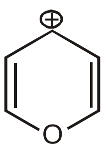
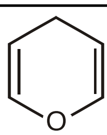
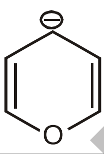
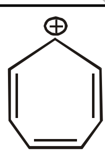
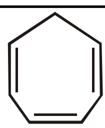
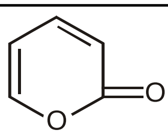
(A) 1 > 2 > 3 (B) 3 > 2 > 1 (C) 2 > 1 > 3 (D) 1 > 3 > 2

DPP NO- 13 Time: 15 minutes

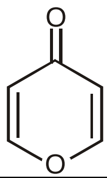
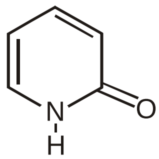
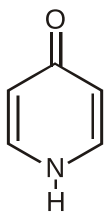
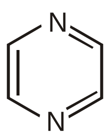
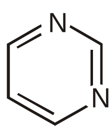
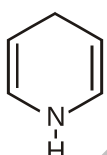
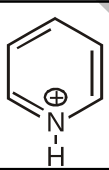
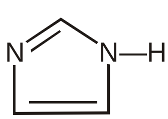
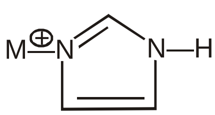
1. Identify the Nature of compound

S.No.	**Compound**	**Aromatic**	**Anti-aromatic**	**Non-aromatic**
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				
(10)				
(11)				
(12)				
(13)				

DPP NO- 14 Time: 15 minutes

S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				
(10)				
(11)				

DPP NO- 15 Time: 15 minutes

S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				

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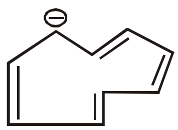
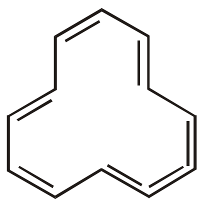
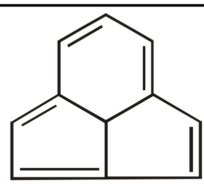
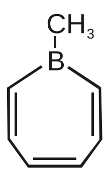
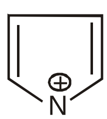
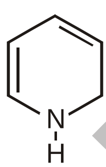
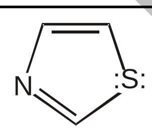
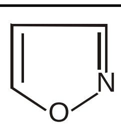
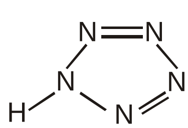
DPP NO- 16 Time: 15 minutes

1. Identify the Nature of compound

S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				

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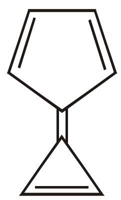
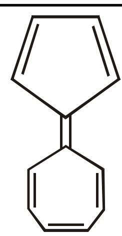
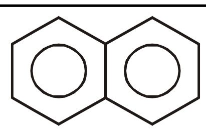
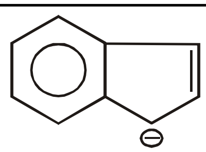
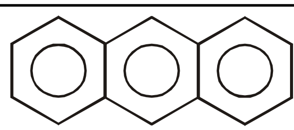
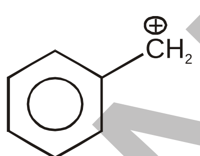
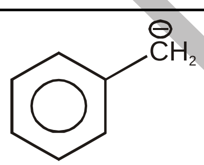
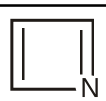
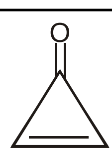
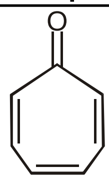
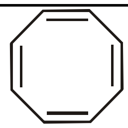
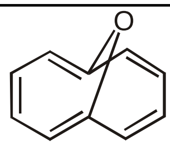
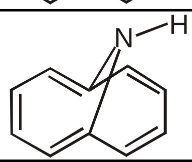
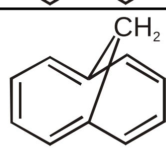
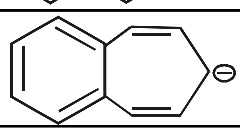
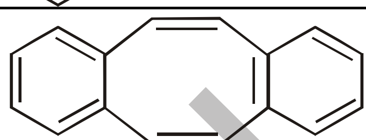
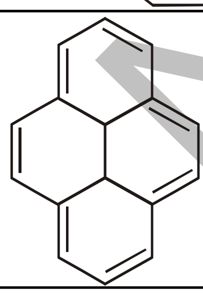
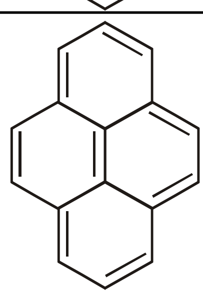
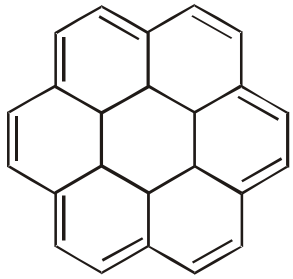
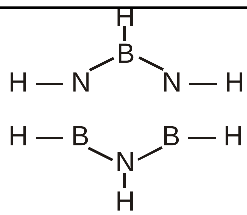
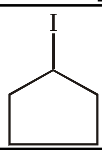
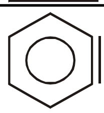
DPP NO- 17 Time: 15 minutes

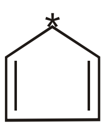
S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				

DPP NO- 18   Time: 15 minutes

S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)				
(3)				
(4)				
(5)				
(6)				
(7)				
(8)				
(9)				

DPP NO- 19 Time: 15 minutes

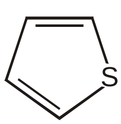
S.No.	Compound	Aromatic	Anti-aromatic	Non-aromatic
(1)				
(2)	 Borazole			
(3)				
(4)				

(2)  ($C^* = C^{14}$) $\xrightarrow{KH}$ (A) + gas (Identify A, B, C, D)

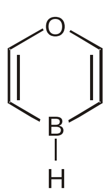
$\downarrow H^+$

B + C + D

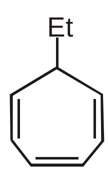
(3) Determine the number of π electrons for each compound below, then indicate whether they are aromatic, antiaromatic, or neither. Assume the molecules are neutral and planar unless otherwise indicated.



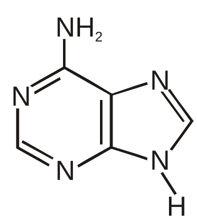
Number of π electrons:_____ Aromatic, Antiaromatic, or Neither ?



Number of π electrons:_____ Aromatic, Antiaromatic, or Neither ?



Number of π electrons:_____ Aromatic, Antiaromatic, or Neither ?

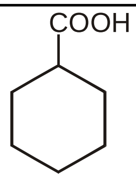
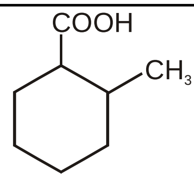
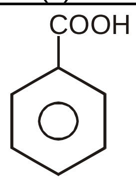
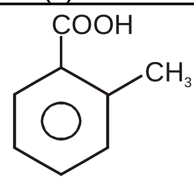
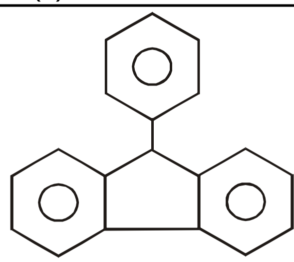
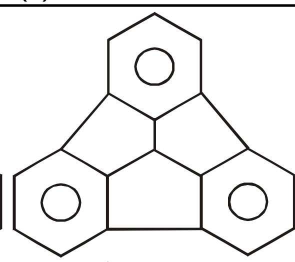
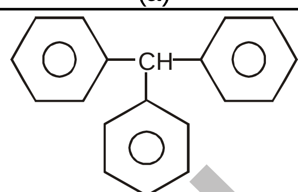
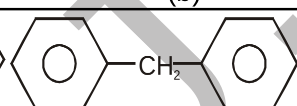
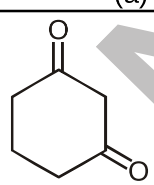
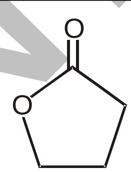
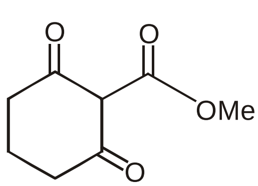
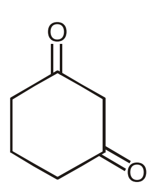


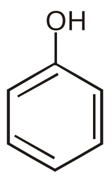
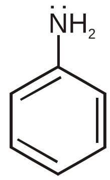
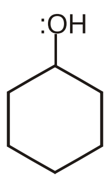
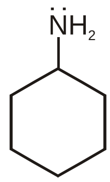
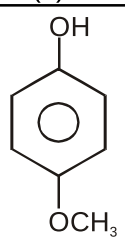
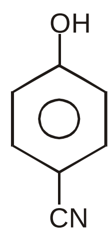
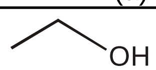
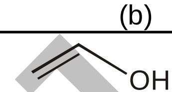
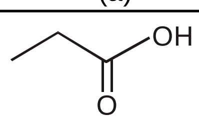
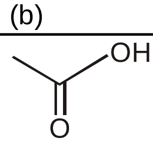
Number of π electrons:_____ Aromatic, Antiaromatic, or Neither ?

ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

DPP NO- 20 Time: 15 minutes

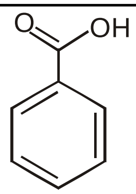
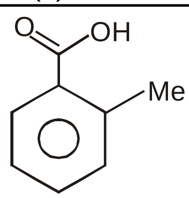
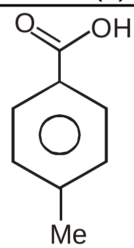
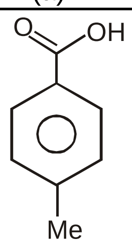
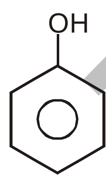
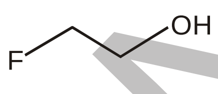
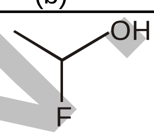
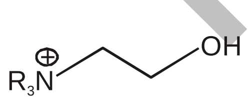
1. Compare Acidic Strength

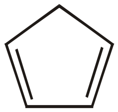
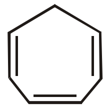
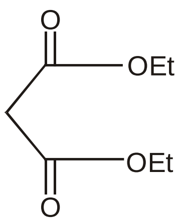
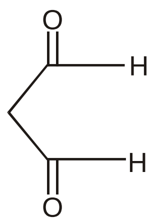
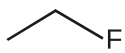
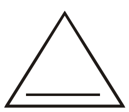
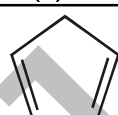
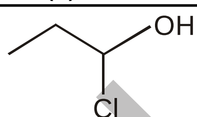
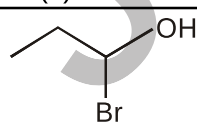
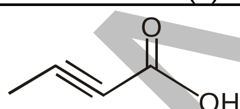
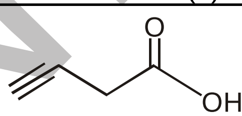
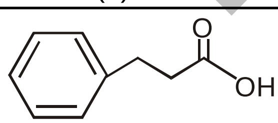
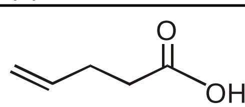
S.No.	**Compound**	**Compare Ka value**		**Compare pKa value**	
		a	**b**	**a**	**b**
(1)	 (a)  (b)				
(2)	 (a)  (b)				
(3)	 (a)  (b)				
(4)	 (a)  (b)				
(5)	 (a)  (b)				
(6)	 (a)  (b)				

S.No.	Compound		Compare Ka value		Compare pKa value	
			a	b	a	b
(7)	 (a)	 (b)				
(8)	 (a)	 (b)				
(9)	 (a)	 (b)				
(10)	$Cl—CH_2—CH_2—COOH$ (a)	$CH_3—CH(Cl)—COOH$ (b)				
(11)	 (a)	 (b)				
(12)	HF (a)	NH_3 (b)				
(13)	$HC \equiv CH$ (a)	$\ddot{N}H_3$ (b)				
(14)	CH_4 (a)	NH_3 (b)				
(15)	$HC \equiv N$ (a)	$\ddot{N}H_3$ (b)				
(16)	 (a)	 (b)				

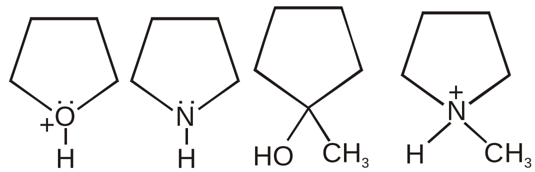
DPP NO-21 Time: 15 minutes

1. Compare Acidic Strength

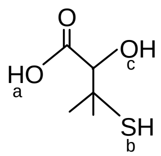
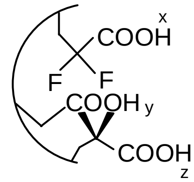
S.No.	Compound		Compare Ka value		Compare pKa value	
			a	b	a	b
(1)	 (a)	$Ph-S(=O)_2-OH$ (b)				
(2)	R — OH (a)	$R-C(=O)-OH$ (b)				
(3)	 (a)	 (b)				
(4)	 (a)	 (b)				
(5)	 (a)	 (b)				
(6)	 (a)	 (b)				
(7)	CH_4 (a)	HF (b)				
(8)	HF (a)	HI (b)				
(9)	H_2S (a)	H_2O (b)				

S.No.	Compound	Compare Ka value		Compare pKa value	
		a	b	a	b
(10)	 (a)  (b)				
(11)	 (a)  (b)				
(12)	 (a)  (b)				
(13)	 (a)  (b)				
(14)	 (a)  (b)				
(15)	CCl_3OH (a) CF_3OH (b)				
(16)	 (a)  (b)				
(17)	 (a)  (b)				
(18)	 (a)  (b)				
(19)	 (a)  (b)				
(20)	$CHCl_3$ (a) HCF_3 (b)				

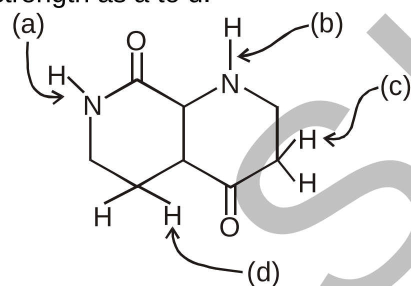
DPP NO- 22 Time: 15 minutes

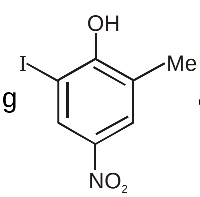
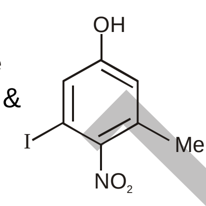
Q.1 Rank the following in order of decreasing acidity. 

Q.2 Consider the following compound. Rank the labeled proton in increasing order of acidity

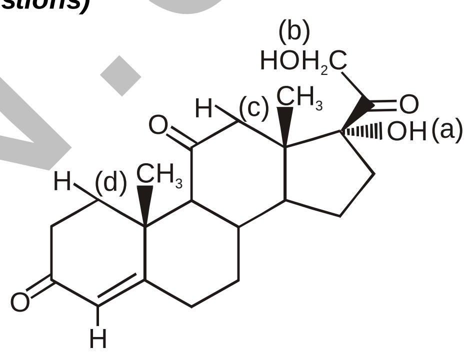
(a)  (b)  Write the stepwise ionization of acid

Q.3 Write correct order of acidic strength as a to d.



Q.4 Among  &  which is more acidic & why? Explain through canonical forms.

Questions No. 5 to 7 (3 questions)



Cortisone

Q.5 Cortisone contains which functional groups?

(A) Ether, alkene, alcohol
(B) Alcohol, ketone, amine
(C) Alcohol, ketone, alkene
(D) Ether, amine, ketone

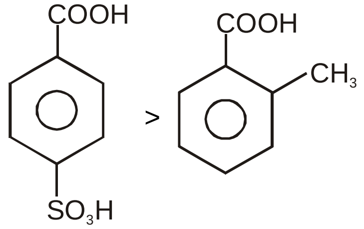
Q.6 Total stereoisomer of the compound Cortisone is

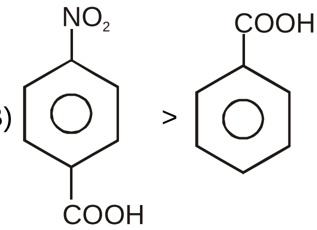
(A) 32 (B) 64 (C) 66 (D) 128

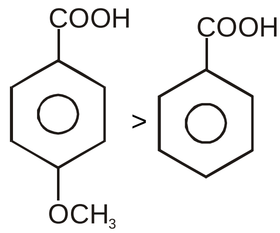
Q.7 Total number of chiral center in Cortisone:

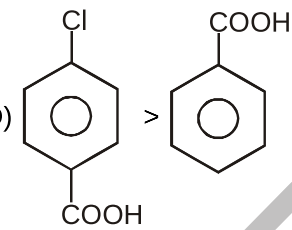
(A) 4 (B) 5 (C) 6 (D) 7

Q.8 Which order of acid strength is wrong

(A) 

(B) 

(C) 

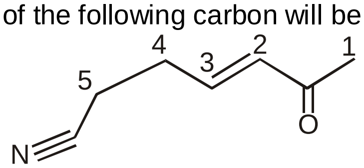
(D) 

Q.9 Which is the order of acidity of the following compounds?

$EtCO_2H$	CH_3CO_2H	CH_3SO_3H	CF_3SO_3H
a	b	c	d

(A) b > a > d > c (B) d > c > a > b (C) d > c > b > a (D) d > a > b > c

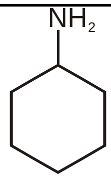
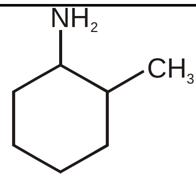
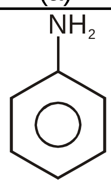
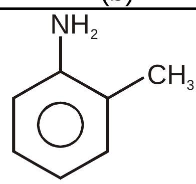
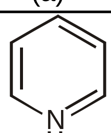
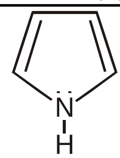
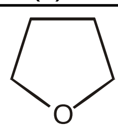
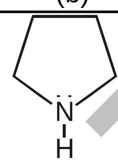
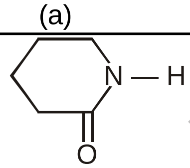
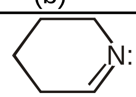
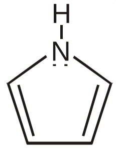
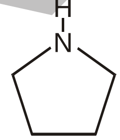
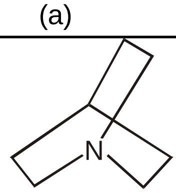
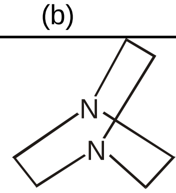
Q.10 Which of the following carbon will be deprotonatated first on treatment with base.



(A) 4 (B) 5 (C) 2 (D) 3

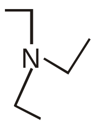
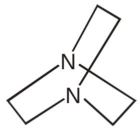
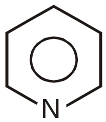
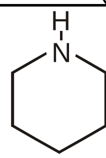
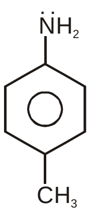
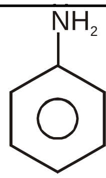
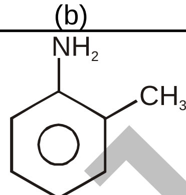
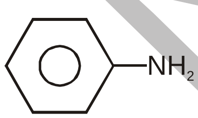
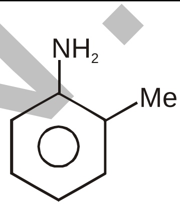
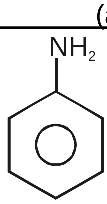
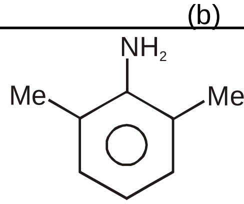
DPP NO-23 Time: 15 minutes

1. Compare which is more basic in nature

S.No.	Compounds	Compare Kb value		Compare pKb value	
		a	b	a	b
(1)	 (a)  (b)				
(2)	 (a)  (b)				
(3)	 (a)  (b)				
(4)	 (a)  (b)				
(5)	 (a)  (b)				
(6)	 (a)  (b)				
(7)	 (a)  (b)				

DPP NO- 24 Time: 15 minutes

1. Compare which is more basic in nature

S.No.	**Compounds**		**Compare Kb value**		**Compare pKb value**	
			a	**b**	**a**	**b**
(1)	 (a)	 (b)				
(2)	 (a)	 (b)				
(3)	 (a)	 (b)				
(4)	Ph — NH — Me (a)	 (b)				
(5)	Ph — NH — Me (a)	Ph — N(Me) — Me (b)				
(6)	 (a)	 (b)				
(7)	$H_2N-C(NH_2)=NH$ (a)	$H_2N-C(CH_3)=NH$ (b)				
(8)	 (a)	 (b)				

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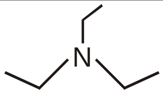
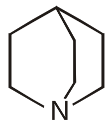
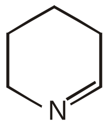
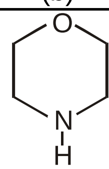
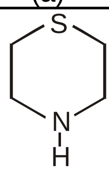
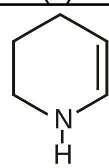
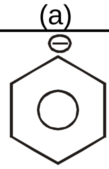
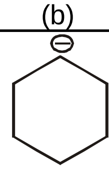
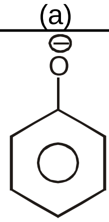
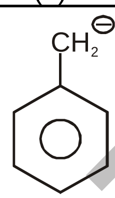
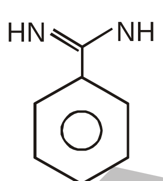
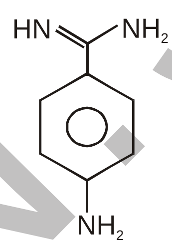
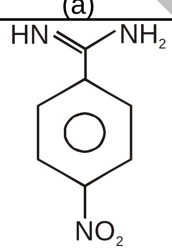
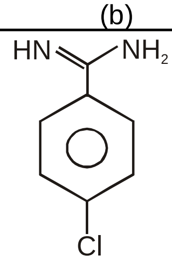
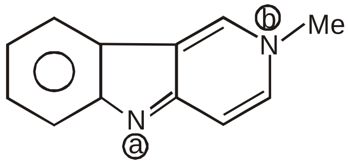
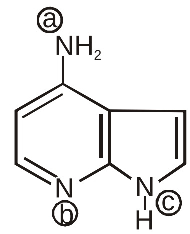
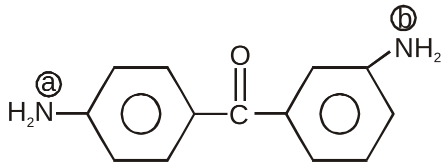
S.No.	Compounds	Compare Kb value		Compare pKb value	
		a	b	a	b
(9)	 (a)  (b)				
(10)	 (a)  (b)				
(11)	 (a)  (b)				
(12)	 (a)  (b)				
(13)	 (a)  (b)				
(14)	 (a)  (b)				
(15)	 (a)  (b)				

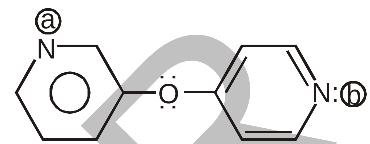
DPP NO- 25 Time: 15 minutes

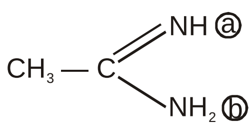
Q.1 Which Nitrogen is most basic

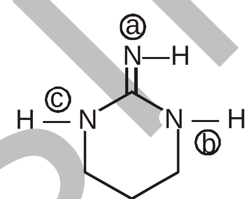
(i)


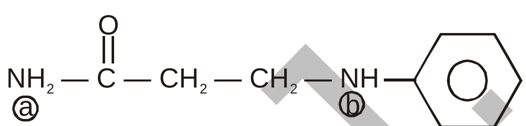
(ii)


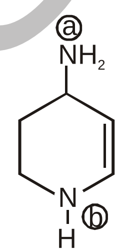
(iii)


(iv)


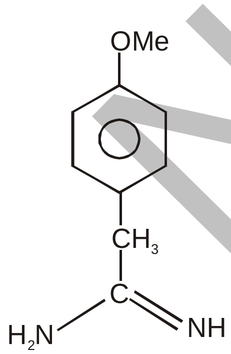
(v)


(vi)


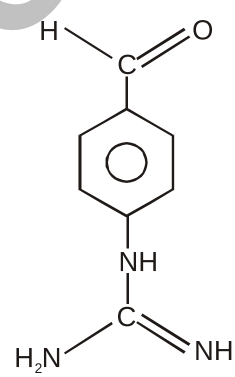
(vii)


(viii)


2. Which is more basic & why?



(i)

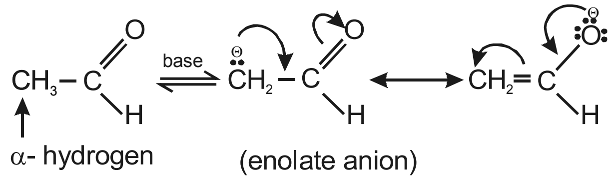


(ii)

Date: DPP NO- 01 Time: 15 minutes

ALDOL CONDENSATION:

The α-hydrogen a carbonyl compound is acidic due to the fact that the anion (also known as the enolate anion) is stabilized by resonance.

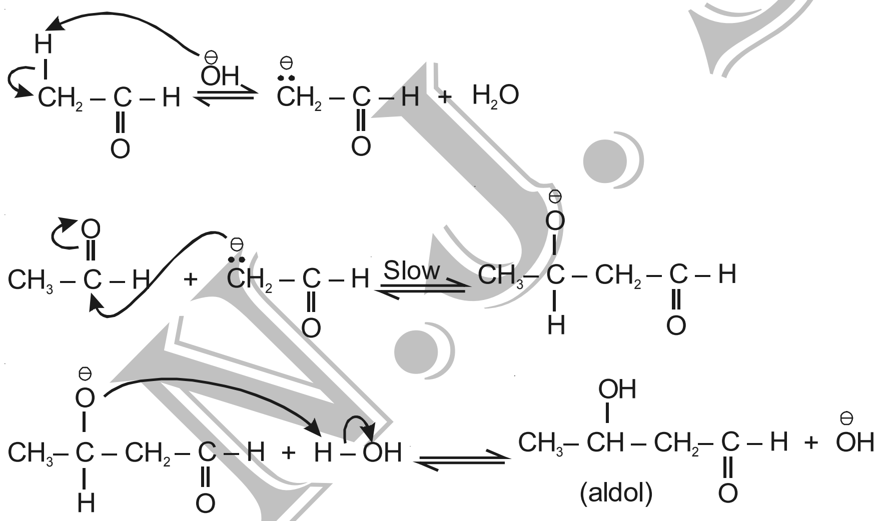


In aqueous base, two acetaldehyde molecules react to form a β-hydroxy aldehyde called aldol. The reaction is called Aldol condensation. The enolate ion is the intermediate in the aldol condensation of aldehyde and ketone. Acetaldehyde for instance, forms a dimeric product aldol in presence of a dilute base ($\approx$ 10% NaOH)

$$2CH_3CHO \xrightarrow[5^\circ C]{\overset{\ominus}{O}H/HOH} CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-CHO \xrightarrow{\Delta} CH_3-CH=CH-CHO$$

β-hydroxy butyraldehyde (Aldol)

Mechanism :



Aldols are stable and may be isolated. They, however can be dehydrated easily by heating the basic reaction mixture or by a separate acid catalyzed reaction. Thus if the above reaction is heated the product is dehydrated to crotonaldehyde (2-butenal). In acid catalysed aldol condensation enol form of carbonyl is the nucleophile in place of enolate.

Q.1 Write the product and mechanism for given reactions. **[8]**

(I) $CH_3-CH_2-\underset{\displaystyle O}{\underset{\|}{C}}-H \xrightarrow{\text{Dil.NaOH}} (A) \xrightarrow{\Delta} (B)$

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Contact: 9414969800, 9549908816
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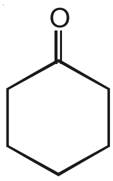
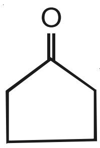
(II)  $\xrightarrow{\text{Dil.NaOH}}$ (C)

(III) $C_6H_5 - CH_2 - CHO \xrightarrow{\text{Dil.NaOH}} (D)$

(IV)  $\xrightarrow{\text{Dil.NaOH}} (E) \xrightarrow{\Delta} (F)$

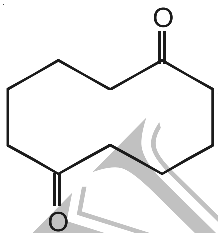
(V) $C_6H_5 - \underset{\underset{O}{\|}}{C} - CH_3 \xrightarrow{\text{Dil.NaOH}} (G) \xrightarrow{\Delta} (H)$

Q.2 Identify the intramolecular aldol product? **[7]**

(I) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - CH_3 \xrightarrow{\text{Dil.NaOH}} (A) \xrightarrow{\Delta} (B)$

(II) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_2 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - CH_3 \xrightarrow{\text{Dil.NaOH}} (C)$

(III) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - CH_3 \xrightarrow{\text{Dil.NaOH}} (D)$

(IV)  $\xrightarrow{\text{Dil.NaOH}} (E) \xrightarrow[\Delta]{} (F)$

(V) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - CH_3 \xrightarrow[\Delta]{\text{Dil.NaOH}} (G)$

Q.3 Find out the total number of aldol products (including and excluding stereo products) and write the IUPAC name of products. **[10]**

(I) $CH_3 - CHO + CH_3 - CH_2 - CHO \xrightarrow[5^\circ C]{NaOH/HOH}$

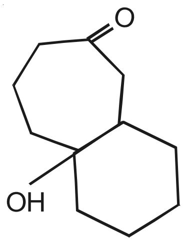
(II) $C_6H_5 - CHO + CH_3 - CHO \xrightarrow[5^\circ C]{NaOH/HOH}$

(III) $CH_3 - CHO + CH_3 - \underset{\underset{O}{\|}}{C} - CH_3 \xrightarrow[5^\circ C]{NaOH/HOH}$

(IV) $CH_3-CH=O + CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[5^\circ C]{NaOH/HOH}$

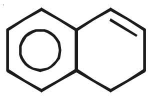
(V) $C_6H_5-CHO + CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[5^\circ C]{NaOH/HOH}$

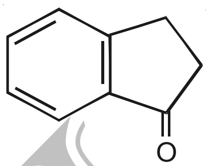
Q.4 Identify the structure of substrate? **[4]**

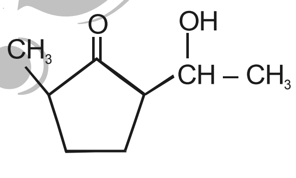
(I) A $\xrightarrow[5^\circ C]{Dil.NaOH}$  A = ?

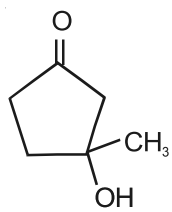
(II) $\underset{(2\ mole)}{A} \xrightarrow[5^\circ C]{Dil.NaOH} CH_3-\underset{\underset{O}{\|}}{C}-CH_2-\underset{\underset{CH_3}{|}}{\overset{\overset{OH}{|}}{C}}-CH_3$ A = ?

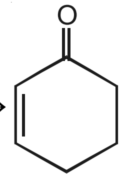
Q.5 Complete reaction sequence : **[7]**

(a)  $\xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3}$ (a) $\xrightarrow[(ii)\ \Delta]{(i)\ \overset{\ominus}{O}H}$ (B)

(b)  $\xrightarrow[(i)\ C_6H_5CHO,\ (iii)\ \Delta]{(i)\ \overset{\ominus}{O}H}$ (A)

(c) (A) + (B) $\xrightarrow[(ii)\ \Delta]{(i)\ \overset{\ominus}{O}H}$ 

(d) (A) $\xrightarrow{OH^{\ominus}}$ 

(e) [X] $\xrightarrow[(ii)\ \Delta]{(i)\overset{\ominus}{O}H}$ 

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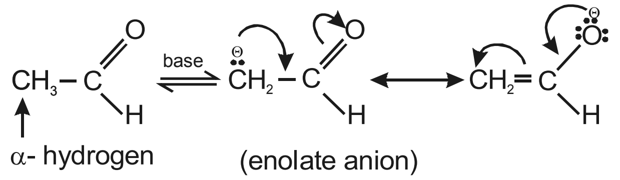
Date: DPP NO- 01 Time: 15 minutes

ALDOL CONDENSATION:

The α-hydrogen a carbonyl compound is acidic due to the fact that the anion (also known as the enolate anion) is stabilized by resonance.

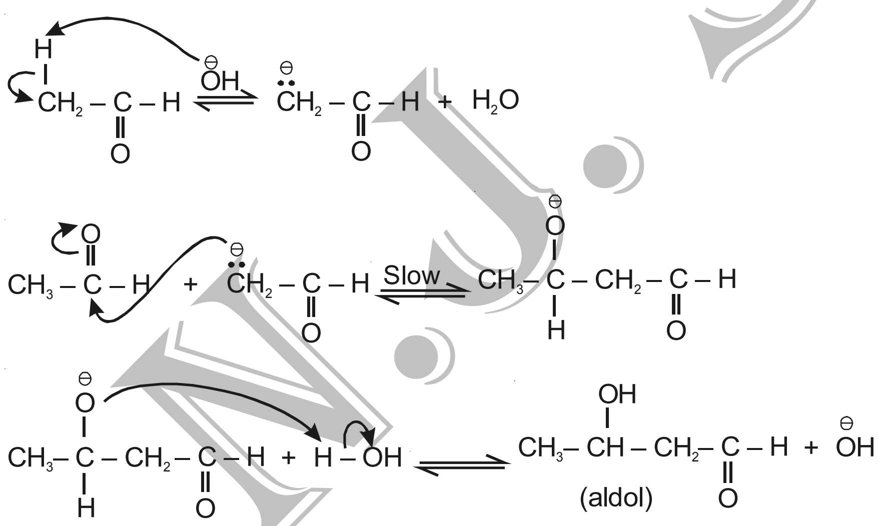


In aqueous base, two acetaldehyde molecules react to form a β-hydroxy aldehyde called aldol. The reaction is called Aldol condensation. The enolate ion is the intermediate in the aldol condensation of aldehyde and ketone. Acetaldehyde for instance, forms a dimeric product aldol in presence of a dilute base ($\approx$ 10% NaOH)

$$2CH_3CHO \xrightarrow[5^\circ C]{\overset{\ominus}{O}H/HOH} \underset{\substack{|\\ OH}}{CH_3-CH}-CH_2-CHO \xrightarrow{\Delta} CH_3-CH=CH-CHO$$

β-hydroxy butyraldehyde (Aldol)

Mechanism :



Aldols are stable and may be isolated. They, however can be dehydrated easily by heating the basic reaction mixture or by a separate acid catalyzed reaction. Thus if the above reaction is heated the product is dehydrated to crotonaldehyde (2-butenal). In acid catalysed aldol condensation enol form of carbonyl is the nucleophile in place of enolate.

Q.1 Write the product and mechanism for given reactions. **[8]**

(I) $CH_3-CH_2-\underset{\substack{\|\\ O}}{C}-H \xrightarrow{\text{Dil.NaOH}} (A) \xrightarrow{\Delta} (B)$

IIT-JEE Chemistry by N.J. Sir
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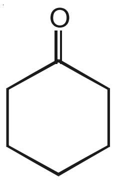
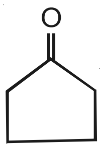
(II)  $\xrightarrow{\text{Dil.NaOH}}$ (C)

(III) $C_6H_5 - CH_2 - CHO \xrightarrow{\text{Dil.NaOH}} (D)$

(IV)  $\xrightarrow{\text{Dil.NaOH}} (E) \xrightarrow{\Delta} (F)$

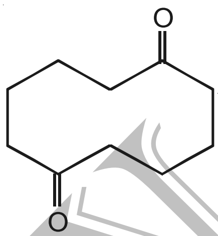
(V) $C_6H_5 - \underset{\underset{O}{\|}}{C} - CH_3 \xrightarrow{\text{Dil.NaOH}} (G) \xrightarrow{\Delta} (H)$

Q.2 Identify the intramolecular aldol product? **[7]**

(I) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - CH_3 \xrightarrow{\text{Dil.NaOH}} (A) \xrightarrow{\Delta} (B)$

(II) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_2 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - CH_3 \xrightarrow{\text{Dil.NaOH}} (C)$

(III) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - CH_3 \xrightarrow{\text{Dil.NaOH}} (D)$

(IV)  $\xrightarrow{\text{Dil.NaOH}} (E) \xrightarrow[\Delta]{} (F)$

(V) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - CH_3 \xrightarrow[\Delta]{\text{Dil.NaOH}} (G)$

Q.3 Find out the total number of aldol products (including and excluding stereo products) and write the IUPAC name of products. **[10]**

(I) $CH_3 - CHO + CH_3 - CH_2 - CHO \xrightarrow[5°C]{NaOH/HOH}$

(II) $C_6H_5 - CHO + CH_3 - CHO \xrightarrow[5°C]{NaOH/HOH}$

(III) $CH_3 - CHO + CH_3 - \underset{\underset{O}{\|}}{C} - CH_3 \xrightarrow[5°C]{NaOH/HOH}$

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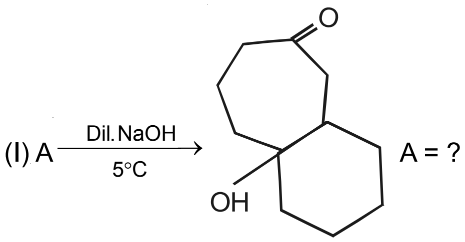
(IV) $CH_3-CH=O + CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[5^\circ C]{NaOH/HOH}$

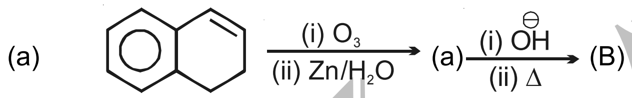
(V) $C_6H_5-CHO + CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[5^\circ C]{NaOH/HOH}$

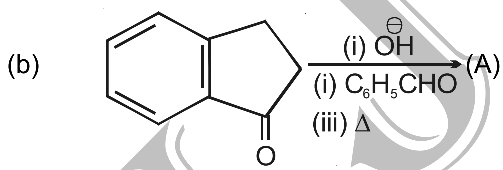
Q.4 Identify the structure of substrate? **[4]**

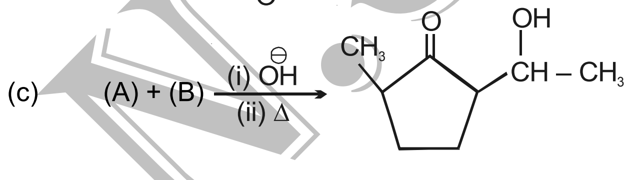


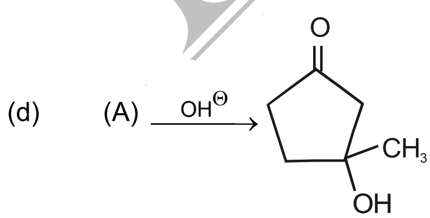
(II) $\underset{(2\ \text{mole})}{A} \xrightarrow[5^\circ C]{Dil.\,NaOH} CH_3-\underset{\underset{O}{\|}}{C}-CH_2-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$ A = ?

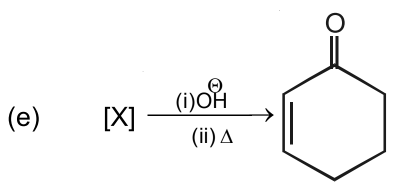
Q.5 Complete reaction sequence : **[7]**











Date: DPP NO- 02 Time: 15 minutes

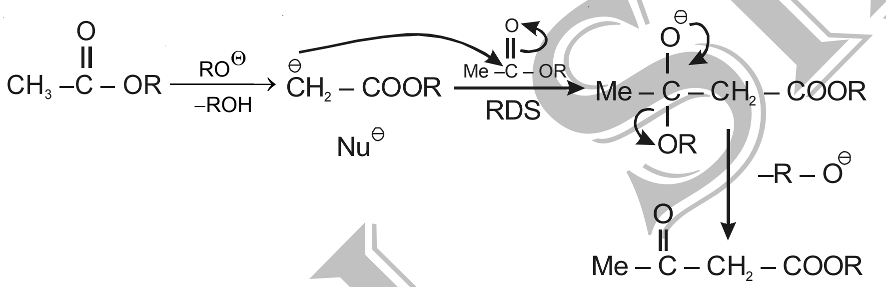
PASSAGE- I:

Claisen Condensation :

Esters undergo SN^{AE} Reaction, when attacked by a Nu^{Θ} generated by the interaction of a base (usually base related to the Alkoxy anion of ester) with one of the molecule of ester and this Nu^{Θ} attacks on another molecule. The reaction over all is considered as condensation of esters known as claisen ester condensation.

$$2\,Me-\overset{\overset{\displaystyle O}{||}}{C}-OR \xrightarrow{RONa} Me-\overset{\overset{\displaystyle O}{||}}{C}-CH_2-\overset{\overset{\displaystyle O}{||}}{C}-OR$$

A β- keto ester



Some times, when two ester groups are present within the molecule then the condensation occurs intramolecule then cyclization caused thus is known as Dieckmann cyclization or Dieckmann's condensation.

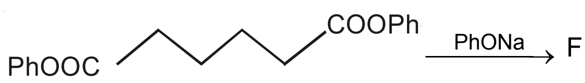
Q.1 $MeCOOEt \xrightarrow{EtOK} A$

Q.2 $EtCOOMe \xrightarrow{MeOK} B$

Q.3 $MeCOOEt + EtCOOMe \xrightarrow{MeOK} C$

Q.4 $C_6H_5COOC_2H_5 + CH_3COOC_2H_5 \xrightarrow{C_2H_5ONa} D + D'$
Ethyl benzoate

Q.5 $\begin{array}{l} COOC_2H_5 \\ | \\ COOC_2H_5 \end{array} + C_6H_5CH_2COOC_2H_5 \xrightarrow{C_2H_5ONa} E$

Q.6 

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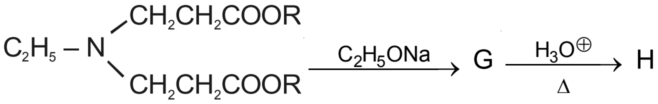
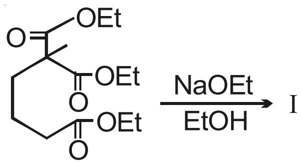
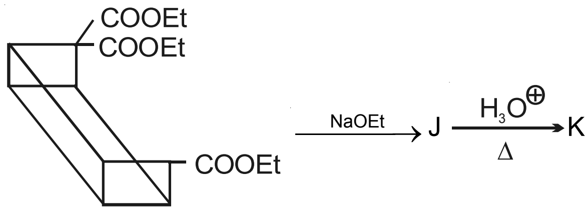
Q.7 Piperidone derivative



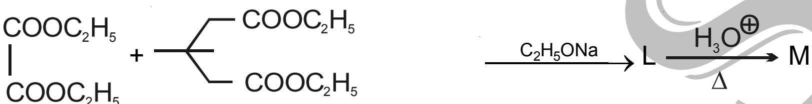
Q.8



Q.9



Q.10



Diethyl-β, β-dimethyl glutrate

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Contact: 9414969800, 9549908816
web : symmetryiitjee.com

Date: DPP NO- 02 Time: 15 minutes

PASSAGE- I:

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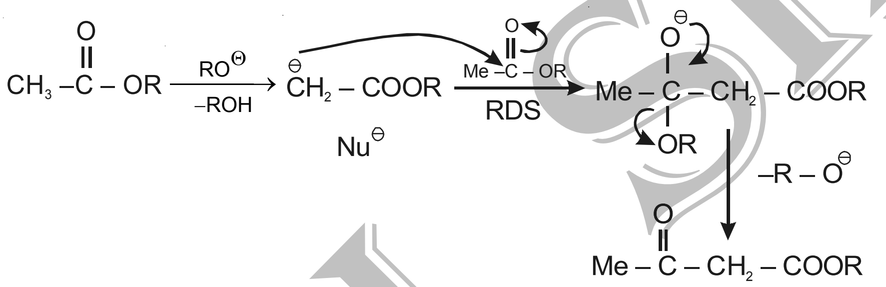
Esters undergo SN^{AE} Reaction, when attacked by a Nu^{Θ} generated by the interaction of a base (usually base related to the Alkoxy anion of ester) with one of the molecule of ester and this Nu^{Θ} attacks on another molecule. The reaction over all is considered as condensation of esters known as claisen ester condensation.

$$2\ Me-\overset{\displaystyle O}{\overset{\|}{C}}-OR \xrightarrow{RONa} Me-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-OR$$

A β- keto ester



Some times, when two ester groups are present within the molecule then the condensation occurs intramolecule then cyclization caused thus is known as Dieckmann cyclization or Dieckmann's condensation.

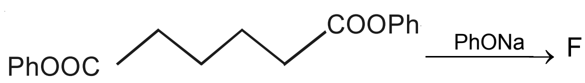
Q.1 $MeCOOEt \xrightarrow{EtOK} A$

Q.2 $EtCOOMe \xrightarrow{MeOK} B$

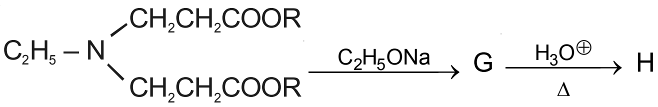
Q.3 $MeCOOEt + EtCOOMe \xrightarrow{MeOK} C$

Q.4 $C_6H_5COOC_2H_5 + CH_3COOC_2H_5 \xrightarrow{C_2H_5ONa} D + D'$
Ethyl benzoate

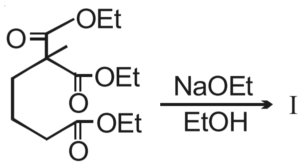
Q.5 $\begin{matrix} COOC_2H_5 \\ | \\ COOC_2H_5 \end{matrix} + C_6H_5CH_2COOC_2H_5 \xrightarrow{C_2H_5ONa} E$

Q.6 

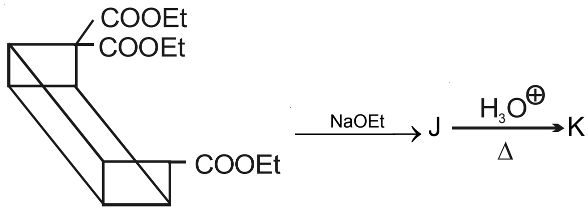
Q.7 Piperidone derivative



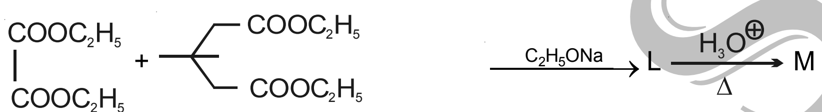
Q.8



Q.9



Q.10



Diethyl-β, β-dimethyl glutrate

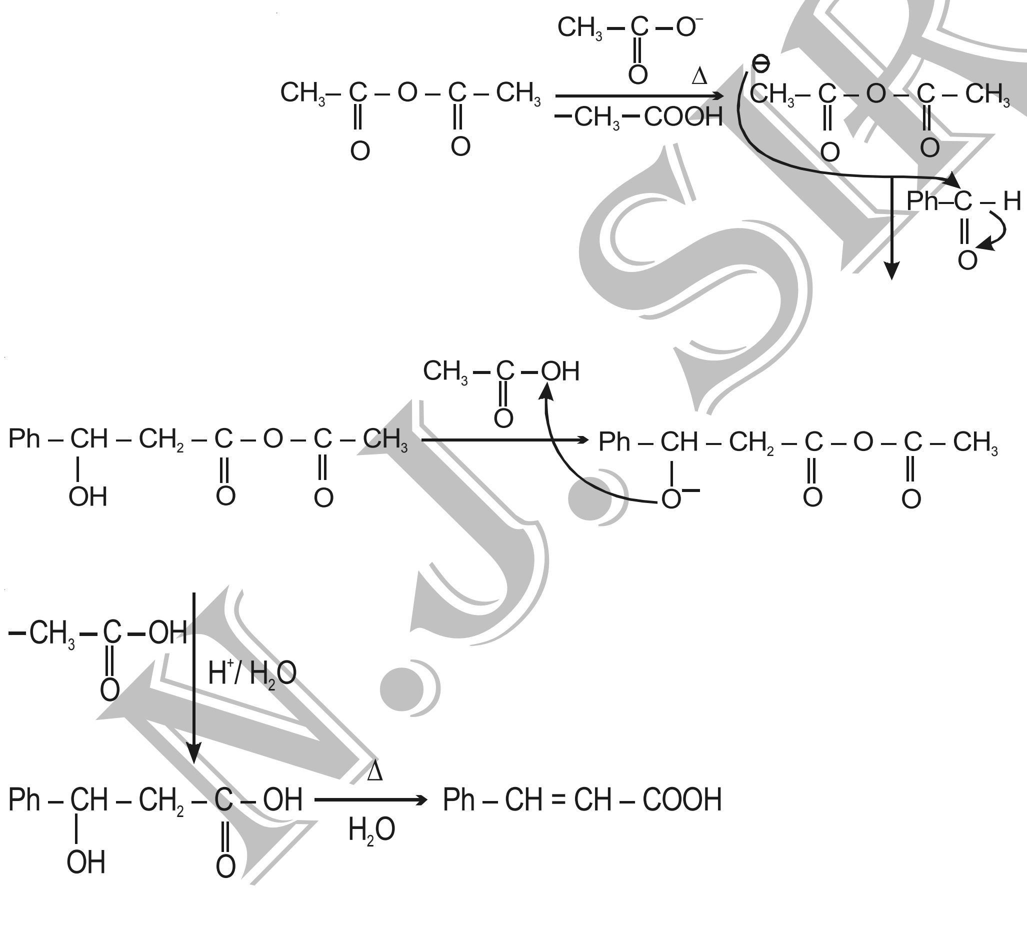
Date: DPP NO-03 Time: 15 minutes

PERKIN CONDENSATION:

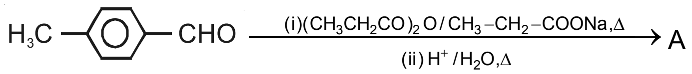
In Perkin reaction, condensation has been effected between aromatic aldehydes and aliphatic acid anhydrides in the presence of sodium or potassium salt of the acid corresponding to the anhydride, to yields α, β- unsaturated aromatic acids.

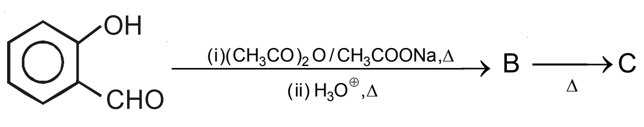
$$C_6H_5-CHO + CH_3-\underset{\underset{O}{\|}}{C}-O-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[\text{(ii) } H^+/H_2O,\Delta]{\text{(i) } CH_3COONa,\Delta} C_6H_5-CH=CH-COOH + CH_3COOH$$

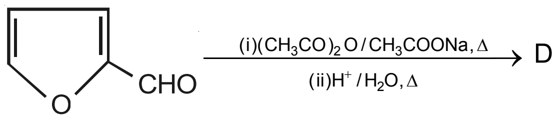
Mechanism

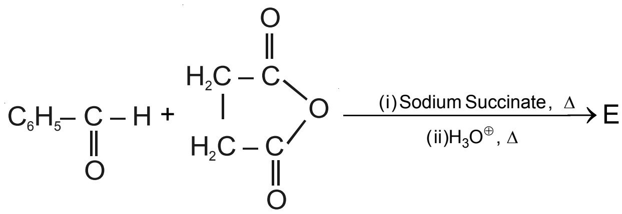


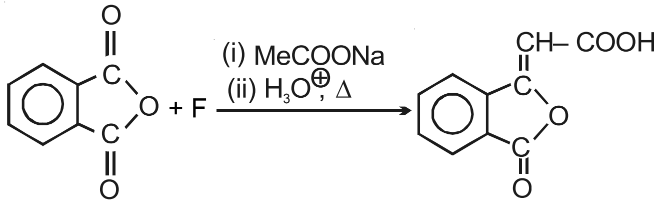
β- Hydroxy acid

Q.1 

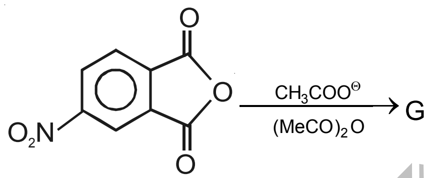
Q.2 

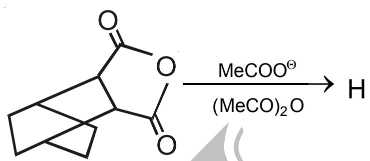
Q.3 

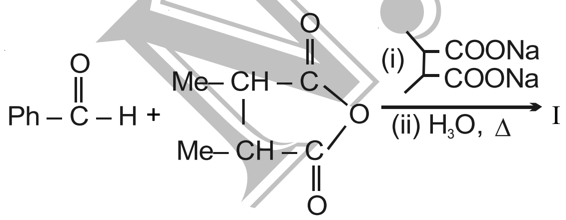
Q.4 

Q.5 

Phthalylacetic acid

Q.6 

Q.7 

Q.8 

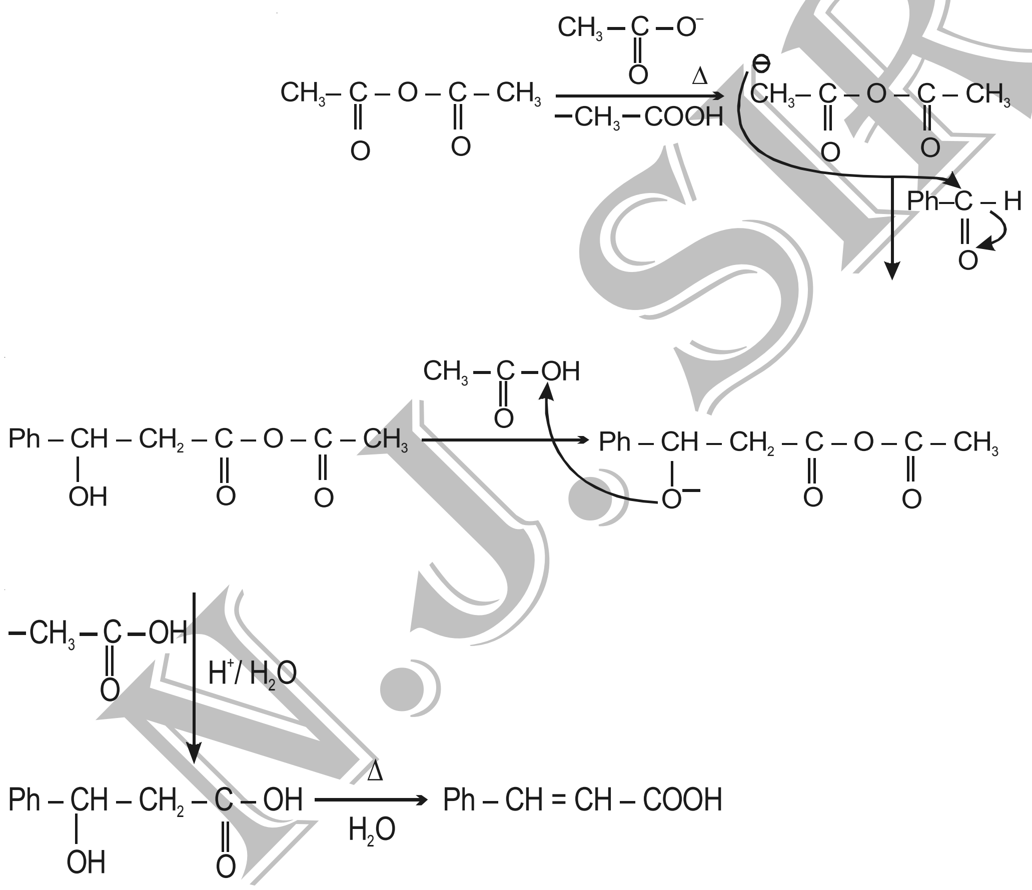
Date: DPP NO-03 Time: 15 minutes

PERKIN CONDENSATION:

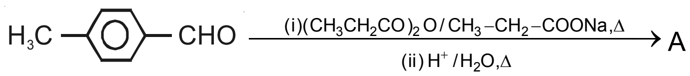
In Perkin reaction, condensation has been effected between aromatic aldehydes and aliphatic acid anhydrides in the presence of sodium or potassium salt of the acid corresponding to the anhydride, to yields α, β- unsaturated aromatic acids.

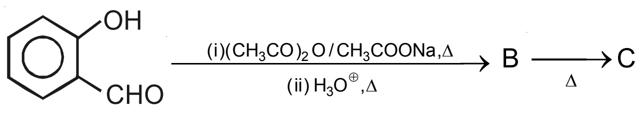
$$C_6H_5-CHO + CH_3-\underset{\underset{O}{\|}}{C}-O-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[\text{(ii) } H^+/H_2O,\Delta]{\text{(i) } CH_3COONa,\Delta} C_6H_5-CH=CH-COOH + CH_3COOH$$

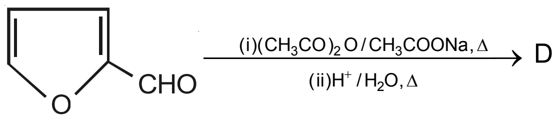
Mechanism

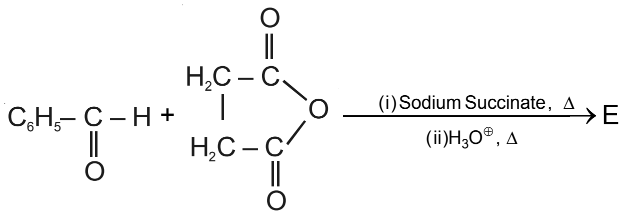


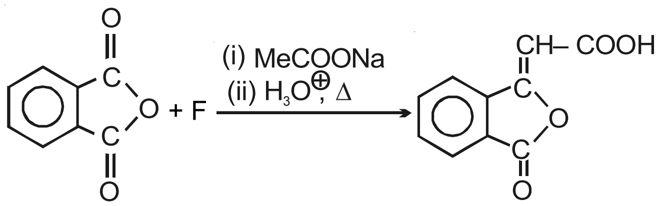
β- Hydroxy acid

Q.1 

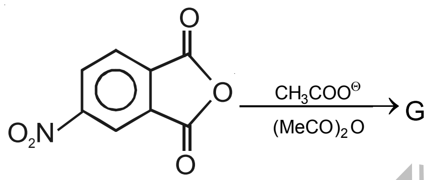
Q.2 

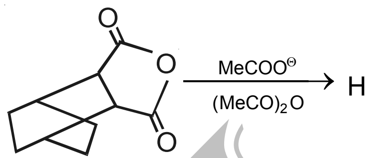
Q.3 

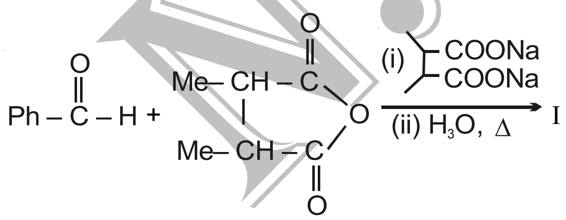
Q.4 

Q.5 

Phthalylacetic acid

Q.6 

Q.7 

Q.8 

Date: DPP NO- 04 Time: 15 minutes

KNOEVENAGEL REACTION :

Reaction of active methylene group with aldehyde and ketones is known as Knoevenagel reaction.

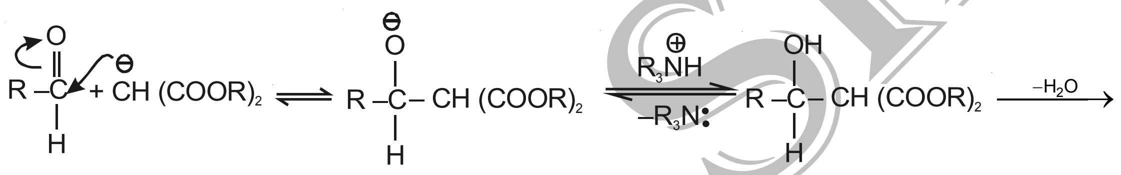
$$RCHO + CH_2\begin{matrix} \diagup Z \\ \diagdown Z' \end{matrix} \xrightarrow[\text{or piperidine}]{\text{Pyridine}} RCH = C(COOR)_2 \xrightarrow[(ii)\,\Delta,-CO_2]{(i)\,H_2O/H^{\oplus}} R-CH=CH-COOH$$

Z can be

CHO, COOMe, COOH, CN, NO_2, $\overset{O}{\overset{\|}{C}}-R$, SOR, SO_2R, SO_2OR etc.

Mechanism

$$R_3\ddot{N} + H_2C(COOR)_2 \rightleftharpoons R_3\overset{\oplus}{N}H + \overset{\ominus}{H}C(COOR)_2$$



$$R-CH=C(COOR)_2 \xrightarrow[(ii)\,\Delta,-CO_2]{(i)\,H_2O/H^{\oplus}} R-CH=CHCOOH$$

High reactivity of the methylene group of the active methylene compound prevents self-condensation of the aldehyde.

Q.1 $CH_3CHO + H_2C(COOR)_2 \xrightarrow[(2)\,H_3O^{\oplus}/\Delta]{(1)\,Pip} A$

Q.2 $C_6H_5CHO + H_2C(COOR)_2 \xrightarrow[(2)\,H_3O^{\oplus}/\Delta]{(1)\,Pip} B$

Q.3 $HOOC-CHO + H_2C(COOR)_2 \xrightarrow[(2)\,H_3O^{\oplus}/\Delta]{(1)\,Pip} C$

Glyoxalic acid

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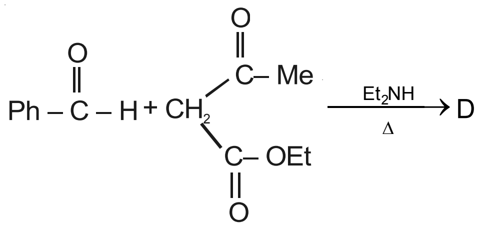
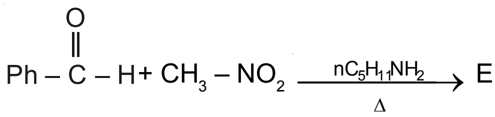
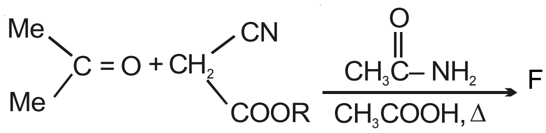
Q.4



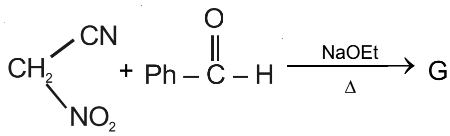
Q.5



Q.6



Q.7



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Date: DPP NO- 04 Time: 15 minutes

KNOEVENAGEL REACTION :

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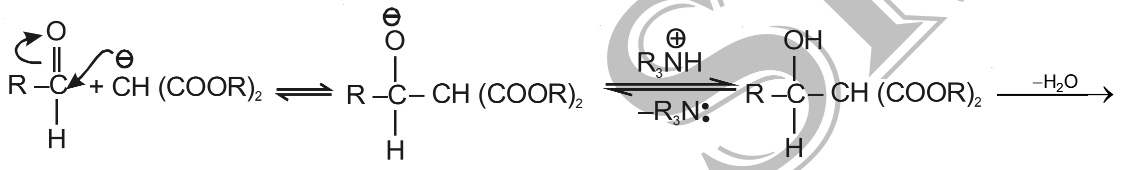
$$RCHO + CH_2\begin{matrix} Z \\ Z' \end{matrix} \xrightarrow[\text{or piperidine}]{\text{Pyridine}} RCH = C(COOR)_2 \xrightarrow[(ii)\,\Delta,-CO_2]{(i)\,H_2O/H^{\oplus}} R-CH=CH-COOH$$

Z can be

CHO, COOMe, COOH, CN, NO_2, $\overset{\overset{O}{\|}}{C}-R$, SOR, SO_2R, SO_2OR etc.

Mechanism

$$R_3\ddot{N} + H_2C(COOR)_2 \rightleftharpoons R_3\overset{\oplus}{N}H + \overset{\ominus}{H}C(COOR)_2$$



$$R-CH=C(COOR)_2 \xrightarrow[(ii)\,\Delta,-CO_2]{(i)\,H_2O/H^{\oplus}} R-CH=CHCOOH$$

High reactivity of the methylene group of the active methylene compound prevents self-condensation of the aldehyde.

Q.1 $CH_3CHO + H_2C(COOR)_2 \xrightarrow[(2)\,H_3O^{\oplus}/\Delta]{(1)\,Pip} A$

Q.2 $C_6H_5CHO + H_2C(COOR)_2 \xrightarrow[(2)\,H_3O^{\oplus}/\Delta]{(1)\,Pip} B$

Q.3 $HOOC-CHO + H_2C(COOR)_2 \xrightarrow[(2)\,H_3O^{\oplus}/\Delta]{(1)\,Pip} C$

Glyoxalic acid

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Q.4 $$Ph-\overset{O}{\overset{\parallel}{C}}-H + CH_2\begin{cases}\overset{O}{\overset{\parallel}{C}}-Me \\ \underset{O}{\underset{\parallel}{C}}-OEt\end{cases} \xrightarrow[\Delta]{Et_2NH} D$$

Q.5 $$Ph-\overset{O}{\overset{\parallel}{C}}-H + CH_3-NO_2 \xrightarrow[\Delta]{nC_5H_{11}NH_2} E$$

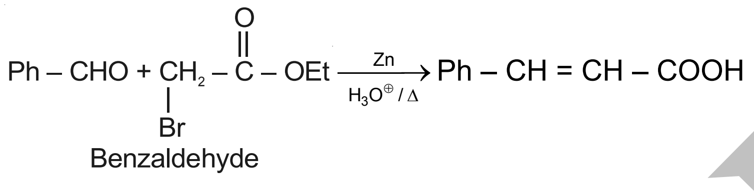
Q.6 $$\begin{matrix}Me \\ Me\end{matrix}\!\!>C=O + CH_2\begin{cases}CN \\ COOR\end{cases} \xrightarrow[CH_3COOH,\ \Delta]{CH_3\overset{O}{\overset{\parallel}{C}}-NH_2} F$$

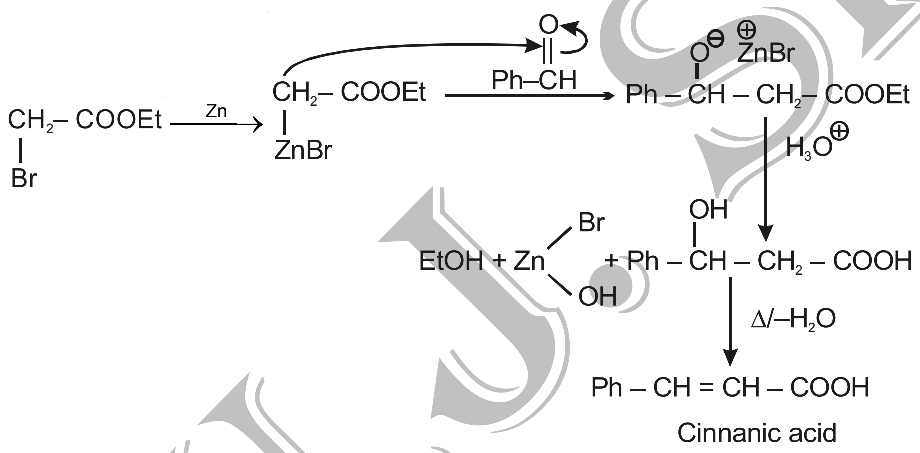
Q.7 $$CH_2\begin{cases}CN \\ NO_2\end{cases} + Ph-\overset{O}{\overset{\parallel}{C}}-H \xrightarrow[\Delta]{NaOEt} G$$

Date: DPP NO- 05 Time: 15 minutes

Reformatsy Reaction :

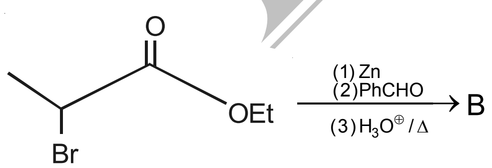
α- halo esters when treated with Zn in gives organometallic halo ester which provides the attacking $Nu^{\ominus}$ for the another reactant, which is a carbonyl compound. When $Nu^{\ominus}$ attacks on carbonyl compound it gives an intermediate which upon acidic hydrolysis followed by heating, results in formation of α, β- unsaturated acid. The overall reaction is known as Reformatsky reaction.



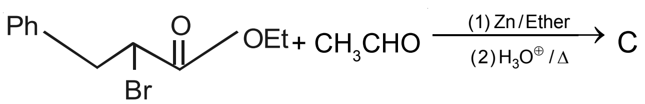


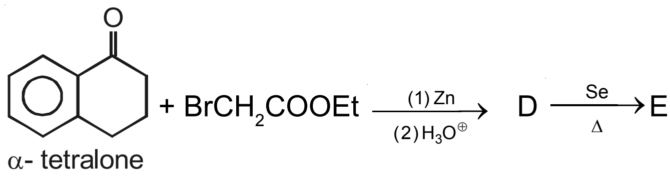
Q.1 $C_6H_5COCH_3 + BrCH_2COOEt \xrightarrow[(2)\,H_3O^{\oplus}/\Delta]{(1)\,Zn} A$

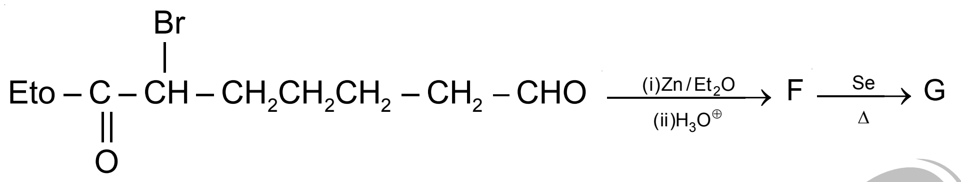
Q.2

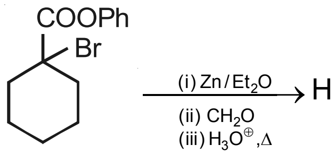


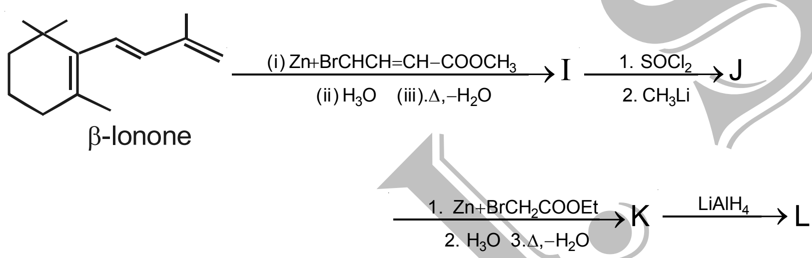
Q.3



Q.4 
α- tetralone
+ BrCH2COOEt
(1) Zn
(2) H3O⊕
D
Se
Δ
E

Q.5 
(i)Zn / Et2O
(ii)H3O⊕
F
Se
Δ
G

Q.6 
COOPh
Br
(i) Zn / Et2O
(ii) CH2O
(iii) H3O⊕,Δ
H

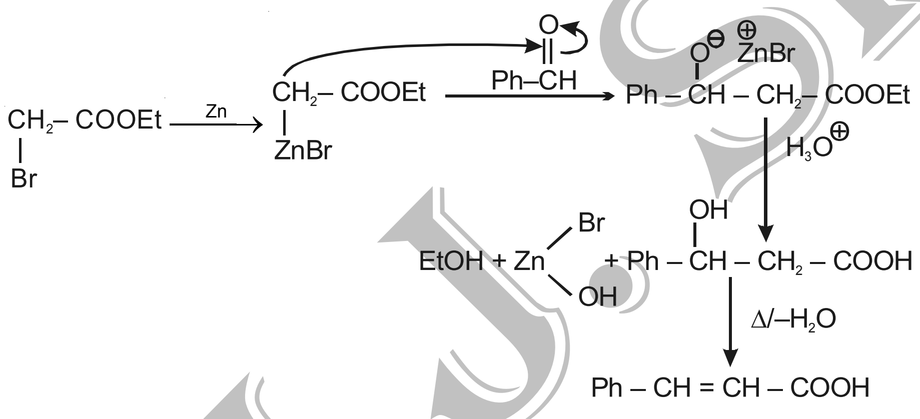
Q.7 
β-Ionone
(i) Zn+BrCHCH=CH−COOCH3
(ii) H3O (iii).Δ,−H2O
I
1. SOCl2
2. CH3Li
J
1. Zn+BrCH2COOEt
2. H3O 3.Δ,−H2O
K
LiAlH4
L

Date: DPP NO- 05 Time: 15 minutes

Reformatsy Reaction :

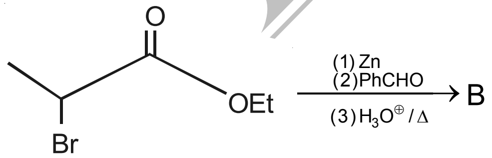
α- halo esters when treated with Zn in gives organometallic halo ester which provides the attacking $Nu^{\ominus}$ for the another reactant, which is a carbonyl compound. When $Nu^{\ominus}$ attacks on carbonyl compound it gives an intermediate which upon acidic hydrolysis followed by heating, results in formation of α, β- unsaturated acid. The overall reaction is known as Reformatsky reaction.

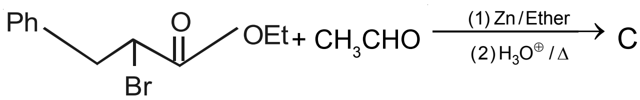
$$\underset{\text{Benzaldehyde}}{Ph-CHO} + \underset{\underset{Br}{|}}{CH_2}-\overset{\overset{O}{||}}{C}-OEt \xrightarrow[H_3O^{\oplus}/\Delta]{Zn} Ph-CH=CH-COOH$$



Cinnanic acid

Q.1 $C_6H_5COCH_3 + BrCH_2COOEt \xrightarrow[(2)\,H_3O^{\oplus}/\Delta]{(1)\,Zn} A$

Q.2 

Q.3 

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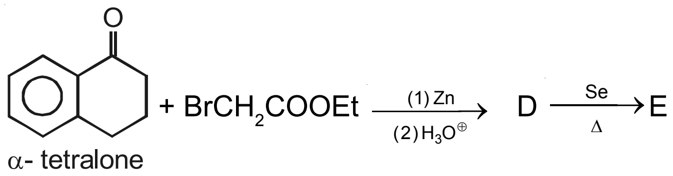
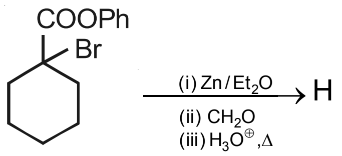
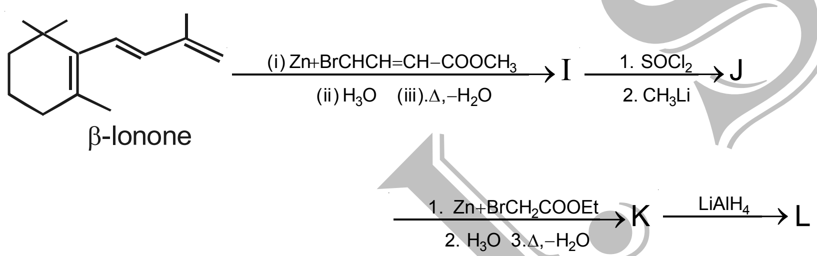
Q.4 

Q.5

$$\text{EtO}-\underset{\underset{\text{O}}{\|}}{\text{C}}-\overset{\overset{\text{Br}}{|}}{\text{CH}}-\text{CH}_2\text{CH}_2\text{CH}_2-\text{CH}_2-\text{CHO}\xrightarrow[\text{(ii)}H_3O^{\oplus}]{\text{(i)}Zn/Et_2O}\text{F}\xrightarrow[\Delta]{\text{Se}}\text{G}$$

Q.6 

Q.7 

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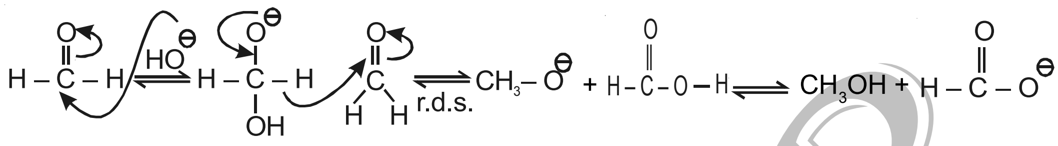
Date: DPP NO-06 Time: 15 minutes

CANNIZARO REACTION :

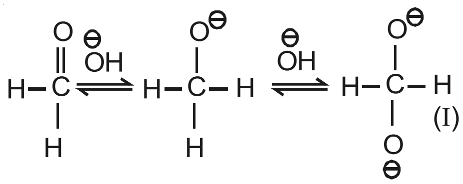
This reaction is given by aldehyde having no α- hydrogens in the presence of conc. NaOH/Δ or KOH/Δ.

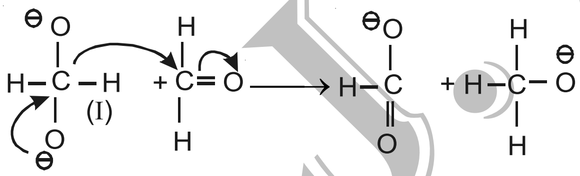
$$H-\overset{O}{\overset{\|}{C}}-H \xrightarrow[\Delta]{KOH} H-\overset{O}{\overset{\|}{C}}-O^{\ominus} + CH_3OH$$

Mechanism of the reaction is



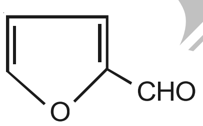
In the presence of a very strong concentration of alkali, aldehyde first forms a doubly charged anion (I) from which a hydride anion is transferred to the second molecule of the aldehyde to form acid and an alkoxide ion. Subsequently, the alkoxide ion acquires a proton from the solvent.

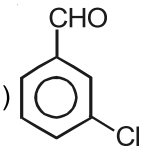


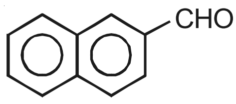


$$HCH_2\overset{\ominus}{O} \xrightarrow[\text{From solvent}]{H_2O} HCH_2OH + \overset{\ominus}{O}H$$

Q.1 Which of the following will not undergo Cannizaro reaction.

(A) 

(B) 

(C) 

(D) Cl_3C-CHO

Q.2 $Ph-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[Pd-BaSO_4]{H_2} (A) \xrightarrow[\Delta,KOH]{HCHO} (C) + (D)$

Product (C) and (D) are-

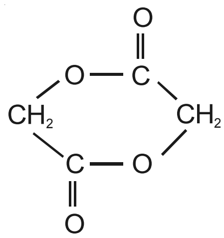
(A) $Ph-CO_2H$, $Ph-OH$ (B) $Ph-CO_2$, HCO_2

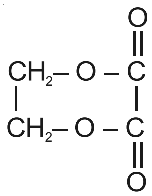
(C) $Ph-CH_2OH$, $H-CO_2^-$ (D) $Ph-CO_2^-$, CH_3OH

Q.3 $\underset{\text{CHO}}{\overset{\text{CHO}}{|}} \xrightarrow{\text{Conc.NaOH}} (A) \xrightarrow[\Delta]{H^+} (B)$

Product (B) is

(A) $H_2C = CH– CO_2H$

(B) 

(C) 

(D) $H_2C = C= O$

Q.4 (i) $HCHO \xrightarrow[\Delta]{NaOD}$

(ii) $DCHO \xrightarrow[\Delta]{NaOD}$

Q.5 (i) $Ph–CHO + HCHO \xrightarrow[\Delta]{KOH}$

(ii) $Ph – \underset{\underset{O}{\|}}{C} – \underset{\underset{O}{\|}}{C} – H \xrightarrow[\Delta]{KOH}$

Q.6 (i) $MeCH_2 – CHO \xrightarrow[\Delta]{KOH}$

(ii) $Me_2CH– CHO \xrightarrow[\Delta]{KOH}$

Q.7 (i) $Me– NO_2 + HCHO\ (excess) \xrightarrow{KOH}$

(ii) $Me– CHO + HCHO\ (excess) \xrightarrow{KOH}$

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Date: DPP NO-06 Time: 15 minutes

CANNIZARO REACTION :

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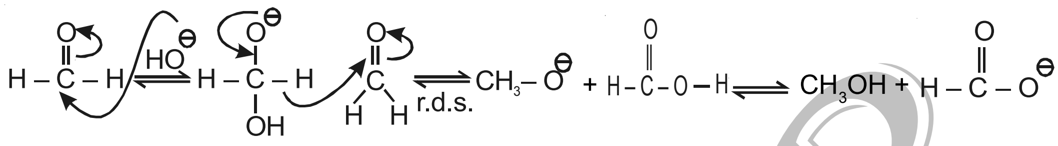
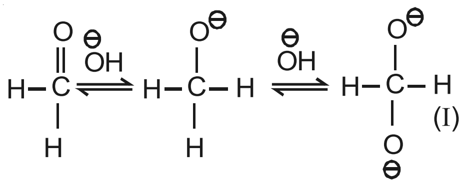
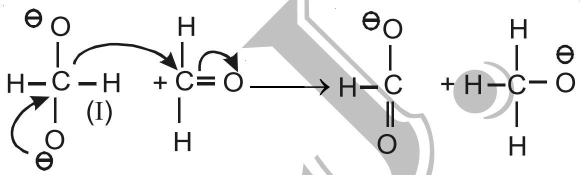
$$H-\overset{O}{\overset{\|}{C}}-H \xrightarrow[\Delta]{KOH} H-\overset{O}{\overset{\|}{C}}-O^{\ominus} + CH_3OH$$

Mechanism of the reaction is



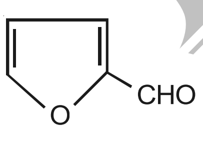
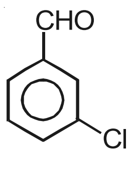
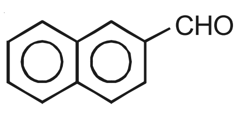
In the presence of a very strong concentration of alkali, aldehyde first forms a doubly charged anion (I) from which a hydride anion is transferred to the second molecule of the aldehyde to form acid and an alkoxide ion. Subsequently, the alkoxide ion acquires a proton from the solvent.





$$HCH_2\overset{\ominus}{O} \xrightarrow[\text{From solvent}]{H_2O} HCH_2OH + \overset{\ominus}{O}H$$

Q.1 Which of the following will not undergo Cannizaro reaction.

(A)  (B)  (C)  (D) Cl_3C-CHO

Q.2 $Ph-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[Pd-BaSO_4]{H_2} (A) \xrightarrow[\Delta,KOH]{HCHO} (C) + (D)$

Product (C) and (D) are-

(A) Ph $-CO_2H$, Ph$-$ OH (B) Ph $-CO_2$, HCO_2

(C) Ph $-CH_2OH$, $H-CO_2^-$ (D) Ph $-CO_2^-$, CH_3OH

IIT-JEE Chemistry by N.J. Sir
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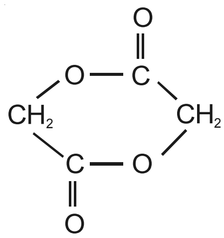
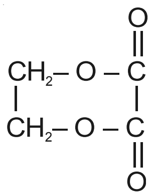
Contact: 9414969800, 9549908816
web : symmetryiitjee.com

Q.3 $\underset{\text{CHO}}{\overset{\text{CHO}}{|}} \xrightarrow{\text{Conc.NaOH}} (A) \xrightarrow[\Delta]{H^+} (B)$

Product (B) is

(A) $H_2C = CH- CO_2H$

(B) 

(C) 

(D) $H_2C = C= O$

Q.4 (i) $HCHO \xrightarrow[\Delta]{NaOD}$

(ii) $DCHO \xrightarrow[\Delta]{NaOD}$

Q.5 (i) $Ph–CHO + HCHO \xrightarrow[\Delta]{KOH}$

(ii) $Ph - \underset{\|}{\overset{}{C}}(O) - \underset{\|}{C}(O) - H \xrightarrow[\Delta]{KOH}$

Q.6 (i) $MeCH_2 – CHO \xrightarrow[\Delta]{KOH}$

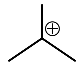
(ii) $Me_2CH– CHO \xrightarrow[\Delta]{KOH}$

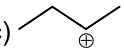
Q.7 (i) $Me– NO_2$ + HCHO (excess) $\xrightarrow{KOH}$

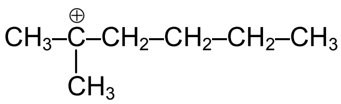
(ii) Me– CHO + HCHO (excess) $\xrightarrow{KOH}$

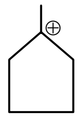
DAILY PROBLEM PRACTICE SHEET

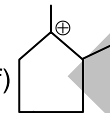
Q.1 (a) $CH_3-\overset{\oplus}{C}H-CH_3$

(b) 

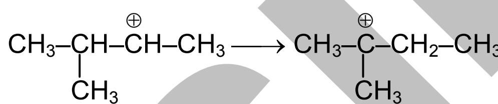
(c) 

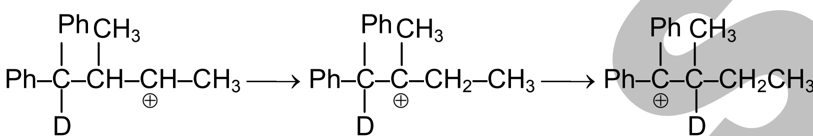
(d) 

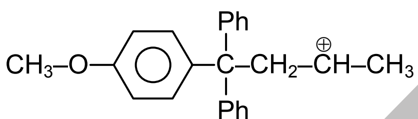
(e) 

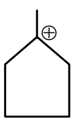
(f) 

(g) $Ph-\underset{\oplus}{C}H-CH_3$

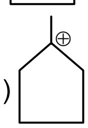
(h) 

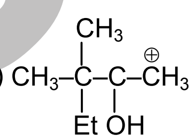
(i) 

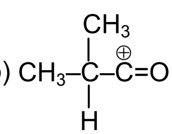
(j) 

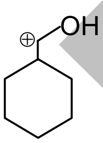
(k) 

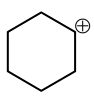
(l) $CH_3-CH_2-\overset{\oplus}{C}H-OH$

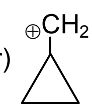
(m) 

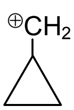
(n) 

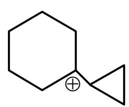
(o) 

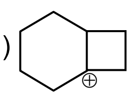
(p) 

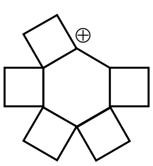
(q) 

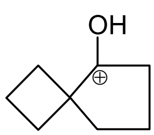
(r) 

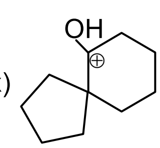
(s) 

(t) 

(u) 

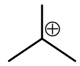
(v) 

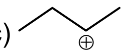
(w) 

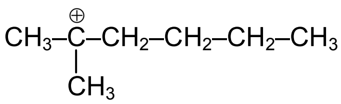
(x) 

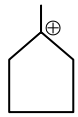
DAILY PROBLEM PRACTICE SHEET

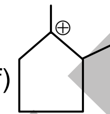
Q.1 (a) $CH_3-\overset{\oplus}{C}H-CH_3$

(b) 

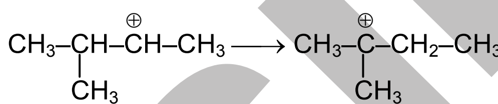
(c) 

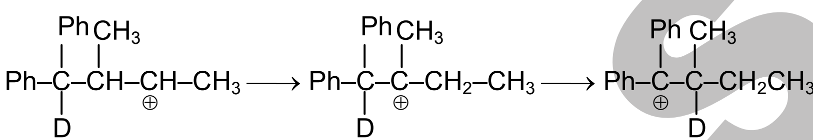
(d) 

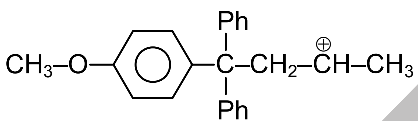
(e) 

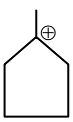
(f) 

(g) $Ph-\underset{\oplus}{C}H-CH_3$

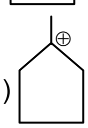
(h) 

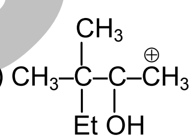
(i) 

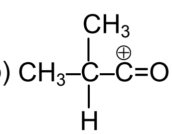
(j) 

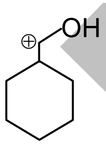
(k) 

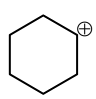
(l) $CH_3-CH_2-\overset{\oplus}{C}H-OH$

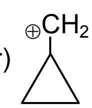
(m) 

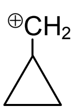
(n) 

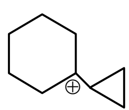
(o) 

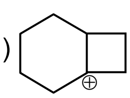
(p) 

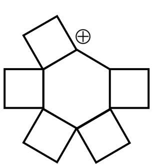
(q) 

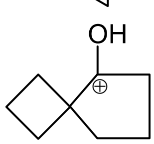
(r) 

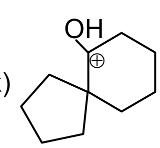
(s) 

(t) 

(u) 

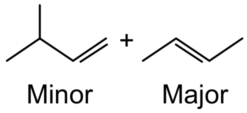
(v) 

(w) 

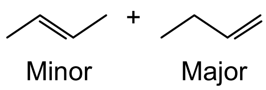
(x) 

DAILY PROBLEM PRACTICE SHEET

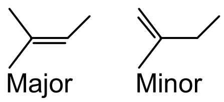
Q.1



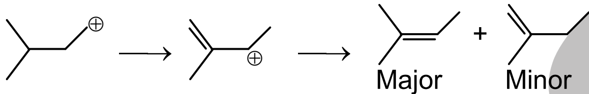
Q.2



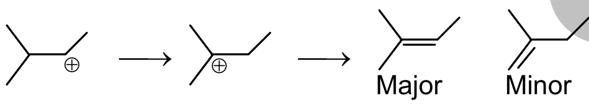
Q.3



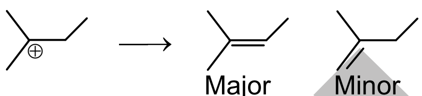
Q.4



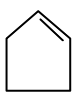
Q.5



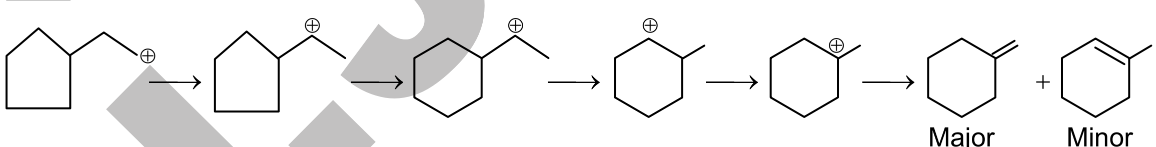
Q.6



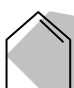
Q.7



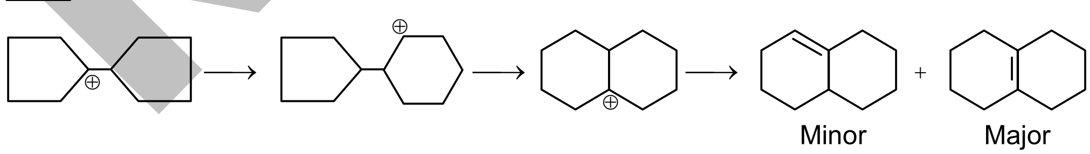
Q.8



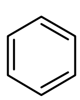
Q.9



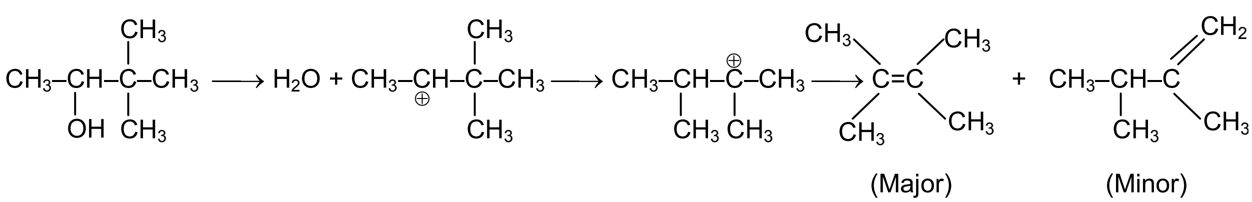
Q.10



Q.11



Q.12

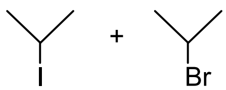


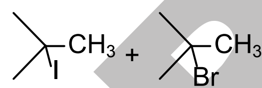
(ELECTROHILIC ADDITION)

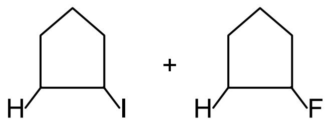
Q.1 (a) (iv) > (iii) > (ii) > (i)
(b) (v) > (iv) > (iii) > (ii) > (i)
(c) (v) > (iv) > (iii) > (ii) > (i)
(d) (ii) > (i)

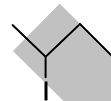
Q.1 $CH_3–CH_2–I$

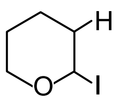
Q.2 X(no. reaction)

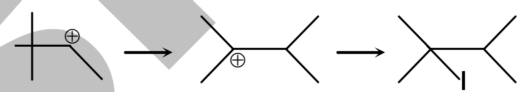
Q.3 

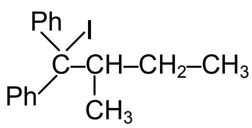
Q.4 

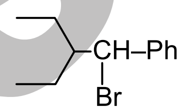
Q.5 

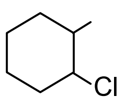
Q.6 

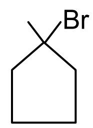
Q.7 

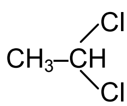
Q.8 

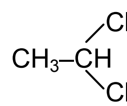
Q.9 

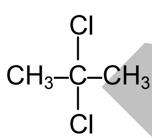
Q.10 

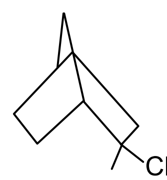
Q.11 

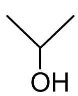
Q.12 

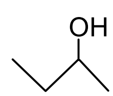
Q.13 

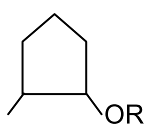
Q.14 

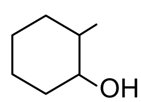
Q.15 

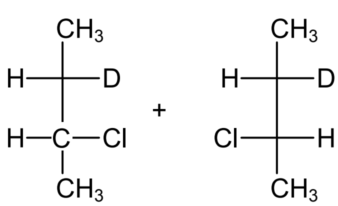
Q.16 

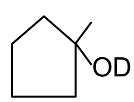
Q.17 

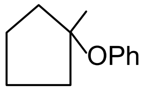
Q.18 

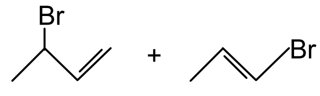
Q.19 

Q.20 

Q.21 

Q.22 

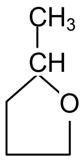
Q.23 

Q.24 

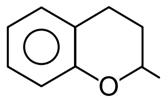
KCP KCP

Q.25 $CH\equiv C-CH_2-\overset{\overset{Cl}{|}}{C}H-CH_3$

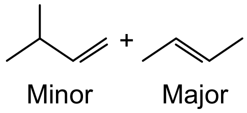
Q.26 $CH_2=\overset{\overset{Cl}{|}}{C}-CH=CH_2$

Q.27 

Q.28 $CH_2=CH-CH=CH-CH_2-OMe$

Q.29 

DAILY PROBLEM PRACTICE SHEET

Q.1


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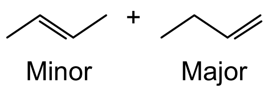

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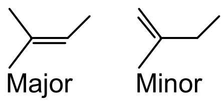

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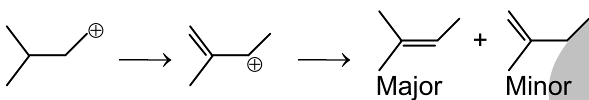

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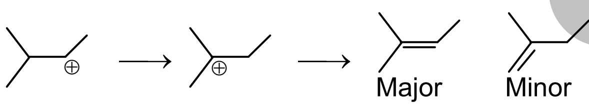

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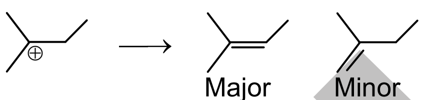

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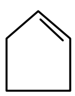

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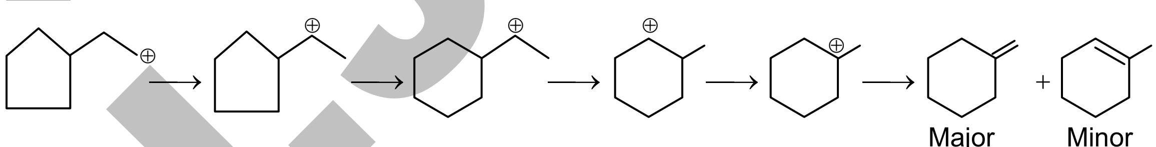
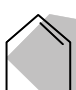
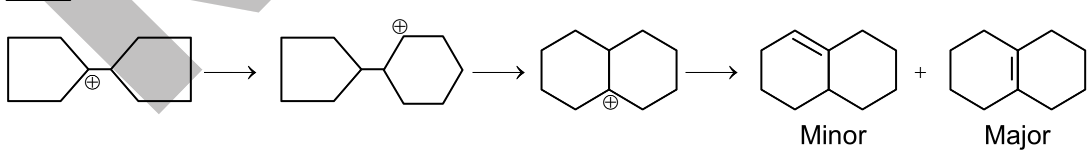
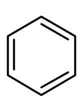
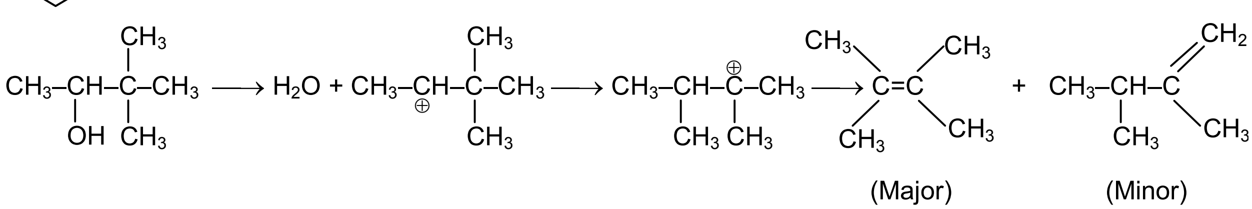


Q.9


Q.10


Q.11


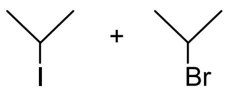
Q.12


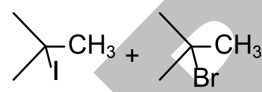
(ELECTROHILIC ADDITION)

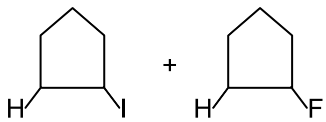
Q.1 (a) (iv) > (iii) > (ii) > (i)
(b) (v) > (iv) > (iii) > (ii) > (i)
(c) (v) > (iv) > (iii) > (ii) > (i)
(d) (ii) > (i)

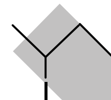
Q.1 $CH_3–CH_2–I$

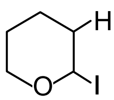
Q.2 X(no. reaction)

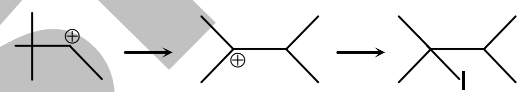
Q.3 

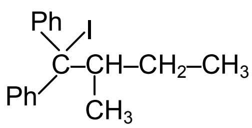
Q.4 

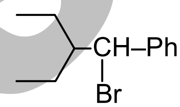
Q.5 

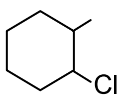
Q.6 

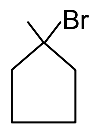
Q.7 

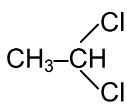
Q.8 

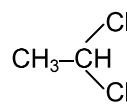
Q.9 

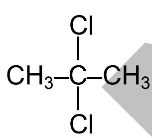
Q.10 

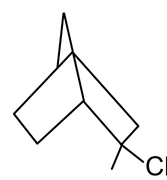
Q.11 

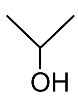
Q.12 

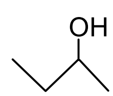
Q.13 

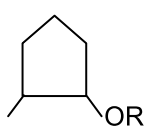
Q.14 

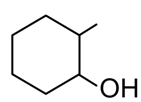
Q.15 

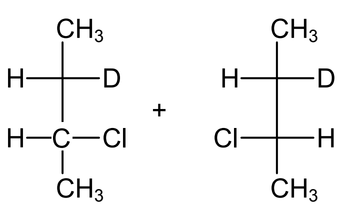
Q.16 

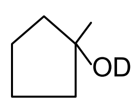
Q.17 

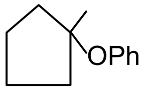
Q.18 

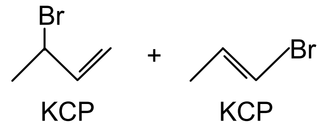
Q.19 

Q.20 

Q.21 

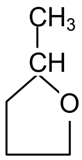
Q.22 

Q.23 

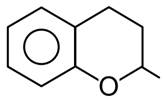
Q.24 

Q.25 $CH{\equiv}C{-}CH_2{-}\overset{\overset{\large Cl}{|}}{C}H{-}CH_3$

Q.26 $CH_2{=}\overset{\overset{\large Cl}{|}}{C}{-}CH{=}CH_2$

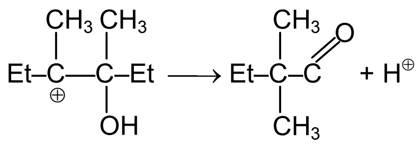
Q.27 

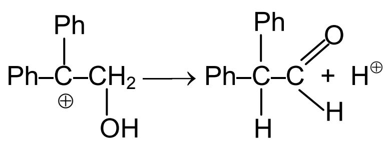
Q.28 $CH_2{=}CH{-}CH{=}CH{-}CH_2{-}OMe$

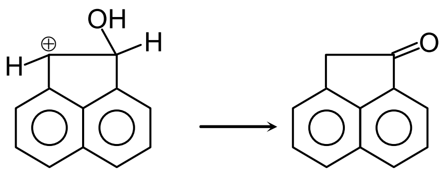
Q.29 

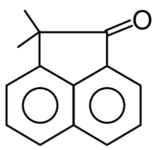
ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

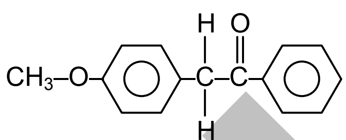
DAILY PROBLEM PRACTICE SHEET

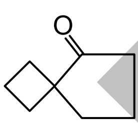
Q.1 

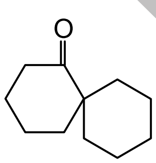
Q.2 

Q.3 

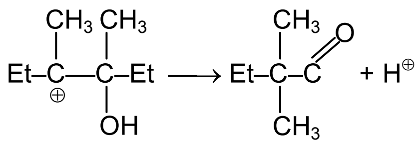
Q.4 

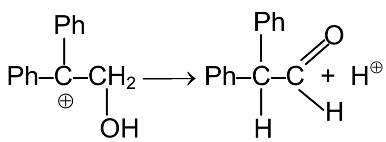
Q.5 

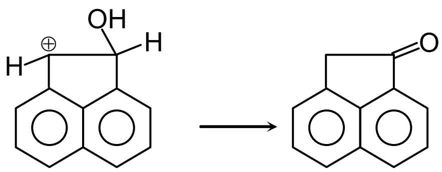
Q.6 

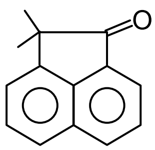
Q.7 

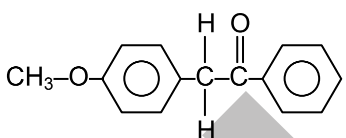
DAILY PROBLEM PRACTICE SHEET

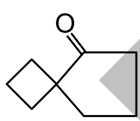
Q.1 

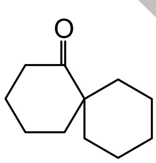
Q.2 

Q.3 

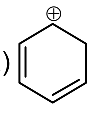
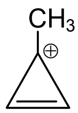
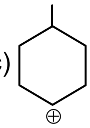
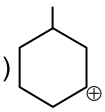
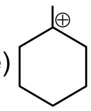
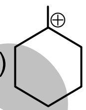
Q.4 

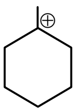
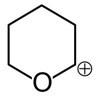
Q.5 

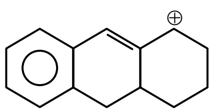
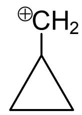
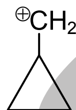
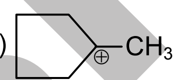
Q.6 

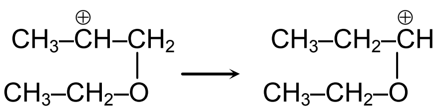
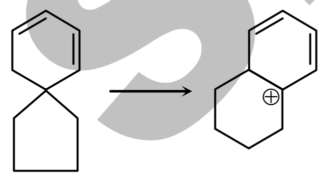
Q.7 

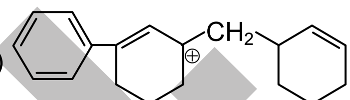
DAILY PROBLEM PRACTICE SHEET

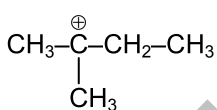
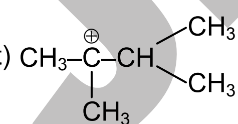
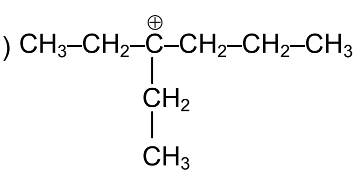
1. (a)  (b)  (c)  (d)  (e)  (f) 

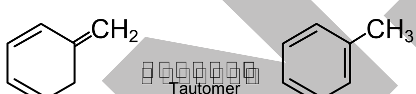
(g)  (h)  (i) $Ph{-}CH_2{-}O{-}CH_2{-}\overset{\oplus}{C}H{-}CH_3 \longrightarrow Ph{-}CH_2{-}O{-}\overset{\oplus}{C}H{-}CH_2{-}CH_3$

(j)  (k)  (l)  (m) 

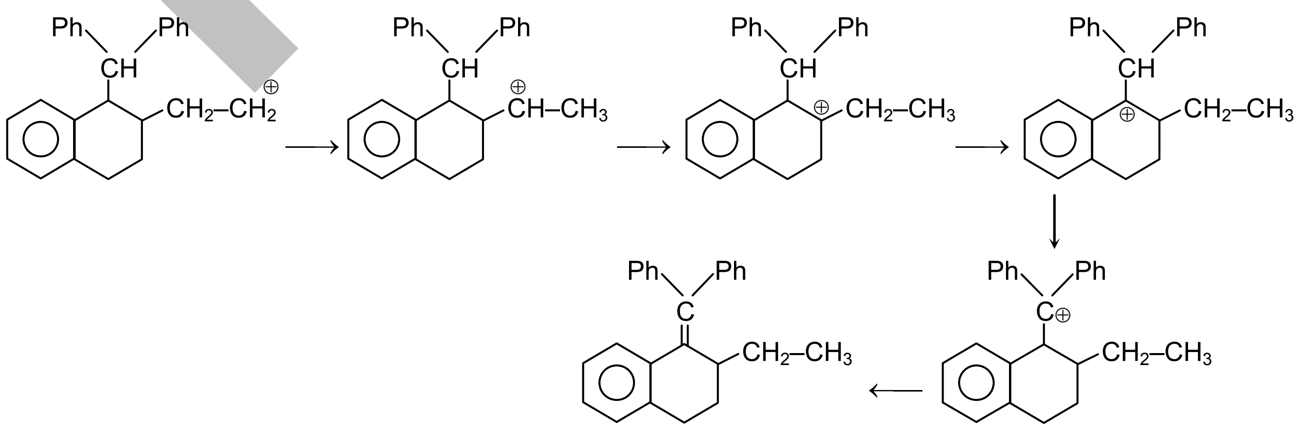
(n)  (o) 

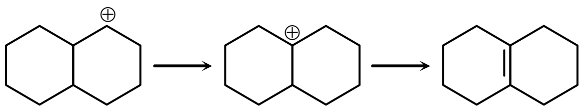
(p) $Ph - CH_2 - \overset{\oplus}{C} = O$ (q)  (q) $CH_3{-}\overset{\oplus}{C}H{-}CH_3$

(s)  (t)  (u) 

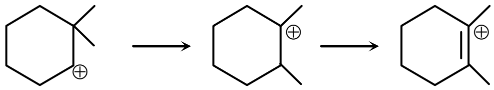
2. 

(A)

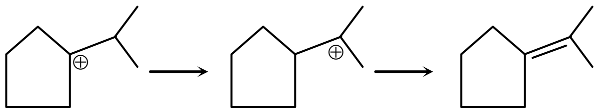
3. 

4. **Reaction-I :** 

$\alpha n = 8$

Reaction-II : 

$\alpha n = 10$

Reaction-III : 

$\alpha n = 10$

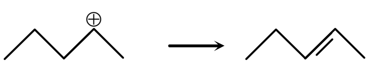
αn = 28

5. (A) 

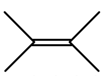
(x) = 2 (C/T)

(B) $CH_3-\overset{CH_3}{\underset{CH_3}{C}} \longrightarrow CH_2=\overset{CH_3}{\underset{CH_3}{C}}$ (1)

(y)

(C) 

(2) (C/T)

(D) 

(B) (1)

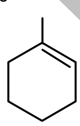
x	y	2	p
2	1	2	1

6. (A) $CH_3-\overset{CH_3}{\underset{\oplus}{C}}-CH_2-CH_3$

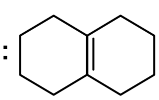
(B) $CH_3-\overset{\oplus}{C}H-CH_3$

(C) $CH_3-\underset{CH_3}{CH}-\overset{\oplus}{C}H-CH_3 \longrightarrow CH_3-\underset{CH_3}{C}-\overset{\oplus}{C}H_2-CH_3$

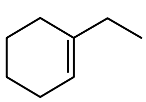
(D) X

7. **Reaction-I :**  (A)

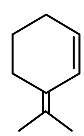
$\alpha H = 7$

Reaction-II :  (B)

$\alpha H = 8$

Reaction-III :  (C)

$\alpha H = 6$

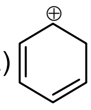
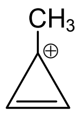
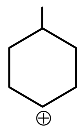
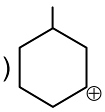
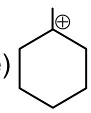
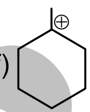
Reaction-IV :  (D)

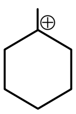
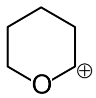
$\alpha H = 10$

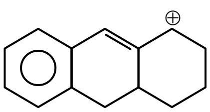
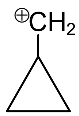
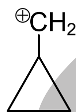
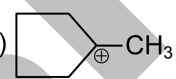
αH = 10

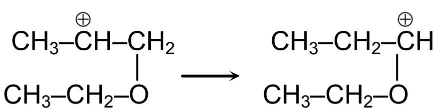
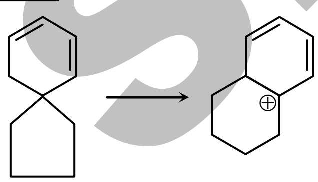
8. **(A)**

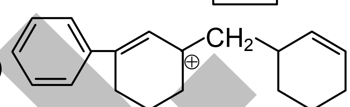
DAILY PROBLEM PRACTICE SHEET

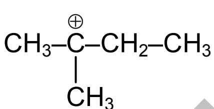
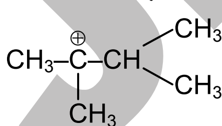
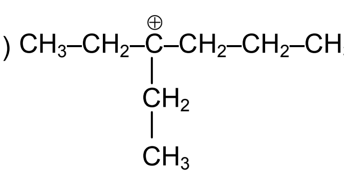
1. (a)  (b)  (c)  (d)  (e)  (f) 

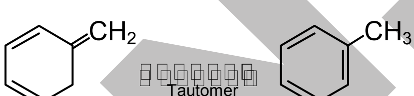
(g)  (h)  (i) $Ph-CH_2-O-CH_2-\overset{\oplus}{C}H-CH_3 \longrightarrow Ph-CH_2-O-\overset{\oplus}{C}H-CH_2-CH_3$

(j)  (k)  (l)  (m) 

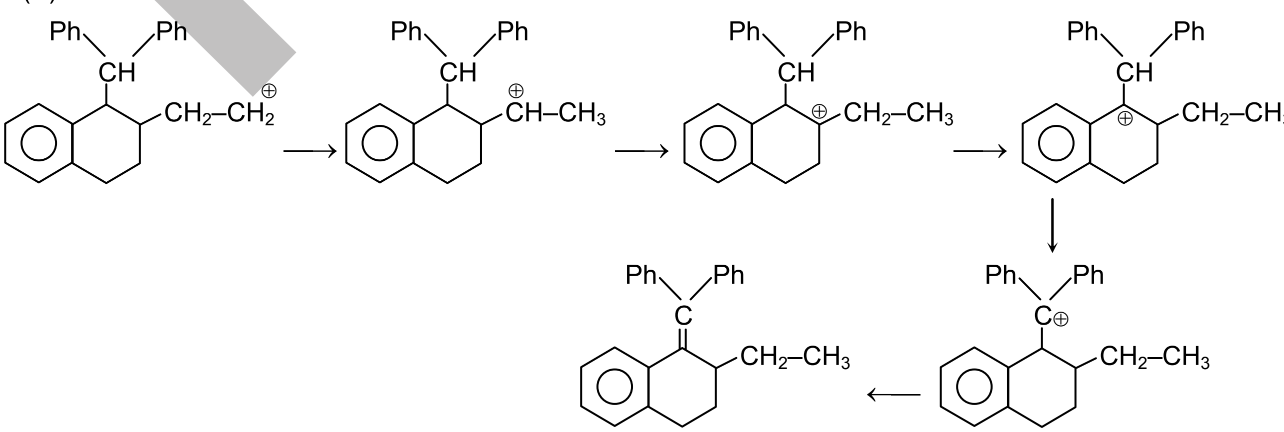
(n)  (o) 

(p) $Ph-CH_2-\overset{\oplus}{C}=O$ (q)  (q) $CH_3-\overset{\oplus}{C}H-CH_3$

(s)  (t)  (u) 

2. 

(A)

3. 

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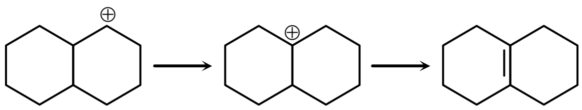
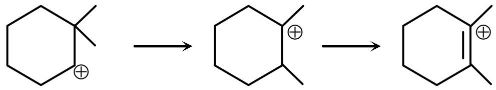
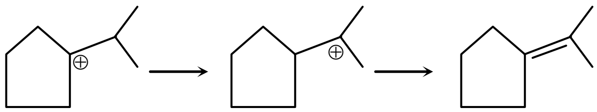
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

4. **Reaction-I :** 

$\alpha n = 8$

Reaction-II : 

$\alpha n = 10$

Reaction-III : 

$\alpha n = 10$

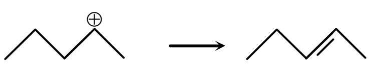
αn = 28

5. (A) 

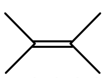
(x) = 2 (C/T)

(B) $CH_3-\underset{CH_3}{\overset{CH_3}{C}} \longrightarrow CH_2=\underset{CH_3}{\overset{CH_3}{C}}$ (1)

(y)

(C) 

(2) (C/T)

(D) 

(B) (1)

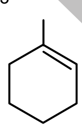
x	y	2	p
2	1	2	1

6. (A) $CH_3-\overset{CH_3}{\underset{\oplus}{C}}-CH_2-CH_3$

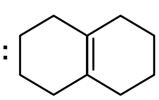
(B) $CH_3-\overset{\oplus}{C}H-CH_3$

(C) $CH_3-\underset{CH_3}{CH}-\overset{\oplus}{C}H-CH_3 \longrightarrow CH_3-\underset{CH_3}{C}-\overset{\oplus}{C}H_2-CH_3$

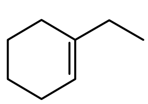
(D) X

7. **Reaction-I :**  (A)

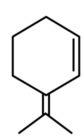
$\alpha H = 7$

Reaction-II :  (B)

$\alpha H = 8$

Reaction-III :  (C)

$\alpha H = 6$

Reaction-IV :  (D)

$\alpha H = 10$

αH = 10

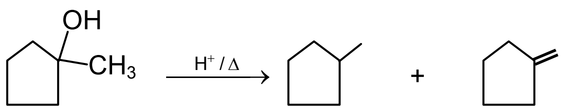
8. **(A)**

DAILY PROBLEM PRACTICE SHEET

1. (a) 1 < 2 (b) 1 < 2 (c) 1 < 2 (d) 1 < 2 (e) 1 > 2

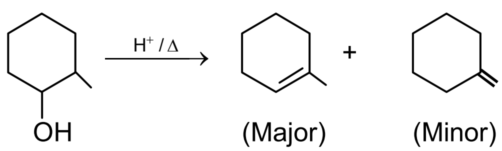
2. (A) $CH_3-CH_2-CH_2-CH(OH)-CH_3 \xrightarrow{H^+/\Delta} CH_3-CH_2-CH=CH-CH_3$ (Major) + $CH_3-CH_2-CH_2-CH=CH_2$ (Minor)

(B)



(Major) (Minor)

(C)



(Major) (Minor)

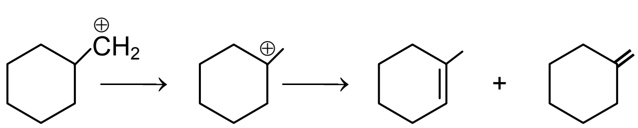
(D) $CH_3-C(CH_3)_2-CH_2 \longrightarrow CH_3-C(CH_3)_2-\overset{\oplus}{C}H_2 \longrightarrow CH_3-\overset{\oplus}{C}(CH_3)-CH_2-CH_3 \longrightarrow CH_3-C(CH_3)=CH-CH_3 \longrightarrow CH_2=C(CH_3)-CH_2-CH_3$

(Major) (Minor)

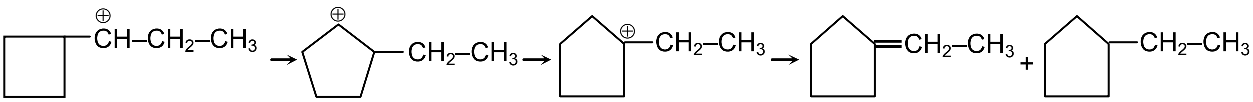
3. (a) $CH_3-C(CH_3)(OH)-CH_3 \xrightarrow{H_2SO_4/\Delta} CH_3-C(CH_3)=CH_2$

(b) $CH_3-CH_2-C(H_3C)-CH(CH_3)-CH_3 \longrightarrow CH_3-CH_2-C(H_3C)=C(CH_3)-CH_3 + CH_3-CH_2-CH(CH_3)-C(=CH_2)-CH_3$

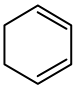
(c)

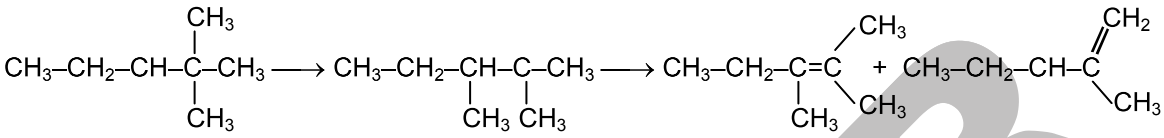


(Major) (Minor)

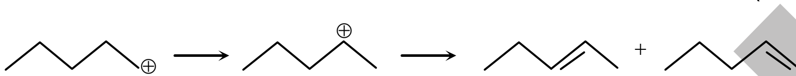
(d) 

(Major) (Minor)

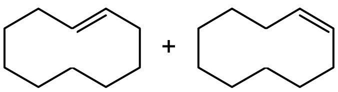
(e) 

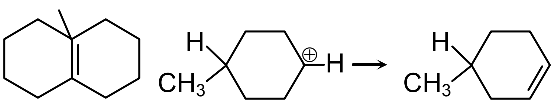
(f) 

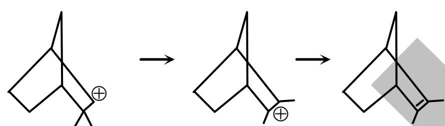
(Major) (Minor)

(g) 

(major) (minor)

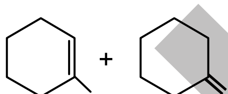
(h) 

(j) 

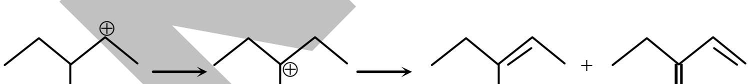
(k) 

(l) 

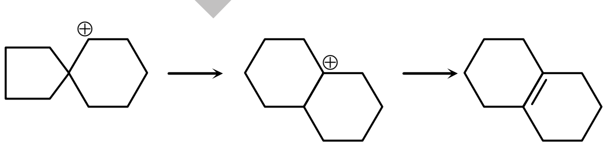
(major) (minor)

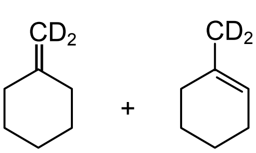
(m) 

(major)

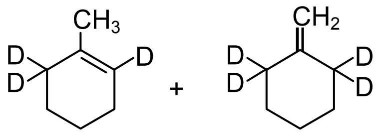
(n) 

(major) (minor)

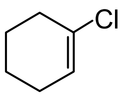
(o) 

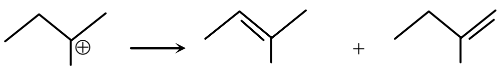
(p) 

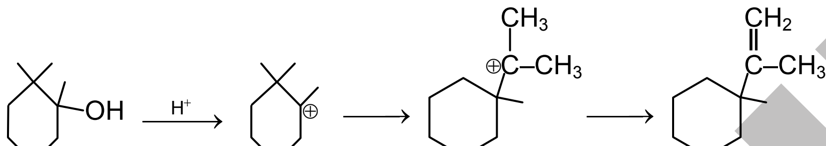
(minor) (major)

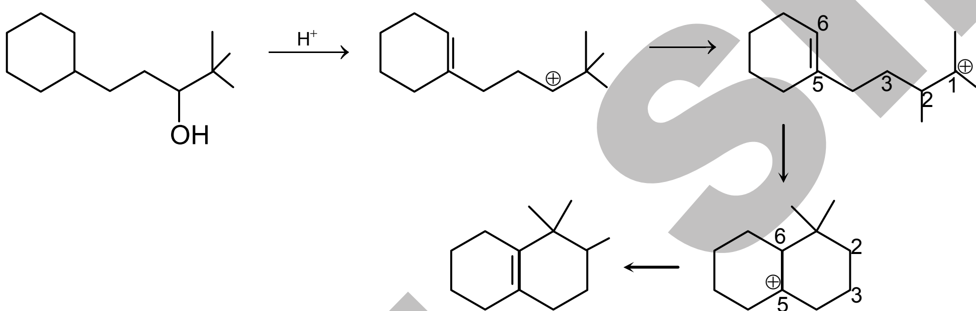
(q) 

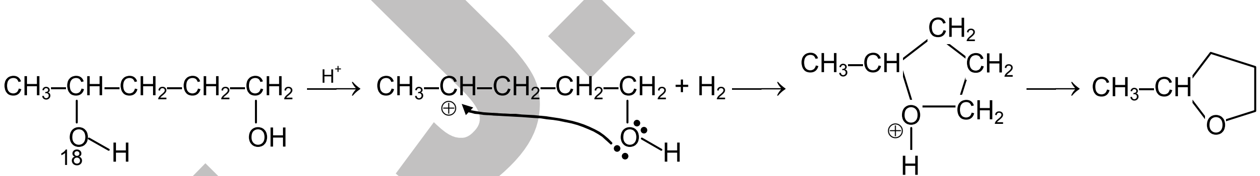
(major) (major)

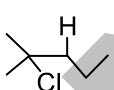
(r) 

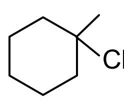
(s) 

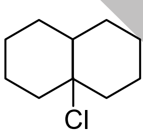
4. (a) 

(b) 

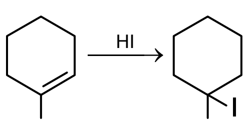
(c) 

5. (a) 

(b) 

(c) 

(d) $CH_3\text{–}\underset{\displaystyle CH_3}{\underset{|}{C}}\text{=}CH_2 \xrightarrow{HCl} CH_3\text{–}\overset{\displaystyle Cl}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}\text{–}CH_3$

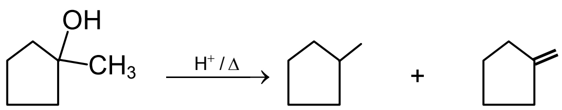
(e) 

DAILY PROBLEM PRACTICE SHEET

1. (a) $1 < 2$ (b) $1 < 2$ (c) $1 < 2$ (d) $1 < 2$ (e) $1 > 2$

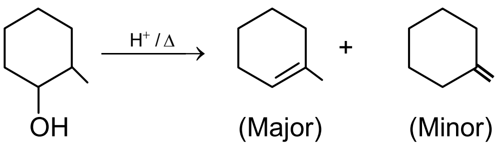
2. (A) $CH_3–CH_2–CH_2–\underset{\large OH}{\underset{|}{C}H}–CH_3 \xrightarrow{H^+/\Delta} CH_3–CH_2–CH=CH–CH_3$ (Major) + $CH_3–CH_2–CH_2–CH=CH_2$ (Minor)

(B)



(Major) (Minor)

(C)



(Major) (Minor)

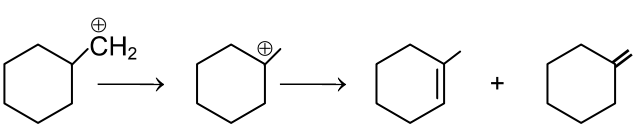
(D) $CH_3–\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}–CH_2 \longrightarrow CH_3–\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}–\overset{\oplus}{C}H_2 \longrightarrow CH_3–\overset{CH_3}{\overset{|}{\underset{\oplus}{C}}}–CH_2–CH_3 \longrightarrow CH_3–\overset{CH_3}{\overset{|}{C}}=CH–CH_3 \longrightarrow CH_2=\underset{CH_3}{\underset{|}{C}}–CH_2–CH_3$

(Major) (Minor)

3. (a) $CH_3–\overset{CH_3}{\overset{|}{\underset{OH}{\underset{|}{C}}}}–CH_3 \xrightarrow{H_2SO_4/\Delta} CH_3–\underset{CH_3}{\underset{|}{C}}=CH_2$

(b) $CH_3–CH_2–\overset{H_3C}{\overset{|}{C}}–\overset{CH_3}{\overset{|}{C}H}–CH_3 \longrightarrow CH_3–CH_2–\overset{H_3C}{\overset{|}{C}}=\overset{CH_3}{\overset{|}{C}}–CH_3 + CH_3–CH_2–\overset{CH_3}{\overset{|}{C}H}–\overset{CH_2}{\overset{\|}{C}}–CH_3$

(c)



(Major) (Minor)

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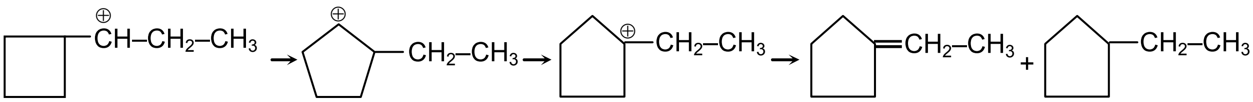
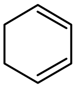
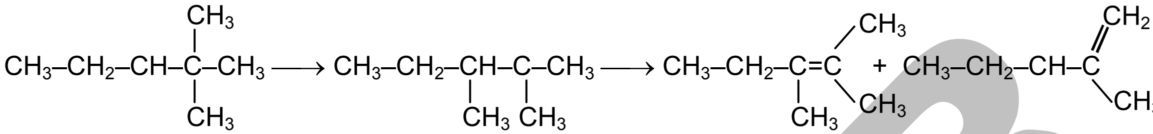
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

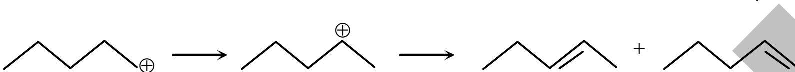
(d) 

(Major) (Minor)

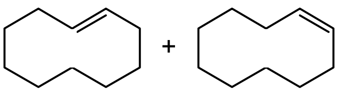
(e) 

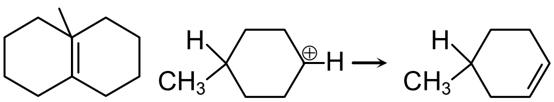
(f) 

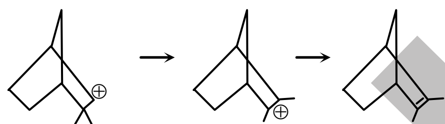
(Major) (Minor)

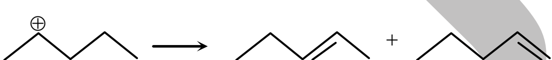
(g) 

(major) (minor)

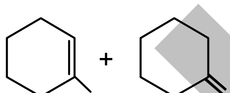
(h) 

(j) 

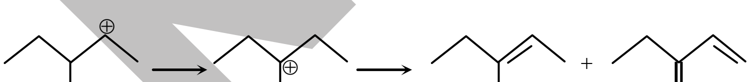
(k) 

(l) 

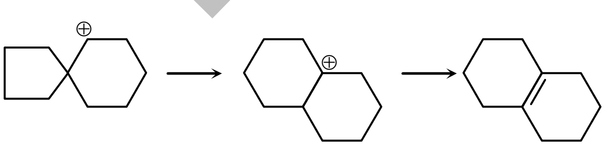
(major) (minor)

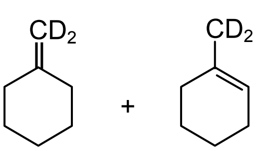
(m) 

(major)

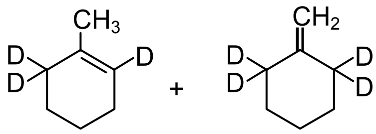
(n) 

(major) (minor)

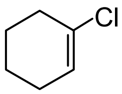
(o) 

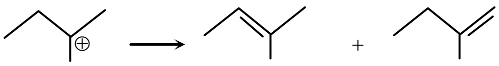
(p) 

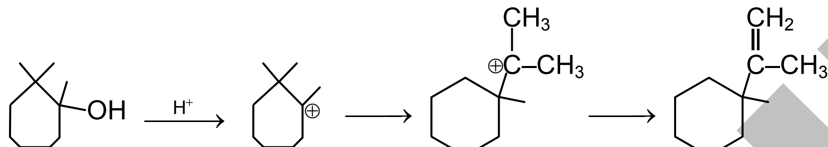
(minor) (major)

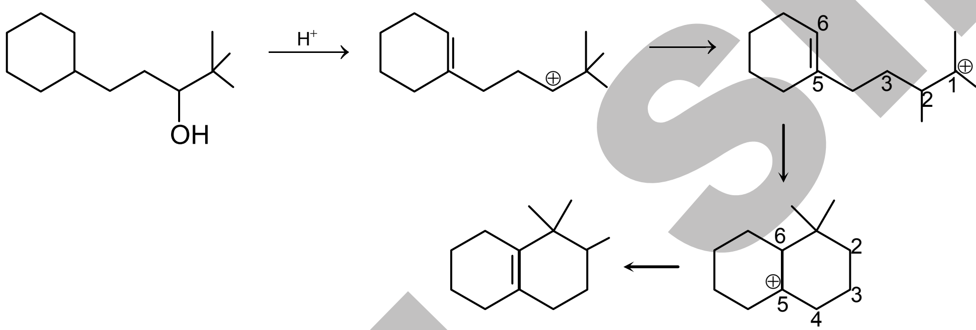
(q) 

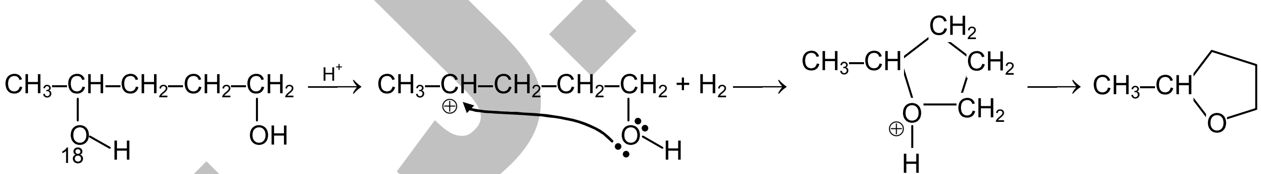
(major) (major)

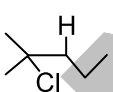
(r) 

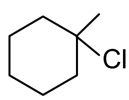
(s) 

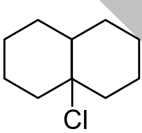
4. (a) 

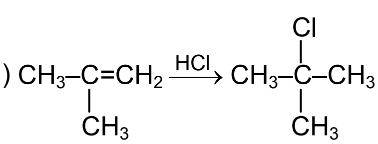
(b) 

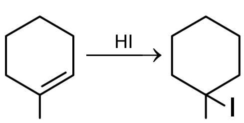
(c) 

5. (a) 

(b) 

(c) 

(d) 

(e) 

Hydrocarbon
Alkanes

Alkanes → Saturated hydrocarbons.
Methods of preparation

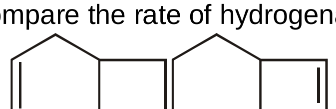
1. Hydrogenation of alkene
Sebatier Sendrens Reaction

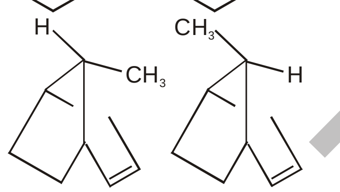
$CH_3-CH=CH_2 \xrightarrow{H_2/Ni,\ Pt,\ Pd}$

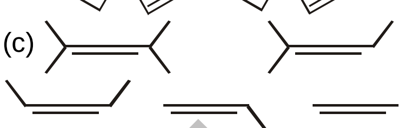
$\xrightarrow{NH_2-NH_2/H_2O_2}$

Important :
1) Unsaturation between like atoms wil reduce C = C, N = N
2) Both H atoms will be attached from same side (Syn-addition)
3) Less stable & less sterically crowded will undergo reduction at faster rate.

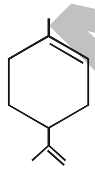
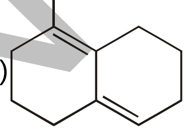
Q.1 Compare the rate of hydrogenation

(a) 

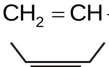
(b) 

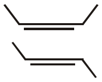
(c) 

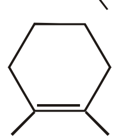
Q.2 Major prduct of reaction

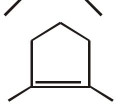
(a)  $\xrightarrow[Ni]{H_2(1eq)}$ (b)  $\xrightarrow[Pt]{H_2(1eq)}$

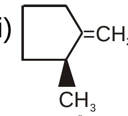
(c) $CH_2=CH-CH=CH_2 \xrightarrow[Ni]{H_2(1eq)}$

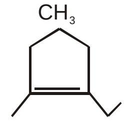
(d)  $\xrightarrow{D_2/Pt}$

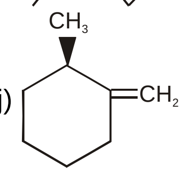
(e)  $\xrightarrow{D_2/Pt}$

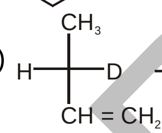
(f)  $\xrightarrow{H_2/Pt}$

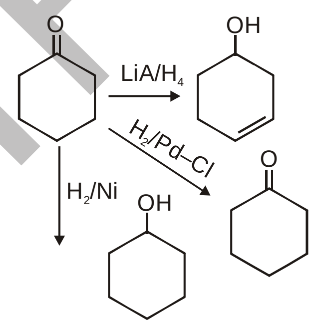
(g)  $\xrightarrow{H_2/(Pt)}$

(i)  $\xrightarrow{H_2/Pt}$

(h)  $\xrightarrow{D_2/Pt}$

(j)  $\xrightarrow{H_2/Pt}$

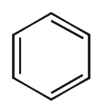
(k)  $\xrightarrow{D_2/Pt}$

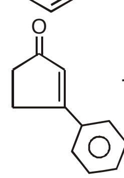
Important : 

Pd–C is used for selectie reduction of alkene, but it cannot reduce $>C=O$

Q.3 $Ph-CH=CH-\overset{O}{\overset{||}{C}}-CH_3 \xrightarrow{H_2/Pd-C}$

$\xrightarrow{H_2/Ni}$

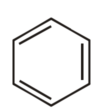
Q.4  $+ H_2 \xrightarrow{Ni}$

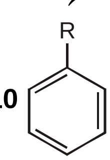
Q.5  $\xrightarrow{H_2/Pd-C}$

Q.6 $\underset{et}{\overset{CH_3}{>}}C=O \xrightarrow{H_2/Ni}$

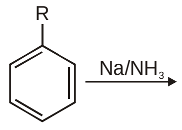
Q.7 $CH_3-C\equiv C-CH_3 \xrightarrow{Pd/BaSO_4}$

Q.8 $CH_3-C\equiv C-CH_3 \xrightarrow{Na/NH_3}$

Q.9  $\xrightarrow{Na/NH_3}$

Q.10  $\xrightarrow{Na/NH_3}$

(R = activating)

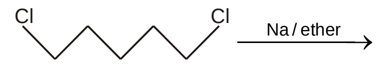
Q.11 

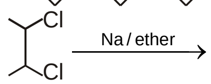
(R = deactivating)

2. From alkyl halides

(a) Wurtz Reaction

$R-x+2Na+x-R \xrightarrow{ether} R-R$

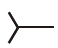
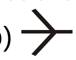
(1) 

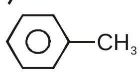
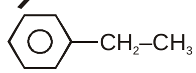
(2) 

(b) Corey House Reaction :

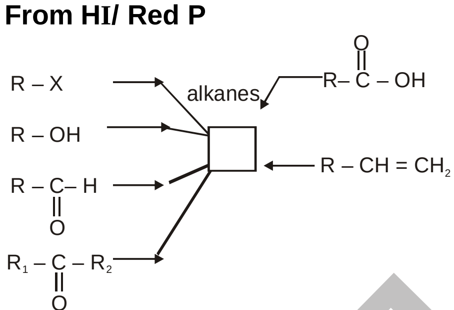
$R_2CuLi + R'-Cl \rightarrow R-R'$

Q.12 Write the steps for preparation of following alkane by corey house reaction ?

(a)  (b) 

(c)  (d) 

3. From HI/ Red P



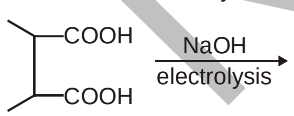
4. From carboxylic acids

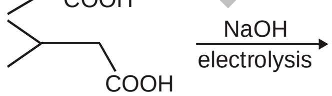
(a) Soda lime decarboxylation

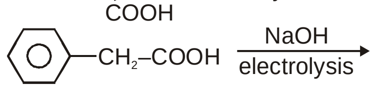
$R-\overset{\overset{O}{||}}{C}-OH \xrightarrow[CaO/\Delta]{NaOH} R-H$

(b) Kolbe" Electrolysis

$R-\overset{\overset{O}{||}}{C}-OH \xrightarrow[Electrolysis]{NaOH} \underbrace{R-R+CO_2}_{anode} + \underbrace{H_2}_{cathode}$

Q.1 

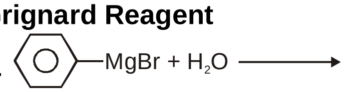
Q.2 

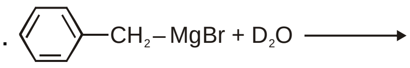
Q.3 

Q.4 $CH_3-COOH \xrightarrow[electrolysis]{NaOH}$

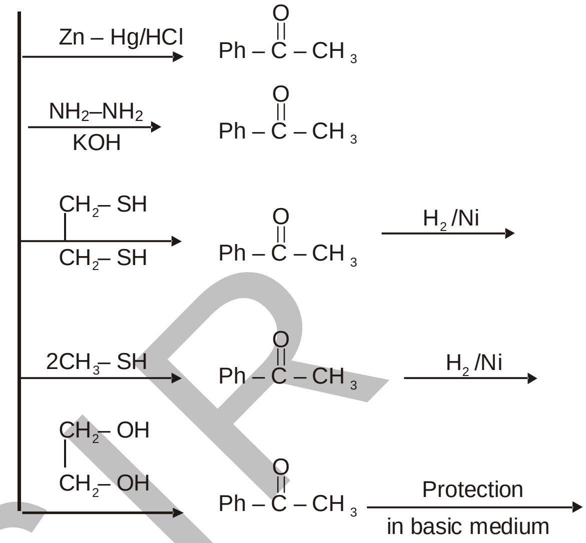
(No. of gases produced at anode)

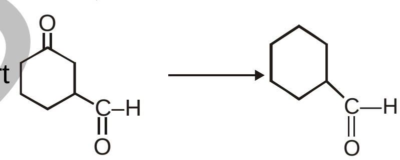
5. Grignard Reagent

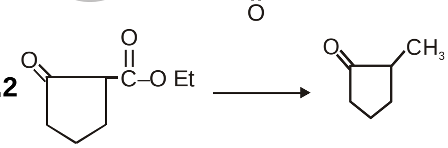
1. 

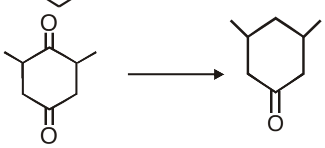
2. 

6. From aldehydes & ketones



Q.1 Convert 

Q.2 

Q.3 

Important

1. $Al_4C_3 + H_2O \longrightarrow Al(OH)_3 + CH_4$

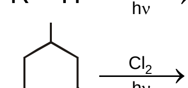
2. $Be_2C + H_2O \longrightarrow Be(OH)_2 + CH_4$

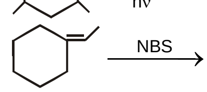
3. $CaC_2 + H_2O \longrightarrow Ca(OH)_2 + CH \equiv CH$

Properties of alkanes

Halogenation

$R-H \xrightarrow[h\nu]{X-X} R-H+H-X$

Q.1  ...... $\{R_1° : R_2° : R_3° = 1 : 4 : 5\}$

Q.2 

Alkene

Methods of preparation

(1) from alkynes

$R_1 - C \equiv C - R_2 \xrightarrow{H_2/Pd\text{–}BaSO_4}$

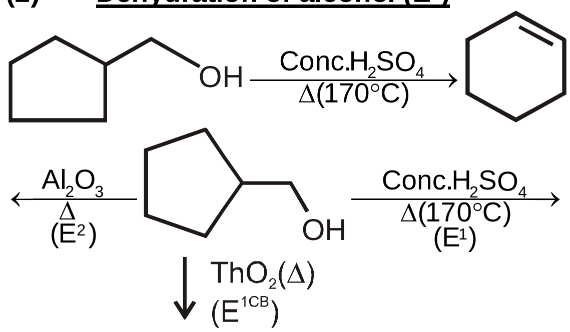
$H_2 - Pd - BaSO_4$ (Rosenmund's Catalyst)

$H_2 - Pb - CaCO_3$ (Lindlar's catalyst.

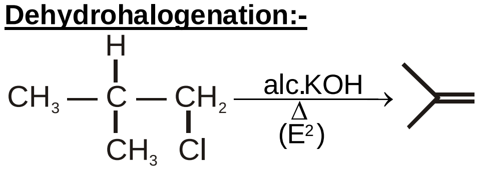
Syn – addition $\longrightarrow$ cis alkene is produced.

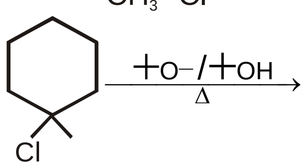
Imp. Reactivity of alkyne is more than alkene towards hydrogenation.

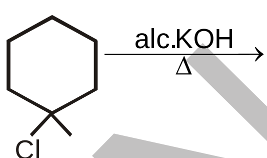
(2) Dehydration of alcohol (E[1])

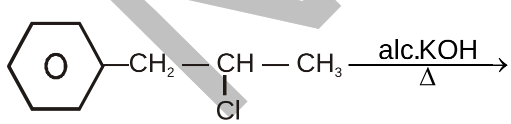


(3) Dehydrohalogenation:-



Q.1 

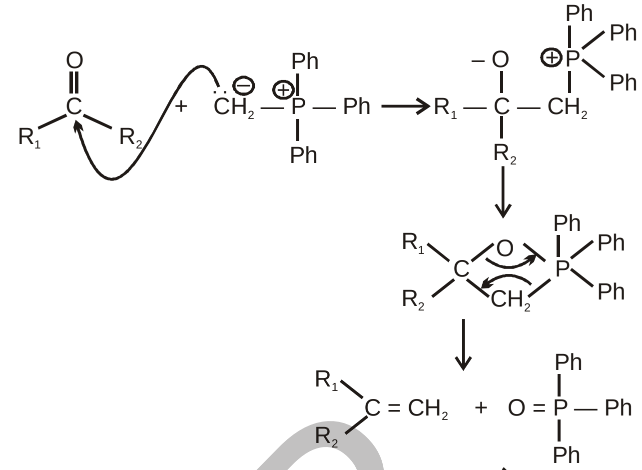
Q.2 

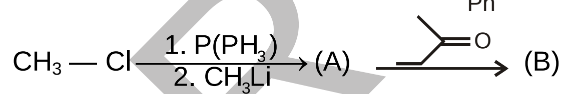
Q.3 

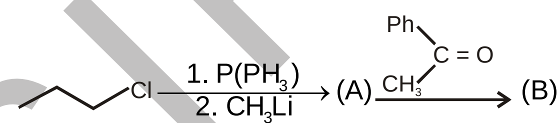
(4) Wittig Reaction

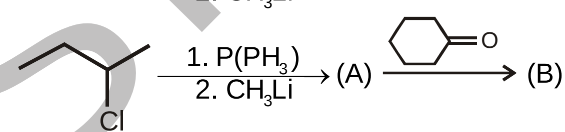
$$\begin{matrix} R_1 \\ R_2 \end{matrix}\!\!\!> C = O + CH_2 = P(Ph)_2 - Ph \longrightarrow \text{- - - - - - - - - -}$$

Mechanism.



Q.1 

Q.2 

Q.3 

(5) Kolbe Electrolysis

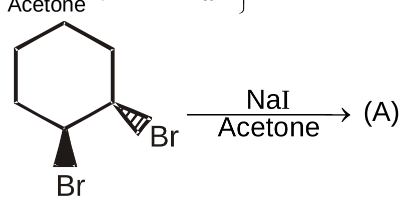
$$\begin{matrix} CH_2 - COOK \\ | \\ CH_2 - COOK \end{matrix} \xrightarrow{\text{electrolysis}} \text{- - - - - - - - -}$$

(6) NaI/Acetone

$$\underset{Br}{CH_2} - \underset{Br}{CH_2} \xrightarrow[\text{Acetone}]{\text{NaI}} \text{- - - - - - - - - -}$$

Remember.

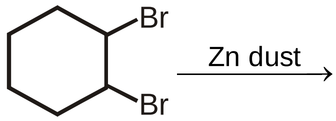
$$\left.\begin{matrix} R - Br \xrightarrow[\text{Acetone}]{\text{NaI}} R - I + NaBr \\ R - Cl \xrightarrow[\text{Acetone}]{\text{NaI}} R - I + NaBr \end{matrix}\right\} \text{(Finkelstein Reaction)}$$

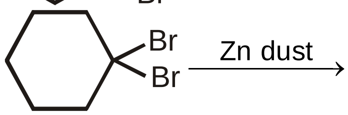
Q.1 

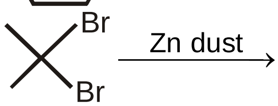
(7) Zn - dust

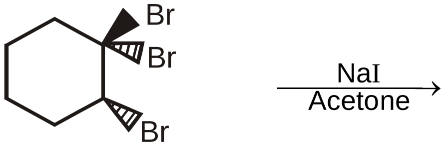
$$CH_3 - \underset{Br}{CH} - \underset{Br}{CH} - CH_3 \xrightarrow{\text{Zn dust}} \text{- - -}$$

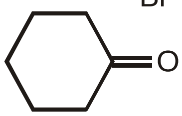
$CH_3-CH(Br)_2 \xrightarrow{\text{Zn dust}}$ - - - - - - - - - -

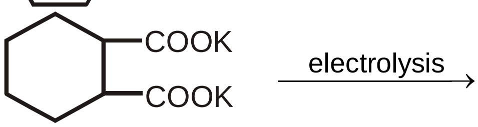
Q.1 

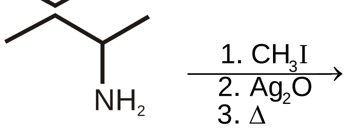
Q.2 

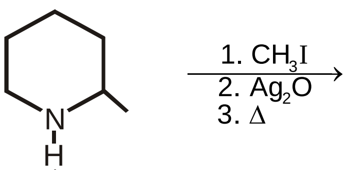
Q.3 

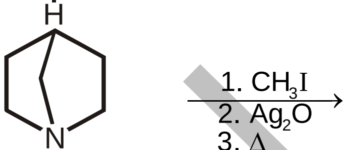
Q.4 

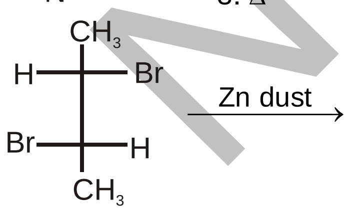
Q.5  + $(Ph)_3P = CH - CH_3 \longrightarrow$

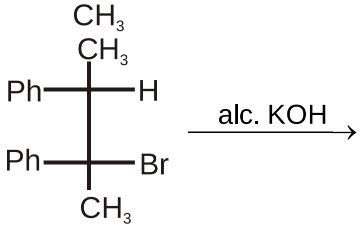
Q.6 

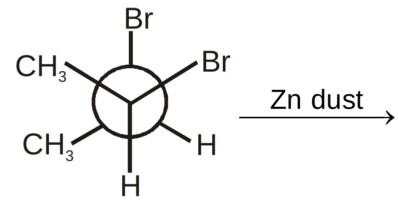
Q.7 

Q.8 

Q.9 

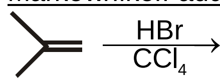
Q.10 

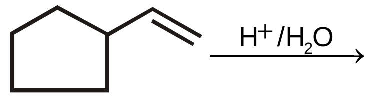
Q.11 

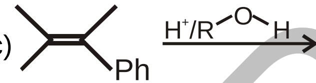
Q.12 

<u>Reaction of Alkene</u>

1. <u>Markownikoff addition</u>

(a) 

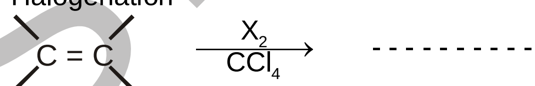
(b) 

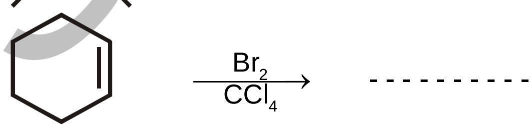
(c) 

2. Anti – Markonikov addition

$CH_3 - CH = CH_2 \xrightarrow[R-O-O-R]{HBr}$

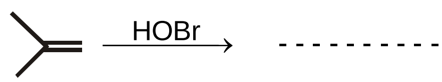
3. Halogenation



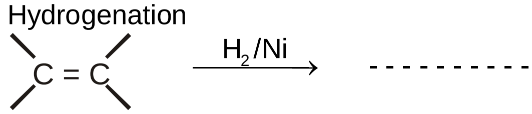


4. Halohydrin

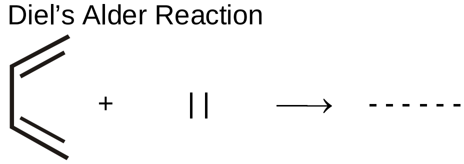
$CH_3 = CH - CH_3 \xrightarrow{HOCl}$ - - - - - -

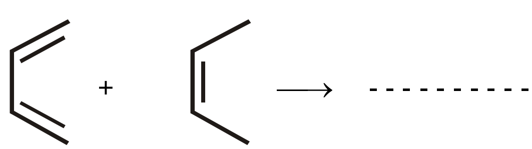


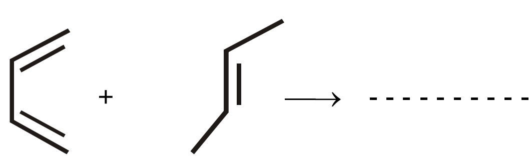
5. Hydrogenation

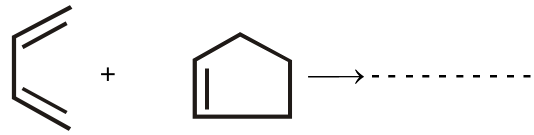


6. Diel's Alder Reaction



1. 

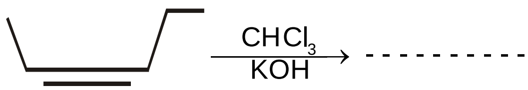
2. 

3. 

7. Reaction with carbene

1. $CH_3 — HC = CH_2 \xrightarrow[h\nu]{CH_2N_2}$ - - - - - - - - - -

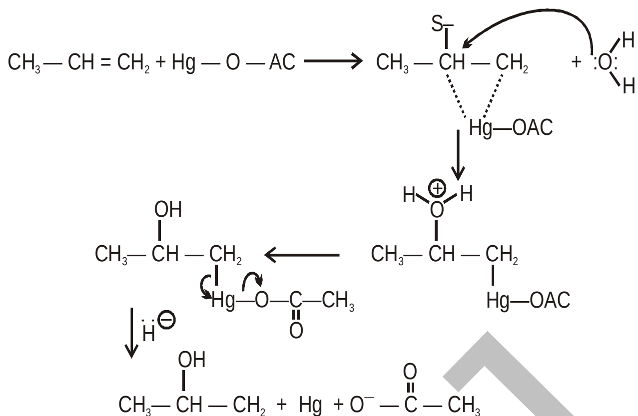
2. $CH_3 — CH = CH — CH_3 \xrightarrow[KOH]{CHCl_3}$ - - - - - -

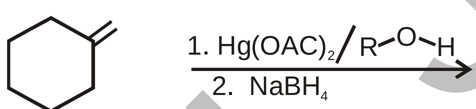
3. 

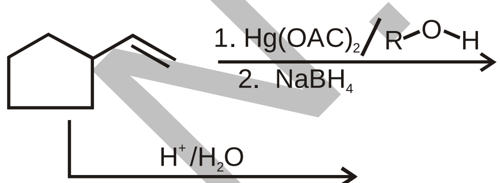
8. OMDM (oxymercuration – demercuration)

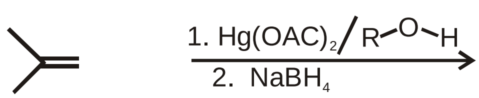
$CH_3 — CH = CH_2 \xrightarrow[2.\ NaBH_4]{1.\ Hg(OAC)_2/H-O-H}$ - - - -

Mechanism:-

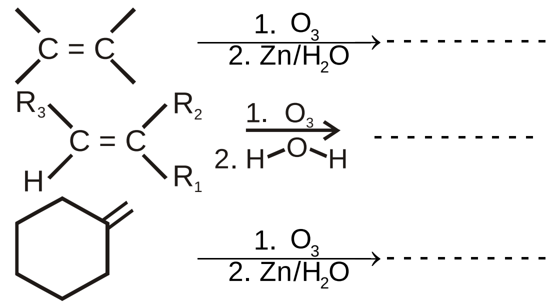


Q.1 

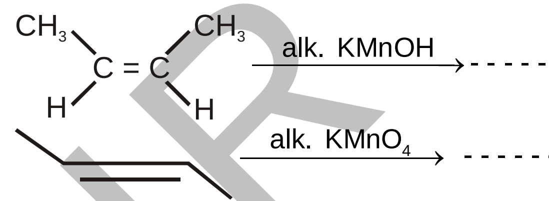
Q.2 

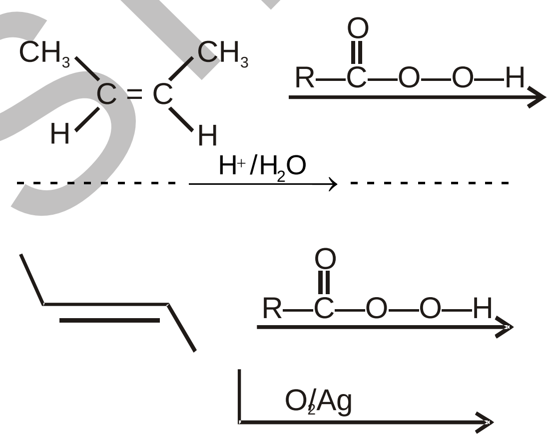
Q.3 

OZONOLYSIS:-



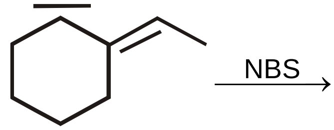
Reaction of alkene (Hydroxylation)

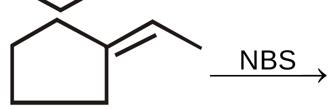
1. 

2. 

NBS

1. 

2. 

3. 

ALKYNES

Preparation of alkynes

1. Intermolecular Kolbe Electrolysis:–

$$\begin{matrix} CH - COOK \\ \| \\ CH - COOK \end{matrix} \xrightarrow{\text{electrolysis}}$$

2. Vicinal dihalides

$$CH_3 - \underset{Br}{\underset{|}{CH}} - \underset{Br}{\underset{|}{CH}} - CH_3 \xrightarrow[E^2]{2NaNH_2}$$

3. Gem dihalides

$$CH_3 - CH_2 - \underset{Br}{\underset{|}{\overset{Br}{\overset{|}{C}}}} - CH_3 \xrightarrow{2NaNH_2}$$

4. Tetra halides

$$CH_3 - \underset{Br}{\underset{|}{\overset{Br}{\overset{|}{C}}}} - \underset{Br}{\underset{|}{\overset{Br}{\overset{|}{C}}}} - CH_3 \xrightarrow[\Delta]{Zn\,dust}$$

5. $CH\,I_3 \xrightarrow[\text{Powder}]{Ag}$

6.

7. 6. $CaC_2\ 2H_2O \longrightarrow$

Conversion of terminal to non – terminal alkyne

$$CH_3 - CH_2 - C \equiv CH \underset{NaNH_2}{\overset{alc.KOH}{\rightleftharpoons}}$$

(n – hexane or paraffin solvent)

---

(1) Forward Reaction:–

$$CH_3 - CH_2 - C \equiv CH + \overline{O}H \rightleftharpoons CH_3 - \overset{\cdot\cdot\,\ominus}{CH} - C \equiv CH + H{-}O{-}H$$

$$\Updownarrow$$

$$CH_3 - HC = C = \overset{\cdot\cdot\,\ominus}{CH}$$

$$\big\downarrow H{-}O{-}H$$

$$CH_3 - HC = C = CH_2 + OH^{\ominus}$$

$$\rightleftharpoons OH^{\ominus}$$

$$CH_3 - \overset{\cdot\cdot\,\ominus}{C} = C = CH_2 + H_2O$$

$$\Updownarrow$$

$$CH_3 - C \equiv C - \overset{\cdot\cdot\,\ominus}{CH_2}$$

$$\big\downarrow H{-}O{-}H$$

$$CH_3 - C \equiv C - CH_3 + OH^{\ominus}$$

driving force is thermodynamic stability.

(2) Reverse Reaction:–

$$CH_3 - C \equiv C - CH_3 + \overset{\cdot\cdot\,\ominus}{NH_2} \rightleftharpoons CH_3 - C \equiv CH_2\overset{\ominus}{:} + NH_3$$

$$\Updownarrow$$

$$CH_3 - \overset{\cdot\cdot\,\ominus}{C} \equiv C = CH_2$$

$$\big\downarrow NH_3$$

$$CH_3 - CH = C = CH_2 + \overset{\cdot\cdot\,\ominus}{NH_2}$$

$$\big\downarrow \overset{\cdot\cdot\,\ominus}{NH_2}$$

$$CH_3 - CH = C = CH{:}\ominus + NH_3$$

$$\Updownarrow$$

$$CH_3 - \overset{\cdot\cdot\,\ominus}{CH} - C \equiv CH$$

$$\big\downarrow NH_3$$

$$CH_3 - CH_2 - C \equiv CH + \ddot{N}H_2^{\ominus}$$

$$\downarrow NaNH_2$$

$$CH_3 - CH_2 - C \equiv C:^{\ominus}\ Na^{\oplus}\ \text{(ppt.)}$$

→ driving force of reaction is insoluble salt of alkyne.

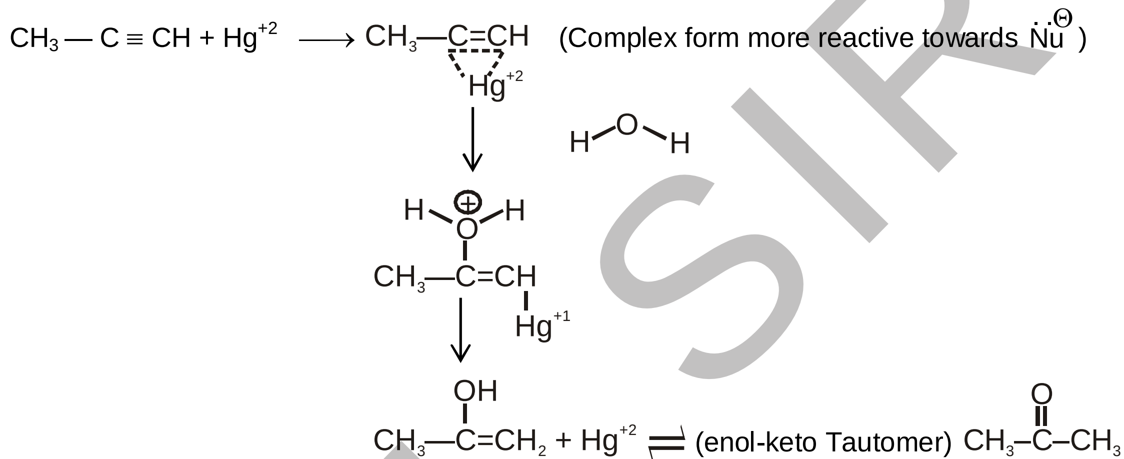
Acidic nature
R - OH > CH ≡ CH > NH_3

Reaction of alkynes

(1) Hydration

$$CH_3 - C \equiv CH \xrightarrow[H_2SO_4]{HgSO_4} CH_3 - \overset{O}{\overset{\|}{C}} - CH_3$$

Mechanism



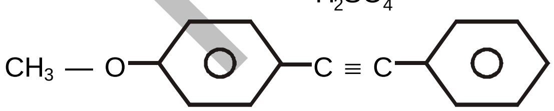
Q. Identify major product:–

(1) $Ph - C \equiv C - CH_3 \xrightarrow[dil.H_2SO_4]{HgSO_4}$

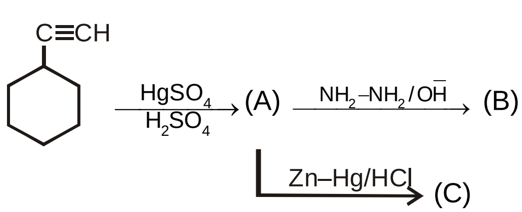
(2) $CH_3 - CH_2 - C \equiv CH \xrightarrow[dil.H_2SO_4]{HgSO_4}$

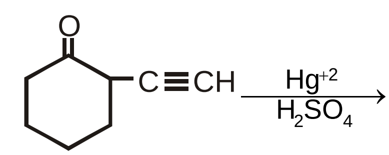
(3) $Ph - CH = CH_2 \xrightarrow[CCl_4]{Br_2}$

(A) $\xrightarrow{2NaNH_2}$ (B) $\xrightarrow[H_2SO_4]{HgSO_4}$ (C)

(4) 

$\xrightarrow[H_2SO_4]{HgSO_4}$

(5) 

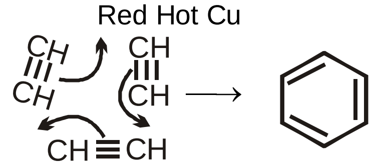
(6) 

(7) $CH_3 - C \equiv CH \xrightarrow[D_2SO_4]{HgSO_4}$

Polymerisation of alkynes

(1) 

Red Hot Cu



(2) $CH_3 - C \equiv CH \xrightarrow[Cu]{Red\ Hot}$

(3) $\begin{matrix} CH \\ ||| \\ CH \end{matrix} \quad \begin{matrix} CH \\ ||| \\ CH \end{matrix} \xrightarrow[\Delta]{Cu}$

S

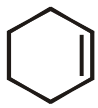
(4) $2CH{\equiv}CH \xrightarrow{NH_4OH/AgNO_3} CH{\equiv}C:^{\Theta} Ag^{+}$ (white ppt.)

$\xrightarrow{\text{ammonical } Cu_2Cl_2} H{-}C{\equiv}C:^{\Theta} Cu^{+}$ (red ppt.)

Test for alkenes & alkynes

Alkenes

1. decolourise Br_2/H_2O.

2.  $\xrightarrow[\text{alk. KMnOH}]{\text{Cold}}$

Alkynes

1. $CH_3-C\equiv CH \xrightarrow[Ag^{+}(NH_3)_2]{\text{ammonical } AgNO_3}$

2. $CH_3-C\equiv C-CH_3 \xrightarrow[AgNO_3]{\text{ammonical}}$

3. decolourise Br_2/H_2O.

4. $2\,CH_3-C\equiv CH \xrightarrow{Cu_2O}$

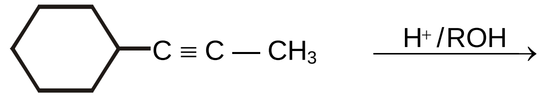
Electrophilic addition

1. $CH_3-C\equiv CH \xrightarrow{HBr}$

2. $CH_3-C\equiv C-CH_3 \xrightarrow{Br_2/CCl_4}$

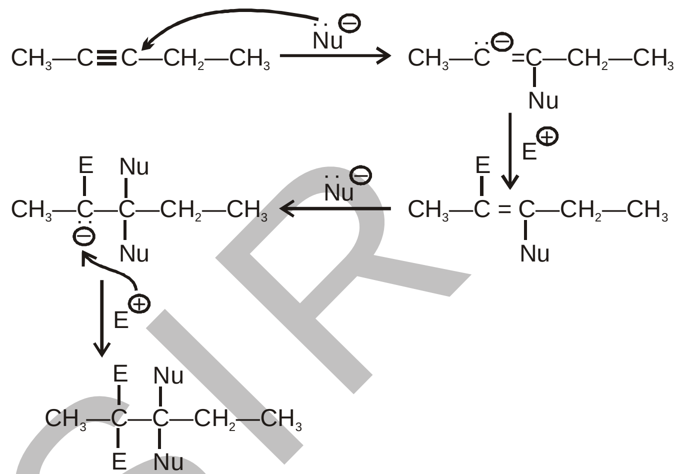
3. $CH_3-C\equiv C-CH_3 \xrightarrow{HCl/CCl_4}$

4. $CH_3-C\equiv C-CH_3 \xrightarrow[HgSO_4]{H^{+}/H_2SO_4}$

5. 

Nucleophilic addition (exceptional)

1.



Since carbanion is stable on Sp carbon atom but these type of reactions not given by alkenes.

1. $CH_3-C\equiv C-CH_3 \xrightarrow{\overline{O}H/H_2O}$

2. $CH_3-C\equiv C-CH_3 \xrightarrow{R\overline{O}/ROH}$

3. $CH_3-C\equiv C-CH_3 \xrightarrow{R-\overset{O}{\overset{\|}{C}}-\overline{O}\,/\,R-\overset{O}{\overset{\|}{C}}-OH}$

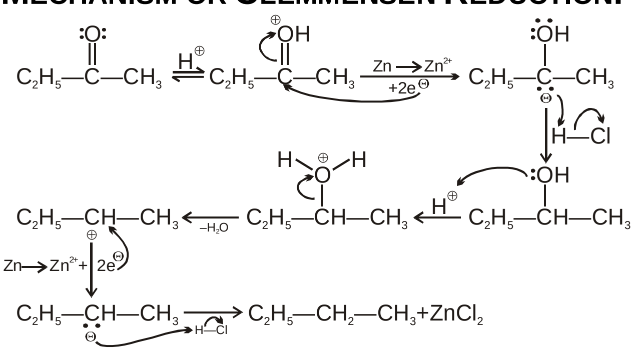
CLEMMENSEN REDUCTION:-

The reduction of carbonyl groups of aldehydes and ketones to methylene groups with amalgamated zinc and concentrated hydrochloric acid is known as Clemmensen reduction. The mechanism summarized below showing that reduction under acidic conditions often involves protonated species to which the metal offers.

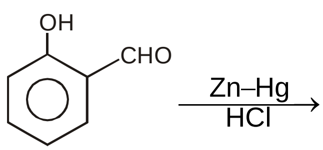
$$C_2H_5 - \overset{O}{\overset{\|}{C}} - CH_3 \xrightarrow[HCl]{Zn(Hg)\ or\ Na(Hg)}$$

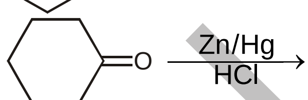
$$C_2H_5 - CH_2 - CH_3$$

MECHANISM OR CLEMMENSEN REDUCTION:-

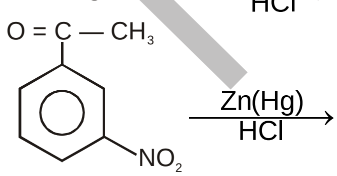


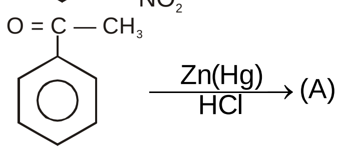
Q.1 $PhCOCH_2 - CH_2COH \xrightarrow[HCl]{Zn/Hg}$

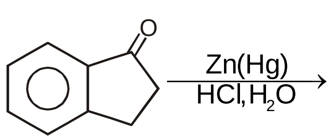
Q.2 

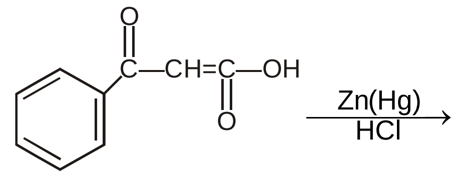
Q.3 

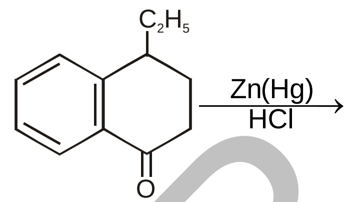
Q.4 $Ph - \overset{O}{\overset{\|}{C}} - CH_3 \xrightarrow[HCl]{Zn(Hg)}$

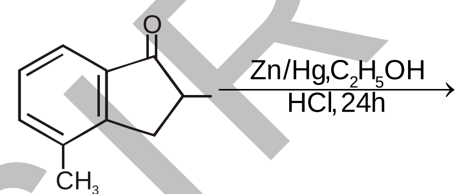
Q.5 

Q.6 

Q.7 

Q.8 

Q.9 

Q.10 

Q.11 $Me(CH_2)_5\ CH = O \xrightarrow[25\%HCl]{Zn,Hg}$

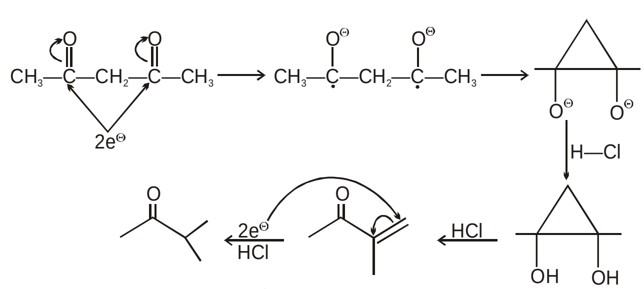
Q.12 **EXCEPTION OF CLEMMENSON:-**

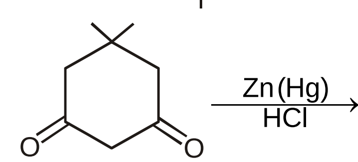
(i) Diketo containing active methylene group when undergoes clemmenson reduction, unexpected product are formed.

$$CH_3 - \overset{O}{\overset{\|}{C}} - CH_2 - \overset{O}{\overset{\|}{C}} - CH_3 \xrightarrow[HCl]{Zn(Hg)}$$

$$CH_3 - \overset{O}{\overset{\|}{C}} - \underset{CH_3}{\underset{|}{CH}} - CH_3$$

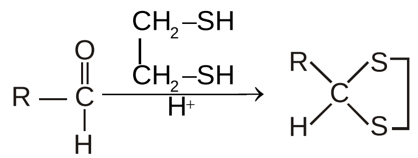
MECHANISM:-



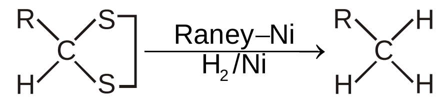
Example 

DPP NO-02 Time: 15 minutes

MOZINGO METHOD:-

(i) 

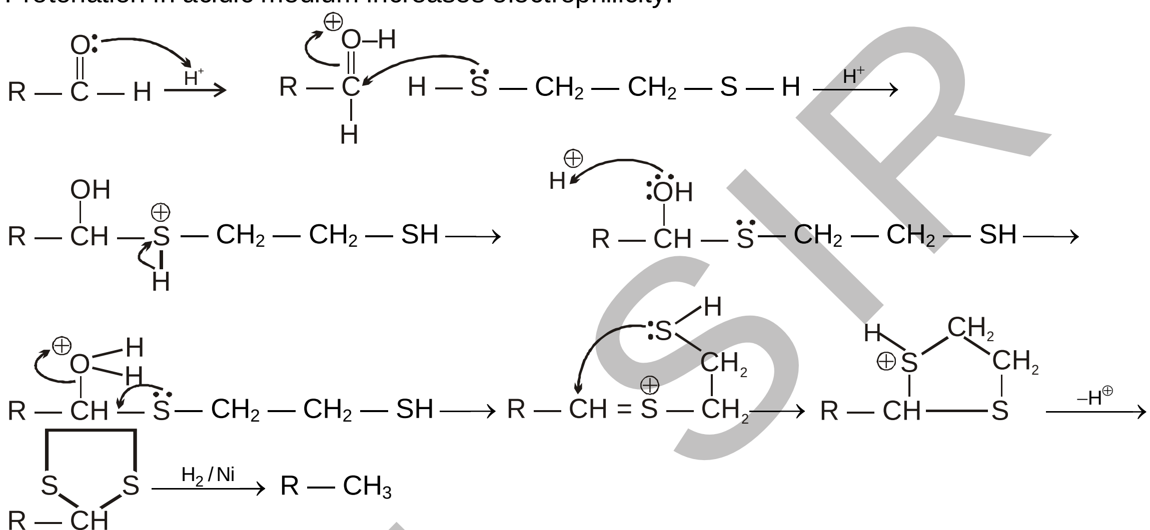
Cyclic thioacetal

(ii) 

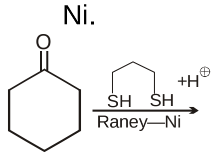
de-sulfurisation

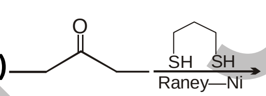
MECHANISM OF MOZINGO METHOD:-

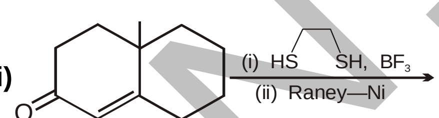
Protonation in acidic medium increases electrophilicity.

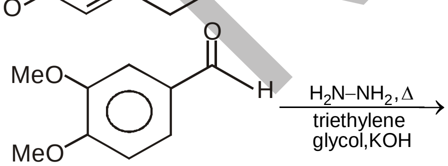


Imp. Raney Nickel → H_2 molecule is adsorbed on Ni.

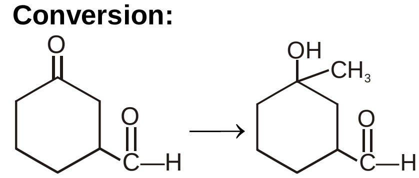
(i) 

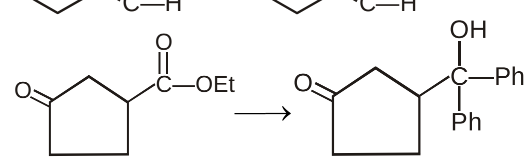
(ii) 

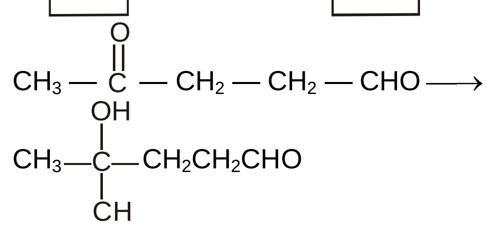
(iii) 

(iv) 

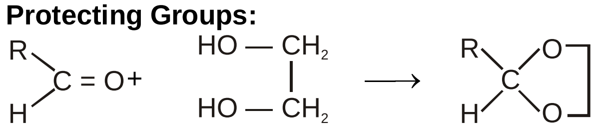
Conversion:

(i) 

(ii) 

(iii) 

Protecting Groups:



cyclic-acetal

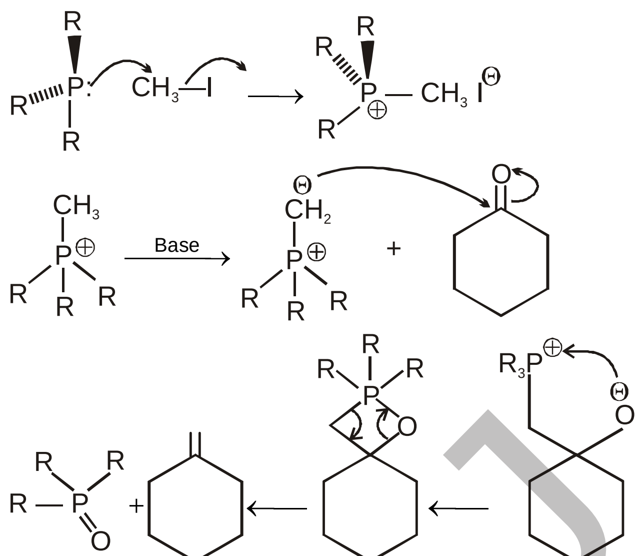
Glycol is used for protection of aldehyde and Ketone.

DPP NO-03 Time: 15 minutes

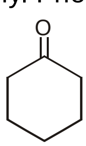
WITTING REACTION

Witting reaction is the substitution of a C = C bond for a C = O bond.

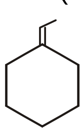
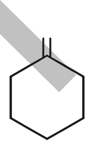
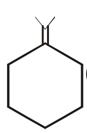
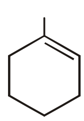
The witting reaction is a reaction between a carbonyl compound (aldehyde or ketone only) and a species known as a phosphonium ylid. An ylid is a species with positive and negative charges on adjacent atoms, and a phosphonium ylid carries its positive charge on Phosphorus, phosphonium ylids are made from phosphonium salts by deprotonating them with a strong base.



Triphenyl Phosphineoxide

Q.1  $+ H_2\overset{\ominus}{C}-\overset{\oplus}{P}Ph_3 \longrightarrow (A)$

product (A) is

(A)  (B)  (C)  (D) 

Q.2 In which of the following Geometrical isomer is formed as a products.

(A) $CH_3 — CH = O + H_2C = PPh_3 \longrightarrow$

(B) $CH_3—CH = O + CH_3 — CH = PPh_3 \longrightarrow$

(C) $H — \overset{O}{\overset{\|}{C}} — H + H_2C = PPh_3 \longrightarrow$

(D) All

Q.3 Witting reaction is used for preparation of:

(A) Alkene (B) Ketone

(C) Aldehyde (D) Acid.

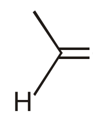
Q.4 Give the structure of he alkene(s) formed in each of the following reactions.

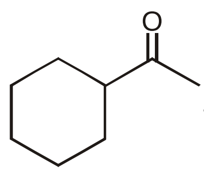
(A) $CH_3CH_2I \xrightarrow{Ph_3P} \xrightarrow{\text{butyllithium}} \xrightarrow{\text{acetone}}$

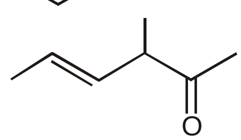
(B) $CH_3Br \xrightarrow{Ph_3P} \xrightarrow{\text{butyllithium}} \xrightarrow{\text{benzaldehyde}}$

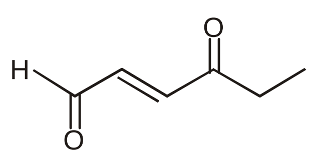
Give the product of the following reaction:

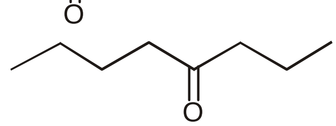
Q.5  $O + CH_2 = PPh_3 \longrightarrow$

Q.6  $O + CH_2 = PPh_3 \longrightarrow$

Q.7  $+ CH_2 = PPh_3 \longrightarrow$

Q.8  $+ CH_2 = PPh_3 \longrightarrow$

Q.9  $+ CH_2 = PPh_3 \longrightarrow$

Q.10  $+ CH_2=PPh_3 \longrightarrow$

DPP NO-04 Time: 15 minutes

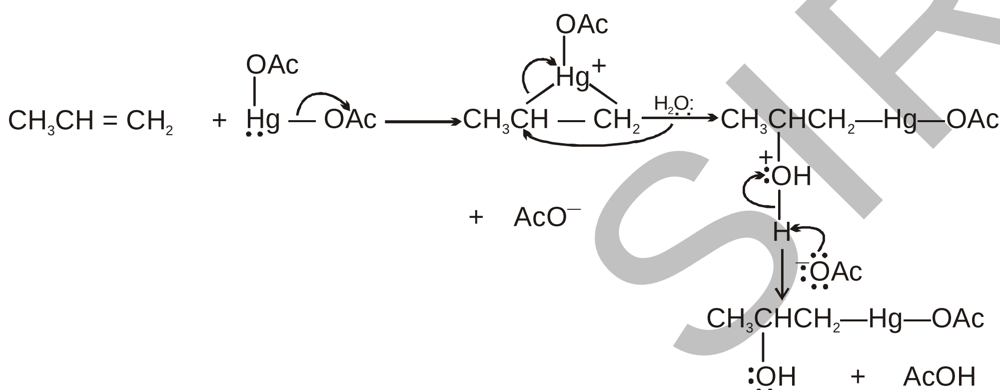
OXYMERCURATION-DEMERCURATION (OMDM):-

OMDM is a hydration process of alkene according to Markawnikoff's rule with no rearrangement of cyclic mercuinium ion. In oxymercuration, the alkene is treated with mercuric acetate in aqueous tetrahydrofuran (THF). When reaction with that reagent in complete, sodium borohydride and hydroxide ion are added to the reaction mixture.

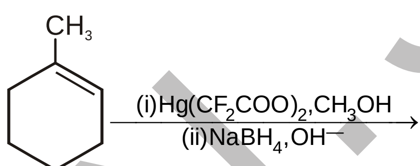
$$R - CH = CH_2 \xrightarrow[\text{(ii) } NaBH_4, HO^-]{\text{(i) } Hg(OAc)_2, H_2O, THF} R - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$$

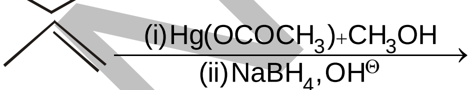
$AcO^- = CH_3COO^-$

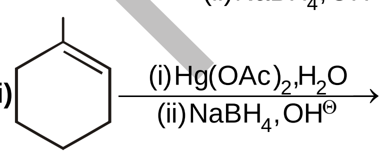
MECHANISM FOR OXYMERCURATION:

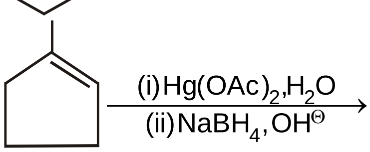


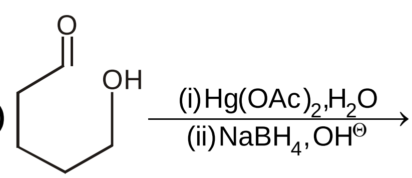
Q.1 Identify the product of the following reaction:-

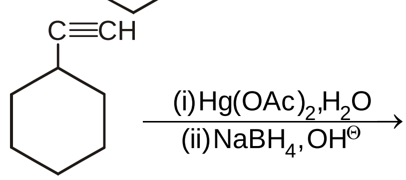
(i) 

(ii) 

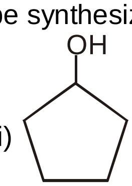
(iii) 

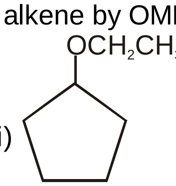
(iv) 

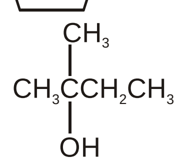
(v) 

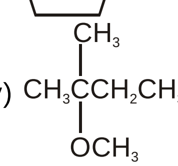
(vi) 

Q.2 How could each of the following compounds be synthesized from an alkene by OMDM?

(i) 

(ii) 

(iii) 

(iv) 

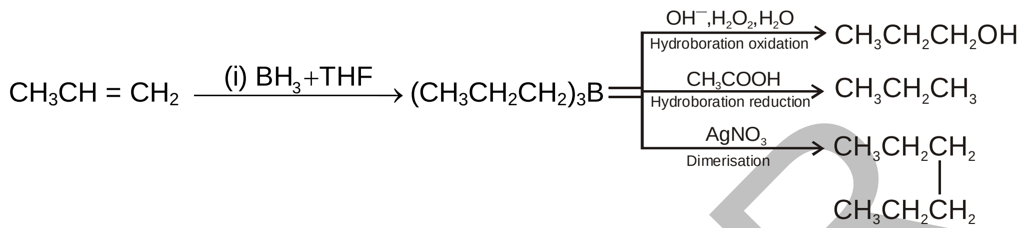
ETOOS Academy Pvt. Ltd.

F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

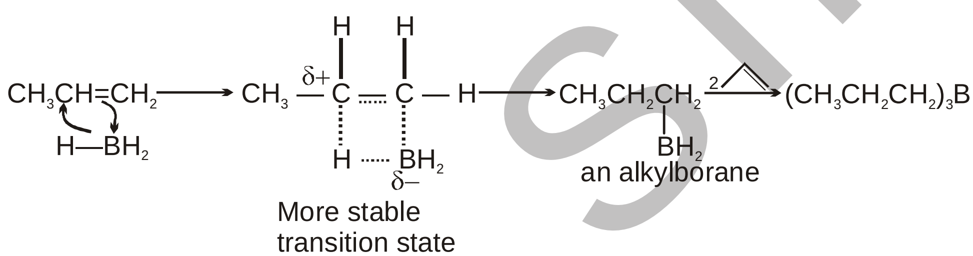
DPP NO-05 Time: 15 minutes

HYDROBORATION-OXIDATION:-

Hydroboration has been developed by brown as a reaction of tremendous synthetic utility because alkyl boranes are able to undergo a variety of transformation. Hydroboration is a one step, four centre, cis addition process in accordance with M. rule but after oxidation it seems to be appear to violate M. rule.

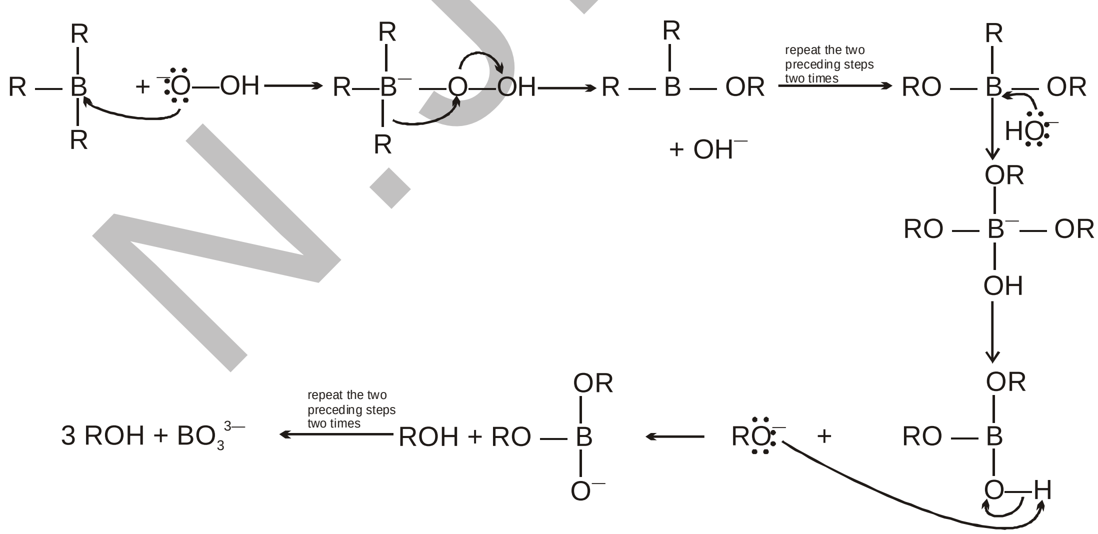


MECHANISM OF HYDROBORATION:



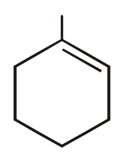
Mechanism of oxidation:-

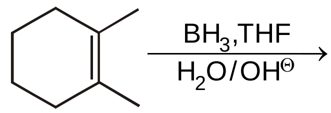
HOOH + HO$^-$ 1 HOO$^-$ + H$_2$O

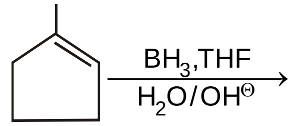


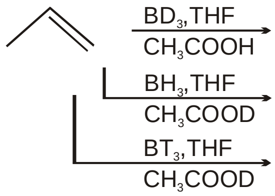
Q.1 Identify the product of the following reaction:-

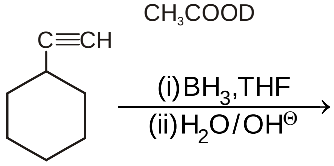
(i) $CH_2 = CH_2 \xrightarrow[\text{(ii)}HO^-,H_2O_2,H_2O]{\text{(i)}BH_3}$

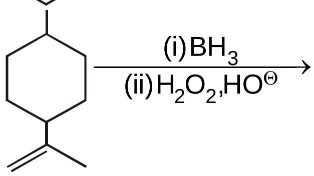
(ii)  $\xrightarrow[\text{(ii)}HO^-,H_2O_2,H_2O]{\text{(i)}BH_3}$

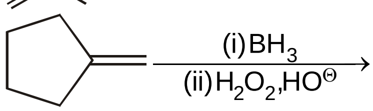
(iii) 

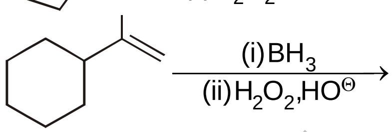
(iv) 

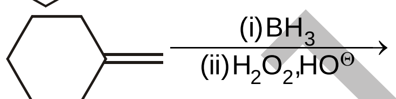
(v) 

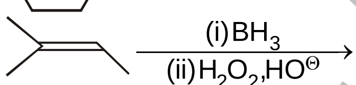
(vi) 

(vii) 

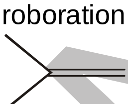
(viii) 

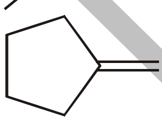
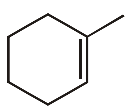
(ix) 

(x) 

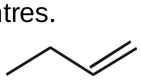
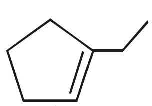
(xi) 

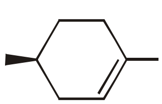
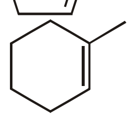
Q.2 What alkyl borane is formed from hydroboration of each alkene?

(A)  (B) 

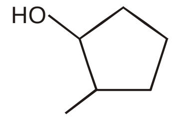
(C)  (D) 

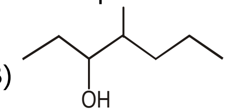
Q.3 Draw the product formed when each alkene is treated with BH_3 followed by H_2O_2, $HO^{\ominus}$ include the stereochemistry at all streogenic centres.

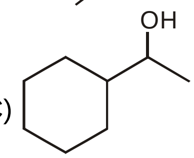
(A)  (B) 

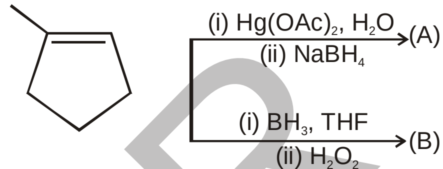
(C)  (D) 

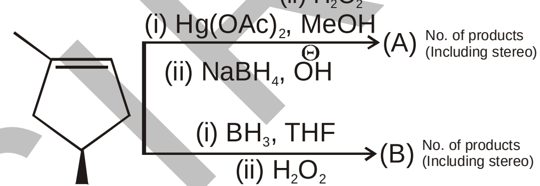
Q.4 What alkene can be used to prepare each alcohol as the exclusive product of a two step hydroboration oxidation sequence?

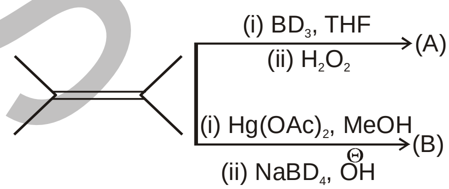
(A) 

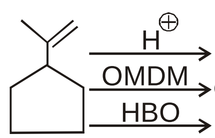
(B) 

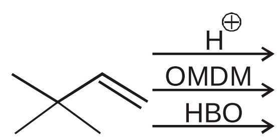
(C) 

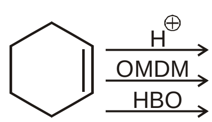
Q.5 

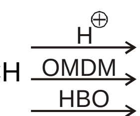
Q.6 

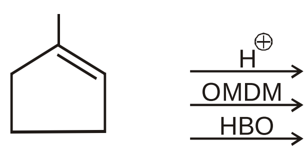
Q.7 

Q.8 

Q.9 

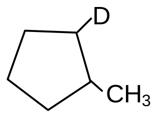
Q.10 

Q.11 $CH_3—C\equiv CH$ 

Q.12 

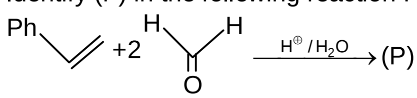
EXERCISE – I

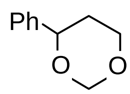
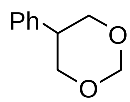
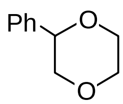
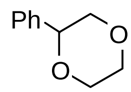
Q.1 1-Methylcyclopentene can be converted into the given compound



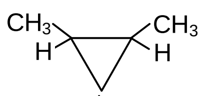
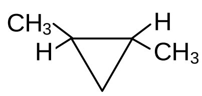
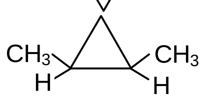
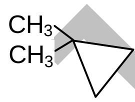
by the use of which of the following regents ?
(A) BD_3 followed by HCOOH
(B) BH_3 followed by HCOOD
(C) BD_3 followed by HCOOD
(D) BH_3 followed by D – C(=O) – O – H

Q.2 Identify (P) in the following reaction :

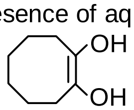
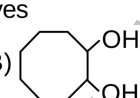
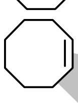
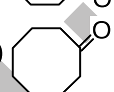


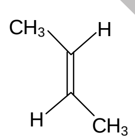
(A) 
(B) 
(C) 
(D) 

Q.3 The reaction of E-2-butene with CH_2I_2 and Zn – Cu Couple in either medium leads to formation of

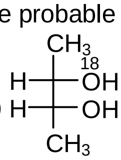
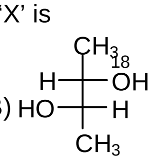
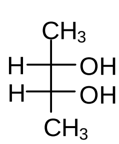
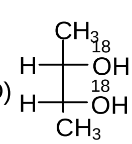
(A) 
(B) 
(C) 
(D) 

Q.4 The reaction of cyclooctyne with $HgSO_4$ in the presence of aq. H_2SO_4 gives

(A) 
(B) 
(C) 
(D) 

Q.5  $\xrightarrow[\text{(ii)}\, H_3O^{\oplus}]{\text{(i)}\, CH_3COO\overset{18}{O}H}$ X

The probable structure of 'X' is

(A) 
(B) 
(C) 
(D) 

Q.6 Compound (A) on oxidation with hot $KMnO_4/OH^{\ominus}$ gives two compound

$CH_3 - \underset{CH_3}{CH} - COOH$ & $CH_3 - \overset{O}{\overset{\|}{C}} - CH_2CH_2CH_3$

compound A will have structure.
(A) $CH_3CH_2 - \underset{CH_3}{C} = \underset{CH_3}{C} - CH_2CH_3$
(B) $CH_3 - \underset{CH_3}{CH} - CH = \underset{CH_3}{C} - CH_2CH_2CH_3$
(C) $CH_3\underset{CH_3}{CH} - C \equiv C - CH_3$
(D) $CH_3 - \underset{CH_3}{CH} - C \equiv C - \underset{CH_3}{CH} - CH_3$

Q.7 Number of required O_2 mole for complete combustion of one mole of propane
(A) 7 (B) 5 (C) 16 (D) 10

Q.8 How much volume of air will be needed for complete combustion of 10 lit. of ethane
(A) 135 lit. (B) 35 lit.
(C) 175 lit. (D) 205 lit.

Q.9 During the preparation of ethane by Kolbe's electrolytic method using inert electrodes the pH of the electrolyte
(A) Increases progressively as the reaction proceeds
(B) Decreases progressively as the reaction proceeds
(C) Remains constant throughout the reaction
(D) May decrease of the concentration of the electrolyte is not very high

Q.10 Ethylene forms ethylene chlorohydrin by the action of
(A) Dry HCl gas
(B) Dry chlorine gas
(C) Solution of chlorine gas in water
(D) Dilute hydrochloric acid

Q.11 Anti–Markownikoff's addition of HBr is not observed in
(A)Propene (B) But-2-ene
(C) Butene (D) Pent-2-ene

Q.12 Which alkene on heating with alkaline KMnO4 solution gives acetone and a gas, which turns lime water milky
(A) 2-Methyl-2-butene (B) Isobutylene
(C) 1-Butene (D) 2-Butene

Q.13 B $\xleftarrow{\text{Lindlar}}$ R – C ≡ C – R $\xrightarrow{Na/NH_3}$ A
A and B are geometrical isomers
(R – CH = CH – R)–
(A) A is trans, B is cis

(B) A and B both are cis
(C) A and B both are trans
(D) A is cis, B is trans

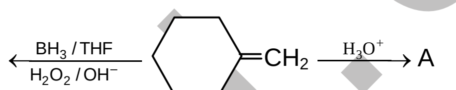
Q.14 Which is expected to react most readily with bromine
(A) $CH_3CH_2CH_3$ (B) $CH_2 = CH_2$
(C) $CH \equiv CH$ (D) $CH_3 - CH = CH_2$

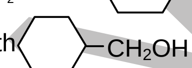
Q.15 An alkyne C_7H_{12} on reaction with alk. $KMnO_4$ and subsequent acidification with HCl yields a mixture of $CH_3-\underset{\large CH_3}{\underset{|}{C}}HCOOH + CH_3CH_2COOH$.
The alkyne is
(A) 3-Hexyne (B) 2-Methyl-3-hexyne
(C) 2-Methyl-2-hexyne (D) 2-Methyl-2-hexene

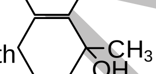
Q.16 A compound (C_5H_8) reacts with ammonical $AgNO_3$ to give a white precipitate and reacts with excess of $KMnO_4$ solution to give $(CH_3)_2CH-COOH$. The compound is
(A) $CH_2 = CH - CH = CH - CH_3$
(B) $(CH_3)_2CH - C \equiv CH$
(C) $CH_3(CH_2)_2C \equiv CH$
(D) $(CH_3)_2C = C = CH_2$

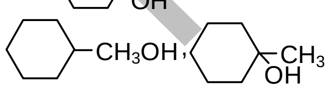
Q.17 Which of the following reagents cannot be used to locate the position of triple bond in $CH_3-C\equiv C-CH_3$
(A) Br_2 (B) O_3 (C) Cu_2^{2+} (D) $KMnO_4$

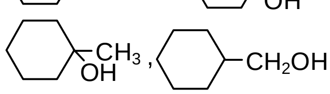
Q.18 $CH_3-CH_2-C\equiv CH \underset{B}{\overset{A}{\rightleftharpoons}} CH_3C\equiv C-CH_3$
A and B are
(A) alcoholic KOH and $NaNH_2$
(B) $NaNH_2$ and alcoholic KOH
(C) $NaNH_2$ and Lindlar
(D) Lindlar and $NaNH_2$

Q.19 

(A) Both 

(B) Both 

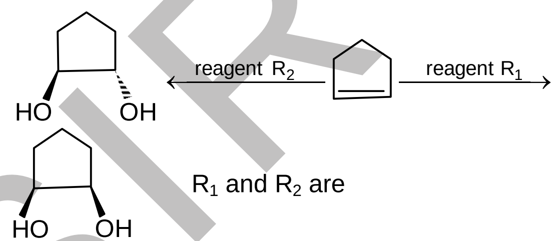
(C) 

(D) 

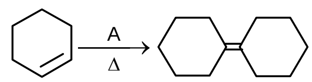
Q.20 $B \xleftarrow[H_2O_2, OH^-]{BH_3THF} CH_3-C\equiv CH \xrightarrow{HgSO_4/H_2SO_4} A$
A and B are -
(A) CH_3CH_2CHO, $CH_3-\overset{\overset{\large O}{||}}{C}-CH_3$
(B) $CH_3-\overset{\overset{\large O}{||}}{C}-CH_3$, CH_3CH_2CHO
(C) CH_3CH_2CHO (both)
(D) $CH_3-\underset{\underset{\large O}{||}}{C}-CH_3$ (both)

Q.21 $CH_3CH=CH_2 \xrightarrow[H_2O_2/OH^-]{B_2D_6}$ product X
X is
(A) $CH_3-\underset{\large OH}{\underset{|}{C}H}-CH_2D$ (B) $CH_3-\underset{\large D}{\underset{|}{C}H}-CH_2OH$
(C) $CH_3-\underset{\large OD}{\underset{|}{C}H}-CH_3$ (D) None is correct

Q.22 Mixture of one mole each of ethene and propyne on reaction with Na will form H_2 gas at S.T.P.
(A) 22.4 L (B) 11.2 L
(C) 33.6 L (D) 44.8 L

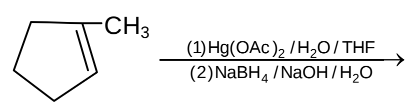
Q.23 

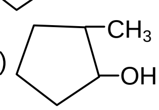
R_1 and R_2 are
(A) Cold alkaline $KMnO_4$, OsO_4/H_2O_2
(B) Cold alkaline $KMnO_4$, $HCO_3H/H_3O^{\oplus}$
(C) Cold alkaline $KMnO_4$, $CH_3-O-O-CH_3$
(D) $C_6H_5CO_3H$, HCO_3H

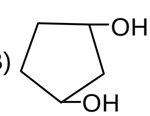
Q.24 

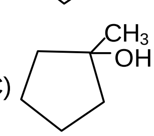
A can be
(A) Conc. H_2SO_4 (B) alcoholic KOH
(C) Et_3N (D) t-BuOK

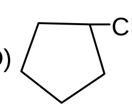
Q.25 $BrCH_2-CH_2-CH_2Br$ reacts with Na in the presence of ether at 100°C to produce
(A) $BrCH_2-CH=CH_2$ (B) $CH_2=C=CH_2$
(C) CH_2-CH_2 / CH_2 (D) All of these

Q.26 

(A) 

(B) 

(C) 

(D) 

Q.27 $\underset{cis}{CH_3-CH=CH-CH_3} \xrightarrow{x}$ product is Y (non-resolvable) then X can be
(A) Br_2 water
(B) $HCO_3H/H_3O^{\oplus}$

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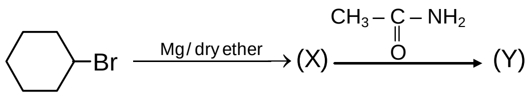
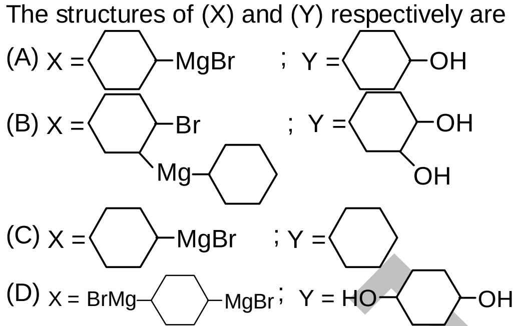
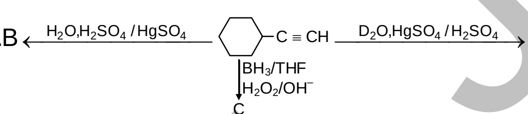
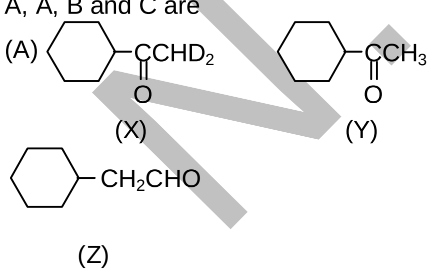
(C) Cold alkaline $KMnO_4$
(D) All of the above

Q.28 A mixture of CH_4, C_2H_4 and C_2H_2 gaseous are passed through a Wolf bottle containing ammonical cuprous chloride. The gas coming out is
(A) Methane
(B) Acetylene
(C) Mixture of methane and ethylene
(D) Original mixture

Q.29 For the ionic reaction of hydrochloric acid with the following alkenes, predict the correct sequence of reactivity as measured by reaction rates :
(I) $ClCH = CH_2$ (II) $(CH_3)_2.C = CH_2$
(III) $OHC.CH = CH_2$ (IV) $(NC)_2C = C(CN)_2$
(A) IV > I > III > II (B) I > IV > II > III
(C) III > II > IV > I (D) II > I > III > IV

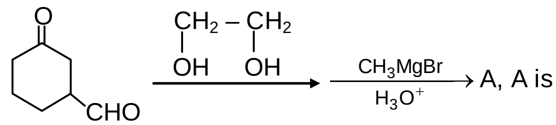
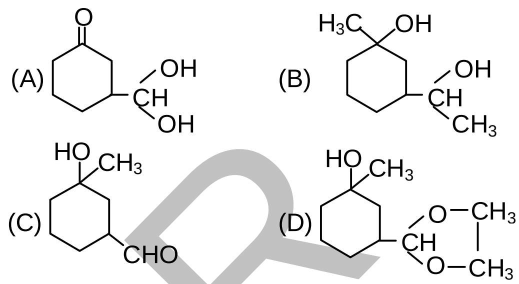
Q.30

The structures of (X) and (Y) respectively are


Q.31

A, A, B and C are

(B) Y, X and Z (C) Y In all cases
(D) Z in all cases

Q.32 End product of the following sequence of reaction is

$CH \equiv CH \xrightarrow{CH_3MgBr} \xrightarrow{CO_2 / H_3O^+} \xrightarrow{HgSO_4 / H_2SO_4} \xrightarrow[\Delta]{Ag_2O} \xrightarrow{\Delta}$

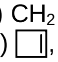
(A) $CH_3 - \overset{O}{\overset{\|}{C}}COOH$ (B) CH_3COOH (C) $CH_3 - \overset{O}{\overset{\|}{C}}CHO$ (D) CH_3COOH

Q.33



EXERCISE – II

Q.1 An alkene on ozonolysis yields only ethanal. There is an isomer of this which on ozonolysis yields :
(A) propanone (B) ethanal
(C) methanal (D) only propanal

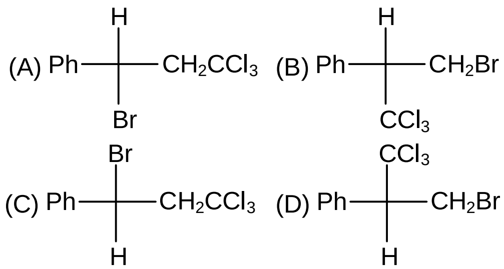
Q.2 Aqueous solution of potassium propanoate is electrolysed. Possible organic products are :
(A) n-Butane (B) $C_2H_5COOC_2H_5$
(C) $CH_3 – CH_3$ (D) $CH_2 = CH_2$

Q.3 (A) $C_4H_6 \xrightarrow{H_2 / Pt}$ (B) $C_4H_8 \xrightarrow{O_3 / H_2O}$ CH_3COOH
Hence A and B are
(A) $CH_3C \equiv CCH_3$, $CH_3CH = CHCH_3$
(B) $CH_2 = CHCH_3 = CH_2$, $CH_3CH = CHCH_3$
(C) , $CH_3CH = CHCH_3$
(D) None

Q.4 $Ph - \underset{\underset{O}{\|}}{C} - CH_3 \xrightarrow{A} Ph - CH_2 - CH_3$
A could be :
(A) NH_2NH_2, glycol/OH^-
(B) Na(Hg)/conc. HCl
(C) Red P/HI
(D) $\underset{SH}{\underset{|}{CH_2}} - \underset{SH}{\underset{|}{CH_2}}$; Raney Ni – H_2

Q.5 $CH_2 = CHCH_2CH = CH_2 \xrightarrow{NBS}$ A, A can be
(A) $CH_2 = CH\underset{\underset{Br}{|}}{C}HCH = CH_2$
(B) $CH_2 = CHCH = CH – CH_2Br$
(C) $CH_2 = CHCH_2CH = CHBr$
(D) $CH_2 = CHCH_2\underset{\underset{Br}{|}}{C} = CH_2$

Q.6 $Ph - CH = CH_2 + BrCCl_3 \xrightarrow{\text{peroxide}}$
Product is :



Q.7 Which of the following will give same product with HBr in presence or absence of peroxide
(A) Cyclohexene
(B) 1-methylcyclohexene
(C) 1,2-dimethylcyclohexene
(D) 1-butene

Q.8 The ionic addition of HCl to which of the following compounds will produces a compound having Cl on carbon next to terminal.
(A) $CF_3.(CH_2)_3.CH = CH_2$
(B) $CH_3.CH = CH_2$
(C) $CF_3.CH = CH_2$
(D) $CH_3.CH_2CH = CH.CH_3$

Q.9 Which reagent is the most useful for distinguishing compound I from the rest of the compounds

$CH_3CH_2C \equiv CH$ (I)	$CH_3C \equiv CCH_3$ (II)
$CH_3CH_2CH_2CH_3$ (III)	$CH_3CH = CH_2$ (IV)

(A) alk. $KMnO_4$ (B) Br_2/CCl_4
(C) Br_2/CH_3COOH (D) Ammonical $AgNO_3$

Q.10

List I	List II
(A) Walden Inversion	(1) Cis addition
(B) Recemic mixture	(2) Trans addition
(C) Alkene $\xrightarrow{\text{Baeyer Reagent}}$	(3) SN_1 reaction
(D) Alkene $\xrightarrow{Br_2}$	(4) SN_2 reaction

Codes :

	A	B	C	D
(a)	3	4	2	1
(b)	3	4	1	2
(c)	4	3	1	2
(d)	4	3	2	1

Q.11 List I List II
(A) $CH_3 - C \equiv C - CH_3 \longrightarrow$ (1) $Na/NH_3(\ell)$
cis-2-butene
(B) $CH_3 - C \equiv C - CH_3 \longrightarrow$ (1) $H_2/Pd/BaSO_4$
trans-2-butene
(C) $CH_3 - C \equiv C - CH_3 \longrightarrow$ (1) alc. KOH, Δ
1-Butyne
(D) $CH_3 - C \equiv C - CH_3 \longrightarrow$ (1) $NaNH_2$, Δ
2-Butyne

Codes :

	A	B	C	D
(a)	2	1	3	4
(b)	1	2	4	3
(c)	1	2	3	4
(d)	2	1	4	3

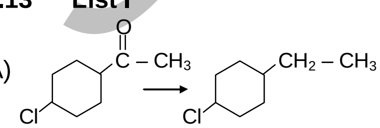
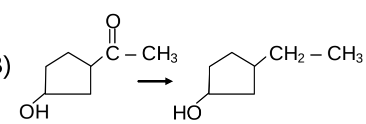
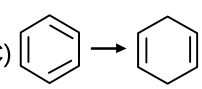
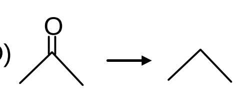
Q.12

List I	List II
(A) $RCOONa \xrightarrow{\text{electrolysis}} R - R$	(1) Corey-House reaction
(B) $R-CH_2-COOH \xrightarrow{\text{Soda lime}} R-CH_3$	(2) Kolbe electrolysis
(C) $RCOOH \xrightarrow[\text{(ii)}Cl_2/\Delta]{\text{(i)}AgNO_3} R - Cl$	(3) degradation
(D) $R' - X + R_2CuLi \rightarrow R - R'$	(4) Hundsdiecker reaction

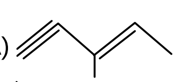
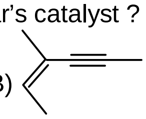
Codes :

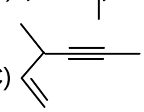
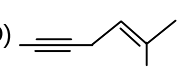
	A	B	C	D
(a)	2	3	4	1
(b)	1	3	4	2
(c)	2	4	3	2
(d)	2	4	1	3

Q.13

List I	List II
(A) 	(1) Birch reduction
(B) 	(2) Stephen's reduction
(C) 	(3) Wolf-Kishner reduction
(D) 	(4) Clemmensen reduction

Q.14 Which of the following produce chiral molecule after treatment with Lindlar's catalyst ?

(A)  (B) 

(C)  (D) 

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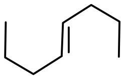
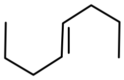
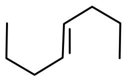
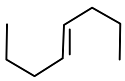
Q.15 **Column I** **Column II**

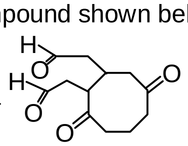
(A)  $\xrightarrow{\text{Cold dil. } KMnO_4}$ (P) Optically inactive due to internal compensation

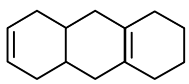
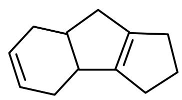
(B)  $\xrightarrow[\text{(ii) } H_3O^{\oplus}]{\text{(i) } CH_3CO_3H}$ (Q) Optically inactive due to external compensation

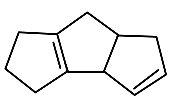
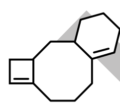
(C)  $\xrightarrow[Ni]{D_2}$ (R) Product has presence of two chiral center

(D)  $\xrightarrow[H_2O]{Br_2}$ (S) Diastereomers will be formed

Q.16 Which starting material should be used to produce the compound shown below ?

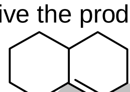
? $\xrightarrow[Zn-H_2O]{O_3}$ 

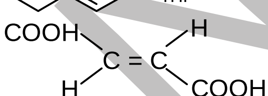
(A)  (B) 

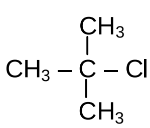
(C)  (D) 

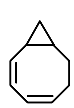
EXERCISE – III

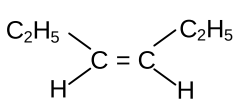
Q.1 Give the product of

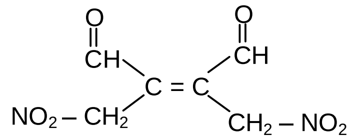
(a)  $\xrightarrow[THF]{BH_3}$ A $\xrightarrow{H_2O_2}$ B

(b)  $\xrightarrow[2. D_2O_2, DO^-]{1. BD_3.THF}$

Q.2  $\xrightarrow{LiAlH_4}$?

Q.3 What are the ozonlysis product of 

Q.4  $\xrightarrow[2. H_2O/H^+]{1. CF_3CO_3H}$ A + B. What are A and B ?

Q.5 

$\xrightarrow{NH_2-NH_2/H_2O_2}$ A. Write the structure of A

Q.6 Give the structure of the alkene that yields on ozonolysis

(i) $CH_3CH_2CH_2CHO$ & HCHO

(ii) $C_2H_5COCH_3$ & $CH_3CH(CH_3)CHO$

(iii) Only $CH_3CO.CH_3$

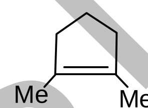
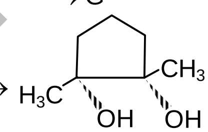
(iv) $CH_3.CHO$ & HCHO & $OHC.CH_2.CHO$

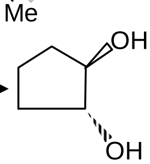
(v) Only $OHC - CH_2CH_2CH_2 - CHO$

Q.7 What are A to K for the following reactions

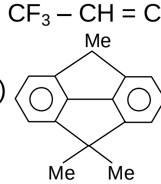
(i) $PhC \equiv CH + CH_3MgX \rightarrow A \xrightarrow{ArCH_2Cl} B \xrightarrow{Li/NH_3} C.$

(ii) $PhCH_2CH_2CH_3 + Br_2 \xrightarrow{h\gamma} D \xrightarrow[KOH]{\text{alcoholic}} E \xrightarrow{\text{cold dil.} KMnO_4} F \xrightarrow{\text{hot } KMnO_4} G$

(iii)  $\xrightarrow{H}$ 

(iv)  $\xrightarrow{I}$ 

(v) $CF_3 - CH = CH_2 \xrightarrow{HBr} J$

(vi)  $\xrightarrow{NBS}$ K

Q.8 Explain the following

(i) 1, 2 shift does not take place during oxymericuration demercuration. Why ?

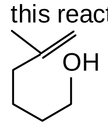
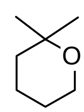
(ii) Halogenation of alkene is anti addition but not syn addition. Why ?

(iii) Anti markovnikov addition is not applicable for HCl. Why ?

(iv) 1, 4–addition takes place in butadi-ene. Why ?

(v) C – H bond is stronger than C – C bond but in chlorination C – H bonds get cleaved but not C – C bond. Why ?

Q.9 The following cyclisation has been observed in the oxymercuration & demercuration of this unsaturated alcohol. Propose a mechanism for this reaction.

 $\xrightarrow[2. NaBH_4]{1. Hg(OAC)_2}$ 

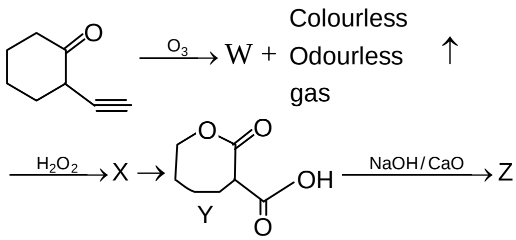
Q.10 Acetylene is acidic but it does not react with NaOH or KOH. Why ?

Q.11 $CH \equiv C - CH_2 - CH = CH_2$, adds up HBr to give $CH \equiv C - CH_2 - CHBr - CH_3$ while $CH \equiv C - CH = CH_2$ adds up HBr to give $CH_2 = C. Br . CH = CH_2$

Q.12 Chlorination of ethane to ethyl chloride is more practicable than the chlorination of n-pentane to 1-chloropentane.

Q.13 Why n-pentane has higher boiling point than neopentane?

Q.14



Identify W, X, Y & Z.

EXERCISE – IV(A)

Q.1 Alcoholic solution of KOH is a specific reagent for **[IIT '90]**
(A) Dehydration
(B) Dehydrogenation
(C) Dehydro halogenation
(D) Dehalogenation

Q.2 Of the following, unsaturated hydrocarbons are **[IIT '90]**
(A) ethyne (B) cyclohexane
(C) n-propane (D) ethene

Q.3 1-chlorobutane on reaction with alcoholic potash gives **[IIT '91]**
(A) 1-butene (B) 1-butanol
(C) 2-butene (D) 2-butanol

Q.4 The hybridization of carbon atoms in C – C single bond of $HC \equiv C - CH = CH_2$ is **[IIT '91]**
(A) $sp^3 - sp^3$ (B) $sp^2 - sp^3$
(C) $sp - sp^2$ (D) $sp^2 - sp^2$

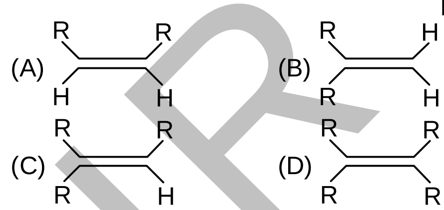
Q.5 The product(s) obtained via oxymercuation ($HgSO_4 + H_2SO_4$) of 1-butyne would be **[IIT '97]**
(A) $CH_3 - CH_2 - \underset{\underset{O}{||}}{C} - CH_3$
(B) $CH_3 - CH_2 - CH_2 - CHO$
(C) $CH_3 - CH_2 - CHO + HCHO$
(D) $CH_3 - CH_2 - COOH + HCOOH$

Q.6 When cyclohexane is poured on water, it floats, because **[IIT '97]**
(A) Cyclohexane is in 'boat' form
(B) Cyclohexane is in 'chair' form
(C) Cyclohexane is in 'crown' form
(D) Cyclohexane is less dense than water

Q.7 Which of the following compounds will show geometrical isomerism ? **[IIT '98]**
(A) 2-butene (B) Propene
(C) 1-phenylpropene (D) 2-methyl-2-butene

Q.8 In the compound $CH_2 = CH - CH_2 - CH_2 - C \equiv CH$, the $C_2 - C_3$ bond is of the type **[IIT '99]**
(A) $sp - sp^2$ (B) $sp^3 - sp^3$
(C) $sp - sp^3$ (D) $sp^2 - sp^3$

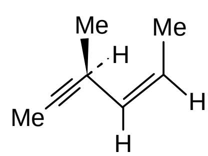
Q.9 Which one of the following alkenes will react fastest with H_2 under catalytic hydrogenation condition **[IIT '2000]**



Q.10 Propyne and propene can be distinguished by
(A) conc. H_2SO_4 (B) Br_2 in CCl_4
(C) dil. $KMnO_4$ (D) $AgNO_3$ in ammonia

Q.11 In the presence of peroxide, hydrogen chloride and hydrogen iodide do not give anti-Markovnikov addition to alkene because **[IIT '2001]**
(A) both are highly ionic
(B) one is oxidising and the other is reducing
(C) one of the step is endothermic in both the cases
(D) All the steps are exothermic in both cases

Q.12



Hydrogenation of the above compound in the presence of poisoned paladium catalyst gives **[IIT '2001]**

(A) An optically active compound
(B) An optically inactive compound
(C) A racemic mixture
(D) A diastereomeric mixture

Q.13 The reaction of propene with HOCl proceeds via the addition of **[IIT '2001]**
(A) H^+ in first step (B) Cl^+ in first step
(C) OH^- in first step
(D) Cl^+ and OH^- in single step

Q.14 The nodal plane in the π-bond of ethene is located in **[IIT '2002]**
(A) the molecular plane
(B) a plane parallel to the molecular plane

(C) a plane perpendicular to the molecular plane which contains the carbon-carbon σ-bond at right angle
(D) a plane perpendicular to the molecular plane which contains the carbon-carbon σ-bond.

Q.15 Consider the following reactions **[IIT '2002]**

$H_3C-\underset{D}{CH}-\underset{CH_3}{CH}-CH_3 + \dot{Br} \rightarrow$ 'X' + HBr

Identify the structure of the major product 'X'

(A) $H_3C-\underset{D}{CH}-\underset{CH_3}{CH}-\dot{C}H_2$

(B) $H_3C-\underset{D}{CH}-\underset{CH_3}{\dot{C}}-CH_3$

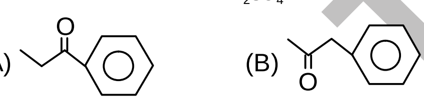
(C) $H_3C-\underset{D}{\dot{C}}-\underset{CH_3}{CH}-CH_3$

(D) $H_3C-\dot{C}H-\underset{CH_2}{CH}-CH_3$

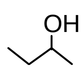
Q.16 Identify a reagent from the following list which can easily distinguish between 1-butyne and 2-butyne **[IIT '2002]**

(A) bromine, CCl_4 (B) H_2, Lindlar catalyst
(C) dilute H_2SO_4, $HgSO_4$
(D) ammonical Cu_2Cl_2 solution

Q.17 $C_6H_5-C\equiv C-CH_3 \xrightarrow[H_2SO_4]{HgSO_4}$ A **[IIT '2003]**

(A) (B)


(C) $C_6H_5-\underset{OH}{C}=CHCH_3$ (D) $C_6H_5-CH=\underset{OH}{C}-CH_3$

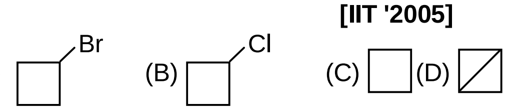
Q.18  $\xrightarrow[-H_2O]{H^+}$ X (mixture) $\xrightarrow{Br_2}$ 5 compounds of molecular formula $C_4H_8Br_2$ **[IIT '2003]**
Number of compounds in X will be :
(A) 2 (B) 3 (C) 4 (D) 5

Q.19 2-hexyne can be converted into trans-2-hexene by the action of : **[IIT '2004]**

(A) $H_2-Pd-BaSO_4$ (B) Li in liq. NH_3
(C) H_2-PtO_2 (D) $NaBH_4$

Q.20 When Phenyl Magnesium Bromide reacts with tert. butanol, which of the following is formed ?
(A) Tert. butyl methyl ether **[IIT '2005]**
(B) Benzene
(C) Tert. butyl benzene
(D) Phenol

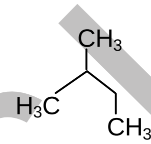
Q.21 1-bromo-3-chlorocyclobutane when treated with two equivalent of Na, in the presence of ether which of the following will be formed ? **[IIT '2005]**

(A) (B) (C) (D)


Q.22 Cyclohexene is best prepared from cyclohexanol by which of the following : **[IIT '2005]**
(A) conc. H_3PO_4 (B) conc. $HCl/ZnCl_2$
(C) conc. HCl (D) conc. HBr

Q.23 $CH_3-CH=CH_2 + NOCl \rightarrow P$ **[IIT '2006]**
Identify the adduct.
(A) $CH_3-\underset{Cl}{CH}-\underset{NO}{CH_2}$ (B) $CH_3-\underset{NO}{CH}-\underset{Cl}{CH_2}$

(C) $CH_3-CH_2-\overset{NO}{\underset{Cl}{CH}}$ (D) $\underset{NO}{CH_2}-CH_2-\underset{Cl}{CH_2}$

Q.24  $\xrightarrow{Cl_2,h\nu}$ N(isomeric products)

$C_5H_{11}Cl \xrightarrow{\text{fractional distillation}}$ M(isomeric products)
What are N and M? **[IIT '2006]**
(A) 6, 6 (B) 6, 4
(C) 4, 4 (D) 3, 3

Q.25 The number of structural isomers for C_6H_{14} is **[IIT '2007]**
(A) 3 (B) 4
(C) 5 (D) 6

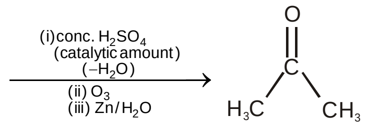
Q.26 The number of stereoisomers obtained by bromination of trans-2-butene is **[IIT '2007]**
(A) 1 (B) 2
(C) 3 (D) 4

Q.27 The synthesis of 3-octyne is achieved by adding a bromoalkane into a mixture of sodium amide and an alkyne. The bromoalkane and alkyne respectively are
[IIT-JEE 2010]
(A) $BrCH_2CH_2CH_2CH_2CH_3$ and $CH_3CH_2C\equiv CH$
(B) $BrCH_2CH_2CH_3$ and $CH_3CH_2CH_2C\equiv CH$
(C) $BrCH_2CH_2CH_2CH_2CH_3$ and $CH_3C\equiv CH$

(D) $BrCH_2CH_2CH_2CH_3$ and $CH_3CH_2C\equiv CH$

Paragraph for question Nos. 28 and 29
An acyclic hydrocarbon P, having molecular formula C_6H_{10}, gave acetone as the only organic product through the following sequence of reaction, in which Q is an intermediate organic compound.**[IIT-JEE 2011]**

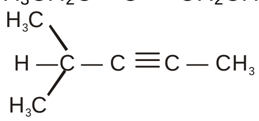
$\underset{(C_6H_{10})}{P} \xrightarrow[\text{(ii) NaBH}_4\text{/ethanol (iii) dil. acid}]{\text{(i) dil.}H_2SO_4\text{/HgSOl4}} Q$

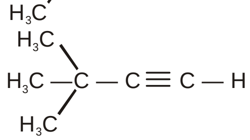


Q.28 The structure of compound P is

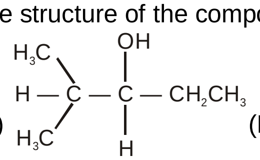
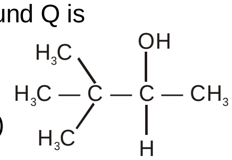
(A) $CH_3CH_2CH_2CH_2 - C \equiv C - H$

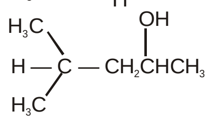
(B) $H_3CH_2C - C \equiv CH_2CH_3$

(C) 

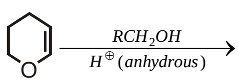
(D) 

Q.29 The structure of the compound Q is

(A)  (B) 

(C)  (D) $CH_3CH_2CH_2\overset{OH}{\overset{|}{C}H}CH_2CH_3$

Q.30 The major product of the following reaction is

 **[IIT '2011]**

(A) a hemiacetal (B) an acetal

(C) an ether (D) an ester

EXERCISE – IV(B)

Q.1 $(CH_3)_2\overset{Cl}{\overset{|}{C}} - CH_2CH_3 \xrightarrow{\text{alc.KOH}} ?$ **[IIT '1992]**

Q.2 $C_6H_5CH_2\underset{\underset{Br}{|}}{C}HCH_3 \xrightarrow[\text{heat}]{\text{alc.KOH}} ? \xrightarrow{\text{HBr}} ?$

[IIT '1993]

Q.3 $C(C_6H_{12})$, an optically active hydrocarbon which on catalytic hydrogenation gives an optically inactive compound, C_6H_{14}. **[IIT '1993]**

Q.4 Draw the stereochemical structure of the product in the following reactions. **[IIT '1994]**

$R - C \equiv C - R \xrightarrow[\text{Lindlar catalyst}]{H_2}$

Q.5 Write down the structures of the stereoismers formed when cis-2-butene is reacted with bromine. **[IIT '1995]**

Q.6 An organic compound $E(C_5H_8)$ on hydrogenation gives compound $F(C_5H_{12})$. Compound E on ozonolysis gives formaldehyde and 2-ketopropanal. Deduce the structure of compound E. **[IIT '1995]**

Q.7 Give the structures of the major organic products from 3-ethyl-2-pentene under each of the following reaction conditions. **[IIT '1996]**

(a) HBr in the presence of peroxide

(b) Br_2 / H_2O

(c) $Hg(OAc)_2$ / H_2O ; $NaBH_4$

Q.8 3, 3–Dimethyl–butan–2–ol loses a molecule of water in the presence of concentrated sulphuric acid to give tetramethylethylene as a major product. Suggest a suitable mechanism. **[IIT '1996]**

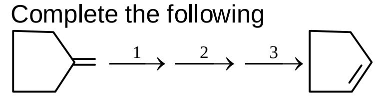
Q.9 Only mole of the compound A (molecular formula C_8H_{12}), incapable of showing stereoisomerism, reacts with only one mole of H_2 on hydrogenation over Pd. A undergoes ozonolysis to give a symmetrical diketone $B(C_8H_{12}O_2)$. What are the structure of A and B? **[IIT '1997]**

Q.10 Compound (A) C_6H_{12} gives a positive test with bromine in carbon tetrachloride. Reaction of (A) with alkaline $KMnO_4$ yields only (B) which is the potassium salt of an acid. Write structure formulae and IUPAC name of (A) and (B). **[IIT '1997]**

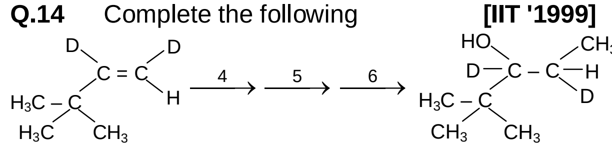
Q.11 The central carbon–carbon bond in 1, 3–butadiene is shorter than that of n-butane. Why ? **[IIT '1998]**

Q.12 Discuss the hybridisation of carbon atoms in allene (C_3H_4) and show the π-orbital overlaps. **[IIT '1999]**

Q.13 Complete the following **[IIT '1999]**



Q.14 Complete the following **[IIT '1999]**



Q.15 Carry out the following transformation in not more than three steps. **[IIT '1999]**

$CH_3 - CH_2 - C \equiv C - H \rightarrow$

$CH_3 - CH_2 - CH_2 - \overset{O}{\overset{\|}{C}} - CH_3$

Q.16 $CH_2 = CH^-$ is more basic than $HC \equiv C^-$ **[IIT '2000]**

Q.17 On reaction with 4N alcoholic KOH at 175°C 1-pentyne is slowly converted into equilibrium mixture of 1.3% 1–pentyne (A), 95.2% 2-pentyne (B) and 3.5% 1, 2-pentadiene (C). Give the suitable mechanism of formation of A, B and C with all intermediates. **[IIT '2001]**

Q.18 Identify X, Y and Z in the following synthetic scheme and write their structures. Is the compound Z optically active ? Justify your answer. **[IIT '2002]**

(A) $CH_3CH_2C \equiv C - H \xrightarrow[\text{(ii)}\, CH_3CH_2Br]{\text{(i)}\, NaNH_2} X$

$\xrightarrow{H_2/Pd\text{–}BaSO_4} Y \xrightarrow{\text{alkaline}\, KMnO_4} Z$

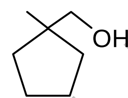
Q.19 A biologically active compound, Bombykol ($C_{16}H_{30}O$) is obtained from a natural source. The structure of the compound is determined by the following reactions. **[IIT '2002]**

(a) On hydrogenation, Bombykol gives a compound A, $C_{16}H_{34}O$ which reacts with acetic anhydride to give an ester.

(b) Bombykol also reacts with acetic anhydride to give another ester, which on oxidative ozonolysis (O_3/H_2O_2) gives a mixture of butanoic acid, oxalic acid and 10-acetoxy decanoic acid.

Determine the number of double bonds in Bombykol. Write the structures of compound A and Bombykol. How many geometrical isomers are possible for Bombykol ? **[IIT '2002]**

Q.20 If after complete ozonolysis of one mole of monomer of natural polymer gives two moles of CH_2O and one mole of $O = \overset{\displaystyle CH_3}{\overset{|}{C}} - CH = O$. Identify the monomer and draw the all-cis structure of natural polymer. **[IIT '2005]**

Q.21 

$\xrightarrow{H^+,\Delta} X \xrightarrow[\text{(ii)}\, Zn/Cl_3COOH]{\text{(i)}\, O_3} Y$ **[IIT '2005]**

Identify X and Y.

ANSWER KEY

EXERCISE - I

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	B	A	B	D	A	B	B	C	A	C	B	B	A	D	B	B	A	A	D	B
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33							
Ans.	B	B	B	A	C	C	C	C	D	C	A	A	C							

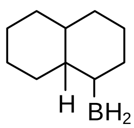
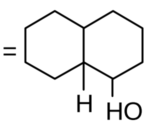
EXERCISE – II

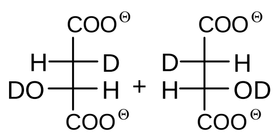
Ques.	1	2	3	4	5	6	7	8	9	10	11	12
Ans.	A,C	A,B,C,D	A,B	A,B,C,D	A,B	A,C	A,C	A,D	D	C	D	A

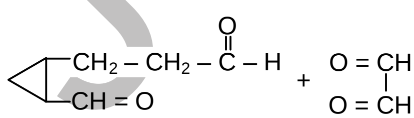
Q.13 (A) 4 ; (B) 3; (C) 1 ; (D) 3,4 **Q.14** C **Q.15** (A) Q,R ; (B) P,R ; (C) Q,R ; (D) Q,R

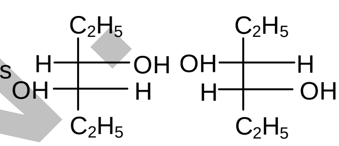
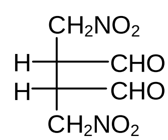
Q.16 (A) B

EXERCISE – III

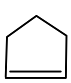
Q.1 (a) (A) =  , (B) = 

(b) 

Q.2 $CH_3-\underset{}{\overset{CH_3}{\overset{|}{C}}}=CH_2$ **Q.3** 

Q.4 A + B are two enatiomers  **Q.5** 

Q.6 (i) C – C – C – C = C (ii) $C-C-\underset{C}{\underset{|}{C}}=C-\overset{C}{\overset{|}{C}}-C$ (iii) $C-\underset{C}{\underset{|}{C}}=\underset{C}{\underset{|}{C}}-C$ (iv) C – C = C – C – C = C

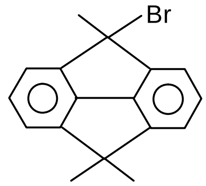
(v) 

Q.7 (A) PhC ≡ CMgx, (B) Ph – C ≡ C – CH_2Ar,

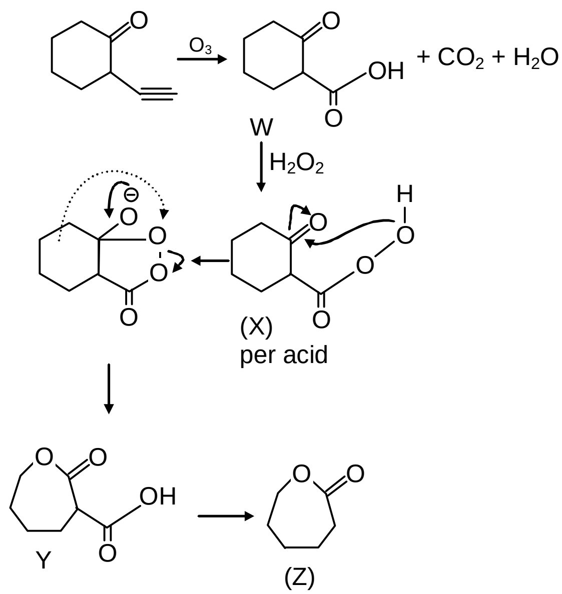
(C) $\underset{H}{\overset{Ph}{>}}C=C\underset{CH_2-Ar}{\overset{H}{<}}$ (D) $Ph-\underset{Br}{\underset{|}{CH}}-Et$

(E) Ph – CH = CH – Me trans, (F) $Ph-\underset{OH}{\underset{|}{CH}}-\underset{OH}{\underset{|}{CH}}-Me$ (threo mix.),

(G) Ph – COOH (H) Cold dil. $KMnO_4$

(I) HCO_3H (J) $CF_3CH_2CH_2Br$, (K) 

Q.14

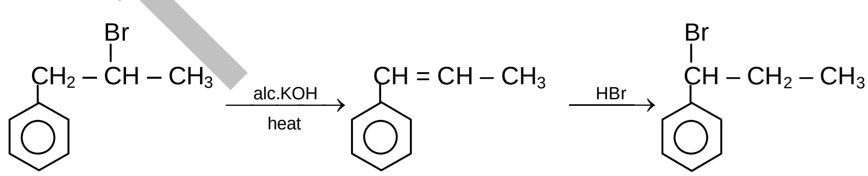


EXERCISE – IV(A)

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	A,D	A	C	A	D	A,C	D	A	D	C	B	B	A	B	D	A	B	B	B
Ques.	21	22	23	24	25	26	27	28	29	30										
Ans.	D	A	A	B	C	A	D	D	B	B										

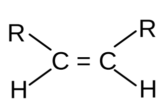
EXERCISE – IV(B)

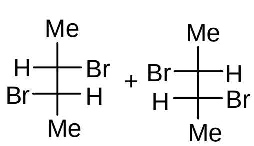
Q.1 $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{C}} = CH - CH_3$

Q.2 

Q.3 $CH_3 - CH_2 - \overset{\displaystyle H}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}} - CH = CH_2$

(C_6H_{12})

Q.4 

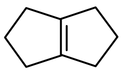
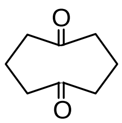
Q.5 

Q.6 (E) $CH_3 - \overset{\displaystyle CH_2}{\overset{||}{C}} - \overset{\displaystyle CH_2}{\overset{||}{CH}}$

Q.7 (a) $(CH_3 - CH_2)\ CH - CH(Br) - CH_3$

(b) $(CH_3 - CH_2)_2\ C(OH) - CH(Br) - CH_3$

(c) $(C_2H_5)_3C - OH$

Q.9 (A)  (B) 

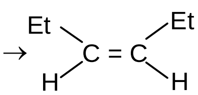
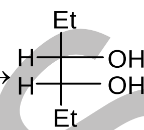
Q.10 (A) $CH_3 - CH_2 - CH = CH - CH_2 - CH_3$ (B) CH_3CH_2COOK

Q.13 $1 \rightarrow$ ozonolysis ; $2 \rightarrow LiAlH_4$; $3 \rightarrow H_2SO_4$

Q.14 $(4) \rightarrow HO - Cl$; $(5) \rightarrow CH_3MgCl$; $(6) \rightarrow H_2O/H^+$

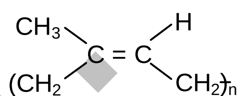
Q.15 (1) $NaNH_2$, (2) Me–I, (3) $HgSO_4$ dilH_2SO_4

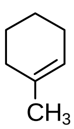
Q.16 Higher electronegativity of sp carbon

Q.18 $(X) \rightarrow Et - C \equiv C - Et$ $(Y) \rightarrow$  $(Z) \rightarrow$  Z is meso so optically inactive

Q.19 Bombykol : HO – C – C – C – C – C – C – C – C – C – C = C – C = C – C – C – C

(A) HO $(CH_3)_{15}CH_3$ 4 geometrical isomers are possible

Q.20 (a) $CH_2 = C(CH_3) - CH = CH_2$ (b) 

Q.21 (X)  , (Y) $CH_3 - \overset{O}{\overset{\|}{C}} - (CH_2)_4 - CH = O$

Hydrocarbon
Alkanes

Alkanes → Saturated hydrocarbons.
Methods of preparation

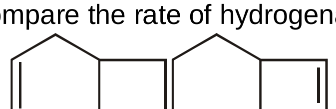
1. Hydrogenation of alkene
Sebatier Sendrens Reaction

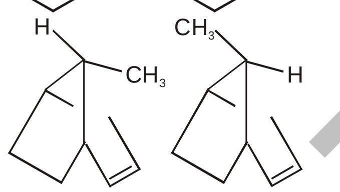
$CH_3 - CH = CH_2 \xrightarrow{H_2/Ni,\ Pt,\ Pd}$

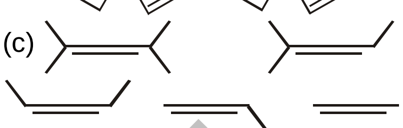
$\xrightarrow{NH_2-NH_2/H_2O_2}$

Important :
1) Unsaturation between like atoms wil reduce C = C, N = N
2) Both H atoms will be attached from same side (Syn-addition)
3) Less stable & less sterically crowded will undergo reduction at faster rate.

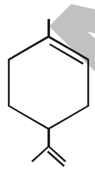
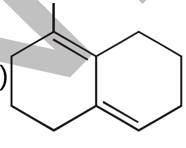
Q.1 Compare the rate of hydrogenation

(a) 

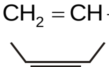
(b) 

(c) 

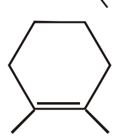
Q.2 Major prduct of reaction

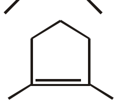
(a)  $\xrightarrow[Ni]{H_2(1eq)}$ (b)  $\xrightarrow[Pt]{H_2(1eq)}$

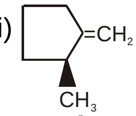
(c) $CH_2 = CH - CH = CH_2 \xrightarrow[Ni]{H_2(1eq)}$

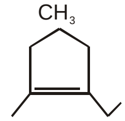
(d)  $\xrightarrow{D_2/Pt}$

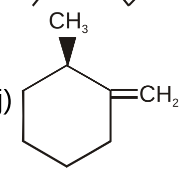
(e)  $\xrightarrow{D_2/Pt}$

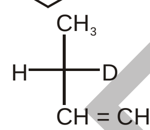
(f)  $\xrightarrow{H_2/Pt}$

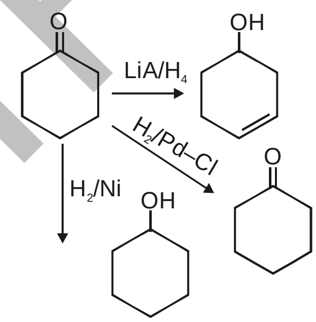
(g)  $\xrightarrow{H_2/(Pt)}$

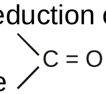
(i)  $\xrightarrow{H_2/Pt}$

(h)  $\xrightarrow{D_2/Pt}$

(j)  $\xrightarrow{H_2/Pt}$

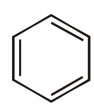
(k)  $\xrightarrow{D_2/Pt}$

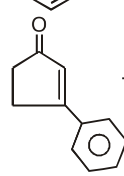
Important : 

Pd–C is used for selectie reduction of alkene, but it cannot reduce 

Q.3 $Ph - CH = CH - \overset{O}{\overset{\|}{C}} - CH_3 \xrightarrow{H_2/Pd-C}$

$\xrightarrow{H_2/Ni}$

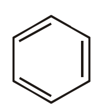
Q.4  $+ H_2 \xrightarrow{Ni}$

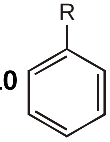
Q.5  $\xrightarrow{H_2/Pd-C}$

Q.6 $\begin{matrix} CH_3 \\ et \end{matrix}\!\!>C = O \xrightarrow{H_2/Ni}$

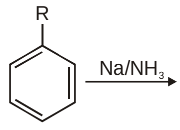
Q.7 $CH_3 - C \equiv C - CH_3 \xrightarrow{Pd/BaSO_4}$

Q.8 $CH_3 - C \equiv C - CH_3 \xrightarrow{Na/NH_3}$

Q.9  $\xrightarrow{Na/NH_3}$

Q.10  $\xrightarrow{Na/NH_3}$

(R = activating)

Q.11 

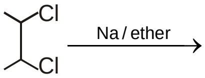
(R = deactivating)

2. From alkyl halides

(a) Wurtz Reaction

$$R-x+2Na+x-R \xrightarrow{\text{ether}} R-R$$

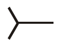
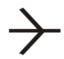
(1) 

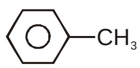
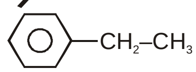
(2) 

(b) Corey House Reaction :

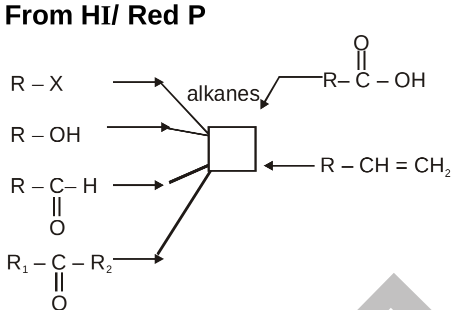
$R_2CuLi + R'–Cl \rightarrow R – R'$

Q.12 Write the steps for preparation of following alkane by corey house reaction ?

(a)  (b) 

(c)  (d) 

3. From HI/ Red P



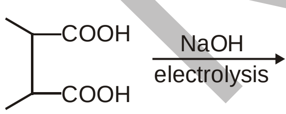
4. From carboxylic acids

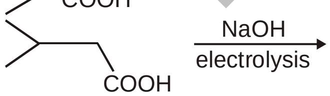
(a) Soda lime decarboxylation

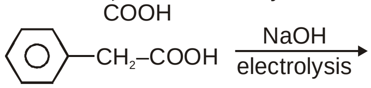
$$R-\overset{\overset{O}{\|}}{C}-OH \xrightarrow[CaO/\Delta]{NaOH} R-H$$

(b) Kolbe" Electrolysis

$$R-\overset{\overset{O}{\|}}{C}-OH \xrightarrow[\text{Electrolysis}]{NaOH} \underbrace{R-R+CO_2}_{\text{anode}} + \underbrace{H_2}_{\text{cathode}}$$

Q.1 

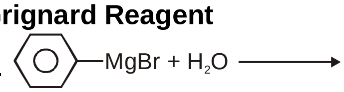
Q.2 

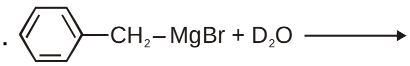
Q.3 

Q.4 $CH_3–COOH \xrightarrow[\text{electrolysis}]{NaOH}$

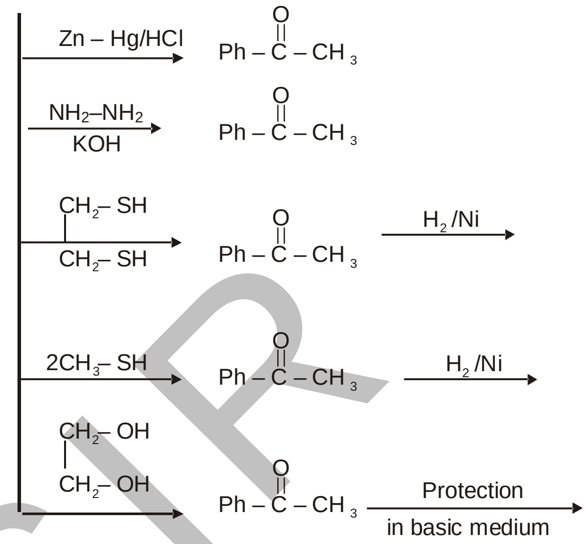
(No. of gases produced at anode)

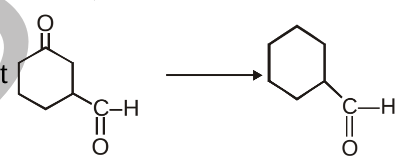
5. Grignard Reagent

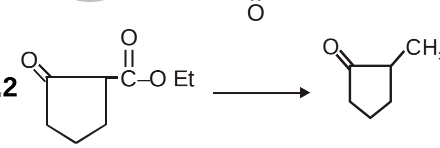
1. 

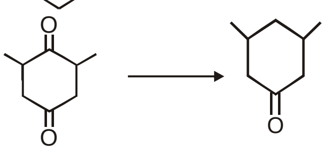
2. 

6. From aldehydes & ketones



Q.1 Convert 

Q.2 

Q.3 

Important

1. $Al_4C_3 + H_2O \longrightarrow Al(OH)_3 + CH_4$

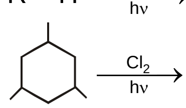
2. $Be_2C + H_2O \longrightarrow Be(OH)_2 + CH_4$

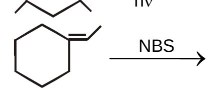
3. $CaC_2 + H_2O \longrightarrow Ca(OH)_2 + CH \equiv CH$

Properties of alkanes

Halogenation

$$R-H \xrightarrow[h\nu]{X-X} R-H+H-X$$

Q.1  ...... $\{R_1° : R_2° : R_3° = 1 : 4 : 5\}$

Q.2 

Alkene

Methods of preparation

(1) from alkynes

$R_1 — C \equiv C — R_2 \xrightarrow{H_2/Pd–BaSO_4}$

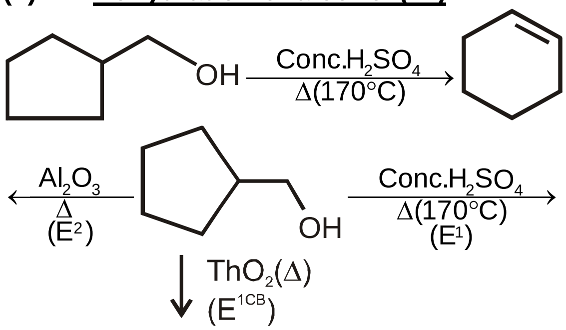
$H_2 — Pd — BaSO_4$ (Rosenmund's Catalyst)

$H_2 — Pb — CaCO_3$ (Lindlar's catalyst.

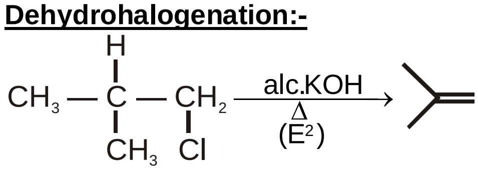
Syn – addition $\longrightarrow$ cis alkene is produced.

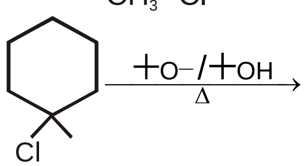
Imp. Reactivity of alkyne is more than alkene towards hydrogenation.

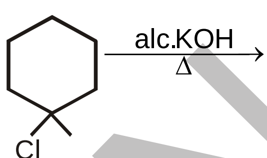
(2) Dehydration of alcohol (E[1])

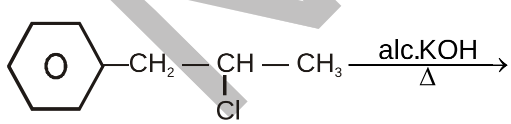


(3) Dehydrohalogenation:-

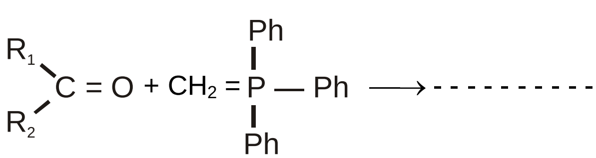


Q.1 

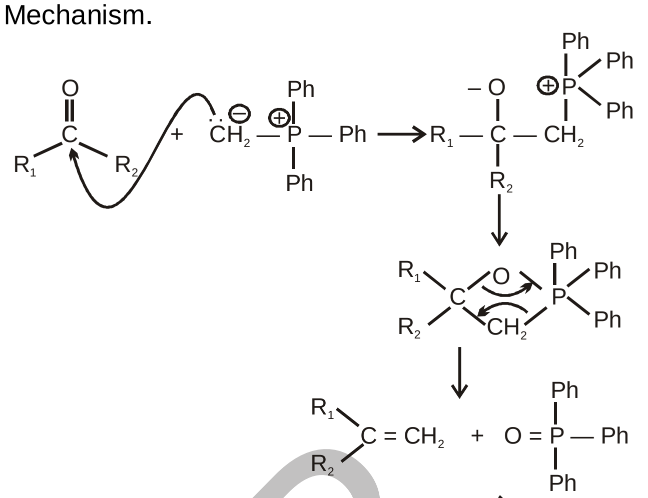
Q.2 

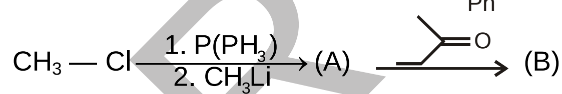
Q.3 

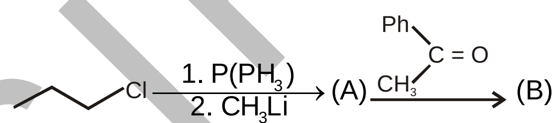
(4) Wittig Reaction

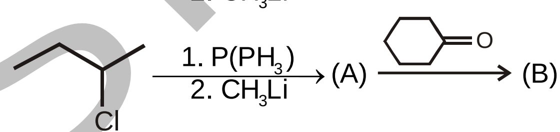


Mechanism.



Q.1 

Q.2 

Q.3 

(5) Kolbe Electrolysis

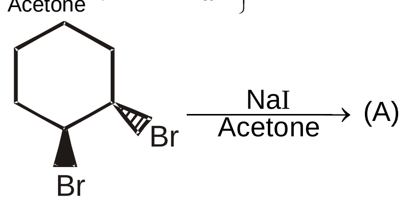
$$\begin{array}{l} CH_2 — COOK \\ | \\ CH_2 — COOK \end{array} \xrightarrow{\text{electrolysis}} \text{- - - - - - - - -}$$

(6) NaI/Acetone

$$\underset{Br}{\overset{}{CH_2}} — \underset{Br}{CH_2} \xrightarrow[\text{Acetone}]{\text{NaI}} \text{- - - - - - - - - -}$$

Remember.

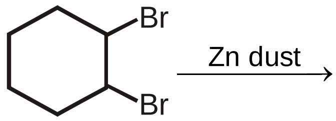
$R — Br \xrightarrow[\text{Acetone}]{\text{NaI}} R — I + NaBr$
$R — Cl \xrightarrow[\text{Acetone}]{\text{NaI}} R — I + NaBr$ (Finkelstein Reaction)

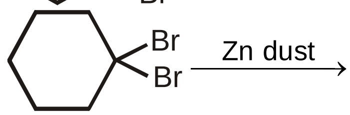
Q.1 

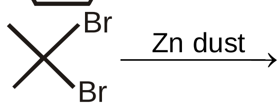
(7) Zn - dust

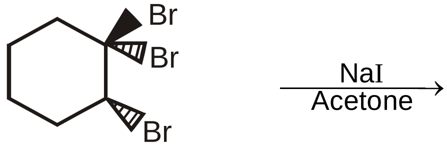
$$CH_3—\underset{Br}{CH} — \underset{Br}{CH} — CH_3 \xrightarrow{\text{Zn dust}} \text{- - -}$$

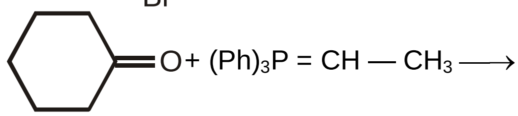
$CH_3-CHBr_2 \xrightarrow{Zn\ dust}$ - - - - - - - - - -

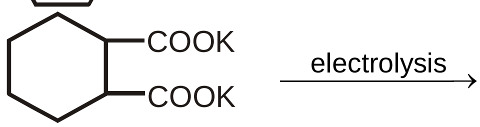
Q.1 

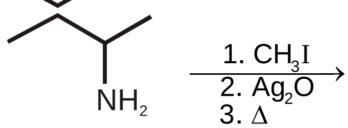
Q.2 

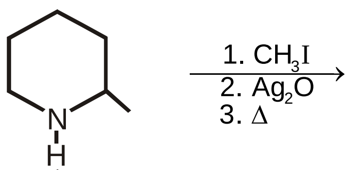
Q.3 

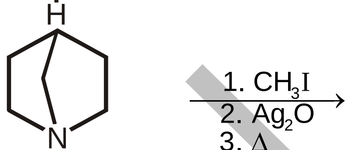
Q.4 

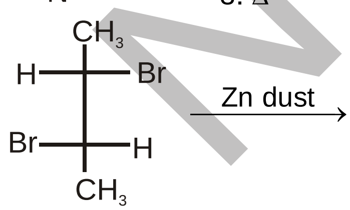
Q.5 

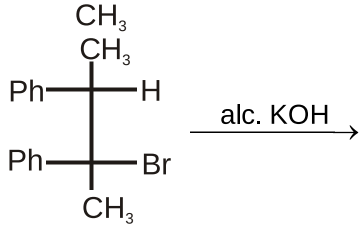
Q.6 

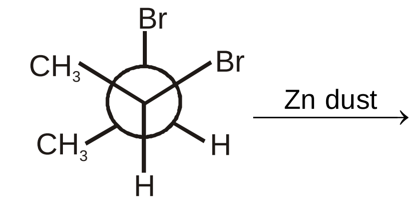
Q.7 

Q.8 

Q.9 

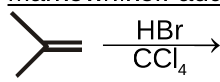
Q.10 

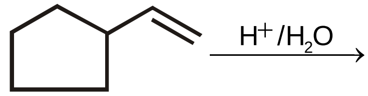
Q.11 

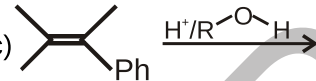
Q.12 

Reaction of Alkene

1. Markownikoff addition

(a) 

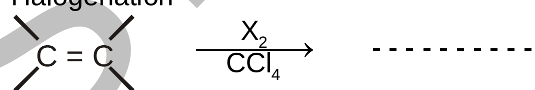
(b) 

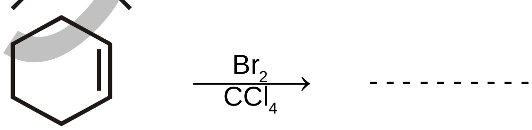
(c) 

2. Anti – Markonikov addition

$CH_3-CH=CH_2 \xrightarrow[R-O-O-R]{HBr}$

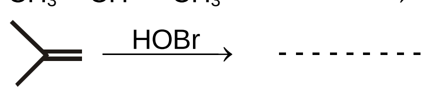
3. Halogenation



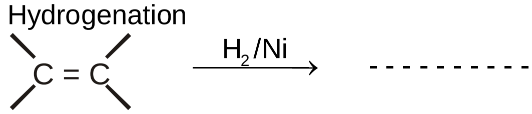


4. Halohydrin

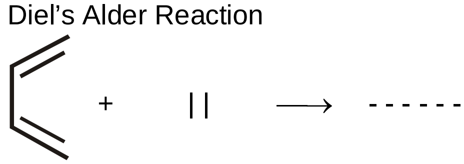
$CH_3=CH-CH_3 \xrightarrow{HOCl}$ - - - - - -

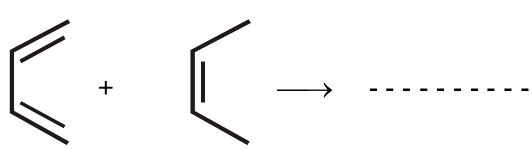


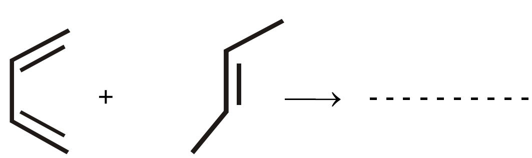
5. Hydrogenation

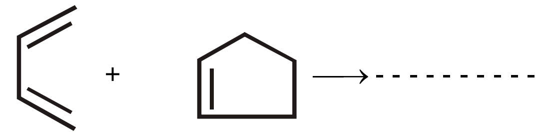


6. Diel's Alder Reaction



1. 

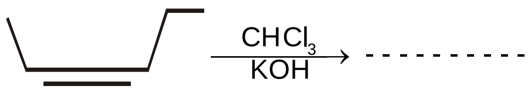
2. 

3. 

7. Reaction with carbene

1. $CH_3 — HC = CH_2 \xrightarrow[h\nu]{CH_2N_2}$ - - - - - - - - - -

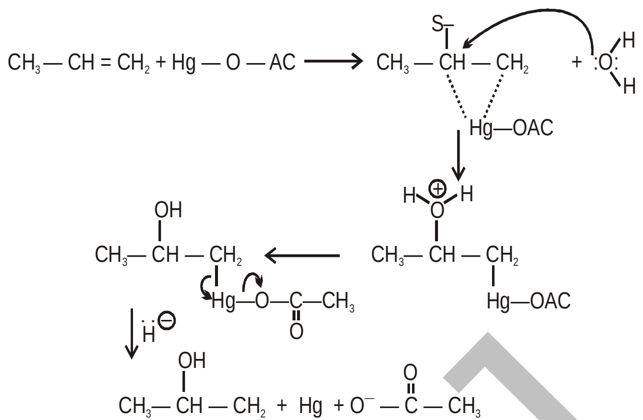
2. $CH_3 — CH = CH — CH_3 \xrightarrow[KOH]{CHCl_3}$ - - - - - -

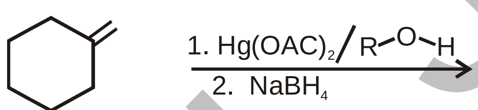
3. 

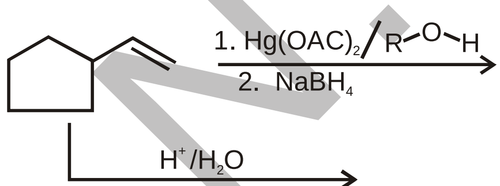
8. OMDM (oxymercuration – demercuration)

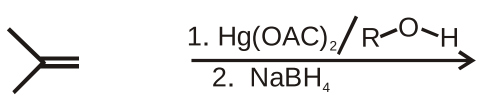
$CH_3 — CH = CH_2 \xrightarrow[\text{2. NaBH}_4]{\text{1. Hg(OAC)}_2 / H-O-H}$ - - - -

Mechanism:-

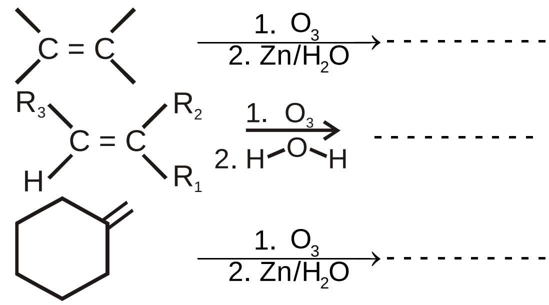


Q.1 

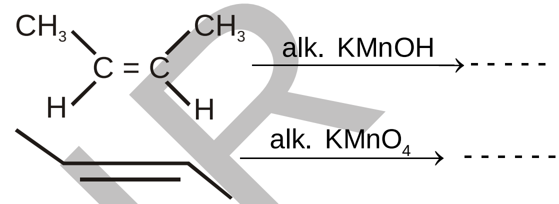
Q.2 

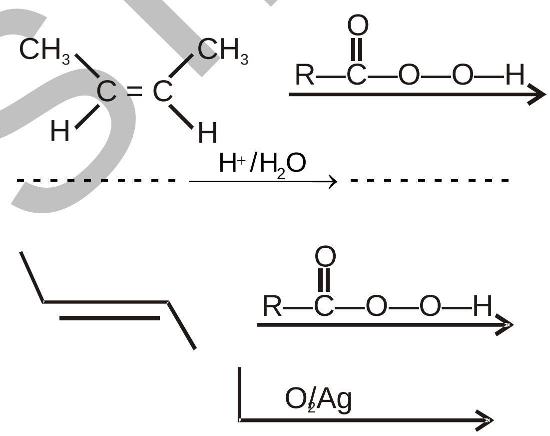
Q.3 

OZONOLYSIS:-



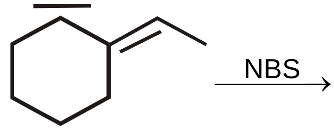
Reaction of alkene (Hydroxylation)

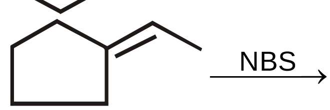
1. 

2. 

NBS

1. 

2. 

3. 

ALKYNES

Preparation of alkynes

1. Intermolecular Kolbe Electrolysis:–

$$\begin{matrix} CH-COOK \\ \| \\ CH-COOK \end{matrix} \xrightarrow{\text{electrolysis}}$$

2. Vicinal dihalides

$$CH_3-\underset{\underset{Br}{|}}{CH}-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow[E^2]{2NaNH_2}$$

3. Gem dihalides

$$CH_3-CH_2-\overset{\overset{Br}{|}}{\underset{\underset{Br}{|}}{C}}-CH_3 \xrightarrow{2NaNH_2}$$

4. Tetra halides

$$CH_3-\overset{\overset{Br}{|}}{\underset{\underset{Br}{|}}{C}}-\overset{\overset{Br}{|}}{\underset{\underset{Br}{|}}{C}}-CH_3 \xrightarrow[\Delta]{Zn\,dust}$$

5. $CH\,I_3 \xrightarrow[Powder]{Ag}$

6.

7. 6. $CaC_2\ 2H_2O \longrightarrow$

Conversion of terminal to non – terminal alkyne

$$CH_3-CH_2-C\equiv CH \underset{NaNH_2}{\overset{alc.KOH}{\rightleftharpoons}}$$

(n – hexane or paraffin solvent)

---

(1) Forward Reaction:–

$$CH_3-CH_2-C\equiv CH + \overline{O}H \rightleftharpoons CH_3-\overset{..}{C}H^{\ominus}-C\equiv CH + H-O-H$$

$$\Updownarrow$$

$$CH_3-HC=C=\overset{..}{C}H^{\ominus}$$

$$\downarrow H-O-H$$

$$CH_3-HC=C=CH_2 + OH^{\ominus}$$

$$\rightleftharpoons OH^{\ominus}$$

$$CH_3-\overset{..}{C}^{\ominus}=C=CH_2 + O\begin{matrix}H\\H\end{matrix}$$

$$\Updownarrow$$

$$CH_2-C\equiv C-\overset{..}{C}H_2^{\ominus}$$

$$\downarrow H-O-H$$

$$CH_3-C\equiv C-CH_3 + OH^{\ominus}$$

driving force is thermodynamic stability.

(2) Reverse Reaction:–

$$CH_3-C\equiv C-CH_3 + \overset{..}{N}H_2^{\ominus} \rightleftharpoons CH_3-C\equiv CH_2\overset{\ominus}{:} + NH_3$$

$$\Updownarrow$$

$$CH_3-\overset{..}{C}^{\ominus}\equiv C=CH_2$$

$$\downarrow NH_3$$

$$CH_3-CH=C=CH_2 + \overset{..}{N}H_2^{\ominus}$$

$$\downarrow \overset{..}{N}H_2^{\ominus}$$

$$CH_3-CH=C=CH:\ominus + NH_3$$

$$\Updownarrow$$

$$CH_3-\overset{..}{C}H^{\ominus}-C\equiv CH$$

$$\downarrow NH_3$$

$$CH_3 - CH_2 - C \equiv CH + \ddot{N}H_2^{\ominus} \xrightarrow{NaNH_2} CH_3 - CH_2 - C \equiv C:^{\ominus}\ Na^{\oplus}\ \text{(ppt.)}$$

→ driving force of reaction is insoluble salt of alkyne.

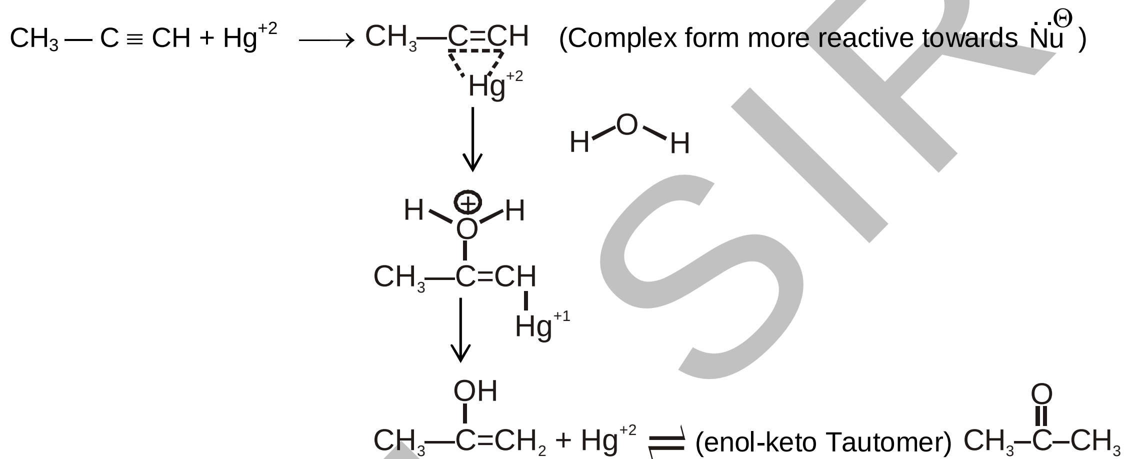
Acidic nature
R - OH > CH ≡ CH > NH_3

Reaction of alkynes

(1) Hydration

$$CH_3 - C \equiv CH \xrightarrow[H_2SO_4]{HgSO_4} CH_3 - \overset{\overset{O}{\|}}{C} - CH_3$$

Mechanism

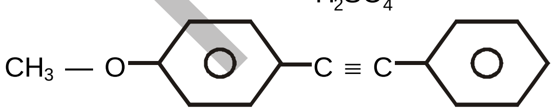


Q. Identify major product:–

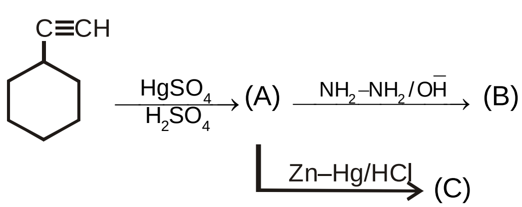
(1) $Ph - C \equiv C - CH_3 \xrightarrow[dil.H_2SO_4]{HgSO_4}$

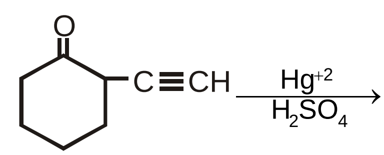
(2) $CH_3 - CH_2 - C \equiv CH \xrightarrow[dil.H_2SO_4]{HgSO_4}$

(3) $Ph - CH = CH_2 \xrightarrow[CCl_4]{Br_2}$ (A) $\xrightarrow{2NaNH_2}$ (B) $\xrightarrow[H_2SO_4]{HgSO_4}$ (C)

(4) 

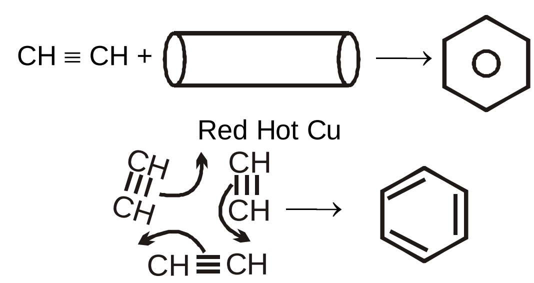
$\xrightarrow[H_2SO_4]{HgSO_4}$

(5) 

(6) 

(7) $CH_3 - C \equiv CH \xrightarrow[D_2SO_4]{HgSO_4}$

Polymerisation of alkynes

(1) 

(2) $CH_3 - C \equiv CH \xrightarrow[Cu]{\text{Red Hot}}$

(3) $$\begin{matrix} CH & & CH \\ ||| & & ||| \\ CH & & CH \\ & S & \end{matrix} \xrightarrow[\Delta]{Cu}$$

(4) $2CH\equiv CH \xrightarrow{NH_4OH/AgNO_3} CH\equiv C:^{\Theta} Ag^{+}$ (white ppt.)

$\xrightarrow{\text{ammonical } Cu_2Cl_2} H—C\equiv C:^{\Theta} Cu^{+}$ (red ppt.)

Test for alkenes & alkynes

Alkenes

1. decolourise Br_2/H_2O.
2. Cyclohexene $\xrightarrow[\text{alk. } KMnOH]{\text{Cold}}$

Alkynes

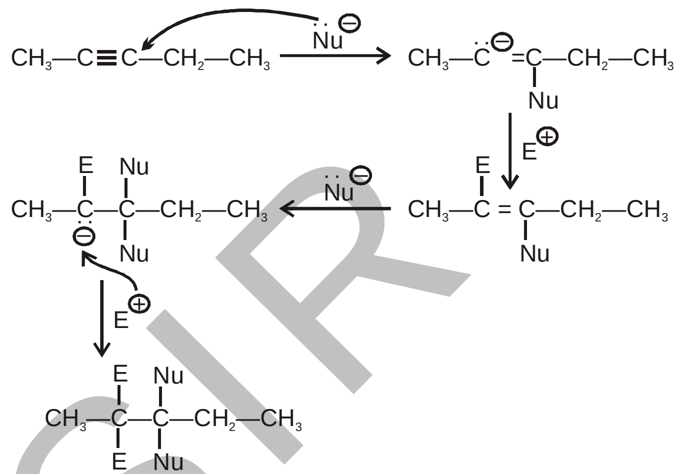
1. $CH_3 — C \equiv CH \xrightarrow[Ag^{+}(NH_3)_2]{\text{ammonical } AgNO_3}$
2. $CH_3 — C \equiv C — CH_3 \xrightarrow{\text{ammonical } AgNO_3}$
3. decolourise Br_2/H_2O.
4. $2\ CH_3 — C \equiv CH \xrightarrow{Cu_2O}$

Electrophilic addition

1. $CH_3 — C \equiv CH \xrightarrow{HBr}$
2. $CH_3 — C \equiv C—CH_3 \xrightarrow{Br_2/CCl_4}$
3. $CH_3 — C \equiv C—CH_3 \xrightarrow{HCl/CCl_4}$
4. $CH_3 — C \equiv C—CH_3 \xrightarrow[HgSO_4]{H^{+}/H_2SO_4}$
5. Cyclohexyl$—C \equiv C — CH_3 \xrightarrow{H^{+}/ROH}$

Nucleophilic addition (exceptional)

1.



Since carbanion is stable on Sp carbon atom but these type of reactions not given by alkenes.

1. $CH_3 — C \equiv C—CH_3 \xrightarrow{\bar{O}H/H_2O}$
2. $CH_3 — C \equiv C—CH_3 \xrightarrow{R\bar{O}/ROH}$
3. $CH_3 — C \equiv C—CH_3 \xrightarrow{R–\overset{O}{\overset{||}{C}}–\bar{O}\,/\,R–\overset{O}{\overset{||}{C}}–OH}$

DPP NO-01 Time: 15 minutes

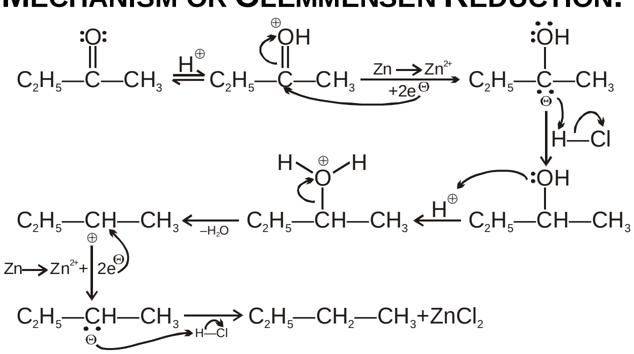
CLEMMENSEN REDUCTION:-

The reduction of carbonyl groups of aldehydes and ketones to methylene groups with amalgamated zinc and concentrated hydrochloric acid is known as Clemmensen reduction. The mechanism summarized below showing that reduction under acidic conditions often involves protonated species to which the metal offers.

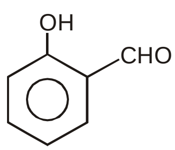
$$C_2H_5-\overset{\overset{\displaystyle O}{||}}{C}-CH_3 \xrightarrow[HCl]{Zn(Hg)\ or\ Na(Hg)}$$

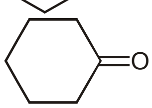
$$C_2H_5-CH_2-CH_3$$

MECHANISM OR CLEMMENSEN REDUCTION:-

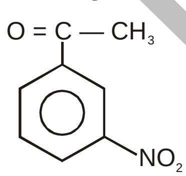


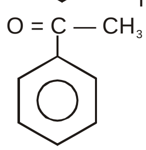
Q.1 $PhCOCH_2-CH_2COH \xrightarrow[HCl]{Zn/Hg}$

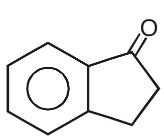
Q.2  $\xrightarrow[HCl]{Zn-Hg}$

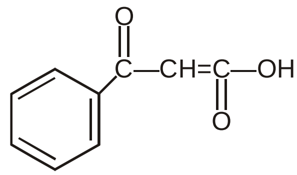
Q.3  $\xrightarrow[HCl]{Zn/Hg}$

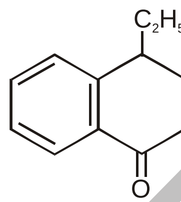
Q.4 $Ph-\overset{\overset{\displaystyle O}{||}}{C}-CH_3 \xrightarrow[HCl]{Zn(Hg)}$

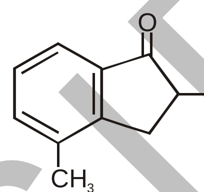
Q.5  $\xrightarrow[HCl]{Zn(Hg)}$

Q.6  $\xrightarrow[HCl]{Zn(Hg)}$ (A)

Q.7  $\xrightarrow[HCl, H_2O]{Zn(Hg)}$

Q.8  $\xrightarrow[HCl]{Zn(Hg)}$

Q.9  $\xrightarrow[HCl]{Zn(Hg)}$

Q.10  $\xrightarrow[HCl, 24h]{Zn/Hg, C_2H_5OH}$

Q.11 $Me(CH_2)_5\ CH=O \xrightarrow[25\%HCl]{Zn, Hg}$

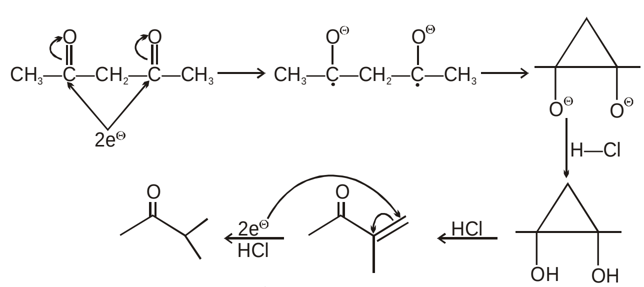
Q.12 **EXCEPTION OF CLEMMENSON:-**

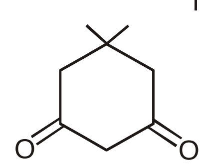
(i) Diketo containing active methylene group when undergoes clemmenson reduction, unexpected product are formed.

$$CH_3-\overset{\overset{\displaystyle O}{||}}{C}-CH_2-\overset{\overset{\displaystyle O}{||}}{C}-CH_3 \xrightarrow[HCl]{Zn(Hg)}$$

$$CH_3-\overset{\overset{\displaystyle O}{||}}{C}-\underset{\underset{\displaystyle CH_3}{|}}{CH}-CH_3$$

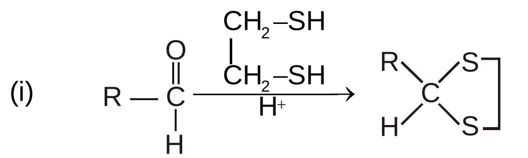
MECHANISM:-



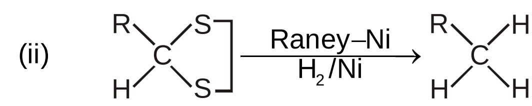
Example  $\xrightarrow[HCl]{Zn(Hg)}$

DPP NO-02 Time: 15 minutes

MOZINGO METHOD:-



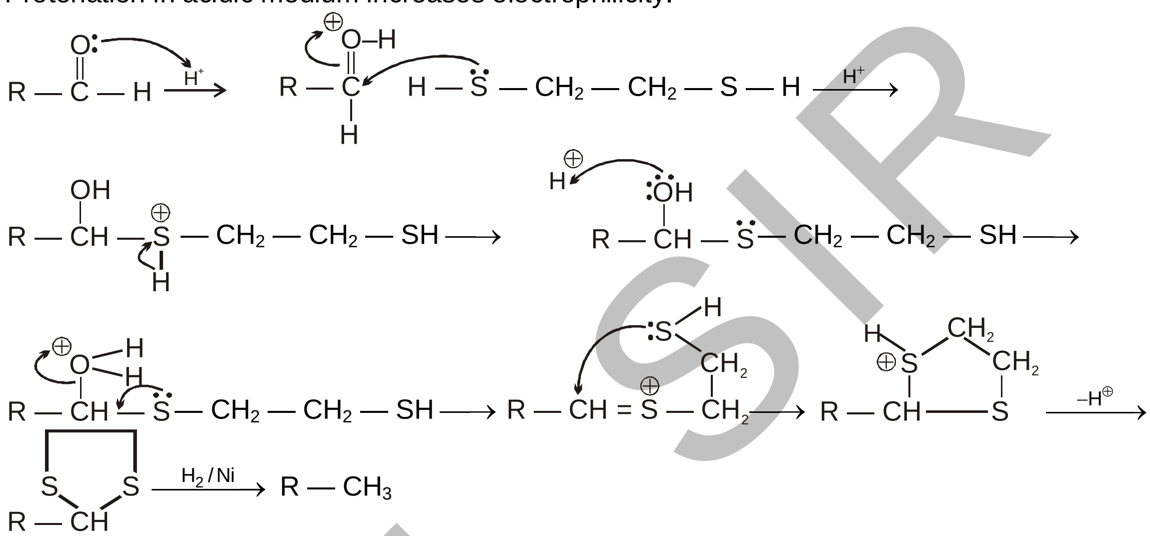
Cyclic thioacetal



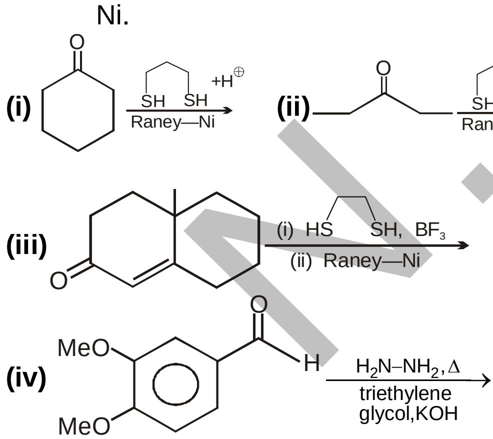
de-sulfurisation

MECHANISM OF MOZINGO METHOD:-

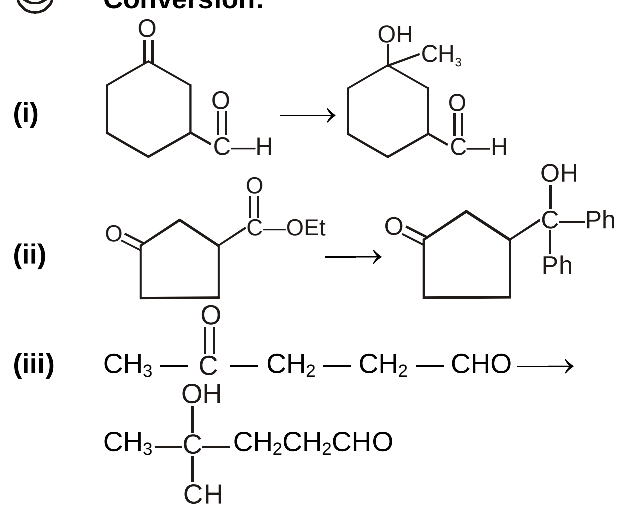
Protonation in acidic medium increases electrophilicity.



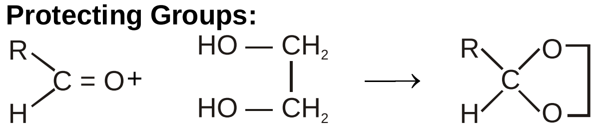
Imp. Raney Nickel $\rightarrow$ H_2 molecule is adsorbed on Ni.



Conversion:



Protecting Groups:



cyclic-acetal

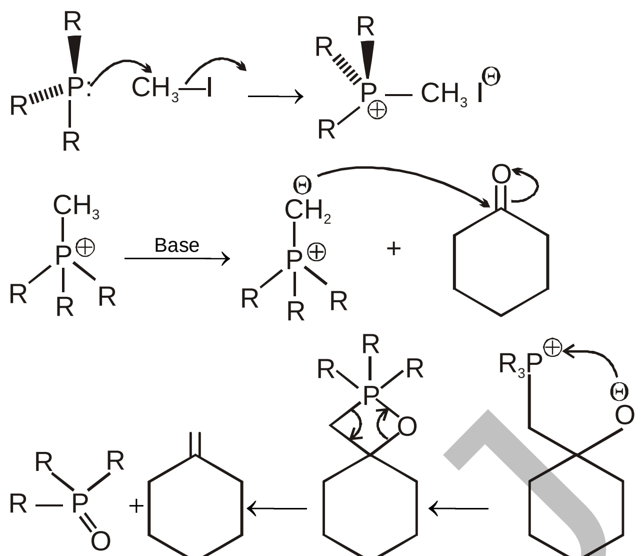
Glycol is used for protection of aldehyde and Ketone.

DPP NO-03 Time: 15 minutes

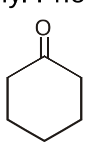
WITTING REACTION

Witting reaction is the substitution of a C = C bond for a C = O bond.

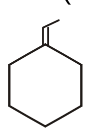
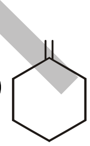
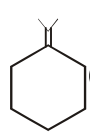
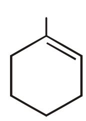
The witting reaction is a reaction between a carbonyl compound (aldehyde or ketone only) and a species known as a phosphonium ylid. An ylid is a species with positive and negative charges on adjacent atoms, and a phosphonium ylid carries its positive charge on Phosphorus, phosphonium ylids are made from phosphonium salts by deprotonating them with a strong base.



Triphenyl Phosphineoxide

Q.1  + $H_2\overset{\ominus}{C}-\overset{\oplus}{P}Ph_3 \longrightarrow$ (A)

product (A) is

(A)  (B)  (C)  (D) 

Q.2 In which of the following Geometrical isomer is formed as a products.

(A) $CH_3 - CH = O + H_2C = PPh_3 \longrightarrow$

(B) $CH_3-CH = O + CH_3 - CH = PPh_3 \longrightarrow$

(C) $H - \overset{O}{\overset{||}{C}} - H + H_2C = PPh_3 \longrightarrow$

(D) All

Q.3 Witting reaction is used for preparation of:

(A) Alkene (B) Ketone

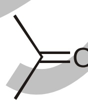
(C) Aldehyde (D) Acid.

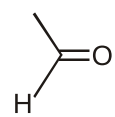
Q.4 Give the structure of he alkene(s) formed in each of the following reactions.

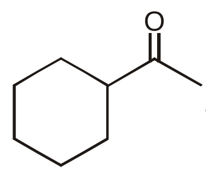
(A) $CH_3CH_2I \xrightarrow{Ph_3P} \xrightarrow{\text{butyllithium}} \xrightarrow{\text{acetone}}$

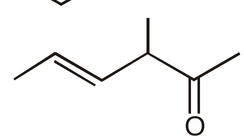
(B) $CH_3Br \xrightarrow{Ph_3P} \xrightarrow{\text{butyllithium}} \xrightarrow{\text{benzaldehyde}}$

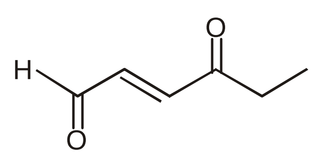
Give the product of the following reaction:

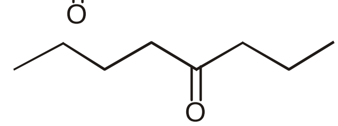
Q.5  + $CH_2 = PPh_3 \longrightarrow$

Q.6  + $CH_2 = PPh_3 \longrightarrow$

Q.7  + $CH_2 = PPh_3 \longrightarrow$

Q.8  + $CH_2 = PPh_3 \longrightarrow$

Q.9  + $CH_2 = PPh_3 \longrightarrow$

Q.10  + $CH_2=PPh_3 \longrightarrow$

DPP NO-04 Time: 15 minutes

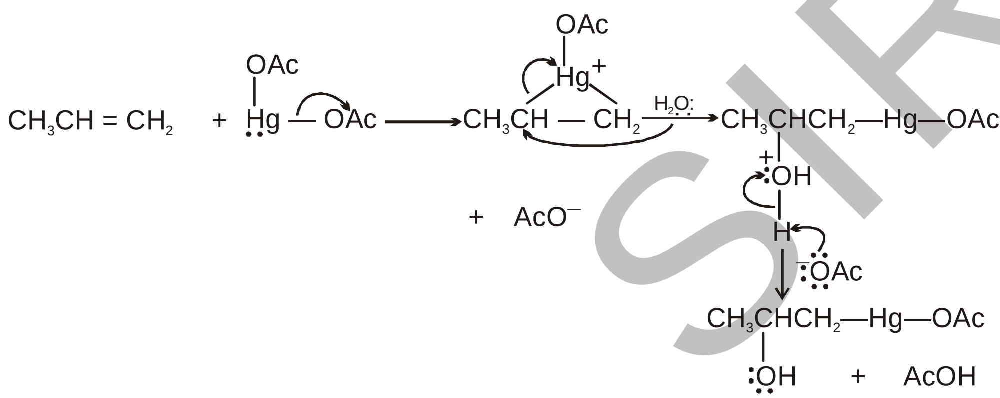
OXYMERCURATION-DEMERCURATION (OMDM):-

OMDM is a hydration process of alkene according to Markawnikoff's rule with no rearrangement of cyclic mercuinium ion. In oxymercuration, the alkene is treated with mercuric acetate in aqueous tetrahydrofuran (THF). When reaction with that reagent in complete, sodium borohydride and hydroxide ion are added to the reaction mixture.

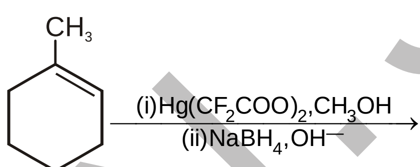
$$R-CH=CH_2 \xrightarrow[\text{(ii) } NaBH_4,\, HO^-]{\text{(i) } Hg(OAc)_2,\, H_2O,\, THF} R-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$$

$AcO^- = CH_3COO^-$

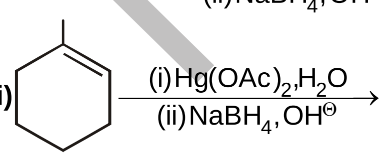
MECHANISM FOR OXYMERCURATION:

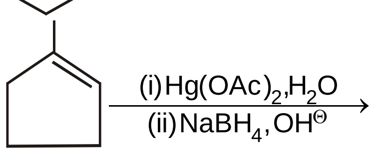


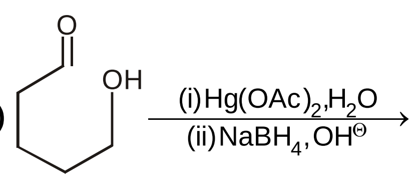
Q.1 Identify the product of the following reaction:-

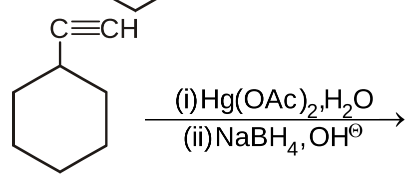
(i) 

(ii) 

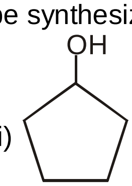
(iii) 

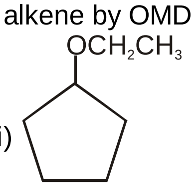
(iv) 

(v) 

(vi) 

Q.2 How could each of the following compounds be synthesized from an alkene by OMDM?

(i) 

(ii) 

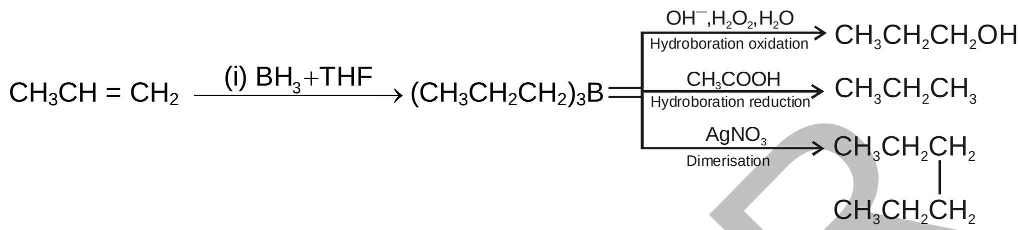
(iii) $CH_3\overset{\displaystyle CH_3}{\overset{|}{C}}CH_2CH_3$ with OH on the central carbon: $CH_3C(CH_3)(OH)CH_2CH_3$

(iv) $CH_3C(CH_3)(OCH_3)CH_2CH_3$

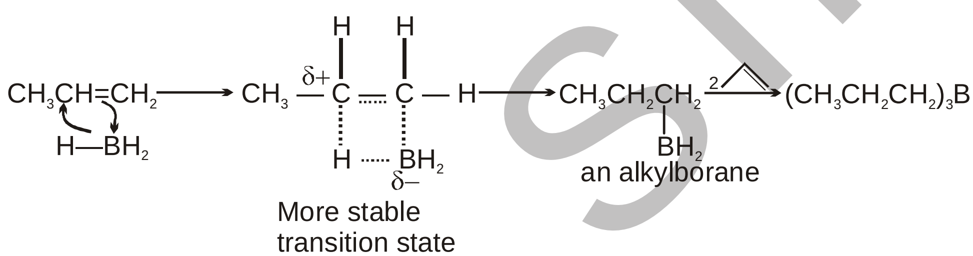
DPP NO-05 Time: 15 minutes

HYDROBORATION-OXIDATION:-

Hydroboration has been developed by brown as a reaction of tremendous synthetic utility because alkyl boranes are able to undergo a variety of transformation. Hydroboration is a one step, four centre, cis addition process in accordance with M. rule but after oxidation it seems to be appear to violate M. rule.

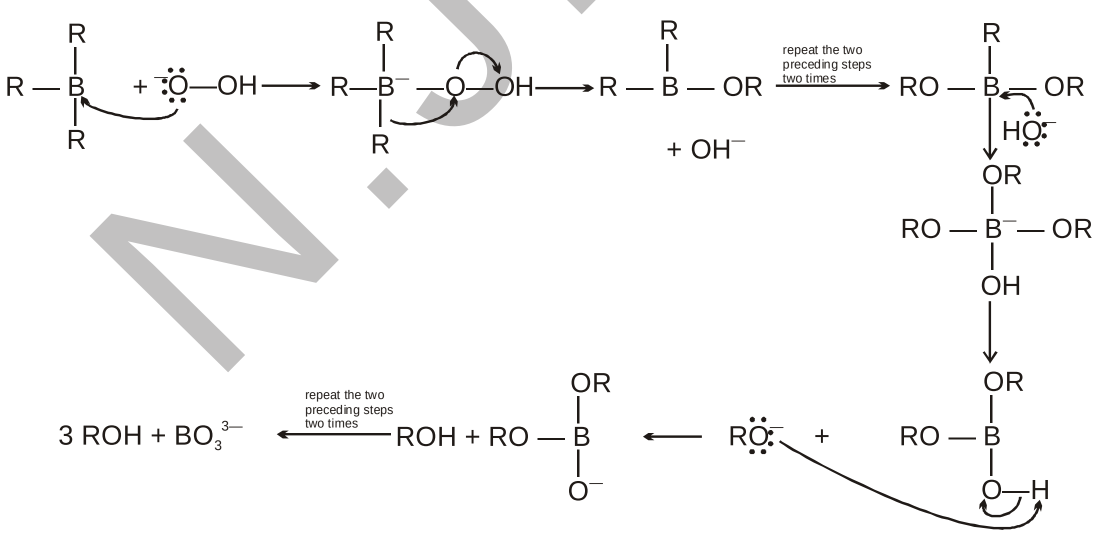


MECHANISM OF HYDROBORATION:



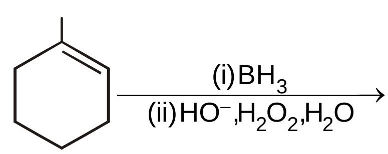
Mechanism of oxidation:-

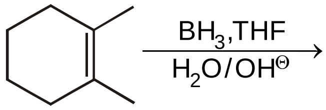
$HOOH + HO^- \; 1 \; HOO^- + H_2O$

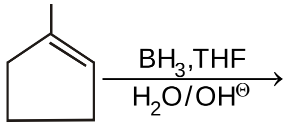


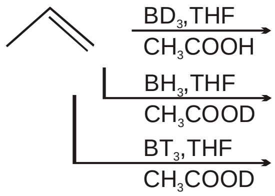
Q.1 Identify the product of the following reaction:-

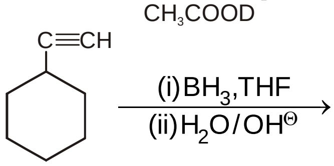
(i) $CH_2 = CH_2 \xrightarrow[\text{(ii)}HO^-,H_2O_2,H_2O]{\text{(i)}BH_3}$

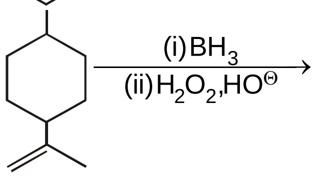
(ii) 

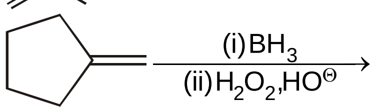
(iii) 

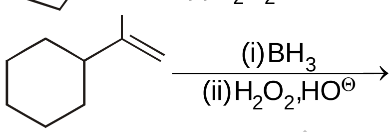
(iv) 

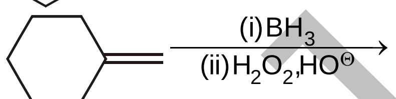
(v) 

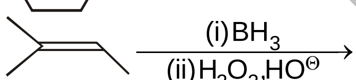
(vi) 

(vii) 

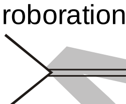
(viii) 

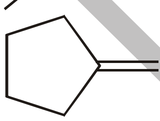
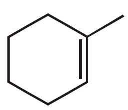
(ix) 

(x) 

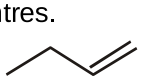
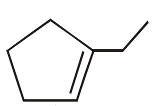
(xi) 

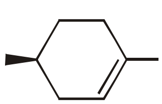
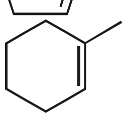
Q.2 What alkyl borane is formed from hydroboration of each alkene?

(A)  (B) 

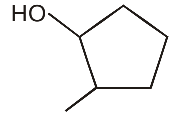
(C)  (D) 

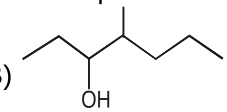
Q.3 Draw the product formed when each alkene is treated with BH_3 followed by H_2O_2, $HO^{\ominus}$ include the stereochemistry at all streogenic centres.

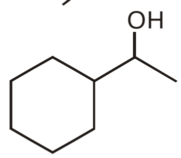
(A)  (B) 

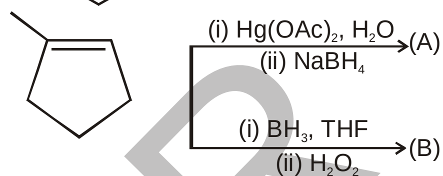
(C)  (D) 

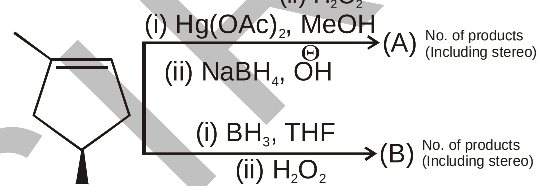
Q.4 What alkene can be used to prepare each alcohol as the exclusive product of a two step hydroboration oxidation sequence?

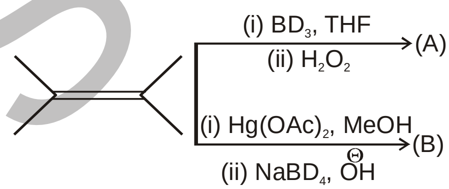
(A) 

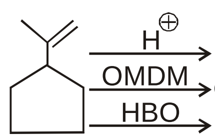
(B) 

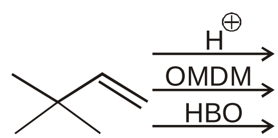
(C) 

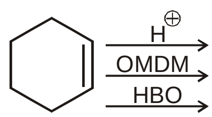
Q.5 

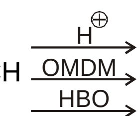
Q.6 

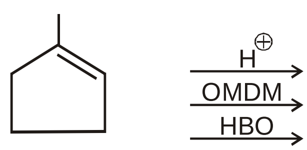
Q.7 

Q.8 

Q.9 

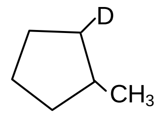
Q.10 

Q.11 $CH_3—C \equiv CH$ 

Q.12 

EXERCISE – I

Q.1 1-Methylcyclopentene can be converted into the given compound



by the use of which of the following regents ?

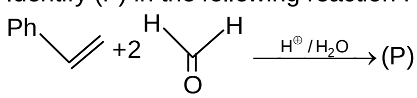
(A) BD_3 followed by HCOOH

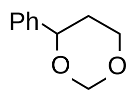
(B) BH_3 followed by HCOOD

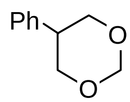
(C) BD_3 followed by HCOOD

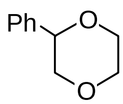
(D) BH_3 followed by $D-\overset{O}{\overset{\|}{C}}-O-H$

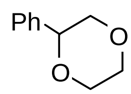
Q.2 Identify (P) in the following reaction :



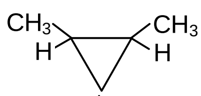
(A) 

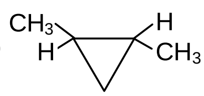
(B) 

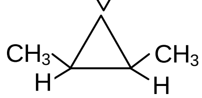
(C) 

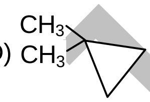
(D) 

Q.3 The reaction of E-2-butene with CH_2I_2 and Zn – Cu Couple in either medium leads to formation of

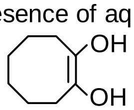
(A) 

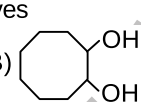
(B) 

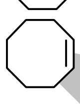
(C) 

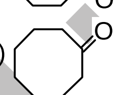
(D) 

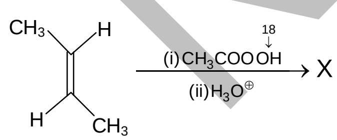
Q.4 The reaction of cyclooctyne with $HgSO_4$ in the presence of aq. H_2SO_4 gives

(A) 

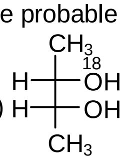
(B) 

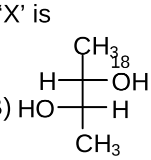
(C) 

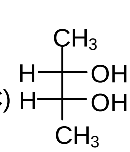
(D) 

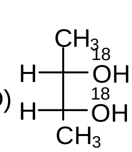
Q.5 

The probable structure of 'X' is

(A) 

(B) 

(C) 

(D) 

Q.6 Compound (A) on oxidation with hot $KMnO_4/OH^{\ominus}$ gives two compound

$CH_3-\underset{CH_3}{\underset{|}{CH}}-COOH$ & $CH_3-\overset{O}{\overset{\|}{C}}-CH_2CH_2CH_3$

compound A will have structure.

(A) $CH_3CH_2-\underset{CH_3}{\underset{|}{C}}=\underset{CH_3}{\underset{|}{C}}-CH_2CH_3$

(B) $CH_3-\underset{CH_3}{\underset{|}{CH}}-CH=\underset{CH_3}{\underset{|}{C}}-CH_2CH_2CH_3$

(C) $CH_3\underset{CH_3}{\underset{|}{CH}}-C\equiv C-CH_3$

(D) $CH_3-\underset{CH_3}{\underset{|}{CH}}-C\equiv C-\underset{CH_3}{\underset{|}{CH}}-CH_3$

Q.7 Number of required O_2 mole for complete combustion of one mole of propane

(A) 7 (B) 5 (C) 16 (D) 10

Q.8 How much volume of air will be needed for complete combustion of 10 lit. of ethane

(A) 135 lit. (B) 35 lit.

(C) 175 lit. (D) 205 lit.

Q.9 During the preparation of ethane by Kolbe's electrolytic method using inert electrodes the pH of the electrolyte

(A) Increases progressively as the reaction proceeds

(B) Decreases progressively as the reaction proceeds

(C) Remains constant throughout the reaction

(D) May decrease of the concentration of the electrolyte is not very high

Q.10 Ethylene forms ethylene chlorohydrin by the action of

(A) Dry HCl gas

(B) Dry chlorine gas

(C) Solution of chlorine gas in water

(D) Dilute hydrochloric acid

Q.11 Anti–Markownikoff's addition of HBr is not observed in

(A)Propene (B) But-2-ene

(C) Butene (D) Pent-2-ene

Q.12 Which alkene on heating with alkaline KMnO4 solution gives acetone and a gas, which turns lime water milky

(A) 2-Methyl-2-butene (B) Isobutylene

(C) 1-Butene (D) 2-Butene

Q.13 $B \xleftarrow{\text{Lindlar}} R-C\equiv C-R \xrightarrow{Na/NH_3} A$

A and B are geometrical isomers

(R – CH = CH – R)–

(A) A is trans, B is cis

(B) A and B both are cis
(C) A and B both are trans
(D) A is cis, B is trans

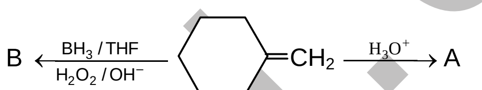
Q.14 Which is expected to react most readily with bromine
(A) $CH_3CH_2CH_3$ (B) $CH_2 = CH_2$
(C) $CH \equiv CH$ (D) $CH_3 - CH = CH_2$

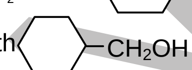
Q.15 An alkyne C_7H_{12} on reaction with alk. $KMnO_4$ and subsequent acidification with HCl yields a mixture of $CH_3-CH(CH_3)COOH + CH_3CH_2COOH$.
The alkyne is
(A) 3-Hexyne (B) 2-Methyl-3-hexyne
(C) 2-Methyl-2-hexyne (D) 2-Methyl-2-hexene

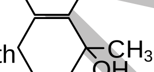
Q.16 A compound (C_5H_8) reacts with ammonical $AgNO_3$ to give a white precipitate and reacts with excess of $KMnO_4$ solution to give $(CH_3)_2CH - COOH$. The compound is
(A) $CH_2 = CH - CH = CH - CH_3$
(B) $(CH_3)_2CH - C \equiv CH$
(C) $CH_3(CH_2)_2C \equiv CH$
(D) $(CH_3)_2C = C = CH_2$

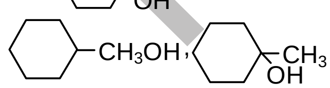
Q.17 Which of the following reagents cannot be used to locate the position of triple bond in $CH_3 - C \equiv C - CH_3$
(A) Br_2 (B) O_3 (C) Cu_2^{2+} (D) $KMnO_4$

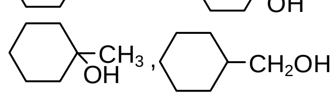
Q.18 $CH_3 - CH_2 - C \equiv CH \underset{B}{\overset{A}{\rightleftharpoons}} CH_3C \equiv C - CH_3$
A and B are
(A) alcoholic KOH and $NaNH_2$
(B) $NaNH_2$ and alcoholic KOH
(C) $NaNH_2$ and Lindlar
(D) Lindlar and $NaNH_2$

Q.19


(A) Both 

(B) Both 

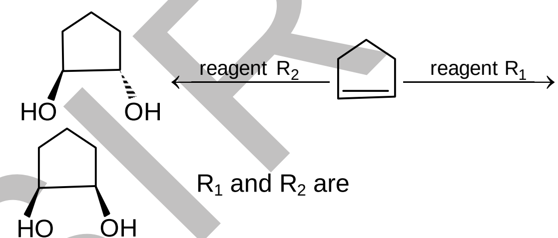
(C) 

(D) 

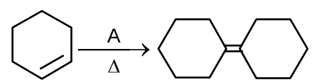
Q.20 $B \xleftarrow[H_2O_2, OH^-]{BH_3THF} CH_3 - C \equiv CH \xrightarrow{HgSO_4 / H_2SO_4} A$
A and B are -
(A) CH_3CH_2CHO, $CH_3 - \overset{O}{\overset{\|}{C}} - CH_3$
(B) $CH_3 - \overset{O}{\overset{\|}{C}} - CH_3$, CH_3CH_2CHO
(C) CH_3CH_2CHO (both)
(D) $CH_3 - \overset{O}{\overset{\|}{C}} - CH_3$ (both)

Q.21 $CH_3CH = CH_2 \xrightarrow[H_2O_2 / OH^-]{B_2D_6}$ product X
X is
(A) $CH_3 - CH(OH) - CH_2D$ (B) $CH_3 - CH(D) - CH_2OH$
(C) $CH_3 - CH(OD) - CH_3$ (D) None is correct

Q.22 Mixture of one mole each of ethene and propyne on reaction with Na will form H_2 gas at S.T.P.
(A) 22.4 L (B) 11.2 L
(C) 33.6 L (D) 44.8 L

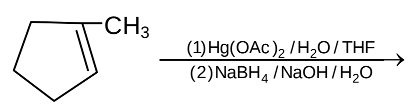
Q.23


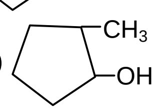
R_1 and R_2 are
(A) Cold alkaline $KMnO_4$, OsO_4/H_2O_2
(B) Cold alkaline $KMnO_4$, $HCO_3H/H_3O^{\oplus}$
(C) Cold alkaline $KMnO_4$, $CH_3 - O - O - CH_3$
(D) $C_6H_5CO_3H$, HCO_3H

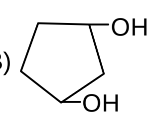
Q.24


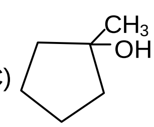
A can be
(A) Conc. H_2SO_4 (B) alcoholic KOH
(C) Et_3N (D) t-BuOK

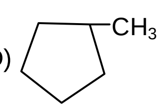
Q.25 $BrCH_2 - CH_2 - CH_2Br$ reacts with Na in the presence of ether at 100°C to produce
(A) $BrCH_2 - CH = CH_2$ (B) $CH_2 = C = CH_2$
(C) cyclo-($CH_2 - CH_2 - CH_2$) (D) All of these

Q.26


A.A is
(A) 

(B) 

(C) 

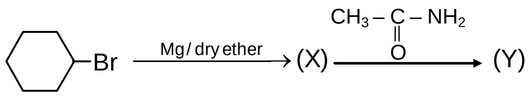
(D) 

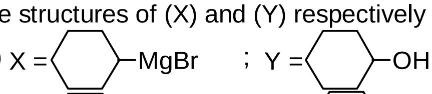
Q.27 $\underset{cis}{CH_3 - CH = CH - CH_3} \xrightarrow{x}$ product is Y (non-resolvable) then X can be
(A) Br_2 water
(B) $HCO_3H/H_3O^{\oplus}$

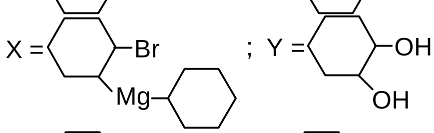
(C) Cold alkaline $KMnO_4$
(D) All of the above

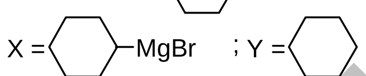
Q.28 A mixture of CH_4, C_2H_4 and C_2H_2 gaseous are passed through a Wolf bottle containing ammonical cuprous chloride. The gas coming out is
(A) Methane
(B) Acetylene
(C) Mixture of methane and ethylene
(D) Original mixture

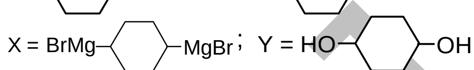
Q.29 For the ionic reaction of hydrochloric acid with the following alkenes, predict the correct sequence of reactivity as measured by reaction rates :
(I) $ClCH = CH_2$ (II) $(CH_3)_2.C = CH_2$
(III) $OHC.CH = CH_2$ (IV) $(NC)_2C = C(CN)_2$
(A) IV > I > III > II (B) I > IV > II > III
(C) III > II > IV > I (D) II > I > III > IV

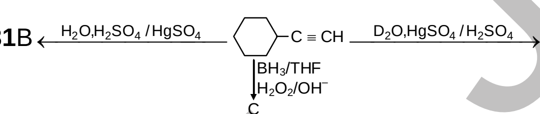
Q.30 

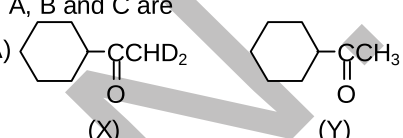
The structures of (X) and (Y) respectively are
(A) 

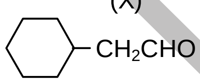
(B) 

(C) 

(D) 

Q.31 

A, A, B and C are
(A) 

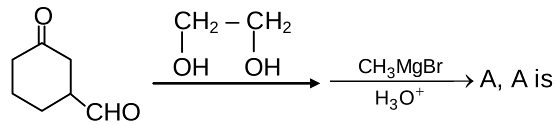


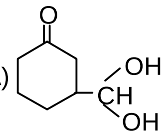
(Z)
(B) Y, X and Z (C) Y In all cases
(D) Z in all cases

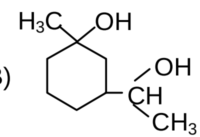
Q.32 End product of the following sequence of reaction is

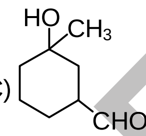
$$CH \equiv CH \xrightarrow{CH_3MgBr} \xrightarrow{CO_2 / H_3O^+} \xrightarrow{HgSO_4 / H_2SO_4} \xrightarrow[\Delta]{Ag_2O} \xrightarrow{\Delta}$$

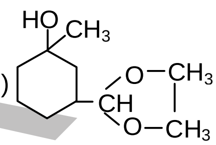
(A) $CH_3 - \overset{O}{\overset{\|}{C}}COOH$ (B) CH_3COOH (C) $CH_3 - \overset{O}{\overset{\|}{C}}CHO$ (D) CH_3COOH

Q.33 

(A) 

(B) 

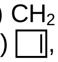
(C) 

(D) 

EXERCISE – II

Q.1 An alkene on ozonolysis yields only ethanal. There is an isomer of this which on ozonolysis yields :
(A) propanone (B) ethanal
(C) methanal (D) only propanal

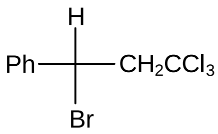
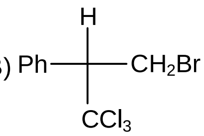
Q.2 Aqueous solution of potassium propanoate is electrolysed. Possible organic products are :
(A) n-Butane (B) $C_2H_5COOC_2H_5$
(C) $CH_3 - CH_3$ (D) $CH_2 = CH_2$

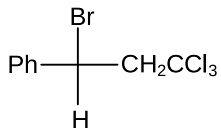
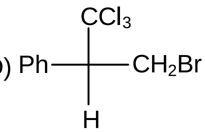
Q.3 (A) $C_4H_6 \xrightarrow{H_2 / Pt}$ (B) $C_4H_8 \xrightarrow{O_3 / H_2O}$ CH_3COOH
Hence A and B are
(A) $CH_3C \equiv CCH_3$, $CH_3CH = CHCH_3$
(B) $CH_2 = CHCH_3 = CH_2$, $CH_3CH = CHCH_3$
(C) , $CH_3CH = CHCH_3$
(D) None

Q.4 $Ph - \underset{\underset{O}{\|}}{C} - CH_3 \xrightarrow{A} Ph - CH_2 - CH_3$
A could be :
(A) NH_2NH_2, glycol/OH^-
(B) Na(Hg)/conc. HCl
(C) Red P/HI
(D) $\underset{SH}{\underset{|}{CH_2}} - \underset{SH}{\underset{|}{CH_2}}$; Raney Ni – H_2

Q.5 $CH_2 = CHCH_2CH = CH_2 \xrightarrow{NBS}$ A, A can be
(A) $CH_2 = CH\underset{Br}{\underset{|}{C}}HCH = CH_2$
(B) $CH_2 = CHCH = CH – CH_2Br$
(C) $CH_2 = CHCH_2CH = CHBr$
(D) $CH_2 = CHCH_2\underset{Br}{\underset{|}{C}} = CH_2$

Q.6 $Ph-CH=CH_2 + BrCCl_3 \xrightarrow{\text{peroxide}}$
Product is :

(A)  (B) 

(C)  (D) 

Q.7 Which of the following will give same product with HBr in presence or absence of peroxide
(A) Cyclohexene
(B) 1-methylcyclohexene
(C) 1,2-dimethylcyclohexene
(D) 1-butene

Q.8 The ionic addition of HCl to which of the following compounds will produces a compound having Cl on carbon next to terminal.
(A) $CF_3.(CH_2)_3.CH=CH_2$
(B) $CH_3.CH=CH_2$
(C) $CF_3.CH=CH_2$
(D) $CH_3.CH_2CH=CH.CH_3$

Q.9 Which reagent is the most useful for distinguishing compound I from the rest of the compounds

$CH_3CH_2C\equiv CH$ (I) $\quad CH_3C\equiv CCH_3$ (II)
$CH_3CH_2CH_2CH_3$ (III) $\quad CH_3CH=CH_2$ (IV)

(A) alk. $KMnO_4$ (B) Br_2/CCl_4
(C) Br_2/CH_3COOH (D) Ammonical $AgNO_3$

Q.10

List I	List II
(A) Walden Inversion	(1) Cis addition
(B) Recemic mixture	(2) Trans addition
(C) Alkene $\xrightarrow[\text{Reagent}]{\text{Baeyer}}$	(3) SN_1 reaction
(D) Alkene $\xrightarrow{Br_2}$	(4) SN_2 reaction

Codes :

	A	B	C	D
(a)	3	4	2	1
(b)	3	4	1	2
(c)	4	3	1	2
(d)	4	3	2	1

Q.11 **List I** **List II**
(A) $CH_3-C\equiv C-CH_3 \longrightarrow$ cis-2-butene (1) $Na/NH_3(\ell)$
(B) $CH_3-C\equiv C-CH_3 \longrightarrow$ trans-2-butene (1) $H_2/Pd/BaSO_4$
(C) $CH_3-C\equiv C-CH_3 \longrightarrow$ 1-Butyne (1) alc. KOH, Δ
(D) $CH_3-C\equiv C-CH_3 \longrightarrow$ 2-Butyne (1) $NaNH_2$, Δ

Codes :

	A	B	C	D
(a)	2	1	3	4
(b)	1	2	4	3
(c)	1	2	3	4
(d)	2	1	4	3

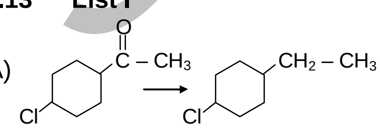
Q.12

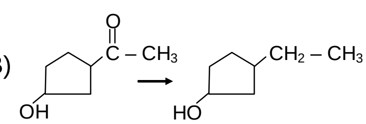
List I	List II
(A) $RCOONa \xrightarrow{\text{electrolysis}} R-R$	(1) Corey-House reaction
(B) $R-CH_2-COOH \xrightarrow{\text{Soda lime}} R-CH_3$	(2) Kolbe electrolysis
(C) $RCOOH \xrightarrow[\text{(ii)} Cl_2/\Delta]{\text{(i)} AgNO_3} R-Cl$	(3) degradation
(D) $R'-X + R_2CuLi \rightarrow R-R'$	(4) Hundsdiecker reaction

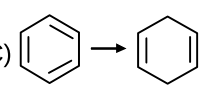
Codes :

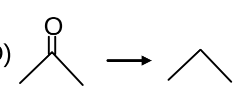
	A	B	C	D
(a)	2	3	4	1
(b)	1	3	4	2
(c)	2	4	3	2
(d)	2	4	1	3

Q.13 **List I** **List II**

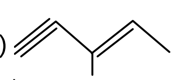
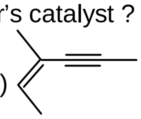
(A)  (1) Birch reduction

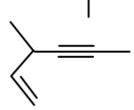
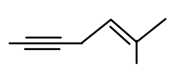
(B)  (2) Stephen's reduction

(C)  (3) Wolf-Kishner reduction

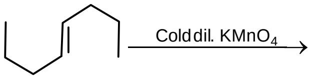
(D)  (4) Clemmensen reduction

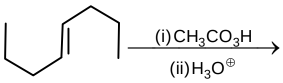
Q.14 Which of the following produce chiral molecule after treatment with Lindlar's catalyst ?

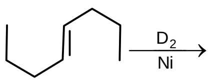
(A)  (B) 

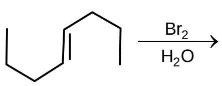
(C)  (D) 

Q.15 **Column I** **Column II**

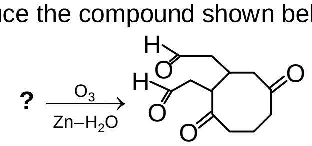
(A)  (P) Optically inactive due to internal compensation

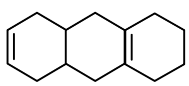
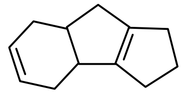
(B)  (Q) Optically inactive due to external compensation

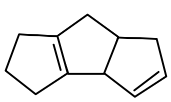
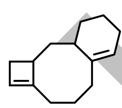
(C)  (R) Product has presence of two chiral center

(D)  (S) Diastereomers will be formed

Q.16 Which starting material should be used to produce the compound shown below ?

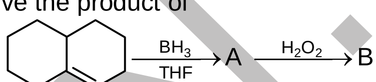


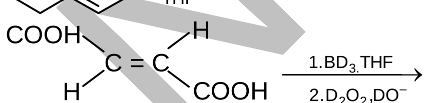
(A)  (B) 

(C)  (D) 

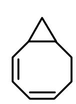
EXERCISE – III

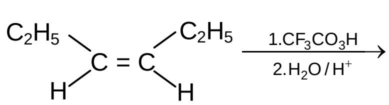
Q.1 Give the product of

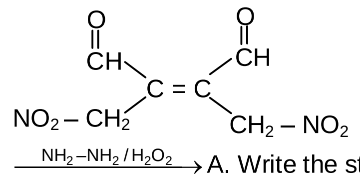
(a) 

(b) 

Q.2 $CH_3-\underset{CH_3}{\overset{CH_3}{C}}-Cl \xrightarrow{LiAlH_4}$?

Q.3 What are the ozonlysis product of 

Q.4  A + B. What are A and B ?

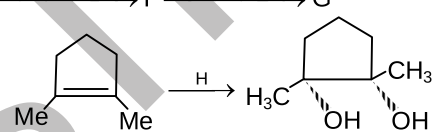
Q.5  A. Write the structure of A

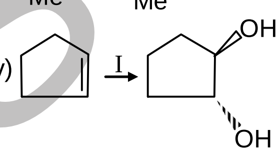
Q.6 Give the structure of the alkene that yields on ozonolysis
(i) $CH_3CH_2CH_2CHO$ & $HCHO$
(ii) $C_2H_5COCH_3$ & $CH_3CH(CH_3)CHO$
(iii) Only $CH_3CO.CH_3$
(iv) $CH_3.CHO$ & $HCHO$ & $OHC.CH_2.CHO$
(v) Only $OHC-CH_2CH_2CH_2-CHO$

Q.7 What are A to K for the following reactions

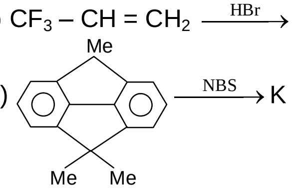
(i) $PhC\equiv CH + CH_3MgX \rightarrow A \xrightarrow{ArCH_2Cl} B \xrightarrow{Li/NH_3} C.$

(ii) $PhCH_2CH_2CH_3 + Br_2 \xrightarrow{h\gamma} D \xrightarrow[KOH]{alcoholic} E \xrightarrow{cold\ dil.KMnO_4} F \xrightarrow{hot\ KMnO_4} G$

(iii) 

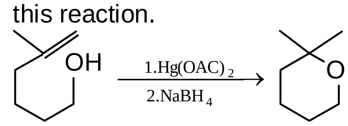
(iv) 

(v) $CF_3-CH=CH_2 \xrightarrow{HBr} J$

(vi) 

Q.8 Explain the following
(i) 1, 2 shift does not take place during oxymericuration demercuration. Why ?
(ii) Halogenation of alkene is anti addition but not syn addition. Why ?
(iii) Anti markovnikov addition is not applicable for HCl. Why ?
(iv) 1, 4–addition takes place in butadi-ene. Why ?
(v) C – H bond is stronger than C – C bond but in chlorination C – H bonds get cleaved but not C – C bond. Why ?

Q.9 The following cyclisation has been observed in the oxymercuration & demercuration of this unsaturated alcohol. Propose a mechanism for this reaction.

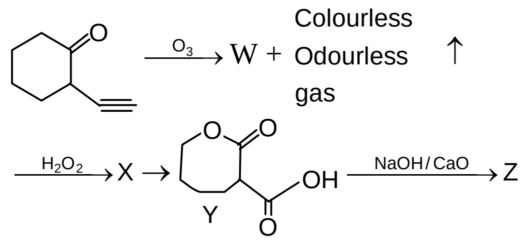


Q.10 Acetylene is acidic but it does not react with NaOH or KOH. Why ?

Q.11 $CH \equiv C - CH_2 - CH = CH_2$, adds up HBr to give $CH \equiv C - CH_2 - CHBr - CH_3$ while $CH \equiv C - CH = CH_2$ adds up HBr to give $CH_2 = C.\ Br\ .\ CH = CH_2$

Q.12 Chlorination of ethane to ethyl chloride is more practicable than the chlorination of n-pentane to 1-chloropentane.

Q.13 Why n-pentane has higher boiling point than neopentane?

Q.14


Identify W, X, Y & Z.

EXERCISE – IV(A)

Q.1 Alcoholic solution of KOH is a specific reagent for **[IIT '90]**
(A) Dehydration
(B) Dehydrogenation
(C) Dehydro halogenation
(D) Dehalogenation

Q.2 Of the following, unsaturated hydrocarbons are **[IIT '90]**
(A) ethyne (B) cyclohexane
(C) n-propane (D) ethene

Q.3 1-chlorobutane on reaction with alcoholic potash gives **[IIT '91]**
(A) 1-butene (B) 1-butanol
(C) 2-butene (D) 2-butanol

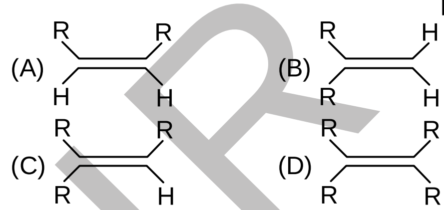
Q.4 The hybridization of carbon atoms in C – C single bond of $HC \equiv C - CH = CH_2$ is **[IIT '91]**
(A) $sp^3 - sp^3$ (B) $sp^2 - sp^3$
(C) $sp - sp^2$ (D) $sp^2 - sp^2$

Q.5 The product(s) obtained via oxymercuation ($HgSO_4 + H_2SO_4$) of 1-butyne would be **[IIT '97]**
(A) $CH_3 - CH_2 - \underset{\underset{O}{||}}{C} - CH_3$
(B) $CH_3 - CH_2 - CH_2 - CHO$
(C) $CH_3 - CH_2 - CHO + HCHO$
(D) $CH_3 - CH_2 - COOH + HCOOH$

Q.6 When cyclohexane is poured on water, it floats, because **[IIT '97]**
(A) Cyclohexane is in 'boat' form
(B) Cyclohexane is in 'chair' form
(C) Cyclohexane is in 'crown' form
(D) Cyclohexane is less dense than water

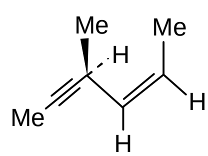
Q.7 Which of the following compounds will show geometrical isomerism ? **[IIT '98]**
(A) 2-butene (B) Propene
(C) 1-phenylpropene (D) 2-methyl-2-butene

Q.8 In the compound $CH_2 = CH - CH_2 - CH_2 - C \equiv CH$, the $C_2 - C_3$ bond is of the type **[IIT '99]**
(A) $sp - sp^2$ (B) $sp^3 - sp^3$
(C) $sp - sp^3$ (D) $sp^2 - sp^3$

Q.9 Which one of the following alkenes will react fastest with H_2 under catalytic hydrogenation condition **[IIT '2000]**


Q.10 Propyne and propene can be distinguished by
(A) conc. H_2SO_4 (B) Br_2 in CCl_4
(C) dil. $KMnO_4$ (D) $AgNO_3$ in ammonia

Q.11 In the presence of peroxide, hydrogen chloride and hydrogen iodide do not give anti-Markovnikov addition to alkene because **[IIT '2001]**
(A) both are highly ionic
(B) one is oxidising and the other is reducing
(C) one of the step is endothermic in both the cases
(D) All the steps are exothermic in both cases

Q.12


Hydrogenation of the above compound in the presence of poisoned paladium catalyst gives **[IIT '2001]**

(A) An optically active compound
(B) An optically inactive compound
(C) A racemic mixture
(D) A diastereomeric mixture

Q.13 The reaction of propene with HOCl proceeds via the addition of **[IIT '2001]**
(A) H^+ in first step (B) Cl^+ in first step
(C) OH^- in first step
(D) Cl^+ and OH^- in single step

Q.14 The nodal plane in the π-bond of ethene is located in **[IIT '2002]**
(A) the molecular plane
(B) a plane parallel to the molecular plane

(C) a plane perpendicular to the molecular plane which contains the carbon-carbon σ-bond at right angle
(D) a plane perpendicular to the molecular plane which contains the carbon-carbon σ-bond.

Q.15 Consider the following reactions **[IIT '2002]**

$H_3C - \underset{|}{\underset{D}{CH}} - \underset{|}{\underset{CH_3}{CH}} - CH_3 + \dot{B}r \rightarrow$ 'X' + HBr

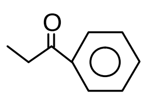
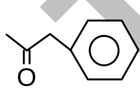
Identify the structure of the major product 'X'

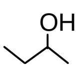
(A) $H_3C - \underset{D}{CH} - \underset{CH_3}{CH} - \dot{C}H_2$
(B) $H_3C - \underset{D}{CH} - \underset{CH_3}{\dot{C}} - CH_3$
(C) $H_3C - \underset{D}{\dot{C}} - \underset{CH_3}{CH} - CH_3$
(D) $H_3C - \dot{C}H - \underset{CH_2}{CH} - CH_3$

Q.16 Identify a reagent from the following list which can easily distinguish between 1-butyne and 2-butyne **[IIT '2002]**

(A) bromine, CCl_4 (B) H_2, Lindlar catalyst
(C) dilute H_2SO_4, $HgSO_4$
(D) ammonical Cu_2Cl_2 solution

Q.17 $C_6H_5 - C \equiv C - CH_3 \xrightarrow[H_2SO_4]{HgSO_4}$ A **[IIT '2003]**

(A)  (B) 
(C) $C_6H_5 - \underset{OH}{C} = CHCH_3$ (D) $C_6H_5 - CH = \underset{OH}{C} - CH_3$

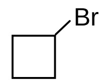
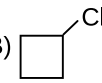
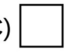
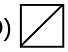
Q.18  $\xrightarrow[-H_2O]{H^+}$ X (mixture) $\xrightarrow{Br_2}$ 5 compounds of molecular formula $C_4H_8Br_2$ **[IIT '2003]**
Number of compounds in X will be :
(A) 2 (B) 3 (C) 4 (D) 5

Q.19 2-hexyne can be converted into trans-2-hexene by the action of : **[IIT '2004]**

(A) $H_2 -$ Pd - $BaSO_4$ (B) Li in liq. NH_3
(C) $H_2 - PtO_2$ (D) $NaBH_4$

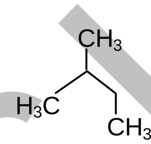
Q.20 When Phenyl Magnesium Bromide reacts with tert. butanol, which of the following is formed ?
(A) Tert. butyl methyl ether **[IIT '2005]**
(B) Benzene
(C) Tert. butyl benzene
(D) Phenol

Q.21 1-bromo-3-chlorocyclobutane when treated with two equivalent of Na, in the presence of ether which of the following will be formed ? **[IIT '2005]**

(A)  (B)  (C)  (D) 

Q.22 Cyclohexene is best prepared from cyclohexanol by which of the following : **[IIT '2005]**
(A) conc. H_3PO_4 (B) conc. $HCl/ZnCl_2$
(C) conc. HCl (D) conc. HBr

Q.23 $CH_3 - CH = CH_2 + NOCl \rightarrow P$ **[IIT '2006]**
Identify the adduct.
(A) $CH_3 - \underset{Cl}{CH} - \underset{NO}{CH_2}$ (B) $CH_3 - \underset{NO}{CH} - \underset{Cl}{CH_2}$
(C) $CH_3 - CH_2 - \overset{NO}{\underset{Cl}{CH}}$ (D) $\underset{NO}{CH_2} - CH_2 - \underset{Cl}{CH_2}$

Q.24  $\xrightarrow{Cl_2, h\nu}$ N(isomeric products)
$C_5H_{11}Cl \xrightarrow{\text{fractional distillation}}$ M(isomeric products)
What are N and M? **[IIT '2006]**
(A) 6, 6 (B) 6, 4
(C) 4, 4 (D) 3, 3

Q.25 The number of structural isomers for C_6H_{14} is **[IIT '2007]**
(A) 3 (B) 4
(C) 5 (D) 6

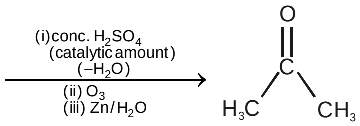
Q.26 The number of stereoisomers obtained by bromination of trans-2-butene is **[IIT '2007]**
(A) 1 (B) 2
(C) 3 (D) 4

Q.27 The synthesis of 3-octyne is achieved by adding a bromoalkane into a mixture of sodium amide and an alkyne. The bromoalkane and alkyne respectively are
[IIT-JEE 2010]
(A) $BrCH_2CH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$
(B) $BrCH_2CH_2CH_3$ and $CH_3CH_2CH_2C \equiv CH$
(C) $BrCH_2CH_2CH_2CH_2CH_3$ and $CH_3C \equiv CH$

(D) $BrCH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$

Paragraph for question Nos. 28 and 29
An acyclic hydrocarbon P, having molecular formula C_6H_{10}, gave acetone as the only organic product through the following sequence of reaction, in which Q is an intermediate organic compound.**[IIT-JEE 2011]**

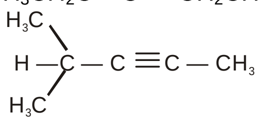
$$\underset{(C_6H_{10})}{P} \xrightarrow[\substack{\text{(ii) NaBH}_4\text{ / ethanol} \\ \text{(iii) dil. acid}}]{\text{(i) dil.}H_2SO_4\text{ / HgSOl4}} Q$$

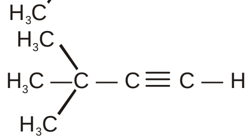


Q.28 The structure of compound P is

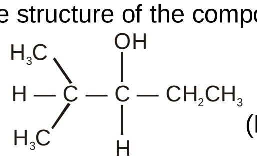
(A) $CH_3CH_2CH_2CH_2-C \equiv C-H$

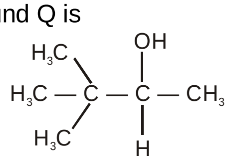
(B) $H_3CH_2C-C \equiv CH_2CH_3$

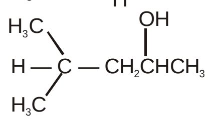
(C) 

(D) 

Q.29 The structure of the compound Q is

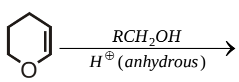
(A) 

(B) 

(C) 

(D) $CH_3CH_2CH_2\overset{OH}{\overset{|}{CH}}CH_2CH_3$

Q.30 The major product of the following reaction is



[IIT '2011]

(A) a hemiacetal (B) an acetal

(C) an ether (D) an ester

EXERCISE – IV(B)

Q.1 $(CH_3)_2\overset{Cl}{\overset{|}{C}}-CH_2CH_3 \xrightarrow{alc.KOH} ?$ **[IIT '1992]**

Q.2 $C_6H_5CH_2\underset{Br}{\underset{|}{C}}HCH_3 \xrightarrow[heat]{alc.KOH} ? \xrightarrow{HBr} ?$

[IIT '1993]

Q.3 $C(C_6H_{12})$, an optically active hydrocarbon which on catalytic hydrogenation gives an optically inactive compound, C_6H_{14}. **[IIT '1993]**

Q.4 Draw the stereochemical structure of the product in the following reactions. **[IIT '1994]**

$R-C \equiv C-R \xrightarrow[\text{Lindlar catalyst}]{H_2}$

Q.5 Write down the structures of the stereoismers formed when cis-2-butene is reacted with bromine. **[IIT '1995]**

Q.6 An organic compound $E(C_5H_8)$ on hydrogenation gives compound $F(C_5H_{12})$. Compound E on ozonolysis gives formaldehyde and 2-ketopropanal. Deduce the structure of compound E. **[IIT '1995]**

Q.7 Give the structures of the major organic products from 3-ethyl-2-pentene under each of the following reaction conditions. **[IIT '1996]**

(a) HBr in the presence of peroxide

(b) Br_2 / H_2O

(c) $Hg(OAc)_2 / H_2O$; $NaBH_4$

Q.8 3, 3–Dimethyl–butan–2–ol loses a molecule of water in the presence of concentrated sulphuric acid to give tetramethylethylene as a major product. Suggest a suitable mechanism. **[IIT '1996]**

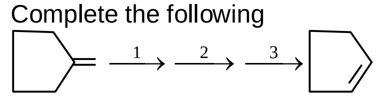
Q.9 Only mole of the compound A (molecular formula C_8H_{12}), incapable of showing stereoisomerism, reacts with only one mole of H_2 on hydrogenation over Pd. A undergoes ozonolysis to give a symmetrical diketone $B(C_8H_{12}O_2)$. What are the structure of A and B? **[IIT '1997]**

Q.10 Compound (A) C_6H_{12} gives a positive test with bromine in carbon tetrachloride. Reaction of (A) with alkaline $KMnO_4$ yields only (B) which is the potassium salt of an acid. Write structure formulae and IUPAC name of (A) and (B). **[IIT '1997]**

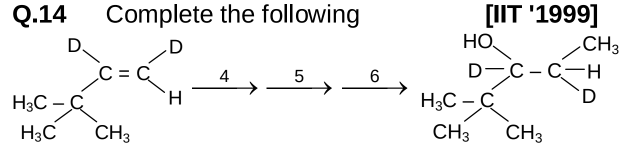
Q.11 The central carbon–carbon bond in 1, 3–butadiene is shorter than that of n-butane. Why ? **[IIT '1998]**

Q.12 Discuss the hybridisation of carbon atoms in allene (C_3H_4) and show the π-orbital overlaps. **[IIT '1999]**

Q.13 Complete the following **[IIT '1999]**



Q.14 Complete the following **[IIT '1999]**



Q.15 Carry out the following transformation in not more than three steps. **[IIT '1999]**

$CH_3-CH_2-C \equiv C-H \rightarrow$

$CH_3-CH_2-CH_2-\overset{O}{\overset{||}{C}}-CH_3$

Q.16 $CH_2 = CH^-$ is more basic than $HC \equiv C^-$ **[IIT '2000]**

Q.17 On reaction with 4N alcoholic KOH at 175°C 1-pentyne is slowly converted into equilibrium mixture of 1.3% 1–pentyne (A), 95.2% 2-pentyne (B) and 3.5% 1, 2-pentadiene (C). Give the suitable mechanism of formation of A, B and C with all intermediates. **[IIT '2001]**

Q.18 Identify X, Y and Z in the following synthetic scheme and write their structures. Is the compound Z optically active ? Justify your answer. **[IIT '2002]**

(A) $CH_3CH_2C \equiv C - H \xrightarrow[\text{(ii) } CH_3CH_2Br]{\text{(i) } NaNH_2} X$

$\xrightarrow{H_2/Pd\text{–}BaSO_4} Y \xrightarrow{\text{alkaline } KMnO_4} Z$

Q.19 A biologically active compound, Bombykol ($C_{16}H_{30}O$) is obtained from a natural source. The structure of the compound is determined by the following reactions. **[IIT '2002]**

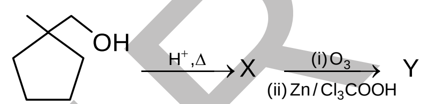
(a) On hydrogenation, Bombykol gives a compound A, $C_{16}H_{34}O$ which reacts with acetic anhydride to give an ester.

(b) Bombykol also reacts with acetic anhydride to give another ester, which on oxidative ozonolysis (O_3/H_2O_2) gives a mixture of butanoic acid, oxalic acid and 10-acetoxy decanoic acid.

Determine the number of double bonds in Bombykol. Write the structures of compound A and Bombykol. How many geometrical isomers are possible for Bombykol ? **[IIT '2002]**

Q.20 If after complete ozonolysis of one mole of monomer of natural polymer gives two moles of CH_2O and one mole of $O=\underset{\displaystyle CH_3}{\overset{|}{C}}-CH=O$. Identify the monomer and draw the all-cis structure of natural polymer. **[IIT '2005]**

Q.21



[IIT '2005]

Identify X and Y.

ANSWER KEY

EXERCISE - I

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	B	A	B	D	A	B	B	C	A	C	B	B	A	D	B	B	A	A	D	B
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33							
Ans.	B	B	B	A	C	C	C	C	D	C	A	A	C							

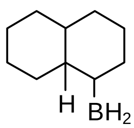
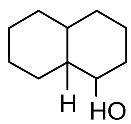
EXERCISE – II

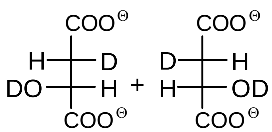
Ques.	1	2	3	4	5	6	7	8	9	10	11	12
Ans.	A,C	A,B,C,D	A,B	A,B,C,D	A,B	A,C	A,C	A,D	D	C	D	A

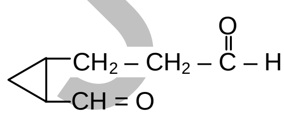
Q.13 (A) 4 ; (B) 3; (C) 1 ; (D) 3,4 **Q.14** C **Q.15** (A) Q,R ; (B) P,R ; (C) Q,R ; (D) Q,R

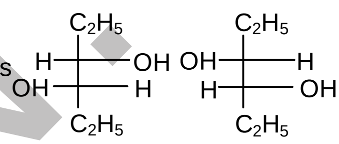
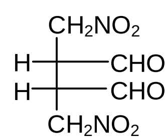
Q.16 (A) B

EXERCISE – III

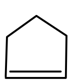
Q.1 (a) (A) =  , (B) = 

(b) 

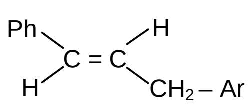
Q.2 $CH_3 - \underset{}{\overset{CH_3}{\overset{|}{C}}} = CH_2$ **Q.3**  + $\begin{array}{c} O = CH \\ | \\ O = CH \end{array}$

Q.4 A + B are two enatiomers  **Q.5** 

Q.6 (i) C – C – C – C = C (ii) $C - C - \underset{\underset{C}{|}}{C} = C - \overset{\overset{C}{|}}{C} - C$ (iii) $C - \underset{\underset{C}{|}}{C} = \underset{\underset{C}{|}}{C} - C$ (iv) C – C = C – C – C = C

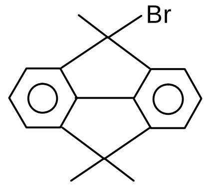
(v) 

Q.7 (A) PhC ≡ CMgx, (B) Ph – C ≡ C – CH_2Ar,

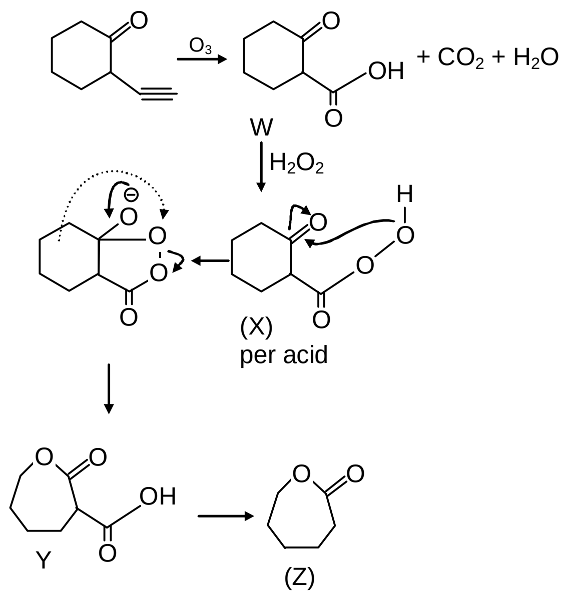
(C)  (D) $Ph - \underset{\underset{Br}{|}}{CH} - Et$

(E) Ph – CH = CH – Me trans, (F) $Ph - \underset{\underset{OH}{|}}{CH} - \underset{\underset{OH}{|}}{CH} - Me$ (threo mix.),

(G) Ph – COOH (H) Cold dil. $KMNO_4$

(I) HCO_3H (J) $CF_3CH_2CH_2Br$, (K) 

Q.14



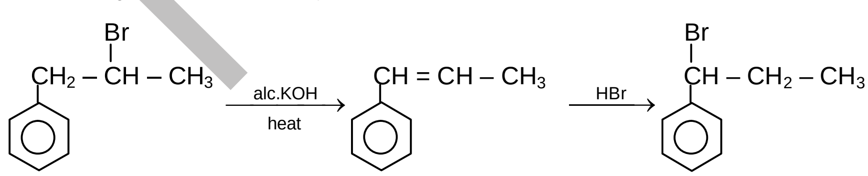
EXERCISE – IV(A)

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	A,D	A	C	A	D	A,C	D	A	D	C	B	B	A	B	D	A	B	B	B
Ques.	21	22	23	24	25	26	27	28	29	30										
Ans.	D	A	A	B	C	A	D	D	B	B										

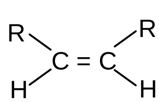
EXERCISE – IV(B)

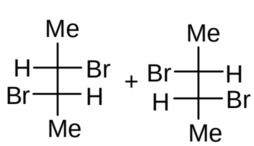
Q.1 $CH_3-\underset{CH_3}{\underset{|}{C}}=CH-CH_3$

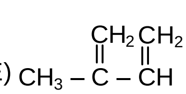
Q.2



Q.3 $CH_3-CH_2-\underset{CH_3}{\overset{H}{C}}-CH=CH_2$
(C_6H_{12})

Q.4 

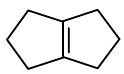
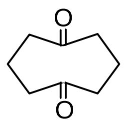
Q.5 

Q.6 (E) 

Q.7 (a) $(CH_3 - CH_2)\ CH - \underset{}{\overset{Br}{\overset{|}{C}}}H - CH_3$

(b) $(CH_3 - CH_2)_2\ \overset{OH}{\overset{|}{C}} - \underset{\underset{Br}{|}}{C}H - CH_3$

(c) $(C_2H_5)_3C- OH$

Q.9 (A)  (B) 

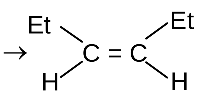
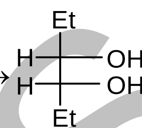
Q.10 (A) $CH_3 - CH_2 - CH = CH - CH_2 - CH_3$ (B) CH_3CH_2COOK

Q.13 $1 \rightarrow$ ozonolysis ; $2 \rightarrow LiAlH_4$; $3 \rightarrow H_2SO_4$

Q.14 $(4) \rightarrow HO - Cl$; $(5) \rightarrow CH_3MgCl$; $(6) \rightarrow H_2O/H^+$

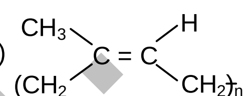
Q.15 (1) $NaNH_2$, (2) Me–I, (3) $HgSO_4$ dilH_2SO_4

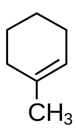
Q.16 Higher electronegativity of sp carbon

Q.18 (X) $\rightarrow Et - C \equiv C - Et$ (Y) $\rightarrow$  (Z) $\rightarrow$  Z is meso so optically inactive

Q.19 Bombykol : HO – C – C – C – C – C – C – C – C – C – C = C – C = C – C – C – C

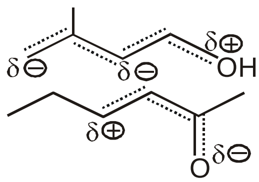
(A) HO $-(CH_3)_{15}$ CH_3 4 geometrical isomers are possible

Q.20 (a) $CH_2 = \overset{CH_3}{\overset{|}{C}} - CH = CH_2$ (b) 

Q.21 (X)  , (Y) $CH_3 - \overset{O}{\overset{||}{C}} - (CH_2)_4 - CH = O$

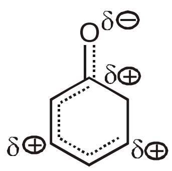
Answers of Organic Chemistry DPP for GOC (conceptual improvement of GOC)

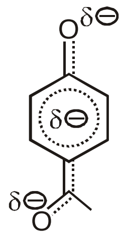
Answers of DPP No. – 1

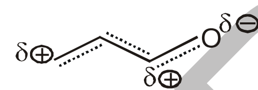
1. 

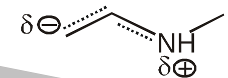
2. 

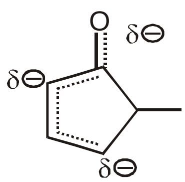
3.

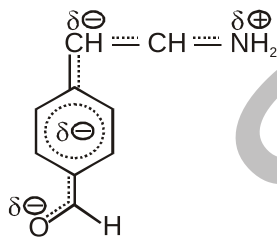
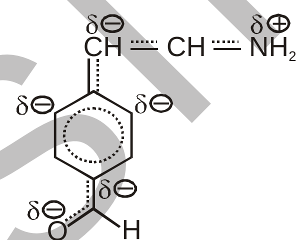
4. 

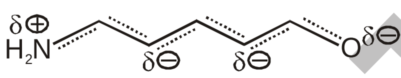
5. 

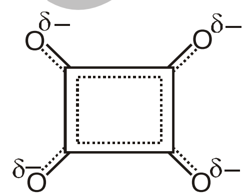
6. 

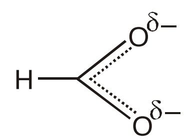
7. 

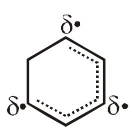
8. 

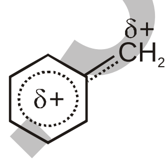
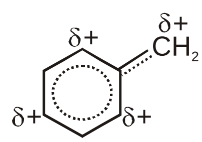
9.  or 

10. 

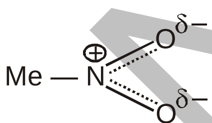
11. 

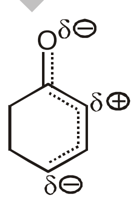
12. 

13. 

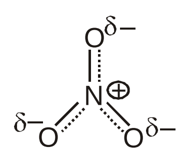
14.  or 

15. $\mathrm{Me}-\overset{\delta+}{\mathrm{S}}\cdots\overset{\delta+}{\mathrm{CH_2}}$

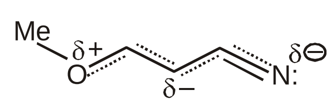
16. 

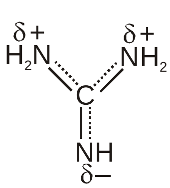
17. 

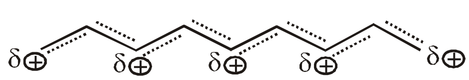
18. $\overset{\delta+}{\mathrm{H_2N}}\cdots\mathrm{C}\equiv\overset{\delta-}{\mathrm{N}}:$

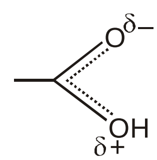
19. 

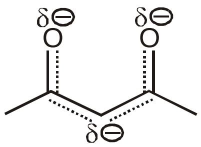
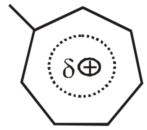
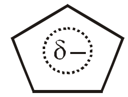
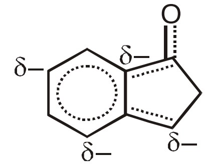
20. $\overset{\delta+}{\mathrm{O}}\equiv\mathrm{C}\cdots\overset{\delta-}{\mathrm{O}}$ or $\overset{\delta-}{\mathrm{O}}\cdots\mathrm{C}\equiv\overset{\delta+}{\mathrm{O}}$

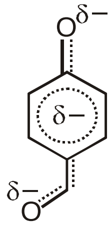
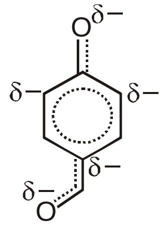
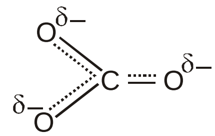
21. 

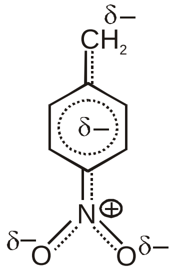
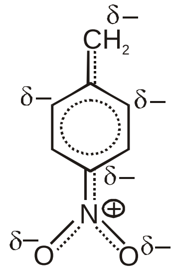
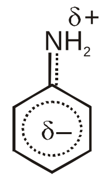
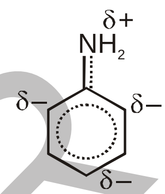
22. 

23. 

24. 

25.  **26.**  **27.**  **28.** 

29.  or  **30.** 

31.  or  **32.**  or 

Answers of DPP No. – 2

1.	a > b	**2.**	b > a	**3.**	b > a	**4.**	b > a	**5.**	a > b > c
6.	a > b	**7.**	a > b	**8.**	------	**9.**	a = b = c	**10.**	a = b
11.	b > a	**12.**	b > a	**13.**	a > c > b	**14.**	a > b > c	**15.**	c > a > b
16.	b > a	**17.**	a > b	**18.**	b > a	**19.**	a > b	**20.**	b > c > a

Answers of DPP No. – 3

1.	a > b > c	**2.**	a = b	**3.**	a > b	**4.**	a = b	**5.**	b > a
6.	a > b	**7.**	b > a	**8.**	b > a	**9.**	b > a	**10.**	a = b
11.	a > b	**12.**	b > c > a	**13.**	b > a	**14.**	b > a	**15.**	a > b
16.	b > a	**17.**	b > a	**18.**	a > b = c	**19.**	a > b	**20.**	a > b

Answers of DPP No. – 4

1.	4	**2.**	5	**3.**	6	**4.**	8	**5.**	2
6.	8	**7.**	6	**8.**	6	**9.**	6	**10.**	10
11.	5	**12.**	3	**13.**	3	**14.**	2	**15.**	5
16.	5	**17.**	2	**18.**	12	**19.**	4	**20.**	4

Answers of DPP No. – 5

1.	5	**2.**	8	**3.**	5	**4.**	3	**5.**	2
6.	1	**7.**	0	**8.**	4	**9.**	2	**10.**	7
11.	1	**12.**	6	**13.**	3	**14.**	3	**15.**	4
16.	7	**17.**	6	**18.**	4	**19.**	6	**20.**	0

Answers of DPP No. –6

1.	i > ii > iii > iv > v	**2.**	iii > i > ii > iv	**3.**	i > ii > iv > iii
4.	i > iii > iv > ii	**5.**	i > iv > ii > iii	**6.**	i > iii > ii > iv
7.	iv > ii > iii > i				

Answers of DPP No. – 7

1.	i > ii > iii > iv > v > vi > vii	**2.**	i > ii > iii > iv	**3.**	i > ii > iii > iv
4.	i > ii > iii > iv	**5.**	i > ii > iii > iv	**6.**	ii > i > iv > iii

Answers of DPP No. – 8

1.	i > iii > ii	**2.**	iii > ii > iv > i	**3.**	iii > ii > iv > i
4.	iii > ii > iv > i	**5.**	i > ii > iv > iii	**6.**	i > ii > iv > iii
7.	ii > iii > i				

Answers of DPP No. – 9

1.	ii > i > iii	**2.**	i > ii > iii	**3.**	ii > i > iii
4.	i > ii > iii	**5.**	ii > i > iii	**6.**	i > ii
7.	iv > iii > ii > I	**8.**	ii > i		

Answers of DPP No. –10

1.	ii > I	**2.**	i > ii	**3.**	i > ii
4.	iii > i > ii	**5.**	i > ii	**6.**	ii > i
7.	i > ii	**8.**	i > ii	**9.**	i > ii
10.	i > ii	**Q.2**	A		

Answers of DPP No. – 11

1.	D	**2.**	A	**3.**	D	**4.**	B	**5.**	B
6.	C	**7.**	D	**8.**	A	**9.**	A	**10.**	A
11.	A	**12.**	C	**13.**	D	**14.**	B	**15.**	A
16.	D	**17.**	B	**18.**	C	**19.**	A	**20.**	D
21.	C	**22.**	A	**23.**	A	**24.**	C	**25.**	C
26.	C	**27.**	D	**28.**	D	**29.**	D	**30.**	B

Answers of DPP No. – 12

1.	C	**2.**	C	**3.**	A	**4.**	C	**5.**	B
6.	C	**7.**	A	**8.**	A	**9.**	D	**10.**	A
11.	A	**12.**	B	**13.**	C	**14.**	A	**15.**	A
16.	B	**17.**	C	**18.**	D	**19.**	C	**20.**	C
21.	A	**22.**	A	**23.**	C	**24.**	A	**25.**	C
26.	A	**27.**	A	**28.**	B	**29.**	B	**30.**	A

Answers of DPP No. – 13

Aromatic : Aro, **Antiaromatic : A.A.** **Non-aromatic : N.A.**

1.	NA	**2.**	AA	**3.**	Aro	**4.**	Aro	**5.**	Aro
6.	NA	**7.**	NA	**8.**	NA	**9.**	Aro	**10.**	AA
11.	AA	**12.**	Aro	**13.**	Aro				

Answers of DPP No. – 14

1.	AA	**2.**	Aro	**3.**	Aro	**4.**	Aro	**5.**	NA
6.	Aro	**7.**	NA	**8.**	NA	**9.**	Aro	**10.**	NA
11.	Aro								

Answers of DPP No. – 15

1.	Aro	**2.**	Aro	**3.**	Aro	**4.**	Aro	**5.**	Aro

6.	NA	**7.**	Aro	**8.**	Aro	**9.**	Aro		

Answers of DPP No. – 16

1.	Aro	**2.**	AA	**3.**	Aro	**4.**	Aro	**5.**	Aro
6.	NA	**7.**	Aro	**8.**	Aro	**9.**	Aro		

Answers of DPP No. – 17

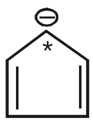
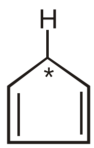
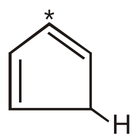
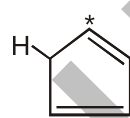
1.	Aro	**2.**	Aro	**3.**	Aro	**4.**	Aro	**5.**	Aro
6.	Aro	**7.**	Aro	**8.**	AA	**9.**	Aro		

Answers of DPP No. – 18

1.	Aro	**2.**	NA	**3.**	Aro	**4.**	Aro	**5.**	Aro
6.	AA	**7.**	AA	**8.**	Aro	**9.**	Aro		

Answers of DPP No. – 19

1.	Aro	**2.**	Aro	**3.**	NA	**4.**	Aro

2. (A)  (B)  (C)  (D) 

3. 6; aromatic 6; aromatic 6; neither 10; aromatic

Answers of DPP No. – 20

Acidic strength is directly proportional to Ka and inversely proportional to pKa. so pKa is just inverse of Ka. Ka is given.

1.	a	**2.**	b	**3.**	b	**4.**	a	**5.**	a
6.	a	**7.**	a	**8.**	a	**9.**	b	**10.**	a
11.	b	**12.**	a	**13.**	a	**14.**	b	**15.**	a
16.	b								

Answers of DPP No. – 21

Acidic strength is directly proportional to Ka and inversely proportional to pKa. so pKa is just inverse of Ka. Ka is given.

1.	b	**2.**	b	**3.**	a	**4.**	a	**5.**	b
6.	a	**7.**	b	**8.**	b	**9.**	a	**10.**	a
11.	a	**12.**	b	**13.**	b	**14.**	a	**15.**	b
16.	b	**17.**	a	**18.**	a	**19.**	a	**20.**	a

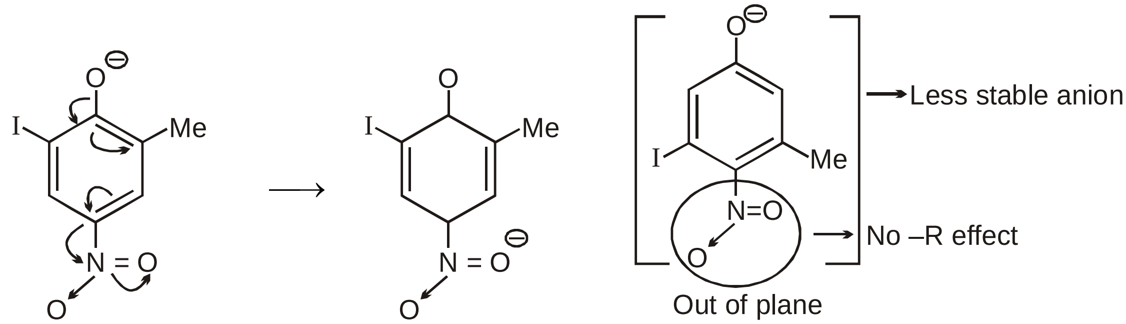
Answers of DPP No. – 22

1. 1 > 4 > 3 > 2

2. (a) Carboxy H is more acidic than hydroxyl or thioxy hydroxyl, between —OH and —SH, latter H is more acidic thus the order of acid strength is: c < b < a

(b) x > y > z

3. a > c > b > d

4. 

5.	C	**6.**	B	**7.**	C	**8.**	C	**9.**	C	**10.**	A

Answers of DPP No. – 23

Basic strength is directly proportional to Ka and inversely proportional to pKb. so pKb is just inverse of Kb. Kb is given.

1.	b	**2.**	a	**3.**	a	**4.**	b	**5.**	b
6.	b	**7.**	a						

Answers of DPP No. – 24

Basic strength is directly proportional to Ka and inversely proportional to pKb. so pKb is just inverse of Kb. Kb is given.

1.	b	**2.**	b	**3.**	a	**4.**	a	**5.**	b
6.	a	**7.**	a	**8.**	a	**9.**	b	**10.**	b
11.	a	**12.**	b	**13.**	b	**14.**	b	**15.**	b

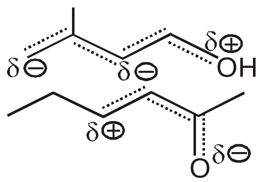
Answers of DPP No. – 25

1. (i) a > b (ii) b > a > c (iii) b > a (iv) b > a (v) a > b (vi) a > b = c (vii) b > a (viii) a > b

2. II > I

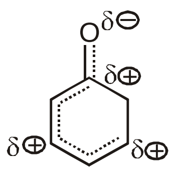
Answers of Organic Chemistry DPP for GOC (conceptual improvement of GOC)

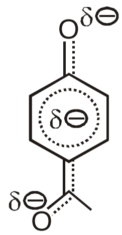
Answers of DPP No. – 1

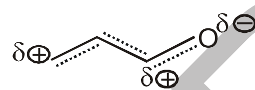
1. 

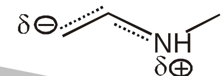
2. 

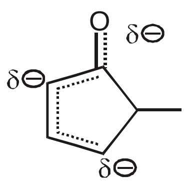
3.

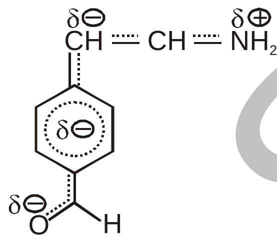
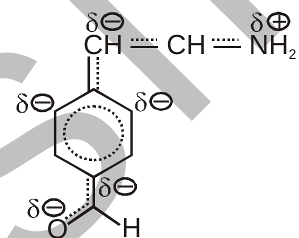
4. 

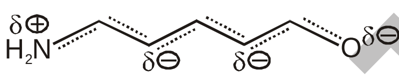
5. 

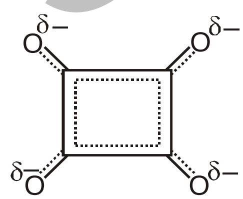
6. 

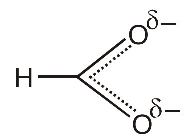
7. 

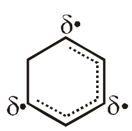
8. 

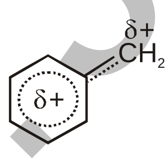
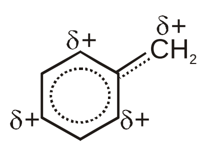
9.  or 

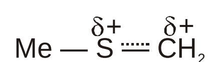
10. 

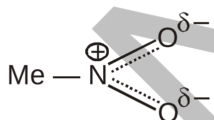
11. 

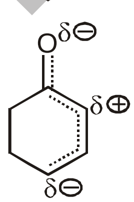
12. 

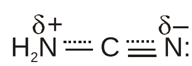
13. 

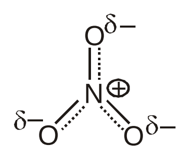
14.  or 

15. 

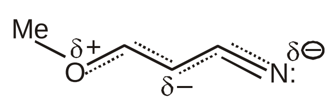
16. 

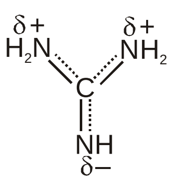
17. 

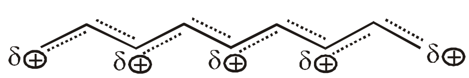
18. 

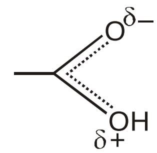
19. 

20.  or 

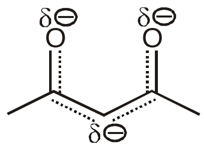
21. 

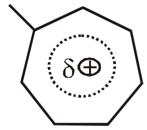
22. 

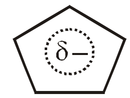
23. 

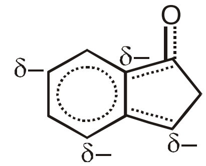
24. 

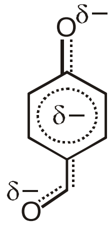
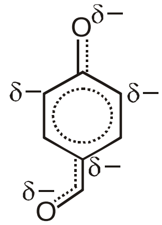
ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

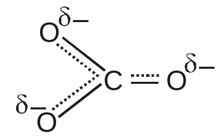
25. 

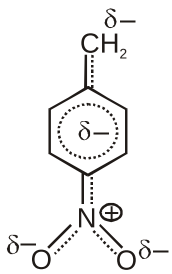
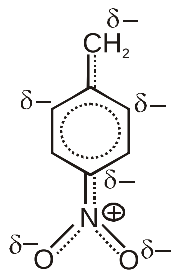
26. 

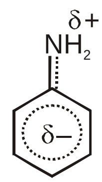
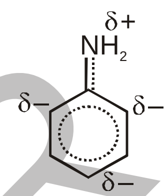
27. 

28. 

29.  or 

30. 

31.  or 

32.  or 

Answers of DPP No. – 2

1.	a > b	**2.**	b > a	**3.**	b > a	**4.**	b > a	**5.**	a > b > c
6.	a > b	**7.**	a > b	**8.**	------	**9.**	a = b = c	**10.**	a = b
11.	b > a	**12.**	b > a	**13.**	a > c > b	**14.**	a > b > c	**15.**	c > a > b
16.	b > a	**17.**	a > b	**18.**	b > a	**19.**	a > b	**20.**	b > c > a

Answers of DPP No. – 3

1.	a > b > c	**2.**	a = b	**3.**	a > b	**4.**	a = b	**5.**	b > a
6.	a > b	**7.**	b > a	**8.**	b > a	**9.**	b > a	**10.**	a = b
11.	a > b	**12.**	b > c > a	**13.**	b > a	**14.**	b > a	**15.**	a > b
16.	b > a	**17.**	b > a	**18.**	a > b = c	**19.**	a > b	**20.**	a > b

Answers of DPP No. – 4

1.	4	**2.**	5	**3.**	6	**4.**	8	**5.**	2
6.	8	**7.**	6	**8.**	6	**9.**	6	**10.**	10
11.	5	**12.**	3	**13.**	3	**14.**	2	**15.**	5
16.	5	**17.**	2	**18.**	12	**19.**	4	**20.**	4

Answers of DPP No. – 5

1.	5	**2.**	8	**3.**	5	**4.**	3	**5.**	2
6.	1	**7.**	0	**8.**	4	**9.**	2	**10.**	7
11.	1	**12.**	6	**13.**	3	**14.**	3	**15.**	4
16.	7	**17.**	6	**18.**	4	**19.**	6	**20.**	0

Answers of DPP No. –6

1.	i > ii > iii > iv > v	**2.**	iii > i > ii > iv	**3.**	i > ii > iv > iii
4.	i > iii > iv > ii	**5.**	i > iv > ii > iii	**6.**	i > iii > ii > iv
7.	iv > ii > iii > i				

Answers of DPP No. – 7

1.	i > ii > iii > iv > v > vi > vii	**2.**	i > ii > iii > iv	**3.**	i > ii > iii > iv
4.	i > ii > iii > iv	**5.**	i > ii > iii > iv	**6.**	ii > i > iv > iii

Answers of DPP No. – 8

1.	i > iii > ii	**2.**	iii > ii > iv > i	**3.**	iii > ii > iv > i
4.	iii > ii > iv > i	**5.**	i > ii > iv > iii	**6.**	i > ii > iv > iii
7.	ii > iii > i				

Answers of DPP No. – 9

1.	ii > i > iii	**2.**	i > ii > iii	**3.**	ii > i > iii
4.	i > ii > iii	**5.**	ii > i > iii	**6.**	i > ii
7.	iv > iii > ii > **I**	**8.**	ii > i		

Answers of DPP No. –10

1.	ii > **I**	**2.**	i > ii	**3.**	i > ii
4.	iii > i > ii	**5.**	i > ii	**6.**	ii > i
7.	i > ii	**8.**	i > ii	**9.**	i > ii
10.	i > ii	**Q.2**	A		

Answers of DPP No. – 11

1.	D	**2.**	A	**3.**	D	**4.**	B	**5.**	B
6.	C	**7.**	D	**8.**	A	**9.**	A	**10.**	A
11.	A	**12.**	C	**13.**	D	**14.**	B	**15.**	A
16.	D	**17.**	B	**18.**	C	**19.**	A	**20.**	D
21.	C	**22.**	A	**23.**	A	**24.**	C	**25.**	C
26.	C	**27.**	D	**28.**	D	**29.**	D	**30.**	B

Answers of DPP No. – 12

1.	C	**2.**	C	**3.**	A	**4.**	C	**5.**	B
6.	C	**7.**	A	**8.**	A	**9.**	D	**10.**	A
11.	A	**12.**	B	**13.**	C	**14.**	A	**15.**	A
16.	B	**17.**	C	**18.**	D	**19.**	C	**20.**	C
21.	A	**22.**	A	**23.**	C	**24.**	A	**25.**	C
26.	A	**27.**	A	**28.**	B	**29.**	B	**30.**	A

Answers of DPP No. – 13

Aromatic : Aro, **Antiaromatic : A.A.** **Non-aromatic : N.A.**

1.	NA	**2.**	AA	**3.**	Aro	**4.**	Aro	**5.**	Aro
6.	NA	**7.**	NA	**8.**	NA	**9.**	Aro	**10.**	AA
11.	AA	**12.**	Aro	**13.**	Aro				

Answers of DPP No. – 14

1.	AA	**2.**	Aro	**3.**	Aro	**4.**	Aro	**5.**	NA
6.	Aro	**7.**	NA	**8.**	NA	**9.**	Aro	**10.**	NA
11.	Aro								

Answers of DPP No. – 15

1.	Aro	**2.**	Aro	**3.**	Aro	**4.**	Aro	**5.**	Aro

6.	NA	**7.**	Aro	**8.**	Aro	**9.**	Aro		

Answers of DPP No. – 16

1.	Aro	**2.**	AA	**3.**	Aro	**4.**	Aro	**5.**	Aro
6.	NA	**7.**	Aro	**8.**	Aro	**9.**	Aro		

Answers of DPP No. – 17

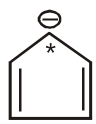
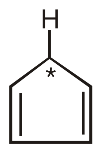
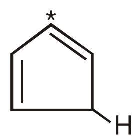
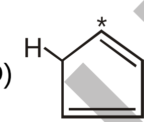
1.	Aro	**2.**	Aro	**3.**	Aro	**4.**	Aro	**5.**	Aro
6.	Aro	**7.**	Aro	**8.**	AA	**9.**	Aro		

Answers of DPP No. – 18

1.	Aro	**2.**	NA	**3.**	Aro	**4.**	Aro	**5.**	Aro
6.	AA	**7.**	AA	**8.**	Aro	**9.**	Aro		

Answers of DPP No. – 19

1.	Aro	**2.**	Aro	**3.**	NA	**4.**	Aro

2. (A)  (B)  (C)  (D) 

3. 6; aromatic 6; aromatic 6; neither 10; aromatic

Answers of DPP No. – 20

Acidic strength is directly proportional to Ka and inversely proportional to pKa. so pKa is just inverse of Ka. Ka is given.

1.	a	**2.**	b	**3.**	b	**4.**	a	**5.**	a
6.	a	**7.**	a	**8.**	a	**9.**	b	**10.**	a
11.	b	**12.**	a	**13.**	a	**14.**	b	**15.**	a
16.	b								

Answers of DPP No. – 21

Acidic strength is directly proportional to Ka and inversely proportional to pKa. so pKa is just inverse of Ka. Ka is given.

1.	b	**2.**	b	**3.**	a	**4.**	a	**5.**	b
6.	a	**7.**	b	**8.**	b	**9.**	a	**10.**	a
11.	a	**12.**	b	**13.**	b	**14.**	a	**15.**	b
16.	b	**17.**	a	**18.**	a	**19.**	a	**20.**	a

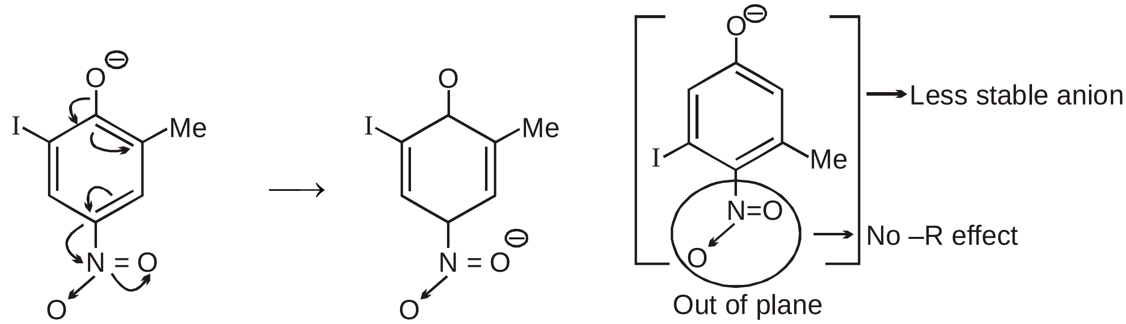
Answers of DPP No. – 22

1. 1 > 4 > 3 > 2

2. (a) Carboxy H is more acidic than hydroxyl or thioxy hydroxyl, between —OH and —SH, latter H is more acidic thus the order of acid strength is: c < b < a

(b) x > y > z

3. a > c > b > d

4. 

5.	C	**6.**	B	**7.**	C	**8.**	C	**9.**	C	**10.**	A

Answers of DPP No. – 23

Basic strength is directly proportional to Ka and inversely proportional to pKb. so pKb is just inverse of Kb. Kb is given.

1.	b	**2.**	a	**3.**	a	**4.**	b	**5.**	b
6.	b	**7.**	a						

Answers of DPP No. – 24

Basic strength is directly proportional to Ka and inversely proportional to pKb. so pKb is just inverse of Kb. Kb is given.

1.	b	**2.**	b	**3.**	a	**4.**	a	**5.**	b
6.	a	**7.**	a	**8.**	a	**9.**	b	**10.**	b
11.	a	**12.**	b	**13.**	b	**14.**	b	**15.**	b

Answers of DPP No. – 25

1. (i) a > b (ii) b > a > c (iii) b > a (iv) b > a (v) a > b (vi) a > b = c
(vii) b > a (viii) a > b

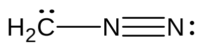
2. II > I

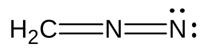
GENERAL ORGANIC CHEMISTRY (G.O.C)

ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

Electronic Displacement Effect

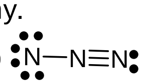
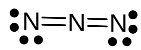
1. Consider structural formulas A and B.

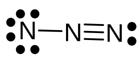
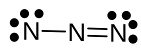

(A)

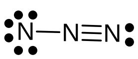
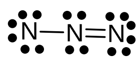

(B)

Are A, B and C constitutional isomers. or are they resonance forms?
(a) Which structures have a negatively charged carbon?
(b) Which structures have a positively charged nitrogen?
(c) Which structures have a negatively charged nitrogen?
(d) What is the net charge on each structure?

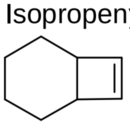
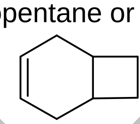
2. In each of the following pairs, determine which of the following represent resonance forms of a single species or depict different substances. If two structures are not resonance forms. Explain why.

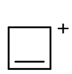
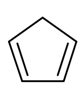
(a)  and 

(b)  and 

(c)  and 

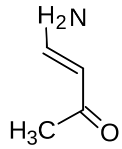
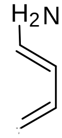
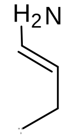
3. Match each alkene with the appropriate heat of combustion:
Heats of combustion (kJ/mol): 5293; 4658; 4656; 4638; 4632
(a) 1-Heptene
(b) 2, 4-Dimethyl-1-pentene
(c) 2,4-Dimethyl-2-pentene
(d) (Z)-4,4-Dimethyl-2-pentene
(e) 2,4,4-Trimethyl-2-pentene

4. Choose the more stable alkene in each of the following pairs. Explain your reasoning.
(a) 1-Methylcyclohexene or 3-methylcyclohexene
(b) Isopropenylcyclopentane or allylcyclopentane
(c)  or 
(d) (Z)-Cyclononene or (E)-cyclononene
(e) (Z)-Cyclooctadecene or (E)-cyclooctadecene

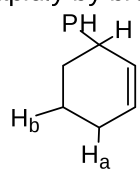
5. Rank the following sets of intermediates in increasing order of their stability giving appropriate reasons for your choice.
(a) $C_6H_5^+, P-NO_2(C_6H_4)^+, P-CH_3-(C_6H_4)^+, P-Cl-C_6H_4^+$
(b)   

6. Discuss the following observations:
(a) C–Cl bond in vinyl chloride is stronger than in chloroethane.
(b) Carbon-carbon bond length in ethene is shorter than in $CH_2{=}CHOCH_3$
(c) CH_3SH is stronger acid than CH_3OH
(d) $CH_3CH_2NH_2$ is stronger base than $CH_2{=}CHNH_2$.

7. Compare the C–N bond-length in the following species:

(i)  (ii)  (iii) 

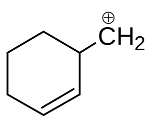
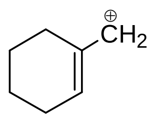
8. Answer the following:
Which of the indicated H is abstracted rapidly by bromine radical and why?

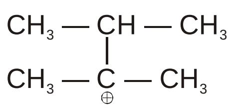
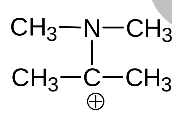


9. In each of the following pairs of ions which ion is more stable:

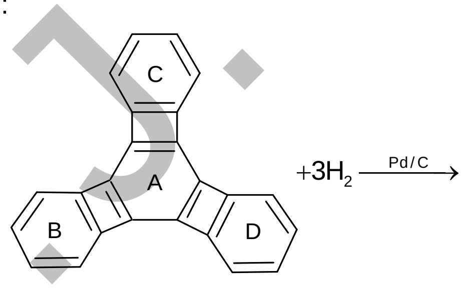
(a) (I) $C_6H_5-\overset{\oplus}{C}H_2$ and (II) $CH_2{=}CH-\overset{\oplus}{C}H_2$

(b) (I) $CH_3-\overset{\oplus}{C}H_2$ and (II) $CH_2{=}\overset{\oplus}{C}H$

(c) (I)  and 

(d) (I)  and 

10. Consider the given reaction:



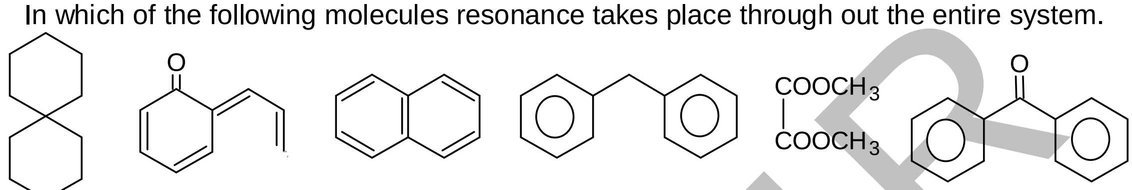
In the above reaction which one of the given ring will undergo reduction?

11. Which of the following statements is (are) true about resonance.
(a) Resonance is an intramolecular process.
(b) Resonance involves delocalization of both σ and π electrons.
(c) Resonance involves delocalization of π electrons only.
(d) Resonance decreases potential energy of a molecule.
(e) Resonance has no effect on the potential energy of a molecule.
(f) Resonance is the only way to increase molecular stability.
(g) Resonance is not the only way to increase molecular stability.
(h) Any resonating molecule is always more stable than any nonresonating molecule.
(i) The canonical structure explains all features of a molecule.
(j) The resonance hybrid explains all features of a molecule.
(k) Resonating structures are real and resonance hybrid is imaginary.
(l) Resonance hybrid is real and resonating structures are imaginary.
(m) Resonance hybrid is always more stable than all canonical structures.

12. Resonance energy will be more if
(a) Canonical structures are equivalent than if canonical structures are non-equivalent.
(b) molecule is aromatic than if molecule is not aromatic.

13. A canonical structure will be more stable if
(a) it has more number of π bonds than if it has less number of π bonds.
(b) the octets of all atoms are complete than if octets of all atoms are not complete.
(c) it involves cyclic delocalization of (4n + 2) π–electrons than if it involves acyclic delocalization of (4n + 2) π–electrons.
(d) it involves cyclic delocalization (4n) π–electrons than if it involves acyclic delocalization of (4n) π–electrons.
(e) +ve charge is on more electronegative atom than if +ve charge is less electronegative.
(f) –ve charge is on more electronegative atom than if –ve.

14. In which of the following molecules resonance takes place through out the entire system.



(a) (b) (c) (d) (e) (f)

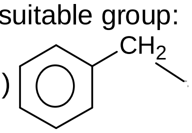
15. Which of the following groups cannot participate in resonance with other suitable group:

(a) $-COOH$ (b) $-CO\overline{O}$ (c) $-COCl$ (d) $-\overset{\oplus}{N}H_3$

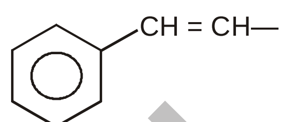
(e) $-\dot{C}H_2$ (f) $CH_2=\overset{\oplus}{N}(CH_3)-$

16. Which of the following group can participate in resonance with other suitable group:

(a) $CH_2=\overset{\oplus}{O}-$ (b) $-CH_2-\overset{-}{C}H_2$ (c) $-CH_2-\overset{\oplus}{C}H_2$ (d)



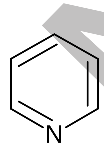
(e)



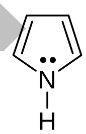
(f) $-BH_2$ (g) $-\overset{\oplus}{P}Ph_3$

17. In which of the following lone-pair indicated is involved in resonance:

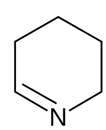
(a)



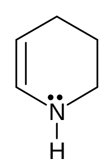
(b)



(c)



(d)



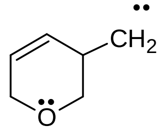
(e) $CH_2=CH-\ddot{C}H_2^{\ominus}$ (f) $CH_2=CH-CH=\ddot{N}H$

19. In which of the following lone-pair indicated is not involved in resonance:

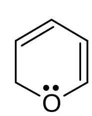
(a) $CH_2=CH-\ddot{N}H-CH_3$ (b) $CH_2=CH-CH=\ddot{O}:$

(c) $CH_2=CH-\ddot{O}-CH=CH_2$ (d) $CH_2=CH-C\equiv N:$

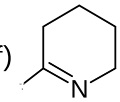
(e)



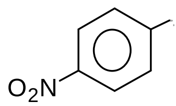
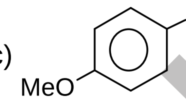
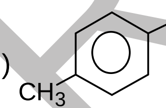
(f)

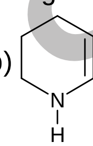
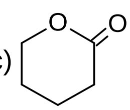


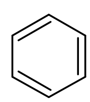
19. Identify electron–donating groups in resonance among the following:
(a) $-COOH$ (b) $-NO_2$ (c) $-OCOCH_3$ (d) $-COOCH_3$
(e) $-CHO$ (f) $-NHCOCH_3$

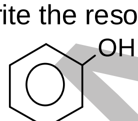
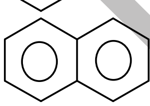
20. Identify electron–with drawing groups in resonance among the following:
(a) $-COOH$ (b) $-CONHCH_3$ (c) $-COCl$
(d) $-NO_2$ (e) $-O-CH{=}CH_2$ (f) 

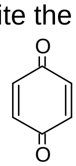
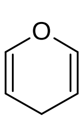
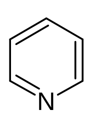
21. Which of the following groups can either donate or with draw a pair of electrons in resonance depending upon situation:
(a) $-NO_2$ (b) $-NO$ (c) $-CH{=}CH_2$ (d) $-CHO$
(e) $-NH_2$ (f) $-N{=}NH$

22. Which of the following groups can only withdraw a pair of electrons in resonance depending upon situation:
(a) $-Ph$ (b)  (c)  (d) 
(e) $-\overset{\oplus}{N}Me_3$ (f) $-CONH_2$

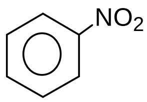
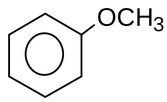
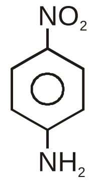
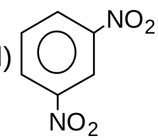
23. Write the resonance hybrid of each of the following:
(a) $CH_2{=}CH-CH_2$ (b)  (c) 
(d) $CH_2{=}CH-\overset{\oplus}{C}H_2$ (e) $CH_2{=}CH-\overset{\bullet}{C}H_2$

24. Write the canonical structures of each of the following:
(a) $R-CO-CH = CH_2$ (b) $CH_3O-CH{=}CH-\overset{\oplus}{N}Me_3$
(c) RCOCl (d) $HCONH_2$ (e) 

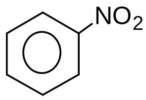
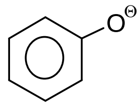
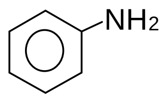
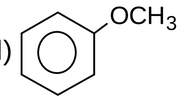
25. Write the resonance hybrid of each of the following:
(a)  (b) $CH_2{=}CH-CH{=}O$ (c) $CH_2{=}C{=}\overline{C}H$
(d)  (e) $CH_2{=}CH-CH{=}CH_2$

26. Write the canonical structures of each of the following:
(a)  (b) $CH_2{=}\overset{\oplus}{N}{=}\overline{N}$ (c) $CH_2{=}C{=}O$
(d)  (e) 

27. In which of the following molecules π–electron density in ring is minimum:

(a)  (b)  (c)  (d) 

28. In which of the following molecules π–electron density in ring is maximum:

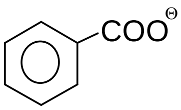
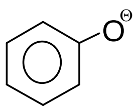
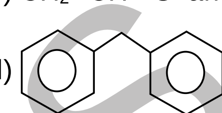
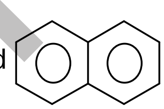
(a)  (b)  (c)  (d) 

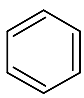
29. $CH_2{=}CH{-}CH{=}CH{-}CH_3$ (I) is more stable than $CH_3{-}CH{=}C{=}CH{-}CH_3$ (II) because

(A) there is resonance in I but not in II
(B) there is tautomerism in I but not in II
(C) there is hyperconjugation in I but not in II
(D) II has more canonical structures than I.

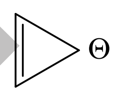
30. Which of the following pairs has higher resonance energy:

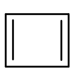
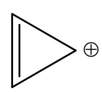
(a) CH_3COOH and CH_3COONa (b) $CH_2{=}CH{-}\overset{\ominus}{O}$ and $CH_2{=}CH{-}OH$

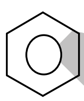
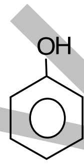
(c)  and  (d)  and 

(e)  and $CH_2{=}CH{-}CH{=}CH{-}CH{=}CH_2$

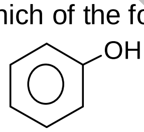
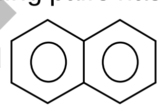
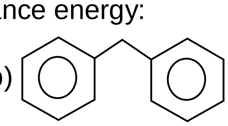
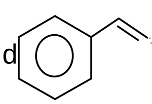
31. Which of the following pairs has less resonance energy:

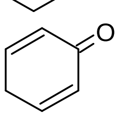
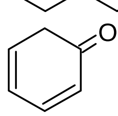
(a) CO_3^{2-} and $HCOO^-$ (b)  and $CH_2{=}CH{-}\overset{-}{C}H_2$

(c)  and $CH_2{=}CH{-}CH{=}CH_2$ (d)  and $CH_2{=}CH{-}\overset{\oplus}{C}H_2$

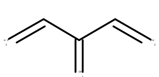
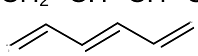
(e)  and 

32. Which of the following pairs has higher resonance energy:

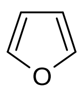
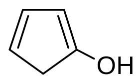
(a)  and  (b)  and 

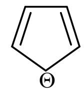
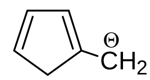
(c)  and 

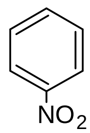
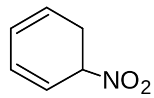
(d) $CH_2{=}CH{-}OH$ and $CH_2{=}CH{-}CH{=}CH{-}OH$

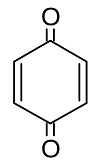
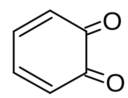
(e)  and 

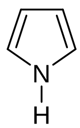
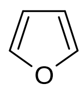
33. Which of the following pairs has less resonance energy:

(a)  and 

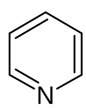
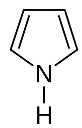
(b)  and 

(c)  and 

(d)  and 

(e)  and 

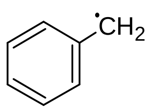
34. Which of the following pairs has higher resonance energy:

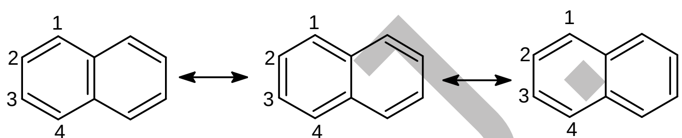
(a)  and 

(b) $CH_2{=}CH{-}O{-}CH{=}CH_2$ and $CH_2{=}CH{-}NH{-}CH{=}CH_2$

(c) $CH_2{=}CH{-}\overset{\ominus}{N}H$ and $HN{=}CH{-}\overset{\ominus}{N}H$

(d) $CH_2{=}CH{-}F$ and $CH_2{=}CH{-}Br$

(e)  and $CH_2{=}CH{-}\dot{C}H_2$

35. 

These are three canonical structures of naphthalene. Examine them and find correct statement among the following:

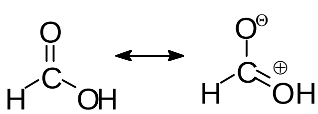
(a) All C–C bonds are of same length

(b) Cl–C2 bond is shorter than C2–C3 bond.

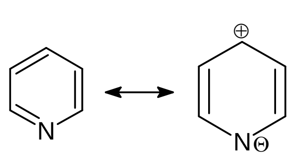
(c) Cl–C2 bond is longer than C2–C3 bond

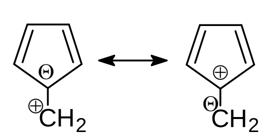
(d) none.

36. Identify more stable canonical structure in each of the following pairs:

(a) 

(b) $\overset{\ominus}{C}H_2{-}C{\equiv}CH \longleftrightarrow CH_2{=}C{=}\overset{\ominus}{C}H$

(c) 

(d) 

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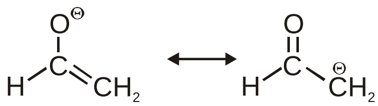
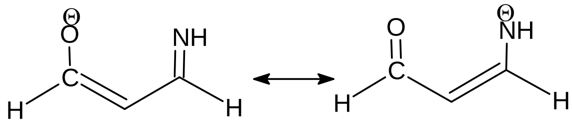
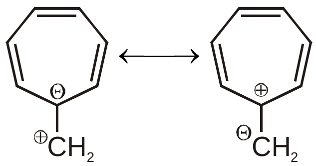
37. Identify less stable canonical structure in each of the following pairs:

(a) $\overset{\oplus}{C}H_2—O—CH_3 \longleftrightarrow CH_2=\overset{\ominus}{O}—CH_3$

(b) 

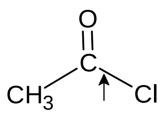
(c) 

(d) 

38. In which of the following pairs, indicated bond is of greater length:

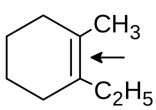
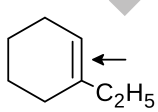
(a) $CH_3—CH_2—Br$ and $CH_3—CH_2—Cl$

(b) $CH_3—CH=CH—Br$ and $CH_3—CH(Br)—CH_3$

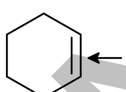
(c)  and $CH_3—CH_2—Cl$

(d) $CH_2=CH—CH=CH_2$ and $CH_2=CH—CH_2—CH_3$

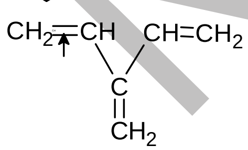
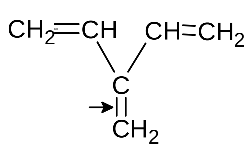
(e) $CH_2=CH—CH=CH_2$ and $CH_2=CH—NO_2$

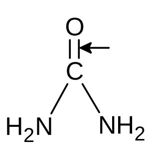
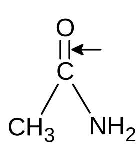
(f)  and 

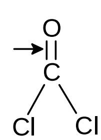
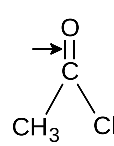
39. In which of the following pairs, indicated bond having less bond dissociation energy

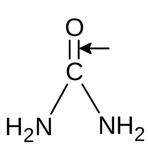
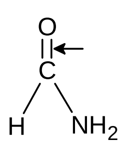
(a)  and $CH_2=CH_2$

(b) $CH_3—C\equiv CH$ and $HC\equiv CH$

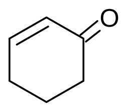
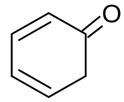
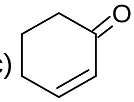
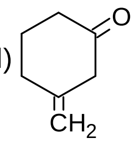
(c)  and 

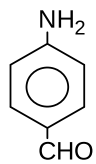
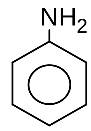
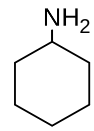
(d)  and 

(e)  and 

(f)  and 

40. Which of the following has longest C—O bond:

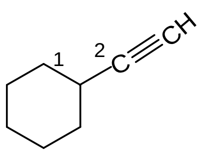
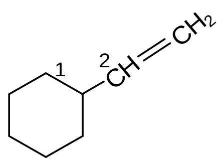
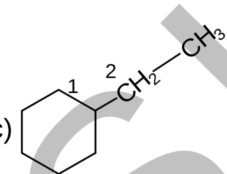
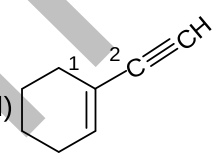
(a)  (b)  (c)  (d) 

41. (I)  (II)  (III)  (IV) $CH_2{=}NH$

Among these compounds, the correct order of C—N bond lengths is:

(a) IV > I > II > III
(b) III > I > II > IV
(c) III > II > I > IV
(d) III > I > IV > II

42. C_1—C_2 bond is shortest in

(a)  (b)  (c)  (d) 

43. Among the following molecules, the correct order of C—C bond length is

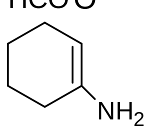
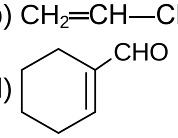
(a) $C_2H_6 > C_2H_4 > C_6H_6 > C_2H_2$
(b) $C_2H_6 > C_6H_6 > C_2H_4 > C_2H_2$ (C_6H_6 is benzene)
(c) $C_2H_4 > C_2H_6 > C_2H_2 > C_6H_6$
(d) $C_2H_6 > C_2H_4 > C_2H_2 > C_6H_6$

44. $CH_3O{-}CH{=}CH{-}NO_2$ I
$CH_2{=}CH{-}NO_2$ II
$CH_2{=}CH{-}Cl$ III
$CH_2{=}CH_2$ IV

Which of the following is the correct order of C—C bond lengths among these compounds:

(a) I > II > III > IV
(b) IV > III > II > I
(c) I > III > II > IV
(d) II > III > I > IV

45. In which of the following molecules resonance is equivalent:

(a) $HCOO^{\ominus}$
(b) $CH_2{=}CH{-}CH{=}CH_2$
(c) 
(d) 

46. $CH_2{=}CH{-}CH{=}CH{-}CH{=}CH_2$ I
$CH_2{=}CH{-}\overset{\oplus}{C}H{-}CH{=}CH{-}\overset{\ominus}{C}H_2$ II
$\overset{\oplus}{C}H_2{-}CH{=}CH{-}CH{=}CH{-}\overset{\ominus}{C}H_2$ III

Among these three canonical structures (through more are possible) what would be their relative contribution in the hybrid:

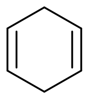
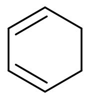
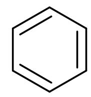
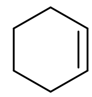
(a) I > II > III (b) III > II > I (c) I > III > II (d) III > I > II

47. For 1-methoxy-1, 3-butadiene, which of the following resonating structure is the least stable?

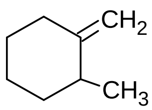
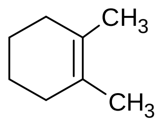
(a) $H_2\overset{\ominus}{C}-\overset{\oplus}{C}H-CH=CH-O-CH_3$ (b) $H_2\overset{\ominus}{C}-CH=CH-CH=\overset{\oplus}{O}-CH_3$

(c) $H_2C=CH-\overset{\oplus}{C}H-\overset{\ominus}{C}H-O-CH_3$ (d) $H_2C=CH-\overset{\ominus}{C}H-CH=\overset{\oplus}{O}-CH_3$

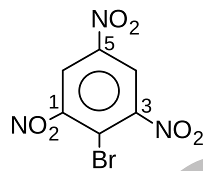
48. Among the following pairs identify the one which gives higher heat of hydrogenation:

(a)  and  (b)  and 

(c) $CH_3-CH=CH-CH_3$ and $CH_3-CH_2-CH=CH_2$

(d)  and 

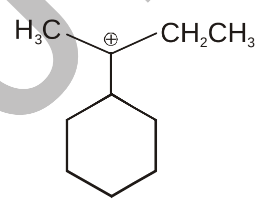
49. Which of the following statements would be true about this compound:



(a) All three C—N bonds are of same length.
(b) Cl—N and C3—N bonds are of same length but shorter than C_5—N bond.
(c) Cl—N and C3—N bonds are of same length but longer than C5—N bond.
(d) Cl—N and C3—N bonds are of different length but both are longer than C5—N bond.

50. Write resonating structures of σ complex formed when an electrophile ($E^{\oplus}$) attacks on (i) α and (ii) β position of naphthalene. Also state which is more stable?

51. The total number of contributing structure showing hyperconjugation (involving C—H bond)for the following carbocation is **[IIT-JEE 2011]**



52. Among the following compound,the most acidic is **[IIT-JEE 2011]**
(A) p-nitrophenol (B)p-hydroxybenzoic acid
(C) o-hydroxybenzoic acid (D) p-toluic acid

Acidity and Basicity

Q.1 Write correct order of acidic strength of following compounds:

(i) (a) $NO_2-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-O-H$ (b) $F-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-O-H$

(c) $Ph-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-O-H$ (d) $CH_3-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-O-H$

(ii) (a) $CH_3-CH_2-\underset{\underset{\displaystyle F}{|}}{CH}-\overset{\overset{\displaystyle O}{\|}}{C}-O-H$ (b) $CH_3-\underset{\underset{\displaystyle F}{|}}{CH}-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-O-H$

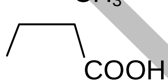
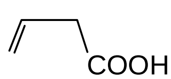
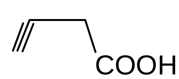
(c) $\underset{\underset{\displaystyle F}{|}}{CH_2}-CH_2-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-O-H$

(iii) (a) $Cl-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-O-H$ (b) $Cl-\underset{\underset{\displaystyle Cl}{|}}{CH}-\overset{\overset{\displaystyle O}{\|}}{C}-O-H$

(c) $Cl-\overset{\overset{\displaystyle Cl}{|}}{\underset{\underset{\displaystyle Cl}{|}}{C}}-\overset{\overset{\displaystyle O}{\|}}{C}-O-H$

(iv) (a) CH_3-CH_2-O-H (b) $CH_3-\underset{\underset{\displaystyle CH_3}{|}}{CH}-O-H$

(c) $CH_3-\overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}}-O-H$

(v) (a)  (b)  (c) 

(vi) (a) $\underset{COOH}{\overset{COOH}{|}}$ (b) $CH_2\begin{matrix} \diagup COOH \\ \diagdown COOH \end{matrix}$ (c) $\underset{CH_2-COOH}{\overset{CH_2-COOH}{|}}$

(vii) (a) $H-F$ (b) $H-Cl$ (c) $H-Br$ (d) $H-I$

(viii) (a) CH_4 (b) NH_3 (c) H_2O (d) $H-F$

(ix) (a) $F-CH_2-CH_2-O-H$ (b) $NO_2-CH_2-CH_2-O-H$

(c) $Br-CH_2-CH_2-O-H$ (d) $\overset{\oplus}{N}H_3-CH_2-CH_2-O-H$

(x) (a) CH_3COOH (b) CH_3CH_2OH (c) C_6H_5OH (d) $C_6H_5SO_3H$

Q.2 Write increasing order of basic strength of following:

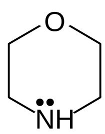
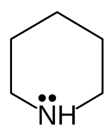
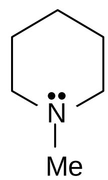
(i) (a) $CH_3^{\ominus}$ (b) $NH_2^{\ominus}$ (c) $OH^{\ominus}$ (d) $F^{\ominus}$

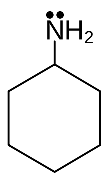
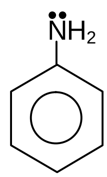
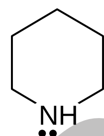
(ii) (a) $F^{\ominus}$ (b) $Cl^{\ominus}$ (c) $Br^{\ominus}$ (d) $I^{\ominus}$

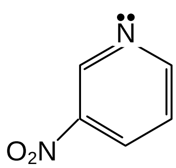
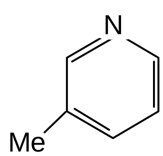
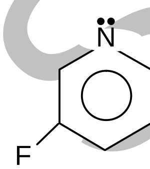
(iii) (a) NH_3 (b) $MeNH_2$ (c) Me_2NH (d) Me_3N (in H_2O)

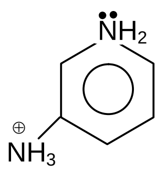
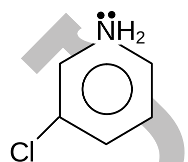
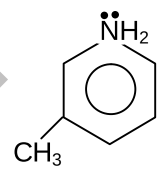
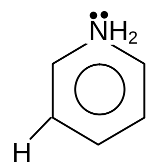
(iv) (a) NH_3 (b) $MeNH_2$ (c) Me_2NH (d) Me_3N (Gas phase)

(v) (a) $R-NH_2$ (b) $Ph-NH_2$ (c) $R-\underset{\underset{O}{\|}}{C}-NH_2$

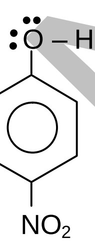
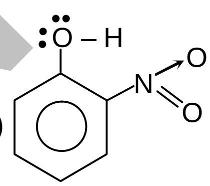
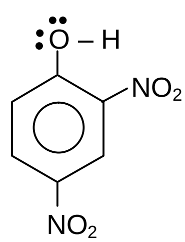
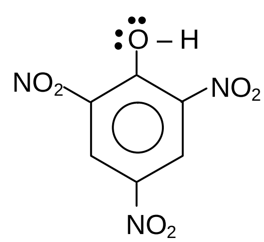
(vi) (a)  (b)  (c) 

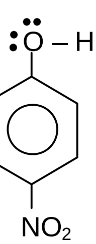
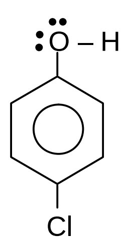
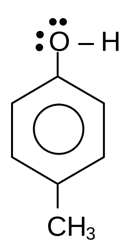
(vii) (a)  (b)  (c) 

(viii) (a)  (b)  (c) 

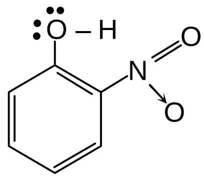
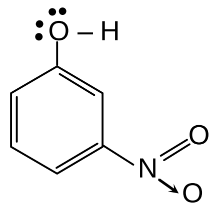
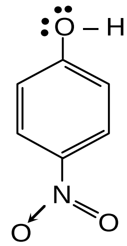
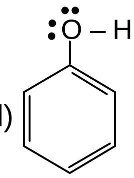
(ix) (a)  (b)  (c)  (d) 

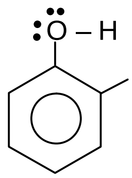
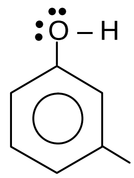
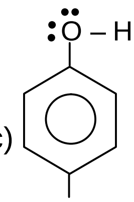
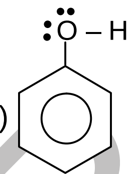
Q.3 Write correct order of acidic strength of following compounds:

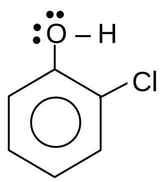
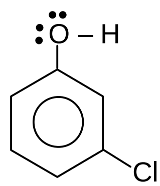
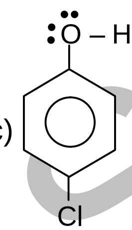
(i) (a)  (b)  (c)  (d) 

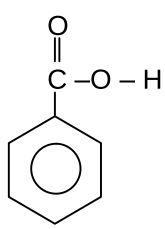
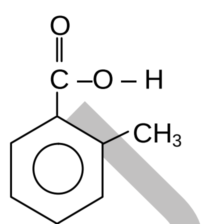
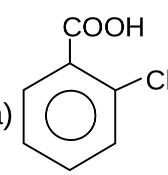
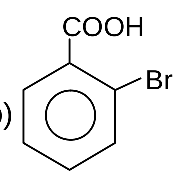
(ii) (a)  (b)  (c) 

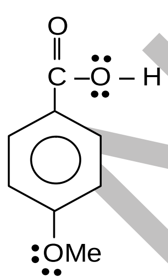
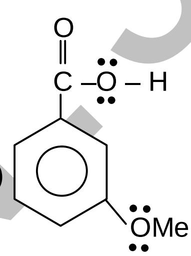
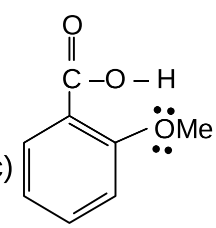
ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

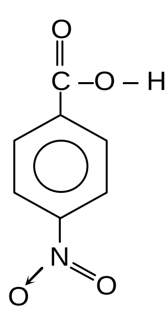
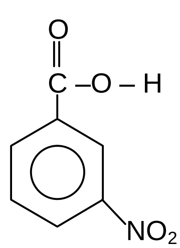
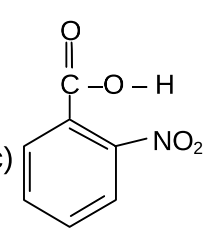
(iii) (a)  (b)  (c)  (d) 

(iv) (a)  (b)  (c)  (d) 

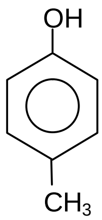
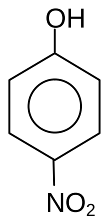
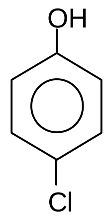
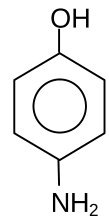
(v) (a)  (b)  (c) 

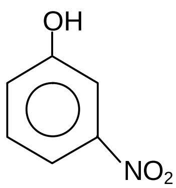
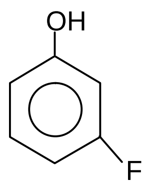
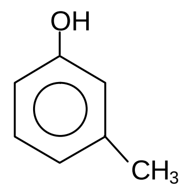
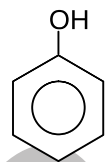
(vi) (a)  (b)  (vii) (a)  (b) 

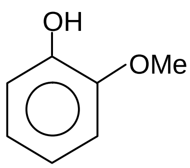
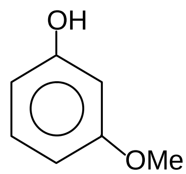
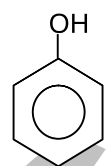
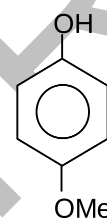
(viii) (a)  (b)  (c) 

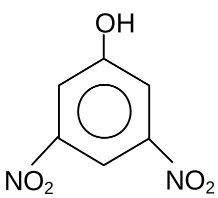
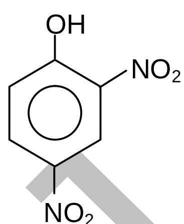
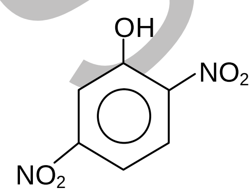
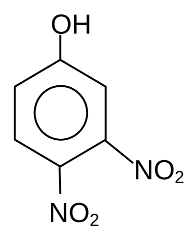
(ix) (a)  (b)  (c) 

Q.4 Select the strongest acid in each of the following sets:

(i) (a)  (b)  (c)  (d) 

(ii) (a)  (b)  (c)  (d) 

(iii) (a)  (b)  (c)  (d) 

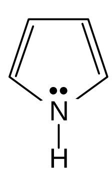
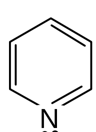
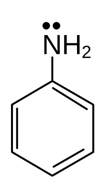
(iv) (a)  (b)  (c)  (d) 

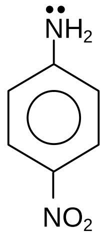
Q.5 Write increasing order of basic strength of following:

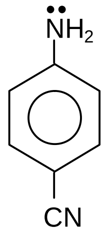
(i) (a) $CH_3-CH_2-\ddot{N}H_2$ (b) $CH_3-CH=\ddot{N}H$ (c) $CH_3-C\equiv\ddot{N}$

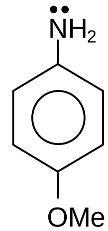
(ii) (a) $CH_3-\underset{\underset{O}{\|}}{C}-\ddot{N}H_2$ (b) $CH_3-CH_2-\ddot{N}H_2$ (c) $CH_3-\underset{\underset{\underset{\cdot\cdot}{NH}}{\|}}{C}-\ddot{N}H_2$

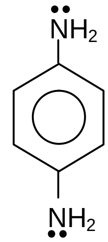
(d) $\ddot{N}H_2-\underset{\underset{\underset{\cdot\cdot}{NH}}{\|}}{C}-\ddot{N}H_2$

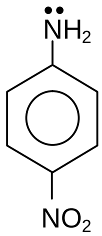
(iii) (a)  (b)  (c) 

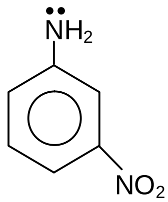
(iv) (a) 

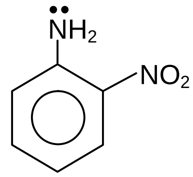
(b) 

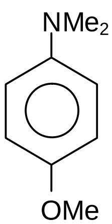
(c) 

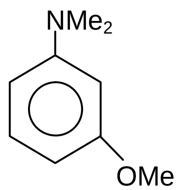
(d) 

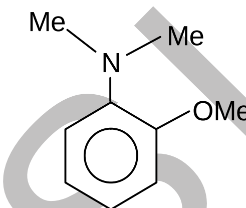
(v) (a) 

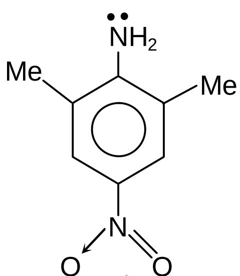
(b) 

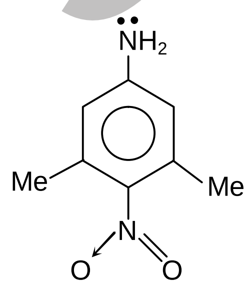
(c) 

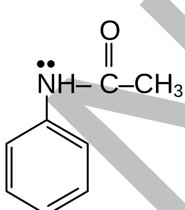
(vi) (a) 

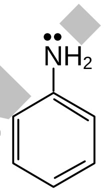
(b) 

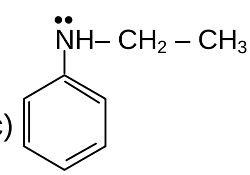
(c) 

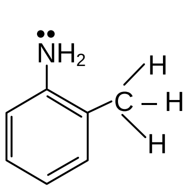
(vii) (a) 

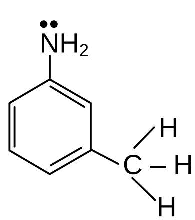
(b) 

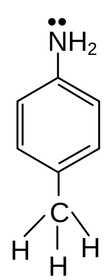
(viii) (a) 

(b) 

(c) 

(ix) (a) 

(b) 

(c) 

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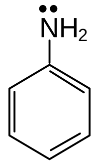
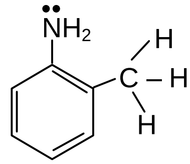
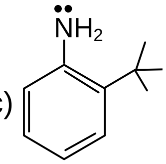
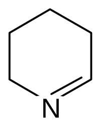
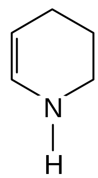
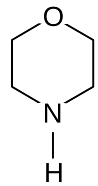
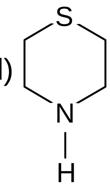
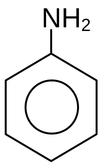
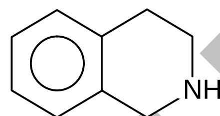
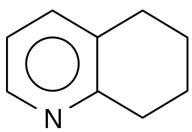
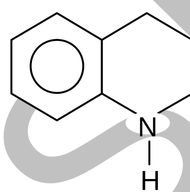
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

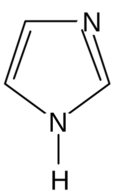
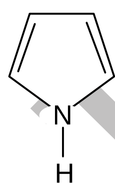
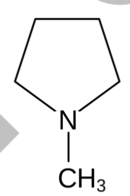
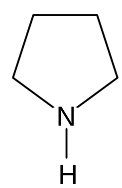
(x) (a)  (b)  (c) 

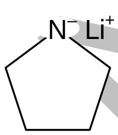
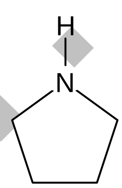
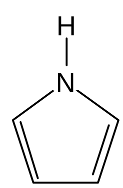
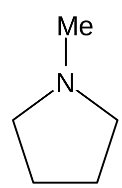
Q.6 Select the strongest base in following compound:

(i) (a)  (b)  (c)  (d) 

(ii) (a)  (b) 

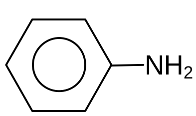
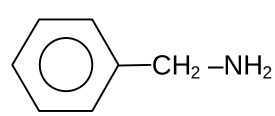
(c)  (d) 

(iii) (a)  (b)  (c)  (d) 

(iv) (a)  (b)  (c)  (d) 

Q.7 Arrange the following compound in decreasing order of their basicity.

(i) (a) $H_2C = CHNa$ (b) CH_3CH_2Na (c) CH_3CH_2ONa (d) $HC \equiv CNa$

(ii) (a)  (b) 

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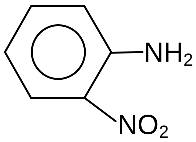
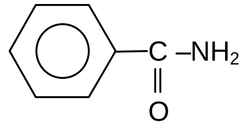
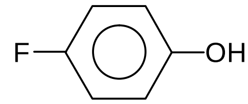
(c) 

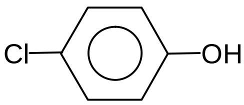
(d) 

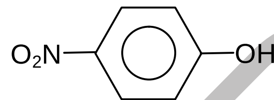
(iii) (a) HO^- (b) NH_3 (c) H_2O (d) HSO_4^-

Q.8 Arrange the given phenols in their decreasing order of acidity:

(I) C_6H_5–OH

(II) 

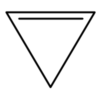
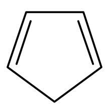
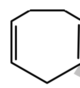
(III) 

(IV) 

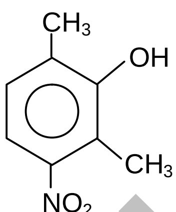
Select the correct answer from the given code :

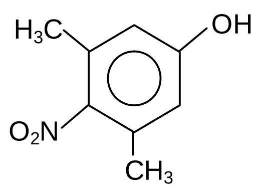
(A) IV > III > I > II
(B) IV > II > III > I
(C) IV > III > II > I
(D) IV > I > III > II

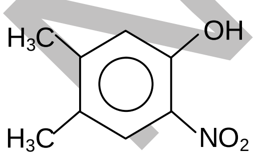
Q.9 Which one of the following is the most acidic?

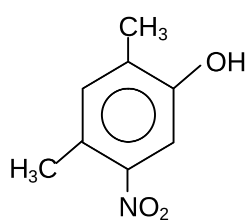
(A) 
(B) 
(C) 
(D) $CH_2 = CH–CH_3$

Q.10 Which one of the following phenols will show highest acidity?

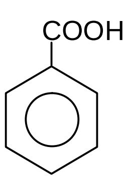
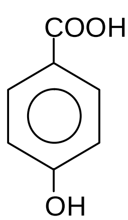
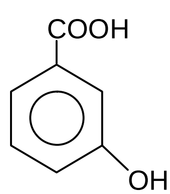
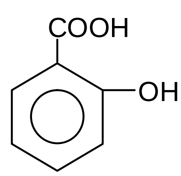
(A) 

(B) 

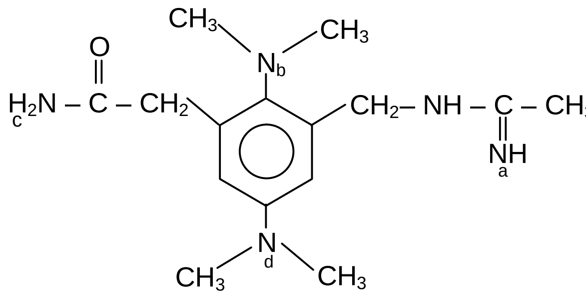
(C) 

(D) 

Q.11 Which of the following is weakest acid?

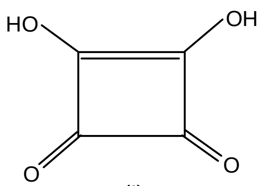
(A) 
(B) 
(C) 
(D) 

Q.12 Basicity order in following compound is:

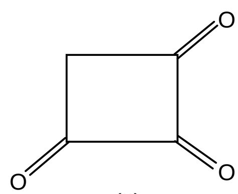


(A) b > d > a > c (B) a > b > d > c (C) a > b > c > d (D) a > c > b > d

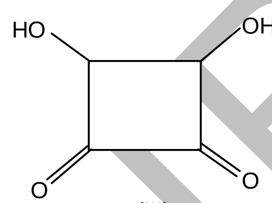
Q.13 The correct pKa order of the following acids is:



(I)



(II)



(III)

(A) I > II > III (B) III > II > I (C) III > I > II (D) I > III > II

Q.14 Arrange pH of the given compounds in decreasing order :

(1) Phenol (2) Ethyl alcohol (3) Formic acid (4) Benzoic acid

(A) 1 > 2 > 3 > 4 (B) 2 > 1 > 4 > 3 (C) 3 > 2 > 4 > 1 (D) 4 > 3 > 1 > 2

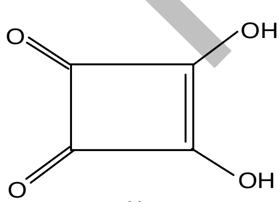
Q.15 Arrange acidity of given compounds in decreasing order :

(I) $CH_3 - NH - CH_2 - CH_2 - OH$ (II) $CH_3 - NH - CH_2 - CH_2 - CH_2 - OH$

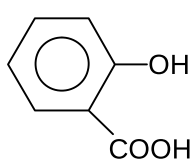
(III) $(CH_3)_3\overset{\oplus}{N} - CH_2 - CH_2 - OH$

(A) III > I > II (B) III > II > I (C) I > II > III (D) II > I > III

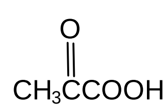
Q.16 Consider the following compound



(I)



(II)

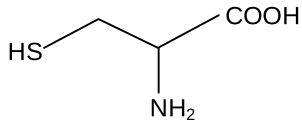


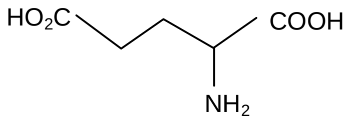
(III)

Which of the above compounds reacts with $NaHCO_3$ giving CO_2

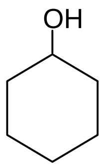
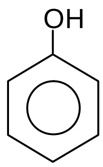
(A) I, II and III (B) I and III (C) II and III (D) I and II

Q.17 Say which pk_a belong to which functional group in case of following amino acids :

(i) cysteine :  1.8, 8.3 & 10.8

(ii) glutamic acid :  : 2.19, 4.25, 9.67

Q.18 Record the following sets of compounds according to increasing pK_a (= –log Ka)

(a)  ,  , cyclohexane carboxylic acid

(b) 1-butyne, 1-butene, butane

(c) Propanoic acid, 3- bromopropanoic acid, 2-nitropropanoic acid

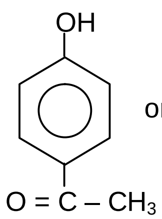
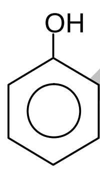
(d) Phenol, o- nitrophenol, o-cresol

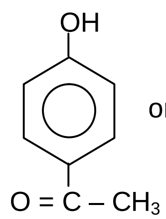
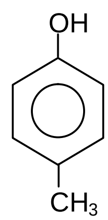
(e) Hexylamine, aniline, methylamine

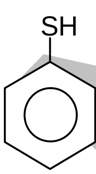
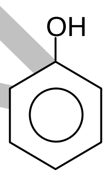
Q.19 Explain which is a stronger acid.

(a) CH_3CH_3 or $BrCH_2NO_2$

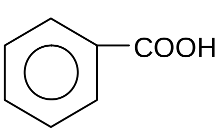
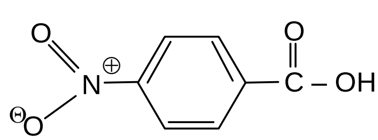
(b) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$ or $CH_3-\overset{\overset{O}{\|}}{C}-CH_2CN$

(c)  or 

(d)  or 

(e)  or 

Q.20 Which of the following would you predict to be the stronger acid?

(a)  or 

(b) $CH_3-CH_2-CH_2-OH$ or $CH_3-CH=CH-OH$

(c) $CH_3-CH=CH-CH_2-OH$ or $CH_3-CH=CH-OH$

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Q.21 Consider the following bases :

(I) o-nitroaniline (II) m-nitroaniline (III) p-nitroaniline

The decreasing order of basicity is:

(A) II > III > I (B) II > I > III (C) I > II > III (D) I > III > II

Q.22 Consider the basicity of the following aromatic amines:

(I) aniline (II) p-nitroaniline

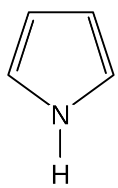
(III) p-methoxyaniline (IV) p-methylaniline

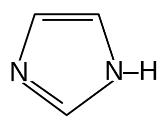
The correct order of decreasing basicity is:

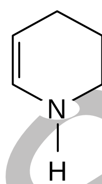
(A) III > IV > I > II (B) III > IV > II > I

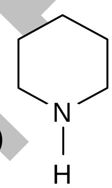
(C) I > II > III > IV (D) IV > III > II > I

Q.23 Which one of the following is least basic in character?

(A) 

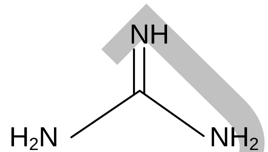
(B) 

(C) 

(D) 

Q.24 In each of the following pair of compounds, which is more basic in aqueous solution? Give an explanation for your choice:

(a) CH_3NH_2 or CF_3NH_2

(b) CH_3CONH_2 or 

(c) n-PrNH_2 or CH_3CN

(d) $C_6H_5N(CH_3)_2$ or 2,6-dimethyl-N-N-dimethylaniline

(e) m-nitroaniline or p-nitroaniline

Q.25 From the following pair, select the stronger base:

(a) p-methoxy aniline or p-cyanoaniline

(b) pyridine or pyrrole

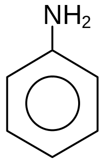
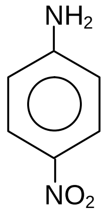
(c) CH_3CN or $CH_3CH_2NH_2$

Q.26 Choose the member of each of the following pairs of compounds that is likely to be the weaker base.

(a) H_2O or $H_3O^{\oplus}$ (b) H_2S, HS^-, S^{2-} (c) Cl^-, SH^- (d) F^-, OH^-, NH_2^-, CH_3^-

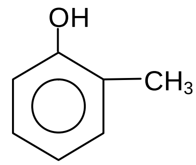
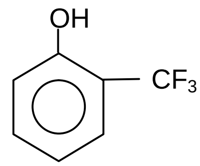
(e) HF, H_2O, NH_3 (f) OH^-, SH^-, SeH^-

Q.27 Explain which compound is the weaker base.

(a)  or 

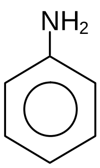
(b) $CH_2 = CH - CH = CH - CH_2^-$ or $CH_2 = CH - CH_2^-$

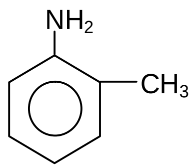
(c) $O^- - \overset{\overset{\large O}{\|}}{C} - \overset{\overset{\large O}{\|}}{C} - OH$ or $HO - \overset{\overset{\large O}{\|}}{C} - \overset{\overset{\large O}{\|}}{C} - OH$

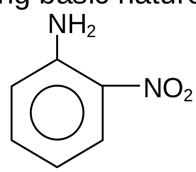
(d)  or 

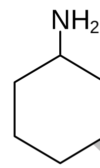
Q.28 Rank the following amines in increasing basic nature.

(a)

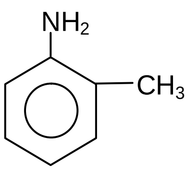

(i)

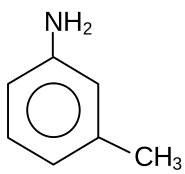

(ii)

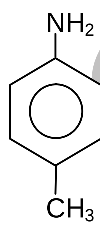

(iii)

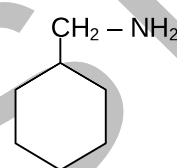

(iv)

(b)

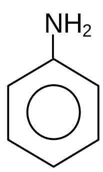

(i)

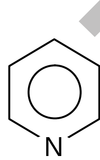

(ii)

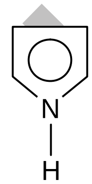

(iii)


(iv)

(c)


(i)


(ii)


(iii)

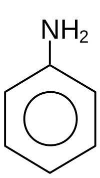
Q.29 Arrange the basic strength of the following compounds.

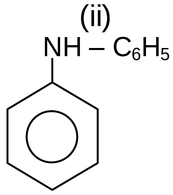
(a) OH^- (i) CH_3COO^- (ii) Cl^- (iii)

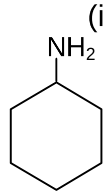
(b) $CH \equiv C^-$ (i) $CH_2 = CH^-$ (ii) $CH_3CH_2^-$ (iii)

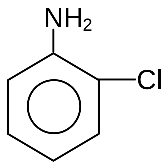
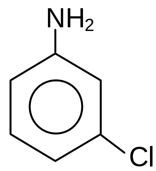
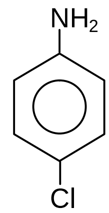
(c) $CH_2 = CHCH_2NH_2$ (i) $CH_3CH_2CH_2NH_2$ (ii) $CH \equiv C - CH_2NH_2$ (iii)

(d)


(i)


(ii)


(iii)

(e)   

(i) (ii) (iii)

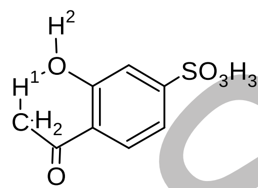
Q.30 Arrange the following compounds in order of increasing basicity.

(a) CH_3NH_2, $CH_3NH_3^{\oplus}$, CH_3NH^-

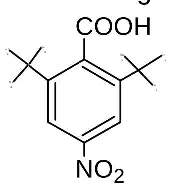
(b) CH_3O^-, CH_3NH^-, $CH_3CH_2^-$

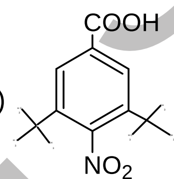
(c) $CH_3CH = CH^-$, $CH_3CH_2CH_2^-$, $CH_3C \equiv C^-$

Q.31 For the following compounds arrange the labeled proton in increasing order of their ease of deprotonation.

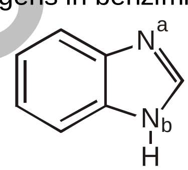


Q.32 Which is stronger acid, A or B and why?

(a) 

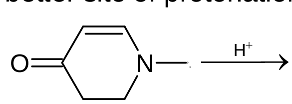
(b) 

Q.33 Discuss the basic strength of two nitrogens in benzimidazole.

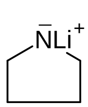
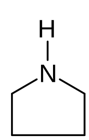
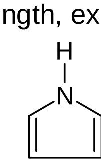


Benzimidazole

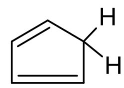
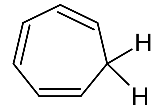
Q.34 In the following structure, which is better site of protonation and why-oxygen or nitrogen?



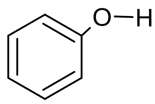
Q.35 Rank the following in increasing order of basic strength, explaining reason for your choice:

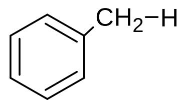
(i)  (ii)  (iii) 

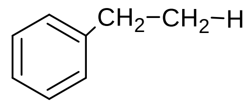
Q.36 One of the indicated proton H_a or H_b, is approximately 10^{30} times more acidic than other, which is more acidic and why?

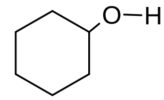



Q.37 Number the following compounds in order of increasing acidity of indicated proton giving mechanistic reasoning:

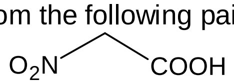
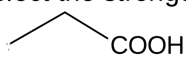

I

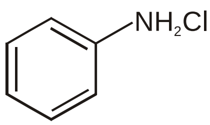
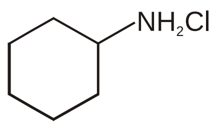

II

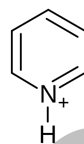
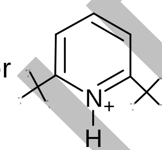

III


IV

Q.38 From the following pair. Select the stronger acid providing clear reasoning:

(a)  or 

(b)  or 

(c)  or 

TAUTOMERISM

Q.1 What statement is correct for Keto-enol tautomerism?

(A) Tautomerism is catalysed by acid and base.

(B) Tautomers are present in dynamic equilibrium state

(C) Generally keto form is more stable than enol form

(d) All

Q.2 Among the following the compounds having the highest enol content:

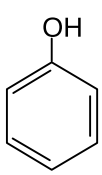
(A) CH_3CHO

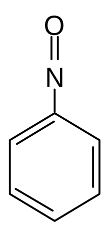
(B) CH_3COCH_3

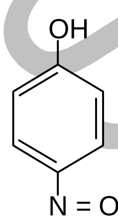
(C) $CH_3 - \underset{\underset{O}{\|}}{C} - CH_2CHO$

(D) $CH_3 - CO - CH_2 - CO_2CH_3$

Q.3 Which compound show tautomerism:

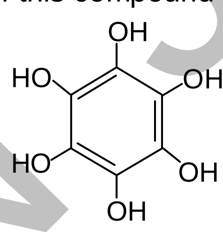
(A) 

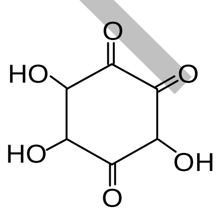
(B) 

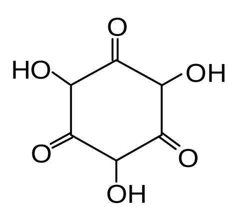
(C) 

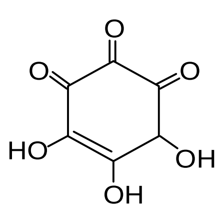
(D) None of these

Q.4 Tautomerism form of this compound is/are :



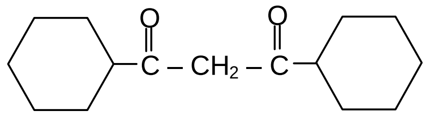
(A) 

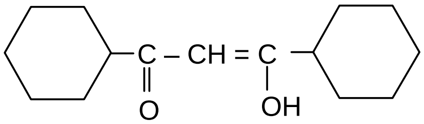
(B) 

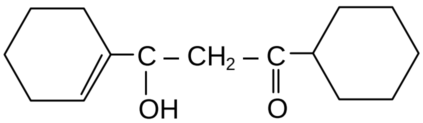
(C) 

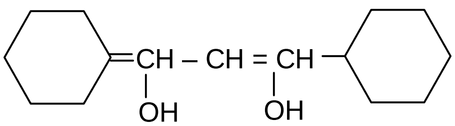
(D) All of these

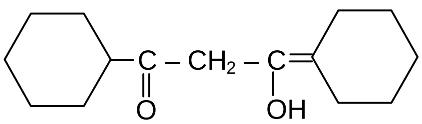
Q.5 Tautomer of following compound is:



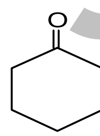
(A) 

(B) 

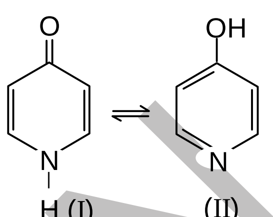
(C) 

(D) 

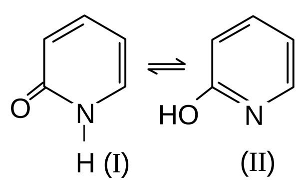
Q. 6 Tautomer in following is/are triad system:

(A) CH_3COCH_3 (B) $CH_3CH_2NO_2$ (C)  (D) HCN

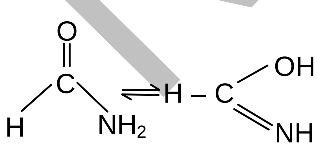
Q.7 In each of the following pairs which is more stable :

(A) 

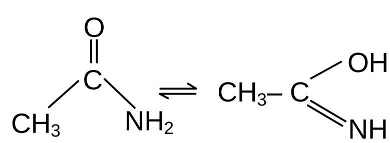
(I) (II)

(B) 

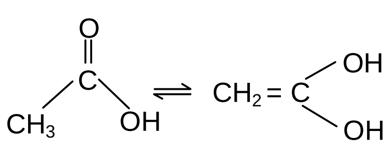
(I) (II)

(C) 

(I) (II)

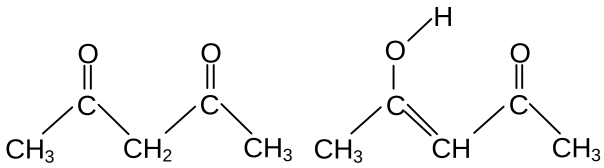
(D) 

(I) (II)

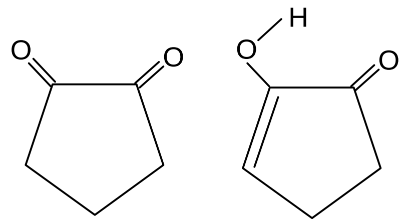
(E) 

(I) (II)

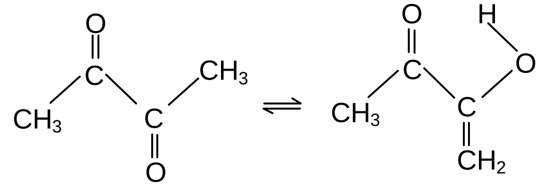
Q.8 In each of the following pairs which is more stable:

(A) 

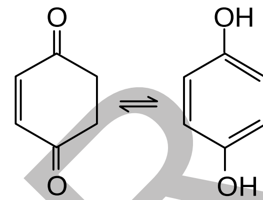
(I) (II)

(B) 

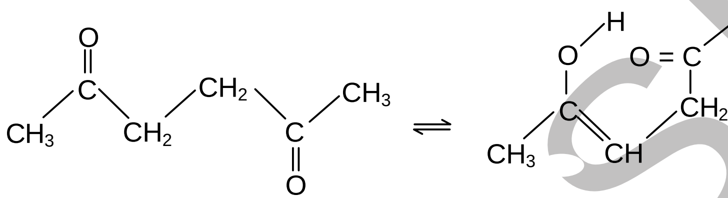
(I) (II)

(C) 

(I) (II)

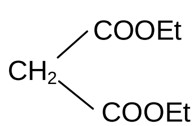
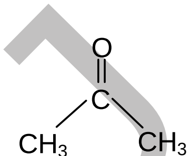
(D) 

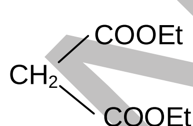
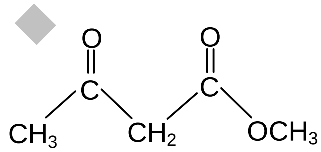
(I) (II)

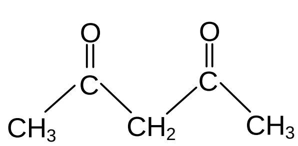
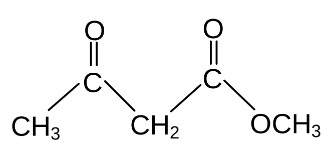
(E) 

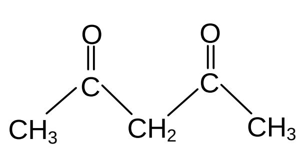
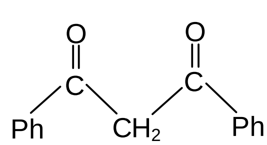
(I) (II)

Q.9 In each of the following pairs which will have higher enol content:

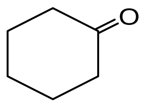
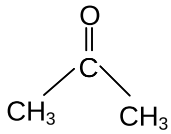
(A)  and 

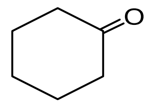
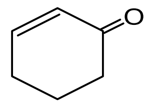
(B)  and 

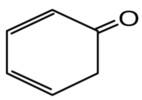
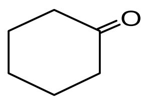
(C)  and 

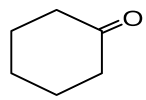
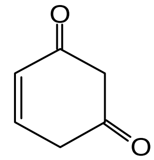
(D)  and 

Q.10 In each of the following pairs which will have less enol content:

(A)  and 

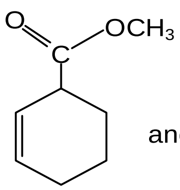
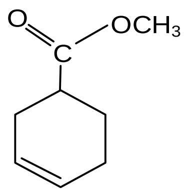
(B)  and 

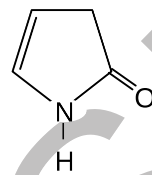
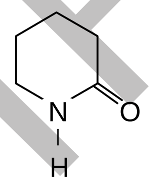
(C)  and 

(D)  and 

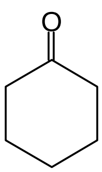
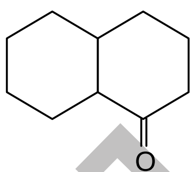
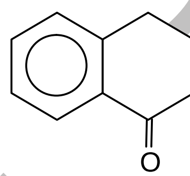
(E) $\underset{\displaystyle Cl}{\underset{|}{CH_2}} - CHO$ and $CH_3 - CHO$

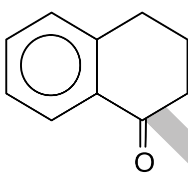
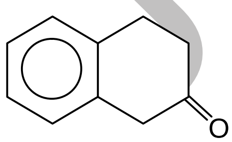
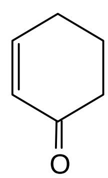
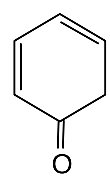
Q.11 In each of the following pairs which will have less enol content:

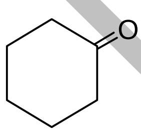
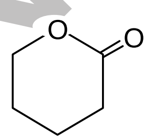
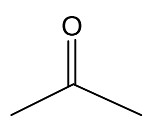
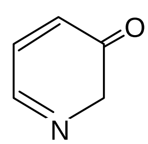
(A)  and 

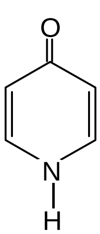
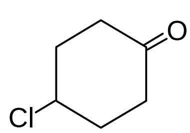
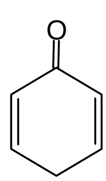
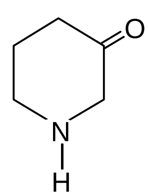
(B)  and 

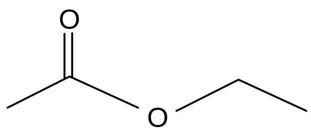
Q.12 In each of the following stets of compounds write the decreasing order of % enol content.

(A)  (I)  (II)  (III)

(B)  (I)  (II)  (III)  (IV)

(C)  (I)  (II)  (III)  (IV)

(D)  (I)  (II)  (III)  (IV)

(E) 
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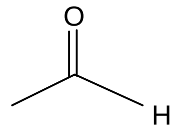
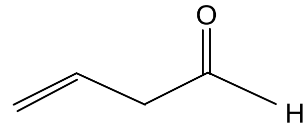

(II)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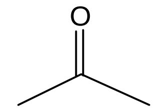
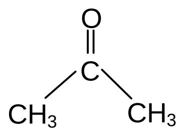
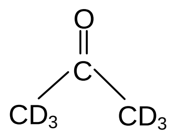

(IV)

Q.13 
(I)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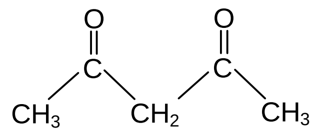
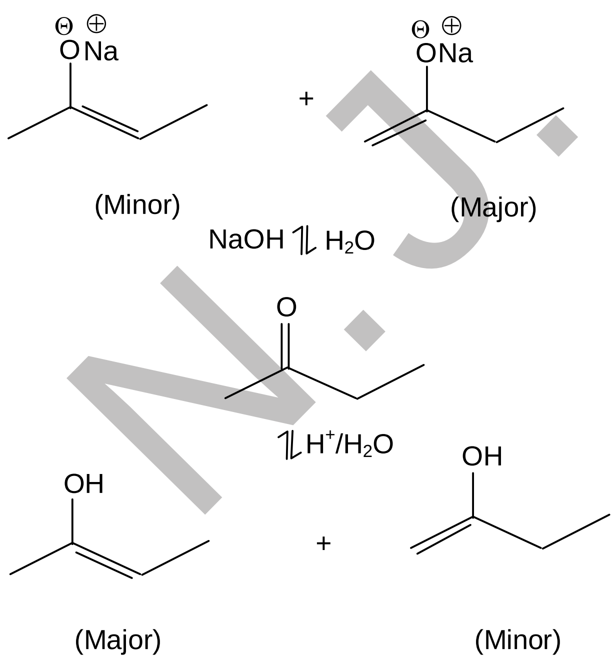

(III)

Among these give ease of enolization.

Q.14 %enol content of acetylacetone in following solvents is found as:

Solvent	% enol content
H_2O	15
Liquid state	76
Hexane	92
Gas phase	92

Explain the observation.

Q.15 

Explain the observation.

ELECTRON DISPLACEMENT EFFECT
Answer Key

1. (a) A (b) A, B (c) B (d) A, B = zero charge

2. (a)

3. (a) 4658, (b) 4638, (c) 4632, (d) 4656, (e) 5293

4. (a) (i), (b) (i), (c) (ii), (d) I, (e) ii

5. (a) ii < iv < i < iii, (b) iii < ii < i

6. (a) $CH_2 = CH \overset{\alpha}{—} \ddot{\underset{..}{C}}l\!:$, $CH_3 — CH_2 \overset{\beta}{—} \ddot{\underset{..}{C}}l\!:$

B.L. ($\beta < \alpha$) since α has partial double bond caracter

(b) $CH_2 \overset{\alpha}{=} CH_2$, $CH_2 \overset{\beta}{=} CH — \ddot{\underset{..}{O}} — CH_3$

B.L. ($\alpha < \beta$) since β has single bond character because of resonance

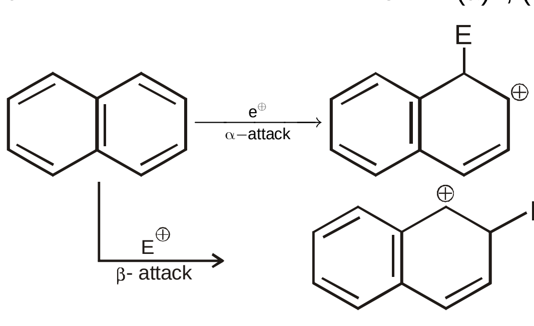
(c) $CH_3 — S \overset{\alpha}{—} H$, $CH_3 — O \overset{\beta}{—} H$

α — (1s — 3P) β (1S — 2P)

(d) In $CH_2 = CH — \dot{N}H_2$

Lone pair on nitrogen is part of conjugation

7.	iii > ii > i	8.	H_c		
9.	(a) I, (b) I, (c) II, (d) II	10.	A	11.	(a), (c),(d),(g),(j),(l),(m)
12.	(a), (b)	13.	(a),(b),(c),(f)	14.	(b), (c) (f)
15.	(d)	16.	(a), (e), (f), (g)	17.	(b), (d), (e)
18.	(b), (d), (e)	19.	(c), (f)	20.	(a), (b), (c), (d), (f)
21.	(b), (c), (f)	22.	(f)		
27.	d	28.	b	29.	a
30.	(a) II, (b) I, (c) I, (d) I, (e) I				
31.	(a) II, (b) I, (c) I, (d) II, (e) I	32.	(a) II, (b) I, (c) II, (d) II, (e) II		
33.	(a) II, (b) II, (c) II, (d) II, (e) II	34.	(a) I, (b) II, (c) II, (d) I, (e) I	35.	b
36.	(a) I, (b) I, (c) I, (d) I,				
37.	(a) I, (b) II, (c) II, (d) I	38.	(a) I, (b) II, (c) II, (d) II, (e) I, (f) I		
39.	(a) I, (b) I, (c) II, (d) I, (e) I, (f) I			40.	b
41.	c	42.	d	43.	b
44.	a	45.	a	46.	a
47.	c	48.	(a) I, (b) I, (c) II, (d) I	49.	c

50. 

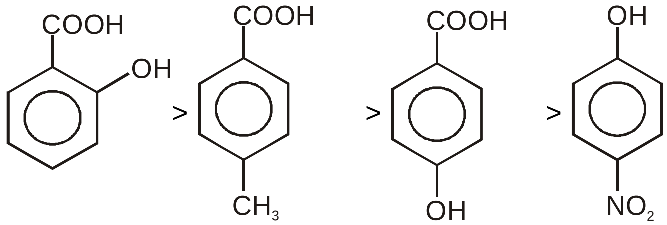
extended conjugation

cross conjugation

51. (6) 6 × H – atoms are there

52. (C)

Due to ortho effect o-hydroxy benzoic acid is strongest acid and correct order of decreasing K_a is



ACIDIY, BASICITY
ANSWER KEY

Q.1 (i) a > b > c > d, (ii) a > b > c, (iii) c > b > a, (iv) a > b > c
(v) c > b > a, (vi) a > b > c (vii) d > c > b > a (viii) d > c > b > a
(ix) d > b > a > c (x) d > a > c > b

Q.2 (i) a > b > c > d (ii) a > b > c > d (iii) c > b > d > a (iv) a < b < c < d
(v) a > b > c (vi) a < b < c (vii) c > a > b (viii) b > c > a
(ix) c > d > b > a

Q.3 (i) d > c > a > b (ii) a > b > c (iii) c > a > b > d (iv) d > b > c > a
(v) a > b > c (vi) b > a (vii) b > a (viii) c > b > a
(ix) c > a > b

Q.4 (i) b (ii) a (iii) b (iv) b

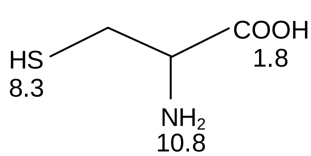
Q.5 (i) a > b > c (ii) d > c > b > a (iii) b > c > a (iv) d > c > b > a
(v) b > a > c (vi) c > a > b (vii) b > a (viii) c > b > a
(ix) c > b > a (x) a > b > c

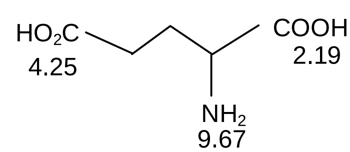
Q.6 (i) d (ii) b (iii) c (iv) a

Q.7 (i) b > a > d > c (ii) b > a > c > d (iii) a > b > c > d

Q.8 c **Q.9** b **Q.10** c **Q.11** b **Q.12** b **Q.13** c **Q.14** b **Q.15** a

Q.16 a

Q.17 (i) cysteine : 

(ii) glutamic acid : 

Q.18 (a) 3 < 2 < 1; (b) 1 < 2 < 3; (c) 3 < 2 < 1 (d) 2 < 1 < 3 **(**e) 2 < 3 < 1

Q.19 (a) 2 ; (b) 2 ; (c) 1 ; (d) 1; (e) 1 **Q.20** (a) 2 : (b) 2 ; (c) 2 **Q.21** A **Q.22** A **Q.23** A

Q.24 (a) i, (b) ii, (c) i, (d) ii, (e) I **Q.25** (a) i, (b) i, (c) ii **Q.26** (a) 2; (b) 1 (c) 1; (d) 1; (e) 1; (f) 3

Q.27 (a) 2 ; (b) 1; (c) 2; (d) 2 **Q.28** (a) 3 < 2 < 1 < 4 (b) 1 < 2 < 3 < 4; (c) 3 < 1 < 2

Q.29 (a) 1 > 2 > 3; (b) 1 < 2 < 3; (c) 3 < 1 < 2; (d) 2 < 1 < 3; (e) 1 < 2 < 3

Q.30 (a) 2 < 1 < 3; (b) 1 < 2 < 3; (c) 3 < 1 < 2

Q.31 1 < 2 < 3 **Q.32** a

Q.33 Basic strength Na > Nb **Q.34** oxygen due to Non conjugate l.p.of e

Q.35 III < II < I **Q.36** H_a

Q.37 III < II < IV < I **Q.38** (a) I, (b) I, (c) I

TAUTOMERISM

ANSWER KEY

Q.1 d **Q.2** c **Q.3** a, c **Q.4** a, b

Q.5 a **Q.6** a, b, c **Q.7** (a) 1; (b) 1; (c) 1; (d) 1; (e) 1

Q.8 (a) 2; (b) 2; (c) 1 ; (d) 2 ; (e) 1 **Q.9** (a) 1; (b) 2; (c) 1; (d) 2

Q.10 (a) 2; (b) 2; (c) 2; (d) 1; (e) 2

Q.11 (a) 2 (b) 2

Q.12 (a) 3 > 1 > 2; (b) 4 > 2 > 1 > 3; (c) 4 > 1 > 3 > 2 (d) 3 > 1 > 4 > 2 (e) 3 > 4 > 2 > 1

Q.13 3 > 1 > 2

GENERAL ORGANIC CHEMISTRY (G.O.C)

ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

Electronic Displacement Effect

1. Consider structural formulas A and B.

(A) (B)

Are A, B and C constitutional isomers. or are they resonance forms?

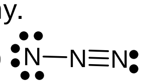
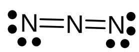
(a) Which structures have a negatively charged carbon?

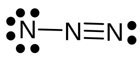
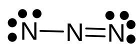
(b) Which structures have a positively charged nitrogen?

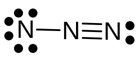
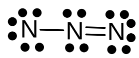
(c) Which structures have a negatively charged nitrogen?

(d) What is the net charge on each structure?

2. In each of the following pairs, determine which of the following represent resonance forms of a single species or depict different substances. If two structures are not resonance forms. Explain why.

(a)  and 

(b)  and 

(c)  and 

3. Match each alkene with the appropriate heat of combustion:

Heats of combustion (kJ/mol): 5293; 4658; 4656; 4638; 4632

(a) 1-Heptene

(b) 2, 4-Dimethyl-1-pentene

(c) 2,4-Dimethyl-2-pentene

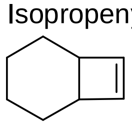
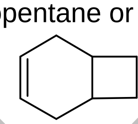
(d) (Z)-4,4-Dimethyl-2-pentene

(e) 2,4,4-Trimethyl-2-pentene

4. Choose the more stable alkene in each of the following pairs. Explain your reasoning.

(a) 1-Methylcyclohexene or 3-methylcyclohexene

(b) Isopropenylcyclopentane or allylcyclopentane

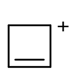
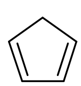
(c)  or 

(d) (Z)-Cyclononene or (E)-cyclononene

(e) (Z)-Cyclooctadecene or (E)-cyclooctadecene

5. Rank the following sets of intermediates in increasing order of their stability giving appropriate reasons for your choice.

(a) $C_6H_5^+, P-NO_2(C_6H_4)^+, P-CH_3-(C_6H_4)^+, P-Cl-C_6H_4^+$

(b)   

6. Discuss the following observations:

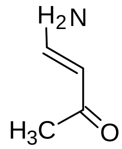
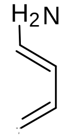
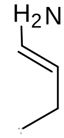
(a) C—Cl bond in vinyl chloride is stronger than in chloroethane.

(b) Carbon-carbon bond length in ethene is shorter than in $CH_2{=}CHOCH_3$

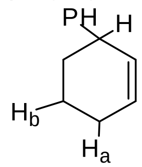
(c) CH_3SH is stronger acid than CH_3OH

(d) $CH_3CH_2NH_2$ is stronger base than $CH_2{=}CHNH_2$.

7. Compare the C–N bond-length in the following species:

(i)  (ii)  (iii) 

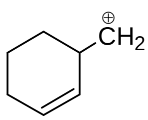
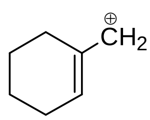
8. Answer the following:
Which of the indicated H is abstracted rapidly by bromine radical and why?

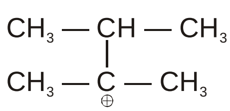
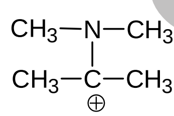


9. In each of the following pairs of ions which ion is more stable:

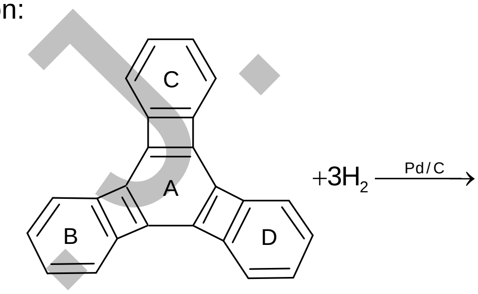
(a) (I) $C_6H_5-\overset{\oplus}{C}H_2$ and (II) $CH_2{=}CH-\overset{\oplus}{C}H_2$

(b) (I) $CH_3-\overset{\oplus}{C}H_2$ and (II) $CH_2{=}\overset{\oplus}{C}H$

(c) (I)  and 

(d) (I)  and 

10. Consider the given reaction:



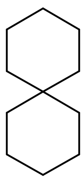
In the above reaction which one of the given ring will undergo reduction?

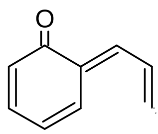
11. Which of the following statements is (are) true about resonance.
(a) Resonance is an intramolecular process.
(b) Resonance involves delocalization of both σ and π electrons.
(c) Resonance involves delocalization of π electrons only.
(d) Resonance decreases potential energy of a molecule.
(e) Resonance has no effect on the potential energy of a molecule.
(f) Resonance is the only way to increase molecular stability.
(g) Resonance is not the only way to increase molecular stability.
(h) Any resonating molecule is always more stable than any nonresonating molecule.
(i) The canonical structure explains all features of a molecule.
(j) The resonance hybrid explains all features of a molecule.
(k) Resonating structures are real and resonance hybrid is imaginary.
(l) Resonance hybrid is real and resonating structures are imaginary.
(m) Resonance hybrid is always more stable than all canonical structures.

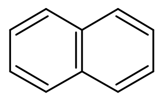
12. Resonance energy will be more if
(a) Canonical structures are equivalent than if canonical structures are non-equivalent.
(b) molecule is aromatic than if molecule is not aromatic.

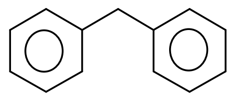
13. A canonical structure will be more stable if
(a) it has more number of π bonds than if it has less number of π bonds.
(b) the octets of all atoms are complete than if octets of all atoms are not complete.
(c) it involves cyclic delocalization of (4n + 2) π–electrons than if it involves acyclic delocalization of (4n + 2) π–electrons.
(d) it involves cyclic delocalization (4n) π–electrons than if it involves acyclic delocalization of (4n) π–electrons.
(e) +ve charge is on more electronegative atom than if +ve charge is less electronegative.
(f) –ve charge is on more electronegative atom than if –ve.

14. In which of the following molecules resonance takes place through out the entire system.

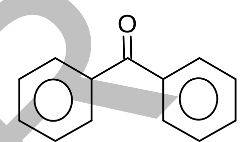

(a)


(b)


(c)

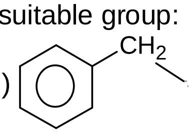

(d)

$COOCH_3$
|
$COOCH_3$
(e)

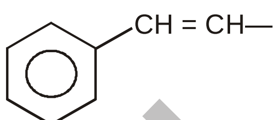

(f)

15. Which of the following groups cannot participate in resonance with other suitable group:
(a) $-COOH$ (b) $-CO\overline{O}$ (c) $-COCl$ (d) $-\overset{\oplus}{N}H_3$
(e) $-\dot{C}H_2$ (f) $CH_2=\overset{\oplus}{N}(CH_3)-$

16. Which of the following group can participate in resonance with other suitable group:
(a) $CH_2=\overset{\oplus}{O}-$ (b) $-CH_2-\overline{C}H_2$ (c) $-CH_2-\overset{\oplus}{C}H_2$ (d)

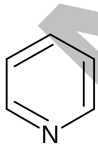


(e)

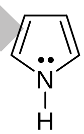


(f) $-BH_2$ (g) $-\overset{\oplus}{P}Ph_3$

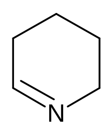
17. In which of the following lone-pair indicated is involved in resonance:
(a)



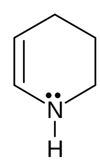
(b)



(c)

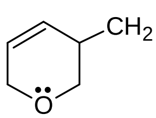


(d)

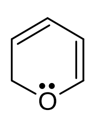


(e) $CH_2=CH-CH_2^{\ominus}$ (f) $CH_2=CH-CH=\ddot{N}H$

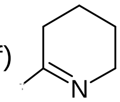
19. In which of the following lone-pair indicated is not involved in resonance:
(a) $CH_2=CH-\ddot{N}H-CH_3$ (b) $CH_2=CH-CH=\ddot{O}:$
(c) $CH_2=CH-\ddot{O}-CH=CH_2$ (d) $CH_2=CH-C\equiv N:$
(e)



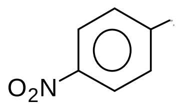
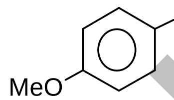
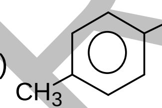
(f)

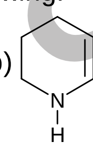
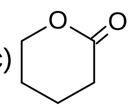


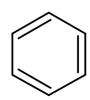
19. Identify electron–donating groups in resonance among the following:
(a) $-COOH$ (b) $-NO_2$ (c) $-OCOCH_3$ (d) $-COOCH_3$
(e) $-CHO$ (f) $-NHCOCH_3$

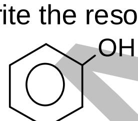
20. Identify electron–with drawing groups in resonance among the following:
(a) $-COOH$ (b) $-CONHCH_3$ (c) $-COCl$
(d) $-NO_2$ (e) $-O-CH{=}CH_2$ (f) 

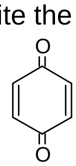
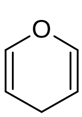
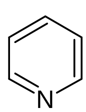
21. Which of the following groups can either donate or with draw a pair of electrons in resonance depending upon situation:
(a) $-NO_2$ (b) $-NO$ (c) $-CH{=}CH_2$ (d) $-CHO$
(e) $-NH_2$ (f) $-N{=}NH$

22. Which of the following groups can only withdraw a pair of electrons in resonance depending upon situation:
(a) $-Ph$ (b)  (c)  (d) 
(e) $-\overset{\oplus}{N}Me_3$ (f) $-CONH_2$

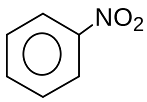
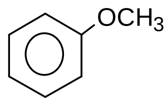
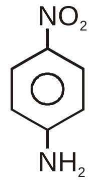
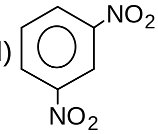
23. Write the resonance hybrid of each of the following:
(a) $CH_2{=}CH-CH_2$ (b)  (c) 
(d) $CH_2{=}CH-\overset{\oplus}{C}H_2$ (e) $CH_2{=}CH-\dot{C}H_2$

24. Write the canonical structures of each of the following:
(a) $R-CO-CH = CH_2$ (b) $CH_3O-CH{=}CH-\overset{\oplus}{N}Me_3$
(c) RCOCl (d) $HCONH_2$ (e) 

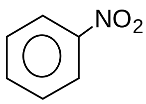
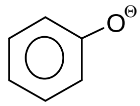
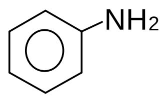
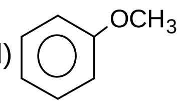
25. Write the resonance hybrid of each of the following:
(a)  (b) $CH_2{=}CH-CH{=}O$ (c) $CH_2{=}C{=}\overset{-}{C}H$
(d)  (e) $CH_2{=}CH-CH{=}CH_2$

26. Write the canonical structures of each of the following:
(a)  (b) $CH_2{=}\overset{\oplus}{N}{=}\overset{-}{N}$ (c) $CH_2{=}C{=}O$
(d)  (e) 

27. In which of the following molecules π–electron density in ring is minimum:

(a)  (b)  (c)  (d) 

28. In which of the following molecules π–electron density in ring is maximum:

(a)  (b)  (c)  (d) 

29. $\underset{\text{I}}{CH_2{=}CH{-}CH{=}CH{-}CH_3}$ is more stable than $\underset{\text{II}}{CH_3{-}CH{=}C{=}CH{-}CH_3}$ because

(A) there is resonance in I but not in II

(B) there is tautomerism in I but not in II

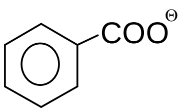
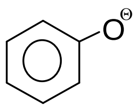
(C) there is hyperconjugation in I but not in II

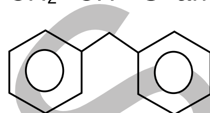
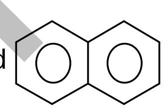
(D) II has more canonical structures than I.

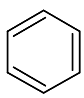
30. Which of the following pairs has higher resonance energy:

(a) CH_3COOH and CH_3COONa

(b) $CH_2{=}CH{-}\overset{\ominus}{O}$ and $CH_2{=}CH{-}OH$

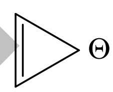
(c)  and 

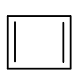
(d)  and 

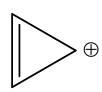
(e)  and $CH_2{=}CH{-}CH{=}CH{-}CH{=}CH_2$

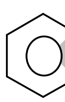
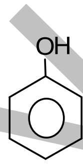
31. Which of the following pairs has less resonance energy:

(a) CO_3^{2-} and $HCOO^-$

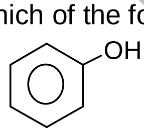
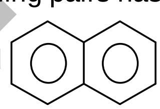
(b)  and $CH_2{=}CH{-}\overset{-}{C}H_2$

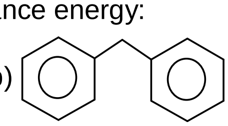
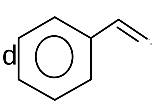
(c)  and $CH_2{=}CH{-}CH{=}CH_2$

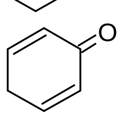
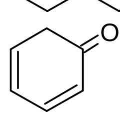
(d)  and $CH_2{=}CH{-}\overset{\oplus}{C}H_2$

(e)  and 

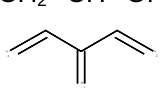
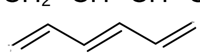
32. Which of the following pairs has higher resonance energy:

(a)  and 

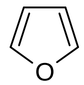
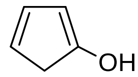
(b)  and 

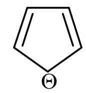
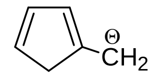
(c)  and 

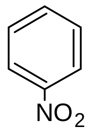
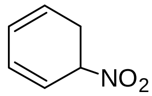
(d) $CH_2{=}CH{-}OH$ and $CH_2{=}CH{-}CH{=}CH{-}OH$

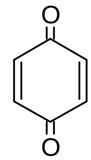
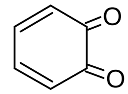
(e)  and 

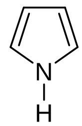
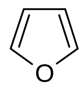
33. Which of the following pairs has less resonance energy:

(a)  and 

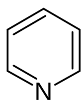
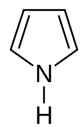
(b)  and 

(c)  and 

(d)  and 

(e)  and 

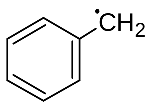
34. Which of the following pairs has higher resonance energy:

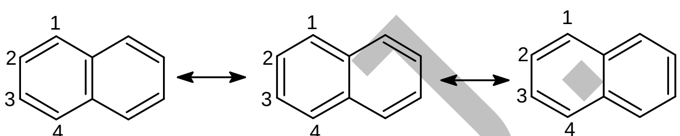
(a)  and 

(b) $CH_2{=}CH{-}O{-}CH{=}CH_2$ and $CH_2{=}CH{-}NH{-}CH{=}CH_2$

(c) $CH_2{=}CH{-}\overset{\ominus}{N}H$ and $HN{=}CH{-}\overset{\ominus}{N}H$

(d) $CH_2{=}CH{-}F$ and $CH_2{=}CH{-}Br$

(e)  and $CH_2{=}CH{-}\dot{C}H_2$

35. 

These are three canonical structures of naphthalene. Examine them and find correct statement among the following:

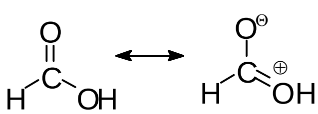
(a) All C–C bonds are of same length

(b) Cl–C2 bond is shorter than C2–C3 bond.

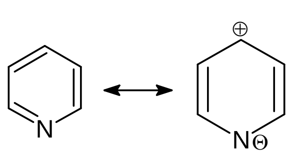
(c) Cl–C2 bond is longer than C2–C3 bond

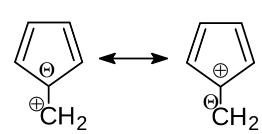
(d) none.

36. Identify more stable canonical structure in each of the following pairs:

(a) 

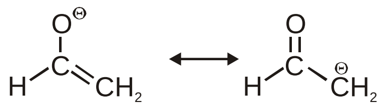
(b) $\overset{\ominus}{C}H_2{-}C{\equiv}CH \longleftrightarrow CH_2{=}C{=}\overset{\ominus}{C}H$

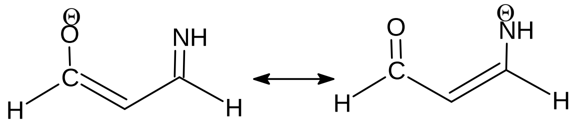
(c) 

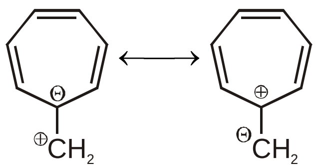
(d) 

37. Identify less stable canonical structure in each of the following pairs:

(a) $\overset{\oplus}{C}H_2—O—CH_3 \longleftrightarrow CH_2=\overset{\ominus}{O}—CH_3$

(b) 

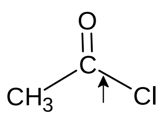
(c) 

(d) 

38. In which of the following pairs, indicated bond is of greater length:

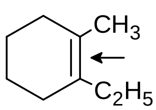
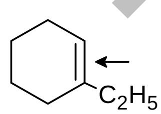
(a) $CH_3—CH_2 \underset{\uparrow}{-} Br$ and $CH_3—CH_2 \underset{\uparrow}{-} Cl$

(b) $CH_3—CH=CH \underset{\uparrow}{-} Br$ and $CH_3 \underset{\rightarrow}{-} \underset{\underset{Br}{|}}{CH}—CH_3$

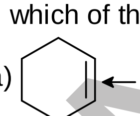
(c)  and $CH_3—CH_2 \underset{\uparrow}{-} Cl$

(d) $CH_2=CH \underset{\uparrow}{-} CH=CH_2$ and $CH_2=CH \underset{\uparrow}{-} CH_2—CH_3$

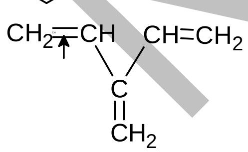
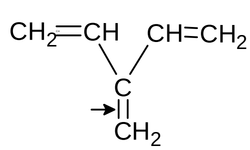
(e) $CH_2=CH \underset{\uparrow}{-} CH=CH_2$ and $CH_2=CH \underset{\uparrow}{-} NO_2$

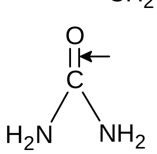
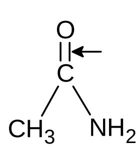
(f)  and 

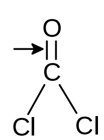
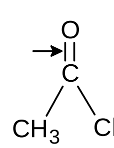
39. In which of the following pairs, indicated bond having less bond dissociation energy

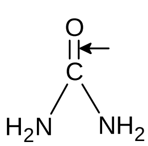
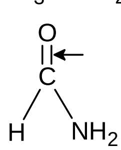
(a)  and $CH_2 \underset{\uparrow}{=} CH_2$

(b) $CH_3—C \underset{\uparrow}{\equiv} CH$ and $HC \underset{\uparrow}{\equiv} CH$

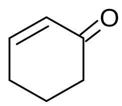
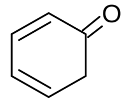
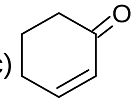
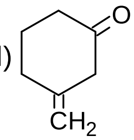
(c)  and 

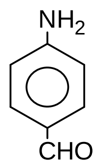
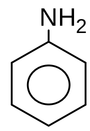
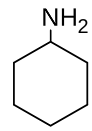
(d)  and 

(e)  and 

(f)  and 

40. Which of the following has longest C—O bond:

(a)  (b)  (c)  (d) 

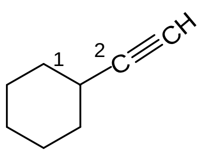
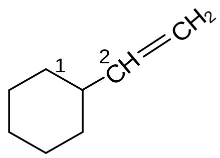
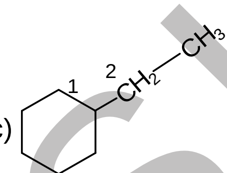
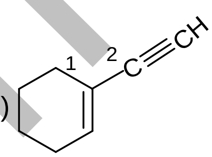
41. (I)  (II)  (III)  (IV) $CH_2{=}NH$

Among these compounds, the correct order of C—N bond lengths is:

(a) IV > I > II > III (b) III > I > II > IV

(c) III > II > I > IV (d) III > I > IV > II

42. C_1—C_2 bond is shortest in

(a)  (b)  (c)  (d) 

43. Among the following molecules, the correct order of C—C bond length is

(a) $C_2H_6 > C_2H_4 > C_6H_6 > C_2H_2$

(b) $C_2H_6 > C_6H_6 > C_2H_4 > C_2H_2$ (C_6H_6 is benzene)

(c) $C_2H_4 > C_2H_6 > C_2H_2 > C_6H_6$

(d) $C_2H_6 > C_2H_4 > C_2H_2 > C_6H_6$

44. $CH_3O{-}CH{=}CH{-}NO_2$ I

$CH_2{=}CH{-}NO_2$ II

$CH_2{=}CH{-}Cl$ III

$CH_2{=}CH_2$ IV

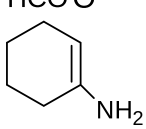
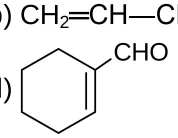
Which of the following is the correct order of C—C bond lengths among these compounds:

(a) I > II > III > IV (b) IV > III > II > I

(c) I > III > II > IV (d) II > III > I > IV

45. In which of the following molecules resonance is equivalent:

(a) $HCOO^{\ominus}$ (b) $CH_2{=}CH{-}CH{=}CH_2$

(c)  (d) 

46. $CH_2{=}CH{-}CH{=}CH{-}CH{=}CH_2$ I

$CH_2{=}CH{-}\overset{\oplus}{C}H{-}CH{=}CH{-}\overset{\ominus}{C}H_2$ II

$\overset{\oplus}{C}H_2{-}CH{=}CH{-}CH{=}CH{-}\overset{\ominus}{C}H_2$ III

Among these three canonical structures (through more are possible) what would be their relative contribution in the hybrid:

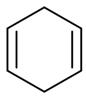
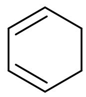
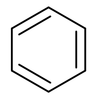
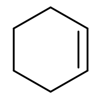
(a) I > II > III (b) III > II > I (c) I > III > II (d) III > I > II

47. For 1-methoxy-1, 3-butadiene, which of the following resonating structure is the least stable?

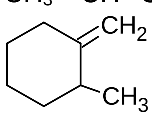
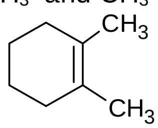
(a) $H_2\overset{\ominus}{C}-\overset{\oplus}{C}H-CH{=}CH-O-CH_3$ (b) $H_2\overset{\ominus}{C}-CH{=}CH-CH{=}\overset{\oplus}{O}-CH_3$

(c) $H_2C{=}CH-\overset{\oplus}{C}H-\overset{\ominus}{C}H-O-CH_3$ (d) $H_2C{=}CH-\overset{\ominus}{C}H-CH{=}\overset{\oplus}{O}-CH_3$

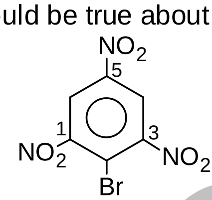
48. Among the following pairs identify the one which gives higher heat of hydrogenation:

(a)  and  (b)  and 

(c) $CH_3-CH{=}CH-CH_3$ and $CH_3-CH_2-CH{=}CH_2$

(d)  and 

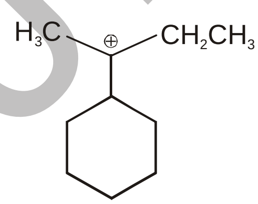
49. Which of the following statements would be true about this compound:



(a) All three C—N bonds are of same length.
(b) Cl—N and C3—N bonds are of same length but shorter than C_5—N bond.
(c) Cl—N and C3—N bonds are of same length but longer than C5—N bond.
(d) Cl—N and C3—N bonds are of different length but both are longer than C5—N bond.

50. Write resonating structures of σ complex formed when an electrophile ($E^{\oplus}$) attacks on (i) α and (ii) β position of naphthalene. Also state which is more stable?

51. The total number of contributing structure showing hyperconjugation (involving C—H bond)for the following carbocation is **[IIT-JEE 2011]**



52. Among the following compound,the most acidic is **[IIT-JEE 2011]**

(A) p-nitrophenol (B)p-hydroxybenzoic acid
(C) o-hydroxybenzoic acid (D) p-toluic acid

Acidity and Basicity

Q.1 Write correct order of acidic strength of following compounds:

(i) (a) $NO_2-CH_2-\overset{O}{\overset{\|}{C}}-O-H$ (b) $F-CH_2-\overset{O}{\overset{\|}{C}}-O-H$

(c) $Ph-CH_2-\overset{O}{\overset{\|}{C}}-O-H$ (d) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-O-H$

(ii) (a) $CH_3-CH_2-\underset{F}{\underset{|}{CH}}-\overset{O}{\overset{\|}{C}}-O-H$ (b) $CH_3-\underset{F}{\underset{|}{CH}}-CH_2-\overset{O}{\overset{\|}{C}}-O-H$

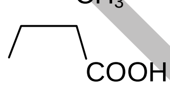
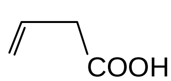
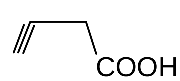
(c) $\underset{F}{\underset{|}{CH_2}}-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-O-H$

(iii) (a) $Cl-CH_2-\overset{O}{\overset{\|}{C}}-O-H$ (b) $Cl-\underset{Cl}{\underset{|}{CH}}-\overset{O}{\overset{\|}{C}}-O-H$

(c) $Cl-\overset{Cl}{\overset{|}{\underset{Cl}{\underset{|}{C}}}}-\overset{O}{\overset{\|}{C}}-O-H$

(iv) (a) CH_3-CH_2-O-H (b) $CH_3-\underset{CH_3}{\underset{|}{CH}}-O-H$

(c) $CH_3-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-O-H$

(v) (a)  (b)  (c) 

(vi) (a) $\begin{array}{l}COOH\\ |\\ COOH\end{array}$ (b) $CH_2\begin{array}{l}\diagup COOH\\ \diagdown COOH\end{array}$ (c) $\begin{array}{l}CH_2-COOH\\ |\\ CH_2-COOH\end{array}$

(vii) (a) H – F (b) H –Cl (c) H – Br (d) H – I

(viii) (a) CH_4 (b) NH_3 (c) H_2O (d) H – F

(ix) (a) $F-CH_2-CH_2-O-H$ (b) $NO_2-CH_2-CH_2-O-H$

(c) $Br-CH_2-CH_2-O-H$ (d) $\overset{\oplus}{N}H_3-CH_2-CH_2-O-H$

(x) (a) CH_3COOH (b) CH_3CH_2OH (c) C_6H_5OH (d) $C_6H_5SO_3H$

Q.2 Write increasing order of basic strength of following:

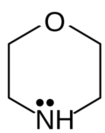
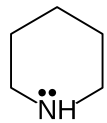
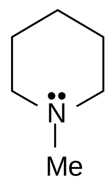
(i) (a) $CH_3^{\ominus}$ (b) $NH_2^{\ominus}$ (c) $OH^{\ominus}$ (d) $F^{\ominus}$

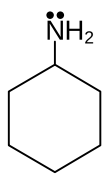
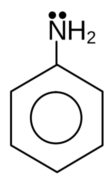
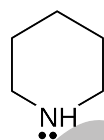
(ii) (a) $F^{\ominus}$ (b) $Cl^{\ominus}$ (c) $Br^{\ominus}$ (d) $I^{\ominus}$

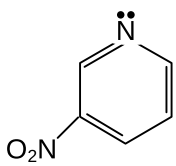
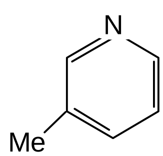
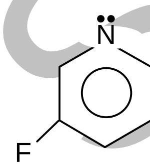
(iii) (a) NH_3 (b) $MeNH_2$ (c) Me_2NH (d) Me_3N (in H_2O)

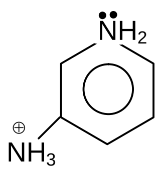
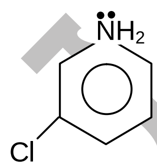
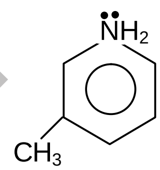
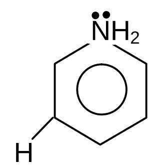
(iv) (a) NH_3 (b) $MeNH_2$ (c) Me_2NH (d) Me_3N (Gas phase)

(v) (a) $R-NH_2$ (b) $Ph-NH_2$ (c) $R-\underset{\underset{O}{\|}}{C}-NH_2$

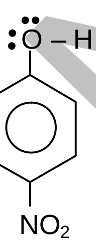
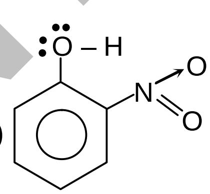
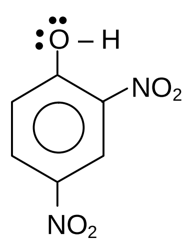
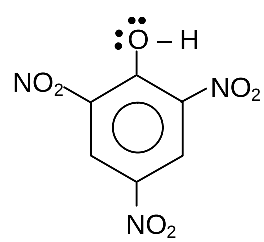
(vi) (a)  (b)  (c) 

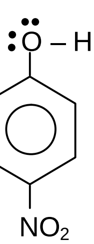
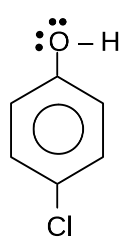
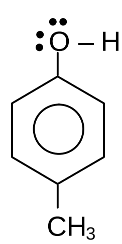
(vii) (a)  (b)  (c) 

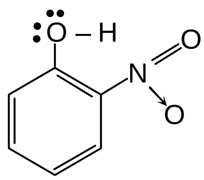
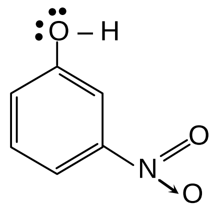
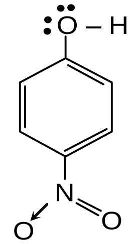
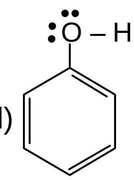
(viii) (a)  (b)  (c) 

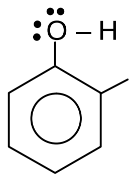
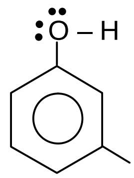
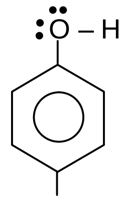
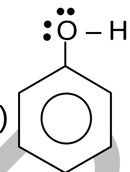
(ix) (a)  (b)  (c)  (d) 

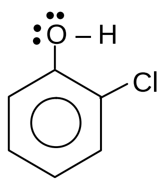
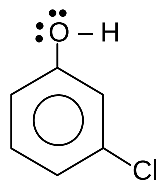
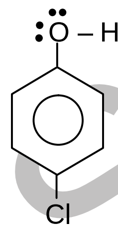
Q.3 Write correct order of acidic strength of following compounds:

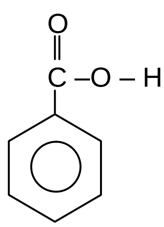
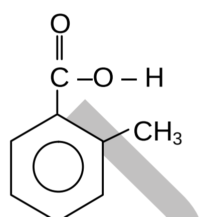
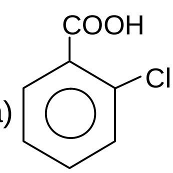
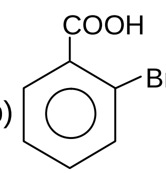
(i) (a)  (b)  (c)  (d) 

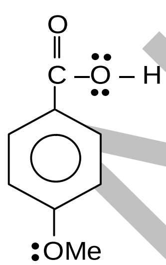
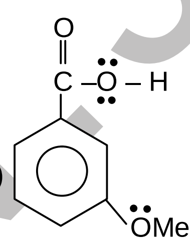
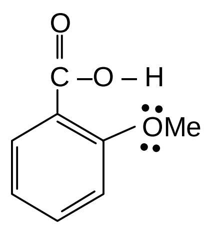
(ii) (a)  (b)  (c) 

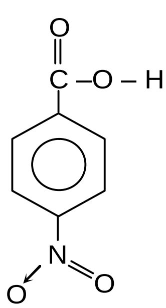
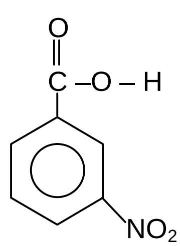
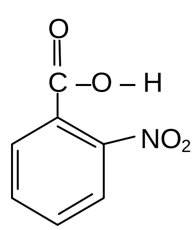
(iii) (a)  (b)  (c)  (d) 

(iv) (a)  (b)  (c)  (d) 

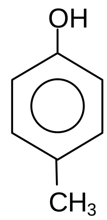
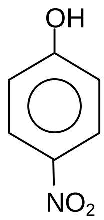
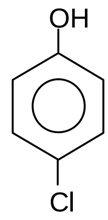
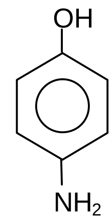
(v) (a)  (b)  (c) 

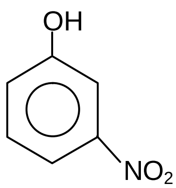
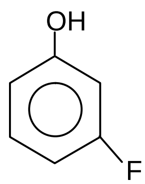
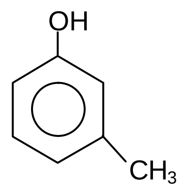
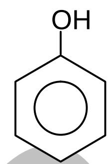
(vi) (a)  (b)  (vii) (a)  (b) 

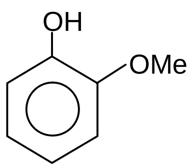
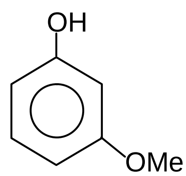
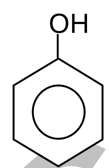
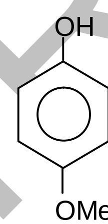
(viii) (a)  (b)  (c) 

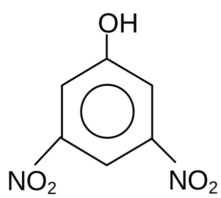
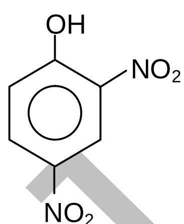
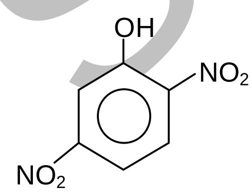
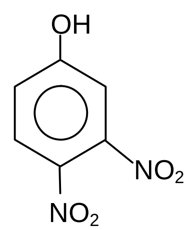
(ix) (a)  (b)  (c) 

Q.4 Select the strongest acid in each of the following sets:

(i) (a)  (b)  (c)  (d) 

(ii) (a)  (b)  (c)  (d) 

(iii) (a)  (b)  (c)  (d) 

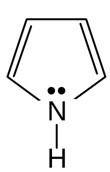
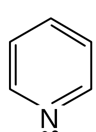
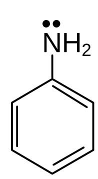
(iv) (a)  (b)  (c)  (d) 

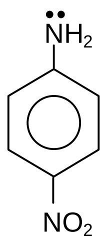
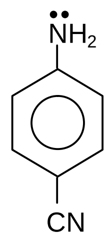
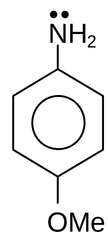
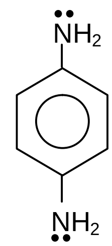
Q.5 Write increasing order of basic strength of following:

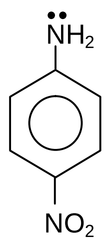
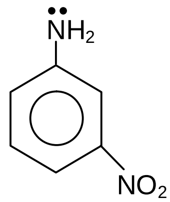
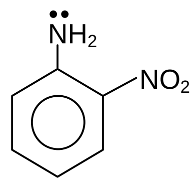
(i) (a) $CH_3 - CH_2 - \ddot{N}H_2$ (b) $CH_3 - CH = \ddot{N}H$ (c) $CH_3 - C \equiv \ddot{N}$

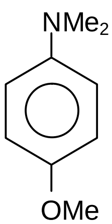
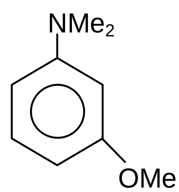
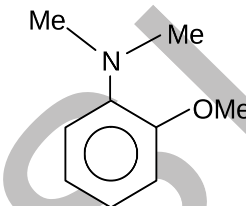
(ii) (a) $CH_3 - \underset{\underset{O}{\|}}{C} - \ddot{N}H_2$ (b) $CH_3 - CH_2 - \ddot{N}H_2$ (c) $CH_3 - \underset{\underset{\ddot{N}H}{\|}}{C} - \ddot{N}H_2$

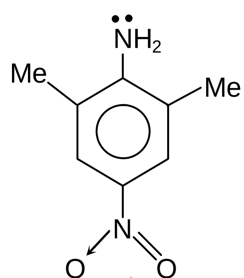
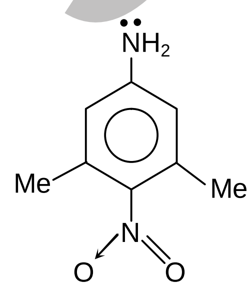
(d) $\ddot{N}H_2 - \underset{\underset{\ddot{N}H}{\|}}{C} - \ddot{N}H_2$

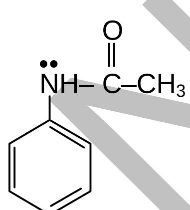
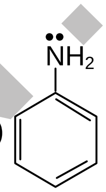
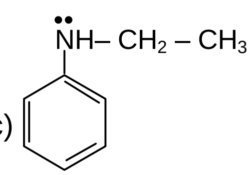
(iii) (a)  (b)  (c) 

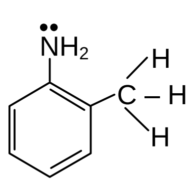
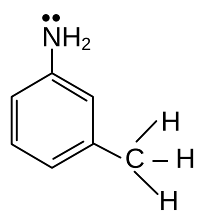
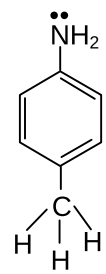
(iv) (a)  (b)  (c)  (d) 

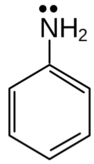
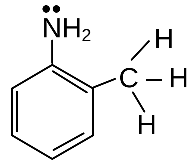
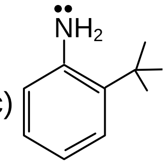
(v) (a)  (b)  (c) 

(vi) (a)  (b)  (c) 

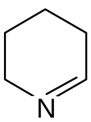
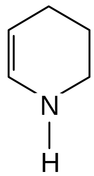
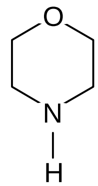
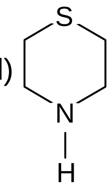
(vii) (a)  (b) 

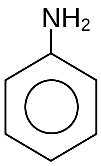
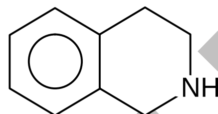
(viii) (a)  (b)  (c) 

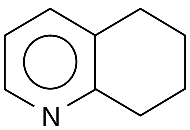
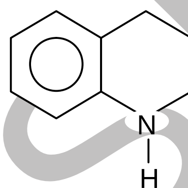
(ix) (a)  (b)  (c) 

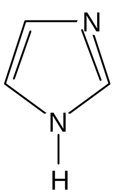
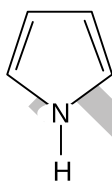
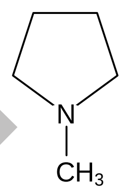
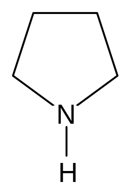
(x) (a)  (b)  (c) 

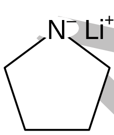
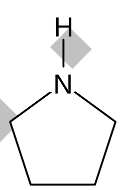
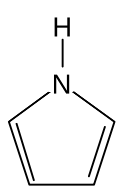
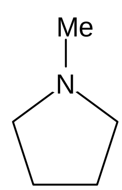
Q.6 Select the strongest base in following compound:

(i) (a)  (b)  (c)  (d) 

(ii) (a)  (b) 

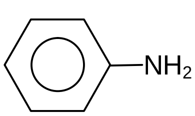
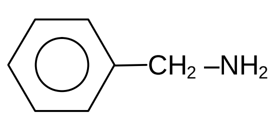
(c)  (d) 

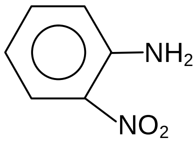
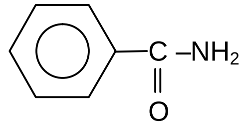
(iii) (a)  (b)  (c)  (d) 

(iv) (a)  (b)  (c)  (d) 

Q.7 Arrange the following compound in decreasing order of their basicity.

(i) (a) $H_2C = CHNa$ (b) CH_3CH_2Na (c) CH_3CH_2ONa (d) $HC \equiv CNa$

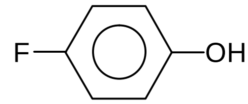
(ii) (a)  (b) 

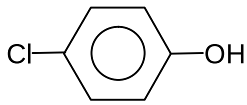
(c)    (d) 

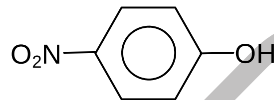
(iii) (a) HO^- (b) NH_3 (c) H_2O (d) HSO_4^-

Q.8 Arrange the given phenols in their decreasing order of acidity:

(I) C_6H_5–OH

(II) 

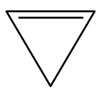
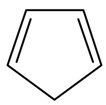
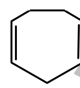
(III) 

(IV) 

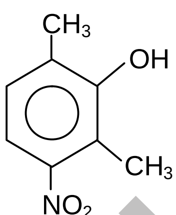
Select the correct answer from the given code :

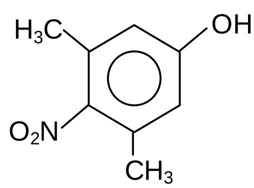
(A) IV > III > I > II
(B) IV > II > III > I
(C) IV > III > II > I
(D) IV > I > III > II

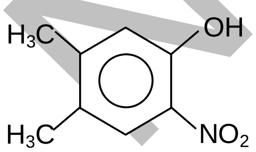
Q.9 Which one of the following is the most acidic?

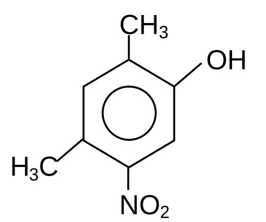
(A) 
(B) 
(C) 
(D) $CH_2 = CH–CH_3$

Q.10 Which one of the following phenols will show highest acidity?

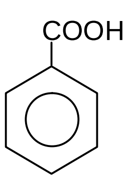
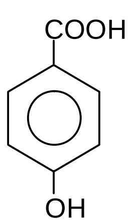
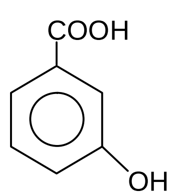
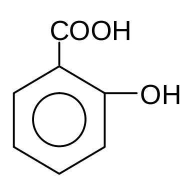
(A) 

(B) 

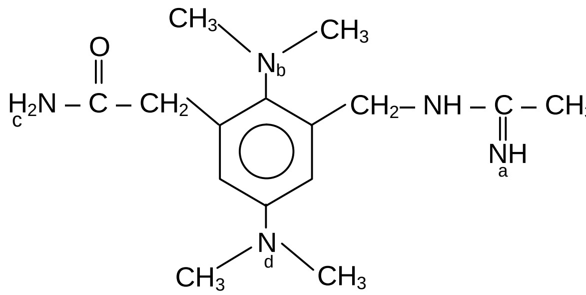
(C) 

(D) 

Q.11 Which of the following is weakest acid?

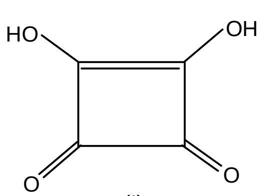
(A) 
(B) 
(C) 
(D) 

Q.12 Basicity order in following compound is:

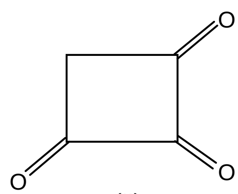


(A) b > d > a > c (B) a > b > d > c (C) a > b > c > d (D) a > c > b > d

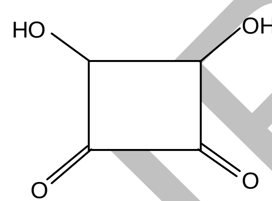
Q.13 The correct pKa order of the following acids is:



(I)



(II)



(III)

(A) I > II > III (B) III > II > I (C) III > I > II (D) I > III > II

Q.14 Arrange pH of the given compounds in decreasing order :

(1) Phenol (2) Ethyl alcohol (3) Formic acid (4) Benzoic acid

(A) 1 > 2 > 3 > 4 (B) 2 > 1 > 4 > 3 (C)3 > 2 > 4 > 1 (D) 4 > 3 > 1 > 2

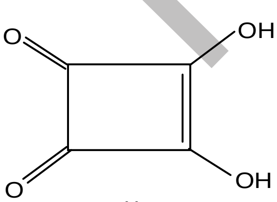
Q.15 Arrange acidity of given compounds in decreasing order :

(I) $CH_3-NH-CH_2-CH_2-OH$ (II) $CH_3-NH-CH_2-CH_2-CH_2-OH$

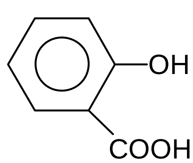
(III) $(CH_3)_3\overset{\oplus}{N}-CH_2-CH_2-OH$

(A) III > I > II (B) III > II > I (C) I > II > III (D) II > I > III

Q.16 Consider the following compound



(I)



(II)

$CH_3\overset{\overset{O}{\|}}{C}COOH$

(III)

Which of the above compounds reacts with $NaHCO_3$ giving CO_2

(A) I, II and III (B) I and III (C) II and III (D) I and II

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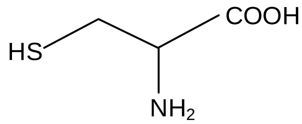
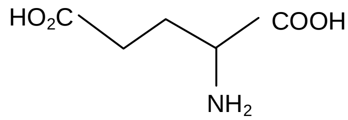
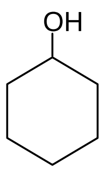
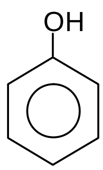
Q.17 Say which pk_a belong to which functional group in case of following amino acids :

(i) cysteine :  1.8, 8.3 & 10.8

(ii) glutamic acid :  : 2.19, 4.25, 9.67

Q.18 Record the following sets of compounds according to increasing pK_a (= –log Ka)

(a)  ,  , cyclohexane carboxylic acid

(b) 1-butyne, 1-butene, butane

(c) Propanoic acid, 3- bromopropanoic acid, 2-nitropropanoic acid

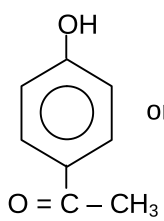
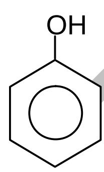
(d) Phenol, o- nitrophenol, o-cresol

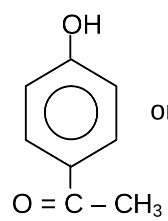
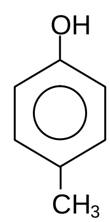
(e) Hexylamine, aniline, methylamine

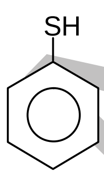
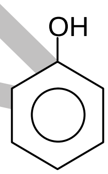
Q.19 Explain which is a stronger acid.

(a) CH_3CH_3 or $BrCH_2NO_2$

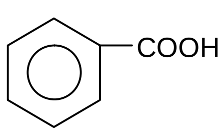
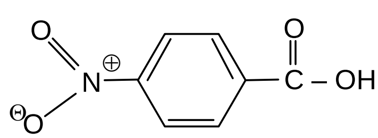
(b) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ or $CH_3-\overset{O}{\overset{\|}{C}}-CH_2CN$

(c)  or 

(d)  or 

(e)  or 

Q.20 Which of the following would you predict to be the stronger acid?

(a)  or 

(b) $CH_3 - CH_2 - CH_2 - OH$ or $CH_3 - CH = CH - OH$

(c) $CH_3 - CH = CH - CH_2 - OH$ or $CH_3 - CH = CH - OH$

Q.21 Consider the following bases :

(I) o-nitroaniline (II) m-nitroaniline (III) p-nitroaniline

The decreasing order of basicity is:

(A) II > III > I (B) II > I > III (C) I > II > III (D) I > III > II

Q.22 Consider the basicity of the following aromatic amines:

(I) aniline (II) p-nitroaniline

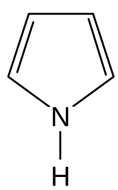
(III) p-methoxyaniline (IV) p-methylaniline

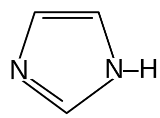
The correct order of decreasing basicity is:

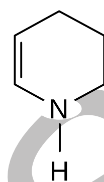
(A) III > IV > I > II (B) III > IV > II > I

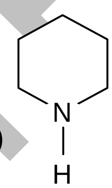
(C) I > II > III > IV (D) IV > III > II > I

Q.23 Which one of the following is least basic in character?

(A) 

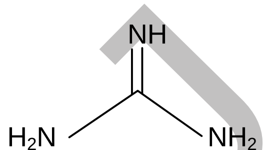
(B) 

(C) 

(D) 

Q.24 In each of the following pair of compounds, which is more basic in aqueous solution? Give an explanation for your choice:

(a) CH_3NH_2 or CF_3NH_2

(b) CH_3CONH_2 or 

(c) n-$PrNH_2$ or CH_3CN

(d) $C_6H_5N\ (CH_3)_2$ or 2,6-dimethyl-N-N-dimethylaniline

(e) m-nitroaniline or p-nitroaniline

Q.25 From the following pair, select the stronger base:

(a) p-methoxy aniline or p-cyanoaniline

(b) pyridine or pyrrole

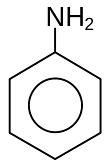
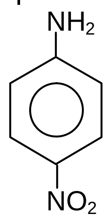
(c) CH_3CN or $CH_3CH_2NH_2$

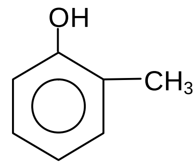
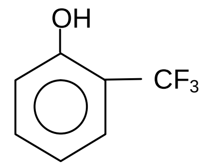
Q.26 Choose the member of each of the following pairs of compounds that is likely to be the weaker base.

(a) H_2O or $H_3O^{\oplus}$ (b) H_2S, HS^-, S^{2-} (c) Cl^-, SH^- (d) F^-, OH^-, NH_2^-, CH_3^-

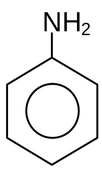
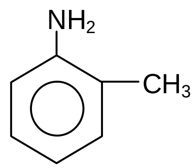
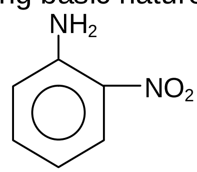
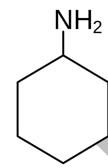
(e) HF, H_2O, NH_3 (f) OH^-, SH^-, SeH^-

Q.27 Explain which compound is the weaker base.

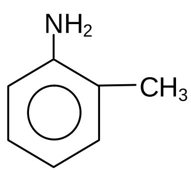
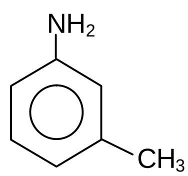
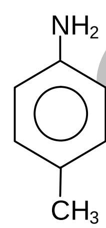
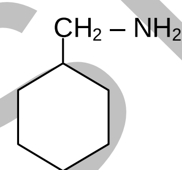
(a)  or  (b) $CH_2 = CH - CH = CH - CH_2^-$ or $CH_2 = CH - CH_2^-$

(c) $O^- - \overset{\overset{O}{\|}}{C} - \overset{\overset{O}{\|}}{C} - OH$ or $HO - \overset{\overset{O}{\|}}{C} - \overset{\overset{O}{\|}}{C} - OH$ (d)  or 

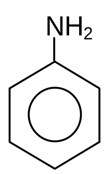
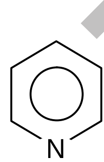
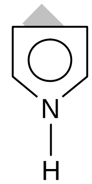
Q.28 Rank the following amines in increasing basic nature.

(a)    

(i) (ii) (iii) (iv)

(b)    

(i) (ii) (iii) (iv)

(c)   

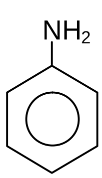
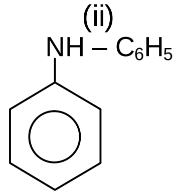
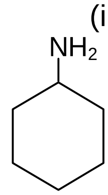
(i) (ii) (iii)

Q.29 Arrange the basic strength of the following compounds.

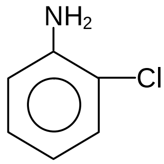
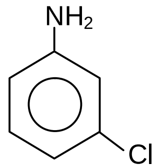
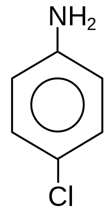
(a) OH^- (i) CH_3COO^- (ii) Cl^- (iii)

(b) $CH \equiv C^-$ (i) $CH_2 = CH^-$ (ii) $CH_3CH_2^-$ (iii)

(c) $CH_2 = CHCH_2NH_2$ (i) $CH_3CH_2CH_2NH_2$ (ii) $CH \equiv C - CH_2NH_2$ (iii)

(d)   

(i) (ii) (iii)

(e)   

(i) (ii) (iii)

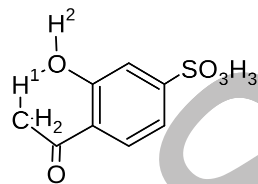
Q.30 Arrange the following compounds in order of increasing basicity.

(a) CH_3NH_2, $CH_3NH_3^{\oplus}$, CH_3NH^-

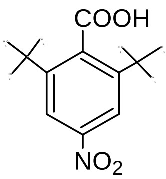
(b) CH_3O^-, CH_3NH^-, $CH_3CH_2^-$

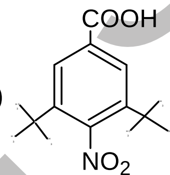
(c) $CH_3CH = CH^-$, $CH_3CH_2CH_2^-$, $CH_3C \equiv C^-$

Q.31 For the following compounds arrange the labeled proton in increasing order of their ease of deprotonation.

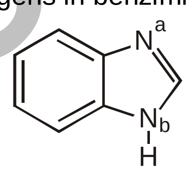


Q.32 Which is stronger acid, A or B and why?

(a) 

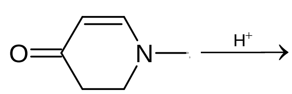
(b) 

Q.33 Discuss the basic strength of two nitrogens in benzimidazole.

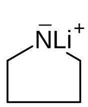
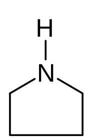
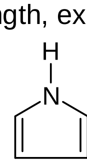


Benzimidazole

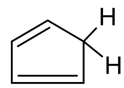
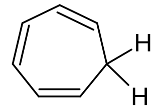
Q.34 In the following structure, which is better site of protonation and why-oxygen or nitrogen?



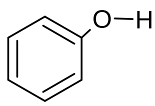
Q.35 Rank the following in increasing order of basic strength, explaining reason for your choice:

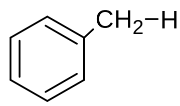
(i)  (ii)  (iii) 

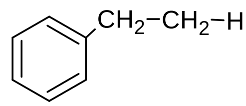
Q.36 One of the indicated proton H_a or H_b, is approximately 10^{30} times more acidic than other, which is more acidic and why?

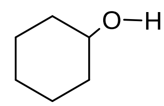



Q.37 Number the following compounds in order of increasing acidity of indicated proton giving mechanistic reasoning:

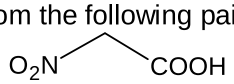
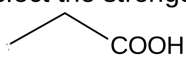

I

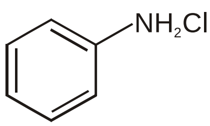
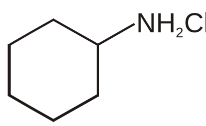

II

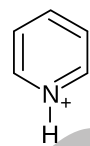
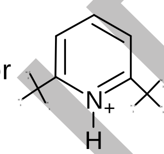

III


IV

Q.38 From the following pair. Select the stronger acid providing clear reasoning:

(a)  or 

(b)  or 

(c)  or 

TAUTOMERISM

Q.1 What statement is correct for Keto-enol tautomerism?

(A) Tautomerism is catalysed by acid and base.

(B) Tautomers are present in dynamic equilibrium state

(C) Generally keto form is more stable than enol form

(d) All

Q.2 Among the following the compounds having the highest enol content:

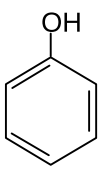
(A) CH_3CHO

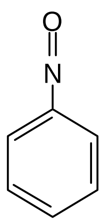
(B) CH_3COCH_3

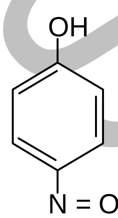
(C) $CH_3-\underset{\underset{O}{\|}}{C}-CH_2CHO$

(D) $CH_3 - CO - CH_2 - CO_2CH_3$

Q.3 Which compound show tautomerism:

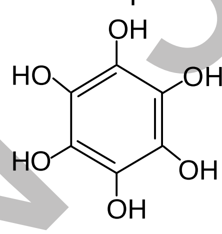
(A) 

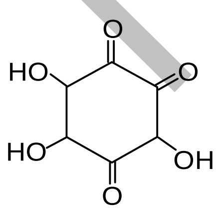
(B) 

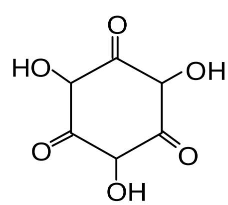
(C) 

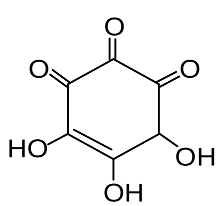
(D) None of these

Q.4 Tautomerism form of this compound is/are :



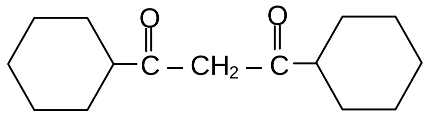
(A) 

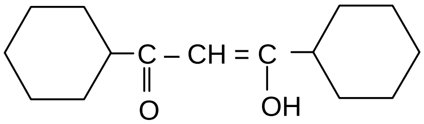
(B) 

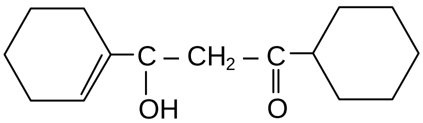
(C) 

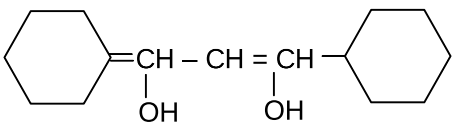
(D) All of these

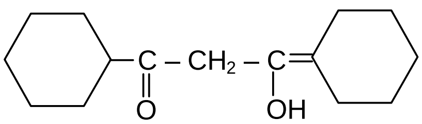
Q.5 Tautomer of following compound is:



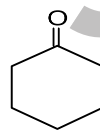
(A) 

(B) 

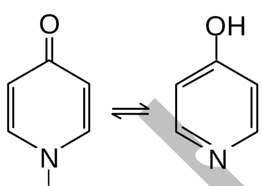
(C) 

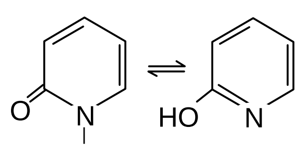
(D) 

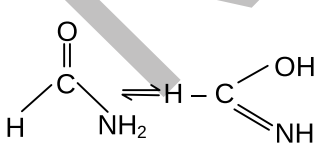
Q. 6 Tautomer in following is/are triad system:

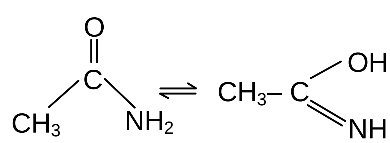
(A) CH_3COCH_3 (B) $CH_3CH_2NO_2$ (C)  (D) HCN

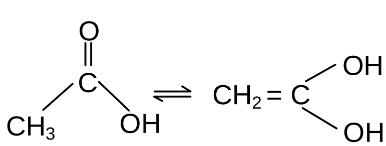
Q.7 In each of the following pairs which is more stable :

(A) 
(I) (II)

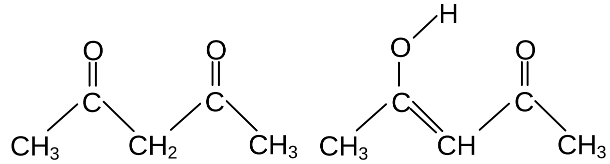
(B) 
(I) (II)

(C) 
(I) (II)

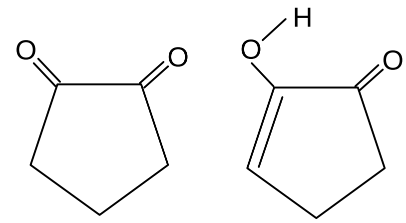
(D) 
(I) (II)

(E) 
(I) (II)

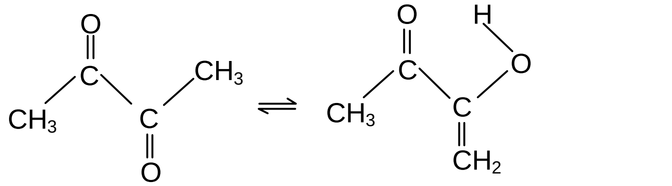
Q.8 In each of the following pairs which is more stable:

(A) 

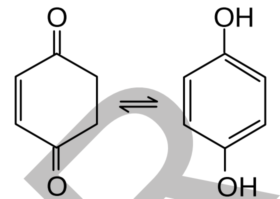
(I) (II)

(B) 

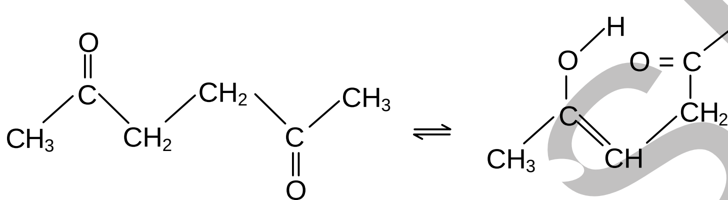
(I) (II)

(C) 

(I) (II)

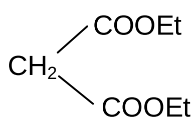
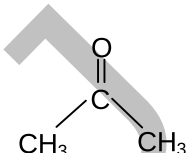
(D) 

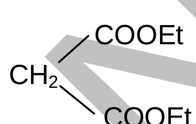
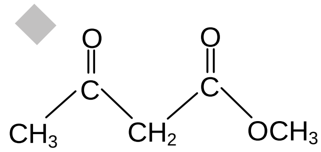
(I) (II)

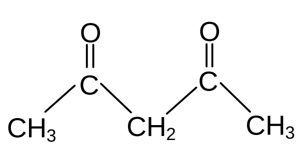
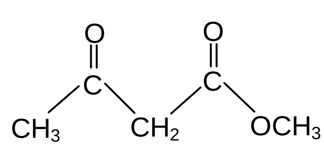
(E) 

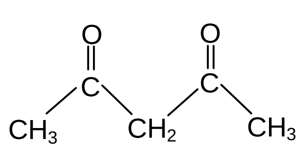
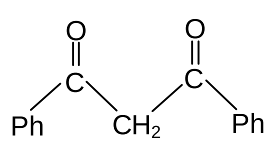
(I) (II)

Q.9 In each of the following pairs which will have higher enol content:

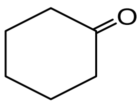
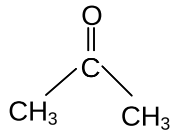
(A)  and 

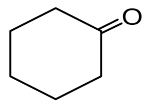
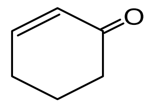
(B)  and 

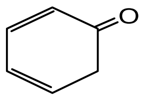
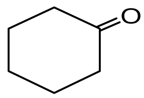
(C)  and 

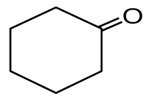
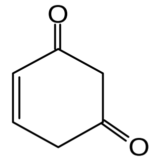
(D)  and 

Q.10 In each of the following pairs which will have less enol content:

(A)  and 

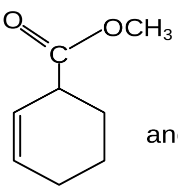
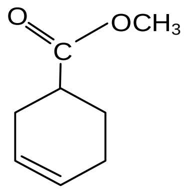
(B)  and 

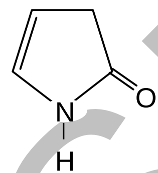
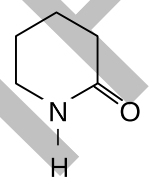
(C)  and 

(D)  and 

(E) $\underset{\underset{Cl}{|}}{CH_2}-CHO$ and CH_3-CHO

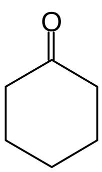
Q.11 In each of the following pairs which will have less enol content:

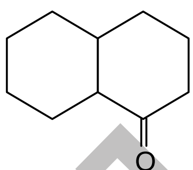
(A)  and 

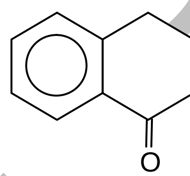
(B)  and 

Q.12 In each of the following stets of compounds write the decreasing order of % enol content.

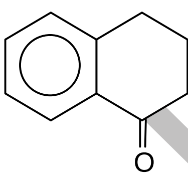
(A)

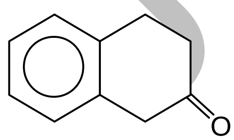

(I)

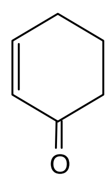

(II)

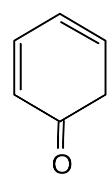

(III)

(B)

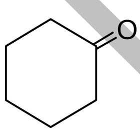

(I)

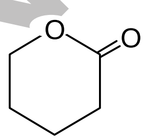

(II)

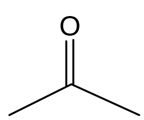

(III)

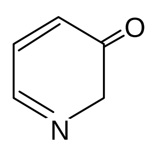

(IV)

(C)

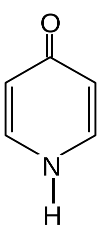

(I)

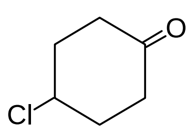

(II)

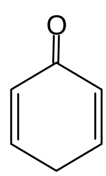

(III)

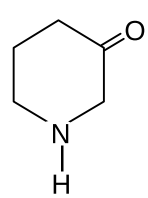

(IV)

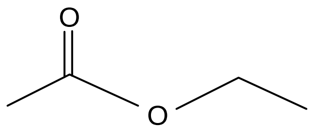
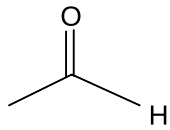
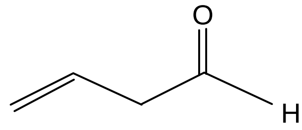
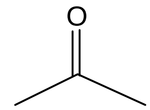
(D)

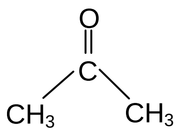
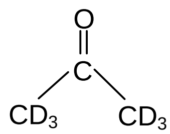
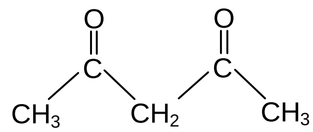

(I)


(II)


(III)


(IV)

(E)  (I)    (II)    (III)    (IV)

Q.13  (I)    (II)    (III)

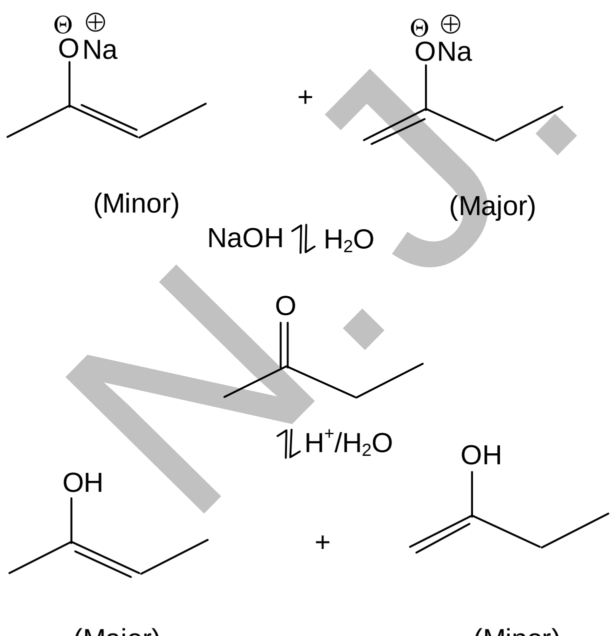
Among these give ease of enolization.

Q.14 %enol content of acetylacetone in following solvents is found as:

Solvent	% enol content
H_2O	15
Liquid state	76
Hexane	92
Gas phase	92

Explain the observation.

Q.15



Explain the observation.

ELECTRON DISPLACEMENT EFFECT
Answer Key

1. (a) A (b) A, B (c) B (d) A, B = zero charge
2. (a)
3. (a) 4658, (b) 4638, (c) 4632, (d) 4656, (e) 5293
4. (a) (i), (b) (i), (c) (ii), (d) I, (e) ii
5. (a) ii < iv < i < iii, (b) iii < ii < i
6. (a) $CH_2 = CH \overset{\alpha}{—} \ddot{\underset{..}{C}}l\!:$, $CH_3 — CH_2 \overset{\beta}{—} \ddot{\underset{..}{C}}l\!:$

   B.L. ($\beta < \alpha$) since α has partial double bond caracter

   (b) $CH_2 \overset{\alpha}{=} CH_2$, $CH_2 \overset{\beta}{=} CH — \ddot{\underset{..}{O}} — CH_3$

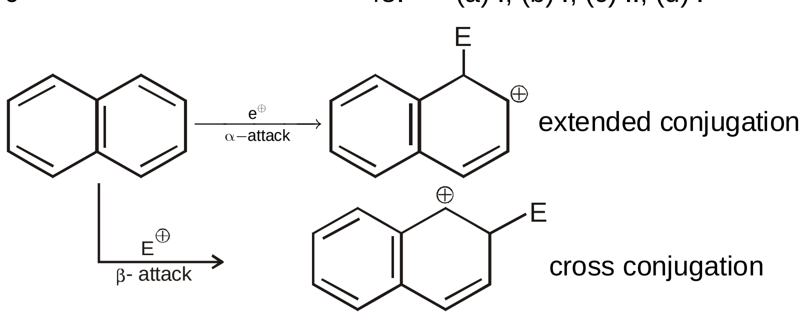
   B.L. ($\alpha < \beta$) since β has single bond character because of resonance

   (c) $CH_3 — S \overset{\alpha}{—} H$, $CH_3 — O \overset{\beta}{—} H$

   α — (1s — 3P) β (1S — 2P)

   (d) In $CH_2 = CH — \dot{N}H_2$

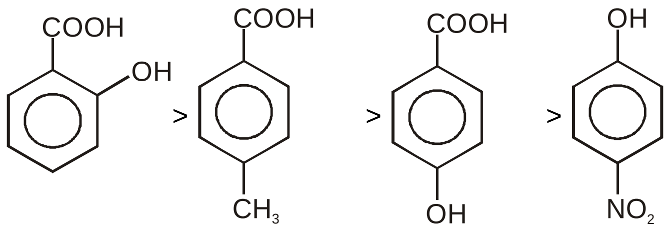
   Lone pair on nitrogen is part of conjugation

7. iii > ii > i
8. H_c
9. (a) I, (b) I, (c) II, (d) II
10. A
11. (a), (c),(d),(g),(j),(l),(m)
12. (a), (b)
13. (a),(b),(c),(f)
14. (b), (c) (f)
15. (d)
16. (a), (e), (f), (g)
17. (b), (d), (e)
18. (b), (d), (e)
19. (c), (f)
20. (a), (b), (c), (d), (f)
21. (b), (c), (f)
22. (f)
27. d
28. b
29. a
30. (a) II, (b) I, (c) I, (d) I, (e) I
31. (a) II, (b) I, (c) I, (d) II, (e) I
32. (a) II, (b) I, (c) II, (d) II, (e) II
33. (a) II, (b) II, (c) II, (d) II, (e) II
34. (a) I, (b) II, (c) II, (d) I, (e) I
35. b
36. (a) I, (b) I, (c) I, (d) I,
37. (a) I, (b) II, (c) II, (d) I
38. (a) I, (b) II, (c) II, (d) II, (e) I, (f) I
39. (a) I, (b) I, (c) II, (d) I, (e) I, (f) I
40. b
41. c
42. d
43. b
44. a
45. a
46. a
47. c
48. (a) I, (b) I, (c) II, (d) I
49. c
50. 

51. (6) 6 × H – atoms are there

52. (C)

Due to ortho effect o-hydroxy benzoic acid is strongest acid and correct order of decreasing K_a is



ACIDIY, BASICITY
ANSWER KEY

Q.1 (i) a > b > c > d, (ii) a > b > c, (iii) c > b > a, (iv) a > b > c
(v) c > b > a, (vi) a > b > c (vii) d > c > b > a (viii) d > c > b > a
(ix) d > b > a > c (x) d > a > c > b

Q.2 (i) a > b > c > d (ii) a > b > c > d (iii) c > b > d > a (iv) a < b < c < d
(v) a > b > c (vi) a < b < c (vii) c > a > b (viii) b > c > a
(ix) c > d > b > a

Q.3 (i) d > c > a > b (ii) a > b > c (iii) c > a > b > d (iv) d > b > c > a
(v) a > b > c (vi) b > a (vii) b > a (viii) c > b > a
(ix) c > a > b

Q.4 (i) b (ii) a (iii) b (iv) b

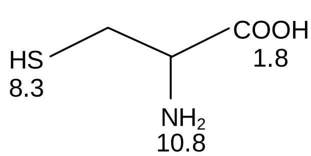
Q.5 (i) a > b > c (ii) d > c > b > a (iii) b > c > a (iv) d > c > b > a
(v) b > a > c (vi) c > a > b (vii) b > a (viii) c > b > a
(ix) c > b > a (x) a > b > c

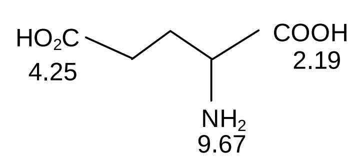
Q.6 (i) d (ii) b (iii) c (iv) a

Q.7 (i) b > a > d > c (ii) b > a > c > d (iii) a > b > c > d

Q.8 c **Q.9** b **Q.10** c **Q.11** b **Q.12** b **Q.13** c **Q.14** b **Q.15** a

Q.16 a

Q.17 (i) cysteine : 

(ii) glutamic acid : 

Q.18 (a) 3 < 2 < 1; (b) 1 < 2 < 3; (c) 3 < 2 < 1 (d) 2 < 1 < 3 **(**e) 2 < 3 < 1

Q.19 (a) 2 ; (b) 2 ; (c) 1 ; (d) 1; (e) 1 **Q.20** (a) 2 : (b) 2 ; (c) 2 **Q.21** A **Q.22** A **Q.23** A

Q.24 (a) i, (b) ii, (c) i, (d) ii, (e) I **Q.25** (a) i, (b) i, (c) ii **Q.26** (a) 2; (b) 1 (c) 1; (d) 1; (e) 1; (f) 3

Q.27 (a) 2 ; (b) 1; (c) 2; (d) 2 **Q.28** (a) 3 < 2 < 1 < 4 (b) 1 < 2 < 3 < 4; (c) 3 < 1 < 2

Q.29 (a) 1 > 2 > 3; (b) 1 < 2 < 3; (c) 3 < 1 < 2; (d) 2 < 1 < 3; (e) 1 < 2 < 3

Q.30 (a) 2 < 1 < 3; (b) 1 < 2 < 3; (c) 3 < 1 < 2

Q.31 1 < 2 < 3 **Q.32** a

Q.33 Basic strength Na > Nb **Q.34** oxygen due to Non conjugate l.p.of e

Q.35 III < II < I **Q.36** H_a

Q.37 III < II < IV < I **Q.38** (a) I, (b) I, (c) I

TAUTOMERISM

ANSWER KEY

Q.1 d **Q.2** c **Q.3** a, c **Q.4** a, b

Q.5 a **Q.6** a, b, c **Q.7** (a) 1; (b) 1; (c) 1; (d) 1; (e) 1

Q.8 (a) 2; (b) 2; (c) 1 ; (d) 2 ; (e) 1 **Q.9** (a) 1; (b) 2; (c) 1; (d) 2

Q.10 (a) 2; (b) 2; (c) 2; (d) 1; (e) 2

Q.11 (a) 2 (b) 2

Q.12 (a) 3 > 1 > 2; (b) 4 > 2 > 1 > 3; (c) 4 > 1 > 3 > 2 (d) 3 > 1 > 4 > 2 (e) 3 > 4 > 2 > 1

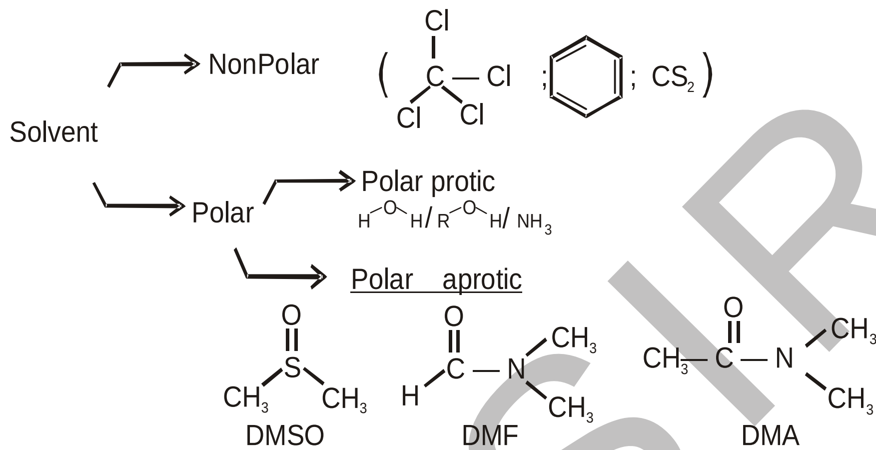
Q.13 3 > 1 > 2

HALOGEN DERIVATIVES

SUBSTITUTION & ELIMINATION

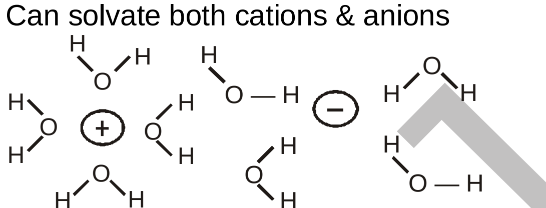
Solvents are most important for reactions since they provide medium for chemical reactions. Molecular collisions are possible only in gaseous phase or in solvent phase.

Solvent



Polar protic Solvent:–

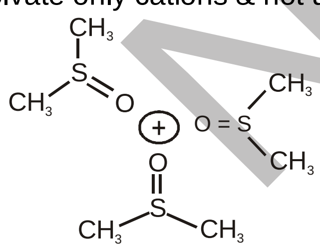
Can solvate both cations & anions



Solvation of cation   Solvation of anions

Polar aprotic solvent

Can solvate only cations & not anions



Nucleophiles:- They are e^- pair donors . Particles which donate e^- pair to generate covalent or coordinate bonds are nucleophiles.

Strength of Nucleophile

Rule-1 (—) charge

Conjugate bases are strong nucleophiles compared to acids:-

(a)	$CH_3 - \ddot{N}H^{\ominus}$	CH_3NH_2
(b)	$CH_3 - \ddot{O}:^{\ominus}$	CH_3OH
(c)	$CH_3 - C(=O) - O^-$	$CH_3 - C(=O) - OH$
(d)	$R - O^-$	$R - OH$
(e)	$H - S - H$	$H - S^{\ominus}$
(f)	$R - SH$	$R - \ddot{S}:^{\ominus}$
(g)	H_3O^+	H_2O

Ans. (a) 1>2 (b) 1>2 (c) 1>2
(d) 1>2 (e) 1<2 (f) 1<2
(g) 1<2

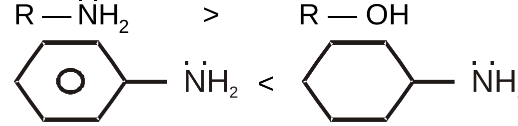
Rule 2:

For atoms of comparable size, better e^- donor is better nucleophile (lower electronegativity better e^- donor)

1. $CH_3 - \ddot{N}H_2$ > $CH_3 - O - H$

2. $R - \ddot{N}H_2$ > $R - OH$

3.



4. $R - O - H$ > $R - C(=O) - O - H$

5. $R-O^{-}$ > $R-\overset{\overset{\displaystyle O}{\|}}{C}-O^{-}$

Rule 3:-

If e^{-} donating atoms are of different size in polar protic solvent

Nucleophilicity α size of atom

(a) $R-OH < R-SH$

(b) $(C_6H_5)_3N < (C_6H_5)_3P$

(c) $F^{\ominus} < Cl^{\ominus} < Br^{\ominus} < I^{\ominus}$

If e^{-} donating atoms are of different size in polar aprotic solvent

Nucleophilicity α basicity

Leaving group (L):- Particles which are substituted by stronger nucleophiles or depart from a molecule to generate carbocation are leaving groups.

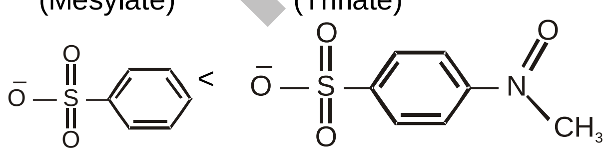
→ Leaving group ability $\propto \dfrac{1}{\text{Base strength}}$

→ Weak bases are good leaving groups.

$$R-L \longrightarrow R^{\oplus} + \ddot{L}^{\ominus}$$

1. $I^{\ominus} > Br^{-} > Cl^{-} >> F^{-}$
2. $H-O-H > OH^{-}$
3. $R-O-H > R-O^{-}$
4. $R-\overset{\overset{\displaystyle O}{\|}}{C}-O^{-} > R-O^{-}$
5. $\overset{\ominus}{O}-\underset{\underset{\displaystyle O}{\|}}{\overset{\overset{\displaystyle O}{\|}}{S}}-CH_3 < \bar{O}-\underset{\underset{\displaystyle O}{\|}}{\overset{\overset{\displaystyle O}{\|}}{S}}-CF_3$

Methylsulphonate (Mesylate)   Trifluoro methylsulphonate (Triflate)

6. 

Nucleophilic substitution (SN – Reactions)

$$R-L \xrightarrow{\ddot{N}u^{\ominus}} R-Nu + \ddot{L}^{\ominus}$$

4 Components

(1) R → Substrate

(2) L ⟶ Leaving group

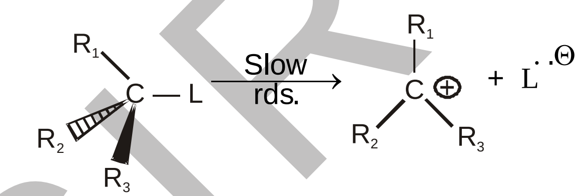
(3) Solvent   (4) Nucleophile.

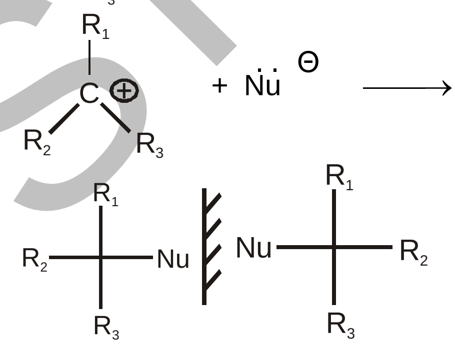
Types of nucleophilic substitution.

1. SN^1 2. SN^2 3. SN^{AR}
4. SN^{NGP} 5. SN^{i} 6. $SN^{1'}$
7. Benzyne.

SN^1 — Nucleophilic substitution first order:-

1. $R-L \longrightarrow R^{\oplus} + \ddot{L}^{\ominus}$
2. $R^{\oplus} + \ddot{N}u^{\ominus} \longrightarrow R-Nu$

1. 

2. 

Characteristics

(1) rate = k $[R-L]^1$; rate is independent on concentration of nuclophile.

(2) rate is directly proportional to stability of carbocation

(3) Rearrangement possible

(4) Planar carbocation can be attacked from both sides

(5) Supported by polar protic solvent.

(6) 2 step reaction

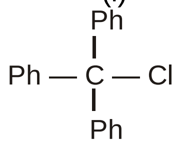
(7) Normally 3° – carbocation & resonance stabilized carbocation support this reaction mechanism if attacking Nuclophile is neutral polar protic solvent.

(8) Solvolysis (SN^1)

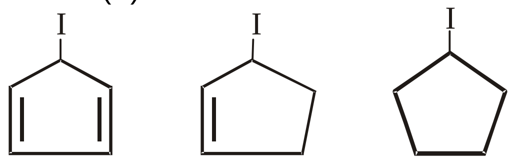
$$Ph-CH_2-Cl \xrightarrow{H-O-H} Ph-CH_2-OH + HCl$$

Q.1 Compare the rate of SN^1 reaction:-

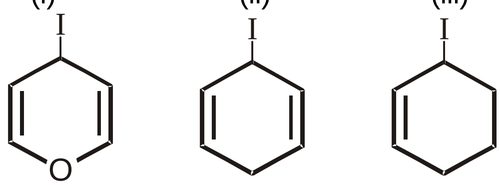
(a) (i) $Ph-CH_2-Cl$ (ii) $Ph-\underset{\displaystyle Ph}{\underset{|}{CH}}-Cl$


(iii)

(b)

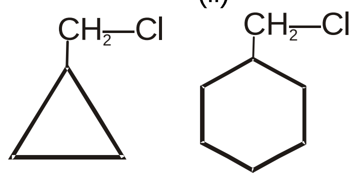

(i) (ii) (iii)

(c)


(i) (ii) (iii)

(d) CH_3-O-CH_2-Cl
(i)
$CH_3-O-CH_2-CH_2-Cl$
(ii)

(e)



(f) $CH_3-O-CH=CH-CH_2-Cl$ & $CH_3-O-CH_2-CH=CH-CH_2-Cl$

(g) (i) $Ph-\underset{\displaystyle CH_3}{\underset{|}{CH}}-Cl \xrightarrow[H_2O]{100\%}$

(ii) $Ph-\underset{\displaystyle CH_3}{\underset{|}{CH}}-Cl \xrightarrow[20\%EtOH]{80\%H_2O}$

Ans: (a) (iii) > (ii) > (i) (b) (ii) > (iii) > (i)
(c) (i) > (ii) > (iii) (d) (i) > (ii)
(e) (i) > (ii) (f) (i) > (ii) (g) (i) > (ii)

Q.2 SN^1 reactions are also known as solvolysis as solvent molecules behave as $\ddot{N}u^{\ominus}$. Write the product in each case.

(1) $Ph-CH_2-Br \xrightarrow{H_2O}$

(2) $Ph-CH_2-Br \xrightarrow{CH_3OH}$

(3) $Ph-CH_2-Br \xrightarrow{EtOH}$

(4) $Ph-CH_2-Br \xrightarrow{H-\overset{\displaystyle O}{\overset{||}{C}}-OH}$

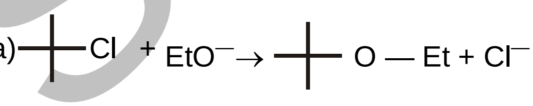
(5) $Ph-CH_2-Br \xrightarrow{PhOH}$

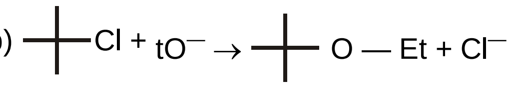
Ans: (1) $Ph-CH_2-OH$
(2) $Ph-CH_2-OCH_3$
(3) $Ph-CH_2-OEt$
(4) $Ph-CH_2-O-\overset{\displaystyle O}{\overset{||}{C}}-H$
(5) $Ph-CH_2-OPh$

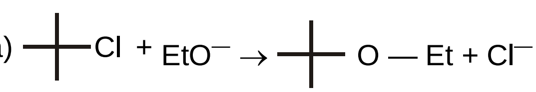
Q.3 Which SN^1 reaction is expected to occur rapidly.

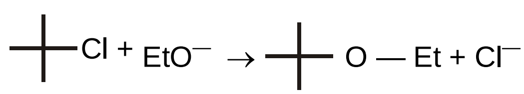
1. (a) $(CH_3)_3\,CCl + H-O-H \rightarrow (CH_3)_3\,C\,OH + HCl$

(b) $(CH_3)_3\,CBr + H-O-H \rightarrow (CH_3)_3\,C\,OH + HBr$

2. (a) 
1.0 M 1.0 M

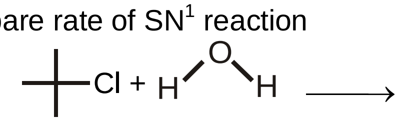
(b) 
2.0 M 1.0 M

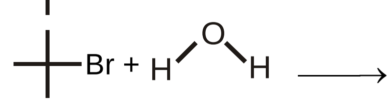
3. (a) 
1.0 M 1.0 M

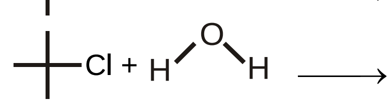
(b) 
1.0 M 1.0 M 1.0 M 2.0 M

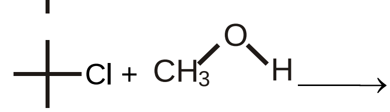
Ans. (1) b > a (2) a < b (3) a = b

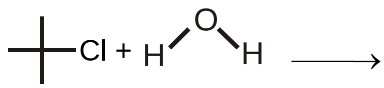
Q.4 Compare rate of SN^1 reaction

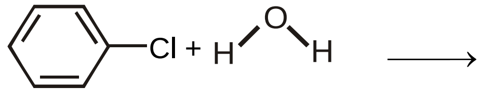
1. (a) 

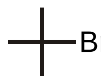
(b) 

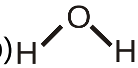
2. (a) 

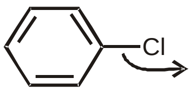
(b) 

3. (a) 

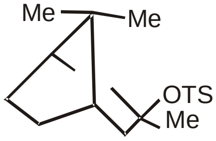
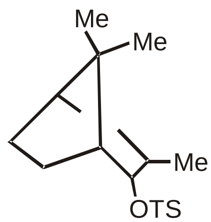
(b) 

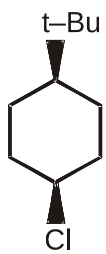
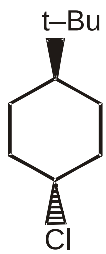
Ans. (1) (b)  (better leaving group)

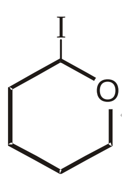
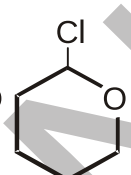
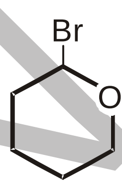
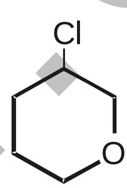
(2) (b)  better solvation

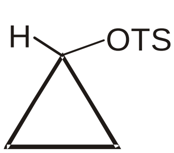
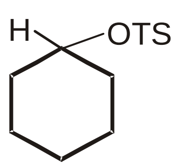
(3) (a)  (double bond character)

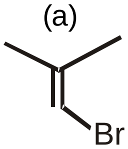
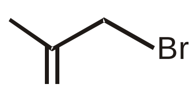
Q.5 Compare rate of SN^1

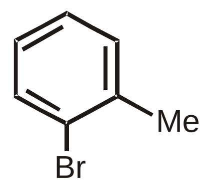
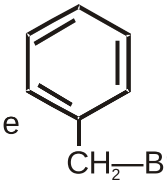
1. 
(a)

(b)

2. 
(a)

(b)

3. 
(a)

(b)

(c)

(d)

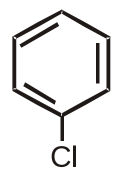
4. 
(a)

(b)

5. 
(a)

(b)

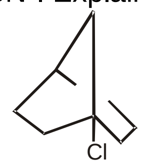
6. 
(a)

(b)

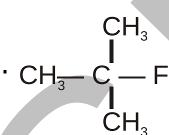
Ans. (1) a > b (2) b > a (3) a > c > b > d
(4) a < b (5) a < b (6) b > a

Q.6 These substrates cannot give SN^1. Explain

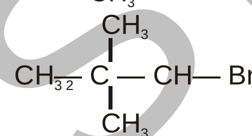
1. 

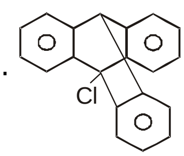
2. $CH_2 = CH — Cl$

3. 

4. 

5. $CH_3 — CH_2 — F$

6. 

7. 

($\overline{O}$, $\overline{F}$ & $CH_3 - \overline{O}$ cannot be substituted strong bars & weak leaving groups)

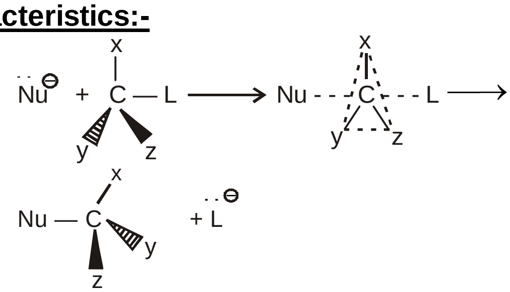
SN^2 reaction nucleophilic substitution

SN^2 — Reaction

Nucleophilic Substitution 2nd order

$$\ddot{Nu}^{\ominus} + R — L \longrightarrow Nu - - R - - L \longrightarrow Nu — R + \ddot{L}^{\ominus}$$

Characteristics:-

1. 

2. rate of reaction $\propto \dfrac{1}{\text{Bulkiness in } x, y \, \& \, z}$.

3. rate $\propto$ strength of $\ddot{Nu}^{\ominus}$

4. rate $\propto$ Leaving group ability of $\ddot{L}^{\ominus}$

5. Inversion of configuration takes place. '

Characteristics

Q.1 Compare rate of SN^2 reaction:–

1. $CH_3 — CH_2 — CH_2 — Br$ & $CH_3—CH(CH_3)—Br$

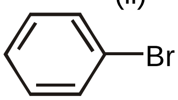
(i) (ii)

2. $CH_3 — CH_2 — CH_2 — CH_2 — Cl$ (i)

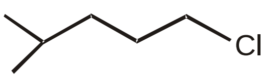
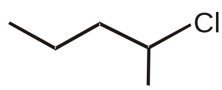
$CH_3 — CH_2 — CH_2 — CH_2 — I$ (ii)

3. $CH_3 — CH — CH_2 — Cl$ (i)

$CH_3 — CH_2(CH_3) — CH_2 — CH_2 — Cl$ (ii)

4.  

(i) (ii)

5.  

(i) (ii)

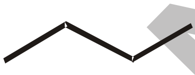
Ans. (1) 1 > 2 (2) 2 > 1 (3) 1 > 2
(4) 1 < 2 (5) 1 > 2

Q.2 Compare rate of SN^2 reaction:–

(A)(i)  Cl + $CH_3 — CH_2 — O^– \longrightarrow$

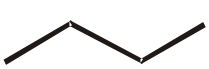
or

(ii)  Cl + $CH_3 — CH_2 — OH \longrightarrow$

(B)(i)  Cl + $CH_3 — CH_2 — O^– \rightarrow$

(ii)  Cl + $CH_3 — CH_2 — S^– \rightarrow$

(C)(i)  Br + $(C_6H_5)_3N \rightarrow$

(ii)  Br + $(C_6H_5)_3P \rightarrow$

(D) (i)  Br + $CH_3O^– \rightarrow$

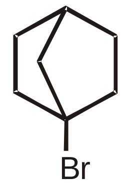
1.0 M 1.0 M

(ii)  Br + $CH_3O^– \rightarrow$

1.0 M 2.0 M

Ans. (A) i > ii (B) I < ii (C) ii > i (D) ii > i

Q.3 1– Bromobicyclo [2.2.1] heptane is extremely unreactive in either SN^1 or SN^2 reaction. Explain:



SN^1 X

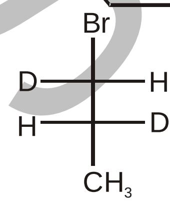
(Bridge Head position)

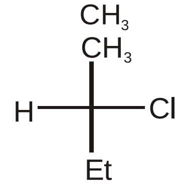
SN^2 X

(Walden unreason not possible)

Q.4 Write the products of SN^2 reaction:–

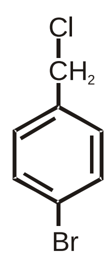
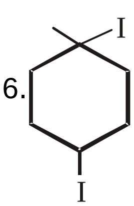
1.  $\xrightarrow{KSH}$

2.  $\xrightarrow{ACO^–}$

3.  $\xrightarrow{KSH}$

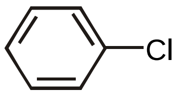
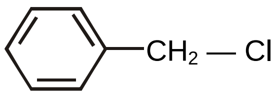
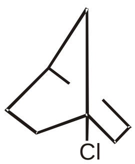
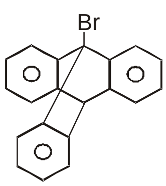
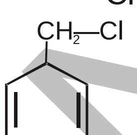
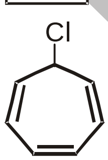
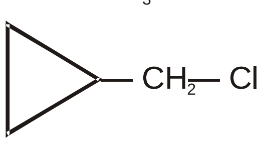
4. $Cl — CH_2 — C(CH_3)_2 — CH_2 — CH_2 — Cl \xrightarrow{KSH}$

$\downarrow$ NaCN (1 eq)

5.  $\xrightarrow{NaCN}$ 6.  $\xrightarrow{KSH(1eq)}$

7. $Br — CH_2 — CH = CH — Br \xrightarrow[(1eq)]{KSH}$

Q.5

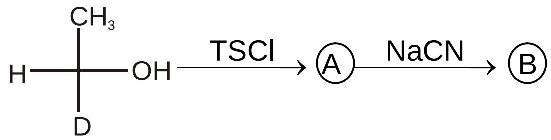
Reactant	SN^1	SN^2
(1) 		
(2) $CH_2=CH-Cl$		
(3) 		
(4) $CH_2=CH-CH_2-Cl$		
(5) 		
(6) CH_3-O-CH_2-Cl		
(7) $CH_3-\underset{CH_3}{\underset{\mid}{N}}-CH-Cl_2$		
(8) CH_3-F		
(9) $CH_3-\overset{CH_3}{\overset{\mid}{\underset{CH_3}{\underset{\mid}{C}}}}-Cl$		
(10) 		
(11) $CH_3-\underset{Cl}{\underset{\mid}{C}}-Et$		
(12) 		
(13) 		
(14) $CH_3-\overset{CH_3}{\overset{\mid}{\underset{CH_3}{\underset{\mid}{C}}}}-CH_2-Cl$		
(15) 		

Q.6 Explain

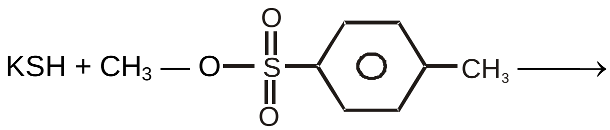
$\overline{O}H + CH_3 — O — CH_3 \longrightarrow$ No. Reaction

$CH_3 — O — CH_3 \xrightarrow{H^+} 2CH_3OH$

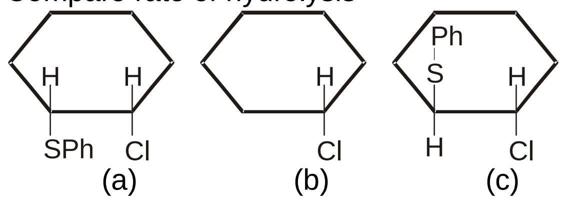
Q.7



Q.8



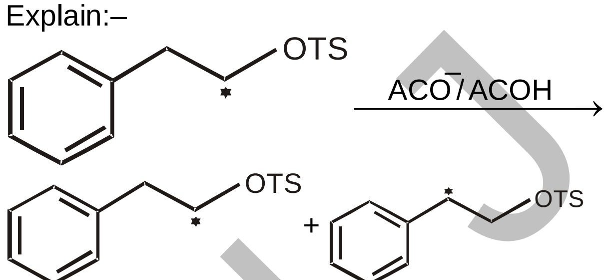
Q.9 Compare rate of hydrolysis



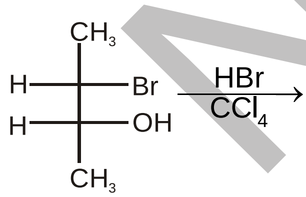
Q.10 Explain mustard gas hydrolysis at a very high rate:–

$Cl — CH_2 — CH_2 — S — CH_2 — CH_2 —Cl$

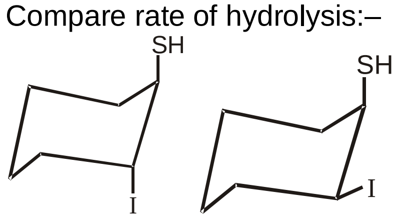
Q.11 Explain:–



Q.12



Q.13 Compare rate of hydrolysis:–



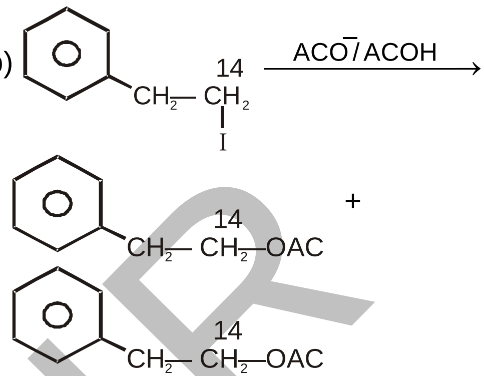
(a) (b)

Q.14 Explain:–

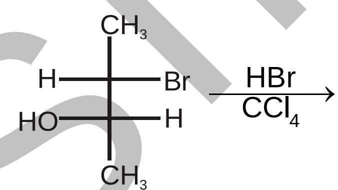
(a) $CH_3 — S — CH_2 — CD_2 — I \xrightarrow{H_2O}$

$CH_3 — S — CH_2 — CD_2 — OH$

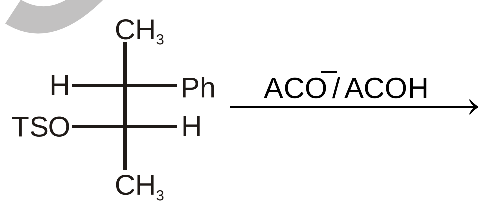
(b)



Q.15

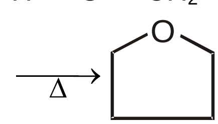


Q.16



Q.17

(1) $H — O — CH_2 — CH_2 — CH_2 — Br$

 + $Br^{\ominus}$ + H^+

(2) $H — O — CH_2 — CH_2 — Br \xrightarrow{\Delta}$

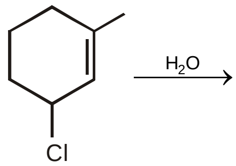
(3) $NH_2—CH_2 — CH_2 — CH_2 — CH_2 — Br$

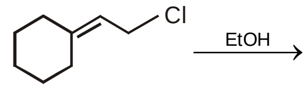
$\xrightarrow[\Delta]{\overline{O}H/H_2O}$

$SN^{1'}$

$CH_3—CH=CH—CH_2—Cl \xrightarrow{H_2O}$

$CH_3—CH=CH—CH_2—OH + CH_3—\underset{\substack{|\\ OH}}{CH}—CH=CH_2$

Q.18 

Q.19 

Q.20 R — X + Reagent $\longrightarrow$ Product

Reagent		$\ddot{Nu}^{\ominus}$	Product
1.	aq. KOH	$O\overline{H}$	
2.	aq. NaOH	$O\overline{H}$	
3.	Na_2CO_3 (aq.)	$O\overline{H}$	
4.	Moist Ag_2O	$O\overline{H}$	
5.	RO^-/R—OH	$R-O^-$	
6.	NH_3	$\ddot{N}H_3$	
7.	$R-NH_2$	$R-\ddot{N}H_2$	
8.	NaSH	$S\overline{H}$	
9.	dry Ag_2O	Ag–O–Ag	
10.	KCN	$\overset{\ominus}{C}N$	
11.	AgCN	Ag — CN:	

ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

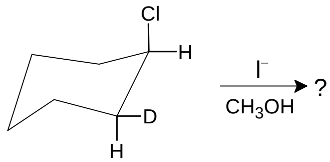
DPP NO-01 Time: 30 minutes

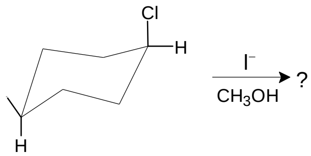
1. Which alkyl halide would you expect to react more rapidly by an S_N2 mechanism? Explain your answer
(A) $CH_3CH_2CH_2Br$ or $(CH_3)_2\ CHBr$
(B) $CH_3CH_2CH_2CH_2Cl$ or $CH_3CH_2CH_2CH_2I$
(C) $(CH_3)_2\ CHCH_2Cl$ or $CH_3CH_2CH_2CH_2Cl$
(D) $(CH_3)_2\ CHCH_2CH_2Cl$ or $CH_3CH_2CH(CH_3)CH_2Cl$
(E) C_6H_5Br or $CH_3CH_2CH_2CH_2CH_2Cl$

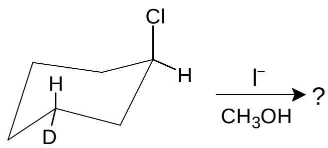
2. Which S_N2 reaction of each pair would you expect to take place more rapidly in a protic solvent?
(A) (1) $CH_3CH_2CH_2Cl + CH_3CH_2O^- \rightarrow CH_3CH_2CH_2OCH_2CH_3 + Cl^-$
OR
(2) $CH_3CH_2CH_2Cl + CH_3CH_2OH \rightarrow CH_3CH_2CH_2OCH_2CH_3 + HCl$
(B) (1) $CH_3CH_2CH_2Cl + CH_3CH_2O^- \rightarrow CH_3CH_2CH_2OCH_2CH_3 + Cl^-$
OR
(2) $CH_3CH_2CH_2Cl + CH_3CH_2S^- \rightarrow CH_3CH_2CH_2SCH_2CH_3 + Cl^-$
(C) (1) $CH_3CH_2CH_2Br + (C_6H_5)_3\ N \rightarrow CH_3CH_2CH_2N(C_6H_5)_3^+ + Br^-$
OR
(2) $CH_3CH_2CH_2Br + (C_6H_5)_3\ P \rightarrow CH_3CH_2CH_2P(C_6H_5)_3^+ + Br^-$
(D) (1) $CH_3CH_2CH_2Br(1.0M)_3 + CH_3O^-(1.0M) \rightarrow CH_3CH_2CH_2OCH_3 + Br^-$
OR
(2) $CH_3CH_2CH_2Br(1.0M) + CH_3O^-(2.0M) \rightarrow CH_3CH_2CH_2OCH_3 + Br^-$

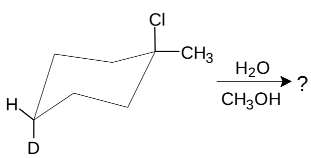
3. Which S_N1 reaction of each pair would you expect to take place more rapidly? Explain your answer.
(A) (1) $(CH_3)_3\ CCl + H_2O \rightarrow (CH_3)_3\ COH + HCl$
OR
(2) $(CH_3)_3\ CBr + H_2O \rightarrow (CH_3)_3\ COH + HBr$
(B) (1) $(CH_3)_3\ CCl + H_2O \rightarrow (CH_3)_3\ COH + HCl$
OR
(2) $(CH_3)_3\ CCl + CH_3OH \rightarrow (CH_3)_3\ COCH_3 + HCl$
(C) (1) $(CH_3)_3\ CCl + (1.0M) + CH_3CH_2O^-(1.0M) \xrightarrow{EtOH} (CH_3)_3\ COCH_2CH_3 + Cl^-$
OR
(2) $(CH_3)_3\ CCl + (2.0M) + CH_3CH_2O^-(1.0M) \xrightarrow{EtOH} (CH_3)_3\ COCH_2CH_3 + Cl^-$
(D) (1) $(CH_3)_3\ CCl + (1.0M) + CH_3CH_2O^-(1.0M) \xrightarrow{EtOH} (CH_3)_3\ COCH_2CH_3 + Cl^-$
(2) $(CH_3)_3\ CCl + (1.0M) + CH_3CH_2O^-(2.0M) \xrightarrow{EtOH} (CH_3)_3\ COCH_2CH_3 + Cl^-$
(E) (1) $(CH_3)_3\ CCl + H_2O \rightarrow (CH_3)_3\ COH + HCl$
(2) $C_6H_5Cl + H_2O \rightarrow C_6H_5OH + HCl$

4. Write conformational structures for the substitution products of the following deuteri compound:

(A) 

(B) 

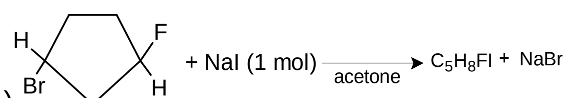
(C) 

(D) 

5. 1-Bromobicyclo [2.2.1] heptane is extremely unreactive in either S_N2 or S_N1 reaction explanations for this behaviour.

6. When ethyl bromide reacts with potassium cyanide in methanol, the major product is some CH_3CH_2NC is formed as well, however. Write Lewis structures for the cyanic both products, land provide a mechanistic explanation of the course of the reaction

7. Give structures for the products of each of the following reactions:

(A) 

(B) 1, 4–Dichlorohexane (1 mole) + NaI (1 mole) $\xrightarrow{\text{acetone}} C_6H_{10}ICl + NaCl$

(C) 1, 2–Dibromoethane (1 mole) + $NaSCH_2CH_2SNa \longrightarrow C_4H_8S_2 + 2NaBr$

(D) 4,Chloro-1-butanol + NaH

$$\xrightarrow[Et_2O]{(-H_2)} C_4H_8ClONa \xrightarrow[Et_2O]{\text{heat}} C_4H_8O + NaCl$$

(E) Propyne + $NaNH_2$

$$\xrightarrow[\text{liq.}NH_3]{(-NH_3)} C_3H_3Na \xrightarrow{CH_3I} C_4H_6 + NaI$$

8. When the alkyl bromides (listed here) were subjected to hydrolises in a mixture of ethanol and water (80% C_2H_5OH/20% H_2O) at 55°C, the rates of the reaction showed the following order: $(CH_3)_3CBr > CH_3Br > CH_3CH_2Br > (CH_3)_2CHBr$

Provide an explanation for this order of reactivity

9. What would be the effect of increasing solvent polarity on the rate of each of the following nucleophilic substitutions reactions?

(a) $Nu: + R - L \longrightarrow R - Nu^+ + :L^-$

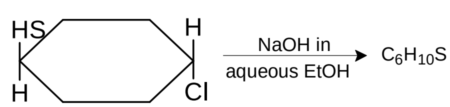
(b) $R - L^+ \longrightarrow R^+ + :L$

10. Competition experiments are those in which two reactants at the same concentration (or one reactant with two reactive sites) compete for a regent. Predict the major product resulting from each of the following competition experiments:

(a) $Cl-CH_2-C(CH_3)_2-CH_2-CH_3-Cl + I^- \longrightarrow$

(b) $Cl-C(CH_3)_2-CH_2-CH_2-Cl + H_2O \longrightarrow$

11. Predict the structure of the product of this reaction:



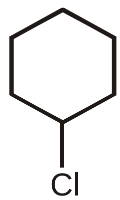
Comparison of SN^1, SN^2, E^1 & E^2

Reactant	**Neutral Nucleophiles or Bases**	**Weak Nucleophiles**	**Strong Bases /Nucleophiles**
	R–O–H, H–O–H, R–S–H, H–S–H $\ddot{N}H_3$	$I^{\ominus}$, $SH^{\ominus}$, $CN^{\ominus}$, $CH_3–\overset{O}{\overset{\parallel}{C}}–O^{-}$ $\ddot{N}^{\ominus}$, $N^{\oplus}$, $\ddot{N}:^{\ominus}$, $Br^{\ominus}$, $SCN^{\ominus}$, $R–S^{\ominus}$,	$R\bar{O}$ / $Et\bar{O}$ / $CH_3\bar{O}$ / $+\bar{O}$ / Et_3N_1
(X ≠ F) CH_3 —X	SN^2	SN^2	SN^2
Ph — CH_2 — X	SN^1(Solvolysis)	SN^2	SN^2
Ph— CH_2—CH_2—X	SN^2	SN^2	E^2 (formation of conjugated double. Bond)
R—CH_2—X	SN^2	SN^2	SN^2 {Exception in sterically hirdered base $+\bar{O}$ / $+$OH or Et_3N, E^2 is major product}
R—CH(Br)—R	SN^1(low Temp.) E^1 (high Temp.	SN^2	E^2
R—C(R)(R)—Br	SN^1 (low Temp.) E^1(high Temp.)	SN^1 (low Temp.) E^1 (high Temp.)	E^2

DPP-02 Time: 30 Minutes

Comparison of SN^1, SN^2, E^1 & E^2

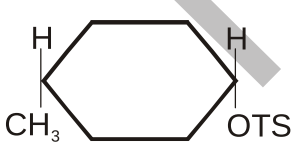
(1) $Ph - CH_2 - Br \xrightarrow[H_2O]{}$

(2)  $\xrightarrow{KSH}$; $\xrightarrow{KCN}$; $\xrightarrow{Et\bar{O}\overset{+}{Na}/EtOH}$

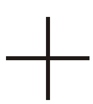
(3) $CH_3 - CH_2 - Br \xrightarrow{CH_3-\bar{O}/CH_3OH}$

(4)  $\xrightarrow{H_2O}$; $\xrightarrow{CH_3OH}$; $\xrightarrow{Et\bar{O}\overset{+}{Na}/EtOH}$; $\xrightarrow{+\bar{O}/+OH}$; $\xrightarrow[Et_3N]{}$

(5) R-2-chloropentane $\xrightarrow{NaI/Acetone}$; $\xrightarrow{NaN_3}$; $\xrightarrow[CH_3-C(=O)-\bar{O}]{}$; $\xrightarrow[Et\bar{O}/EtOH]{}$; $\xrightarrow{NaCN}$

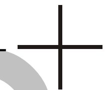
(6)  $\xrightarrow{Et\bar{O}\overset{+}{Na}/EtOH}$; $\xrightarrow{NaI/\overset{+}{A}cetone}$

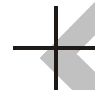
(7) $CH_2=CH-CH(Br)-CH_3$ $\xrightarrow{EtONa/EtOH}$; $\xrightarrow{NaI/Acetone}$

(8)  $O - H \xrightarrow{NaH}$

(A) $\xrightarrow{CH_3-CH_2-CH_2-Br}$ (B)

(9) $CH_3 - C(CH_3)_2 - CH(Br) - CH_3 \xrightarrow[\Delta]{EtOH}$

(10) (a) $CH_3 - O^- +$  $Br \longrightarrow$

(b)  $O^- + CH_3 - Br \longrightarrow$

(11) To prepare $CH_3-O-CH(CH_3)_2$, which of the following will give better yield:–

(1) $CH_3 - ONa + CH_3 - CH(CH_3) - CH_3 \longrightarrow$

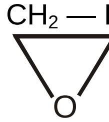
(2) $CH_3 - CH(CH_3) - ONa + CH_3 - I \longrightarrow$

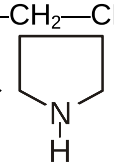
(12) Styrene ($C_6H_5 - CH = CH_2$) is to be prepared by dehydrohalogenation using alc.KOH. Which of the following will give better yield.

(1) $CH_3-CH(Ph)(Br) \xrightarrow{alc.KOH}$

(2) $\underset{Ph}{CH_2} - CH_2 - Br \xrightarrow{alc.KOH}$

(13) Write mechanism which accounts for the following products.

(a) $HO - CH_2 - CH_2 - Br \xrightarrow{\bar{O}H/H_2O}$ 

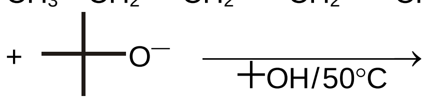
(b) $NH_2 - CH_2 - CH_2 - CH_2 - CH_2 - Br \xrightarrow{\bar{O}H/H_2O}$ 

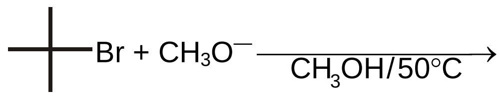
(14) Major Product of reactions (E^1, E^2, SN^1 & SN^2)

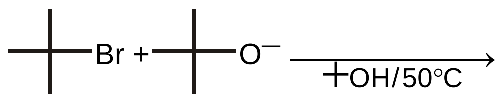
(a) $CH_3—CH_2—CH_2—CH_2—CH_2—Br$

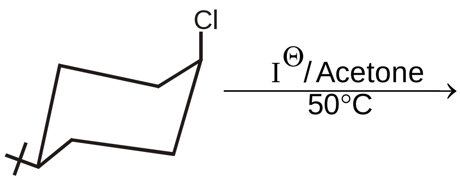
$+ CH_3—CH_2—O^- \xrightarrow[50°C]{CH_3CH_2OH}$

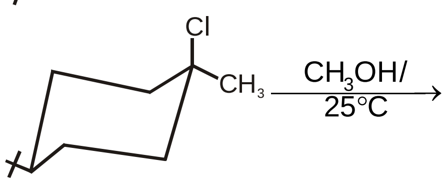
(b) $CH_3—CH_2—CH_2—CH_2—CH_2—Br$



(c) 

(d) 

(e) 

(f) 

(g) 3-Chloropentane + $CH_3O^- \xrightarrow[50°C]{CH_3OH}$

(h) 3-Chloropentane + $CH_3—\overset{O}{\overset{\|}{C}}—O^-$

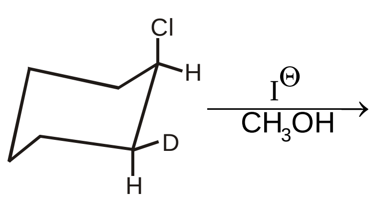
$\xrightarrow[50°C]{CH_3—\overset{O}{\overset{\|}{C}}—OH}$

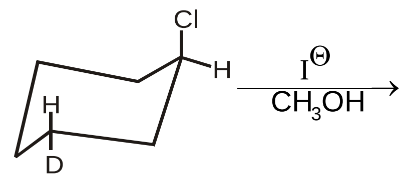
(i) $\overset{\Theta}{OH}$ + (R) -2-bromobutane $\xrightarrow{25°C}$

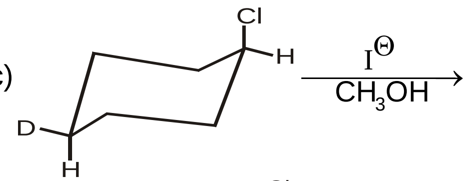
(j) (S)-3-bromo-3-methylhexane $\xrightarrow[CH_3OH]{25°C}$

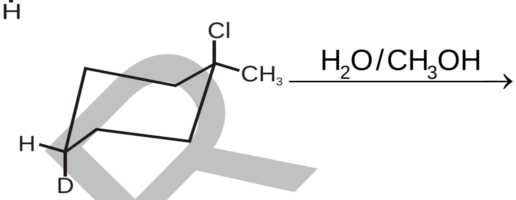
(k) (S)-2-bromooctane $\xrightarrow[CH_3OH/50°C]{I^{\Theta}}$

(15) Major product (E^1,E^2,SN^1 or SN^2)

(a) 

(b) 

(c) 

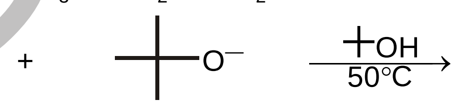
(d) 

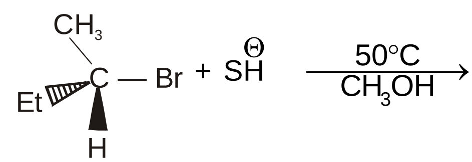
(16) Give major product (E^1, E^2, SN^1 or SN^2)

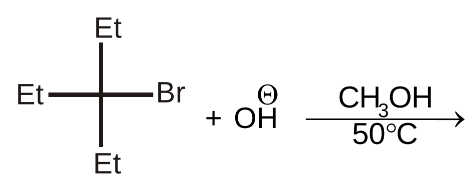
(a) $CH_3—CH_2—CH_2—Br$

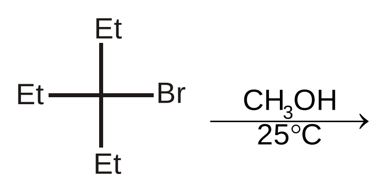
$+ CH_3—O^- \xrightarrow[50°C]{CH_3—OH}$

(b) $CH_3—CH_2—CH_2—Br$



(c) 

(d) 

(e) 

(16) Consider the reaction of $\overset{\Theta}{I}$ with $CH_3—CH_2—Cl$.

(a) Would you expect the reaction to be SN^1 or SN^2

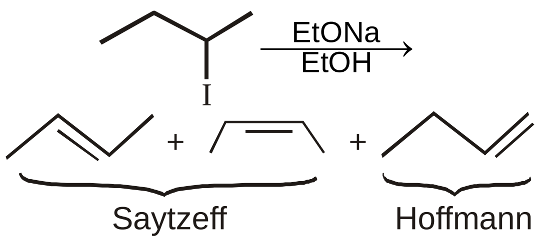
(b) The rate constant of the reaction at 60°C is 5×10^{-5} L mol^{-1} sec^{-1}. What is the reaction rate if [$\overset{\Theta}{I}$] = 0.1 mol/L and [$CH_3—CH_2—Cl$] = 0.1 mol/L.

DPP- 03 Time: 30 Minutes

E^{1CB} - *Mechanism*

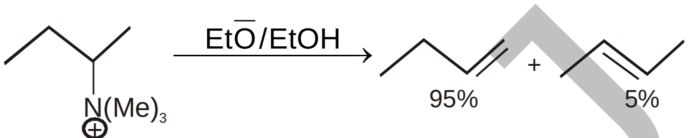
Hoffmann V/S Saytzeff alkene (elimination)

1.



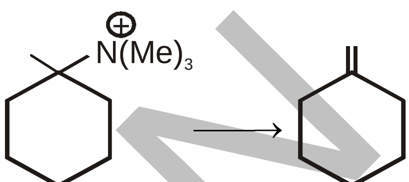
L.G.	% Hoffmann
$-\overset{\oplus}{N}(Me)_3$	90%
$-\overset{\oplus}{S}(Et)_2$	74%
– F	70%
— Br	19%

↑ L.G. Tendency

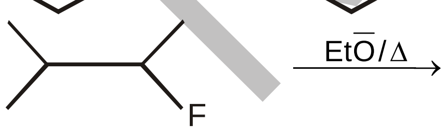


T.S. has more carbanion character.

Q.1

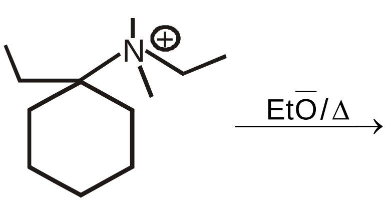


Q.2



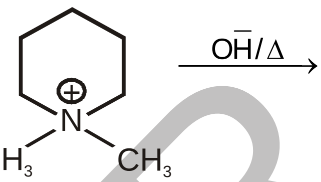
Q.3 $Me—CH_2—\underset{\overset{\oplus}{N}(Me)_3}{\overset{Me}{C}}—CH_2—Me \xrightarrow{Et\bar{O}/\Delta}$

Q.4

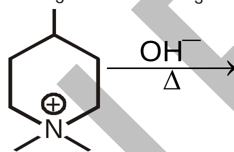


Q.5 $Ph—CH_2—\underset{F}{CH}—CH_3 \xrightarrow[\Delta]{OH^-}$

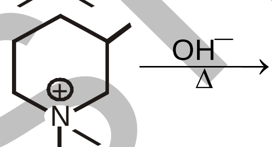
Q.6



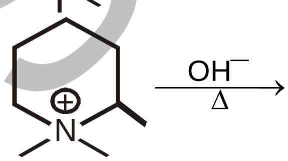
Q.7



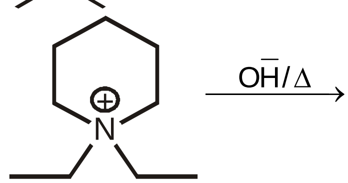
Q.8



Q.9



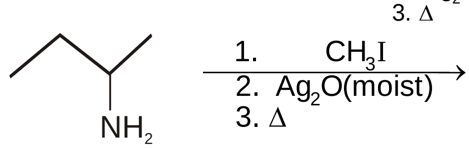
Q.10



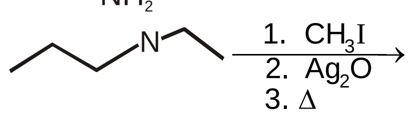
<u>Hoffmann exhaustive methylation</u>

Q.1 $CH_3—CH_2—CH_2—NH_2 \xrightarrow[\text{2. } Ag_2O\text{(moist)} \quad \text{3. } \Delta]{\text{1. } CH_3I}$

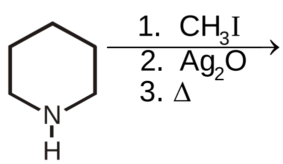
Q.2



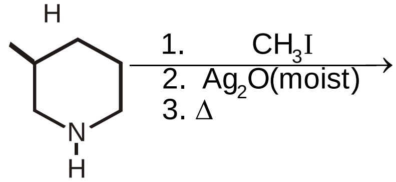
Q.3

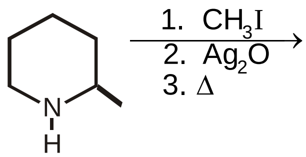


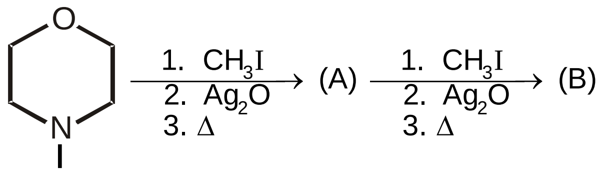
Q.4



Q.5



Q.6 

Q.7 

Q.8 $CHCl_2 — CF_3 \xrightarrow[\Delta]{\text{alc.KOH}}$

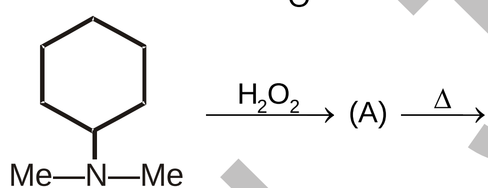
Q.9 $CH_3—\overset{\overset{\large O}{\|}}{C}—CH_2—CH_2—F \xrightarrow[\Delta]{OH^-}$

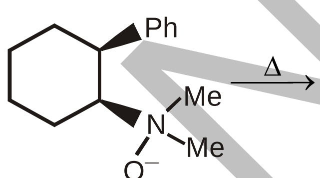
Q.10 $CH_3 — \underset{\underset{\large O}{\|}}{C} — CH_2 — CH_2 — F \xrightarrow{Et\bar{O}}$

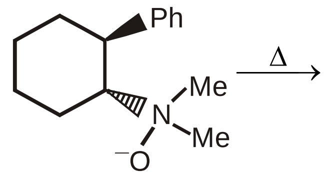
Q.11 $CH_3 — \underset{\underset{\large O}{\|}}{C} — CH_2 — CH_2 — F \xrightarrow[\Delta]{Et\bar{O}}$

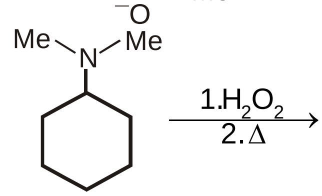
E[1]

Q.1 $Ph — CH_2 — CH_2 — \overset{\overset{\large CH_3}{|}}{\underset{\underset{\large O^-}{|}}{N}} — Me \xrightarrow{\Delta}$

Q.2 

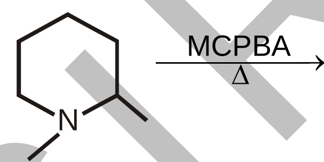
Q.3 

Q.4 

Q.5 

Q.6 $CH_3 — \underset{\underset{\large Ph}{|}}{N} — CH_2 — CH_2 — CH_3$

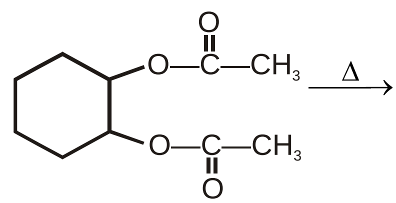
$\xrightarrow{\text{MCPBA}} (A) \xrightarrow{\Delta}$

Q.7 

Q.8 $Ph — \overset{\overset{\large O}{\|}}{C} — O — CH_2 — CH_3 \xrightarrow{\Delta}$

Q.9 $CH_3—CH_2—\overset{\overset{\large S}{\|}}{C}—S—CH_2—CH_3 \xrightarrow{\Delta}$

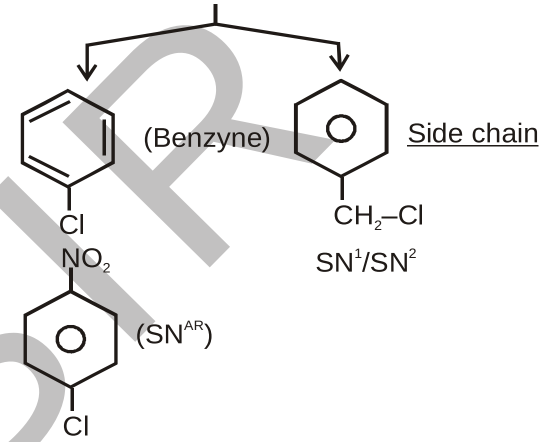
Q.10 $CH_3 — CH_2 — \overset{\overset{\large O}{\|}}{C} — O — CH_2 —CH_3 \xrightarrow{\Delta}$

Q.11 

HALOGEN DERIVATIVES

Classification

- Aliphatic
  - Unsaturated
    - $CH_2=CH-Cl$ (Vinyl)
    - $CH_2=CH-CH_2-Cl$ (Allyl)
  - Saturated
    - Monohalogen
      - $CH_3-CH_2-CH_2-Cl$ (1°)
      - $CH_3-CH(Cl)-CH_3$ (2°)
      - $CH_3-C(CH_3)(Cl)-CH_3$ (3°)
    - dihalogen
      - $CH_3-CH(Cl)_2$ (gem) (geminal)
      - $CH_3-CH(Cl)-CH(Cl)$ (Vic) (Vicinal)
      - $CH_2(Cl)-CH_2-CH_2(Cl)$ (Isolated)
    - Polyhalogen
      - $CHCl_3$ (Chloroform)
      - CCl_4 (Carbon tetrachloride pyrene)
- Aromatic



General Method of Preparation

(1) Form alkanes

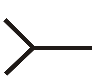
$$R-H \xrightarrow[h\nu]{X-X} R-X + H-X$$

$X_2 = Cl_2$ or Br_2

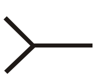
Cl_2 = Non – Selective ; Br_2 = Selective

$X_2 \neq F_2$ and $X_2 \neq I_2$

F_2 = uncontrollable ; I_2 = reversible

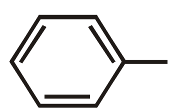
Q.1  $\xrightarrow[h\nu]{Cl_2}$ % = _ _ _ + % = _ _ _

$\{R_1^\circ : R_2^\circ : R_3^\circ = 1 : 3.8 : 4.5\}$

 $\xrightarrow[h\nu]{Br_2}$ – – – – – –

Q.2 $CH_3-CH(CH_3)-CH_2-CH_3 \xrightarrow[h\nu]{Br_2}$

$\xrightarrow[h\nu]{Cl_2}$ ---- % of 3° mono-chloroproduct

Q.3  $-CH_3 \xrightarrow{Cl_2/h\nu}$ Monochloro

$\xrightarrow{Br_2/h\nu}$ Monobromo

(2) From alkenes

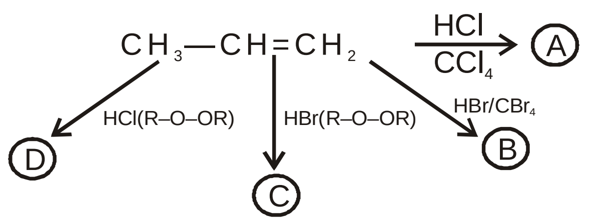
$$R-CH=CH_2 \xrightarrow[CCl_4]{HX} R-CH(X)-CH_3$$

: Markownikoff addition; Classical carbocation

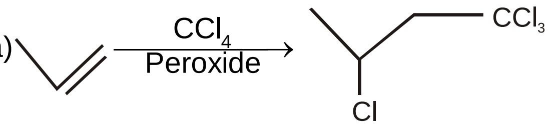
$$R-CH=CH_2 \xrightarrow[R-O-OR]{HBr} R-CH_2-CH_2-Br$$

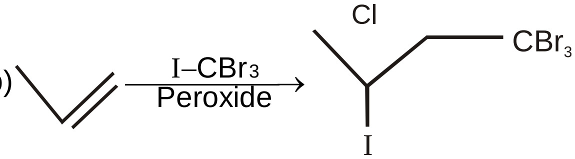
Anti – markownikoff addition peroxide effect or Kharash effect

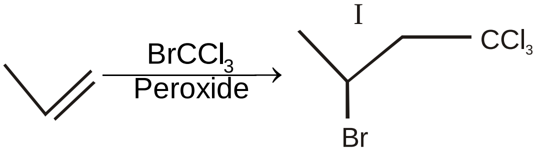
Q.1



Q.2 Write mechanism:–

(a) 

(b) 

(c) 

(3) Reed's Reaction

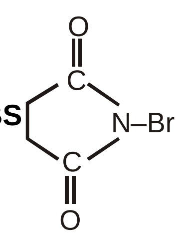
$R - H \xrightarrow[h\nu]{SO_2Cl_2} R-Cl + SO_2\uparrow + HCl\uparrow$

$\boxed{SO_2Cl_2 \longrightarrow \text{Sulphuryl Chloride}}$

Mechanism. (free radical substitution)

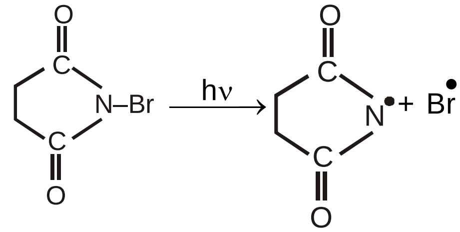
1. $Cl-SO_2-Cl \xrightarrow{h\nu} \dot{Cl} + Cl-\dot{S}O_2 \longrightarrow SO_2 + \dot{Cl}$

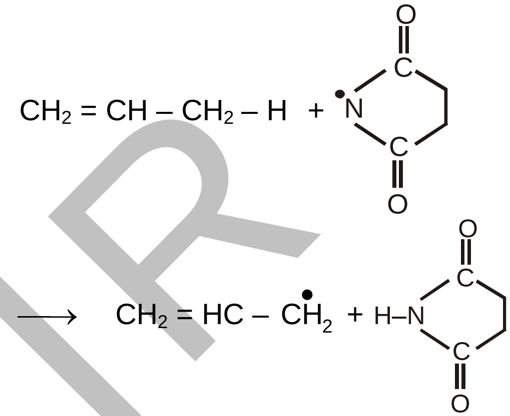
2. $R-H + \dot{Cl} \longrightarrow H-Cl + \dot{R} + \xrightarrow{\dot{Cl}} R-Cl.$
(Reaction rate is slow; selective and better method then direct halogenation)

(4) **NBS**  (N-Bromo Succinimide)

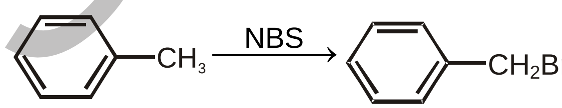
$CH_3 - CH = CH_2 \xrightarrow{NBS} \underset{|\atop Br}{CH_2} - CH = CH_2$

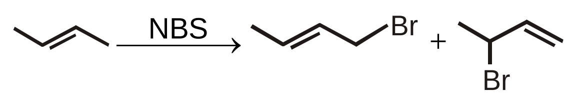
Mechanism:–

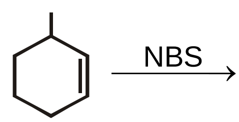
(1) 

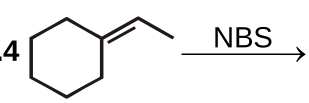
(2) 

(3) $CH_2 = CH - \dot{C}H_2 + \dot{Br} \longrightarrow$
$CH_2 = CH - CH_2 - Br$

Q.1 

Q.2 

Q.3 

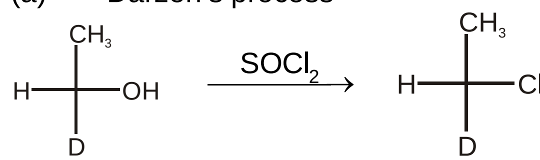
Q.4 

Imp. $\boxed{CH_3 - CH = CH_2 \xrightarrow[500^\circ C]{Cl_2} \underset{|\atop Cl}{CH_2} - CH = CH_2}$

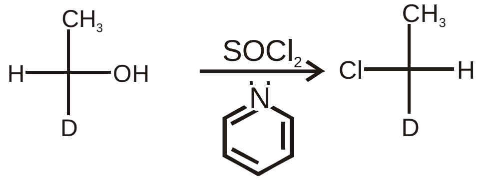
at high temperature free radical substitution and not Non-classical carbocation addition

(5) From alcohols

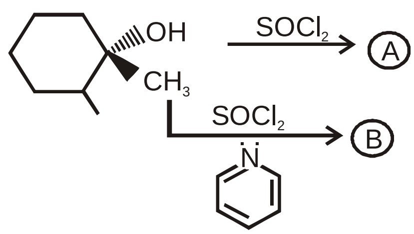
(a) Darzen's process

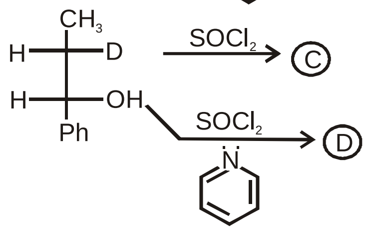


+ SO_2 + HCl (Retention of configuration)



$+ SO_2 + HCl$ (inversion of configuration)

Q.1 

Q.2 

(b) R—OH + Lucas Reagent ($HCl/ZnCl_2$)

$$R\text{—}OH \xrightarrow{HCl/ZnCl_2} R\text{—}Cl \text{ (Turbidity)}$$

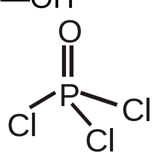
Test to distinguish 1° / 2° / 3° – alcohol.
3° – alcohol ⟶ within seconds
2° – alcohol ⟶ within minutes
1° – alcohol ⟶ within hrs

$$R\text{—}OH \xrightarrow{HI} R\text{—}I$$

$$R\text{—}OH \xrightarrow{KBr} \text{No. Reaction}$$

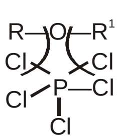
(c) $R\text{—}OH \xrightarrow{PCl_3} R\text{—}Cl + H_3PO_3$
(SN^2)

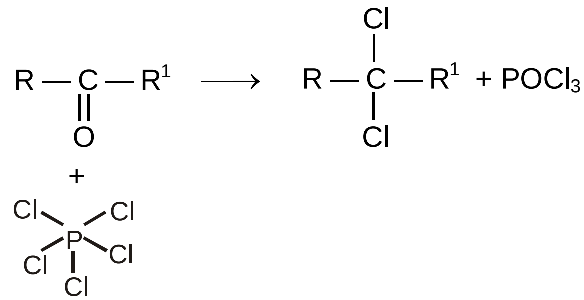
$R\text{—}OH \xrightarrow{PCl_5} R\text{—}Cl$

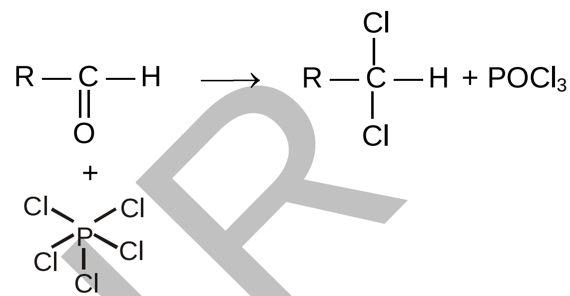
+  (SN^i (or SN^2))

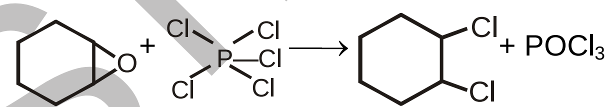
(high temperature SN^2 dominates)

PCl_5

(1)  $\longrightarrow$ R—Cl + R'—Cl + $POCl_3$

(2) 

(3) 

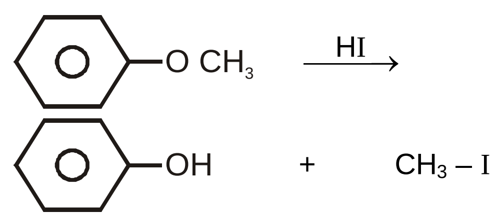
(4) 

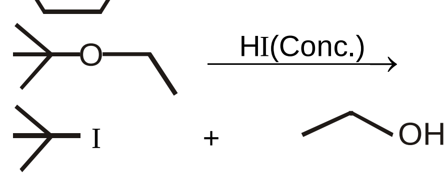
(6) From ethers

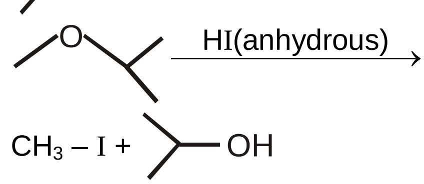
$$R\text{—}O\text{—}R' \xrightarrow[\text{(anhydrous)}]{HI} R\text{—}OH + R'\text{–}I(SN^2)$$

$$R\text{—}O\text{—}R' \xrightarrow{HI(Conc.)} R\text{—}OH + R'\text{–}I(SN^1)$$

$$R\text{—}O\text{—}R' \xrightarrow[\text{(excess)}]{HI} R\text{—}I + R'\text{–}I$$

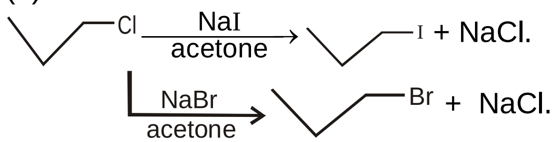
Q.1 

Q.2 

Q.3 

(7) Halide exchange Reaction

(a) Finkelstein Reaction



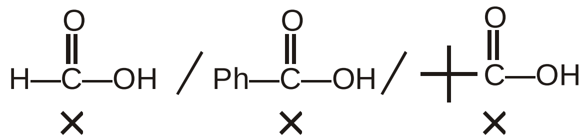
(b) Swartz Reaction

$$R\text{—}Cl \xrightarrow[\text{or AgF}]{NaF/DMF} R\text{—}F + NaCl.$$

(8) H.V.Z. Reaction (Hell Volhard Zelinesky)

$$CH_3\text{—}\overset{O}{\overset{\|}{C}}\text{—}OH \xrightarrow[Cl_2]{\text{Red P}} \underset{Cl}{\underset{|}{CH_2}}\text{—}\overset{O}{\overset{\|}{C}}\text{—}OH$$

Imp



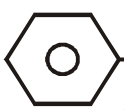
(a) Hunds diecker Reaction

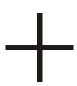
$$R\text{—}\overset{O}{\overset{\|}{C}}\text{—}OH \xrightarrow[2.\,Br_2/CCl_4/\Delta]{1.\,AgOH} R\text{ — }Br$$

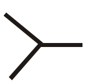
Properties of Halogen Derivatives

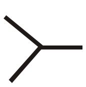
(1) Williamson ether synthesis

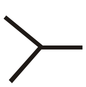
$R\text{—}ONa + R^1\text{ — }Cl \longrightarrow R\text{—}O\text{—}R^1 + NaCl \quad (SN^2)$

Q.1  ONa + CH_3 — Cl ⟶

Q.2  ONa + CH_3 — Cl ⟶

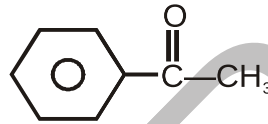
Q.3  ONa + CH_3 — Cl ⟶

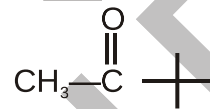
Q.4  ONa +  CH_2–Br ⟶

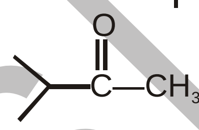
Q.5  ONa +  Br ⟶

(2) Haloform Reaction

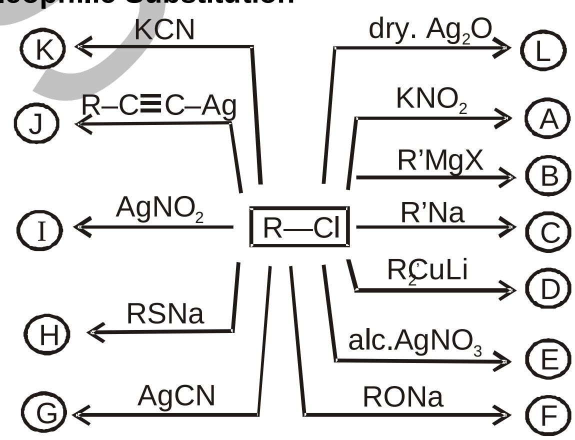
$$CH_3\text{—}\overset{O}{\overset{\|}{C}}\text{—}H \xrightarrow{I_2/NaOH} \underset{\text{(yellow)}}{CHI_3} + H\text{—}\overset{O}{\overset{\|}{C}}\text{—}O^-Na^+$$

Q.1  $\xrightarrow{NaOH/I_2}$

Q.2  $\xrightarrow{NaOH/I_2}$

Q.3  $\xrightarrow{NaOH/I_2}$

Nucleophilic Substitution

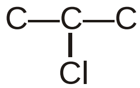
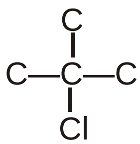
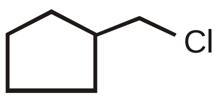
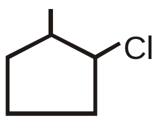
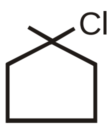
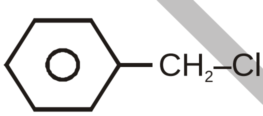


(4) Hoffmann exhaustive alkylation

$$CH_3\text{—}Cl \xrightarrow{NH_3} \left(CH_3\text{—}\overset{CH_3}{\underset{CH_3}{N^{\oplus}}}\text{—}CH_3\right)Cl^-$$

(5) With $AgNO_3$(aq) & $AgNO_3$(alc.)

Gives ppt. with

	Substrate	**aq. $AgNO_3$**	**alc. $AgNO_3$**
1.	C—C—C—Cl		
2.			
3.			
4.			
5.			
6.			
7.	C = C — Cl		
8.	C = C – CH_2 – Cl		
9.			
10.			

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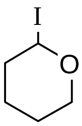
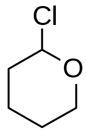
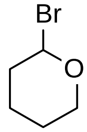
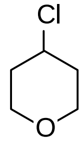
EXERCISE – I

Q.1 Which one of the following compounds will be most reactive for S_N1 reactions :

(A)  (B)  (C)  (D) 

Q.2 Consider the following groups :

(I) — OAc (II) — OMe

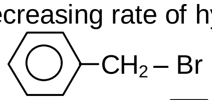
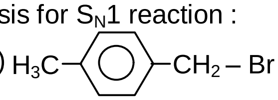
(III) — O — SO_2 – Me (IV) — O — SO_2 — CF_3

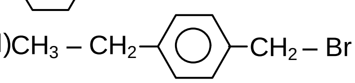
The order of leaving group nature is :

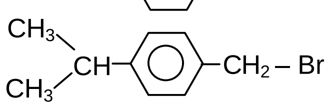
(A) I > II > III > IV (B) IV > III > I > II

(C) III > II > I > IV (D) II > III > IV > I

Q.3 Arrange the following compounds in order of decreasing rate of hydrolysis for S_N1 reaction :

(I)  (II) 

(II) 

(IV) 

(A) II > III > IV > I (B) IV > III > II > I

(C) III > IV > II > I (D) I > II > III > I

Q.4 Consider the given reaction :

$CH_3-CH=CH-CH_2-OH \xrightarrow[S_N1']{HBr} [P]$

In the given reaction the product [P] is :

(A) $CH_3-CH=CH-CH_2-Br$

(B) $CH_3-\overset{Br}{\overset{|}{C}H}-CH=CH_2$

(C) $CH_2=CH-CH=CH_2$

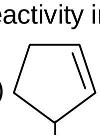
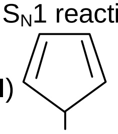
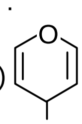
(D) $CH_3-\overset{Br}{\overset{|}{C}H}-CH_2-CH_2-OH$

Q.5 The given compound CH_3-O-CH_2-Br gives which one of the following reactions :

(A) Only S_N1 (B) Only S_N2

(C) S_N1 as well as S_N2 (D) E1

Q.6 Among the bromides I-III given below, the order of reactivity in S_N1 reaction is :

(I)  (II)  (III) 

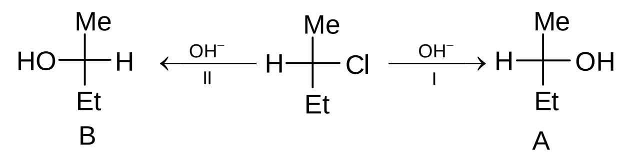
(A) III > I > II (B) III > II > I

(C) II > III > I (D) II > I > III

Q.7 Which of the following compounds is most rapidly hydrolysed by S_N1 mechanism.

(A) C_6H_5Cl (B) $Cl-CH_2-CH=CH_2$

(C) $(C_6H_5)_3CCl$ (D) $C_6H_5CH_2Cl$

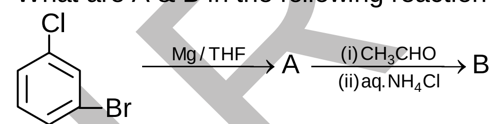
Q.8 

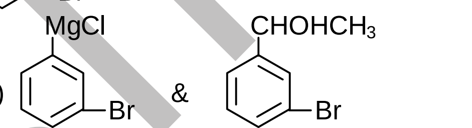
Steps I and II are

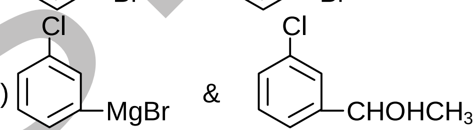
(A) I can't be S_N1 (B) II can't be S_N1

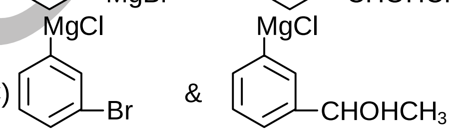
(C) I S_N1 & II S_N2 (D) I S_N2 & II S_N1

Q.9 What are A & B in the following reaction ?



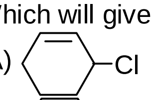
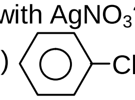
(A) 

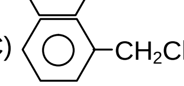
(B) 

(C) 

(D) None of these

Q.10 Which will give white ppt. with $AgNO_3$?

(A)  (B) 

(C)  (D) Both A & C

Q.11 When ethyl bromide is treated with moist Ag_2O, main product is :

(A) Ethyl ether (B) Ethanol

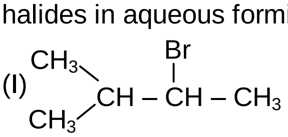
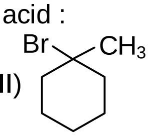
(C) Ethoxy ethane (D) All of the above

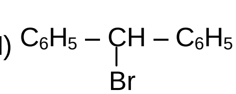
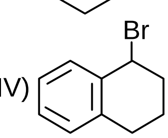
Q.12 When ethyl bromide is treated with dry Ag_2O,main product is :

(A) Ethyl ether (B) Ethanol

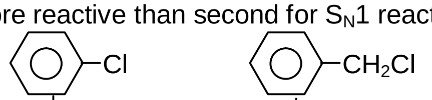
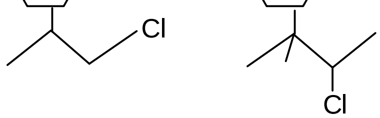
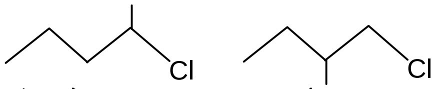
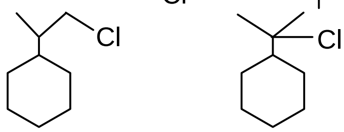
(C) Ethoxy ethane (D) All of the above

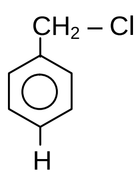
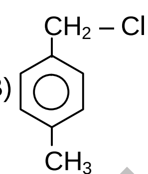
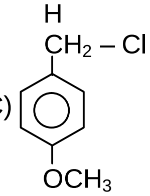
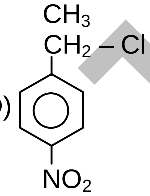
Q.13 Consider the S_N1 solvolysis of the following halides in aqueous formic acid :

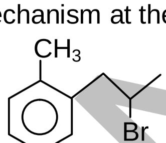
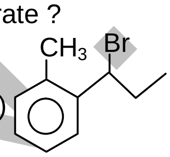
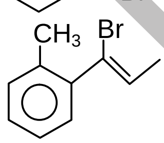
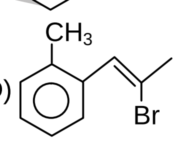
(I)  (II) 

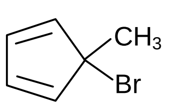
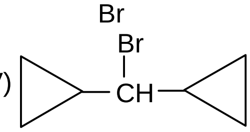
(III)  (IV) 

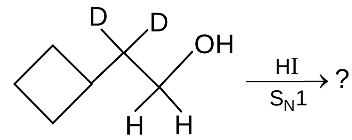
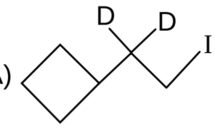
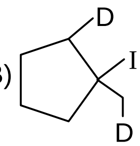
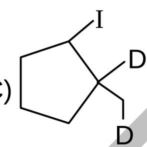
Which one of the following is correct sequence of the halides given above in the decreasing order of their reactivity?
(A) III > IV > II > I (B) II > IV > I > III
(C) I > II > III > IV (D) III > I > II > IV

Q.14 In the given pair in which pair the first compound is more reactive than second for S_N1 reaction
(A) 
(B) 
(C) 
(D) 

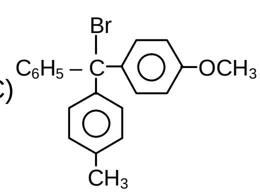
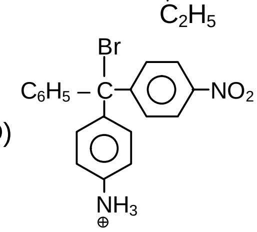
Q.15 Which of the following is most reactive toward S_N1.
(A)  (B) 
(C)  (D) 

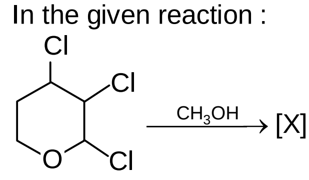
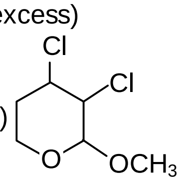
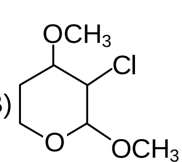
Q.16 Which compound undergoes hydrolysis by the S_N1 mechanism at the fastest rate ?
(A)  (B) 
(C)  (D) 

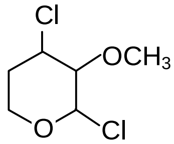
Q.17 Arrange the following compounds in decreasing order of their reactivity for hydrolysis reaction
(I) $C_6H_5-CH_2-Br$ (II) $C_6H_5-\underset{\displaystyle Br}{\underset{|}{C}H}-C_2H_5$
(III)  (IV) 
(A) I > II > III > IV (B) IV > II > I > III
(C) III > IV > II > I (D) IV > III > II > I

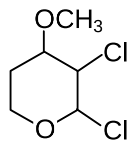
Q.18 
Major product is :
(A)  (B) 
(C)  (D) None of these

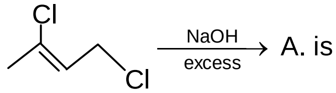
Q.19 Which one of the following compounds will give enantiomeric pair on treatment with HOH ?
(A) $C_6H_5-\overset{\displaystyle C_2H_5}{\overset{|}{\underset{\displaystyle C_2H_5}{\underset{|}{C}}}}-I$ (B) $CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle C_2H_5}{\underset{|}{C}}}}-Br$
(C) $C_6H_5-\overset{\displaystyle H}{\overset{|}{\underset{\displaystyle D}{\underset{|}{C}}}}-Br$ (D) $C_2H_5-\overset{\displaystyle C_2H_5}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-Br$

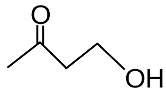
Q.20 For the given reaction
$$R-\overset{\displaystyle R_1}{\overset{|}{\underset{\displaystyle R_2}{\underset{|}{C}}}}-X \xrightarrow{HOH} R-\overset{\displaystyle R_1}{\overset{|}{\underset{\displaystyle R_2}{\underset{|}{C}}}}-OH$$
Which substrate will give maximum racemisation ?
(A) $C_6H_5-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle C_2H_5}{\underset{|}{C}}}}-Br$ (B) $CH_2=CH-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle C_2H_5}{\underset{|}{C}}}}-Br$
(C)  (D) 

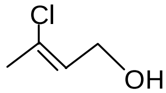
Q.21 In the given reaction :

(excess)
(A)  (B) 

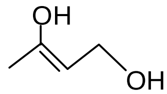
(C) 

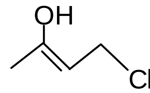
(D) 

Q.22 

(A) 

(B) 

(C) 

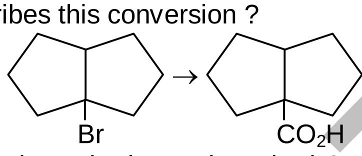
(D) 

Q.23 Compare the two methods shown for the preparation of carboxylic acids :

Method 1 : RBr $\xrightarrow[\text{diethyl ether}]{\text{Mg}}$ RMgBr $\xrightarrow[\text{(ii)}H_3O^+]{\text{(I)}CO_2}$ RCO_2H

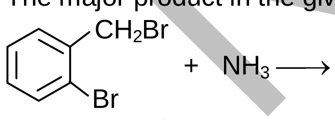
Method 2 : RBr $\xrightarrow{\text{NaCN}}$ RCN $\xrightarrow[\text{heat}]{H_2O,HCl}$ RCO_2H

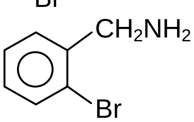
Which of the following statements correctly describes this conversion ?

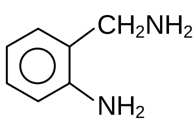


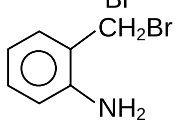
(A) Both method 1 and method 2 are appropriate for carrying out this conversion
(B) Neither method 1 nor method 2 is appropriate for carrying out this conversion.
(C) Method 1 will work well, but method 2 is not appropriate
(D) Method 2 will work well, but method 1 is not appropriate

Q.24 The major product in the given reaction



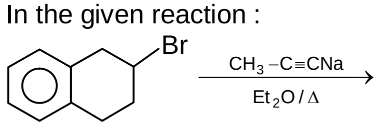
(A) 

(B) 

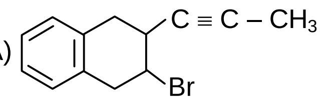
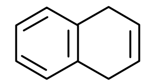
(C) 

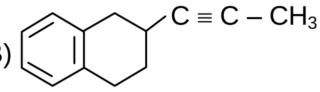
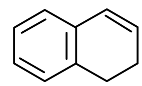
(D) All of these

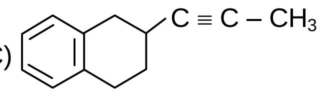
Q.25 In the given reaction :

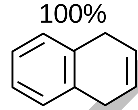


the products are :

(A)  and 
20% 80%

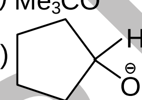
(B)  + 
20% 80%

(C) 
100%

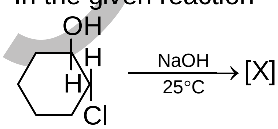
(D) 
100%

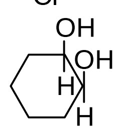
Q.26 Which of the following nucleophile will show minimum reactivity towards S_N2 reaction :

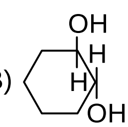
(A) $Me_3C\overset{\ominus}{O}$ (B) $Me\overset{\ominus}{O}$

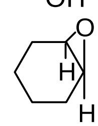
(C)  (D) $Me_2CH\overset{\ominus}{O}$

Q.27 In the given reaction

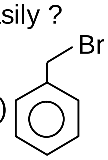
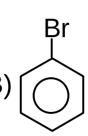
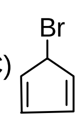
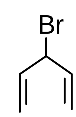


(A) 

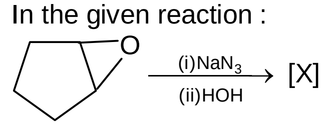
(B) 

(C) Mixture of (A) and (B) (D) 

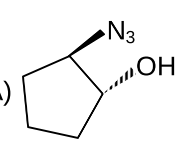
Q.28 Which of the following can not give S_N1 reaction easily ?

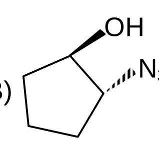
(A)  (B)  (C)  (D) 

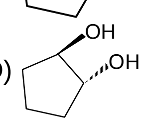
Q.29 In the given reaction :



[X] will be

(A) 

(B) 

(C) Mixture of (A) and (B) (D) 

Q.30 In the given reaction :

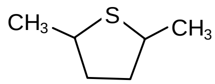
$CH_3-\underset{\displaystyle OTs}{\underset{|}{C}H}-CH_2-CH_2-\underset{\displaystyle OTs}{\underset{|}{C}H}-CH_3$

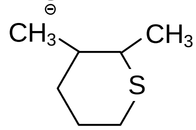
$$\xrightarrow[\text{(ii) KOH}]{\text{(i) } \overset{\ominus}{S}H \text{ (one equivalent)}} [x]$$

[X] will be :

(A) $CH_3-\overset{\displaystyle OTs}{\overset{|}{C}H}-CH_2-CH_2-\overset{\displaystyle \overset{\ominus}{S}}{\overset{|}{C}H}-CH_3$

(B) $CH_3-\underset{\displaystyle \underset{\ominus}{S}}{\underset{|}{C}H}-CH_2-CH_2-\underset{\displaystyle \underset{\ominus}{S}}{\underset{|}{C}H}-CH_3$

(C) 

(D) 

Q.31 For $CH_3Br + OH^- \longrightarrow CH_3OH + Br^-$

the rate of reaction is given by the expression :

(A) rate = k $[CH_3Br]$ (B) rate = k $[OH^-]$

(C) rate = k $[CH_3Br]$ $[OH^-]$

(D) rate = k$[CH_3Br]^\circ$ $[OH^-]^\circ$

Q.32 Non-occurrence of the following reaction

$Br^- + CH_3OH \longrightarrow BrCH_3 + OH^-$, is due to

(A) Attacking nucleophile is stronger one

(B) Leaving group is a strong base

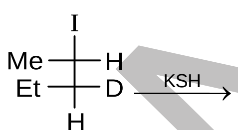
(C) Alcohols are not good substrate

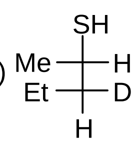
(D) Hydroxide ions are weak bases

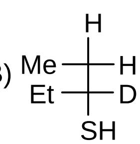
Q.33 The reactivity of 2-bromo-2-methylbutane (I), 1-bromopentane (II) and 2-bromopentane(III) towards S_N2 displacement is such that :

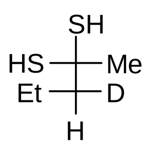
(A) I > II > III (B) I > III > II

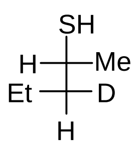
(C) II > III > I (D) II > I > III

Q.34 

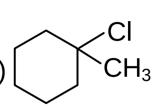
(A) 

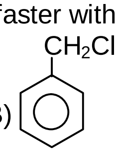
(B) 

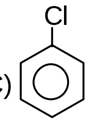
(C) 

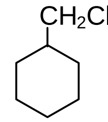
(D) 

Q.35 Which reaction proceeds faster with NaI is DMSO.

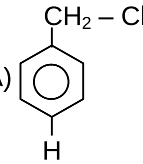
(A) 

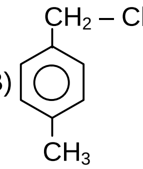
(B) 

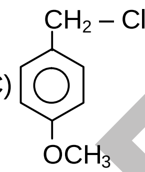
(C) 

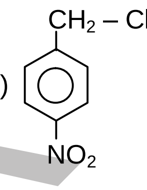
(D) 

Q.36 Which of the following is most reactive toward S_N2.

(A) 

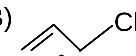
(B) 

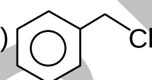
(C) 

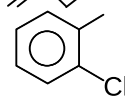
(D) 

Q.37 In which of the following, replacement of Cl^- is most difficult?

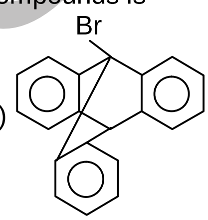
(A) 

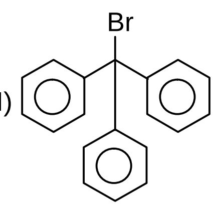
(B) 

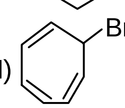
(C) 

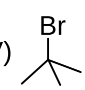
(D) 

Q.38 Correct order of rate of hydrolysis for following compounds is

(I) 

(II) 

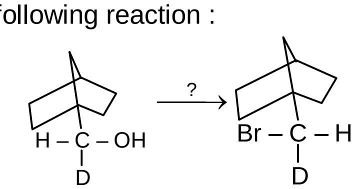
(III) 

(IV) 

(A) III > II > IV > I (B) I > II > III > IV

(C) III > I > II > IV (D) III > II > I > IV

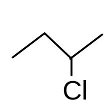
Q.39 Which reaction conditions (reagents) is suitable for the following reaction :



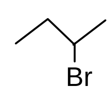
(A) Br_2 / CCl_4 (B) $SOBr_2$

(C) HBr / conc. H_2SO_4 (D) PBr_3

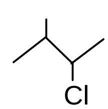
Q.40 Arrange these compounds in order of increasing S_N2 reaction rate :



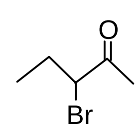
(I)



(II)



(III)



(IV)

(A) III < I < II < IV (B) III < II < I < IV

(C) IV < III < I < II (D) III < IV < I < II

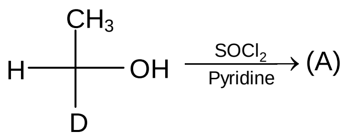
Q.41 The reaction of $SOCl_2$ on alkanols to form alkyl chlorides gives good yields because

(A) Alkyl chlorides are immiscible with $SOCl_2$

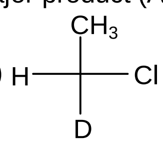
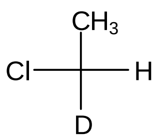
(B) The other products of the reaction are gaseous and escape out

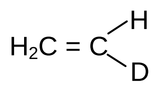
(C) Alcohol and $SOCl_2$ are soluble in water

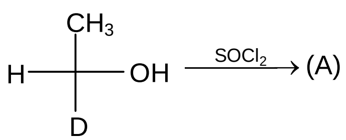
(D) The reaction does not occurs via intermediate formation of an alkyl chloro sulphite

Q.42 

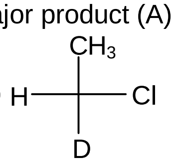
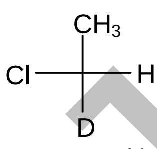
Major product (A) is :

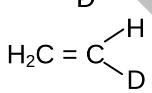
(A)  (B) 

(C) $H_2C = CH_2$ (D) 

Q.43 

Major product (A) is :

(A)  (B) 

(C) $H_2C = CH_2$ (D) 

Q.44 In the given reaction :

$CH_3 - CH_2 - \ddot{S} - \dot{C}H_2 - CH_2 - Br \xrightarrow{HOH} [X]$

[X] will be :

(A) $CH_3 - CH_2 - S - \overset{*}{C}H_2 - CH_2 - OH$

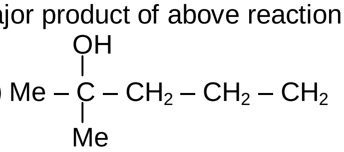
(B) $CH_3 - CH_2 - S - CH_2 - \overset{*}{C}H_2 - OH$

(C) 1 : 1 mixture of (A) and (B)

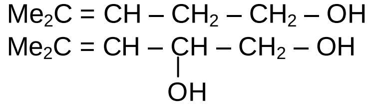
(D) 2 : 1 mixture of (A) and (B)

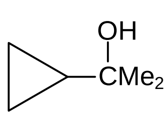
Q.45 $Me_2C = CH - CH_2 - CH_2 - Cl \xrightarrow{H_2O} (X)$

Major product of above reaction is

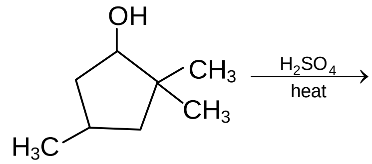
(A) 

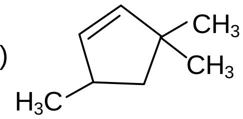
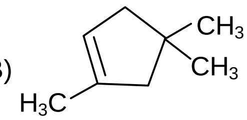
(B) $Me_2C = CH - CH_2 - CH_2 - OH$

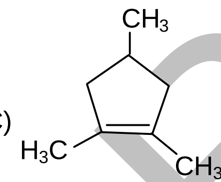
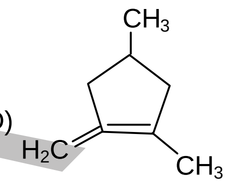
(C) 

(D) 

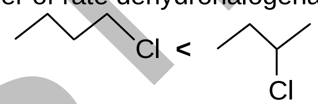
Q.46 The major product formed in the following reaction is :

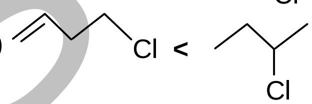


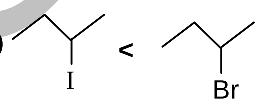
(A)  (B) 

(C)  (D) 

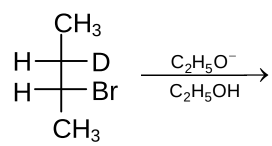
Q.47 In the given pairs, which pair represent correct order of rate dehydrohalogenation reaction

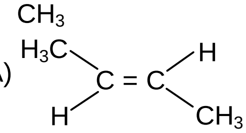
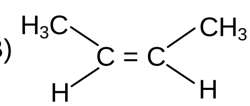
(A) 

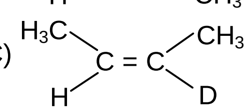
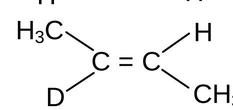
(B) 

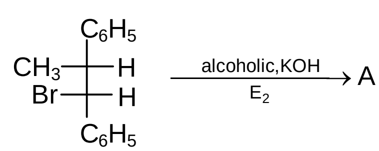
(C) 

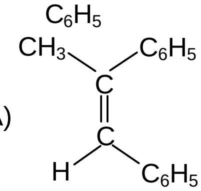
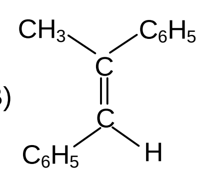
(D) $CH_3 - CH_2 - Cl < CD_3 - CD_2 - Cl$

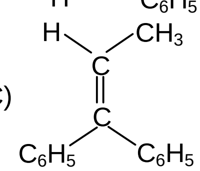
Q.48  Major product is :

(A)  (B) 

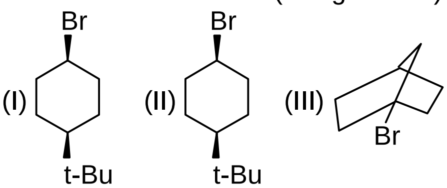
(C)  (D) 

Q.49 

(A)  (B) 

(C)  (D) None is correct

Q.50 The rate of elimination (using EtONa) of :.

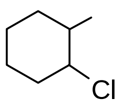


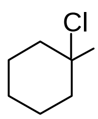
(A) I > II > III (B) I > III > II
(C) II > I > III (D) III > I > II

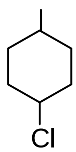
EXERCISE – II

Q.1 S_N1 & S_N2 is not favourable in
(A) $H_2C = CH – Cl$ (B) $Ph – CH_2 – Cl$
(C) $Ph – Cl$ (D) $H_2C = CH – CH_2 – Cl$

Q.2 S_N1 & S_N2 product are same in (excluding stereoisomer)

(A) 

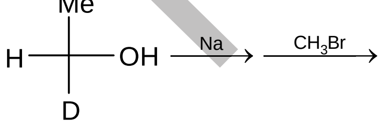
(B) 

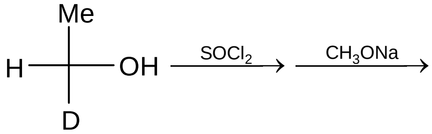
(C) 

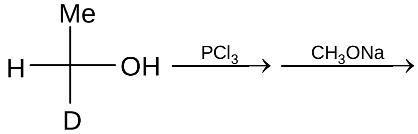
(D) $Ph – \underset{CH_3}{CH} – \underset{Cl}{CH} – CH_3$

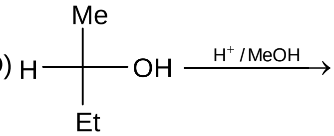
Q.3 Which of the following statements is/are **true** ?
(A) $CH_3 – CH_2 – CH_2 – I$ will react more readily than $(CH_3)_2CHI$ for S_N2 reactions.
(B) $CH_3 – CH_2 – CH_2 – Cl$ will react more readily than $CH_3 – CH_2 – CH_2 – Br$ for S_N2 reactions.
(C) $CH_3 – CH_2 – CH_2 – CH_2 – Br$ will react more readily than $(CH_3)_3C – CH_2 – Br$ for S_N2 reactions.
(D) $CH_3 – O – C_6H_4 – CH_2Br$ will react more readily than $NO_2 – C_6H_5 – CH_2Br$ for S_N2 reactions.

Q.4 In which of the following case configuration about chiral C* is retained :

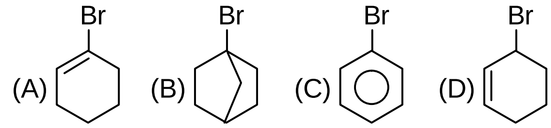
(A) 

(B) 

(C) 

(D) 

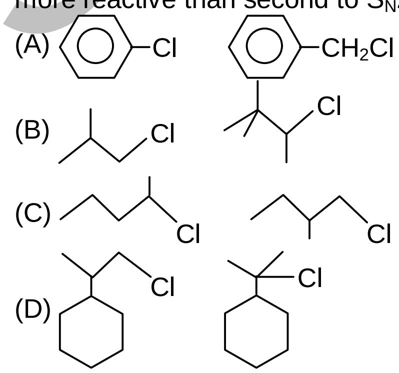
Q.5 S_N2 reaction will be negligible in



Q.6 Rate of S_N2 depends on
(A) Conc. of Nucleophile (B) Conc. of substrate
(C) Nature of leaving group (D) Nature of solvent

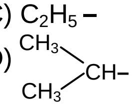
Q.7 Correct statement(s) for the product(s) of following reaction.
$CH_2 = CH – CH_2 – Ph \xrightarrow{Cl_2 / 500°C}$
(A) Four different products are formed
(B) Two optically active products are formed
(C) The optically active compound formed here can also be made by the reaction of HCl
(D) The reaction path is free radical substitution.

Q.8 In the given pair in which pair the first compound is more reactive than second to S_N2 reaction.



Q.9 A gem dichloride is formed in the reaction :
(A) CH_3CHO and PCl_5 (B) CH_3COCH_3 and PCl_5
(C) $CH_2 = CH_2$ and Cl_2 (D) $CH_2 = CHCl$ and HCl

Q.10 Match List – I with List – II for given S_N2 reaction & select the correct answer from the codes given below
$Z – CH_2Br + CH_3\overset{\ominus}{O} \longrightarrow Z – CH_2 – OCH_3 + Br^{\ominus}$

List – I	**List – II (relative reactivity)**
(A) H–	(P) 0.1
(B) CH_3 –	(Q) 3
(C) C_2H_5 –	(R) 1
(D) 	(S) 100

Q.11 In which product formation takes place according to Hoffmann's rule

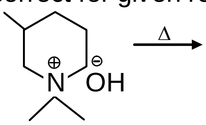
(A) $CH_3CH_2-\underset{\substack{|\\ Br}}{CH}-CH_3 \xrightarrow[\Delta]{t\text{–}Bu\,\overset{\ominus\oplus}{O\,K}}$

(B) $CH_3CH_2-\underset{\substack{|\\ Br}}{CH}-CH_3 \xrightarrow[\Delta]{CH_3CH_2\overset{\ominus\oplus}{OK}}$

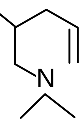
(C) $CH_3CH_2-\underset{\substack{|\\ CH_3}}{CH}-\overset{\oplus}{N}(CH_3)_3 \xrightarrow[\Delta]{\overset{\ominus}{O}H}$

(D) $CH_3CH_2\underset{\substack{|\\ \overset{\oplus}{S}(CH_3)_2}}{CH}-CH_3 \xrightarrow[\Delta]{\overset{\ominus}{O}H}$

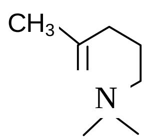
Q.12 Which of following are correct for given reaction



(A) Major product of reaction is



(B) Major product is



(C) The reaction is thermal elimination reaction (E^{1CB})

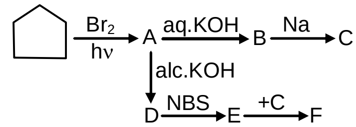
(D) The reaction is E_2 reaction

Q.13 Match the List I (reaction) with List II (reaction intermediate) and select the correct answer using the codes given below the Lists.

List I	List II
(A) $CF_3-CHCl_2 \xrightarrow{alc.KOH/\Delta} CF_2=CCl_2$	(1) Transition state
(B) $CH_3-\underset{\substack{|\\ CH_3}}{\overset{\substack{CH_3\\ |}}{C}}-OH \xrightarrow{H^{\oplus}} CH_3-\underset{\substack{|\\ CH_3}}{C}=CH_2$	(2) Carbocation
(C) $CH_3-CH_2-Br \xrightarrow[\Delta]{alc.KOH} CH_2=CH_2$	(3) Carbanion
(D) $CH_3-\underset{\substack{|\\ CH_3}}{\overset{\substack{Br\\ |}}{C}}-CH_3 \xrightarrow{alc.KOH/\Delta} CH_3-\underset{\substack{|\\ CH_3}}{C}=CH_2$	(4) Free radical

EXERCISE – III

Q.1 Identify A, B, C, D, E and F in the following series of reaction.



Q.2 What are the products of the following reactions?

(a) $CH_3-\underset{\substack{|\\ CH_3}}{\overset{\substack{CH_3\\ |}}{C}}-Cl+\bar{O}CH_3 \longrightarrow$

(b) $CH_3-\underset{\substack{|\\ CH_3}}{\overset{\substack{CH_3\\ |}}{C}}-O^-+CH_3-X \longrightarrow$

Q.3 Complete the following by providing the structure of (A),(B), (C) and (D).

(i) $CH_3CH_2CH_2OH \xrightarrow{PBr_3} (A) \xrightarrow{Alc.KOH} (B) \xrightarrow{HBr} (C) \xrightarrow{NH_3} (D)$

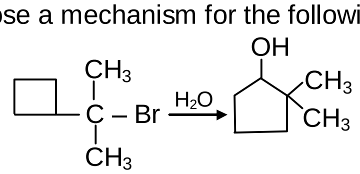
(ii) $CH_3CH_2CH_2I \xrightarrow{Alc.KOH} (A) \xrightarrow{H^+/H_2O} (B) \xrightarrow{SOCl_2} (C) \xrightarrow[LiAlH_4]{H} (D)$

(iii) $CH_3CH_2CH=CH_2 \xrightarrow[Light]{NBS} (A) \xrightarrow{Alc.KOH} (B) \xrightarrow{HBr} (C)$

(iv) $CH_3CH_2MgBr \xrightarrow{CH_3CHO/H_2O} (A) \xrightarrow{HBr} (B) \xrightarrow{Alc.KOH} (C)$

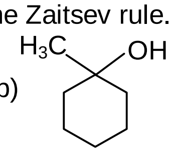
Q.4 CH_3-CH_2I reacts more rapidly with strong base in comparison to CD_3CH_2I. **Li** **List II**

Q.5 Propose a mechanism for the following reactions.

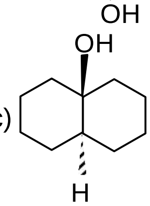


Q.6 Each of the following alcohols has been subjected to acid catalyzed dehydration and yields a mixture of two isomeric alkenes. Identify the two alkenes in each case, and predict which one is the major product on the basis of the Zaitsev rule.

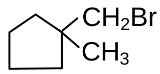
(a) $(CH_3)_2\underset{\substack{|\\ OH}}{C}CH(CH_3)_2$ (b)

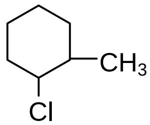


(c)



Q.7 Give the major product (with proper explanation) when following halogen compounds are treated with sodium ethoxide.

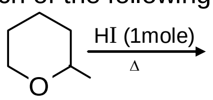
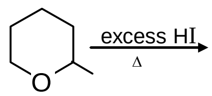
(a) $CH_3 - \underset{\underset{Br}{|}}{CH} - \underset{\underset{CH_3}{|}}{CH}CH_3$ (b) 

(c) 

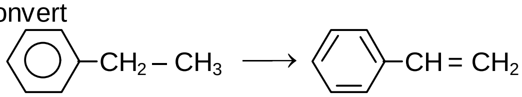
Q.8 2-chloro-3-methylbutane on treatment with alcoholic potash gives 2-methylbutene-2 as major product.

Q.9 KCN reacts with R – I to give alkyl cyanide, while AgCN results in isocyanide as major product.

Q.10 Predict the product(s) and write the mechanism of each of the following reactions.

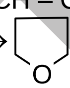
(i)  (ii) 

Q.11 Convert

(i) 

(ii) $CH_3CH_2CH = CH_2 \longrightarrow CH_3CH_2CH_2CH_2NH_2$

(iii) $CH_3CH_2CH = CH_2 \longrightarrow CH_2 = CH - CH = CH_2$

(iv) $OH - CH_2 - CH_2CH = CH_2 \longrightarrow$ 

Q.12 Treatment of 2-bromobutane with hot alcoholic KOH gives a mixture of three isomeric butenes (A), (B) and (C). Ozonolysis of the minor product (A), gives formaldehyde and another aldehyde in equimolar amounts. What are the structural formulae of (A),(B) and (C)?

Q.13 A hydrocarbon C_8H_{10} (A) on ozonolysis gives compound $C_4H_6O_2$ (B) only. The compound (B) can also be obtained from the alkyl bromide C_3H_5Br (C) upon treatment with magnesium in dry ether followed by CO_2 and acidification. Identify (A), (B) and (C) and also give equations for the reactions.

EXERCISE – IV(A)

Q.1 Aryl halides are less reactive towards nucleophilic substitution reaction as compared to alkyl halides due to **[IIT 1990]**
(A) The formation of less stable carbonium ion
(B) Resonance stabilization
(C) The inductive effect
(D) sp^2 hybridised carbon attached to the halogen

Q.2 Arrange the following compounds in order of increasing dipole moment **[IIT 1996]**

Toluene (I), m-dichlorobenzene (II), o-dichlorobenzene (III), p-dichlorobenzene (IV)

(A) I < IV < II < III (B) IV < I < II < III
(C) IV < I < III < II (D) IV < II < I < III

Q.3 $(CH_3)_3CMgCl$ reaction with D_2O produces : **[IIT 1997]**
(A) $(CH_3)_3CD$ (B) $(CH_3)_3OD$
(C) $(CD_3)_3CD$ (D) $(CH_3)_3OD$

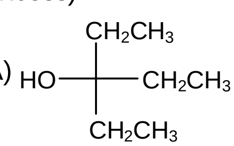
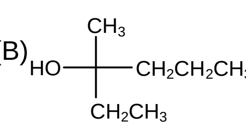
Q.4 The order of reactivity of the following alkyl halides for a S_N2 reaction is : **[IIT 2000]**
(A) RF > RC > R – Br > R – I
(B) R – F > R – Br > R – Cl > R – I
(C) R – Cl > R – Br > RF > R I
(D) R – I > RBr > R – Cl > R – F

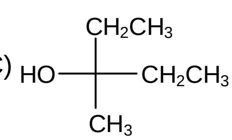
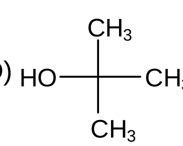
Q.5 Identify the set of reagents / reaction conditions 'X' and 'Y' in the following set of transformation :

$CH_3 - CH_2 - CH_2Br \xrightarrow{X} \text{Product} \xrightarrow{Y} CH_3 - \underset{\underset{Br}{|}}{CH} - CH_3$ **[IIT 2002]**

(A) X = dilute aqueous NaOH, 20°C; Y = HBr / acetic acid, 20°C
(B) X = concentrated alcoholic NaOH, 80°C; Y = HBr / acetic acid 20°C
(C) X = dilute aqueous NaOH, 20°C; Y = $Br_2/CHCl_3$, 0°C
(D) X = concentrated alcoholic NaOH, 80°C; Y = Br_2 / $CHCl_3$, 0°C

Q.6 CH_3MgBr + Ethyl ester $\rightarrow$ which can be formed as product **[IIT 2003]**
(excess)

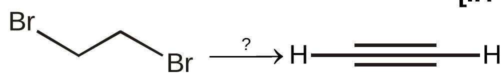
(A)  (B) 

(C)  (D) 

Q.7 Match the following **[IIT 2006]**

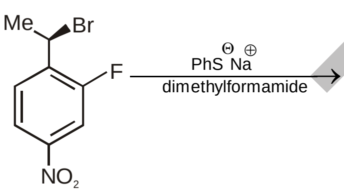
Column I	**Column II**
(A) $CH_3 - CHBr - CD_3$ on treatment with alc. KOH gives $CH_2 = CH - CD_3$ as a major product	(P) E1 reaction
(B) $Ph - CHBr - CH_3$ reacts faster than $Ph - CHBr - CD_3$	(Q) E2 reaction
(C) $Ph - CD_2 - CH_2Br$ on treatment with $C_2H_5OD/C_2H_5O^-$ gives $Ph - CD = CH_2$ as the major product.	(R) E1 cb reaction
(D) $PhCH_2CH_2Br$ and $PhCD_2CH_2Br$ react with same rate	(S) First order reaction

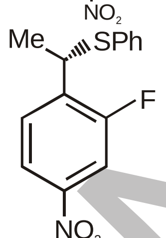
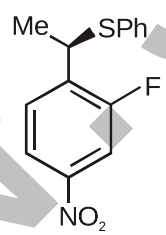
Q.8 The reagent(s) for the following conversion, **[IIT 2007]**

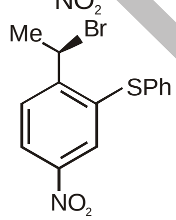
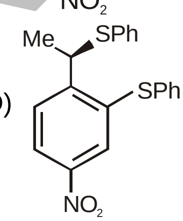


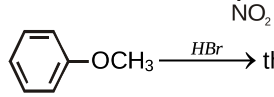
(A) alcoholic KOH
(B) alcoholic KOH followed by $NaNH_2$
(C) aqueous KOH followed by $NaNH_2$
(D) Zn/CH_3OH

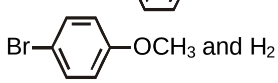
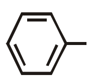
Q.9 The major product of the following reaction is **[IIT 2008]**

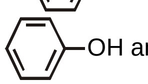


(A)  (B) 

(C)  (D) 

Q.10 In the reaction  the products are

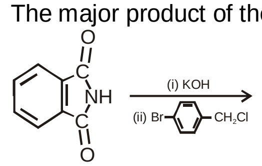
(A)  and H_2 (B)  and CH_3Br

(C)  and CH_3OH (D)  and CH_3Br

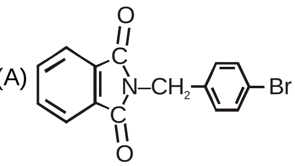
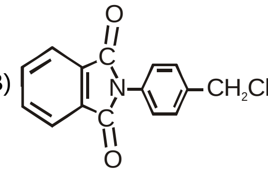
[IIT-JEE 2010]

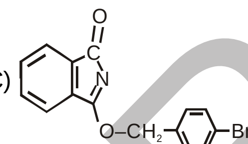
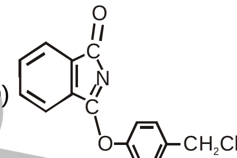
Q.11 The total number of alkenes possible by dehydrobromination of 3-bromo-3-cyclopentylhexane using alcoholic KOH is **[IIT-JEE 2011]**

Q.12 The major product of the following reaction is



[IIT-JEE 2011

(A)  (B) 

(C)  (D) 

EXERCISE – IV(B)

Q.1 Identify the major product in[II the following reactions : **[IIT 1993]**

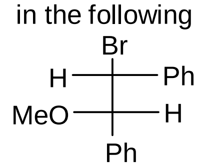
(i) $C_6H_5 - CH_2 - \underset{}{\overset{Cl}{\overset{|}{C}H}} - CH_3 \xrightarrow[KOH\,\Delta]{alcoholic} ?$

$\xrightarrow{HBr} ?$

(ii) $C_6H_5COOH + CH_3MgI \longrightarrow ? + ?$

Q.2 An alkyl halide X of formula $C_6H_{13}Cl$ on treatment with potassium tertiary butoxide gives two isomeric alkenes Y and Z (C_6H_{12}). Both alkenes on hydrogenation give 2, 4-dimethylbutane. Predict the structures of X, Y and Z. **[IIT 1996]**

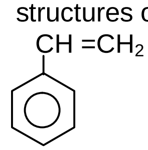
Q.3 Predict the structure of the intermediates/products in the following reaction sequence- **[IIT 1996]**

 $\xrightarrow[Acetone]{NaI}$ C

Q.4 (a) $C_6H_5CH_2\overset{\overset{C_6H_5}{|}}{C}HCl \xrightarrow[Heat]{Alcoholic\,KOH}$ A + B Write structures of (A) and (B).

(b) $(CH_3)_2CHOCH_3 \xrightarrow[Heat]{HI(excess)}$ A + B Write structures of A and B. **[IIT 1998]**

Q.5 Complete the following reaction with appropriate structures of products / reagents. **[IIT 1998]**

 $\xrightarrow{Br_2}$ (A) $\xrightarrow[(II)\,CH_3I]{(i)\,NaNH_2\,(3equi.)}$ (B)

Q.6 What would be major product ?**[IIT-JEE 2000]**

$CH_3 - \underset{CH_3}{\underset{|}{\overset{\overset{CH_3}{|}}{C}}} - CH_2Br \xrightarrow[\Delta]{C_2H_5OH} ?$

ANSWER KEY

EXERCISE - I

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	A	B	A	B	C	A	C	C	B	D	B	C	A	C	C	B	B	B	C	C
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	A	B	C	A	B	A	D	C	C	C	C	B	C	D	B	D	D	A	D	C
Ques.	44	42	43	44	45	46	47	48	49	50										
Ans.	B	B	A	C	D	C	A	C	A	A										

EXERCISE – II

Ques.	1	2	3	4	5	6	7	8
Ans.	A,C	B,C	A,C	A,C	A,B,C	A,B,C,D	A,B,C,D	B,D
Ques.	9							
Ans.	A,B,D							

Q.10 (A) S ; (B) Q ; (C) R ; (D) P **Q.11** A, C, D **Q.12** A, C **Q.13** (A) 3 ; (B) 2 ; (C) 1 ; (D) 1

EXERCISE – III

Q.1 **Q.2**

Q.3 (i) A, $CH_3CH_2CH_2Br$; B, $CH_3CH = CH_2$; C, $CH_3CHBrCH_3$; D, $CH_3CHNH_2CH_3$
(ii) A, $CH_3CH = CH_2$; B, $CH_3CHOHCH_3$; C, $CH_3CHClCH_3$; D, $CH_3CH_2CH_2$
(iii) A, $CH_3CHBrCH = CH_2$; B, $CH_2 = CH – CH = CH_2$; C, $CH_3CHBrCH = CH_2$ & $CH_3CH = CH – CH_2Br$
(iv) A, $CH_3CH_2CHOHCH_3$; B, $CH_3CH_2CHBrCH_3$; C, $CH_3CH = CH – CH_3$

Q.4 The elimination of HI (or DI) in presence of strong base shows E_2 elimination. The rate determining step involves breaking up of C – H (or C – D) bond. The C – D bond being stronger than C– H and thus elimination is faster in case of $CH_3 – CH_2I$.

Q.5 **Q.6** Stability of alkene by α-hydrogen **Q.7**

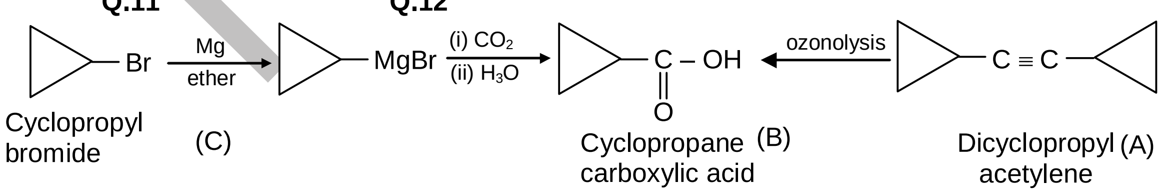
Q.8 $H_3C – \underset{\large CH_3}{\underset{|}{C}H} – \underset{\large Cl}{\underset{|}{C}H} – CH_3 \xrightarrow{KOH(alc)} \underset{\text{major}}{CH_3 – \underset{\large CH_3}{\underset{|}{C}} = CH – CH_3} + \underset{\text{minor}}{CH_3 – \underset{\large CH_3}{\underset{|}{C}H} – CH = CH_2}$

Elimination occurs according to saytzeff rule. The major product is one which involves elimination of H from less hydrogenated carbon.

Q.9 KCN is an ionic compound $[K^+(:C \equiv N:)^-]$ in which both C and N carry a lone pair electron. Carbon carrying lone pair of electrons is more reactive and thus alkyl attacks carbon to give alkyl cyanide AgCN being covalent has Ag – C ≡ N : structure with lone pair on N thus R attacks on N atom and R – N $\overset{-}{\equiv}$C is formed.

Q.10 **Q.11** **Q.12**

Q.13



EXERCISE – IV(A)

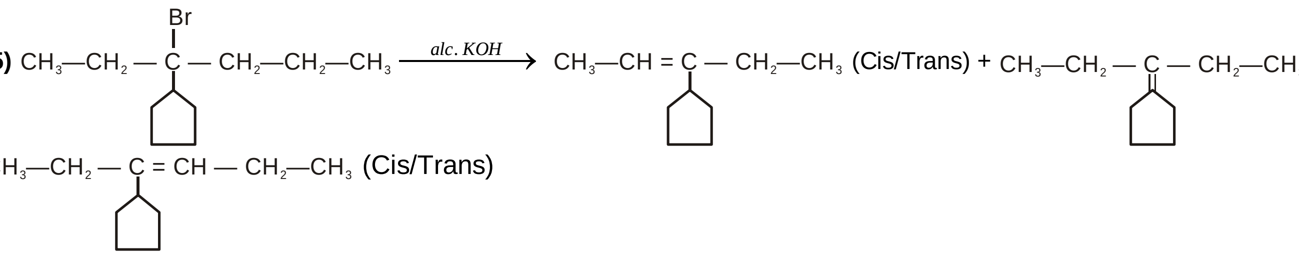
Ques.	1	2	3	4	5	6		
Ans.	B,D	B	A	D	B	D		

Q.7 A – Q ;B – Q; C – R, S; D – P, S
Q.8 B

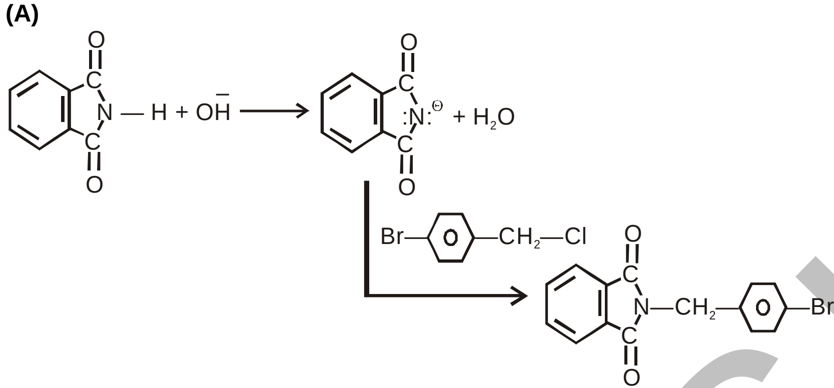
Q.9 A

Q.10 **D**

Q.11 **(5)**



Q.12 **(A)**

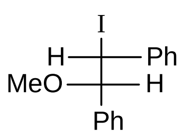


EXERCISE – IV(B)

Q.1 (i) $C_6H_5-CH=CH-CH_3$; $C_6H_5-\overset{Br}{CH}-CH_2-CH_3$

(ii) $C_6H_5COOMgI + CH_4$

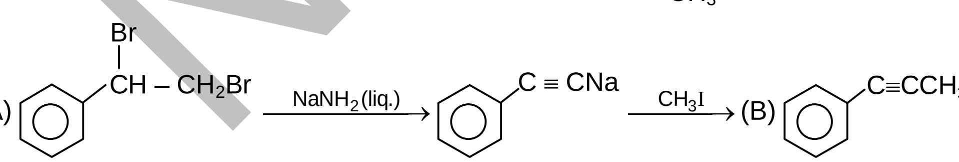
Q.2 (X) : $CH_3-\underset{Cl}{\overset{CH_3}{C}}-\overset{CH_3}{CH}-CH_3$; (Y) : $CH_2=\overset{CH_3}{C}-\overset{CH_3}{CH}-CH_3$; (Z) : $CH_3-\underset{CH_3}{C}-\underset{CH_3}{CH}-CH_3$

Q.3 

(NGP due to MeO, so retention of configuration.

Q.4 (a) Cis and trans forms of stibene $C_6H_5CH=CHC_6H_5$; (b) $\genfrac{}{}{0pt}{}{CH_3}{CH_3}\!\!>CHI + CH_3I$

Q.5 (A)



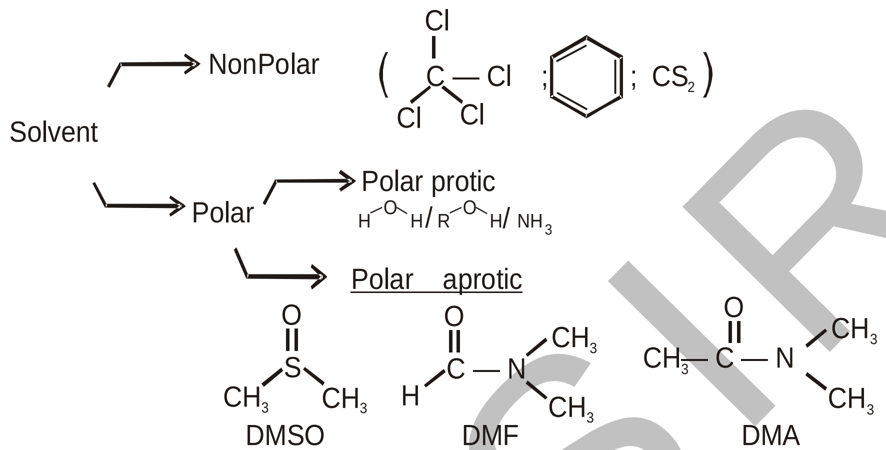
Q.6 $CH_3-\overset{CH_3}{C}=CHCH_3$

HALOGEN DERIVATIVES

SUBSTITUTION & ELIMINATION

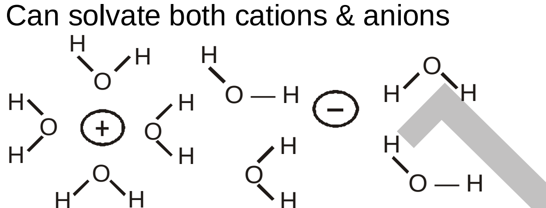
Solvents are most important for reactions since they provide medium for chemical reactions. Molecular collisions are possible only in gaseous phase or in solvent phase.

Solvent



Polar protic Solvent:–

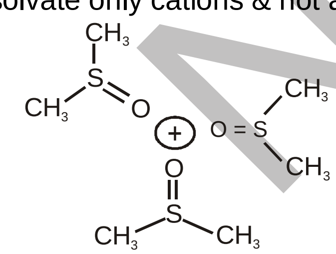
Can solvate both cations & anions



Solvation of cation   Solvation of anions

Polar aprotic solvent

Can solvate only cations & not anions



Nucleophiles:- They are e$^-$ pair donors . Particles which donate e$^-$ pair to generate covalent or coordinate bonds are nucleophiles.

Strength of Nucleophile

Rule-1 (—) charge

Conjugate bases are strong nucleophiles compared to acids:-

(a) $CH_3 - \ddot{N}H^{\ominus}$ CH_3NH_2

(b) $CH_3 - \ddot{O}:^{\ominus}$ CH_3OH

(c) $CH_3 - C(=O) - O^-$ $CH_3 - C(=O) - OH$

(d) $R - O^-$ $R - OH$

(e) $H - S - H$ $H - S^{\ominus}$

(f) $R - SH$ $R - \ddot{S}:^{\ominus}$

(g) H_3O^+ H_2O

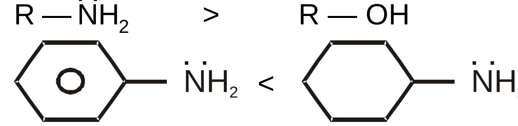
Ans. (a) 1>2   (b) 1>2   (c) 1>2
(d) 1>2   (e) 1<2   (f) 1<2
(g) 1<2

Rule 2:

For atoms of comparable size, better e$^-$ donor is better nucleophile (lower electronegativity better e$^-$ donor)

1. $CH_3 - \dot{N}H_2$ > $CH_3 - O - H$

2. $R - \dot{N}H_2$ > $R - OH$

3. 

4. $R - O - H$ > $R - C(=O) - O - H$

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5. $R-O^-$ > $R-\overset{\overset{O}{\|}}{C}-O^-$

Rule 3:-

If e^- donating atoms are of different size in polar protic solvent

Nucleophilicity α size of atom

(a) $R-OH < R-SH$

(b) $(C_6H_5)_3N < (C_6H_5)_3P$

(c) $F^{\ominus} < Cl^{\ominus} < Br^{\ominus} < I^{\ominus}$

If e^- donating atoms are of different size in polar aprotic solvent

Nucleophilicity α basicity

Leaving group (L):- Particles which are substituted by stronger nucleophiles or depart from a molecule to generate carbocation are leaving groups.

→ Leaving group ability $\propto \dfrac{1}{\text{Base strength}}$

→ Weak bases are good leaving groups.

$R-L \longrightarrow R^{\oplus} + \ddot{L}^{\ominus}$

1. $I^{\ominus} > Br^- > Cl^- >> F^-$

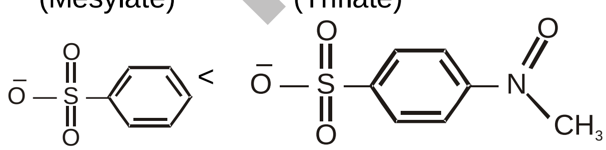
2. $H-O-H > OH^-$

3. $R-O-H > R-O^-$

4. $R-\overset{\overset{O}{\|}}{C}-O^- > R-O^-$

5. $\overset{\ominus}{O}-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-CH_3 < \bar{O}-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-CF_3$

Methylsulphonate (Mesylate) Trifluoro methylsulphonate (Triflate)

6. 

Nucleophilic substitution (SN – Reactions)

$R-L \xrightarrow{\ddot{N}u^{\ominus}} R-Nu + \ddot{L}^{\ominus}$

4 Components

(1) R → Substrate

(2) L ⟶ Leaving group

(3) Solvent (4) Nucleophile.

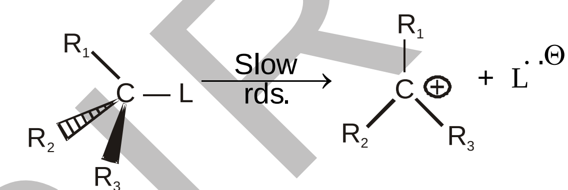
Types of nucleophilic substitution.

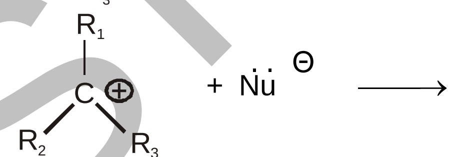
1. SN^1 2. SN^2 3. SN^{AR}
4. SN^{NGP} 5. SN^i 6. $SN^{1'}$
7. Benzyne.

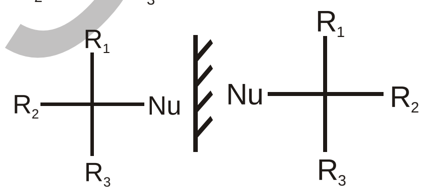
SN^1 — Nucleophilic substitution first order:-

1. $R-L \longrightarrow R^{\oplus} + \ddot{L}^{\ominus}$

2. $R^{\oplus} + \ddot{N}u^{\ominus} \longrightarrow R-Nu$

1. 

2. 



Characteristics

(1) rate = k $[R-L]^1$; rate is independent on concentration of nuclophile.

(2) rate is directly proportional to stability of carbocation

(3) Rearrangement possible

(4) Planar carbocation can be attacked from both sides

(5) Supported by polar protic solvent.

(6) 2 step reaction

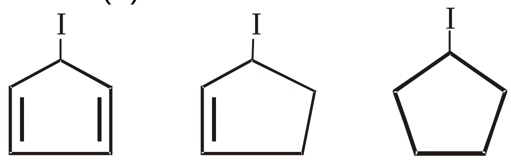
(7) Normally 3° – carbocation & resonance stabilized carbocation support this reaction mechanism if attacking Nuclophile is neutral polar protic solvent.

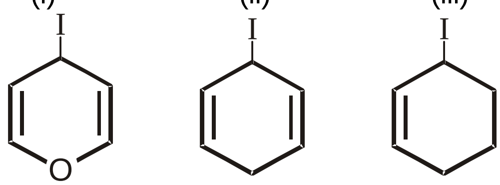
(8) Solvolysis (SN^1)

$Ph-CH_2-Cl \xrightarrow{H-O-H} Ph-CH_2-OH + HCl$

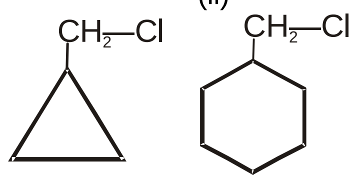
Q.1 Compare the rate of SN^1 reaction:-

(a) $Ph - CH_2 - Cl$ (i) $\quad Ph - CH(Ph) - Cl$ (ii) $\quad Ph_3C - Cl$ (iii)

(b)

(i) (ii) (iii)

(c)

(i) (ii) (iii)

(d) $CH_3 - O - CH_2 - Cl$ (i)
$CH_3 - O - CH_2 - CH_2 - Cl$ (ii)

(e)


(f) $CH_3 - O - CH = CH - CH_2 - Cl$ &
$CH_3 - O - CH_2 - CH = CH - CH_2 - Cl$

(g) (i) $Ph - CH(CH_3) - Cl \xrightarrow[H_2O]{100\%}$

(ii) $Ph - CH(CH_3) - Cl \xrightarrow[20\% EtOH]{80\% H_2O}$

Ans: (a) (iii) > (ii) > (i) (b) (ii) > (iii) > (i)
(c) (i) > (ii) > (iii) (d) (i) > (ii)
(e) (i) > (ii) (f) (i) > (ii) (g) (i) > (ii)

Q.2 SN^1 reactions are also known as solvolysis as solvent molecules behave as $\ddot{N}u^{\ominus}$. Write the product in each case.

(1) $Ph - CH_2 - Br \xrightarrow{H_2O}$

(2) $Ph - CH_2 - Br \xrightarrow{CH_3OH}$

(3) $Ph - CH_2 - Br \xrightarrow{EtOH}$

(4) $Ph - CH_2 - Br \xrightarrow{H-C(=O)-OH}$

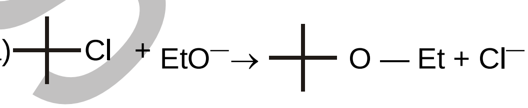
(5) $Ph - CH_2 - Br \xrightarrow{PhOH}$

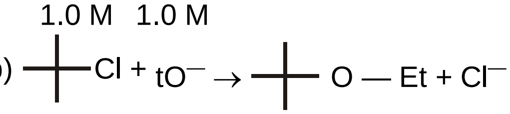
Ans: (1) $Ph - CH_2 - OH$
(2) $Ph - CH_2 - OCH_3$
(3) $Ph - CH_2 - OEt$
(4) $Ph - CH_2 - O - C(=O) - H$
(5) $Ph - CH_2 - OPh$

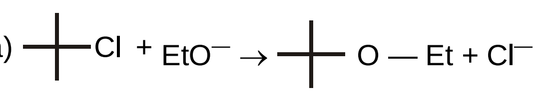
Q.3 Which SN^1 reaction is expected to occur rapidly.

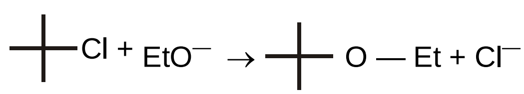
1. (a) $(CH_3)_3\,CCl + H-O-H \rightarrow (CH_3)_3\,C\,OH + HCl$

(b) $(CH_3)_3\,CBr + H-O-H \rightarrow (CH_3)_3\,C\,OH + HBr$

2. (a)

1.0 M 1.0 M

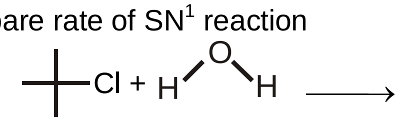
(b)

2.0 M 1.0 M

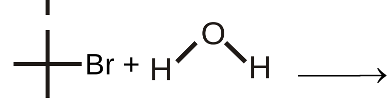
3. (a)

1.0 M 1.0 M

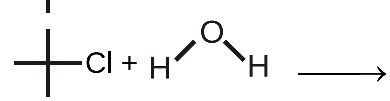
(b)

1.0 M 1.0 M 1.0 M 2.0 M

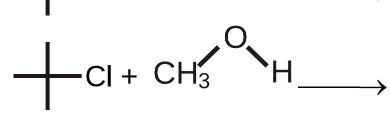
Ans. (1) b > a (2) a < b (3) a = b

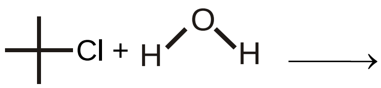
Q.4 Compare rate of SN^1 reaction

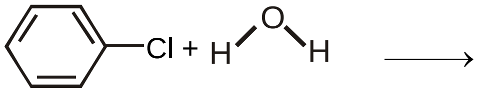
1. (a)


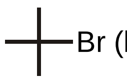
(b)


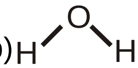
2. (a)


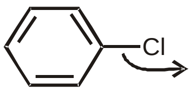
(b)


3. (a) 

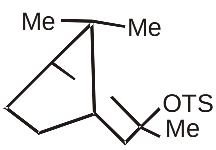
(b) 

Ans. (1) (b)  (better leaving group)

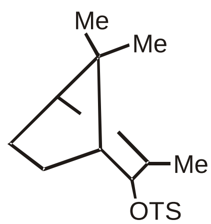
(2) (b)  better solvation

(3) (a)  (double bond character)

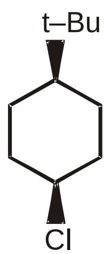
Q.5 Compare rate of SN^1

1. 

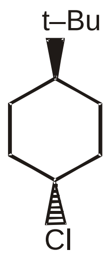
(a)



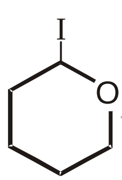
(b)

2. 

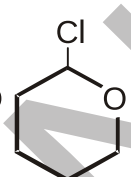
(a)



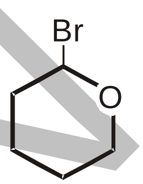
(b)

3. 

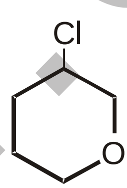
(a)



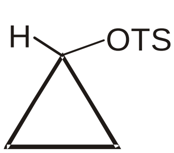
(b)



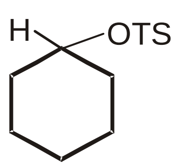
(c)



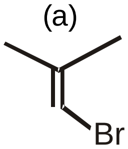
(d)

4. 

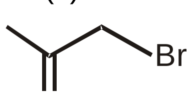
(a)



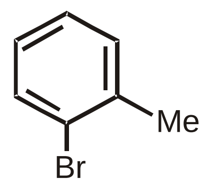
(b)

5. 

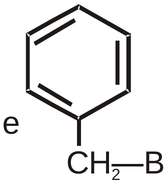
(a)



(b)

6. 

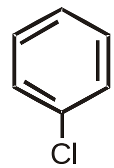
(a)



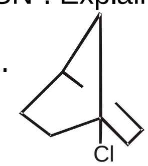
(b)

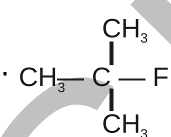
Ans. (1) a > b (2) b > a (3) a > c > b > d
(4) a < b (5) a < b (6) b > a

Q.6 These substrates cannot give SN^1. Explain

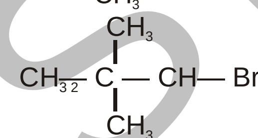
1. 

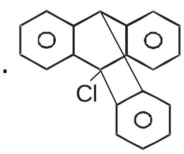
2. $CH_2 = CH — Cl$

3. 

4. 

5. $CH_3 — CH_2 — F$

6. 

7. 

($\overline{O}$, $\overline{F}$ & $CH_3-\overline{O}$ cannot be substituted strong bars & weak leaving groups)

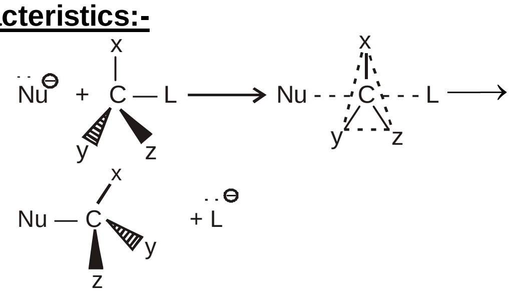
SN^2 reaction nucleophilic substitution

<u>SN^2 — Reaction</u>

Nucleophilic Substitution 2[nd] order

$$\ddot{N}u^{\Theta} \quad + \quad R — L \longrightarrow Nu - - R - - L$$
$$\downarrow$$
$$Nu — R + \ddot{L}^{\Theta}$$

<u>Characteristics:-</u>

1. 

2. rate of reaction $\propto \dfrac{1}{\text{Bulkiness in } x, y \,\&\, z}$.

3. rate $\propto$ strength of $\ddot{N}u^{\Theta}$

4. rate $\propto$ Leaving group ability of $\ddot{L}^{\Theta}$

5. Inversion of configuration takes place. ‘

Characteristics

Q.1 Compare rate of SN^2 reaction:–

1. $CH_3-CH_2-CH_2-Br$ & $CH_3-\underset{\underset{CH_3}{|}}{CH}-Br$

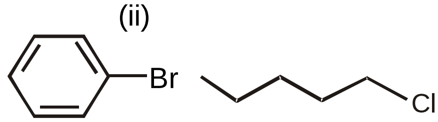
(i) (ii)

2. $CH_3-CH_2-CH_2-CH_2-Cl$ (i)

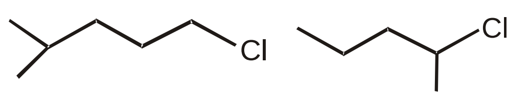
$CH_3-CH_2-CH_2-CH_2-I$ (ii)

3. $CH_3-CH-CH_2-Cl$ (i)

$CH_3-\underset{\underset{CH_3}{|}}{CH_2}-CH_2-CH_2-Cl$ (ii)

4. 

(i) (ii)

5. 

(i) (ii)

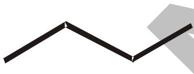
Ans. (1) 1 > 2 (2) 2 > 1 (3) 1 > 2
(4) 1 < 2 (5) 1 > 2

Q.2 Compare rate of SN^2 reaction:–

(A)(i)  $Cl + CH_3-CH_2-O^- \longrightarrow$

or

(ii)  $Cl + CH_3-CH_2-OH \longrightarrow$

(B)(i)  $Cl + CH_3-CH_2-O^- \rightarrow$

(ii)  $Cl + CH_3-CH_2-S^- \rightarrow$

(C)(i)  $Br + (C_6H_5)_3N \rightarrow$

(ii)  $Br + (C_6H_5)_3P \rightarrow$

(D) (i)  $Br + CH_3O^- \rightarrow$

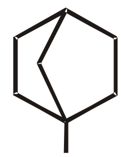
1.0 M 1.0 M

(ii)  $Br + CH_3O^- \rightarrow$

1.0 M 2.0 M

Ans. (A) i > ii (B) I < ii (C) ii > i (D) ii > i

Q.3 1– Bromobicyclo [2.2.1] heptane is extremely unreactive in either SN^1 or SN^2 reaction. Explain:



Br

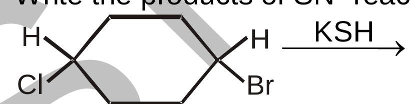
SN^1 X

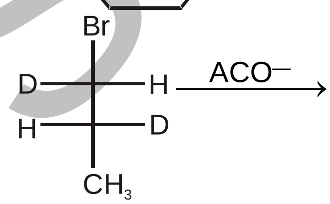
(Bridge Head position)

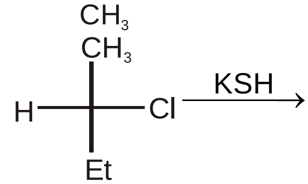
SN^2 X

(Walden unreason not possible)

Q.4 Write the products of SN^2 reaction:–

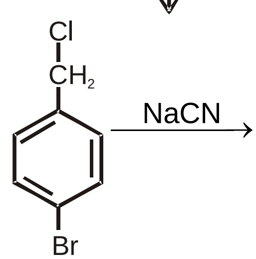
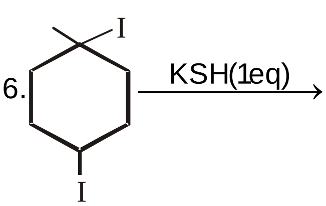
1. 

2. 

3. 

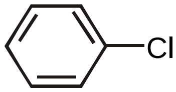
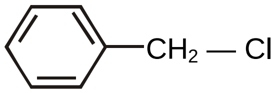
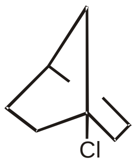
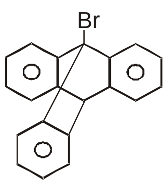
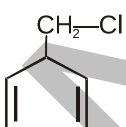
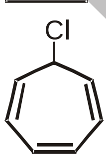
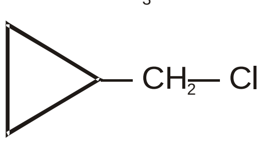
4. $Cl-CH_2-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2-CH_2-Cl \xrightarrow{KSH}$

$\downarrow$ NaCN (1 eq)

5.  6. 

7. $Br-CH_2-CH=CH-Br \xrightarrow[(1eq)]{KSH}$

Q.5

Reactant	SN^1	SN^2
(1) 		
(2) $CH_2 = CH - Cl$		
(3) 		
(4) $CH_2 = CH - CH_2 - Cl$		
(5) 		
(6) $CH_3 - O - CH_2 - Cl$		
(7) $CH_3 - \underset{CH_3}{\underset{\vert}{N}} - CH - Cl_2$		
(8) $CH_3 - F$		
(9) $CH_3 - \overset{CH_3}{\overset{\vert}{\underset{CH_3}{\underset{\vert}{C}}}} - Cl$		
(10) 		
(11) $CH_3 - \underset{Cl}{\underset{\vert}{C}} - Et$		
(12) 		
(13) 		
(14) $CH_3 - \overset{CH_3}{\overset{\vert}{\underset{CH_3}{\underset{\vert}{C}}}} - CH_2 - Cl$		
(15) 		

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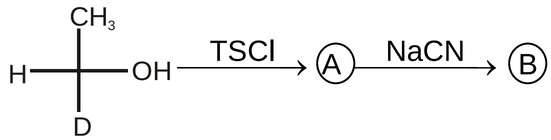
Q.6 Explain

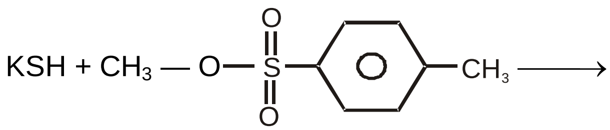
$\overline{O}H + CH_3 — O — CH_3 \longrightarrow$ No. Reaction

$CH_3 — O — CH_3 \xrightarrow{H^+} 2CH_3OH$

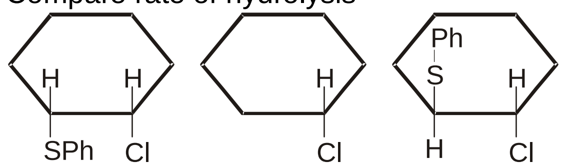
Q.7



Q.8



Q.9 Compare rate of hydrolysis

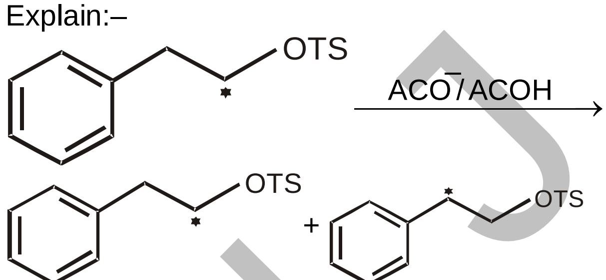


(a) (b) (c)

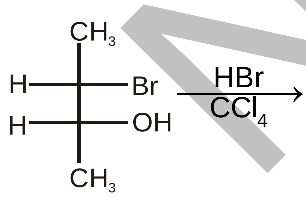
Q.10 Explain mustard gas hydrolysis at a very high rate:–

$Cl — CH_2 — CH_2 — S — CH_2 — CH_2 —Cl$

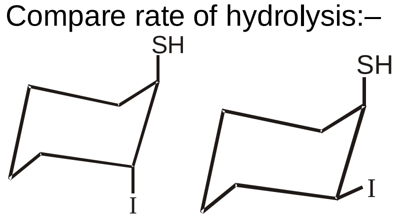
Q.11 Explain:–



Q.12



Q.13 Compare rate of hydrolysis:–



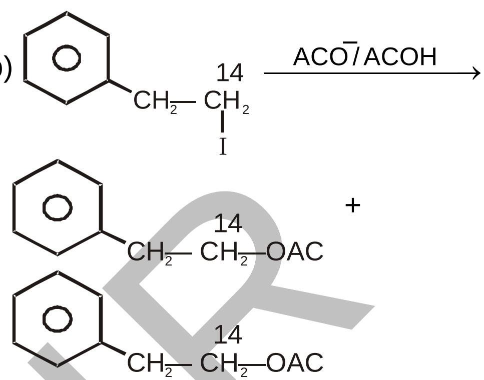
(a) (b)

Q.14 Explain:–

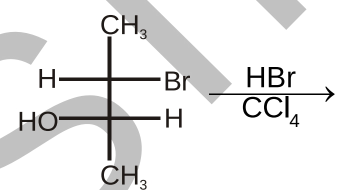
(a) $CH_3— S — CH_2 — CD_2 — I \xrightarrow{H_2O}$

$CH_3 — S — CH_2 — CD_2 — OH$

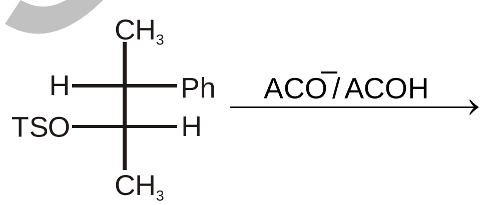
(b)



Q.15

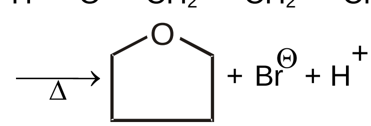


Q.16



Q.17

(1) $H — O — CH_2 — CH_2 — CH_2 — Br$



(2) $H — O — CH_2 — CH_2 — Br \xrightarrow[\Delta]{}$

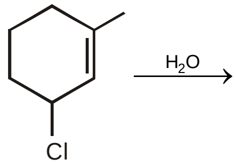
(3) $NH_2—CH_2 — CH_2 — CH_2 — CH_2 — Br$

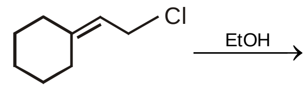
$\xrightarrow[\Delta]{\overline{O}H/H_2O}$

$SN^{1'}$

$CH_3—CH=CH—CH_2—Cl \xrightarrow{H_2O}$

$CH_3—CH=CH—CH_2—OH + CH_3—\underset{\displaystyle OH}{\underset{|}{CH}}—CH=CH_2$

Q.18 

Q.19 

Q.20 R — X + Reagent $\longrightarrow$ Product

	Reagent	$\ddot{N}u^{\ominus}$	Product
1.	aq. KOH	$O\overline{H}$	
2.	aq. NaOH	$O\overline{H}$	
3.	Na_2CO_3 (aq.)	$O\overline{H}$	
4.	Moist Ag_2O	$O\overline{H}$	
5.	RO^-/R—OH	$R-O^-$	
6.	NH_3	$\ddot{N}H_3$	
7.	$R-NH_2$	$R-\ddot{N}H_2$	
8.	NaSH	$S\overline{H}$	
9.	dry Ag_2O	$Ag-O-Ag$	
10.	KCN	$\overset{\ominus}{C}N$	
11.	AgCN	Ag — CN:	

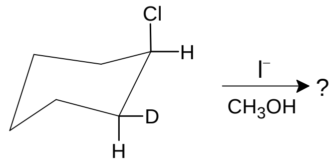
DPP NO-01 Time: 30 minutes

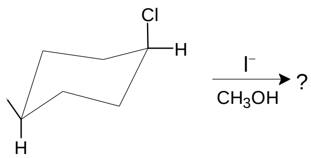
1. Which alkyl halide would you expect to react more rapidly by an S_N2 mechanism? Explain your answer
   (A) $CH_3CH_2CH_2Br$ or $(CH_3)_2CHBr$
   (B) $CH_3CH_2CH_2CH_2Cl$ or $CH_3CH_2CH_2CH_2I$
   (C) $(CH_3)_2CHCH_2Cl$ or $CH_3CH_2CH_2CH_2Cl$
   (D) $(CH_3)_2CHCH_2CH_2Cl$ or $CH_3CH_2CH(CH_3)CH_2Cl$
   (E) C_6H_5Br or $CH_3CH_2CH_2CH_2CH_2Cl$

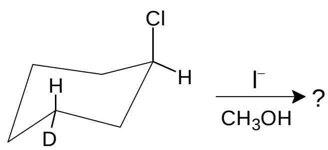
2. Which S_N2 reaction of each pair would you expect to take place more rapidly in a protic solvent?
   (A) (1) $CH_3CH_2CH_2Cl + CH_3CH_2O^- \rightarrow CH_3CH_2CH_2OCH_2CH_3 + Cl^-$
   OR
   (2) $CH_3CH_2CH_2Cl + CH_3CH_2OH \rightarrow CH_3CH_2CH_2OCH_2CH_3 + HCl$
   (B) (1) $CH_3CH_2CH_2Cl + CH_3CH_2O^- \rightarrow CH_3CH_2CH_2OCH_2CH_3 + Cl^-$
   OR
   (2) $CH_3CH_2CH_2Cl + CH_3CH_2S^- \rightarrow CH_3CH_2CH_2SCH_2CH_3 + Cl^-$
   (C) (1) $CH_3CH_2CH_2Br + (C_6H_5)_3N \rightarrow CH_3CH_2CH_2\overset{+}{N}(C_6H_5)_3 + Br^-$
   OR
   (2) $CH_3CH_2CH_2Br + (C_6H_5)_3P \rightarrow CH_3CH_2CH_2\overset{+}{P}(C_6H_5)_3 + Br^-$
   (D) (1) $CH_3CH_2CH_2Br(1.0M)_3 + CH_3O^-(1.0M) \rightarrow CH_3CH_2CH_2OCH_3 + Br^-$
   OR
   (2) $CH_3CH_2CH_2Br(1.0M) + CH_3O^-(2.0M) \rightarrow CH_3CH_2CH_2OCH_3 + Br^-$

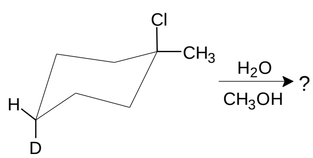
3. Which S_N1 reaction of each pair would you expect to take place more rapidly? Explain your answer.
   (A) (1) $(CH_3)_3CCl + H_2O \rightarrow (CH_3)_3COH + HCl$
   OR
   (2) $(CH_3)_3CBr + H_2O \rightarrow (CH_3)_3COH + HBr$
   (B) (1) $(CH_3)_3CCl + H_2O \rightarrow (CH_3)_3COH + HCl$
   OR
   (2) $(CH_3)_3CCl + CH_3OH \rightarrow (CH_3)_3COCH_3 + HCl$
   (C) (1) $(CH_3)_3CCl + (1.0M) + CH_3CH_2O^-(1.0M) \xrightarrow{EtOH} (CH_3)_3COCH_2CH_3 + Cl^-$
   OR
   (2) $(CH_3)_3CCl + (2.0M) + CH_3CH_2O^-(1.0M) \xrightarrow{EtOH} (CH_3)_3COCH_2CH_3 + Cl^-$
   (D) (1) $(CH_3)_3CCl + (1.0M) + CH_3CH_2O^-(1.0M) \xrightarrow{EtOH} (CH_3)_3COCH_2CH_3 + Cl^-$
   (2) $(CH_3)_3CCl + (1.0M) + CH_3CH_2O^-(2.0M) \xrightarrow{EtOH} (CH_3)_3COCH_2CH_3 + Cl^-$
   (E) (1) $(CH_3)_3CCl + H_2O \rightarrow (CH_3)_3COH + HCl$
   (2) $C_6H_5Cl + H_2O \rightarrow C_6H_5OH + HCl$

4. Write conformational structures for the substitution products of the following deuteri compound:

(A) 

(B) 

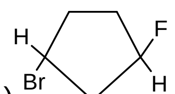
(C) 

(D) 

5. 1-Bromobicyclo [2.2.1] heptane is extremely unreactive in either S_N2 or S_N1 reaction explanations for this behaviour.

6. When ethyl bromide reacts with potassium cyanide in methanol, the major product is some CH_3CH_2NC is formed as well, however. Write Lewis structures for the cyanic both products, land provide a mechanistic explanation of the course of the reaction

7. Give structures for the products of each of the following reactions:

(A)  + NaI (1 mol) $\xrightarrow{\text{acetone}}$ C_5H_8FI + NaBr

(B) 1, 4–Dichlorohexane (1 mole) + NaI (1 mole) $\xrightarrow[\text{acetone}]{}$ $C_6H_{10}ICl + NaCl$

(C) 1, 2–Dibromoethane (1 mole) + $NaSCH_2CH_2SNa \longrightarrow C_4H_8S_2 + 2NaBr$

(D) 4,Chloro-1-butanol + NaH $\xrightarrow[Et_2O]{(-H_2)} C_4H_8ClONa \xrightarrow[Et_2O]{heat} C_4H_8O + NaCl$

(E) Propyne + $NaNH_2$ $\xrightarrow[liq.NH_3]{(-NH_3)} C_3H_3Na \xrightarrow{CH_3I} C_4H_6 + NaI$

8. When the alkyl bromides (listed here) were subjected to hydrolises in a mixture of ethanol and water (80% C_2H_5OH/20% H_2O) at 55°C, the rates of the reaction showed the following order: $(CH_3)_3CBr > CH_3Br > CH_3CH_2Br > (CH_3)_2CHBr$

Provide an explanation for this order of reactivity

9. What would be the effect of increasing solvent polarity on the rate of each of the following nucleophilic substitutions reactions?

(a) $Nu: + R - L \longrightarrow R - Nu^+ + :L^-$

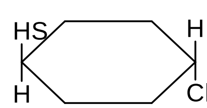
(b) $R - L^+ \longrightarrow R^+ + :L$

10. Competition experiments are those in which two reactants at the same concentration (or one reactant with two reactive sites) compete for a regent. Predict the major product resulting from each of the following competition experiments:

(a) $Cl-CH_2-C(CH_3)_2-CH_2-CH_3-Cl + I^- \longrightarrow$

(b) $Cl-C(CH_3)_2-CH_2-CH_2-Cl + H_2O \longrightarrow$

11. Predict the structure of the product of this reaction:

 $\xrightarrow[\text{aqueous EtOH}]{\text{NaOH in}}$ $C_6H_{10}S$

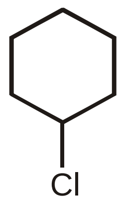
Comparison of SN^1, SN^2, E^1 & E^2

Reactant	Neutral Nucleophiles or Bases	Weak Nucleophiles	Strong Bases /Nucleophiles
	$R-O-H$, $H-O-H$, $R-S-H$, $H-S-H$ $\ddot{N}H_3$	$\overset{\ominus}{I}$, $S\overset{\ominus}{H}$, $C\overset{\ominus}{N}$, $CH_3-\overset{O}{\overset{\Vert}{C}}-O^-$ $\underset{\ominus}{\ddot{N}}$, $\underset{\oplus}{N}$, $\ddot{N}:\ominus$, $B\overset{\ominus}{r}$, $SC\overset{\ominus}{N}$, $R-\overset{\ominus}{S}$,	$R\overline{O}$ / $Et\overline{O}$ / $CH_3\overline{O}$ / $+\overline{O}$ / Et_3N_1
$(X \neq F)$ CH_3-X	SN^2	SN^2	SN^2
$Ph-CH_2-X$	SN^1(Solvolysis)	SN^2	SN^2
$Ph-CH_2-CH_2-X$	SN^2	SN^2	E^2 (formation of conjugated double. Bond)
$R-CH_2-X$	SN^2	SN^2	SN^2 {Exception in sterically hirdered base $+\overline{O}$ / $+OH$ or Et_3N, E^2 is major product}
$R-\underset{Br}{\underset{\vert}{CH}}-R$	SN^1(low Temp.) E^1 (high Temp.	SN^2	E^2
$R-\underset{R}{\underset{\vert}{\overset{R}{\overset{\vert}{C}}}}-Br$	SN^1 (low Temp.) E^1(high Temp.)	SN^1 (low Temp.) E^1 (high Temp.)	E^2

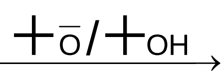
DPP-02 Time: 30 Minutes

Comparison of SN^1, SN^2, E^1 & E^2

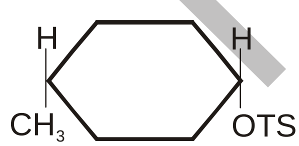
(1) $Ph-CH_2-Br \xrightarrow{H_2O}$

(2)  $\xrightarrow{KSH}$; $\xrightarrow{KCN}$; $\xrightarrow{Et\bar{O}\overset{+}{Na}/EtOH}$

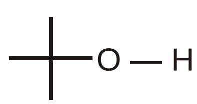
(3) $CH_3-CH_2-Br \xrightarrow{CH_3-\bar{O}/CH_3OH}$

(4)  $\xrightarrow{H_2O}$; $\xrightarrow{CH_3OH}$; $\xrightarrow{Et\bar{O}\overset{+}{Na}/EtOH}$;  ; $\xrightarrow[Et_3N]{}$

(5) R-2-chloropentane $\xrightarrow{NaI/Acetone}$; $\xrightarrow{NaN_3}$; $\xrightarrow[CH_3-\overset{\overset{O}{||}}{C}-\bar{O}]{}$; $\xrightarrow[Et\bar{O}/EtOH]{}$; $\xrightarrow{NaCN}$

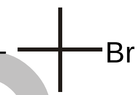
(6)  $\xrightarrow{Et\bar{O}\overset{+}{Na}/EtOH}$; $\xrightarrow{NaI/\overset{+}{A}cetone}$

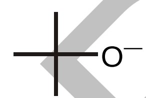
(7) $CH_2=CH-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow{EtONa/EtOH}$; $\xrightarrow{NaI/Acetone}$

(8)  $\xrightarrow{NaH}$

(A) $\xrightarrow{CH_3-CH_2-CH_2-Br}$ (B)

(9) $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow[\Delta]{EtOH}$

(10) (a) $CH_3-O^- +$  $\longrightarrow$

(b)  $+ CH_3-Br \longrightarrow$

(11) To prepare $CH_3-O-CH(CH_3)_2$, which of the following will give better yield:–

(1) $CH_3-ONa + CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_3 \longrightarrow$

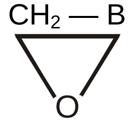
(2) $CH_3-\underset{\underset{CH_3}{|}}{CH}-ONa + CH_3-I \longrightarrow$

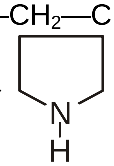
(12) Styrene ($C_6H_5-CH=CH_2$) is to be prepared by dehydrohalogenation using alc.KOH. Which of the following will give better yield.

(1) $CH_3-CH(Ph)(Br) \xrightarrow{alc.KOH}$

(2) $\underset{}{\overset{\overset{Ph}{|}}{CH_2}}-CH_2-Br \xrightarrow{alc.KOH}$

(13) Write mechanism which accounts for the following products.

(a) $HO-CH_2-CH_2-Br \xrightarrow{\bar{O}H/H_2O}$ 

(b) $NH_2-CH_2-CH_2-CH_2-CH_2-Br \xrightarrow{\bar{O}H/H_2O}$ 

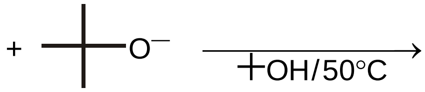
(14) Major Product of reactions

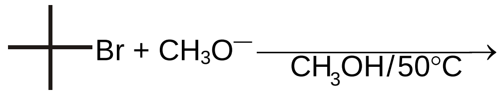
(E^1, E^2, SN^1 & SN^2)

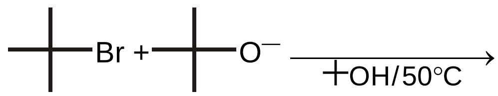
(a) $CH_3-CH_2-CH_2-CH_2-CH_2-Br$

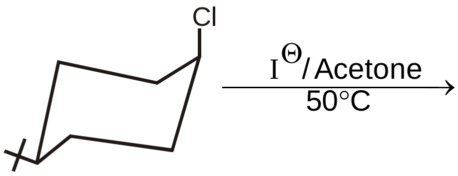
$+\ CH_3-CH_2-O^- \xrightarrow[50^\circ C]{CH_3CH_2OH}$

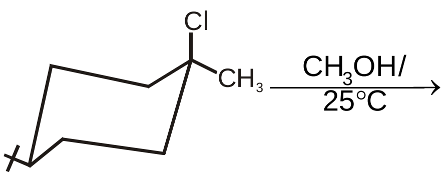
(b) $CH_3-CH_2-CH_2-CH_2-CH_2-Br$



(c) 

(d) 

(e) 

(f) 

(g) 3-Chloropentane + $CH_3O^- \xrightarrow[50^\circ C]{CH_3OH}$

(h) 3-Chloropentane + $CH_3-\overset{O}{\overset{\|}{C}}-O^-$

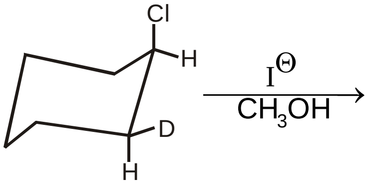
$\xrightarrow[50^\circ C]{CH_3-\overset{O}{\overset{\|}{C}}-OH}$

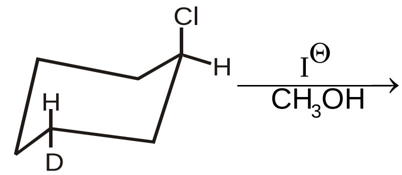
(i) $\overset{\Theta}{OH}$ + (R) -2-bromobutane $\xrightarrow{25^\circ C}$

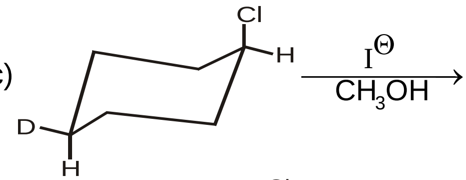
(j) (S)-3-bromo-3-methylhexane $\xrightarrow[CH_3OH]{25^\circ C}$

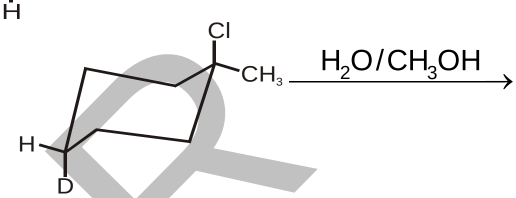
(k) (S)-2-bromooctane $\xrightarrow[CH_3OH/50^\circ C]{I^\Theta}$

(15) Major product (E^1, E^2, SN^1 or SN^2)

(a) 

(b) 

(c) 

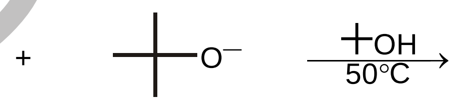
(d) 

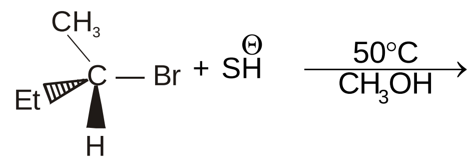
(16) Give major product (E^1, E^2, SN^1 or SN^2)

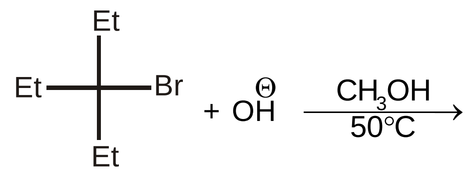
(a) $CH_3-CH_2-CH_2-Br$

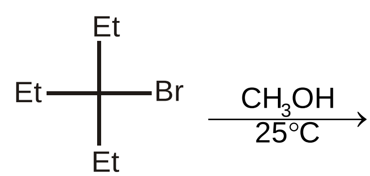
$+\ CH_3-O^- \xrightarrow[50^\circ C]{CH_3-OH}$

(b) $CH_3-CH_2-CH_2-Br$



(c) 

(d) 

(e) 

(16) Consider the reaction of $\overset{\Theta}{I}$ with CH_3-CH_2-Cl.

(a) Would you expect the reaction to be SN^1 or SN^2

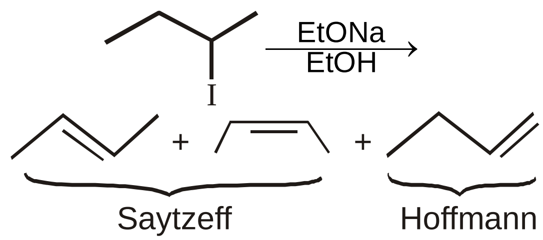
(b) The rate constant of the reaction at 60°C is 5×10^{-5} L mol^{-1} sec^{-1}. What is the reaction rate if [$\overset{\Theta}{I}$] = 0.1 mol/L and [CH_3-CH_2-Cl] = 0.1 mol/L.

DPP- 03 Time: 30 Minutes

E^{1CB} - *Mechanism*

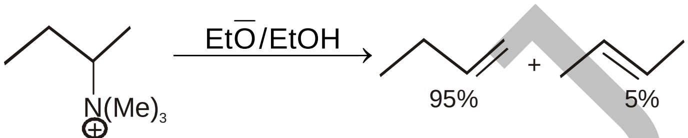
Hoffmann V/S Saytzeff alkene (elimination)

1.



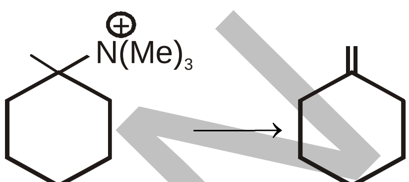
L.G.	% Hoffmann
$-\overset{\oplus}{N}(Me)_3$	90%
$-\overset{\oplus}{S}(Et)_2$	74%
– F	70%
— Br	19%

↑ L.G. Tendency

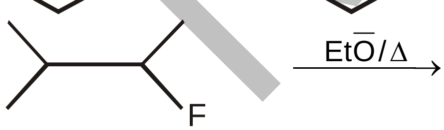


T.S. has more carbanion character.

Q.1

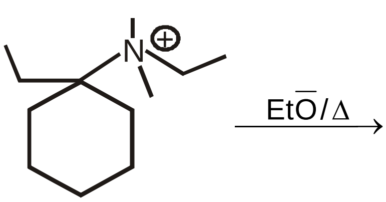


Q.2



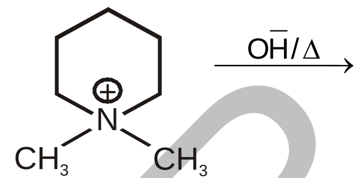
Q.3 $Me-CH_2-\underset{\overset{\oplus}{N}(Me)_3}{\overset{Me}{C}}-CH_2-Me \xrightarrow{Et\bar{O}/\Delta}$

Q.4

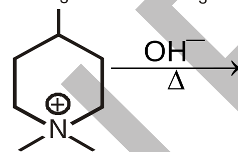


Q.5 $Ph-CH_2-\underset{F}{CH}-CH_3 \xrightarrow[\Delta]{OH^-}$

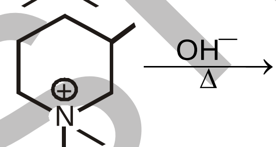
Q.6



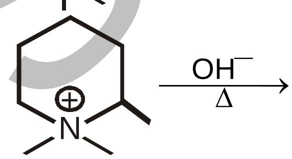
Q.7



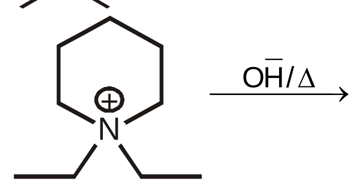
Q.8



Q.9



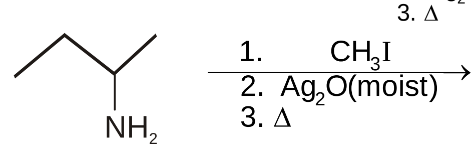
Q.10



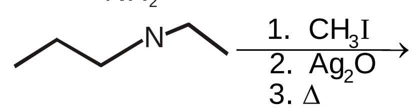
<u>Hoffmann exhaustive methylation</u>

Q.1 $CH_3-CH_2-CH_2-NH_2 \xrightarrow[\text{2. } Ag_2O\text{(moist)} \quad \text{3. } \Delta]{\text{1. } CH_3I}$

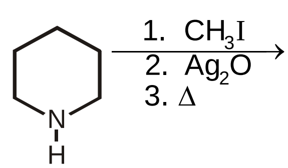
Q.2



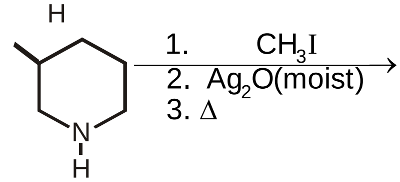
Q.3



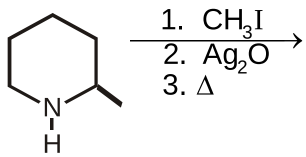
Q.4



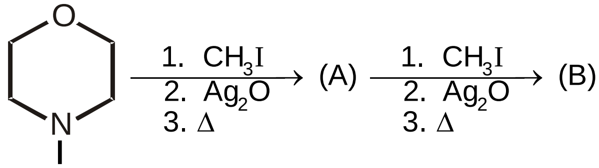
Q.5



Q.6



Q.7



Q.8 $CHCl_2 - CF_3 \xrightarrow[\Delta]{\text{alc.KOH}}$

Q.9 $CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - CH_2 - CH_2 - F \xrightarrow[\Delta]{OH^-}$

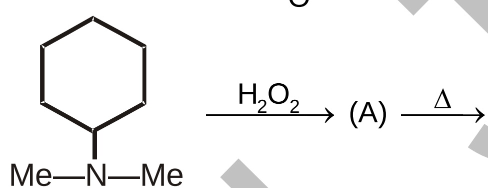
Q.10 $CH_3 - \underset{\underset{\displaystyle O}{\|}}{C} - CH_2 - CH_2 - F \xrightarrow{Et\bar{O}}$

Q.11 $CH_3 - \underset{\underset{\displaystyle O}{\|}}{C} - CH_2 - CH_2 - F \xrightarrow[\Delta]{Et\bar{O}}$

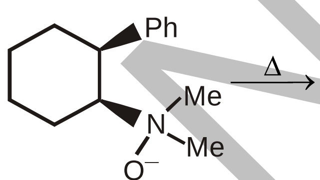
E[1]

Q.1 $Ph - CH_2 - CH_2 - \overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle O^-}{|}}{N}} - Me \xrightarrow{\Delta}$

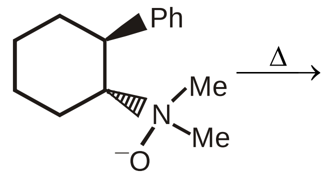
Q.2



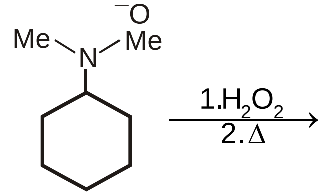
Q.3



Q.4



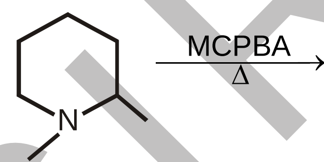
Q.5



Q.6 $CH_3 - \underset{\underset{\displaystyle Ph}{|}}{N} - CH_2 - CH_2 - CH_3$

$\xrightarrow{\text{MCPBA}} (A) \xrightarrow{\Delta}$

Q.7

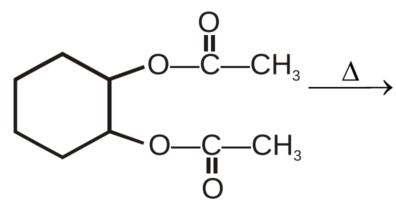


Q.8 $Ph - \overset{\overset{\displaystyle O}{\|}}{C} - O - CH_2 - CH_3 \xrightarrow{\Delta}$

Q.9 $CH_3 - CH_2 - \overset{\overset{\displaystyle S}{\|}}{C} - S - CH_2 - CH_3 \xrightarrow{\Delta}$

Q.10 $CH_3 - CH_2 - \overset{\overset{\displaystyle O}{\|}}{C} - O - CH_2 - CH_3 \xrightarrow{\Delta}$

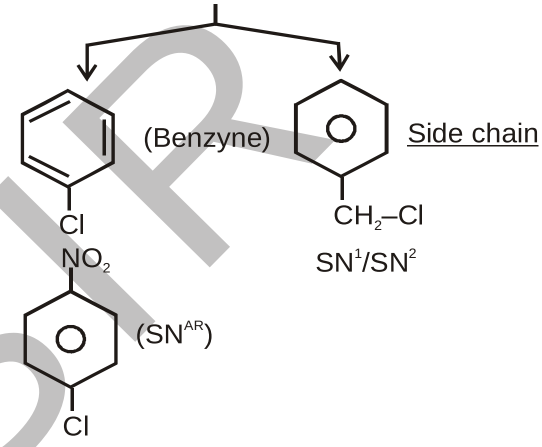
Q.11



HALOGEN DERIVATIVES

Classification

- Aliphatic
  - Unsaturated
    - $CH_2=CH-Cl$ (Vinyl)
    - $CH_2=CH-CH_2-Cl$ (Allyl)
  - Saturated
    - Monohalogen
      - $CH_3-CH_2-CH_2-Cl$ (1°)
      - $CH_3-\underset{\large Cl}{CH}-CH_3$ (2°)
      - $CH_3-\underset{\large Cl}{\overset{\large CH_3}{C}}-CH_3$ (3°)
    - dihalogen
      - $CH_3-CH\begin{matrix}Cl\\Cl\end{matrix}$ (gem) (geminal)
      - $CH_3-\underset{\large Cl}{CH}-\underset{\large Cl}{CH}$ (Vic) (Vicinal)
      - $\underset{\large Cl}{CH_2}-CH_2-\underset{\large Cl}{CH_2}$ (Isolated)
    - Polyhalogen
      - $CHCl_3$ (Chloroform)
      - CCl_4 (Carbon tetrachloride pyrene)
- Aromatic



General Method of Preparation

(1) Form alkanes

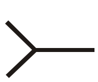
$$R—H \xrightarrow[h\nu]{X-X} R—X + H—X$$

$X_2 = Cl_2$ or Br_2

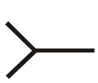
Cl_2 = Non – Selective ; Br_2 = Selective

$X_2 \neq F_2$ and $X_2 \neq I_2$

F_2 = uncontrollable ; I_2 = reversible

Q.1  $\xrightarrow[h\nu]{Cl_2}$ % = _ _ _ + % = _ _ _

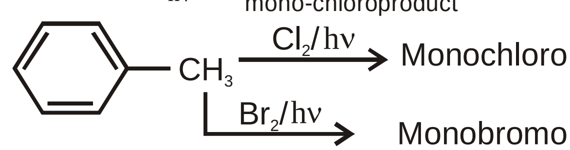
$\left\{R_1^\circ : R_2^\circ : R_3^\circ = 1 : 3.8 : 4.5\right\}$

 $\xrightarrow[h\nu]{Br_2}$ _ _ _ _ _ _

Q.2 $CH_3—\underset{\large CH_3}{CH}—CH_2—CH_3 \xrightarrow[h\nu]{Br_2}$

$\xrightarrow[h\nu]{Cl_2}$ ---- % of 3° mono-chloroproduct

Q.3



(2) From alkenes

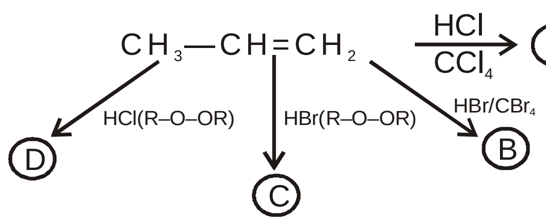
$$R—CH = CH_2 \xrightarrow[CCl_4]{HX} R—\underset{\large X}{CH}—CH_3$$

: Markownikoff addition; Classical carbocation

$$R — CH = CH_2 \xrightarrow[R-O-OR]{HBr} R—CH_2—CH_2—Br$$

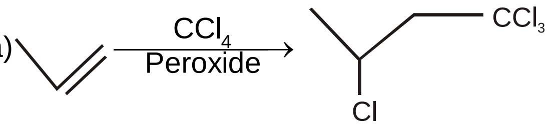
Anti – markownikoff addition peroxide effect or Kharash effect

Q.1

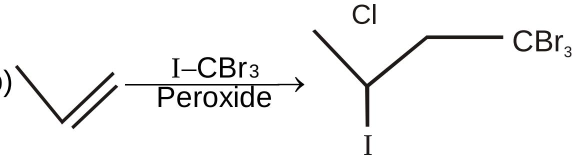


Q.2 Write mechanism:–

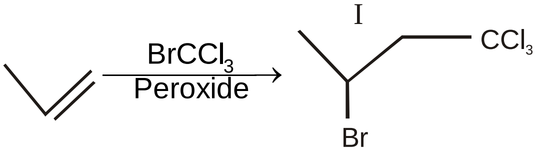
(a)



(b)



(c)



(3) Reed's Reaction

$$R - H \xrightarrow[h\nu]{SO_2Cl_2} R—Cl + SO_2\uparrow + HCl\uparrow$$

$$\boxed{SO_2Cl_2 \longrightarrow \text{Sulphuryl Chloride}}$$

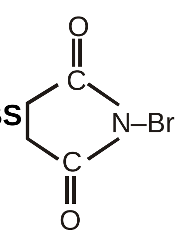
Mechanism. (free radical substitution)

1. $Cl—\overset{O}{\overset{\|}{\underset{\underset{O}{\|}}{S}}}—Cl \xrightarrow{h\nu} \dot{Cl} + Cl—\overset{O}{\overset{\|}{\underset{\underset{O}{\|}}{S}}}\bullet \longrightarrow SO_2 + \dot{Cl}$

2. $R—H + \dot{Cl} \longrightarrow H—Cl + \dot{R} + \dot{Cl} \longrightarrow R— Cl.$

(Reaction rate is slow; selective and better method then direct halogenation)

(4) **NBS**

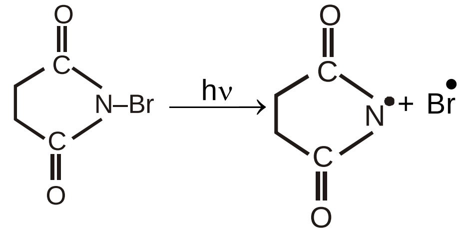


(N-Bromo Succinimide)

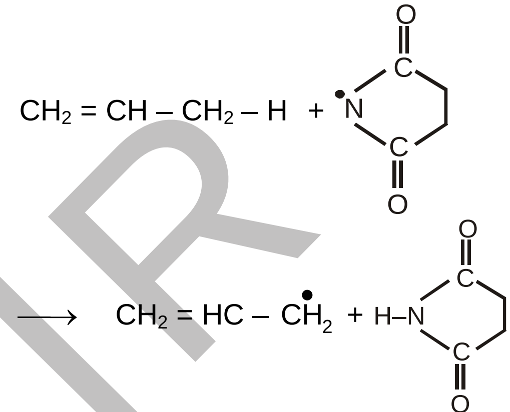
$$CH_3 — CH = CH_2 \xrightarrow{NBS} \underset{\underset{Br}{|}}{CH_2} — CH = CH_2$$

Mechanism:–

(1)

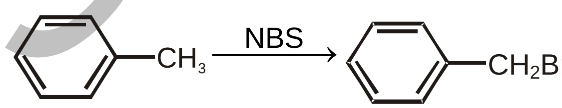


(2)

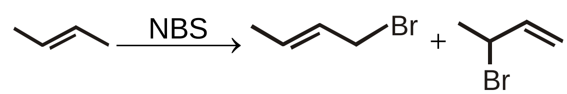


(3) $CH_2 = CH – \dot{C}H_2 + \dot{Br} \longrightarrow$
$CH_2 = CH – CH_2 – Br$

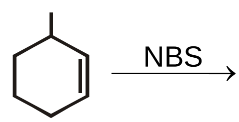
Q.1



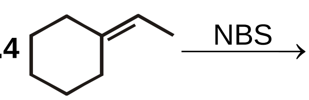
Q.2



Q.3



Q.4



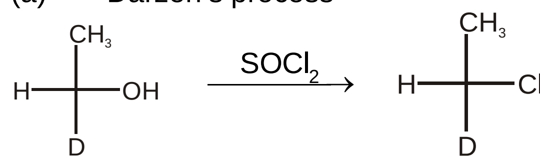
Imp.

$$\boxed{CH_3 - CH = CH_2 \xrightarrow[500^\circ C]{Cl_2} \underset{\underset{Cl}{|}}{CH_2} - CH = CH_2}$$

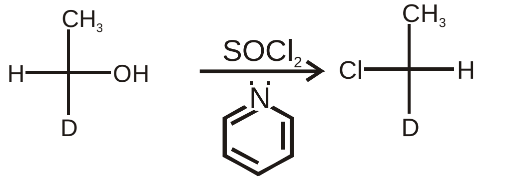
at high temperature free radical substitution and not Non-classical carbocation addition

(5) From alcohols

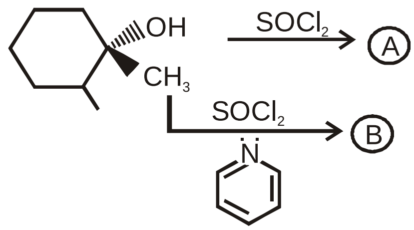
(a) Darzen's process

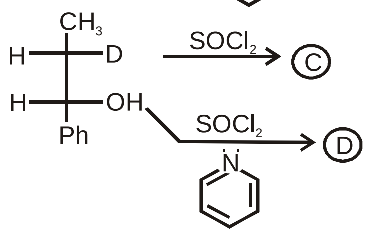


$+ SO_2 + HCl$ (Retention of configuration)



+ SO_2 + HCl (inversion of configuration)

Q.1 

Q.2 

(b) R—OH + Lucas Reagent ($HCl/ZnCl_2$)

$R\text{—}OH \xrightarrow{HCl/ZnCl_2} R\text{—}Cl$ (Turbidity)

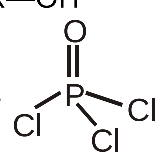
Test to distinguish 1° / 2° / 3° – alcohol.
3° – alcohol $\longrightarrow$ within seconds
2° – alcohol $\longrightarrow$ within minutes
1° – alcohol $\longrightarrow$ within hrs

$R\text{—}OH \xrightarrow{HI} R\text{—}I$

$R\text{—}OH \xrightarrow{KBr}$ No. Reaction

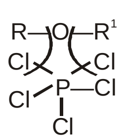
(c) $R\text{—}OH \xrightarrow{PCl_3} R\text{—}Cl + H_3PO_3$
(SN^2)

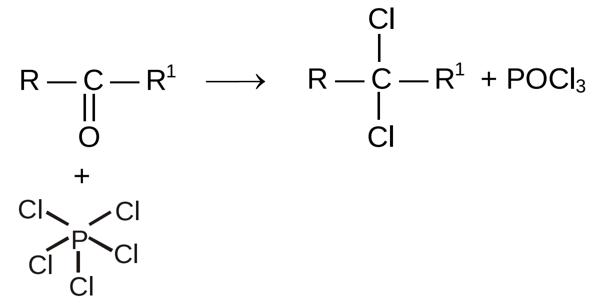
$R\text{—}OH \xrightarrow{PCl_5} R\text{—}Cl$

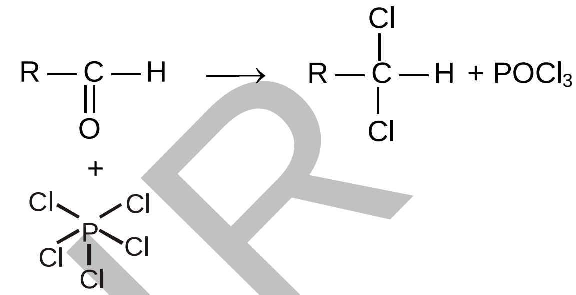
+  (SN^i (or SN^2))

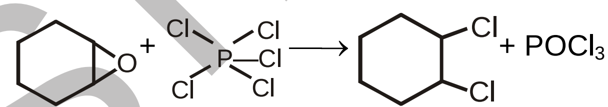
(high temperature SN^2 dominates)

PCl_5

(1)  $\longrightarrow$ R—Cl + R'—Cl + $POCl_3$

(2) 

(3) 

(4) 

(6) **From ethers**

$R\text{—}O\text{—}R' \xrightarrow[\text{(anhydrous)}]{HI}$

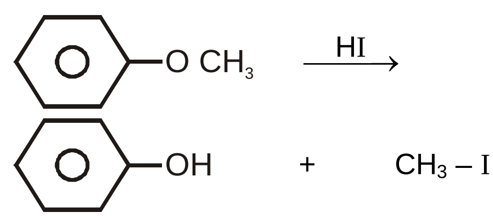
R—OH + R'– I(SN^2)

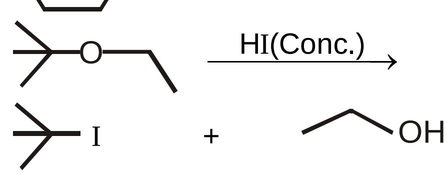
$R\text{—}O\text{—}R' \xrightarrow{HI(Conc.)}$

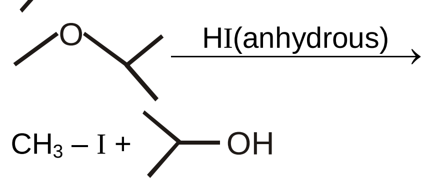
R—OH + R'– I(SN^1)

$R\text{—}O\text{—}R' \xrightarrow[\text{(excess)}]{HI}$

R— I + R'– I

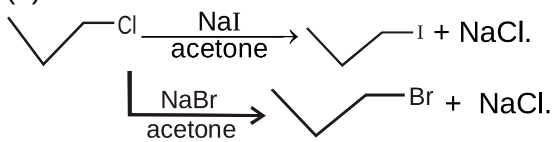
Q.1 

Q.2 

Q.3 

(7) Halide exchange Reaction

(a) Finkelstein Reaction



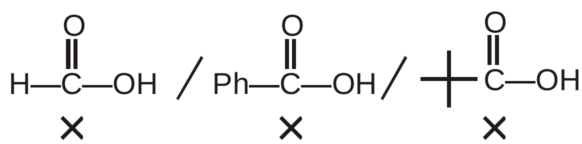
(b) Swartz Reaction

$$R{-}Cl \xrightarrow[\text{or AgF}]{NaF/DMF} R{-}F + NaCl.$$

(8) H.V.Z. Reaction (Hell Volhard Zelinesky)

$$CH_3{-}\overset{O}{\overset{\|}{C}}{-}OH \xrightarrow[Cl_2]{Red\,P} \underset{Cl}{\underset{|}{CH_2}}{-}\overset{O}{\overset{\|}{C}}{-}OH$$

Imp



(a) Hunds diecker Reaction

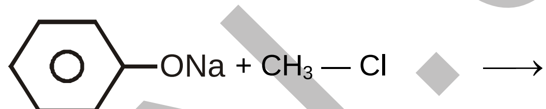
$$R{-}\overset{O}{\overset{\|}{C}}{-}OH \xrightarrow[2.\,Br_2/CCl_4/\Delta]{1.\,AgOH} R - Br$$

Properties of Halogen Derivatives

(1) Williamson ether synthesis

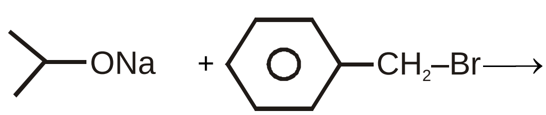
$R{-}ONa + R^1 - Cl \longrightarrow$

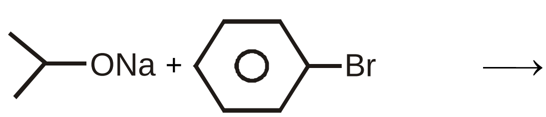
$R{-}O{-}R^1 + NaCl \quad (SN^2)$

Q.1 

Q.2 

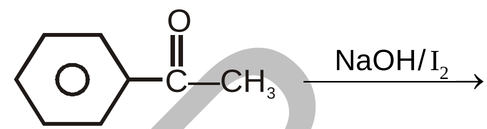
Q.3 

Q.4 

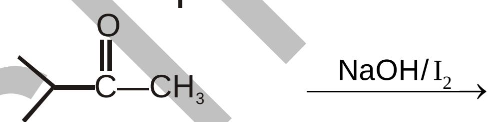
Q.5 

(2) Haloform Reaction

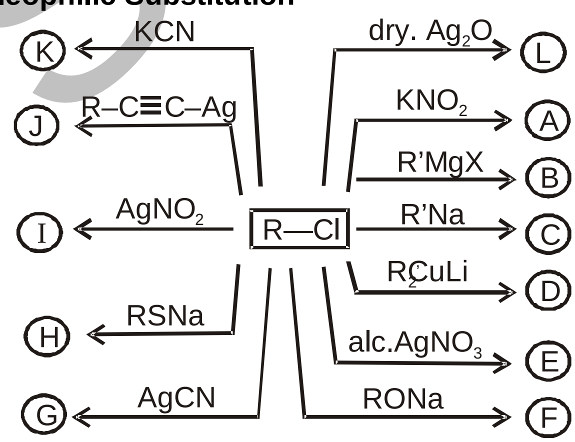
$$CH_2{-}\overset{O}{\overset{\|}{C}}{-}H \xrightarrow{I_2/NaOH} \underset{\text{(yellow)}}{CHI_3} + H{-}\overset{O}{\overset{\|}{C}}{-}O^- Na^+$$

Q.1 

Q.2 

Q.3 

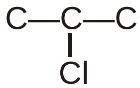
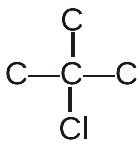
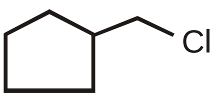
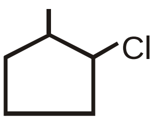
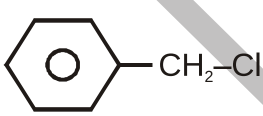
Nucleophilic Substitution



(4) Hoffmann exhaustive alkylation

$$CH_3{-}Cl \xrightarrow{NH_3} \left(CH_3{-}\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{N^{\oplus}}}}}{-}CH_3\right) Cl^-$$

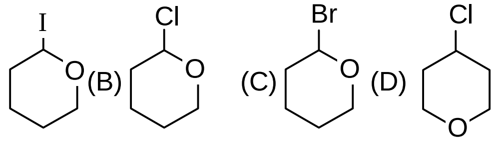
(5) With $AgNO_3$(aq) & $AgNO_3$(alc.)

	Substrate	Gives ppt. with aq. $AgNO_3$	Gives ppt. with alc. $AgNO_3$
1.	C—C—C—Cl		
2.			
3.			
4.			
5.			
6.			
7.	C = C — Cl		
8.	C = C – CH_2 – Cl		
9.			
10.			

EXERCISE – I

Q.1 Which one of the following compounds will be most reactive for S_N1 reactions :

(A) (B) (C) (D)



Q.2 Consider the following groups :

(I) — OAc (II) — OMe

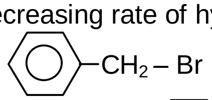
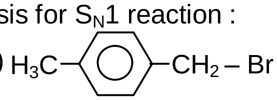
(III) — O — SO_2 – Me (IV) — O — SO_2 — CF_3

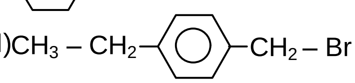
The order of leaving group nature is :

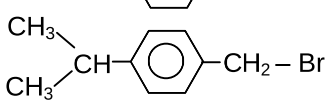
(A) I > II > III > IV (B) IV > III > I > II

(C) III > II > I > IV (D) II > III > IV > I

Q.3 Arrange the following compounds in order of decreasing rate of hydrolysis for S_N1 reaction :

(I)  (II) 

(II) 

(IV) 

(A) II > III > IV > I (B) IV > III > II > I

(C) III > IV > II > I (D) I > II > III > I

Q.4 Consider the given reaction :

$CH_3 - CH = CH - CH_2 - OH \xrightarrow[S_N1']{HBr} [P]$

In the given reaction the product [P] is :

(A) $CH_3 - CH = CH - CH_2 - Br$

(B) $CH_3 - \underset{}{\overset{Br}{CH}} - CH = CH_2$

(C) $CH_2 = CH - CH = CH_2$

(D) $CH_3 - \overset{Br}{CH} - CH_2 - CH_2 - OH$

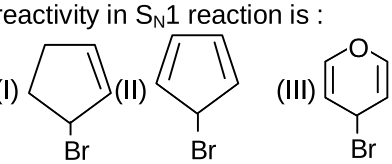
Q.5 The given compound $CH_3 - O - CH_2 - Br$ gives which one of the following reactions :

(A) Only S_N1 (B) Only S_N2

(C) S_N1 as well as S_N2 (D) E1

Q.6 Among the bromides I-III given below, the order of reactivity in S_N1 reaction is :

(I) (II) (III)



(A) III > I > II (B) III > II > I

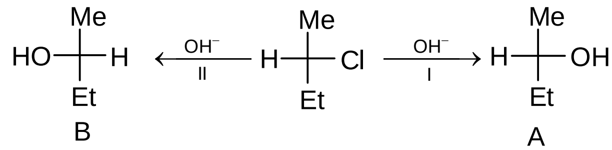
(C) II > III > I (D) II > I > III

Q.7 Which of the following compounds is most rapidly hydrolysed by S_N1 mechanism.

(A) C_6H_5Cl (B) $Cl - CH_2 - CH = CH_2$

(C) $(C_6H_5)_3CCl$ (D) $C_6H_5CH_2Cl$

Q.8

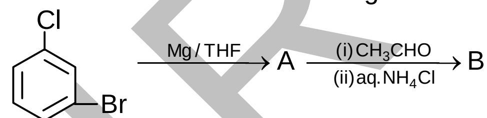


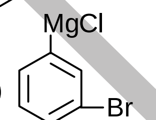
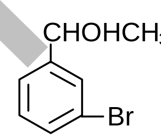
Steps I and II are

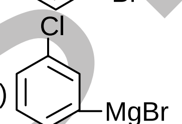
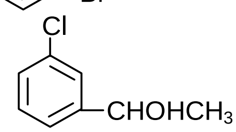
(A) I can't be S_N1 (B) II can't be S_N1

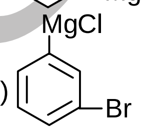
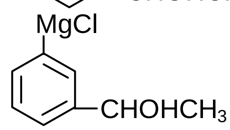
(C) I S_N1 & II S_N2 (D) I S_N2 & II S_N1

Q.9 What are A & B in the following reaction ?



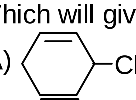
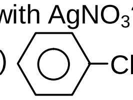
(A)  & 

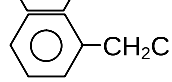
(B)  & 

(C)  & 

(D) None of these

Q.10 Which will give white ppt. with $AgNO_3$?

(A)  (B) 

(C)  (D) Both A & C

Q.11 When ethyl bromide is treated with moist Ag_2O, main product is :

(A) Ethyl ether (B) Ethanol

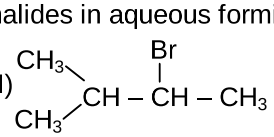
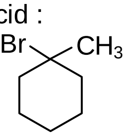
(C) Ethoxy ethane (D) All of the above

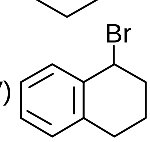
Q.12 When ethyl bromide is treated with dry Ag_2O,main product is :

(A) Ethyl ether (B) Ethanol

(C) Ethoxy ethane (D) All of the above

Q.13 Consider the S_N1 solvolysis of the following halides in aqueous formic acid :

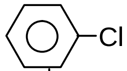
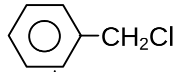
(I)  (II) 

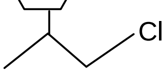
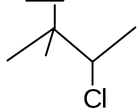
(III) $C_6H_5 - \underset{Br}{CH} - C_6H_5$ (IV) 

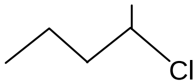
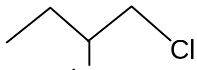
Which one of the following is correct sequence of the halides given above in the decreasing order of their reactivity?

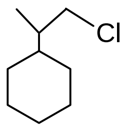
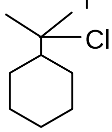
(A) III > IV > II > I (B) II > IV > I > III
(C) I > II > III > IV (D) III > I > II > IV

Q.14 In the given pair in which pair the first compound is more reactive than second for S_N1 reaction

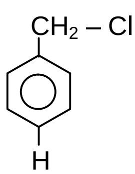
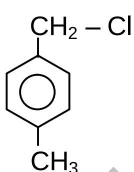
(A)  

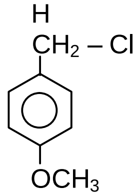
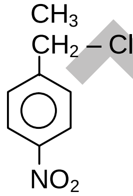
(B)  

(C)  

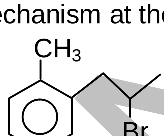
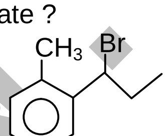
(D)  

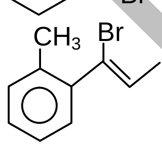
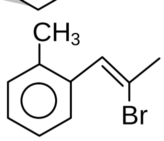
Q.15 Which of the following is most reactive toward S_N1.

(A)  (B) 

(C)  (D) 

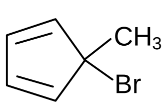
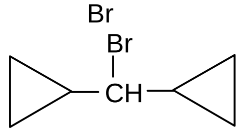
Q.16 Which compound undergoes hydrolysis by the S_N1 mechanism at the fastest rate ?

(A)  (B) 

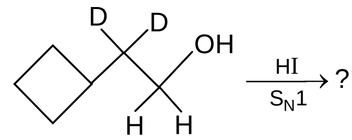
(C)  (D) 

Q.17 Arrange the following compounds in decreasing order of their reactivity for hydrolysis reaction

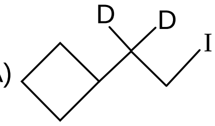
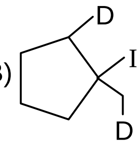
(I) $C_6H_5-CH_2-Br$ (II) $C_6H_5-CH(Br)-C_2H_5$

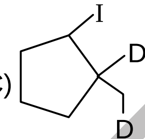
(III)  (IV) 

(A) I > II > III > IV (B) IV > II > I > III
(C) III > IV > II > I (D) IV > III > II > I

Q.18 

Major product is :

(A)  (B) 

(C)  (D) None of these

Q.19 Which one of the following compounds will give enantiomeric pair on treatment with HOH ?

(A) $C_6H_5-C(C_2H_5)(C_2H_5)-I$ (B) $CH_3-C(CH_3)(C_2H_5)-Br$

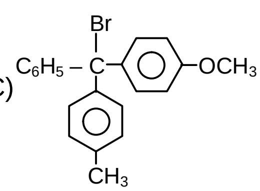
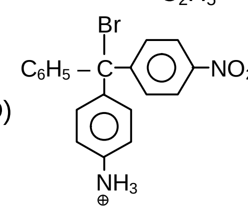
(C) $C_6H_5-C(H)(D)-Br$ (D) $C_2H_5-C(C_2H_5)(CH_3)-Br$

Q.20 For the given reaction

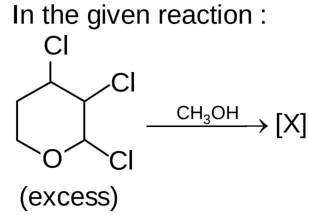
$$R-C(R_1)(R_2)-X \xrightarrow{HOH} R-C(R_1)(R_2)-OH$$

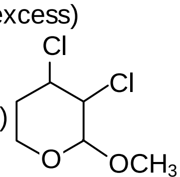
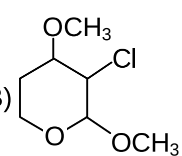
Which substrate will give maximum racemisation ?

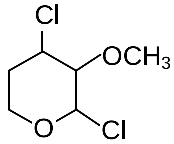
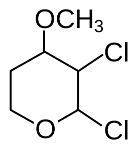
(A) $C_6H_5-C(CH_3)(C_2H_5)-Br$ (B) $CH_2=CH-C(CH_3)(C_2H_5)-Br$

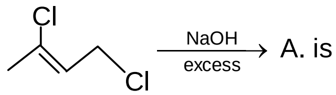
(C)  (D) 

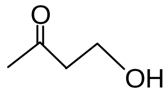
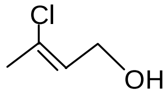
Q.21 In the given reaction :

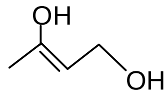
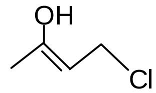


(A)  (B) 

(C)    (D) 

Q.22 

(A)    (B) 

(C)    (D) 

Q.23 Compare the two methods shown for the preparation of carboxylic acids :

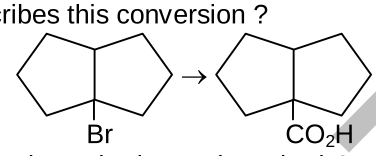
Method 1 : RBr $\xrightarrow[\text{diethyl ether}]{\text{Mg}}$ RMgBr

$\xrightarrow[\text{(ii)} H_3O^+]{\text{(I)} CO_2}$ RCO_2H

Method 2 : RBr $\xrightarrow{\text{NaCN}}$ RCN

$\xrightarrow[\text{heat}]{H_2O, HCl}$ RCO_2H

Which of the following statements correctly describes this conversion ?



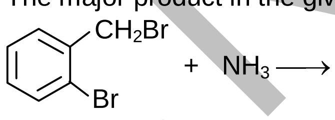
(A) Both method 1 and method 2 are appropriate for carrying out this conversion

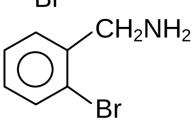
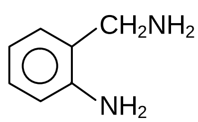
(B) Neither method 1 nor method 2 is appropriate for carrying out this conversion.

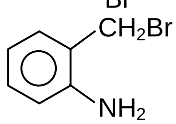
(C) Method 1 will work well, but method 2 is not appropriate

(D) Method 2 will work well, but method 1 is not appropriate

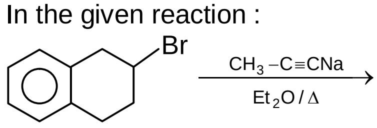
Q.24 The major product in the given reaction



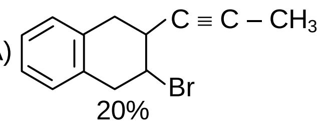
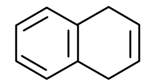
(A)    (B) 

(C)    (D) All of these

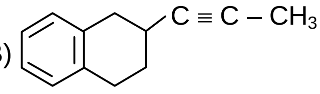
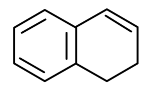
Q.25 In the given reaction :



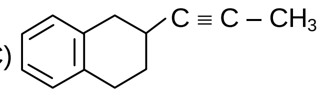
the products are :

(A)  and 

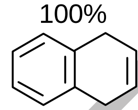
20%   80%

(B)  + 

20%   80%

(C) 

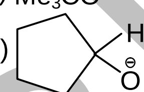
100%

(D) 

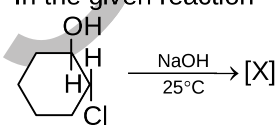
100%

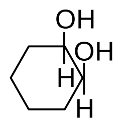
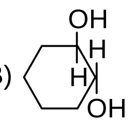
Q.26 Which of the following nucleophile will show minimum reactivity towards S_N2 reaction :

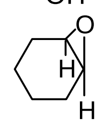
(A) $Me_3C\overset{\ominus}{O}$ (B) $Me\overset{\ominus}{O}$

(C)    (D) $Me_2CH\overset{\ominus}{O}$

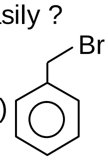
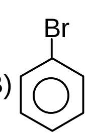
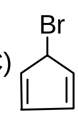
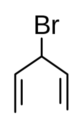
Q.27 In the given reaction



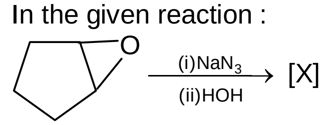
(A)    (B) 

(C) Mixture of (A) and (B) (D) 

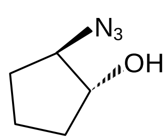
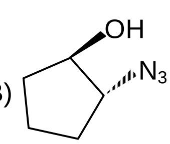
Q.28 Which of the following can not give S_N1 reaction easily ?

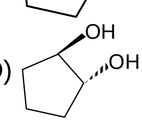
(A)    (B)    (C)    (D) 

Q.29 In the given reaction :



[X] will be

(A)    (B) 

(C) Mixture of (A) and (B)   (D) 

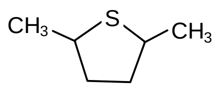
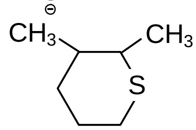
Q.30 In the given reaction :

$CH_3 - \underset{\mid \atop OTs}{CH} - CH_2 - CH_2 - \underset{\mid \atop OTs}{CH} - CH_3 \xrightarrow[\text{(ii) KOH}]{\text{(i) } \overset{\ominus}{S}H \text{ (one equivalent)}} [x]$

[X] will be :

(A) $CH_3 - \overset{OTs \atop \mid}{CH} - CH_2 - CH_2 - \overset{\overset{\ominus}{S} \atop \mid}{CH} - CH_3$

(B) $CH_3 - \underset{\mid \atop \underset{\ominus}{S}}{CH} - CH_2 - CH_2 - \underset{\mid \atop \underset{\ominus}{S}}{CH} - CH_3$

(C)  (D) 

Q.31 For $CH_3Br + OH^- \longrightarrow CH_3OH + Br^-$

the rate of reaction is given by the expression :

(A) rate = k [CH_3Br] (B) rate = k [OH^-]

(C) rate = k [CH_3Br] [OH^-]

(D) rate = k[CH_3Br]° [OH^-]°

Q.32 Non-occurrence of the following reaction

$Br^- + CH_3OH \longrightarrow BrCH_3 + OH^-$, is due to

(A) Attacking nucleophile is stronger one

(B) Leaving group is a strong base

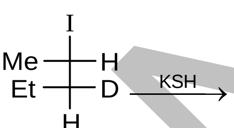
(C) Alcohols are not good substrate

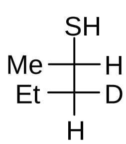
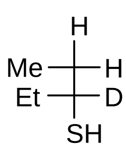
(D) Hydroxide ions are weak bases

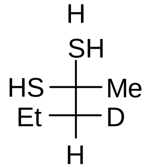
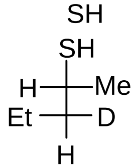
Q.33 The reactivity of 2-bromo-2-methylbutane (I), 1-bromopentane (II) and 2-bromopentane(III) towards S_N2 displacement is such that :

(A) I > II > III (B) I > III > II

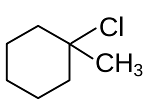
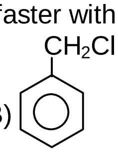
(C) II > III > I (D) II > I > III

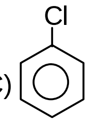
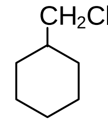
Q.34 

(A)  (B) 

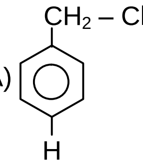
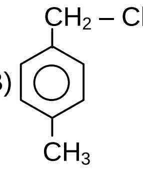
(C)  (D) 

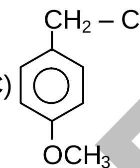
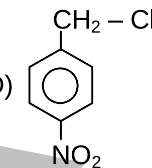
Q.35 Which reaction proceeds faster with NaI is DMSO.

(A)  (B) 

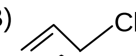
(C)  (D) 

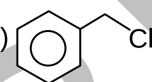
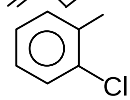
Q.36 Which of the following is most reactive toward S_N2.

(A)  (B) 

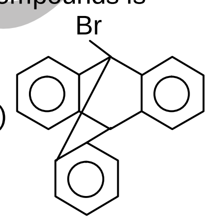
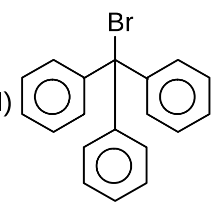
(C)  (D) 

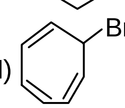
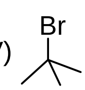
Q.37 In which of the following, replacement of Cl^- is most difficult?

(A)  (B) 

(C)  (D) 

Q.38 Correct order of rate of hydrolysis for following compounds is

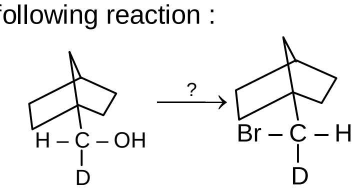
(I)  (II) 

(III)  (IV) 

(A) III > II > IV > I (B) I > II > III > IV

(C) III > I > II > IV (D) III > II > I > IV

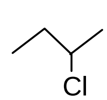
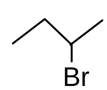
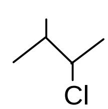
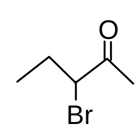
Q.39 Which reaction conditions (reagents) is suitable for the following reaction :



(A) Br_2 / CCl_4 (B) $SOBr_2$

(C) HBr / conc. H_2SO_4 (D) PBr_3

Q.40 Arrange these compounds in order of increasing S_N2 reaction rate :

(I) (II) (III) (IV)

(A) III < I < II < IV (B) III < II < I < IV

(C) IV < III < I < II (D) III < IV < I < II

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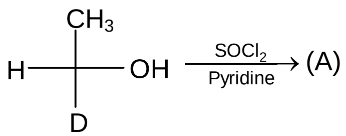
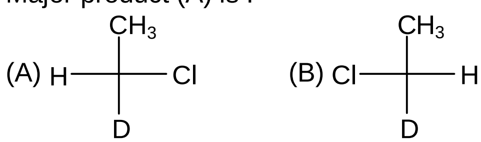
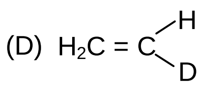
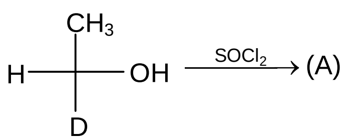
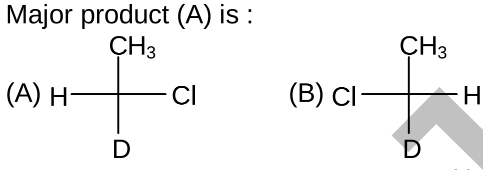
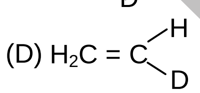
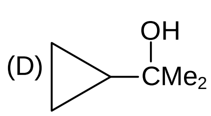
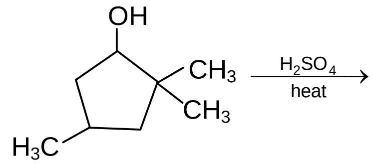
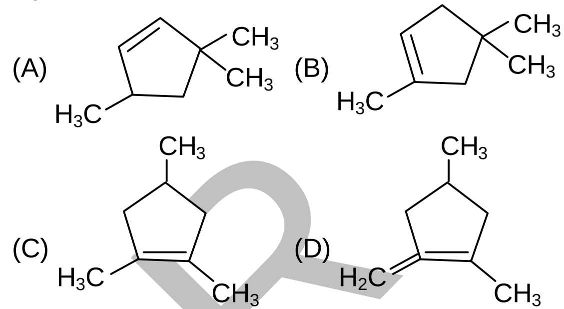
Q.41 The reaction of $SOCl_2$ on alkanols to form alkyl chlorides gives good yields because
(A) Alkyl chlorides are immiscible with $SOCl_2$
(B) The other products of the reaction are gaseous and escape out
(C) Alcohol and $SOCl_2$ are soluble in water
(D) The reaction does not occurs via intermediate formation of an alkyl chloro sulphite

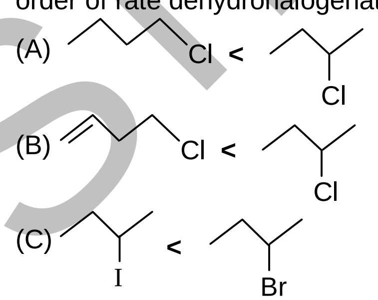
Q.42

Major product (A) is :

(C) $H_2C = CH_2$


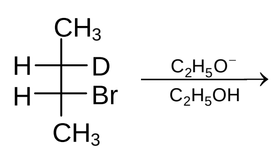
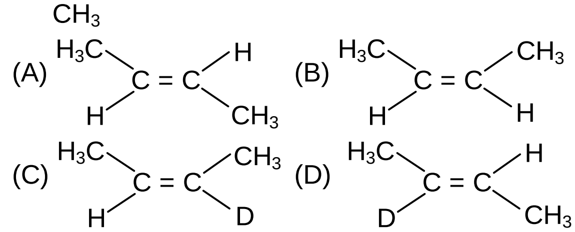
Q.43

Major product (A) is :

(C) $H_2C = CH_2$


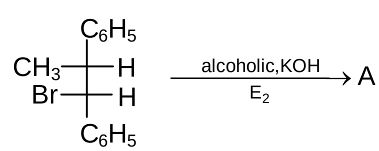
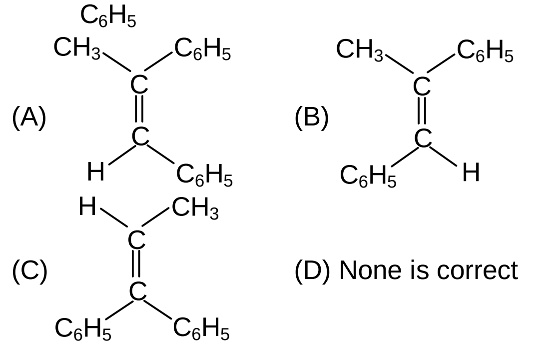
Q.44 In the given reaction :
$CH_3 - CH_2 - \ddot{\underset{\cdot\cdot}{S}} - \dot{C}H_2 - CH_2 - Br \xrightarrow{HOH} [X]$
[X] will be :
(A) $CH_3 - CH_2 - S - \overset{*}{C}H_2 - CH_2 - OH$
(B) $CH_3 - CH_2 - S - CH_2 - \overset{*}{C}H_2 - OH$
(C) 1 : 1 mixture of (A) and (B)
(D) 2 : 1 mixture of (A) and (B)

Q.45 $Me_2C = CH - CH_2 - CH_2 - Cl \xrightarrow{H_2O} (X)$
Major product of above reaction is
(A) $Me - \underset{Me}{\overset{OH}{C}} - CH_2 - CH_2 - CH_2$
(B) $Me_2C = CH - CH_2 - CH_2 - OH$
(C) $Me_2C = CH - \underset{OH}{CH} - CH_2 - OH$


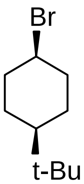
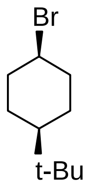
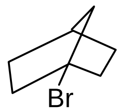
Q.46 The major product formed in the following reaction is :



Q.47 In the given pairs, which pair represent correct order of rate dehydrohalogenation reaction

(D) $CH_3 - CH_2 - Cl < CD_3 - CD_2 - Cl$

Q.48

? Major product is :


Q.49


(D) None is correct

Q.50 The rate of elimination (using EtONa) of :.

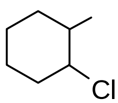
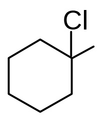
(I)  (II)  (III) 

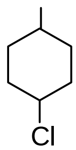
(A) I > II > III (B) I > III > II
(C) II > I > III (D) III > I > II

EXERCISE – II

Q.1 S_N1 & S_N2 is not favourable in
(A) $H_2C = CH - Cl$ (B) $Ph - CH_2 - Cl$
(C) $Ph - Cl$ (D) $H_2C = CH - CH_2 - Cl$

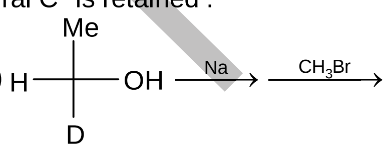
Q.2 S_N1 & S_N2 product are same in (excluding stereoisomer)

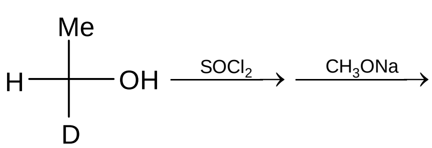
(A)  (B) 

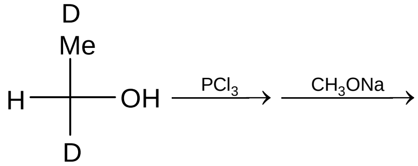
(C)  (D) $Ph - \underset{CH_3}{\underset{|}{CH}} - \underset{Cl}{\underset{|}{CH}} - CH_3$

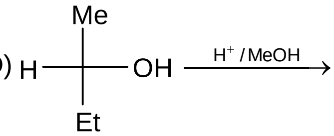
Q.3 Which of the following statements is/are **true** ?
(A) $CH_3 - CH_2 - CH_2 - I$ will react more readily than $(CH_3)_2CHI$ for S_N2 reactions.
(B) $CH_3 - CH_2 - CH_2 - Cl$ will react more readily than $CH_3 - CH_2 - CH_2 - Br$ for S_N2 reactions.
(C) $CH_3 - CH_2 - CH_2 - CH_2 - Br$ will react more readily than $(CH_3)_3C - CH_2 - Br$ for S_N2 reactions.
(D) $CH_3 - O - C_6H_4 - CH_2Br$ will react more readily than $NO_2 - C_6H_5 - CH_2Br$ for S_N2 reactions.

Q.4 In which of the following case configuration about chiral C* is retained :

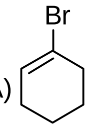
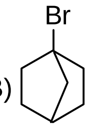
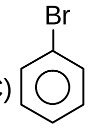
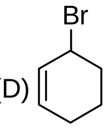
(A) 

(B) 

(C) 

(D) 

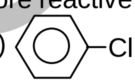
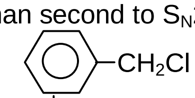
Q.5 S_N2 reaction will be negligible in

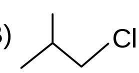
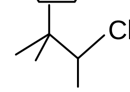
(A)  (B)  (C)  (D) 

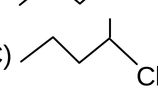
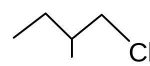
Q.6 Rate of S_N2 depends on
(A) Conc. of Nucleophile (B) Conc. of substrate
(C) Nature of leaving group (D) Nature of solvent

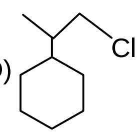
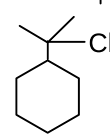
Q.7 Correct statement(s) for the product(s) of following reaction.
$CH_2 = CH - CH_2 - Ph \xrightarrow{Cl_2\,/\,500°C}$
(A) Four different products are formed
(B) Two optically active products are formed
(C) The optically active compound formed here can also be made by the reaction of HCl
(D) The reaction path is free radical substitution.

Q.8 In the given pair in which pair the first compound is more reactive than second to S_N2 reaction.

(A)  

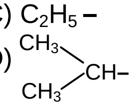
(B)  

(C)  

(D)  

Q.9 A gem dichloride is formed in the reaction :
(A) CH_3CHO and PCl_5 (B) CH_3COCH_3 and PCl_5
(C) $CH_2 = CH_2$ and Cl_2 (D) $CH_2 = CHCl$ and HCl

Q.10 Match List – I with List – II for given S_N2 reaction & select the correct answer from the codes given below
$Z - CH_2Br + CH_3\overset{\ominus}{O} \longrightarrow Z - CH_2 - OCH_3 + Br^{\ominus}$

List – I	**List – II (relative reactivity)**
(A) H–	(P) 0.1
(B) CH_3-	(Q) 3
(C) C_2H_5-	(R) 1
(D) 	(S) 100

Q.11 In which product formation takes place according to Hoffmann's rule

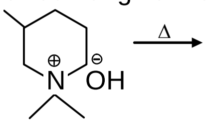
(A) $CH_3CH_2-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3 \xrightarrow[\Delta]{t\text{–}Bu\,\overset{\ominus}{O}\,\overset{\oplus}{K}}$

(B) $CH_3CH_2-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3 \xrightarrow[\Delta]{CH_3CH_2\overset{\ominus}{O}\overset{\oplus}{K}}$

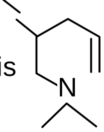
(C) $CH_3CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\overset{\oplus}{N}(CH_3)_3 \xrightarrow[\Delta]{\overset{\ominus}{OH}}$

(D) $CH_3CH_2\underset{\displaystyle \overset{\oplus}{S}(CH_3)_2}{\underset{|}{CH}}-CH_3 \xrightarrow[\Delta]{\overset{\ominus}{OH}}$

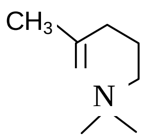
Q.12 Which of following are correct for given reaction



(A) Major product of reaction is



(B) Major product is



(C) The reaction is thermal elimination reaction (E^{1CB})

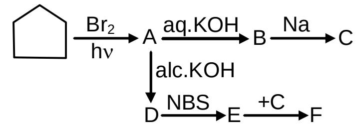
(D) The reaction is E_2 reaction

Q.13 Match the List I (reaction) with List II (reaction intermediate) and select the correct answer using the codes given below the Lists.

List I	List II
(A) $CF_3-CHCl_2 \xrightarrow{alc.KOH/\Delta} CF_2=CCl_2$	(1) Transition state
(B) $CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-OH \xrightarrow{H^{\oplus}} CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2$	(2) Carbocation
(C) $CH_3-CH_2-Br \xrightarrow[\Delta]{alc.KOH} CH_2=CH_2$	(3) Carbanion
(D) $CH_3-\overset{\displaystyle Br}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-CH_3 \xrightarrow{alc.KOH/\Delta} CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2$	(4) Free radical

EXERCISE – III

Q.1 Identify A, B, C, D, E and F in the following series of reaction.



Q.2 What are the products of the following reactions?

(a) $CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-Cl+\bar{O}CH_3 \longrightarrow$

(b) $CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-O^-+CH_3-X \longrightarrow$

Q.3 Complete the following by providing the structure of (A),(B), (C) and (D).

(i) $CH_3CH_2CH_2OH \xrightarrow{PBr_3} (A) \xrightarrow{Alc.KOH} (B) \xrightarrow{HBr} (C) \xrightarrow{NH_3} (D)$

(ii) $CH_3CH_2CH_2I \xrightarrow{Alc.KOH} (A) \xrightarrow{H^+/H_2O} (B) \xrightarrow{SOCl_2} (C) \xrightarrow[LiAlH_4]{H} (D)$

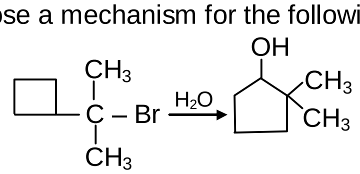
(iii) $CH_3CH_2CH=CH_2 \xrightarrow[Light]{NBS} (A) \xrightarrow{Alc.KOH} (B) \xrightarrow{HBr} (C)$

(iv) $CH_3CH_2MgBr \xrightarrow{CH_3CHO/H_2O} (A) \xrightarrow{HBr} (B) \xrightarrow{Alc.KOH} (C)$

Q.4 CH_3-CH_2I reacts more rapidly with strong base in comparison to CD_3CH_2I.

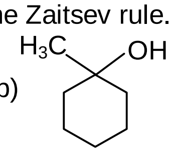
Li **List II**

Q.5 Propose a mechanism for the following reactions.

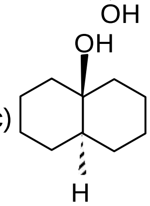


Q.6 Each of the following alcohols has been subjected to acid catalyzed dehydration and yields a mixture of two isomeric alkenes. Identify the two alkenes in each case, and predict which one is the major product on the basis of the Zaitsev rule.

(a) $(CH_3)_2\underset{\displaystyle OH}{\underset{|}{C}}CH(CH_3)_2$ (b)



(c)



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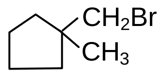
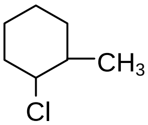
Q.7 Give the major product (with proper explanation) when following halogen compounds are treated with sodium ethoxide.

(a) $CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - \underset{\displaystyle CH_3}{\underset{|}{CHCH_3}}$

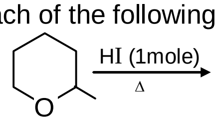
(b) 

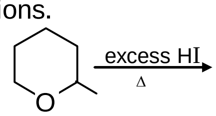
(c) 

Q.8 2-chloro-3-methylbutane on treatment with alcoholic potash gives 2-methylbutene-2 as major product.

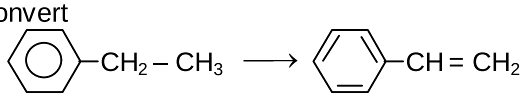
Q.9 KCN reacts with R – I to give alkyl cyanide, while AgCN results in isocyanide as major product.

Q.10 Predict the product(s) and write the mechanism of each of the following reactions.

(i) 

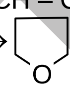
(ii) 

Q.11 Convert

(i) 

(ii) $CH_3CH_2CH = CH_2 \longrightarrow CH_3CH_2CH_2CH_2NH_2$

(iii) $CH_3CH_2CH = CH_2 \longrightarrow CH_2 = CH - CH = CH_2$

(iv) $OH - CH_2 - CH_2CH = CH_2 \longrightarrow$ 

Q.12 Treatment of 2-bromobutane with hot alcoholic KOH gives a mixture of three isomeric butenes (A), (B) and (C). Ozonolysis of the minor product (A), gives formaldehyde and another aldehyde in equimolar amounts. What are the structural formulae of (A),(B) and (C)?

Q.13 A hydrocarbon C_8H_{10} (A) on ozonolysis gives compound $C_4H_6O_2$ (B) only. The compound (B) can also be obtained from the alkyl bromide C_3H_5Br (C) upon treatment with magnesium in dry ether followed by CO_2 and acidification. Identify (A), (B) and (C) and also give equations for the reactions.

EXERCISE – IV(A)

Q.1 Aryl halides are less reactive towards nucleophilic substitution reaction as compared to alkyl halides due to **[IIT 1990]**

(A) The formation of less stable carbonium ion
(B) Resonance stabilization
(C) The inductive effect
(D) sp^2 hybridised carbon attached to the halogen

Q.2 Arrange the following compounds in order of increasing dipole moment **[IIT 1996]**

Toluene I	m-dichlorobenzene II
o-dichlorobenzene III	p-dichlorobenzene IV

(A) I < IV < II < III (B) IV < I < II < III
(C) IV < I < III < II (D) IV < II < I < III

Q.3 $(CH_3)_3CMgCl$ reaction with D_2O produces : **[IIT 1997]**

(A) $(CH_3)_3CD$ (B) $(CH_3)_3OD$
(C) $(CD_3)_3CD$ (D) $(CH_3)_3OD$

Q.4 The order of reactivity of the following alkyl halides for a S_N2 reaction is : **[IIT 2000]**

(A) RF > RC > R – Br > R – I
(B) R – F > R – Br > R – Cl > R – I
(C) R – Cl > R – Br > RF > R I
(D) R – I > RBr > R – Cl > R – F

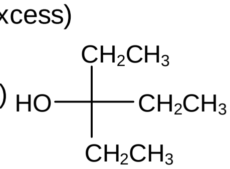
Q.5 Identify the set of reagents / reaction conditions 'X' and 'Y' in the following set of transformation :

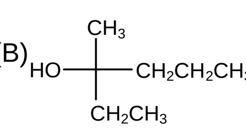
$CH_3 - CH_2 - CH_2Br \xrightarrow{X} \text{Product} \xrightarrow{Y} CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$ **[IIT 2002]**

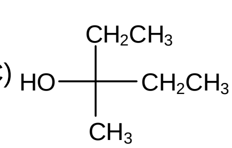
(A) X = dilute aqueous NaOH, 20°C; Y = HBr / acetic acid, 20°C
(B) X = concentrated alcoholic NaOH, 80°C; Y = HBr / acetic acid 20°C
(C) X = dilute aqueous NaOH, 20°C; Y = $Br_2/CHCl_3$, 0°C
(D) X = concentrated alcoholic NaOH, 80°C; Y = Br_2 / $CHCl_3$, 0°C

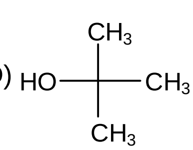
Q.6 CH_3MgBr + Ethyl ester $\rightarrow$ which can be formed as product **[IIT 2003]**

(excess)

(A) 

(B) 

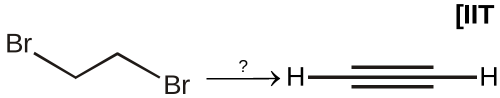
(C) 

(D) 

Q.7 Match the following **[IIT 2006]**

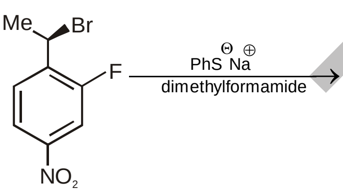
Column I	**Column II**
(A) $CH_3 - CHBr - CD_3$ on treatment with alc. KOH gives $CH_2 = CH - CD_3$ as a major product	(P) E1 reaction
(B) $Ph - CHBr - CH_3$ reacts faster than $Ph - CHBr - CD_3$	(Q) E2 reaction
(C) $Ph - CD_2-CH_2Br$ on treatment with $C_2H_5OD/C_2H_5O^-$ gives $Ph - CD = CH_2$ as the major product.	(R) E1 cb reaction
(D) $PhCH_2CH_2Br$ and $PhCD_2CH_2Br$ react with same rate	(S) First order reaction

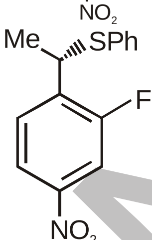
Q.8 The reagent(s) for the following conversion, **[IIT 2007]**

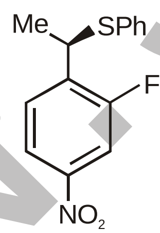


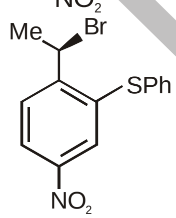
(A) alcoholic KOH
(B) alcoholic KOH followed by $NaNH_2$
(C) aqueous KOH followed by $NaNH_2$
(D) Zn/CH_3OH

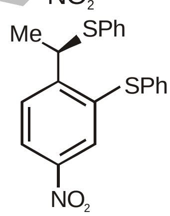
Q.9 The major product of the following reaction is **[IIT 2008]**

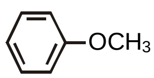


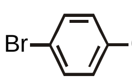
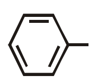
(A) 

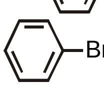
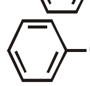
(B) 

(C) 

(D) 

Q.10 In the reaction  $\xrightarrow{HBr}$ the products are

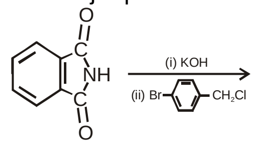
(A)  and H_2 (B)  and CH_3Br

(C)  and CH_3OH (D)  and CH_3Br

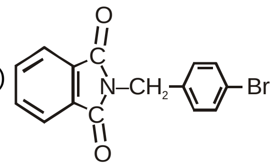
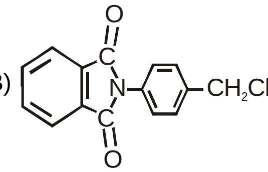
[IIT-JEE 2010]

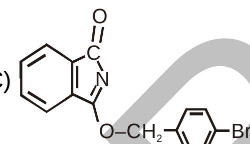
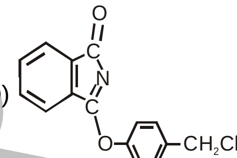
Q.11 The total number of alkenes possible by dehydrobromination of 3-bromo-3-cyclopentylhexane using alcoholic KOH is **[IIT-JEE 2011]**

Q.12 The major product of the following reaction is



[IIT-JEE 2011

(A)  (B) 

(C)  (D) 

EXERCISE – IV(B)

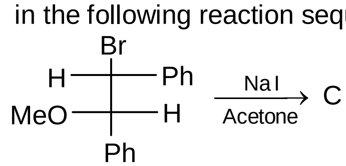
Q.1 Identify the major product in[II the following reactions : **[IIT 1993]**

(i) $C_6H_5 - CH_2 - \overset{\overset{\large Cl}{|}}{C}H - CH_3 \xrightarrow[KOH\,\Delta]{alcoholic} ? \xrightarrow{HBr} ?$

(ii) $C_6H_5COOH + CH_3MgI \longrightarrow ? + ?$

Q.2 An alkyl halide X of formula $C_6H_{13}Cl$ on treatment with potassium tertiary butoxide gives two isomeric alkenes Y and Z (C_6H_{12}). Both alkenes on hydrogenation give 2, 4-dimethylbutane. Predict the structures of X, Y and Z. **[IIT 1996]**

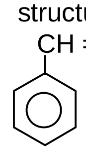
Q.3 Predict the structure of the intermediates/products in the following reaction sequence- **[IIT 1996]**



Q.4 (a) $C_6H_5CH_2\overset{\overset{\large C_6H_5}{|}}{C}HCl \xrightarrow[Heat]{Alcoholic\,KOH} A + B$ Write structures of (A) and (B).

(b) $(CH_3)_2CHOCH_3 \xrightarrow[Heat]{HI(excess)} A + B$ Write structures of A and B. **[IIT 1998]**

Q.5 Complete the following reaction with appropriate structures of products / reagents. **[IIT 1998]**

 $\xrightarrow{Br_2}$ (A) $\xrightarrow[(II)\,CH_3I]{(i)\,NaNH_2\,(3equi.)}$ (B)

Q.6 What would be major product ? **[IIT-JEE 2000]**

$$CH_3 - \underset{\underset{\large CH_3}{|}}{\overset{\overset{\large CH_3}{|}}{C}} - CH_2Br \xrightarrow[\Delta]{C_2H_5OH} ?$$

ANSWER KEY

EXERCISE - I

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	A	B	A	B	C	A	C	C	B	D	B	C	A	C	C	B	B	B	C	C
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	A	B	C	A	B	A	D	C	C	C	C	B	C	D	B	D	D	A	D	C
Ques.	44	42	43	44	45	46	47	48	49	50										
Ans.	B	B	A	C	D	C	A	C	A	A										

EXERCISE – II

Ques.	1	2	3	4	5	6	7	8
Ans.	A,C	B,C	A,C	A,C	A,B,C	A,B,C,D	A,B,C,D	B,D
Ques.	9							
Ans.	A,B,D							

Q.10 (A) S ; (B) Q ; (C) R ; (D) P **Q.11** A, C, D **Q.12** A, C **Q.13** (A) 3 ; (B) 2 ; (C) 1 ; (D) 1

EXERCISE – III

Q.1 **Q.2**

Q.3 (i) A, $CH_3CH_2CH_2Br$; B, $CH_3CH = CH_2$; C, $CH_3CHBrCH_3$; D, $CH_3CHNH_2CH_3$
(ii) A, $CH_3CH = CH_2$; B, $CH_3CHOHCH_3$; C, $CH_3CHClCH_3$; D, $CH_3CH_2CH_2$
(iii) A, $CH_3CHBrCH = CH_2$; B, $CH_2 = CH - CH = CH_2$; C, $CH_3CHBrCH = CH_2$ & $CH_3CH = CH - CH_2Br$
(iv) A, $CH_3CH_2CHOHCH_3$; B, $CH_3CH_2CHBrCH_3$; C, $CH_3CH = CH - CH_3$

Q.4 The elimination of HI (or DI) in presence of strong base shows E_2 elimination. The rate determining step involves breaking up of C – H (or C – D) bond. The C – D bond being stronger than C– H and thus elimination is faster in case of $CH_3 - CH_2I$.

Q.5 **Q.6** Stability of alkene by α-hydrogen **Q.7**

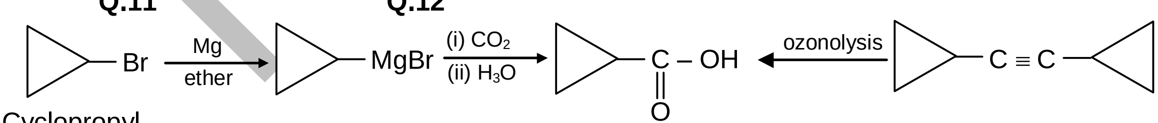
Q.8 $H_3C - \underset{CH_3}{\underset{|}{CH}} - \underset{Cl}{\underset{|}{CH}} - CH_3 \xrightarrow{KOH(alc)} \underset{\text{major}}{CH_3 - \underset{CH_3}{\underset{|}{C}} = CH - CH_3} + \underset{\text{minor}}{CH_3 - \underset{CH_3}{\underset{|}{CH}} - CH = CH_2}$

Elimination occurs according to saytzeff rule. The major product is one which involves elimination of H from less hydrogenated carbon.

Q.9 KCN is an ionic compound $[K^+(:C \equiv N:)^-]$ in which both C and N carry a lone pair electron. Carbon carrying lone pair of electrons is more reactive and thus alkyl attacks carbon to give alkyl cyanide AgCN being covalent has Ag – C ≡ N : structure with lone pair on N thus R attacks on N atom and R – N $\overset{=}{\equiv}$C is formed.

Q.10 **Q.11** **Q.12**

Q.13



Cyclopropyl bromide (C) Cyclopropane carboxylic acid (B) Dicyclopropyl acetylene (A)

EXERCISE – IV(A)

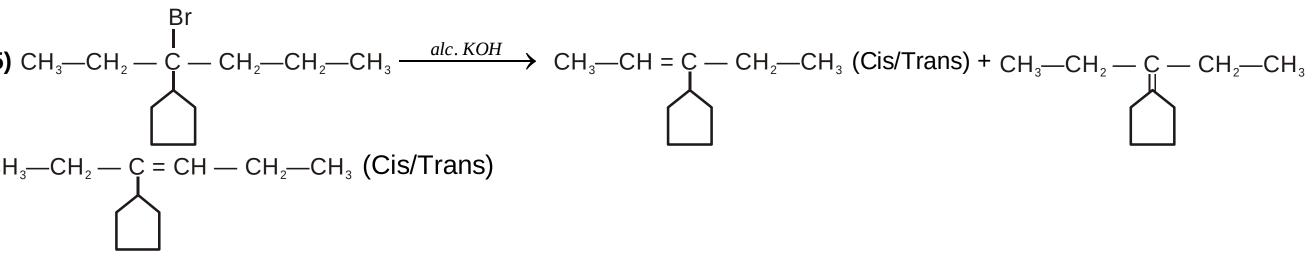
Ques.	1	2	3	4	5	6		
Ans.	B,D	B	A	D	B	D		

Q.7 A – Q ;B – Q; C – R, S; D – P, S
Q.8 B

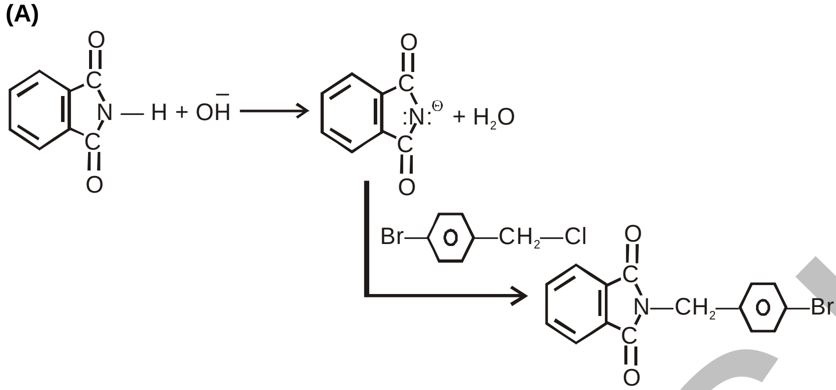
Q.9 A

Q.10 **D**

Q.11 **(5)**



Q.12 **(A)**



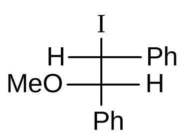
EXERCISE – IV(B)

Q.1 (i) $C_6H_5-CH=CH-CH_3$; $C_6H_5-CH(Br)-CH_2-CH_3$

(ii) $C_6H_5COOMgI + CH_4$

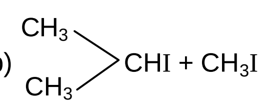
Q.2 (X) : $CH_3-C(CH_3)(Cl)-CH(CH_3)-CH_3$; (Y) : $CH_2=C(CH_3)-CH(CH_3)-CH_3$; (Z) : $CH_3-C(CH_3)=C(CH_3)-CH_3$

Q.3

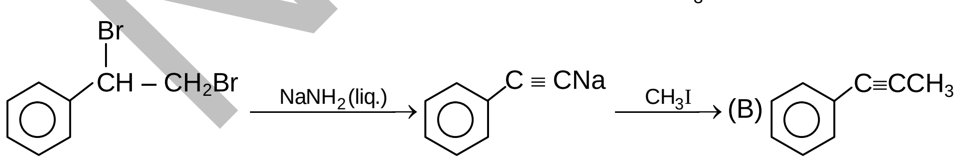


(NGP due to MeO, so retention of configuration.

Q.4 (a) Cis and trans forms of stibene $C_6H_5CH=CHC_6H_5$; (b)



Q.5 (A)



Q.6 $CH_3-C(CH_3)=CHCH_3$

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Answers for Isomeris DPP (Conceptual Improvement of Isomerism)

Answers of DPP No. – 1

Q.1(a)	Identical	(b)	Position	(c)	Position	(d)	Functional	(e)	Position
(f)	Position	(g)	Chain	(h)	Position	(i)	Position	(j)	Functional
(k)	Functional	(l)	Functional	(m)	Functional	(n)	Functional	(o)	Functional
(p)	Chain	(q)	Ring chain	(r)	Chain				
Q.2(a)	Metamers	(b)	Identical	(c)	Metamers	(d)	Metamers	(e)	Functional
(f)	Functional	(g)	Functional	(h)	Metamers				

Q.3 A-Q, B-Q, C-R, D-S

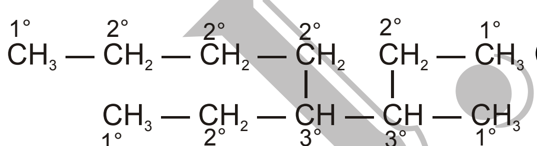
Answers of DPP No. – 2

1.	Position isomers	**2.**	Metamers	**3.**	Positional	**4.**	Chain
5.	Identical	**6.**	Functional	**7.**	Functional		
8.	Functional	**9.**	Non-identical	**10.**	Non-identical		
11.	Ring chain	**12.**	Non-identical / homologous				
13.	Position isomers	**14.**	Chain isomers	**15.**	Position	**16.**	Metamers
17.	Chain	**18.**	Position	**19.**	Position	**20.**	Identical
21.	Identical	**22.**	Functional				

Answers of DPP No. – 3

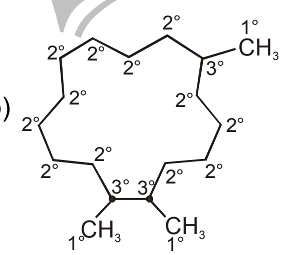
1.	C	**2.**	D	**3.**	B	**4.**	B	**5.**	C	**6.**	A	**7.**	C
8.	B	**9.**	B	**10.**	C	**Q.11**	D	**Q.12**	C	**Q.13**	C	**Q.14**	C
Q.15	D												

Q.16. (a) (1°,2°,3°)



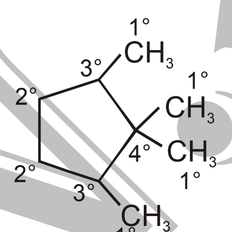
4-ethyl-3-methyloctane

(b) (1°,2°,3°)



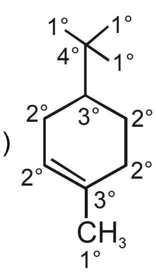
1,2,7-trimethylcyclopentadecane

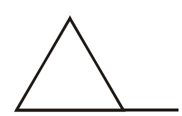
(c) (1°,2°,3°, 4°)



1,1,2,5-tetramethylcyclopentane

(d) (1°,2°,3°, 4°)



Q.17 (5) DBE = 1 $CH_2 = CH — CH_2 — CH_3$, $CH_3 — HC = CH — CH_2$, , ,

$CH_3 — \underset{\displaystyle CH_3}{\underset{|}{C}} = CH_2$

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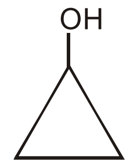
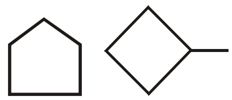
Contact: 9414969800, 9549908816
web : symmetryiitjee.com

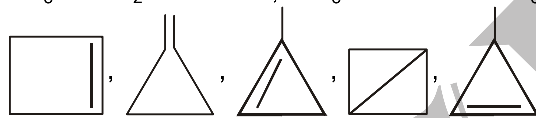
Q.18 DBE = 1 (5)C_3H_6O $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-H$, $CH_3-\underset{\underset{O}{\|}}{C}-CH_3$, ,

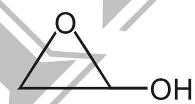
$CH_2=CH-CH_2-OH$, $CH_2=CH-O-CH_3$

Q.19 (5) DBE = 1 $CH_3-CH_2-CH_2-HC=CH_2$, $CH_3-CH_2-HC=CH-CH_3$, $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}=CH_2$,

, $CH_3-CH=\underset{\underset{CH_3}{|}}{C}-CH_3$, $CH_2=CH-\underset{\underset{CH_3}{|}}{CH}-CH_3$, ,

Q.20 (9) DBE = 2 C_4H_6 $CH_3-CH_2-C\equiv CH$, $CH_3-C\equiv C-CH_3$, $CH_2=CH-CH=CH_2$,

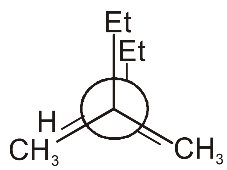
$CH_3-CH=C=CH_2$, 

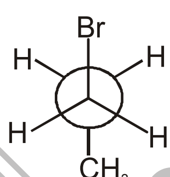
Q.21 (4) $\underset{H}{\overset{O}{\overset{\|}{C}}}-CH_2-OH$, $CH_3-\overset{O}{\overset{\|}{C}}-O-H$, $H-\overset{O}{\overset{\|}{C}}-O-CH_3$, 

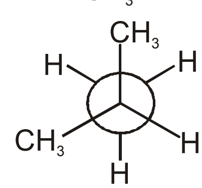
Answers of DPP No. – 4

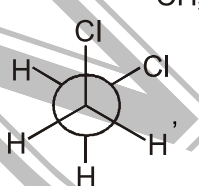
Q.1(a) Position (b) Position (c) Position (d) Position (e) Chain
(f) Position (g) Position (h) Position (i) Position (j) Chain
(k) Position

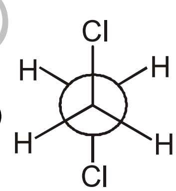
Q.2(a) 7 (b) 3 (c) 4 (d) 2 (e) 4 **Q.3** (a) $\pi = 2$, $\sigma = 30$ (b) $\pi = 5$ $\sigma = 17$ (c) $\pi = 3$ $\sigma = 34$
(d) $\pi = 4$ $\sigma = 27$ (e) $\pi = 4$ $\sigma = 3$ (f) $\pi = 2$ $\sigma = 5$ (g) π = s2 $\sigma = 7$

Q.4 A **Q.5** C **Q.6** C **Q.7** D **Q.8** 

Q.9 $CH_3-CH_2-CH_2-Br$ 

Q.10 $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_3$ 

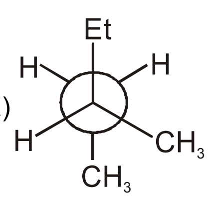
Q.11 (a) (gauche) 

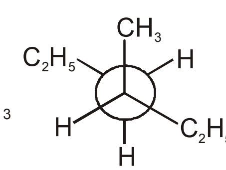
, (anti) 

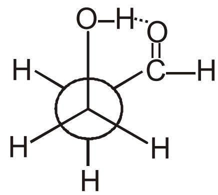
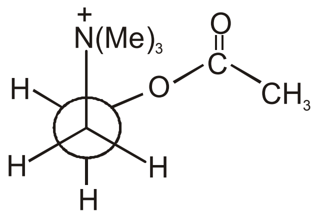
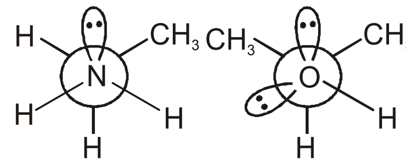
(b) 1, 2

Q.12 C **Q.13** A **Q.14** 0.75 D = 0.3 X μgauche $\mu\text{gauche} = \frac{7.5}{3} = 2.5$ D.

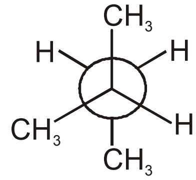
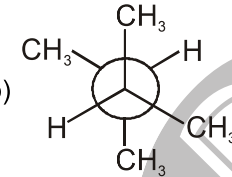
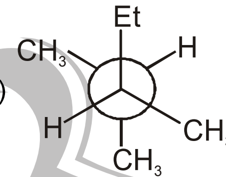
Q.15 a > c > b

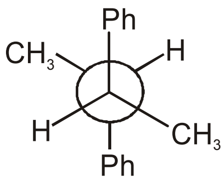
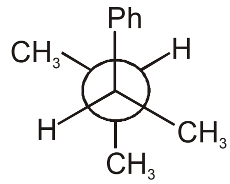
Q.16 $CH_3-CH_2-\underset{\underset{CH_3}{|}}{\overset{\gamma}{CH}}-\overset{\beta}{CH_2}-CH_3$ (a) 

(b) $CH_3-CH_2-\underset{\underset{CH_3}{|}}{\overset{\gamma}{CH}}-\overset{\beta}{CH_2}-CH_2-CH_3$ 

Q.17  **Q.18**  **Q.19** 

Q.20 T ↑ μ↑

Q.21 (a) gauche (b) anti **Q.22** (a)  (b)  (c) 

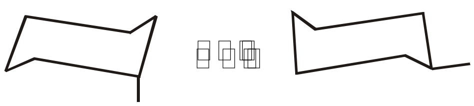
(d)  (e) 

Q.23 (a) i > ii > iii (b) i > ii > iii (c) 3 > 2 > 1 > 4 (d) i > ii > iii (e) i > ii

Answers of DPP No. – 5

Q.1 (a) 120° (b) < 109°28' (c) 0° (d) 60° **Q.2** C **Q.3** B **Q.4** D

Q.5 E

 Keq = 18

x 100-x

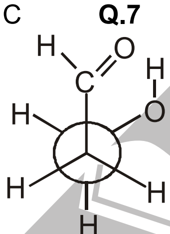
$$\frac{100-x}{x} = 18$$

18 × = 100 – x

19 × = 100

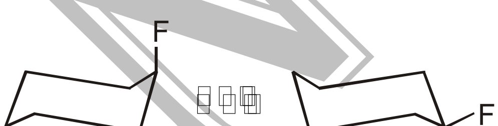
X = 100/19

Q.6 C **Q.7** D **Q.8** C **Q.9** B **Q.10** B **Q.11** A, B, D **Q.12** B

Q.13 

Q.14

+1	+1	+1	+1	+1
E	C/A	B/D/F	B	E
Anti	All Gauche	All eclipsed	Highest in energy	Lowest in energy

Q.15  Keq = 1.5

x 100-x

$$\frac{100-x}{x} = 1.5$$

1.5 × = 100 – x

25 × = 100

$X = \frac{100}{25} \times 10$

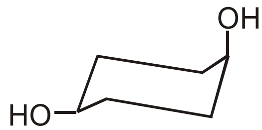
= 40%

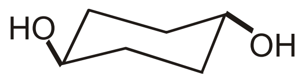
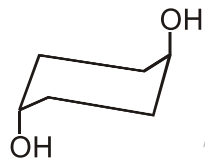
Q.16 C

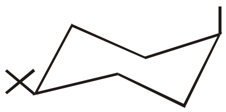
Answers of DPP No. – 6

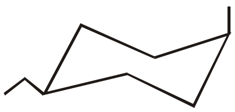
Q.1 A – P, R; B – Q, S; C – P, R; D – Q, R **Q.2** (IV) > (III) > (I) > (II) **Q.3** B

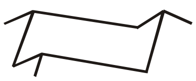
Q.4 Xanti = 3/4

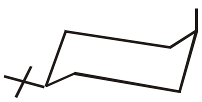
Q.5 (a)  < and 

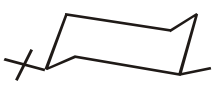
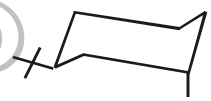
(b)  > and 

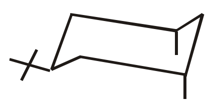
(c)  < and 

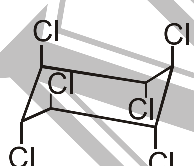
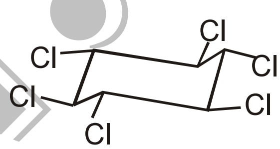
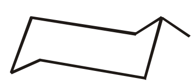
(d)  > and 

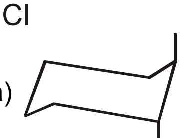
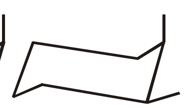
(e)  > and 

(f)  < and 

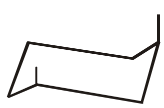
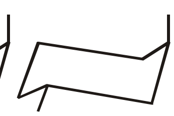
(g)  > and 

(h)  > and 

Q.6 (a)  (b)  **Q.7** 

Q.8 c > d > b > a **Q.9** (a)  

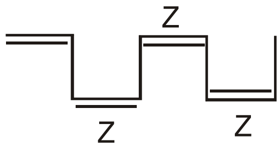
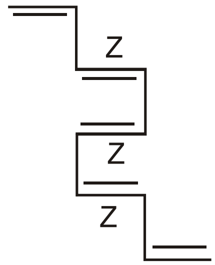
Trans Cis

(b)  

Cis Trans

Answers of DPP No. – 7

Q.1 (1) Z (2) Z (3) E (4) Z (5) Z (6) E (7) E (8) Z (9) Z (10) E (11) Z (12) Z (13) E
(14) E (15) Z (16) E (17) E (18) E (19) Z (20) E (21) Z (22) E (23) E (24) Z

(25) Z  (26) Z  (27) E (28) E (29) Z

Q.2 (1) (A) X (B) X (C) √ (D) X (E) √ (F) √

(2) (A) X (B) √ (C) √ (D) X

(3) (A) Cis (B) Trans (C) Cis (D) Cis (E) Trans (F) Cis (G) Trans (H) Trans (I) Cis (J) X (K) Trans (L) Cis

(4) (A) X (B) X (C) √ (D) √

Answers of DPP No. – 8

Q.1 (1) 2^1 (2) 2^3 (3) 2^3 (4) 2^3 (5) 2^2 (6) 2^2 (7) $2^{3-1} + 2^{(3-1)/2} = 6$ (8) $2^{3-1} + 2^{(3-1)/2} = 6$ (9) 2^3 (10) $2^{2-1} + 2^{2/2-1} = 2 + 1 = 3$ (11) 2^1 (12) 2^1 (13) 2^1 (14) 2^1 (15) 2^1 (16) 2^1 (17) 2^1 (18) 2^4 (19) $2^{3-1} + 2^{(3-1)/2} = 6$ (20) $2^3 = 8$ (21) 2^1 (22) 2 (23) $2^2 = 4$ (24) 2 (25) 2 (26) 2^1 (27) 2^3 (28) 2^2 (29) 2^2 (30) 2^2 (31) 4 (32) 2^2 (33) 2^1

Q.2 Trans **Q.3** Trans

Q.4 (A) $2^{3-1} + 2^{(3-1)/2} = 6$

(B) $2^1 = 2$

(C) $2^1 = 2$

(D) $2^2 = 4$

(E) $2^1 = 2$

Q.5 B, C **Q.6** B

Answers of DPP No. – 9

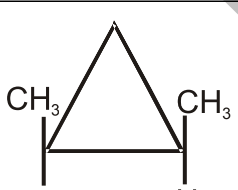
Q.1 A **Q.2** C **Q.3** D **Q.4** (A) 2^2 (B) 2 (C) 2 (D) 2^3 (E) 2^1 (F) 2^1 **Q.5** A,B,C

Q.6 D **Q.7** (A), (B)

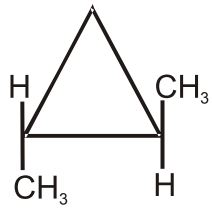
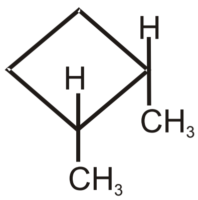
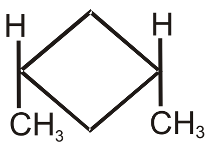
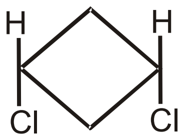
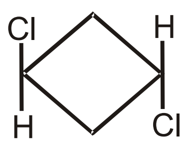
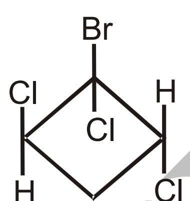
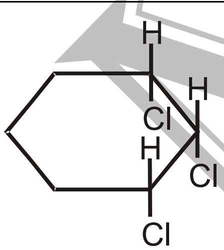
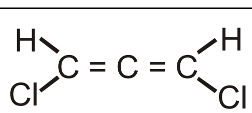
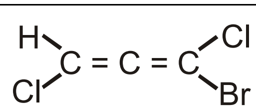
Q.8 (A) √ (B) √ (C) X (D) √ (E) √ (F) X (G) √ (H) √ (I) √ (J) X (K) √ (L) √ (M) √ (N) √

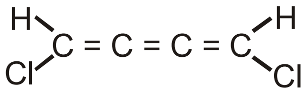
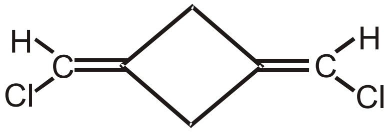
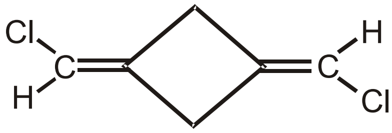
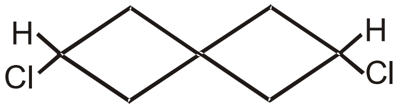
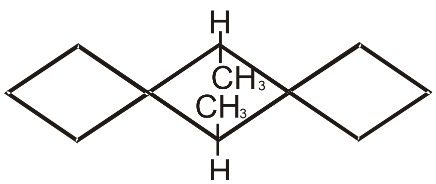
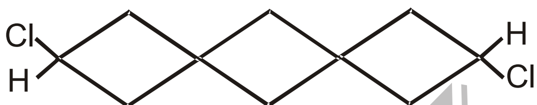
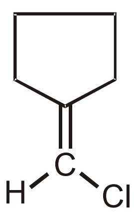
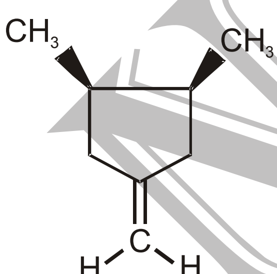
Q.9 B **Q.10** B **Q.11** B **Q.12** (A) = Keq < 1 (B) Keq = 1 (C) Keq > 1 (D) Keq = 1

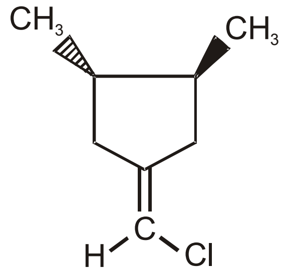
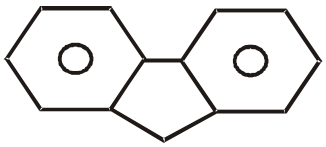
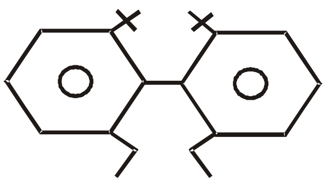
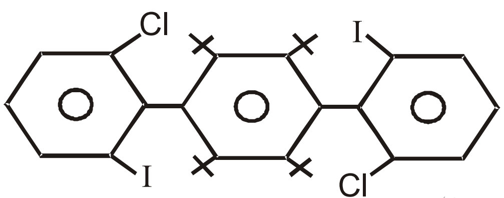
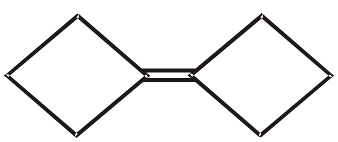
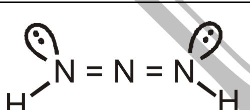
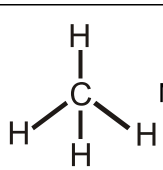
Answers of DPP No. – 10

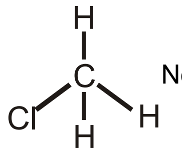
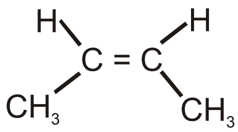
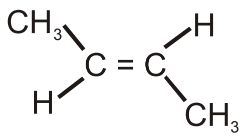
Compound	P.O.S.	C.O.S.	Optically active
1. 	√	X	X

A-833, Indra Vihar, near IL back door,
Contact: 9414969800, 9549908816
web : symmetryiitjee.com

2. 	X	X	√
3. 	√	X	X
4. 	√	X	X
5. 	√	X	X
6. 	√	√	X
7. 	X	X	√
8. 	√	X	X
9. 	X	X	√
10. 	X	X	√

11. 	√	X	X
12. 	√	X	X
13. 	√	√	X
14. 	X	X	√
15. 	√	√	X
16. 	√	√	X
17. 	√	X	X
18. 	√	X	X

19. 	X	X	√
20. 	√	X	X
21. 	X	X	√
22. 	X	√	X
23. 	√	√	X
24. O = C = O	√	X	X
25. O = C = $\overset{\oplus}{O}$–H	√	X	X
26. H–$\overset{\oplus}{O}$ = C = $\overset{\oplus}{O}$–H	X	X	√
27. 	X	X	√
28.  No. of POS = $4C_2$ = 6	√	X	X

29.  No. of POS = 3	√	X	X
30.  No. of POS = 2	√	X	X
31.  No. of POS = 1	√	√	X

Answers of DPP No. – 11

Q.1 (i) 2 (ii) 3 (iii) 4 (iv) 10 **Q.2** (a) 1 > 3 > 2 > 4 (b) 2 > 1 > 3 > 4 (c) 2 > 1 > 4 > 3
(d) 3 > 1 > 2 > 4 (e) 3 > 1 > 2 > 4 (f) 4 > 2 > 3 > 1 (g) 4 > 3 > 2 > 1

Q.3 (a) R (b) R (c) S (d) S (e) R (f) S (g) R (h) S (i) S (j) S (k) S (l) R (m) S
(n) R (o) S (p) S (q) R, R (r) R, R (s) S, R (t) R, S (u) R, S

Q.4 (a) R (b) R (c) S (d) S (e) R (f) S (g) R (h) S (i) S (j) S (k) S (l) R (m) S
(n) T (o) S (p) S (q) R,R (r) S,R (s) S, R (t) R, S (u) R, S
(v) R, S (w) R, S (x) R, S (y) R, R, R (z) R

Answers of DPP No. – 12

Q.1 A $\rightarrow$ Q; B $\rightarrow$ Q; C $\rightarrow$ R,S; D $\rightarrow$ Q; **Q.2** A $\rightarrow$ T,P,S; B $\rightarrow$ T, P; C $\rightarrow$ S; D $\rightarrow$ Q;
Q.3 B **Q.4** **Q.5** D
Q.6 A-B = Enantiomer, C-D = Enantiomer, A-C, A-D = distereomers, B-C & B-D = disteromers
Q.7 A **Q.8** 8 **Q.9** 5 **Q.10** **Q.11** C **Q.12** **Q.13**
Q.14 (a) 4 (b) 4 (c) 7

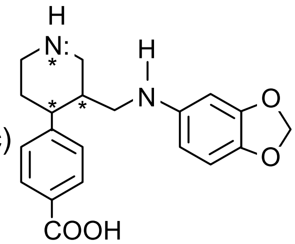
Answers of DPP No. – 13

Q.1 A $\rightarrow$ S,P; B $\rightarrow$ Q; C $\rightarrow$ S,P; D $\rightarrow$ S,R; **Q.2** A $\rightarrow$ T; B $\rightarrow$ S,R; C $\rightarrow$ P; D $\rightarrow$ T;
Q.3 A **Q.4** C **Q.5** A **Q.6** A **Q.7** A **Q.8** C **Q.9** D
Q.10 **Q.11** A, B, D **Q.12** **Q.13** 4
Q.14 (a) diastereomers (b) distereomers (c) distereomers (d) distereomers
(e) enantiomers (f) distereomers
Q.15 No-sym. Present
(i) optical isomers = 2^7 = 128.
(ii) optically active = $2^n = 2^7 = 128$
(iii) meso = 0
(iv) enantiopair $\frac{2^n}{2} = \frac{128}{2} = 64.$

Answers of DPP No. – 14

Q.1 A $\rightarrow$ Q, R; B $\rightarrow$ S, R, T; C $\rightarrow$ Q, R, T; D $\rightarrow$ P, Q;

Q.2 A $\rightarrow$ P, R; B $\rightarrow$ S; C $\rightarrow$ P, R, S; D $\rightarrow$ Q;
Q.3 B **Q.4** D **Q.5** B **Q.6** (A) X (B) X (C) √ (D) √
Q.7 α = 125°
Q.8 (A) chiral (B) achiral (C) achiral (D) achiral (E) chiral (F) achiral (G) chiral (H) achiral (I) chiral (J) chiral (K) chiral (L) chiral (M) achiral
Q.9 (a) – 12.5° (b) + 8.6° (c)



Q.10 (i) achiral (ii) achiral (iii) chiral (iv) chiral (v) achiral (vi) achiral (vii) chiral (viii) chiral (ix) achiral

Answers of DPP No. – 16

1. Diastereomer **2.** Identical (a & b); Diasteromer (a & b ; b & c) **3.** Diastereomer
4. Diastereomer **5.** Identical **6.** Identical **7.** Identical
8. Consitutional Isomer **9.** Diastereomer **10.** Enantiomer **11.** Enantiomer
12. Diastereomer **13.** Constitutional isomer **14.** Consitutional isomer
15. Constitutional isomer

Answers of DPP No. – 17

1. Constitutional isomer **2.** Constitutional isomer **3.** Constitutional isomer **4.** Enantiomer
5. Enantiomer **6.** Enantiomer **7.** Diastereomer
8. Consitutional Isomer **9.** Identical **10.** Constitutional isomer
11. Diastereomer **12.** Enantiomer **13.** Constitutional isomer
14. Identical **15.** Diastereomer

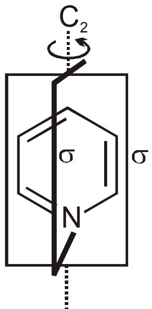
Answers of DPP No. – 18

1. Enantiomer **2.** Identical **3.** Identical **4.** Diastereomer
5. Diastereomer **6.** Constitutional isomer
7. Enantiomer (b & c); Diasteromer (a & b ; b & c) **8.** Diastereomer **9.** Identical
10. Constitutional isomer **11.** Constitutional isomer **12.** Constitutional isomer
13. Constitutional isomer **14.** Identical **15.** Constitutional isomer
16. Constitutional isomer

Answers of DPP No. – 19

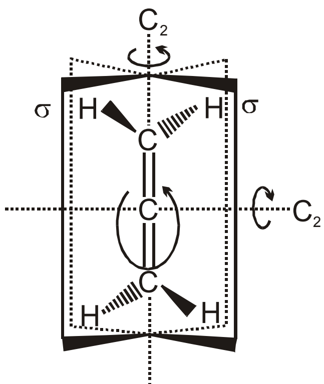
1. Constitutional isomer **2.** Constitutional isomer **3.** Constitutional isomer
4. Constitutional isomer **5.** Constitutional isomer **6.** Constitutional isomer
7. Other **8.** Constitutional isomer **9.** Other
10. Other **11.** Constitutional isomer **12.** Constitutional isomer
13. Constitutional isomer **14.** Constitutional isomer **15.** Enantiomer

Answers of DPP No. – 20

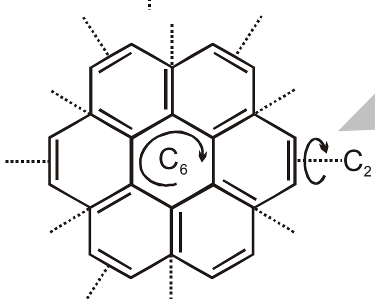
1. 

C : The C_2 axis lies along the Intersection of the 2 vertical σ-planes.

2. C_{2v}

3. 

D_{2d} : 3 C_2 axis with the 2σ planes intersecting the principle (vertical) C_2 axis.

4. 

D_{6h} : There are 3 pairs of vertical σ planes (not shown) and of C_2 axis intersecting the C_6 axis. The C atoms lie in the horizontal σ-plane.

5. P.O.S. (σ) ; C_3 **6.** C_2 **7.** P.O.S.(σ) ; C_2 ; C_3 ; S_4 ; S_2

Answers of DPP No. – 21

1. P.O.S. (σ) ; C_2 **2.** P.O.S. (σ) ; C_2 ; C_3 ; S_4 ; S_2 **3.** P.O.S. (σ) ; C_2

4. P.O.S. (σ) ; C_2 **5.** P.O.S. (σ) ; C_2 **6.** P.O.S. (σ) ; C_2 ; S_2

7. C_2 **8.** C_2 **9.** C_2 **10.** P.O.S. (σ) ; C_2 ; S_2

Answers of DPP No. – 22

S.NO.	MESO	ACTIVE ISOMERS	TOTAL ISOMERS
1.	3	2	5
2.	-	4	4
3.	-	-	2
4.	-	8	8
5.	-	16	16

6.	2	8	10
7.	-	8	8
8.	-	4	4
9.	1	2	3
10.	-	-	2
11.	1	2	3
12.	-	4	4
13.	1	2	3
14.	2	8	10
15.	-	32	32
15.	-	8	8

Answers of DPP No. – 23

S.NO.	MESO	ACTIVE ISOMERS	TOTAL ISOMERS
1.	1	2	3
2.	-	4	4
3.	1	2	3
4.	-	16	16
5.	-	-	2
6.	-	32	32
7.	-	-	3
8.	-	4	4

Answers of DPP No. – 24

S.NO.	MESO	ACTIVE ISOMERS	TOTAL ISOMERS
1.	1	2	3
2.	-	16	16
3.	-	16	16
4.	-	16	16
5.	1	2	3
6.	-	2	2
7.	1	2	3
8.	-	4	4
9.	8	128	136

Answers of DPP No. – 25

S.NO.	MESO	ACTIVE ISOMERS	TOTAL ISOMERS
1.	-	-	2
2.	-	16	16
3.	1	2	3
4.	-	8	8
5.	-	8	8
6.	1	2	3

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7.	-	4	4
8.	-	4	4
9.	-	2	2
10.	-	2	2
11.	8	128	136

Answers of DPP No. – 26

Optically active:- OA Chiral molecule:- CM Achiral molecule:- AM Optically inactive:- OI
No. of chiral cente:- CC

1.	AM, OI, CC = 1	**2.**	OA, CM, CC = 0	**3.**	OA, CM, CC = 1
4.	OA, CM, CC = 1	**5.**	OA, CM, CC = 0	**6.**	AM, OI, CC = 2
7.	OA, CM, CC = 2	**8.**	OA, CM, CC = 5	**9.**	AM, OI, CC = 2
10.	AM, OI, CC = 4	**11.**	OA, CM, CC = 2	**12.**	OA, CM, CC = 2
13.	OA, CM, CC = 3	**14.**	OA, CM, CC = 2	**15.**	AM, OI, CC = 2
16.	AM, OI, CC = 2				

Answers of DPP No. – 27

Optically active:- OA Chiral molecule:- CM Achiral molecule:- AM Optically inactive:- OI
No. of chiral cente:- CC

1.	AM, OI, CC = 0	**2.**	AM, OI, CC = 0	**3.**	AM, OI, CC = 0
4.	AM, OI, CC = 2	**5.**	AM, OI, CC = 3	**6.**	AM, OI, CC = 0
7.	OA, CM, CC = 0	**8.**	AM, OI, CC = 0	**9.**	AM, OI, CC = 0
10.	AM, OI, CC = 4	**11.**	OA, CM, CC = 2	**12.**	OA, CM, CC = 2
13.	AM, OI, CC = 2	**14.**	AM, OI, CC = 2	**15.**	CM, OA, CC = 2
16.	AM, OI, CC = 2				

Answers of DPP No. – 28

Optically active:- OA Chiral molecule:- CM Achiral molecule:- AM Optically inactive:- OI
No. of chiral cente:- CC

1.	AM, OI, CC = 0	**2.**	OA, CM, CC = 0	**3.**	OA, CM, CC = 1
4.	OA, CM, CC = 2	**5.**	OI, AM, CC = 0	**6.**	AM, OI, CC = 0
7.	OA, CM, CC = 3	**8.**	OA, CM, CC = 2	**9.**	AM, OI, CC = 0
10.	AM, OI, CC = 0	**11.**	AM, OI, CC = 2	**12.**	OA, CM, CC = 0
13.	AM, OI, CC = 0	**14.**	CM, OA, CC = 0	**15.**	AM, OI, CC = 0
16.	CM, OA, CC = 0	**17.**	CM, OA, CC = 2		

Answers for Isomeris DPP (Conceptual Improvement of Isomerism)

Answers of DPP No. – 1

Q.1 (a) Identical (b) Position (c) Position (d) Functional (e) Position
(f) Position (g) Chain (h) Position (i) Position (j) Functional
(k) Functional (l) Functional (m) Functional (n) Functional (o) Functional
(p) Chain (q) Ring chain (r) Chain

Q.2 (a) Metamers (b) Identical (c) Metamers (d) Metamers (e) Functional
(f) Functional (g) Functional (h) Metamers

Q.3 A-Q, B-Q, C-R, D-S

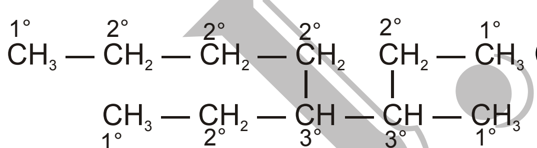
Answers of DPP No. – 2

1.	Position isomers	**2.**	Metamers	**3.**	Positional	**4.**	Chain
5.	Identical	**6.**	Functional	**7.**	Functional		
8.	Functional	**9.**	Non-identical	**10.**	Non-identical		
11.	Ring chain	**12.**	Non-identical / homologous				
13.	Position isomers	**14.**	Chain isomers	**15.**	Position	**16.**	Metamers
17.	Chain	**18.**	Position	**19.**	Position	**20.**	Identical
21.	Identical	**22.**	Functional				

Answers of DPP No. – 3

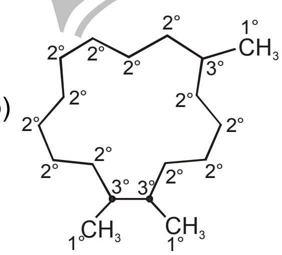
1.	C	**2.**	D	**3.**	B	**4.**	B	**5.**	C	**6.**	A	**7.**	C
8.	B	**9.**	B	**10.**	C	**Q.11**	D	**Q.12**	C	**Q.13**	C	**Q.14**	C
Q.15	D												

Q.16. (a) (1°,2°,3°)



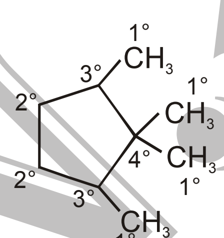
4-ethyl-3-methyloctane

(b) (1°,2°,3°)



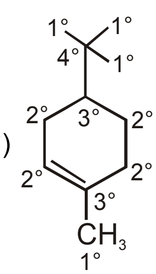
1,2,7-trimethylcyclopentadecane

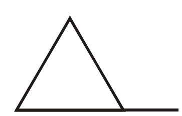
(c) (1°,2°,3°, 4°)



1,1,2,5-tetramethylcyclopentane

(d) (1°,2°,3°, 4°)



Q.17 (5) DBE = 1 $CH_2 = CH — CH_2 — CH_3$, $CH_3 — HC = CH — CH_2$, , ,

$CH_3 — \underset{\displaystyle CH_3}{\underset{|}{C}} = CH_2$

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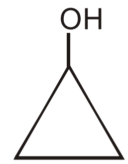
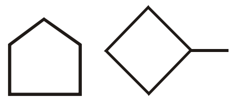
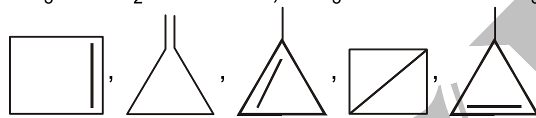
Q.18 DBE = 1 (5)C_3H_6O $CH_3 — CH_2 — CHO$, $CH_3 — CO — CH_3$, ,

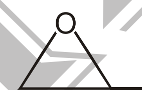
$CH_2 = CH — CH_2 — OH$, $CH_2 = CH — O — CH_3$

Q.19 (5) DBE = 1 $CH_3—CH_2—CH_2—HC=CH_2$, $CH_3—CH_2—HC=CH — CH_3$, $CH_3 — CH_2 — CH(CH_3) = CH_2$,

, $CH_3—CH=C(CH_3)—CH_3$, $CH_2=CH—CH(CH_3)—CH_3$, ,

Q.20 (9) DBE = 2 C_4H_6 $CH_3 — CH_2 — C \equiv CH$, $CH_3 — C \equiv C — CH_3$, $CH_2=CH —CH = CH_2$,

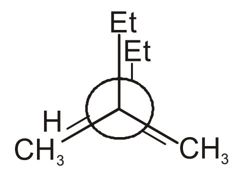
$CH_3 — CH = C = CH_2$, ,

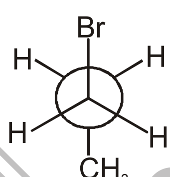
Q.21 (4) $HCO — CH_2 — OH$, $CH_3 — COOH$, $H — CO — O — CH_3$, '

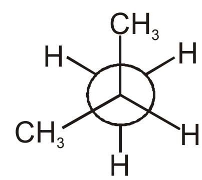
Answers of DPP No. – 4

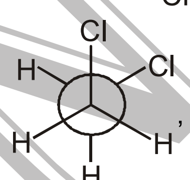
Q.1(a) Position (b) Position (c) Position (d) Position (e) Chain
(f) Position (g) Position (h) Position (i) Position (j) Chain
(k) Position

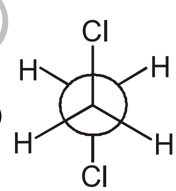
Q.2(a) 7 (b) 3 (c) 4 (d) 2 (e) 4 **Q.3** (a) π = 2, σ = 30 (b) π = 5 σ = 17 (c) π = 3 σ = 34
(d) π = 4 σ = 27 (e) π = 4 σ =3 (f) π = 2 σ = 5 (g) π = s2 σ = 7

Q.4 A **Q.5** C **Q.6** C **Q.7** D **Q.8** 

Q.9 $CH_3–CH_2–CH_2–Br$ 

Q.10 $CH_3 — CH(CH_3) — CH_3$ 

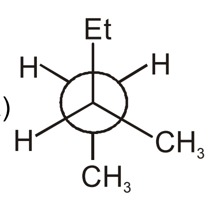
Q.11 (a) (gauche) 

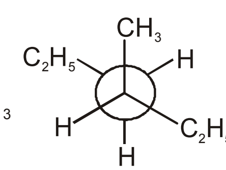
, (anti) 

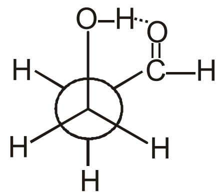
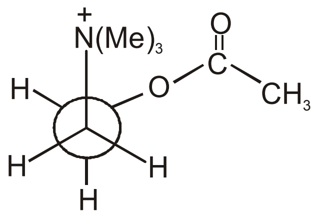
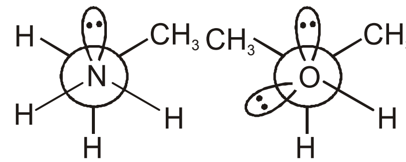
(b) 1, 2

Q.12 C **Q.13** A **Q.14** 0.75 D = 0.3 X μgauche $\mu\text{gauche} = \frac{7.5}{3} = 2.5$ D.

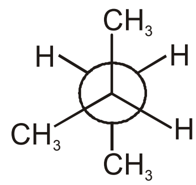
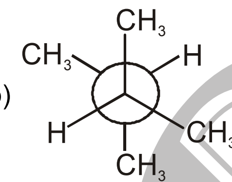
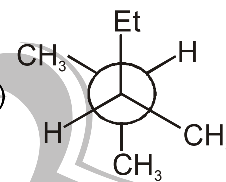
Q.15 a > c > b

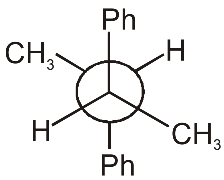
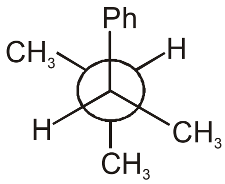
Q.16 $CH_3—CH_2—\overset{\gamma}{C}H(CH_3)—\overset{\beta}{C}H_2—CH_3$ (a) 

(b) $CH_3—CH_2—\overset{\gamma}{C}H(CH_3)—\overset{\beta}{C}H_2—CH_2—CH_3$ 

Q.17  **Q.18**  **Q.19** 

Q.20 T ↑ μ↑

Q.21 (a) gauche (b) anti **Q.22** (a)  (b)  (c) 

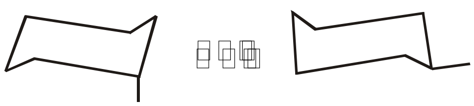
(d)  (e) 

Q.23 (a) i > ii > iii (b) i > ii > iii (c) 3 > 2 > 1 > 4 (d) i > ii > iii (e) i > ii

Answers of DPP No. – 5

Q.1 (a) 120° (b) < 109°28[1] (c) 0° (d) 60° **Q.2** C **Q.3** B **Q.4** D

Q.5 E

 Keq = 18

x 100-x

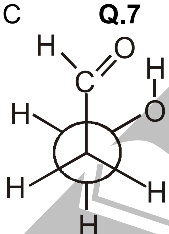
$$\frac{100-x}{x} = 18$$

18 × = 100 – x

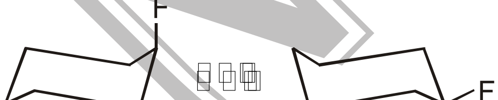
19 × = 100

X = 100/19

Q.6 C **Q.7** D **Q.8** C **Q.9** B **Q.10** B **Q.11** A, B, D **Q.12** B

Q.13  **Q.14**

+1	+1	+1	+1	+1
$\boxed{E}$	$\boxed{C/A}$	$\boxed{B/D/F}$	$\boxed{B}$	$\boxed{E}$
Anti	All Gauche	All eclipsed	Highest in energy	Lowest in energy

Q.15  Keq = 1.5

x 100-x

$$\frac{100-x}{x} = 1.5$$

1.5 × = 100 – x

25 × = 100

$X = \frac{100}{25} \times 10$

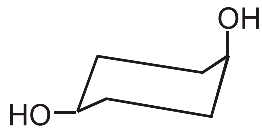
= 40%

Q.16 C

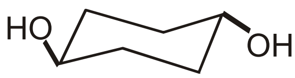
Answers of DPP No. – 6

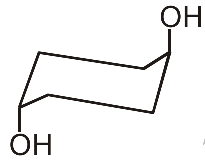
Q.1 A – P, R; B – Q, S; C – P, R; D – Q, R **Q.2** (IV) > (III) > (I) > (II) **Q.3** B

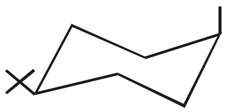
Q.4 Xanti = 3/4

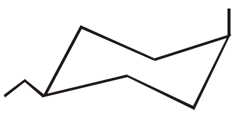
Q.5 (a) 

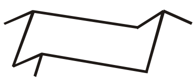
< and 

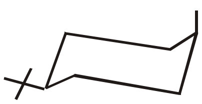
(b) 

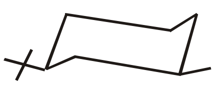
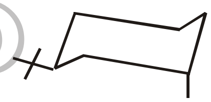
> and 

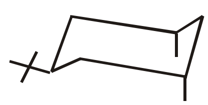
(c)  < and 

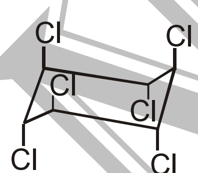
(d)  > and 

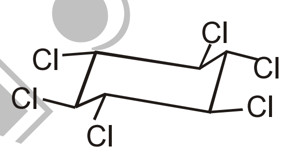
(e)  > and 

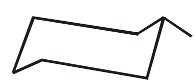
(f)  < and 

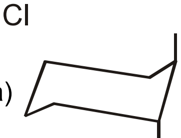
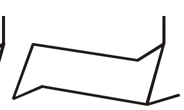
(g)  > and 

(h)  > and 

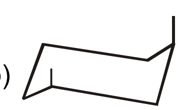
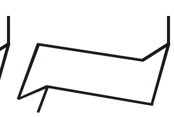
Q.6 (a) 

(b) 

Q.7 

Q.8 c > d > b > a **Q.9** (a)  

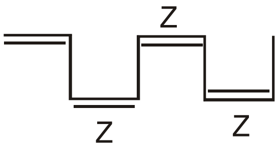
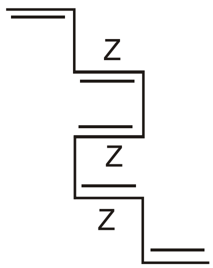
Trans Cis

(b)  

Cis Trans

Answers of DPP No. – 7

Q.1 (1) Z (2) Z (3) E (4) Z (5) Z (6) E (7) E (8) Z (9) Z (10) E (11) Z (12) Z (13) E
(14) E (15) Z (16) E (17) E (18) E (19) Z (20) E (21) Z (22) E (23) E (24) Z

(25) Z  (26) Z  (27) E (28) E (29) Z

Q.2 (1) (A) X (B) X (C) √ (D) X (E) √ (F) √

(2) (A) X (B) √ (C) √ (D) X

(3) (A) Cis (B) Trans (C) Cis (D) Cis (E) Trans (F) Cis (G) Trans
(H) Trans (I) Cis (J) X (K) Trans (L) Cis

(4) (A) X (B) X (C) √ (D) √

Answers of DPP No. – 8

Q.1 (1) 2^1 (2) 2^3 (3) 2^3 (4) 2^3 (5) 2^2 (6) 2^2 (7) $2^{3-1}+2^{(3-1)/2}=6$ (8) $2^{3-1}+2^{(3-1)/2}=6$ (9) 2^3
(10) $2^{2-1}+2^{2/2-1}=2+1=3$ (11) 2^1 (12) 2^1 (13) 2^1 (14) 2^1 (15) 2^1 (16) 2^1 (17) 2^1 (18) 2^4
(19) $2^{3-1}+2^{(3-1)/2}=6$ (20) $2^3=8$ (21) 2^1 (22) 2 (23) $2^2=4$ (24) 2 (25) 2 (26) 2^1 (27) 2^3
(28) 2^2 (29) 2^2 (30) 2^2 (31) 4 (32) 2^2 (33) 2^1

Q.2 Trans **Q.3** Trans

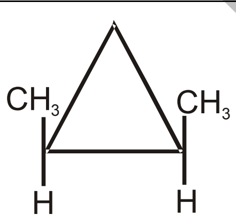
Q.4 (A) $2^{3-1}+2^{(3-1)/2}=6$
(B) $2^1=2$
(C) $2^1=2$
(D) $2^2=4$
(E) $2^1=2$

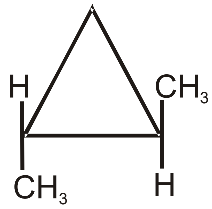
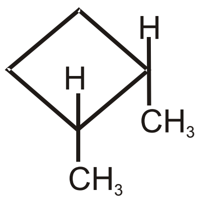
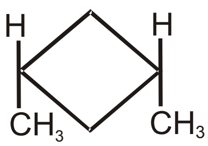
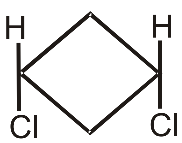
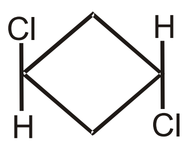
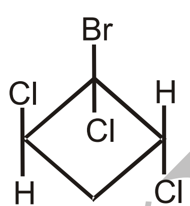
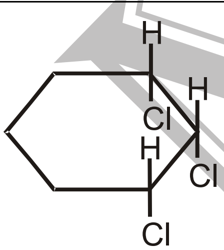
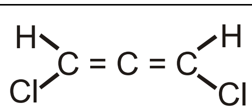
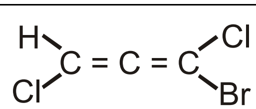
Q.5 B, C **Q.6** B

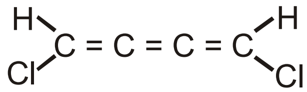
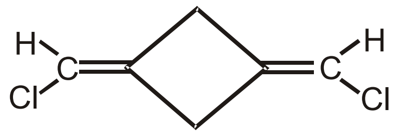
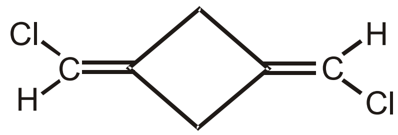
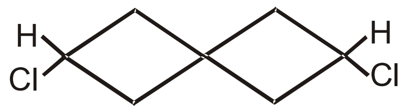
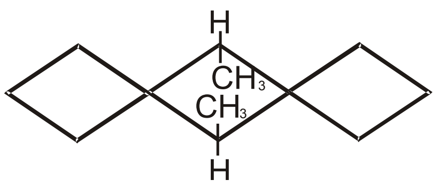
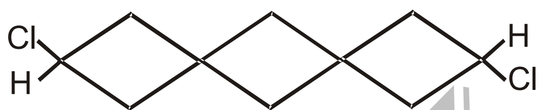
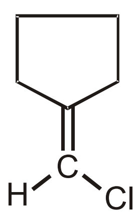
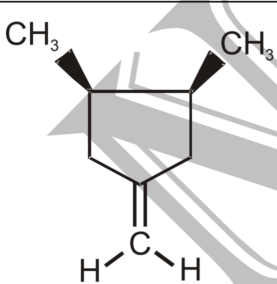
Answers of DPP No. – 9

Q.1 A **Q.2** C **Q.3** D **Q.4** (A) 2^2 (B) 2 (C) 2 (D) 2^3 (E) 2^1 (F) 2^1 **Q.5** A,B,C
Q.6 D **Q.7** (A), (B)
Q.8 (A) √ (B) √ (C) X (D) √ (E) √ (F) X (G) √ (H) √ (I) √ (J) X (K) √ (L) √ (M) √
(N) √
Q.9 B **Q.10** B **Q.11** B **Q.12** (A) = Keq < 1 (B) Keq = 1 (C) Keq > 1 (D) Keq = 1

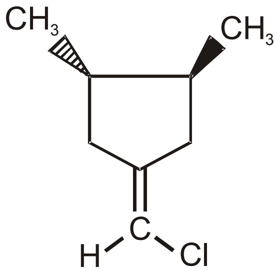
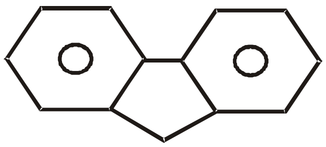
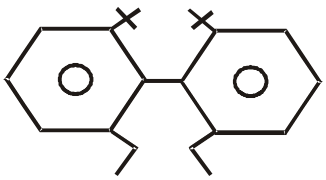
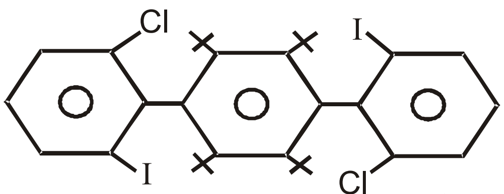
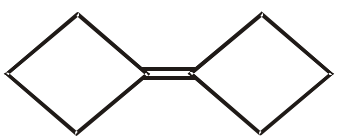
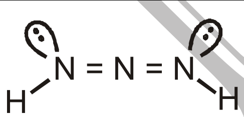
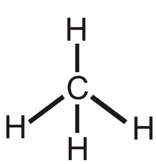
Answers of DPP No. – 10

Compound	P.O.S.	C.O.S.	Optically active
1. 	√	X	X

2. 	X	X	√
3. 	√	X	X
4. 	√	X	X
5. 	√	X	X
6. 	√	√	X
7. 	X	X	√
8. 	√	X	X
9. 	X	X	√
10. 	X	X	√

11. 	√	X	X
12. 	√	X	X
13. 	√	√	X
14. 	X	X	√
15. 	√	√	X
16. 	√	√	X
17. 	√	X	X
18. 	√	X	X

A-833, Indra Vihar, near IL back door,
Contact: 9414969800, 9549908816
web : symmetryiitjee.com

19. 	X	X	√
20. 	√	X	X
21. 	X	X	√
22. 	X	√	X
23. 	√	√	X
24. O = C = O	√	X	X
25. $O = C = \overset{\oplus}{O}-H$	√	X	X
26. $H-\overset{\oplus}{O} = C = \overset{\oplus}{O}-H$	X	X	√
27. 	X	X	√
28.  No. of POS = $4C_2$ = 6	√	X	X

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A-833, Indra Vihar, near IL back door,
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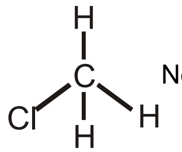
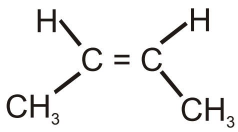
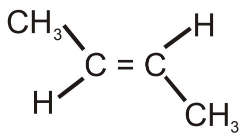
29.  No. of POS = 3	√	X	X
30.  No. of POS = 2	√	X	X
31.  No. of POS = 1	√	√	X

Answers of DPP No. – 11

Q.1 (i) 2 (ii) 3 (iii) 4 (iv) 10

Q.2 (a) 1 > 3 > 2 > 4 (b) 2 > 1 > 3 > 4 (c) 2 > 1 > 4 > 3 (d) 3 > 1 > 2 > 4 (e) 3 > 1 > 2 > 4 (f) 4 > 2 > 3 > 1 (g) 4 > 3 > 2 > 1

Q.3 (a) R (b) R (c) S (d) S (e) R (f) S (g) R (h) S (i) S (j) S (k) S (l) R (m) S (n) R (o) S (p) S (q) R, R (r) R, R (s) S, R (t) R, S (u) R, S

Q.4 (a) R (b) R (c) S (d) S (e) R (f) S (g) R (h) S (i) S (j) S (k) S (l) R (m) S (n) T (o) S (p) S (q) R,R (r) S,R (s) S, R (t) R, S (u) R, S (v) R, S (w) R, S (x) R, S (y) R, R, R (z) R

Answers of DPP No. – 12

Q.1 A $\rightarrow$ Q; B $\rightarrow$ Q; C $\rightarrow$ R,S; D $\rightarrow$ Q;

Q.2 A $\rightarrow$ T,P,S; B $\rightarrow$ T, P; C $\rightarrow$ S; D $\rightarrow$ Q;

Q.3 B **Q.4** **Q.5** D

Q.6 A-B = Enantiomer, C-D = Enantiomer, A-C, A-D = distereomers, B-C & B-D = disteromers

Q.7 A **Q.8** 8 **Q.9** 5 **Q.10** **Q.11** C **Q.12** **Q.13**

Q.14 (a) 4 (b) 4 (c) 7

Answers of DPP No. – 13

Q.1 A $\rightarrow$ S,P; B $\rightarrow$ Q; C $\rightarrow$ S,P; D $\rightarrow$ S,R;

Q.2 A $\rightarrow$ T; B $\rightarrow$ S,R; C $\rightarrow$ P; D $\rightarrow$ T;

Q.3 A **Q.4** C **Q.5** A **Q.6** A **Q.7** A **Q.8** C **Q.9** D

Q.10 **Q.11** A, B, D **Q.12** **Q.13** 4

Q.14 (a) diastereomers (b) distereomers (c) distereomers (d) distereomers (e) enantiomers (f) distereomers

Q.15 No-sym. Present

(i) optical isomers = 2^7 = 128.

(ii) optically active = $2^n = 2^7$ = 128

(iii) meso = 0

(iv) enantiopair $\frac{2^n}{2} = \frac{128}{2}$ = 64.

Answers of DPP No. – 14

Q.1 A $\rightarrow$ Q, R; B $\rightarrow$ S, R, T; C $\rightarrow$ Q, R, T; D $\rightarrow$ P, Q;

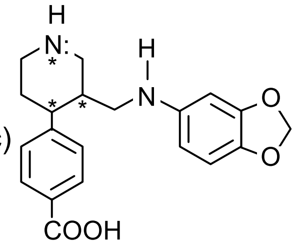
Q.2 $A \rightarrow P, R$; $B \rightarrow S$; $C \rightarrow P, R, S$; $D \rightarrow Q$;

Q.3 B **Q.4** D **Q.5** B **Q.6** (A) X (B) X (C) √ (D) √

Q.7 $\alpha = 125°$

Q.8 (A) chiral (B) achiral (C) achiral (D) achiral (E) chiral (F) achiral (G) chiral
(H) achiral (I) chiral (J) chiral (K) chiral (L) chiral (M) achiral

Q.9 (a) – 12.5° (b) + 8.6° (c)



Q.10 (i) achiral (ii) achiral (iii) chiral (iv) chiral (v) achiral (vi) achiral (vii) chiral
(viii) chiral (ix) achiral

Answers of DPP No. – 16

1. Diastereomer **2.** Identical (a & b); Diasteromer (a & b ; b & c) **3.** Diastereomer
4. Diastereomer **5.** Identical **6.** Identical **7.** Identical
8. Consitutional Isomer **9.** Diastereomer **10.** Enantiomer **11.** Enantiomer
12. Diastereomer **13.** Constitutional isomer **14.** Consitutional isomer
15. Constitutional isomer

Answers of DPP No. – 17

1. Constitutional isomer **2.** Constitutional isomer **3.** Constitutional isomer **4.** Enantiomer
5. Enantiomer **6.** Enantiomer **7.** Diastereomer
8. Consitutional Isomer **9.** Identical **10.** Constitutional isomer
11. Diastereomer **12.** Enantiomer **13.** Constitutional isomer
14. Identical **15.** Diastereomer

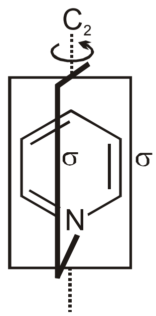
Answers of DPP No. – 18

1. Enantiomer **2.** Identical **3.** Identical **4.** Diastereomer
5. Diastereomer **6.** Constitutional isomer
7. Enantiomer (b & c); Diasteromer (a & b ; b & c) **8.** Diastereomer **9.** Identical
10. Constitutional isomer **11.** Constitutional isomer **12.** Constitutional isomer
13. Constitutional isomer **14.** Identical **15.** Constitutional isomer
16. Constitutional isomer

Answers of DPP No. – 19

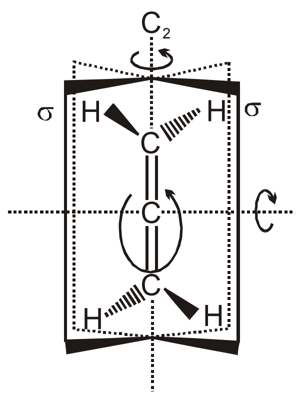
1. Constitutional isomer **2.** Constitutional isomer **3.** Constitutional isomer
4. Constitutional isomer **5.** Constitutional isomer **6.** Constitutional isomer
7. Other **8.** Constitutional isomer **9.** Other
10. Other **11.** Constitutional isomer **12.** Constitutional isomer
13. Constitutional isomer **14.** Constitutional isomer **15.** Enantiomer

Answers of DPP No. – 20

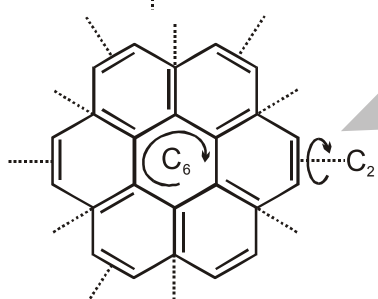
1. 

C : The C_2 axis lies along the Intersection of the 2 vertical σ-planes.

2. C_{2v}

3. 

D_{2d} : 3 C_2 axis with the 2σ planes intersecting the principle (vertical) C_2 axis.

4. 

D_{6h} : There are 3 pairs of vertical σ planes (not shown) and of C_2 axis intersecting the C_6 axis. The C atoms lie in the horizontal σ-plane.

5. P.O.S. (σ) ; C_3 **6.** C_2 **7.** P.O.S.(σ) ; C_2 ; C_3 ; S_4 ; S_2

Answers of DPP No. – 21

1. P.O.S. (σ) ; C_2 **2.** P.O.S. (σ) ; C_2 ; C_3 ; S_4 ; S_2 **3.** P.O.S. (σ) ; C_2

4. P.O.S. (σ) ; C_2 **5.** P.O.S. (σ) ; C_2 **6.** P.O.S. (σ) ; C_2 ; S_2

7. C_2 **8.** C_2 **9.** C_2 **10.** P.O.S. (σ) ; C_2 ; S_2

Answers of DPP No. – 22

S.NO.	MESO	ACTIVE ISOMERS	TOTAL ISOMERS
1.	3	2	5
2.	-	4	4
3.	-	-	2
4.	-	8	8
5.	-	16	16

6.	2	8	10
7.	-	8	8
8.	-	4	4
9.	1	2	3
10.	-	-	2
11.	1	2	3
12.	-	4	4
13.	1	2	3
14.	2	8	10
15.	-	32	32
15.	-	8	8

Answers of DPP No. – 23

S.NO.	MESO	ACTIVE ISOMERS	TOTAL ISOMERS
1.	1	2	3
2.	-	4	4
3.	1	2	3
4.	-	16	16
5.	-	-	2
6.	-	32	32
7.	-	-	3
8.	-	4	4

Answers of DPP No. – 24

S.NO.	MESO	ACTIVE ISOMERS	TOTAL ISOMERS
1.	1	2	3
2.	-	16	16
3.	-	16	16
4.	-	16	16
5.	1	2	3
6.	-	2	2
7.	1	2	3
8.	-	4	4
9.	8	128	136

Answers of DPP No. – 25

S.NO.	MESO	ACTIVE ISOMERS	TOTAL ISOMERS
1.	-	-	2
2.	-	16	16
3.	1	2	3
4.	-	8	8
5.	-	8	8
6.	1	2	3

7.	-	4	4
8.	-	4	4
9.	-	2	2
10.	-	2	2
11.	8	128	136

Answers of DPP No. – 26

Optically active:- OA Chiral molecule:- CM Achiral molecule:- AM Optically inactive:- OI
No. of chiral cente:- CC

1.	AM, OI, CC = 1	**2.**	OA, CM, CC = 0	**3.**	OA, CM, CC = 1
4.	OA, CM, CC = 1	**5.**	OA, CM, CC = 0	**6.**	AM, OI, CC = 2
7.	OA, CM, CC = 2	**8.**	OA, CM, CC = 5	**9.**	AM, OI, CC = 2
10.	AM, OI, CC = 4	**11.**	OA, CM, CC = 2	**12.**	OA, CM, CC = 2
13.	OA, CM, CC = 3	**14.**	OA, CM, CC = 2	**15.**	AM, OI, CC = 2
16.	AM, OI, CC = 2				

Answers of DPP No. – 27

Optically active:- OA Chiral molecule:- CM Achiral molecule:- AM Optically inactive:- OI
No. of chiral cente:- CC

1.	AM, OI, CC = 0	**2.**	AM, OI, CC = 0	**3.**	AM, OI, CC = 0
4.	AM, OI, CC = 2	**5.**	AM, OI, CC = 3	**6.**	AM, OI, CC = 0
7.	OA, CM, CC = 0	**8.**	AM, OI, CC = 0	**9.**	AM, OI, CC = 0
10.	AM, OI, CC = 4	**11.**	OA, CM, CC = 2	**12.**	OA, CM, CC = 2
13.	AM, OI, CC = 2	**14.**	AM, OI, CC = 2	**15.**	CM, OA, CC = 2
16.	AM, OI, CC = 2				

Answers of DPP No. – 28

Optically active:- OA Chiral molecule:- CM Achiral molecule:- AM Optically inactive:- OI
No. of chiral cente:- CC

1.	AM, OI, CC = 0	**2.**	OA, CM, CC = 0	**3.**	OA, CM, CC = 1
4.	OA, CM, CC = 2	**5.**	OI, AM, CC = 0	**6.**	AM, OI, CC = 0
7.	OA, CM, CC = 3	**8.**	OA, CM, CC = 2	**9.**	AM, OI, CC = 0
10.	AM, OI, CC = 0	**11.**	AM, OI, CC = 2	**12.**	OA, CM, CC = 0
13.	AM, OI, CC = 0	**14.**	CM, OA, CC = 0	**15.**	AM, OI, CC = 0
16.	CM, OA, CC = 0	**17.**	CM, OA, CC = 2		

ISOMERISM

ISOMERISM

In the study of organic chemistry we come across many cases when two or more compounds are made of equal number of like atoms. A molecular formula does not tell the nature of organic compound; sometimes several organic compounds may have same molecular formula. These compounds possess the same molecular formula but differ from each other in physical or chemical properties, are called isomers and the phenomenon is termed isomerism (Greek, isos = equal; meros = parts). Since isomers have the same molecular formula, the difference in their properties must be due to different modes of the combination or arrangement of atoms with in the molecule. Broadly speaking, isomerism is of two types.

i) Structural Isomerism

ii) Stereoisomerism

i) Structural isomerism: When the isomerism is simply due to difference in the arrangement of atoms with in the molecule without any reference to space, the phenomenon is termed structural isomerism. In other words, while they have same molecular formulas they possess different structural formulas. This type of isomerism which arises from difference in the structure of molecules, includes:

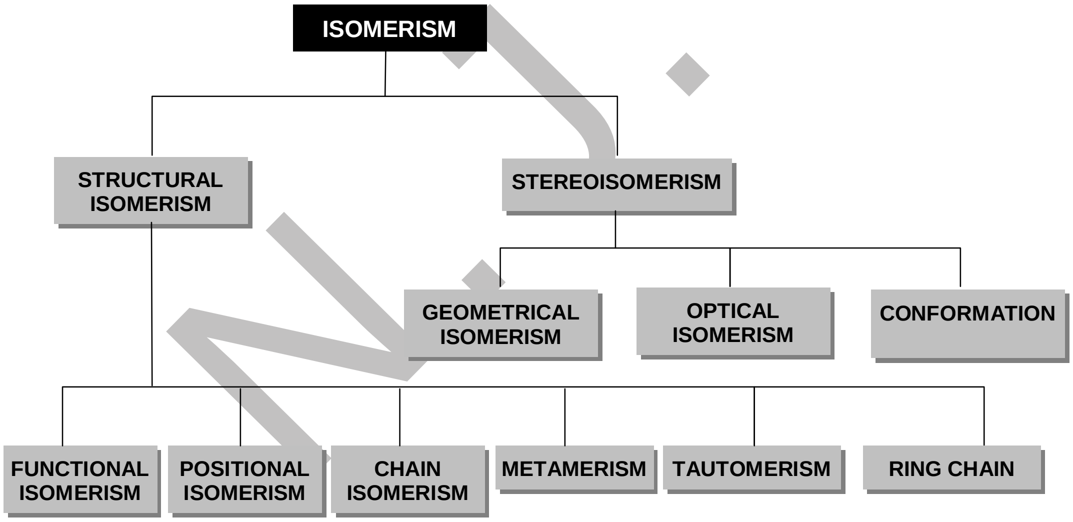
a) Chain
b) Positional Isomerism
c) Functional Isomerism
d) Metamerism and
e) Tautomerism
f) Ring-chain Isomerism

ii) Stereoisomerism: When isomerism is caused by the different arrangements of atoms or groups in space, the phenomenon is called Stereoisomerism (Greek, Stereos = occupying space). The stereoisomers have the same structural formulas but differ in the spatial arrangement of atoms or groups in the molecule. In other words, stereoisomerism is exhibited by such compounds which have identical molecular structure but different configurations.

Stereoisomerism is of three types :

a) Conformation b) Geometrical. c). Optical

Thus various types of isomerism could be summarised as follows.



Chain Isomerism

This type of isomerism arises from the difference in the structure of carbon chain which forms the nucleus of the molecule. It is, therefore, named as **chain, or Skeletal isomerism.** For example, there are known two butanes which have the same molecular formula (C_4H_{10}) but differ in the structure of the carbon chains in their molecules.

$CH_3–CH_2–CH_2–CH_3$ *n-butane*

$H_3C–CH–CH_3$ (with CH_3 on the middle carbon) *isobutane*

While n-butane has a continuous chain of four carbon atoms, isobutane has a branched chain. These chain isomers have somewhat different physical and chemical properties, n-butane boiling at -0.5^o and isobutane at -10.2^o. This kind of isomerism is also shown by other classes of compounds. Thus n-butyl alcohol and isobutyl alcohol having the same molecular formula C_4H_9OH are chain isomers.

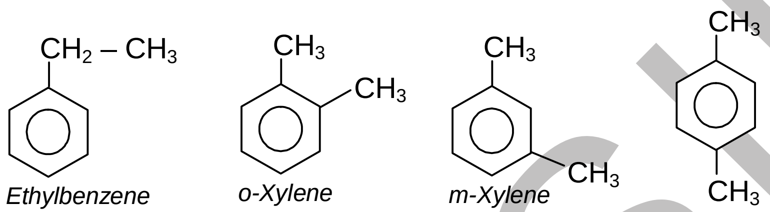
$CH_3–CH_2–CH_2–CH_2OH$
n-butyl alcohol

$CH_3–\underset{\underset{CH_3}{|}}{CH}–CH_2OH$
isobutyl alcohol

It may be understood clearly that the molecules of chain isomers differ only in respect of the linking of the carbon atoms in the alkanes or in the alkyl radicals present in other compounds.

Q.1 ***Give the possible chain isomers for ethyl benzene.***

Sol.:



Ethylbenzene *o-Xylene* *m-Xylene* *p-Xylene*

Positional Isomerism

It is the type of isomerism in which the compounds possessing same molecular formula differ in their properties due to the difference in the position of either the functional group or the multiple bond or the branched chain attached to the main carbon chain. For example, n-propyl alcohol and isopropyl alcohol are the positional isomers.

$CH_3–CH_2–CH_2–OH$
n-propyl alcohol

$CH_3–\overset{\overset{CH_3}{|}}{CH}–OH$
isopropyl alcohol

Butene also has two positional isomers:

$CH_2=CH–CH_2–CH_3$
1-butene

$CH_3–CH=CH–CH_3$
2-butene

1-Chlorobutane and 2-Chlorobutane are also the positional isomers:

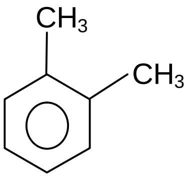
$$\underset{1\text{–Chlorobutane}}{CH_3-CH_2-CH_2-CH_2Cl} \qquad \underset{2\text{–Chlorobutane}}{CH_3CH_2-CHCl-CH_3}$$

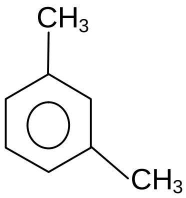
Methylpentane also has two positional isomers:

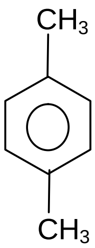
$CH_3—CH_2—CH_2—\underset{\underset{CH_3}{|}}{CH}—CH_3$
2-Methylpentane

$CH_3—CH_2—\underset{\underset{CH_3}{|}}{CH}—CH_2—CH_3$
3-Methylpentane

In the aromatic series, the disubstitution products of benzene also exhibit positional isomerism due to different relative positions occupied by the two substituents on the benzene ring. Thus xylene, $C_6H_4(CH_3)_2$, exists in the following three forms which are positional isomers.


o-Xylene

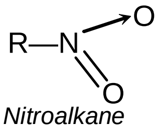

m-Xylene


p-Xylene

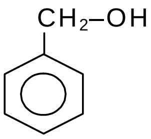
Functional Isomerism

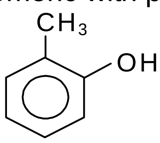
When any two compounds have the same molecular formula but possess different functional groups, they are called **functional isomers** and the phenomenon is termed **functional isomerism.** In other words substances with the same molecular formula but belonging to different classes of compounds exhibit functional isomerism. Thus,

1. Diethyl ether and butyl alcohol both have the molecular formula C_4H_6O, but contain different functional groups.
   $C_2H_5–O–C_2H_5$ $\quad$ $C_4H_9–OH$
   diethyl ether $\quad$ *butyl alcohol*
   The functional group in diethyl ether is (–O–), while is butyl alcohol it is (–OH).
2. Acetone and propionaldehyde both with the molecular formula C_3H_6O are functional isomers.
   $CH_3–CO–CH_3$ $\quad$ $CH_3–CH_2–CHO$
   acetone $\quad$ *acetaldehyde*
   In acetone the functional group is (–CO–), while in acetaldehyde it is (–CHO).
3. Cyanides are isomeric with isocyanides:
   $\underset{\text{Alkyl cyanide}}{RCN}$ $\quad$ $\underset{\text{Alkyl isocyanide}}{RNC}$
4. Carboxylic acids are isomeric with esters.
   $\underset{\text{Propanoic acid}}{CH_3CH_2COOH}$ $\quad$ $\underset{\text{Methyl ethanoate}}{CH_3COOCH_3}$
5. Nitroalkanes are isomeric with alkyl nitrites:

   
   Nitroalkane

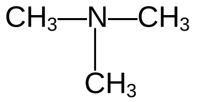
   R—O—N=O
   Alkyl nitrite
6. Sometimes a double bond containing compound may be isomeric with a triple bond containing compound. This also is called as functional isomerism. Thus, butyne is isomeric with butadiene (molecular formula C_4H_6).
   $\underset{\text{1–Butyne}}{CH_3-CH_2C \equiv CH}$ $\quad$ $\underset{\text{1,3–Butadiene}}{CH_2 = CH - CH = CH_2}$
7. Unsaturated alcohols are isomeric with aldehydes. Thus,
   $\underset{\text{Vinyl alcohol}}{CH_2 = CH - OH}$ $\quad$ $\underset{\text{Acetaldehyde}}{CH_3CHO}$
8. Unsaturated alcohols containing three or more carbon atoms are isomeric to aldehydes as well as ketones:
   $\underset{\text{Allyl alcohol}}{CH_2 = CH - CH_2OH}$ $\quad$ $\underset{\text{Propionaldehyde}}{CH_3CH_2CHO}$ $\quad$ $\underset{\text{Acetone}}{CH_3COCH_3}$
9. Aromatic alcohols may be isomeric with phenols:

   
   Benzyl alcohol

   
   o-Cresol

10. Primary,secondary and tertiary amines of same molecular formula are also the functional isomers.

$CH_3CH_2CH_2NH_2$ n–propylamine (1°) $\quad$ $CH_3-NH-C_2H_5$ Ethylmethylamine (2°)



Trimethylamine(3°)

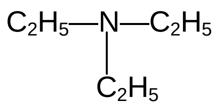
Metamerism

This type of isomerism is due to the unequal distribution of carbon atoms on either side of the functional group in the molecule of compounds belonging to the same class. For example, methyl propyl ether and diethyl ether both have the same molecular formula.

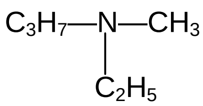
$CH_3–CO–C_3H_7$ *methyl propyl ether* $\quad$ $C_2H_5–O–C_2H_5$ *diethyl ether*

in methyl propyl ether the chain is 1 and 3, while in diethyl ether it is 2 and 2. This isomerism known as **Metamerism** is shown by members of classes such as ethers, and amines where the central functional group is flanked by two chains. The individual isomers are known as **Metamers.**

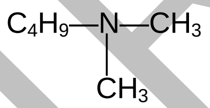
Examples:



Triethylamine



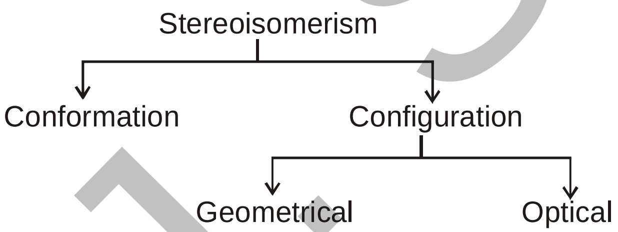
Ethylmethylpropylamine



Butyldimethylamine

Stereoisomerism

The isomers which differ only in the orientation of atoms in space are known as stereoisomerism.

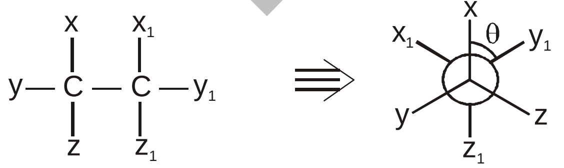


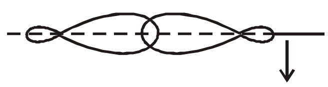
(A) <u>Conformation</u>:-

Single bonds are cylindrically symmetrical. The rotation about single bonds do not effectively change the overlapping region of σ-bonds. The 3-D structures arises due to rotation about σ-bonds are known as conformations. The study of energy of molecule with respect to angle of rotation is known as conformational analysis.

"The temporary molecular shapes that result from rotations of groups about single bonds are called **conformations** of the molecule, and analysis of the energy with respect to angle of rotation is **conformational analysis."**

<u>Newmann</u> <u>Projections</u>:-





Cylindrically symmetrical

θ = dihedral angle $\boxed{0^\circ \le \theta \le 60^\circ}$

The minimum angle between projected bonds of front carbon atom and back carbon atom is dihedral angle.

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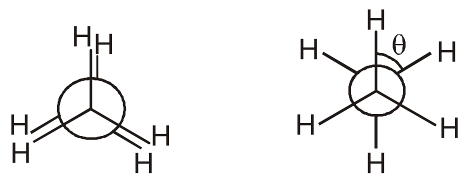
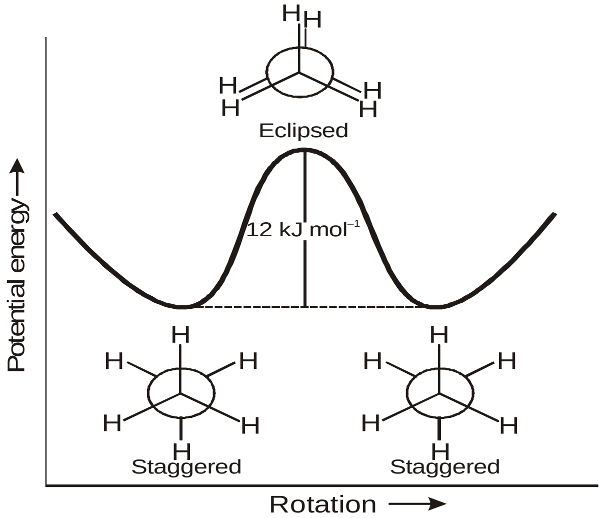
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

1 Conformation in ethane ($CH_3 — CH_3$)



$\theta = 0°$ (eclipsed) $\theta = 60°$ (Staggered)



Energy diagram for ethane

(1) Infinite values of θ are possible.
(2) Energy required for rotation 3kcal/mol. Which is available at room temperature.
(3) All other than eclipsed and staggered are known as skew.

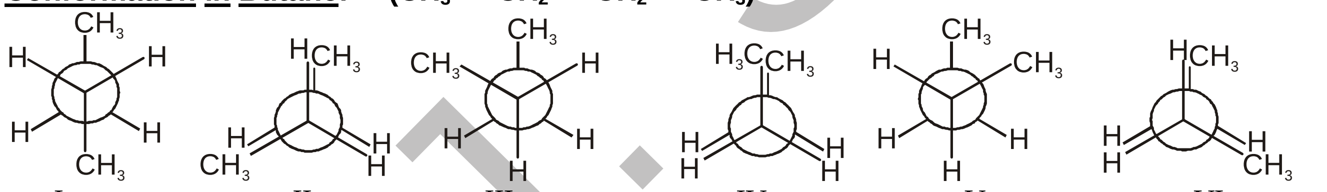
Torsional Strain:-

Is the name given to the repulsion felt by the bonded electron of front carbon atom with the bonded electrons of back carbon atom.

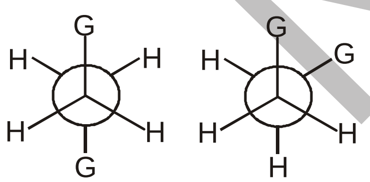
Steric Strain:-

Strain felt by the repulsion of atoms or groups of atoms of front carbon atom with back carbon atom.
In most circumstances torisonal strain dominates over steric strain.

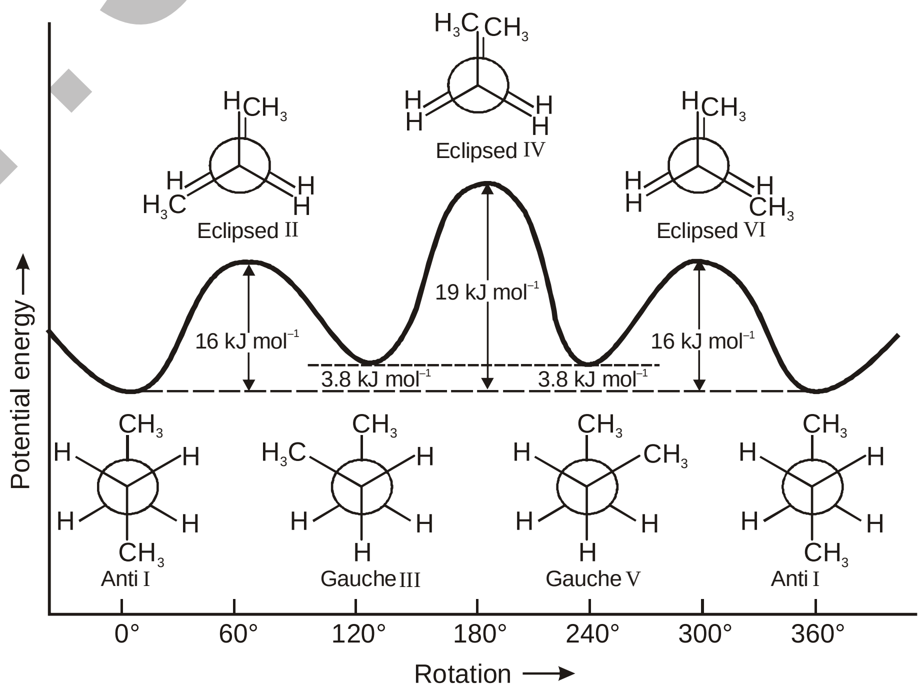
2 Conformation in Butane:- ($CH_3 — CH_2 — CH_2 — CH_3$)



I	II	III	IV	V	VI
An anti conformation	An eclipsed conformation	A gauche conformation	An eclipsed conformation	An gauche conformation	An eclipsed conformation



Anti gauche



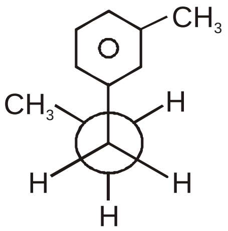
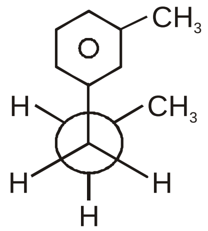
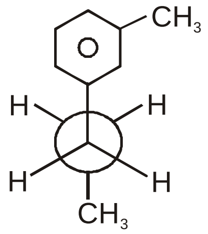
Energy diagram for butane

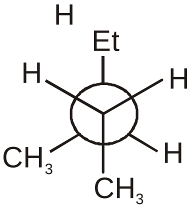
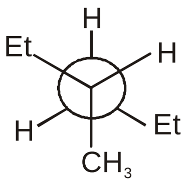
Q.2 Draw most stable conformers of

(a) 3-methyl pentane (C_2 — C_3)

(b) 3-methyl hexane (C_3 — C_4)

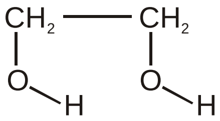
Q.3 Compare relative stabilities of given conformers:-

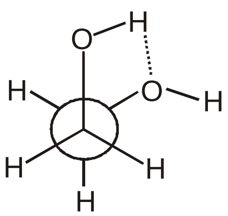
(a)  (b)  (c) 

Ans. **(2)** (a)  (b) 

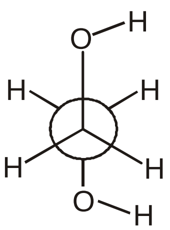
(3) (c) > (a) > (b)

Q.4 Which is more stable for the following compound gauche or anti?





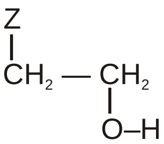
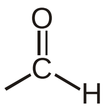
Gauche



anti

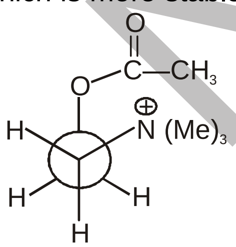
Gauche > anti

<u>Reason:</u> Because of intramolecular H – bonding

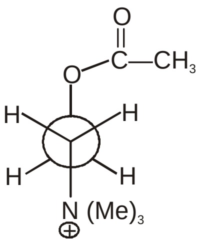
 **Imp:-** Z = OH, —$\ddot{N}H_2$, —OMe, F, Cl, Br, ,  ,

In all cases gauche > anti

Q.5 Which is more stable



(a)



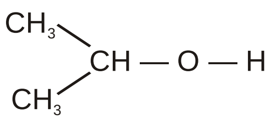
(b)

(a) > (b)

<u>Gauche effect</u>:-

Most bulky substituent should occupy gauche position w.r.t. lone pair.

Q.6 Draw most stable forms of

(a) CH_3 — CH_2 — NH_2 (b) 

Effect of Temperature:-

With the increase in temperature % of eclipsed form will increase & staggered decrease.

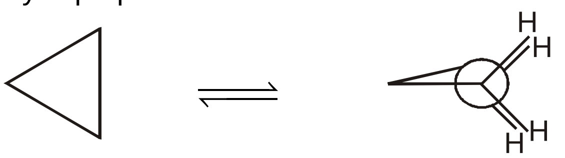
Q.7 What is the effect on dipole moment of 1,2-dichloroethane when temperature is increased?

Q.8 CH_2 — CH_2
| |
COOH COOH

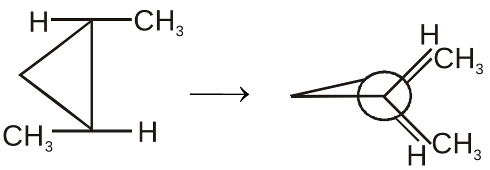
Explain:- At low pH gauche is more stable and at high pH staggered is more stable.

Conformation in Cycloalkanes:-

(1) Cyclopropane:-



Cis-1, 2-dimethylcyclopropane



Trans-1, 2-dimethylcyclopropane

Q.9 Trans 1,2-dimethylcyclopropane is more stable than cis form. Explain?

3 Conformation in cyclohexane:-

→ Draw chair form of cyclohexane & identify axial & equatorial positions

Q.10 Draw 1,2,3,4,5,6 — hexamethylcyclohexane in which
(a) all methyl axial positions.
(b) all methyl equatorial position.

Note:-

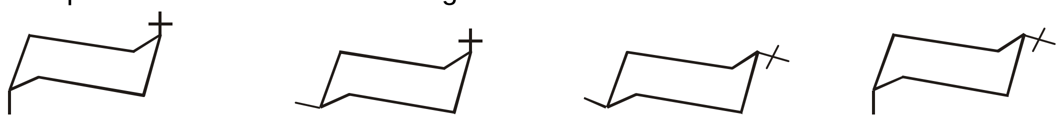
Substituents are more stable at equatorial and less stable at axial.

Reason → (1) axial is gauche while equatorial is anti
(2) 1, 3 & 1,5-diaxial interactions are present in axial position

Q.11 Draw most stable form of methylcyclohexane.

Q.12 Draw most stable isomer of 1,2-dimethylcyclohexane & 1,3-dimethylcyclohexane

Q.13 Compare stabilities of the following



(a) (b) (c) (d)

Q.14

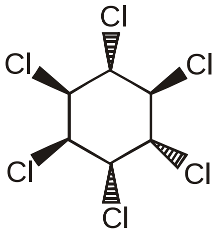
Draw structures & compare stabilities of following:-

(a) cis & trans 1,2-dimethylcyclohexane

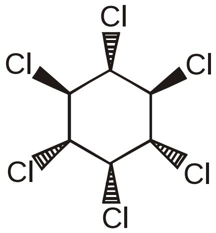
(b) cis & trans 1,3-dimethylcyclohexane

(c) 1-ethyl-2-methylcyclohexane

Q.15 Draw most stable form of

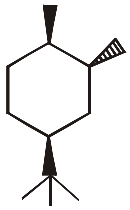


(a)

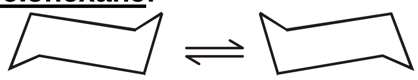


(b)

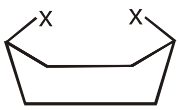
Q.16 Draw most stable conformation of



<u>Flipping</u> <u>in</u> <u>cyclohexane</u>:-

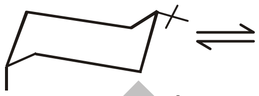


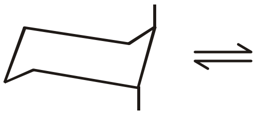
When ring flipping takes place axial converts to equatorial & equatorial converts to axial.

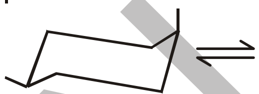


→ Boat form is less stable than chair form because of flag pole interactions.

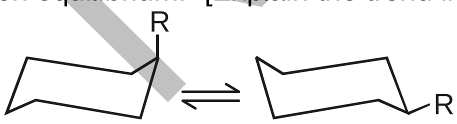
Q.17 Flip the following & predict the direction of equilibrium

(a) 

(b) 

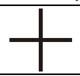
(c) 

Q.18 For given equilibrium:- [Explain the trend in numerical values of Keq.]



Keq.

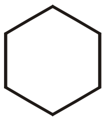
(a)

R	Keq.
H	1
CH_3	18
Et	23
$-CH(Me)Me$	38
	3800

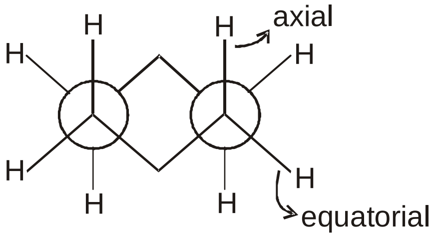
(b)

R	Keq.
F	1.5
Cl	2.4
Br	2.2
I	2.2

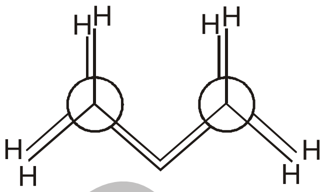
Cyclohexane:-



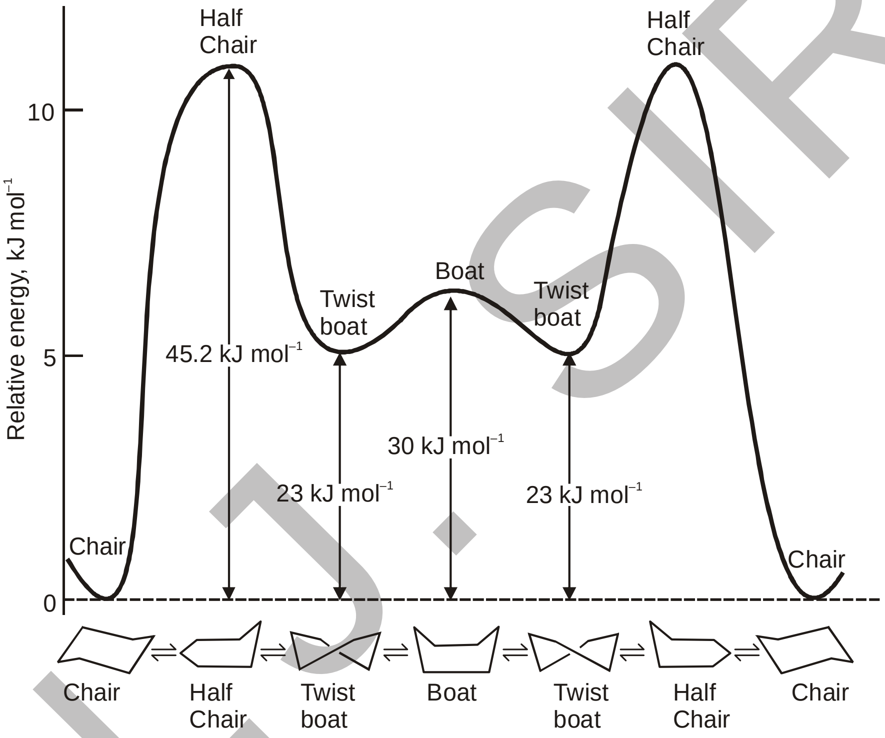
Cyclohexane



Chair form



Boat form

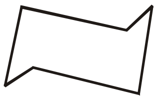
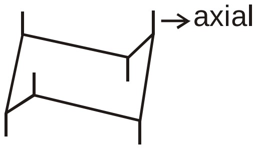


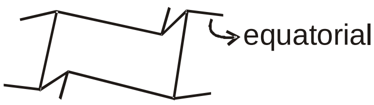
The relative energies of the various conformations of cyclohexane. The positions of maximum energy are conformations called half-chair conformations, in which the carbon atoms of one end of the ring have become coplanar.

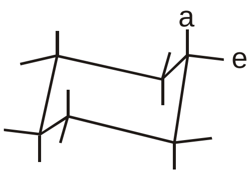
Q.19 Chair form is more stable than Boat form. Explain?

Q.20 In chair form substituents are more stable at equatorial and less stable at axial. Explain?

<u>Conventional</u> <u>drawing</u> <u>of</u> <u>chair form</u>:-

(1)  (2)  (3)  (4) 

(5) 

(6) 

(B) GEOMETRICAL ISOMERISM

Geometrical isomerism arises due to attachment on different atoms or groups to bonds or systems which cannot rotate freely. Following type of compounds can show geometrical isomerism:-

(a) Double bond system

(b) Substituted cycloalkanes

(c) Cycloalkenes

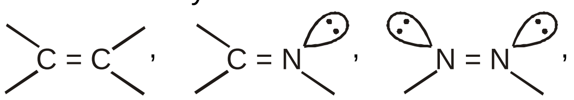
(d) Triphenylsystem

(e) Resonating structures

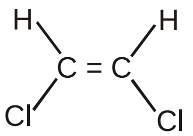
(f) Reactions leading to G.I.

(g) Bicyclo compounds

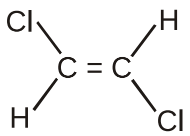
(a) Double bond system:-



(1) Cis-Trans.



Cis



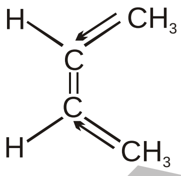
Trans

→ Boiling point of Cis-Trans isomers are related to the dipole moment (μ) of isomers.

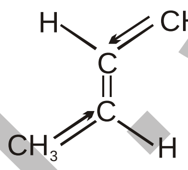
→ Melting point of G.I. are related to close (effective) packing in crystal lattice (usually mp. of Trans > Cis)

Ex. Identify cis-trans & compare mp & bp.

(a)



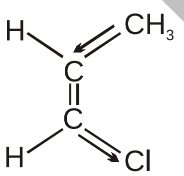
Cis



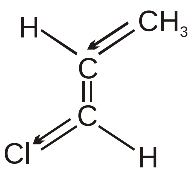
Trans

μ Cis > μ Trans
B.P. Cis > B.P. Trans
M.P. Cis < M.P. Trans

(b)



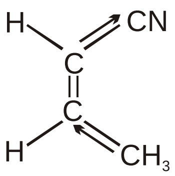
Cis



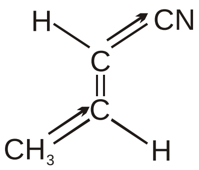
Trans

μ Trans > μ Cis
B.P. Trans > B.P. Cis
M.P. Trans > M.P. Cis

(c)



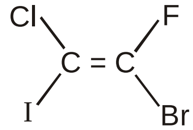
Cis



Trans

μ Trans > μ Cis
B.P. Trans > B.P. Cis
M.P. Trans > M.P. Cis

(2) E/Z Nomenclature:-



- Cis/Trans cannot be assigned

CIP system (cahn Ingold prelong)

Rule-1 Higher priority on the basis of higher atomic number

Ex.1 —F, —Cl, —Br, I

Ans. I > Br > Cl > F

Ex.2 —OH, —SH, — I

Ans. — I>—SH > —OH

Rule-2 If atomic number are same compare on the basis of atomic mass.

Ex.3 $—CH_3$, $—\overset{14}{C}H_3$, —OH, $—\overset{18}{O}H$

Ans. $—\overset{18}{O}H$ > —OH > $\overset{14}{C}H_3$ > $— CH_3$

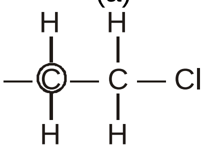
Ex.4 H, D, T

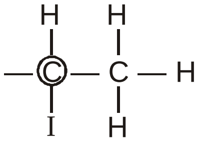
Ans. T > D > H

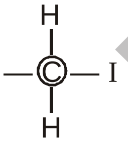
Rule-3 If atomic No. of atom attached is same look of next 3 atoms attached. Highest atomic No. atom attached will have highest priority.

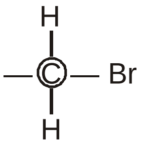
Ex.5 $— CH_2 — CH_2 — Cl$, $— \underset{|\,\,\,\,}{\underset{I}{CH}} — CH_3$, $— CH_2 — I$, $— CH_2 — Br$,

(a) (b) (c) (d)

 H, C, H (a)

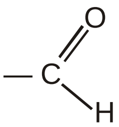
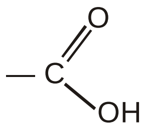
 H, C, I (b)

 H, I, H (c)

 H, H, Br (d)

Priority (b) > (c) > (d) > (a)

Rule-4 Double bonds are counted 2-times & triple bonds 3-times

Ex.6   $— C \equiv N$ $— CH_2I$

(a) (b) (c) (d)

(a)	—C(=O)—H	O, O, H
(b)	—C(=O)—OH	O, O, O
(c)	—C≡N	N, N, N
(d)	—CH_2I	H, H, I

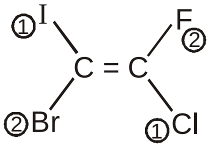
Ans. (d) > (b) > (a) > (c)

Rule-5 Real structures will have higher priority over virtual structures

Ex.7 (a) —C(CH_3)$_3$ (b) —C≡CH (c) —C(CH_3)=CH_2

Ans. (a) > (c) > (b)

For E/Z nomenclature priorities are assigned on the basis of groups/atoms attached to each carbon atom on the basis of CIP rules.

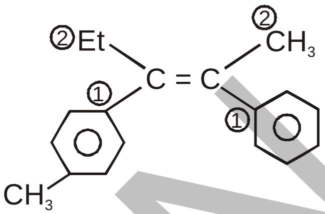


E

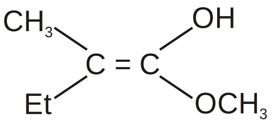
If opposite priorities are on the same side it is E and if same priorities are together it is Z.

Examples:-

1.



2.



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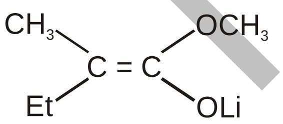

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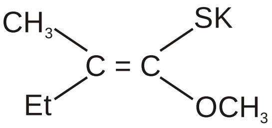
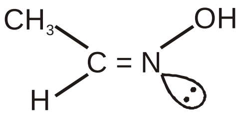


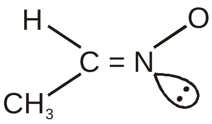
Ans. 1. Z 2. Z 3. E 4. E

Syn-anti Nomenclature:-

(1)

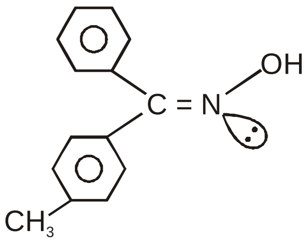


Aldoxime
Anti

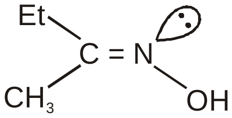


Aldoxime
syn

ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

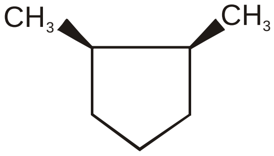
(2) 

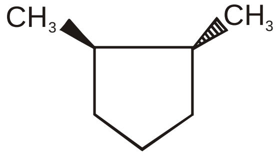
1. Syn-phenylparatolylketoxime
2. Anti-paratolylphenylketoxime

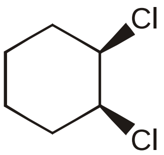
(3) 

1. Syn-methylethylketoxime
2. Anti-ethylmethylketoxime

(B) Substitued cycloalkanes:-

(1) 
Cis


Trans

(2) 
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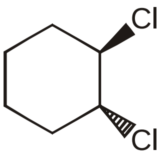
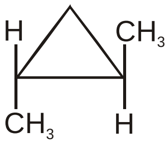
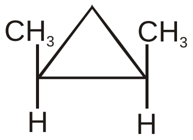

Trans

(3) 
Trans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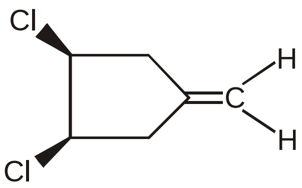
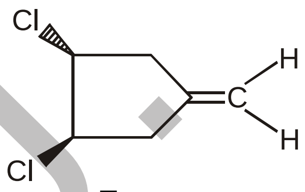
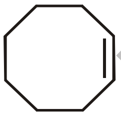
(4) 
Cis

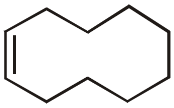

Trans

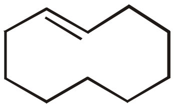
(C) Cycloalkene:-

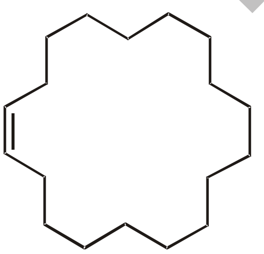
Min. No. of carbon atoms required for cyclic double bond to show G.I. is 8.

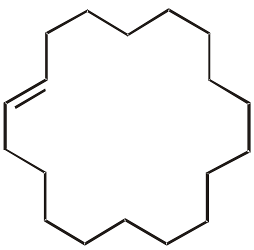

Cis


Trans


Cis


Trans

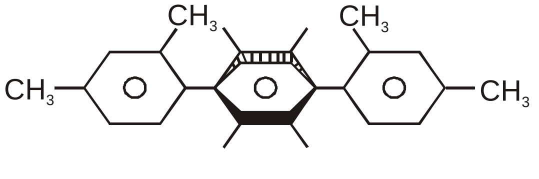

Cis


Trans

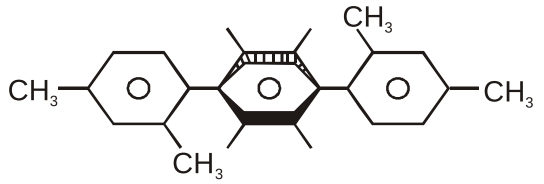
For carbon atom less than 11 cis is more stable and for greater than or equal to 11 trans is more stable.

(d) **Triphenylsystem:-**

(1)

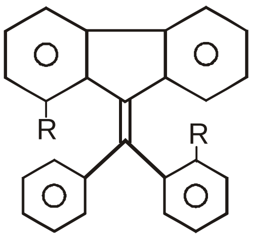


Cis

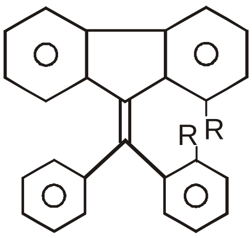


Trans

(2)

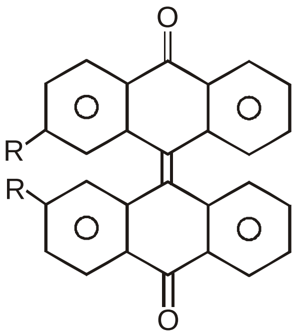


Trans

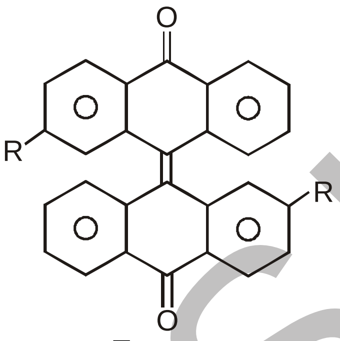


Cis

(3)



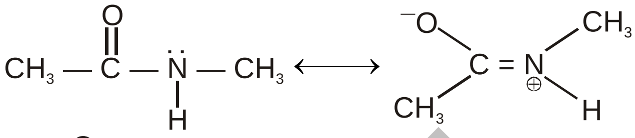
Cis



Trans

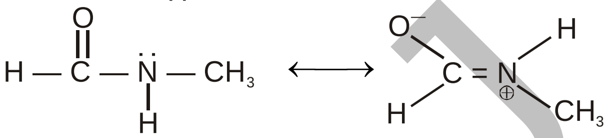
(e) Few molecules can show G.I. in resonating structures

(1)



√

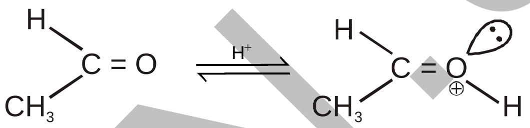
(2)



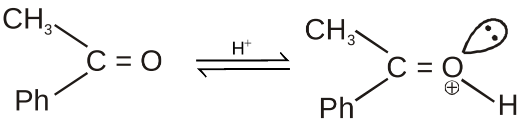
√

(f) Few reactions can also lead to G.I.

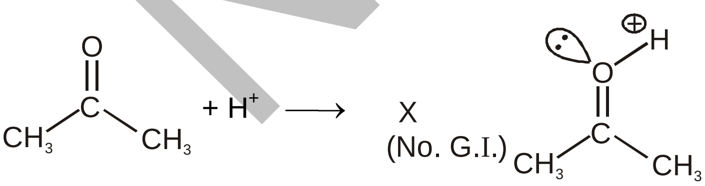
(1)



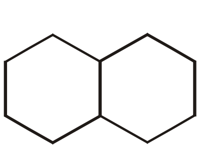
(2)



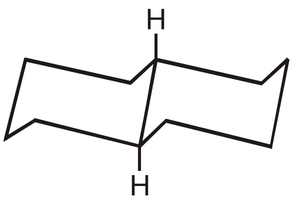
(3)



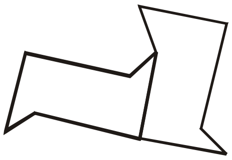
(g) Bicyclo compounds:-



decalin



Trans



Cis

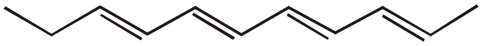
Calculation of G.I.

Case A unsymmetrical molecule

$CH_3 — CH = CH — CH = CH — CH_2 — CH_3$

Total No. of G.I. = 2^n

n = No. of double bonds showing G.I.

(1)  2^4

(2)  2^3

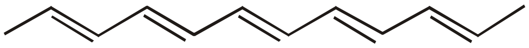
Case B Symmetrical molecule

$CH_3 — CH = CH — CH = CH — CH_3$

Total No. of G.I. $= 2^{n-1} = 2^{(n-1)/2}$ (n = odd)

$= 2^{n-1} + 2^{n/2-1}$ (n = even)

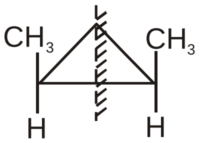
(1)  $2^{4-1} + 2^{4/2-1} = 10$

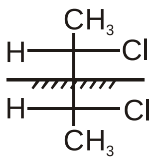
(2)  $2^{5-1} + 2^{(5-1)/2} = 2^4 + 2^2 = 20$

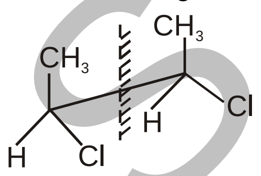
(C) OPTICAL ISOMERISM

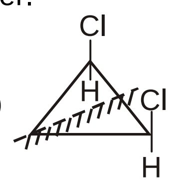
Plane of symmetry (POS):-

Plane of symmetry is defined as an imaginary plane which divides the molecule into two equal halves such that both halves are exactly identical and are mirror images of each other.

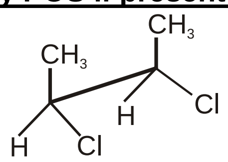
Ex:- (1) 

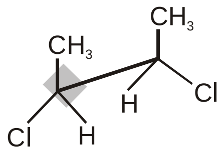
(2) 

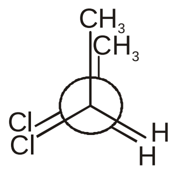
(3) 

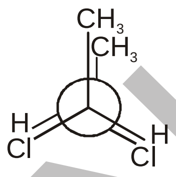
(4) 

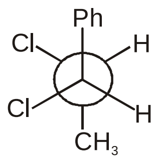
Q.21 **<u>Identify POS if present:-</u>**

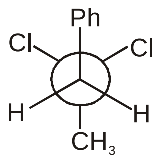
1. 

2. 

3. 

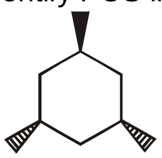
4. 

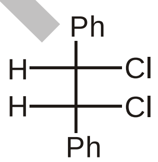
5. 

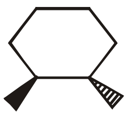
6. 

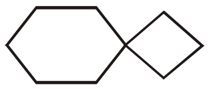
Ans. 1. √ 2. x 3. √ 4. x 5. x 6. √

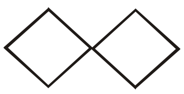
Q.22 Identify POS if present:-

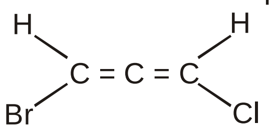
1. 

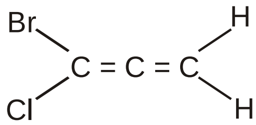
2. 

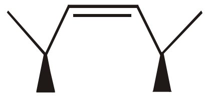
3. 

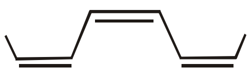
4. 

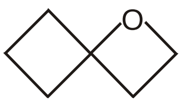
5. 

6. 

7. 

8. 

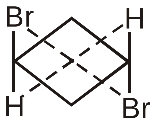
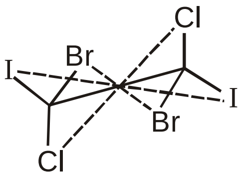
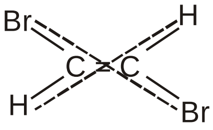
9. 

10. 

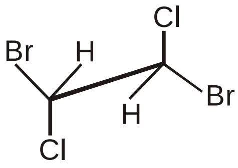
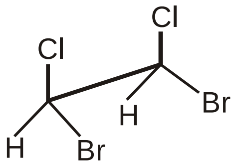
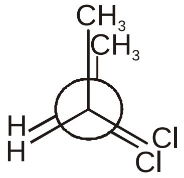
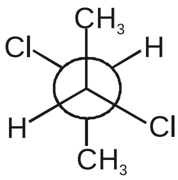
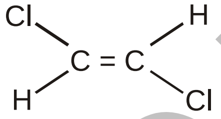
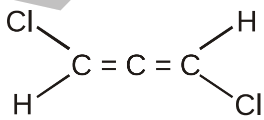
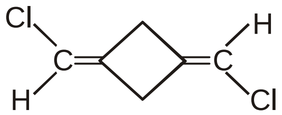
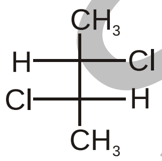
Ans. 1. √ 2. √ 3. X 4. √ 5. √ 6. X 7. √ 8. √ 9. √ 10. √

Centre of symmetry (COS)

Centre of symmetry is defined as imaginary point present for a molecule about which every atom has exactly identical mirror image.

Ex:- (1)  (2)  (3) 

Q.23 Identify COS if present.

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 

Ans.

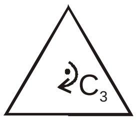
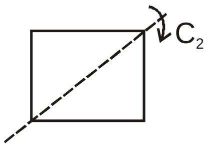
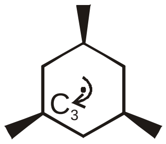
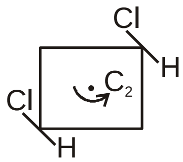
1. √ 2. X 3. X 4. √ 5. √ 6. X 7. √ 8. X

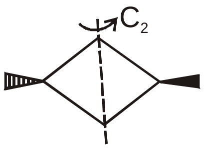
Axis of symmetry (AOS) (C_n)

Axis of symmetry (AOS) C_n is defined as an imaginary axis about which if the molecule is rotated by 360°, the structure repeats itself more than one time.

$$C_n \quad ; \quad n = \frac{360^\circ}{\theta} ;$$

θ = angle about which if molecule is rotated to repeat the 3-D arrangement.

Ex:- (1)  (2)  (3)  (4) 

(5) 

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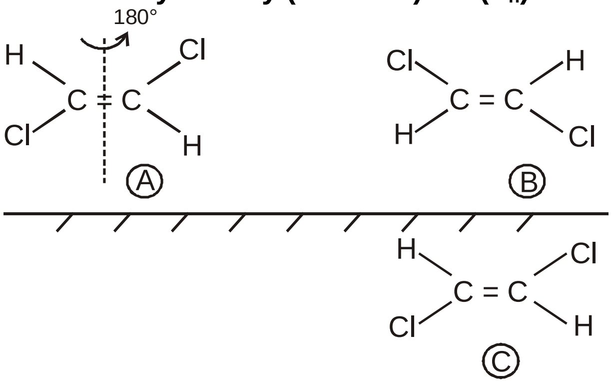
A.A.O.S.

Alternate axis of symmetry (A.A.O.S.) (S_n)



S_n: alternate axis of symmetry

$n = \frac{360^\circ}{\theta}$; θ = angle about which the molecule is rotate

Conditions:-

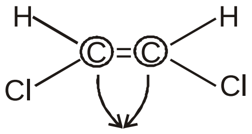
(1) (A) & (B) are unequal; (B) is formed by the rotation of (A)

(2) (A) & C) must be equal; (C) is mirror image of (B) when mirror is kept $\perp^r$ to axis

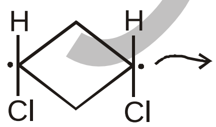
Axis of symmetry for above molecule is S_2.

Stereocentre:-

An atom present in the molecule about which if two groups are exchanged it generates new stereo isomer.

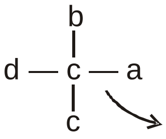


Both are stereocentre.



Both are stereocentre

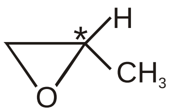
Chiral centre:-

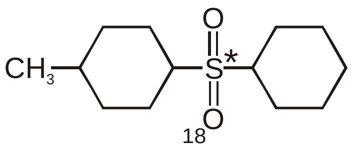


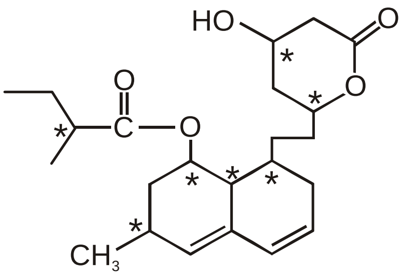
$a \neq b \neq c \neq d$

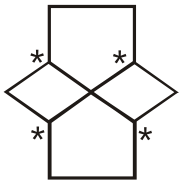
chiral centre / stereocentre / asymmetric carbon / stereogenic centre.

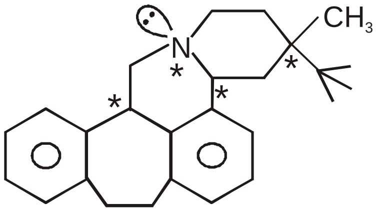
Examples:-

1. 

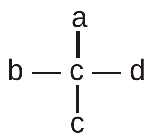
2. 

3. 

4. 

5. 

<u>Prochiral carbon:-</u>

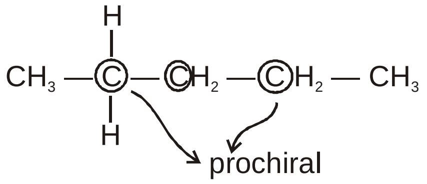


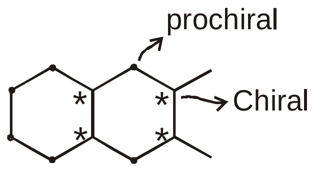
$a \neq b \neq c$

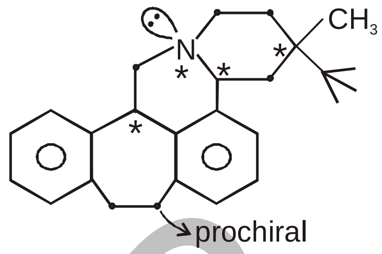
but $d = a$

or $d = b$
or $d = c$

Examples:-

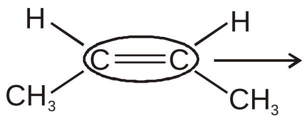
1. 

2. 

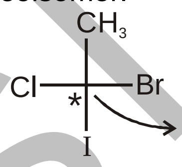
3. 

<u>Stereogenic centre/area/location</u>:-

→ a location which has the potential to generate a pair of stereoisomer.



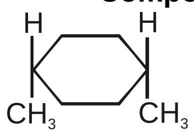
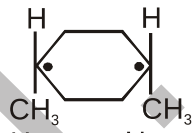
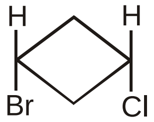
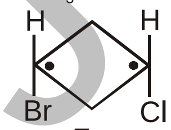
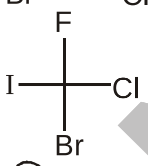
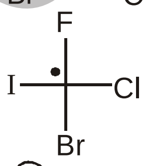
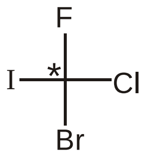
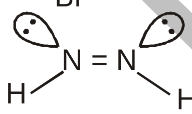
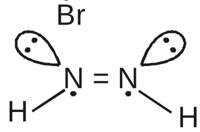
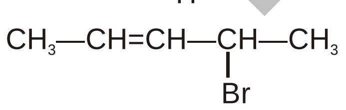
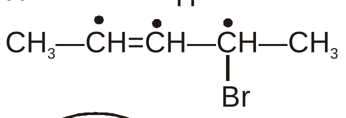
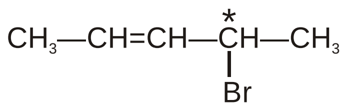
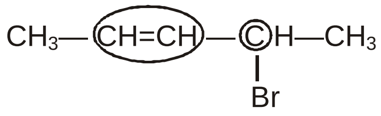
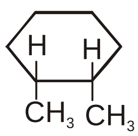
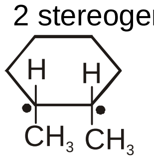
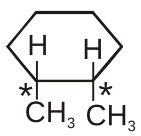
one stereogenic centre.



one stereogenic centre.

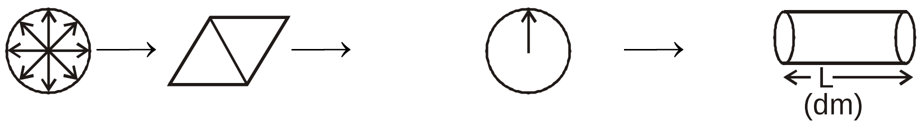
→ Every chiral centre is a stereocentre and also a stereogenic centre.

Q.24 Identify presence of stereocentre and chiral centre.

	Compound	**Stereocentre**	**Chiralcentre**
1.			X
2.			X
3.			
4.			X
5.			
		 2 stereogenic centre	
6.			

Optical Activity by Polarimeter Tube Experiment:-

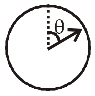
Case A



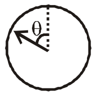
$\begin{bmatrix}\text{Compound is} \\ \text{optically inactive}\end{bmatrix}$

Light Biprism Plane polarised light C = Conc. in (gm/ml)

Case B.



dextrorotatory d(+)



Laevorotatory l(–)

$\begin{bmatrix}\text{Compound is} \\ \text{optically active}\end{bmatrix}$

If temperature & wavelength are constant

$\theta \propto$ conc. of solution (gm/ml)

$\theta \propto \ell$ (dm)

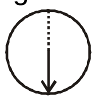
$\theta \propto C \times \ell$

$\theta = [\alpha]_{\lambda}^{T} \times C \times \ell$

$$\alpha = \frac{\theta}{C \times \ell} \begin{Bmatrix} \theta = \text{observed rotation} \\ \alpha = \text{Specific angle of rotation} \end{Bmatrix}$$

Specific Rotation($\propto$):-

Rotation caused by 1gm/ml of solution in 1 dm length polarimeter tube at specific temperature and fixed wavelength of light.

Confusion  θ = + 180° or – 180°

If concentration is halfed and θ becomes + 90° then d if – 90° then ℓ

Ex. Observed rotation of 2gm/ml of solution placed in 25cm length polarimeter tube is +138°. Calculate its specific rotation.

Ans. + 27.6°

Optical Purity (O.P.) or enantiomeric excess (*e. e.*)

$$\text{O.P. } (e.\ e.) = \frac{\text{excess of one enantiomer over other}}{\text{Total mix}} \times 100$$

$$= \frac{|d - l|}{d + l} \times 100$$

$$\text{O.P.} = \frac{\text{observed specific rotation}}{\text{Sp. rotation of pure enantiomer}} \times 100$$

	% of d	% of l	optical purity	% of Racemic mixture
1	100%	0%	100%	0%
2	99%	1%	98%	2%
3	90%	10%	80%	20%
4	75%	25%	50%	50%
5	10%	90%	80%	20%
6	1%	99%	98%	2%
7	0%	100%	100%	0%

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Q.25 In a lactic acid aq. solution (+6 gm) of d and 4 gm of ℓ are mixed. Calculate observed specific rotation if specific rotation of pure lactic acid = + 13.6°

Sol. O.P. = $\dfrac{d-\ell}{|d+\ell|}\times 100 \qquad = \dfrac{6-4}{10}\times 100 = 20\%$

Observed sp. rot. = 20% of 13.6°
= 2.72°

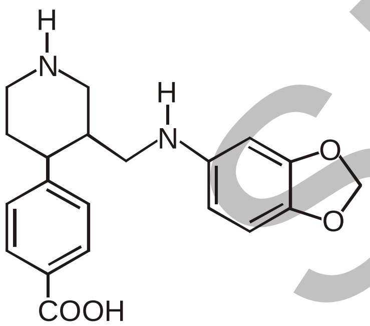
Q.26 Calculate the specific rotation of the following samples taken at 25° using the sodium D line.

(a) 1.0 gm of sample is dissolved in 20.0 ml. of ethanol. Then 5 ml of this solution is placed in a 20.0 cm polarimeter tube. The observed rotation is 1.25° counterclockwise.

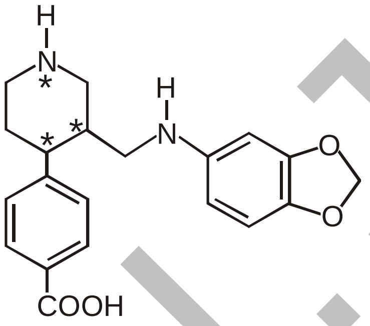
(b) 0.050 gm of sample is dissolved in 2.0 ml of ethanol, and this solution is placed in a 2.0 cm polarimeter tube. The observed rotation is clockwise 0.043°.

Ans. (a) –12.5° (b) + 8.6°

Q.27 Indicate the stereocentres in the following molecule and total number of stereoisomers possible.



Ans.



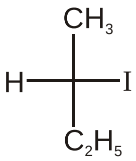
$2^3 = 8$

Q.28 The specific rotation of (s) – iodobutane is + 15.90°.

(a) Draw the structure of (s) – 2 – iodobutane.

(b) Predict the specific rotation of (R) – 2 – iodobutane.

(c) Determine the % composition of mixture of (R) and (S) – 2– iodobutane with specific rotation of 7.95°.

Ans. (a)  (b) – 15.90° (c) 75% s and 25 % R

Q.29 Dextrorotatory $\propto$ - pinene has a specific rotation $[\propto]_D^{20}$ = + 51.3°. A sample of $\propto$ - pinene containing both enantiomer was found to have specific rotation value $[\propto]_D^{20}$ = 30.8°. The % of (+) and (–) enantiomers in the sample are respectively

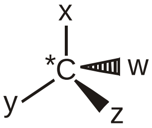
Ans. 80.02% (d) 19.98% (*l*)

<u>Chiral</u> <u>Molecule</u>:-

Chiral molecules are those molecules which are optically active

Optically active → POS X
→ COS X
→ AAOS X

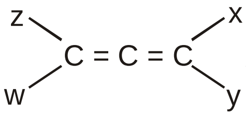
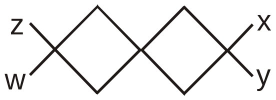
Compounds containing single chiral atoms:-

→  If x ≠ y ≠ z ≠ w; then carbon atom is chiral

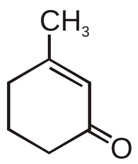
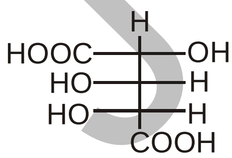
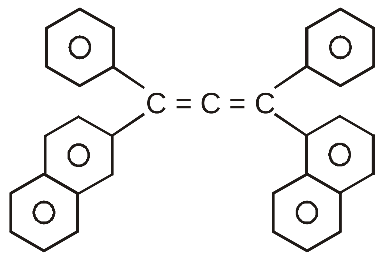
→ Molecules containing single chiral carbon atom are optically active because of absence of POS or COS.

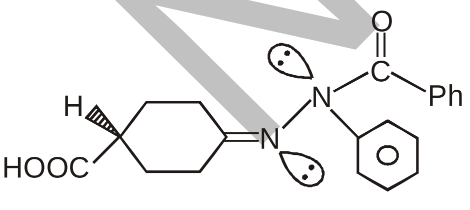
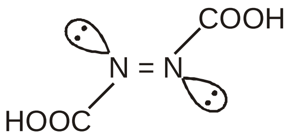
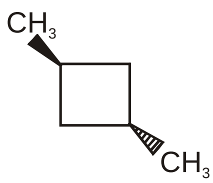
→ Every chiral carbon can be given configuration as R & S depending upon priorities of groups attached on the basis of CIP system (Cahn Ingold prelong system).

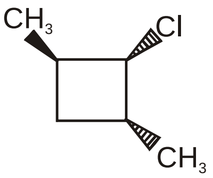
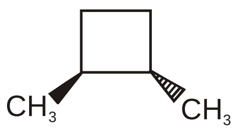
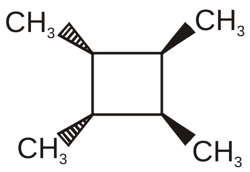
Note:-

1. All compounds containing one chiral atom are optically active are chiral molecules.
2. Multiple chiral containing molecules are optically inactive if POS or COS is present and are known as achiral molecules.
3.  x ≠ y & z ≠ w are chiral molecules.
4.  x ≠ y & z ≠ w are chiral molecules.

Q.30 Select chiral molecules out of following:-

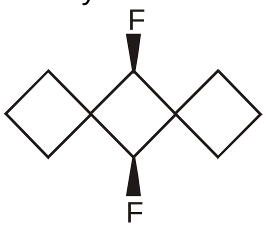
(i)  (ii)  (iii) 

(iv)  (v)  (vi) 

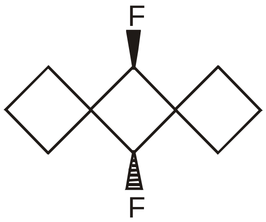
(vii)  (viii)  (ix) 

Ans. (i) achiral (ii) achiral (iii) chiral (iv) chiral (v) achiral (vi) achiral (vii) chiral
(viii) chiral (ix) achiral

Q.31 Identify POS and COS if present:-



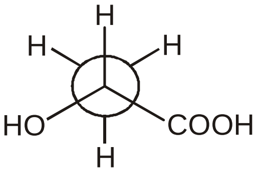
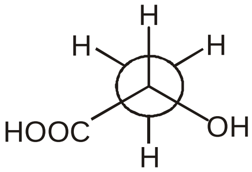
(a)

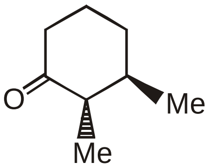
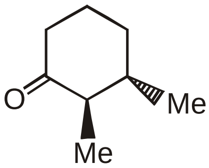


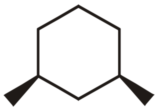
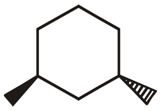
(b)

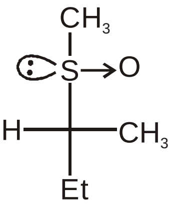
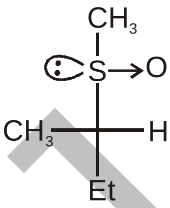
Ans. (a) POS = √ COS = X (b) POS = √ COS = √

Q.32 Identify relationship between following molecules:-

(a)  & 

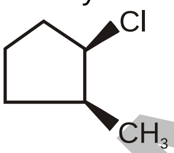
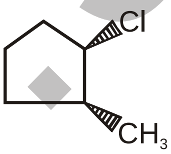
(b)  & 

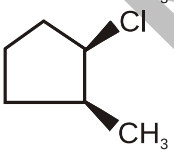
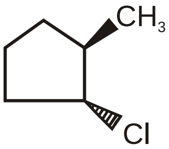
(c)  & 

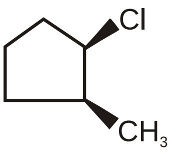
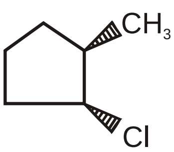
(d)  & 

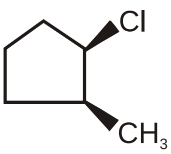
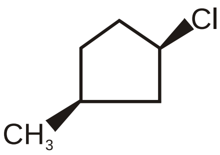
Ans. (a) enantiomers (b) enantiomers (c) diastereomers (d) diastereomers

Q.33 Identify relationship:-

(a)  & 

(b)  & 

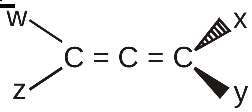
(c)  & 

(d)  & 

Ans. (a) enantiomers (b) diastereomers (c) identical (d) position isomers

Stereochemistry of cumulene:-

Allene:-

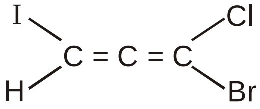


If $x \neq y$ & $z \neq w$; optically active.

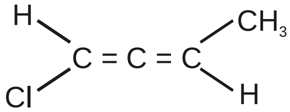
Note:-

- all optically active molecules show optical isomerism.
- above molecule will not show G.I.
- No. POS or COS

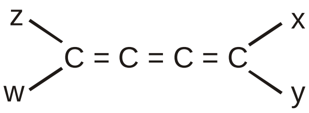
Ex:- (1)



(2)



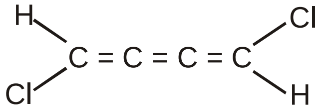
Note:-



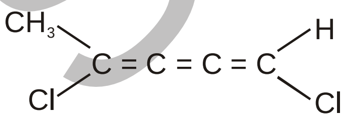
- will not show optical activity
- will show geometrical isomerism if $x \neq y$ & $z \neq w$.
- has POS that is molecular plane.

Ex. Identify POS or COS if present

1.



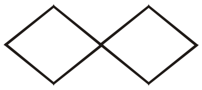
2.



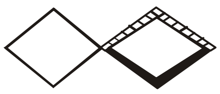
Ans.	POS	COS	G.I.	Optically active
1.	√	√	√	X
2.	√	X	√	X

Spiro compound:-

(a)

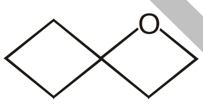


actual 3D ⟶

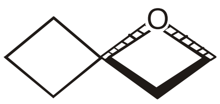


POS √ COS X Optically inactive

(b)

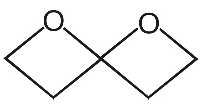


actual 3D ⟶

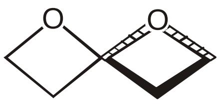


POS √ COS X Optically inactive

(c)

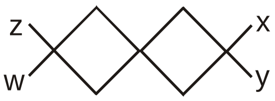


actual 3D

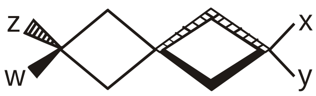


POS X COS X Optically active

(d)

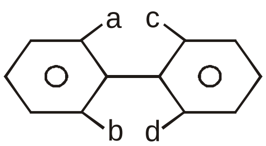


actual 3D

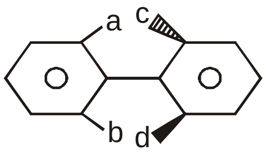


Optically active if $x \neq y$ & $z \neq w$

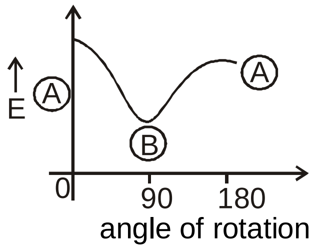
Stereochemistry of Biphenyl



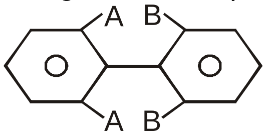
(a)



(b)

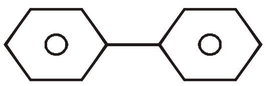


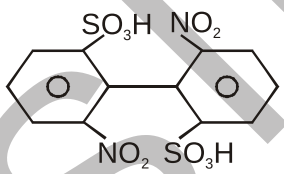
If rings are out of plane then optically active if a ≠ b & c ≠ d.

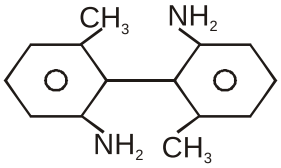
(a) 

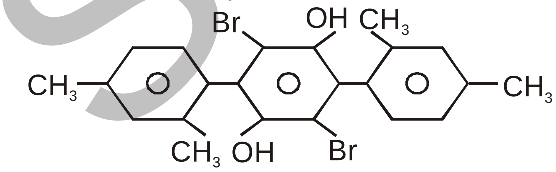
optically inactive

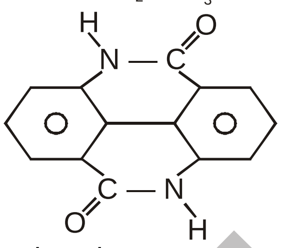
Examples:-

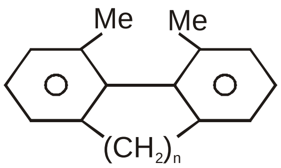
1. 

2. 

3. 

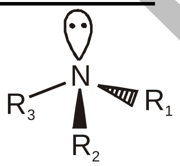
4. 

5. 

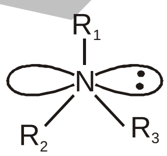
6. 

Ans. **1.** inactive **2.** active **3.** active **4.** inactive (COS present)
5. inactive (planar) **6.** n = 1 (inactive) n = 2,3 (active)

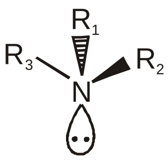
Amine Inversion:-



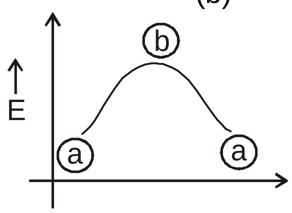
(a)



(b)



(a)



Note:-

(1) The energy required for amine inversion is available at room temperature.

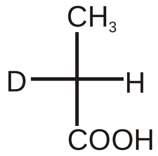
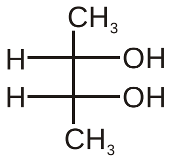
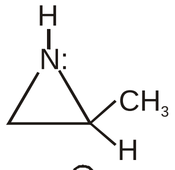
(2) Optically inactive even if $R_1 \neq R_2 \neq R_3$

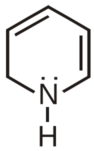
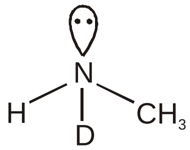
(3) Possible only if R_1, R_2 & R_3 are lighter groups.

Resolvable and Non-Resolvable Compounds:-

Resolution:- Separation of enantiomers from enantiomeric mixture is resolution Resolvable compounds are those compounds which can be separated into enantiomeric mixture.

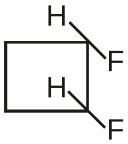
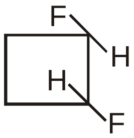
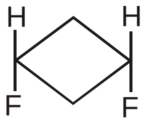
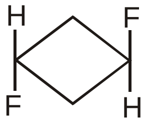
Examples:-

1.  **2.**  **3.** 

4.  **5.**  **6.** 

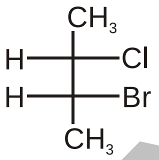
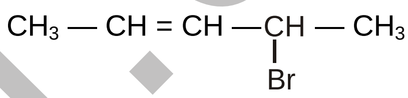
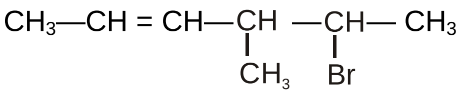
Ans. 1. Resolvable 2. Non-Resolvable 3. Resolvable 4. Resolvable
5. Resolvable 6. Non-Resolvable

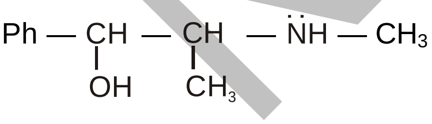
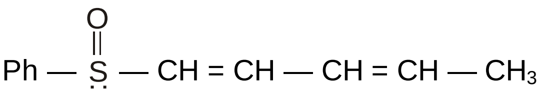
Q.34 **Column Matching**

(A)		(P)	POS
(B)		(Q)	COS
(C)		(R)	Resolvable
(D)		(S)	Non-resolvable

Ans. (A) $\rightarrow$ P, S; (B) $\rightarrow$ R; (C) $\rightarrow$ P, S (D) $\rightarrow$ P,Q,S

Q.35 Calculate total number of stereoisomers of following:-

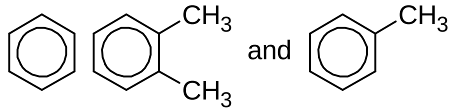
(1)  (2)  (3) 

(4)  (5) 

Ans. (1) 2^2 (2) 2^2 (3) 2^3 (4) 2^3 (5) 2^3

Exercise-1

Q.1 $C_3H_6Br_2$ can show:
(A) Two gem dibromide (B) Two vic dibromide
(C) Two tertiary dibromo alkane (D) Two secondary dibromo alkane

Q.2 

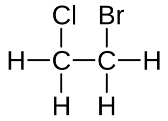
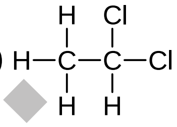
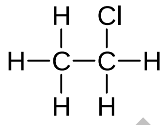
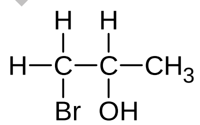
Number of secondary carbon atoms present in the above compounds are respectively:
(A) 6 ,4, 5 (B) 4, 5, 6 (C) 5, 4, 6 (D) 6, 2, 1

Q.3 The number of primary, secondary and tertiary amines possible with the molecular formula C_3H_9N s given by the set:
(A) 1, 2, 2 (B) 1, 2, 1 (C) 2, 1, 1 (D) 3, 0, 1

Q.4 The compound 1,2-butadiene has
(A) only sp hybridized carbons atoms
(B) only sp^2 hybridized carbon atoms
(C) both sp and sp^2 hybridized carbon atoms
(D) sp, sp^2 and sp^3 hybridized carbon atoms

Q.5 The number of isomers of C_5H_{10} is:
(A) 10 (B) 11 (C) 12 (D) 13

Q.6 The C–H bond distance is the longest in:
(A) C_2H_2 (B) C_2H_4 (C) C_2H_6 (D) $C_2H_2Br_2$

Q.7 Which of following have asymmetric carbon atom?
(A)  (B) 
(C)  (D) 

Q.8 The number of isomers of dibromoderivative of an alkene (molar mass 186 g mol^{-1}) is:
(A) two (B) three (C) four (D) six

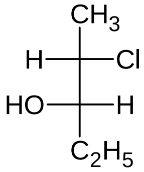
Q.9 Mesotartaric acid and d-tartaric acid are HOOC — CH(OH) — CH(OH) — COOH (Tartaric acid):
(A)position isomers (B) enantiomers (C) diastereomers (D) racemic mixture

Q.10 The number of isomers of structural C_7H_{16} is:
(A) 5 (B) 7 (C) 9 (D) 11

Q.11 The number of different substitution product possible when ethane is allowed to react with bromine in sunlight is:
(A)7 (B) 8 (C) 9 (D) 10

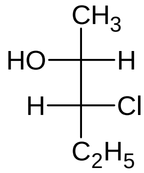
Q.12 The number of isomers of $C_3H_5Br_3$ is:
(A)4 (B) 5 (C) 6 (D) 7

Q.13 The number of optically active compounds in the isomers of C_4H_9Br is:
(A)1 (B) 2 (C) 3 (D) 4

Q.14 

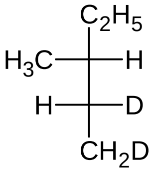
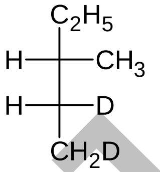
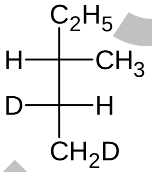
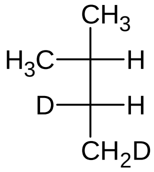
The compound with the above configuration is called:
(A) (2S, 3S)-2-chloro-3-hydroxypentane (B) (2S, 3R)-2-chloro-3-hydroxypentane
(C) (2R, 3R)-2-chloro-3-hydroxypentane (D) (2R, 3S)-2-chloro-3-hydroxypentane

Q.15 The correct decreasing priority of ligands $-NO_2$, $-C\equiv N$, $-NH_2$ and $-CH_2NH_2$ in absolute configuration of an enantiomer is:
(A) $NO_2 > NH_2 > C\equiv N > CH_2NH_2$ (B) $NO_2 > C\equiv N > NH_2 > CH_2NH_2$
(C) $NH_2 > NO_2 > C\equiv N > CH_2NH_2$ (D) $NH_2 > NO_2 > CH_2NH_2 > C\equiv N$

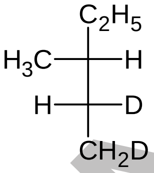
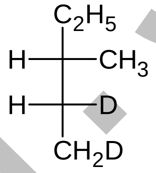
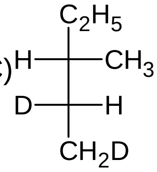
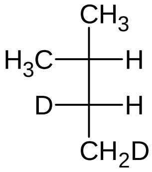
Q.16 The full name of the compound  is:
(A) (2R, 3R)-3-chloro-2-pentanol (B) (2R, 3S)-3-chloro-2-pentanol
(C) (2S, 3R)-3-chloro-2-pentanol (D) (2S, 3S)-3-chloro-2-pentanol

Q.17 The preferred conformation of trans-1, 2-dibromocyclohexane is:
(A) diaxial (B) diequatorial
(C) axial/equatorial (D) neither A, B, nor C

Q.18 The structure of (2R, 3R)$C_2H_5CH(CH_3)CH(D)CH_2D$ is:

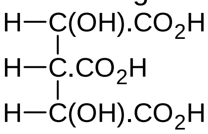
(A)  (B)  (C)  (D) 

Q.19 The structure of (2R, 3S)$C_2H_5CH(CH_3)CH(D)CH_2D$ is:

(A)  (B)  (C)  (D) 

Q.20 The number of meso diastereomers of $C_6H_{12}Cl_2$ is:
(A) 2 (B) 3 (C) 4 (D) 5

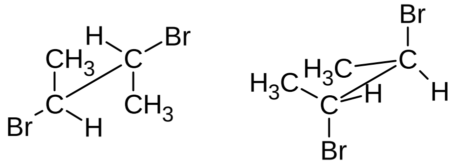
Q.21 How many stereoisomers can exist for the following acid



(A) two (B) four (C) eight (D) sixteen

Q.22 How many stereoisomers of the following molecule are possible?
HOOC.CH = C = CH.COOH
(A) two optical isomers (B) two geometrical isomers
(C) two optical and two geometrical isomers (D) None

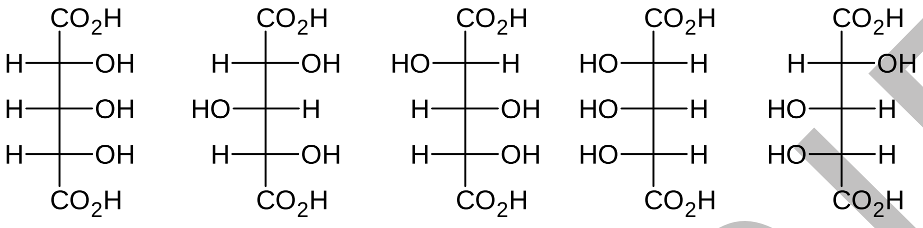
Q.23 The structures shown here are related as being:



(A) confermers (B) enantiomorphs
(C) geometrical isomers (D) diastereoisomers

Q.24 Which of the following cannot be written in an isomeric form?
(A) $CH_3 – CH(OH) – CH_2 – CH_3$ (B) $CH_3 – CHO$
(C) CH2 = CH – Cl (D) $Cl – CH_2CH_2–Cl$

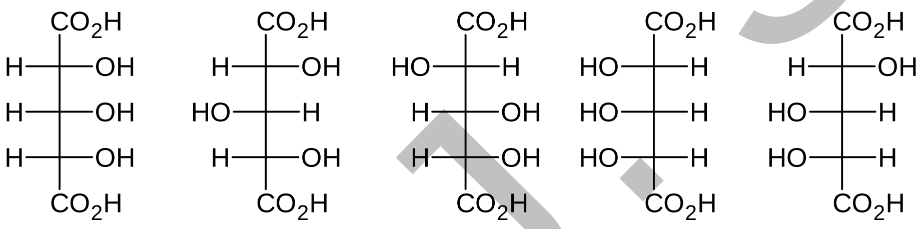
Q.25



(I) (II) (III) (IV) (V)

Which of the above formulae represent identical compounds?
(A) I and II (B) I and IV (C)II and IV (D) III and IV

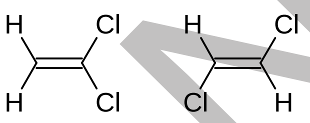
Q.26



(I) (II) (III) (IV) (V)

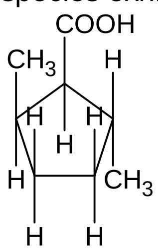
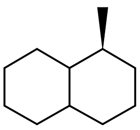
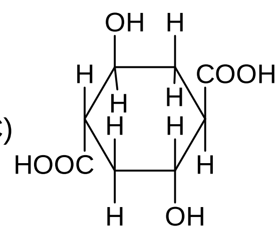
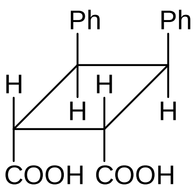
Which of the above compounds are enantiomers?
(A) II and III (B) III and IV (C) III and V (D) I and V

Q.27



The above compounds differ in:
(A) configuration (B) conformation (C) structure (D) chirality

Q.28 Which species exhibits a plane of symmetry?

(A)  (B)  (C)  (D) 

Q.29 Applying the sequence rule, which of the following priority arrangements is correct in determining the R/S configuration of:
(A) $–C_6H_5$ > $–CH = CH_2$ > – CHO > –COOH
(B) –COOH > $–CH = CH_2$ > – CHO > – C_6H_5
(C) –COOH > –CHO > $–C_6H_5$ > $–CH = CH_2$
(D) –COOH > $–C_6H_5$ > –CHO > $–CH = CH_2$

Q.30 How many primary amines are possible for the formula $C_4H_{11}N$?
(A) 2 (B) 3 (C) 4 (D) 5

Q.31 The type of isomerism observed in urea molecule is:
(A) Chain (B) Position (C) Geometrical (D) Functional

Q.32 Number of possible 3D-isomers of glucose are:
(A) 10 (B) 14 (C) 16 (D) 20

Q.33 The total number of isomeric optically active monochloro isopentanes is:
(A) two (B) three (C) four (D) one

Q.34 The compounds $C_2H_5OC_2H_5$ and $CH_3OCH_2CH_2CH_3$ are:
(A) enantiomers (B) geometrical isomers
(C) Metamers (D) conformational isomers

Q.35 Which of the following compounds displays geometrical isomerism?
(A) $CH_2 = CHBr$ (B) $CH_2 = CBr_2$
(C) $ClCH = CHBr$ (D) $Br_2C = CCl_2$

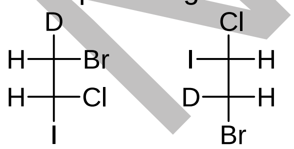
Q.36 The number of optically active isomers observed in 2,3-dichlorobutane is:
(A) 0 (B) 2 (C) 3 (D) 4

Q.37 How many total isomers are possible by replacing one hydrogens atoms of propane with chlorine?
(A) 2 (B) 3 (C) 4 (D) 5

Q.38 A compound has the formula C_2HCl_2Br. The number of total isomers that are possible is:
(A) 1 (B) 2 (C) 3 (D) 4

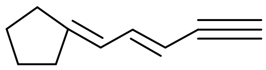
Q.39 On chlorination of propane number of products of the formula $C_3H_6Cl_2$ is:
(A) 3 (B) 4 (C) 5 (D) 6

Q.40 The two compounds given below are



(A) enantiomers (B) identical (C) optically inactive (D) diastereomers

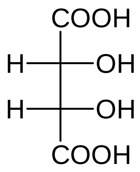
Q.41 The number of cis-trans isomer possible for the following compound:

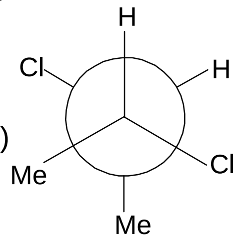


(A) 2 (B) 4 (C) 6 (D) 8

Q.42 A pure sample of 2-chlorobutane shows rotation of PPL by 30° in standard conditions. When above sample is made impure by mixing its opposite form, so that the composition of the mixture becomes 87.5% d-form and 12.5% ℓ-form, then what will be the observed rotation for the mixture.
(A) –22.5° (B) +22.5° (C) +7.5° (D) –7.5°

Q.43 When an optically active compound is placed in a 10 dm tube is present 20 gm in a 200 ml solution rotates the PPL by 30°. Calculate the angle of rotation and specific angle of rotation if above solution is diluted to 1 Litre.
(A) 16° and 36° (B) 6° and 30° (C) 3° and 30° (D) 6° and 36°

Q.44 Which of the following will not show optical isomerism?
(A) Cl – CH = C = C = CH – Cl (B) Cl – CH = C = C = C = CH – Cl
(C)


(D)


Exercise – II

Q.1 $C_4H_6O_2$ does represent:
(A) A diketone (B) A compound with two aldehyde
(C) An alkenoic acid (D) An alkanoic acid

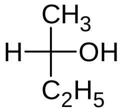
Q.2 Only two isomeric monochloro derivatives are possible for (excluding stereo)
(A) n-butane (B) 2,2-dimethylpentane
(C) benzene (D) 2-methylpropane

Q.3 Which of the following statements is/are not correct?
(A) Metamerism belongs to the category of structural isomerism
(B) Tautomeric structures are the resonating structures of a molecule
(C) Keto form is always more stable than the enol form
(D) Geometrical isomerism is shown only by alkenes

Q.4 Which of the following statements is/are correct?
(A) A meso compound has chiral centres but exhibits no optical activity
(B) A meso compound has no chiral centres and thus are optically inactive
(C) A meso compound has molecules which are superimposable on their mirror images even though they contain chiral centres
(D) A meso compound is optically inactive because the rotation caused by any molecule is cancelled by an equal and opposite rotation caused by another molecule that is the mirror image of the first

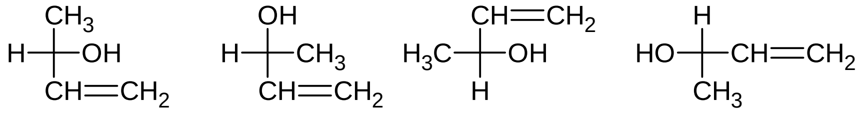
Q.5 Which of the following statements is/are not correct for D–(+) glyceraldehyde?
(A) The symbol D indicates the dextrorotatory nature of the compound
(B) The sing (+) indicates the dextrorotatory nature of the compound
(C) The symbol D indicates that hydrogen atom lies left to the chiral centre in the Fischer projection diagram
(D) The symbol D indicates that hydrogen atom lies right to the chiral centre in the Fischer production diagram

Q.6 Which of the following compounds is optically active?
(A) 1-Bromobutane
(B) 2-Bromobutane
(C) 1-Bromo-2-methylpropane
(D) 2-Bromo-2-methylpropane

Q.7 Which of the following operations on the Fischer formula  does not change its absolute configuration?

(A) Exchanging groups across the horizontal bond
(B) Exchanging groups across the vertical bond
(C) Exchanging groups across the horizontal bond and also across the vertical bond
(D) Exchanging a vertical and horizontal group

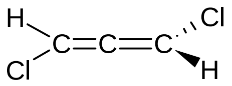
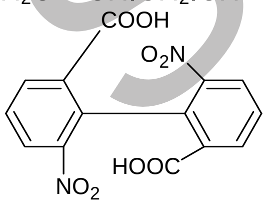
Q.8 Which of the following combinations amongst the four Fischer projections represents the same absolute configurations?



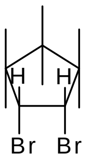
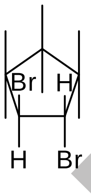
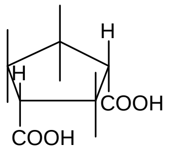
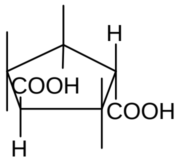
(I) (II) (III) (IV)

(A) (II) and (III) (B) (I) and (IV) (C) (II) and (IV) (D) (III) and (IV)

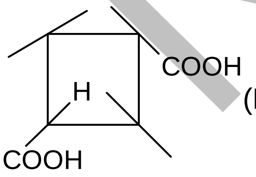
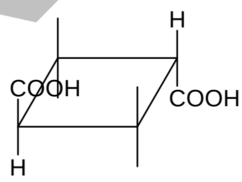
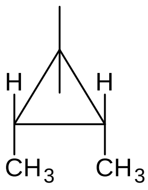
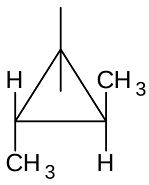
Q.9 Which of the following statements for a meso compound is/are correct?
(A) The meso compound has either a plane or a point of symmetry
(B) The meso compound has at least one pair of similar stereocentres
(C) The meso compound is achiral
(D) The meso compound is formed when equal amounts of two enantiomers are mixed

Q.10 Which of the following compounds are optically active?
(A) $CH_3.CHOH.CH_2.CH_3$
(B) $H_2C = CH.CH_2.CH = CH_2$
(C) 
(D) 

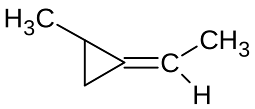
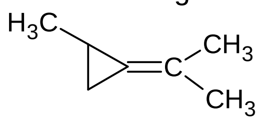
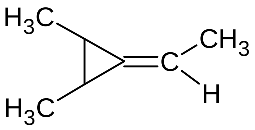
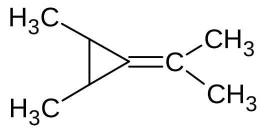
Q.11 Which out of the following are Non-resolvable?

(A) 
(B) 
(C) 
(D) 

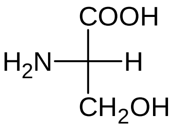
Q.12 Which out of the following are resolvable?

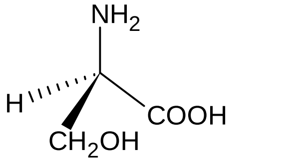
(A) 
(B) 
(C) 
(D) 

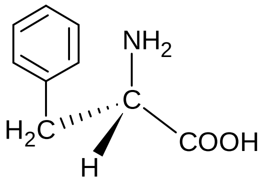
Q.13 Which of the following will show optical isomerism as well as geometrical isomerism?

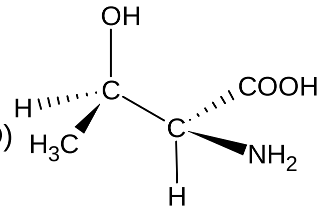
(A) 
(B) 
(C) 
(D) 

Q.14 Which of the following are correct representation of L-amino acids?

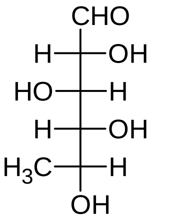
(A) 

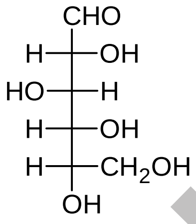
(B) 

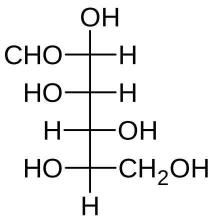
(C) 

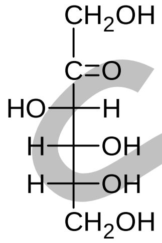
(D) 

Q.15 Which of the following are D sugars?

(A) 

(B) 

(C) 

(D) 

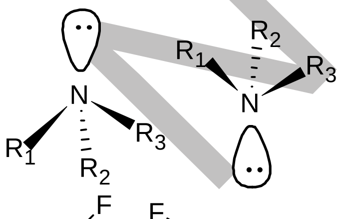
Q.16 What observed rotation is expected when a 1.5 M solution of (R)-2-butanol is mixed with an equal volume of a 0.75 M solution of racemic 2-butanol and the resulting solution is analysed in a sample container that is 1 dm long? The specific rotation of (R)-2-butanol is –13.9° ml gm^{-1} dm^{-1}.

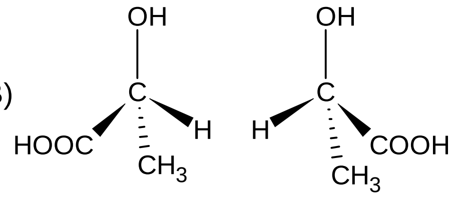
(A) +0.77° (B) –0.77° (C) +0.35° (D)–0.35°

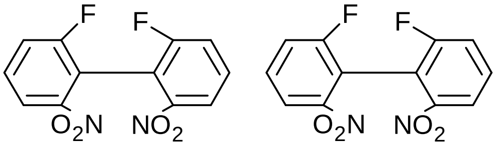
Q.17 Which of the following have zero dipole moment?

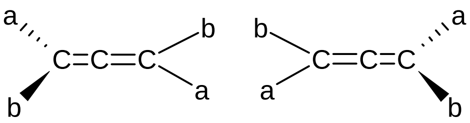
(A) p-Dichlorobenzene (B) Benzene-1, 4-diol
(C) Fumaric acid (D) Maleic acid

Q.18 Which of the following pairs can be resolved?

(A) 

(B) 

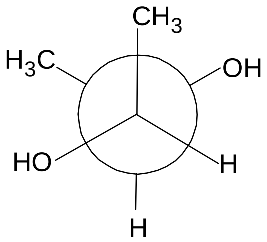
(C) 

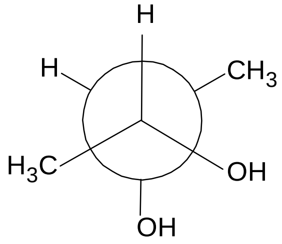
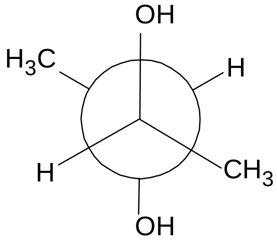
(D) 

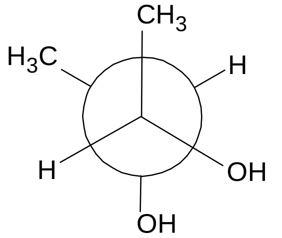
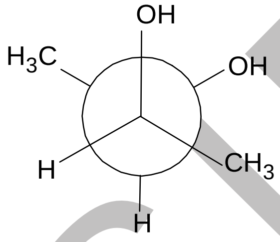
Q.19 Which of the following states are correct:

(A) Any chiral compound with a single asymmetric carbon must have a positive optical rotation if the compound has the R configuration
(B) If a structure has no plane of symmetry it is chiral
(C) All asymmetric carbons are stereocentres
(D) Alcohol and ether are functional isomers

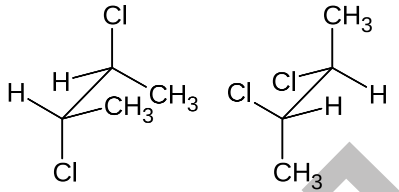
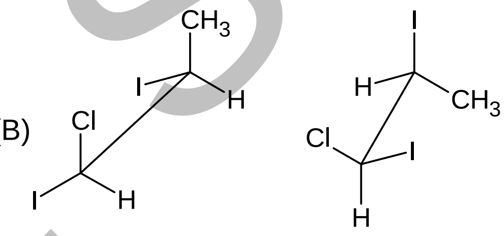
Q.20 Which of the following molecules is/are identical with that represented by?

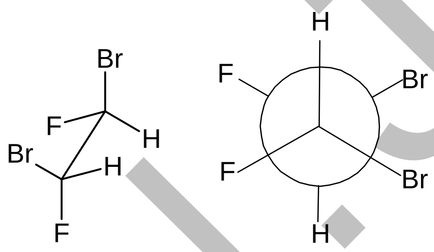
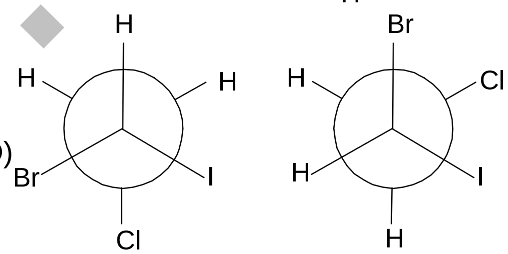


(A) 
(B) 

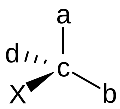
(C) 
(D) 

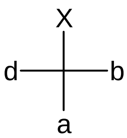
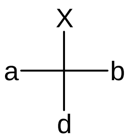
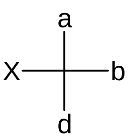
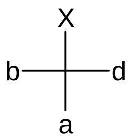
Q.21 Which of the following pairs of compound is/are identical?

(A) 
(B) 

(C) 
(D) 

Q.22 The Fischer projection of the molecule as represented in the wedge edge?

 is:

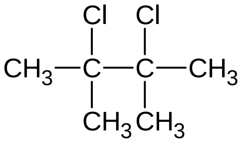
(A) 
(B) 
(C) 
(D) 

Q.23 Which of the following switching ligands or rotating Fischer structures changes its absolute configuration?
(A) An even number of switches
(B) An odd number of switches
(C) Rotating the Fischer projection by 180° in the plane of the paper
(D) Exchange ligands across the horizontal bond as well as those across the vertical bond

Q.24 Match List–I with List–II and select the correct answer from the codes given below the lists:

List I		List II	
(A)	Constitutional isomers	(P)	Stereoisomers that are not enantiomers
(B)	Stereoisomers	(Q)	Isomers that have same constitution but differ in the arrangement of their atoms in space
(C)	Enantiomers	(R)	Isomers that differ in the order in which their atoms are connected
(D)	Diastereoisomers	(S)	Stereoisomers that are related as an object and its non-superimposable mirror image

Q.25 Each of compounds in column A is subjected to further chlorination. Match the following for them.

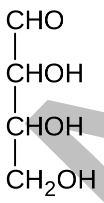
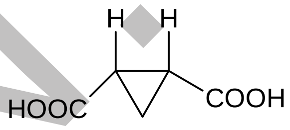
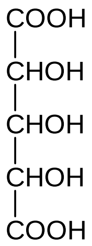
Column A		Column B	
(A)	$CHCl_2 - CH_2 - CH_3$	(P)	Optically active
(B)	$CH_2Cl - CHCl - CH_3$	(Q)	Only one trichloro product
(C)	$CH_2Cl - CH_2 - CH_2 - Cl$	(R)	Three trichloro product
(D)	$CH_3 - CCl_2 - CH_3$	(S)	Four trichloro product
(E)		(T)	Atleast one of the trichloro product is optically active.
		(U)	Two trichloro products

Exercise III

Q.1 How many isomers are possible for Nitrophenol?

Q.2 A compound with molecular formula $C_4H_{10}O$, can show metamerism, functional isomerism and positional isomerism. Justify the statement.

Q.3 Calculate the total number of stereoisomers in the following compounds.

(I)  (II)  (III) 

Q.4 A 0.1 M solution of an enantiomerically pure chiral compound. D has an observed rotation of +0.20° in a 1 dm sample container, the molecular mass of the compound is 150.

(a) What is the specific rotation of D?

(b) What is the observed rotation if this solution of D is diluted with an equal volume of solvent?

(c) What is the observed if this solution is mixed with an equal volume of a solution that is 0.1 M in L, the enantiomer of D?

(d) What is the specific rotation of D after the dilution described in part (b)?

(e) What is the specific rotation of L, the enantiomer of D, after the dilution described in part (b)?

(f) What is the observed rotation of 10 ml of a solution that contains 0.01 mole of D and 0.005 mole of L? (Assume a 1 dm path length)

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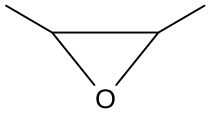
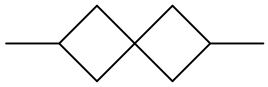
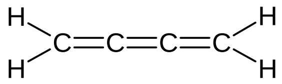
Q.5 In what stereoisomeric forms would you expect the following compounds to exist?

(a) $EtCH(CO_2H)Me$

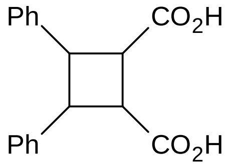
(b) $MeCH(CO_2Et)CO_2H$

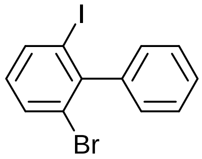
(c) 

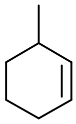
(d) 

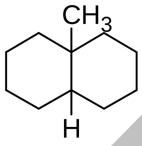
(e) 

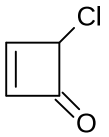
(f) Et(Me)C = C = C(Me)Et

(g) 

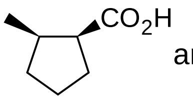
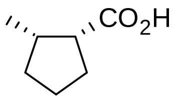
(h) 

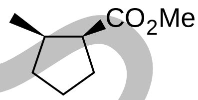
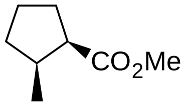
(i) 

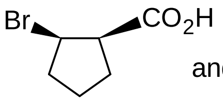
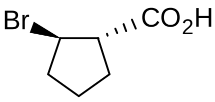
(j) 

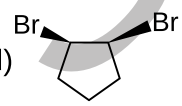
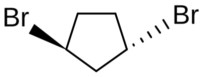
(k) 

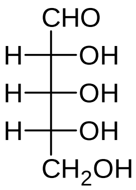
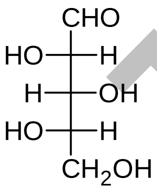
Q.6 What are the relationships between the following pairs of isomers?

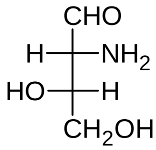
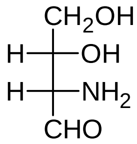
(a)  and 

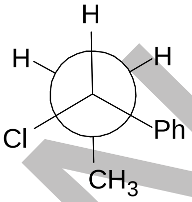
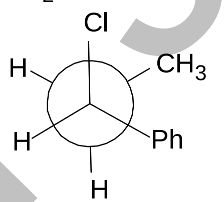
(b)  and 

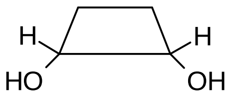
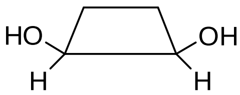
(c)  and 

(d)  and 

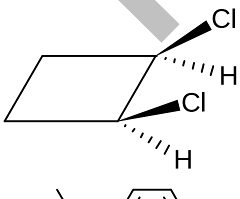
(e)  and 

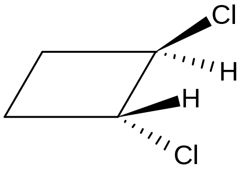
(f)  and 

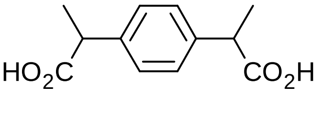
(g)  and 

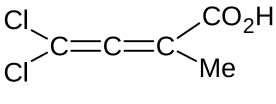
(h)  and 

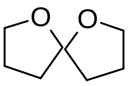
Q.7 With reasons, state whether each of the following compounds I to IX is chiral.

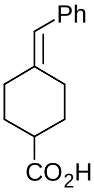
(I) 

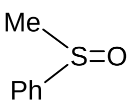
(II) 

(III) 

(IV) 

(V) 

(VI) 

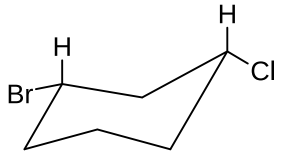
(VII) 

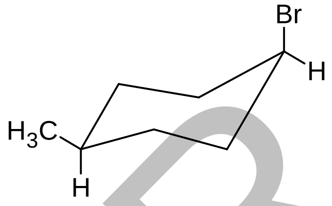
Q.8 Draw the two chair conformers of each compound and indicate which conformer is more stable?
(a) cis-1-ethyl-3-methylcyclohexane
(b) trans-1-ethyl-2-isopropylcyclohexane
(c) trans-1-ethyl-2-methylcyclohexane
(d) trans-1-ethyl-3-methylcyclohexane
(e) cis-1-ethyl-3-isopropylcyclohexane
(f) cis-1-ethyl-4-isopropylcyclohexane

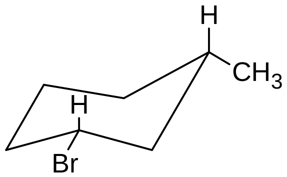
Q.9 Draw the most stable conformer of N-methylpiperidine.

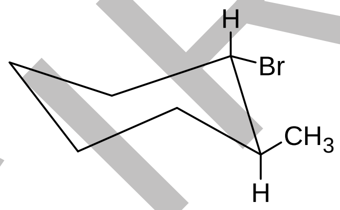
Q.10 Considering rotation about the C-3–C-4 bond of 2-methylhexane.
(a) Draw the Newman projection of the most stable conformer.
(b) Draw the Newman projection of the least stable conformer.

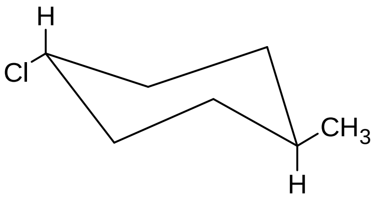
Q.11 Determine whether each of the following compounds is a cis isomer or a trans isomer.

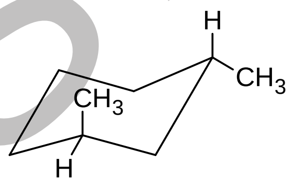
(a) 

(b) 

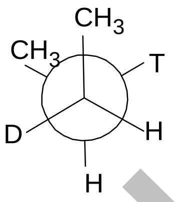
(c) 

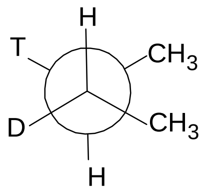
(d) 

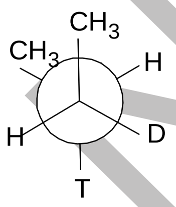
(e) 

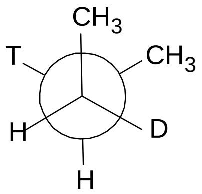
(f) 

Q.12 Comment on the relationship among the following compounds.

(I) 

(II) 

(III) 

(IV) 

Exercise IV (A)

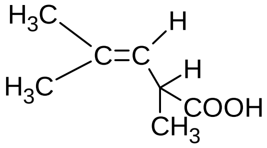
Q.1 True or False:
m-chlorobromobenzene is an isomer of m-bromochlorobenzene. **[IIT-JEE 1985]**

Q.2 Only two isomeric monochloro derivatives are possible for: **[IIT-JEE 1986]**
(A) n-butane
(B) 2,4-dimethylpentane
(C) benzene
(D) 2-methylpropane

Q.3 True or false: **[IIT-JEE 1990]**
2,3,4-Trichloropentane has three asymmetric carbon atoms.

Q.4 Isomers which can be interconverted through rotation around a single bond are:
(A) Conformers (B) Diasereomers
(C) Enantiomers (D) Positional isomers **[IIT-JEE 1992]**

Q.5 The optically active tartaric acid is named as D–(+)–tartaric acid because it has a positive:
(A) optical rotation and is derived from D-glucose
(B) pH in organic solvent
(C) optical rotation and is derived from D–(+)–glyceraldehyde
(D) optical rotation only when substituted by deuterium **[IIT-JEE 1992]**

Q.6 The 

shows: **[IIT-JEE 1995 (Scr.)]**
(A) geometrical isomerism (B) optical isomerism
(C) geometrical and optical isomerism (D) tautomerism

Q.7 How many optically active stereoisomers are possible for butane-2, 3-diol?
(A) 1 (B) 2 (C) 3 (D) 4 **[IIT-JEE 1997]**

Q.8 The number of possible enantiomeric pairs that can be produced during monochlorination of 2-methyl butane is: **IIT-JEE 1997]**
(A) 2 (B) 3 (C) 4 (D) 1

Q.9 When cyclohexane is poured on water, it floats, because: **[IIT-JEE 1997]**
(A) cyclohexane is in 'boat' form (B) cyclohexane is in 'chair' form
(C) cyclohexane is in 'crown' form (D) cyclohexane is less dense than water

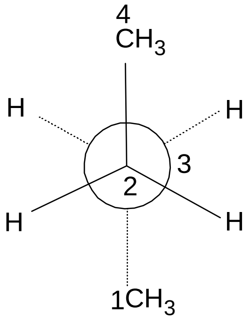
Q.10 Which of the following compounds will show geometrical isomerism? **[IIT-JEE 1998]**
(A) 2-butene (B) propene
(C) 1-phenylpropene (D) 2-methyl-2-butene

Q.11 Which of the following compounds will exhibit geometrical isomerism? **[IIT-JEE 2000 (Scr.)]**
(A) 1-Phenyl-2-butene (B) 3-Phenyl-1-butene
(C) 2-Phenyl-1-butene (D) 1,1-Diphenyl-1-propene

Q.12 The number of isomers for the compound with molecular formula C_2BrC/FI is:
(A) 3 (B) 4 (C) 5 (D) 6 **[IIT-JEE 2001 (Scr.)]**

Q.13 Which of the following compounds exhibits stereoisomerism? **[IIT-JEE 2002 (Scr.)]**
(A) 2-methylbutene-1 (B) 3-methylbutyne-1
(C) 3-methylbutanoic acid (D) 2-methylbutanoic acid

Q.14 In the given conformation, if C_2 is rotated about C_2–C_3 bond anticlockwise by an angle of 120° then the conformation obtained is: **[IIT-JEE 2004 (Scr.)]**



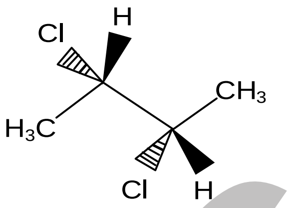
(A) fully eclipsed conformation (B) partially eclipsed conformation
(C) gauche conformation (D) staggered conformation

Q.15 On monochlorination of 2-methylbutane, the total number of chiral compounds formed is:
(A) 2 (B) 4 (C) 6 (D) 8 **[IIT-JEE 2004]**

Q.16 The number of structural isomers for C_6H_{14} is: **[IIT-JEE 2007]**
(A) 3 (B) 4 (C) 5 (D) 6

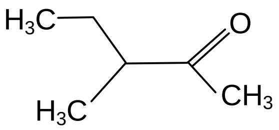
Q.17 Statement 1: Molecules that are not superimposable on their mirror images are chiral.
Because
Statement 2: All chiral molecules have chiral centres. **[IIT-JEE 2007]**
(A) Statement-1 is true, Statement-2 is true, Statement-2 is a correct explanation of Statement-1.
(B) Statement-1 is true, Statmeent-2 is true, Statement-2 is NOT a correct explanation for Statement–1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

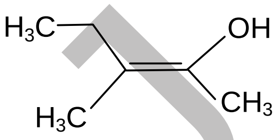
Q.18 The correct statement(s) about the compound given below is (are): **[IIT-JEE 2008]**

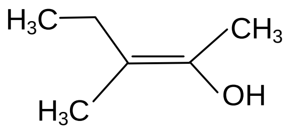


(A) The compound is optically active
(B) The compound possesses centre of symmetry
(C) The compound possesses plane of symmetry
(D) The compound possesses axis of symmetry

Q.19 The correct statement(s) concerning the structures E,F and G is (are) **[IIT-JEE 2008]**


(E)

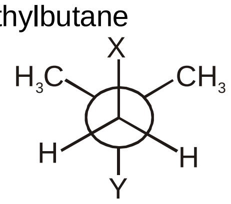

(F)


(G)

(A) E, F and G are resonance structures (B) E, F and E, G are tautomers
(C) F and G are geometrical isomers (D) F and G are diastereomers

Q.20 The correct statement(s) about the compound $H_3C(HO)HC–CH = CH–CH(OH)CH_3$(X) is (are) **[IIT-JEE 2009]**
(A) The total number of stereoisomers possible for X is 6
(B) The total number of diastereomers possible for X is 3
(C) If the stereochemistry about the double bond in X is trans, the number of enantiomers possible for X is 4.
(D) If the stereochemistry about the double bond in X is cis, the number of enantiomers possible for X is 2.

Q.21 In the Newman projection for 2,2-dimethylbutane **[IIT-JEE 2010]**

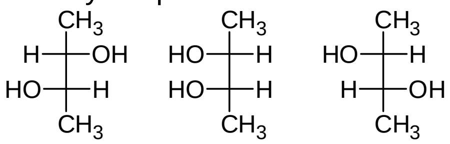


X and Y can respectively be
(A) H and H (B) H and C_2H_5 (C) C_2H_5 and H (D) CH_3 and CH_3

Exercise – IV (B)

Q.1 Write structural formulae for all the isomeric alcohols having the molecular formula $C_4H_{10}O$. **[IIT-JEE 1984]**

Q.2 Identify the pairs of enantiomers and diastereomers form the following compounds I, II and III.



(I) (II) (III) **[IIT-JEE 2000]**

Q.3 (i) $\mu_{obs} = \sum_i \mu_i x_i$

Where μ_i is the dipole moment of a stable conformer of the molecule, $Z – CH_2 – CH_2 – Z$ and x_i is the mole fraction of the stable conformer.
Given : μ_{obs} = 1.0 D and x (Anti) = 0.82
Draw all the stable conformers of $Z – CH_2 – CH_2 – Z$ and calculate the value of $\mu_{(Gauche)}$.

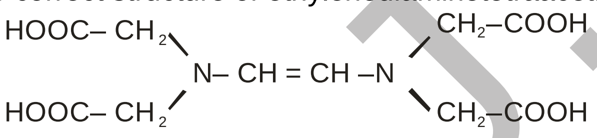
(ii) Draw the stable conformer of Y – CHD – CHD – Y (meso form), when Y = CH_3 (rotation about $C_2\ C_3$) and Y = OH (rotation about C_1–C_2) in Newmann projection. **[IIT-JEE 2005]**

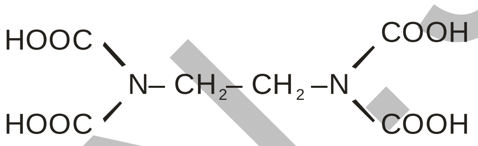
Q.4 The total number of cyclic structural as well as stereo isomers possible for a compound with the molecular formula C_5H_{10} is. **[IIT-JEE 2009]**

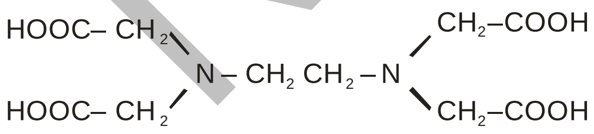
Q.5 The total number of cyclic isomers possible for a hydrocarbon with the molecular formula C_4H_6 is **[IIT-JEE 2010]**

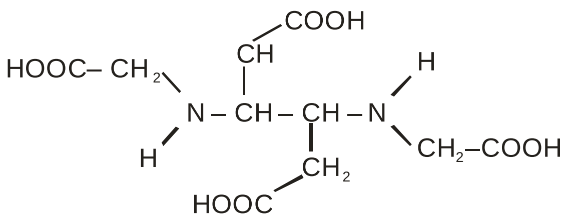
Q.6 The bond energy **(in kcal mol^{-1})** of a C – C single bond is approximately **[IIT-JEE 2010]**
(A) 1 (B) 10 (C) 100 (D) 1000

Q.7 The correct structure of ethylenediaminetetraacetic acid (EDTA) is **[IIT-JEE 2010]**

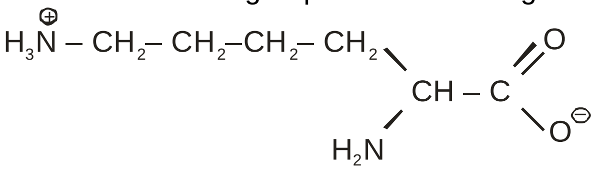
(A)


(B)


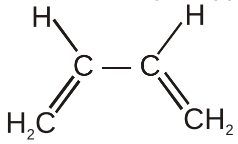
(C)


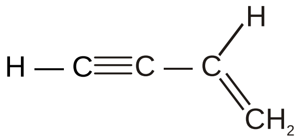
(D)


Q.8 The total number of basic groups in the following form of lysine is **[IIT-JEE 2010]**



Q.9 Amongst the given options, the compounds) in which all the atoms are in one plane in all the possible conformations (if any), is (are) **[IIT-JEE 2011]**

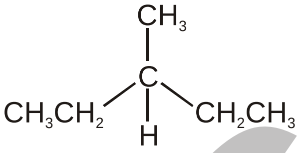
(A) 

(B) 

(C) $H_2C = C = O$

(D) $H_2C = C = CH_2$

Q.10 The maximum number of isomers (including stereoisomers) that are possible on monochlorination of the following compound is **[IIT-JEE 2011]**



Answer Key

Exercise – 1

1	2	3	4	5	6	7	8	9	10
AB	A	C	D	D	C	D	B	C	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	C	B	A	A	A	B	A	B	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	A	D	C	B	C	C	D	C	D
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
D	C	C	C	C	B	A	C	C	A
41	**42**	**43**	**44**						
A	B	B	A						

Exercise – 2

1	2	3	4	5	6	7	8	9	10
ABC	AD	BCD	AC	AD	B	C	C	ABC	ACD
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
AC	D	ACD	ACD	ACD	B	AC	BCD	CD	AD
21	**22**	**23**							
A	AC	B							

24. (A)R; (B)Q; (C)QS: (D)P,Q

25. (A) S,T (B)P,S,T (C)U, (D) Q, (E) T,U

Exercise – III

1. 3

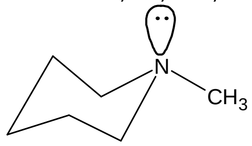
3. (I) 4, (II) 3, (III) 4

4. (a) + 13.3; (b) 0.10; (c) zero; (d) unchanged; (e) unchanged; (f) 1

5. Optical : a, b, c, d, f, g, I, j, k; Geometrical isomer: c,g,j; None : e, h.

6. (a) Enantiomers, (b) Enantiomers, (c) Geometrical isomers & Diastereomers, (d) Positional, (e) Optical (Diastereomers), (f) Diastereomers, (g) Enantiomers, (h) Identical, isomers & Diastereomers

7. achiral : I, III, IV ; chiral : II, V, VI, VII

9. 

11. (a) cis (b) cis (c) cis (d) trans (e) trans (f) trans

12. II, III and IV are Identical; I is Enantiomer of these.

Exercise IV (A)

1	2	3	4	5	6	7	8	9	10
False	D	True	A	C	B	B	A	D	AC
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	D	D	C	B	C	C	A,D	B,C,D	A,D
21									
C, D									

Exercise – IV (B)

1. (a) $CH_3 - CH_2 - CH_2 - CH_2 - OH$

(b) $CH_3 - CH_2 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$

(c) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - OH$

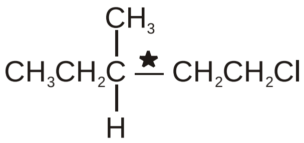
(d) $CH_3 - \overset{\displaystyle OH}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}} - CH_3$

2. enantiomers –I and III; diastereomers – I and II and II and III

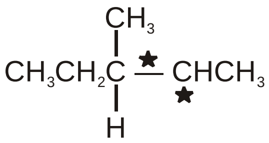
3. (i) $\frac{1}{0.18}$ D, (ii) anti form when Y = CH_3 and Gauche when Y = –OH

4. 7 **5.** 5 **6.** C **7.** C **8.** 3 **9.** B, C

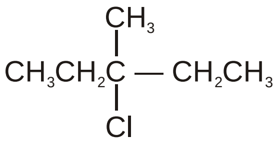
10. 8



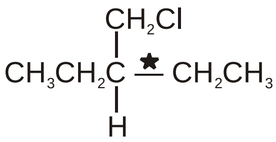
Enantiomeric pair = 2



Two Enantiomeric pairs = 4



1



1

Total = 2 + 4 + 1 + 1 = 8

ISOMERISM

ISOMERISM

In the study of organic chemistry we come across many cases when two or more compounds are made of equal number of like atoms. A molecular formula does not tell the nature of organic compound; sometimes several organic compounds may have same molecular formula. These compounds possess the same molecular formula but differ from each other in physical or chemical properties, are called isomers and the phenomenon is termed isomerism (Greek, isos = equal; meros = parts). Since isomers have the same molecular formula, the difference in their properties must be due to different modes of the combination or arrangement of atoms with in the molecule. Broadly speaking, isomerism is of two types.

i) Structural Isomerism
ii) Stereoisomerism

i) Structural isomerism: When the isomerism is simply due to difference in the arrangement of atoms with in the molecule without any reference to space, the phenomenon is termed structural isomerism. In other words, while they have same molecular formulas they possess different structural formulas. This type of isomerism which arises from difference in the structure of molecules, includes:

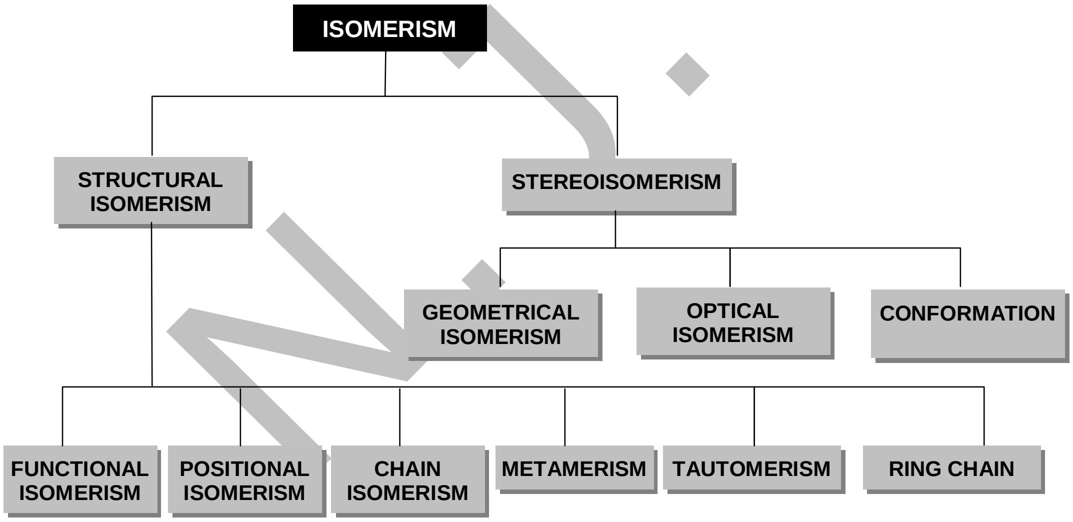
a) Chain
b) Positional Isomerism
c) Functional Isomerism
d) Metamerism and
e) Tautomerism
f) Ring-chain Isomerism

ii) Stereoisomerism: When isomerism is caused by the different arrangements of atoms or groups in space, the phenomenon is called Stereoisomerism (Greek, Stereos = occupying space). The stereoisomers have the same structural formulas but differ in the spatial arrangement of atoms or groups in the molecule. In other words, stereoisomerism is exhibited by such compounds which have identical molecular structure but different configurations.

Stereoisomerism is of three types :

a) Conformation b) Geometrical. c). Optical

Thus various types of isomerism could be summarised as follows.



Chain Isomerism

This type of isomerism arises from the difference in the structure of carbon chain which forms the nucleus of the molecule. It is, therefore, named as **chain, or Skeletal isomerism.** For example, there are known two butanes which have the same molecular formula (C_4H_{10}) but differ in the structure of the carbon chains in their molecules.

$CH_3–CH_2–CH_2–CH_3$ — *n-butane*

$H_3C–CH(CH_3)–CH_3$ — *isobutane*

While n-butane has a continuous chain of four carbon atoms, isobutane has a branched chain. These chain isomers have somewhat different physical and chemical properties, n-butane boiling at -0.5^o and isobutane at -10.2^o. This kind of isomerism is also shown by other classes of compounds. Thus n-butyl alcohol and isobutyl alcohol having the same molecular formula C_4H_9OH are chain isomers.

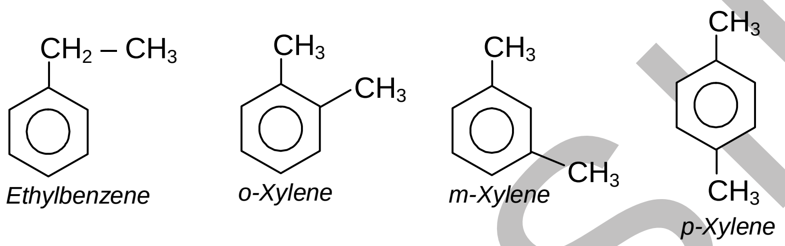
$CH_3–CH_2–CH_2–CH_2OH$ *n-butyl alcohol*

$$\begin{array}{c} CH_3–CH–CH_2OH \\ | \\ CH_3 \end{array}$$
isobutyl alcohol

It may be understood clearly that the molecules of chain isomers differ only in respect of the linking of the carbon atoms in the alkanes or in the alkyl radicals present in other compounds.

Q.1 ***Give the possible chain isomers for ethyl benzene.***

Sol.:



Positional Isomerism

It is the type of isomerism in which the compounds possessing same molecular formula differ in their properties due to the difference in the position of either the functional group or the multiple bond or the branched chain attached to the main carbon chain. For example, n-propyl alcohol and isopropyl alcohol are the positional isomers.

$CH_3–CH_2–CH_2–OH$ *n-propyl alcohol*

$$\begin{array}{c} CH_3 \\ | \\ CH_3–CH–OH \end{array}$$
isopropyl alcohol

Butene also has two positional isomers:

$CH_2=CH–CH_2–CH_3$ *1-butene* $\quad$ $CH_3–CH=CH–CH_3$ *2-butene*

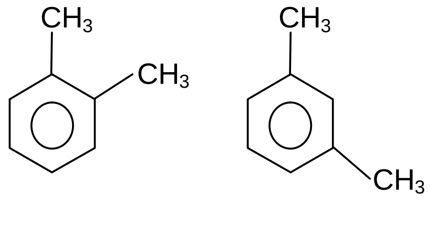
1-Chlorobutane and 2-Chlorobutane are also the positional isomers:

$$\underset{\text{1–Chlorobutane}}{CH_3-CH_2-CH_2-CH_2Cl} \qquad \underset{\text{2–Chlorobutane}}{CH_3CH_2-CHCl-CH_3}$$

Methylpentane also has two positional isomers:

$$\begin{array}{c} CH_3—CH_2—CH_2—CH—CH_3 \\ \qquad\qquad\quad | \\ \qquad\qquad\quad CH_3 \end{array} \qquad \begin{array}{c} CH_3—CH_2—CH—CH_2—CH_3 \\ | \\ CH_3 \end{array}$$
2-Methylpentane $\quad$ *3-Methylpentane*

In the aromatic series, the disubstitution products of benzene also exhibit positional isomerism due to different relative positions occupied by the two substituents on the benzene ring. Thus xylene, $C_6H_4(CH_3)_2$, exists in the following three forms which are positional isomers.

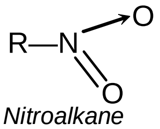


o-Xylene m-Xylene p-Xylene

Functional Isomerism

When any two compounds have the same molecular formula but possess different functional groups, they are called **functional isomers** and the phenomenon is termed **functional isomerism.** In other words substances with the same molecular formula but belonging to different classes of compounds exhibit functional isomerism. Thus,

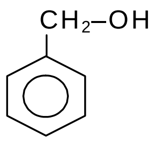
1. Diethyl ether and butyl alcohol both have the molecular formula C_4H_6O, but contain different functional groups.
   $C_2H_5–O–C_2H_5$ $C_4H_9–OH$
   diethyl ether *butyl alcohol*
   The functional group in diethyl ether is (–O–), while is butyl alcohol it is (–OH).
2. Acetone and propionaldehyde both with the molecular formula C_3H_6O are functional isomers.
   $CH_3–CO–CH_3$ $CH_3–CH_2–CHO$
   acetone *acetaldehyde*
   In acetone the functional group is (–CO–), while in acetaldehyde it is (–CHO).
3. Cyanides are isomeric with isocyanides:
   $\underset{\text{Alkyl cyanide}}{RCN}$ $\underset{\text{Alkyl isocyanide}}{RNC}$
4. Carboxylic acids are isomeric with esters.
   $\underset{\text{Propanoic acid}}{CH_3CH_2COOH}$ $\underset{\text{Methyl ethanoate}}{CH_3COOCH_3}$
5. Nitroalkanes are isomeric with alkyl nitrites:



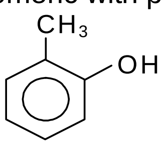
Nitroalkane

R—O—N=O
Alkyl nitrite

6. Sometimes a double bond containing compound may be isomeric with a triple bond containing compound. This also is called as functional isomerism. Thus, butyne is isomeric with butadiene (molecular formula C_4H_6).
   $\underset{\text{1–Butyne}}{CH_3-CH_2C\equiv CH}$ $\underset{\text{1,3–Butadiene}}{CH_2=CH-CH=CH_2}$
7. Unsaturated alcohols are isomeric with aldehydes. Thus,
   $\underset{\text{Vinyl alcohol}}{CH_2=CH-OH}$ $\underset{\text{Acetaldehyde}}{CH_3CHO}$
8. Unsaturated alcohols containing three or more carbon atoms are isomeric to aldehydes as well as ketones:
   $\underset{\text{Allyl alcohol}}{CH_2=CH-CH_2OH}$ $\underset{\text{Propionaldehyde}}{CH_3CH_2CHO}$ $\underset{\text{Acetone}}{CH_3COCH_3}$
9. Aromatic alcohols may be isomeric with phenols:



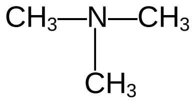
Benzyl alcohol



o-Cresol

10. Primary,secondary and tertiary amines of same molecular formula are also the functional isomers.

$CH_3CH_2CH_2NH_2$ n–propylamine (1°) $CH_3-NH-C_2H_5$ Ethylmethylamine (2°)



Trimethylamine(3°)

Metamerism

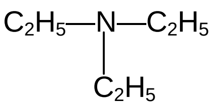
This type of isomerism is due to the unequal distribution of carbon atoms on either side of the functional group in the molecule of compounds belonging to the same class. For example, methyl propyl ether and diethyl ether both have the same molecular formula.

$CH_3–CO–C_3H_7$ $C_2H_5–O–C_2H_5$

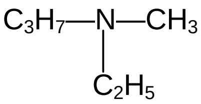
methyl propyl ether *diethyl ether*

in methyl propyl ether the chain is 1 and 3, while in diethyl ether it is 2 and 2. This isomerism known as **Metamerism** is shown by members of classes such as ethers, and amines where the central functional group is flanked by two chains. The individual isomers are known as **Metamers.**

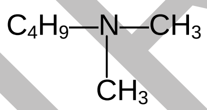
Examples:



Triethylamine



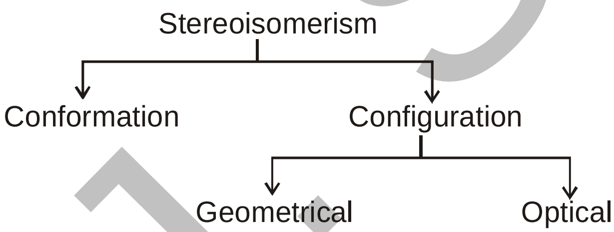
Ethylmethylpropylamine



Butyldimethylamine

Stereoisomerism

The isomers which differ only in the orientation of atoms in space are known as stereoisomerism.

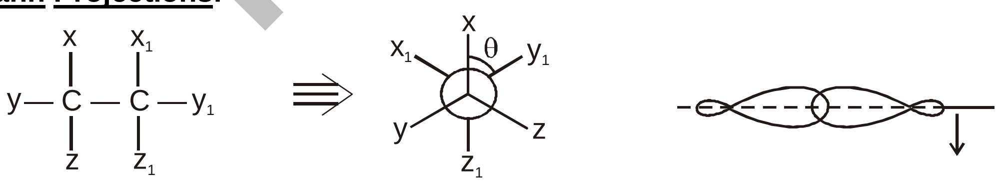


(A) **<u>Conformation</u>:-**

Single bonds are cylindrically symmetrical. The rotation about single bonds do not effectively change the overlapping region of σ-bonds. The 3-D structures arises due to rotation about σ-bonds are known as conformations. The study of energy of molecule with respect to angle of rotation is known as conformational analysis.

"The temporary molecular shapes that result from rotations of groups about single bonds are called **conformations** of the molecule, and analysis of the energy with respect to angle of rotation is **conformational analysis."**

<u>Newmann</u> <u>Projections</u>:-

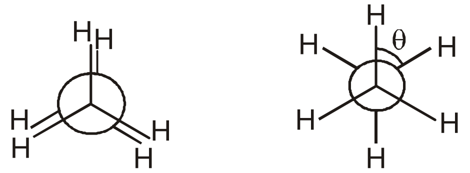


Cylindrically symmetrical

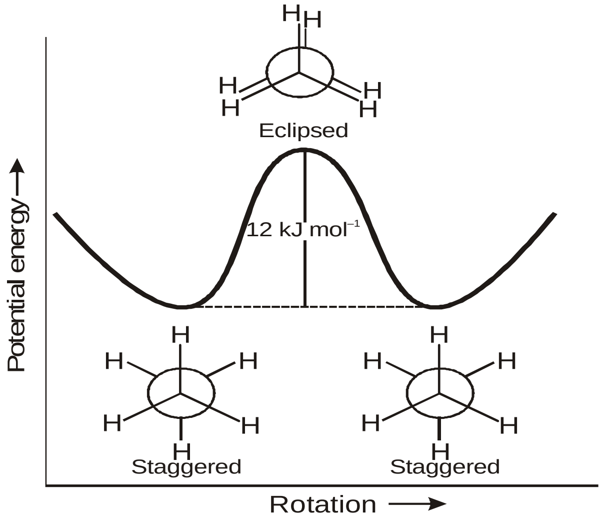
θ = dihedral angle $\boxed{0^\circ \le \theta \le 60^\circ}$

The minimum angle between projected bonds of front carbon atom and back carbon atom is dihedral angle.

1 Conformation in ethane ($CH_3 — CH_3$)



θ = 0° (eclipsed) θ = 60° (Staggered)



Energy diagram for ethane

(1) Infinite values of θ are possible.
(2) Energy required for rotation 3kcal/mol. Which is available at room temperature.
(3) All other than eclipsed and staggered are known as skew.

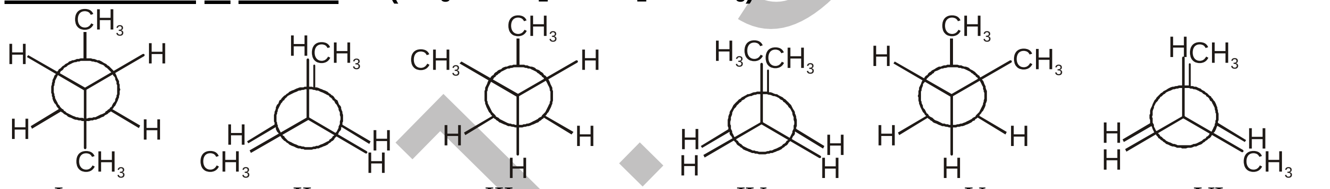
Torsional Strain:-

Is the name given to the repulsion felt by the bonded electron of front carbon atom with the bonded electrons of back carbon atom.

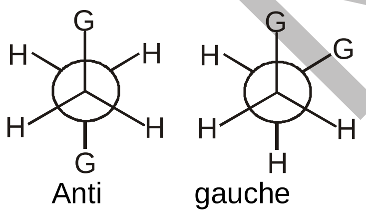
Steric Strain:-

Strain felt by the repulsion of atoms or groups of atoms of front carbon atom with back carbon atom.
In most circumstances torisonal strain dominates over steric strain.

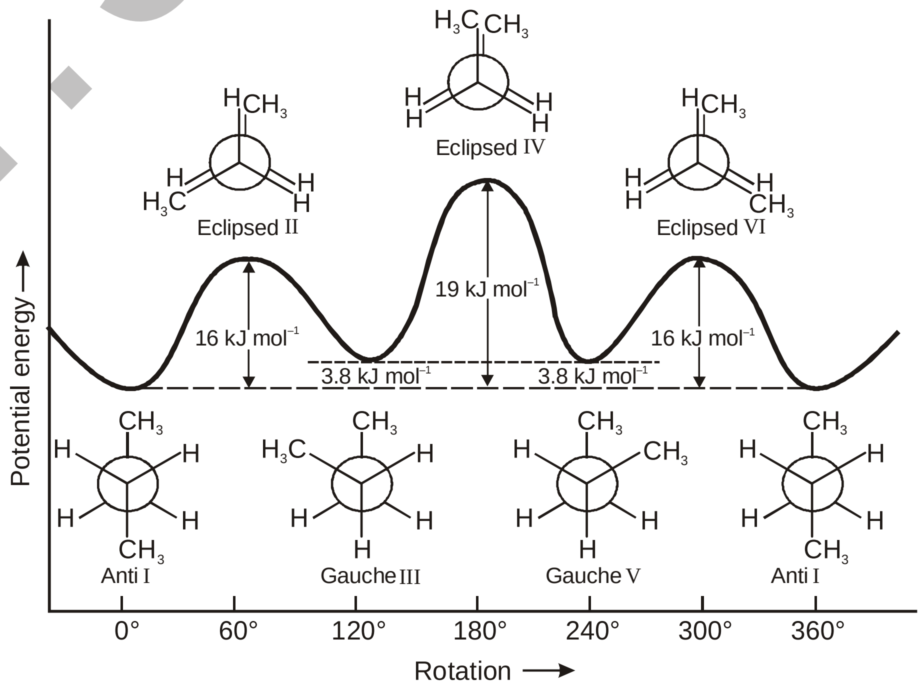
2 Conformation in Butane:- ($CH_3 — CH_2 — CH_2 — CH_3$)



I	II	III	IV	V	VI
An anti conformation	An eclipsed conformation	A gauche conformation	An eclipsed conformation	An gauche conformation	An eclipsed conformation



Anti gauche



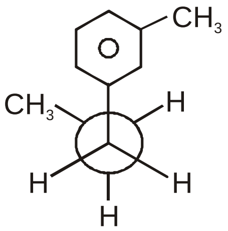
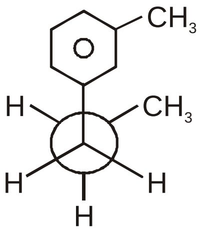
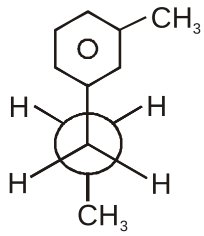
Energy diagram for butane

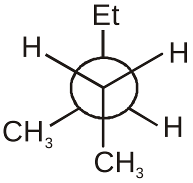
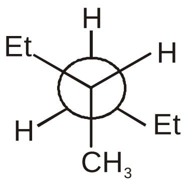
Q.2 Draw most stable conformers of

(a) 3-methyl pentane (C_2 — C_3)

(b) 3-methyl hexane (C_3 — C_4)

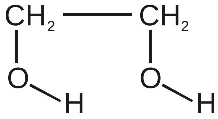
Q.3 Compare relative stabilities of given conformers:-

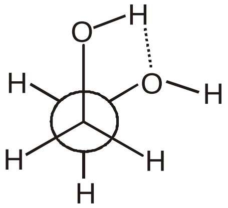
(a)  (b)  (c) 

Ans. **(2)** (a)  (b) 

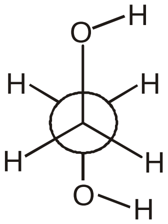
(3) (c) > (a) > (b)

Q.4 Which is more stable for the following compound gauche or anti?





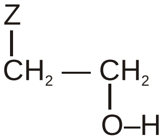
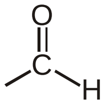
Gauche



anti

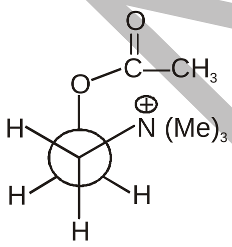
Gauche > anti

Reason: Because of intramolecular H – bonding

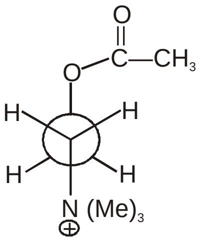
 **Imp:-** Z = OH, —$\ddot{N}H_2$, —OMe, F, Cl, Br,  ,

In all cases gauche > anti

Q.5 Which is more stable



(a)



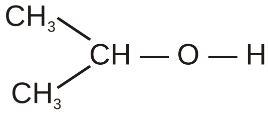
(b)

(a) > (b)

Gauche effect:-

Most bulky substituent should occupy gauche position w.r.t. lone pair.

Q.6 Draw most stable forms of

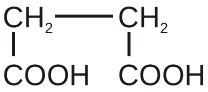
(a) CH_3 — CH_2 — NH_2 (b) 

Effect of Temperature:-

With the increase in temperature % of eclipsed form will increase & staggered decrease.

Q.7 What is the effect on dipole moment of 1,2-dichloroethane when temperature is increased?

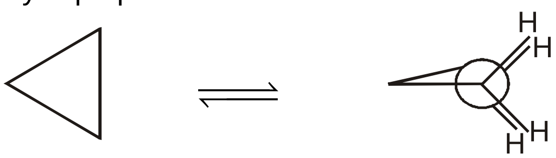
Q.8

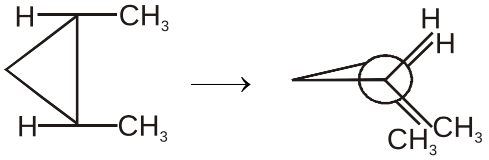


Explain:- At low pH gauche is more stable and at high pH staggered is more stable.

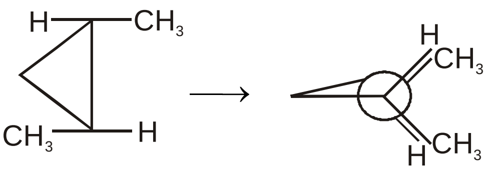
Conformation in Cycloalkanes:-

(1) Cyclopropane:-





Cis-1, 2-dimethylcyclopropane



Trans-1, 2-dimethylcyclopropane

Q.9 Trans 1,2-dimethylcyclopropane is more stable than cis form. Explain?

3 Conformation in cyclohexane:-

→ Draw chair form of cyclohexane & identify axial & equatorial positions

Q.10 Draw 1,2,3,4,5,6 — hexamethylcyclohexane in which

(a) all methyl axial positions.

(b) all methyl equatorial position.

Note:-

Substituents are more stable at equatorial and less stable at axial.

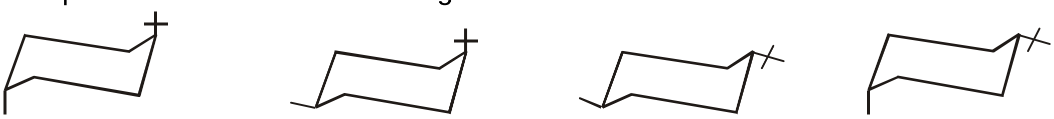
Reason → (1) axial is gauche while equatorial is anti

(2) 1, 3 & 1,5-diaxial interactions are present in axial position

Q.11 Draw most stable form of methylcyclohexane.

Q.12 Draw most stable isomer of 1,2-dimethylcyclohexane & 1,3-dimethylcyclohexane

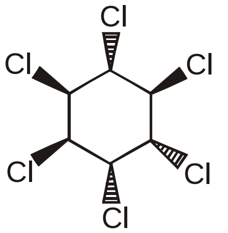
Q.13 Compare stabilities of the following

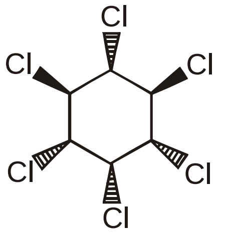


(a) (b) (c) (d)

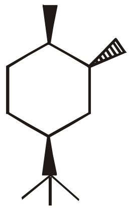
Q.14
Draw structures & compare stabilities of following:-
(a) cis & trans 1,2-dimethylcyclohexane
(b) cis & trans 1,3-dimethylcyclohexane
(c) 1-ethyl-2-methylcyclohexane

Q.15 Draw most stable form of

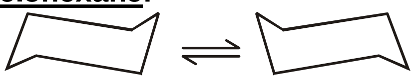

(a)


(b)

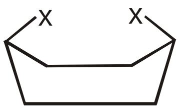
Q.16 Draw most stable conformation of



<u>Flipping</u> <u>in</u> <u>cyclohexane</u>:-

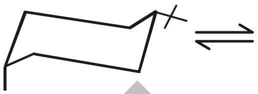


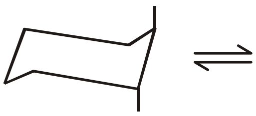
When ring flipping takes place axial converts to equatorial & equatorial converts to axial.

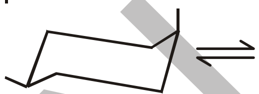


→ Boat form is less stable than chair form because of flag pole interactions.

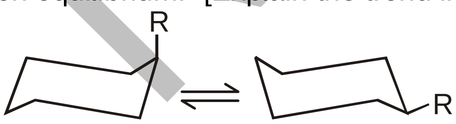
Q.17 Flip the following & predict the direction of equilibrium

(a) 

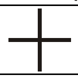
(b) 

(c) 

Q.18 For given equilibrium:- [Explain the trend in numerical values of Keq.]



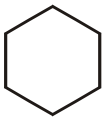
(a)

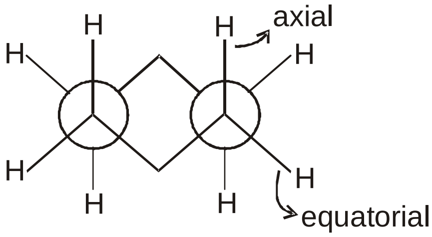
R	**Keq.**
H	1
CH_3	18
Et	23
$-CH\langle^{Me}_{Me}$	38
	3800

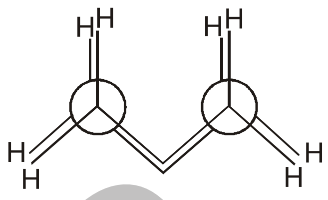
(b)

R	Keq.
F	1.5
Cl	2.4
Br	2.2
I	2.2

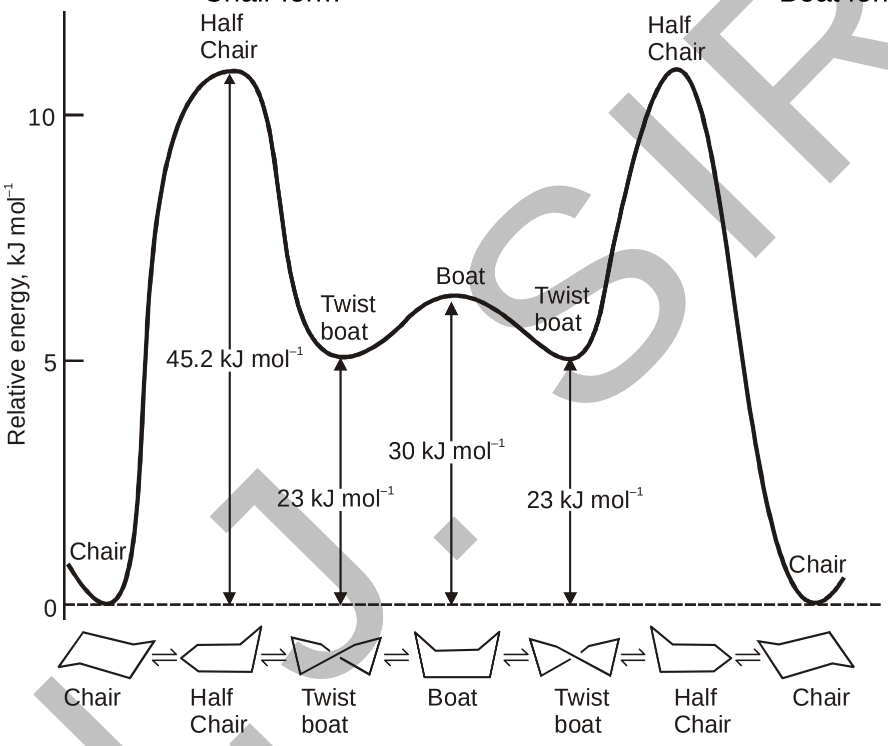
Cyclohexane:-







Cyclohexane Chair form Boat form

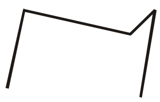
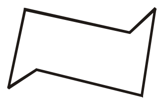
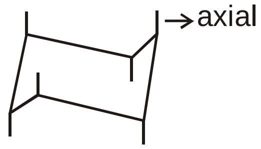


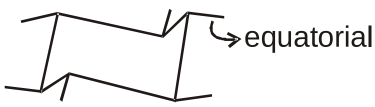
The relative energies of the various conformations of cyclohexane. The positions of maximum energy are conformations called half-chair conformations, in which the carbon atoms of one end of the ring have become coplanar.

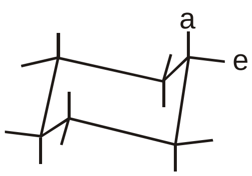
Q.19 Chair form is more stable than Boat form. Explain?

Q.20 In chair form substituents are more stable at equatorial and less stable at axial. Explain?

<u>Conventional</u> <u>drawing</u> <u>of</u> <u>chair form</u>:-

(1)  (2)  (3)  (4) 

(5) 

(6) 

(B) GEOMETRICAL ISOMERISM

Geometrical isomerism arises due to attachment on different atoms or groups to bonds or systems which cannot rotate freely. Following type of compounds can show geometrical isomerism:-

(a) Double bond system

(b) Substituted cycloalkanes

(c) Cycloalkenes

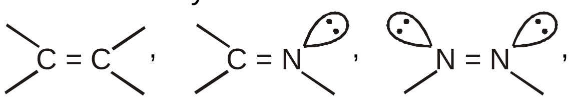
(d) Triphenylsystem

(e) Resonating structures

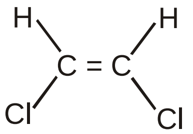
(f) Reactions leading to G.I.

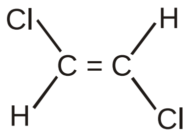
(g) Bicyclo compounds

(a) Double bond system:-



(1) Cis-Trans.


Cis

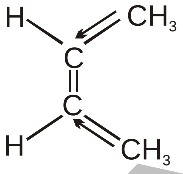

Trans

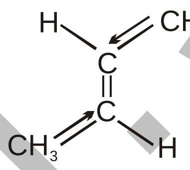
→ Boiling point of Cis-Trans isomers are related to the dipole moment (μ) of isomers.

→ Melting point of G.I. are related to close (effective) packing in crystal lattice (usually mp. of Trans > Cis)

Ex. Identify cis-trans & compare mp & bp.

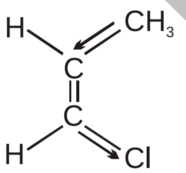
(a)

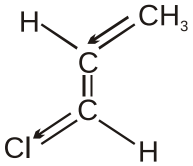

Cis


Trans

μ Cis > μ Trans
B.P. Cis > B.P. Trans
M.P. Cis < M.P. Trans

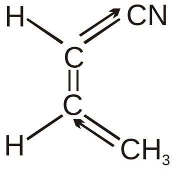
(b)

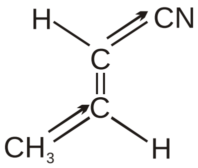

Cis


Trans

μ Trans > μ Cis
B.P. Trans > B.P. Cis
M.P. Trans > M.P. Cis

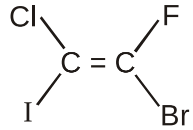
(c)


Cis


Trans

μ Trans > μ Cis
B.P. Trans > B.P. Cis
M.P. Trans > M.P. Cis

(2) E/Z Nomenclature:-



- Cis/Trans cannot be assigned

CIP system (cahn Ingold prelong)

Rule-1 Higher priority on the basis of higher atomic number

Ex.1 —F, —Cl, —Br, I

Ans. I > Br > Cl > F

Ex.2 —OH, —SH, — I

Ans. — I>—SH > —OH

Rule-2 If atomic number are same compare on the basis of atomic mass.

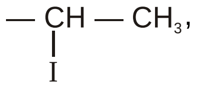
Ex.3 $—CH_3$, $—\overset{14}{C}H_3$, —OH, $—\overset{18}{O}H$

Ans. $—\overset{18}{O}H > —OH > \overset{14}{C}H_3 > —CH_3$

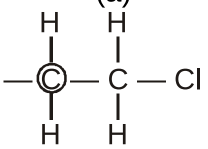
Ex.4 H, D, T

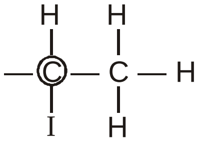
Ans. T > D > H

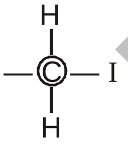
Rule-3 If atomic No. of atom attached is same look of next 3 atoms attached. Highest atomic No. atom attached will have highest priority.

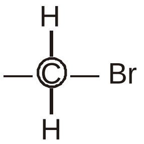
Ex.5 $— CH_2 — CH_2 — Cl$,  $— CH_2 — I$, $— CH_2 — Br$,

(a) (b) (c) (d)

 H, C, H (a)

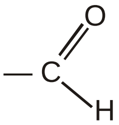
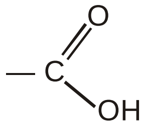
 H, C, I (b)

 H, I, H (c)

 H, H, Br (d)

Priority (b) > (c) > (d) > (a)

Rule-4 Double bonds are counted 2-times & triple bonds 3-times

Ex.6   $— C \equiv N$ $— CH_2I$

(a) (b) (c) (d)

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$-\overset{\overset{\large O}{||}}{C}-H$ (a)	O, O, H
$-\overset{\overset{\large O}{||}}{C}-OH$ (b)	O, O, O
$-C\equiv N$ (c)	N, N, N
$-CH_2I$ (d)	H, H, I

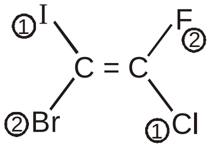
Ans. (d) > (b) > (a) > (c)

Rule-5 Real structures will have higher priority over virtual structures

Ex.7 $-\underset{\underset{\large CH_3}{|}}{\overset{\overset{\large CH_3}{|}}{C}}-CH_3$ (a) $\qquad -C\equiv CH$ (b) $\qquad -\overset{\overset{\large CH_3}{|}}{C}=CH_2$ (c)

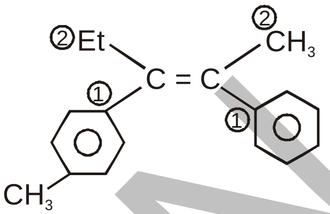
Ans. (a) > (c) > (b)

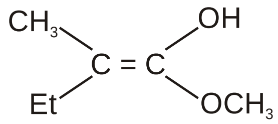
For E/Z nomenclature priorities are assigned on the basis of groups/atoms attached to each carbon atom on the basis of CIP rules.

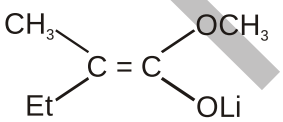

E

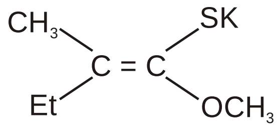
If opposite priorities are on the same side it is E and if same priorities are together it is Z.

Examples:-

1. 

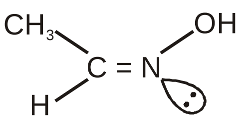
2. 

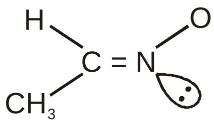
3. 

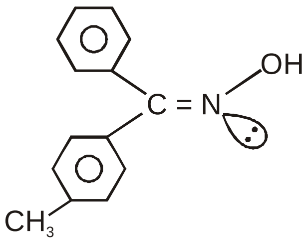
4. 

Ans. 1. Z 2. Z 3. E 4. E

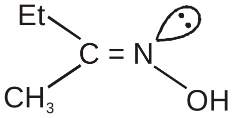
Syn-anti Nomenclature:-

(1) 
Aldoxime
Anti


Aldoxime
syn

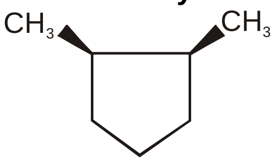
(2) 

1. Syn-phenylparatolylketoxime
2. Anti-paratolylphenylketoxime

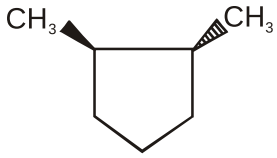
(3) 

1. Syn-methylethylketoxime
2. Anti-ethylmethylketoxime

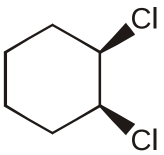
(B) Substitued cycloalkanes:-

(1) 

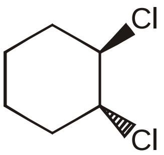
Cis



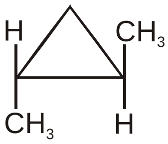
Trans

(2) 

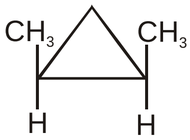
Cis



Trans

(3) 

Trans



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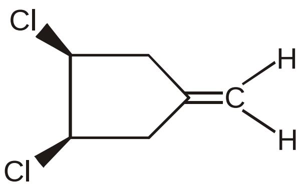
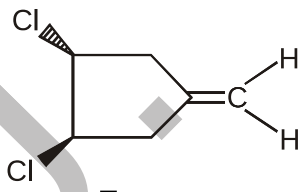
(4) 

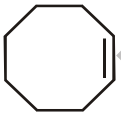
Cis



Trans

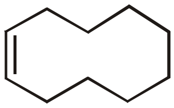
(C) Cycloalkene:-

Min. No. of carbon atoms required for cyclic double bond to show G.I. is 8.

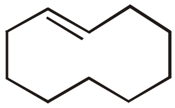


Cis

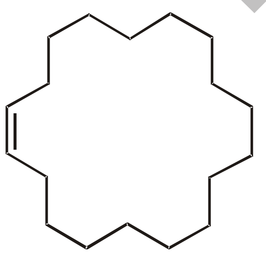
Trans



Cis



Trans



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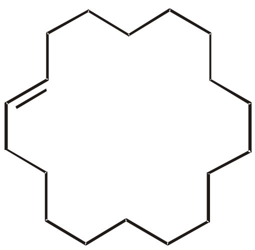
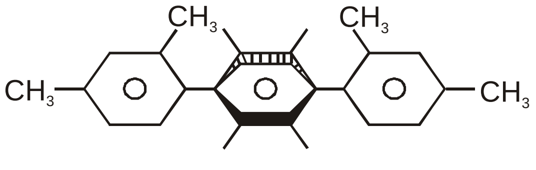


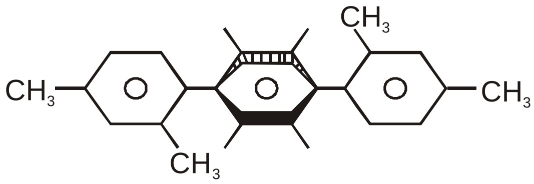
Trans

For carbon atom less than 11 cis is more stable and for greater than or equal to 11 trans is more stable.

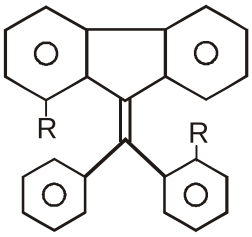
(d) **Triphenylsystem:-**

(1) 

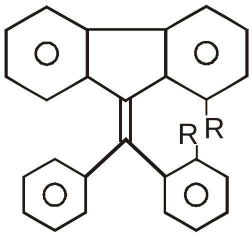
Cis



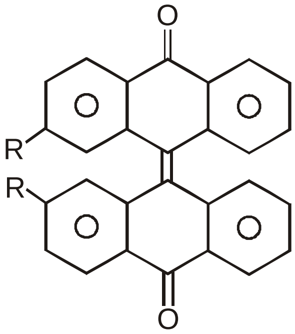
Trans

(2) 

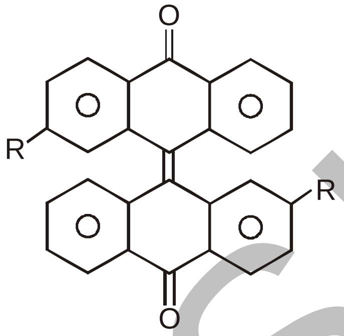
Trans



Cis

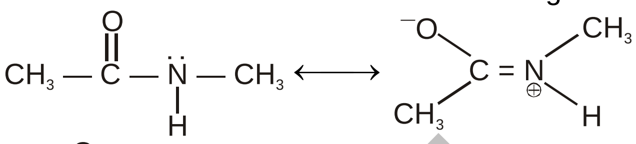
(3) 

Cis

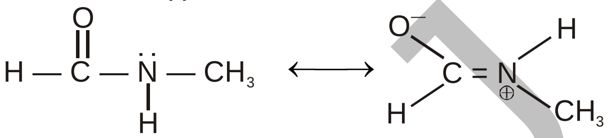


Trans

(e) Few molecules can show G.I. in resonating structures

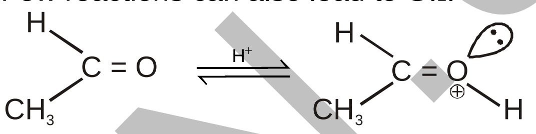
(1) 

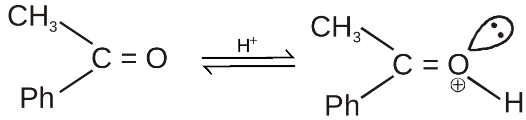
√

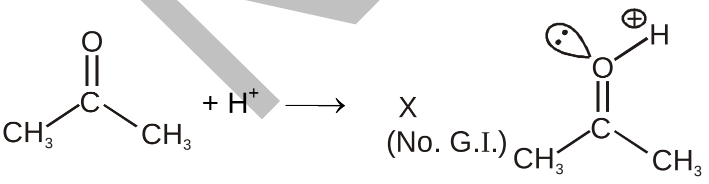
(2) 

√

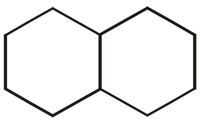
(f) Few reactions can also lead to G.I.

(1) 

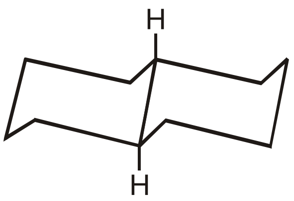
(2) 

(3) 

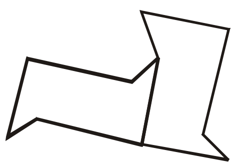
(g) Bicyclo compounds:-



decalin



Trans



Cis

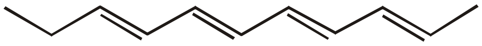
Calculation of G.I.

Case A unsymmetrical molecule

$CH_3 — CH = CH — CH = CH — CH_2 — CH_3$

Total No. of G.I. = 2^n

n = No. of double bonds showing G.I.

(1)  2^4

(2)  2^3

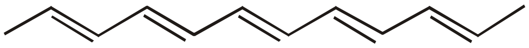
Case B Symmetrical molecule

$CH_3 — CH = CH — CH = CH — CH_3$

Total No. of G.I. $= 2^{n-1} = 2^{(n-1)/2}$ (n = odd)

$= 2^{n-1} + 2^{n/2-1}$ (n = even)

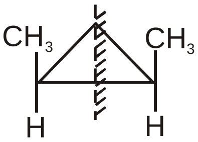
(1)  $2^{4-1} + 2^{4/2-1} = 10$

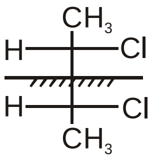
(2)  $2^{5-1} + 2^{(5-1)/2} = 2^4 + 2^2 = 20$

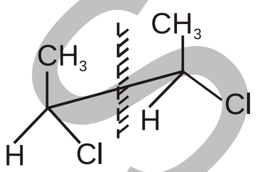
(C) OPTICAL ISOMERISM

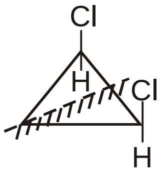
Plane of symmetry (POS):-

Plane of symmetry is defined as an imaginary plane which divides the molecule into two equal halves such that both halves are exactly identical and are mirror images of each other.

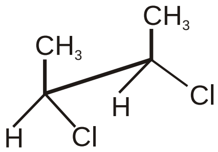
Ex:- (1) 

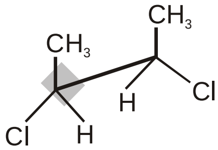
(2) 

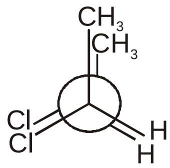
(3) 

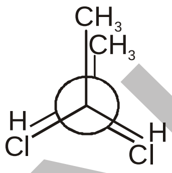
(4) 

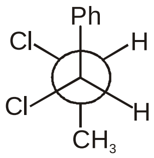
Q.21 **<u>Identify POS if present:-</u>**

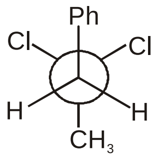
1. 

2. 

3. 

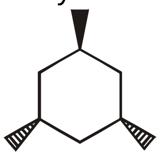
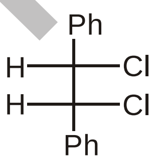
4. 

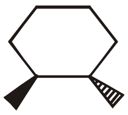
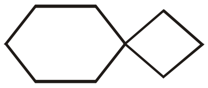
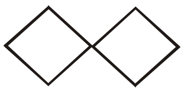
5. 

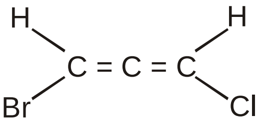
6. 

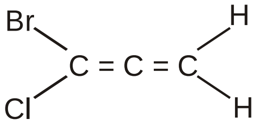
Ans. 1. √ 2. x 3. √ 4. x 5. x 6. √

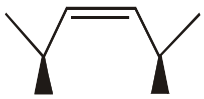
Q.22 Identify POS if present:-

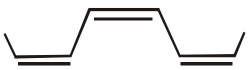
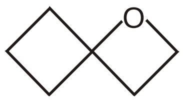
1. 
2. 

3. 
4. 
5. 

6. 

7. 

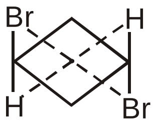
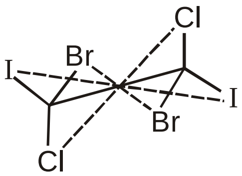
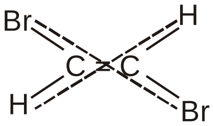
8. 

9. 
10. 

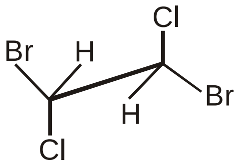
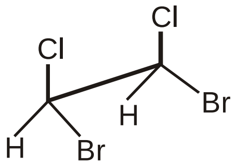
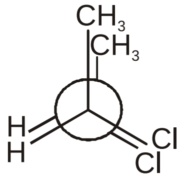
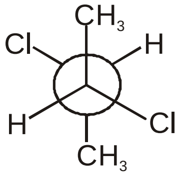
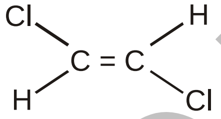
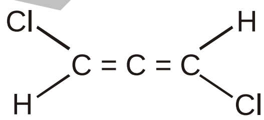
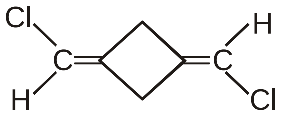
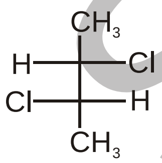
Ans. 1. √ 2. √ 3. X 4. √ 5. √ 6. X 7. √ 8. √ 9. √ 10. √

Centre of symmetry (COS)

Centre of symmetry is defined as imaginary point present for a molecule about which every atom has exactly identical mirror image.

Ex:- (1)  (2)  (3) 

Q.23 Identify COS if present.

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 

Ans.

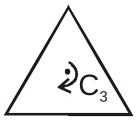
1. √ 2. X 3. X 4. √ 5. √ 6. X 7. √ 8. X

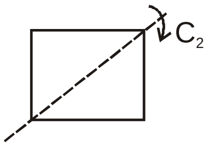
Axis of symmetry (AOS) (C_n)

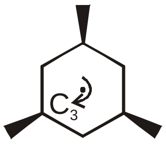
Axis of symmetry (AOS) C_n is defined as an imaginary axis about which if the molecule is rotated by 360°, the structure repeats itself more than one time.

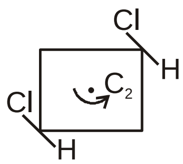
C_n ; $n = \frac{360^\circ}{\theta}$;

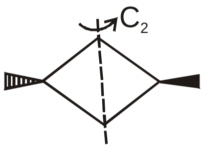
θ = angle about which if molecule is rotated to repeat the 3-D arrangement.

Ex:- (1) 

(2) 

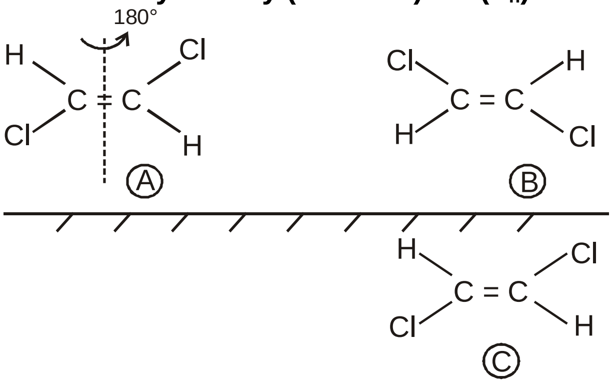
(3) 

(4) 

(5) 

A.A.O.S.

Alternate axis of symmetry (A.A.O.S.) (S_n)



S_n: alternate axis of symmetry

$n = \frac{360^\circ}{\theta}$; θ = angle about which the molecule is rotate

Conditions:-

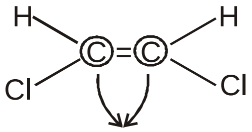
(1) (A) & (B) are unequal; (B) is formed by the rotation of (A)

(2) (A) & C) must be equal; (C) is mirror image of (B) when mirror is kept $\perp^r$ to axis

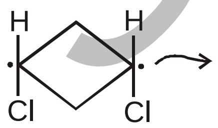
Axis of symmetry for above molecule is S_2.

<u>Stereocentre:-</u>

An atom present in the molecule about which if two groups are exchanged it generates new stereo isomer.

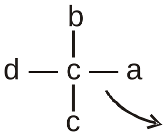


Both are stereocentre.



Both are stereocentre

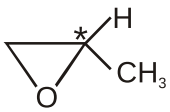
<u>Chiral centre:-</u>

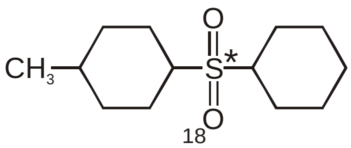


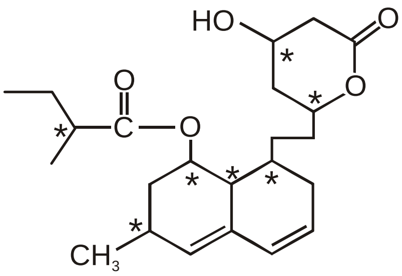
$a \neq b \neq c \neq d$

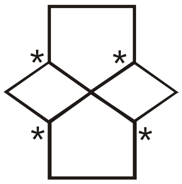
chiral centre / stereocentre / asymmetric carbon / stereogenic centre.

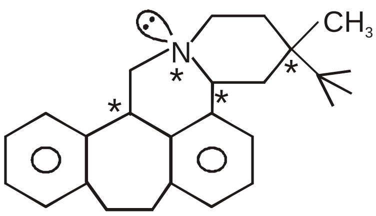
Examples:-

1. 

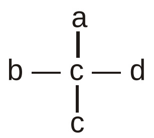
2. 

3. 

4. 

5. 

Prochiral carbon:-

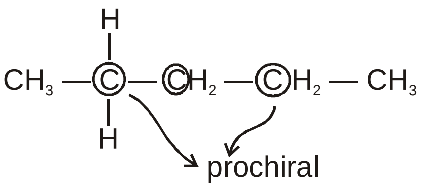


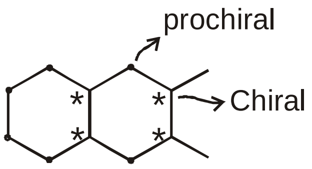
$a \neq b \neq c$

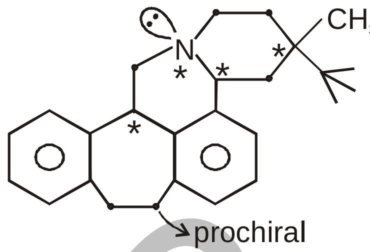
but d = a

or d = b
or d = c

Examples:-

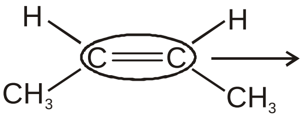
1. 

2. 

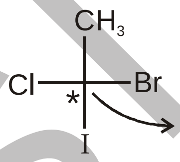
3. 

Stereogenic centre/area/location:-

→ a location which has the potential to generate a pair of stereoisomer.



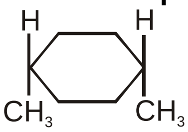
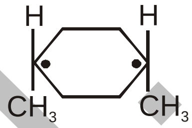
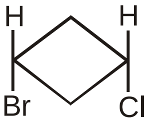
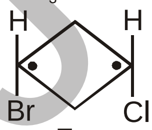
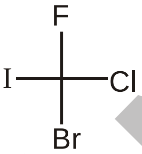
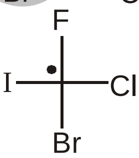
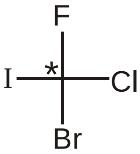
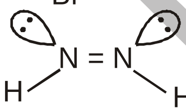
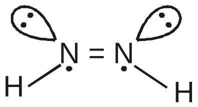
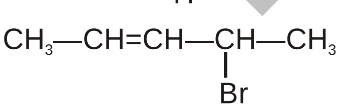
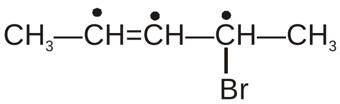
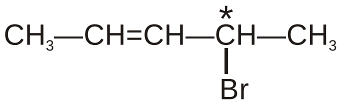
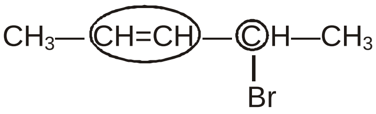
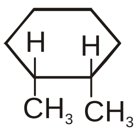
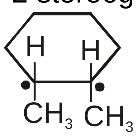
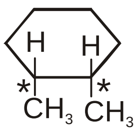
one stereogenic centre.



one stereogenic centre.

→ Every chiral centre is a stereocentre and also a stereogenic centre.

Q.24 Identify presence of stereocentre and chiral centre.

	Compound	**Stereocentre**	**Chiralcentre**
1.			X
2.			X
3.			
4.			X
5.			
		 2 stereogenic centre	
6.			

ETOOS Academy Pvt. Ltd.
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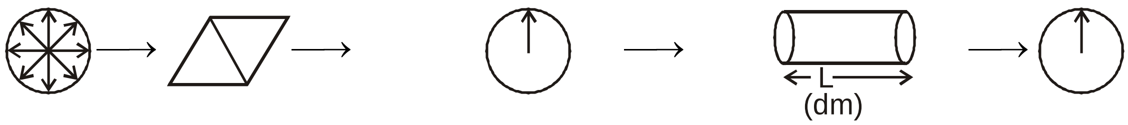
Optical Activity by Polarimeter Tube Experiment:-

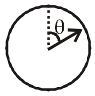
Case A



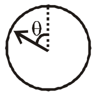
$\begin{bmatrix}\text{Compound is} \\ \text{optically inactive}\end{bmatrix}$

Light | Biprism | Plane polarised light | C = Conc. in (gm/ml)

Case B.



dextrorotatory d(+)



Laevorotatory l(–)

$\begin{bmatrix}\text{Compound is} \\ \text{optically active}\end{bmatrix}$

If temperature & wavelength are constant

$\theta \quad \propto \quad$ conc. of solution (gm/ml)

$\theta \quad \propto \quad \ell$ (dm)

$\theta \quad \propto \quad C \times \ell$

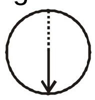
$\theta = [\alpha]_{\lambda}^{T} \times C \times \ell$

$$\alpha = \frac{\theta}{C \times \ell} \begin{Bmatrix} \theta = \text{observed rotation} \\ \alpha = \text{Specific angle of rotation} \end{Bmatrix}$$

Specific Rotation($\propto$):-

Rotation caused by 1gm/ml of solution in 1 dm length polarimeter tube at specific temperature and fixed wavelength of light.

Confusion



θ = + 180° or – 180°

If concentration is halfed and θ becomes + 90° then d if – 90° then ℓ

Ex. Observed rotation of 2gm/ml of solution placed in 25cm length polarimeter tube is +138°. Calculate its specific rotation.

Ans. + 27.6°

Optical Purity (O.P.) or enantiomeric excess (*e. e.*)

$$\text{O.P. } (e.\ e.) = \frac{\text{excess of one enantiomer over other}}{\text{Total mix}} \times 100$$

$$= \frac{|d - l|}{d + l} \times 100$$

$$\text{O.P.} = \frac{\text{observed specific rotation}}{\text{Sp. rotation of pure enantiomer}} \times 100$$

	% of d	% of l	optical purity	% of Racemic mixture
1	100%	0%	100%	0%
2	99%	1%	98%	2%
3	90%	10%	80%	20%
4	75%	25%	50%	50%
5	10%	90%	80%	20%
6	1%	99%	98%	2%
7	0%	100%	100%	0%

Q.25 In a lactic acid aq. solution (+6 gm) of d and 4 gm of ℓ are mixed. Calculate observed specific rotation if specific rotation of pure lactic acid = + 13.6°

Sol. O.P. = $\dfrac{d-\ell}{|d+\ell|} \times 100 \qquad = \dfrac{6-4}{10} \times 100 = 20\%$

Observed sp. rot. = 20% of 13.6°

= 2.72°

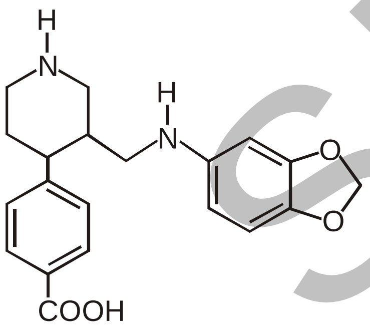
Q.26 Calculate the specific rotation of the following samples taken at 25° using the sodium D line.

(a) 1.0 gm of sample is dissolved in 20.0 ml. of ethanol. Then 5 ml of this solution is placed in a 20.0 cm polarimeter tube. The observed rotation is 1.25° counterclockwise.

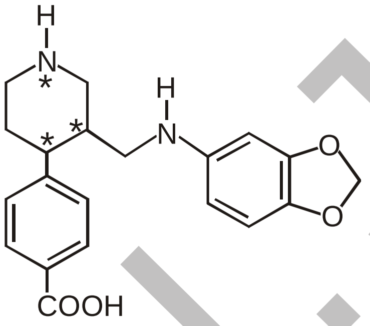
(b) 0.050 gm of sample is dissolved in 2.0 ml of ethanol, and this solution is placed in a 2.0 cm polarimeter tube. The observed rotation is clockwise 0.043°.

Ans. (a) –12.5° (b) + 8.6°

Q.27 Indicate the stereocentres in the following molecule and total number of stereoisomers possible.



Ans.



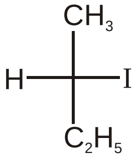
$2^3 = 8$

Q.28 The specific rotation of (s) – iodobutane is + 15.90°.

(a) Draw the structure of (s) – 2 – iodobutane.

(b) Predict the specific rotation of (R) – 2 – iodobutane.

(c) Determine the % composition of mixture of (R) and (S) – 2– iodobutane with specific rotation of 7.95°.

Ans. (a) 

(b) – 15.90° (c) 75% s and 25 % R

Q.29 Dextrorotatory $\propto$ - pinene has a specific rotation $[\propto]_D^{20}$ = + 51.3°. A sample of $\propto$ - pinene containing both enantiomer was found to have specific rotation value $[\propto]_D^{20}$ = 30.8°. The % of (+) and (–) enantiomers in the sample are respectively

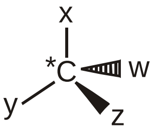
Ans. 80.02% (d) 19.98% (*l*)

Chiral Molecule:-

Chiral molecules are those molecules which are optically active

Optically active → POS X
→ COS X
→ AAOS X

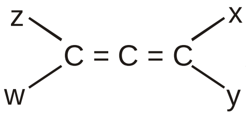
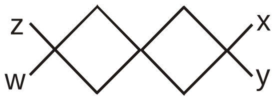
Compounds containing single chiral atoms:-

→  If $x \neq y \neq z \neq w$; then carbon atom is chiral

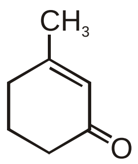
→ Molecules containing single chiral carbon atom are optically active because of absence of POS or COS.

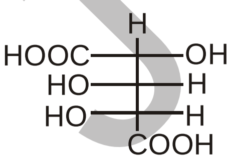
→ Every chiral carbon can be given configuration as R & S depending upon priorities of groups attached on the basis of CIP system (Cahn Ingold prelong system).

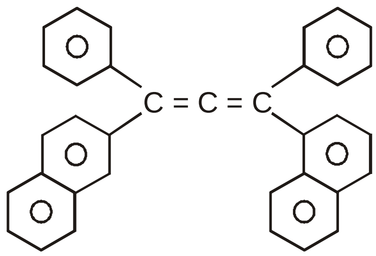
Note:-

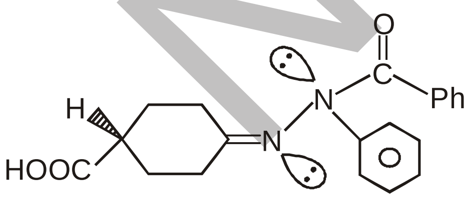
1. All compounds containing one chiral atom are optically active are chiral molecules.
2. Multiple chiral containing molecules are optically inactive if POS or COS is present and are known as achiral molecules.
3.  $x \neq y$ & $z \neq w$ are chiral molecules.
4.  $x \neq y$ & $z \neq w$ are chiral molecules.

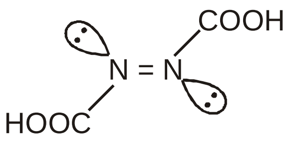
Q.30 Select chiral molecules out of following:-

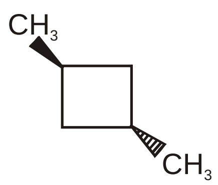
(i) 

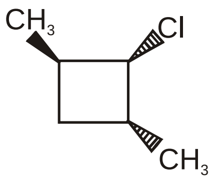
(ii) 

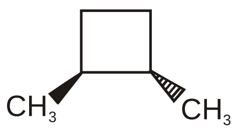
(iii) 

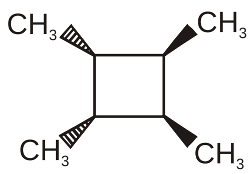
(iv) 

(v) 

(vi) 

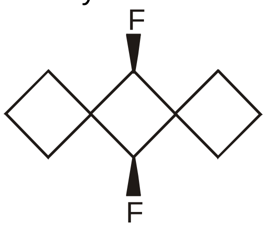
(vii) 

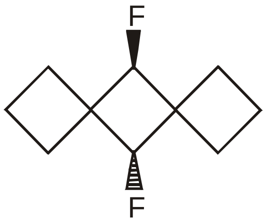
(viii) 

(ix) 

Ans. (i) achiral (ii) achiral (iii) chiral (iv) chiral (v) achiral (vi) achiral (vii) chiral
(viii) chiral (ix) achiral

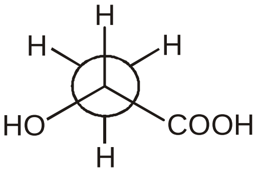
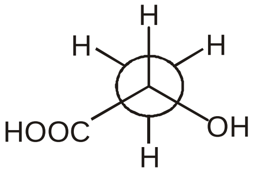
Q.31 Identify POS and COS if present:-

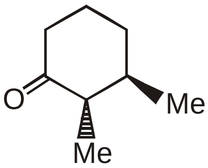
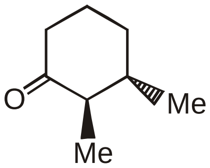

(a)

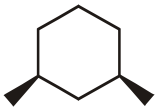
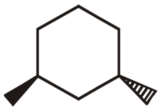

(b)

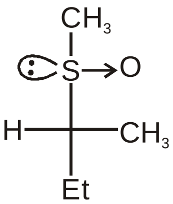
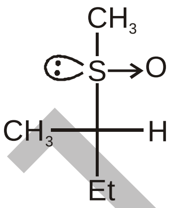
Ans. (a) POS = √ COS = X (b) POS = √ COS = √

Q.32 Identify relationship between following molecules:-

(a)  & 

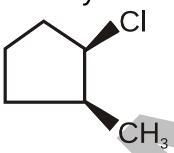
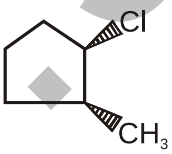
(b)  & 

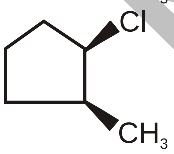
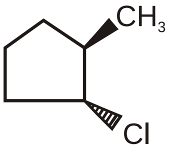
(c)  & 

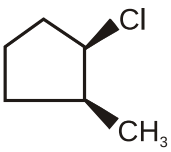
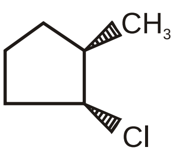
(d)  & 

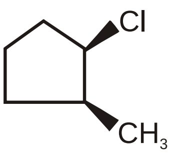
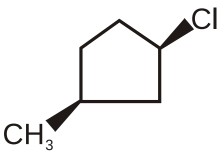
Ans. (a) enantiomers (b) enantiomers (c) diastereomers (d) diastereomers

Q.33 Identify relationship:-

(a)  & 

(b)  & 

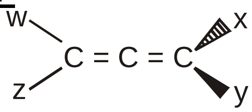
(c)  & 

(d)  & 

Ans. (a) enantiomers (b) diastereomers (c) identical (d) position isomers

Stereochemistry of cumulene:-

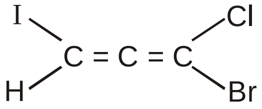
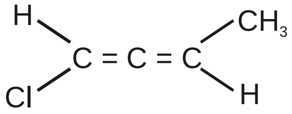
Allene:-



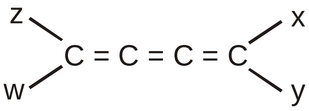
If $x \neq y$ & $z \neq w$; optically active.

Note:-

- all optically active molecules show optical isomerism.
- above molecule will not show G.I.
- No. POS or COS

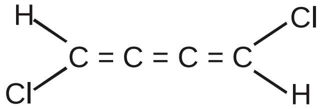
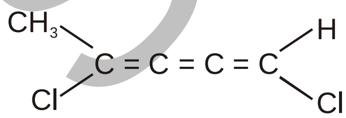
Ex:- (1)  (2) 

Note:-



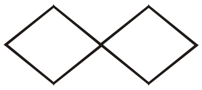
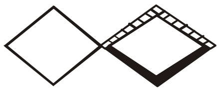
- will not show optical activity
- will show geometrical isomerism if $x \neq y$ & $z \neq w$.
- has POS that is molecular plane.

Ex. Identify POS or COS if present

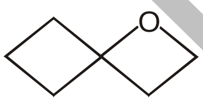
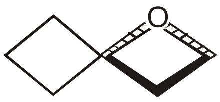
1. 
2. 

Ans.	POS	COS	G.I.	Optically active
1.	√	√	√	X
2.	√	X	√	X

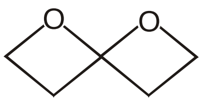
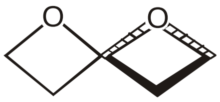
Spiro compound:-

(a)  actual 3D ⟶ 

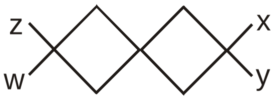
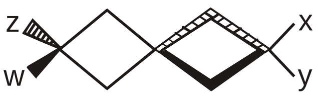
POS √ COS X Optically inactive

(b)  actual 3D ⟶ 

POS √ COS X Optically inactive

(c)  actual 3D 

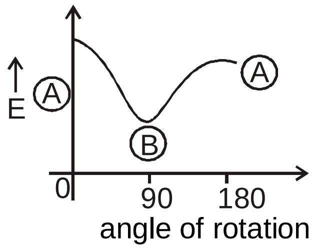
POS X COS X Optically active

(d)  actual 3D 

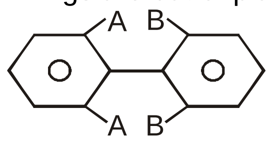
Optically active if $x \neq y$ & $z \neq w$

Stereochemistry of Biphenyl

(a) (b)

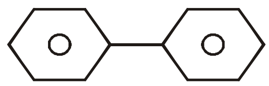


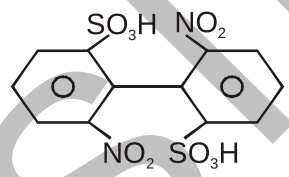
If rings are out of plane then optically active if a ≠ b & c ≠ d.

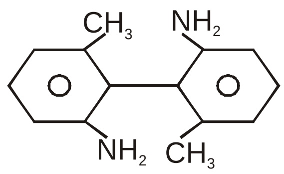
(a) 

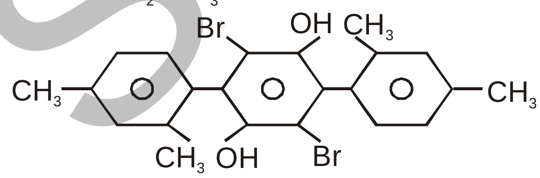
optically inactive

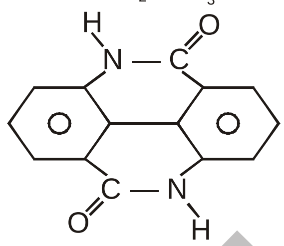
Examples:-

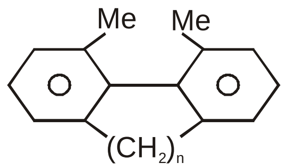
1. 

2. 

3. 

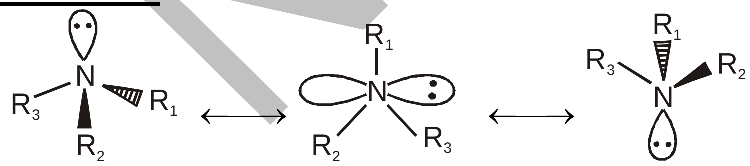
4. 

5. 

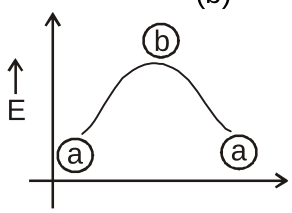
6. 

Ans. **1.** inactive **2.** active **3.** active **4.** inactive (COS present)
5. inactive (planar) **6.** n = 1 (inactive) n = 2,3 (active)

Amine Inversion:-



(a) (b) (a)



Note:-

(1) The energy required for amine inversion is available at room temperature.

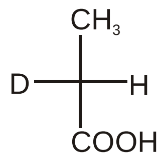
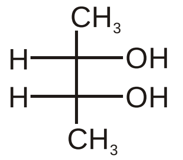
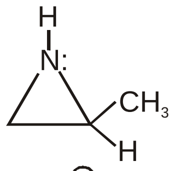
(2) Optically inactive even if $R_1 \neq R_2 \neq R_3$

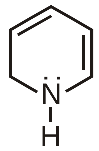
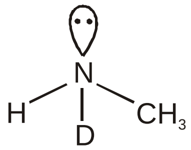
(3) Possible only if R_1, R_2 & R_3 are lighter groups.

<u>Resolvable and Non-Resolvable Compounds:-</u>

<u>Resolution:-</u> Separation of enantiomers from enantiomeric mixture is resolution Resolvable compounds are those compounds which can be separated into enantiomeric mixture.

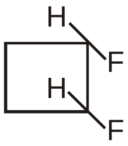
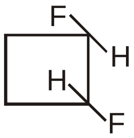
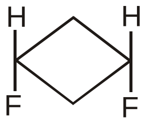
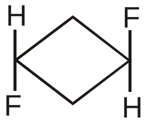
Examples:-

1.  **2.**  **3.** 

4.  **5.** $Ph - \overset{\overset{O}{\|}}{\ddot{S}} - CH_3$ **6.** 

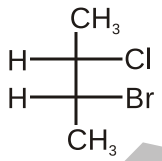
Ans. 1. Resolvable 2. Non-Resolvable 3. Resolvable 4. Resolvable
5. Resolvable 6. Non-Resolvable

Q.34 **Column Matching**

(A)		(P)	POS
(B)		(Q)	COS
(C)		(R)	Resolvable
(D)		(S)	Non-resolvable

Ans. (A) $\rightarrow$ P, S; (B) $\rightarrow$ R; (C) $\rightarrow$ P, S (D) $\rightarrow$ P,Q,S

Q.35 Calculate total number of stereoisomers of following:-

(1) 

(2) $CH_3 - CH = CH - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$

(3) $CH_3 - CH = CH - \underset{\displaystyle CH_3}{\underset{|}{CH}} - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$

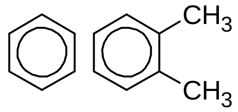
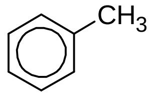
(4) $Ph - \underset{\displaystyle OH}{\underset{|}{CH}} - \underset{\displaystyle CH_3}{\underset{|}{CH}} - \ddot{N}H - CH_3$

(5) $Ph - \overset{\overset{O}{\|}}{\underset{\cdot\cdot}{S}} - CH = CH - CH = CH - CH_3$

Ans. (1) 2^2 (2) 2^2 (3) 2^3 (4) 2^3 (5) 2^3

Exercise-1

Q.1 $C_3H_6Br_2$ can show:
(A) Two gem dibromide
(B) Two vic dibromide
(C) Two tertiary dibromo alkane
(D) Two secondary dibromo alkane

Q.2  and 

Number of secondary carbon atoms present in the above compounds are respectively:
(A) 6 ,4, 5 (B) 4, 5, 6 (C) 5, 4, 6 (D) 6, 2, 1

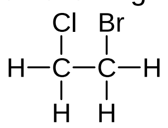
Q.3 The number of primary, secondary and tertiary amines possible with the molecular formula C_3H_9N s given by the set:
(A) 1, 2, 2 (B) 1, 2, 1 (C) 2, 1, 1 (D) 3, 0, 1

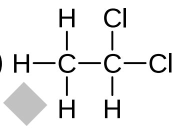
Q.4 The compound 1,2-butadiene has
(A) only sp hybridized carbons atoms
(B) only sp^2 hybridized carbon atoms
(C) both sp and sp^2 hybridized carbon atoms
(D) sp, sp^2 and sp^3 hybridized carbon atoms

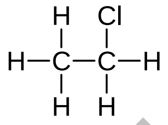
Q.5 The number of isomers of C_5H_{10} is:
(A) 10 (B) 11 (C) 12 (D) 13

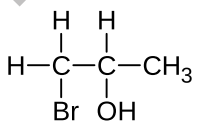
Q.6 The C–H bond distance is the longest in:
(A) C_2H_2 (B) C_2H_4 (C) C_2H_6 (D) $C_2H_2Br_2$

Q.7 Which of following have asymmetric carbon atom?

(A) 

(B) 

(C) 

(D) 

Q.8 The number of isomers of dibromoderivative of an alkene (molar mass 186 g mol^{-1}) is:
(A) two (B) three (C) four (D) six

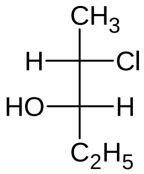
Q.9 Mesotartaric acid and d-tartaric acid are HOOC — CH(OH) — CH(OH) — COOH (Tartaric acid):
(A)position isomers (B) enantiomers (C) diastereomers (D) racemic mixture

Q.10 The number of isomers of structural C_7H_{16} is:
(A) 5 (B) 7 (C) 9 (D) 11

Q.11 The number of different substitution product possible when ethane is allowed to react with bromine in sunlight is:
(A)7 (B) 8 (C) 9 (D) 10

Q.12 The number of isomers of $C_3H_5Br_3$ is:
(A)4 (B) 5 (C) 6 (D) 7

Q.13 The number of optically active compounds in the isomers of C_4H_9Br is:
(A)1 (B) 2 (C) 3 (D) 4

Q.14 

The compound with the above configuration is called:

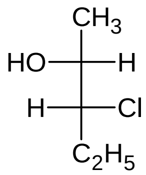
(A) (2S, 3S)-2-chloro-3-hydroxypentane (B) (2S, 3R)-2-chloro-3-hydroxypentane

(C) (2R, 3R)-2-chloro-3-hydroxypentane (D) (2R, 3S)-2-chloro-3-hydroxypentane

Q.15 The correct decreasing priority of ligands $-NO_2$, $-C\equiv N$, $-NH_2$ and $-CH_2NH_2$ in absolute configuration of an enantiomer is:

(A) $NO_2 > NH_2 > C \equiv N > CH_2NH_2$ (B) $NO_2 > C \equiv N > NH_2 > CH_2NH_2$

(C) $NH_2 > NO_2 > C \equiv N > CH_2NH_2$ (D) $NH_2 > NO_2 > CH_2NH_2 > C \equiv N$

Q.16 The full name of the compound  is:

(A) (2R, 3R)-3-chloro-2-pentanol (B) (2R, 3S)-3-chloro-2-pentanol

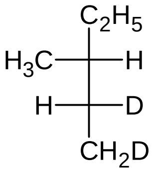
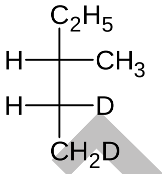
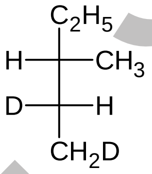
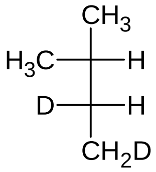
(C) (2S, 3R)-3-chloro-2-pentanol (D) (2S, 3S)-3-chloro-2-pentanol

Q.17 The preferred conformation of trans-1, 2-dibromocyclohexane is:

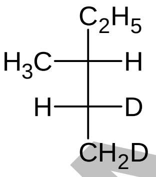
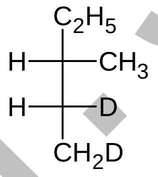
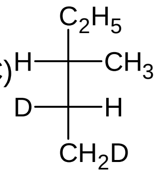
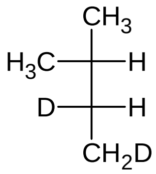
(A) diaxial (B) diequatorial

(C) axial/equatorial (D) neither A, B, nor C

Q.18 The structure of (2R, 3R)$C_2H_5CH(CH_3)CH(D)CH_2D$ is:

(A)  (B)  (C)  (D) 

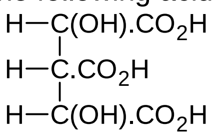
Q.19 The structure of (2R, 3S)$C_2H_5CH(CH_3)CH(D)CH_2D$ is:

(A)  (B)  (C)  (D) 

Q.20 The number of meso diastereomers of $C_6H_{12}Cl_2$ is:

(A) 2 (B) 3 (C) 4 (D) 5

Q.21 How many stereoisomers can exist for the following acid



(A) two (B) four (C) eight (D) sixteen

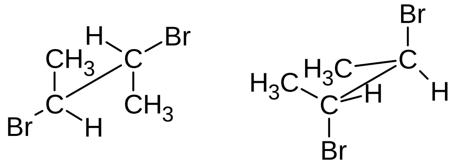
Q.22 How many stereoisomers of the following molecule are possible?

HOOC.CH = C = CH.COOH

(A) two optical isomers (B) two geometrical isomers

(C) two optical and two geometrical isomers (D) None

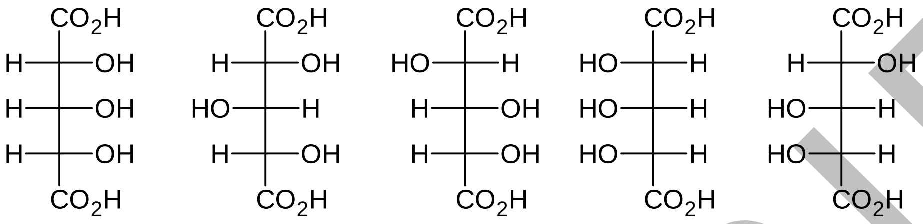
Q.23 The structures shown here are related as being:



(A) confermers (B) enantiomorphs
(C) geometrical isomers (D) diastereoisomers

Q.24 Which of the following cannot be written in an isomeric form?
(A) $CH_3 – CH(OH) – CH_2 – CH_3$ (B) $CH_3 – CHO$
(C) CH2 = CH – Cl (D) $Cl – CH_2CH_2–Cl$

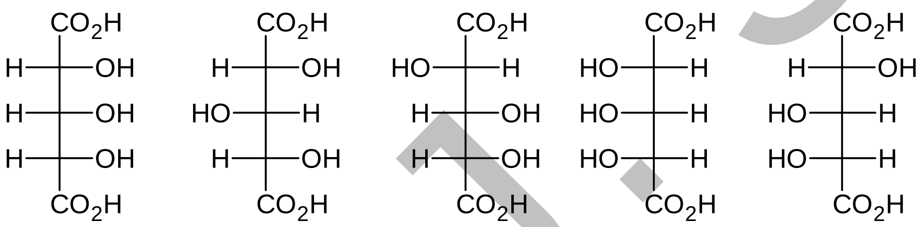
Q.25



(I) (II) (III) (IV) (V)

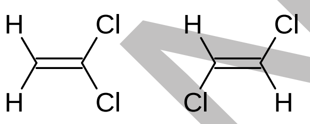
Which of the above formulae represent identical compounds?
(A) I and II (B) I and IV (C)II and IV (D) III and IV

Q.26



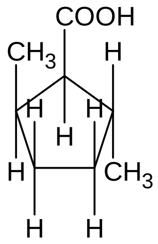
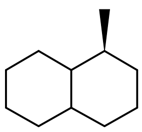
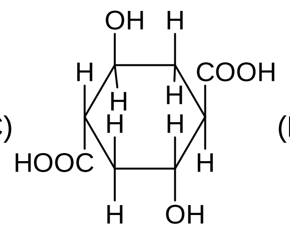
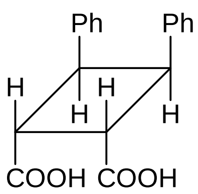
(I) (II) (III) (IV) (V)

Which of the above compounds are enantiomers?
(A) II and III (B) III and IV (C) III and V (D) I and V



Q.27 The above compounds differ in:
(A) configuration (B) conformation (C) structure (D) chirality

Q.28 Which species exhibits a plane of symmetry?

(A)  (B)  (C)  (D) 

Q.29 Applying the sequence rule, which of the following priority arrangements is correct in determining the R/S configuration of:
(A) $–C_6H_5$ > $–CH = CH_2$ > – CHO > –COOH
(B) –COOH > $–CH = CH_2$ > – CHO > – C_6H_5
(C) –COOH > –CHO > $–C_6H_5$ > $–CH = CH_2$
(D) –COOH > $–C_6H_5$ > –CHO > $–CH = CH_2$

Q.30 How many primary amines are possible for the formula $C_4H_{11}N$?
(A) 2 (B) 3 (C) 4 (D) 5

Q.31 The type of isomerism observed in urea molecule is:
(A) Chain (B) Position (C) Geometrical (D) Functional

Q.32 Number of possible 3D-isomers of glucose are:
(A) 10 (B) 14 (C) 16 (D) 20

Q.33 The total number of isomeric optically active monochloro isopentanes is:
(A) two (B) three (C) four (D) one

Q.34 The compounds $C_2H_5OC_2H_5$ and $CH_3OCH_2CH_2CH_3$ are:
(A) enantiomers (B) geometrical isomers
(C) Metamers (D) conformational isomers

Q.35 Which of the following compounds displays geometrical isomerism?
(A) $CH_2 = CHBr$ (B) $CH_2 = CBr_2$
(C) $ClCH = CHBr$ (D) $Br_2C = CCl_2$

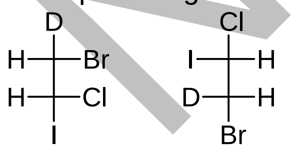
Q.36 The number of optically active isomers observed in 2,3-dichlorobutane is:
(A) 0 (B) 2 (C) 3 (D) 4

Q.37 How many total isomers are possible by replacing one hydrogens atoms of propane with chlorine?
(A) 2 (B) 3 (C) 4 (D) 5

Q.38 A compound has the formula C_2HCl_2Br. The number of total isomers that are possible is:
(A) 1 (B) 2 (C) 3 (D) 4

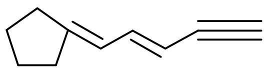
Q.39 On chlorination of propane number of products of the formula $C_3H_6Cl_2$ is:
(A) 3 (B) 4 (C) 5 (D) 6

Q.40 The two compounds given below are



(A) enantiomers (B) identical (C) optically inactive (D) diastereomers

Q.41 The number of cis-trans isomer possible for the following compound:

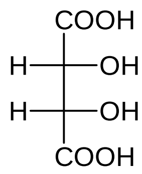


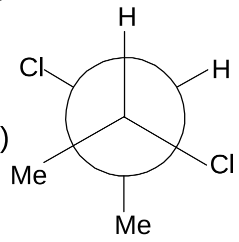
(A) 2 (B) 4 (C) 6 (D) 8

Q.42 A pure sample of 2-chlorobutane shows rotation of PPL by 30° in standard conditions. When above sample is made impure by mixing its opposite form, so that the composition of the mixture becomes 87.5% d-form and 12.5% ℓ-form, then what will be the observed rotation for the mixture.
(A) –22.5° (B) +22.5° (C) +7.5° (D) –7.5°

Q.43 When an optically active compound is placed in a 10 dm tube is present 20 gm in a 200 ml solution rotates the PPL by 30°. Calculate the angle of rotation and specific angle of rotation if above solution is diluted to 1 Litre.
(A) 16° and 36° (B) 6° and 30° (C) 3° and 30° (D) 6° and 36°

Q.44 Which of the following will not show optical isomerism?
(A) Cl – CH = C = C = CH – Cl (B) Cl – CH = C = C = C = CH – Cl

(C) 

(D) 

Exercise – II

Q.1 $C_4H_6O_2$ does represent:
(A) A diketone
(B) A compound with two aldehyde
(C) An alkenoic acid
(D) An alkanoic acid

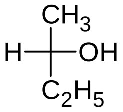
Q.2 Only two isomeric monochloro derivatives are possible for (excluding stereo)
(A) n-butane
(B) 2,2-dimethylpentane
(C) benzene
(D) 2-methylpropane

Q.3 Which of the following statements is/are not correct?
(A) Metamerism belongs to the category of structural isomerism
(B) Tautomeric structures are the resonating structures of a molecule
(C) Keto form is always more stable than the enol form
(D) Geometrical isomerism is shown only by alkenes

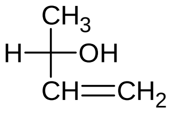
Q.4 Which of the following statements is/are correct?
(A) A meso compound has chiral centres but exhibits no optical activity
(B) A meso compound has no chiral centres and thus are optically inactive
(C) A meso compound has molecules which are superimposable on their mirror images even though they contain chiral centres
(D) A meso compound is optically inactive because the rotation caused by any molecule is cancelled by an equal and opposite rotation caused by another molecule that is the mirror image of the first

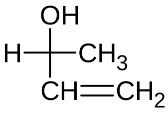
Q.5 Which of the following statements is/are not correct for D–(+) glyceraldehyde?
(A) The symbol D indicates the dextrorotatory nature of the compound
(B) The sing (+) indicates the dextrorotatory nature of the compound
(C) The symbol D indicates that hydrogen atom lies left to the chiral centre in the Fischer projection diagram
(D) The symbol D indicates that hydrogen atom lies right to the chiral centre in the Fischer production diagram

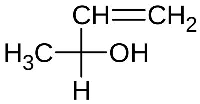
Q.6 Which of the following compounds is optically active?
(A) 1-Bromobutane
(B) 2-Bromobutane
(C) 1-Bromo-2-methylpropane
(D) 2-Bromo-2-methylpropane

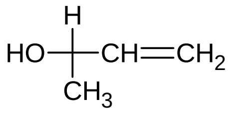
Q.7 Which of the following operations on the Fischer formula  does not change its absolute configuration?
(A) Exchanging groups across the horizontal bond
(B) Exchanging groups across the vertical bond
(C) Exchanging groups across the horizontal bond and also across the vertical bond
(D) Exchanging a vertical and horizontal group

Q.8 Which of the following combinations amongst the four Fischer projections represents the same absolute configurations?


(I)

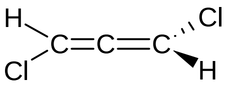
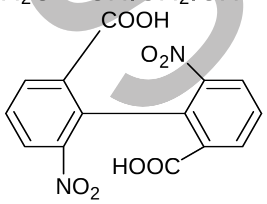

(II)

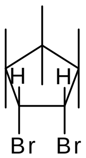
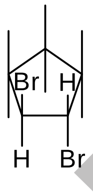
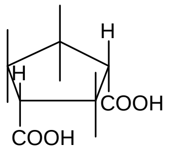
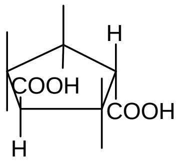

(III)

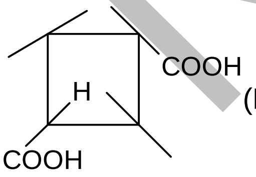
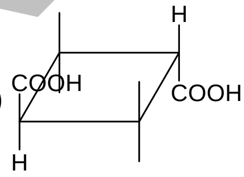
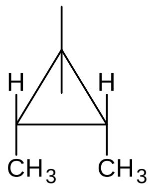
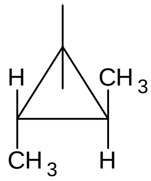

(IV)

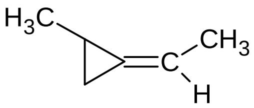
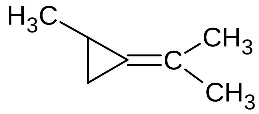
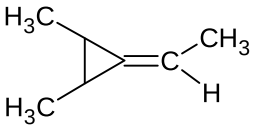
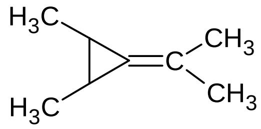
(A) (II) and (III) (B) (I) and (IV) (C) (II) and (IV) (D) (III) and (IV)

Q.9 Which of the following statements for a meso compound is/are correct?
(A) The meso compound has either a plane or a point of symmetry
(B) The meso compound has at least one pair of similar stereocentres
(C) The meso compound is achiral
(D) The meso compound is formed when equal amounts of two enantiomers are mixed

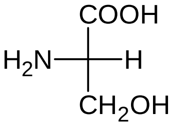
Q.10 Which of the following compounds are optically active?
(A) $CH_3.CHOH.CH_2.CH_3$
(B) $H_2C = CH.CH_2.CH = CH_2$
(C) 
(D) 

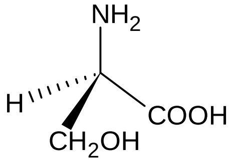
Q.11 Which out of the following are Non-resolvable?
(A) 
(B) 
(C) 
(D) 

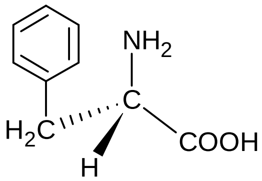
Q.12 Which out of the following are resolvable?
(A) 
(B) 
(C) 
(D) 

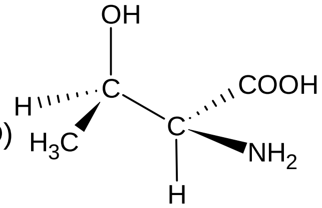
Q.13 Which of the following will show optical isomerism as well as geometrical isomerism?
(A) 
(B) 
(C) 
(D) 

Q.14 Which of the following are correct representation of L-amino acids?

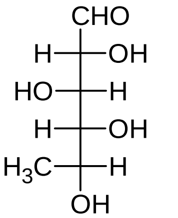
(A) 

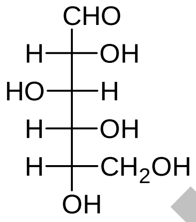
(B) 

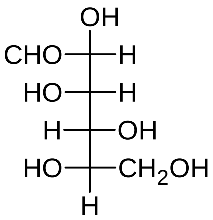
(C) 

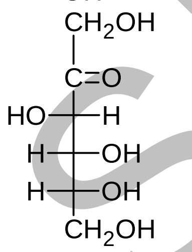
(D) 

Q.15 Which of the following are D sugars?

(A) 

(B) 

(C) 

(D) 

Q.16 What observed rotation is expected when a 1.5 M solution of (R)-2-butanol is mixed with an equal volume of a 0.75 M solution of racemic 2-butanol and the resulting solution is analysed in a sample container that is 1 dm long? The specific rotation of (R)-2-butanol is $-13.9°$ ml gm^{-1} dm^{-1}.

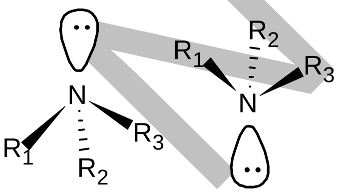
(A) +0.77° (B) –0.77° (C) +0.35° (D)–0.35°

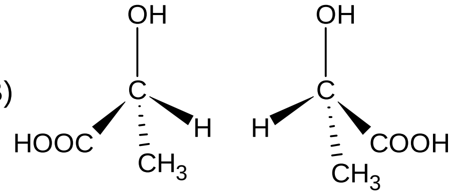
Q.17 Which of the following have zero dipole moment?

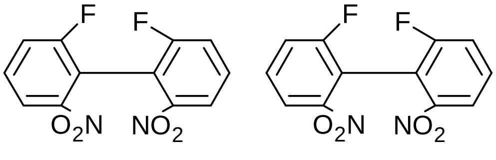
(A) p-Dichlorobenzene (B) Benzene-1, 4-diol

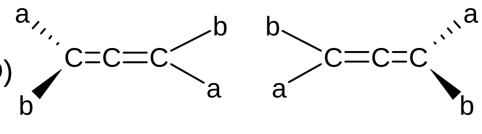
(C) Fumaric acid (D) Maleic acid

Q.18 Which of the following pairs can be resolved?

(A) 

(B) 

(C) 

(D) 

Q.19 Which of the following states are correct:

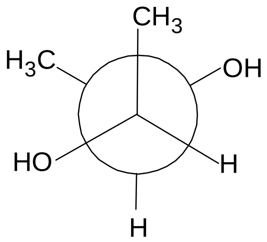
(A) Any chiral compound with a single asymmetric carbon must have a positive optical rotation if the compound has the R configuration

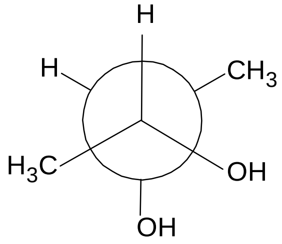
(B) If a structure has no plane of symmetry it is chiral

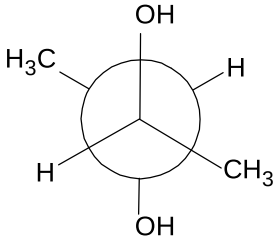
(C) All asymmetric carbons are stereocentres

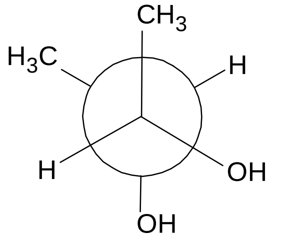
(D) Alcohol and ether are functional isomers

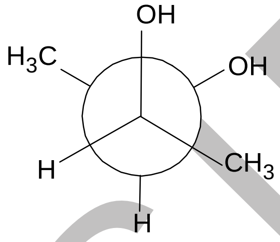
Q.20 Which of the following molecules is/are identical with that represented by?



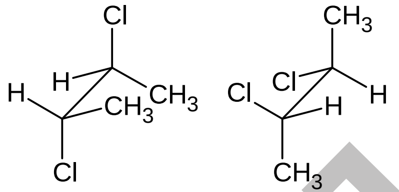
(A) 

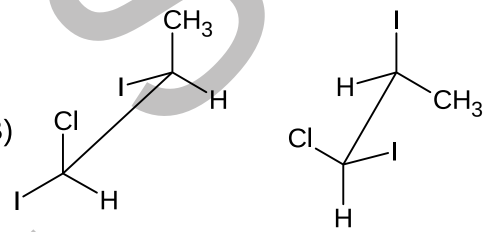
(B) 

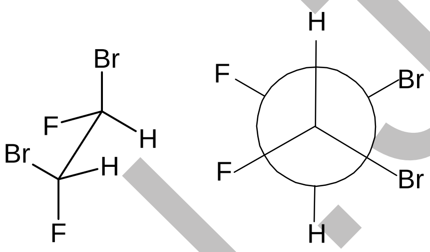
(C) 

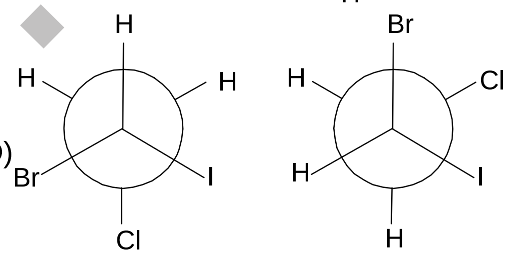
(D) 

Q.21 Which of the following pairs of compound is/are identical?

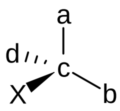
(A) 

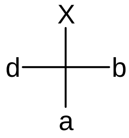
(B) 

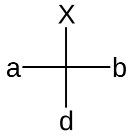
(C) 

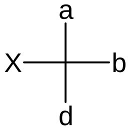
(D) 

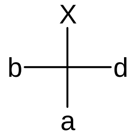
Q.22 The Fischer projection of the molecule as represented in the wedge edge?

 is:

(A) 

(B) 

(C) 

(D) 

Q.23 Which of the following switching ligands or rotating Fischer structures changes its absolute configuration?
(A) An even number of switches
(B) An odd number of switches
(C) Rotating the Fischer projection by 180° in the plane of the paper
(D) Exchange ligands across the horizontal bond as well as those across the vertical bond

Q.24 Match List–I with List–II and select the correct answer from the codes given below the lists:

List I		List II	
(A)	Constitutional isomers	(P)	Stereoisomers that are not enantiomers
(B)	Stereoisomers	(Q)	Isomers that have same constitution but differ in the arrangement of their atoms in space
(C)	Enantiomers	(R)	Isomers that differ in the order in which their atoms are connected
(D)	Diastereoisomers	(S)	Stereoisomers that are related as an object and its non-superimposable mirror image

Q.25 Each of compounds in column A is subjected to further chlorination. Match the following for them.

Column A		Column B	
(A)	$CHCl_2 - CH_2 - CH_3$	(P)	Optically active
(B)	$CH_2Cl - CHCl - CH_3$	(Q)	Only one trichloro product
(C)	$CH_2Cl - CH_2 - CH_2 - Cl$	(R)	Three trichloro product
(D)	$CH_3 - CCl_2 - CH_3$	(S)	Four trichloro product
(E)	$CH_3-C(Cl)(CH_3)-C(Cl)(CH_3)-CH_3$	(T)	Atleast one of the trichloro product is optically active.
		(U)	Two trichloro products

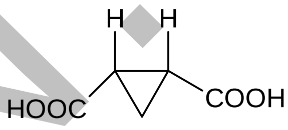
Exercise III

Q.1 How many isomers are possible for Nitrophenol?

Q.2 A compound with molecular formula $C_4H_{10}O$, can show metamerism, functional isomerism and positional isomerism. Justify the statement.

Q.3 Calculate the total number of stereoisomers in the following compounds.

(I) $CHO - CHOH - CHOH - CH_2OH$

(II) 

(III) $COOH - CHOH - CHOH - CHOH - COOH$

Q.4 A 0.1 M solution of an enantiomerically pure chiral compound. D has an observed rotation of +0.20° in a 1 dm sample container, the molecular mass of the compound is 150.

(a) What is the specific rotation of D?

(b) What is the observed rotation if this solution of D is diluted with an equal volume of solvent?

(c) What is the observed if this solution is mixed with an equal volume of a solution that is 0.1 M in L, the enantiomer of D?

(d) What is the specific rotation of D after the dilution described in part (b)?

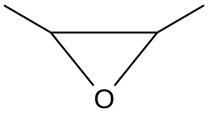
(e) What is the specific rotation of L, the enantiomer of D, after the dilution described in part (b)?

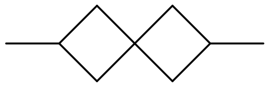
(f) What is the observed rotation of 10 ml of a solution that contains 0.01 mole of D and 0.005 mole of L? (Assume a 1 dm path length)

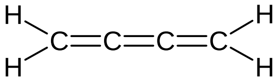
Q.5 In what stereoisomeric forms would you expect the following compounds to exist?

(a) $EtCH(CO_2H)Me$

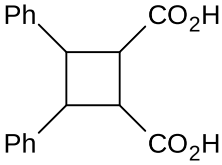
(b) $MeCH(CO_2Et)CO_2H$

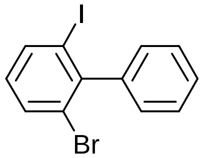
(c) 

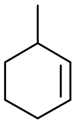
(d) 

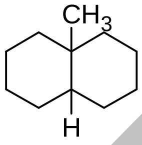
(e) 

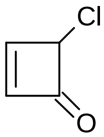
(f) $Et(Me)C = C = C(Me)Et$

(g) 

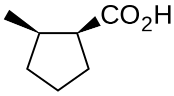
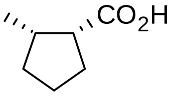
(h) 

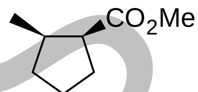
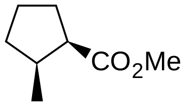
(i) 

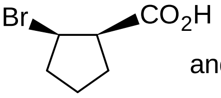
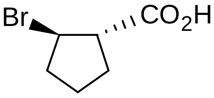
(j) 

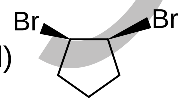
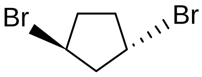
(k) 

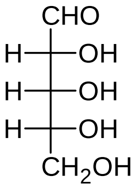
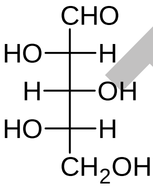
Q.6 What are the relationships between the following pairs of isomers?

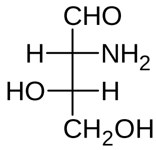
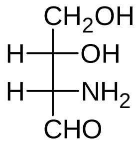
(a)  and 

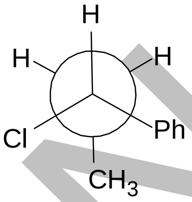
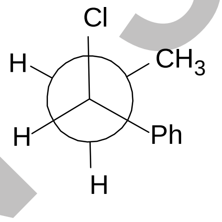
(b)  and 

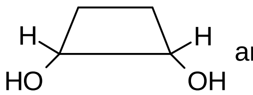
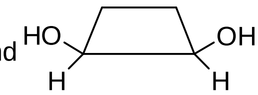
(c)  and 

(d)  and 

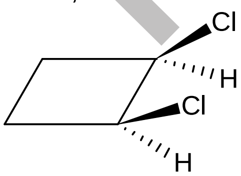
(e)  and 

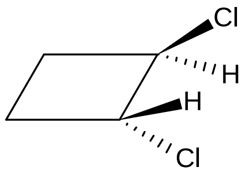
(f)  and 

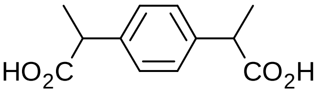
(g)  and 

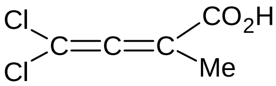
(h)  and 

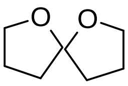
Q.7 With reasons, state whether each of the following compounds I to IX is chiral.

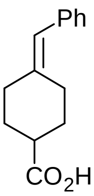
(I) 

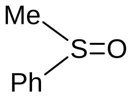
(II) 

(III) 

(IV) 

(V) 

(VI) 

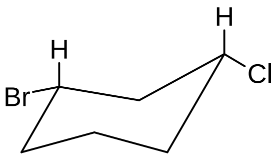
(VII) 

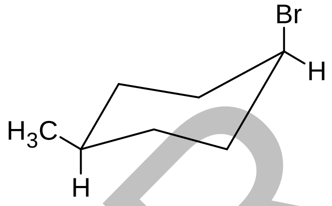
Q.8 Draw the two chair conformers of each compound and indicate which conformer is more stable?
(a) cis-1-ethyl-3-methylcyclohexane
(b) trans-1-ethyl-2-isopropylcyclohexane
(c) trans-1-ethyl-2-methylcyclohexane
(d) trans-1-ethyl-3-methylcyclohexane
(e) cis-1-ethyl-3-isopropylcyclohexane
(f) cis-1-ethyl-4-isopropylcyclohexane

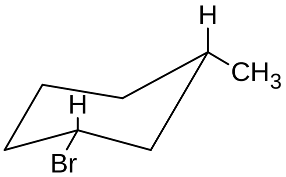
Q.9 Draw the most stable conformer of N-methylpiperidine.

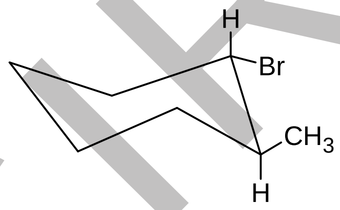
Q.10 Considering rotation about the C-3–C-4 bond of 2-methylhexane.
(a) Draw the Newman projection of the most stable conformer.
(b) Draw the Newman projection of the least stable conformer.

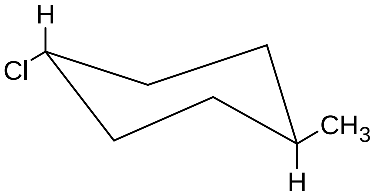
Q.11 Determine whether each of the following compounds is a cis isomer or a trans isomer.

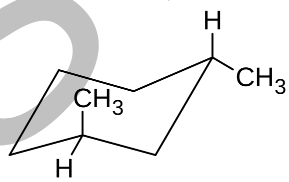
(a) 

(b) 

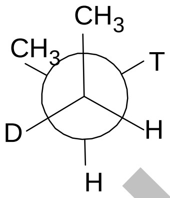
(c) 

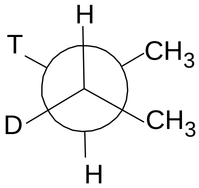
(d) 

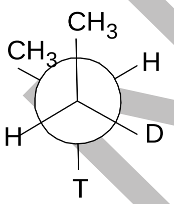
(e) 

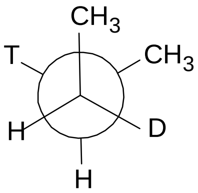
(f) 

Q.12 Comment on the relationship among the following compounds.

(I) 

(II) 

(III) 

(IV) 

Exercise IV (A)

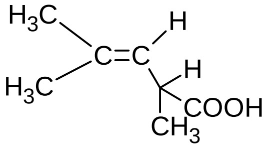
Q.1 True or False:
m-chlorobromobenzene is an isomer of m-bromochlorobenzene. **[IIT-JEE 1985]**

Q.2 Only two isomeric monochloro derivatives are possible for: **[IIT-JEE 1986]**
(A) n-butane
(B) 2,4-dimethylpentane
(C) benzene
(D) 2-methylpropane

Q.3 True or false: **[IIT-JEE 1990]**
2,3,4-Trichloropentane has three asymmetric carbon atoms.

Q.4 Isomers which can be interconverted through rotation around a single bond are:
(A) Conformers (B) Diasereomers
(C) Enantiomers (D) Positional isomers **[IIT-JEE 1992]**

Q.5 The optically active tartaric acid is named as D–(+)–tartaric acid because it has a positive:
(A) optical rotation and is derived from D-glucose
(B) pH in organic solvent
(C) optical rotation and is derived from D–(+)–glyceraldehyde
(D) optical rotation only when substituted by deuterium **[IIT-JEE 1992]**

Q.6 The  shows: **[IIT-JEE 1995 (Scr.)]**

(A) geometrical isomerism (B) optical isomerism
(C) geometrical and optical isomerism (D) tautomerism

Q.7 How many optically active stereoisomers are possible for butane-2, 3-diol?
(A) 1 (B) 2 (C) 3 (D) 4 **[IIT-JEE 1997]**

Q.8 The number of possible enantiomeric pairs that can be produced during monochlorination of 2-methyl butane is: **IIT-JEE 1997]**
(A) 2 (B) 3 (C) 4 (D) 1

Q.9 When cyclohexane is poured on water, it floats, because: **[IIT-JEE 1997]**
(A) cyclohexane is in 'boat' form (B) cyclohexane is in 'chair' form
(C) cyclohexane is in 'crown' form (D) cyclohexane is less dense than water

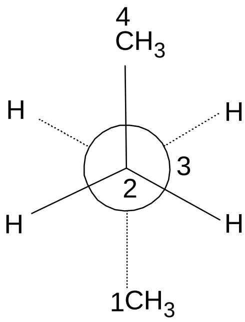
Q.10 Which of the following compounds will show geometrical isomerism? **[IIT-JEE 1998]**
(A) 2-butene (B) propene
(C) 1-phenylpropene (D) 2-methyl-2-butene

Q.11 Which of the following compounds will exhibit geometrical isomerism? **[IIT-JEE 2000 (Scr.)]**
(A) 1-Phenyl-2-butene (B) 3-Phenyl-1-butene
(C) 2-Phenyl-1-butene (D) 1,1-Diphenyl-1-propene

Q.12 The number of isomers for the compound with molecular formula C_2BrC/FI is:
(A) 3 (B) 4 (C) 5 (D) 6 **[IIT-JEE 2001 (Scr.)]**

Q.13 Which of the following compounds exhibits stereoisomerism? **[IIT-JEE 2002 (Scr.)]**
(A) 2-methylbutene-1 (B) 3-methylbutyne-1
(C) 3-methylbutanoic acid (D) 2-methylbutanoic acid

Q.14 In the given conformation, if C_2 is rotated about C_2–C_3 bond anticlockwise by an angle of 120° then the conformation obtained is: **[IIT-JEE 2004 (Scr.)]**



(A) fully eclipsed conformation (B) partially eclipsed conformation
(C) gauche conformation (D) staggered conformation

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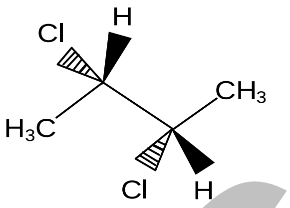
Q.15 On monochlorination of 2-methylbutane, the total number of chiral compounds formed is:
(A) 2 (B) 4 (C) 6 (D) 8 **[IIT-JEE 2004]**

Q.16 The number of structural isomers for C_6H_{14} is: **[IIT-JEE 2007]**
(A) 3 (B) 4 (C) 5 (D) 6

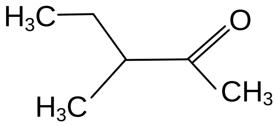
Q.17 Statement 1: Molecules that are not superimposable on their mirror images are chiral.
Because
Statement 2: All chiral molecules have chiral centres. **[IIT-JEE 2007]**
(A) Statement-1 is true, Statement-2 is true, Statement-2 is a correct explanation of Statement-1.
(B) Statement-1 is true, Statmeent-2 is true, Statement-2 is NOT a correct explanation for Statement–1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

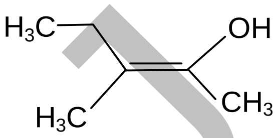
Q.18 The correct statement(s) about the compound given below is (are): **[IIT-JEE 2008]**

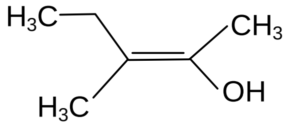


(A) The compound is optically active
(B) The compound possesses centre of symmetry
(C) The compound possesses plane of symmetry
(D) The compound possesses axis of symmetry

Q.19 The correct statement(s) concerning the structures E,F and G is (are) **[IIT-JEE 2008]**


(E)

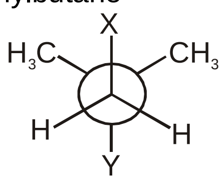

(F)


(G)

(A) E, F and G are resonance structures (B) E, F and E, G are tautomers
(C) F and G are geometrical isomers (D) F and G are diastereomers

Q.20 The correct statement(s) about the compound $H_3C(HO)HC-CH=CH-CH(OH)CH_3$(X) is (are) **[IIT-JEE 2009]**
(A) The total number of stereoisomers possible for X is 6
(B) The total number of diastereomers possible for X is 3
(C) If the stereochemistry about the double bond in X is trans, the number of enantiomers possible for X is 4.
(D) If the stereochemistry about the double bond in X is cis, the number of enantiomers possible for X is 2.

Q.21 In the Newman projection for 2,2-dimethylbutane **[IIT-JEE 2010]**

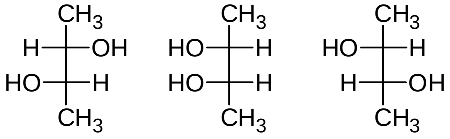


X and Y can respectively be
(A) H and H (B) H and C_2H_5 (C) C_2H_5 and H (D) CH_3 and CH_3

Exercise – IV (B)

Q.1 Write structural formulae for all the isomeric alcohols having the molecular formula $C_4H_{10}O$. **[IIT-JEE 1984]**

Q.2 Identify the pairs of enantiomers and diastereomers form the following compounds I, II and III.



(I) (II) (III) **[IIT-JEE 2000]**

Q.3 (i) $\mu_{obs} = \sum_i \mu_i x_i$

Where μ_i is the dipole moment of a stable conformer of the molecule, Z – CH_2 – CH_2 – Z and x_i is the mole fraction of the stable conformer.
Given : μ_{obs} = 1.0 D and x (Anti) = 0.82
Draw all the stable conformers of Z – CH_2 – CH_2 – Z and calculate the value of $\mu_{(Gauche)}$.

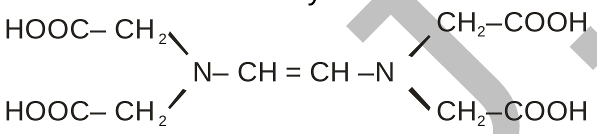
(ii) Draw the stable conformer of Y – CHD – CHD – Y (meso form), when Y = CH_3 (rotation about C_2 C_3) and Y = OH (rotation about C_1–C_2) in Newmann projection. **[IIT-JEE 2005]**

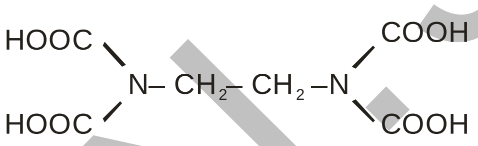
Q.4 The total number of cyclic structural as well as stereo isomers possible for a compound with the molecular formula C_5H_{10} is. **[IIT-JEE 2009]**

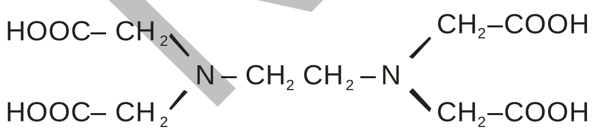
Q.5 The total number of cyclic isomers possible for a hydrocarbon with the molecular formula C_4H_6 is **[IIT-JEE 2010]**

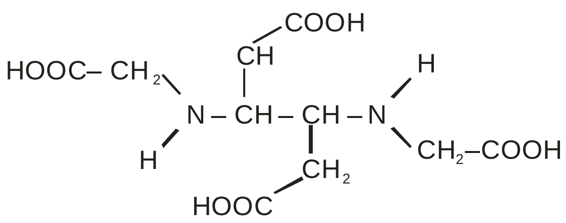
Q.6 The bond energy **(in kcal mol^{-1})** of a C – C single bond is approximately **[IIT-JEE 2010]**
(A) 1 (B) 10 (C) 100 (D) 1000

Q.7 The correct structure of ethylenediaminetetraacetic acid (EDTA) is **[IIT-JEE 2010]**

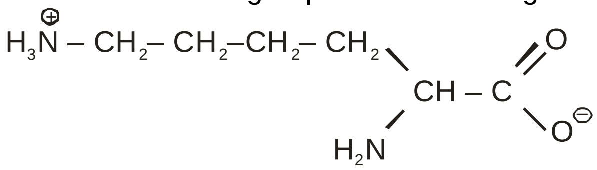
(A)


(B)


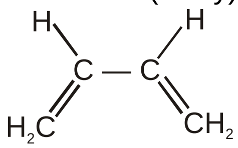
(C)


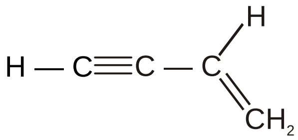
(D)


Q.8 The total number of basic groups in the following form of lysine is **[IIT-JEE 2010]**



Q.9 Amongst the given options, the compounds) in which all the atoms are in one plane in all the possible conformations (if any), is (are) **[IIT-JEE 2011]**

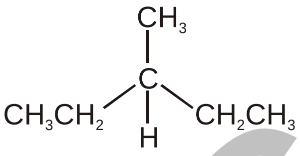
(A) 

(B) 

(C) $H_2C=C=O$

(D) $H_2C=C=CH_2$

Q.10 The maximum number of isomers (including stereoisomers) that are possible on monochlorination of the following compound is **[IIT-JEE 2011]**



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Answer Key

Exercise – 1

1	2	3	4	5	6	7	8	9	10
AB	A	C	D	D	C	D	B	C	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	C	B	A	A	A	B	A	B	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	A	D	C	B	C	C	D	C	D
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
D	C	C	C	C	B	A	C	C	A
41	**42**	**43**	**44**						
A	B	B	A						

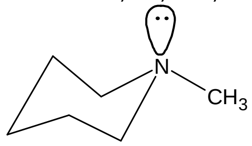
Exercise – 2

1	2	3	4	5	6	7	8	9	10
ABC	AD	BCD	AC	AD	B	C	C	ABC	ACD
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
AC	D	ACD	ACD	ACD	B	AC	BCD	CD	AD
21	**22**	**23**							
A	AC	B							

24. (A)R; (B)Q; (C)QS: (D)P,Q

25. (A) S,T (B)P,S,T (C)U, (D) Q, (E) T,U

Exercise – III

1. 3
3. (I) 4, (II) 3, (III) 4
4. (a) + 13.3; (b) 0.10; (c) zero; (d) unchanged; (e) unchanged; (f) 1
5. Optical : a, b, c, d, f, g, I, j, k; Geometrical isomer: c,g,j; None : e, h.
6. (a) Enantiomers, (b) Enantiomers, (c) Geometrical isomers & Diastereomers, (d) Positional, (e) Optical (Diastereomers), (f) Diastereomers, (g) Enantiomers, (h) Identical, isomers & Diastereomers
7. achiral : I, III, IV ; chiral : II, V, VI, VII
9. 

11. (a) cis (b) cis (c) cis (d) trans (e) trans (f) trans

12. II, III and IV are Identical; I is Enantiomer of these.

Exercise IV (A)

1	2	3	4	5	6	7	8	9	10
False	D	True	A	C	B	B	A	D	AC
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	D	D	C	B	C	C	A,D	B,C,D	A,D
21									
C, D									

Exercise – IV (B)

1. (a) $CH_3 - CH_2 - CH_2 - CH_2 - OH$

(b) $CH_3 - CH_2 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$

(c) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - OH$

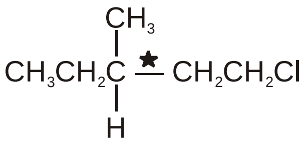
(d) $CH_3 - \overset{\displaystyle OH}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}} - CH_3$

2. enantiomers –I and III; diastereomers – I and II and II and III

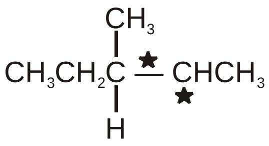
3. (i) $\frac{1}{0.18}$ D, (ii) anti form when Y = CH_3 and Gauche when Y = –OH

4. 7 **5.** 5 **6.** C **7.** C **8.** 3 **9.** B, C

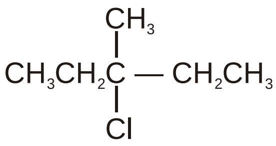
10. 8



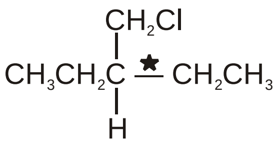
Enantiomeric pair = 2



Two Enantiomeric pairs = 4



1

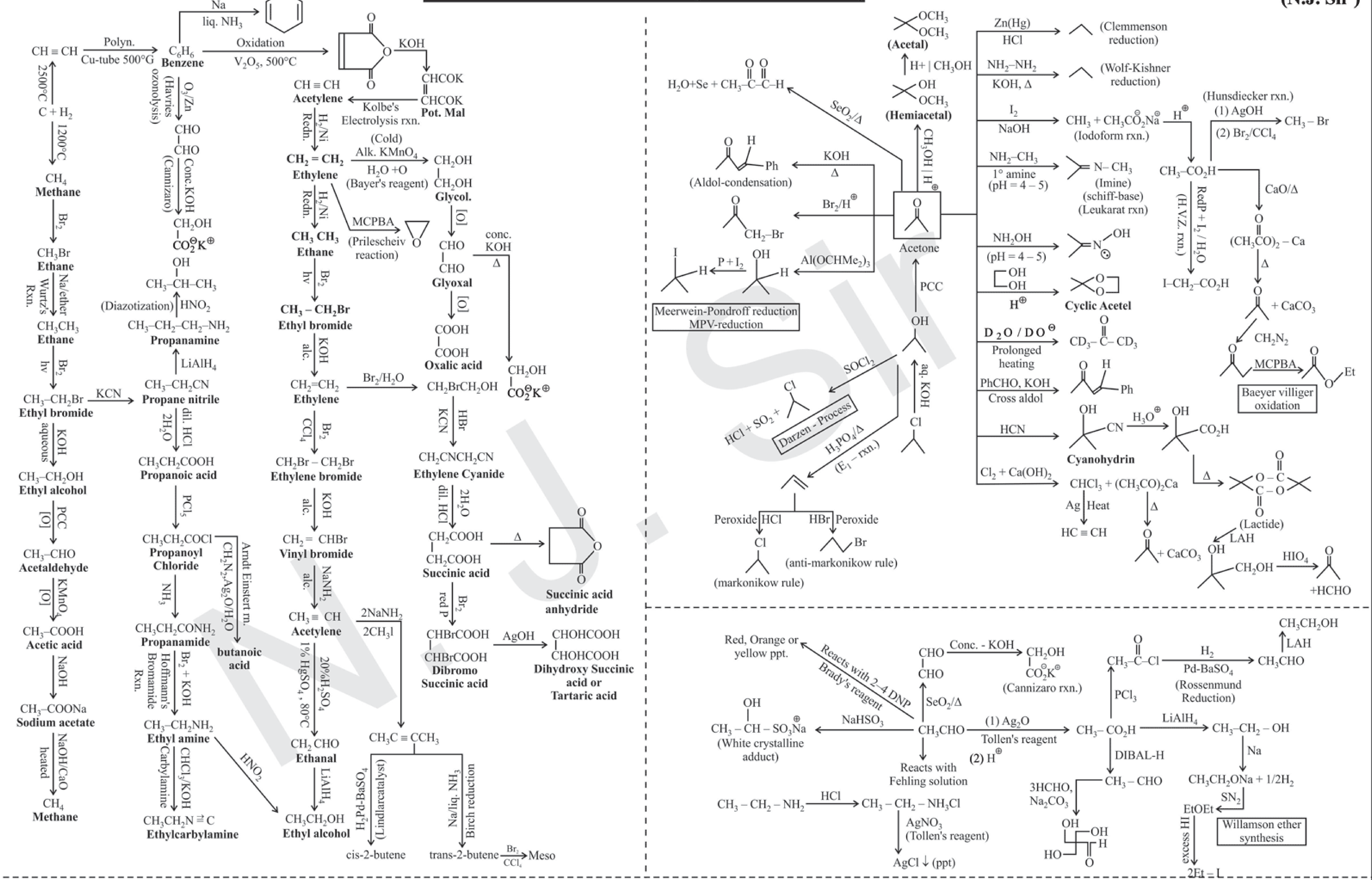


1

Total = 2 + 4 + 1 + 1 = 8

LEARNING CHART (ALIPHATIC)

Navneet Jethwani
(N.J. Sir)



LEARNING CHART (ALIPHATIC)

Navneet Jethwani
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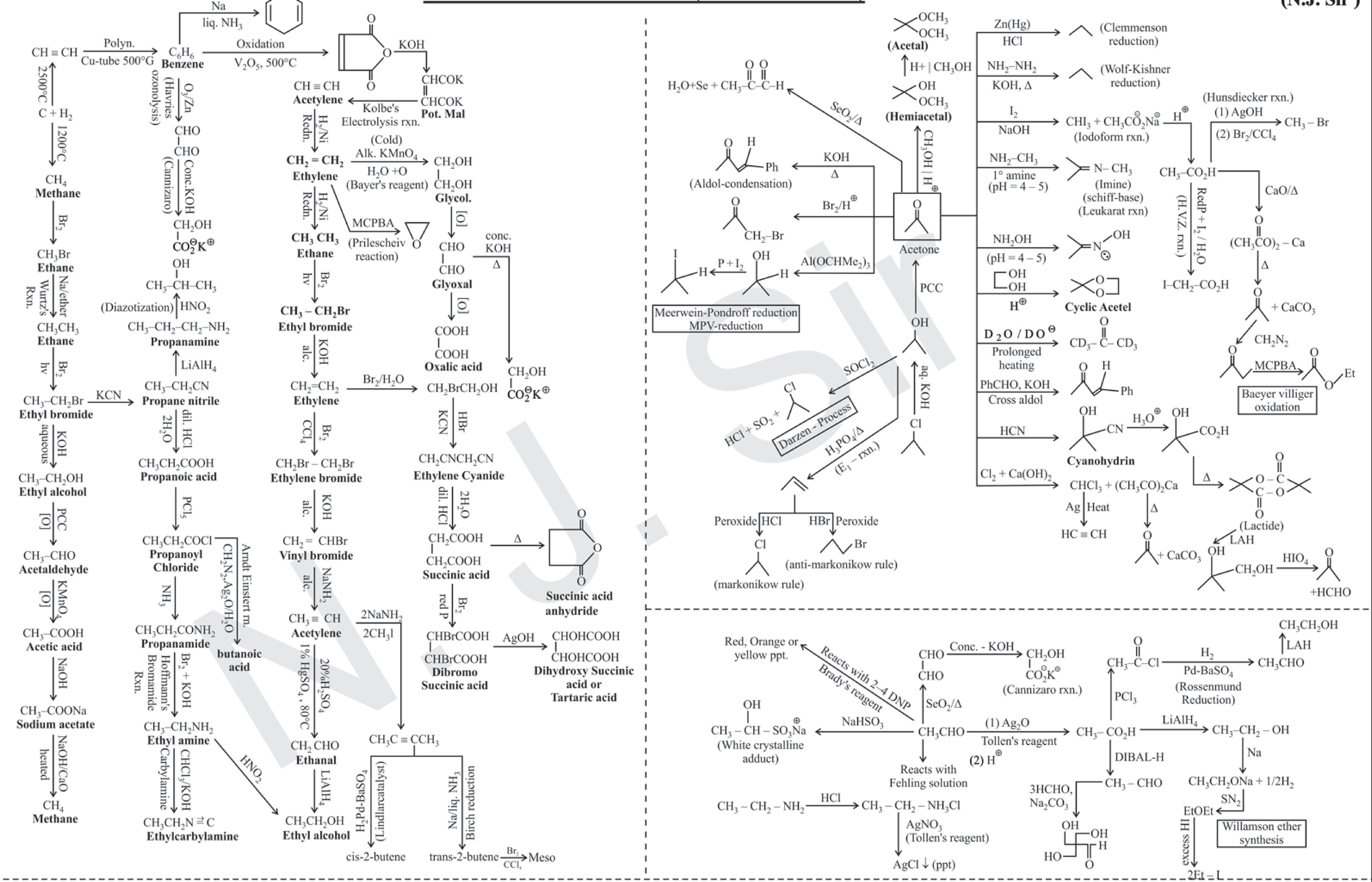
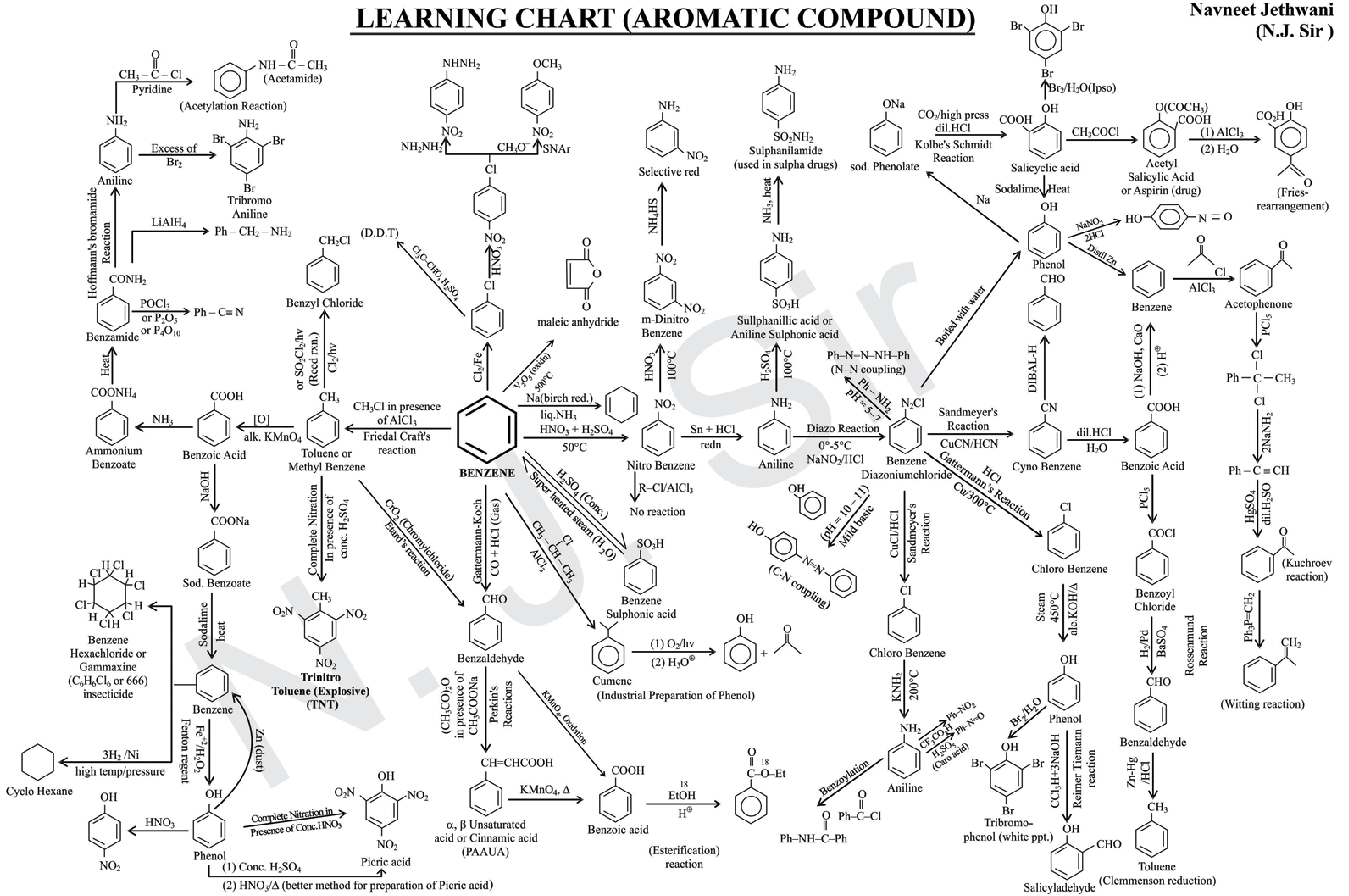


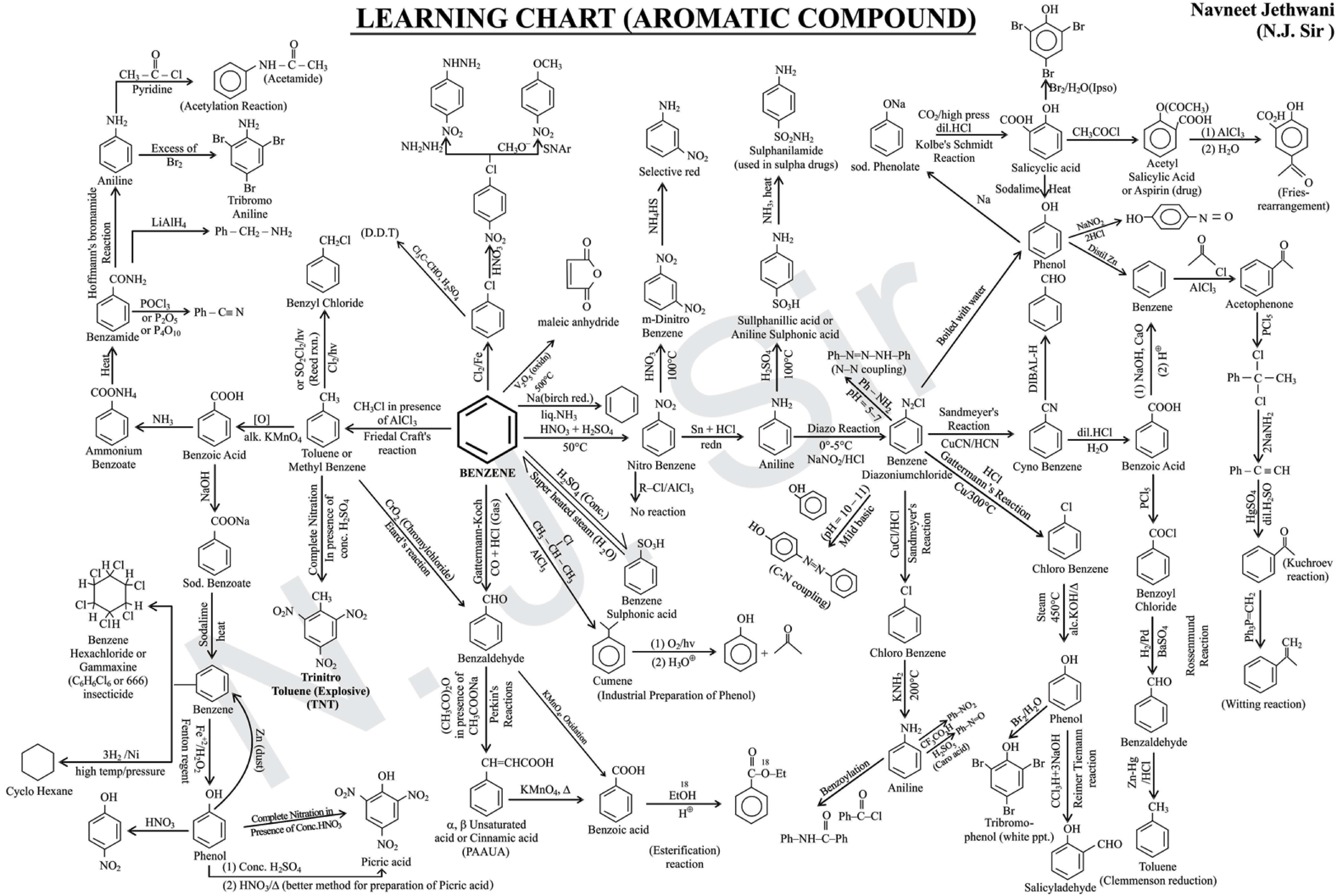
LEARNING CHART (AROMATIC COMPOUND)

Navneet Jethwani
(N.J. Sir)



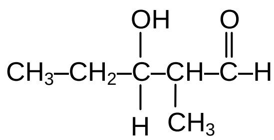
LEARNING CHART (AROMATIC COMPOUND)

Navneet Jethwani
(N.J. Sir)

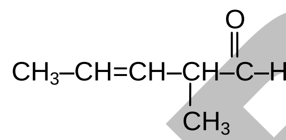


DAILY PROBLEM PRACTICE SHEET

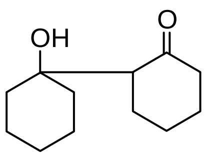
Q.1 Name reactions

(I) 

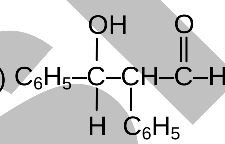
(A)



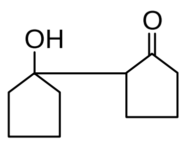
(B)

(II) 

(C)

(III) 

(D)

(IV) 

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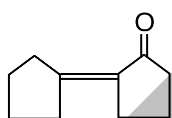
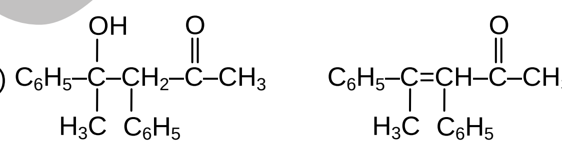
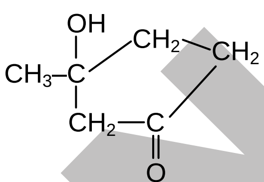


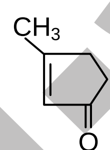
(F)

(V) 

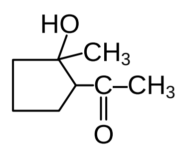
(G)

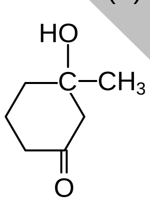
Q.2 (I) 

(A)

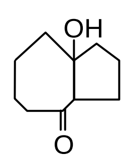


(B)

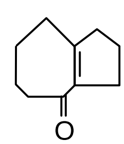
(II) 

(III) 

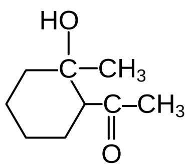
(D)

(IV) 

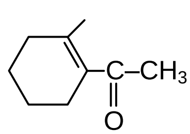
(E)



(F)

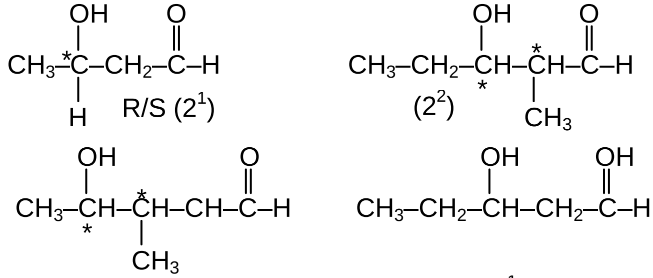
(V) 

(G)



(H)

Q.3 (I)

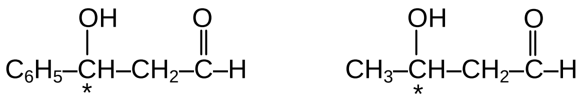


R/S (2^1) (2^2)

2^2 2^1

= 12

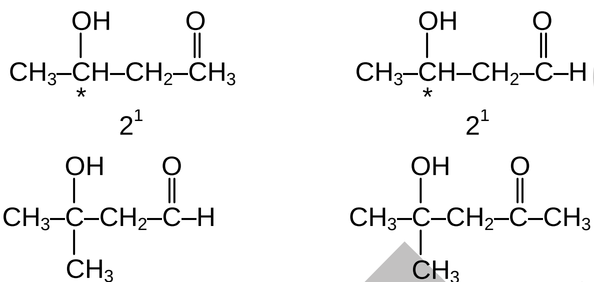
(II)



2^1 2^1

= 4

(III)

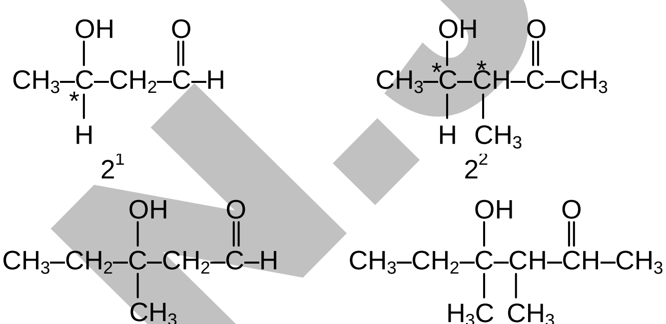


2^1 2^1

2^0 2^0

= 10

(IV)

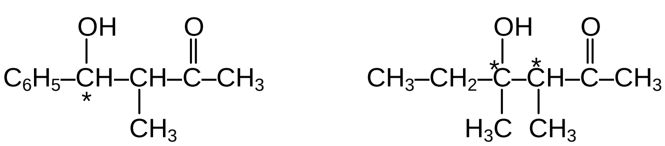


2^1 2^2

2^1 2^1

= 10

(V)



2^1 2^2

= 6

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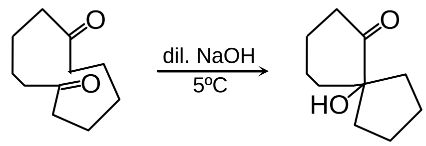
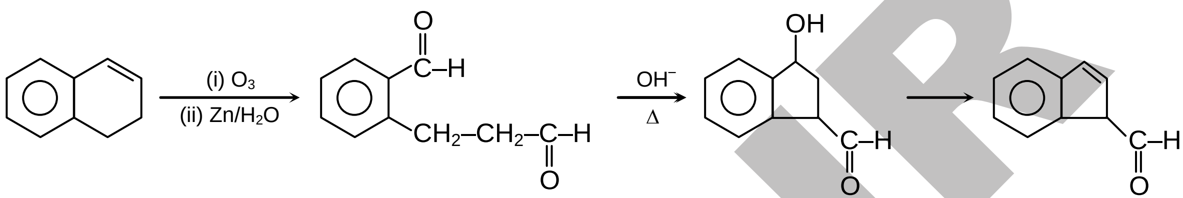
Q.4 (I)



(A) (B)

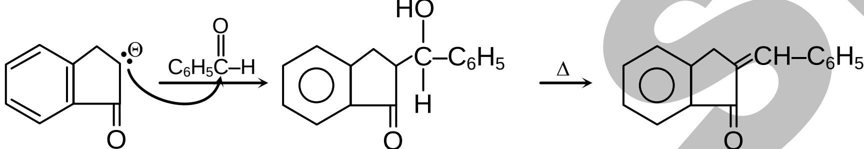
(II) $$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[5^{o}C]{\text{dil. NaOH}} CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\underset{CH_3}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-CH_3$$

Q.5 (a)

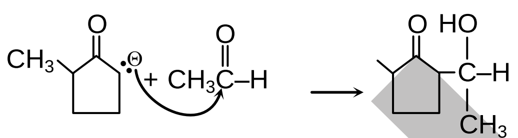


(A) (B)

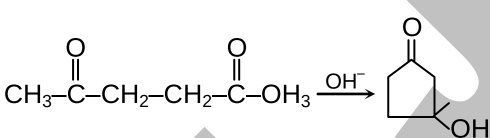
(b)



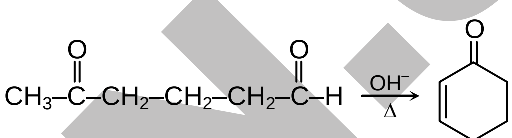
(c)



(d)

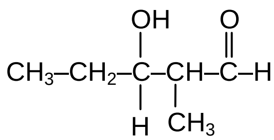


(e)

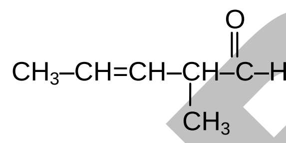


DAILY PROBLEM PRACTICE SHEET

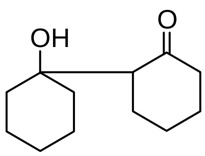
Q.1 Name reactions

(I) 

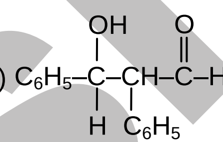
(A)



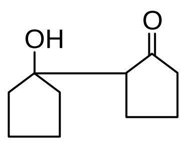
(B)

(II) 

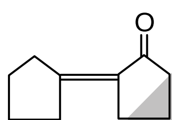
(C)

(III) 

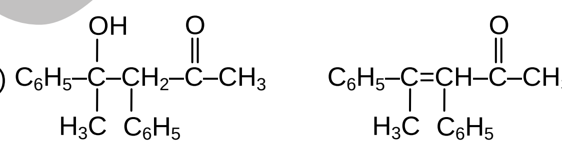
(D)

(IV) 

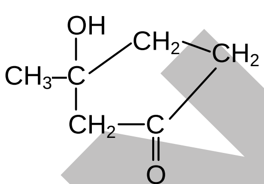
(E)



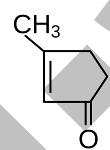
(F)

(V) 

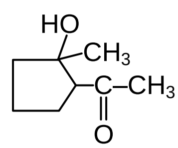
(G)

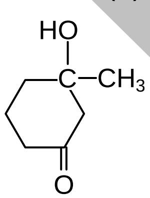
Q.2 (I) 

(A)

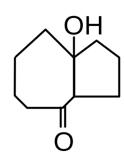


(B)

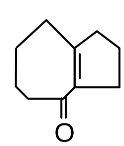
(II) 

(III) 

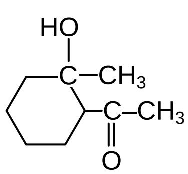
(D)

(IV) 

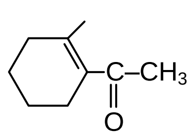
(E)



(F)

(V) 

(G)



(H)

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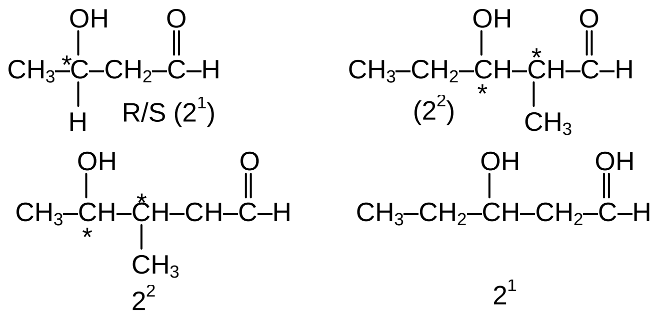
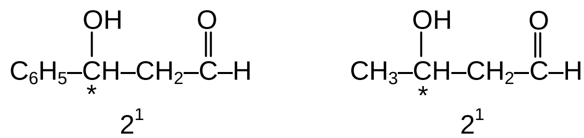
Q.3 (I)



= 12

(II)



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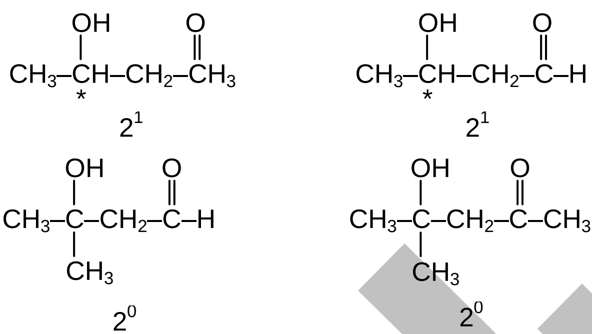
(III)



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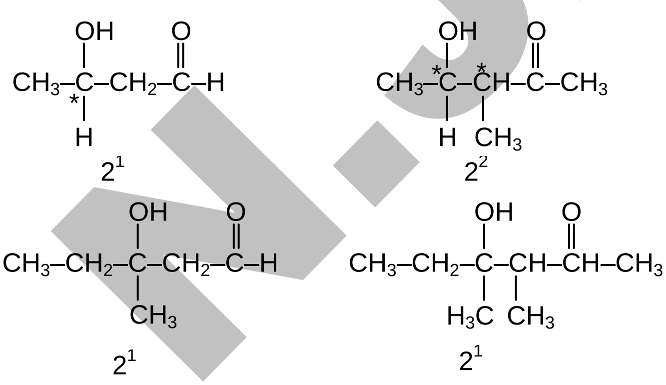
(IV)



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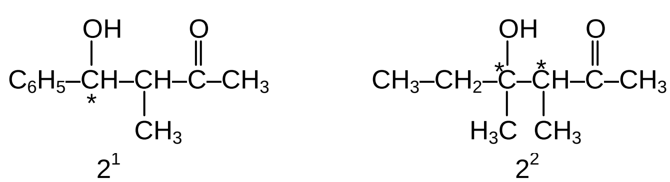
(V)



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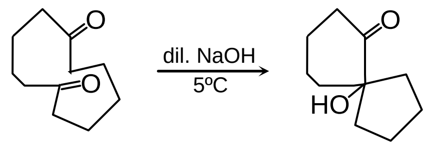
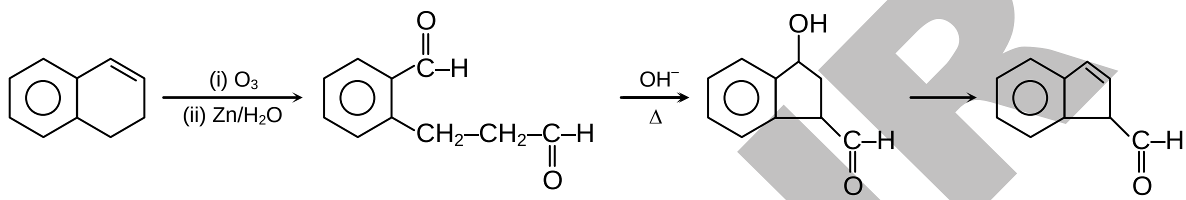
Q.4 (I)



(A) (B)

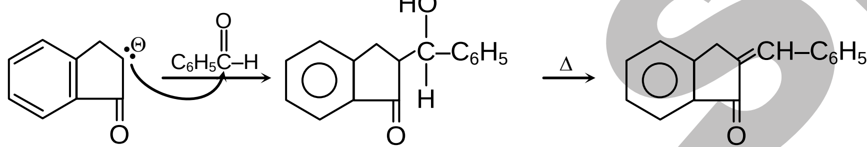
(II) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[5^{\circ}C]{\text{dil. NaOH}} CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\underset{CH_3}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-CH_3$

Q.5 (a)

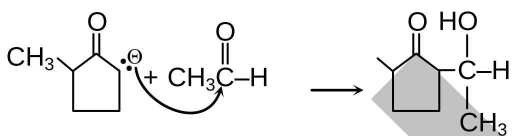


(A) (B)

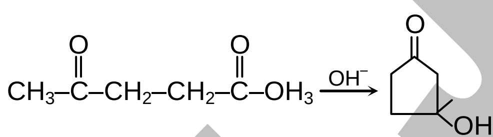
(b)



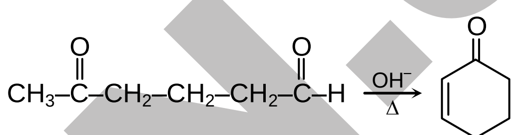
(c)



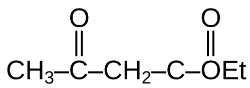
(d)



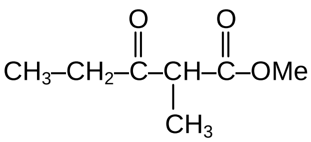
(e)



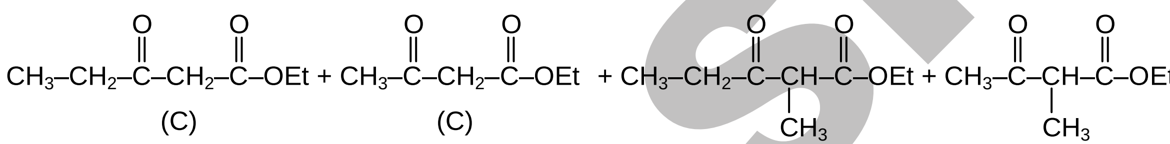
DAILY PROBLEM PRACTICE SHEET

Q.1 

(A)

Q.2 

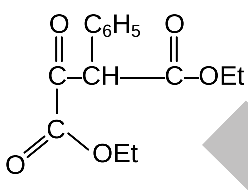
(B)

Q.3 

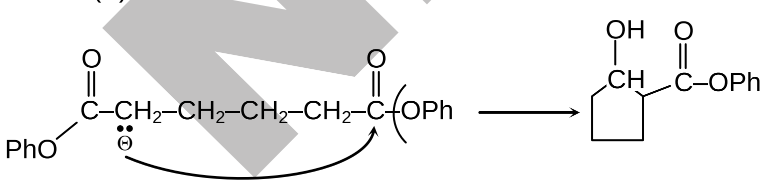
(C) (C) (C) (C)

Q.4 

(D) (D)

Q.5 

(E)

Q.6 

(F)

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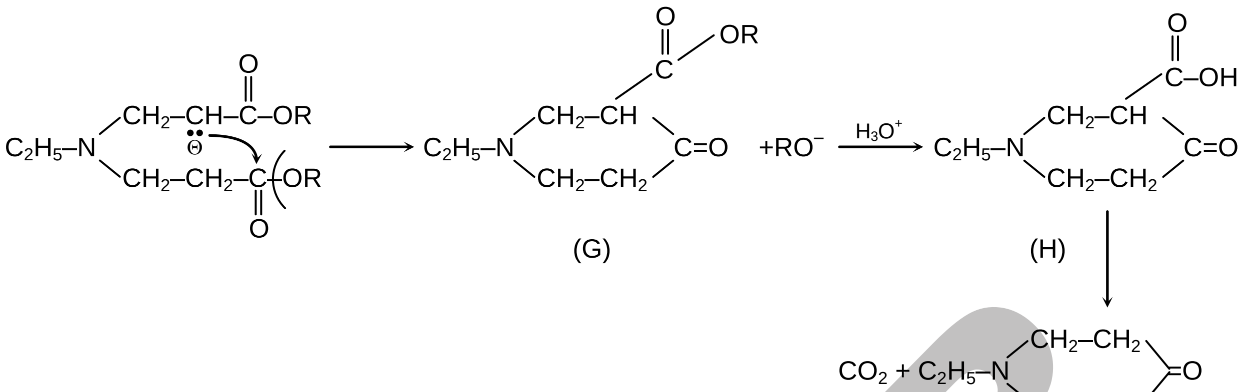
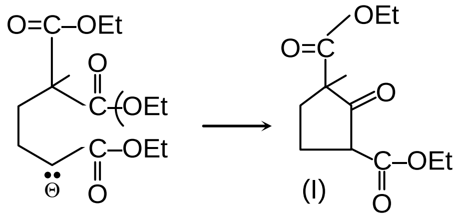
Q.7



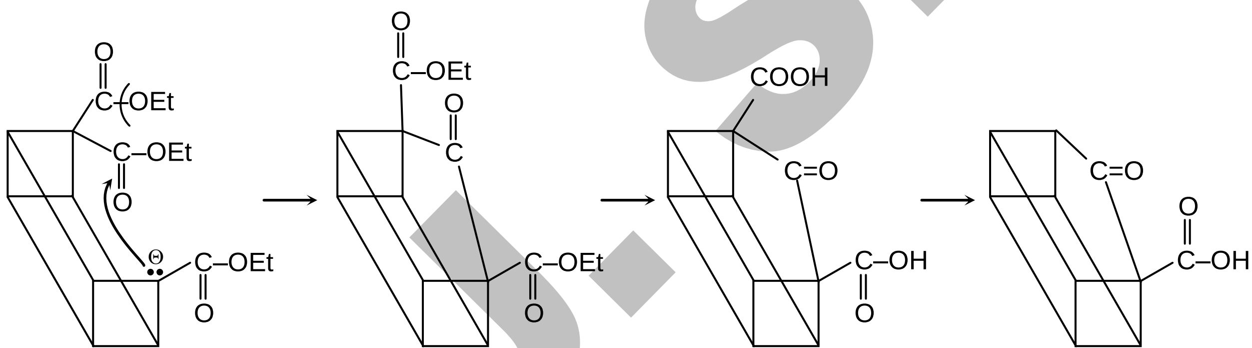
(G) (H)

Q.8



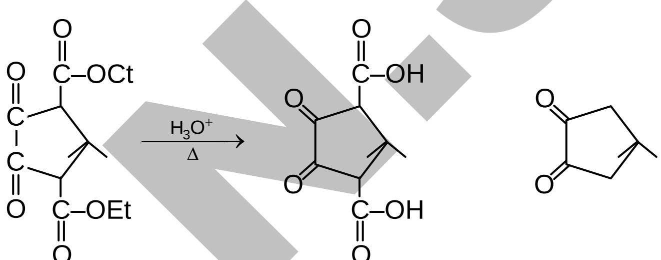
(I)

Q.9



(J) (K)

Q.10



(L) (L) (M)

DAILY PROBLEM PRACTICE SHEET

Q.1 $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-OEt$

(A)

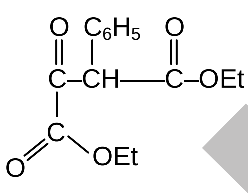
Q.2 $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\underset{CH_3}{\underset{|}{CH}}-\overset{O}{\overset{\|}{C}}-OMe$

(B)

Q.3 $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-OEt$ (C) $+$ $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-OEt$ (C) $+$ $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\underset{CH_3}{\underset{|}{CH}}-\overset{O}{\overset{\|}{C}}-OEt$ (C) $+$ $CH_3-\overset{O}{\overset{\|}{C}}-\underset{CH_3}{\underset{|}{CH}}-\overset{O}{\overset{\|}{C}}-OEt$ (C)

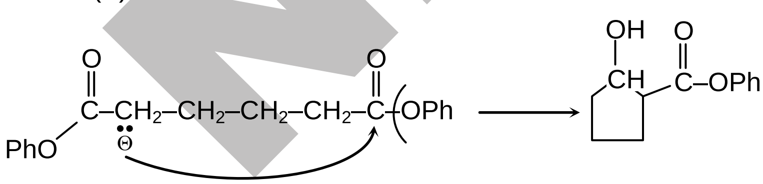
Q.4 $C_6H_5-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-OEt$ (D) $+$ $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-OEt$ (D)

Q.5



(E)

Q.6



(F)

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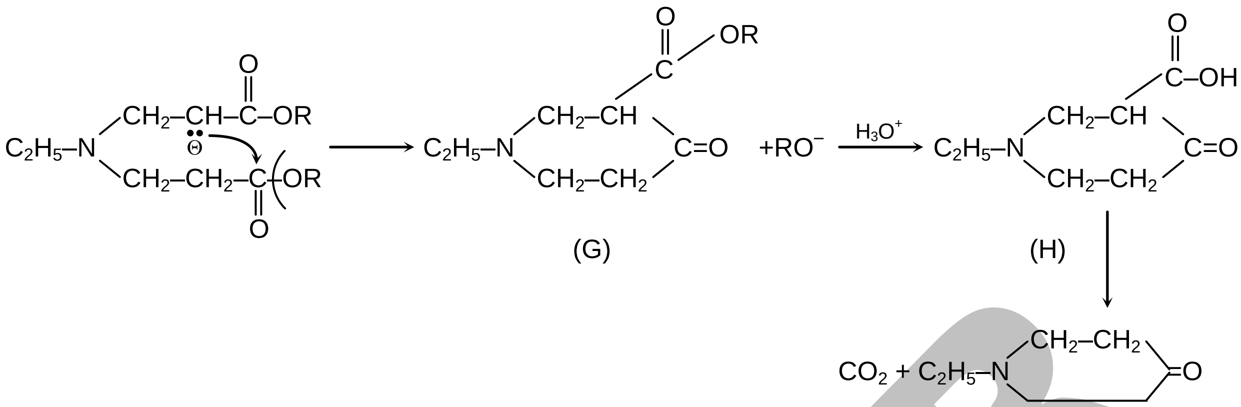
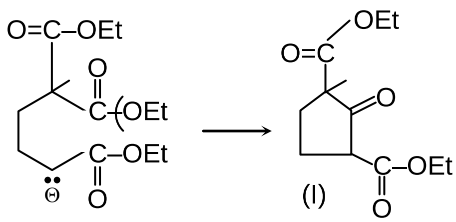
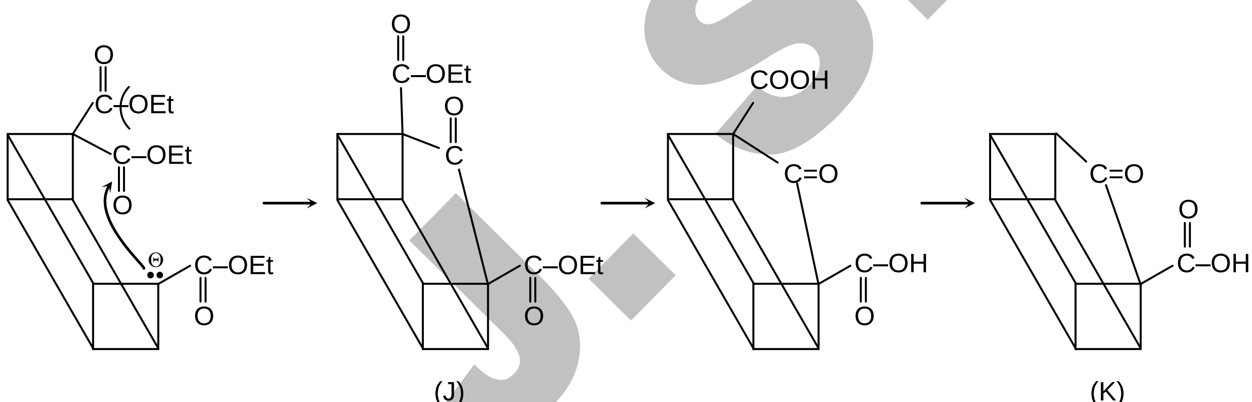
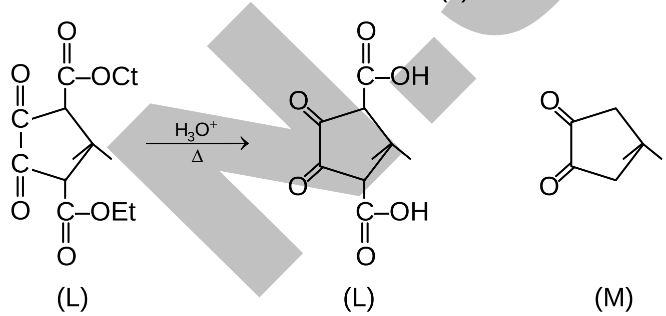
Q.7 

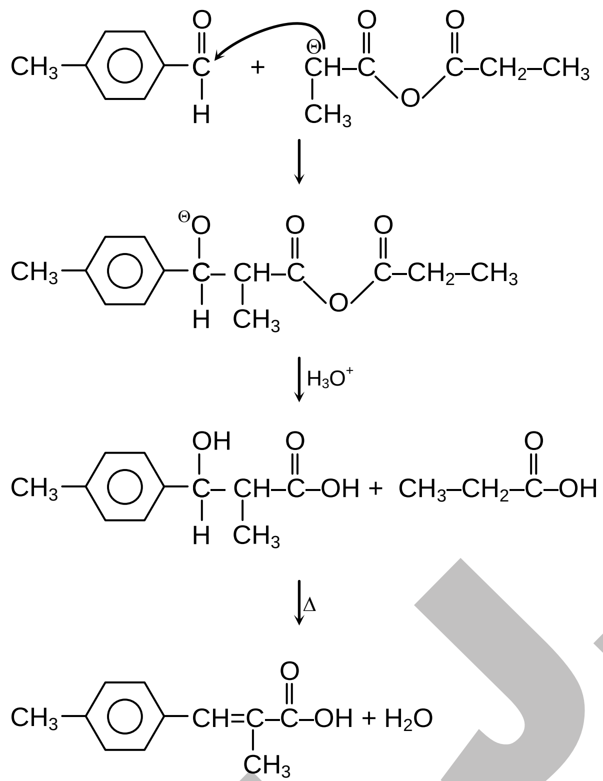
Q.8 

Q.9 

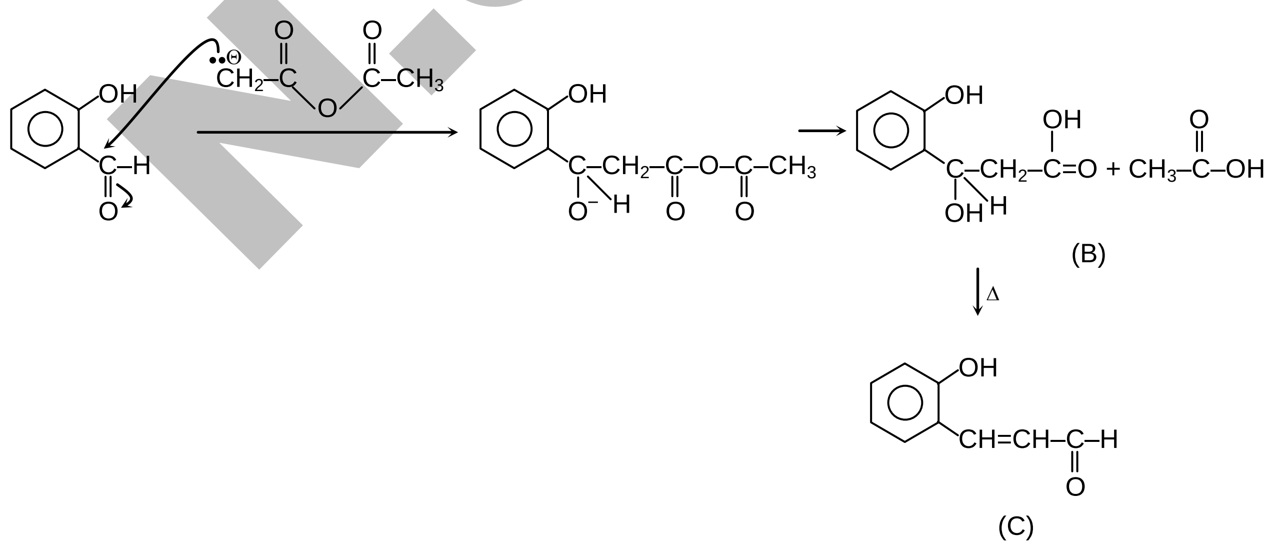
Q.10 

DAILY PROBLEM PRACTICE SHEET

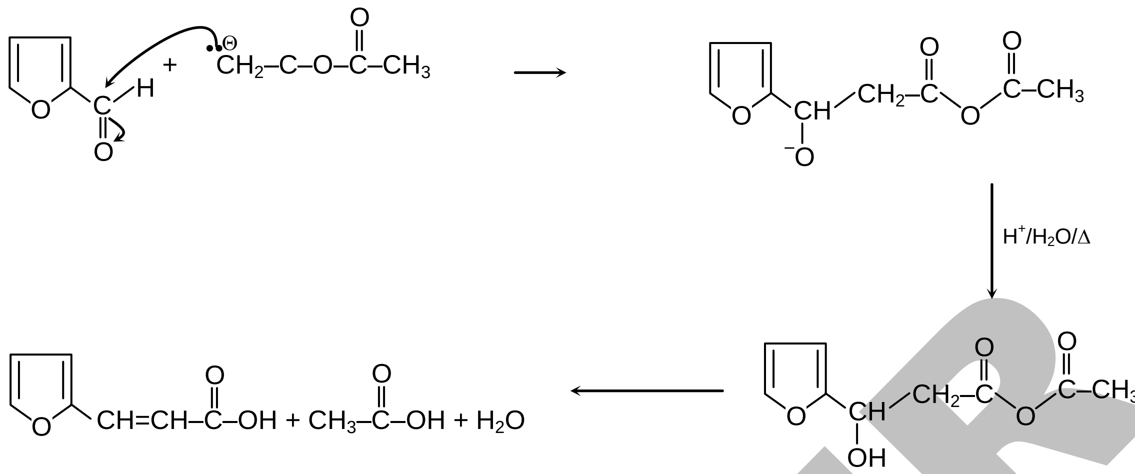
Q.1



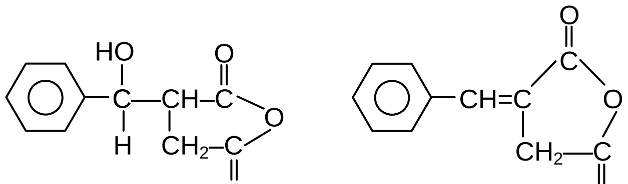
Q.2



Q.3

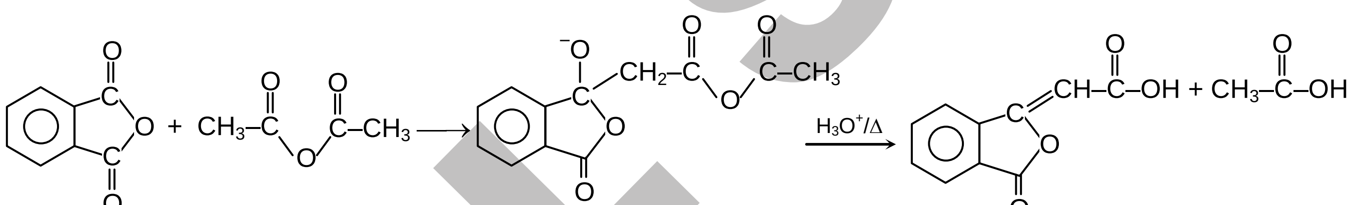


Q.4



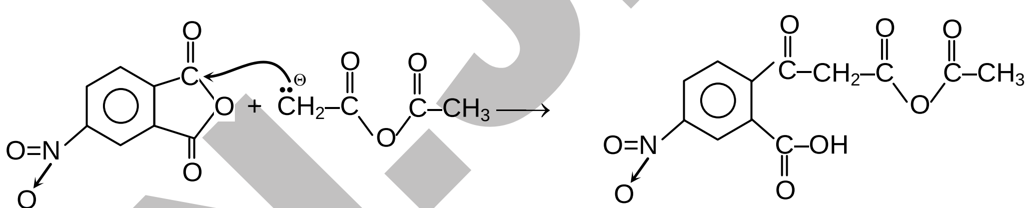
(E)

Q.5

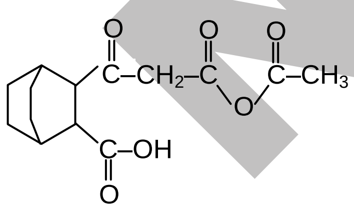


(F)

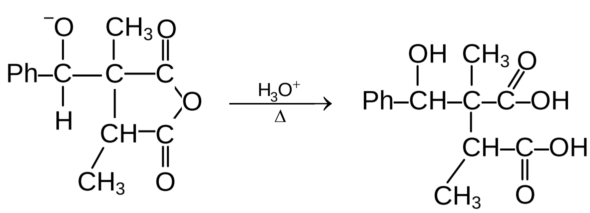
Q.6



Q.7



Q.8



DAILY PROBLEM PRACTICE SHEET

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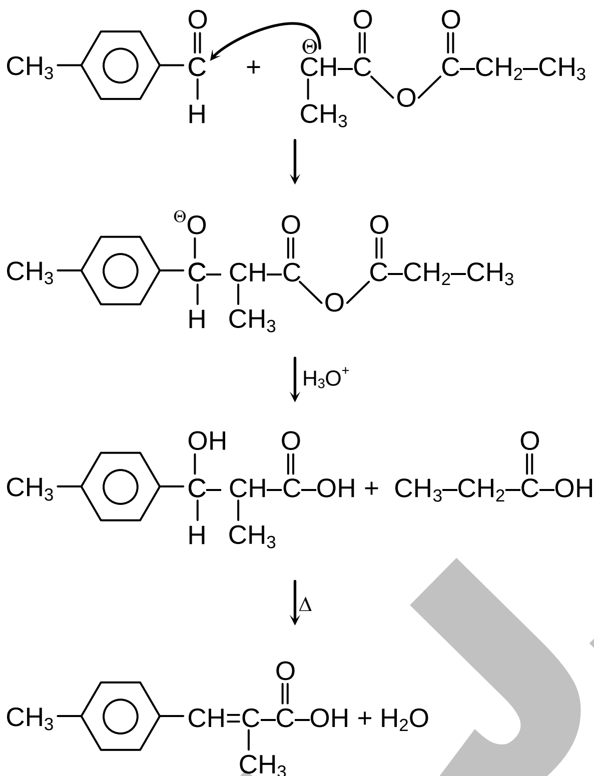

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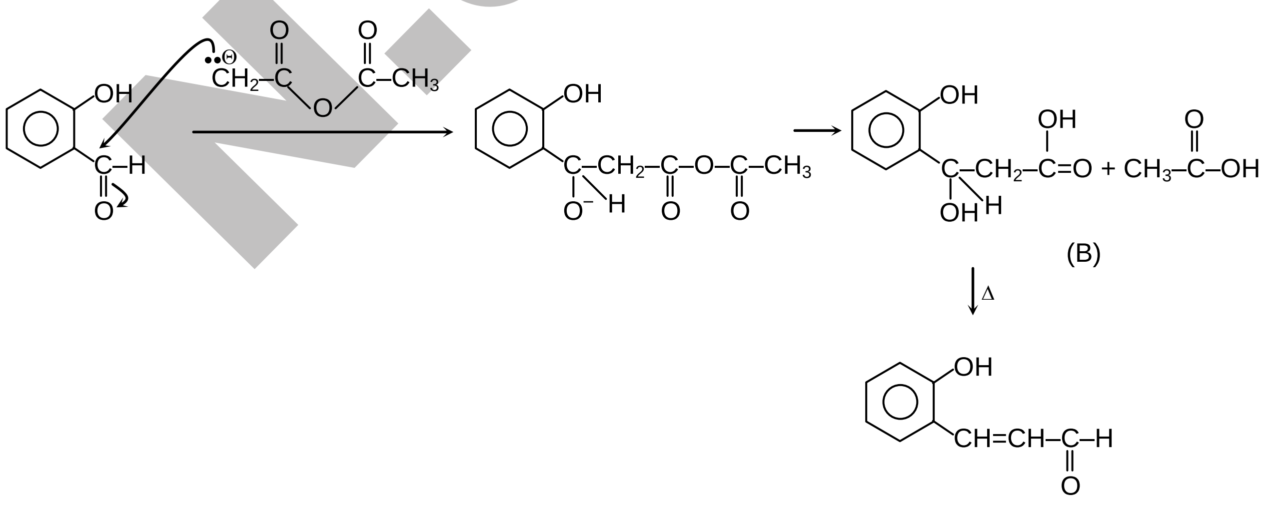

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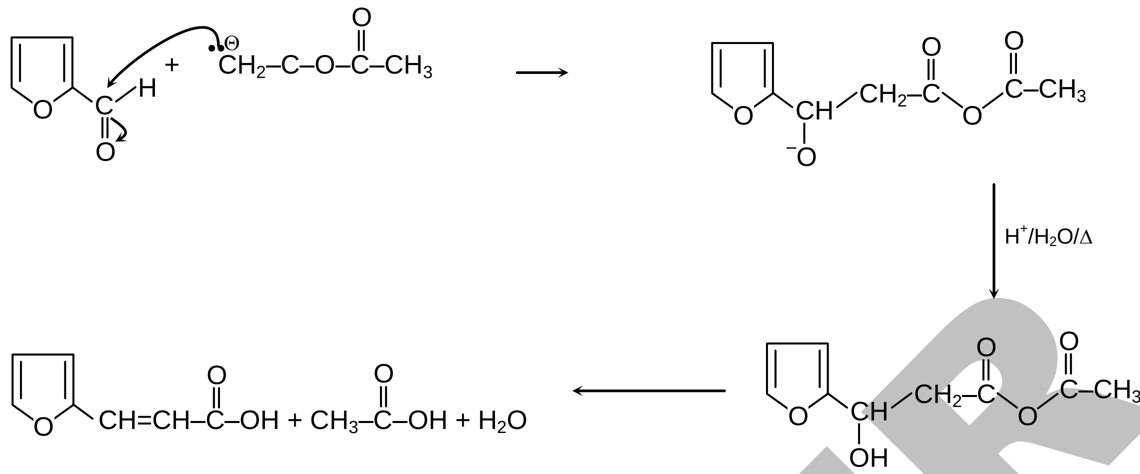

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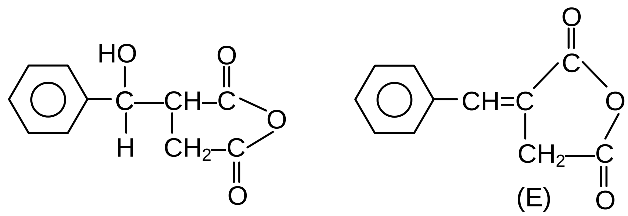

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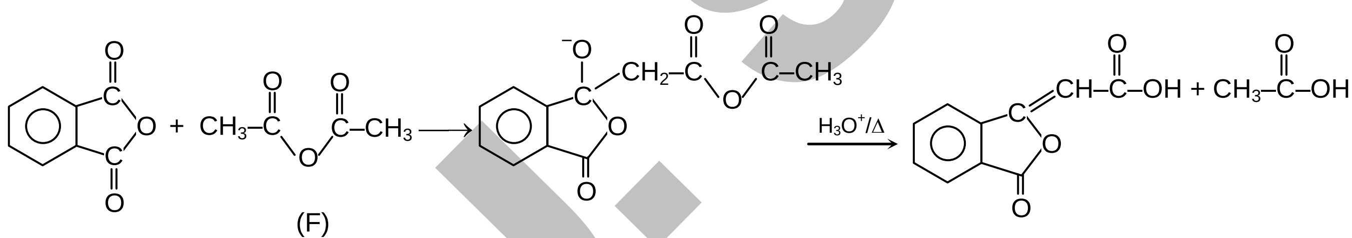

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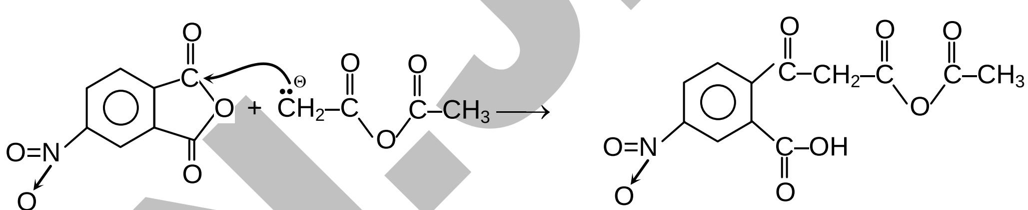

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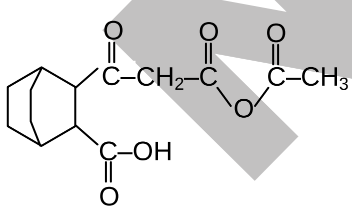

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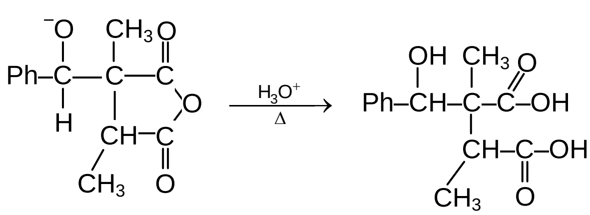

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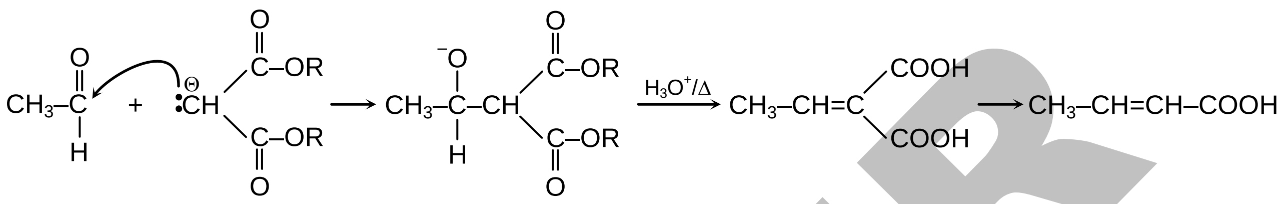

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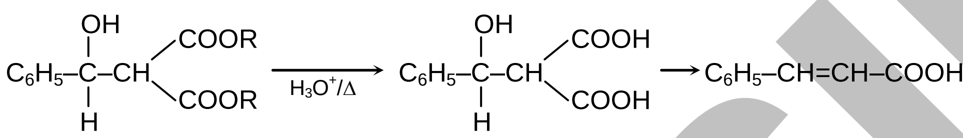

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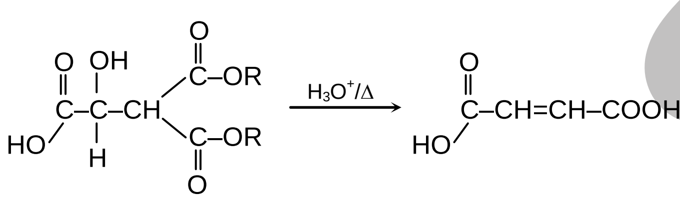

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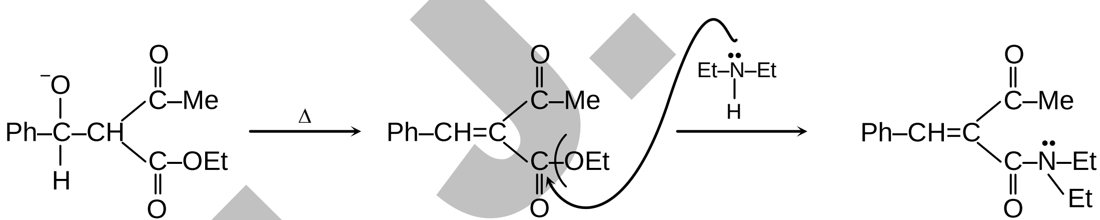

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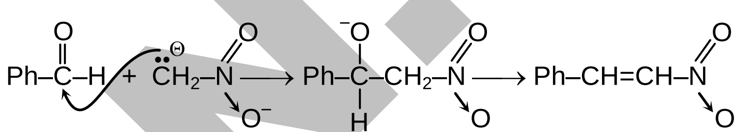

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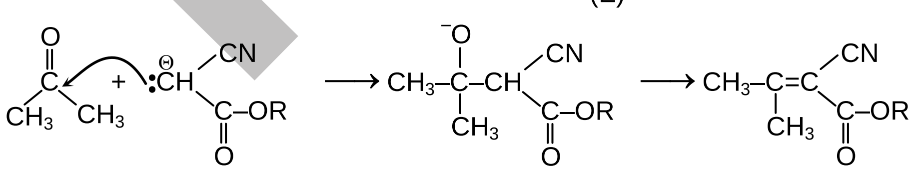

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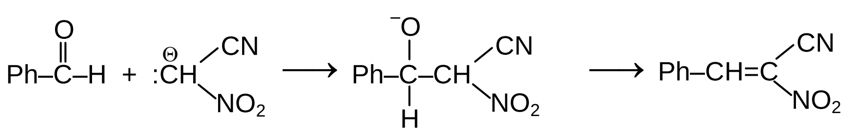

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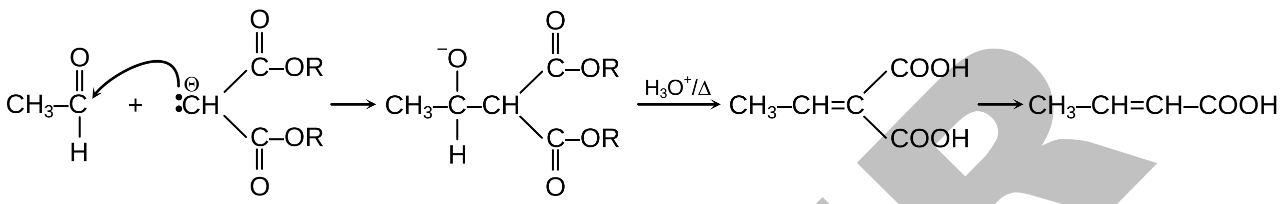

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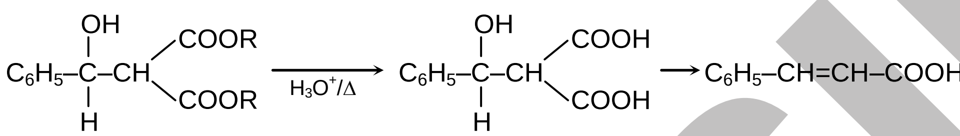

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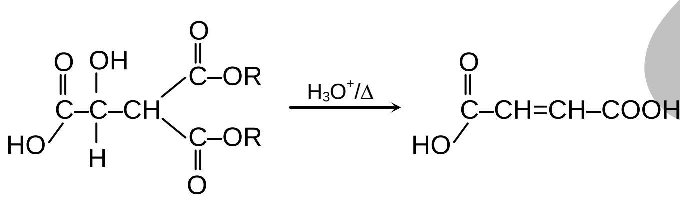

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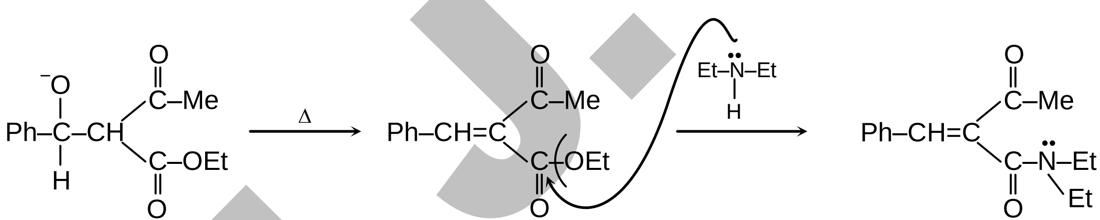

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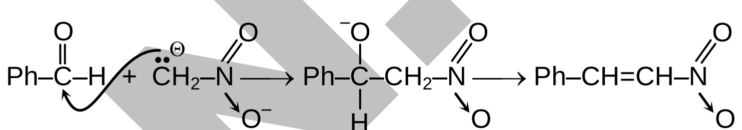

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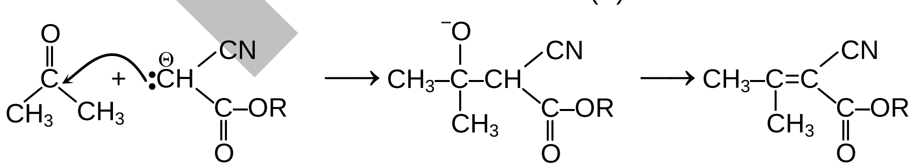

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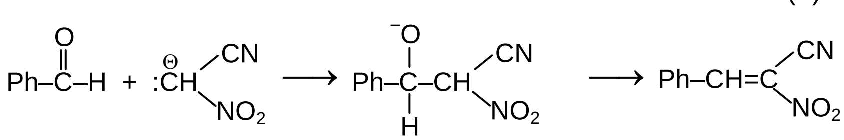

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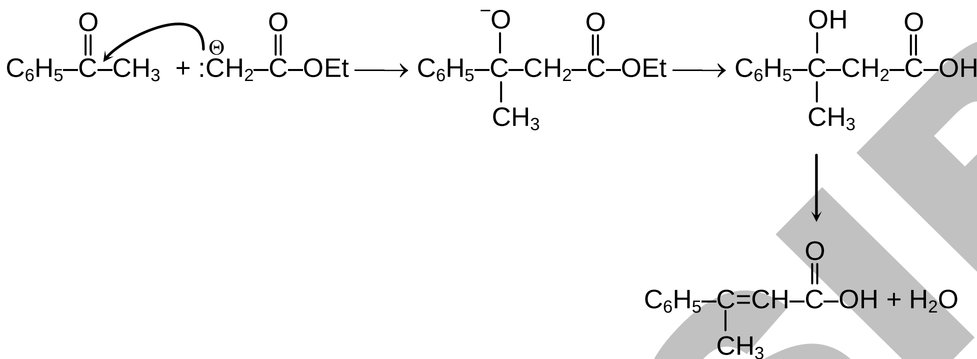

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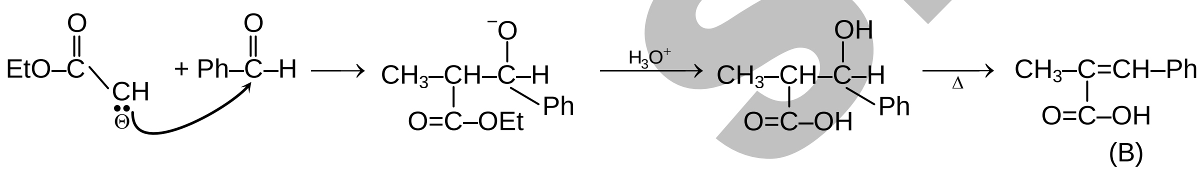

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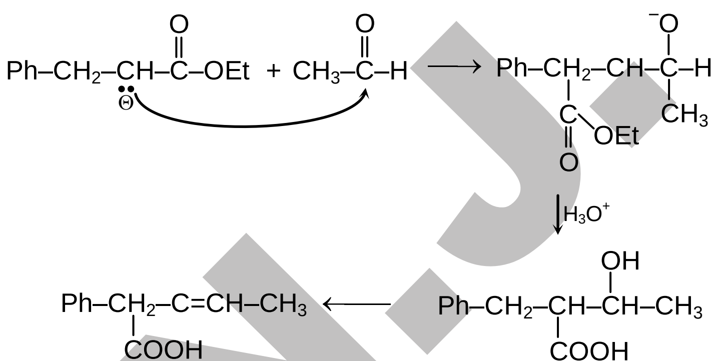

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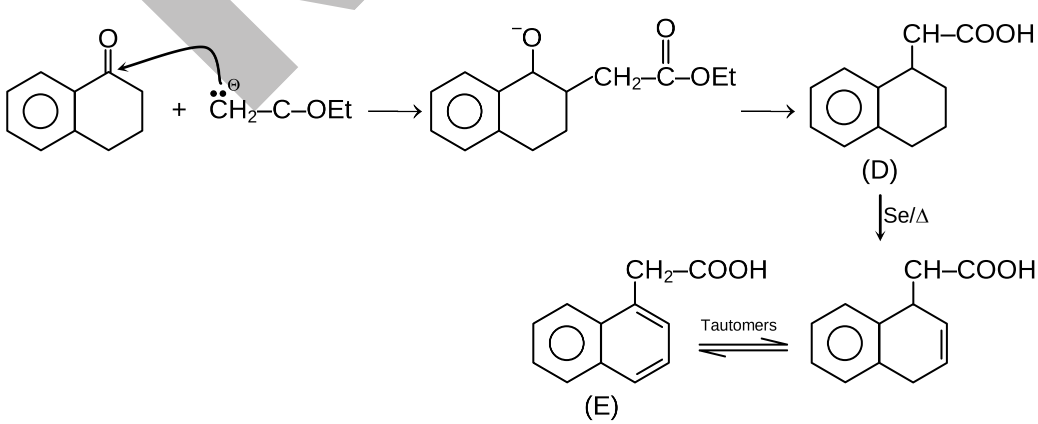

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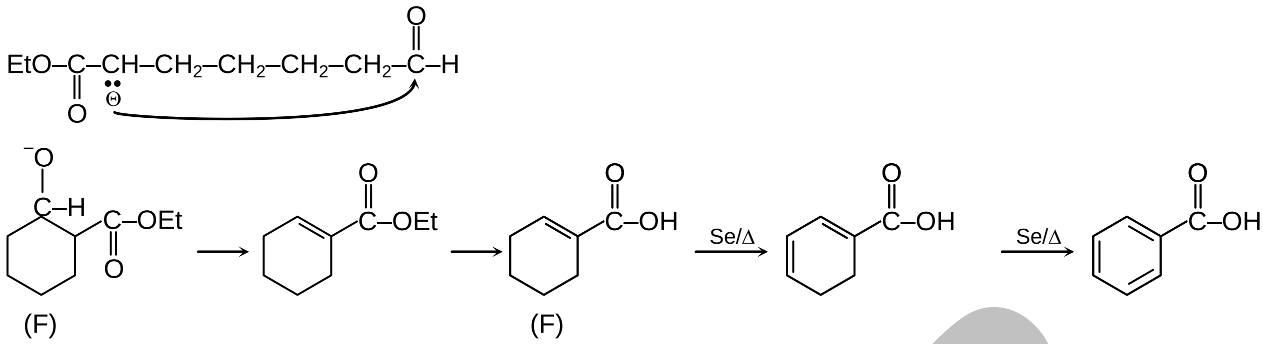

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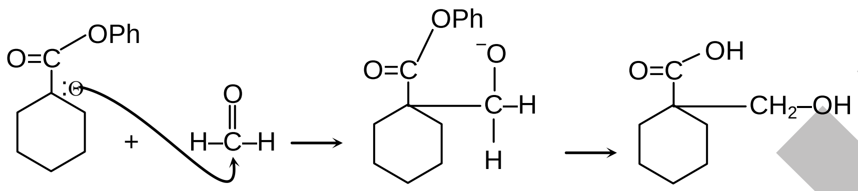

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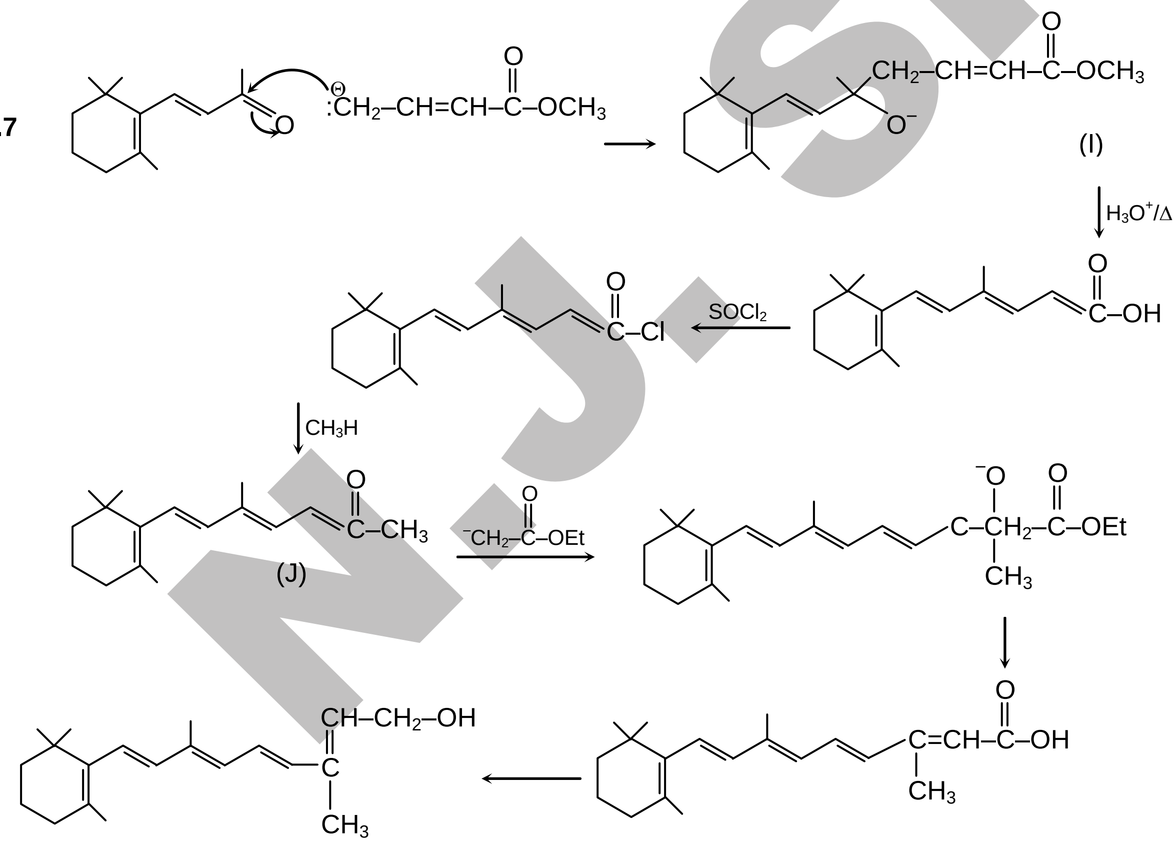

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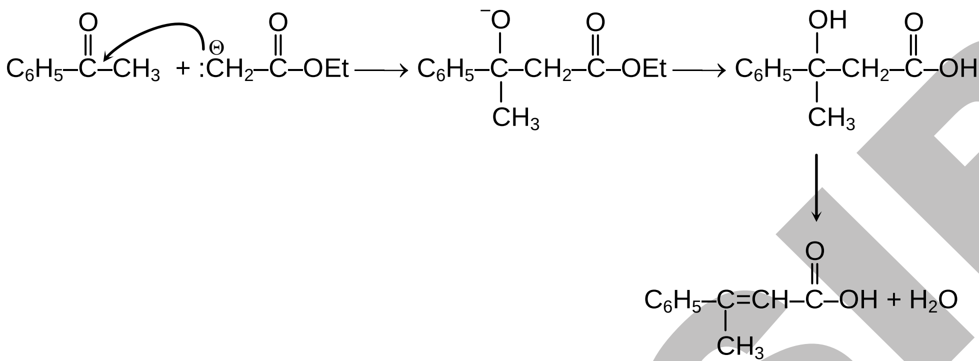

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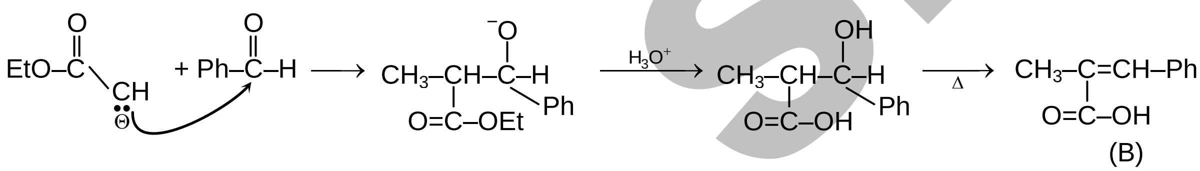

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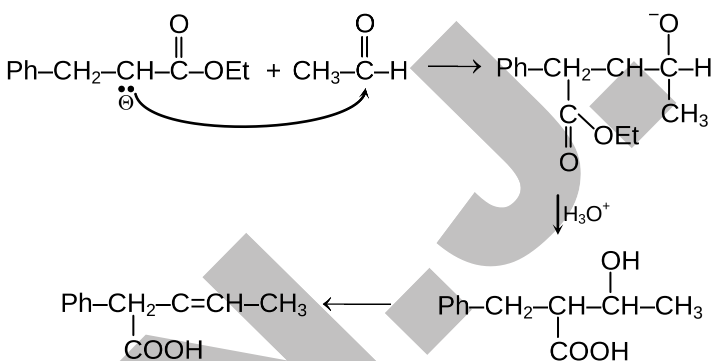

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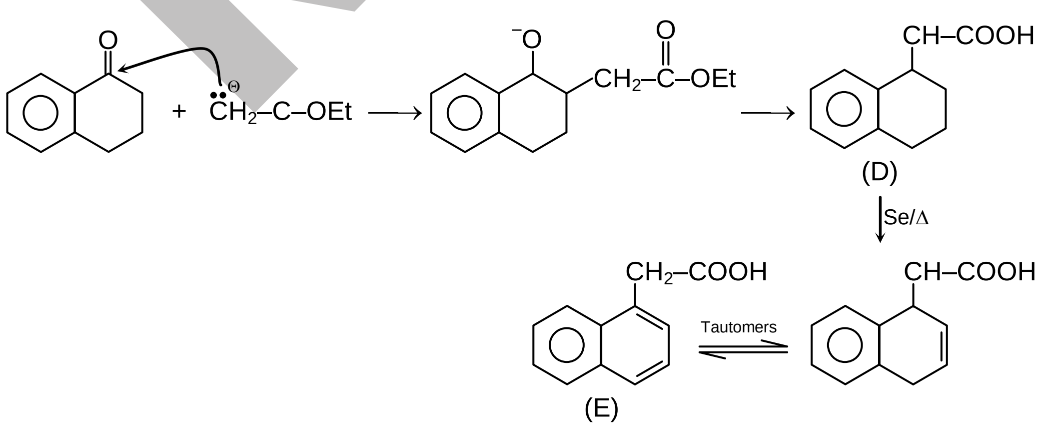

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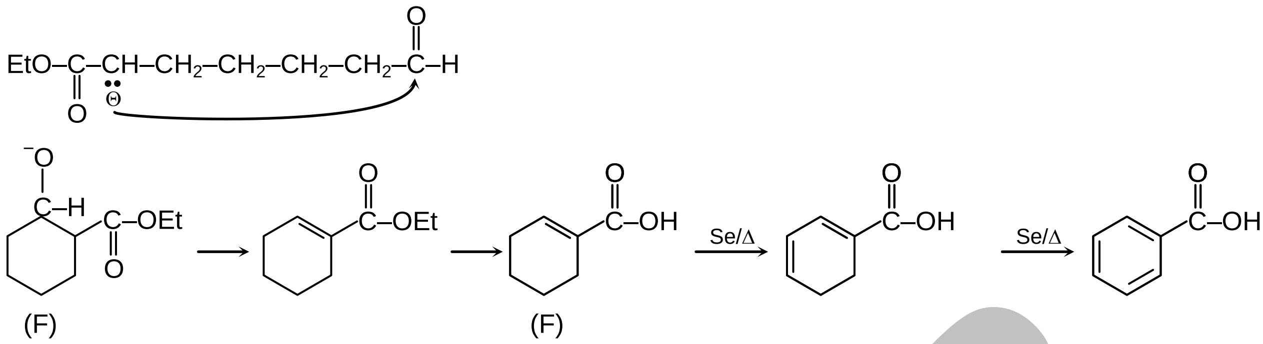

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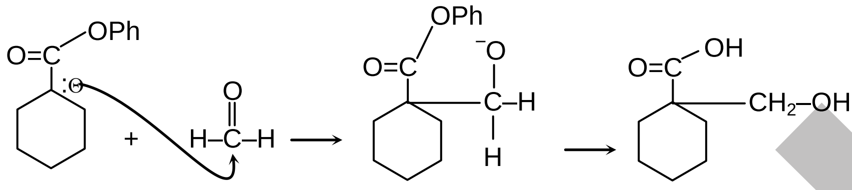

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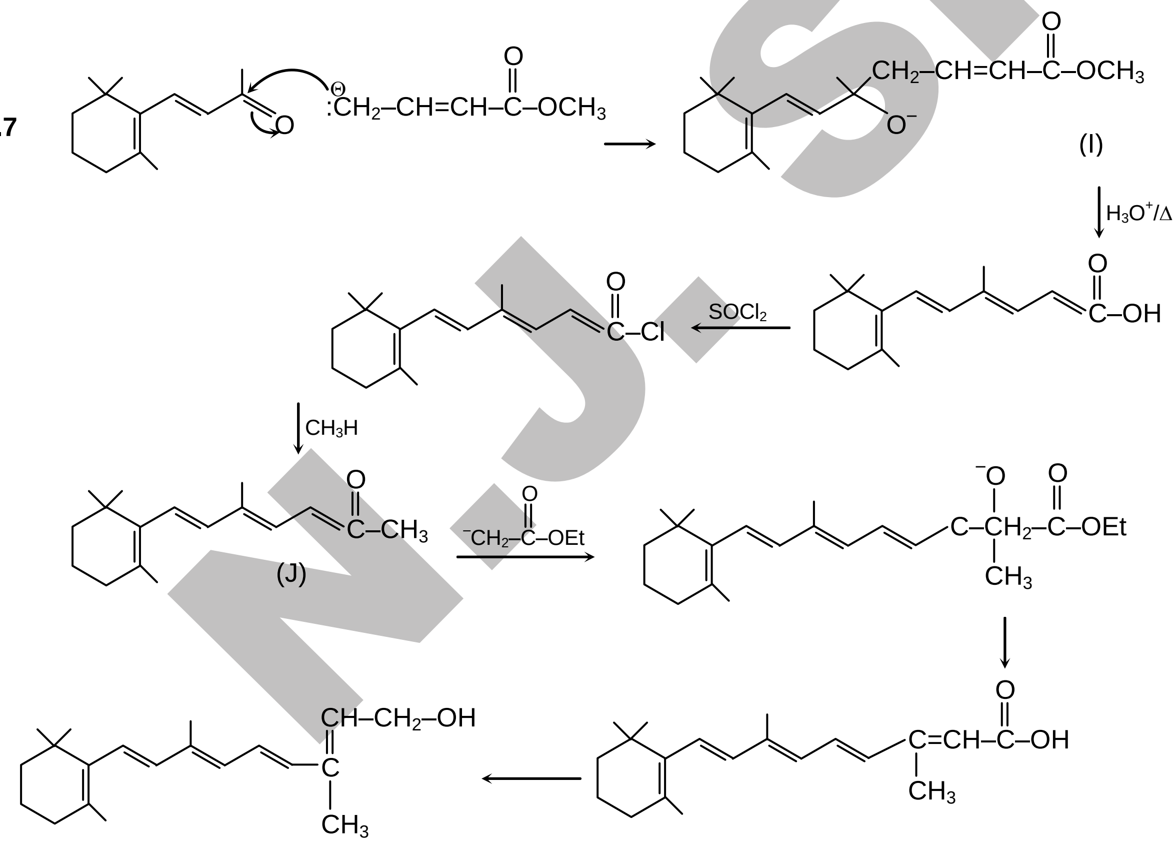


NOMENCLATURE

OF

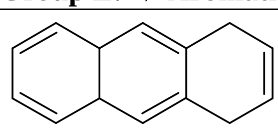
ORGANIC COMPOUNDS

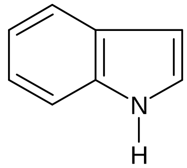
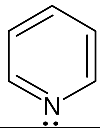
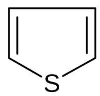
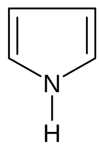
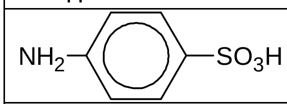
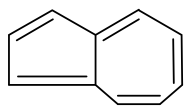
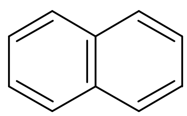
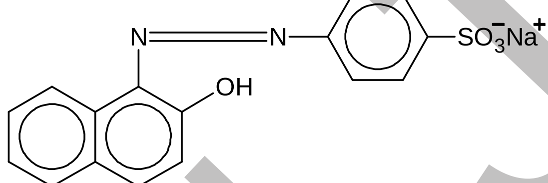
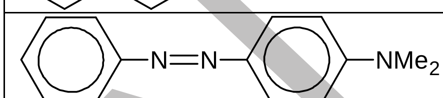
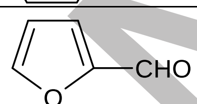
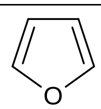
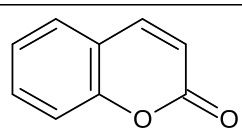
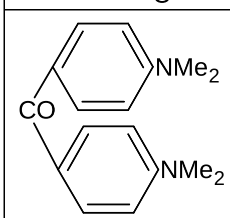
COMMON NAMES

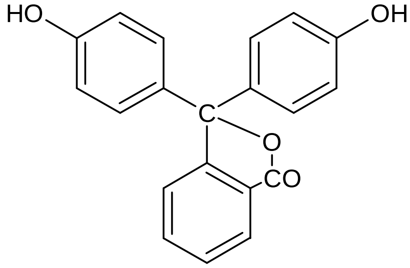
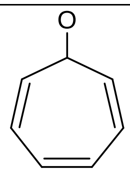
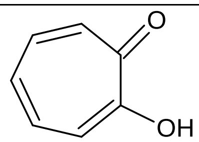
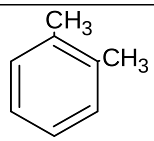
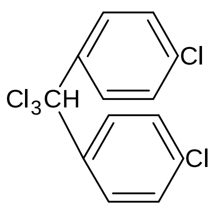
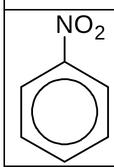
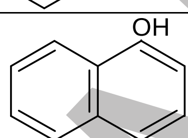
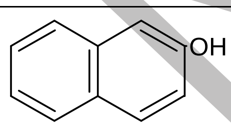
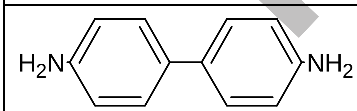
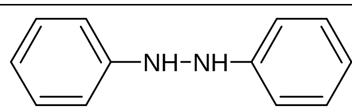
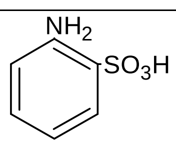
Compound	Common name
Group A : $\rightarrow$ Alkanes	
$CH_3-CH(CH_3)-CH-CH_3$	Isopentane
$CH_3-C(CH_3)_2-CH_2-CH(CH_3)-CH_3$	Iso Octane
$CH_3-C(CH_3)_2-CH_3$	Neo Pentane
$CH_3-C(CH_3)_2-CH(CH_3)-CH_3$	Tripentane
$CH_3-CH_2-CH(CH_3)-CH_2$	Active Amyl Group
Group B: $\rightarrow$ Alkenes	
$CH_3-CH_2-CH=CH_2$	α-Butylene
$CH_3-CH=CH-CH_3$	β-Butylene
$CH_3-C(CH_3)=CH_2$	Iso Butylene
$CH_2=C=CH_2$	Allene
$CH_2=C(CH_3)-CH=CH_2$	Isoprene
$CH\equiv CH$	Purified Acetylene or Norcelyne
$CH_2=CH-C\equiv CH$	Vinyl Acetylene
$CH_3-C\equiv CH$	Allylene
Group D: $\rightarrow$ Alkylhalide	
CH_3CHCl_2	Ethylidene Chloride (A Jem dihalide)
$CH_2(Cl)-CH_2(Cl)$	Ethylene Dichloride (A Vinyl dihalide)
$ClCH_2-CH_2-S-CH_2-CH_2Cl$	Mustard Gas (Poisionous; used in war)
CH_2Cl-CH_2Cl	Westron (Solvent)
$ClCH=CCl_2$	Westrosol or Triclean (Solvent)
$Cl_2C=CCl_2$	Tetraclean or Perclean
$Cl-C(Cl)(Cl)-NO_2$	Chloropicrin (tear gas)

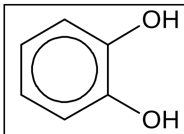
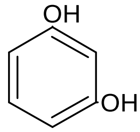
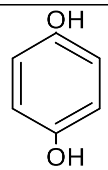
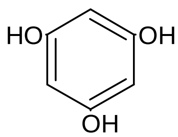
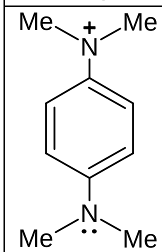
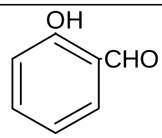
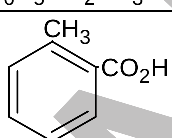
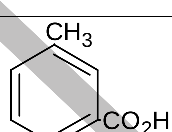
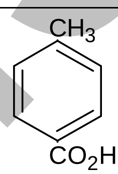
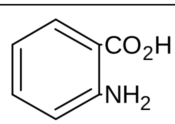
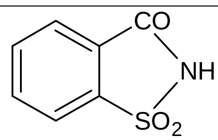
$CH_3-\overset{\overset{CCl_3}{\vert}}{\underset{\underset{OH}{\vert}}{C}}-CH_3$	Chloretone
$CH_2=\overset{\overset{Cl}{\vert}}{C}-CH=CH_2$	Chloroprene
$\begin{array}{l} H-C-Cl \\ \quad\;\; \Vert \\ H-C-AsCl_2 \end{array}$	Lewisite
Group E:$\rightarrow$ Alcohol	
$\begin{array}{l} CH_2-OH \\ \vert \\ CH_2-OH \end{array}$	Glycol or Ethylene
$\underset{OH}{\underset{\vert}{CH_2}}-\underset{OH}{\underset{\vert}{CH}}-\underset{OH}{\underset{\vert}{CH_2}}$	Glycerol
$CH\equiv C-CH_2-OH$	Propargyl Alcohol
$CH_2=CH-CH_2-OH$	Allyl Alcohol
$CH_2=CH-OH$	Vinyl Alcohol
$\begin{array}{l} \qquad\;\; CH_3 \\ \qquad\quad \vert \\ CH_3-C-OH \\ \qquad\quad \vert \\ CH_3-C-OH \\ \qquad\quad \vert \\ \qquad\;\; CH_3 \end{array}$	Pinacol
Group F:$\rightarrow$ Ether	
$C_6H_5-O-CH_3$	Anesol (Methyl Phenyl Ether)
$C_6H_5-O-C_2H_5$	Phenetol (Ethyl Phenyl Ether)
$CH_3CH(OCH_3)_2$	Methylal
$\begin{array}{lcl} H & & OCH_3 \\ & C & \\ CH_3 & & OCH_3 \end{array}$ or $CH_3CH(OCH_3)_2$	Methylal
Group G:$\rightarrow$ Aldehyde	
$\begin{array}{l} CHO \\ \vert \\ COOH \end{array}$	Glyoxalic acid
$CH_3-\overset{\overset{CH_3}{\vert}}{\underset{\underset{CH_3}{\vert}}{C}}-CHO$ or $(CH_3)_3C-CHO$	Pavaldehyde
$CH_3CH=CH-CHO$	Crotonaldehyde
$CH_2=CH-CHO$	Acraldehyde or Acrolein
$(CH_3)_2CHCHO$	Isobutyraldehyde
$CH_3-\underset{O}{\underset{\Vert}{C}}-\underset{O}{\underset{\Vert}{C}}-CH_3$	Dimethyl Glyoxal

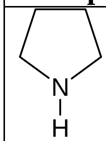
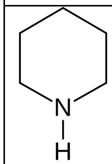
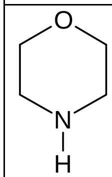
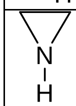
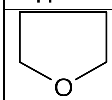
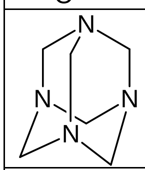
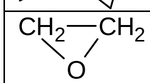
$H_2C(OH)-CH(OH)-CHO$	Glyceraldehyde
$O=C(H)-C(H)=O$	Glyoxal
$CH_3-C(=O)-C(=O)-H$	Methyl Glyoxal or Pyruvic Aldehyde
Group H: $\rightarrow$ **Ketone**	
CH_3COCH_3	Acetone
$(CH_3)_2C=CH-C(=O)-CH=C(CH_3)_2$	Phorone
$(CH_3)_2C=CH-C(=O)-CH_3$	Mesityl Oxide
$H_2C=C=O$	Ketene
Group I: $\rightarrow$ **Carboxylicacid**	
$CH_3-CH_2-CH_2-CH_2-COOH$	Valeric Acide (n-Pentanoic acid)
$CH_3(CH_2)_4COOH$	Caproic Acid (n-Hexanoic acid)
CH_2-COOH $CH(OH)-COOH$	Malic Acid
$CH_2(COOH)-C(OH)(COOH)-CH_2(COOH)$	Citric Acid (In lemon)
$CH_2=CH-COOH$	Acralic Acid
$CH_3-C(H)(OH)-COOH$	Lactic Acid (In milk)
$HO-C(=O)-OH(H_2CO_3)$	Carbonic Acid
$CH_3-CO-COOH$	Pyruvic Acid
$CH_3-CH=CH-COOH$	Crotonic Acid
$C_6H_5-CH(OH)-COOH$	Mendalic Acid
NH_2-CH_2-COOH	Glycine (Amino Acetic Acid)
NH_2COOH	Carbamic Acid (Amino formic Acid)
$COOH-(CH_2)_4-COOH$	Adipic Acid
$C_6H_5CH=CHCOOH$	Cinnamic Acid

$NH_2-CH(CH_3)-COOH$	Alanine
$HO-CH_2-COOH$	Glycolic Acid
$COOH-COOH$	Oxalic acid
$CH_2(COOH)_2$	Malonic acid
CH_2-COOH / CH_2-COOH	Succinic acid
$HO-CH(COOH)-CH_2-COOH$	Malic acid
$HO-CH(COOH)-CH(COOH)-OH$	Tarteric acid
$H-C(COOH)=C(COOH)-H$ (cis)	Maleic acid
$H-C(COOH)=C(H)-COOH$ (trans)	Fumeric acid
Group J:$\rightarrow$ Acid Derivatives	
$Cl-CO-CO-Cl$	Oxalyl Chloride
NH_2COONH_4	Ammonium Carbamate
$CH_3-CO-CH_2-CO-O-C_2H_5$	Aceto Acetic Ester or Ethyl Aceto Acetate
$NH_2-CO-CO-NH_2$	Oxanamide
$Cl-CO-Cl$	Phosgene
$H_2N-CO-NH_2$	Urea
Group K: N–Derivatives	
$CH_2=CH-C\equiv N$	Vinyl Cyanide or Acrelio Nitrile
$H-C\equiv N$	Forma Nitrile
$CH_3-C\equiv N$	Aceto Nitrile
CH_3-NCO	MIC
Group L:$\rightarrow$ Aromatic Compounds	
	Anthracene

	Indol
	Pyridine
	Thiophene
	Pyrol
	Sulphanilic acid
	Azulene
	Napthelene
	Orange II
	Butter Yellow
	Furfurel
	Furan
	Conmarine
	Michler's Ketone

	Phenolphthalein
	Tropone (Cycloheptatrienone)
	Tropolone (Cycloheptatrienolone)
	o-xylene
	DDT (Dichlorodiphenyltrichloroethane)
	Nitrobenzene (oil of mirbane)
	α-naphthol
	β-naphthol
	Benzidine
	Hydrazobenzene
	Orthanilic Acid

	Catechol
	Resorcinol
	Quinol
	Phloroglucinol
	Wurster salts
	Salicylaldehyde (o-hydroxybenzaldehyde)
$C_6H_5CONH_2$	Benzamide
$(C_6H_5CO)_2O$	Benzoic Anhydride
$(C_6H_5CO)_2O_2$	Benzoyl Peroxide
$C_6H_5CO_2CH_3$	Perbenzoic acid
 o-toluic acid, m.p. 103^{o}C  m-toluic acid, m.p. 111^{o}C  p-toluic acid, m.p. 180^{o}C	Toluic acids
	Anthranilic acid (o-aminobenzoic acid)
	Saccharin (o-sulphobenzoic imide)
$C_6H_5CH{=}CH_2$	Styrene
C_6H_5CHO	Benzaldehyde
$C_6H_5COCOC_6H_5$	Benzil

$(C_6H_5)_2C(OH)CO_2H$	Benzilic acid
Group M: → Hetrocyclic Compounds	
	Pyrrolidine
	Piperidine
	Morpholine
	Aziridine
	Tatrahydrofuran
	Hexa-methlyenetetramine or Urotropene
	Oxirane or Ethylene Oxide or Oxo Cyclo Propane

EXERCISE-1

Q.1 How many 1° Carbon atom will be present in a simplest hydrocarbon having two 3° and one 2° carbon atom?
(A) 3 (B) 4 (C) 5 (D) 6

Q.2 How many carbons are in simplest alkyne having two side chains?
(A) 5 (B) 6 (C) 7 (D) 8

Q.3 Which of the following pairs have absence of carbocyclic ring in both compounds?
(A) Pyridine, Benzene (B) Benzene, Cyclohexane
(C) Cyclohexane, Furane (D) Furane, Pyridine

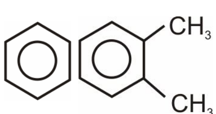
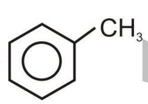
Q.4 The commercial name of trichloroethene is
(A) Westron (B) Perclene (C) Westrosol (D) Orlone

Q.5 How many secondary carbon atoms does methyl cyclopropane have?
(A) None (B) One (C) Two (D) Three

Q.6 The compound which has one isopropyl group is
(A) 2, 2, 3, 3- Tetramethyl pentane (B) 2,2- Dimethyl pentane
(C) 2, 3,3- Trimethyl pentane (D) 2- Methyl pentane

Q.7 Which of the following is the first member of ester homologous series ?
(A) Ethyl ethanoate (B) Methyl ethanoate
(C) Methyl methanoate (D) Ethyl methanoate

Q.8 The group of heterocyclic compounds is :
(A) Phenol, Furane (B) Furane, Thiophene
(C) Thiophene, Phenol (D) Furane, Aniline

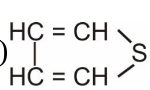
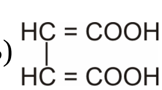
Q.9  and 

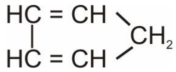
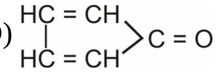
Number of secondary carbon atoms present in the above compounds are respectively :
(A) 6, 4, 5 (B) 4, 5, 6 (C) 5, 4, 6 (D) 6, 2, 1

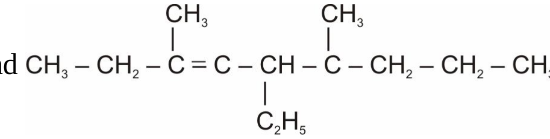
Q.10 A substance containing an equal number of primary, secondary and tertiary carbon atoms is :
(a) Mesityl Oxide (B) Mesitylene
(C) Maleic acid (D) Malonic acid

Q.11 The molecular formula of the first member of the family of alkenynes and its name is given by the set
(A) C_3H_2, Alkene (B) C_5H_6, Pent-1-en-3-yne
(C) C_6H_8, Hex-1-en-5-yne (D) C_4H_4, Butenyne

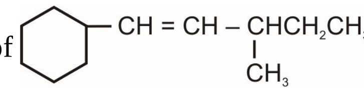
Q.12 Which of the following is a heterocyclic compound

(A)  (B) 

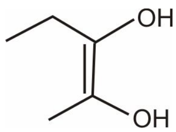
(C)  (D) 

Q.13 The correct IUPAC name of the compound :

(A) 5-Ethyl-3, 6-dimethyl non-3-ene
(B) 5-Ethyl-4, 7-dimethyl non-3-ene
(C) 4- Methyl-5, 7- diethyl oct-2-ene
(D) 2, 4-Ethyl-5-methyl oct-2-ene

Q.14 The IUPAC name of  is

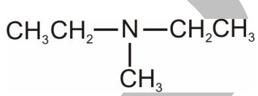
(A) 1-Cyclohexyl-3- methylpent-1-ene (B) 3-Methyl-5-cyclohexylpent-1-ene
(C) 1-Cyclohexyl-3-ethylbut-1-ene (D) 1-Cyclohexyl-3, 4-dimethyl-but-1-ene

Q.15 IUPAC name of  is

(A) But-2-ene-2,3–diol (B) Pent-2 – ene – 2, 3-diol
(C) 2- Methylbut-2-ene-2, 3-diol (D) Pent-3-ene– 3, 4-diol

Q.16 IUPAC name of  is :

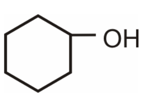
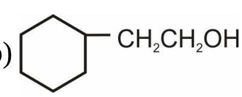
(A) 5- Methyl hexanol (B) 2- Methyl hexanol
(C) 2- Methyl hex-3- enol (D) 4- Methyl pent-2-enol

Q.17 The IUPAC name of  is :

(A) N-Methyl-N- ethyl ethanamine (B) Diethyl methanamine
(C) N-Ethyl-N-methyl ethanamine (D) Methyl diethyl ethanamine

Q.18 The IUPAC name of acetyl acetone is :
(A) Pentane-2, 5- dione (B) Pentane –2, 4– dione
(C) Hexane-2, 4- dione (D) Butane-2,4- dione

Q.19 When vinyl and allyl are joined each other, we get :
(A) Conjugated alkadiene (B) cumulative alkadiene
(C) Isolated alkadiene (D) Allenes

Q.20 (a)  and (b) 

True statement for the above compounds is :
(A) (a) is phenol while (b) is alcohol
(B) Both (a) and (b) are primary alcohol
(C) (a) is primary and (b) is secondary alcohol
(D) (a) is secondary and (b)is primary alcohol

Q.21 The IUPAC name of the following structure (CH_3) C.C.C.(CH_3) $CH(CH_3)$ is :
(A) 3- Methylhex-4-yn-2-ene (B) 3- Methylhex-2-en-4-yne
(C) 4- Methylhex-4-en-4-yne (D) all are correct

Q.22 The IUPAC name of the following structure is
$[CH_3CH(CH_3)]_2C\ (CH_2CH_3)\ C(CH_3)\ C(CH_2CH_3)_2$:
(A) 3, 5- Diethyl-4, 6- dimethyl-5- [1- methylethyl] hept-3-ene
(B) 3, 5- Diethyl-5-isopropyl-4, 6- dimethylhept-2-ene
(C) 3, 5-Diethyl-5-propyl-4, 6- dimethylhept-3-ene
(D) None of these

Q.23 The correct IUPAC name of $CH_3{-}CH_2{-}\underset{\underset{CH_2}{\|}}{C}{-}COOH$ is:
(A) 2- Methyl butanoic acid (B) 2- Ethylprop-2- enoic acd
(C) 2- Carboxybutene (D) none of the above

Q.24 The correct IUPAC name of 2- ethylpent-3-yne is
(A) 3-Methyl hex-4-yne (B) 4-Ethyl pent-2-yne
(C) 4- methyl hex-2 yne (D) none of these

Q.25 The IUPAC name of the compound Glycerine $\underset{\underset{OH}{|}}{CH_2}-\underset{\underset{OH}{|}}{CH}-\underset{\underset{OH}{|}}{CH_2}$ is :
(A) 1, 2, 3- Tri hydroxy propane (B) 3- Hydroxy pentane-1, 5- diol
(C) 1, 2, 3- Hydroxy propane (D) Propane-1, 2, 3- triol

Q.26 All the following IUPAC names are correct except:
(A) 1-Chloro-1- ethoxy propane (B) 1- Amino-1- ethoxypropane
(C) 1- Ethoxy-2-propanol (D) 1- Ethoxy-1- propanamine

Q.27 The IUPAC name of the compound $CH_3CH = CHCH = CHC \equiv CCH_3$ is :
(A) Octa-4, 6-diene-2-yne (B) Octa-2, 4-diene-6-yne
(C) Oct-2-yne-4, 6-diene (D) Oct-6-yne-2, 4-diene

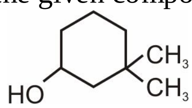
Q.28 $C_3H_6Br_2$ can show:
(A) Two gem dibromide (B) Three vic dibromide
(C) Two tert. dibromo alkane (D) Two sec. dibromo alkane

Q.29 The IUPAC name of β- ethoxy-α- hydroxy propionic acid (trivial name) is-
(A) 1, 2- Dihydroxy-1- oxo-3- ethoxy propane
(B) 1-Carboxy-2- ethoxy ethanol
(C) 3- Ethoxy-2- hydroxy propanoic acid
(D) All above

Q.30 As per IUPAC rules, which one of the following groups, will be regarded as the principal functional group?
(A) $-C \equiv C-$ (B) $-OH$ (C) $-\underset{\underset{O}{\|}}{C}-$ (D) $-\underset{\underset{O}{\|}}{C}-H$

Q.31 The IUPAC name of the compound Br(C*l*) CI. CF_3 is :
(A) 2- Bromo-2-chloro-2-iodo–1, 1, 1- trifluoroethane
(B) 1, 1, 1-Trifluoro-2- bromo-2-chloro-2- iodo ethane
(C) 2- Bromo-2-chloro-1, 1, 1-trifluro-2-iodo ethane
(D) 1-Bromo-1- chloro-2, 2, 2– trifloro-1- iodo ethane

Q.32 The IUPAC name of the given compound is



(A) 1,1-Dimethyl-3-hydroxy cyclohexane
(B) 3,3-Dimethyl-1-hydroxy cyclohexane
(C) 3,3- Dimethyl cyclo hexanol
(D) 1,1-Dimethylcyclohexan-3-ol

Q.33 The IUPAC name of $(C_2H_5)_2NCH_2\underset{\substack{|\\ Cl}}{CH}.COOH$ is :

(A) 2-Chloro-4-N-ethylpentanoic acid
(B) 2-Chloro-3-(N, N-diethyl amino)-propanoic acid
(C) 2-Chloro-2-oxo diethylamine
(D) 2-Chloro-2-carboxy-N-ethyl ethane

Q.34 The IUPAC name of the compound is $CH_3-\underset{\substack{|\\ CH_3}}{CH}-\overset{\substack{Ph\\ |}}{CH}-NH_2$

(A) 1- Amino-1- phenyl-2-methyl propane
(B) 2- Methyl-1- phenyl propan-1- amine
(C) 2- Methyl-1- amino-1- phenyl propane
(D) 1- Isopropyl-1- phenyl methyl amine

Q.35 Which of the following compound is wrongly named?

(A) $CH_3CH_2CH_2\underset{\substack{|\\ Cl}}{CH}COOH$; 2-Chloro pentanoic acid

(B) $CH_3C\equiv C\underset{\substack{|\\ CH_3}}{CH}COOH$; 2- Methyl hex-3- enoic acid

(C) $CH_3CH_2CH = CHCOCH_3$; Hex-3-en-2-one

(D) $CH_3-\underset{\substack{|\\ CH_3}}{CH}CH_2CH_2CHO$; 4- Methyl pentanal

Q.36 The correct IUPAC name of the following compound is

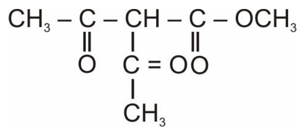
$$O=\underset{\substack{|\\ OH}}{C}-CH_2-\underset{\substack{|\\ H-C=O}}{CH}-CHO$$

(A) 3,3-Diformylpropanoic acid (B) 3- Formyl-4-oxo-butanoic acid
(C) 3,3-Dioxo propanoic acid (D) 3,3-Dicarbaldehyde propanoic acid

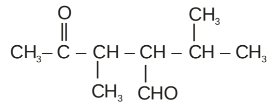
Q.37 The correct IUPAC name of compound $CH_3-CH_2-\underset{\substack{\|\\ O}}{C}-\underset{\substack{|\\ CN}}{CH}-CHO$ is

(A) 2-Cyano-3-oxopentanal (B) 2- Formyl-3- oxopentanenitrile
(C) 2-Cyanopentane-1, 3-dione (D) 1,3-Dioxo-2-cyanopentane

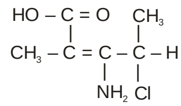
Q.38 IUPAC name of:



(A) Methyl2,2-bis (1-oxyethyl)ethanoate (B) 2,2-Bis(1-oxoethyl)-1-methoxyethanone
(C) Methyl 2-(1-oxoethyl)-3-oxobutanoate (D) Methyl 2- acetyl-3- oxo butanoate

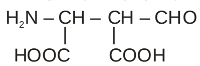
Q.39 The IUPAC name of compound  is :

(A) 3, 5-Dimethyl-4-Formyl pentanone (B) 1- Isopropyl-2- methyl-4-oxo butanal
(C) 2- Isopropyl-3-methyl -4-oxo pentanal (D) None of the above

Q.40 The IUPAC name of compound  is :

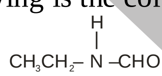
(A) 2- Amino-3-chloro-2-methylpent-2-enoic acid
(B) 3- Amino-4-chloro-2- methylpent-2-enoic acid
(C) 4-Amino-3-chloro-2-methylpent-2-enoic acid
(D) All of the above

Q.41 The IUPAC name of the structure is



(A) 3- Amino-2-formyl butane-1, 4-dioic acid
(B) 3- amino-2, 3-dicarboxy propanal
(C) 2- Amino-3- formyl butane-1, 4- dioic acid
(D) 1- Amino-2-formyl succinic acid

Q.42 One among the following is the correct IUPAC name of the compound



(A) N-Formyl aminoethane (B) N-Ethyl formyl amine
(C) N-Ethyl methanamide (D) Ethylamino methanal

Q.43 The number of primary, secondary and tertiary amines possible with the molecular formula C_3H_9N is :

(A) 1, 2, 2 (B) 1, 2, 1 (C) 2, 1, 1 (D) 3, 0, 1

Q.44 The IUPAC name of $C_6H_5CH = CH – COOH$ is

(A) Cinnamic acid (B) 1- Phenyl-2- carboxy ethane
(C) 3- Phenyl prop-2- enoic acid (D) Dihydroxy-3- phenyl propionic acid

Q.45 The IUPAC name of $BrCH_2 – CH – CO – CH_2 – CH_2CH_3$ is

|

$CONH_2$

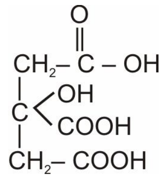
(A) 2- Bromomethyl-3- oxohexanamide (B) 1-Bromo-2-amino-3-oxohexane
(C) 1-Bromo-2-amino-n- propyl ketone (D) 3- Bromo-2- propyl propanamide

Q.46 IUPAC name will be $CH_2 – CH – CH_2$

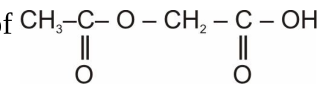
| | |

CN CN CN

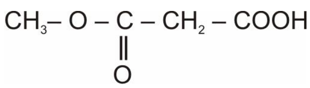
(A) 1,2,3- Tricyano propane (B) Propane-1, 2, 3- trinitrile
(C) 1, 2, 3- Cyano propane (D) Propane-1, 2, 3-tricarbonitrile

Q.47 The IUPAC name of compound 

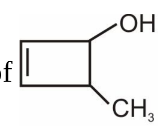
(A) 1, 2, 3-Tricarboxypropan-2-ol
(B) 2- Hydroxy propane-1, 2, 3-tricarboxylic acid
(C) 3- hydroxyl-3-carboxypentane-1, 5-dioic acid
(D) none of these

Q.48 The IUPAC name of  is :

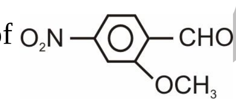
(A) 1- Acetoxy acetic acid
(B) 2- Acetoxy ethanoic acid
(C) 2- Ethanoyloxyacetic acid
(D) 2-Ethanoyloxyethanoic acid

Q.49 

The correct IUPAC systematic name of the above compound is:
(A) 2- Acetoxy ethanoic acid
(B) 2- Methoxy carbonyl ethanoic acid
(C) 3- Methoxy formyl ethanoic acid
(D) 2- Methoxy formyl acetic acid

Q.50 The IUPAC name of  is

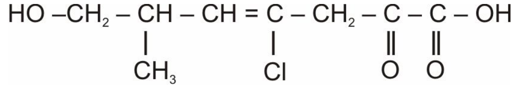
(A) 3- Methyl cyclobut-1-ene-2-ol
(B) 4-Methyl cyclobut-2-ene-1-ol
(C) 4- Methyl cyclobut-1-ene-3- ol
(D) 2- Methyl cyclobut-3-ene-1-ol

Q.51 The IUPAC name of  is

(A) 2- Methoxy-4- nitro benzaldehyde
(B) 4- Nitro anisaldehyde
(C) 3- Methoxy-4- formyl nitro benzene
(D) 2- Formyl-4- nitro anisole

Q.52 The IUPAC name of compound
$H_3COOC – CH – COOCH_3$
|
CH_2OH
(A) 2-(hydroxyl methyl) methyl propanedioate
(B) Methyl-2- (hydroxy methyl) propanedioate
(C) 2-(Hydroxy methyl) dimethyl propanedioate
(D) None of these

Q.53 The suffix of the principal group, the prefixes for the other groups and the name of the parent in the structure

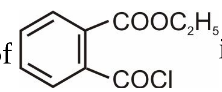


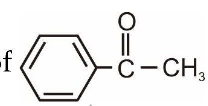
(A) –oic acid, chloro, hydroxy, oxo, methyl, hept-4-ene
(B) –oic acid, chloro, hydroxy, methyl, oxo, hept-4-ene

(C) –one, carboxy, chloro, methyl, hydroxy, hept-4-ene
(D) –one, carboxy, chloro, methyl, hydroxy, hept -4-ene

Q.54 The IUPAC name of $OHC - CH_2 - CH_2 - \underset{|}{\overset{CH_2 - CHO}{CH}} - CH_2 - CHO$ is
(A) 4,4-Di(formalmethyl) butanal
(B) 2-(formylmethyl)butane-1, 4-dicarbaldehyde
(C) Hexane-3-acetal-1, 6-dial
(D) 3-(Formylmethyl)hexane-1, 6-dial

Q.55 Which of the following is crotonic acid-
(A) $CH_2 = CH - COOH$
(B) $C_6H_5 - CH = CH - COOH$
(C) $CH_3 - CH = CH - COOH$
(D) $\begin{array}{l} CH - COOH \\ \| \\ CH - COOH \end{array}$

Q.56 The IUPAC name of  is :
(A) 2-Chlorocarbonyl ethylbenzoate
(B) 2-Carboxyethyl benzoyl chloride
(C) Ethyl-2-(Chlorocarbonyl)benzoate
(D) Ethyl-1-(Chlorocarbonyl) benzoate

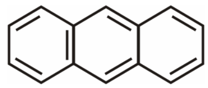
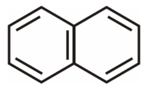
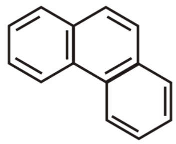
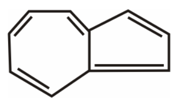
Q.57 The IUPAC name of  is :
(A) Phenyl ethanone
(B) Methyl phenyl ketone
(C) Acetophenone
(D) Phenyl methyl ketone

Q.58 Structural formula of isopropyl methanoate is
(A) $CH_3 - \underset{\underset{O}{\|}}{C} - O - \underset{\underset{CH_3}{|}}{CH} - CH_3$
(B) $H - \underset{\underset{O}{\|}}{C} - O - CH_2 - \underset{\underset{CH_3}{|}}{CH} - CH_3$
(C) $CH_3 - \underset{\underset{O}{\|}}{C} - O - CH_2 - \underset{\underset{CH_3}{|}}{CH_2}$
(D) $H - \underset{\underset{O}{\|}}{C} - O - \underset{\underset{CH_3}{|}}{CH} - CH_3$

Q.59 Which of the following is not correctly matched:

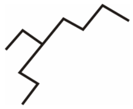
Column-I	**Column- II**
(A) Lactic acid	(P) $CH_3 - \underset{\underset{OH}{|}}{CH} - COOH$
(B) Tartaric acid	(Q) $\begin{array}{l} HO - CH - COOH \\ \quad\;\; | \\ HO - CH - COOH \end{array}$
(C) Pivaldehyde	(R) $CH_3C(CH_3)_2CHO$
(D) Iso-octane	(S) $CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$

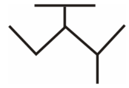
Q.60 **Column-I** **Column-II**

	Column-I		Column-II
(A)		(P)	Phenanthrene
(B)		(Q)	Anthracene
(C)		(R)	Azulene
(D)		(S)	Napthalene

EXERCISE-II

Give the IUPAC names for each of the following :

Q.1 

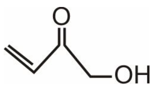
Q.2 

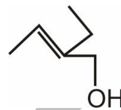
Q.3 

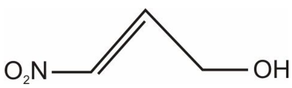
Q.4 

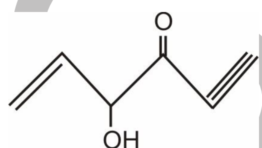
Q.5 

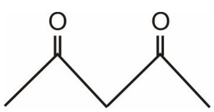
Q.6 

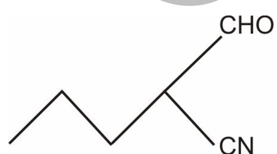
Q.7 

Q.8 

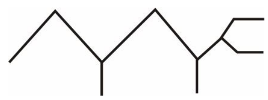
Q.9 

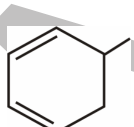
Q.10 

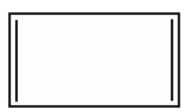
Q.11 

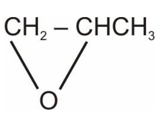
Q.12 

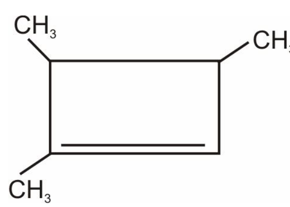
Q.13 

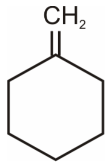
Q.14 

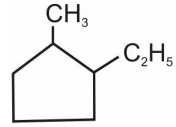
Q.15 

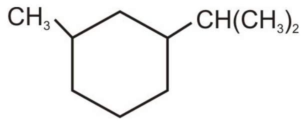
Q.16 

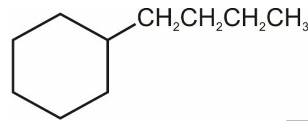
Q.17 

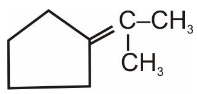
Q.18 

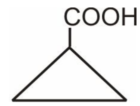
Q.19 

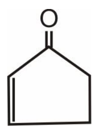
Q.20 

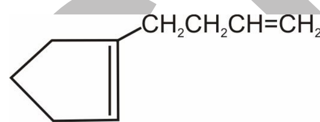
Q.21 

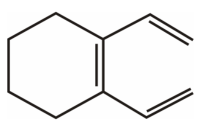
Q.22 

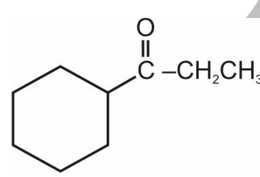
Q.23 

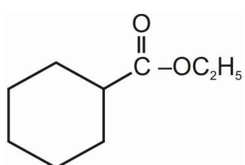
Q.24 

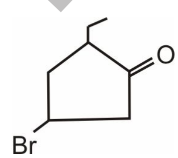
Q.25 

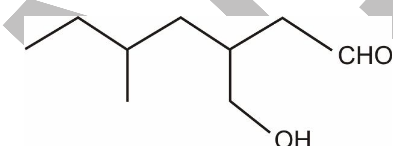
Q.26 

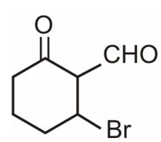
Q.27 

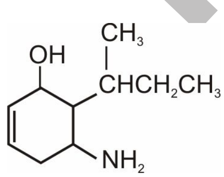
Q.28 

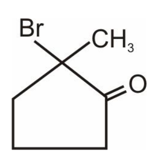
Q.29 

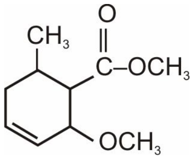
Q.30 

Q.31 

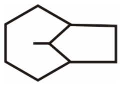
Q. 32 

Q.33 

Q.34 

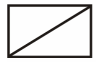
Q.35 

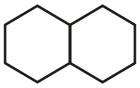
Q.36 

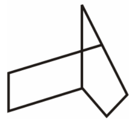
Q.37 

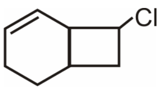
Q.38 

Q.39 

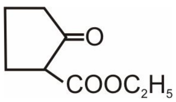
Q.40 

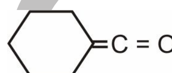
Q.41 

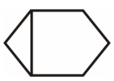
Q.42 

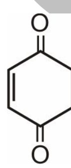
Q.43 

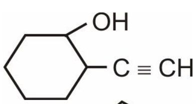
Q.44 

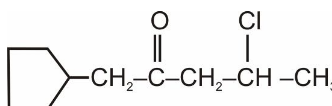
Q.45 

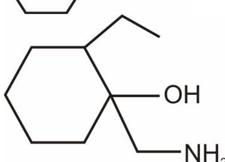
Q.46 

Q.47 

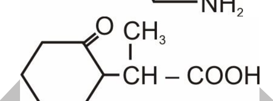
Q.48 

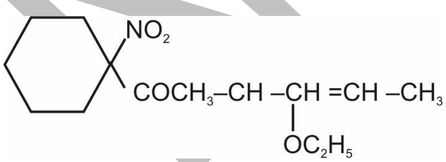
Q.49 

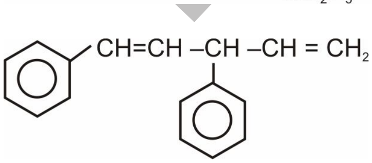
Q.50 

Q.51 

Q.52 

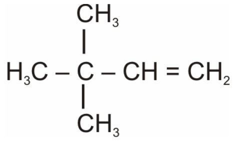
Q.53 

Q.54 

Q.55 

EXERCISE-III

Q.1 The IUPAC name of the compound having the formula is-



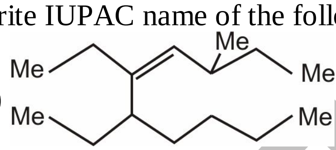
(A) 3, 3, 3- trimethyl-1-propene (B) 1, 1, 1-trimethyl-2- propene
(C) 3, 3-dimethyl-1–butene (D) 2, 2-dimethyl-3-butene **[JEE 1984]**

Q.2 Write the IUPAC name of $CH_3CH_2CH = CH$. COOH **[JEE 1986]**

Q.3 The IUPAC name of the compound $CH_2= CH - CH (CH_3)_2$ is
(A) 1,1-dimethyl-2- propene (B) 3- Methyl-1- butene
(C) 2- vinyl propane (D) None of the above **[JEE 1987]**

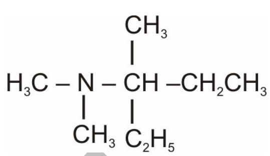
Q.4 The number of sigma and pi-bonds in 1-butene 3-yne are
(A) 5 sigma and 5 pi (B) 7 sigma and 3 pi
(C) 8 sigma and 2 pi (D) 6 sigma and 4 pi **[JEE 1989]**

Q.5 Write IUPAC name of the following

(a) 

[JEE 1990]

Me = Methyl group

(b) 

[JEE 1991]

Q.6 Write IUPAC name of succinic acid. **[JEE 1994]**

Q.7 The IUPAC name of C_6H_5COCl is
(A) Benzoyl chloride (B) Benzene chloro ketone
(C) Benzene carbonyl chloride (D) Chloro phenyl ketone **[JEE 2006]**

Q.8 The IUPAC name of the following compound is **[JEE 2009]**
(A) 4- Bromo-3-cyanophenol
(B) 2- Bromo-5-hydroxybenzonitrile
(C) 2- Cyano-4-hydroxybromobenzene
(D) 6-Bromo-3-hydroxybenzonitrile

ANSWER KEY

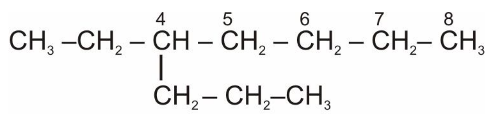
EXERCISE-1

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	B	D	C	C	D	C	B	A	B	D	A	A	A	B
Q.No.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	D	C	B	C	D	B	A	B	C	D	B	B	A	C	D
Q.No.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Ans.	D	C	B	B	B	B	B	C	C	B	C	C	C	C	A
Q.No.	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	
Ans.	D	B	D	B	B	A	B	B	D	C	C	A	D	D	

Q.60 (A) Q, (B) S, (C) P, (D) R

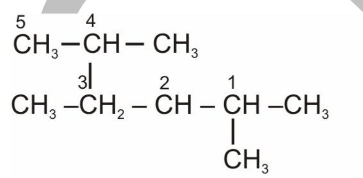
EXERCISE-2

Q.1



4-Ethyl octane

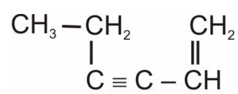
Q.2



3-Ethyl-2,4-dimethyl pentane

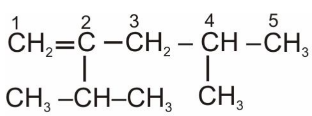
Q.3 5-Methyl hepta-1, 3, 6- triene

Q.4



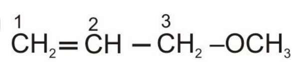
Hexen-3-yne

Q.5



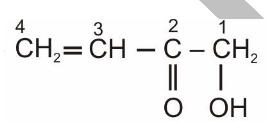
2-Isopropyl-4-methylpentene
or 4- Methyl-2-(methyl ethyl) pentene

Q.6



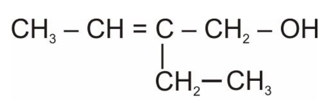
3-Methoxypropene

Q.7



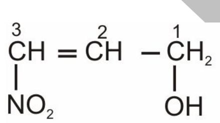
1- Hydroxybut-3-en-2-one

Q.8



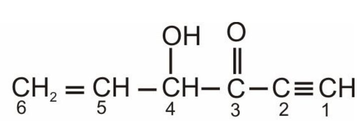
2-Ethylbut-2-en-1-ol

Q.9

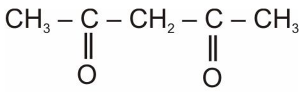


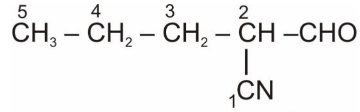
3-nitroprop-2-en-1-ol

Q.10



4-hydroxyhex-5-en-1-yn-3-one

Q.11 
Pentane-2,4-dione

Q.12 
2- Formyl pentane nitrile

Q.13 2, 2, 6, 7- tetramethyloctane

Q.14 3-Ethyl-4, 6- dimethyloctane

Q.15 5 Methyl cyclohexa-1, 3- diene

Q.16 1, 3- cyclobutadiene

Q.17 1,2-epoxy propane

Q.18 1, 3,4- trimethyl-1-cyclobutene

Q.19 Methylene cyclohexane

Q.20 1-ethyl-2- methylcyclopentane

Q.21 1-methyl-3-(methyl ethyl cyclohexane)
Or 3- isopropyl-1-methylcyclohexane

Q.22 Butyl cyclohexane

Q.23 Isopropylidenecyclopentane
Or 1- methyl ethylidene cyclopentane

Q.24 Cyclopropanecarboxylic acid

Q.25 Cyclopent-2-en-1-one

Q.26 1-(3-butenyl)cyclopentene

Q.27 1,2-diethenyl cyclohexene

Q.28 1-cyclohexyl-1- propanone

Q.29 Ethyl cyclohexanecarboxylate

Q.30 4- Bromo-2-ethyl cyclopentanone

Q.31 3-(hydroxymethyl)-5-methylheptanal

Q.32 2- Bromo-6 -Oxocyclohexanecarbaldehyde

Q.33 5-amino-6 (1-methyl propyl)cyclo-hex-2-enol

Q.34 2- bromo-2-methyl cyclopentanone

Q.35 Methyl-2- methoxy-6-methyl-3- cyclohexene carboxylate

Q.36 Bicylo (2.2.1) heptane

Q.37 9- methyl bicyclo (4. 2. 1) nonane

Q.38 spiro (2. 5) octane

Q.39 spiro (4. 5) decane

Q.40 Bicyclo (1. 1. 0) butane

Q.41 Bicyclo (4. 4, 0) decane

Q.42 Bicyclo (2. 2.1) heptane

Q.43 8-chloro bicyclo (4. 2. 0) oct-2-ene

Q.44 2-cyclopenten-1- ol

Q.45 Ethyl-2- oxo-cyclo pentane carboxylate

Q.46 Cyclohexylidene methanone

Q.47 Bicyclo (3. 1. 0) hexane

Q.48 Cyclohex-2-en-1, 4 dione

Q.49 2- ethynyl cyclohexanol

Q.50 4-chloro 1- cyclopentyl pentane-2- one

Q.51 1- Amino methyl-2- ethyl cyclohexanol

Q.52 1-propyl-4-isopropyl-1-cyclohexene or 4-(methyl ethyl)-1- propyl cyclohexene

Q.53 2-(2-oxo-cyclohexyl)propanoic acid

Q.54 3-ethoxy-1(1-nitrocyclohexyl)-hex-4-en-1-one

Q.55 1,3-diphenyl-1, 4- pentadiene

EXERCISE-III

Q.1 C

Q.2 $\underset{5}{CH_3} - \underset{4}{CH_2} - \underset{3}{CH} = \underset{2}{CH} - \underset{1}{COOH}$

2- pentene, 1- oic acid and or 2- pentenoic acid

Q.3 B

Q. 4 B

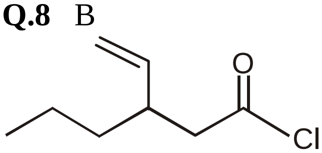
Q.5 (a) 5, 6-diethyl-3-methyl-dec-4 ene

(b) N, N, 3- trimethyl-3-pentanamine

Q.6 Butane-1, 4-dioic acid

Q.7 C

Q.8 B



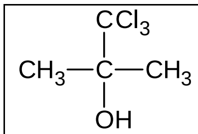
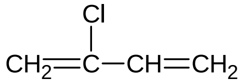
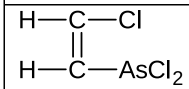
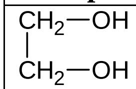
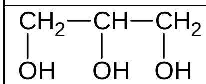
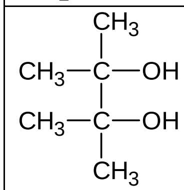
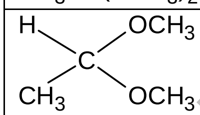
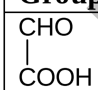
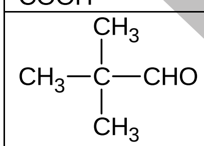
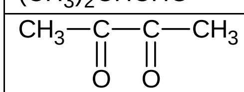
NOMENCLATURE

OF

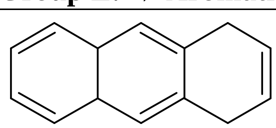
ORGANIC COMPOUNDS

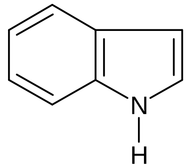
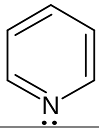
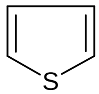
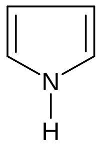
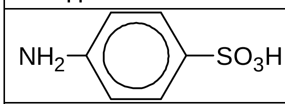
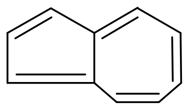
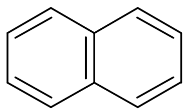
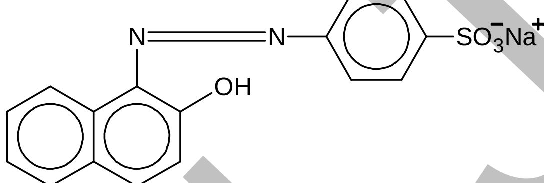
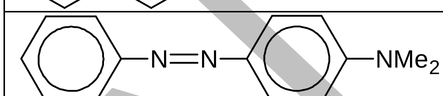
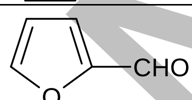
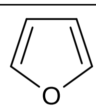
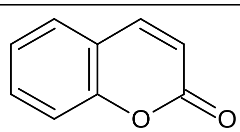
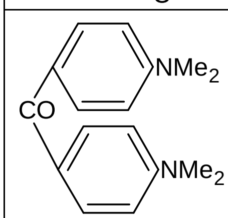
COMMON NAMES

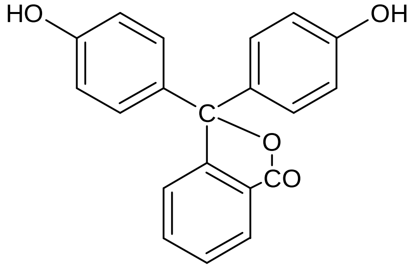
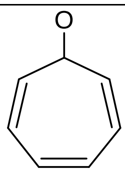
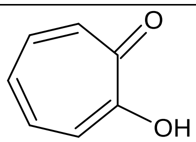
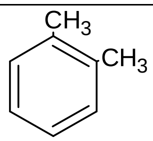
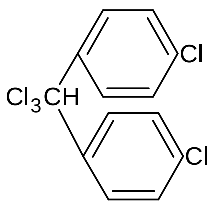
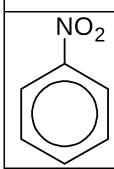
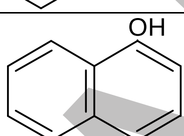
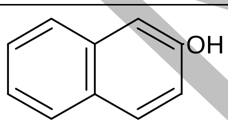
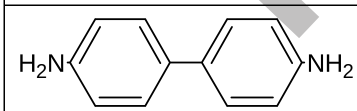
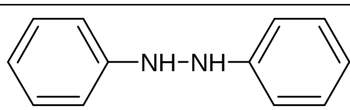
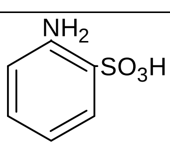
Compound	Common name
Group A : $\rightarrow$ Alkanes	
$CH_3-\underset{CH_3}{\underset{\mid}{CH}}-CH-CH_3$	Isopentane
$CH_3-\overset{CH_3}{\overset{\mid}{\underset{CH_3}{\underset{\mid}{C}}}}-CH_2-\underset{CH_3}{\underset{\mid}{CH}}-CH_3$	Iso Octane
$CH_3-\overset{CH_3}{\overset{\mid}{\underset{CH_3}{\underset{\mid}{C}}}}-CH_3$	Neo Pentane
$CH_3-\overset{CH_3}{\overset{\mid}{\underset{CH_3}{\underset{\mid}{C}}}}-\underset{CH_3}{\underset{\mid}{CH}}-CH_3$	Tripentane
$CH_3-CH_2-\underset{CH_3}{\underset{\mid}{CH}}-CH_2$	Active Amyl Group
Group B:$\rightarrow$ Alkenes	
$CH_3-CH_2-CH=CH_2$	α-Butylene
$CH_3-CH=CH-CH_3$	β-Butylene
$CH_3-\underset{CH_3}{\underset{\mid}{C}}=CH_2$	Iso Butylene
$CH_2=C=CH_2$	Allene
$CH_2=\overset{CH_3}{\overset{\mid}{C}}-CH=CH_2$	Isoprene
$CH\equiv CH$	Purified Acetylene or Norcelyne
$CH_2=CH-C\equiv CH$	Vinyl Acetylene
$CH_3-C\equiv CH$	Allylene
Group D:$\rightarrow$ Alkylhalide	
CH_3CHCl_2	Ethylidene Chloride (A Jem dihalide)
$\underset{Cl}{\underset{\mid}{CH_2}}-\underset{Cl}{\underset{\mid}{CH_2}}$	Ethylene Dichloride (A Vinyl dihalide)
$\overset{CH_2Cl}{\overset{\mid}{CH_2}}-S-\overset{CH_2Cl}{\overset{\mid}{CH_2}}$	Mustard Gas (Poisionous; used in war)
$\underset{CH_2Cl}{\underset{\mid}{CH_2Cl}}$	Westron (Solvent)
$ClCH=CCl_2$	Westrosol or Triclean (Solvent)
$Cl_2C=CCl_2$	Tetraclean or Perclean
$Cl-\overset{Cl}{\overset{\mid}{\underset{Cl}{\underset{\mid}{C}}}}-NO_2$	Chloropicrin (tear gas)

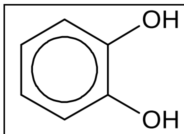
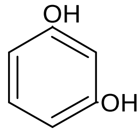
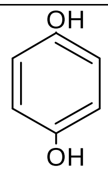
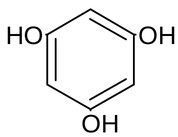
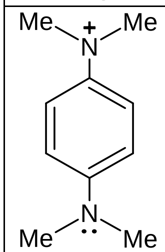
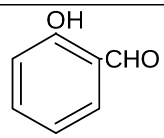
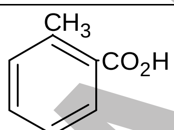
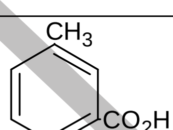
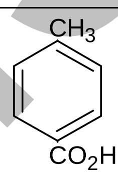
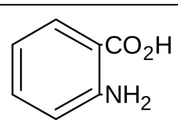
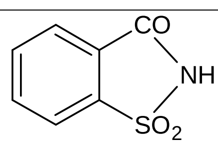
	Chloretone
	Chloroprene
	Lewisite
Group E:→ Alcohol	
	Glycol or Ethylene
	Glycerol
$CH \equiv C-CH_2-OH$	Propargyl Alcohol
$CH_2=CH-CH_2-OH$	Allyl Alcohol
$CH_2=CH-OH$	Vinyl Alcohol
	Pinacol
Group F:→ Ether	
$C_6H_5-O-CH_3$	Anesol (Methyl Phenyl Ether)
$C_6H_5-O-C_2H_5$	Phenetol (Ethyl Phenyl Ether)
$CH_3CH(OCH_3)_2$	Methylal
 or $CH_3CH(OCH_3)_2$	Methylal
Group G:→ Aldehyde	
	Glyoxalic acid
 or $(CH_3)_3C-CHO$	Pavaldehyde
$CH_3CH=CH-CHO$	Crotonaldehyde
$CH_2=CH-CHO$	Acraldehyde or Acrolein
$(CH_3)_2CHCHO$	Isobutyraldehyde
	Dimethyl Glyoxal

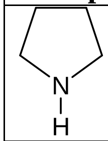
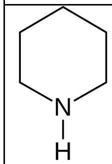
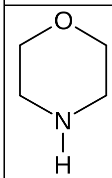
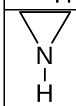
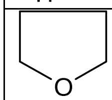
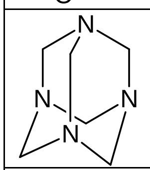
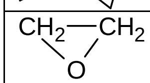
$H_2C(OH)-CH(OH)-CHO$	Glyceraldehyde
$OHC-CHO$ ($O{=}C(H)-C(H){=}O$)	Glyoxal
$CH_3-C(=O)-C(=O)-H$	Methyl Glyoxal or Pyruvic Aldehyde
Group H:$\rightarrow$ Ketone	
CH_3COCH_3	Acetone
$(CH_3)_2C{=}CH-C(=O)-CH{=}C(CH_3)_2$	Phorone
$(CH_3)_2C{=}CH-C(=O)-CH_3$	Mesityl Oxide
$H_2C{=}C{=}O$	Ketene
Group I:$\rightarrow$ Carboxylicacid	
$CH_3-CH_2-CH_2-CH_2-COOH$	Valeric Acide (n-Pentanoic acid)
$CH_3(CH_2)_4COOH$	Caproic Acid (n-Hexanoic acid)
CH_2-COOH $\vert$ $CH(OH)-COOH$	Malic Acid
$HOOC-CH_2-C(OH)(COOH)-CH_2-COOH$	Citric Acid (In lemon)
$CH_2{=}CH-COOH$	Acralic Acid
$CH_3-C(H)(OH)-COOH$	Lactic Acid (In milk)
$HO-C(=O)-OH(H_2CO_3)$	Carbonic Acid
$CH_3-CO-COOH$	Pyruvic Acid
$CH_3-CH{=}CH-COOH$	Crotonic Acid
$C_6H_5-CH(OH)-COOH$	Mendalic Acid
NH_2-CH_2-COOH	Glycine (Amino Acetic Acid)
NH_2COOH	Carbamic Acid (Amino formic Acid)
$COOH-(CH_2)_4-COOH$	Adipic Acid
$C_6H_5CH{=}CHCOOH$	Cinnamic Acid

$\begin{array}{rcl} & CH_3 & \\ & \vert & \\ NH_2- & C & -H \\ & \vert & \\ & COOH & \end{array}$	Alanine
$HO-CH_2-COOH$	Glycolic Acid
$\begin{array}{l}COOH\\ \vert\\ COOH\end{array}$	Oxalic acid
$CH_2\begin{array}{l}\diagup COOH\\ \diagdown COOH\end{array}$	Malonic acid
$\begin{array}{l}CH_2-COOH\\ \vert\\ CH_2-COOH\end{array}$	Succinic acid
$\begin{array}{rcl}HO- & CH & -COOH\\ & \vert & \\ & CH_2 & -COOH\end{array}$	Malic acid
$\begin{array}{rcl}HO- & CH & -COOH\\ & \vert & \\ HO- & CH & -COOH\end{array}$	Tarteric acid
$\begin{array}{rcccl} & & & O & \\ & & & \Vert & \\ H- & C & - & C & -OH\\ & \Vert & & & \\ H- & C & - & C & -OH\\ & & & \Vert & \\ & & & O & \end{array}$	Maleic acid
$\begin{array}{rcccccl} & & & & & O & \\ & & & & & \Vert & \\ & & H- & C & - & C & -OH\\ & & & \Vert & & & \\ HO- & C & - & C & -H & & \\ & \Vert & & & & & \\ & O & & & & & \end{array}$	Fumeric acid
Group J:$\rightarrow$ Acid Derivatives	
$\begin{array}{rcccl}Cl- & C & - & C & -Cl\\ & \Vert & & \Vert & \\ & O & & O & \end{array}$	Oxalyl Chloride
NH_2COONH_4	Ammonium Carbamate
$\begin{array}{rcccl}CH_3- & C & -CH_2- & C & -O-C_2H_5\\ & \Vert & & \Vert & \\ & O & & O & \end{array}$	Aceto Acetic Ester or Ethyl Aceto Acetate
$\begin{array}{rcccl}NH_2- & C & - & C & -NH_2\\ & \Vert & & \Vert & \\ & O & & O & \end{array}$	Oxanamide
$\begin{array}{rcl}Cl- & C & -Cl\\ & \Vert & \\ & O & \end{array}$	Phosgene
$\begin{array}{rcl}H_2N- & C & -NH_2\\ & \Vert & \\ & O & \end{array}$	Urea
Group K: N–Derivatives	
$CH_2=CH-C\equiv N$	Vinyl Cyanide or Acrelio Nitrile
$H-C\equiv N$	Forma Nitrile
$CH_3-C\equiv N$	Aceto Nitrile
CH_3-NCO	MIC
Group L:$\rightarrow$ Aromatic Compounds	
	Anthracene

	Indol
	Pyridine
	Thiophene
	Pyrol
	Sulphanilic acid
	Azulene
	Napthelene
	Orange II
	Butter Yellow
	Furfurel
	Furan
	Conmarine
	Michler's Ketone

	Phenolphthalein
	Tropone (Cycloheptatrienone)
	Tropolone (Cycloheptatrienolone)
	o-xylene
	DDT (Dichlorodiphenyltrichloroethane)
	Nitrobenzene (oil of mirbane)
	α-naphthol
	β-naphthol
	Benzidine
	Hydrazobenzene
	Orthanilic Acid

	Catechol
	Resorcinol
	Quinol
	Phloroglucinol
	Wurster salts
	Salicylaldehyde (o-hydroxybenzaldehyde)
$C_6H_5CONH_2$	Benzamide
$(C_6H_5CO)_2O$	Benzoic Anhydride
$(C_6H_5CO)_2O_2$	Benzoyl Peroxide
$C_6H_5CO_2CH_3$	Perbenzoic acid
 o-toluic acid, m.p. 103^{o}C  m-toluic acid, m.p. 111^{o}C  p-toluic acid, m.p. 180^{o}C	Toluic acids
	Anthranilic acid (o-aminobenzoic acid)
	Saccharin (o-sulphobenzoic imide)
$C_6H_5CH{=}CH_2$	Styrene
C_6H_5CHO	Benzaldehyde
$C_6H_5COCOC_6H_5$	Benzil

$(C_6H_5)_2C(OH)CO_2H$	Benzilic acid
Group M: → Hetrocyclic Compounds	
	Pyrrolidine
	Piperidine
	Morpholine
	Aziridine
	Tatrahydrofuran
	Hexa-methlyenetetramine or Urotropene
	Oxirane or Ethylene Oxide or Oxo Cyclo Propane

EXERCISE-1

Q.1 How many 1° Carbon atom will be present in a simplest hydrocarbon having two 3° and one 2° carbon atom?
(A) 3 (B) 4 (C) 5 (D) 6

Q.2 How many carbons are in simplest alkyne having two side chains?
(A) 5 (B) 6 (C) 7 (D) 8

Q.3 Which of the following pairs have absence of carbocyclic ring in both compounds?
(A) Pyridine, Benzene (B) Benzene, Cyclohexane
(C) Cyclohexane, Furane (D) Furane, Pyridine

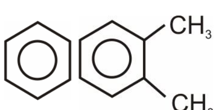
Q.4 The commercial name of trichloroethene is
(A) Westron (B) Perclene (C) Westrosol (D) Orlone

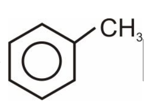
Q.5 How many secondary carbon atoms does methyl cyclopropane have?
(A) None (B) One (C) Two (D) Three

Q.6 The compound which has one isopropyl group is
(A) 2, 2, 3, 3- Tetramethyl pentane (B) 2,2- Dimethyl pentane
(C) 2, 3,3- Trimethyl pentane (D) 2- Methyl pentane

Q.7 Which of the following is the first member of ester homologous series ?
(A) Ethyl ethanoate (B) Methyl ethanoate
(C) Methyl methanoate (D) Ethyl methanoate

Q.8 The group of heterocyclic compounds is :
(A) Phenol, Furane (B) Furane, Thiophene
(C) Thiophene, Phenol (D) Furane, Aniline

Q.9 

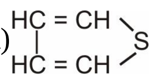
and 

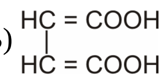
Number of secondary carbon atoms present in the above compounds are respectively :
(A) 6, 4, 5 (B) 4, 5, 6 (C) 5, 4, 6 (D) 6, 2, 1

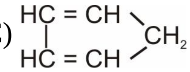
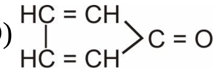
Q.10 A substance containing an equal number of primary, secondary and tertiary carbon atoms is :
(a) Mesityl Oxide (B) Mesitylene
(C) Maleic acid (D) Malonic acid

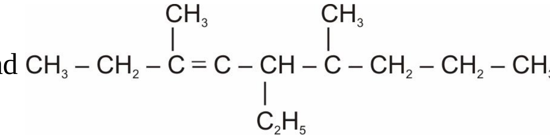
Q.11 The molecular formula of the first member of the family of alkenynes and its name is given by the set
(A) C_3H_2, Alkene (B) C_5H_6, Pent-1-en-3-yne
(C) C_6H_8, Hex-1-en-5-yne (D) C_4H_4, Butenyne

Q.12 Which of the following is a heterocyclic compound

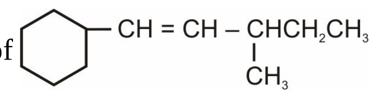
(A) 

(B) 

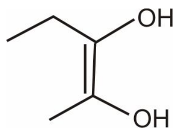
(C)    (D) 

Q.13 The correct IUPAC name of the compound :

(A) 5-Ethyl-3, 6-dimethyl non-3-ene
(B) 5-Ethyl-4, 7-dimethyl non-3-ene
(C) 4- Methyl-5, 7- diethyl oct-2-ene
(D) 2, 4-Ethyl-5-methyl oct-2-ene

Q.14 The IUPAC name of  is

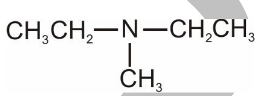
(A) 1-Cyclohexyl-3- methylpent-1-ene
(B) 3-Methyl-5-cyclohexylpent-1-ene
(C) 1-Cyclohexyl-3-ethylbut-1-ene
(D) 1-Cyclohexyl-3, 4-dimethyl-but-1-ene

Q.15 IUPAC name of  is

(A) But-2-ene-2,3–diol
(B) Pent-2 – ene – 2, 3-diol
(C) 2- Methylbut-2-ene-2, 3-diol
(D) Pent-3-ene– 3, 4-diol

Q.16 IUPAC name of  is :

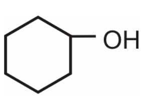
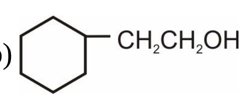
(A) 5- Methyl hexanol
(B) 2- Methyl hexanol
(C) 2- Methyl hex-3- enol
(D) 4- Methyl pent-2-enol

Q.17 The IUPAC name of  is :

(A) N-Methyl-N- ethyl ethanamine
(B) Diethyl methanamine
(C) N-Ethyl-N-methyl ethanamine
(D) Methyl diethyl ethanamine

Q.18 The IUPAC name of acetyl acetone is :
(A) Pentane-2, 5- dione
(B) Pentane –2, 4– dione
(C) Hexane-2, 4- dione
(D) Butane-2,4- dione

Q.19 When vinyl and allyl are joined each other, we get :
(A) Conjugated alkadiene
(B) cumulative alkadiene
(C) Isolated alkadiene
(D) Allenes

Q.20 (a)  and (b) 

True statement for the above compounds is :
(A) (a) is phenol while (b) is alcohol
(B) Both (a) and (b) are primary alcohol
(C) (a) is primary and (b) is secondary alcohol
(D) (a) is secondary and (b)is primary alcohol

Q.21 The IUPAC name of the following structure (CH_3) C.C.C.(CH_3) $CH(CH_3)$ is :
(A) 3- Methylhex-4-yn-2-ene (B) 3- Methylhex-2-en-4-yne
(C) 4- Methylhex-4-en-4-yne (D) all are correct

Q.22 The IUPAC name of the following structure is
$[CH_3CH(CH_3)]_2C$ (CH_2CH_3) $C(CH_3)$ $C(CH_2CH_3)_2$:
(A) 3, 5- Diethyl-4, 6- dimethyl-5- [1- methylethyl] hept-3-ene
(B) 3, 5- Diethyl-5-isopropyl-4, 6- dimethylhept-2-ene
(C) 3, 5-Diethyl-5-propyl-4, 6- dimethylhept-3-ene
(D) None of these

Q.23 The correct IUPAC name of $CH_3-CH_2-\underset{\underset{CH_2}{||}}{C}-COOH$ is:
(A) 2- Methyl butanoic acid (B) 2- Ethylprop-2- enoic acd
(C) 2- Carboxybutene (D) none of the above

Q.24 The correct IUPAC name of 2- ethylpent-3-yne is
(A) 3-Methyl hex-4-yne (B) 4-Ethyl pent-2-yne
(C) 4- methyl hex-2 yne (D) none of these

Q.25 The IUPAC name of the compound Glycerine $\underset{OH}{\underset{|}{CH_2}}-\underset{OH}{\underset{|}{CH}}-\underset{OH}{\underset{|}{CH_2}}$ is :
(A) 1, 2, 3- Tri hydroxy propane (B) 3- Hydroxy pentane-1, 5- diol
(C) 1, 2, 3- Hydroxy propane (D) Propane-1, 2, 3- triol

Q.26 All the following IUPAC names are correct except:
(A) 1-Chloro-1- ethoxy propane (B) 1- Amino-1- ethoxypropane
(C) 1- Ethoxy-2-propanol (D) 1- Ethoxy-1- propanamine

Q.27 The IUPAC name of the compound $CH_3CH = CHCH = CHC \equiv CCH_3$ is :
(A) Octa-4, 6-diene-2-yne (B) Octa-2, 4-diene-6-yne
(C) Oct-2-yne-4, 6-diene (D) Oct-6-yne-2, 4-diene

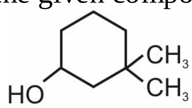
Q.28 $C_3H_6Br_2$ can show:
(A) Two gem dibromide (B) Three vic dibromide
(C) Two tert. dibromo alkane (D) Two sec. dibromo alkane

Q.29 The IUPAC name of β- ethoxy-α- hydroxy propionic acid (trivial name) is-
(A) 1, 2- Dihydroxy-1- oxo-3- ethoxy propane
(B) 1-Carboxy-2- ethoxy ethanol
(C) 3- Ethoxy-2- hydroxy propanoic acid
(D) All above

Q.30 As per IUPAC rules, which one of the following groups, will be regarded as the principal functional group?
(A) $-C \equiv C-$ (B) –OH (C) $-\underset{\underset{O}{||}}{C}-$ (D) $-\underset{\underset{O}{||}}{C}-H$

Q.31 The IUPAC name of the compound Br(C*l*) CI. CF_3 is :
(A) 2- Bromo-2-chloro-2-iodo–1, 1, 1- trifluoroethane
(B) 1, 1, 1-Trifluoro-2- bromo-2-chloro-2- iodo ethane
(C) 2- Bromo-2-chloro-1, 1, 1-trifluro-2-iodo ethane
(D) 1-Bromo-1- chloro-2, 2, 2– trifloro-1- iodo ethane

Q.32 The IUPAC name of the given compound is



(A) 1,1-Dimethyl-3-hydroxy cyclohexane
(B) 3,3-Dimethyl-1-hydroxy cyclohexane
(C) 3,3- Dimethyl cyclo hexanol
(D) 1,1-Dimethylcyclohexan-3-ol

Q.33 The IUPAC name of $(C_2H_5)_2NCH_2\underset{\substack{|\\ Cl}}{C}H.\ COOH$ is :

(A) 2-Chloro-4-N-ethylpentanoic acid
(B) 2-Chloro-3-(N, N-diethyl amino)-propanoic acid
(C) 2-Chloro-2-oxo diethylamine
(D) 2-Chloro-2-carboxy-N-ethyl ethane

Q.34 The IUPAC name of the compound is $CH_3-\underset{\substack{|\\ CH_3}}{C}H-\overset{\substack{Ph\\ |}}{C}H-NH_2$

(A) 1- Amino-1- phenyl-2-methyl propane
(B) 2- Methyl-1- phenyl propan-1- amine
(C) 2- Methyl-1- amino-1- phenyl propane
(D) 1- Isopropyl-1- phenyl methyl amine

Q.35 Which of the following compound is wrongly named?

(A) $CH_3CH_2CH_2\underset{\substack{|\\ Cl}}{C}HCOOH$; 2-Chloro pentanoic acid

(B) $CH_3C\equiv C\underset{\substack{|\\ CH_3}}{C}HCOOH$; 2- Methyl hex-3- enoic acid

(C) $CH_3CH_2CH = CHCOCH_3$; Hex-3-en-2-one

(D) $CH_3-\underset{\substack{|\\ CH_3}}{C}HCH_2CH_2CHO$; 4- Methyl pentanal

Q.36 The correct IUPAC name of the following compound is

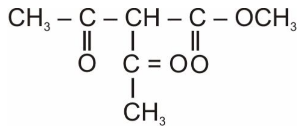
$$O=\underset{\substack{|\\ OH}}{C}-CH_2-\underset{\substack{|\\ H-C=O}}{C}H-CHO$$

(A) 3,3-Diformylpropanoic acid (B) 3- Formyl-4-oxo-butanoic acid
(C) 3,3-Dioxo propanoic acid (D) 3,3-Dicarbaldehyde propanoic acid

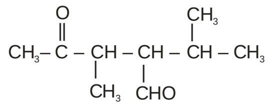
Q.37 The correct IUPAC name of compound $CH_3-CH_2-\underset{\substack{\|\\ O}}{C}-\underset{\substack{|\\ CN}}{C}H-CHO$ is

(A) 2-Cyano-3-oxopentanal (B) 2- Formyl-3- oxopentanenitrile
(C) 2-Cyanopentane-1, 3-dione (D) 1,3-Dioxo-2-cyanopentane

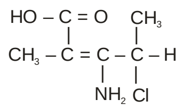
Q.38 IUPAC name of:



(A) Methyl2,2-bis (1-oxyethyl)ethanoate (B) 2,2-Bis(1-oxoethyl)-1-methoxyethanone
(C) Methyl 2-(1-oxoethyl)-3-oxobutanoate (D) Methyl 2- acetyl-3- oxo butanoate

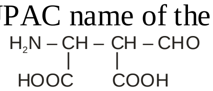
Q.39 The IUPAC name of compound  is :

(A) 3, 5-Dimethyl-4-Formyl pentanone (B) 1- Isopropyl-2- methyl-4-oxo butanal
(C) 2- Isopropyl-3-methyl -4-oxo pentanal (D) None of the above

Q.40 The IUPAC name of compound  is :

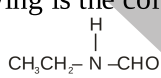
(A) 2- Amino-3-chloro-2-methylpent-2-enoic acid
(B) 3- Amino-4-chloro-2- methylpent-2-enoic acid
(C) 4-Amino-3-chloro-2-methylpent-2-enoic acid
(D) All of the above

Q.41 The IUPAC name of the structure is



(A) 3- Amino-2-formyl butane-1, 4-dioic acid
(B) 3- amino-2, 3-dicarboxy propanal
(C) 2- Amino-3- formyl butane-1, 4- dioic acid
(D) 1- Amino-2-formyl succinic acid

Q.42 One among the following is the correct IUPAC name of the compound



(A) N-Formyl aminoethane (B) N-Ethyl formyl amine
(C) N-Ethyl methanamide (D) Ethylamino methanal

Q.43 The number of primary, secondary and tertiary amines possible with the molecular formula C_3H_9N is :

(A) 1, 2, 2 (B) 1, 2, 1 (C) 2, 1, 1 (D) 3, 0, 1

Q.44 The IUPAC name of $C_6H_5CH = CH – COOH$ is

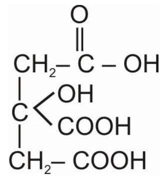
(A) Cinnamic acid (B) 1- Phenyl-2- carboxy ethane
(C) 3- Phenyl prop-2- enoic acid (D) Dihydroxy-3- phenyl propionic acid

Q.45 The IUPAC name of $BrCH_2 – \underset{\large CONH_2}{\underset{|}{CH}} – CO – CH_2 – CH_2CH_3$ is

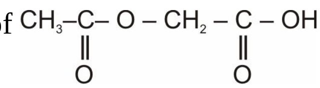
(A) 2- Bromomethyl-3- oxohexanamide (B) 1-Bromo-2-amino-3-oxohexane
(C) 1-Bromo-2-amino-n- propyl ketone (D) 3- Bromo-2- propyl propanamide

Q.46 IUPAC name will be $\underset{\large CN}{\underset{|}{CH_2}} – \underset{\large CN}{\underset{|}{CH}} – \underset{\large CN}{\underset{|}{CH_2}}$

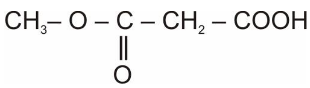
(A) 1,2,3- Tricyano propane (B) Propane-1, 2, 3- trinitrile
(C) 1, 2, 3- Cyano propane (D) Propane-1, 2, 3-tricarbonitrile

Q.47 The IUPAC name of compound 

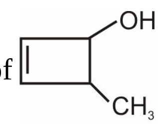
(A) 1, 2, 3-Tricarboxypropan-2-ol
(B) 2- Hydroxy propane-1, 2, 3-tricarboxylic acid
(C) 3- hydroxyl-3-carboxypentane-1, 5-dioic acid
(D) none of these

Q.48 The IUPAC name of  is :

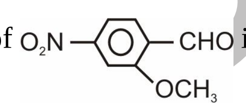
(A) 1- Acetoxy acetic acid
(B) 2- Acetoxy ethanoic acid
(C) 2- Ethanoyloxyacetic acid
(D) 2-Ethanoyloxyethanoic acid

Q.49 

The correct IUPAC systematic name of the above compound is:
(A) 2- Acetoxy ethanoic acid
(B) 2- Methoxy carbonyl ethanoic acid
(C) 3- Methoxy formyl ethanoic acid
(D) 2- Methoxy formyl acetic acid

Q.50 The IUPAC name of  is

(A) 3- Methyl cyclobut-1-ene-2-ol
(B) 4-Methyl cyclobut-2-ene-1-ol
(C) 4- Methyl cyclobut-1-ene-3- ol
(D) 2- Methyl cyclobut-3-ene-1-ol

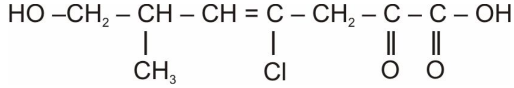
Q.51 The IUPAC name of  is

(A) 2- Methoxy-4- nitro benzaldehyde
(B) 4- Nitro anisaldehyde
(C) 3- Methoxy-4- formyl nitro benzene
(D) 2- Formyl-4- nitro anisole

Q.52 The IUPAC name of compound
$H_3COOC – CH – COOCH_3$
|
CH_2OH

(A) 2-(hydroxyl methyl) methyl propanedioate
(B) Methyl-2- (hydroxy methyl) propanedioate
(C) 2-(Hydroxy methyl) dimethyl propanedioate
(D) None of these

Q.53 The suffix of the principal group, the prefixes for the other groups and the name of the parent in the structure



(A) –oic acid, chloro, hydroxy, oxo, methyl, hept-4-ene
(B) –oic acid, chloro, hydroxy, methyl, oxo, hept-4-ene

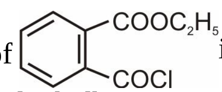
(C) –one, carboxy, chloro, methyl, hydroxy, hept-4-ene
(D) –one, carboxy, chloro, methyl, hydroxy, hept -4-ene

Q.54 The IUPAC name of $OHC - CH_2 - CH_2 - \underset{|}{\overset{CH_2 - CHO}{CH}} - CH_2 - CHO$ is

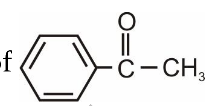
(A) 4,4-Di(formalmethyl) butanal
(B) 2-(formylmethyl)butane-1, 4-dicarbaldehyde
(C) Hexane-3-acetal-1, 6-dial
(D) 3-(Formylmethyl)hexane-1, 6-dial

Q.55 Which of the following is crotonic acid-

(A) $CH_2 = CH - COOH$
(B) $C_6H_5 - CH = CH - COOH$
(C) $CH_3 - CH = CH - COOH$
(D) $\begin{array}{l} CH - COOH \\ \| \\ CH - COOH \end{array}$

Q.56 The IUPAC name of  is :

(A) 2-Chlorocarbonyl ethylbenzoate
(B) 2-Carboxyethyl benzoyl chloride
(C) Ethyl-2-(Chlorocarbonyl)benzoate
(D) Ethyl-1-(Chlorocarbonyl) benzoate

Q.57 The IUPAC name of  is :

(A) Phenyl ethanone
(B) Methyl phenyl ketone
(C) Acetophenone
(D) Phenyl methyl ketone

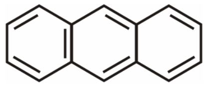
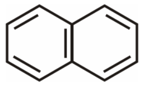
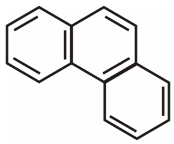
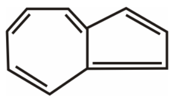
Q.58 Structural formula of isopropyl methanoate is

(A) $CH_3 - \underset{\underset{O}{\|}}{C} - O - \underset{\underset{CH_3}{|}}{CH} - CH_3$
(B) $H - \underset{\underset{O}{\|}}{C} - O - CH_2 - \underset{\underset{CH_3}{|}}{CH} - CH_3$
(C) $CH_3 - \underset{\underset{O}{\|}}{C} - O - CH_2 - \underset{\underset{CH_3}{|}}{CH_2}$
(D) $H - \underset{\underset{O}{\|}}{C} - O - \underset{\underset{CH_3}{|}}{CH} - CH_3$

Q.59 Which of the following is not correctly matched:

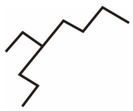
Column-I		**Column- II**
(A) Lactic acid	(P)	$CH_3 - \underset{\underset{OH}{|}}{CH} - COOH$
(B) Tartaric acid	(Q)	$\begin{array}{c} HO - CH - COOH \\ \vert \\ HO - CH - COOH \end{array}$
(C) Pivaldehyde	(R)	$CH_3C(CH_3)_2CHO$
(D) Iso-octane	(S)	$CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$

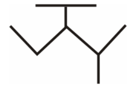
Q.60 **Column-I** **Column-II**

	Column-I		Column-II
(A)		(P)	Phenanthrene
(B)		(Q)	Anthracene
(C)		(R)	Azulene
(D)		(S)	Napthalene

EXERCISE-II

Give the IUPAC names for each of the following :

Q.1 

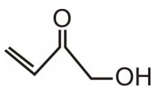
Q.2 

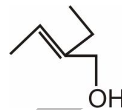
Q.3 

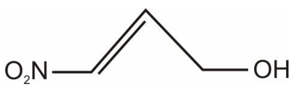
Q.4 

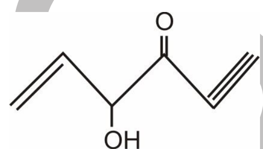
Q.5 

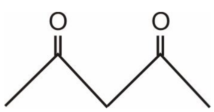
Q.6 

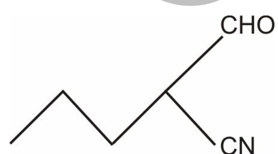
Q.7 

Q.8 

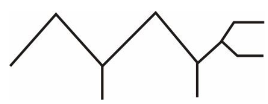
Q.9 

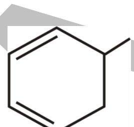
Q.10 

Q.11 

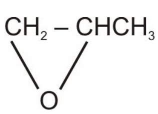
Q.12 

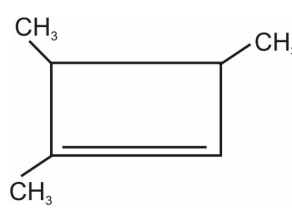
Q.13 

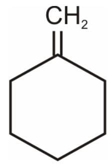
Q.14 

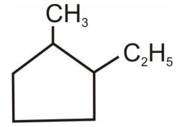
Q.15 

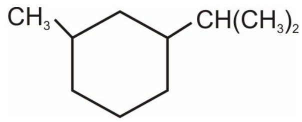
Q.16 

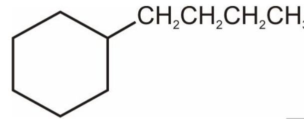
Q.17 

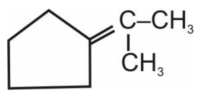
Q.18 

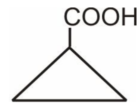
Q.19 

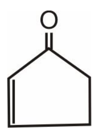
Q.20 

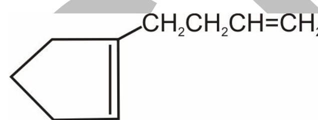
Q.21 

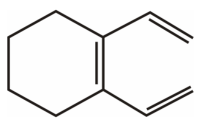
Q.22 

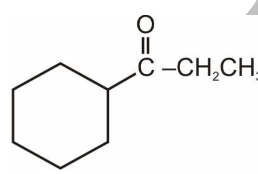
Q.23 

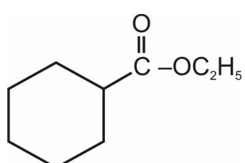
Q.24 

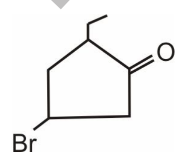
Q.25 

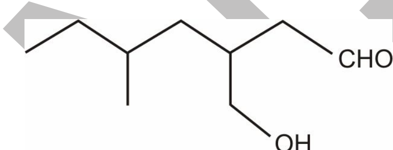
Q.26 

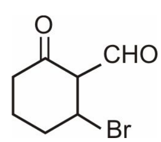
Q.27 

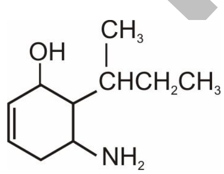
Q.28 

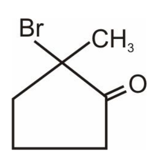
Q.29 

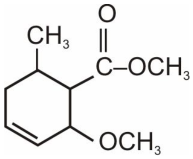
Q.30 

Q.31 

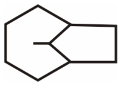
Q. 32 

Q.33 

Q.34 

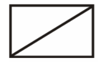
Q.35 

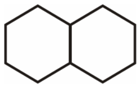
Q.36 

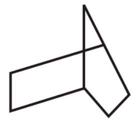
Q.37 

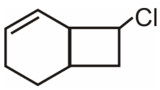
Q.38 

Q.39 

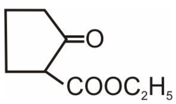
Q.40 

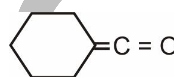
Q.41 

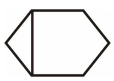
Q.42 

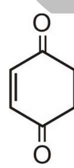
Q.43 

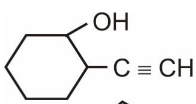
Q.44 

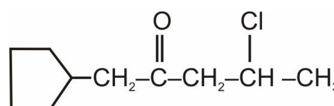
Q.45 

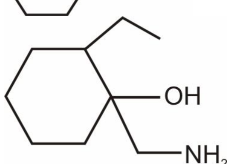
Q.46 

Q.47 

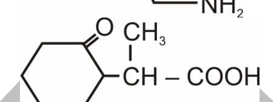
Q.48 

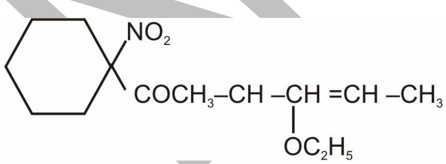
Q.49 

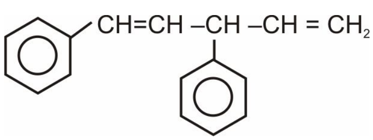
Q.50 

Q.51 

Q.52 

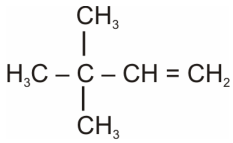
Q.53 

Q.54 

Q.55 

EXERCISE-III

Q.1 The IUPAC name of the compound having the formula is-



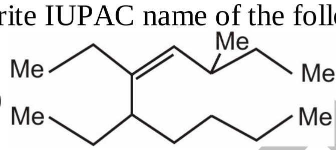
(A) 3, 3, 3- trimethyl-1-propene (B) 1, 1, 1-trimethyl-2- propene
(C) 3, 3-dimethyl-1–butene (D) 2, 2-dimethyl-3-butene **[JEE 1984]**

Q.2 Write the IUPAC name of $CH_3CH_2CH = CH . COOH$ **[JEE 1986]**

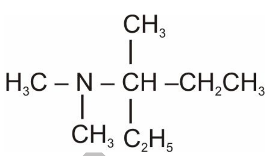
Q.3 The IUPAC name of the compound $CH_2= CH – CH (CH_3)_2$ is
(A) 1,1-dimethyl-2- propene (B) 3- Methyl-1- butene
(C) 2- vinyl propane (D) None of the above **[JEE 1987]**

Q.4 The number of sigma and pi-bonds in 1-butene 3-yne are
(A) 5 sigma and 5 pi (B) 7 sigma and 3 pi
(C) 8 sigma and 2 pi (D) 6 sigma and 4 pi **[JEE 1989]**

Q.5 Write IUPAC name of the following

(a)  **[JEE 1990]**

Me = Methyl group

(b)  **[JEE 1991]**

Q.6 Write IUPAC name of succinic acid. **[JEE 1994]**

Q.7 The IUPAC name of C_6H_5COCl is
(A) Benzoyl chloride (B) Benzene chloro ketone
(C) Benzene carbonyl chloride (D) Chloro phenyl ketone **[JEE 2006]**

Q.8 The IUPAC name of the following compound is **[JEE 2009]**
(A) 4- Bromo-3-cyanophenol
(B) 2- Bromo-5-hydroxybenzonitrile
(C) 2- Cyano-4-hydroxybromobenzene
(D) 6-Bromo-3-hydroxybenzonitrile

ANSWER KEY

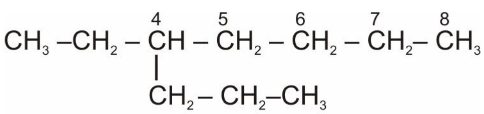
EXERCISE-1

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	B	D	C	C	D	C	B	A	B	D	A	A	A	B
Q.No.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	D	C	B	C	D	B	A	B	C	D	B	B	A	C	D
Q.No.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Ans.	D	C	B	B	B	B	B	C	C	B	C	C	C	C	A
Q.No.	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	
Ans.	D	B	D	B	B	A	B	B	D	C	C	A	D	D	

Q.60 (A) Q, (B) S, (C) P, (D) R

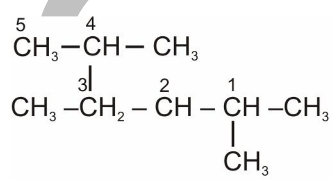
EXERCISE-2

Q.1



4-Ethyl octane

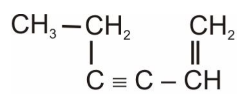
Q.2



3-Ethyl-2,4-dimethyl pentane

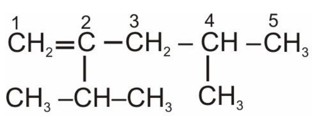
Q.3 5-Methyl hepta-1, 3, 6- triene

Q.4



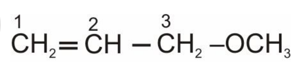
Hexen-3-yne

Q.5



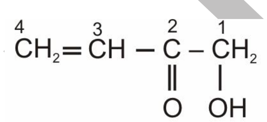
2-Isopropyl-4-methylpentene
or 4- Methyl-2-(methyl ethyl) pentene

Q.6



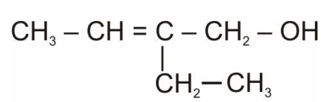
3-Methoxypropene

Q.7



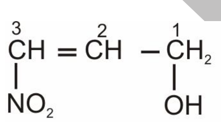
1- Hydroxybut-3-en-2-one

Q.8



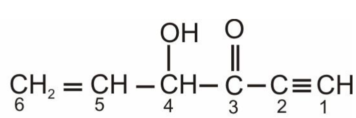
2-Ethylbut-2-en-1-ol

Q.9

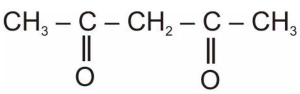


3-nitroprop-2-en-1-ol

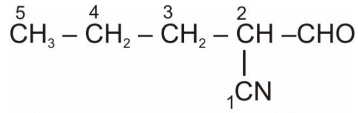
Q.10



4-hydroxyhex-5-en-1-yn-3-one

Q.11 

Pentane-2,4-dione

Q.12 

2- Formyl pentane nitrile

Q.13 2, 2, 6, 7- tetramethyloctane

Q.14 3-Ethyl-4, 6- dimethyloctane

Q.15 5 Methyl cyclohexa-1, 3- diene

Q.16 1, 3- cyclobutadiene

Q.17 1,2-epoxy propane

Q.18 1, 3,4- trimethyl-1-cyclobutene

Q.19 Methylene cyclohexane

Q.20 1-ethyl-2- methylcyclopentane

Q.21 1-methyl-3-(methyl ethyl cyclohexane)
Or 3- isopropyl-1-methylcyclohexane

Q.22 Butyl cyclohexane

Q.23 Isopropylidenecyclopentane
Or 1- methyl ethylidene cyclopentane

Q.24 Cyclopropanecarboxylic acid

Q.25 Cyclopent-2-en-1-one

Q.26 1-(3-butenyl)cyclopentene

Q.27 1,2-diethenyl cyclohexene

Q.28 1-cyclohexyl-1- propanone

Q.29 Ethyl cyclohexanecarboxylate

Q.30 4- Bromo-2-ethyl cyclopentanone

Q.31 3-(hydroxymethyl)-5-methylheptanal

Q.32 2- Bromo-6 -Oxocyclohexanecarbaldehyde

Q.33 5-amino-6 (1-methyl propyl)cyclo-hex-2-enol

Q.34 2- bromo-2-methyl cyclopentanone

Q.35 Methyl-2- methoxy-6-methyl-3- cyclohexene carboxylate

Q.36 Bicylo (2.2.1) heptane

Q.37 9- methyl bicyclo (4. 2. 1) nonane

Q.38 spiro (2. 5) octane

Q.39 spiro (4. 5) decane

Q.40 Bicyclo (1. 1. 0) butane

Q.41 Bicyclo (4. 4, 0) decane

Q.42 Bicyclo (2. 2.1) heptane

Q.43 8-chloro bicyclo (4. 2. 0) oct-2-ene

Q.44 2-cyclopenten-1- ol

Q.45 Ethyl-2- oxo-cyclo pentane carboxylate

Q.46 Cyclohexylidene methanone

Q.47 Bicyclo (3. 1. 0) hexane

Q.48 Cyclohex-2-en-1, 4 dione

Q.49 2- ethynyl cyclohexanol

Q.50 4-chloro 1- cyclopentyl pentane-2- one

Q.51 1- Amino methyl-2- ethyl cyclohexanol

Q.52 1-propyl-4-isopropyl-1-cyclohexene or 4-(methyl ethyl)-1- propyl cyclohexene

Q.53 2-(2-oxo-cyclohexyl)propanoic acid

Q.54 3-ethoxy-1(1-nitrocyclohexyl)-hex-4-en-1-one

Q.55 1,3-diphenyl-1, 4- pentadiene

EXERCISE-III

Q.1 C

Q.2 $\underset{\mathbf{5}}{CH_3} - \underset{\mathbf{4}}{CH_2} - \underset{\mathbf{3}}{CH} = \underset{\mathbf{2}}{CH} - \underset{\mathbf{1}}{COOH}$

2- pentene, 1- oic acid and or 2- pentenoic acid

Q.3 B

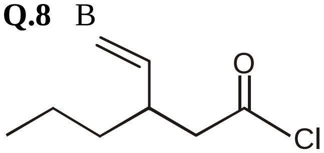
Q. 4 B

Q.5 (a) 5, 6-diethyl-3-methyl-dec-4 ene (b) N, N, 3- trimethyl-3-pentanamine

Q.6 Butane-1, 4-dioic acid

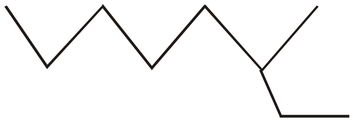
Q.7 C

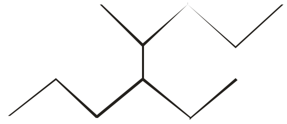
Q.8 B

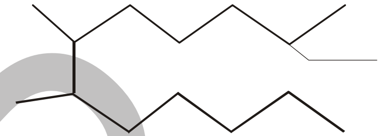


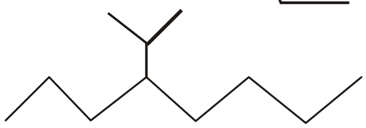
NOMENCLATURE

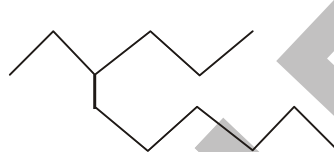
Rule-1 Select the longest chain

Q.1 

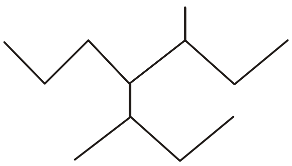
Q.2 

Q.3 

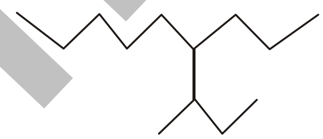
Q.4 

Q.5 

Rule-2 If 2-chains are same lengths select chain with more number of branches.

Q.1 

Q.2 

Q.3 

Rule-3 General formula

Prefix(s) + $\boxed{\text{Word Root}}$ + Suffix (P) + Suffix (s)

Word Root :- Represents Number of carbon atoms in main chain.

1.	No. of Carbon atoms	Word Root0……..
	1	meth
	2	eth
	3	prop
	4	but
	5	pent
	6	hex
	7	hept
	8	oct
	9	non
	10	dec
	11	undec
	12	dodec
	13	tridec
	14	tetradec
	15	pentadec
	16	hexadec
	17	heptadec
	18	octadec
	19	nonadec
	20	eicos
	30	tricont

Rule-4 Side chains are represented as alkyl group

$C_nH_{2n+1} \longrightarrow$ alkyl

CH_3^{-} methyl (Me)

$CH_3 - CH_2 -$ Ethyl (Et)

$CH_3 - CH_2 - CH_2 -$ propyl (pr)

$CH_3 - CH_2 - CH_2 - CH_2 -$ butyl (bu)

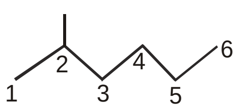
$$\begin{array}{l} CH_3 - CH - \\ \qquad\quad | \\ \qquad\ \ CH_3 \end{array}$$ (1-methyl ethyl)

$$\begin{array}{l} CH_3 - CH - CH_2 - \\ \qquad\quad | \\ \qquad\ \ CH_3 \end{array}$$ (2-methypropyl)

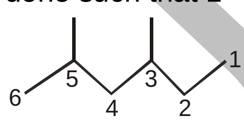
$$\begin{array}{l} \qquad\ \ CH_3 \\ \qquad\quad | \\ CH_3 - C - \\ \qquad\quad | \\ \qquad\ \ CH_3 \end{array}$$ (2,2,-dimethyl ethyl)

Rule-5 Alkyl groups are used as prefixes

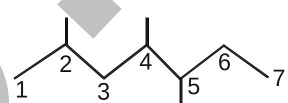
Rule-6 Numbering should be done such that 1st locant gets lowest possible number.



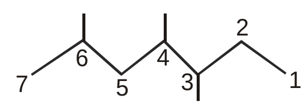
(Correct)



(Incorrect)



(Correct)



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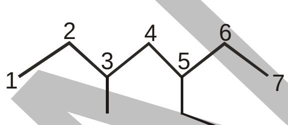
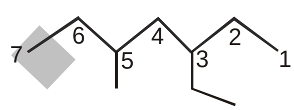


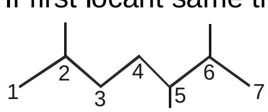
(Incorrect)
3-methyl
5-ethyl



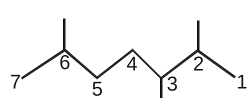
(Correct)
3-ethyl
5-methyl

Rule-6

If first locant same then look for sum rule:-



2 + 5 + 6 = 13
Higher sum
Incorrect



2 + 3 + 6 = 11
lower sum
Correct

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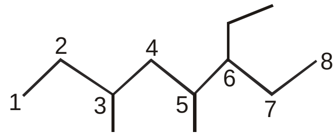
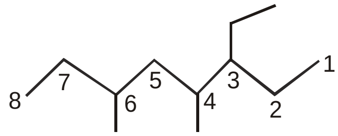
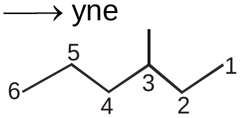


3 + 5 + 6 = 14
Incorrect



3 + 4 + 6 = 13
Correct

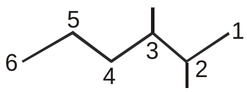
Rule-7 Suffix (P) ⟶ Primary suffix
Alkane ⟶ ane
Alkene ⟶ ene
Alkyne ⟶ yne



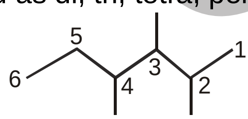
Prefix(s) + Word Root + Suffix (p) + Suffix (s)
3-methyl hexane

Remember ⟶
Number, number
Number – word,
No gap between 2 letters

Rule-8 Multiple substituents are represented as di, tri, tetra, penta etc.

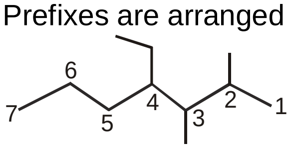


2,3-dimethyl hexane

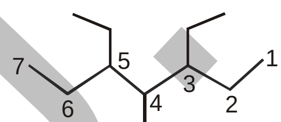


2,3, 4-trimethyl hexane

Rule-9 Prefixes are arranged in alphabetical order



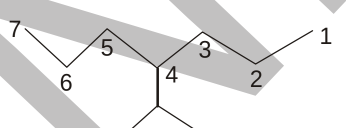
4-ethyl-2, 3-dimethylheptane



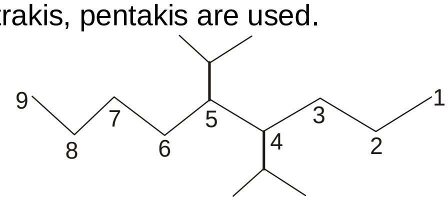
3,5-diethyl-4-methylheptane

di, tri etc. are not considered for arranging in alphabetical order

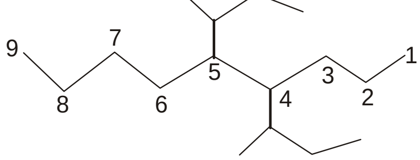
Rule-10 **Complex Substituent:-**
For multiple substituents bis, tris, tetrakis, pentakis are used.



4-(1-methylethyl)heptane

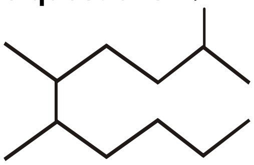


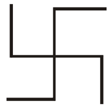
4,5-bis-(1-methylethyl)nonane

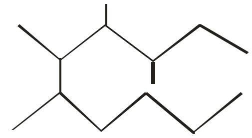


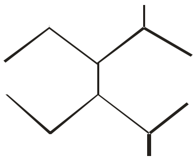
4,5-bis-(1-methylpropyl)nonane

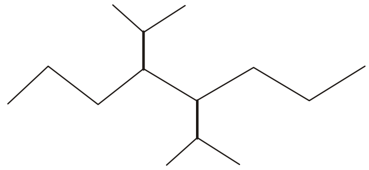
Practice questions:→

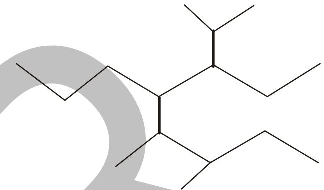
Q.1 

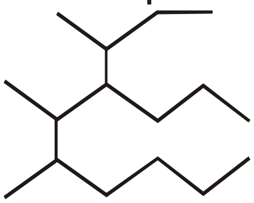
Q.2 

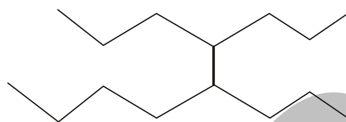
Q.3 

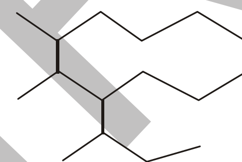
Q.4 

Q.5 

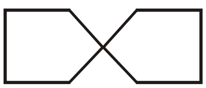
Q.6 

Q.7 

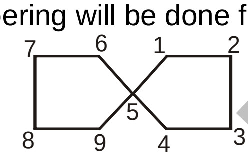
Q.8 

Q.9 

<u>Nomenclature</u> <u>or</u> <u>Spiro</u> <u>Compound</u>:-

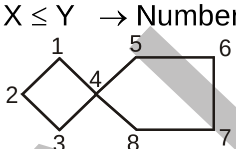
:→  → only one common carbon between 2 cyclic rings

→ Numbering will be done from neighbouring position of common carbon.

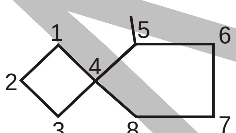


→ General formula
Spiro (x.y) + word root + Suffix(p) + Suffix(s)

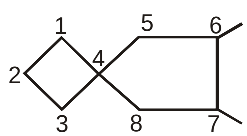
X ≤ Y → Numbering is done in increasing order



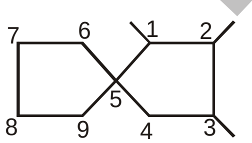
Spiro [3.4] octane

Q.1 

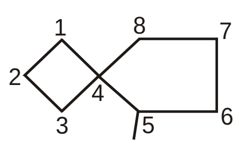
5 – methylspiro[3.4]octane

Q.2 

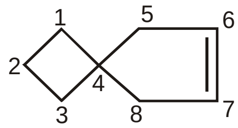
6,7 – dimethylspiro[3.4] octane

Q.3 

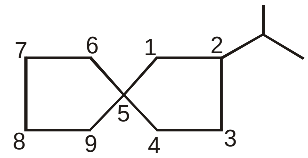
1,2,3 – trimethylspiro[4.4] nonane

Q.4 

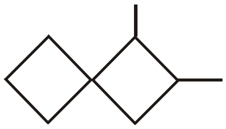
5 – methylspiro[3.4] octane

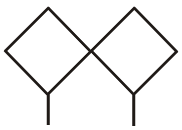
Q.5 

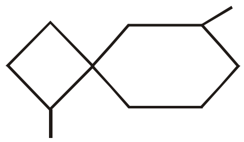
Spiro [3.4] oct – 6 – ene

Q.6 

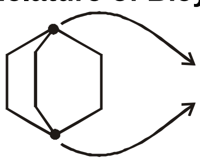
2 – (1-methylethyl)spiro[4.4]nonane

Q.7 

Q.1 

Q.2 

Nomenclature of Bicyclo compound

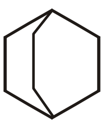
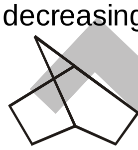
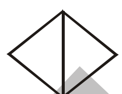
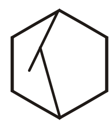
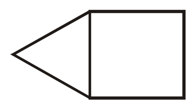
:→  Bridge positions

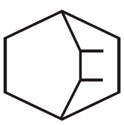
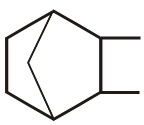
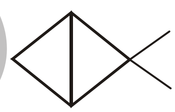
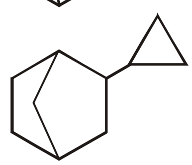
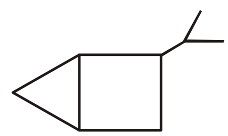
Prefix(s) + bicyclo [x.y.z.] + word root + suffix (p) + suffix (s)

$\boxed{X \geq Y \geq Z}$

→ Numbering is done from bridge head postion

→ Numbering is done in decreasing order of carbon atoms

(1)  (2)  (3)  (4)  (5) 

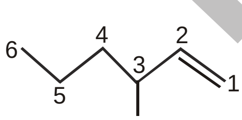
(6)  (7)  (8)  (9)  (10) 

Ans:- (1) bicyclo [2.2.2] octane (2) bicyclo [2.2.1] heptane
(3) bicyclo [1.1.0] butane (4) 7 – methylbicyclo [2.2.1] heptane

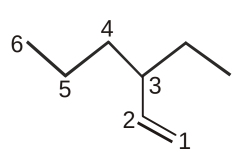
Nomenclature of alkens:→

→ Select chains such that = is included in main chain

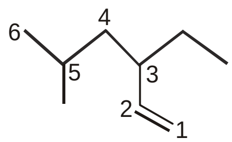
→ If more than one = are present, maximum double bonds should be included.

Q.1 

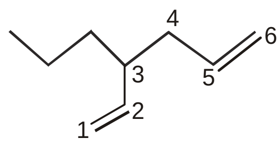
3–methyl hex–1–ene

Q.2 

3–ethyl hex–1–ene

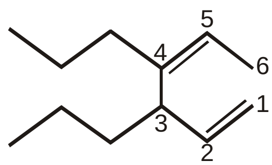
Q.3 

3–ethyl –5–methylhex–1–ene

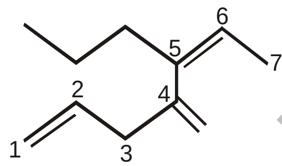
Q.4 

3–propylhexa–1, 5-diene

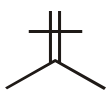
→ In case of diene, triene ………..the letter ‘a’ is placed after word root.

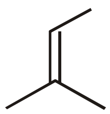
Q.5 

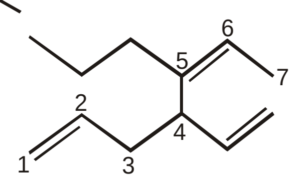
3,4-dipropyl hexa – 1, 4 – diene

Q.6 

4 – methylidene – 5 – propylhepta – 1,5 – diene

 Methylidene (doubly bonded substituents are named as methyl + idene)

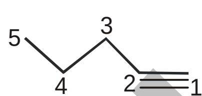
 Ethylidene



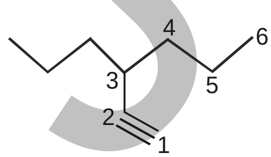
4 – ethenyl – 5 – propyl hepta – 1, 5 – diene

Nomenclature of alkynes:-

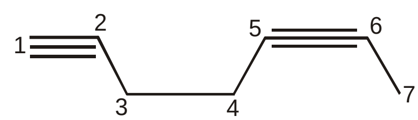
Suffix (p) ⟶ yne

Q.1 

Pent – 1 – yne

Q.2 

3 – propylhex – 1 – yne

Q.3 

hepta – 1, 5 – diyne

Q.4 $H_3C — C \equiv C — CH_2 — \underset{\underset{CH_3}{|}}{CH} — CH_3$

Q.5 $H_3C — C.C — CH — (Et)_2$

Q.6 $(CH_3 — CH_2)_2 — CH.CH — (CH_2 — CH_3)_2$

Q.7 $\overset{1}{H_2C} = \overset{2}{CH} — \overset{3}{CH_2} — \overset{4}{CH_2} — \overset{5}{C} \equiv \overset{6}{CH}$

Hex – 1 – ene – 5 – yne X

Hex – 1 – en – 5 – yne √

If ene and yne are present at same number alphabetical order is considered.

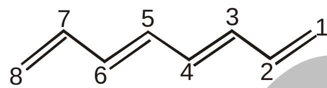
$\boxed{\bar{X} \rightarrow a, i, o, u, y}$ Remember

Q.8 $H_3\overset{7}{C} - \overset{6}{C}H = \overset{5}{C}H - \overset{4}{C}H_2 - \overset{3}{C}H_2 - \overset{2}{C} \equiv \overset{1}{C}H$

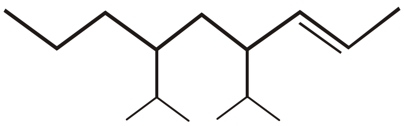
Hept – 1 – yne – 5 – ene X
Hept – 5 – ene – 15 – yne X
Hept – 5 – en – 1 – yne √

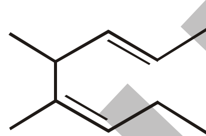
Q.9 $H\underset{6}{C} \equiv \underset{5}{C} - \underset{4}{C}H_2 - \underset{3}{\overset{\overset{CH_2}{\|}}{C}} - \underset{2}{C}H = \underset{1}{C}H_2$

3 – methylidenehex – 1 – en – 5 – yne

Q.10 

Octa – 1, 3, 5, 7 – tetraene

Q.11 

Q.12 

Nomenclature of Functional group containing Compound

: ⟶

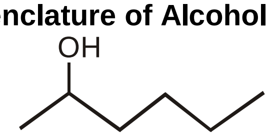
Functional group	Name	Suffix(s)	Prefix
1. $-\overset{\overset{O}{\|}}{C}-OH$	Carboxylic Acid	Oic acid (When Carbon included) Carboxylic acid (When Carbon is not included)	Carboxy
2. $-SO_3H$	Sulphonic acid	Sulphonic acid	Sulpho
3. $-\overset{\overset{O}{\|}}{C}-O-\underset{\underset{O}{\|}}{C}-$	Anhydride	Oic anyhdride (Carboxylic anhydride)	— —
4. $-\overset{\overset{O}{\|}}{C}-OR$	Ester	Alkyl…….Oate (carboxylate when carbon not included)	Alkoxy Carbonyl
5. $-\overset{\overset{O}{\|}}{C}-Cl$	Acid halide	Oyl chloride (Carbonyl Chloride)	haloformyl
6. $-\underset{\underset{O}{\|}}{C}-NH_2$	Amide	Amide (Carbamide)	Carbamoyl
7. — CN	Cyanide	Nitrile (Carbonitrile)	Cyano
8. — NC	Isocyanide	Carbylamine	Isocyano
9. $-C\begin{smallmatrix}\nearrow O \\ \searrow H\end{smallmatrix}$	Aldehyde	al (Carbaldehyde)	Formyl
10. $-\overset{\overset{O}{\|}}{C}-$	Ketone	One	Keto/oxo
11. — OH	Alcohol	Ol	Hydroxyl

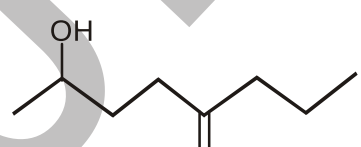
12. — SH	Thiol	Thiol	Mercapto
13. — NH_2	Amine	Amine	Amino
14. — C = C <	Alkene	—	(ene) Sufffix(p)
15. — C ≡ C —	Alkyne	—	(Yne) Suffix(p)
16. — NO_2	—	—	Nitro
— NO	—	—	Nitroso
— F	—	—	Fluoro

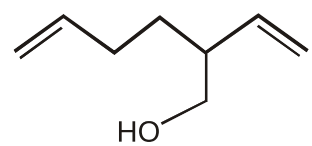
Nomenclature of Functional group containing Compound

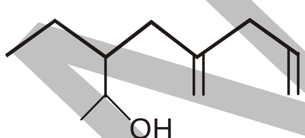
Functional group	Name	Suffix(s)	Prefix
— Cl		—	Chloro
— Br		—	Bromo
— I		—	Iodo
— O		—	Epoxy
= N		—	Diazo
— OR		—	Alkoxy

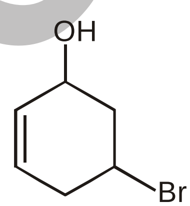
Nomenclature of Alcohol:-

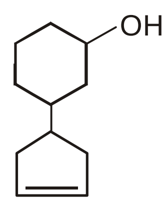
1. 

2. 

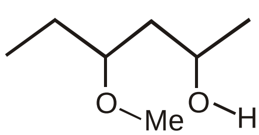
3. 

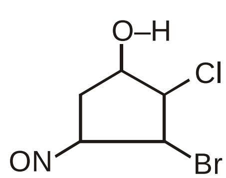
4. 

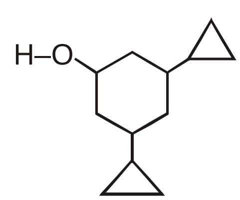
5. 

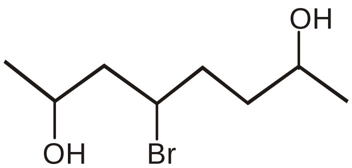
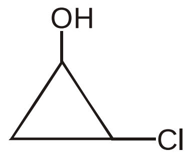
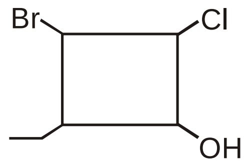
6. 

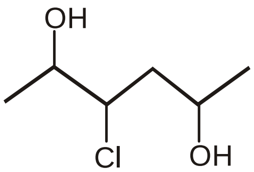
Ans.
1. hexan – 2 – ol
2. 5 – propylhex – 5 – en – 2 – ol
3. 2 – ethenylhex – 5 – enol
4. 3-ethyl-5-methylidene oct – 7 – en – 2 – ol
5. 5-bromocyclo hex – 2 – en – 1 – ol
6. 5-cyclohexyl cyclopent – 2- en – 1 – ol

Q.1 

Q.2 

Q.3 

Q.4  **Q.5**  **Q.6** 

Q.7 

Ans. 1. 4-methoxy hexan-2-ol 2. 3-bromo-2-chloro-4-nitrosocyclopentan-1-ol
3. 3,5-dicyclo propyl hexan-1-ol

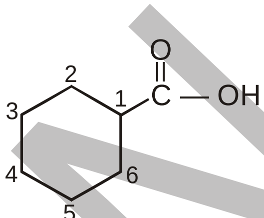
Nomenclature of carboxylic acid:→

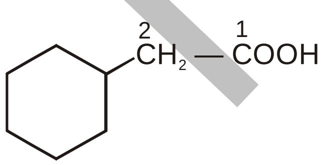
→ If carbon included in main chain
Suffix (s) ⟶ Oic acid

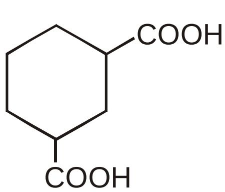
→ If carbon non included in main chain
Suffix (s) ⟶ Carboxylic acid

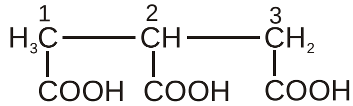
1. $\underset{3}{H_3C}-\underset{2}{CH_2}-\underset{1}{\overset{\overset{O}{||}}{C}}-OH$ ⟶ propane-1-oic acid X
propan-1-oic acid √

2. $\overset{4}{H_3C}-\overset{3}{\underset{CH_3}{\underset{|}{CH}}}-\underset{2}{CH_2}-\underset{1}{\overset{\overset{O}{||}}{C}}-OH$ ⟶ 3-methylbutane-1-oic acid X
3-methylbutanss-1-oic acid √

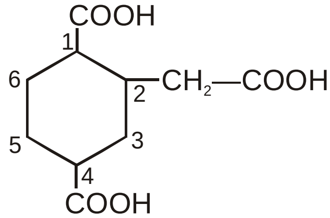
3.  ⟶ cyclohexane-1-carboxylic acid (correct new) √
⟶ 1-cyclohexylmethan-1-oic acid (old)

4.  ⟶ 2-cyclohexylethan-1-oic acid

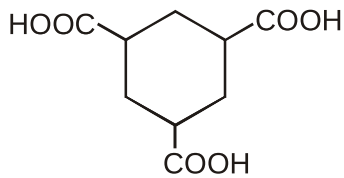
5.  ⟶ cyclohexane-1,3-dicarboxylic acid

Q. 

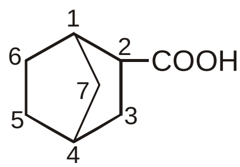
Propane-1, 2, 3-tricarboxylic acid (New)

Q. 

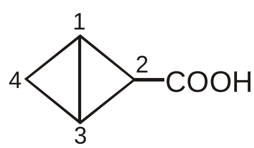
2-carboxymethyl cyclohexane-1, 4 dicarboxylic acid

Q. 

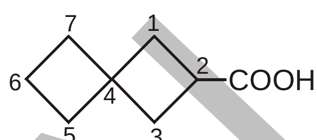
Cyclohexane 1, 3, 5-tricarboxylic acid

Q. 

Bicyclo [2.2.1] heptane-2-carboxylic acid

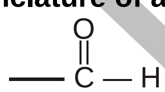
Q. 

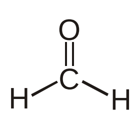
Bicyclo [1.1.0] butane-2 carboxylic acid

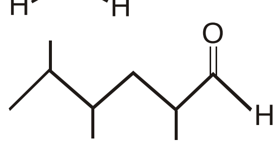
Q. 

Spiro [.3] heptane-2-carboxylic acid

Nomenclature of aldehyde:-

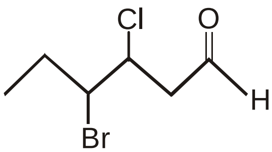
 al $\longrightarrow$ suffix(s)

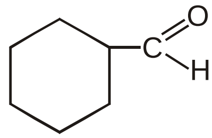
 Methan-1-al

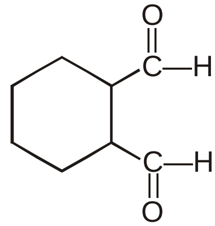
1. 

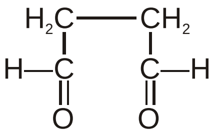
2. 

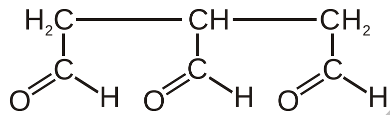
Ans. (1) 2,4,5 trimethyl hexan-1-al (2) Octa-3,5,7-trien-1-al

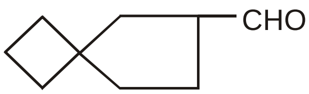
Q. 

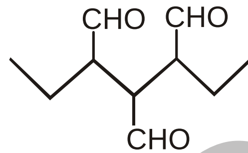
Q. 

Q. 

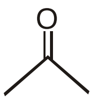
Q. 

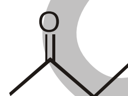
Q. 

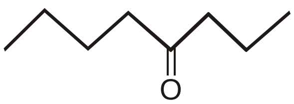
Q. 

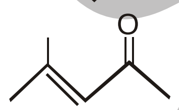
Q. 

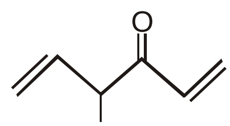
Nomenclature of ketones:-

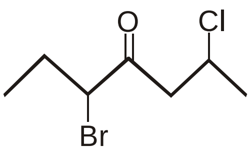
(1)  propane-2-one

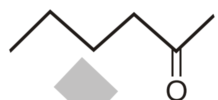
(2)  butan-2-one

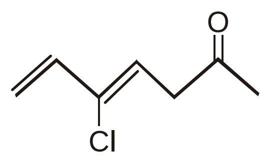
(3) 

(4) 

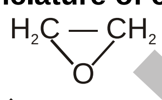
(5) 

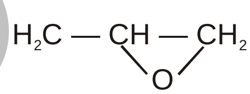
(6) 

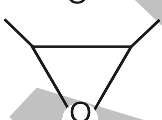
(7) 

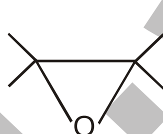
(8) 

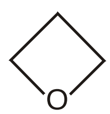
Nomenclature of cyclic ethers:-

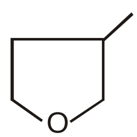
(1)  1,2-epoxyethane

(2)  1,2-epoxypropane

(3) 

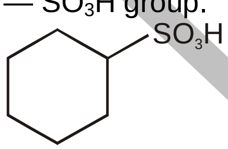
(4) 

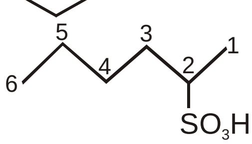
(5) 

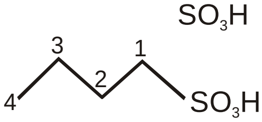
(6) 

Nomenclature of sulphonic acid:-

— SO_3H group.

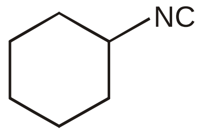
(1)  cyclohexanesulphonic acid

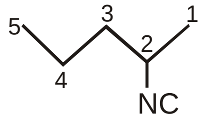
(2)  hexane-2-sulphonic acid

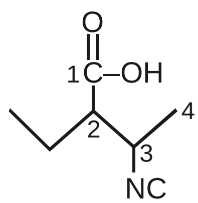
(3)  butane-1-sulphonic acid

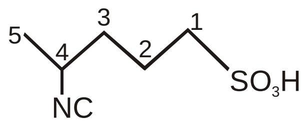
Nomenclature of Isocyanide (–NC):-

(1) $H_3C - CH_2 - N \Rrightarrow C$ ethan-1-carbylamine

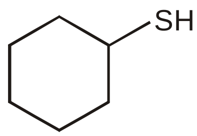
(2)  cyclohexane-1-carbylamine

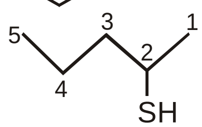
(3)  pentan-2-carbylamine

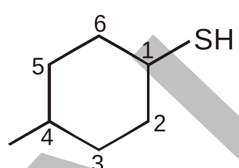
(4)  2-ethyl-3-isocyanobutan-1-oic acid

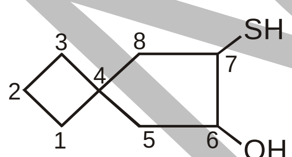
(5)  4-isocyanopentane-1-sulphonic acid

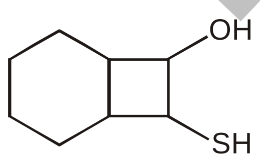
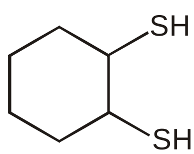
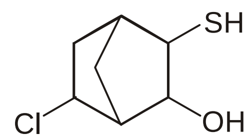
Nomenclature of thiol. (— SH):-

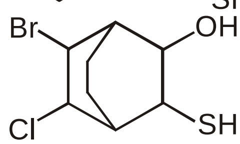
(1)  cyclohexanethiol

(2)  pentane-2-thiol

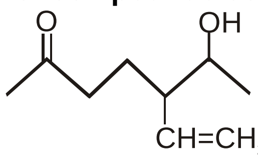
(3)  4-methylcyclohexane-1-thiol

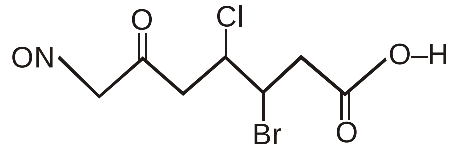
(4)  7-merceptospiro [3.4] heptan-6-Ol

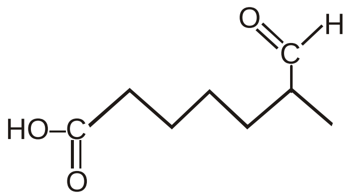
(5)  (6)  (7) 

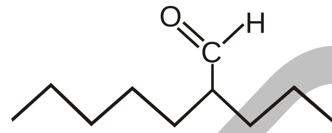
(8) 

Nomenclature of compounds containing multiple functional group:-

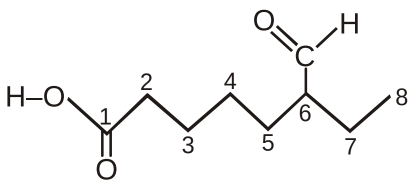
:→ (1) 

(2) 

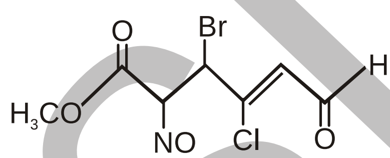
(3) 

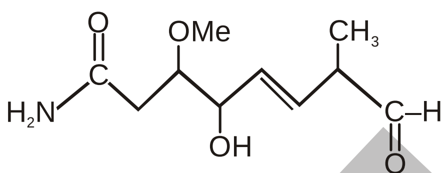
(4) 

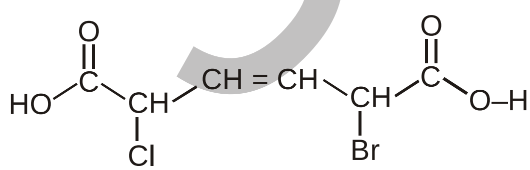
Ans. (1) 5-ethenyl-6-hydroxyheptan-2-one (2) 3-bromo-4-chloro-7-nitroso-6-oxoheptan-1-oic acid
(3) 6-methyl-7-oxoheptan-1-oic acid (4) 2-propylheptan-1-al

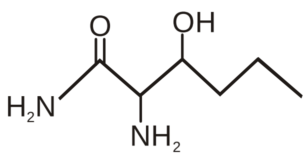
Q.1 

6-formyloctan-1-oic acid

Q.2 

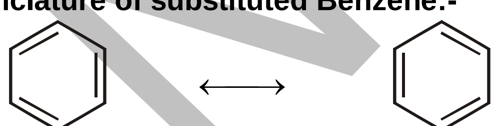
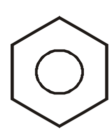
Q.3 

Q.4 

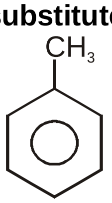
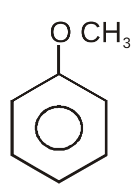
Q.5 

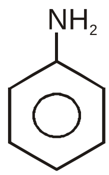
Ans. **Q.1** 6-formyloctan-1-oic acid
Q.2 Methyl-3-bromo-4-chloro-2-nitroso-6-oxo-hex-4-enoate
Q.3 4-hydroxy-3-methoxy-7-methyl-8-oxo-oct-5-enamide
Q.4 2-bromo-5-chlorohex-3-ene-1,6-dioic acid
Q.5 2-amino-3-hydroxyhexanamide

Nomenclature of substituted Benzene:-

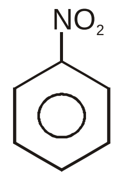
  Benzene

Monosubstituted Benzene:-

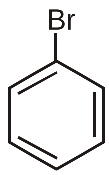
 Methyl benzene (Toluene)  Methyl benzene (Anisole)



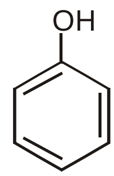
Amino benzene (Aniline)



Nitrobenzene

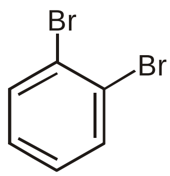


Bromobenzene

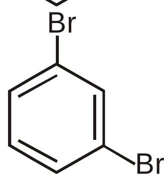


Hydroxybenzene (phenol)

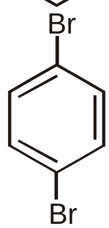
Disubstituted Benzene:-



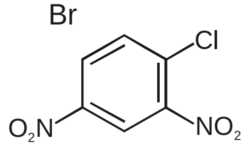
1,2-dibromobenzene (o-dibromobenzene)



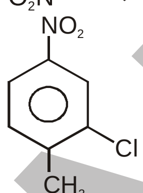
1,3-dibromobenzene, [metadibromobenzne (m-dibromobenzene)]



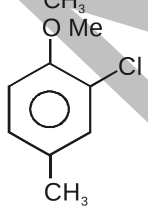
1,4-dibromobenzene, [paradibromobenzene (p-dibromobenzne)]



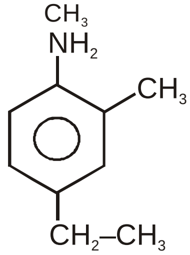
1-chloro-2, 4-dinitrobenzene, (4-chloro 1, 3-dinitrobenzne X)



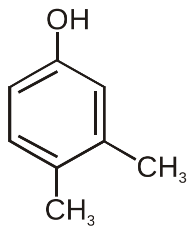
2-chloro-1-methyl-4-nitrobenzne



2-chloro-4-methylanisole

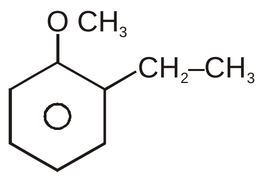


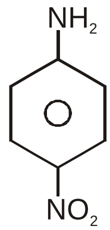
4-ethyl-2-methylaniline

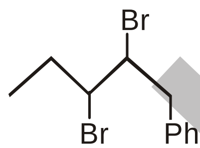


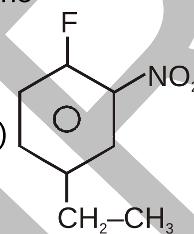
3,4-dimethylphenol

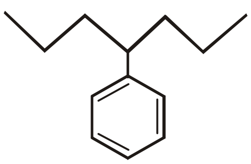
Q. Write the structure of :-
(a) o-ethylanisole (b) p-nitroaniline
(c) 2,3-dibromo-1-phenylpentane (d) 4-ethyl-1 flouro-2-nitrobenzene

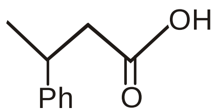
Ans. (a) 

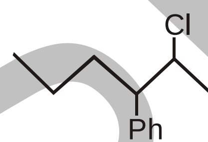
(b) 

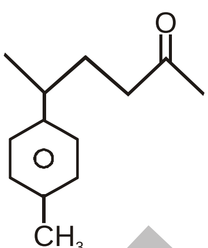
(c) 

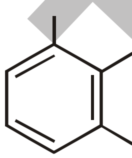
(d) 

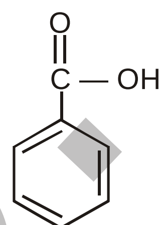
Q.1 

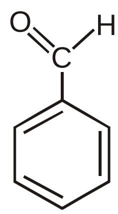
Q.2 

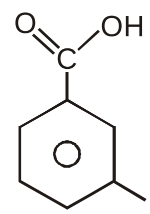
Q.3 

Q.4 

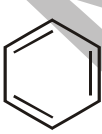
Q.5 

Q.6 

Q.7 

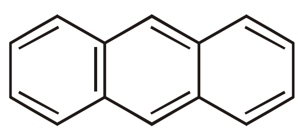
Q.8 

Common Name:-

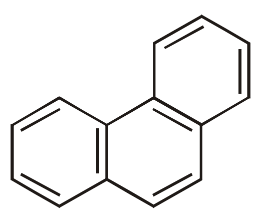


Benzene

Napthalene



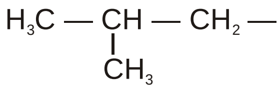
Anthracene



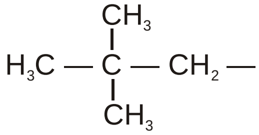
Phenanthrene

Common Name

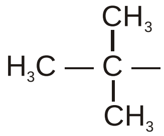
	I.U.P.A.C.	**Common**
$H_3C-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-$	1-methyl ethyl	Isopropyl



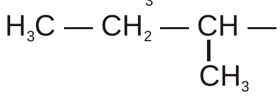
2-methylbutyl isobutyl



2,2-dimethylpropyl Neopentyl



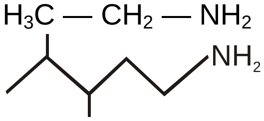
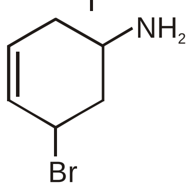
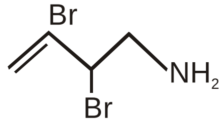
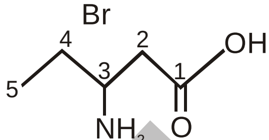
tert.-butyl

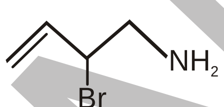


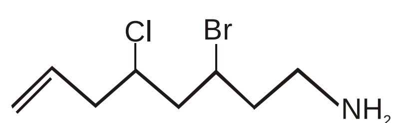
sec.butyl

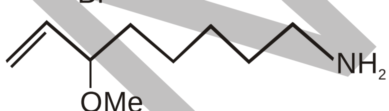
Nomenclature of Amines:-
—NH_2

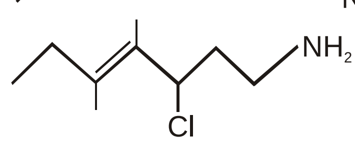
Suffix(a) $\longrightarrow$ Amine
Prefix $\longrightarrow$ Amino

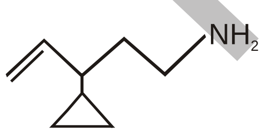
1. $H_3C-CH_2-NH_2$ $\longrightarrow$ Ethanamine
2.  $\longrightarrow$ 3,4-dimethylpentanamine
3.  $\longrightarrow$ 5-bromocyclohex-3-enamine
4.  $\longrightarrow$ 2-bromobut-3-enamine
5.  $\longrightarrow$ 3-aminobutan-1-oic acid

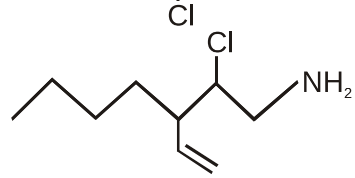
Q.1 

Q.2 

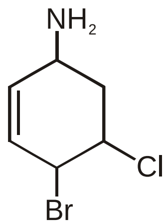
Q.3 

Q.4 

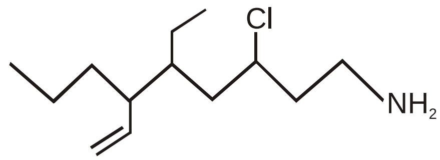
Q.5. 

Q.6 

Q.7

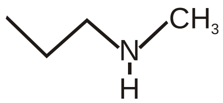


Q.8



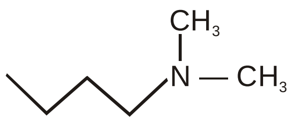
Ans. **Q.1** 2-bromobut-3-enamine **Q.2** 3-bromo-5-chloro oct-7-enamine
Q.3 6-methoxyoct-7-enamine **Q.4** 3-chloro-4,5-dimethyl hept-4-enamine
Q.5 3-cyclopylpent-4-enamine **Q.6** 3-butyl-2-chloropent-4-enamine
Q.7 4-bromo-5-chlorohex-2-enamine **Q.8** 3-chloro-5-ethyl-6-propyl oct-7-enamine

Q.1



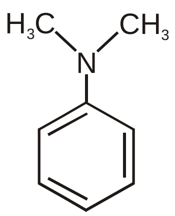
N-methylaminopropane

Q.2



N, N-dimethylaminobutane

Q.3



N, N-dimethylaminobenzene

Nomenclature of Esters:-

$$R' - \overset{O}{\overset{\|}{C}} - OR$$

$\downarrow$

Alkyl

$\downarrow$

(Name starts with alkyl)

Q.1 $H_3C - CH_2 - \overset{O}{\overset{\|}{C}} - O - CH_3$

Methylpropan-1-oate

Q.2 $H_3C - \overset{O}{\overset{\|}{C}} - O - CH_2 - CH_2 - CH_3$

propylethan-1-oate

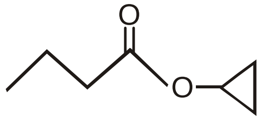
Q.3 $\overset{Br}{\overset{|}{H_2C}} - CH_2 - \overset{O}{\overset{\|}{C}} - O - CH_3$

Methyl-3-bromo-propan-1-oate

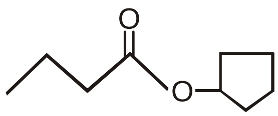
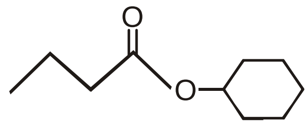
Q.4 $H_3C - \overset{O}{\overset{\|}{C}} - O - CH_2 - CH = CH_2$

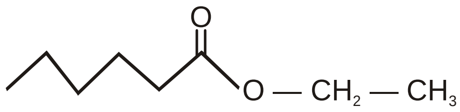
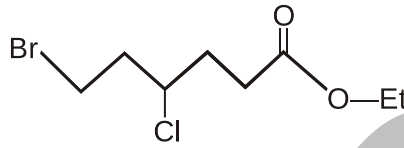
Prop-2-enylethanoate

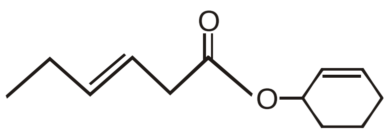
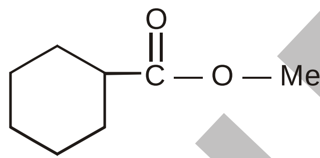
Q.5

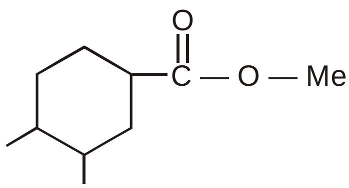


Cyclopropylbutanoate

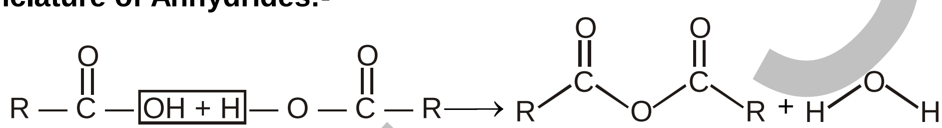
(1)  (2) 

(3)  (4) 

(5)  (6) 

(7)  (8) $H_3C - CH_2 - \overset{\overset{O}{||}}{C} - O\ Me$

Nomenclature of Anhydrides:-



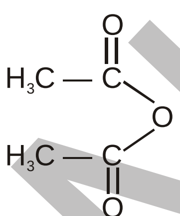
→ Formed by loss of $H-O-H$

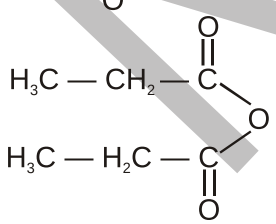
→ Suffix(s) → oic anhydride (If carbon included)

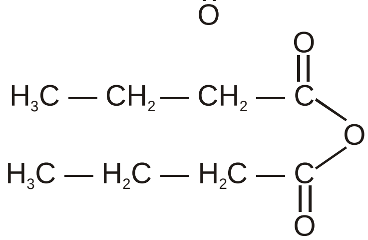
→ Carboxylic anhydride (if carbon not included)

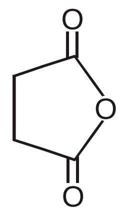
Naming of symmetrical Anhydrides:-

:⟶

(1)  ethanoic anhydride

(2)  propanoic anhydride

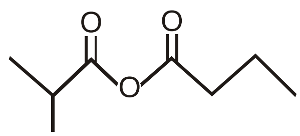
(3)  butanoic anhydride

(4)  butane-1,4-dioic anhydride

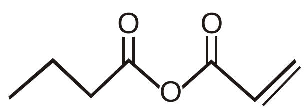
Naming of Unsymmetrical anhydride:-

(1) $H_3C-\overset{\overset{O}{||}}{C}-O-\overset{\overset{O}{||}}{C}-CH_2-CH_3$

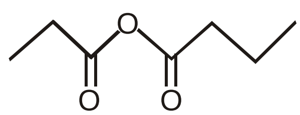
Ethanoic propanoic anhydride

(2) 

Butanoic-2-methylpropanoic anhydride

(3) 

Butanoic prop-2-enoicanhydride

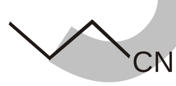
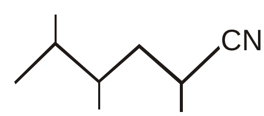
(4) 

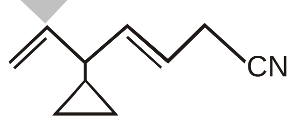
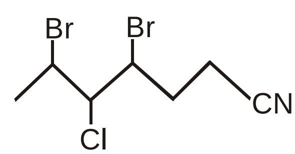
Butanoic propanoic anhydride

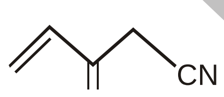
Nomenclature of cyanides:-

—CN → Nitrile

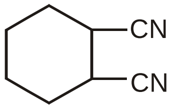
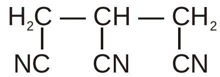
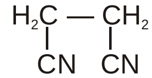
—CN → Carbonitrile

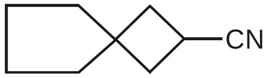
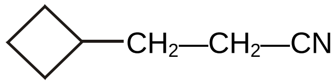
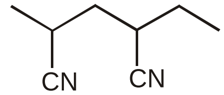
Q.1 $H_3C-C\equiv N$ **Q.2**  **Q.3** 

Q.4  **Q.5**  **Q.6** 

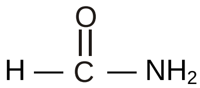
Q.7  **Q.8** 

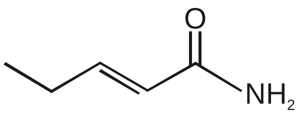
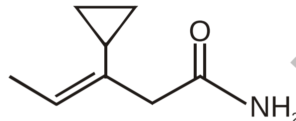
Ans. **Q.1** ethanenitrile **Q.2** butanenitrile **Q.3** 2,4,5-trimethylhexanenitrile
Q.4 4-ethylpent-4-ene-1-nitrile **Q.5** 5-cyclopropylhepta-3,6-diene-1-nitrile
Q.6 4,6-dibromo-5-chloropentane-nitrile **Q.7** 3-methylidenepent-4-one-1nitrile
Q.8 5-bromohex-3-ene-1-nitrile

Q.1  **Q.2**  **Q.3** 

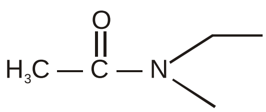
Q.3  **Q.4**  **Q.5** 

Nomenclature of Amides:-

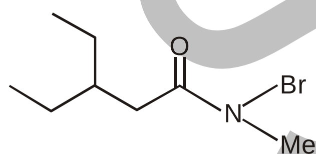
 Methanamide

(1)  (2)  (3) 

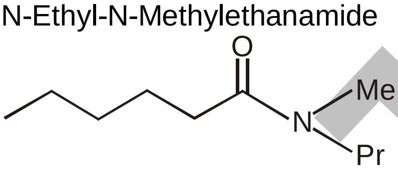
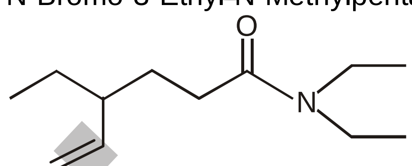
Ans. (1) pent-2-en-1-amide, pent-2-enamide
(2) 3-cyclopropyl pent-3-en-1-amide
(3) N-methylhexan-1-amide

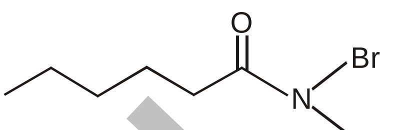
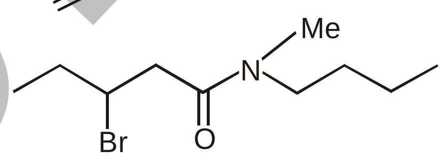
(4) 

N-Ethyl-N-Methylethanamide

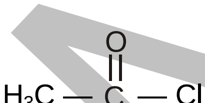
(5) 

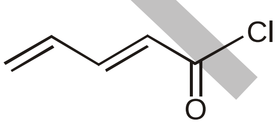
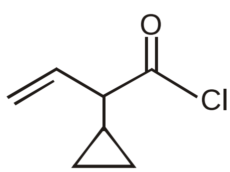
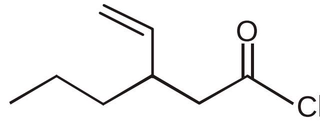
N-Bromo-3-Ethyl-N-Methylpentanamide

(6)  (7) 

(8)  (9) 

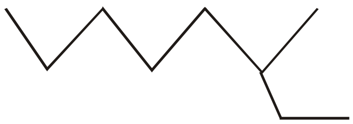
Nomenclature of Acid Halides:-

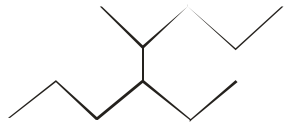
(1)  ethanoylchloride

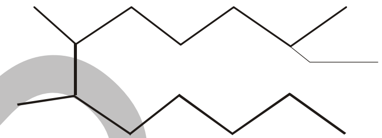
(2)  (3)  (4) 

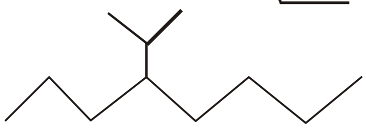
NOMENCLATURE

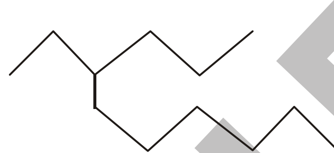
Rule-1 Select the longest chain

Q.1 

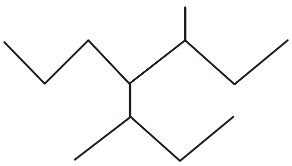
Q.2 

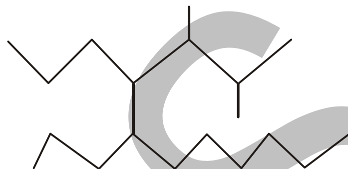
Q.3 

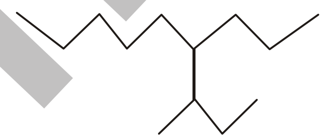
Q.4 

Q.5 

Rule-2 If 2-chains are same lengths select chain with more number of branches.

Q.1 

Q.2 

Q.3 

Rule-3 General formula

Prefix(s) + $\boxed{\text{Word Root}}$ + Suffix (P) + Suffix (s)

Word Root :- Represents Number of carbon atoms in main chain.

1.	No. of Carbon atoms	Word Root0……..
	1	meth
	2	eth
	3	prop
	4	but
	5	pent
	6	hex
	7	hept
	8	oct
	9	non
	10	dec
	11	undec
	12	dodec
	13	tridec
	14	tetradec
	15	pentadec
	16	hexadec
	17	heptadec
	18	octadec
	19	nonadec
	20	eicos
	30	tricont

Rule-4 Side chains are represented as alkyl group

$C_nH_{2n+1} \longrightarrow$ alkyl

CH_3— methyl (Me)

$CH_3 — CH_2 —$ Ethyl (Et)

$CH_3 — CH_2 — CH_2 —$ propyl (pr)

$CH_3 — CH_2 — CH_2 — CH_2 —$ butyl (bu)

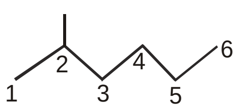
$$\begin{array}{l} CH_3 — CH — \\ \qquad\quad | \\ \qquad\; CH_3 \end{array}$$ (1-methyl ethyl)

$$\begin{array}{l} CH_3 — CH — CH_2 — \\ \qquad\quad | \\ \qquad\; CH_3 \end{array}$$ (2-methypropyl)

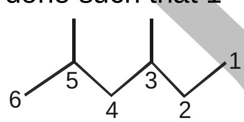
$$\begin{array}{l} \qquad\; CH_3 \\ \qquad\quad | \\ CH_3 — C — \\ \qquad\quad | \\ \qquad\; CH_3 \end{array}$$ (2,2,-dimethyl ethyl)

Rule-5 Alkyl groups are used as prefixes

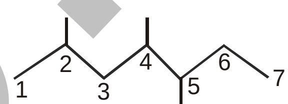
Rule-6 Numbering should be done such that 1st locant gets lowest possible number.



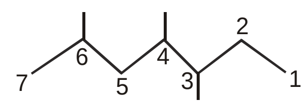
(Correct)



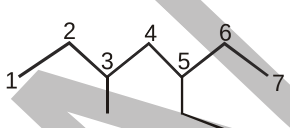
(Incorrect)



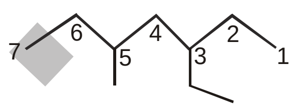
(Correct)



(Incorrect)



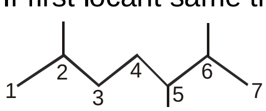
(Incorrect)
3-methyl
5-ethyl



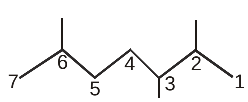
(Correct)
3-ethyl
5-methyl

Rule-6

If first locant same then look for sum rule:-



2 + 5 + 6 = 13
Higher sum
Incorrect



2 + 3 + 6 = 11
lower sum
Correct

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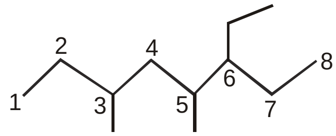
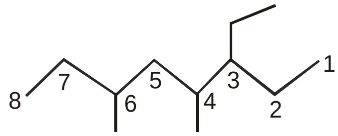
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

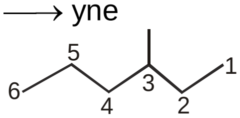


3 + 5 + 6 = 14
Incorrect



3 + 4 + 6 = 13
Correct

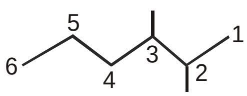
Rule-7 Suffix (P) ⟶ Primary suffix
Alkane ⟶ ane
Alkene ⟶ ene
Alkyne ⟶ yne



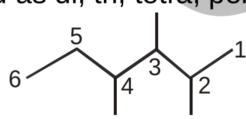
Prefix(s) + Word Root + Suffix (p) + Suffix (s)
3-methyl hexane

Remember ⟶
Number, number
Number – word,
No gap between 2 letters

Rule-8 Multiple substituents are represented as di, tri, tetra, penta etc.

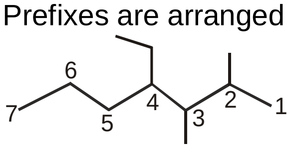


2,3-dimethyl hexane

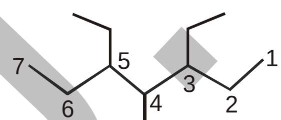


2,3, 4-trimethyl hexane

Rule-9 Prefixes are arranged in alphabetical order



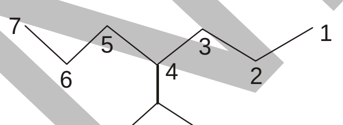
4-ethyl-2, 3-dimethylheptane



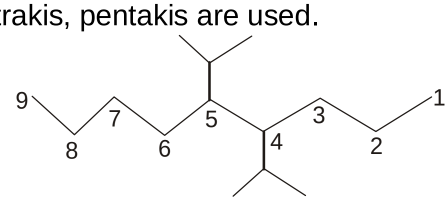
3,5-diethyl-4-methylheptane

di, tri etc. are not considered for arranging in alphabetical order

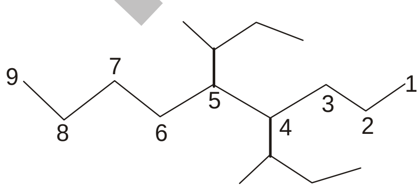
Rule-10 **Complex Substituent:-**
For multiple substituents bis, tris, tetrakis, pentakis are used.



4-(1-methylethyl)heptane

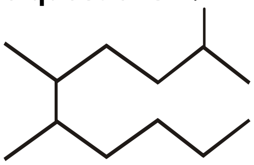


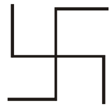
4,5-bis-(1-methylethyl)nonane

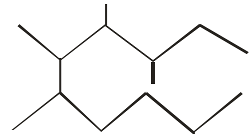


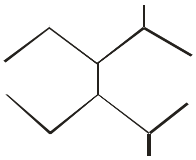
4,5-bis-(1-methylpropyl)nonane

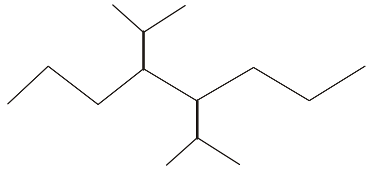
Practice questions:→

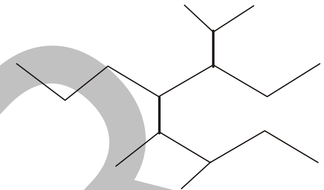
Q.1 

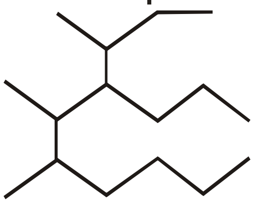
Q.2 

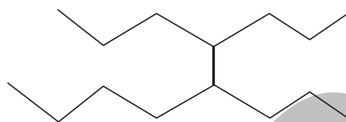
Q.3 

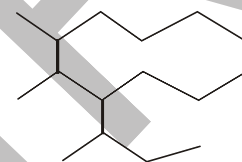
Q.4 

Q.5 

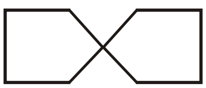
Q.6 

Q.7 

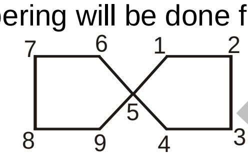
Q.8 

Q.9 

<u>Nomenclature</u> <u>or</u> <u>Spiro</u> <u>Compound</u>:-

:→  → only one common carbon between 2 cyclic rings

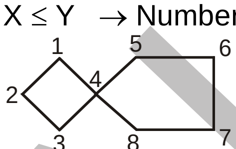
→ Numbering will be done from neighbouring position of common carbon.



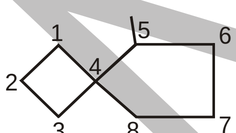
→ General formula

Spiro (x.y) + word root + Suffix(p) + Suffix(s)

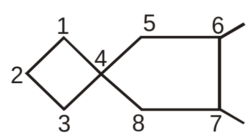
X ≤ Y → Numbering is done in increasing order



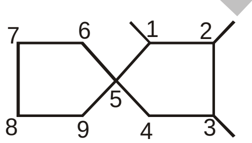
Spiro [3.4] octane

Q.1 

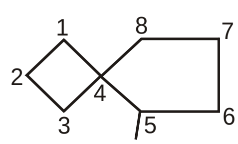
5 – methylspiro[3.4]octane

Q.2 

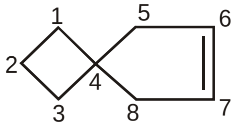
6,7 – dimethylspiro[3.4] octane

Q.3 

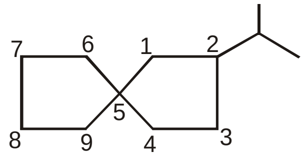
1,2,3 – trimethylspiro[4.4] nonane

Q.4 

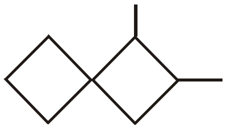
5 – methylspiro[3.4] octane

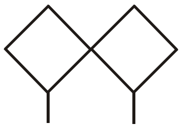
Q.5 

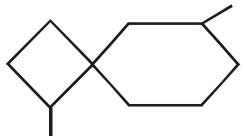
Spiro [3.4] oct – 6 – ene

Q.6 

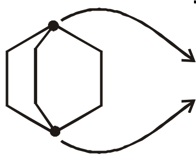
2 – (1-methylethyl)spiro[4.4]nonane

Q.7 

Q.1 

Q.2 

Nomenclature of Bicyclo compound

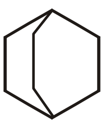
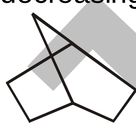
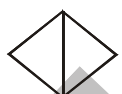
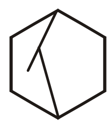
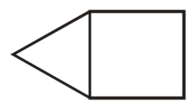
:→  Bridge positions

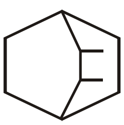
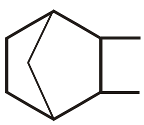
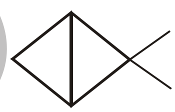
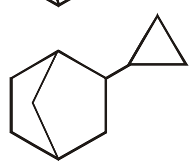
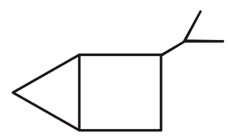
Prefix(s) + bicyclo [x.y.z.] + word root + suffix (p) + suffix (s)

$\boxed{X \geq Y \geq Z}$

→ Numbering is done from bridge head postion

→ Numbering is done in decreasing order of carbon atoms

(1)  (2)  (3)  (4)  (5) 

(6)  (7)  (8)  (9)  (10) 

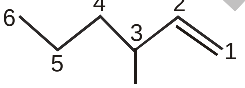
Ans:- (1) bicyclo [2.2.2] octane (2) bicyclo [2.2.1] heptane

(3) bicyclo [1.1.0] butane (4) 7 – methylbicyclo [2.2.1] heptane

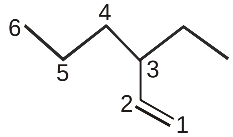
Nomenclature of alkens:→

→ Select chains such that = is included in main chain

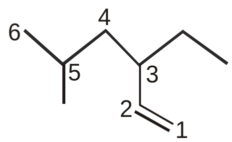
→ If more than one = are present, maximum double bonds should be included.

Q.1 

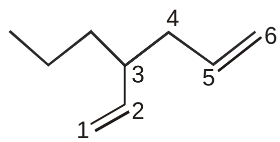
3–methyl hex–1–ene

Q.2 

3–ethyl hex–1–ene

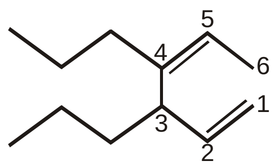
Q.3 

3–ethyl –5–methylhex–1–ene

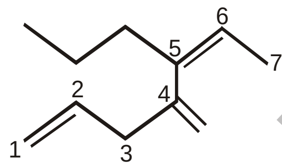
Q.4 

3–propylhexa–1, 5-diene

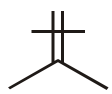
→ In case of diene, triene ………..the letter 'a' is placed after word root.

Q.5 

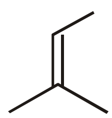
3,4-dipropyl hexa – 1, 4 – diene

Q.6 

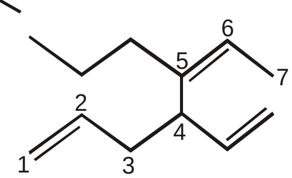
4 – methylidene – 5 – propylhepta – 1,5 – diene



Methylidene (doubly bonded substituents are named as methyl + idene)



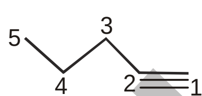
Ethylidene



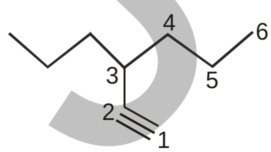
4 – ethenyl – 5 – propyl hepta – 1, 5 – diene

Nomenclature of alkynes:-

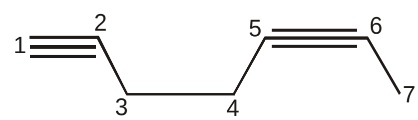
Suffix (p) $\longrightarrow$ yne

Q.1 

Pent – 1 – yne

Q.2 

3 – propylhex – 1 – yne

Q.3 

hepta – 1, 5 – diyne

Q.4 $H_3C - C \equiv C - CH_2 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3$

Q.5 $H_3C - C.C - CH - (Et)_2$

Q.6 $(CH_3 - CH_2)_2 - CH.CH - (CH_2 - CH_3)_2$

Q.7 $\overset{1}{H_2C} = \overset{2}{CH} - \overset{3}{CH_2} - \overset{4}{CH_2} - \overset{5}{C} \equiv \overset{6}{CH}$

Hex – 1 – ene – 5 – yne X

Hex – 1 – en – 5 – yne √

If ene and yne are present at same number alphabetical order is considered.

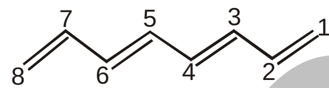
$\boxed{\bar{X} \to a,i,o,u,y}$ Remember

Q.8 $\overset{7}{H_3C} - \overset{6}{CH} = \overset{5}{CH} - \overset{4}{CH_2} - \overset{3}{CH_2} - \overset{2}{C} \equiv \overset{1}{CH}$

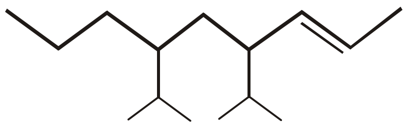
Hept – 1 – yne – 5 – ene X
Hept – 5 – ene – 15 – yne X
Hept – 5 – en – 1 – yne √

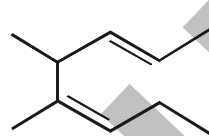
Q.9 $\underset{6}{HC} \equiv \underset{5}{C} - \underset{4}{CH_2} - \underset{3}{\overset{\overset{CH_2}{||}}{C}} - \underset{2}{CH} = \underset{1}{CH_2}$

3 – methylidenehex – 1 – en – 5 – yne

Q.10 

Octa – 1, 3, 5, 7 – tetraene

Q.11 

Q.12 

Nomenclature of Functional group containing Compound

: ⟶

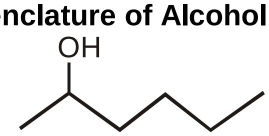
Functional group	Name	Suffix(s)	Prefix
1. $-\overset{\overset{O}{\Vert}}{C}-OH$	Carboxylic Acid	Oic acid (When Carbon included) Carboxylic acid (When Carbon is not included)	Carboxy
2. $-SO_3H$	Sulphonic acid	Sulphonic acid	Sulpho
3. $-\overset{\overset{O}{\Vert}}{C}-O-\underset{\underset{O}{\Vert}}{C}-$	Anhydride	Oic anyhdride (Carboxylic anhydride)	— —
4. $-\overset{\overset{O}{\Vert}}{C}-OR$	Ester	Alkyl…….Oate (carboxylate when carbon not included)	Alkoxy Carbonyl
5. $-\overset{\overset{O}{\Vert}}{C}-Cl$	Acid halide	Oyl chloride (Carbonyl Chloride)	haloformyl
6. $-\underset{\underset{O}{\Vert}}{C}-NH_2$	Amide	Amide (Carbamide)	Carbamoyl
7. $-CN$	Cyanide	Nitrile (Carbonitrile)	Cyano
8. $-NC$	Isocyanide	Carbylamine	Isocyano
9. $-C\overset{O}{\underset{H}{\lessgtr}}$	Aldehyde	al (Carbaldehyde)	Formyl
10. $-\overset{\overset{O}{\Vert}}{C}-$	Ketone	One	Keto/oxo
11. $-OH$	Alcohol	Ol	Hydroxyl

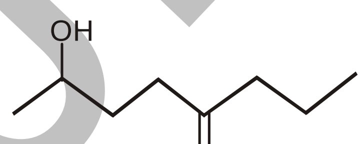
12. — SH	Thiol	Thiol	Mercapto
13. — NH_2	Amine	Amine	Amino
14. $>C=C<$	Alkene	—	(ene) Sufffix(p)
15. — C ≡ C —	Alkyne	—	(Yne) Suffix(p)
16. — NO_2	—	—	Nitro
— NO	—	—	Nitroso
— F	—	—	Fluoro

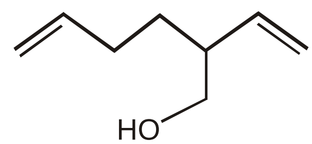
Nomenclature of Functional group containing Compound

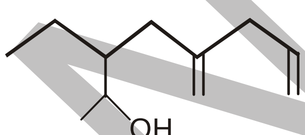
Functional group	Name	Suffix(s)	Prefix
— Cl		—	Chloro
— Br		—	Bromo
— I		—	Iodo
— O		—	Epoxy
= N		—	Diazo
— OR		—	Alkoxy

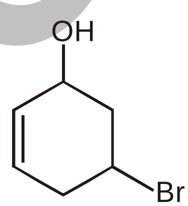
Nomenclature of Alcohol:-

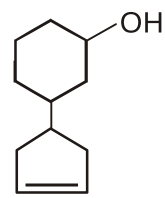
1. 

2. 

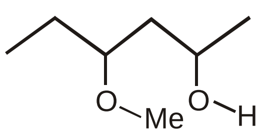
3. 

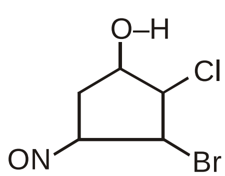
4. 

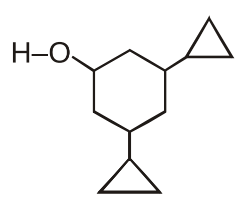
5. 

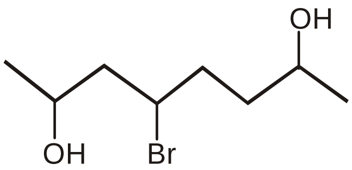
6. 

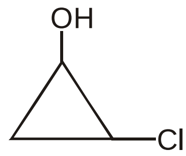
Ans. 1. hexan – 2 – ol
2. 5 – propylhex – 5 – en – 2 – ol
3. 2 – ethenylhex – 5 – enol
4. 3-ethyl-5-methylidene oct – 7 – en – 2 – ol
5. 5-bromocyclo hex – 2 – en – 1 – ol
6. 5-cyclohexyl cyclopent – 2- en – 1 – ol

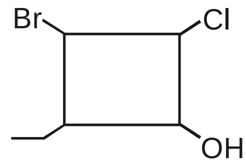
Q.1 

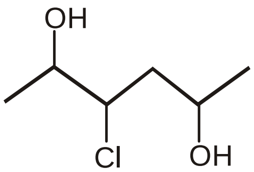
Q.2 

Q.3 

Q.4 

Q.5 

Q.6 

Q.7 

Ans. 1. 4-methoxy hexan-2-ol 2. 3-bromo-2-chloro-4-nitrosocyclopentan-1-ol
3. 3,5-dicyclo propyl hexan-1-ol

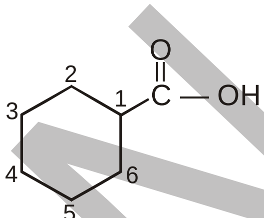
Nomenclature of carboxylic acid:→

→ If carbon included in main chain
Suffix (s) ⟶ Oic acid

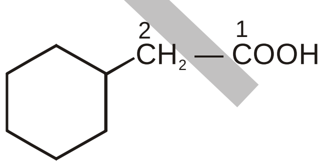
→ If carbon non included in main chain
Suffix (s) ⟶ Carboxylic acid

1. $\underset{3}{H_3C} - \underset{2}{CH_2} - \underset{1}{\overset{\overset{\displaystyle O}{||}}{C}} - OH$ ⟶ propane-1-oic acid X
propan-1-oic acid √

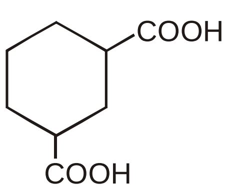
2. $\underset{}{\overset{4}{H_3C}} - \overset{3}{\underset{\underset{\displaystyle CH_3}{|}}{CH}} - \underset{2}{CH_2} - \underset{1}{\overset{\overset{\displaystyle O}{||}}{C}} - OH$ ⟶ 3-methylbutane-1-oic acid X
3-methylbutanss-1-oic acid √

3. 

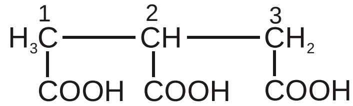
⟶ cyclohexane-1-carboxylic acid (correct new) √
⟶ 1-cyclohexylmethan-1-oic acid (old)

4. 

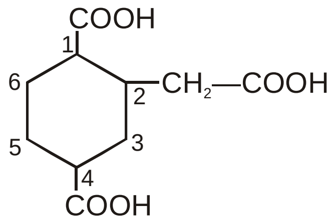
⟶ 2-cyclohexylethan-1-oic acid

5. 

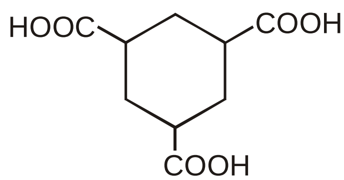
⟶ cyclohexane-1,3-dicarboxylic acid

Q. 

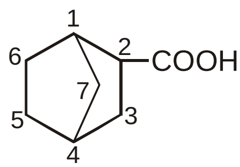
Propane-1, 2, 3-tricarboxylic acid (New)

Q. 

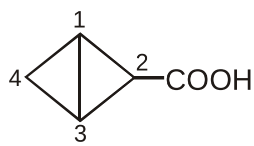
2-carboxymethyl cyclohexane-1, 4 dicarboxylic acid

Q. 

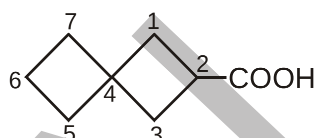
Cyclohexane 1, 3, 5-tricarboxylic acid

Q. 

Bicyclo [2.2.1] heptane-2-carboxylic acid

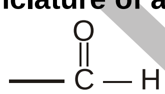
Q. 

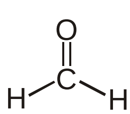
Bicyclo [1.1.0] butane-2 carboxylic acid

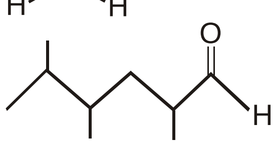
Q. 

Spiro [.3] heptane-2-carboxylic acid

Nomenclature of aldehyde:-

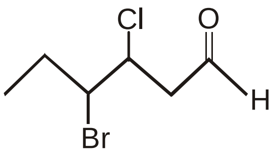
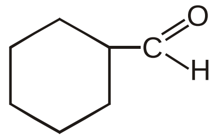
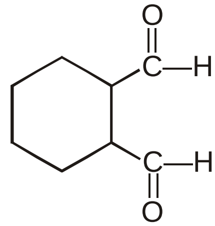
 al $\longrightarrow$ suffix(s)

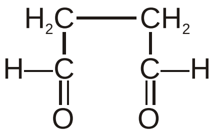
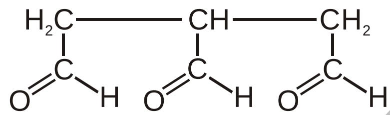
 Methan-1-al

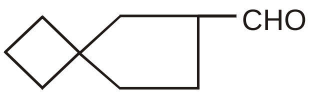
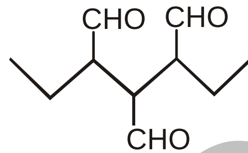
1. 

2. 

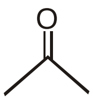
Ans. (1) 2,4,5 trimethyl hexan-1-al (2) Octa-3,5,7-trien-1-al

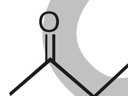
Q.  Q.  Q. 

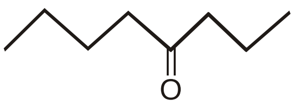
Q.  Q. 

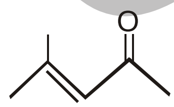
Q.  Q. 

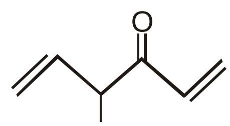
Nomenclature of ketones:-

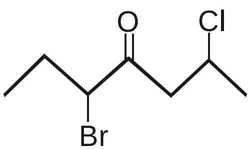
(1)  propane-2-one

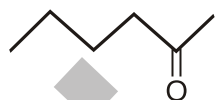
(2)  butan-2-one

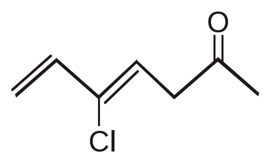
(3) 

(4) 

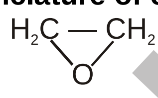
(5) 

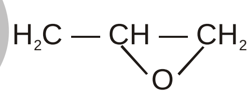
(6) 

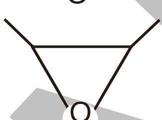
(7) 

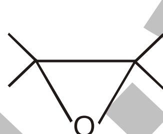
(8) 

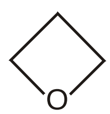
Nomenclature of cyclic ethers:-

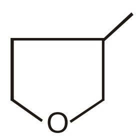
(1)  1,2-epoxyethane

(2)  1,2-epoxypropane

(3) 

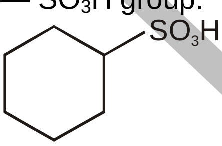
(4) 

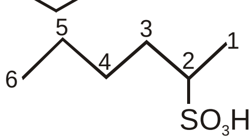
(5) 

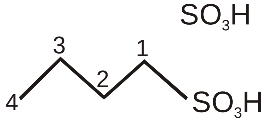
(6) 

Nomenclature of sulphonic acid:-

— SO_3H group.

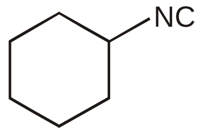
(1)  cyclohexanesulphonic acid

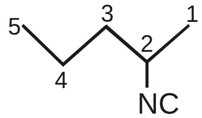
(2)  hexane-2-sulphonic acid

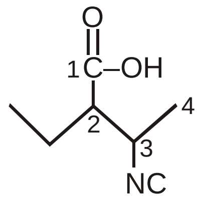
(3)  butane-1-sulphonic acid

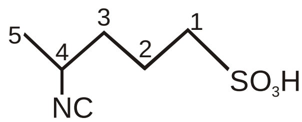
Nomenclature of Isocyanide (–NC):-

(1) $H_3C - CH_2 - N \Rrightarrow C$ ethan-1-carbylamine

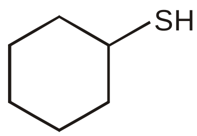
(2)  cyclohexane-1-carbylamine

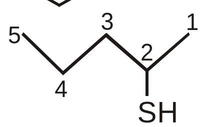
(3)  pentan-2-carbylamine

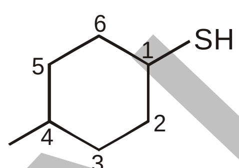
(4)  2-ethyl-3-isocyanobutan-1-oic acid

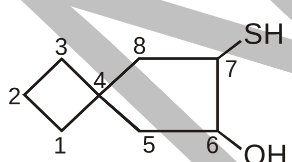
(5)  4-isocyanopentane-1-sulphonic acid

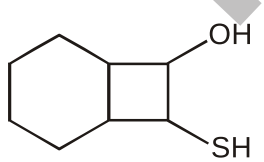
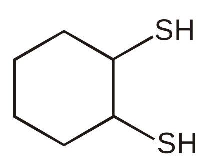
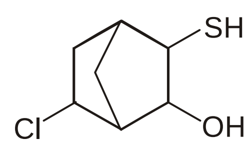
Nomenclature of thiol. (— SH):-

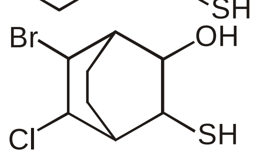
(1)  cyclohexanethiol

(2)  pentane-2-thiol

(3)  4-methylcyclohexane-1-thiol

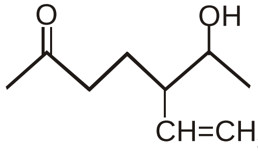
(4)  7-merceptospiro [3.4] heptan-6-Ol

(5)  (6)  (7) 

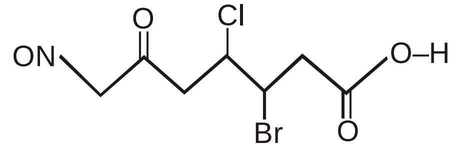
(8) 

Nomenclature of compounds containing multiple functional group:-

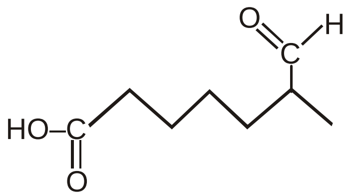
:→ (1)



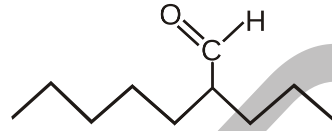
(2)



(3)

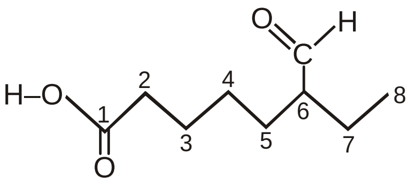


(4)



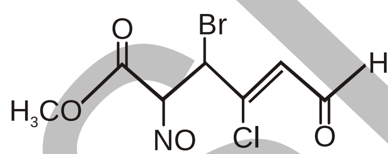
Ans. (1) 5-ethenyl-6-hydroxyheptan-2-one (2) 3-bromo-4-chloro-7-nitroso-6-oxoheptan-1-oic acid
(3) 6-methyl-7-oxoheptan-1-oic acid (4) 2-propylheptan-1-al

Q.1

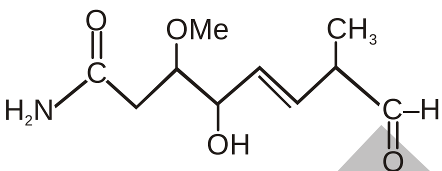


6-formyloctan-1-oic acid

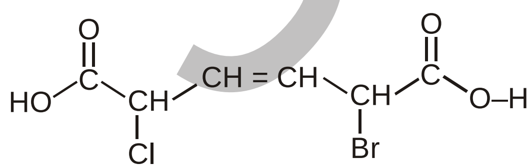
Q.2



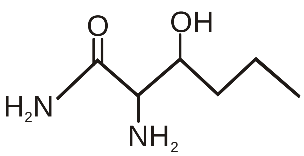
Q.3



Q.4

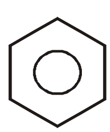


Q.5



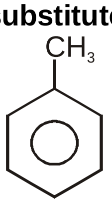
Ans. **Q.1** 6-formyloctan-1-oic acid
Q.2 Methyl-3-bromo-4-chloro-2-nitroso-6-oxo-hex-4-enoate
Q.3 4-hydroxy-3-methoxy-7-methyl-8-oxo-oct-5-enamide
Q.4 2-bromo-5-chlorohex-3-ene-1,6-dioic acid
Q.5 2-amino-3-hydroxyhexanamide

Nomenclature of substituted Benzene:-

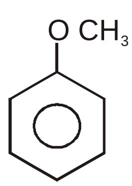


Benzene

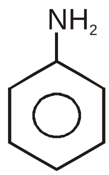
Monosubstituted Benzene:-



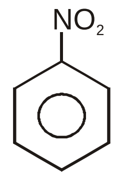
Methyl benzene (Toluene)



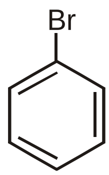
Methyl benzene (Anisole)



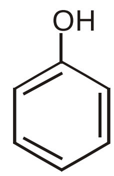
Amino benzene (Aniline)



Nitrobenzene

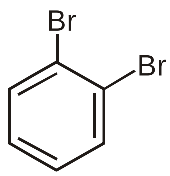


Bromobenzene

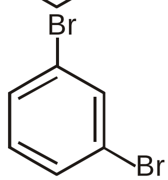


Hydroxybenzene (phenol)

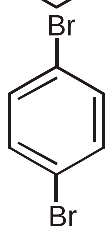
Disubstituted Benzene:-



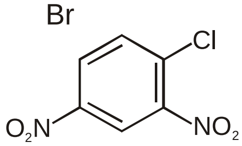
1,2-dibromobenzene (o-dibromobenzene)



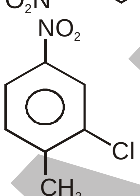
1,3-dibromobenzene, [metadibromobenzne (m-dibromobenzene)]



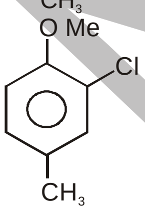
1,4-dibromobenzene, [paradibromobenzene (p-dibromobenzne)]



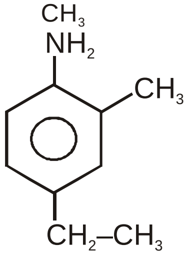
1-chloro-2, 4-dinitrobenzene, (4-chloro 1, 3-dinitrobenzne X)



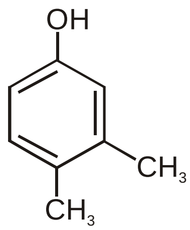
2-chloro-1-methyl-4-nitrobenzne



2-chloro-4-methylanisole



4-ethyl-2-methylaniline

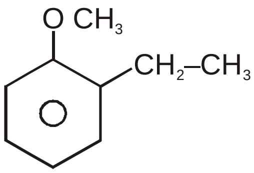


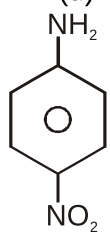
3,4-dimethylphenol

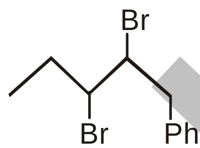
Q. Write the structure of :-

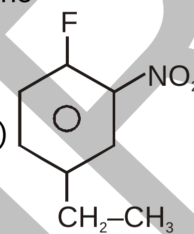
(a) o-ethylanisole (b) p-nitroaniline

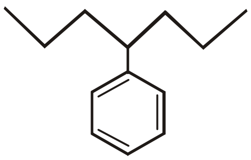
(c) 2,3-dibromo-1-phenylpentane (d) 4-ethyl-1 flouro-2-nitrobenzene

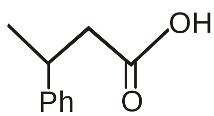
Ans. (a) 

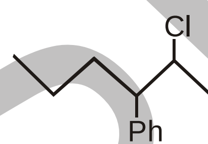
(b) 

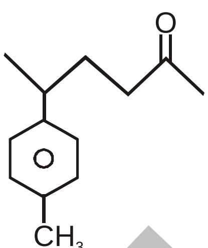
(c) 

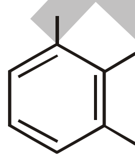
(d) 

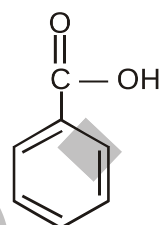
Q.1 

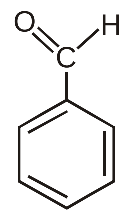
Q.2 

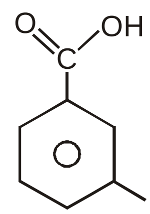
Q.3 

Q.4 

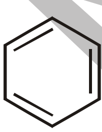
Q.5 

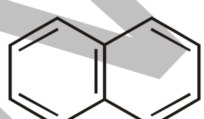
Q.6 

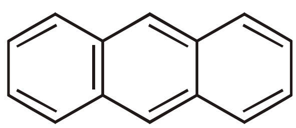
Q.7 

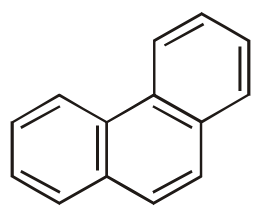
Q.8 

Common Name:-

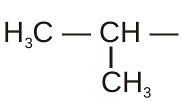

Benzene


Napthalene


Anthracene


Phenanthrene

Common Name



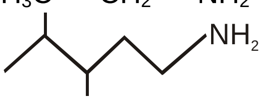
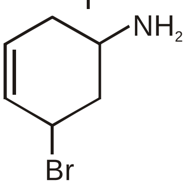
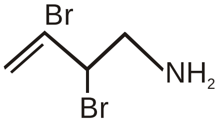
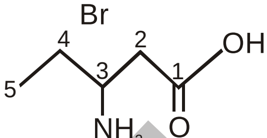
	I.U.P.A.C.	**Common**
	1-methyl ethyl	Isopropyl

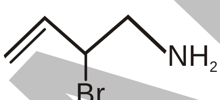
ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, Jhalawar Road, Kota, Rajasthan (324005)

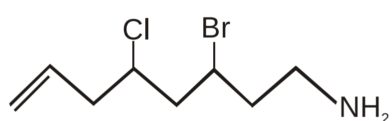
$H_3C-CH(CH_3)-CH_2-$	2-methylbutyl	isobutyl
$H_3C-C(CH_3)_2-CH_2-$	2,2-dimethylpropyl	Neopentyl
$H_3C-C(CH_3)_2-$	tert.-butyl	
$H_3C-CH_2-CH(CH_3)-$	sec.butyl	

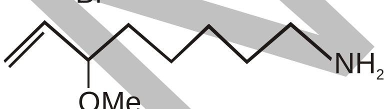
Nomenclature of Amines:-
—NH_2

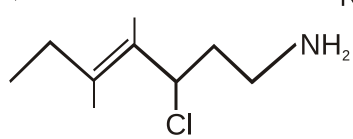
Suffix(a) $\longrightarrow$ Amine
Prefix $\longrightarrow$ Amino

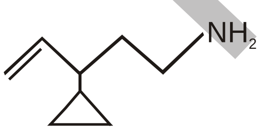
1. $H_3C-CH_2-NH_2$ $\longrightarrow$ Ethanamine
2.  $\longrightarrow$ 3,4-dimethylpentanamine
3.  $\longrightarrow$ 5-bromocyclohex-3-enamine
4.  $\longrightarrow$ 2-bromobut-3-enamine
5.  $\longrightarrow$ 3-aminobutan-1-oic acid

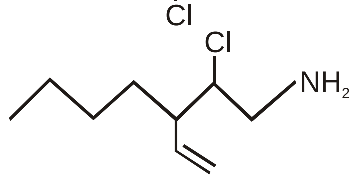
Q.1 

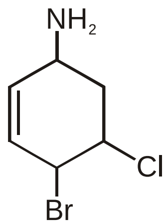
Q.2 

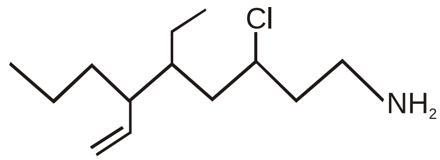
Q.3 

Q.4 

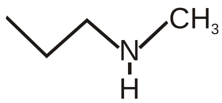
Q.5. 

Q.6 

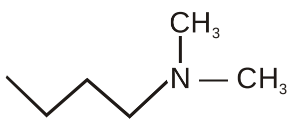
Q.7 

Q.8 

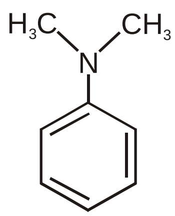
Ans. **Q.1** 2-bromobut-3-enamine **Q.2** 3-bromo-5-chloro oct-7-enamine
Q.3 6-methoxyoct-7-enamine **Q.4** 3-chloro-4,5-dimethyl hept-4-enamine
Q.5 3-cyclopylpent-4-enamine **Q.6** 3-butyl-2-chloropent-4-enamine
Q.7 4-bromo-5-chlorohex-2-enamine **Q.8** 3-chloro-5-ethyl-6-propyl oct-7-enamine

Q.1 

N-methylaminopropane

Q.2 

N, N-dimethylaminobutane

Q.3 

N, N-dimethylaminobenzene

Nomenclature of Esters:-

$$R' - \overset{\overset{O}{\|}}{C} - OR$$

↓

Alkyl

↓

(Name starts with alkyl)

Q.1 $H_3C - CH_2 - \overset{\overset{O}{\|}}{C} - O - CH_3$

Methylpropan-1-oate

Q.2 $H_3C - \overset{\overset{O}{\|}}{C} - O - CH_2 - CH_2 - CH_3$

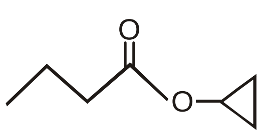
propylethan-1-oate

Q.3 $\underset{}{\overset{\overset{Br}{|}}{H_2C}} - CH_2 - \overset{\overset{O}{\|}}{C} - O - CH_3$

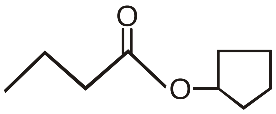
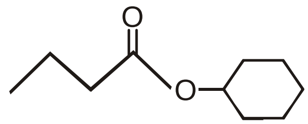
Methyl-3-bromo-propan-1-oate

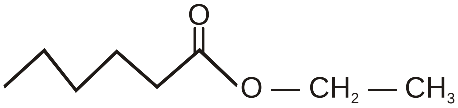
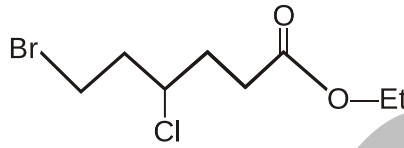
Q.4 $H_3C - \overset{\overset{O}{\|}}{C} - O - CH_2 - CH = CH_2$

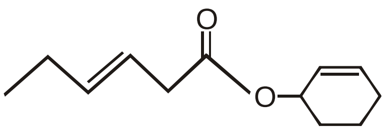
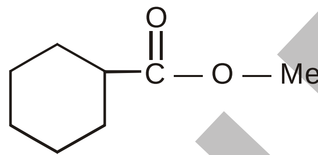
Prop-2-enylethanoate

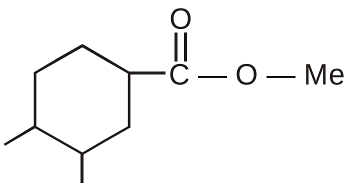
Q.5 

Cyclopropylbutanoate

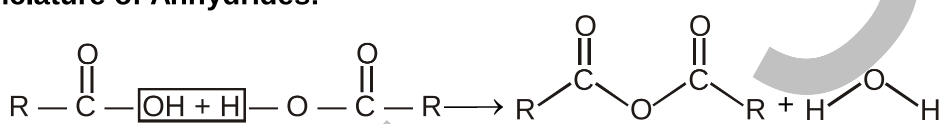
(1)  (2) 

(3)  (4) 

(5)  (6) 

(7)  (8) $H_3C - CH_2 - \overset{O}{\overset{||}{C}} - O\ Me$

Nomenclature of Anhydrides:-



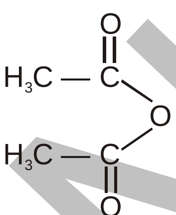
→ Formed by loss of H–O–H

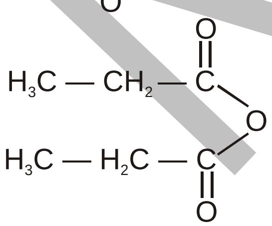
→ Suffix(s) → oic anhydride (If carbon included)

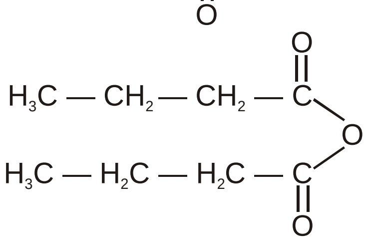
→ Carboxylic anhydride (if carbon not included)

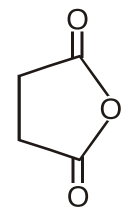
Naming of symmetrical Anhydrides:-

:⟶

(1)  ethanoic anhydride

(2)  propanoic anhydride

(3)  butanoic anhydride

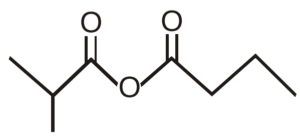
(4) 

butane-1,4-dioic anhydride

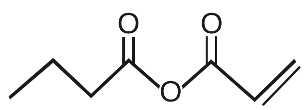
Naming of Unsymmetrical anhydride:-

(1) $H_3C - \overset{\overset{\large O}{||}}{C} - O - \overset{\overset{\large O}{||}}{C} - CH_2 - CH_3$

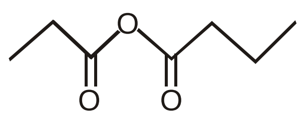
Ethanoic propanoic anhydride

(2) 

Butanoic-2-methylpropanoic anhydride

(3) 

Butanoic prop-2-enoicanhydride

(4) 

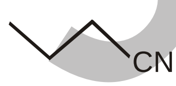
Butanoic propanoic anhydride

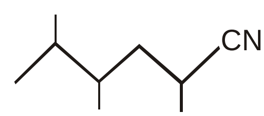
Nomenclature of cyanides:-

—CN → Nitrile

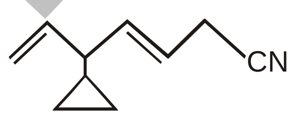
—CN → Carbonitrile

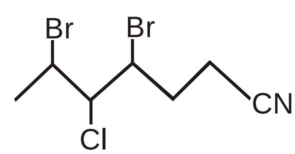
Q.1 $H_3C - C \equiv N$

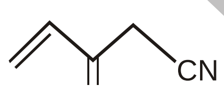
Q.2 

Q.3 

Q.4 

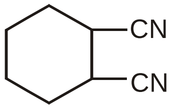
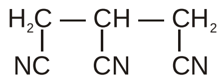
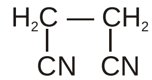
Q.5 

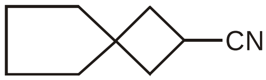
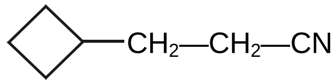
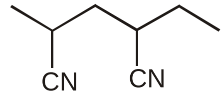
Q.6 

Q.7 

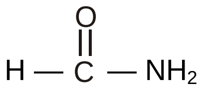
Q.8 

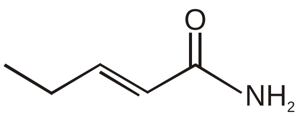
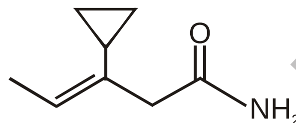
Ans.
Q.1 ethanenitrile **Q.2** butanenitrile **Q.3** 2,4,5-trimethylhexanenitrile
Q.4 4-ethylpent-4-ene-1-nitrile **Q.5** 5-cyclopropylhepta-3,6-diene-1-nitrile
Q.6 4,6-dibromo-5-chloropentane-nitrile **Q.7** 3-methylidenepent-4-one-1nitrile
Q.8 5-bromohex-3-ene-1-nitrile

Q.1  **Q.2**  **Q.3** 

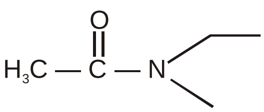
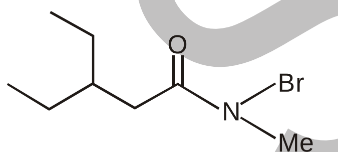
Q.3  **Q.4**  **Q.5** 

Nomenclature of Amides:-

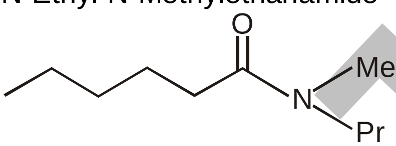
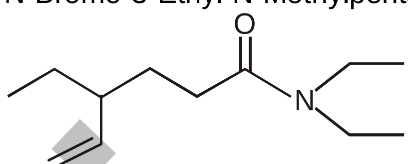
 Methanamide

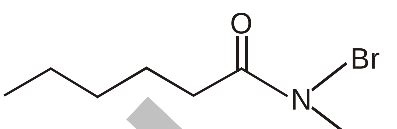
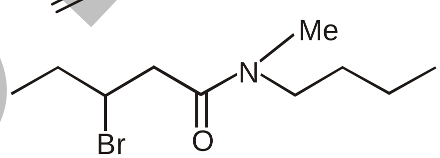
(1)  (2)  (3) 

Ans. (1) pent-2-en-1-amide, pent-2-enamide
(2) 3-cyclopropyl pent-3-en-1-amide
(3) N-methylhexan-1-amide

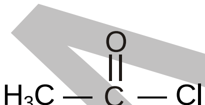
(4)  (5) 

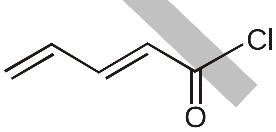
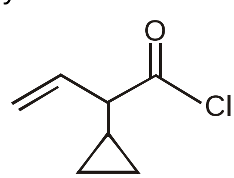
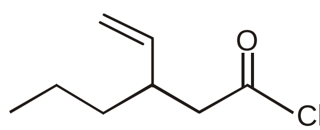
N-Ethyl-N-Methylethanamide N-Bromo-3-Ethyl-N-Methylpentanamide

(6)  (7) 

(8)  (9) 

Nomenclature of Acid Halides:-

(1)  ethanoylchloride

(2)  (3)  (4) 

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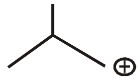
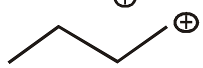
REACTION MECHANISM

DPP NO-01 Time: 15 minutes

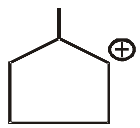
Q.1

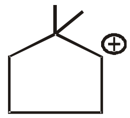
(a) $CH_3-CH_2-\overset{\oplus}{C}H_2 \longrightarrow$ _____

(b)  $\longrightarrow$ _______

(c)  $\longrightarrow$ _____

(d) $CH_3-CH_2-CH_2-\underset{CH_3}{\overset{CH_3}{C}}-\overset{\oplus}{C}H_2 \longrightarrow$ _____

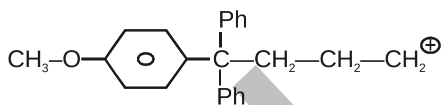
(e)  $\longrightarrow$ ________

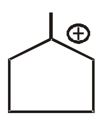
(f)  $\longrightarrow$ _________

(g) $Ph-CH_2-\overset{\oplus}{C}H_2 \longrightarrow$ ____

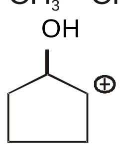
(h) $CH_3-\overset{CH_3}{CH}-CH_2-\overset{\oplus}{C}H_2 \longrightarrow$ ___

(i) $Ph-\underset{D}{\overset{Ph}{C}}-\overset{Me}{CH}-CH_2-\overset{\oplus}{C}H_2 \longrightarrow$ ____

(j)  $\longrightarrow$ ___

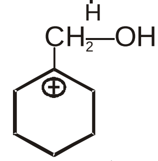
(k)  $\longrightarrow$ _______

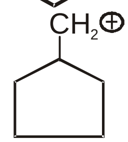
(l) $CH_3-\overset{\oplus}{C}H-CH_2-OH \longrightarrow$ ______

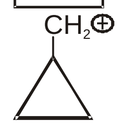
(m)  $\longrightarrow$ _________

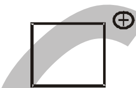
(n) $CH_3-\underset{\oplus}{\overset{CH_3}{C}}-\underset{OH}{\overset{Me}{C}}-et \longrightarrow$ _________

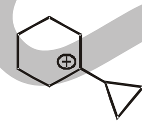
(o) $CH_3-\underset{H}{\overset{CH_3}{C}}-\underset{\oplus}{C}=\ddot{O}: \longrightarrow$ _________

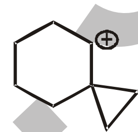
(p)  $\longrightarrow$ ________

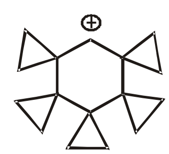
(q)  $\longrightarrow$ _________

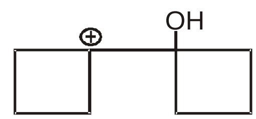
(r)  $\longrightarrow$ _________

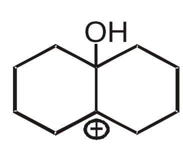
(s)  $\longrightarrow$ _________

(t)  $\longrightarrow$ _________

(u)  $\longrightarrow$ ________

(v)  $\longrightarrow$ _________

(w)  $\longrightarrow$ _________

(x)  $\longrightarrow$ ________

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DPP NO-02 Time: 15 minutes

Dehydration of Alcohol

Q.1 $CH_3—CH_2—CH_2—OH \xrightarrow[170°C]{Conc. H_2SO_4} CH_3—CH=CH_2$

Mechanism:–

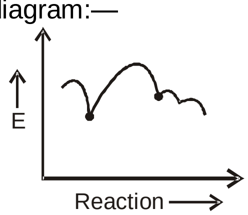
(1) $CH_3 — CH_2 — CH_2 — \ddot{O} — H + H^+ \rightleftharpoons CH_3 — CH_2 — CH_2 — \overset{\oplus}{\ddot{O}}H_2$

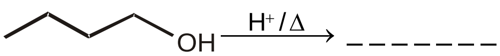
$\downarrow$ rds

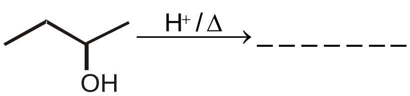
$CH_3—\overset{\oplus}{C}H—CH_3 \longleftarrow CH_3 — CH_2 — CH_2^{\oplus} + :\ddot{O}H_2$

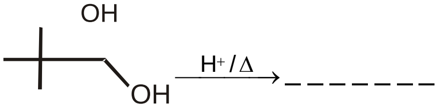
(2) $CH_3 — \overset{\oplus}{C}H — CH_3 + :\ddot{O}H_2 \longrightarrow CH_3—CH=CH_2 + H_3O^+$

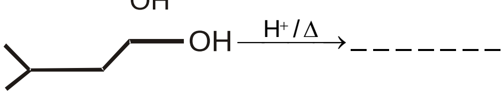
Energy profile diagram:—

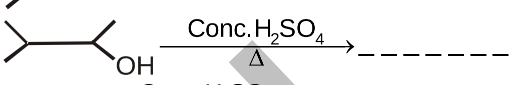


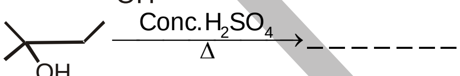
Q.1 

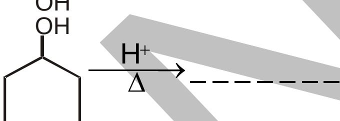
Q.2 

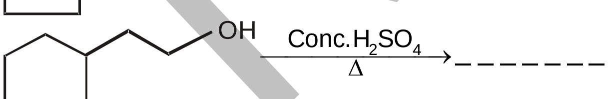
Q.3 

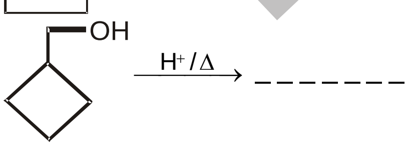
Q.4 

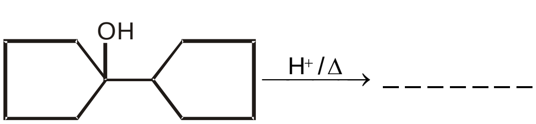
Q.5 

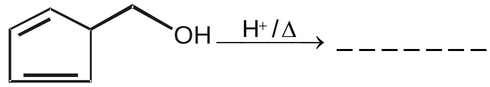
Q.6 

Q.7 

Q.8 

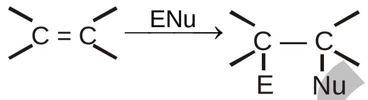
Q.9 

Q.10 

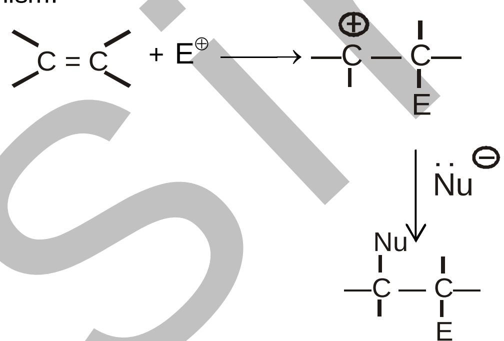
Q.11 

Q.8 3, 3–Dimethyl–butan–2–ol loses a molecule of water in the presence of concentrated sulphuric acid to give tetramethylethylene as a major product. Suggest a suitable mechanism.

Electrophilic addition:–



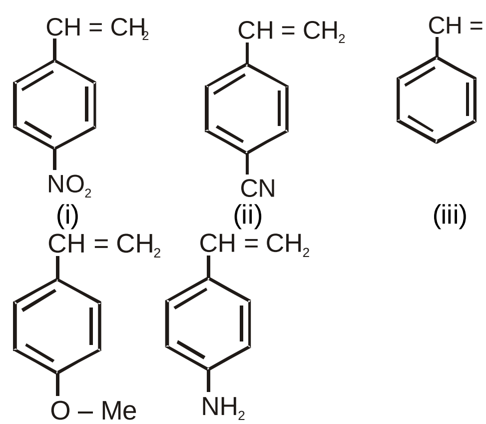
Mechanism:–



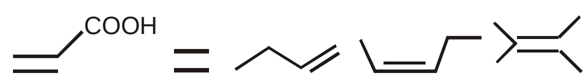
Q.1 Compare rate of electrophilic addition on alkenes:–

(a) 

(i) (ii) (iii) (iv)

(b) 

(i) (ii) (iii) (iv) (v)

(c) 

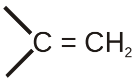
(i) (ii) (iii) (iv) (v)

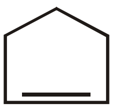
(d) Ph — CH = CH_2 (i) PH — CH = CH — Ph (ii)

Q.1 $CH_2 = CH_2 \xrightarrow{HI}$ ___________

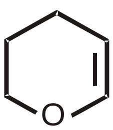
Q.2 $CH_2 = CH_2 \xrightarrow{KBr}$ ___________

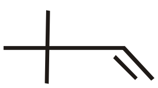
Q.3  $\xrightarrow[KBr]{HI}$ ___________

Q.4  $\xrightarrow[KBr]{HI}$ ___________

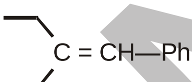
Q.5  $\xrightarrow[KF]{HI}$ ___________

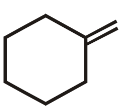
Q.6  $\xrightarrow{HI}$ ___________

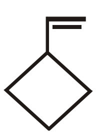
Q.7  $\xrightarrow{HCl}$ ___________

Q.8  $\xrightarrow{HI}$ ___________

Q.9 $(Ph)_2CH—\underset{\large Me}{CH}—CH=CH_2 \xrightarrow{HI}$ ___________

Q.10  $\xrightarrow{HBr}$ ___________

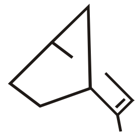
Q.11  $\xrightarrow{HCl}$ ___________

Q.12  $\xrightarrow{HBr}$ ___________

Q.13 $CH_2 = CH — Cl \xrightarrow{HCl}$ ___________

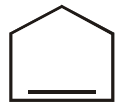
Q.14 $CH \equiv CH \xrightarrow{HCl(2eq.)}$ ___________

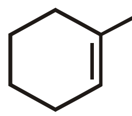
Q.15 $CH_3 — C \equiv CH \xrightarrow{HCl(2eq.)}$ ___________

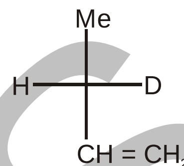
Q.16  $\xrightarrow{HCl}$ ___________

Q.17  $\xrightarrow{dil.H_2SO_4}$ ___________

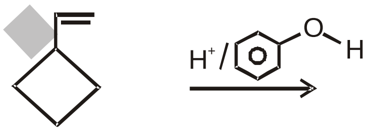
Q.18  $\xrightarrow{H^+/H_2O}$ ___________

Q.19  $\xrightarrow{H^+/R–OH}$ ___________

Q.20  $\xrightarrow{H^+/H_2O}$ ___________

Q.21  $\xrightarrow{HCl}$ ___________

Q.22  $\xrightarrow{D^+/D_2O}$ ___________

Q.23  ___________

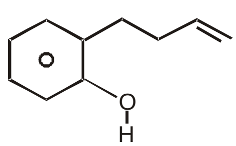
Q.24  $\xrightarrow{HBr}$ ___________

Q.25 $CH \equiv C — CH_2 — CH = CH_2 \xrightarrow{HCl}$ ________

Q.26 $CH \equiv C — CH = CH_2 \xrightarrow{HCl}$ ___________

Q.27 $HO—CH_2—CH_2—CH_2—CH = CH_2 \xrightarrow[MeOH]{H^+}$ ___

Q.28 $CH_2= CH—\overset{\large OH}{CH}—CH=CH_2 \xrightarrow{H^+/MeOH}$ ______

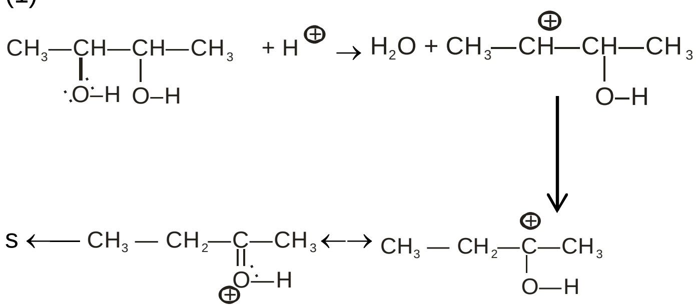
Q.29  $\xrightarrow{H^+}$ ___________

DPP NO-03 Time: 15 minutes

Q.1

$$CH_3-\underset{OH}{\underset{|}{CH}}-\underset{OH}{\underset{|}{CH}}-CH_3 \xrightarrow[\Delta]{H^+} CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$$

Mechanism:–
(1)



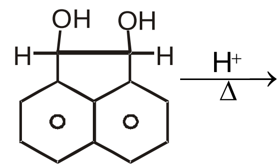
Q.1

$$Et-\underset{OH}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}-\underset{OH}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}-Et \xrightarrow[\Delta]{H^+}$$

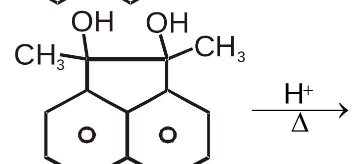
Q.2

$$Ph-\underset{OH}{\underset{|}{\overset{Ph}{\overset{|}{C}}}}-\underset{OH}{\underset{|}{CH_2}} \xrightarrow[\Delta]{H^+}$$

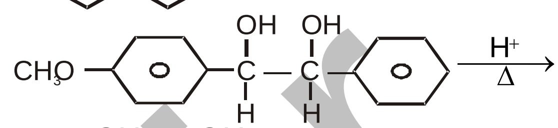
Q.3



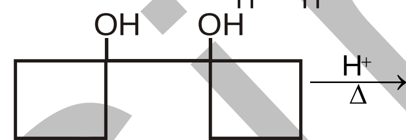
Q.4



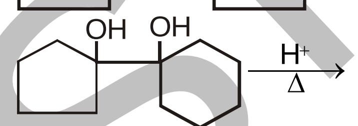
Q.5



Q.6



Q.7



Diazotization of primary amine:–

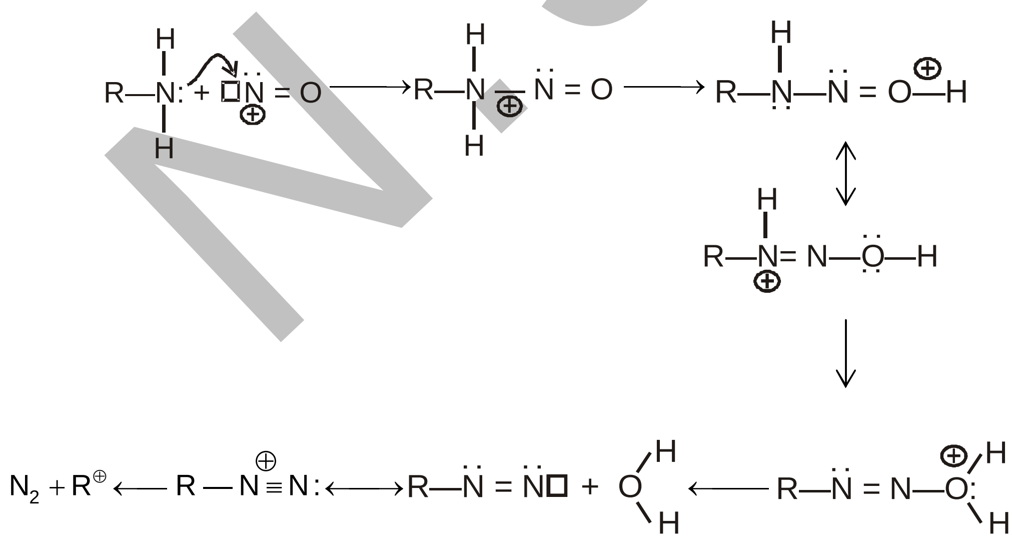
$$R-\ddot{N}H_2 \xrightarrow[HCl]{NaNO_2} R-N^{\oplus}\equiv N: \xrightarrow[\Delta]{} R^{\oplus}+N_2$$

Mechanism:–

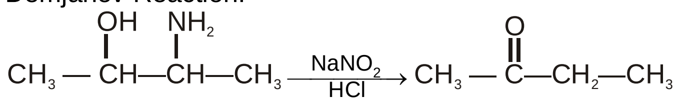
(1) $NaNO_2 + HCl \longrightarrow H-O-N=O + NaCl$

(2) $H-O-N=O + H^{\oplus} \longrightarrow H_2O + \square\overset{\oplus}{N}=O$

(3)

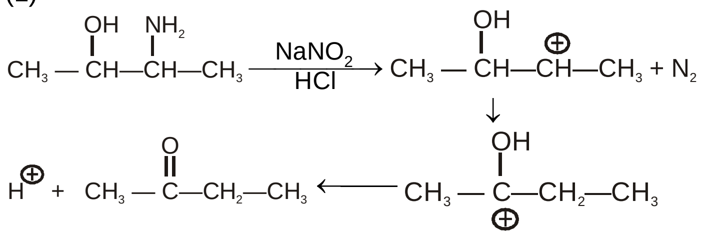


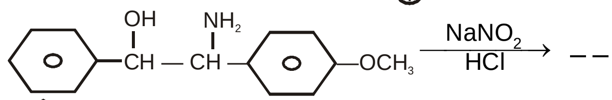
Demjanov Reaction:–

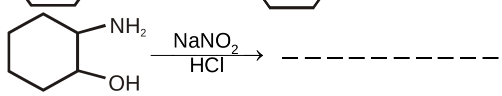


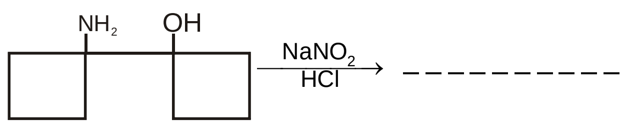
Mechanism:–

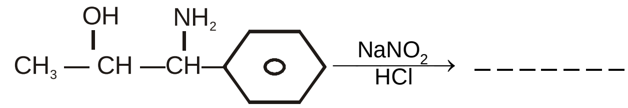
(1)

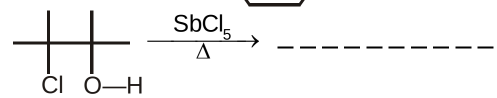


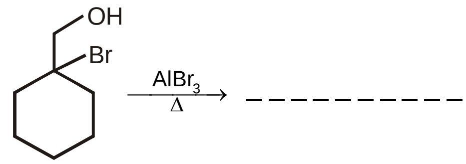
Q.1 

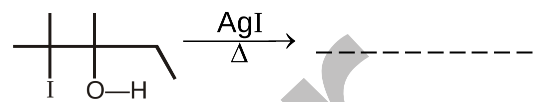
Q.2 

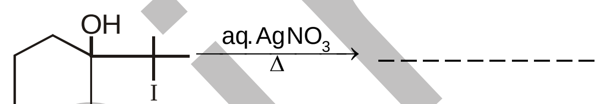
Q.3 

Q.4 

Q.5 

Q.6 

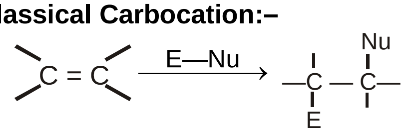
Q.7 

Q.8 

IIT-JEE ChEmistry by N.J. sir ORGANIC chemistry

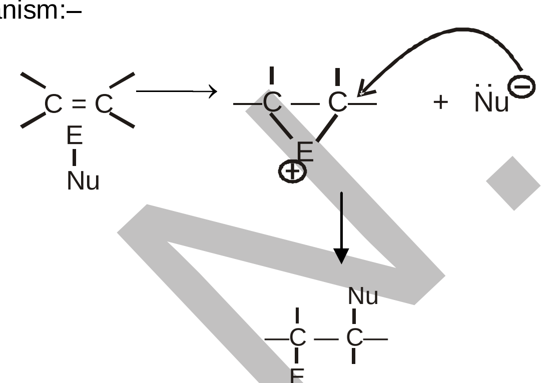
DPP NO-04 Time: 15 minutes

Non Classical Carbocation:–



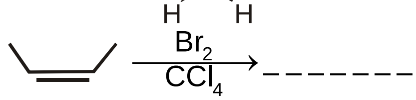
Mechanism:–

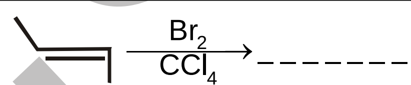
(1)



Q.1 $CH_2 = CH_2 \xrightarrow{Br_2}$ _______

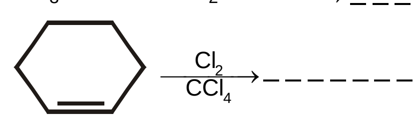
Q.2 $CH_2 = CH_2 \xrightarrow[H_2O]{Br_2}$ _______

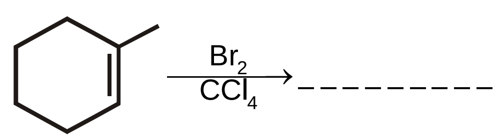
Q.3 

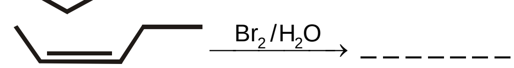
Q.4 

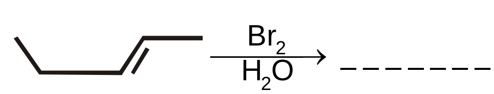
Q.5 $CH_3 — CH = CH_2 \xrightarrow{ICl}$ _______

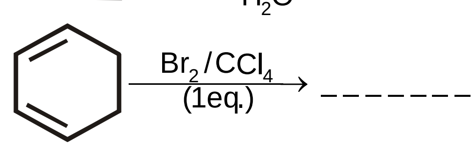
Q.6 $CH_3 — CH = CH_2 \xrightarrow{HOCl}$ _______

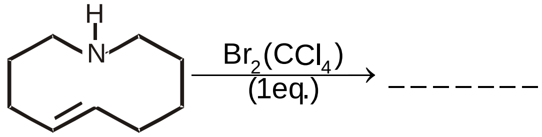
Q.7 

Q.8 

Q.9 

Q.10 

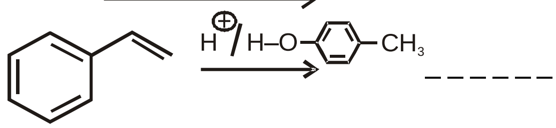
Q.11 

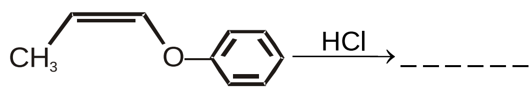
Q.12 

Q.13 $CH_3 - CH = CH_2 \xrightarrow{HCl}$ ______

$\xrightarrow{CH_3Cl\ /\ AlCl_3}$

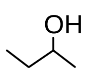
$\xrightarrow{CH_3Cl}$

Q.14 

Q.15 

Q.13 The reaction of propene with HOCl proceeds via the addition of **[IIT '2001]**
(A) H^+ in first step
(B) Cl^+ in first step
(C) OH^- in first step
(D) Cl^+ and OH^- in single step

Ans. B

Q.18  $\xrightarrow[-H_2O]{H^+}$ X (mixture) $\xrightarrow{Br_2}$ 5 compounds of molecular formula $C_4H_8Br_2$ **[IIT '2003]**
Number of compounds in X will be :
(A) 2 (B) 3 (C) 4 (D) 5

Ans. B

Q.23 $CH_3 - CH = CH_2 + NOCl \rightarrow P$ **[IIT '2006]**
Identify the adduct.
(A) $CH_3 - \underset{Cl}{CH} - \underset{NO}{CH_2}$ (B) $CH_3 - \underset{NO}{CH} - \underset{Cl}{CH_2}$

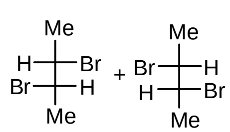
(C) $CH_3 - CH_2 - \overset{NO}{\underset{Cl}{CH}}$ (D) $\underset{NO}{CH_2} - CH_2 - \underset{Cl}{CH_2}$

Ans. A

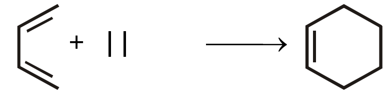
Q.26 The number of stereoisomers obtained by bromination of trans-2-butene is **[IIT '2007]**
(A) 1 (B) 2 (C) 3 (D) 4

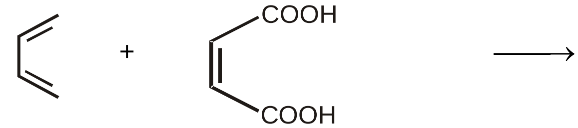
Ans. A

Q.5 Write down the structures of the stereoismers formed when cis-2-butene is reacted with bromine. **[IIT '1995]**

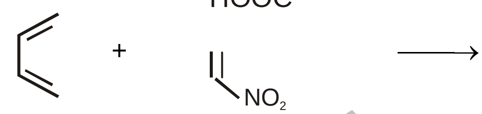
Ans. 

Diel's Alder Reaction:–

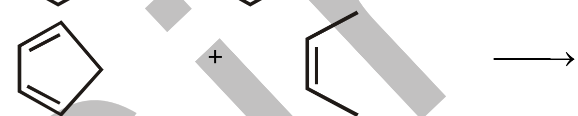


Q.1 

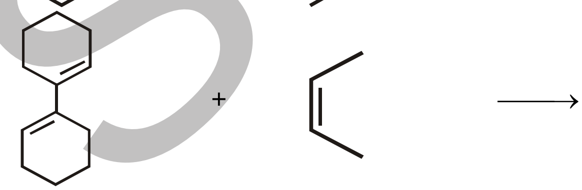
Q.2 

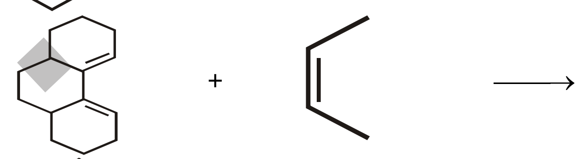
Q.3 

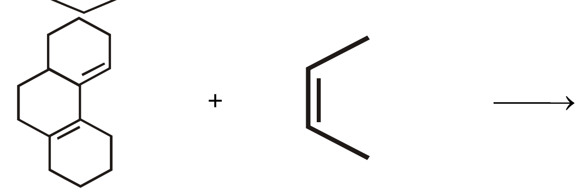
Q.4 

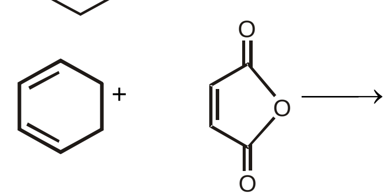
Q.5 

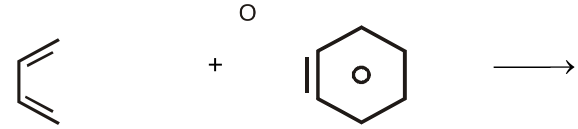
Q.6 

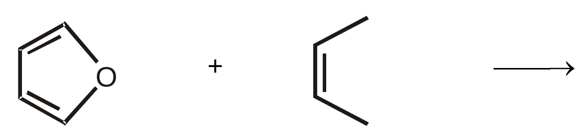
Q.7 

Q.8 

Q.9 

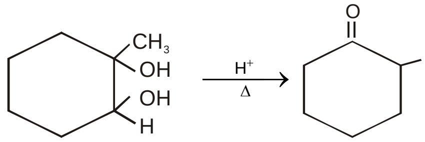
Q.10 

Q.11 

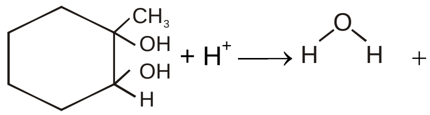
Q.12 

DPP NO- 05 Time: 15 minutes

Fill in the blanks:–

Q.1 

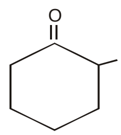
Mechanism :–

(i)  ––––––––––––

(Intermediate carbocation)

(ii) –––––––––––– $\xrightarrow{\text{Rearrargemet}}$ ––––––––––––

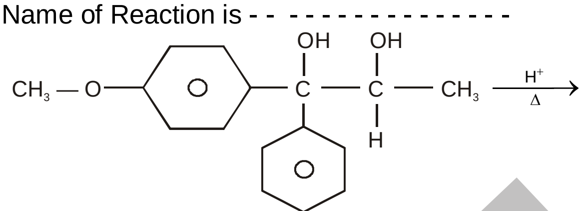
(Intermediate carbocation) (Re arranged carbocation)

(iii) –––––––––––– $\longrightarrow H^+ +$ 

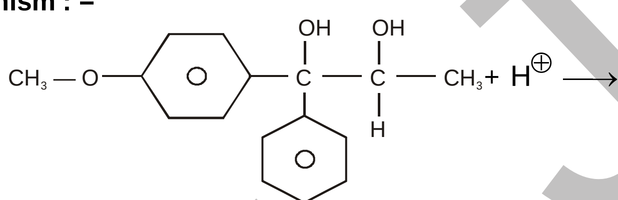
(Re arranged carbocation)

(iv) $\frac{\Delta[H^+]}{\Delta t}$ = - - - - - - - - - - - - - - - -

(v) Name of Reaction is - - - - - - - - - - - - - - - - -

Q.2  Product

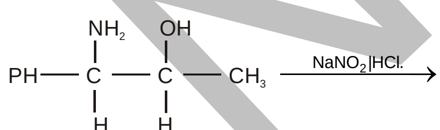
Mechanism : –

 Intermediate Carbocation

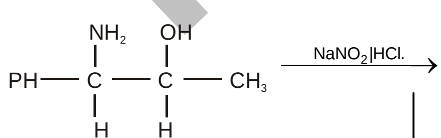
––––––––––––––––

(i) Intermediate Carbocation –––––––––––––––– $\longrightarrow$ rearranged Carbocation ––––––––––––––––

(ii) Rearranged Carbocation –––––––––––––––– $\longrightarrow H^+$ Product –––––

Q.3  Product –––––

Mechanism : –

(i)  - - - - - - - - - - - - - -

Rearrangement

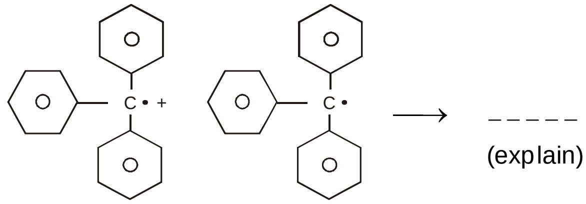
H^+ + - - - - - - - - - - - $\longleftarrow$ - - - - - - - - - - - - -

None of Reaction - - - - - - - - - - - - - -

Q.4 $CH_3-\underset{CH_3}{\overset{CH_3}{C^\circ}} + CH_3-\underset{CH_3}{\overset{CH_3}{C^\circ}} \longrightarrow$ __________ (Major Product)

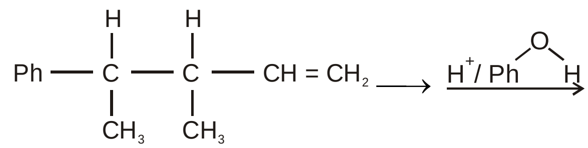
Q.5 $CH_3 - C^\circ H_2 + CH_3 - C^\circ H_2 \longrightarrow$ __________ (Major Product)

Q.6



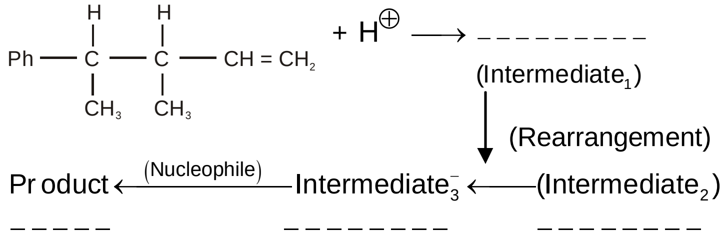
_____ (explain)

Q.7

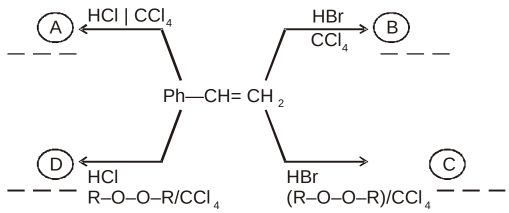


Mechanism : –

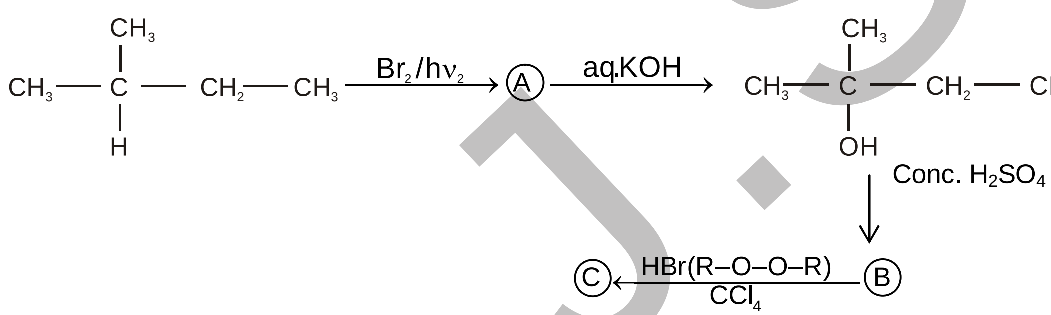
(i)



Q.8



Q.9



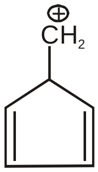
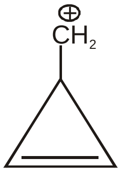
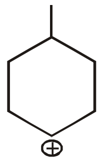
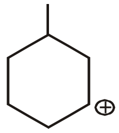
Ⓐ & Ⓒ are Idenitcal / Isomers / Positon Isomers.

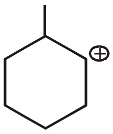
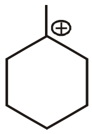
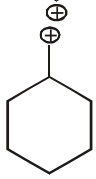
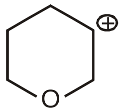
Q.10 $Ph_3C-\overset{O}{\overset{||}{C}}-OH \xrightarrow[\text{electrolysis}]{\text{NaOH}}$

<u>Anode</u>	<u>Cathode</u>
(I) __________ $\longrightarrow e^- + Ph_3C-\overset{O}{\overset{||}{C}}-O^\circ$	(i) $2H_2O + 2e^- \longrightarrow$ ______
(ii) $Ph_3C-\overset{O}{\overset{||}{C}}-O^\circ \longrightarrow CO_2 +$ ________ Intermediate	
(iii) Intermediate $\longrightarrow$ - - - - - - - - - - - - _______	

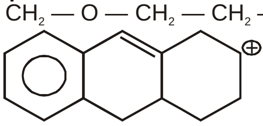
DPP NO- 06 Time: 15 minutes

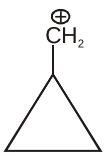
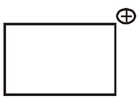
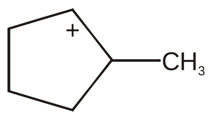
1. Which of following carbocation will undergo rearrangement?

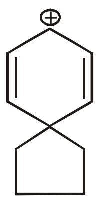
(a)  (b)  (c)  (d) 

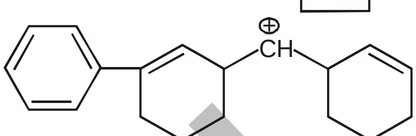
(e)  (f)  (g)  (h) 

(i) $\overset{Ph}{CH_2}$ — O — CH_2 — CH_2 — $\overset{\oplus}{C}H_2$

(j) 

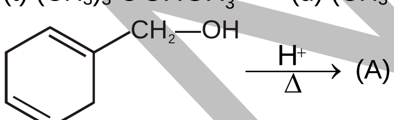
(k)  (l)  (m) 

(n) $\overset{\oplus}{C}H_2 — CH_2 — CH_2$ — O — $CH_2 — CH_3$ (o)  (p) $\overset{Ph}{CH_2} — \overset{\oplus}{C} = O$

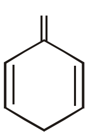
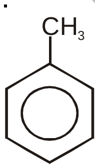
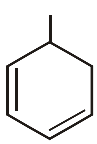
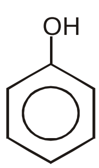
(q) 

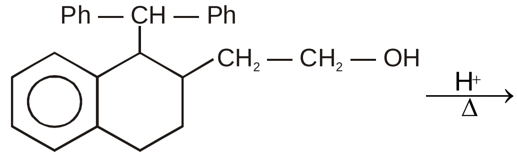
(r) $CH_3CH_2CH_2^+$ (s) $(CH_3)_2CH\overset{+}{C}HCH_3$

(t) $(CH_3)_3C\overset{+}{C}HCH_3$ (u) $(CH_3CH_2)_3CCH_2^+$

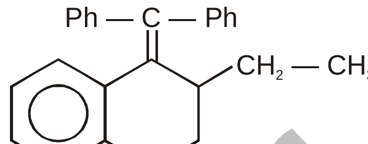
2. 

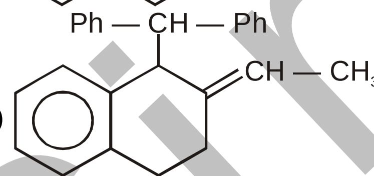
(A) an heating isomerizes to (B). What is the structure of (B).

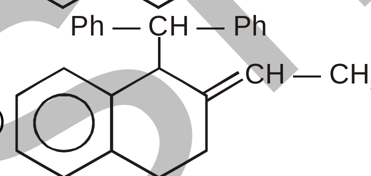
(A)  (B)  (C)  (D) 

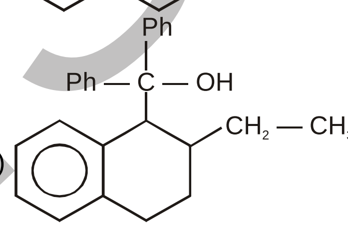
3. 

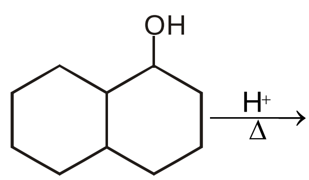
(A) (major), Major product (A) is

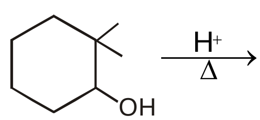
(A) 

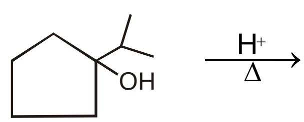
(B) 

(C) 

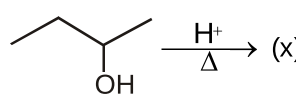
(D) 

4. Reaction-1  (A) (major)

Reaction-2  (A) (major)

Reaction-3  (A) (major)

Sum of α-hydrogen (A + B + C) is.

5. (A)  (x)

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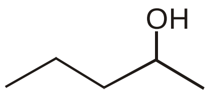
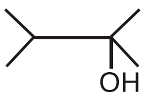
(B)  $\xrightarrow[\Delta]{H^+}$ (y)

(C)  $\xrightarrow[\Delta]{H^+}$ (z)

(D)  $\xrightarrow[\Delta]{H^+}$ (p)

Total number of products obtained in above reactions including minor products is (include stereoisomer)

x	y	z	p

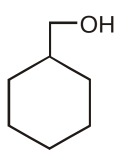
6. In which of following reaction rearrangement take place with change is carbon skeleton.

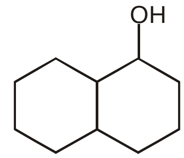
(A) $CH_3-\underset{CH_3}{\overset{CH_3}{C}}-\overset{\oplus}{C}H_2$ (B) $CH_3-CH_2\,CH_2^{\oplus}$

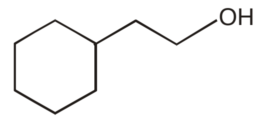
(C) $CH_3-\underset{CH_3}{CH}-CH_2-\overset{\oplus}{C}H_2$

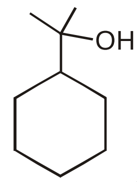
(D) $CH_3-CH^{\oplus}-CH_3$

7. Sum of α-hydrogen in major product of the reaction.

Reaction-1  $\xrightarrow[\Delta]{H^+}$ (A)

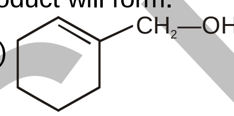
Reaction-2  $\xrightarrow[\Delta]{H^+}$ (B)

Reaction-3  $\xrightarrow[\Delta]{H^+}$ (C)

Reaction-4  $\xrightarrow[\Delta]{H^+}$ (D)

Sum of α-hydrogen is A + B + C + D =

8. In which of following reaction resonance stabilized product will form.

(A)  $\xrightarrow[\Delta]{H^+}$

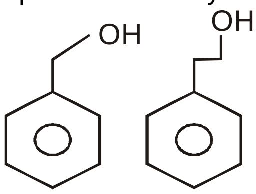
(B)  $\xrightarrow[\Delta]{H^+}$

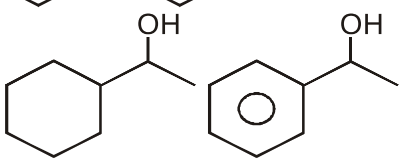
(C)  $\xrightarrow[\Delta]{H^+}$

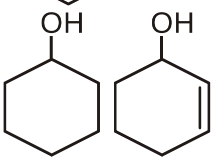
(D) All

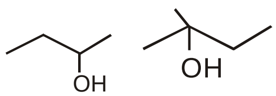
DPP NO- 07 Time: 15 minutes

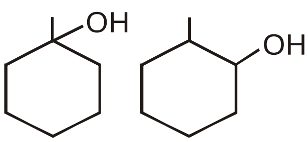
Q.1 Compare rate of dehydration (acid-catalyzed)

(a)


(b)


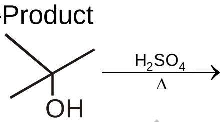
(c)


(d)


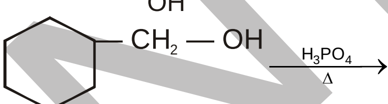
(e)


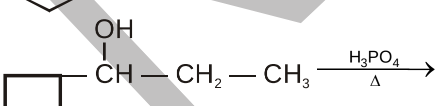
Q.2 Predict the major product of acid-catalyzed dehydration of alcohols
(A) 2-pentanol
(B) 1-methyl cyclopentanol
(C) 2-methyl cyclohexanol
(D) 2, 2-dimethyl-1-propanol

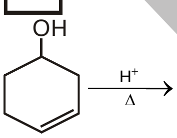
Q.3 Identify-Product

(a)


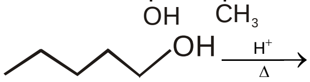
(b) $CH_3-CH_2-\underset{OH}{\overset{CH_3}{C}}-\overset{CH_3}{CH}-CH_3 \xrightarrow[\Delta]{H_2SO_4}$

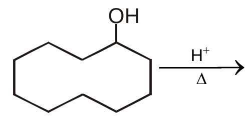
(c)


(d)


(e)


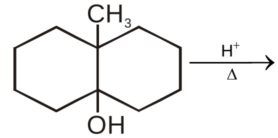
(f) $CH_3-CH_2-\underset{OH}{CH}-\underset{CH_3}{\overset{CH_3}{C}}-CH_3 \xrightarrow[\Delta]{H^+}$

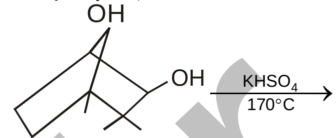
(g)


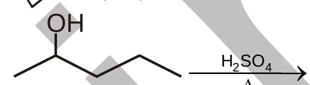
(h)

A + B

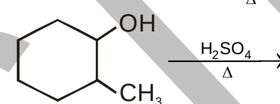
(i)

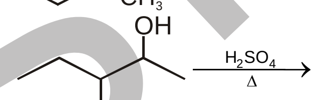
A + B

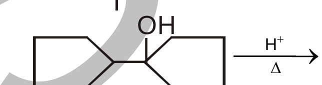
(j)

A + B

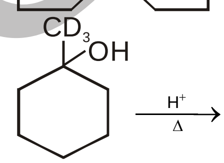
(k)


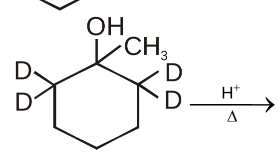
(l)


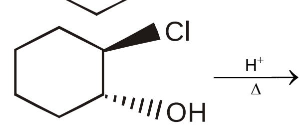
(m)


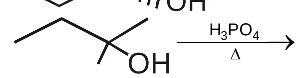
(n)


(o)


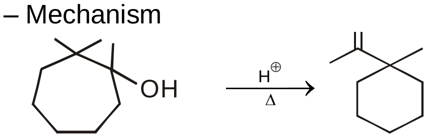
(p)


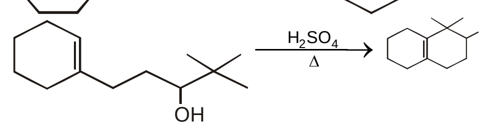
(q)


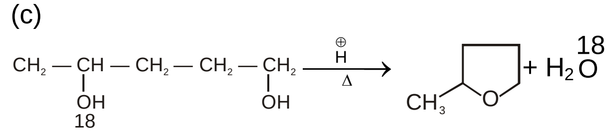
(r)


(s)


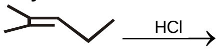
Q.4 Write – Mechanism

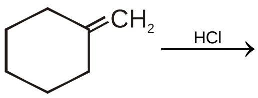
(a)


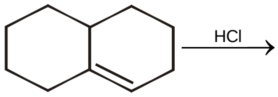
(b)


(c)


Q.5 Predict Major Product

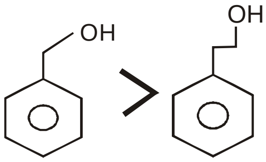
(a) 

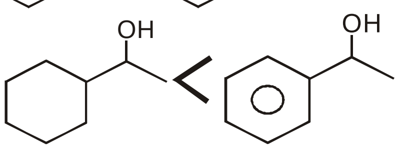
(b) 

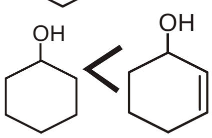
(c) 

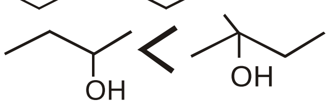
(d) 2-methyl propene $\xrightarrow{HCl}$

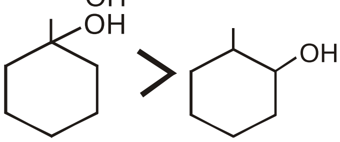
(e) 1-methyl cyclohexene $\xrightarrow{HI^-}$

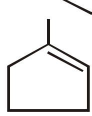
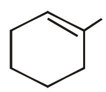
Ans.1 (a) 

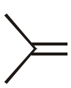
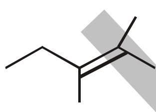
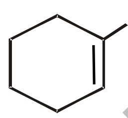
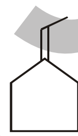
(b) 

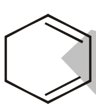
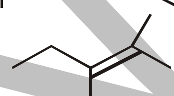
(c) 

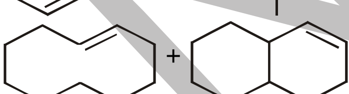
(d) 

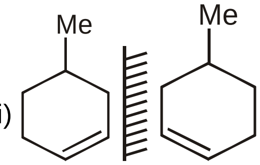
(e) 

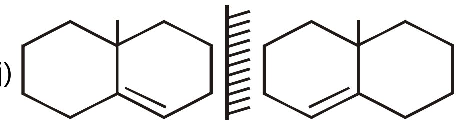
Ans.2 (A)  (B)  (C)  (D) C — C(C) = C — C

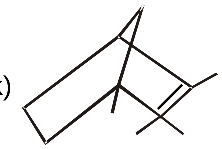
Ans.3 (a)  (b)  (c)  (d) 

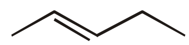
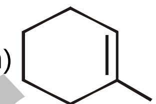
(e)  (f)  (g) 

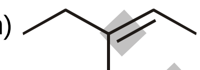
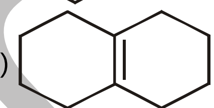
(h) 

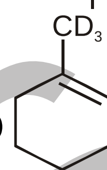
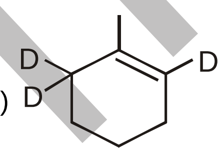
(i) 

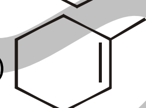
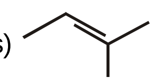
(j) 

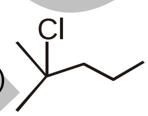
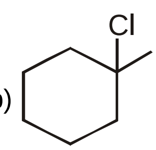
(k) 

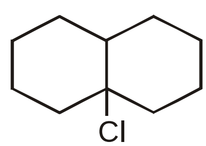
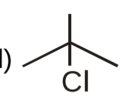
(l)  (m) 

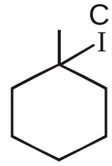
(n)  (o) 

(p)  (q) 

(r)  (s) 

Ans.5 (a)  (b) 

(c)  (d) 

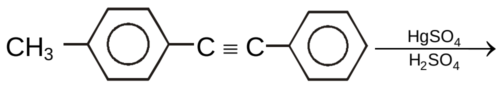
(e) 

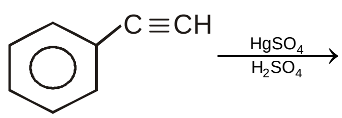
DPP NO- 08 Time: 15 minutes

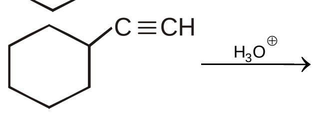
Q.1 Identify major products:

(a) $CH_3-\underset{CH_3}{\overset{CH_3}{C}}-C\equiv CH \xrightarrow[H_2SO_4]{HgSO_4}$

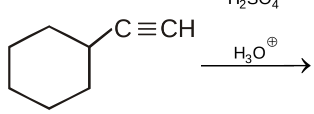
(b) $CH_3-C\equiv CH \xrightarrow[H_2SO_4]{HgSO_4}$

(c) 

(d) 

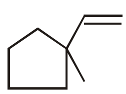
(e) 

(f) $CH_3-C\equiv CH \xrightarrow[H_2SO_4]{HgSO_4}$

(g) 

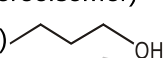
(h) I-phenyl cyclohexene $\xrightarrow{H_3O^{\oplus}}$

(i) I-methyl cyclopetene $\xrightarrow{H_3O^{\oplus}}$

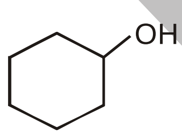
(j)  $\xrightarrow{HBr}$

(k) $Ph-CH_2-CH=CH_2 \xrightarrow[CCl_4]{HBr}$

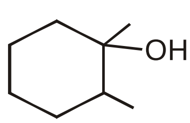
Q.2 Find total product in following reaction ? (including stereoisomer)

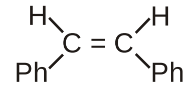
(a)  $\xrightarrow[\Delta]{H^{\oplus}}$ (x) products $\xrightarrow[CCl_4]{Br_2}$ (z) (products)

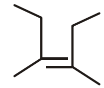
$\xrightarrow[CCl_4]{HBr}$ (y) (products) (Markonikoff products)

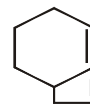
(b)  $\xrightarrow[\Delta]{H^{+}}$ (A) $\xrightarrow[CCl_4]{HBr}$ (B)

(A) $\xrightarrow[CCl_4]{Br_2}$ (C)

(c)  $\xrightarrow[\Delta]{H^{\oplus}}$

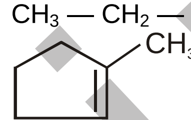
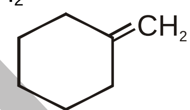
(d)  $\xrightarrow{H_3O^{\oplus}}$

(e)  $\xrightarrow[CCl_4]{HBr}$

(f)  $\xrightarrow{D-Cl}$ (x); $\xrightarrow{D_3O^{\oplus}}$ (y)

Q.3 What will be major – product obtained from addition of HBr to each of the following compounds.

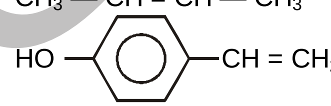
(a) $CH_3-CH_2-CH=CH_2$

(b)  (c) 

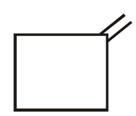
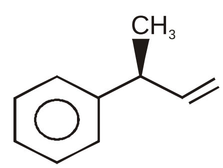
(d) $CH_3-CH=\overset{CH_3}{C}-CH_3$

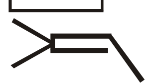
(e) $H_2C=\overset{CH_3}{C}-CH_2-CH_3$

(f) $CH_3-CH=CH-CH_3$

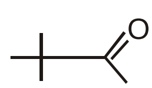
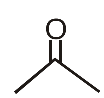
(g) 

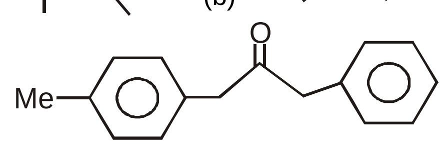
(h) $CH_3-\underset{CH_3}{CH}-CH_2-CH=CH_2$

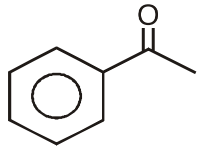
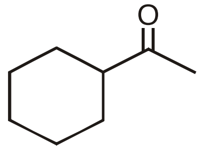
(i)  (j) 

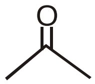
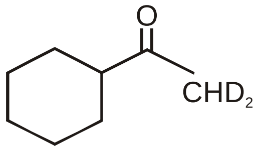
(k) 

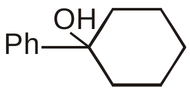
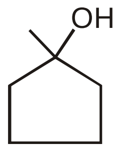
Ans.

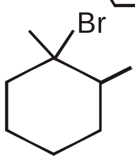
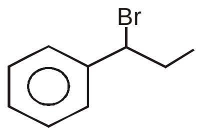
1. (a)  (b) 

(c) 

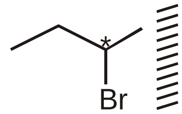
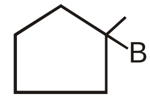
(d)  (e) 

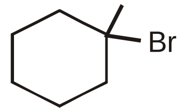
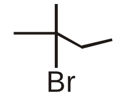
(f)  (g) 

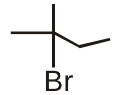
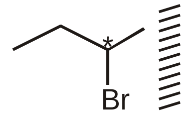
(h)  (i) 

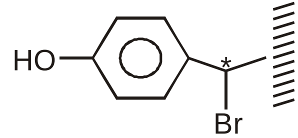
(j)  (k) 

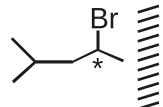
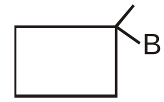
2. (a) x $\rightarrow$ 3 ; y $\rightarrow$ 2 ; z $\rightarrow$ 5
(b) A $\rightarrow$ 1 ; B $\rightarrow$ 1 ; C $\rightarrow$ 2
(c) 3 (d) 2
(e) 4 (f) x $\rightarrow$ 4 ; y $\rightarrow$ 4

3. (a)  M. I. (b) 

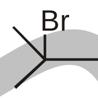
(c)  (d) 

(e)  (f) 

M. I. (g)  M. I.

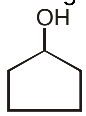
(h)  M. I. (i) 

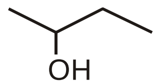
(j)  M. I.

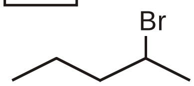
(k) 

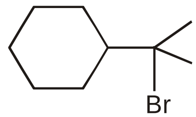
DPP NO- 09 Time: 15 minutes

Q.1 How will prepare following compound using alkene as the starting material ?

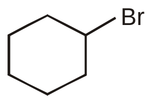
(a) 

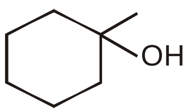
(b) 

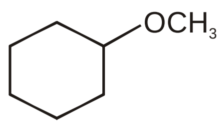
(c) 

(d) 

(e) $CH_3 - O - \underset{CH_3}{\overset{CH_3}{C}} - CH_3$

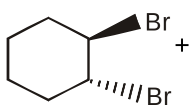
(f) 

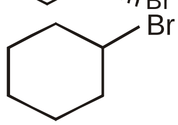
(g) 

(i) 

Q.2 Identify reactant in following reaction

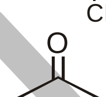
(a) (A) $\xrightarrow[CCl_4]{Br_2}$ meso – 2, 3 – dibromobutane

(b) (B) $\xrightarrow[CCl_4]{Br_2}$  + Mirror Image

(c) (C) $\xrightarrow[CCl_4]{HBr}$ 

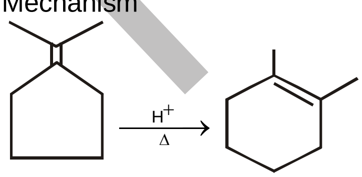
(d) (D) $\xrightarrow[CCl_4]{HBr}$ 

(e) (E) $\xrightarrow[CCl_4]{HBr}$ $CH_3 - \underset{CH_3}{\overset{CH_3}{C}} - CH_2 - Br$

(f) (F) $\xrightarrow{H_3O^{\oplus}}$ 

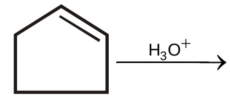
(g) (G) $\xrightarrow[CCl_4]{HBr}$ racemic mixture of 2, 3 – dibromobutane.

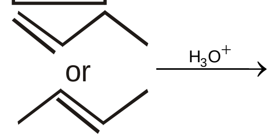
Q.3 Write – Mechanism

(a) 

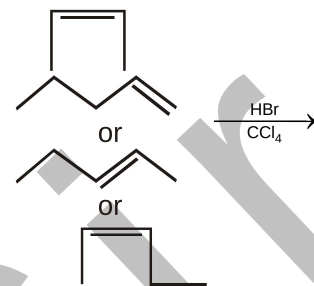
(b) $Ph—CH_2—CH_2—OH \xrightarrow{H_3O^{\oplus}} Ph - \overset{OH}{CH} - CH_3$

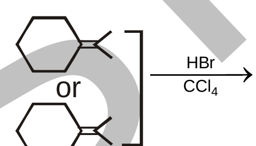
Ans.

1. (a) 

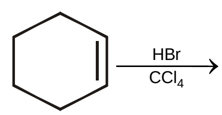
(b) 

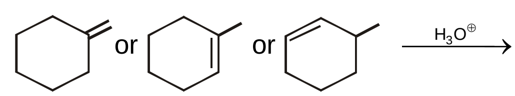
or

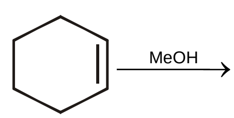
(c) 

(d) 

(e) 

(f) 

(g) 

(h) 

2. (a) A $\rightarrow$ Trans but-2-ene
(b) B $\rightarrow$ cyclohexene
(c) C $\rightarrow$ cyclohexene
(d) D $\rightarrow$ 2-Methylpropene
(e) E $\rightarrow$ can not prepared by alkene
(f) F $\rightarrow$ Propyne
(g) G $\rightarrow$ Cis but 2-ene

DPP NO-10 Time: 15 minutes

OZONOLYSIS: The reaction of alkene of alkene with ozone (O_3) followed by hydrolysis is known as ozonolysis.

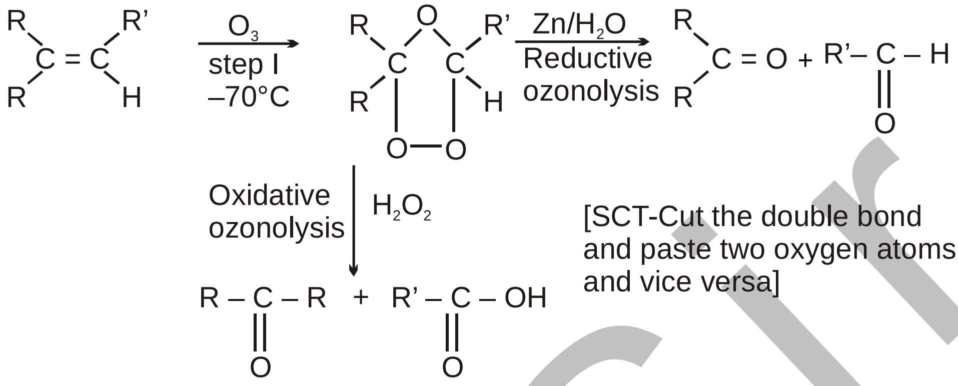
It is two types : (I) Reductive ozonolysis → In presence of reducing agent

(II) Oxidative ozonolysis → In presence of oxidizing agent

Reducing agents: Zn, H_2O or Zn, CH_3COOH or $(CH_3)_2S$ or $(Ph)_3$ P etc.

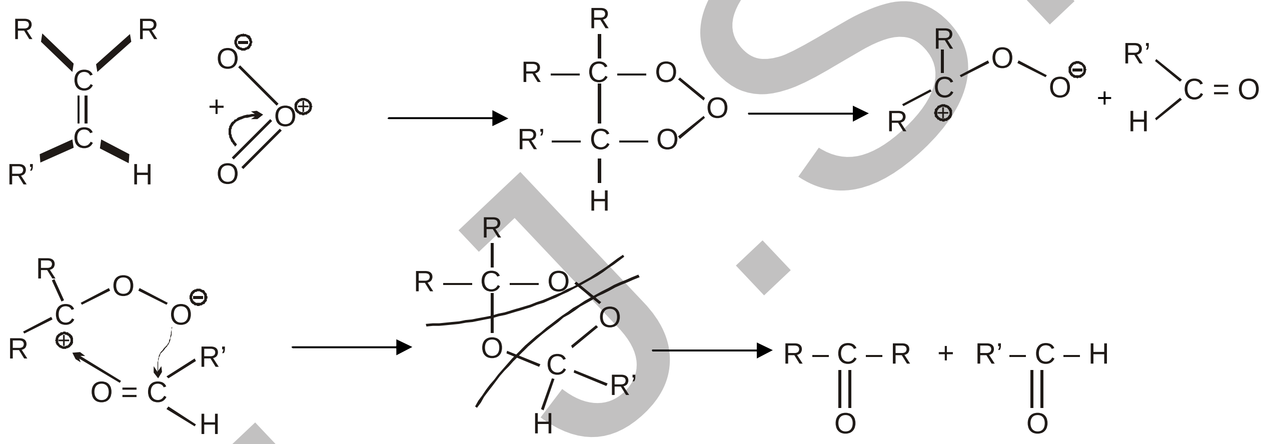
Oxidising agents: H_2O_2 or $R-\underset{\underset{O}{||}}{C}-O-O-H$ or Ag_2 O etc.

Example 1:



[SCT-Cut the double bond and paste two oxygen atoms and vice versa]

Mechanism:



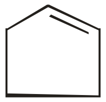
Note : In case of oxidative ozonolysis aldehyde (not ketone) further undergoes oxidation which gives acid as product.

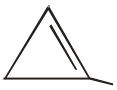
Q.1 Give the product of the following reaction. **[7 × 2 = 14]**

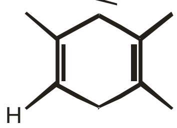
(i) $H_2C=CH_2 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

(ii) $CH_3-CH=CH_2 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

(iii) $CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

(iv)  $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

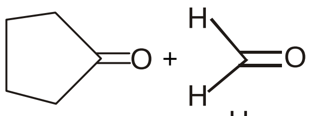
(v)  $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

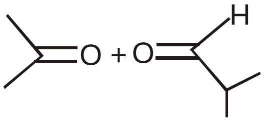
(vi)  $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

(vii) $H_2C=CH-CH_2-CH=CH-CH_3 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

Q.2 Find out the structure of reactant. **[11 × 2 = 22]**

(i) $X \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3} CH_3-CH_2-\underset{\underset{O}{||}}{C}-H$

(ii) **X** $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$ 

(iii) X $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$ 

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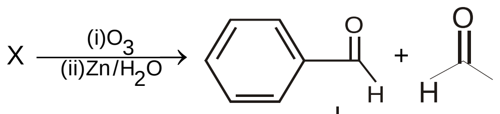
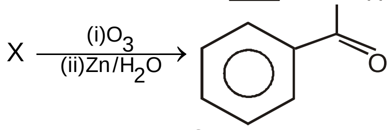
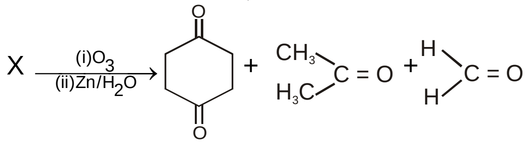
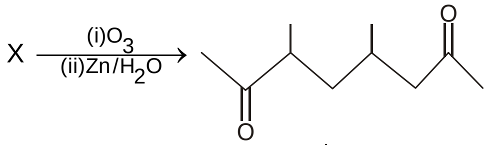
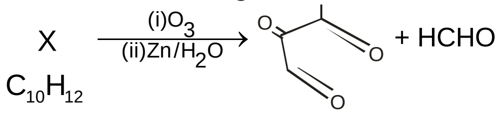
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, KJhalawar Road, Kota, Rajasthan (324005)

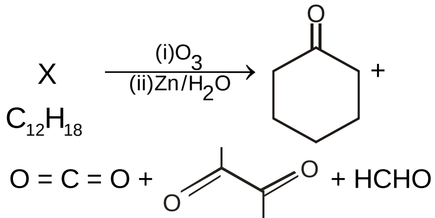
(iv) 

(v) 

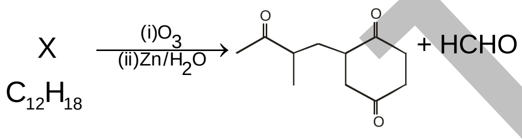
(vi) 

(vii) 

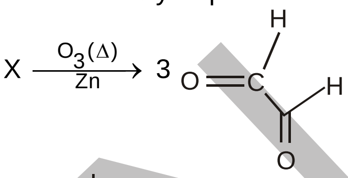
(viii) 

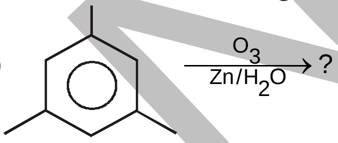
(ix) 

(x) $\underset{(X)}{C_6H_4} \xrightarrow[(ii)Zn/H_2O]{(i)O_3} C_3H_2O_3$

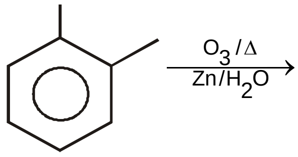
(xi) 

Q.3 Give the ozonolysis product of the following.

(i) 

(ii) 

How many species will be formed.

(iii) 

How many species will be formed.

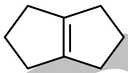
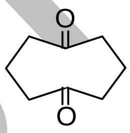
Q.4 How many initial ozonoids are possible in given reaction.

(i) $CH_2 = CH_2 \xrightarrow[(ii)Zn/H_2O]{(i)O_3/\Delta}$

(ii) $CH_3 - CH = CH - CH_3 \xrightarrow[(ii)Zn/H_2O]{(i)O_3/\Delta}$

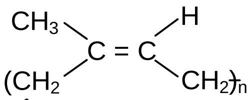
(iii) $CH_3 - CH = CH_2 \xrightarrow[(ii)Zn/H_2O]{(i)O_3/\Delta}$

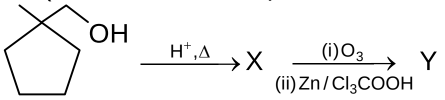
Q.9 Only mole of the compound A (molecular formula C_8H_{12}), incapable of showing stereoisomerism, reacts with only one mole of H_2 on hydrogenation over Pd. A undergoes ozonolysis to give a symmetrical diketone $B(C_8H_{12}O_2)$. What are the structure of A and B?

Ans. (A)  (B) 

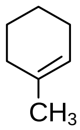
Q.21 If after complete ozonolysis of one mole of monomer of natural polymer gives two moles of CH_2O and one mole of $O = \overset{CH_3}{\overset{|}{C}} - CH = O$. Identify the monomer and draw the all-cis structure of natural polymer. **[IIT '2005]**

Ans. (a) $CH_2 = \overset{CH_3}{\overset{|}{C}} - CH = CH_2$

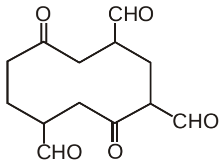
(b) 

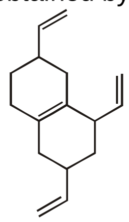
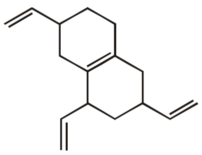
Q.22 

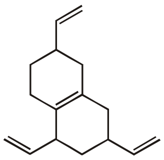
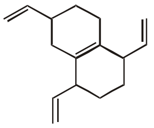
Identify X and Y.

Ans. (X)  , (Y) $CH_3 - \overset{O}{\overset{||}{C}} - (CH_2)_4 - CH = O$

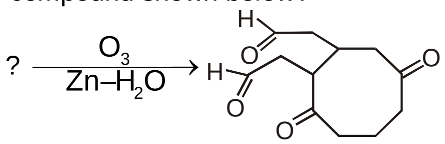
DPP NO-11 Time: 15 minutes

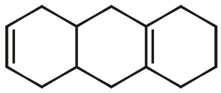
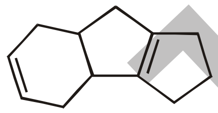
Q.1 
is obtained by the ozonolysis of following?

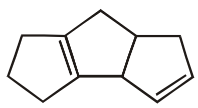
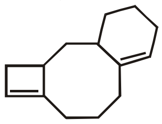
(A)  (B) 

(C)  (D) 

Q.2 Which starting material should be used to produce the compound shown below?



(A)  (B) 

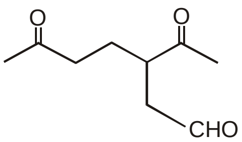
(C)  (D) 

Q.3 $CH_3-\underset{OH}{\overset{CH_3}{C}}-CH_3 \xrightarrow[\Delta]{H^+} (A) \xrightarrow[Zn,H_2O]{O_3} (P) + HCHO$

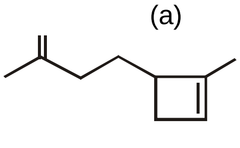
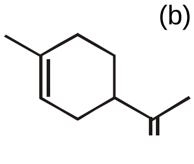
Product (P) is

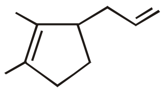
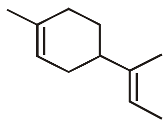
(A) CH_3-CH_2-CHO (B) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$
(C) $CH_3-\underset{CH_3}{\underset{|}{CH}}-OH$ (D) CH_3-CHO

Q.4 The reactants that lead to product (a) and (b) on ozonolysis are

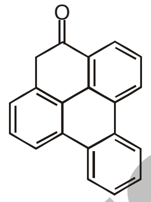
 HCHO

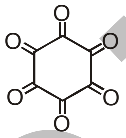
(a) (b)

(A)  (B) 

(C)  (D) 

Q.5 This compound on ozonolysis gives which of the following compounds

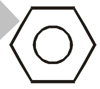
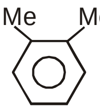


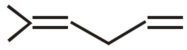
(I)  (II) $OHC-\underset{O}{\underset{\|}{C}}-\overset{O}{\overset{\|}{C}}-CH_2-\underset{O}{\underset{\|}{C}}-CHO$

(III) $\underset{CHO}{\underset{|}{CHO}}$ (IV) $OHC-\overset{O}{\overset{\|}{C}}-\underset{O}{\underset{\|}{C}}-CH_2-CH=O$

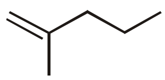
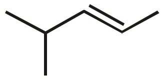
(A) I, II, III & IV (B) I, III, IV
(C) I, II, III (D) I, II, IV

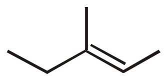
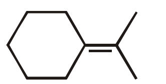
Q.6 Which of the following will give three different compounds on ozonolysis

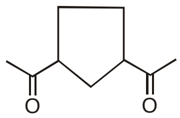
(A)  (B) 

(C)  (D) 

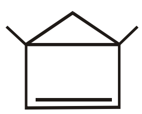
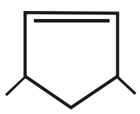
Q.7 Which one of the following compounds gives acetone $(CH_3)_2C=O$ as one of the products of its ozonolysis?

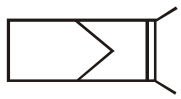
(A)  (B) 

(C)  (D) 

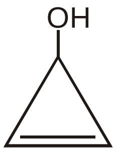
Q.8 Sentene $\xrightarrow{\text{ozonolysis}}$ 

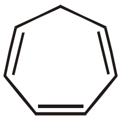
Which is the correct structure of Sentene.

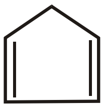
(A)  (B) 

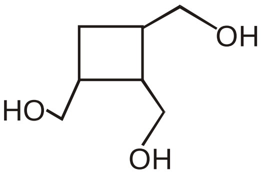
(C)  (D) 

Q.9 In which of following reaction product formed is aromatic

(A)  $\xrightarrow[\Delta]{HBr}$

(B)  $\xrightarrow[\Delta]{HF}$

(C)  $\xrightarrow[\Delta]{KH}$

(D)  $\xrightarrow[\Delta]{H_2SO_4}$

Q.10 Propane reacts with chlorine in sunlight to give two products. 1-chloropropane is obtained in 44% yield and 2-chloropropane is obtained in 56% yield of the total product. 2-Methylpropane reacts with chlorine under same conditions to produce 1-chloro-2-methylpropane 66% and 2-chloro-2-methylpropane 33% What will be the percent yield (X) of the major product obtained when 1,3,5-trimethylclohexane is treated with Cl_2 in similar conditions. **(Round answer to nearest integer)**

DPP NO-12 Time: 15 minutes

Free Radicals:–

Wurtz Reaction:–

$R — X \xrightarrow[ether]{Na} R — R$

Mechanism:– (Free radical Mechanism)

(1) $Na \longrightarrow Na^+ + e^-$

(2) $R — X + e^- \longrightarrow \dot{R} + :\ddot{X}:^{\ominus}$

(3) $\dot{R} + \dot{R} \longrightarrow R — R$

(Ionic Mechanism)

(1) $Na \longrightarrow Na^+ + e^-$

(2) $R — X + 2e^- \longrightarrow R + :\ddot{X}:^{\ominus}$

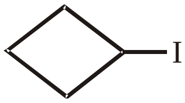
(3) $\ddot{R}^{\ominus} + R — X \longrightarrow R — R + :\ddot{X}:^{\ominus}$

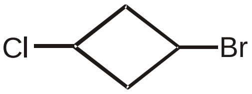
Q.1 $CH_3 — Cl \xrightarrow[ether]{Na}$ _______

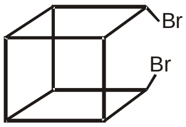
Q.2 $Et — Cl \xrightarrow[ether]{Na}$ _______

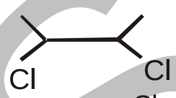
Q.3 $CH_3 — Cl + Et — Cl \xrightarrow[ether]{Na}$ _______

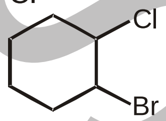
Q.4 $(Ph)_3$ Cl $\xrightarrow[ether]{Na}$ _______

Q.5  $\xrightarrow[ether]{Na}$ _______

Q.6  $\xrightarrow[ether]{Na}$ _______

Q.7  $\xrightarrow[ether]{Na}$ _______

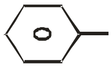
Q.8  $\xrightarrow[ether]{Na}$ _________ _

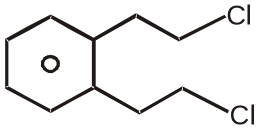
Q.9  $\xrightarrow[ether]{Na}$ _______

Q.10  $\xrightarrow[ether]{Na}$ _______

Q.11  $\xrightarrow[ether]{Na}$ _ _____

Q.12 $Ph — Cl \xrightarrow[THF]{Na}$ _______ (fitting Reaction)

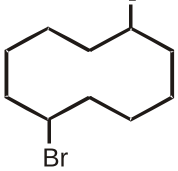
Q.13  $— Cl + Cl — CH_3 \xrightarrow[THF]{Na}$ __ (Wurtz fitting)

Q.14  $\xrightarrow[ether]{Na}$ _______

Q.15 $\underset{Br}{\underset{|}{CH_2}} — \underset{Br}{\underset{|}{CH_2}} \xrightarrow{Zn}$ _______

Q.16 $H — C(Cl)_3 \xrightarrow{Ag/Powder}$ _______

Q.17 $\underset{Br}{\underset{|}{CH_2}} — CH{=}CH — \underset{Br}{\underset{|}{CH_2}} \xrightarrow[ether]{Na}$ _______

Q.18  $\xrightarrow[ether]{Na}$ _______

ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, KJhalawar Road, Kota, Rajasthan (324005)

DPP NO-13 Time: 15 minutes

Q.1. On chlorination, an equimolar mixture of ethane and neopentane yields neopentyl chloride and ethyl chloride in the ratio 2.3 : 1. How does the reactivity of 1^o hydrogen in neopentane compare with the of a 1^o hydrogen in ethane?

Q.2. Give product(s) in each of the following reactions

$CH_3-CH(CH_3)-CH_2-CH_2-CH_3 \xrightarrow{Br_2/h\nu} (A)$

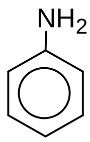
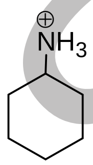
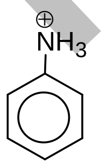
Q.3 Bromination of methane is slowed down by addition of fairly large amount of HBr.
(a) Suggest a possible explanation for this.
(b) Account for the fact that addition of HCl does not have a similar effect upon chlorination of CH_4.

Q.4. Which of the following compounds on gentle heating, will undergo homolytic bond cleavage easily:

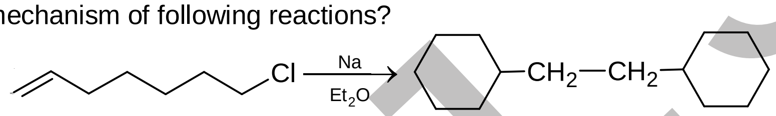
(A) $(CH_3)_2C-O-C(=O)-CH_3$ (B) $(CH_3)_3C-OC(CH_3)_3$
(C) $(CH_3)_3C-C_6H_5$ (D) $(CH_3)_3C-O-O-C(CH_3)_3$

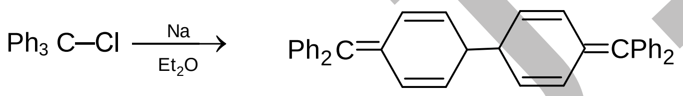
Q.5. Amongst the following, the most basic compound is:
(A) $C_6H_5NH_2$ (B) p-NO_2–$C_6H_4NH_2$ (C) m-NO_2–$C_6H_4NH_2$ (D) $C_6H_5CH_2NH_2$

Q.6 Which of the following is most acidic?

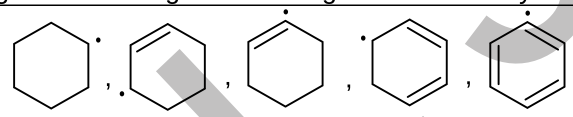
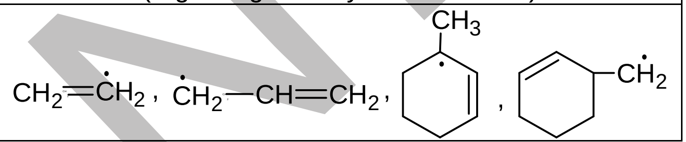
(A)  (B) $CH_3-\overset{\oplus}{N}H_3$ (C)  (D) 

Q.7. Write mechanism of following reactions?

(a) 

(b) 

Q.8. Arrange the following in increasing order of stability.

(a)	
	(regarding stability of free radical)
(b)	

Q.9. Supply the structure and type of intermediate species designated by

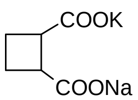
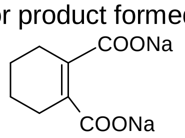
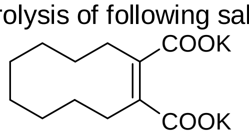
(a) $CH_3CH(OH)-CH_3 + H^+ \xrightarrow{\Delta} ? + H_2O$ (b) $CH_3CH_2-N=N-CH_2CH_3 \xrightarrow{\Delta} ? + N_2$

(c) $CH_3CHI_2 + Zn \longrightarrow ? + ZnI_2$ (d) $CH_3C\equiv CH + NaNH_2 \longrightarrow ?\overset{+}{N}a + NH_3$

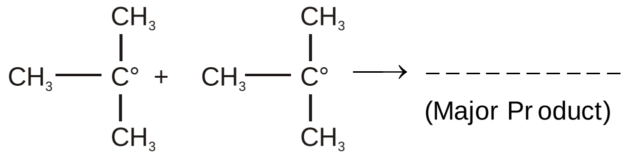
(e) $CH_3CH_2Cl + AlCl_3 \longrightarrow AlCl_4^- + ?$

Q.10. Name any organic compound which on electrolysis give H_2 on both the electrodes.

Q.11. Given structure of major product formed by electrolysis of following salts.

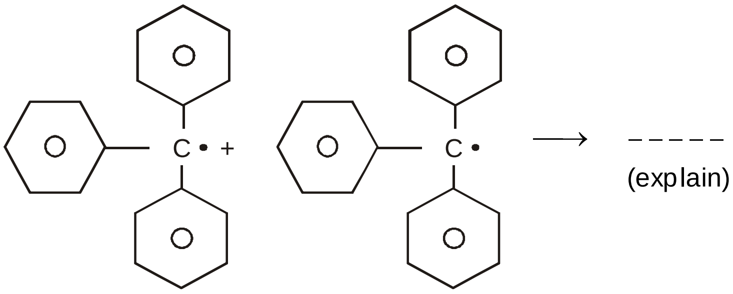
(a)  (b)  (c) 

Q.12

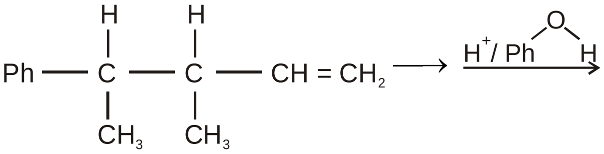


Q.13 $CH_3 - \overset{\circ}{C}H_2 + CH_3 - C^{\circ}H_2 \longrightarrow$ ---------- (Major Product)

Q.6

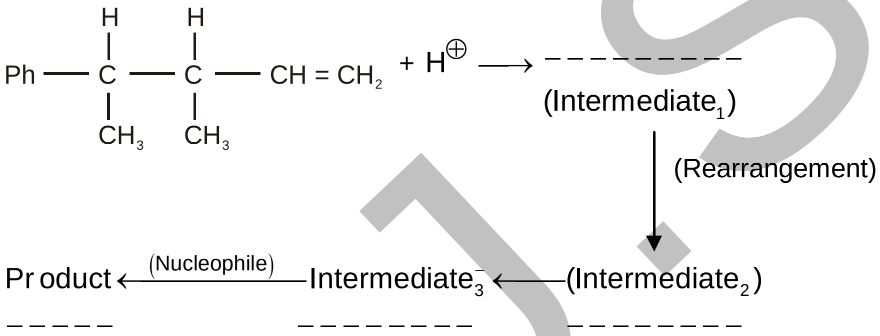


Q.14

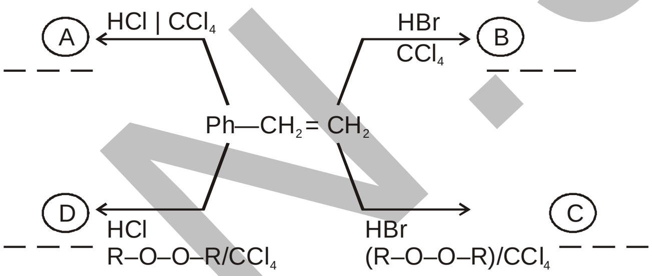


Mechanism : –

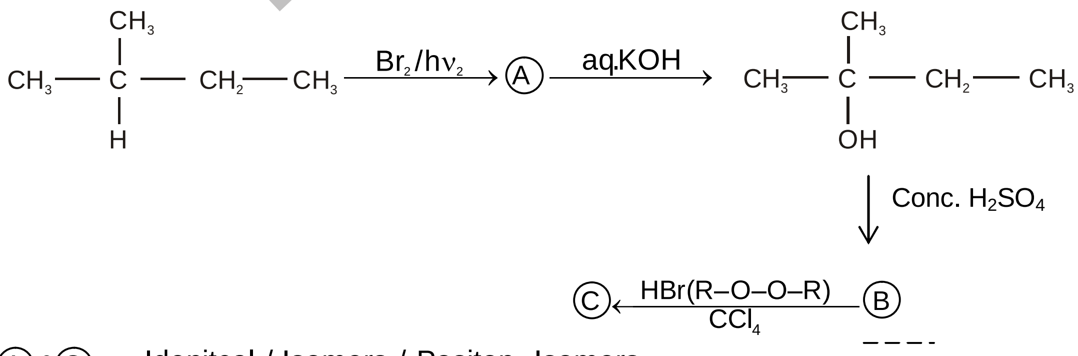
(ii)



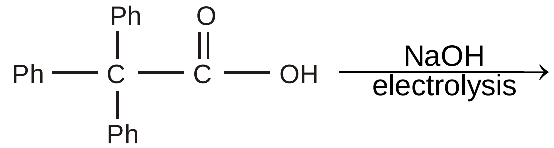
Q.15

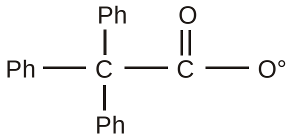
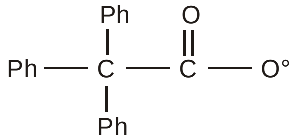


Q.16



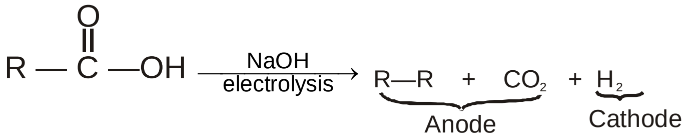
Ⓐ & Ⓒ are Idenitcal / Isomers / Positon Isomers.

Q.17 

Anode	Cathode
(I) ——————— $\longrightarrow e^- +$ 	(i) $2H_2O + 2e^- \longrightarrow$ ——————
(ii)  $\longrightarrow CO_2 +$ ———————— Intermediate	
(iii) Intermediate $\longrightarrow$ - - - - - - - - - - - - - ———————	

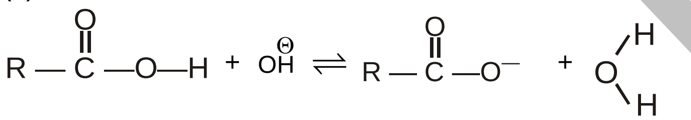
DPP NO- 14 Time: 15 minutes

Kolbe Electrolysis:–

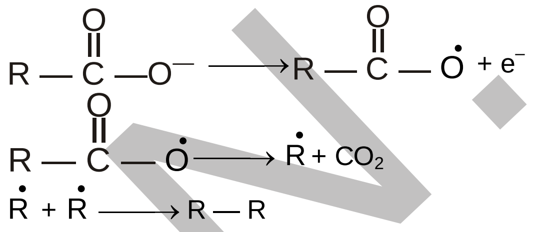


Mechanism:–

(1)



Anode:–

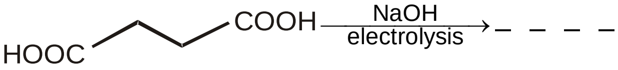


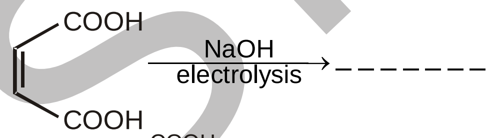
Cathode:–

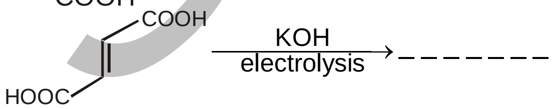
(1) $2H_2O + 2e^- \longrightarrow 2\overline{OH} + H_2$

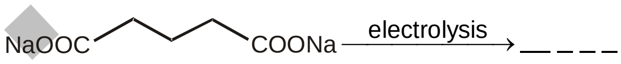
Q.1 $CH_3COOK \xrightarrow{\text{electrolysis}}$ ————————

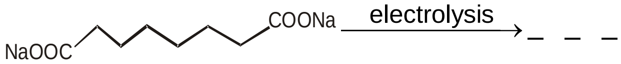
Q.2 $Et - COOH \xrightarrow[\text{electrolysis}]{\text{NaOH}}$ ————————

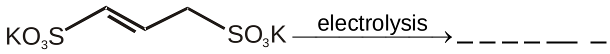
Q.3 

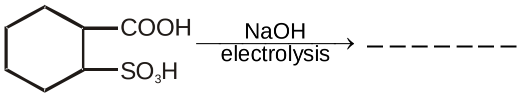
Q.4 

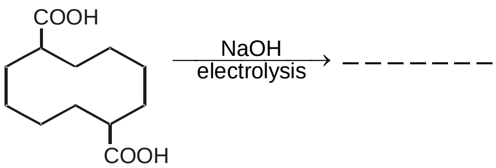
Q.5 

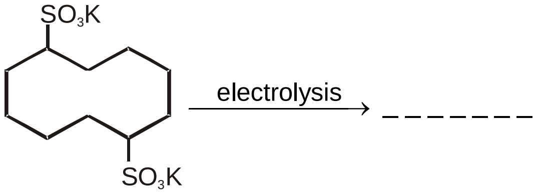
Q.6 

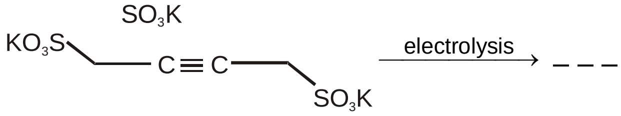
Q.7 

Q.8 

Q.9 

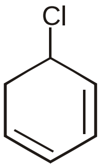
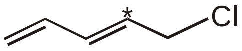
Q.10 

Q.11 

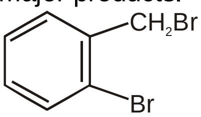
Q.12 

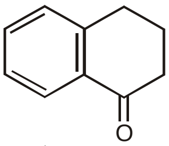
DPP NO- 15 Time: 15 minutes

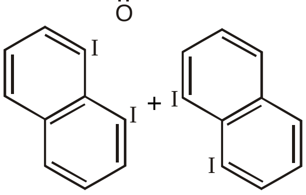
Q.1 Matrix

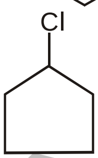
Reactions	**Number of dimerization product (excluding stereoisomers)**
(A) $CH_3 - CH_2 - Cl \xrightarrow[\text{Dry ether}]{\text{Na}}$	(P) 1
(B)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$	(Q) 3
(C) $H_2\overset{14}{C} = CH - CH_2 - Cl \xrightarrow[\text{Dry ether}]{\text{Na}}$	(R) 6
(D)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$ + $CH_3 - Cl$ $(H_2\overset{*}{C} = \overset{14}{C}H_2)$	(S) None

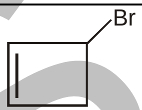
Q.2 Identify major products.

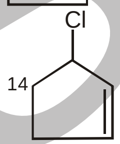
(1)  + 4 Na $\longrightarrow$

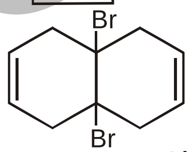
(2)  $\xrightarrow[C_2H_5OH]{\text{Al–Hg}}$

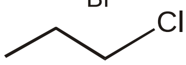
(3)  $\xrightarrow[120\text{–}260°C]{\text{Cu}}$

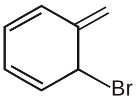
(4)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

(5)  $\xrightarrow[\text{DE}]{\text{Na}}$

(6)  $\xrightarrow[\text{DE}]{\text{Na}}$

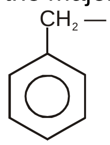
(7)  $\xrightarrow[\text{DE}]{\text{Na}}$

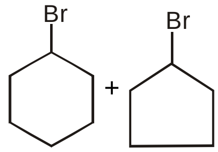
(8)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

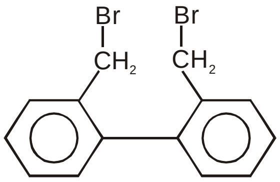
(9)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

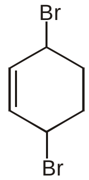
DPP NO- 16 Time: 15 minutes

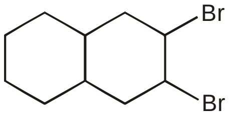
Q.1 Identify the major product:-

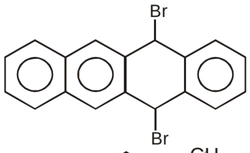
(1)  + $\xrightarrow[\text{Dry ether}]{\text{Na}}$

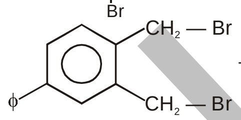
(2)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

(3)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

(4)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$ (A) $\xrightarrow{\text{Se}}$ (B)

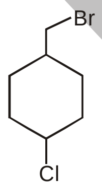
(5)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

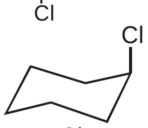
(6)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$ Naphthacene

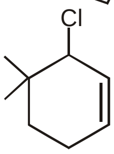
(7)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$ (A) + (B);

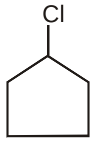
(A) & (B) are isomer.

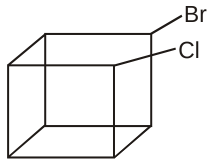
(8) $H_2\overset{*}{C}=CH—CH_2—Cl \xrightarrow[\text{Dry ether}]{\text{Na}} A + B + C$

(9)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

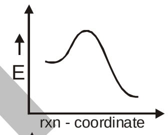
(10)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

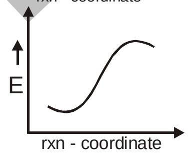
(11)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

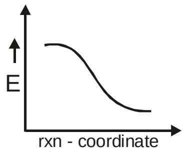
(12) $CH_3 — CH_2 — Cl$ +  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

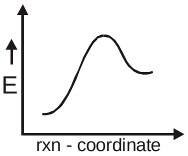
(13)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

2. Which of following is correct matching of energy profile diagram?

(1) $\overset{\oplus}{C}H_3 + \overset{\Theta}{Cl} \rightarrow CH_3 — Cl$ 

(2) $Cl — Cl \xrightarrow{hv} 2Cl$ 

(3) $CH_3\bullet + CH_3\bullet \rightarrow CH_3 — CH_3$ 

(4) $Cl\bullet + H — CH_3 \rightarrow H — Cl + {}^{\bullet}CH_3$ 

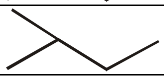
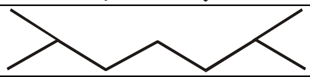
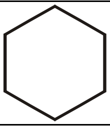
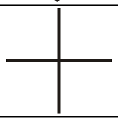
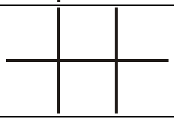
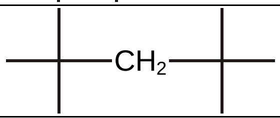
Bond energy $\left(H-Cl = 432\dfrac{KJ}{mole}\right)\left(CH_3-H = 440\dfrac{KJ}{mole}\right)$

3. When pentane is heated to a very high temperatue, radical reactions take palce that produce (among other products) methane, ethane, propane, and butane. This type of change is called thermal cracking. Among the reactions that take place are the following:-

(1) $CH_3CH_2CH_2CH_2CH_3 \longrightarrow CH_3\bullet + CH_3CH_2CH_2CH_2\bullet$
(2) $CH_3CH_2CH_2CH_2CH_3 \longrightarrow CH_3CH_2\bullet + CH_3CH_2CH_2\bullet$
(3) $CH_3\bullet + CH_3\bullet \longrightarrow CH_3CH_3$
(4) $CH_3\bullet + CH_3CH_2CH_2CH_2CH_3 \longrightarrow CH_4 + CH_3CH_2CH_2CH_2CH_2\bullet$
(5) $CH_3\bullet + CH_3CH_2\bullet \longrightarrow CH_3CH_2CH_3$
(6) $CH_3CH_2\bullet + CH_3CH_2\bullet \longrightarrow CH_3CH_2CH_2CH_3$

(a) For which of these reactions would you expect E_{act} to equal zero?
(b) To be greter than zero?
(c) To equal $\Delta H°$?

DPP NO-17 Time: 15 minutes

1.	Compound	Number of monochloroproduct	Number of monocloroproduct (excluding stereoisomer)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

2.

1.	Compound	Number of Dichloroproduct (including stereoisomer)	Optically active product
1.	1-chlorobutane		
2.	R-2-chlorobutane		
3.	3-chloropentane		
4.	R-2-chloropentane		
5.	S-2-chlorobutane		
6.	R & S-2-chloropentane		
7.	R & S-2-chloro butane		

ETOOS Academy Pvt. Ltd.
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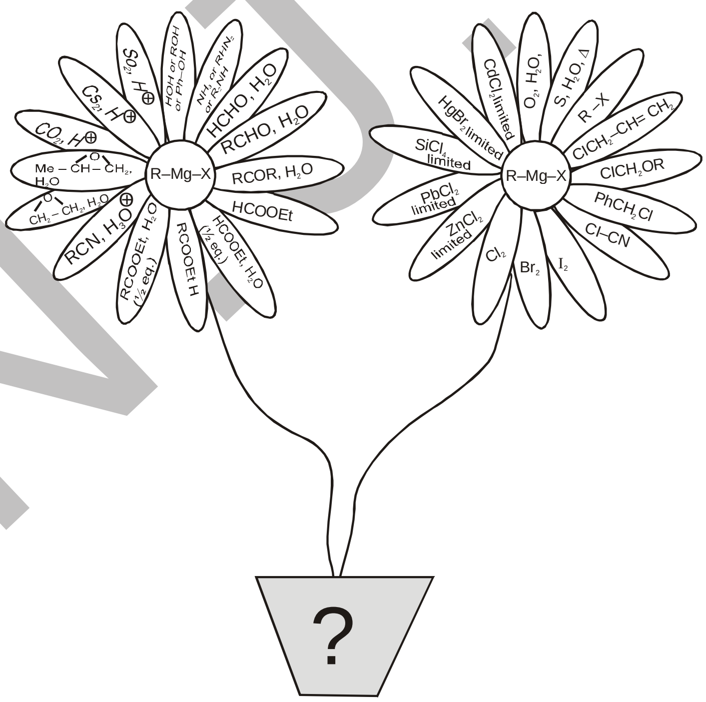
Question bank on

GRIGNARD'S REAGENT



ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, KJhalawar Road, Kota, Rajasthan (324005)

GRIGNARD'S REAGENT

Q.1 The order of reactivity of alkyl halide in the reaction $R - X + Mg \rightarrow RMgX$ is
(A) RI > RBr > RCl (B) RCl> RBr > RI
(C) RBr > RCl > RI (D) RBr > RI > RCl

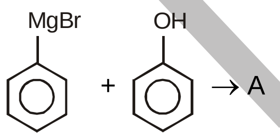
Q.2
$$Br{-}CH_2{-}C{\equiv}C{-}CH_2{-}Br \xrightarrow[\text{(excess) } Et_2O]{Mg} BrMg{-}CH_2{-}C{\equiv}C{-}CH_2{-}MgBr$$
$$Br{-}CH_2{-}C{\equiv}C{-}CH_2{-}Br \xrightarrow[Et_2O]{Mg\text{(1 eq.)}} \text{Product}$$
The major product is
(A) $Br-Mg-CH_2-C \equiv C-CH_2-Br$
(B) Cyclobutyne
(C) $-(CH_2-C \equiv C-CH_2)_n-$
(D) $CH_2 = C = C = CH_2$

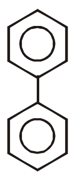
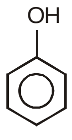
Q.3 On conversion into Grignard followed by treatment with ethanol, how many alkyl halides (excluding stereoisomers) would yield 2- methyl butane
(A) 2 (B) 3 (C) 4 (D) 5

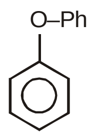
Q.4 Which of the following reacts with Grignard reagent to give alkane?
(A) nitro ethane (B) acetyl acetone (C) acetaldehyde (D) acetone

Q.5 How many litres of methane would be produced when 0.595 g of CH_3MgBr is treated with excess of $C_4H_9NH_2$
(A) 0.8 litre (B) 0.08 litre
(C) 0.112 litre (D) 1.12 litre

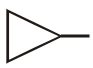
Q.6 How many litres of ethene would be produced when 2.62 g of vinyl magnesium bromide is treated with 224 ml of ethyne at STP
(A) 0.224 litre (B) 0.08 litre
(C) 0.448 litre (D) 1.12 litre

Q.7 

(A)  (B)  (C) 

(D) 

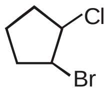
Q.8 In which of the following reactions 3º alcohol will be obtained as a product.

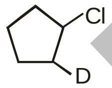
(A)  MgBr (excess) $H-\overset{O}{\overset{\|}{C}}-Cl + \longrightarrow \xrightarrow[H^+]{}$

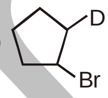
(B) $PhMgBr\text{(excess)} + CH_3-\overset{O}{\overset{\|}{C}}-Cl \longrightarrow \xrightarrow[H^+]{}$

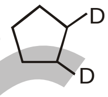
(C) $CH_3MgBr\text{(excess)} + CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3 \longrightarrow \xrightarrow[H^+]{}$

(D) $CH_3MgBr\text{ (excess)} + Cl-\overset{O}{\overset{\|}{C}}-O-Et \longrightarrow \xrightarrow[H^+]{}$

Q.9 

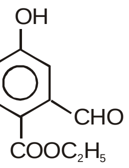
(A) 

(B) 

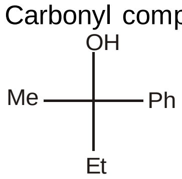
(C) 

(D) None of these

Q.10 Compounds are shown with the no. of RMgX required for complete reaction, select the incorrect option

(A) $CH_3COOC_2H_5$	1
(B) CH_3COCl	2
(C) $HOCH_2COOC_2H_5$	3
(D) 	4

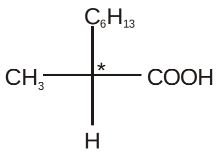
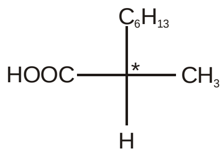
Q.11 What will be the order of reactivity of the following carbonyl compound with Grignard's reagent?
(I) $\begin{matrix}H\\H\end{matrix}\!>C=O$ (II) $\begin{matrix}H\\CH_3\end{matrix}\!>C=O$ (III) $\begin{matrix}CH_3\\CH_3\end{matrix}\!>C=O$ (IV) $\begin{matrix}Me_3C\\Me_3C\end{matrix}\!>C=O$
(A) I > II > III > IV (B) IV > III> II> I
(C) II > I > IV > III (D) III > II> I > IV

Q.12 Carbonyl compound (X) + Grignard reagent (Y) →


X, Y will be-

(A) $Et-\overset{O}{\overset{\|}{C}}-Ph$, MeMgBr (B) $Me-\overset{O}{\overset{\|}{C}}-Ph$, Et MgBr
(D) $Me-\overset{O}{\overset{\|}{C}}-Et$, Ph MgBr (D) $Et-\overset{O}{\overset{\|}{C}}-Ph$, Et MgBr

Q.13 (R) – 2–Bromooctane $\xrightarrow[\text{(ii) } CO_2 \text{ (iii) } H^{\oplus}]{\text{(i) Mg}}$ X; X is

(A)  (B) 

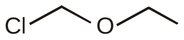
(C) A and B both (D) None of these

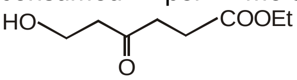
Q.14 In which one of the following reaction products are not correctly matched in

(A) RMg X + CO_2 $\xrightarrow{(2)\ H^{\oplus}}$ Carboxylic acid

(B) RMgX + $C_2H_5OH \longrightarrow$ Alkane

(C) RMgX + $CH_3CH_2Cl \longrightarrow$ Alkene

(D) RMgX +  $\longrightarrow$ Ether

Q.15 The number of moles of grignard reagent consumed per mole of the compound  is

(A) 4 (B) 2 (C) 3 (D) 1

Q.16 Select the correct statement :

(A) 1, 4- dibromobutane react with excess of magnesium in ether to generate di-Grignard reagent.

(B)1, 2- dichlorocyclohexane treated with excess of Mg in ether produces cyclohexene.

(C) Vicinal dihalides undergo dehalogenation to give alkene when heated with Zn dust or Mg.

(D) 1, 3- dichloropropane by treatment with Zn dust or Mg forms cyclopropane.

Q.17 $CH_3–CH = CH_2 \xrightarrow[\Delta]{Br_2} \xrightarrow[\text{Dry Ether}]{Mg}$

$\xrightarrow[NH_4Cl]{CH_3–\overset{O}{\overset{\|}{C}}–CH_3} \xrightarrow[\Delta]{H^+}$ X (Major)

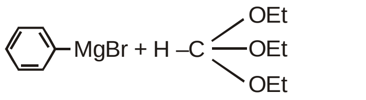
End product of above reaction is

(A) $CH_2= CH – CH_2– \overset{CH_2}{\overset{\|}{C}} – CH_3$

(B) $H_2C = CH – CH = \underset{CH_3}{\underset{|}{C}} – CH_3$

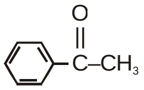
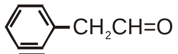
(C) $H_2C = CH – CH_2 – \overset{OH}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}} – CH_3$

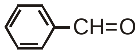
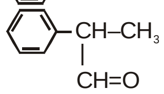
(D) $H_2C = CH– CH_2–\underset{CH_3}{\underset{|}{CH}}–CH_2–OH$

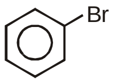
Q.18  $\xrightarrow[H_3O^+]{\text{followed}}$

Ethyl ortho formate

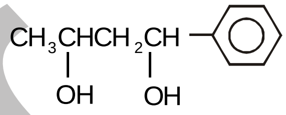
Product

(A)  (B) 

(C)  (D) 

Q.19  $\xrightarrow[\text{2. } CH_3\underset{OH}{\underset{|}{C}H}CH_2\underset{O}{\underset{\|}{C}H} \quad \text{3. } H_3O^+]{\text{1. Mg/ether}}$ Product (s)

Select the product from the following

I.  II. $CH_3\underset{OH}{\underset{|}{C}H}CH_2\underset{O}{\underset{\|}{C}H}$ III. 

(A) III (B) I, III

(C) I, II (D) II, III

Q.20 $C_2H_5O – \overset{O}{\overset{\|}{C}} – OC_2H_5 \xrightarrow{2CH_3MgBr}$ A. Product A formed

(A) is ethyl acetate

(B) further react with CH_3MgBr/H_2O^+ to give acetone

(C) further react with $CH_3Mg\ Br/H_2O^+$ to give t- butyl alcohol

(D) Can give pinacol when treated with Mg followed by H_2O

Q.21 Order of rate of reaction of following compound with phenyl magnesium bromide is

$Me – \overset{O}{\overset{\|}{C}} – Cl$ (I) $\quad Me – \overset{O}{\overset{\|}{C}} – H$ (II) $\quad Me – \overset{O}{\overset{\|}{C}} – O – Et$ (III)

(A) I > II > III (B) II > III > I

(C) III > I > II (D) II > I > III

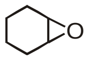
Q.22 Select the correct order of decreasing reactivity of the following compounds towards the attack of Grignard reagent

(I) Methyl benzoate (II) Benzaldehyde

(III) Benzoylchloride (IV) Acetophenone

(A) II > III > I > IV (B) I > II > III > IV

(C) III > II > IV > I (D) II > IV > I > III

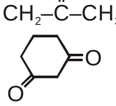
Q.23  $\xrightarrow[NH_4Cl]{CH_3MgX}$ Product is

(A) Enantiomer (B) Diastereisomer

(C) Meso (D) Achiral

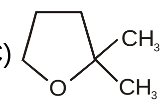
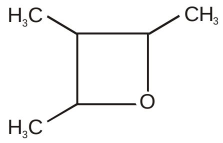
Q.24 Nucleophilic addition of Grignard reagent cannot occur in

(A) $CH_3– \overset{O}{\overset{\|}{C}}– \overset{O}{\overset{\|}{C}}–CH_3$ (B) $CH_3– \overset{O}{\overset{\|}{C}}– CH_2–\overset{O}{\overset{\|}{C}}–CH_3$

(C) $CH_3– \overset{O}{\overset{\|}{C}}– CH_2–CH_2–\overset{O}{\overset{\|}{C}}–CH_3$ (D) 

Q.25 $CH_3\overset{\overset{\displaystyle O}{\|}}{C}CH_2CH_2CH_2Cl \xrightarrow{CH_3MgBr}$ A, A is

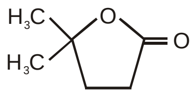
(A) $CH_3\underset{OH}{\overset{CH_3}{C}}CH_2CH_2CH_2Cl$ (B) $CH_3\underset{\underset{\displaystyle O}{\|}}{C}CH_2CH_2CH_2CH_3$

(C)  (D) 

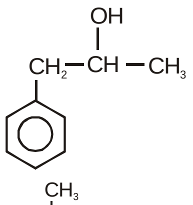
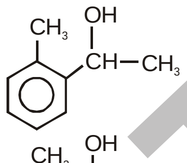
Q.26 $CH_3\overset{\overset{\displaystyle O}{\|}}{C}CH_2CH_2\overset{\overset{\displaystyle O}{\|}}{C}OCH_2CH_3 \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } CH_3MgBr\text{(one mole)}}$ A,

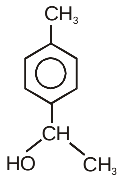
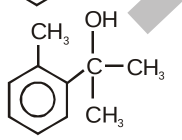
A formed in this reaction is

(A) $CH_3\underset{CH_3}{\overset{OH}{C}}CH_2CH_2\overset{\overset{\displaystyle O}{\|}}{C}OCH_2CH_3$ (B) $CH_3\overset{\overset{\displaystyle O}{\|}}{C}CH_2CH_2\overset{\overset{\displaystyle O}{\|}}{C}CH_3$

(C)  (D) $CH_3\underset{OH}{\overset{CH_3}{C}}CH_2CH_2\underset{OH}{\overset{CH_3}{C}}CH_3$

Q.27 $PhCH_3 \xrightarrow[h\nu]{Cl_2}$ (A) $\xrightarrow[\text{ether}]{Mg}$ (B) $\xrightarrow[NH_4Cl]{CH_3CHO}$ (C)

(A)  (B) 

(C)  (D) 

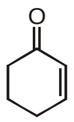
Q.28 Select the correct order of reactivity towards Grignard reagent for nucleophilic attack.

(A) $R-\overset{\overset{\displaystyle O}{\|}}{C}-R > R-\overset{\overset{\displaystyle O}{\|}}{C}-H$

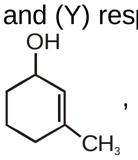
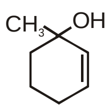
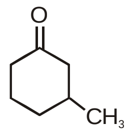
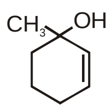
(B) $Cl-CH_2-\underset{\underset{\displaystyle O}{\|}}{C}-H > CH_3CH_2-\underset{\underset{\displaystyle O}{\|}}{C}-H$

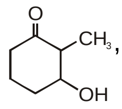
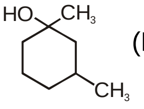
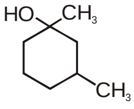
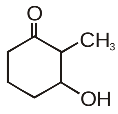
(C) $CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-O-C_6H_4-NO_2 < CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-O-C_6H_5$

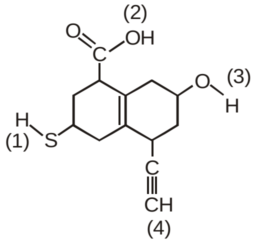
(D) $R-\overset{\overset{\displaystyle O}{\|}}{C}-OR > R-\overset{\overset{\displaystyle O}{\|}}{C}-NR_2$

Q.29  $\xrightarrow[\text{(ii) } H_2O/H^+]{\text{(i) } CH_3MgBr/CuCl}$ (X) Major + (Y)

(X) and (Y) respectively are

(A) ,  (B) , 

(C) ,  (D) , 

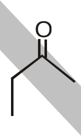
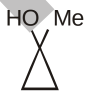
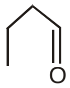
Q.30  $\xrightarrow{\text{RMgX (2 moles)}}$

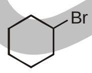
Deprotonation will occur from the following positions:

(A) 1, 2 (B) 1, 3
(C) any two positions (D) 1, 4

Q.31  $\xrightarrow[NH_4Cl]{2CH_3MgX}$ $P_1 + P_2$

Identify P_1 & P_2.

(A) CH_4 (B)  (C)  (D) 

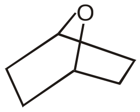
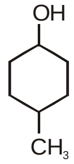
Q.32  $\xrightarrow{Mg}$ (A) $\xrightarrow[\text{(ii) } H^+/H_2O]{\text{(i) } ^{14}CO_2}$ (B) $\xrightarrow{NaHCO_3}$ (C) gas

Product C is

(A) CO (B) $^{14}CO_2$ (C) CO_2
(D) A mixtue of $^{14}CO_2$ and CO_2

Q.33 $2CH_3MgBr \xrightarrow[\text{(ii) } H^+]{\text{(i) } CH_3ONH_2}$

(A) $CH_3-O-NH-CH_3$ (B) $CH_3-NH-CH_3$
(C) CH_3-NH_2 (D) CH_3-OH

Q.34  $\xrightarrow[\text{(ii) } H^+/H_2O]{\text{(i) } CH_3MgBr}$ (A) 

(A) The product is optically active
(B) The product contains plane of symmetry
(C) The product shows geometrical isomerism
(D) The product shows optical isomerism

Q.35 Which of the following is incorrect.

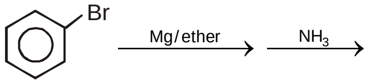
(A) $Cl-\overset{\overset{\displaystyle O}{\|}}{C}-OC_2H_5 \xrightarrow[\text{(1 eq)}]{CH_3MgX} CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-OC_2H_5$

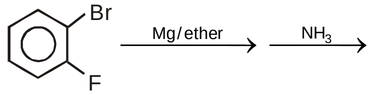
(B) $CH_3-C(OC_2H_5)_3 \xrightarrow[\text{(1 eq)}]{C_2H_5MgX} CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-OC_2H_5$

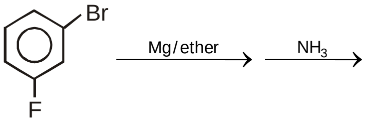
(C) $CH_3MgX + \overset{\overset{\displaystyle S}{\|}}{C}=S \xrightarrow{H_3O^+} CH_3-\overset{\overset{\displaystyle S}{\|}}{C}-SH$

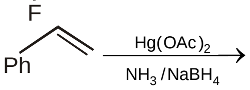
(D) $CH_3MgX + \overset{\overset{\displaystyle O}{\|}}{C}=O \xrightarrow{H_3O^+} CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-OH$

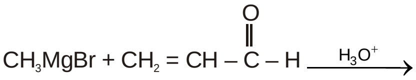
Q.36 Which reaction gives 1° aromatic amine as major product.

(A) 

(B) 

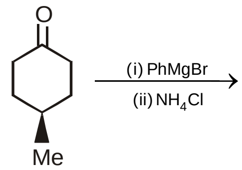
(C) 

(D) 

Q.37  Product (1, 4 addition). It is

(A) $CH_2=CH-C(OH)(CH_3)-H$ (B) $CH_2(OH)CH=CH-CH_3$

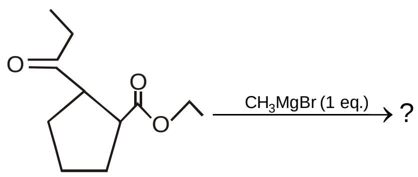
(C) $CH_3CH_2CH_2CHO$ (D) None

Q.38  Product

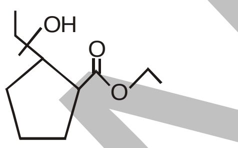
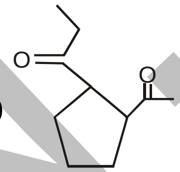
Produtcs in this reaction will be

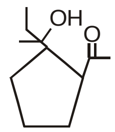
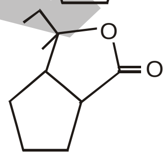
(A) Stereoisomers (B) Enantiomer

(C) Diastereomers (D) Geometrical isomers

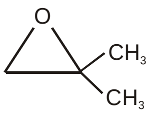
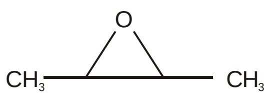
Q.39 

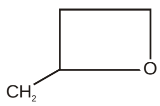
The product is:

(A)  (B) 

(C)  (D) 

Q.40 $CH_2=C=O \xrightarrow[\text{(ii) } CH_3MgBr \text{ (2equi.)}]{\text{(i) } Br_2} C_4H_8O$

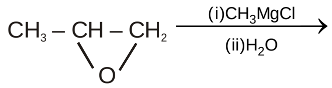
(A)  (B) 

(C)  (D) All of these

Q.41 $RMgX \xrightarrow[\text{(ii)}NH_4Cl]{\text{(i)}CH_3CN} (A) \xrightarrow[NH_4Cl]{RMgX}$ (B) will be

(A) 1°ROH (B) 2°ROH

(C) 3°ROH (D) Alkene

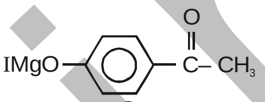
Q.42 

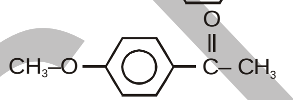
(A) $CH_3-CH(CH_3)-CH_2OH$ (B) $CH_3-CH(OH)-CH_2-CH_3$

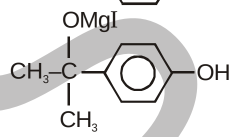
(C) $CH_3-CH(CH_3)-CH_3$

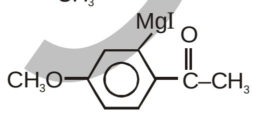
(D) $HO-CH_2-CH_2-CH_2-CH_2-OH$

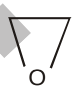
Q.43 The reaction of 1 mole each of p-hydroxy acetophenone and methyl magnesium iodide will give

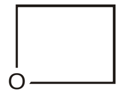
(A) CH_4 + 

(B) 

(C) 

(D) 

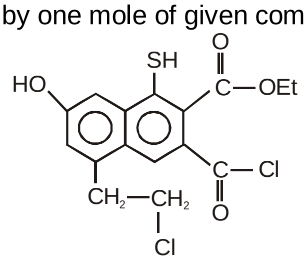
Q.44 (i)  + Ph Mg Br $\xrightarrow{r_1}$ Ph CH_2CH_2OH

(ii)  + Ph Mg Br $\xrightarrow{r_2}$ Ph $CH_2CH_2CH_2OH$

(A) $r_2 > r_1$ (B) $r_1 > r_2$

(C) $r_1 = r_2$ (D) $r_1 = 2r_2$

Q.45 How many moles of Grignard reagent will be required by one mole of given compound?



(A) 7 (B) 6 (C) 8 (D) 5

Q.46 Consider the given organometallic compound.

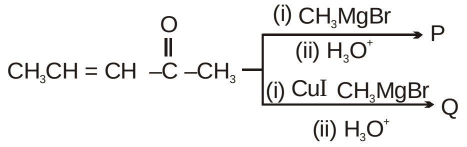
(I) $(CH_3)_2Hg$ (II) $(CH_3)_2Zn$

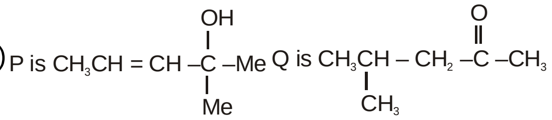
(III) $(CH_3)_2Mg$ (IV) CH_3Li

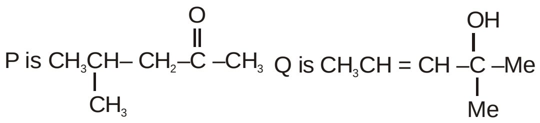
The correct decreasing order of ionic character is

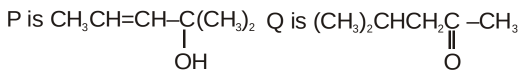
(A) I > II > III > IV (B) II > I > III > IV

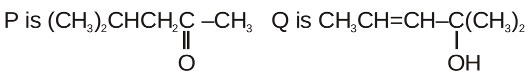
(C) I > III > II > IV (D) IV > III > II > I

Q.47 

(A) 

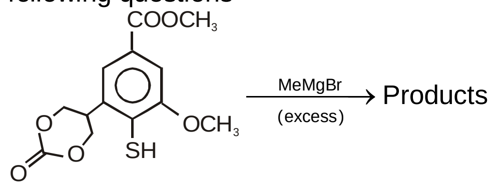
(B) 

(C) 

(D) 

For Q. no. 48 to Q.no.50

Consider the given reaction and answer the following questions



Q.48 No. of RMgX consumed in the reaction is

(A) 4 (B) 5 (C) 6 (D) 7

Q.49 How many product will be formed in given reaction (excluding stereo)

(A) 2 (B) 3 (C) 4 (D) 5

Q.50 Which of the following reaction will give the same Hydrocarbon formed as one of the product in the above reaction.

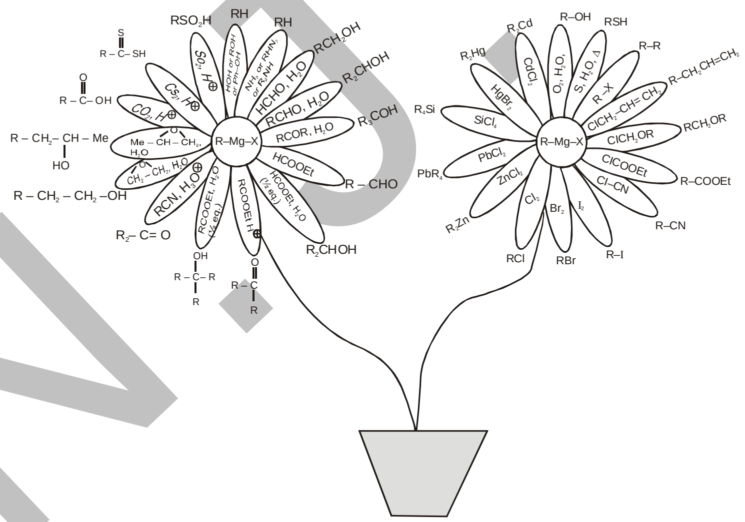
(A) EtMgBr + Me – OH $\rightarrow$

(B) PhMgBr + Me – OH $\rightarrow$

(C) MeMgBr + Ph – OH $\rightarrow$

(D) MeMgBr + CH_3 – CHO $\rightarrow$

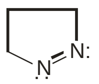
ANSWER KEY

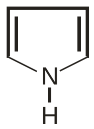


Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	A	D	C	A,B	C	C	A	B,C,D	D	A	A	A,B,C	C	C	A
Q.No.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	A,C,D	B	C	C	C,D	A	C	A	B,D	C	C	A,B,C	B	B	A
Q.No.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Ans.	A,B	C	C,D	B,C	B	B	C	A,C,D	D	A	C	B	A	B	A
Q.No.	**46**	**47**	**48**	**49**	**50**										
Ans.	D	C	C	C	C										

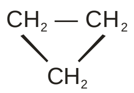
DPP NO- 01 Time: 15 minutes

Explain:

1. $CH_2 = CH_2 \xrightarrow{CH_2N_2}$ 

2. $CH \equiv CH \xrightarrow{CH_2N_2}$ 

Simon Smith Reaction:–

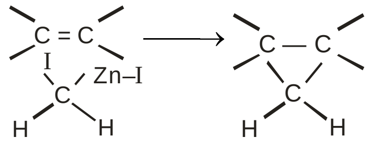
$CH_2 = CH_2 \xrightarrow[Zn/Cu]{CH_2I_2}$ 

Mechanism:– 1) $Zn \longrightarrow Zn^{+2} + Ze^{-}$

1. $I - CH_2 - I \xrightarrow{2e^-} I - CH_2:^{\ominus} + I^{\ominus}$

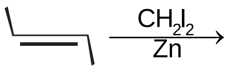
$\downarrow Zn^{+2}$

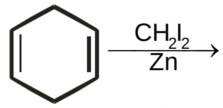
$I - CH_2 - Zn\,I$
(Carbenoid)

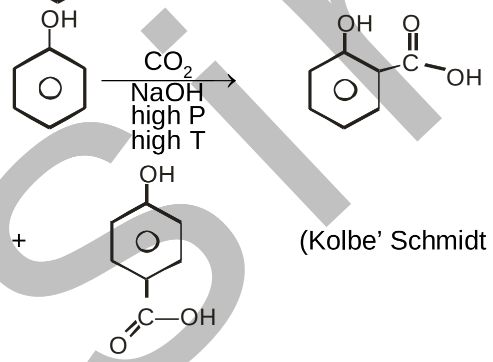
2.  (No bond rotation)

Characteristics :–

1. The reaction is stereospecific in nature

Q.1  **2.** 

3. 

4. 

(Kolbe' Schmidt Reaction)

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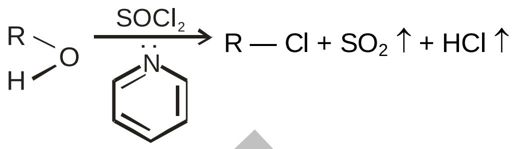
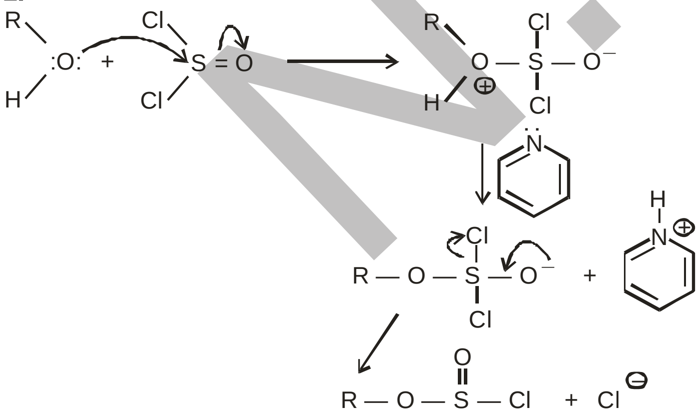
DPP NO- 02 Time: 15 minutes

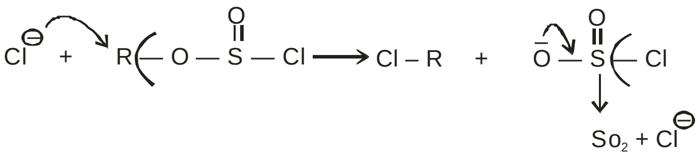


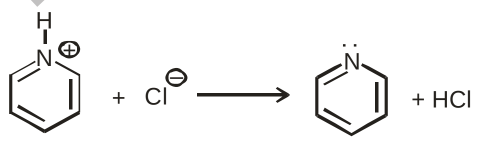
Mechanism: –

1.



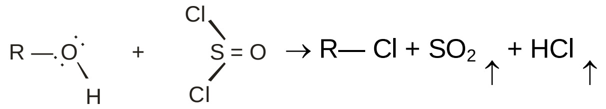
2.



3. 

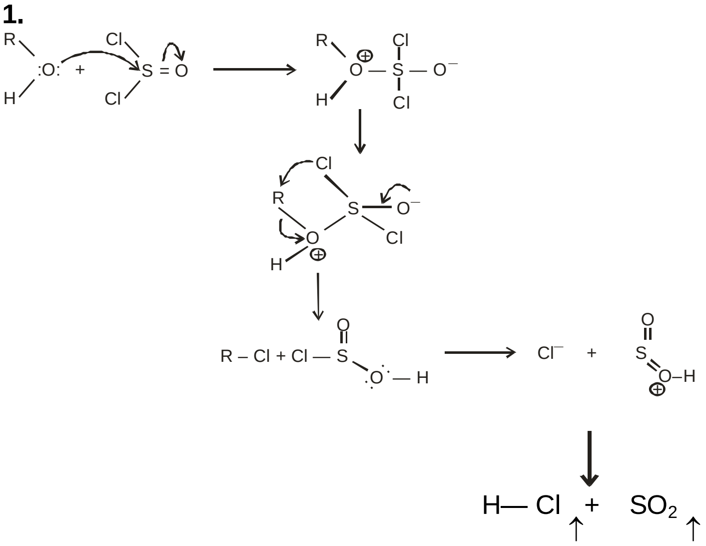
This reaction leads to inversion of Configuration.

Darzen's Process.



Machanism:–

1.



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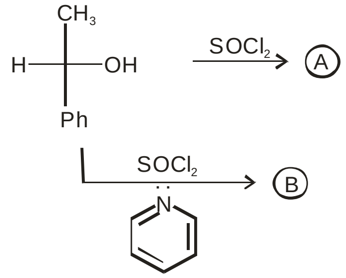
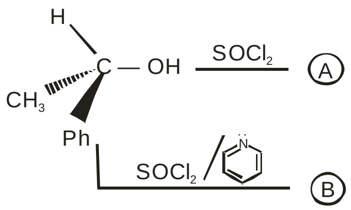
Note: the reaction leads to selection of configuration Retention of configuration.

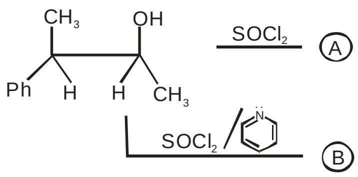
Q.1



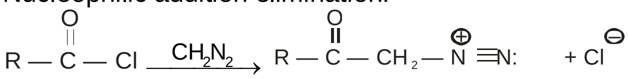
Q.2



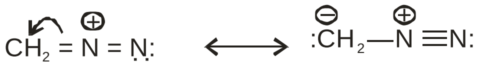
Q.3



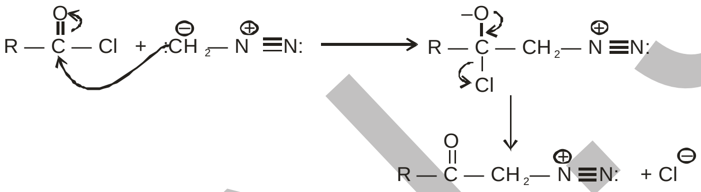
Nucleophilic addition elimination:—



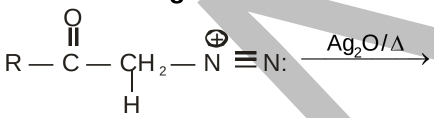
Mechanism:—



1.

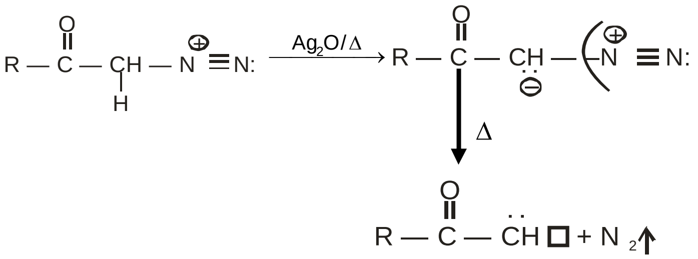


Wolf Rearrangement:—

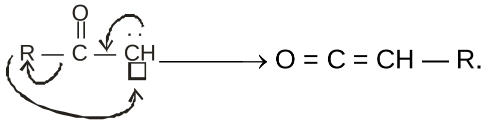


Mechanism:—

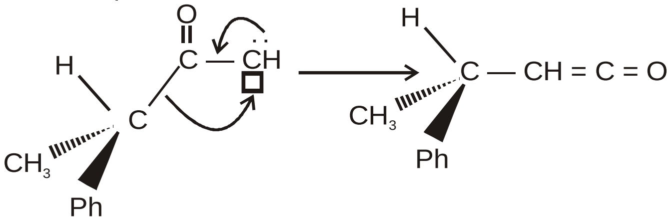
1.



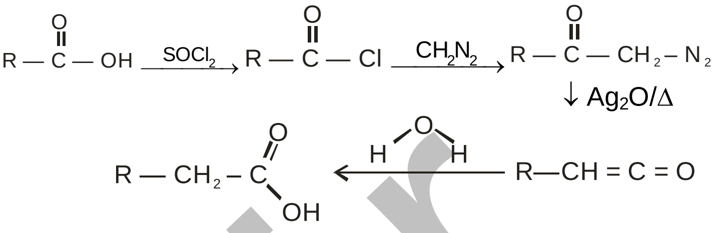
2.

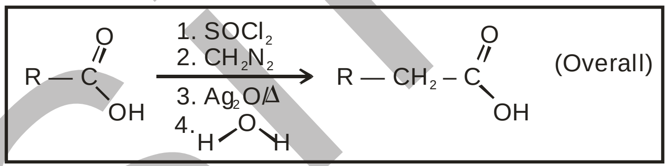


For example:—



Arndt Eistert Reaction:–



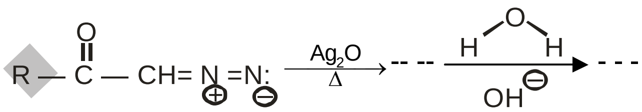


Characteristics:—

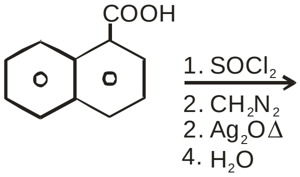
1. The reaction is known as homologation
2. The reaction occurs with relation of configuration.

Ex.1

1.

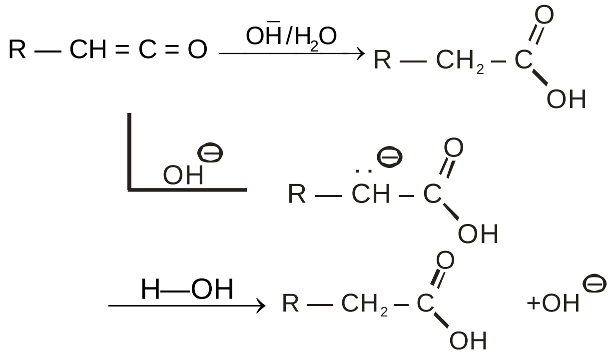


2.



Nucleophilic addition:—

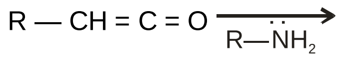
1.



2.

3.

4.



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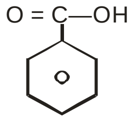
Diazo methane

Acid-Base Reaction:–

1. $CH_2N_2 + HCl \longrightarrow CH_3Cl + N_2\uparrow$

2. $R-OH + CH_2N_2 \longrightarrow$

3. $R-C(=O)-O-H + CH_2N_2 \longrightarrow$

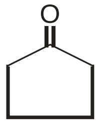
4.  $+ CH_2N_2 \longrightarrow$

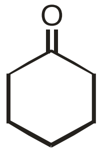
5. $CH_3-C(=O)-OH + CH_2N_2 \longrightarrow$

Homologation Reaction:–

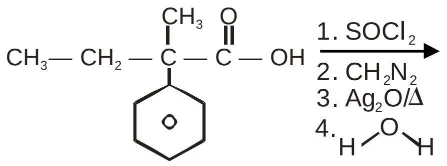
1. $R-\overset{O}{\overset{\|}{C}}-H \xrightarrow{CH_2N_2} R-\overset{O}{\overset{\|}{C}}-CH_2-H + R-\underset{H}{C}(-O-)CH_2$

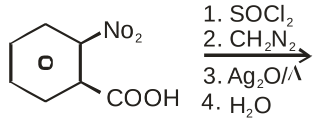
2. $R-\overset{O}{\overset{\|}{C}}-R \xrightarrow{CH_2N_2}$ - - - - - - - - + - - - - - - - - - -

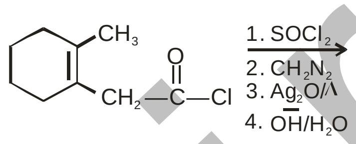
3.  $\xrightarrow{CH_2N_2}$ - - - - - - - + - - - - - - - - - -

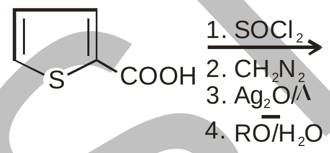
4.  $\xrightarrow{CH_2N_2}$ - - - - - - + - - - - - - - - - -

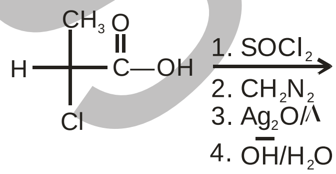
5. $Et-\overset{O}{\overset{\|}{C}}-H \xrightarrow{CH_2N_2}$ - - - - - - + - - - - - - - - - -

6.  - - - - - - - -

7.  - - - - - - - -

8.  - - - - - - - - - - - - - - -

9.  - - - - - - - - - - - - - - -

10.  - - - - - - - - - - - - - - -

11. $Et-\overset{O}{\overset{\|}{C}}-H \xrightarrow{CH_2N_2}$ - - - - - - - - + - - - - - - - - - - -

12. $Et-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{CH_2N_2}$ - - - - - - - - + - - - - - - - - - - -

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DPP NO- 03 Time: 15 minutes

Nitrenes :–

Q.1 Fill in the blanks:–

(a) $R-\ddot{N}=\overset{\oplus}{N}=\ddot{N}:^{\ominus} \xrightarrow[\Delta]{h\upsilon}$

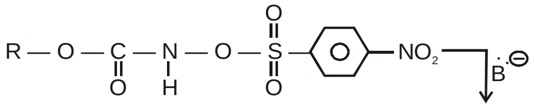
- - - - - - - - - - - + - - - - - - - - - - - - - - - (gas)

(b) $R-\overset{O}{\overset{\|}{\underset{\underset{O}{\|}}{S}}}-\ddot{N}=\overset{\oplus}{N}=N:^{\ominus} \xrightarrow[\Delta]{h\upsilon}$

- - - - - - - - - - - + - - - - - - - - - - - - - - - (gas)

(c) $R-O-\underset{\underset{O}{\|}}{C}-\ddot{N}=\overset{\oplus}{N}=\ddot{N}:^{\ominus} \xrightarrow[\Delta]{h\upsilon}$

- - - - - - - - - - - + - - - - - - - - - - - - - - - (gas)

(d) 

- - - - - - - - + - - - - - - - - - - (gas)

(e) $H-N=\overset{\oplus}{N}=\ddot{N}:^{\ominus} \xrightarrow{h\upsilon}$

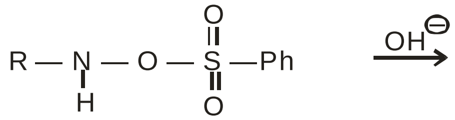
- - - - - - - - - - - + - - - - - - - - - - - - - - - (gas)

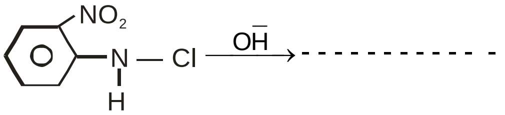
(f) $R-\underset{\underset{O}{\|}}{C}-\ddot{N}=\overset{\oplus}{N}=\ddot{N}:^{\ominus} \xrightarrow{h\upsilon}$

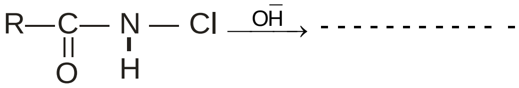
- - - - - - - - - - - + - - - - - - - - - - - - - - - (gas)

(g) $H-N=C=O \xrightarrow{h\upsilon}$

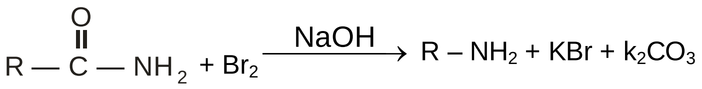
----------- + CO ____

(h) 

(i) 

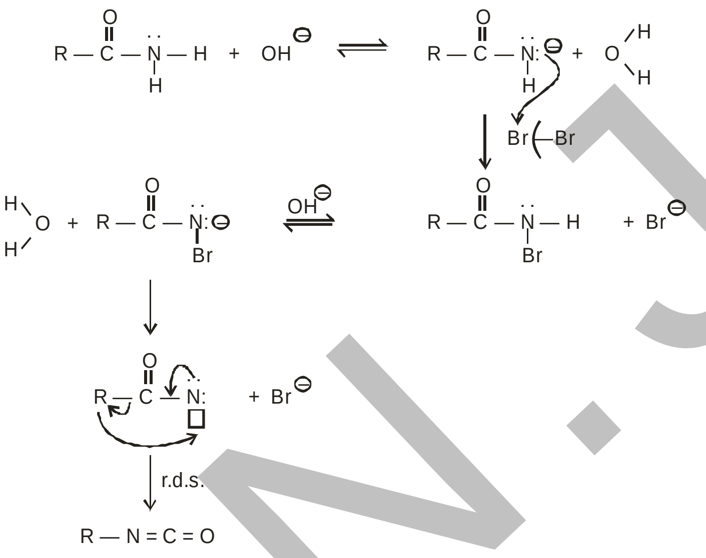
(j) 

Hoffmann Bromanide Reaction:–

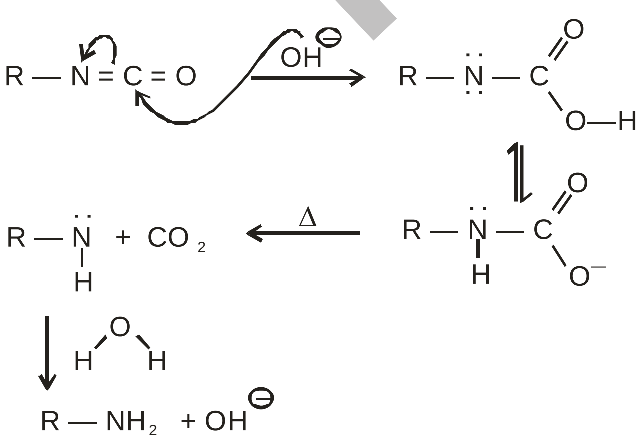


Mechanism:–

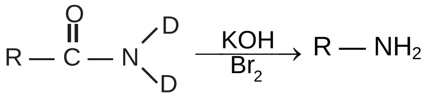
1.



2

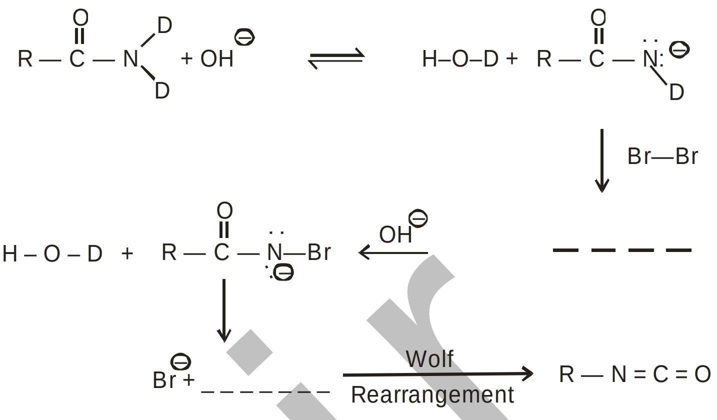


Fill in the blanks:–

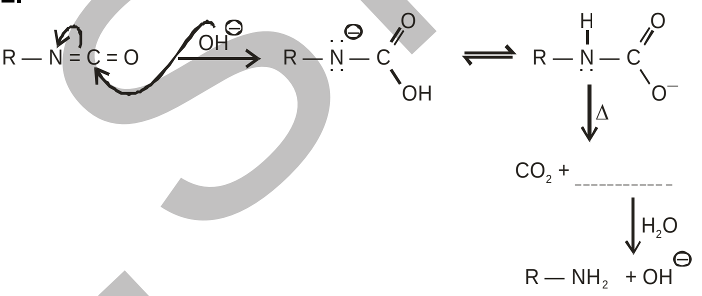


Mechanism:–

1.

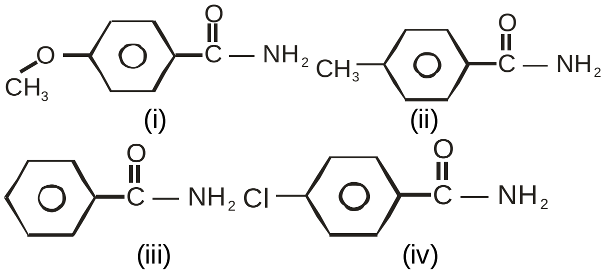


2.

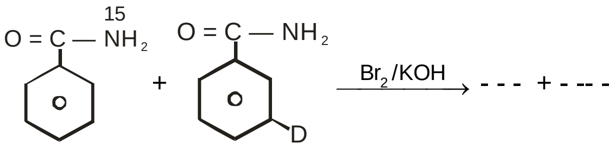


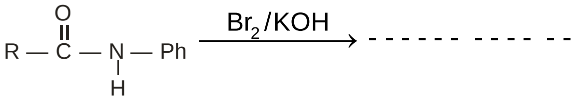
Q.1 Compare rate of reaction:–

(a)

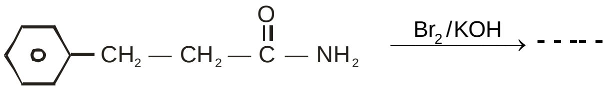


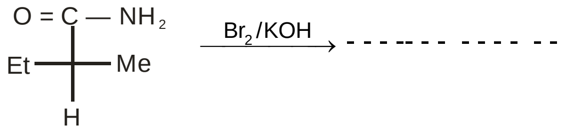
Q.2 Fill in the blanks:–

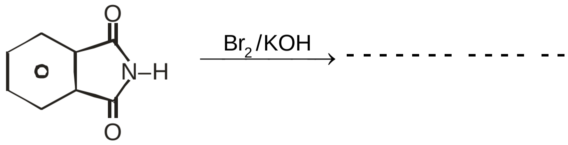
(a) 

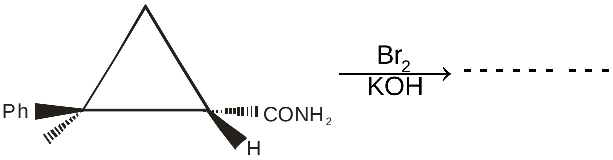
(b) 

Q.3

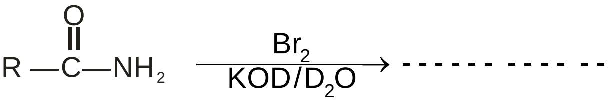
(a) 

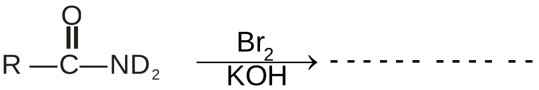
(b) 

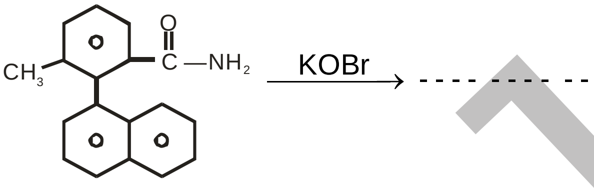
(c) 

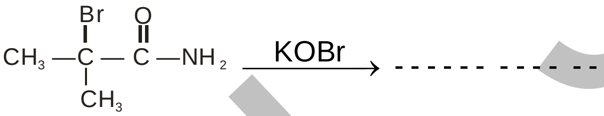
(d) 

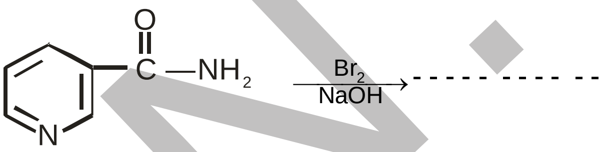
(e) 

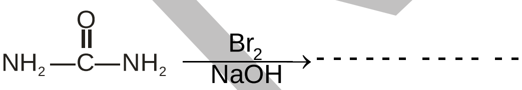
(f) 

(g) 

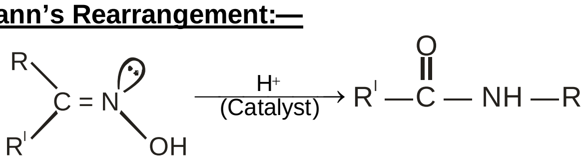
(h) 

(i) 

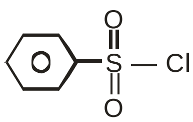
(j) 

(k) 

Beckmann's Rearrangement:—



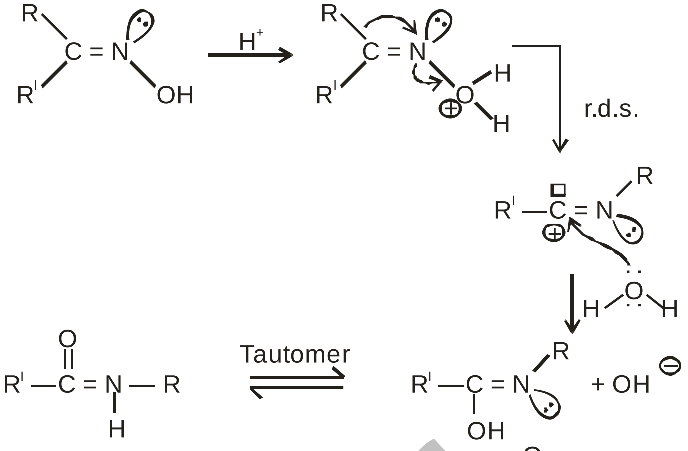
Catalyst:–

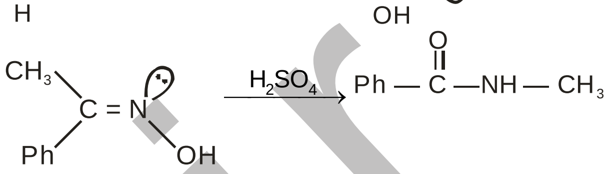
H_2SO_4, $SOCl_2$, SO_3, PCl_5, P_2O_3, PCl_3, BF_3, 

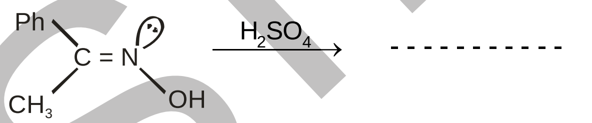
Migration of R is always from anti position.

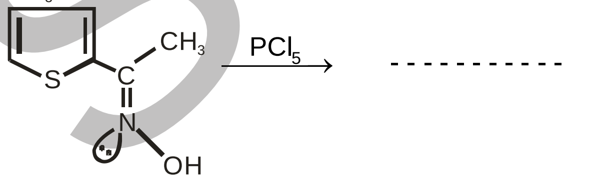
Mechanism:–

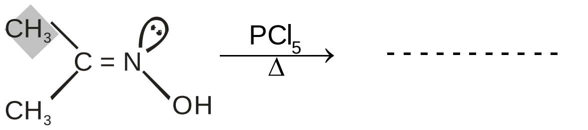
1.

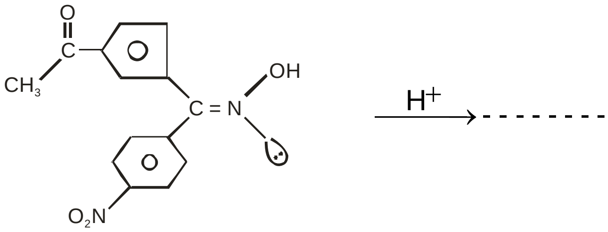


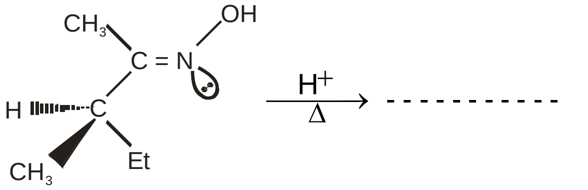
Q.1 

Q.2 

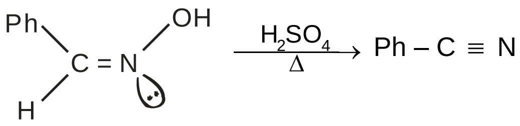
Q.3 

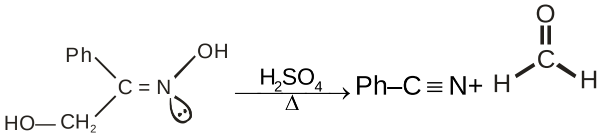
Q.4 

Q.5 

Q.6 

Q.7
Explain:–

(a) 

(b) 

DPP NO- 04 Time: 15 minutes

Curtius reaction:–

$$R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{NaN_3} R-\overset{O}{\overset{\|}{C}}-N=N=N$$

$$R-\overset{O}{\overset{\|}{C}}-OCH_2-CH_3 \xrightarrow{NH_2-NH_2}$$

$$R-\overset{O}{\overset{\|}{C}}-NH-NH_2 \xrightarrow{HNO_2} R-\overset{O}{\overset{\|}{C}}-\overset{\oplus}{N}=N=\overset{\ominus}{N}:$$

$$R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[2.\ \Delta]{1.\ NaN_3} R-N=C=O \xrightarrow[\Delta]{\overline{O}H/H_2O} R-NH_2$$

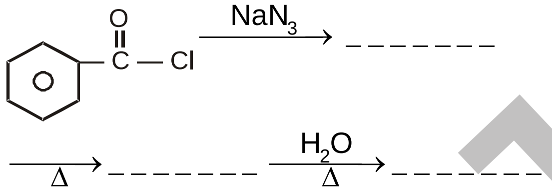
Imp.

$$R-N=C=O \xrightarrow{R'-OH} R-NH-\overset{O}{\overset{\|}{C}}-OR^1$$

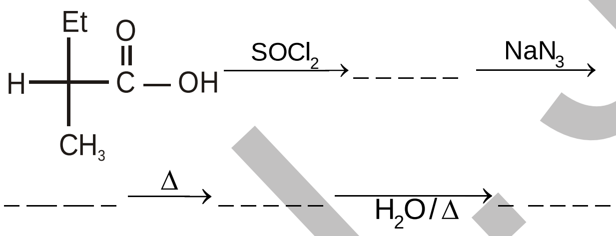
$$R-N=C=O \xrightarrow{R-NH_2} R-\underset{H}{N}-\overset{O}{\overset{\|}{C}}-NH-R$$

$$R-N=C=O \xrightarrow[\Delta]{HOH} R-NH_2+CO_2$$

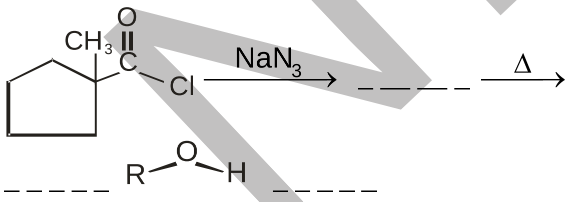
Q.1



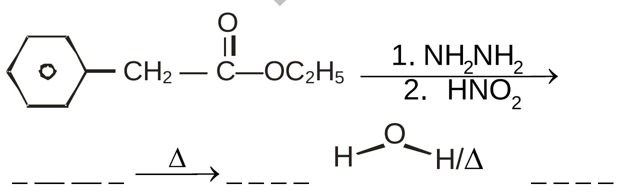
Q.2



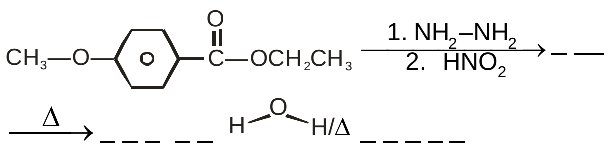
Q.3



Q.4



Q.5

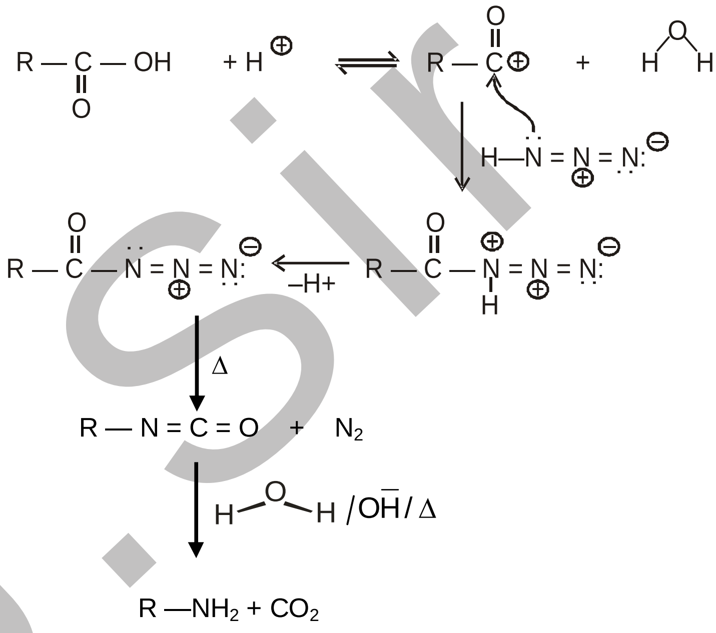


Schmidt Reaction:–

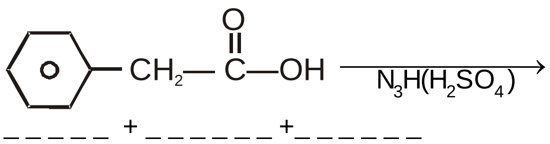
$$R-\overset{O}{\overset{\|}{C}}-O-H + HN_3 \xrightarrow{H_2SO_4} R-NH_2 + CO_2 +$$

N_2.

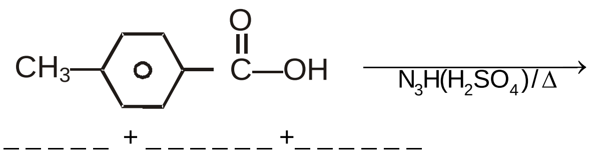
Mechanism:–



Q.1



Q.2



Schimidt miscellaneous:–

$$R-\overset{O}{\overset{\|}{C}}-R \xrightarrow[N_3H/\Delta]{H+} R-\overset{O}{\overset{\|}{C}}-\underset{H}{N}-R$$

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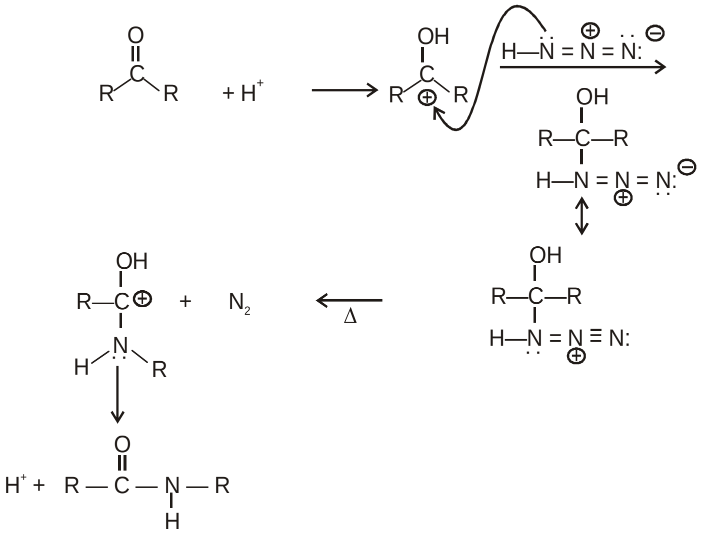
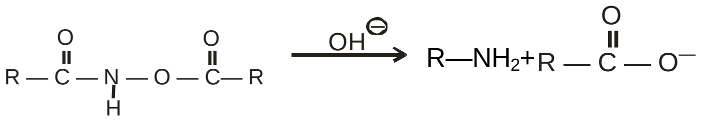
Mechanism:–

1.

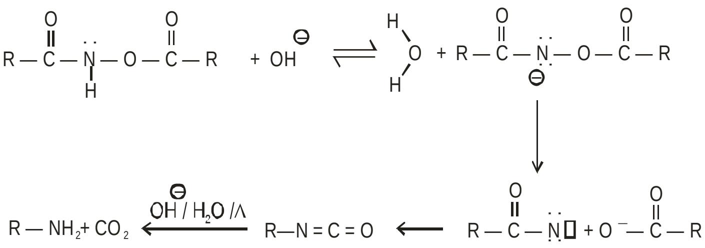


Lossen's Rearrangement:–

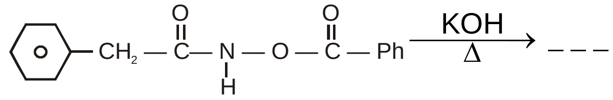


Mechanism:–

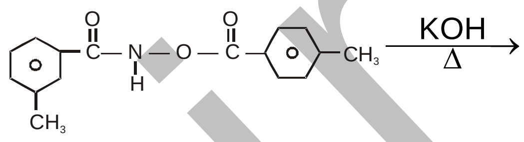
1.



Q.1



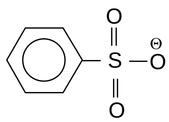
Q.2

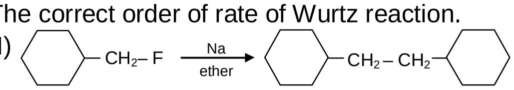
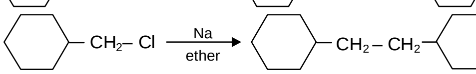
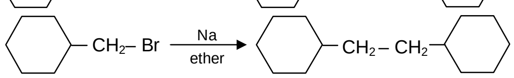
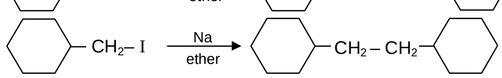


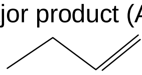
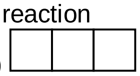
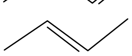
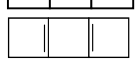
Reaction Intermediates

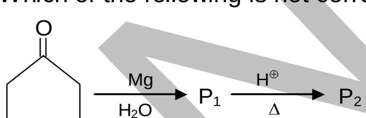
EXERCISE – I

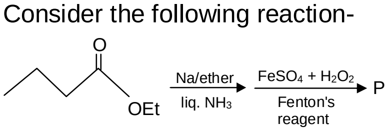
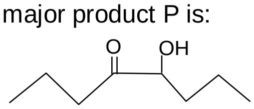
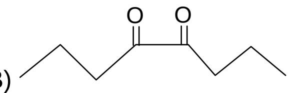
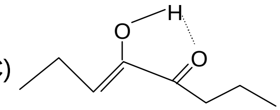
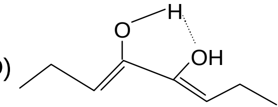
Q.1 2-Chloropentane on halogenation with chlorine gives 2,3-dichloropentane. What will be the structure of free radical species formed in the reaction?
(A) Planar (B) Trigonal planar
(C) Square planar (D) Pyramidal

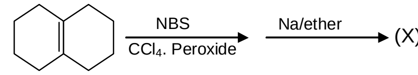
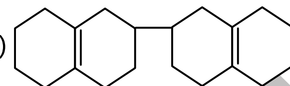
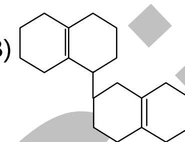
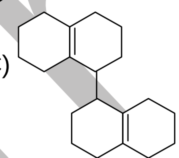
Q.2 Decreasing order of nucleophilicity of the following nucleophile is :
(1) $CH_3O^{\ominus}$ (2) $\overset{\ominus}{C}N$
(3)  (4) $CH_3CO_2^{\ominus}$
(A) 4 > 3 > 2 > 1 (B) 1 > 2 > 4> 3
(C) 2 > 1 > 3 > 4 (D) 1 > 2 > 3 > 4

Q.3 The correct order of rate of Wurtz reaction.
(I) 
(II) 
(III) 
(IV) 
(A) I > II > III > IV (B) II > I > III > IV
(C) IV > III > II > I
(D) In all rate of Wurtz reaction is same

Q.4 $\begin{matrix} CH_3-CH-CO_2K \\ | \\ CH_3-CH-CO_2K \end{matrix} \xrightarrow{\text{electrolysis}}$ (A) (Major)
Major product (A) of above reaction
(A)  (B) 
(C)  (D) 

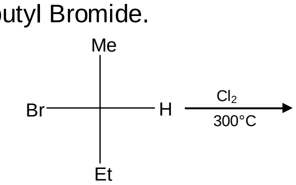
Q.5 Which of the following is not correct about P_2.

(A) It is a spiro compound
(B) It is a Ketone
(C) It can show tautomerism
(D) It is an alkene

Q.6 Consider the following reaction-

the major product P is:
(A) 
(B) 
(C) 
(D) 

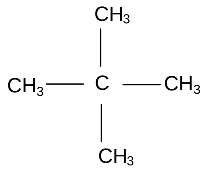
Q.7 
X is :
(A) 
(B)  (C) 
(D) None of these

Q.8 What will be the major product, when 2-methyl butane undergoes bromination in presence of light?
(A) 1-bromo-2-methyl butane
(B) 2- bromo-2-methyl butane
(C) 2- bromo-3-methyl butane
(D) 1-bromo-3-methyl butane

Q.9 Which can not be the possible product of the given reaction
$CH_3-CH_2-\underset{\underset{O}{||}}{C}-OAg \xrightarrow[CCl_4,\ \Delta]{Br_2}$ Product (s)
(A) CH_3-CH_2-Br
(B) $CH_3-CH_2-\underset{\underset{O}{||}}{C}-O-CH_2-CH_3$
(C) $CH_3-CH_2-CH_2-CH_3$
(D) $CH_3-CH_2-CH_3$

Q.10 Pick the correct statement for monochlorination of R-secbutyl Bromide.

(A) There are five possible product; four are optically active one is optically inactive
(B) There are five possible product; three are optically inactive & two are optically active
(C) There are five possible product; two are optically inactive & three are optically active
(D) None of these

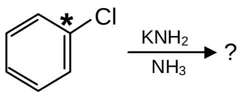
Q.11 Correct order of rate of photochlorination for following compounds is

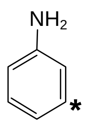
$CH_3 - CH_3$ $CD_3 - CD_3$ 

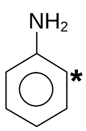
(I) (II) (III)

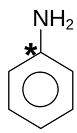
(A) II < I < III (B) I < II < III
(C) III < I < II (D) II < III < I

Q.12 Product can be



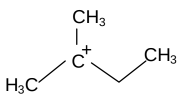
(A) 

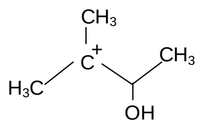
(B) 

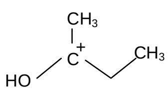
(C) 

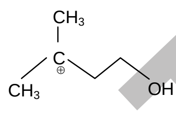
(D) (B) and (C) both

Q.13 Which of the following carbocation is most stable?

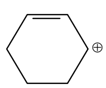
(A) 

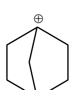
(B) 

(C) 

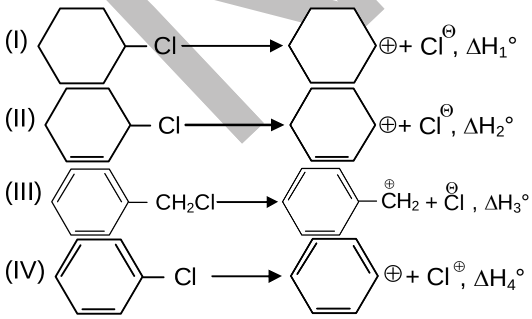
(D) 

Q.14 Which carbocation is least likely to form as an intermediate?

(A) $(C_6H_5)_3\overset{+}{C}$ (B) 

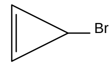
(C)  (D) $CH_2 = \overset{+}{C}H$

Q.15 For the reactions

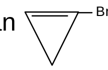


The correct decreasing order of enthalpies of reaction for producing carbocation is:

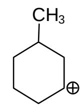
(A) $\Delta H_1^o > \Delta H_2^o > \Delta H_3^o > \Delta H_4^o$
(B) $\Delta H_4^o > \Delta H_1^o > \Delta H_2^o > \Delta H_3^o$
(C) $\Delta H_3^o > \Delta H_2^o > \Delta H_1^o > \Delta H_4^o$
(D) $\Delta H_2^o > \Delta H_1^o > \Delta H_4^o > \Delta H_3^o$

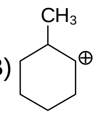
Q.16 

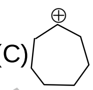
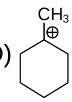
, which is not the correct statement

(A) I is more soluble than bromocyclopropane
(B) I gives pale yellow ppt. on addition with $AgNO_3$
(C) I is having lower dipole moment than bromocyclopropane
(D) I is more ionic than 

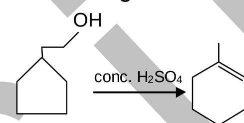
Q.17 Which one of the following carbocation would you expect to rearrange.

(A) 

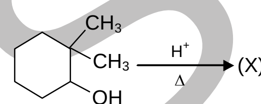
(B) 

(C) 
(D) 

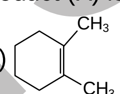
Q.18 How many, 1,2-Shifts are involved during the course of following reaction:

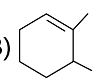


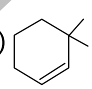
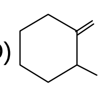
(A) 1 (B) 2 (C) 3 (D) 4

Q.19 

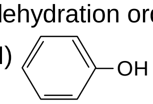
Product (X) is:

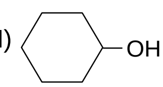
(A) 

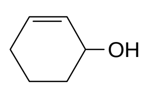
(B) 

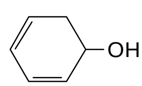
(C) 
(D) 

Q.20 Among the given compounds, the correct dehydration order is:

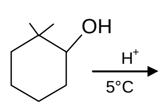
(I) 

(II) 

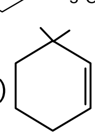
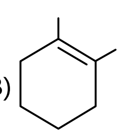
(III) 

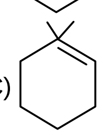
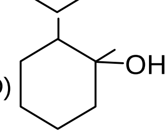
(IV) 

(A) I < II < III < IV (B) II < III < IV < I
(C) I < III < IV < II (D) I < II < III = IV

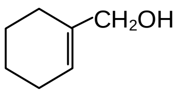
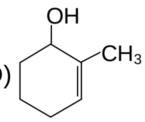
Q.21 

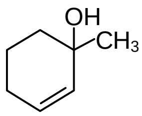
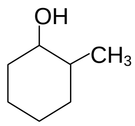
P. The product P is

(A) 
(B) 

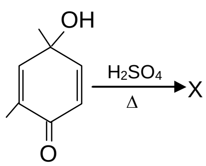
(C) 
(D) 

Q.22 Rate of dehydration when given compounds are treated with conc. H_2SO_4.

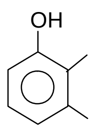
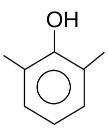
(P)  (Q) 

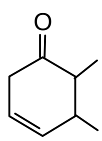
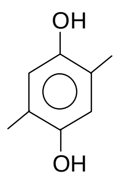
(R)  (S) 

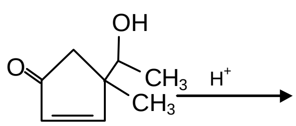
(A) P > Q > R > S (B) Q > P > R > S
(C) R > Q > P > S (D) R > Q > S > P

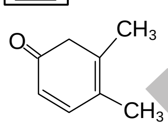
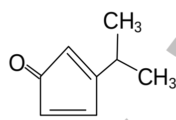
Q.23 

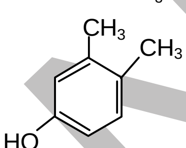
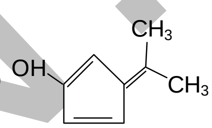
'X' is

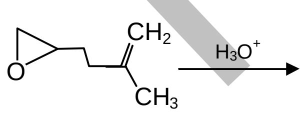
(A)  (B) 

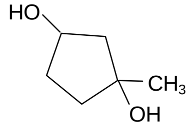
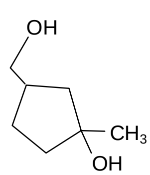
(C)  (D) 

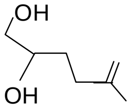
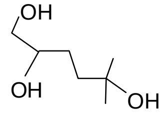
Q.24  major product is

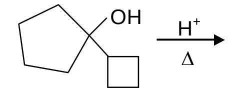
(A)  (B) 

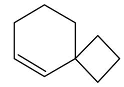
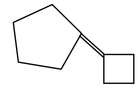
(C)  (D) 

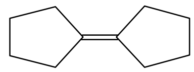
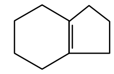
Q.25  A, A is

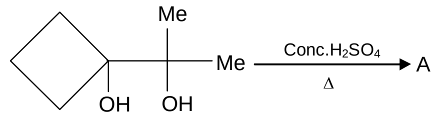
(A)  (B) 

(C)  (D) 

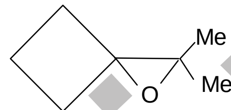
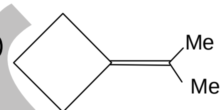
Q.26 

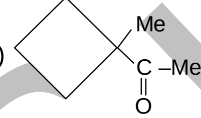
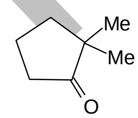
(A)  (B) 

(C)  (D) 

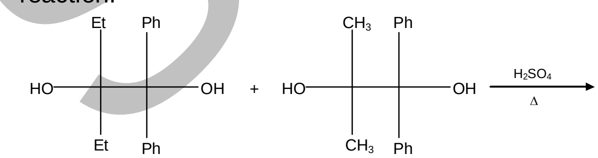
Q.27 

Product 'A' is-

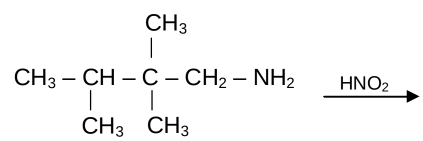
(A)  (B) 

(C)  (D) 

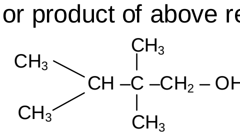
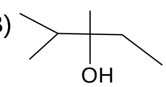
Q.28 How many products are obtained in the given reaction:

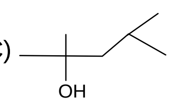
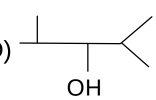


(A) 1 (B) 2 (C) 3 (D) 4

Q.29  (X)

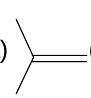
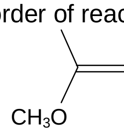
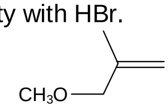
(major)
Major product of above reaction is:

(A)  (B) 

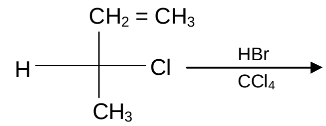
(C)  (D) 

Q.30 Which will dehydrate at fastest rate by H_3PO_4 :
(A) 2-methyl butane-2-ol (B) 3-methyl butane-2-ol
(C) Butane-1-ol (D) 2-methyl butane-1-ol

Q.31 What is the order of reactivity with HBr.

(a)  (b)  (c) 

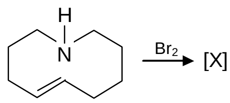
(A) a > b > c (B) b > a > c
(C) c > b > a (D) b > c > a

Q.32 

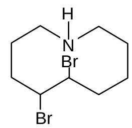
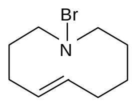
What is stereochemistry of product?

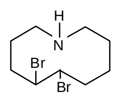
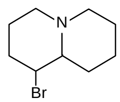
(A) Racemic mixture (B) Optically inactive
(C) Diastereomers (D) Meso product

Q.33 In the given reaction :

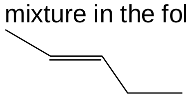


[X] is :

(A)  (B) 

(C)  (D) 

Q.34 Select the incorrect statement about the product mixture in the following reaction:

 $\xrightarrow[CCl_4]{Br_2}$ Products

(A) it is optically active (B) it is racemic mixture
(C) it is a resolvable mixture
(D) it is a mixture of erythro compounds

Q.35 $\overset{3}{Cl_3C}-\overset{2}{CH}=\overset{1}{CH_2}$ (I) $\overset{3}{H_3C}-\overset{2}{CH}=\overset{1}{CH_2}$ (II)

In addition of HOBr to (I) and (II)
(A) Br is at C_2 in both cases
(B) Br is at C_2 in II and at C_1 in I
(C) Br is at C_1 in II and C_2 in I
(D) Br is at C_1 in both cases

Q.36 Which of the following compounds yield most stable carbanion after rupture of $(C_1 - C_2)$ bond:

(A) $CH_3-\underset{1}{\overset{O}{\overset{\|}{C}}}-\underset{2}{CCl_3}$ (B) $CH_3-\underset{1}{\overset{O}{\overset{\|}{C}}}-\underset{2}{CBr_3}$

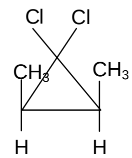
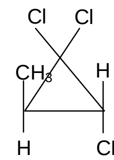
(C) $CH_3-CH_2-\underset{1}{\overset{O}{\overset{\|}{C}}}-\underset{2}{CI_3}$ (D) None of these

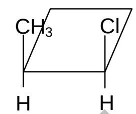
Q.37 $^{14}CH_2=CH-CH_3 \xrightarrow[CCl_4/\text{Peroxide}]{NBS} \xrightarrow{\text{Mg/ether}} \xrightarrow{D_2O}$ Product(s)

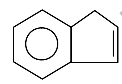
Product(s) is/are :
(A) $^{14}CH_2=CH-CH_2-D$ (B) $CH_2=CH-{}^{14}CH_2-D$
(C) Both of these (D) None of these

Q.38 Stability order of following singlet halocarbene is
(A) $CF_2 > CCl_2 > CBr_2 > CI_2$
(B) $CI_2 > CBr_2 > CCl_2 > CF_2$
(C) $CCl_2 > CF_2 > CBr_2 > CI_2$
(D) $CF_2 > CI_2 > CCl_2 > CBr_2$

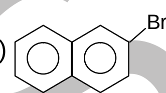
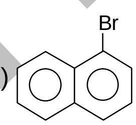
Q.39 Trans-Butene-2 $\xrightarrow[\text{Solvent}]{CHCl_3/KOH}$ Product

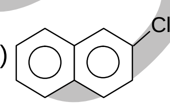
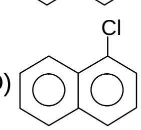
(A)  (B) 

(C)  (D) Both (A) and (B)

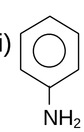
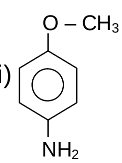
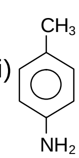
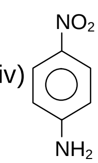
Q.40  $\xrightarrow[KOH]{CHCl_2Br}$ Product

Product is :

(A)  (B) 

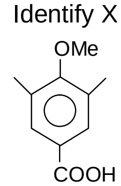
(C)  (D) 

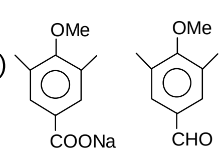
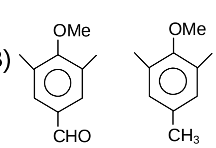
Q.41 The order of rate of reaction of following towards carbylamine reaction:

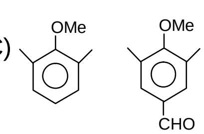
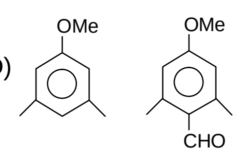
(i)  (ii)  (iii)  (iv) 

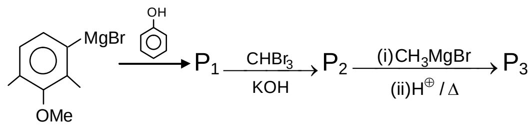
(A) (ii) > (i) > (iii) > (iv) (B) (ii) > (iii) > (i) > (ii)
(C) (iv) > (i) > (iii) > (ii) (D) None

Q.42 Identify X and Y :

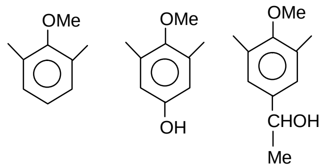
 $\xrightarrow[CaO/\Delta]{NaOH}$ X $\xrightarrow[(ii) H_3O^{\oplus}]{(i) CHCl_3/KOH}$ Y.

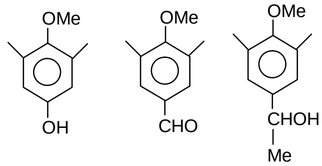
(A)  (B) 

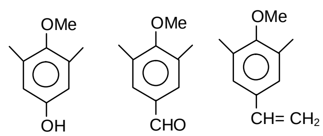
(C)  (D) 

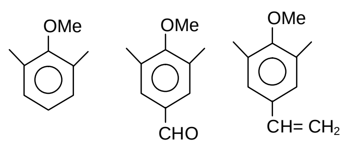
Q.43 

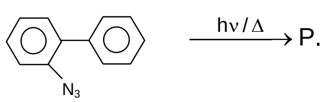
P_1, P_2 and P_3 are

(A) 

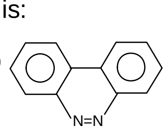
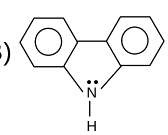
(B) 

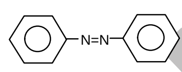
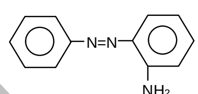
(C) 

(D) 

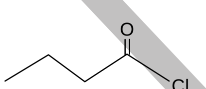
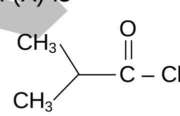
Q.44 

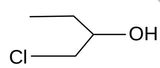
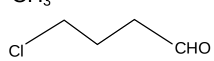
'P' is:

(A)  (B) 

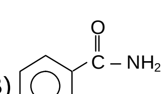
(C)  (D) 

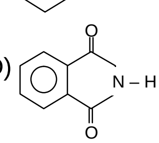
Q.45 (X) $C_4H_7OCl \xrightarrow{NH_3} C_4H_9ON \xrightarrow[KOH]{Br_2}$ $CH_3CH_2CH_2NH_2$. Compound (X) is

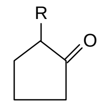
(A)  (B) 

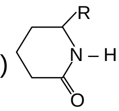
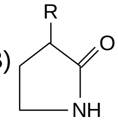
(C)  (D) 

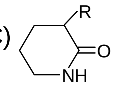
Q.46 Which of the following can not give Hoffmann's bromamide reaction:

(A) $Me - \overset{O}{\overset{\|}{C}} - NH - Br$ (B) 

(C) $Me - \overset{O}{\overset{\|}{C}} - NH - Me$ (D) 

Q.47  $\xrightarrow[H_2SO_4]{HN_3}$ P. Identify P.

(A)  (B) 

(C)  (D) Both (A) and (C)

Q.48 $\begin{matrix} Me_2CH \\ Me \end{matrix}\!\!>C = N\diagdown OH \xrightarrow[\Delta]{conc.H_2SO_4} A$

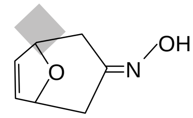
Major product of this reaction is

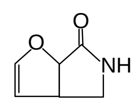
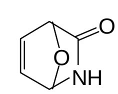
(A) $Me_2CH - NH - \underset{\underset{O}{\|}}{C} - Me$

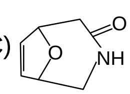
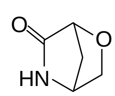
(B) $Me - NH - \underset{\underset{O}{\|}}{C} - CHMe_2$

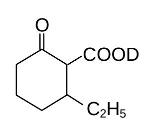
(C) $Me - \underset{\underset{OH}{|}}{\overset{\overset{Me}{|}}{C}} - CH = N - Me$

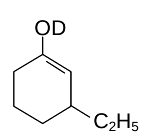
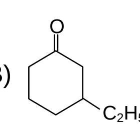
(C) $CH_2 = \underset{\underset{Me}{|}}{C} - CH = N - Me$

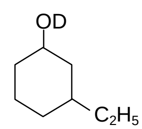
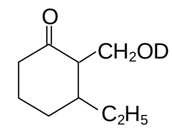
Q.49  $\xrightarrow[\text{Chloride}]{\text{P-Toluene sulphonyl}}$ P. 'P' is

(A)  (B) 

(C)  (D) 

Q.50  $\xrightarrow{\Delta}$ product is

(A)  (B) 

(C)  (D) 

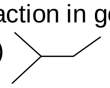
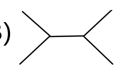
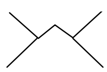
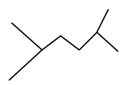
EXERCISE – II

Q.1 Match the column :

Column-I	Column-II
(A) Electrophile	(P) $CH_3 – CH = CH – CH_3$
(B) Nucleophile	(Q) $:CHCl$
(C) Lewis acid	(R) $CH_3 – \dot{C}H_2$
(D) Lewis base	(S) Guanidine

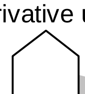
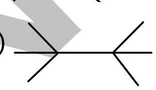
Q.2 Select the correct statements :
(A) Protonation increases electrophilic nature of carbonyl group
(B) $CF_3SO_3^-$ is better leaving group than $CH_3SO_3^-$
(C) Benzyl carbocation is stabilized by resonance
(D) $CCl_3CH(OH)_2$ is unstable

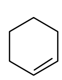
Q.3 Which of the following can be produced by Wurtz reaction in good yield.

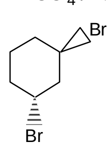
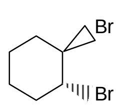
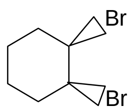
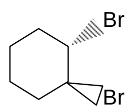
(A) 
(B) 
(C) 
(D) 

Q.4 Select **true** statement(s) :
(A) Instead of radical substitution, cyclopropane undergoes electrophilic addition reactions in sun light.
(B) In general, bromination is more selective than chlorination
(C) The2,4,6-tri-tert, butylphenoxy radical is resistant to dimerization
(D) The radical-catalysed chlorination, $ArCH_3 \rightarrow ArCH_2Cl$, occurs faster when Ar= phenyl than when Ar= p-nitrophenyl.

Q.5 Choose all alkane that give only one monochloro derivative upon reaction with chlorine in sun light.

(A) 
(B) 
(C) 
(D) 

Q.6  $\xrightarrow[CCl_4/h\nu]{NBS} \xrightarrow{HBr}$ (X)+(Y) enantiomeric pair.

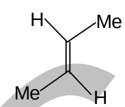
(A) 
(B) 
(C) 
(D) 

Q.7 $H_3C –CH_2 –CH_2 –CH_2(OH) \xrightarrow[\Delta]{conc.\ H_2SO_4}$ X + Y

$\xrightarrow[CCl_4/peroxide]{NBS} \xrightarrow{(CH_3–CH(CH_3))_2CuLi}$ Product(s)

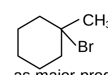
Product(s) are :
(A) $H_3C –CH = CH – CH(CH_3)_2$
(B) $H_3C –CH(CH_3) – CH(CH_3) –CH = CH_2$
(C) $H_3C –CH(CH_3) –CH_2 –CH = CH – CH_3$
(D) $H_3C –CH(CH_3) –CH = CH – CH_2 – CH_3$

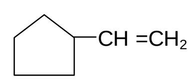
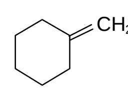
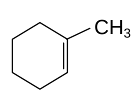
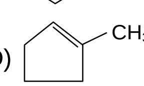
Q.8 Select correct statement about the product (P) of the reaction :

 $\xrightarrow{Br_2/CCl_4}$ P

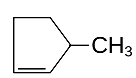
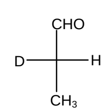
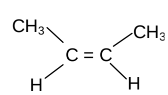
(A) P is optically inactive due to internal compensation
(B) P is optically inactive due to the presence of plane of symmetry in the molecule
(C) The structure of P can have three optical isomers possible
(D) P can have four possible optical isomers.

Q.9 Products formed when HCl adds to 2,4-hexadiene is:
(A) 4-chloro-2-hexene (B) 2-chloro-3-hexene
(C) 2-chloro-4-hexene (D) 1-chloro-2-hexene

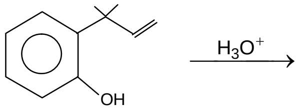
Q.10 In the given reaction C_7H_{12} (A) $\xrightarrow{HBr}$  as major product

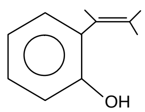
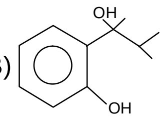
(A) can be
(A) 
(B) 
(C) 
(D) 

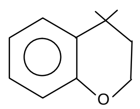
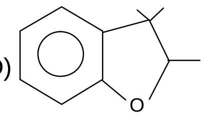
Q.11 Which of following reaction product are diastereomer of each other.

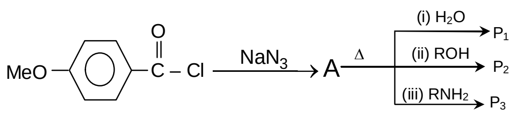
(A)  $\xrightarrow[CCl_4]{Br_2}$
(B)  $\xrightarrow[(ii)\ H^+]{(i)\ NaCN}$
(C)  $\xrightarrow[CCl_4]{HBr}$
(D) $CH_3 –CH(Et) – CH = CH –Ph \xrightarrow[peroxide]{HCl}$

Q.12 Which of the following can be formed during this reaction?

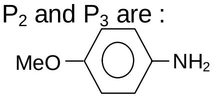


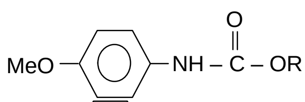
(A)  (B) 

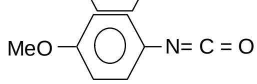
(C)  (D) 

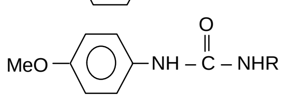
Q.13 

P_1, P_2 and P_3 are :

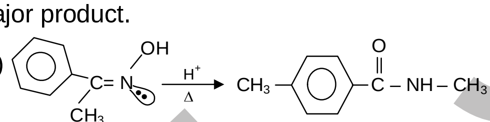
(A) 

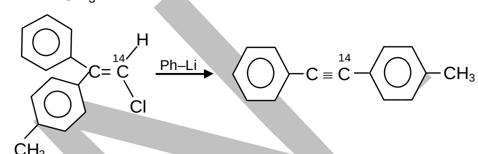
(B) 

(C) 

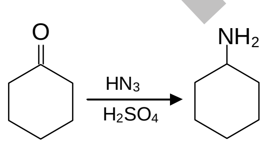
(D) 

Q.14 Which of the following reaction is not representing major product.

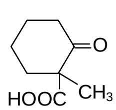
(A) 

(B) 

(C) $Ph - \overset{O}{\overset{||}{C}} - NH_2 \xrightarrow[KOH]{Br_2} Ph - NH_2$

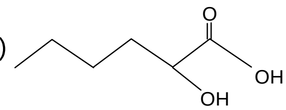
(D) 

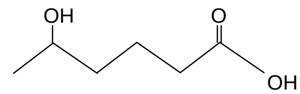
Q.15 In which of following compound chiral center is not affected on heating.

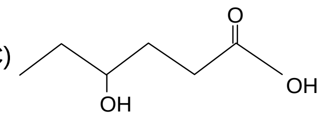
(A) $CH_3 - \underset{OH}{\underset{|}{C}H} - COOH$ (B) 

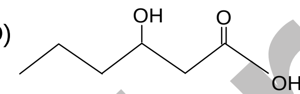
(C) $CH_3 - \underset{OH}{\underset{|}{C}H} - CH_2 - COOH$ (D) $CH_3 - \underset{CH_2COOH}{\underset{|}{C}H}COOH$

Q.16 Which of the following will give cyclic products upon being heated or being treated by an acid?

(A) 

(B) 

(C) 

(D) 

Q.17 Select the correct statements.

(A) methyl malonic acid is converted into propanoic acid on heating

(B) succinic acid forms succinic anhydride on heating

(C) 3-hydroxy propanoic acid forms Lactide on heating

(D) $CH_3 - \overset{O}{\overset{||}{C}} - CH_2COOH$ forms acetone on heating

Q.18 $C_5H_8O_4(A) \xrightarrow{\Delta} C_4H_8O_2(B) \xrightarrow[\Delta]{\text{Soda lime}} (C)$

C is a hydrocarbon occupying 0.509 litre per g at NTP approximately. Hence A and B are:

(A) methyl malonic acid, propanoic acid

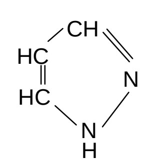
(B) succinic acid, succinic anhydride

(C) Dimethylmalonic acid, 2-Methylpropanoic acid

(D) Ethyl Malonic acid, Butanoic acid

Q.19 Which of the following reaction **is not incorrectly** formulated.

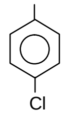
(A) $CH_2{=}CH{-}CH_3 \xrightarrow[\text{UV light}]{+SO_2Cl_2} CH_2Cl{-}CHCl{-}CH_3$

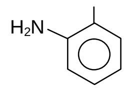
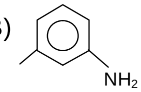
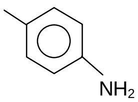
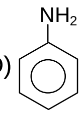
(B) $HC \equiv CH + CH_2N_2 \longrightarrow$ 

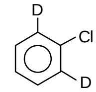
(C) $(CH_3)_3CH + Cl_2 \xrightarrow[\text{halogenation}]{\text{photo}} (CH_3)_3C{-}Cl$

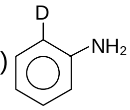
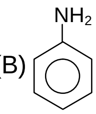
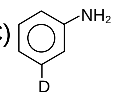
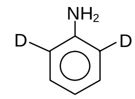
as major product

(D) $CH_3 - C \equiv C - H \xrightarrow{HCl} CH_3 - \underset{Cl}{\underset{|}{C}H} - \underset{Cl}{\underset{|}{C}H_2}$

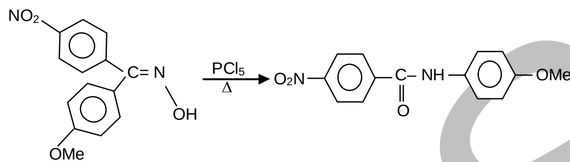
Q.20  $\xrightarrow[NH_3, -33°C]{KNH_2}$?

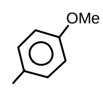
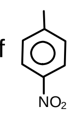
(A) 
(B) 
(C) 
(D) 

Q.21  $\xrightarrow[\text{liq. } NH_3]{KNH_2}$?

(A) 
(B) 
(C) 
(D) 

Q.22 This question consist of two statements, printed as assertion and reason, while answering this question you are required to choose any one of the following responses.
(A) If assertion is true but the reason is false.
(B) If assertion is false but the reason is true.
(C) If both assertion and reason are true and the reason is a correct explanation of assertion
(D) If both assertion and reason are true but reason is not a correct explanation of assertion

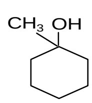
Assertion : 

Reason : Migratory aptitude of  group is greater than migratory aptitude of  group during cation rearrangements.

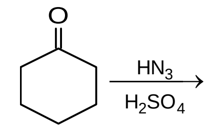
Q.23 Each of the compounds in Column A is subjected to further chlorination. Match the following for them.

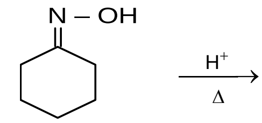
Column-A		**Column-B**
(A) $CHCl_2 - CH_2 - CH_3$	(P)	Optically active original compound
(B) $CH_2Cl - CHCl - CH_3$	(Q)	Only one trichloro product
(C) $CH_2Cl - CH_2 - CH_2-Cl$	(R)	Three trichloro product
(D) $CH_3 - CCl_2 - CH_3$	(S)	Four trichloro product
(E) $CH_3 - C(Cl)(CH_3) - C(Cl)(CH_3) - CH_3$	(T)	Atleast one of the trichloro product is optically active
	(U)	Two trichloro products

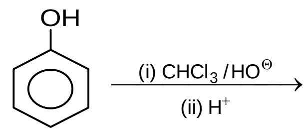
Q.24 Column-I and Column-II contains four entries each. Entries of column-I are to be matched with some entries of column-II. One or more than one entries of column-I may have the matching with the same entries of column-II and one entry of column-I may have one or more than one matching with entries of column-II.

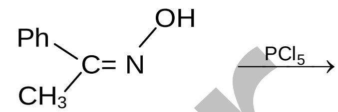
Column-I (Reaction)		**Column-II (Type of intermediate formed)**
(A) $Ph-CHCl_2 \xrightarrow[\Delta]{HO^{\ominus}}$ (A)	(P)	Carbocation
(B) $R - Br \xrightarrow[\text{dry ether}]{Na}$	(Q)	Carbanion
(C) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[\text{(ii) } H_2SO_4,\ \Delta]{\text{(i) } Mg/H_2O}$	(R)	Free- radical
(D)  $\xrightarrow[\Delta]{H^+}$	(S)	Carbene

Q.25 **Column-I** **Column-II**

(A) Caprolactum formation take place in — (P) 

(B) Beckmann rearrangement is — (Q) 

(C) Schmidt reaction is — (R) 

(D) Reaction in which number of carbon increases — (S) 

EXERCISE – III

Q.1 Identify P_1 to P_8.

$CH_3-CH=CH-CH_2-\underset{D}{\overset{H}{C}}-CH_2-\underset{T}{\overset{H}{C}}-CH_3 \xrightarrow{H-Br} P_1 + P_2$

$CH_3-CH=CH-CH_2-\underset{D}{CH}-CH_2-\underset{T}{\overset{H}{C}}-CH_3 \xrightarrow{H-Br}$

$P_1 + P_2 + P_3 + P_4$

$CH_3-CH=CH-CH_2-\underset{D}{CH}-CH_2-\underset{T}{CH}-CH_3 \xrightarrow{H-Br}$

$P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 + P_8$

Q.2 Compare the rate of decarboxylation in sodalime process for the following.

(i) (a) $HC\equiv C-COOH$ (b) $CH_2=CH-COOH$
(c) CH_3-CH_2-COOH

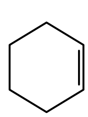
(ii) (a) $\underset{NO_2}{CH_2}-CH_2-COOH$ (b) $F-CH_2-CH_2-COOH$
(c) $Cl-CH_2CH_2-COOH$

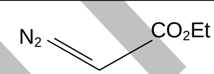
(iii) (a) $CH_3-\underset{F}{CH}-COOH$ (b) $CH_3-\underset{Cl}{CH}-COOH$
(c) $CH_3-\underset{CH_3}{CH}-COOH$

Q.3 Which compound is more stable explain.

(a) $CH_3-\overset{O}{\overset{\|}{C}}-CH=\overset{\oplus}{N}=\overset{\ominus}{N}$ and $CH_3-CH=\overset{\oplus}{N}=\overset{\ominus}{}$

Q.4 Give product and suggest mechanism for these reactions.

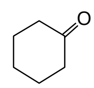
(i) $? \xleftarrow[BuLi]{MeOCH_2Cl}$  $\xrightarrow[^tBuOK]{CHBr_3} ?$

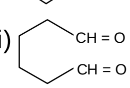
(ii) $Ph-CH=CH_2 +$  $\xrightarrow[Zn]{\Delta} ?$

(iii) $Cl_3C-\overset{O}{\overset{\|}{C}}-OH + Na \longrightarrow A \xrightarrow[CH_2=CH_2]{\Delta} B$. Find out A & B.

Q.5 (a) Formulate the reactions between but-1-ene in presence of small amount of benzoyl peroxide and (i) CCl_4 (ii) $CBrCl_3$
Give your reasons.
(b) The dichlorocarbene reacts with phenol in base where as it doesn't reacts with benzene explain.

Q.6 Give the product of the following reaction.

(i)  $\xrightarrow[H_2O]{Mg} A$

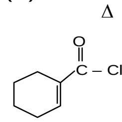
(ii)  $\xrightarrow[H_2O]{Mg} B$

(iii) $Me-\overset{O}{\overset{\|}{C}}-Et \xrightarrow[H_2O]{Mg} \xrightarrow[\Delta]{H_2SO_4} C$

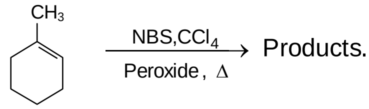
(iv) $Ph-\overset{O}{\overset{\|}{C}}-Me \xrightarrow[H_2O]{Mg} \xrightarrow[\Delta]{H_2SO_4} D$

Q.7 Identify missing products in the given reaction sequence.

(a) $CH_3-CH_2-CH_3 \xrightarrow{Br_2/h\nu} (A) \xrightarrow{aq.\,KOH} (B) \xrightarrow[\Delta]{H_2SO_4} (C) \xrightarrow[CCl_4]{Br_2} (D) = ?$

(b)  $\xrightarrow{NaN_3} (P) \xrightarrow[\Delta]{Ag_2O} (Q) \xrightarrow{H_2O} (R) \xrightarrow[+HCl]{NaNO_2} (S)$

Q.8 Find out the total number of products (including stereo) in the given reaction:



Q.9 With the help of following data show HBr exhibits the peroxide effect.

	$\Delta H_1°$/ kJ mol^{-1}	$\Delta H_2°$/kJ mol^{-1}
H – X	$\dot{X} + CH_2=CH_2 \longrightarrow XCH_2-\dot{C}H_2$	$XCH_2-\dot{C}H_2 + H-X \longrightarrow XCH_2CH_3 + \dot{X}$
HCl	–67	+ 12.6
HBr	–25.1	– 50.2
HI	+46	–117.1

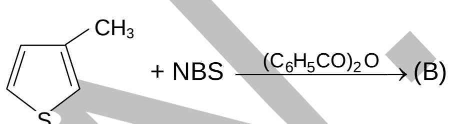
Q.10 Addition of small amount of $(C_2H_5)_4$ Pb to a mixture of methane and chlorine, starts the reaction at 140°C instead of the usual minimum 250°C. Why?

Q.11 On chlorination, an equimolar mixture of ethane and neopentane yields neopentyl chloride and ethyl chloride in the ratio 2.3 : 1. How does the reactivity of 1° hydrogen in neopentane compare with that of a 1° hydrogen in ethane?

Q.12 It required 0.7 g of a hydrocarbon (A) to react completely with Br_2(2.0 g) and form a non resolvable product. On treatment of (A) with HBr it yielded monobromo alkane (B). The same compound (B) was obtained when (A) was treated with HBr in presence of peroxide. Write down the structure formula of (A) and (B) and explain the reactions involved.

Q.13 Give product(s) in each of the following reactions.

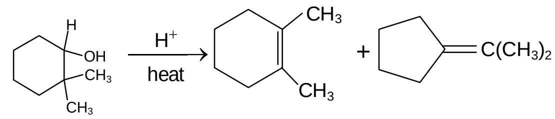
(a) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_2-CH_3 \xrightarrow{Br_2/h\nu}$ (A)(major)

(b) 

(c) $CH_3-CH_2-CH=CH_2 + Me_3COCl \xrightarrow{h\nu}$ (C) + (D)

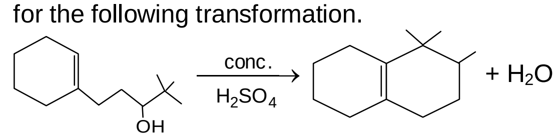
(d) $C_6H_5-CH_2-CH_2-CH_3 \xrightarrow{CH_3-C(CH_3)_2-O-Cl\,/\,\Delta}$ (E)(major)

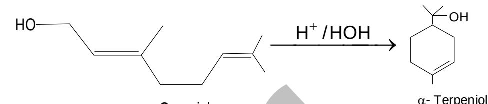
Q.14 We saw that acid-catalyzed dehydration of 2,2-dimethyl-cyclohexanol afforded 1,2-dimethylcyclohexene. To explain this product we must write a mechanism for the reaction in which a methyl shift transforms a secondary carbocation to a tertiary one. Another product of the dehydration of 2,2-dimethylcyclohexanol is isopropylidenecyclopentane. Write a mechanism to rationalize its formation.



2,2-Dimethylcyclohexanol   1,2-Dimethylcyclohexene   Isopropylidenecyclopentane

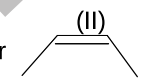
Q.15 (a) Write a reasonable and detailed mechanism for the following transformation.

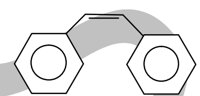
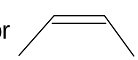


(b) 

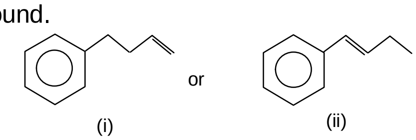
Geraniol   α- Terpeniol

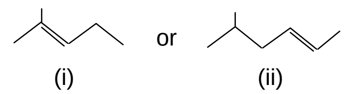
Q.16 Assuming that cation stability governs the barrier for protonation in H–X additions, predict which compound in each of the pairs in parts (a) and (b) will be more rapidly hydrochlorinated in a polar solvent.

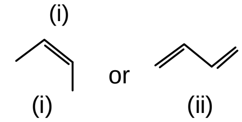
(a) (I) $CH_2 = CH_2$ or (II) 

(b)  or 

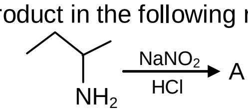
Q.17 Choose the member of the following pairs of unsaturated hydrocarbons that is more reactive towards acid-catalysed hydration and predict the regiochemistry of the alcohols formed from this compound.

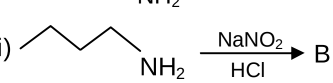
(a) 

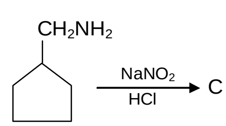
(b) 

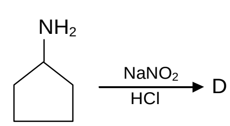
(c) 

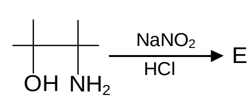
Q.18 Give product in the following reaction.

(i) 

(ii) 

(iii) 

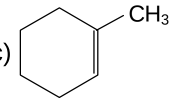
(iv) 

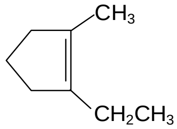
(v) 

Q.19 What are the products of the following reactions?

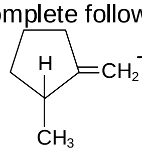
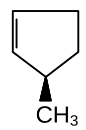
(a) $PhCH = CHCH_3 + HBr \longrightarrow A$

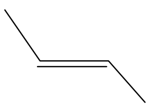
(b) $(H_3C)_2C = C(CH_3)H + HI \longrightarrow B$

(c)  $+ HBr \xrightarrow{\text{Peroxide}} C$

(d)  $+ HCl \longrightarrow D$

Q.20 Complete following reaction:

(a)  $\xrightarrow{HCl}$ (b)  $\xrightarrow[CCl_4]{Br_2}$

(c)  $\xrightarrow[CS_2]{Cl_2}$

Total number of products obtained in this reaction is?

EXERCISE – IV (A)

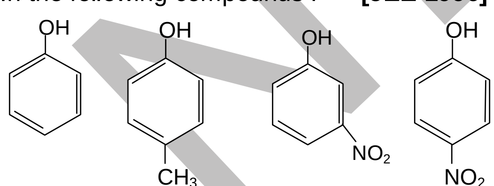
Q.1 Reaction of R–CO – NH_2 with a mixture of Br_2 and KOH gives R – NH_2 as the main product. The intermediates involved in this reaction are : **[JEE 1992]**

(A) R –CO –NHBr (B) RNHBr
(C) R – N = C = O (D) R.CO.NBr_2

Q.2 Which one of the following has the smallest heat of hydrogenation per mole? **[JEE 1993]**

(A) 1-Butene (B) trans-2-Butene
(C) cis-2-Butene (D) 1,3-Butadiene

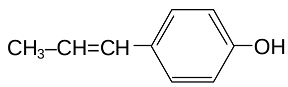
Q.3 In the following compounds : **[JEE 1996]**

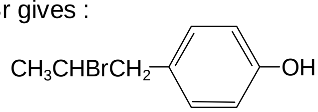


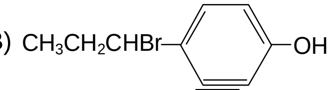
(I) (II) (III) (IV)

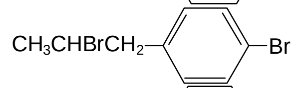
The order of acidity is :

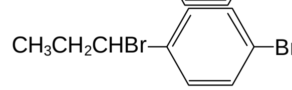
(A) III > IV > I > II (B) I > IV > III > II
(C) II > I > III > IV (D) IV > III > I > II

Q.4 The reaction of  with HBr gives : **[JEE 1998]**

(A) 

(B) 

(C) 

(D) 

Q.5 An aromatic molecule will: **[JEE 1999]**

(A) have 4n π electrons
(B) have (4n +2) π electrons
(C) be planar
(D) be cyclic

Q.6 The enol form of acetone, after Prolonged treatment with D_2O, gives: **[JEE 1999]**

(A) $CH_3 – C(OD) = CH_2$ (B) $CH_3 – C(=O) – CH_3$
(C) $CH_2 = C(OH) – CH_2D$ (D) $CD_2 = C(OD) – CD_3$

Q.7 A solution of (+) 1-chloro-1-phenylethane in toluene racemizes slowly in the presence of small amount of $SbCl_5$ due to formation of: **[JEE 1999]**

(A) carbanion (B) carbene
(C) free radical (D) carbocation

Q.8 Amongst the following, the most basic compound is : **[JEE 2000]**

(A) $C_6H_5NH_2$ (B) p-NO_2–$C_6H_4NH_2$
(C) m-NO_2–$C_6H_4NH_2$ (D) $C_6H_5CH_2NH_2$

Q.9 The correct order of basicities of the following compounds is: **[JEE 2001]**

$CH_3 – C(=NH)NH_2$ (1) $CH_3CH_2NH_2$ (2) $(CH_3)_2NH$ (3) $CH_3C(=O)NH_2$ (4)

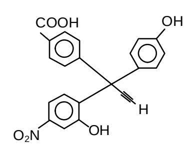
(A) 2 > 1 > 3 > 4 (B) 1 > 3 > 2 > 4
(C) 3 > 1 > 2 > 4 (D) 1 > 2 > 3 > 4

Q.10 Left to right sp^2, sp^2, sp, sp hybridization is present in : **[JEE 2003]**

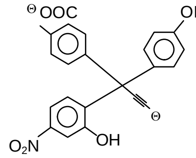
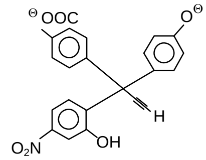
(A) $H_2C = CH – C \equiv N$ (B) $H_2C = C = CH –CH_3$
(C) $HC \equiv C – C \equiv CH$ (D) $HC \equiv C – CH = CH_2$

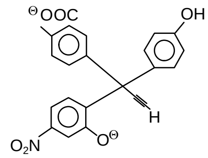
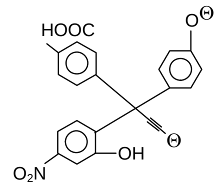
Q.11 Maximum dipole moment will be of: **[JEE 2003]**

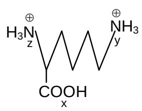
(A) CCl_4 (B) $CHCl_3$ (C) CH_2Cl_2 (D) CH_3Cl

Q.12 

when X is made to react with 2 eq. of $NaNH_2$ the product formed will be : **[JEE 2003]**

(A)  (B) 

(C)  (D) 

Q.13  **[JEE 2004]**

Correct order of acidic strength is:

(A) x > y > z (B) z > y > x

(C) y > z > x (D) x > z > y

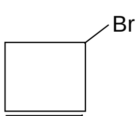
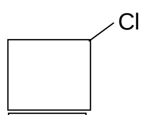
Q.14 Order of rate of reaction of following compound with phenyl magnesium bromide is: **[JEE 2004]**

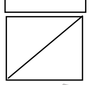
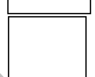
$$\underset{\text{(I)}}{Ph-\underset{\underset{O}{\|}}{C}-Ph} \qquad \underset{\text{(II)}}{Me-\underset{\underset{O}{\|}}{C}-H} \qquad \underset{\text{(III)}}{Me-\underset{\underset{O}{\|}}{C}-Me}$$

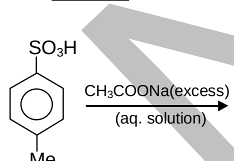
(A) I > II > III (B) II > III > I

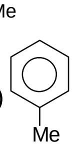
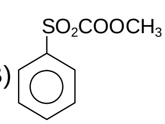
(C) III > I > II (D) II > I > III

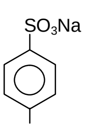
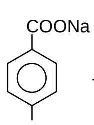
Q.15 1-Bromo-3-chloro cyclobutane on reaction with 2-equivalent of sodium in ether gives **[JEE 2005]**

(A)  (B) 

(C)  (D) 

Q.16  **[JEE 2005]**

(A)  (B) 

(C)  + CH_3COOH (D)  + H_2SO_4

Q.17 Conversion of cyclohexanol into cyclohexene is most effective in: **[JEE 2005]**

(A) concentrated H_3PO_4 (B) concentrated HCl

(C) concentrated HCl/$ZnCl_2$

(D) concentrated HBr

Q.18 For 1-methoxy-1,3- butadiene, which of the following resonating structure is the least stable? **[JEE 2005]**

(A) $H_2\overset{\ominus}{C}-\overset{\oplus}{C}H-CH=CH-O-CH_3$

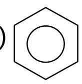
(B) $H_2\overset{\ominus}{C}-CH=CH-CH=\overset{\oplus}{O}-CH_3$

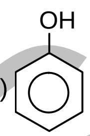
(C) $H_2C=CH-\overset{\oplus}{C}H-\overset{\ominus}{C}H-O-CH_3$

(D) $H_2C=CH-\overset{\ominus}{C}H-CH=\overset{\oplus}{O}-CH_3$

Q.19

$$Ph-MgBr + CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH \longrightarrow A$$

(A)  (B) $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OPh$

(C)  (D) $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-Ph$

Q.20 When benzene sulfonic acid and p-nitrophenol are treated with $NaHCO_3$, the gases released respectively are **[JEE 2006]**

(A) SO_2, NO_2 (B) SO_2, NO

(C) SO_2, CO_2 (D) CO_2, CO_2

Q.21 (I) 1,2-dihydroxy benzene

(II) 1,3-dihydroxy benzene

(III) 1,4-dihydroxy benzene

(IV) Hydroxy benzene **[JEE 2006]**

The increasing order of boiling points of above mentioned alcohols is

(A) I < II < III < IV (B) I < II < IV < III

(C) IV < I < II < III (D) IV < II < I < III

Q.22 $CH_3NH_2 + CHCl_3 + KOH \rightarrow$ Nitrogen containing compound + KCl + H_2O. Nitrogen containing compound is **[JEE 2006]**

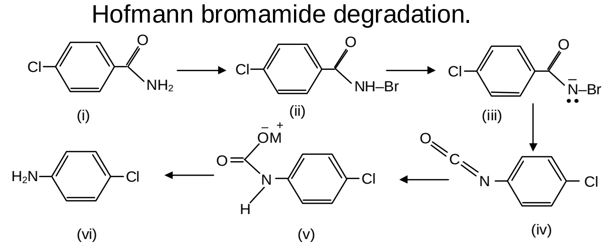
(A) $CH_3-C\equiv N$ (B) $CH_3-NH-CH_3$

(C) $CH_3-\overset{-}{N}\equiv\overset{+}{C}$ (D) $CH_3\overset{+}{N}\equiv\overset{-}{C}$

Question No. 23 to 25 (3 questions)

Comprehension I

$RCONH_2$ is converted into RNH_2 by means of Hofmann bromamide degradation.

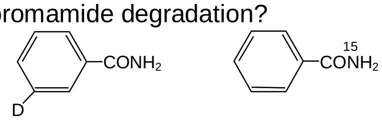


In this reaction, RCONHBr is formed from which this reaction has derived its name. Electron donating group at phenyl activates the reaction. Hofmann degradation reaction is an Intramolecular reaction.

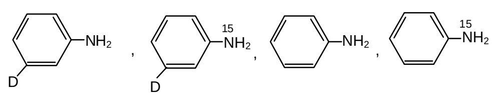
Q.23 How can the conversion of (i) to (ii) be brought about? **[JEE 2006]**
(A) KBr (B) KBr + CH_3ONa
(C) KBr + KOH (D) Br_2 + KOH

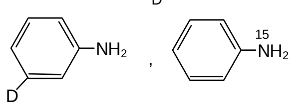
Q.24 Which is the rate determining step in Hofmann bromamide degradation? **[JEE 2006]**
(A) Formation of (i) (B) Formation of (ii)
(C) Formation of (iii) (D) Formation of (iv)

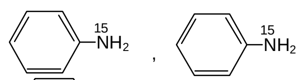
Q.25 What are the constituent amines formed when the mixture of (i) and (ii) undergoes Hofmann bromamide degradation?

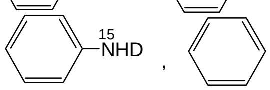


(i) (ii)

(A) 

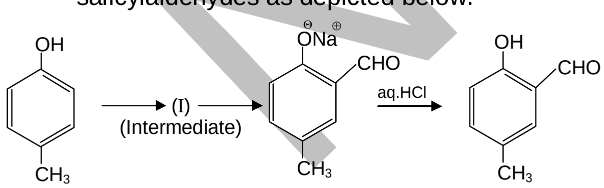
(B) 

(C) 

(D)  **[JEE 2006]**

Paragraph for Question Nos. 26 to 28 (3 questions)

Riemer-Tiemann reaction introduces an aldehyde group, on to the aromatic ring of phenol, ortho to the hydroxyl group. This reaction involves electrophilic aromatic substitution. This is a general method for the synthesis of substituted salicylaldehydes as depicted below.

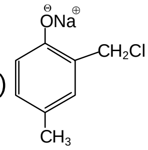
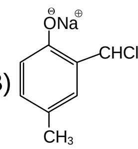


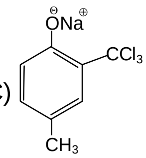
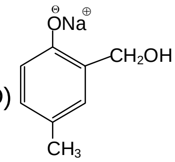
(I) (II) (III)

Q.26 Which one of the following reagents is used in the above reaction? **[JEE 2007]**
(A) aq. NaOH + CH_3Cl (B) aq. NaOH + CH_2Cl_2
(C) aq. NaOH + $CHCl_3$ (D) aq. NaOH + CCl_4

Q.27 The electrophile in this reaction is **[JEE 2007]**
(A) : CHCl (B) $^+CHCl_2$
(C) :CCl_2 (D) •CCl_3

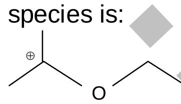
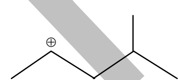
Q.28 The structure of the intermediate I is: **[JEE 2007]**

(A)  (B) 

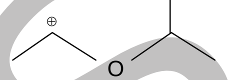
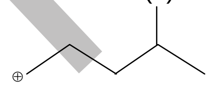
(C)  (D) 

Q.29 Hyperconjugation involves overlap of the following orbitals: **[JEE 2008]**
(A) $\sigma - \sigma$ (B) $\sigma - p$ (C) $p - p$ (D) $\pi - \pi$

Q.30 The correct stability order for the following species is: **[JEE 2008]**

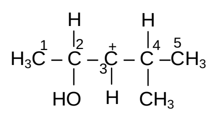
(I) (II)

(III) (IV)

(A) (II) > (IV) > (I) > (III) (B) (I) > (II) > (III) > (IV)
(C) (II) > (I) > (IV) > (III) (D) (I) > (III) > (II) > (IV)

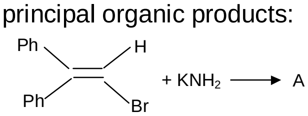
Q.31 In the following carbocation, H/CH_3 that is most likely to migrate to the positively charged carbon is **[JEE 2009]**

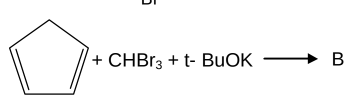


(A) CH_3 at C-4 (B) H at C-4
(C) CH_3 at C-2 (D) H at C-2

EXERCISE – IV (B)

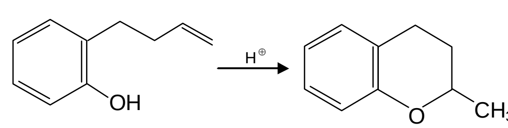
Q.1 Complete the following, giving the structures of the principal organic products: **[JEE 1997]**

(a) 

(b) 

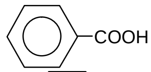
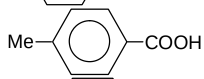
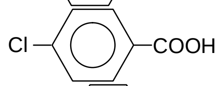
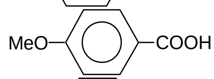
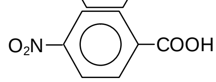
Q.2 Write the intermediate steps for each of the following reaction. **[JEE 1998]**

(i) $C_6H_5CH(OH)\,C \equiv CH \xrightarrow{H_3O^{\oplus}} C_6H_5CH = CH - CHO$

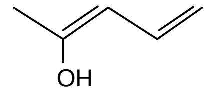
(ii) 

Q.3 Out of anhydrous $AlCl_3$ and hydrous $AlCl_3$ which is more soluble in diethyl ether? Explain with reason. **[JEE 2003]**

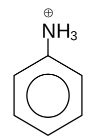
Q.4 Match K_a values with suitable acid: **[JEE 2003]**

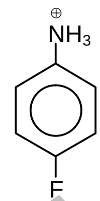
	K_a		Acid
(i)	3.3×10^{-5}	(a)	
(ii)	4.2×10^{-5}	(b)	
(iii)	6.3×10^{-5}	(c)	
(iv)	6.4×10^{-5}	(d)	
(v)	30.6×10^{-5}	(e)	

Q.5 Give resonating structures of the following compound. **[JEE 2003]**



Q.6 Which of the following is more acidic and why? **[JEE 2004]**





ANSWER KEY

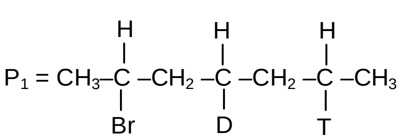
EXERCISE-1

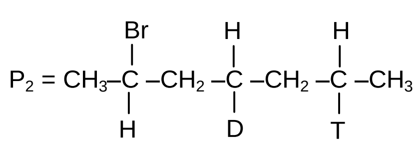
Q.No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Ans.	B	B	C	C	D	B	C	B	D	D	A	D	C	C	B
Q.No.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	C	B	C	A	A	D	C	D	C	B	D	D	B	C	A
Q.No.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Ans.	B	C	D	A	C	A	C	A	B	C	B	C	D	B	A
Q.No.	**46**	**47**	**48**	**49**	**50**										
Ans.	C	D	B	C	A										

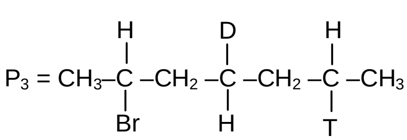
EXERCISE-II

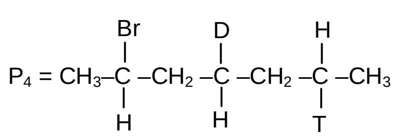
Q.No.	**1**	**A**	**B**	**C**	**D**	**2**	**3**	**4**	**5**	**6**	**7**
Ans.		Q,R	P,S	Q	P,S	A,B,C	B,D	B,C,D	A,B,D	B,D	B,C
Q.No.	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Ans.	A,B,C	A,B	A,B,C	A,B,D	A,B,D	A,B,D	A,B,D	A,B,D	A,B,C	A,B,D	C,D
Q.No.	**19**	**20**	**21**	**22**	**23**	**A**	**B**	**C**	**D**	**E**	
Ans.	A,C,D	B,C	A,C	B		S,T	P,S,T	U	Q	T,U	
Q.No.	**24**	**A**	**B**	**C**	**D**	**25**	**A**	**B**	**C**	**D**	
Ans.		Q,S	Q,R	P,R	P		P,Q	Q,S	P	R	

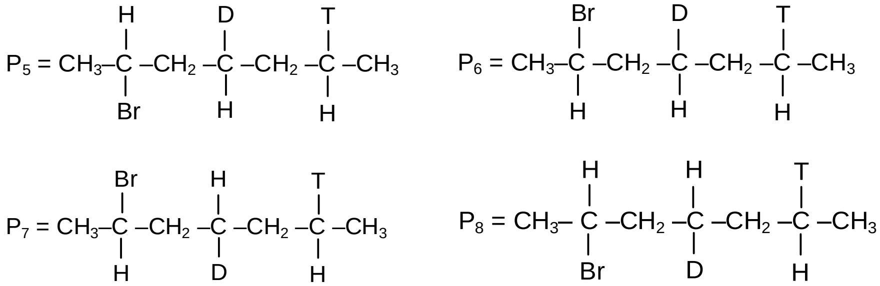
EXERCISE-III

Q.1 

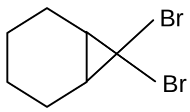
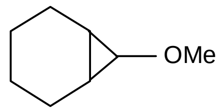
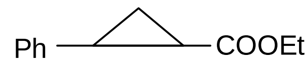


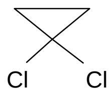




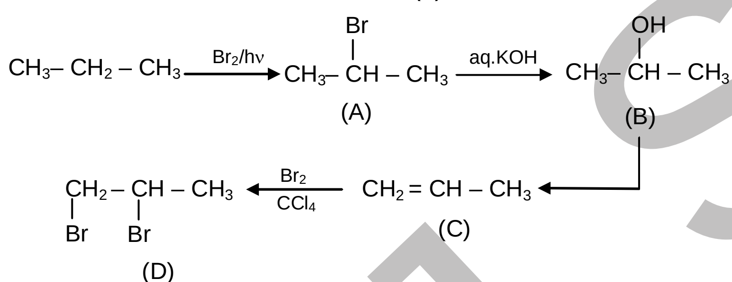


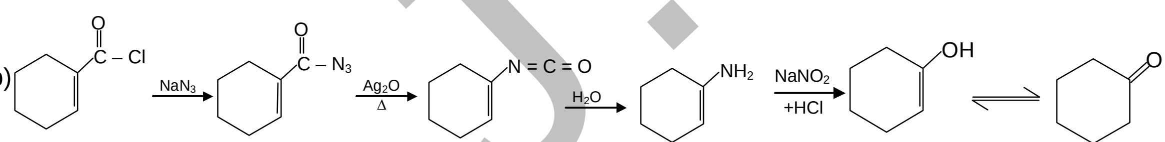
Q.2 (i) a > b > c; (ii) a > b > c ; (iii) b > a > c Q.3 (a) Due to Resonance

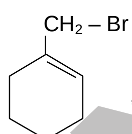
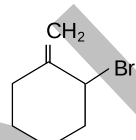
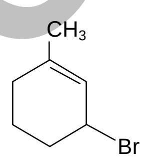
Q.4 (i)  &  (ii) 

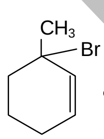
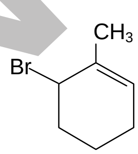
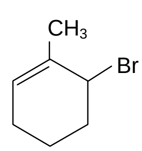
(iii) A : $:CCl_2$ B : 

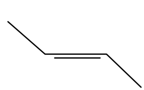
Q.5 (a) Free radical mechanism (b) Due to more electron density

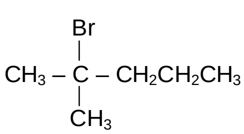
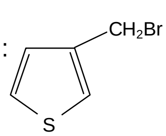
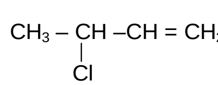
Q.7 (a) 

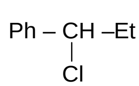
(b) 

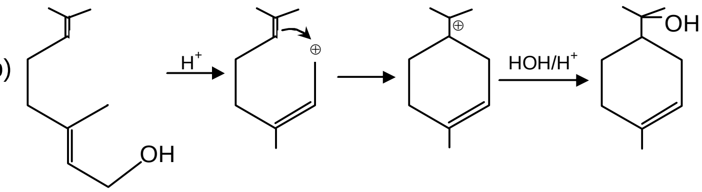
Q.8  ,  and its enantiomer,  and its enantiomer,

 and its enantiomer,  , 

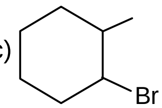
Q.11 1.15 times more reaction Q.12 A = 

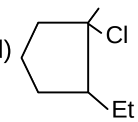
Q.13 (a) A :  (b)B :  (c) C: 

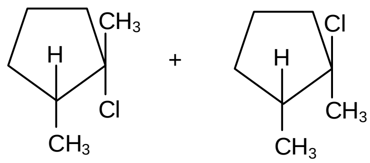
D: CH_3– CH = CH–CH_2Cl (d) E: 

Q.15 (b) 

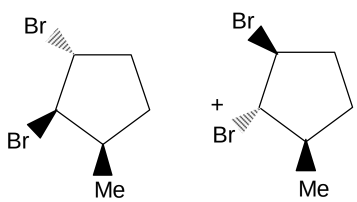
Q.16 (a) II, (b) I Q.17 (a) II, (b) I, (c) II

Q.19 (a) Ph –CH(Br) – Et (b) $Me_2C(I)$ –Et, (c) 

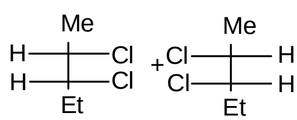
(d) 

Q.20 (a) 

(diastereoisomers)

(b) 

(diastereoisomers)

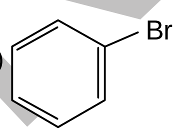
(c) 

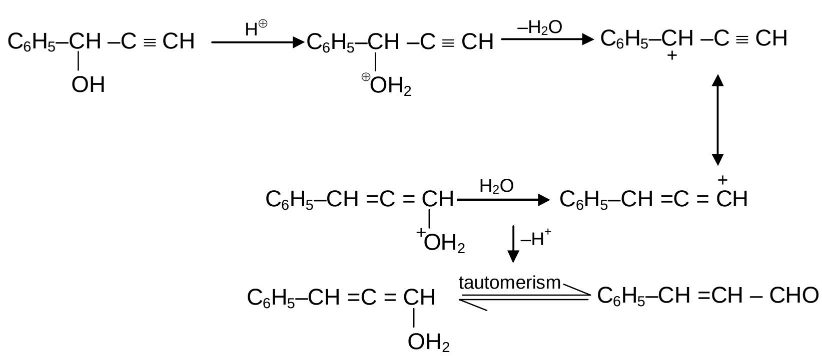
(Enantiomers)

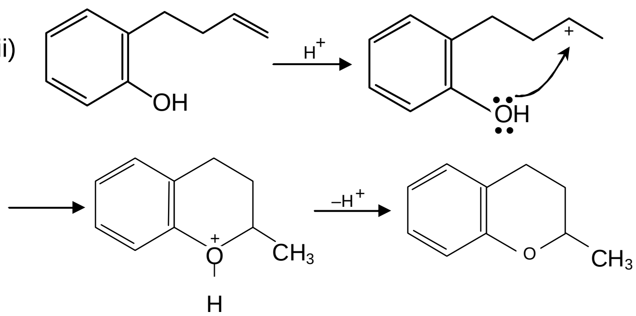
EXERCISE –IV(A)

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	D	D	B	B,C,D	D	D	D	B	A	D	C	D	B	C
Q.No.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	C	A	C	A	D	C	D	D	D	B	C	C	B	B	D
Q.No.	**31**														
Ans.	D														

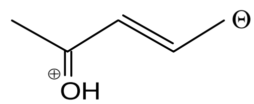
EXERCISE –IV(B)

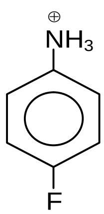
Q.1 (A) PhC ≡ CPh, (B) 

Q.2 

(ii) 

Q.3 Anhydrous $AlCl_3$ is more stable then hydrous $AlCl_3$ because it is having vacant 3p orbital of Al which can accept lone pair of electrons from oxygen of diethylether.

Q.4 (i)-(d), (ii)- (b), (iii) –(a), (iv) –(c), (v)-(e) Q.5 

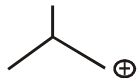
Q.6  is more acidic as overall effect of –F is electron withdrawing so loss of portion is easier from this compound.

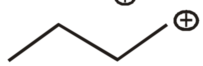
REACTION MECHANISM

DPP NO-01 Time: 15 minutes

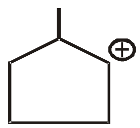
Q.1

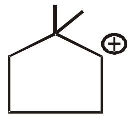
(a) $CH_3—CH_2—\overset{\oplus}{C}H_2$ ⟶ _____

(b)  ⟶ ________

(c)  ⟶ _____

(d) $CH_3—CH_2—CH_2—\underset{CH_3}{\overset{CH_3}{C}}—\overset{\oplus}{C}H_2$ ⟶ _____

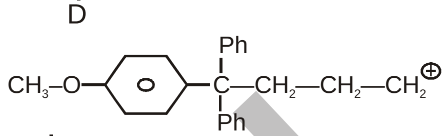
(e)  ⟶ _________

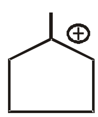
(f)  ⟶ __________

(g) $Ph—CH_2—\overset{\oplus}{C}H_2$ ⟶ ____

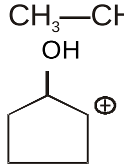
(h) $CH_3—\overset{CH_3}{CH}—CH_2—\overset{\oplus}{C}H_2$ ⟶ ___

(i) $Ph—\underset{D}{\overset{Ph}{C}}—\overset{Me}{CH}—CH_2—\overset{\oplus}{C}H_2$ ⟶ ____

(j)  ⟶ ___

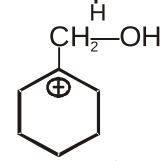
(k)  ⟶ ________

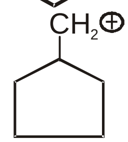
(l) $CH_3—\overset{\oplus}{C}H—CH_2—OH$ ⟶ ______

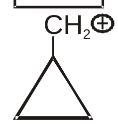
(m)  ⟶ __________

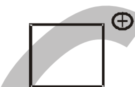
(n) $CH_3—\underset{\oplus}{\overset{CH_3}{C}}—\underset{OH}{\overset{Me}{C}}—et$ ⟶ __________

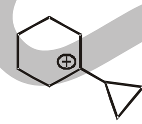
(o) $CH_3—\underset{H}{\overset{CH_3}{C}}—\underset{\oplus}{C}=\ddot{O}:$ ⟶ __________

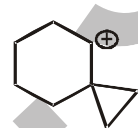
(p)  ⟶ ________

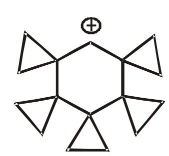
(q)  ⟶ __________

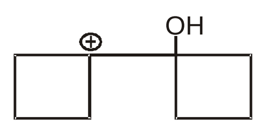
(r)  ⟶ __________

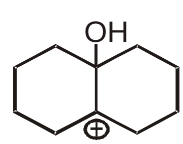
(s)  ⟶ _________

(t)  ⟶ __________

(u)  ⟶ ________

(v)  ⟶ __________

(w)  ⟶ __________

(x)  ⟶ _________

DPP NO-02 Time: 15 minutes

Dehydration of Alcohol

Q.1 $CH_3—CH_2—CH_2—OH \xrightarrow[170°C]{Conc.H_2SO_4} CH_3—CH=CH_2$

Mechanism:–

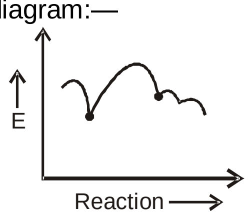
(1) $CH_3 — CH_2 — CH_2 — \ddot{O} — H \quad + H^+ \rightleftharpoons CH_3 — CH_2 — CH_2 — \overset{\oplus}{O}H_2$

$\downarrow$ rds

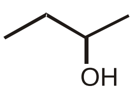
$CH_3—\overset{\oplus}{C}H—CH_3 \longleftarrow CH_3 — CH_2 — CH_2^{\oplus} + :\ddot{O}H_2$

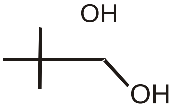
(2) $CH_3 — \overset{\oplus}{C}H — CH_3 + :\ddot{O}H_2 \longrightarrow CH_3—CH=CH_2 + H_3O^+$

Energy profile diagram:—

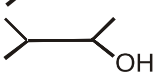


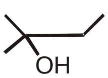
Q.1  $\xrightarrow{H^+/\Delta}$ _______

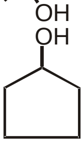
Q.2  $\xrightarrow{H^+/\Delta}$ _______

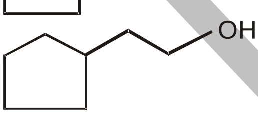
Q.3  $\xrightarrow{H^+/\Delta}$ _______

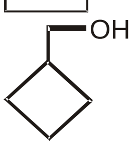
Q.4  $\xrightarrow{H^+/\Delta}$ _______

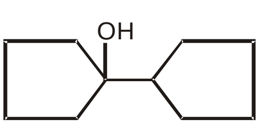
Q.5  $\xrightarrow[\Delta]{Conc.H_2SO_4}$ _______

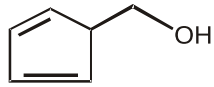
Q.6  $\xrightarrow[\Delta]{Conc.H_2SO_4}$ _______

Q.7  $\xrightarrow[\Delta]{H^+}$ _______

Q.8  $\xrightarrow[\Delta]{Conc.H_2SO_4}$ _______

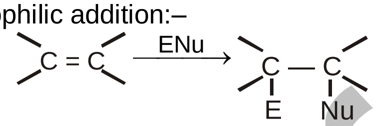
Q.9  $\xrightarrow{H^+/\Delta}$ _______

Q.10  $\xrightarrow{H^+/\Delta}$ _______

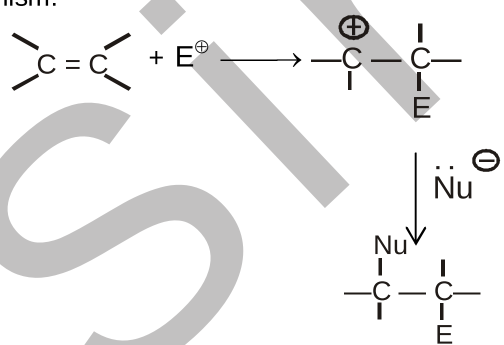
Q.11  $\xrightarrow{H^+/\Delta}$ _______

Q.8 3, 3–Dimethyl–butan–2–ol loses a molecule of water in the presence of concentrated sulphuric acid to give tetramethylethylene as a major product. Suggest a suitable mechanism.

Electrophilic addition:–



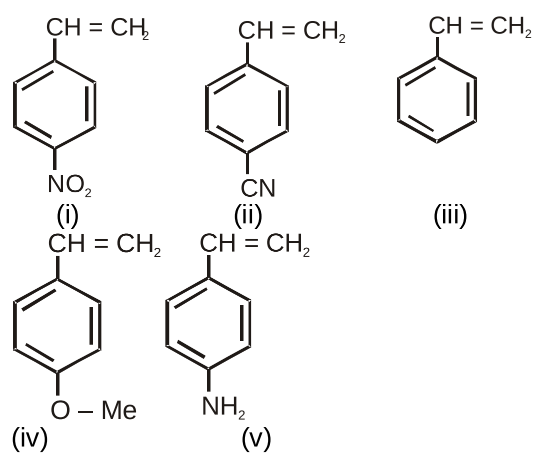
Mechanism:–

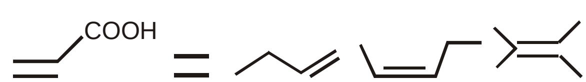


Q.1 Compare rate of electrophilic addition on alkenes:–

(a) 

(i) (ii) (iii) (iv)

(b) 

(c) 

(i) (ii) (iii) (iv) (v)

(d) $Ph — CH = CH_2$ (i) $PH — CH = CH — Ph$ (ii)

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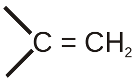
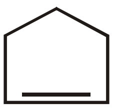
Q.1 $CH_2 = CH_2 \xrightarrow{HI}$ ___________

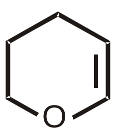
Q.2 $CH_2 = CH_2 \xrightarrow{KBr}$ ___________

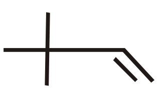
Q.3  $\xrightarrow[KBr]{HI}$ ___________

Q.4  $\xrightarrow[KBr]{HI}$ ___________

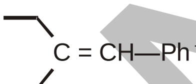
Q.5  $\xrightarrow[KF]{HI}$ ___________

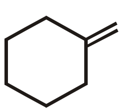
Q.6  $\xrightarrow{HI}$ ___________

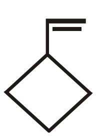
Q.7  $\xrightarrow{HCl}$ ___________

Q.8  $\xrightarrow{HI}$ ___________

Q.9 $(Ph)_2\,CH—\underset{\displaystyle Me}{CH}—CH=CH_2 \xrightarrow{HI}$ ___________

Q.10  $\xrightarrow{HBr}$ ___________

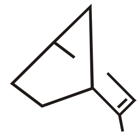
Q.11  $\xrightarrow{HCl}$ ___________

Q.12  $\xrightarrow{HBr}$ ___________

Q.13 $CH_2 = CH — Cl \xrightarrow{HCl}$ ___________

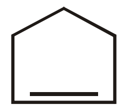
Q.14 $CH \equiv CH \xrightarrow{HCl(2eq.)}$ ___________

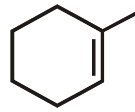
Q.15 $CH_3 — C \equiv CH \xrightarrow{HCl(2eq.)}$ ___________

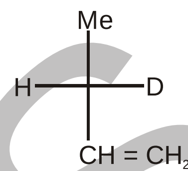
Q.16  $\xrightarrow{HCl}$ ___________

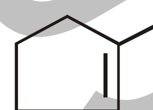
Q.17  $\xrightarrow{dil.H_2SO_4}$ ___________

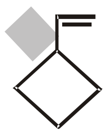
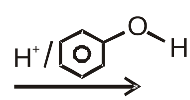
Q.18  $\xrightarrow{H^+/H_2O}$ ___________

Q.19  $\xrightarrow{H^+/R–OH}$ ___________

Q.20  $\xrightarrow{H^+/H_2O}$ ___________

Q.21  $\xrightarrow{HCl}$ ___________

Q.22  $\xrightarrow{D^+/D_2O}$ ___________

Q.23   ___________

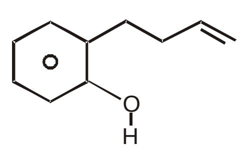
Q.24  $\xrightarrow{HBr}$ ___________

Q.25 $CH \equiv C — CH_2 — CH = CH_2 \xrightarrow{HCl}$ ___________

Q.26 $CH \equiv C — CH = CH_2 \xrightarrow{HCl}$ ___________

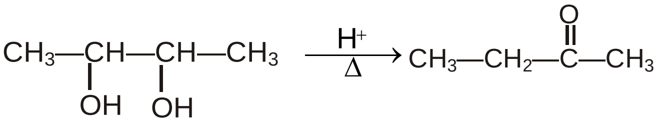
Q.27 $HO—CH_2—CH_2—CH_2—CH = CH_2 \xrightarrow[MeOH]{H^+}$ ___

Q.28 $CH_2= CH—\overset{\displaystyle OH}{CH}—CH=CH_2 \xrightarrow{H^+/MeOH}$ ______

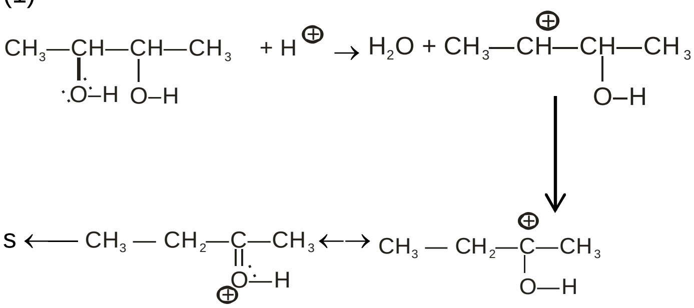
Q.29  $\xrightarrow{H^+}$ ___________

DPP NO-03 Time: 15 minutes

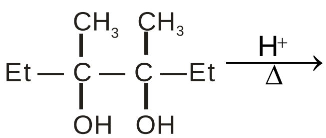
Q.1



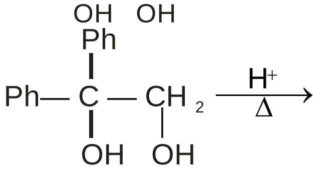
Mechanism:–
(1)



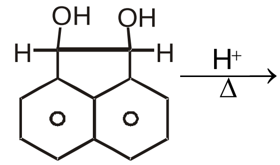
Q.1



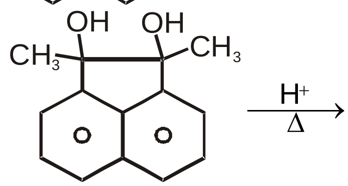
Q.2



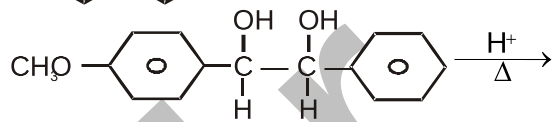
Q.3



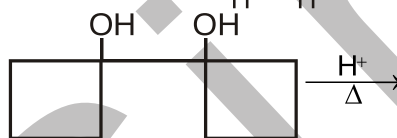
Q.4



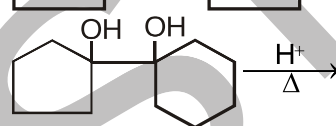
Q.5



Q.6



Q.7



Diazotization of primary amine:–

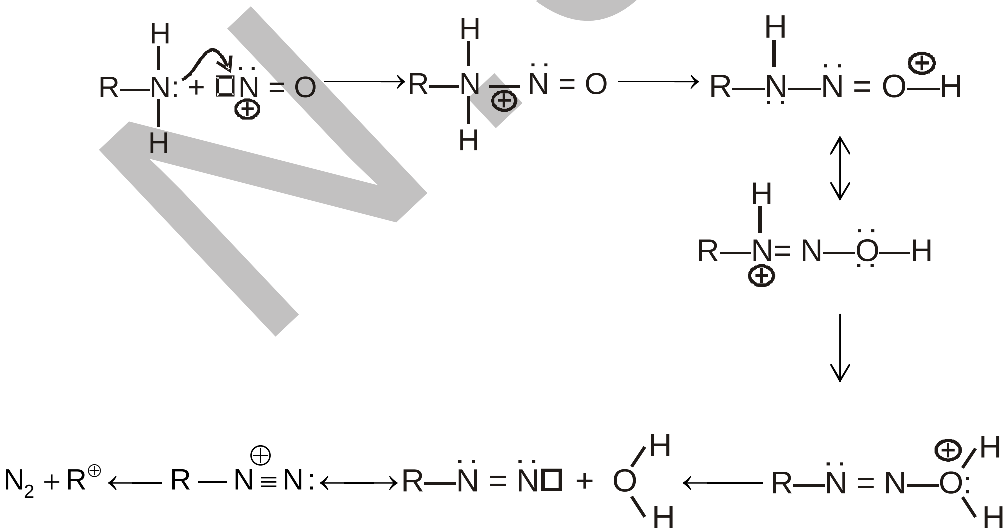
$$R-\ddot{N}H_2 \xrightarrow[HCl]{NaNO_2} R-N^{\oplus}\equiv N: \xrightarrow[\Delta]{} R^{\oplus} + N_2$$

Mechanism:–

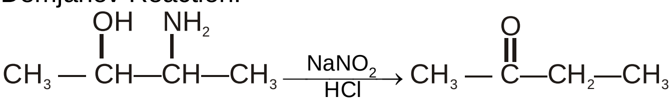
(1) $NaNO_2 + HCl \longrightarrow H-O-N=O + NaCl$

(2) $H-O-N=O + H^{\oplus} \longrightarrow H_2O + \square\overset{..}{N}^{\oplus}=O$

(3)

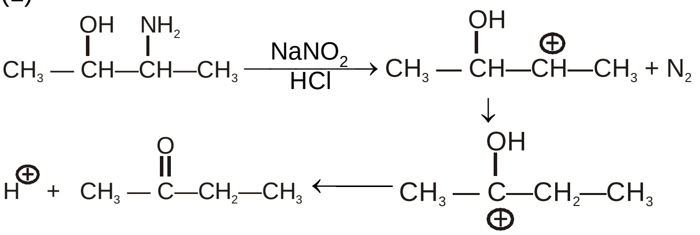


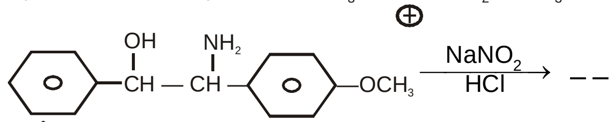
Demjanov Reaction:–

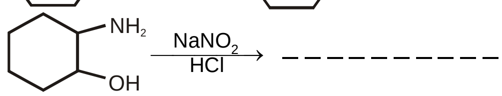


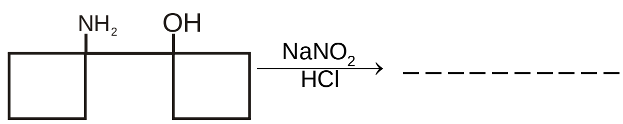
Mechanism:–

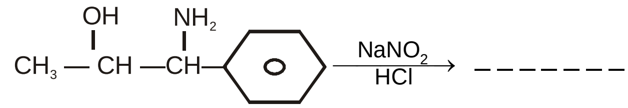
(1)

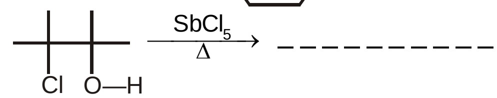


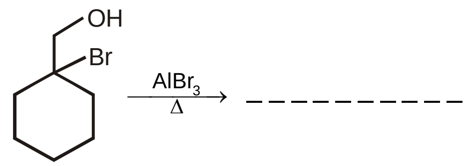
Q.1 

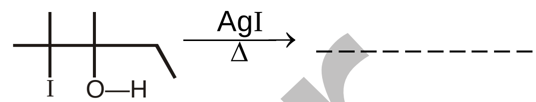
Q.2 

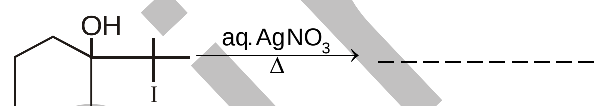
Q.3 

Q.4 

Q.5 

Q.6 

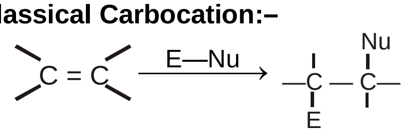
Q.7 

Q.8 

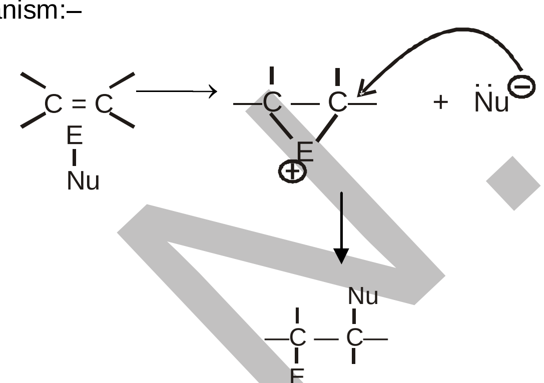
IIT-JEE ChEmistry by N.J. sir ORGANIC chemistry

DPP NO-04 Time: 15 minutes

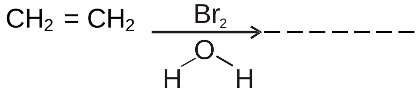
Non Classical Carbocation:–

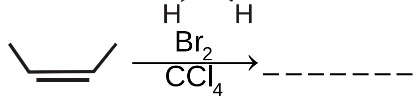


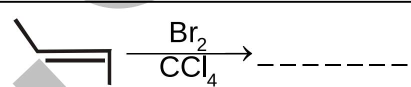
Mechanism:–

(1) 

Q.1 $CH_2 = CH_2 \xrightarrow{Br_2}$ _______

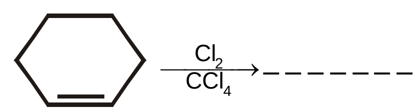
Q.2 

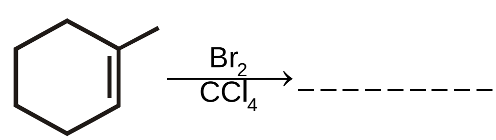
Q.3 

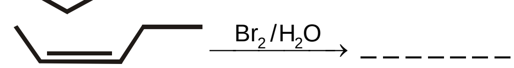
Q.4 

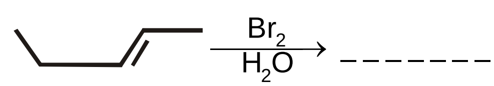
Q.5 $CH_3 - CH = CH_2 \xrightarrow{ICl}$ _______

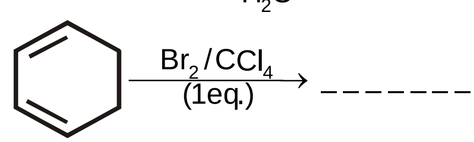
Q.6 $CH_3 - CH = CH_2 \xrightarrow{HOCl}$ _______

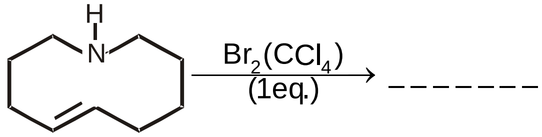
Q.7 

Q.8 

Q.9 

Q.10 

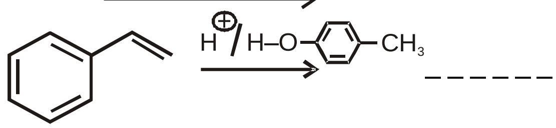
Q.11 

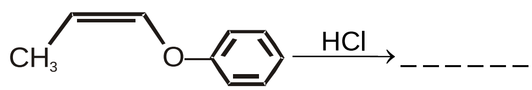
Q.12 

Q.13 $CH_3 — CH = CH_2 \xrightarrow{HCl}$ ______

$\xrightarrow{CH_3Cl\ /\ AlCl_3}$

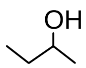
$\xrightarrow{CH_3Cl}$

Q.14 

Q.15 

Q.13 The reaction of propene with HOCl proceeds via the addition of **[IIT '2001]**
(A) H^+ in first step
(B) Cl^+ in first step
(C) OH^- in first step
(D) Cl^+ and OH^- in single step

Ans. B

Q.18  $\xrightarrow[-H_2O]{H^+}$ X (mixture) $\xrightarrow{Br_2}$ 5 compounds of molecular formula $C_4H_8Br_2$ **[IIT '2003]**
Number of compounds in X will be :
(A) 2 (B) 3 (C) 4 (D) 5

Ans. B

Q.23 $CH_3 - CH = CH_2 + NOCl \rightarrow P$ **[IIT '2006]**
Identify the adduct.
(A) $CH_3 - \underset{Cl}{\underset{|}{CH}} - \underset{NO}{\underset{|}{CH_2}}$ (B) $CH_3 - \underset{NO}{\underset{|}{CH}} - \underset{Cl}{\underset{|}{CH_2}}$

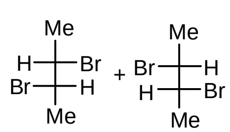
(C) $CH_3 - CH_2 - \overset{NO}{\overset{|}{\underset{Cl}{\underset{|}{CH}}}}$ (D) $\underset{NO}{\underset{|}{CH_2}} - CH_2 - \underset{Cl}{\underset{|}{CH_2}}$

Ans. A

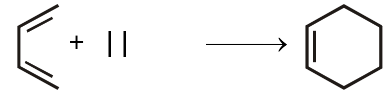
Q.26 The number of stereoisomers obtained by bromination of trans-2-butene is **[IIT '2007]**
(A) 1 (B) 2 (C) 3 (D) 4

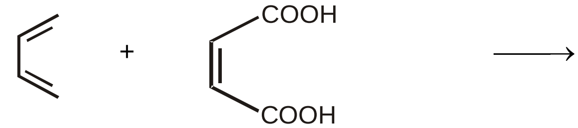
Ans. A

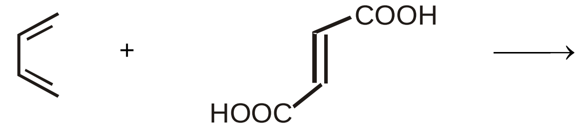
Q.5 Write down the structures of the stereoismers formed when cis-2-butene is reacted with bromine. **[IIT '1995]**

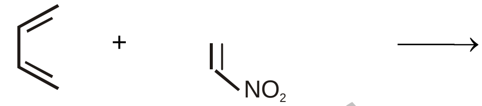
Ans. 

Diel's Alder Reaction:–



Q.1 

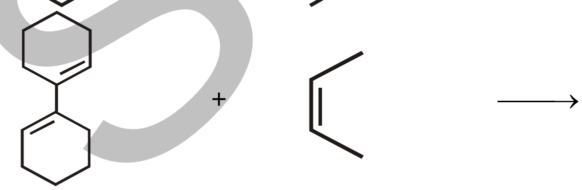
Q.2 

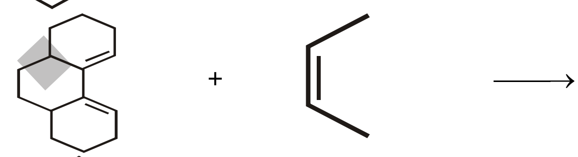
Q.3 

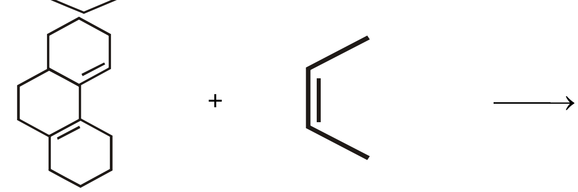
Q.4 

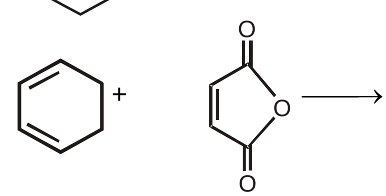
Q.5 

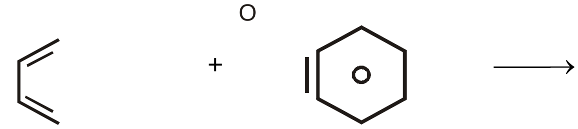
Q.6 

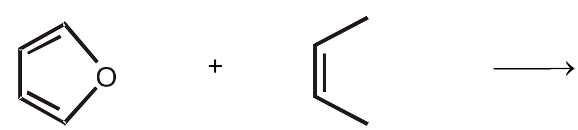
Q.7 

Q.8 

Q.9 

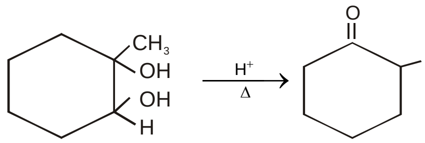
Q.10 

Q.11 

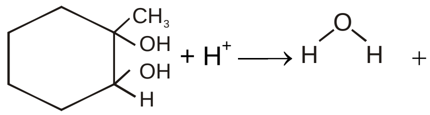
Q.12 

DPP NO- 05 Time: 15 minutes

Fill in the blanks:–

Q.1 

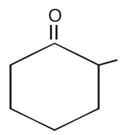
Mechanism :–

(i)  + ___________

(Intermediate carbocation)

(ii) ___________ $\xrightarrow{\text{Rearrargemet}}$ ___________

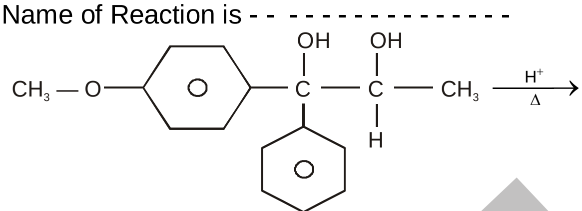
(Intermediate carbocation) (Rearranged carbocation)

(iii) ___________ $\longrightarrow H^+ +$ 

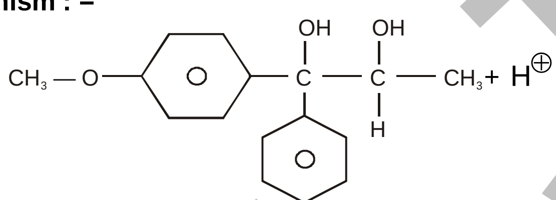
(Rearranged carbocation)

(iv) $\frac{\Delta[H^+]}{\Delta t}$ = ___________

(v) Name of Reaction is ___________

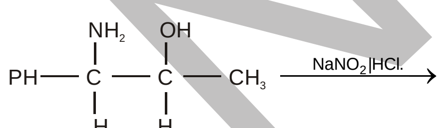
Q.2  Product

Mechanism : –

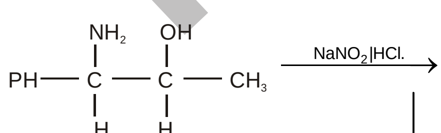
 Intermediate Carbocation ___________

(i) Intermediate Carbocation ___________ $\longrightarrow$ rearranged Carbocation ___________

(ii) Rearranged Carbocation ___________ $\longrightarrow H^+$ Product _____

Q.3  Product _____

Mechanism : –

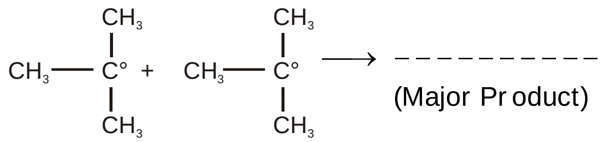
(i)  - - - - - - - - - - - - -

Rearrangement

$H^+ +$ - - - - - - - - - - - $\longleftarrow$ - - - - - - - - - - - -

None of Reaction - - - - - - - - - - - - - -

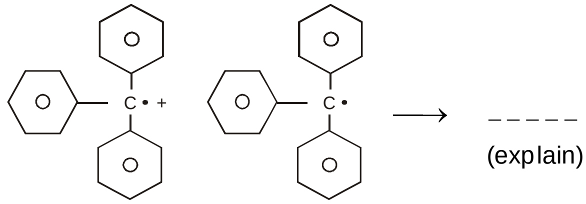
Q.4



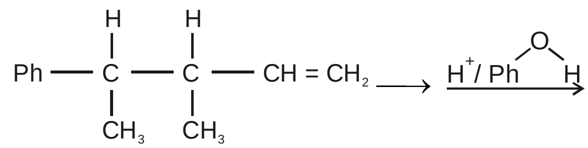
Q.5 $CH_3 - \overset{\circ}{C}H_2 + CH_3 - C^{\circ}H_2 \longrightarrow$ _ _ _ _ _ _ _ _ _ _

(Major Product)

Q.6

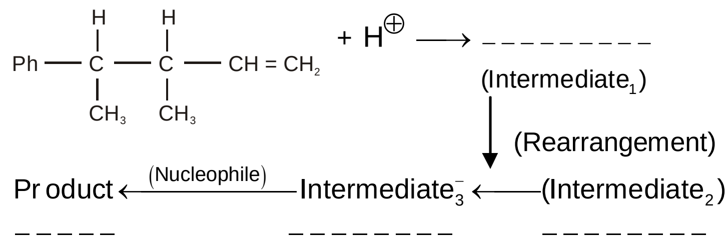


Q.7

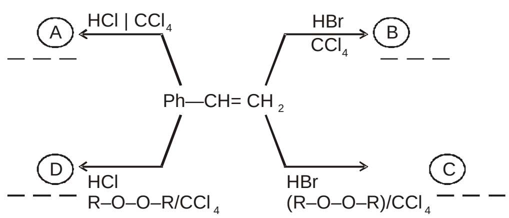


Mechanism : –

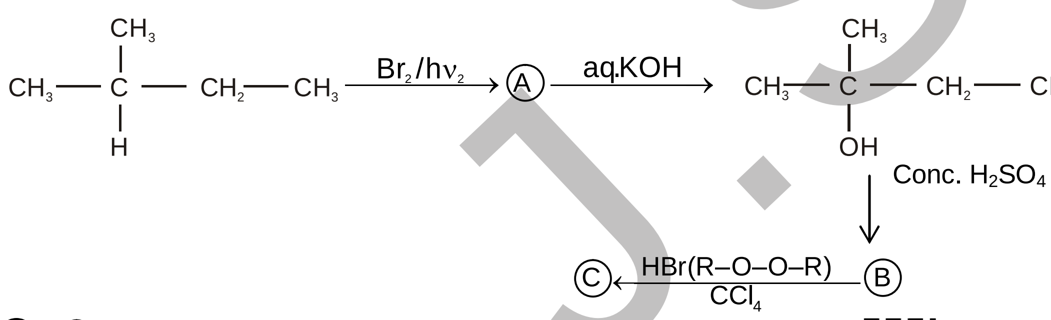
(i)



Q.8

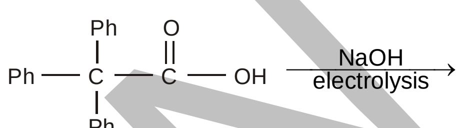


Q.9



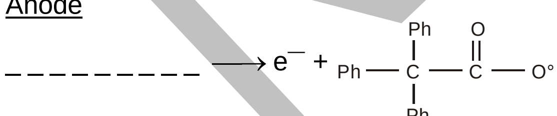
A & C are Idenitcal / Isomers / Positon Isomers.

Q.10

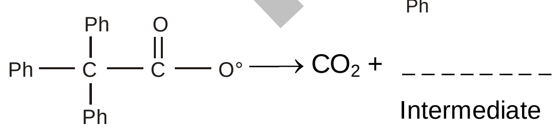


Anode

(I)



(ii)



(iii) Intermediate $\longrightarrow$ - - - - - - - - - - - - -

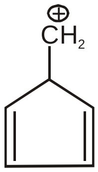
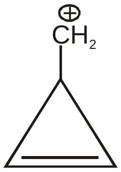
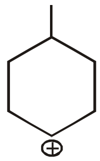
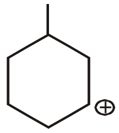
_ _ _ _ _ _ _

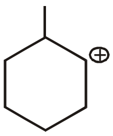
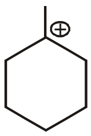
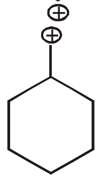
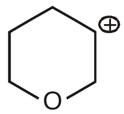
Cathode

(i) $2H_2O + 2e^- \longrightarrow$ _ _ _ _ _ _

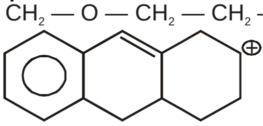
DPP NO- 06 Time: 15 minutes

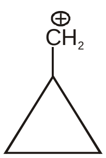
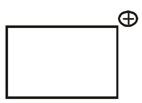
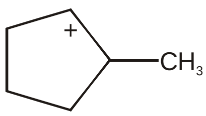
1. Which of following carbocation will undergo rearrangement?

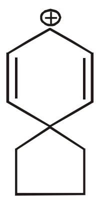
(a)  (b)  (c)  (d) 

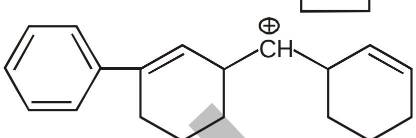
(e)  (f)  (g)  (h) 

(i) $\overset{Ph}{CH_2}$ — O — CH_2 — CH_2 — $\overset{\oplus}{C}H_2$

(j) 

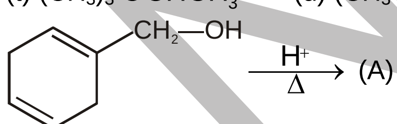
(k)  (l)  (m) 

(n) $\overset{\oplus}{C}H_2$ — CH_2 — CH_2 — O — CH_2 — CH_3 (o)  (p) $\overset{Ph}{CH_2}$ — $\overset{\oplus}{C}$ = O

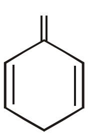
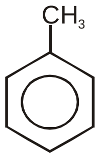
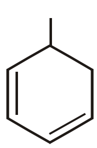
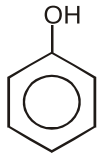
(q) 

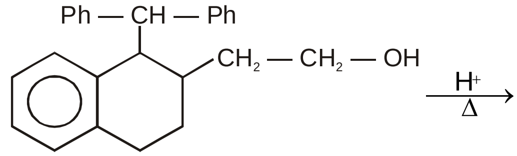
(r) $CH_3CH_2CH_2^+$ (s) $(CH_3)_2\,CH\overset{+}{C}HCH_3$

(t) $(CH_3)_3\,C\overset{+}{C}HCH_3$ (u) $(CH_3CH_2)_3CCH_2^+$

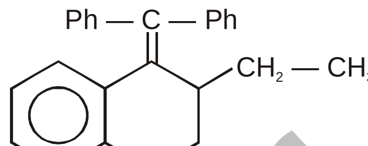
2. 

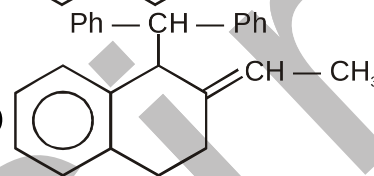
(A) an heating isomerizes to (B). What is the structure of (B).

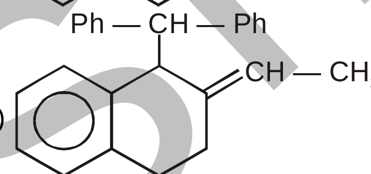
(A)  (B)  (C)  (D) 

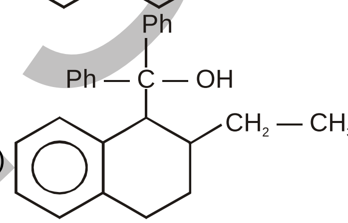
3. 

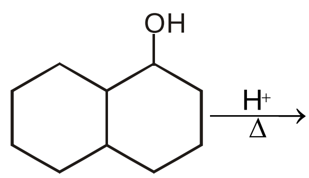
(A) (major), Major product (A) is

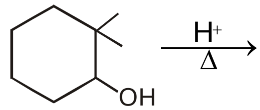
(A) 

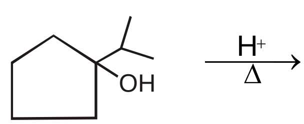
(B) 

(C) 

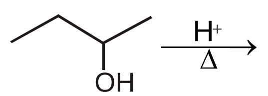
(D) 

4. Reaction-1  (A) (major)

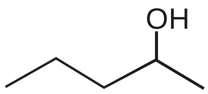
Reaction-2  (A) (major)

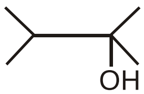
Reaction-3  (A) (major)

Sum of α-hydrogen (A + B + C) is.

5. (A)  (x)

(B)  $\xrightarrow[\Delta]{H^+}$ (y)

(C)  $\xrightarrow[\Delta]{H^+}$ (z)

(D)  $\xrightarrow[\Delta]{H^+}$ (p)

Total number of products obtained in above reactions including minor products is (include stereoisomer)

x	y	z	p

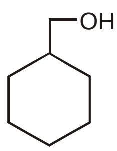
6. In which of following reaction rearrangement take place with change is carbon skeleton.

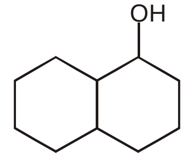
(A) $CH_3-\overset{CH_3}{\underset{CH_3}{\overset{|}{\underset{|}{C}}}}-\overset{\oplus}{C}H_2$ (B) $CH_3-CH_2\,CH_2^{\oplus}$

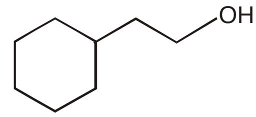
(C) $CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-\overset{\oplus}{C}H_2$

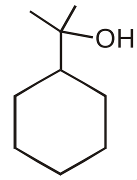
(D) $CH_3-CH^{\oplus}-CH_3$

7. Sum of α-hydrogen in major product of the reaction.

Reaction-1  $\xrightarrow[\Delta]{H^+}$ (A)

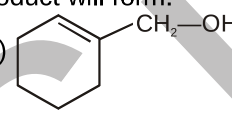
Reaction-2  $\xrightarrow[\Delta]{H^+}$ (B)

Reaction-3  $\xrightarrow[\Delta]{H^+}$ (C)

Reaction-4  $\xrightarrow[\Delta]{H^+}$ (D)

Sum of α-hydrogen is A + B + C + D =

8. In which of following reaction resonance stabilized product will form.

(A)  $\xrightarrow[\Delta]{H^+}$

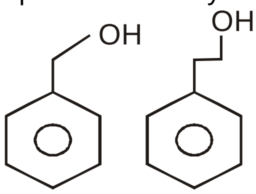
(B)  $\xrightarrow[\Delta]{H^+}$

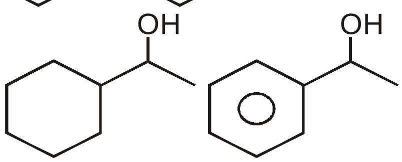
(C)  $\xrightarrow[\Delta]{H^+}$

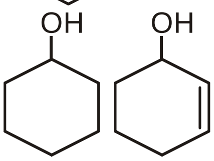
(D) All

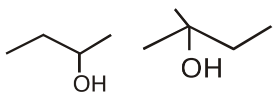
DPP NO- 07 Time: 15 minutes

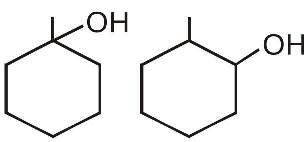
Q.1 Compare rate of dehydration (acid-catalyzed)

(a) 

(b) 

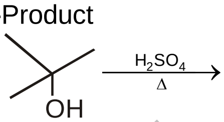
(c) 

(d) 

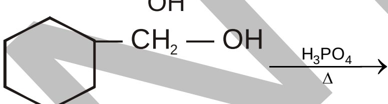
(e) 

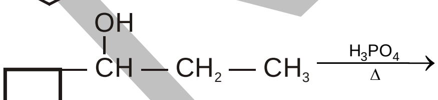
Q.2 Predict the major product of acid-catalyzed dehydration of alcohols
(A) 2-pentanol
(B) 1-methyl cyclopentanol
(C) 2-methyl cyclohexanol
(D) 2, 2-dimethyl-1-propanol

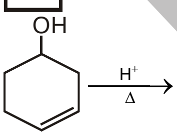
Q.3 Identify-Product

(a) 

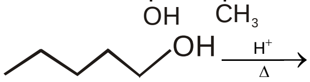
(b) $CH_3-CH_2-\underset{OH}{\overset{CH_3}{C}}-\overset{CH_3}{CH}-CH_3 \xrightarrow[\Delta]{H_2SO_4}$

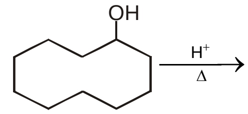
(c) 

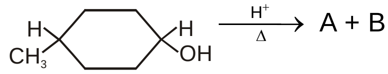
(d) 

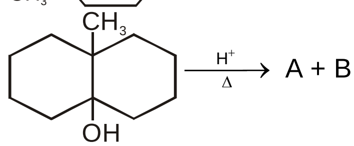
(e) 

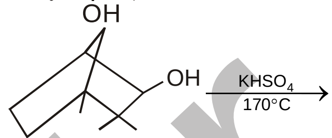
(f) $CH_3-CH_2-\underset{OH}{CH}-\underset{CH_3}{\overset{CH_3}{C}}-CH_3 \xrightarrow[\Delta]{H^+}$

(g) 

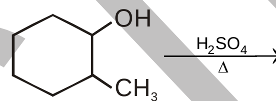
(h) 

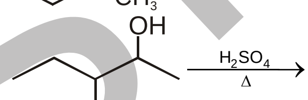
(i) 

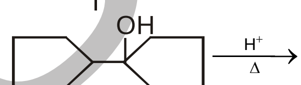
(j) 

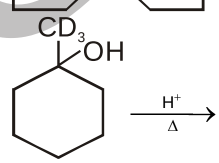
(k) 

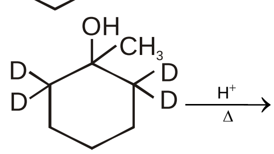
(l) 

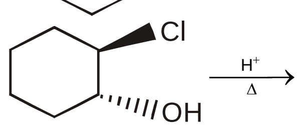
(m) 

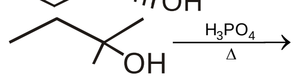
(n) 

(o) 

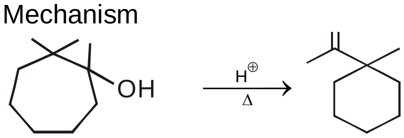
(p) 

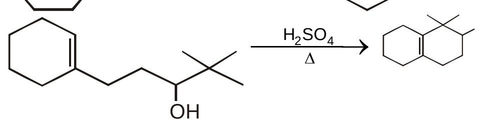
(q) 

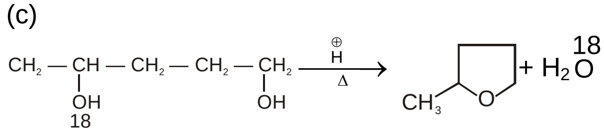
(r) 

(s) 

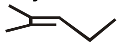
Q.4 Write – Mechanism

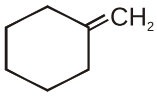
(a) 

(b) 

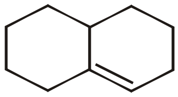
(c) 

Q.5 Predict Major Product

(a)  $\xrightarrow{HCl}$

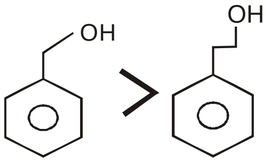
(b) 

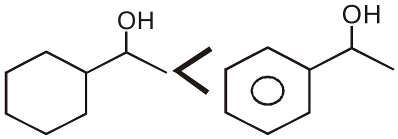
$\xrightarrow{HCl}$

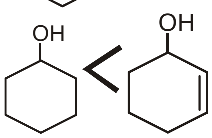
(c)  $\xrightarrow{HCl}$

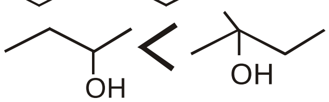
(d) 2-methyl propene $\xrightarrow{HCl}$

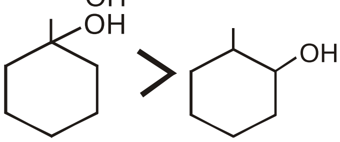
(e) 1-methyl cyclohexene $\xrightarrow{HI^-}$

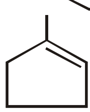
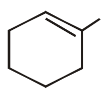
Ans.1 (a) 

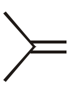
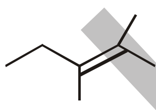
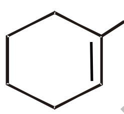
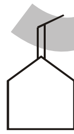
(b) 

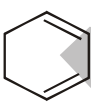
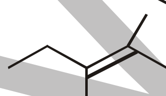
(c) 

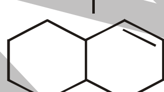
(d) 

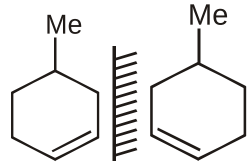
(e) 

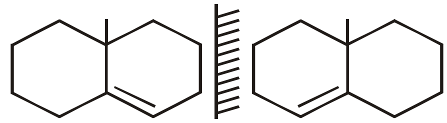
Ans.2 (A)  (B)  (C)  (D) $C-\overset{C}{\overset{|}{C}}=C-C$

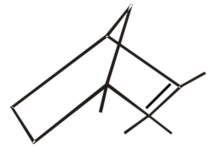
Ans.3 (a)  (b)  (c)  (d) 

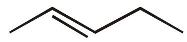
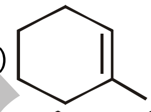
(e)  (f)  (g) 

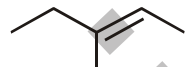
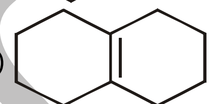
(h)  + 

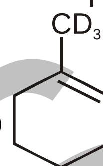
(i) 

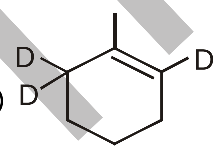
(j) 

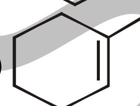
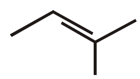
(k) 

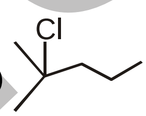
(l)  (m) 

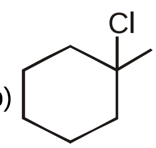
(n)  (o) 

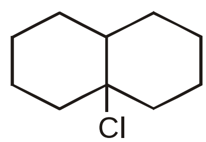
(p) 

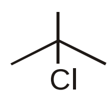
(q) 

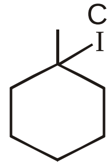
(r)  (s) 

Ans.5 (a) 

(b) 

(c) 

(d) 

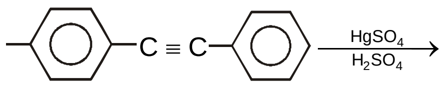
(e) 

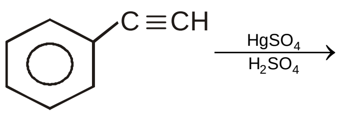
DPP NO- 08 Time: 15 minutes

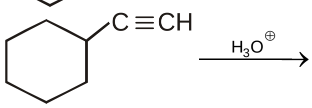
Q.1 Identify major products:

(a) $CH_3-C(CH_3)_2-C\equiv CH \xrightarrow[H_2SO_4]{HgSO_4}$

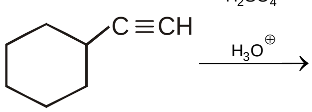
(b) $CH_3-C\equiv CH \xrightarrow[H_2SO_4]{HgSO_4}$

(c) 

(d) 

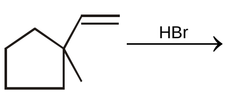
(e) 

(f) $CH_3-C\equiv CH \xrightarrow[H_2SO_4]{HgSO_4}$

(g) 

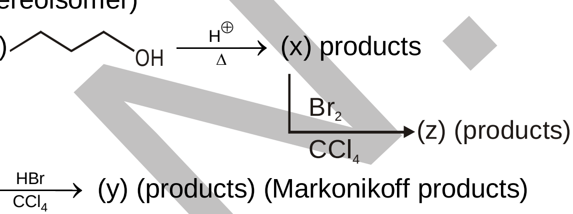
(h) I-phenyl cyclohexene $\xrightarrow{H_3O^{\oplus}}$

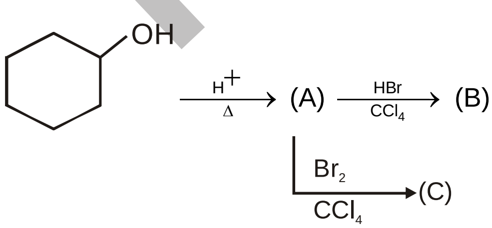
(i) I-methyl cyclopetene $\xrightarrow{H_3O^{\oplus}}$

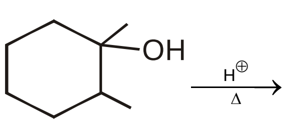
(j) 

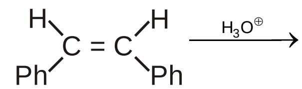
(k) $Ph-CH_2-CH=CH_2 \xrightarrow[CCl_4]{HBr}$

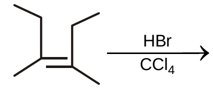
Q.2 Find total product in following reaction ? (including stereoisomer)

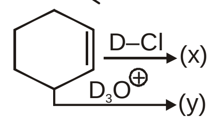
(a) 

(b) 

(c) 

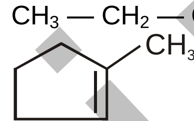
(d) 

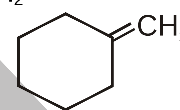
(e) 

(f) 

Q.3 What will be major – product obtained from addition of HBr to each of the following compounds.

(a) $CH_3-CH_2-CH=CH_2$

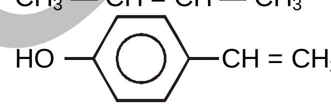
(b) 

(c) 

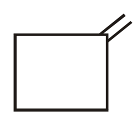
(d) $CH_3-CH=C(CH_3)-CH_3$

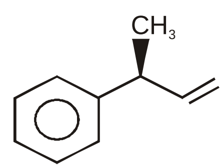
(e) $H_2C=C(CH_3)-CH_2-CH_3$

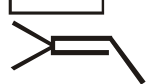
(f) $CH_3-CH=CH-CH_3$

(g) 

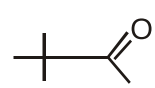
(h) $CH_3-CH(CH_3)-CH_2-CH=CH_2$

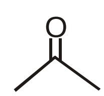
(i) 

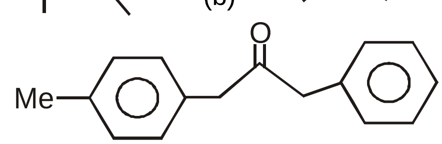
(j) 

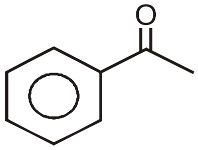
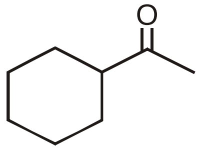
(k) 

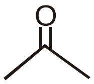
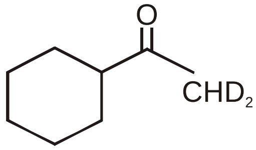
Ans.

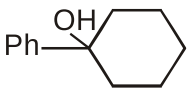
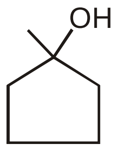
1. (a) 

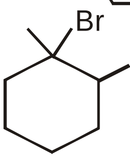
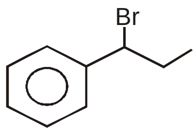
(b) 

(c) 

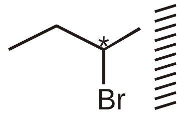
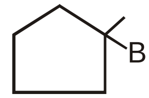
(d)  (e) 

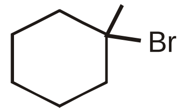
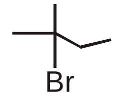
(f)  (g) 

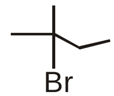
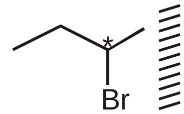
(h)  (i) 

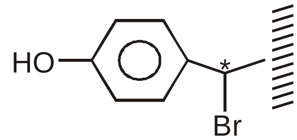
(j)  (k) 

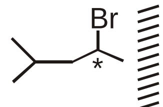
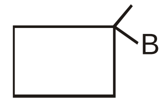
2. (a) $x \rightarrow 3$; $y \rightarrow 2$; $z \rightarrow 5$
(b) $A \rightarrow 1$; $B \rightarrow 1$; $C \rightarrow 2$
(c) 3 (d) 2
(e) 4 (f) $x \rightarrow 4$; $y \rightarrow 4$

3. (a)  M. I. (b) 

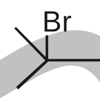
(c)  (d) 

(e)  (f) 

M. I. (g)  M. I.

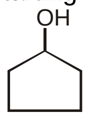
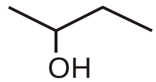
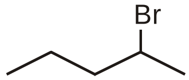
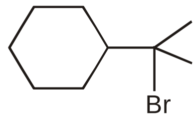
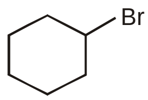
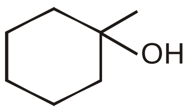
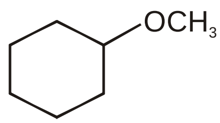
(h)  M. I. (i) 

(j)  M. I.

(k) 

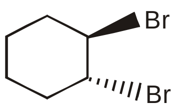
DPP NO- 09 Time: 15 minutes

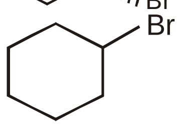
Q.1 How will prepare following compound using alkene as the starting material ?

(a) 
(b) 
(c) 
(d) 
(e) $CH_3 - O - \underset{CH_3}{\overset{CH_3}{C}} - CH_3$
(f) 
(g) 
(i) 

Q.2 Identify reactant in following reaction

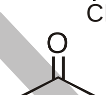
(a) (A) $\xrightarrow[CCl_4]{Br_2}$ meso – 2, 3 – dibromobutane

(b) (B) $\xrightarrow[CCl_4]{Br_2}$  + Mirror Image

(c) (C) $\xrightarrow[CCl_4]{HBr}$ 

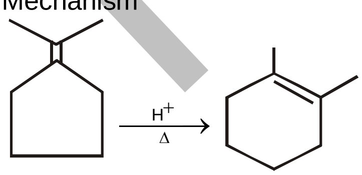
(d) (D) $\xrightarrow[CCl_4]{HBr}$ 

(e) (E) $\xrightarrow[CCl_4]{HBr}$ $CH_3 - \underset{CH_3}{\overset{CH_3}{C}} - CH_2 - Br$

(f) (F) $\xrightarrow{H_3O^{\oplus}}$ 

(g) (G) $\xrightarrow[CCl_4]{HBr}$ racemic mixture of 2, 3 – dibromobutane.

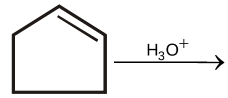
Q.3 Write – Mechanism

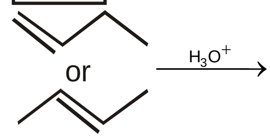
(a) 

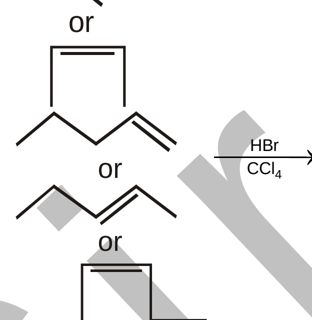
(b) $Ph—CH_2—CH_2—OH \xrightarrow{H_3O^{\oplus}} Ph - \overset{OH}{CH} - CH_3$

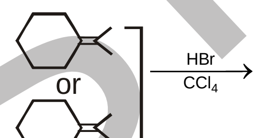
Ans.

1.

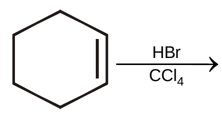
(a) 

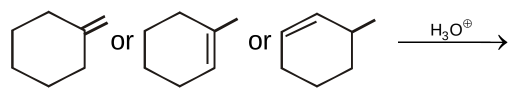
(b) 

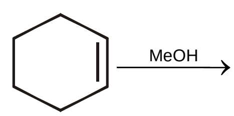
(c) 

(d) 

(e) 

(f) 

(g) 

(h) 

2. (a) A $\rightarrow$ Trans but-2-ene
(b) B $\rightarrow$ cyclohexene
(c) C $\rightarrow$ cyclohexene
(d) D $\rightarrow$ 2-Methylpropene
(e) E $\rightarrow$ can not prepared by alkene
(f) F $\rightarrow$ Propyne
(g) G $\rightarrow$ Cis but 2-ene

DPP NO-10 Time: 15 minutes

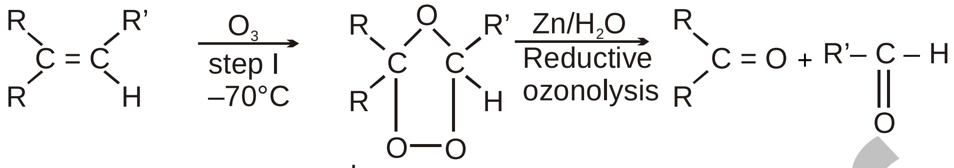
OZONOLYSIS: The reaction of alkene of alkene with ozone (O_3) followed by hydrolysis is known as ozonolysis.

It is two types : (I) Reductive ozonolysis $\rightarrow$ In presence of reducing agent

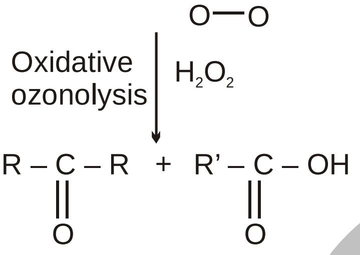
(II) Oxidative ozonolysis $\rightarrow$ In presence of oxidizing agent

Reducing agents: Zn, H_2O or Zn, CH_3COOH or $(CH_3)_2S$ or $(Ph)_3$ P etc.

Oxidising agents: H_2O_2 or $R-\overset{\overset{O}{||}}{C}-O-O-H$ or Ag_2 O etc.

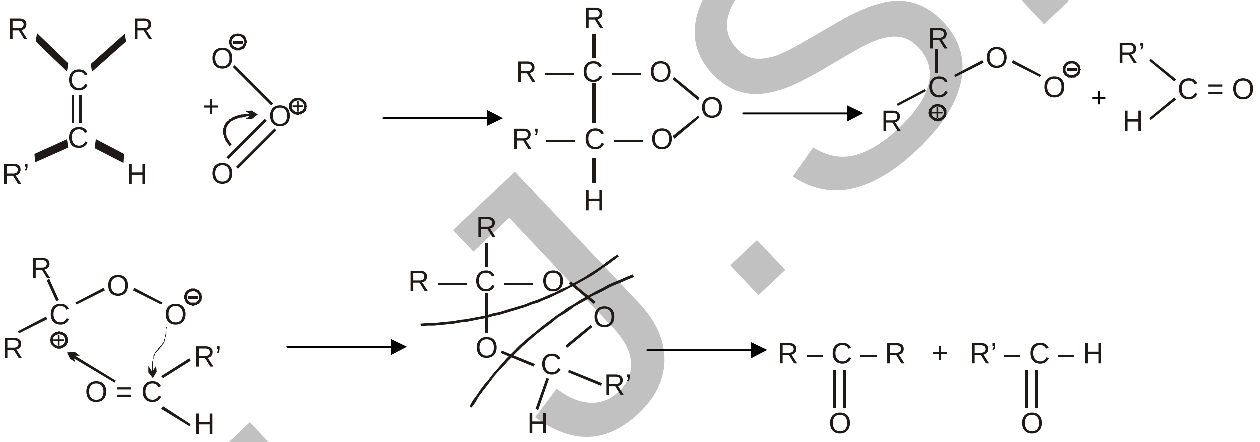


Example 1:



[SCT-Cut the double bond and paste two oxygen atoms and vice versa]

Mechanism:



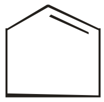
Note : In case of oxidative ozonolysis aldehyde (not ketone) further undergoes oxidation which gives acid as product.

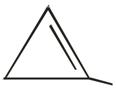
Q.1 Give the product of the following reaction. **[7 × 2 = 14]**

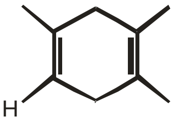
(i) $H_2C = CH_2 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

(ii) $CH_3 - CH = CH_2 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

(iii) $CH_3 - \underset{}{\overset{\overset{CH_3}{|}}{C}} = CH_2 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

(iv)  $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

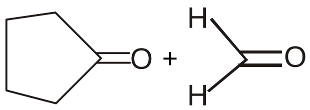
(v)  $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

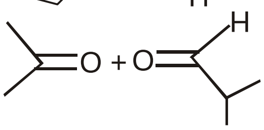
(vi)  $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

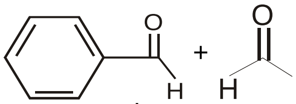
(vii) $H_2C = CH - CH_2 - CH = CH - CH_3 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$

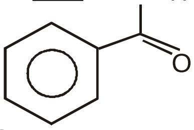
Q.2 Find out the structure of reactant. **[11 × 2 = 22]**

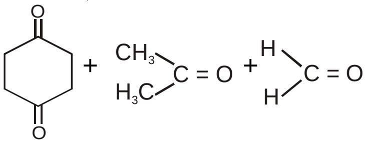
(i) $X \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3} CH_3 - CH_2 - \underset{\underset{O}{||}}{C} - H$

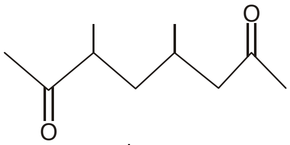
(ii) **X** $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$ 

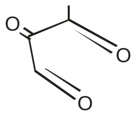
(iii) X $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$ 

(iv) X $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$ 

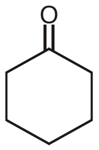
(v) X $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$ 

(vi) X $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$ 

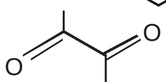
(vii) X $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$ 

(viii) X $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$  + HCHO

$C_{10}H_{12}$

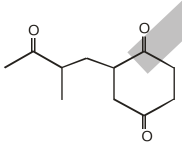
(ix) X $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$  +

$C_{12}H_{18}$

O = C = O +  + HCHO

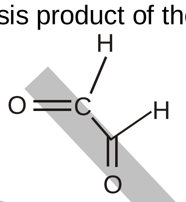
(x) C_6H_4 $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$ $C_3H_2O_3$

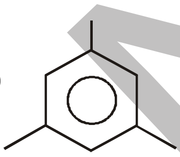
(X)

(xi) X $\xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3}$  + HCHO

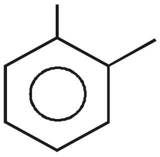
$C_{12}H_{18}$

Q.3 Give the ozonolysis product of the following.

(i) X $\xrightarrow[\text{Zn}]{\text{O}_3(\Delta)}$ 3 

(ii)  $\xrightarrow[\text{Zn/H}_2\text{O}]{\text{O}_3}$?

How many species will be formed.

(iii)  $\xrightarrow[\text{Zn/H}_2\text{O}]{\text{O}_3/\Delta}$

How many species will be formed.

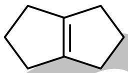
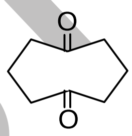
Q.4 How many initial ozonoids are possible in given reaction.

(i) $CH_2 = CH_2 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3/\Delta}$

(ii) $CH_3 - CH = CH - CH_3 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3/\Delta}$

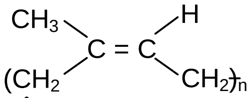
(iii) $CH_3 - CH = CH_2 \xrightarrow[\text{(ii)Zn/H}_2\text{O}]{\text{(i)O}_3/\Delta}$

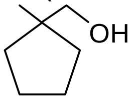
Q.9 Only mole of the compound A (molecular formula C_8H_{12}), incapable of showing stereoisomerism, reacts with only one mole of H_2 on hydrogenation over Pd. A undergoes ozonolysis to give a symmetrical diketone B($C_8H_{12}O_2$). What are the structure of A and B?

Ans. (A)  (B) 

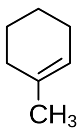
Q.21 If after complete ozonolysis of one mole of monomer of natural polymer gives two moles of CH_2O and one mole of $O = \overset{\overset{\displaystyle CH_3}{|}}{C} - CH = O$. Identify the monomer and draw the all-cis structure of natural polymer. **[IIT '2005]**

Ans. (a) $CH_2 = \overset{\overset{\displaystyle CH_3}{|}}{C} - CH = CH_2$

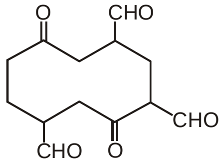
(b) 

Q.22  $\xrightarrow{H^+,\Delta}$ X $\xrightarrow[\text{(ii) Zn / Cl}_3\text{COOH}]{\text{(i) O}_3}$ Y

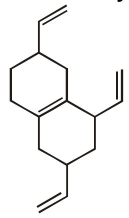
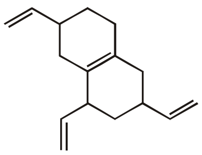
Identify X and Y.

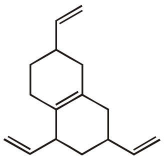
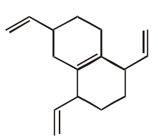
Ans. (X) , (Y) $CH_3 - \overset{\overset{\displaystyle O}{||}}{C} - (CH_2)_4 - CH = O$

DPP NO-11 Time: 15 minutes

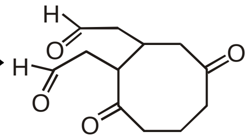
Q.1 

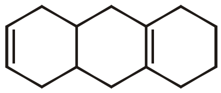
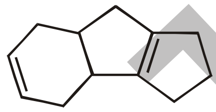
is obtained by the ozonolysis of following?

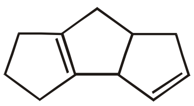
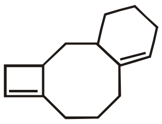
(A)  (B) 

(C)  (D) 

Q.2 Which starting material should be used to produce the compound shown below?

? $\xrightarrow[\text{Zn–}H_2O]{O_3}$ 

(A)  (B) 

(C)  (D) 

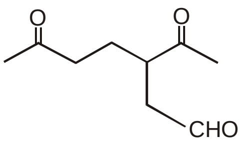
Q.3 $CH_3-\underset{OH}{\overset{CH_3}{C}}-CH_3 \xrightarrow[\Delta]{H^+} (A) \xrightarrow[Zn, H_2O]{O_3} (P) + HCHO$

Product (P) is

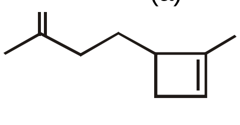
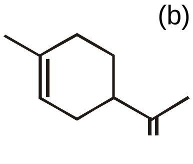
(A) CH_3-CH_2-CHO (B) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$

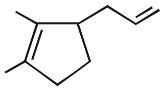
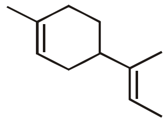
(C) $CH_3-\underset{CH_3}{CH}-OH$ (D) CH_3-CHO

Q.4 The reactants that lead to product (a) and (b) on ozonolysis are

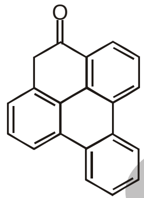
 HCHO

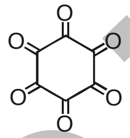
(a) (b)

(A)  (B) 

(C)  (D) 

Q.5 This compound on ozonolysis gives which of the following compounds



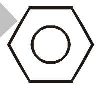
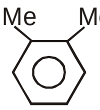
(I)  (II) $OHC-\underset{O}{\underset{\|}{C}}-\overset{O}{\overset{\|}{C}}-CH_2-\underset{O}{\underset{\|}{C}}-CHO$

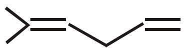
(III) $\underset{CHO}{\overset{CHO}{|}}$ (IV) $OHC-\overset{O}{\overset{\|}{C}}-\underset{O}{\underset{\|}{C}}-CH_2-CH=O$

(A) I, II, III & IV (B) I, III, IV

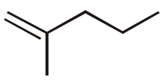
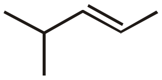
(C) I, II, III (D) I, II, IV

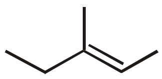
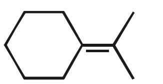
Q.6 Which of the following will give three different compounds on ozonolysis

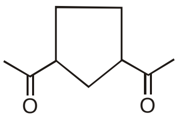
(A)  (B) 

(C)  (D) 

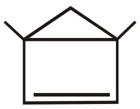
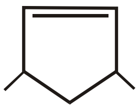
Q.7 Which one of the following compounds gives acetone $(CH_3)_2C=O$ as one of the products of its ozonolysis?

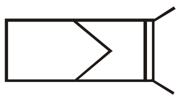
(A)  (B) 

(C)  (D) 

Q.8 Sentene $\xrightarrow{\text{ozonolysis}}$ 

Which is the correct structure of Sentene.

(A)  (B) 

(C)  (D) 

Q.9 In which of following reaction product formed is aromatic

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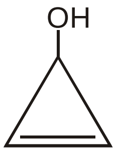
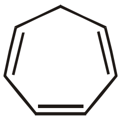
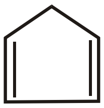
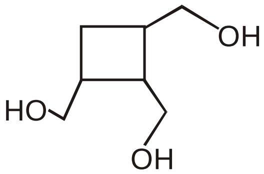
(A)  $\xrightarrow[\Delta]{HBr}$

(B)  $\xrightarrow[\Delta]{HF}$

(C)  $\xrightarrow[\Delta]{KH}$

(D)  $\xrightarrow[\Delta]{H_2SO_4}$

Q.10 Propane reacts with chlorine in sunlight to give two products. 1-chloropropane is obtained in 44% yield and 2-chloropropane is obtained in 56% yield of the total product. 2-Methylpropane reacts with chlorine under same conditions to produce 1-chloro-2-methylpropane 66% and 2-chloro-2-methylpropane 33% What will be the percent yield (X) of the major product obtained when 1,3,5-trimethylclohexane is treated with Cl_2 in similar conditions. **(Round answer to nearest integer)**

DPP NO-12 Time: 15 minutes

Free Radicals:–
Wurtz Reaction:–

$R — X \xrightarrow[ether]{Na} R — R$

Mechanism:– (Free radical Mechanism)

(1) $Na \longrightarrow Na^+ + e^-$

(2) $R — X + e^- \longrightarrow \dot{R} + \ddot{X}^{\ominus}$

(3) $\dot{R} + \dot{R} \longrightarrow R — R$

(Ionic Mechanism)

(1) $Na \longrightarrow Na^+ + e^-$

(2) $R — X + 2e^- \longrightarrow R + \ddot{X}^{\ominus}$

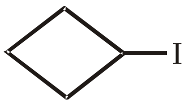
(3) $\ddot{R}^{\ominus} + R — X \longrightarrow R — R + \ddot{X}^{\ominus}$

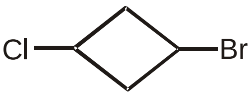
Q.1 $CH_3 — Cl \xrightarrow[ether]{Na}$ _______

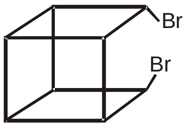
Q.2 $Et — Cl \xrightarrow[ether]{Na}$ _______

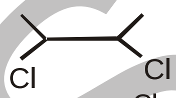
Q.3 $CH_3 — Cl + Et — Cl \xrightarrow[ether]{Na}$ _______

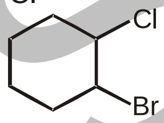
Q.4 $(Ph)_3$ Cl $\xrightarrow[ether]{Na}$ _______

Q.5  $\xrightarrow[ether]{Na}$ _______

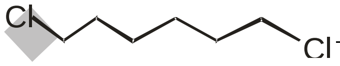
Q.6  $\xrightarrow[ether]{Na}$ _______

Q.7  $\xrightarrow[ether]{Na}$ _______

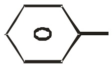
Q.8  $\xrightarrow[ether]{Na}$ _________ _

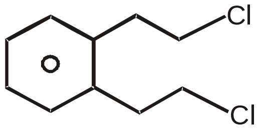
Q.9  $\xrightarrow[ether]{Na}$ _______

Q.10  $\xrightarrow[ether]{Na}$ _______

Q.11  $\xrightarrow[ether]{Na}$ _ _____

Q.12 Ph — Cl $\xrightarrow[THF]{Na}$ _______(fitting Reaction)

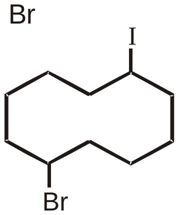
Q.13 —Cl + Cl — CH_3 $\xrightarrow[THF]{Na}$ __ (Wurtz fitting)

Q.14  $\xrightarrow[ether]{Na}$ _______

Q.15 $\underset{Br}{\underset{|}{CH_2}}—\underset{Br}{\underset{|}{CH_2}} \xrightarrow{Zn}$ _______

Q.16 $H—C(Cl)_3$ $\xrightarrow{Ag/Powder}$ _______

Q.17 $\underset{Br}{\underset{|}{CH_2}}—CH=CH—\underset{Br}{\underset{|}{CH_2}} \xrightarrow[ether]{Na}$ _______

Q.18  $\xrightarrow[ether]{Na}$ _______

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DPP NO-13 Time: 15 minutes

Q.1. On chlorination, an equimolar mixture of ethane and neopentane yields neopentyl chloride and ethyl chloride in the ratio 2.3 : 1. How does the reactivity of 1^o hydrogen in neopentane compare with the of a 1^o hydrogen in ethane?

Q.2. Give product(s) in each of the following reactions

$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}H}-CH_2-CH_2-CH_3 \xrightarrow{Br_2 / hv} (A)$$

Q.3 Bromination of methane is slowed down by addition of fairly large amount of HBr.
(a) Suggest a possible explanation for this.
(b) Account for the fact that addition of HCl does not have a similar effect upon chlorination of CH_4.

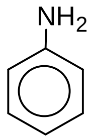
Q.4. Which of the following compounds on gentle heating, will undergo homolytic bond cleavage easily:

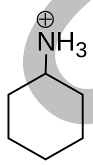
(A) $(CH_3)_2C-O-\overset{\displaystyle O}{\overset{||}{C}}-CH_3$ (B) $(CH_3)_3C-OC(CH_3)_3$

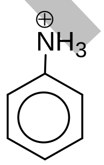
(C) $(CH_3)_3C-C_6H_5$ (D) $(CH_3)_3C-O-O-C(CH_3)_3$

Q.5. Amongst the following, the most basic compound is:
(A) $C_6H_5NH_2$ (B) p-NO_2—$C_6H_4NH_2$ (C) m-NO_2—$C_6H_4NH_2$ (D) $C_6H_5CH_2NH_2$

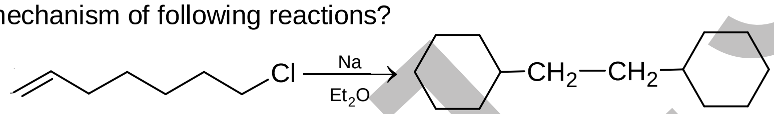
Q.6 Which of the following is most acidic?

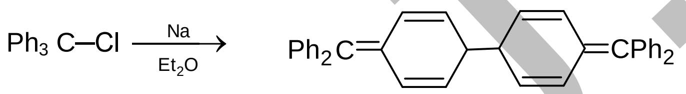
(A) 

(B) $CH_3-\overset{\oplus}{N}H_3$
(C) 

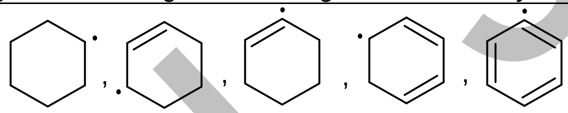
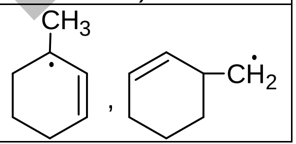
(D) 

Q.7. Write mechanism of following reactions?

(a) 

(b) 

Q.8. Arrange the following in increasing order of stability.

(a)	
	(regarding stability of free radical)
(b)	$CH_2=\dot{C}H_2$, $\dot{C}H_2-CH=CH_2$, 

Q.9. Supply the structure and type of intermediate species designated by

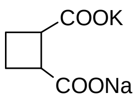
(a) $CH_3\underset{\displaystyle OH}{\underset{|}{C}H}-CH_3 + H^+ \xrightarrow{\Delta} ? + H_2O$ (b) $CH_3CH_2-N=N-CH_2CH_3 \xrightarrow{\Delta} ? + N_2$

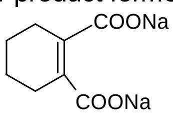
(c) $CH_3CHI_2 + Zn \longrightarrow ? + ZnI_2$ (d) $CH_3C\equiv CH + NaNH_2 \longrightarrow ?\ \overset{+}{N}a + NH_3$

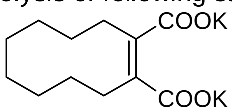
(e) $CH_3CH_2Cl + AlCl_3 \longrightarrow AlCl_4^- + ?$

Q.10. Name any organic compound which on electrolysis give H_2 on both the electrodes.

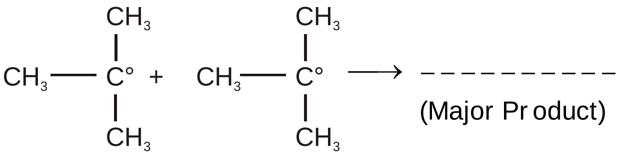
Q.11. Given structure of major product formed by electrolysis of following salts.

(a) 

(b) 

(c) 

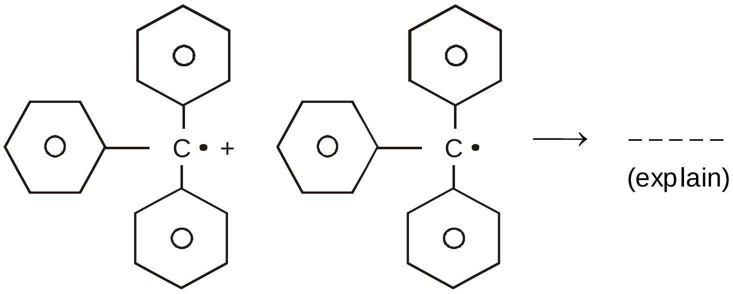
Q.12



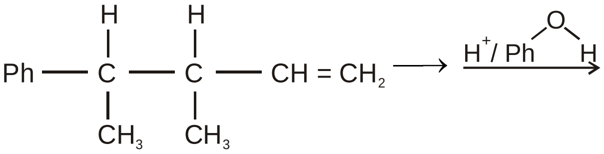
Q.13 $CH_3 - \overset{\circ}{C}H_2 + CH_3 - C^{\circ}H_2 \longrightarrow$ ----------

(Major Product)

Q.6

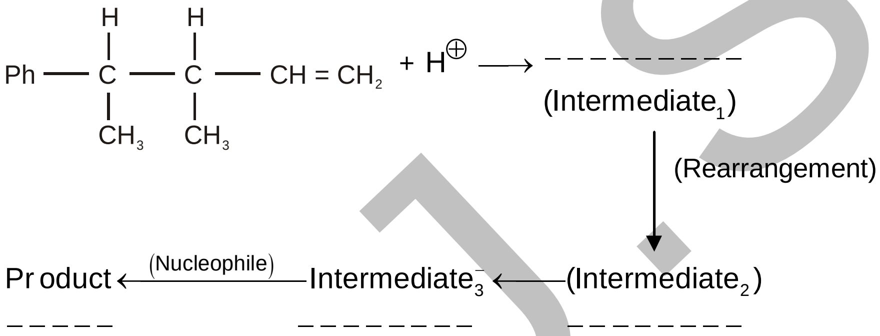


Q.14

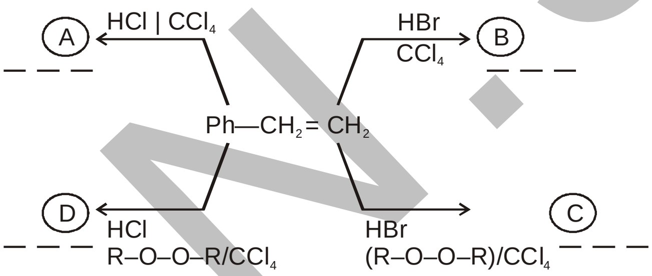


Mechanism : –

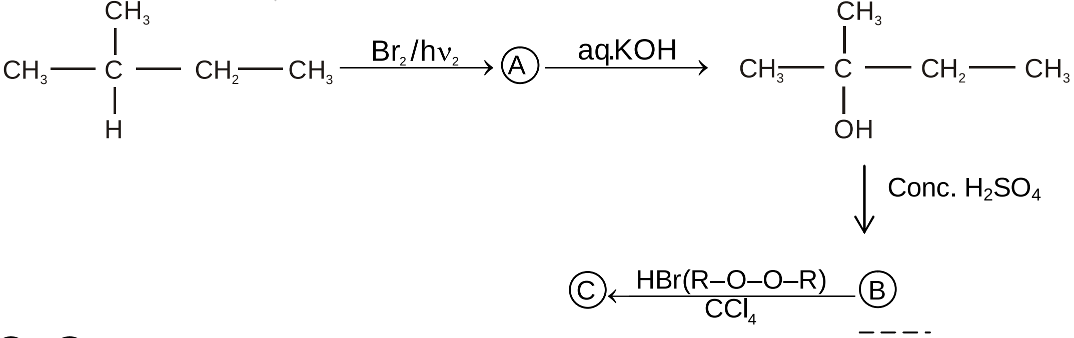
(ii)



Q.15



Q.16



(A) & (C) are Idenitcal / Isomers / Positon Isomers.

----- ----- ----- -----

Q.17 $Ph-\overset{Ph}{\underset{Ph}{C}}-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[\text{electrolysis}]{NaOH}$

Anode

(I) _ _ _ _ _ _ _ _ _ $\longrightarrow e^- + Ph-\overset{Ph}{\underset{Ph}{C}}-\overset{O}{\overset{\|}{C}}-O^{\circ}$

(ii) $Ph-\overset{Ph}{\underset{Ph}{C}}-\overset{O}{\overset{\|}{C}}-O^{\circ} \longrightarrow CO_2 +$ _ _ _ _ _ _ _ _

Intermediate

(iii) Intermediate $\longrightarrow$ - - - - - - - - - - - -

_ _ _ _ _ _ _

Cathode

(i) $2H_2O + 2e^- \longrightarrow$ _ _ _ _ _ _

IIT-JEE ChEmistry by N.J. sir — ORGANIC chemistry

DPP NO- 14 — Time: 15 minutes

Kolbe Electrolysis:–

$$R-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[\text{electrolysis}]{NaOH} \underbrace{R-R + CO_2}_{\text{Anode}} + \underbrace{H_2}_{\text{Cathode}}$$

Mechanism:–

(1)

$$R-\overset{O}{\overset{\|}{C}}-O-H + \overset{\ominus}{O}H \rightleftharpoons R-\overset{O}{\overset{\|}{C}}-O^- + O{<}^{H}_{H}$$

Anode:–

(1) $R-\overset{O}{\overset{\|}{C}}-O^- \longrightarrow R-\overset{O}{\overset{\|}{C}}-\dot{O} + e^-$

(2) $R-\overset{O}{\overset{\|}{C}}-\dot{O} \longrightarrow \dot{R} + CO_2$

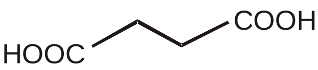
(2) $\dot{R} + \dot{R} \longrightarrow R-R$

Cathode:–

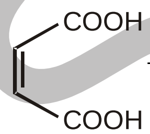
(1) $2H_2O + 2e^- \longrightarrow 2\overline{OH} + H_2$

Q.1 $CH_3COOK \xrightarrow{\text{electrolysis}}$ _ _ _ _ _ _ _

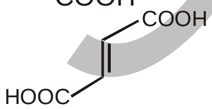
Q.2 $Et-COOH \xrightarrow[\text{electrolysis}]{NaOH}$ _ _ _ _ _ _ _

Q.3 

$\xrightarrow[\text{electrolysis}]{NaOH}$ _ _ _ _

Q.4 

$\xrightarrow[\text{electrolysis}]{NaOH}$ _ _ _ _ _ _ _

Q.5 

$\xrightarrow[\text{electrolysis}]{KOH}$ _ _ _ _ _ _ _

Q.6 

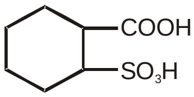
$\xrightarrow{\text{electrolysis}}$ _ _ _ _

Q.7 

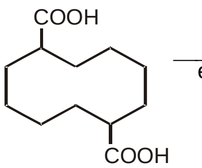
$\xrightarrow{\text{electrolysis}}$ _ _ _

Q.8 

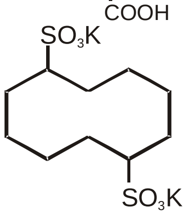
$\xrightarrow{\text{electrolysis}}$ _ _ _ _ _ _ _

Q.9 

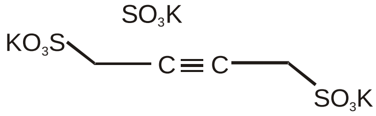
$\xrightarrow[\text{electrolysis}]{NaOH}$ _ _ _ _ _ _ _

Q.10 

$\xrightarrow[\text{electrolysis}]{NaOH}$ _ _ _ _ _ _ _

Q.11 

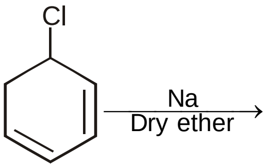
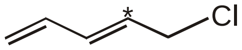
$\xrightarrow{\text{electrolysis}}$ _ _ _ _ _ _ _

Q.12 

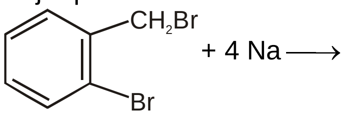
$\xrightarrow{\text{electrolysis}}$ _ _ _

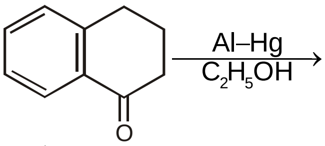
DPP NO- 15 Time: 15 minutes

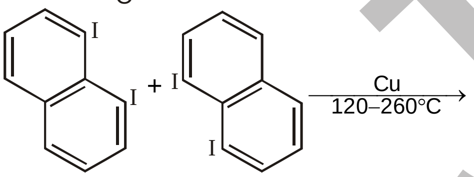
Q.1 **Matrix**

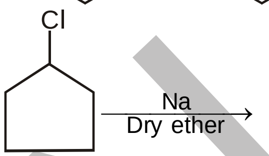
Reactions	**Number of dimerization product (excluding stereoisomers)**
(A) $CH_3 - CH_2 - Cl \xrightarrow[\text{Dry ether}]{\text{Na}}$	(P) 1
(B) 	(Q) 3
(C) $H_2\overset{14}{C} = CH - CH_2 - Cl \xrightarrow[\text{Dry ether}]{\text{Na}}$	(R) 6
(D)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$ + $CH_3 - Cl$ ($H_2\overset{*}{C} = \overset{14}{C}H_2$)	(S) None

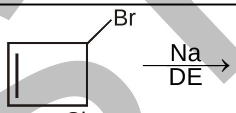
Q.2 Identify major products.

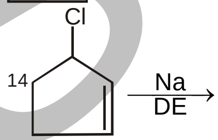
(1) 

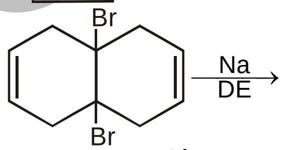
(2) 

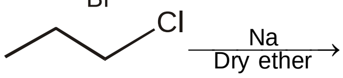
(3) 

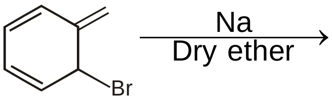
(4) 

(5) 

(6) 

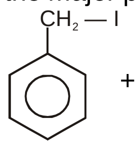
(7) 

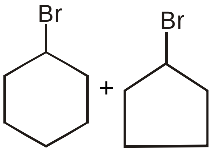
(8) 

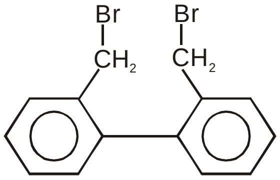
(9) 

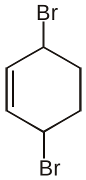
DPP NO- 16 Time: 15 minutes

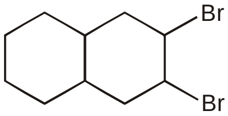
Q.1 Identify the major product:-

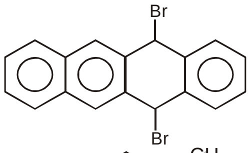
(1)  + $\xrightarrow[\text{Dry ether}]{\text{Na}}$

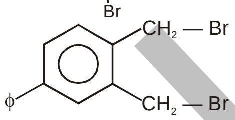
(2)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

(3)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

(4)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$ (A) $\xrightarrow{\text{Se}}$ (B)

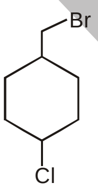
(5)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

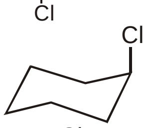
(6)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$ Naphthacene

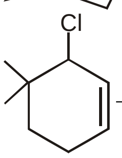
(7)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$ (A) + (B);

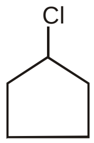
(A) & (B) are isomer.

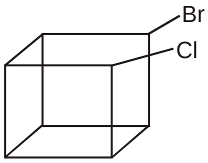
(8) $H_2C^*=CH—CH_2—Cl \xrightarrow[\text{Dry ether}]{\text{Na}} A + B + C$

(9)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

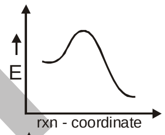
(10)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

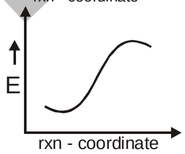
(11)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

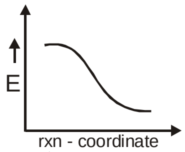
(12) $CH_3 — CH_2 — Cl$ +  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

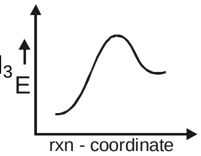
(13)  $\xrightarrow[\text{Dry ether}]{\text{Na}}$

2. Which of following is correct matching of energy profile diagram?

(1) $\overset{\oplus}{C}H_3 + \overset{\ominus}{Cl} \rightarrow CH_3 — Cl$ 

(2) $Cl — Cl \xrightarrow{hv} 2Cl$ 

(3) $CH_3\bullet + CH_3\bullet \rightarrow CH_3 — CH_3$ 

(4) $Cl\bullet + H — CH_3 \rightarrow H — Cl + {}^{\bullet}CH_3$ 

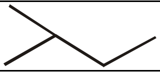
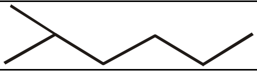
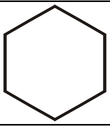
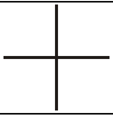
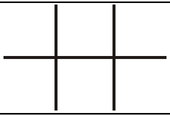
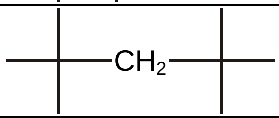
Bond energy $\left(H - Cl = 432 \dfrac{KJ}{mole}\right)\left(CH_3 - H = 440 \dfrac{KJ}{mole}\right)$

3. When pentane is heated to a very high temperatue, radical reactions take palce that produce (among other products) methane, ethane, propane, and butane. This type of change is called thermal cracking. Among the reactions that take place are the following:-

(1) $CH_3CH_2CH_2CH_2CH_3 \longrightarrow CH_3\bullet + CH_3CH_2CH_2CH_2\bullet$
(2) $CH_3CH_2CH_2CH_2CH_3 \longrightarrow CH_3CH_2\bullet + CH_3CH_2CH_2\bullet$
(3) $CH_3\bullet + CH_3\bullet \longrightarrow CH_3CH_3$
(4) $CH_3\bullet + CH_3CH_2CH_2CH_2CH_3 \longrightarrow CH_4 + CH_3CH_2CH_2CH_2CH_2\bullet$
(5) $CH_3\bullet + CH_3CH_2\bullet \longrightarrow CH_3CH_2CH_3$
(6) $CH_3CH_2\bullet + CH_3CH_2\bullet \longrightarrow CH_3CH_2CH_2CH_3$

(a) For which of these reactions would you expect E_{act} to equal zero?
(b) To be greter than zero?
(c) To equal $\Delta H°$?

DPP NO-17 Time: 15 minutes

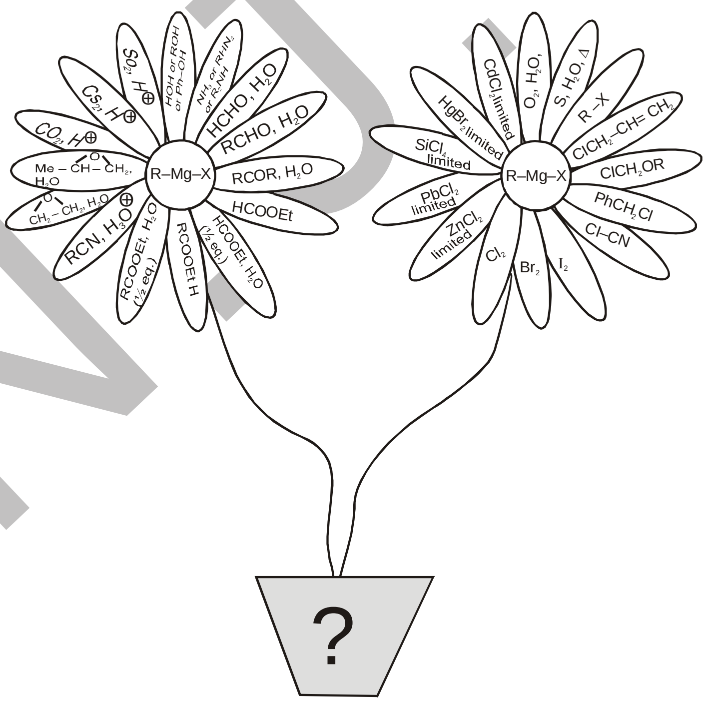
1.	Compound	Number of monochloroproduct	Number of monocloroproduct (excluding stereoisomer)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

2.

1.	Compound	Number of Dichloroproduct (including stereoisomer)	Optically active product
1.	1-chlorobutane		
2.	R-2-chlorobutane		
3.	3-chloropentane		
4.	R-2-chloropentane		
5.	S-2-chlorobutane		
6.	R & S-2-chloropentane		
7.	R & S-2-chloro butane		

Question bank on

GRIGNARD'S REAGENT



GRIGNARD'S REAGENT

Q.1 The order of reactivity of alkyl halide in the reaction $R - X + Mg \rightarrow RMgX$ is
(A) RI > RBr > RCl (B) RCl> RBr > RI
(C) RBr > RCl > RI (D) RBr > RI > RCl

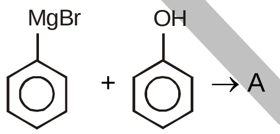
Q.2
$$Br{-}CH_2{-}C{\equiv}C{-}CH_2{-}Br \xrightarrow[\text{(excess)}\ Et_2O]{Mg} BrMg{-}CH_2{-}C{\equiv}C{-}CH_2{-}MgBr$$
$$\xrightarrow[Et_2O]{Mg(1\ eq.)} \text{Product}$$
The major product is
(A) $Br{-}Mg{-}CH_2{-}C \equiv C{-}CH_2{-}Br$
(B) Cyclobutyne
(C) $-(CH_2{-}C \equiv C{-}CH_2)_n-$
(D) $CH_2 = C = C = CH_2$

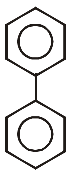
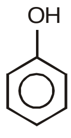
Q.3 On conversion into Grignard followed by treatment with ethanol, how many alkyl halides (excluding stereoisomers) would yield 2- methyl butane
(A) 2 (B) 3 (C) 4 (D) 5

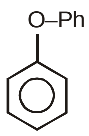
Q.4 Which of the following reacts with Grignard reagent to give alkane?
(A) nitro ethane (B) acetyl acetone (C) acetaldehyde (D) acetone

Q.5 How many litres of methane would be produced when 0.595 g of CH_3MgBr is treated with excess of $C_4H_9NH_2$
(A) 0.8 litre (B) 0.08 litre
(C) 0.112 litre (D) 1.12 litre

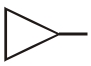
Q.6 How many litres of ethene would be produced when 2.62 g of vinyl magnesium bromide is treated with 224 ml of ethyne at STP
(A) 0.224 litre (B) 0.08 litre
(C) 0.448 litre (D) 1.12 litre

Q.7 

(A)  (B)  (C) 

(D) 

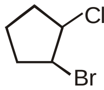
Q.8 In which of the following reactions 3º alcohol will be obtained as a product.

(A)  MgBr (excess) $H - \overset{O}{\overset{\|}{C}} - Cl + \longrightarrow \xrightarrow[H^+]{}$

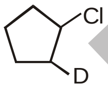
(B) PhMgBr(excess) + $CH_3 - \overset{O}{\overset{\|}{C}} - Cl \longrightarrow \xrightarrow[H^+]{}$

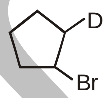
(C) CH_3MgBr(excess)+ $CH_3 - \overset{O}{\overset{\|}{C}} - O - \overset{O}{\overset{\|}{C}} - CH_3 \longrightarrow \xrightarrow[H^+]{}$

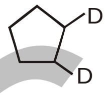
(D) CH_3MgBr (excess) + $Cl - \overset{O}{\overset{\|}{C}} - O - Et \longrightarrow \xrightarrow[H^+]{}$

Q.9 

$\xrightarrow[\text{ether}]{\text{1 equivalent Mg}}$ X $\xrightarrow{D_2O}$ Y ; Y is

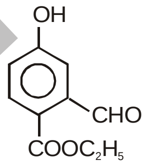
(A) 

(B) 

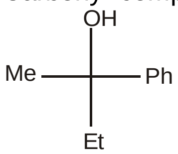
(C) 

(D) None of these

Q.10 Compounds are shown with the no. of RMgX required for complete reaction, select the incorrect option

(A) $CH_3COOC_2H_5$	1
(B) CH_3COCl	2
(C) $HOCH_2COOC_2H_5$	3
(D) 	4

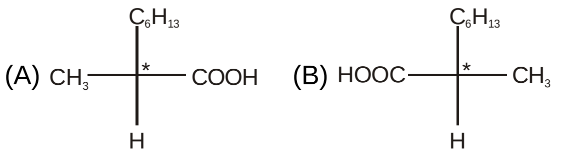
Q.11 What will be the order of reactivity of the following carbonyl compound with Grignard's reagent?
(I) $\begin{matrix}H\\H\end{matrix}\!>\!C{=}O$ (II) $\begin{matrix}H\\CH_3\end{matrix}\!>\!C{=}O$ (III) $\begin{matrix}CH_3\\CH_3\end{matrix}\!>\!C{=}O$ (IV) $\begin{matrix}Me_3C\\Me_3C\end{matrix}\!>\!C{=}O$
(A) I > II > III > IV (B) IV > III> II> I
(C) II > I > IV > III (D) III > II> I > IV

Q.12 Carbonyl compound (X) + Grignard reagent (Y) →


X, Y will be-

(A) $Et - \overset{O}{\overset{\|}{C}} - Ph$, MeMgBr (B) $Me - \overset{O}{\overset{\|}{C}} - Ph$, Et MgBr
(D) $Me - \overset{O}{\overset{\|}{C}} - Et$, Ph MgBr (D) $Et - \overset{O}{\overset{\|}{C}} - Ph$, Et MgBr

Q.13 (R) – 2–Bromooctane $\xrightarrow[\text{(ii) } CO_2 \text{ (iii) } H^{\oplus}]{\text{(i) Mg}}$ X; X is



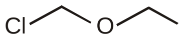
(C) A and B both (D) None of these

Q.14 In which one of the following reaction products are not correctly matched in

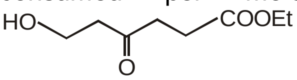
(A) $RMgX + CO_2 \xrightarrow{(2)\ H^{\oplus}}$ Carboxylic acid

(B) $RMgX + C_2H_5OH \longrightarrow$ Alkane

(C) $RMgX + CH_3CH_2Cl \longrightarrow$ Alkene

(D) RMgX +  $\longrightarrow$ Ether

Q.15 The number of moles of grignard reagent consumed per mole of the compound



is

(A) 4 (B) 2 (C) 3 (D) 1

Q.16 Select the correct statement :

(A) 1, 4- dibromobutane react with excess of magnesium in ether to generate di-Grignard reagent.

(B) 1, 2- dichlorocyclohexane treated with excess of Mg in ether produces cyclohexene.

(C) Vicinal dihalides undergo dehalogenation to give alkene when heated with Zn dust or Mg.

(D) 1, 3- dichloropropane by treatment with Zn dust or Mg forms cyclopropane.

Q.17 $CH_3-CH=CH_2 \xrightarrow[\Delta]{Br_2} \xrightarrow[\text{Dry Ether}]{Mg}$

$\xrightarrow[NH_4Cl]{CH_3-\overset{O}{\overset{\|}{C}}-CH_3} \xrightarrow[\Delta]{H^+}$ X (Major)

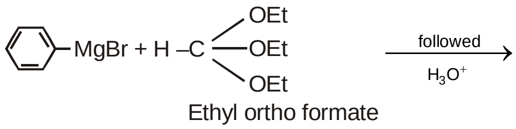
End product of above reaction is

(A) $CH_2=CH-CH_2-\overset{CH_2}{\overset{\|}{C}}-CH_3$

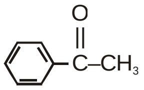
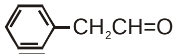
(B) $H_2C=CH-CH=\underset{CH_3}{\underset{|}{C}}-CH_3$

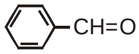
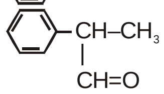
(C) $H_2C=CH-CH_2-\overset{OH}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-CH_3$

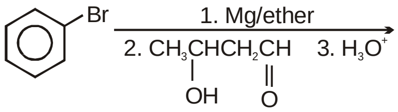
(D) $H_2C=CH-CH_2-\underset{CH_3}{\underset{|}{CH}}-CH_2-OH$

Q.18 

Product

(A)  (B) 

(C)  (D) 

Q.19 

Select the product from the following

(A) III (B) I, III

(C) I, II (D) II, III

Q.20 $C_2H_5O-\overset{O}{\overset{\|}{C}}-OC_2H_5 \xrightarrow{2CH_3MgBr}$ A. Product A formed

(A) is ethyl acetate

(B) further react with CH_3MgBr/H_2O^+ to give acetone

(C) further react with CH_3MgBr/H_2O^+ to give t- butyl alcohol

(D) Can give pinacol when treated with Mg followed by H_2O

Q.21 Order of rate of reaction of following compound with phenyl magnesium bromide is

$Me-\overset{O}{\overset{\|}{C}}-Cl$ (I) $Me-\overset{O}{\overset{\|}{C}}-H$ (II) $Me-\overset{O}{\overset{\|}{C}}-O-Et$ (III)

(A) I > II > III (B) II > III > I

(C) III > I > II (D) II > I > III

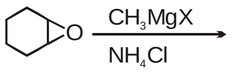
Q.22 Select the correct order of decreasing reactivity of the following compounds towards the attack of Grignard reagent

(I) Methyl benzoate (II) Benzaldehyde

(III) Benzoylchloride (IV) Acetophenone

(A) II > III > I > IV (B) I > II > III > IV

(C) III > II > IV > I (D) II > IV > I > III

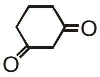
Q.23  Product is

(A) Enantiomer (B) Diastereisomer

(C) Meso (D) Achiral

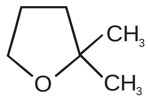
Q.24 Nucleophilic addition of Grignard reagent cannot occur in

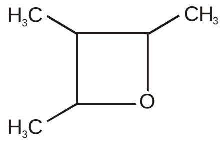
(A) $CH_3-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-CH_3$ (B) $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$

(C) $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$ (D) 

Q.25 $CH_3\overset{O}{\overset{||}{C}}CH_2CH_2CH_2Cl \xrightarrow{CH_3MgBr}$ A, A is

(A) $CH_3\overset{CH_3}{\underset{OH}{C}}CH_2CH_2CH_2Cl$ (B) $CH_3\underset{O}{\underset{||}{C}}CH_2CH_2CH_2CH_3$

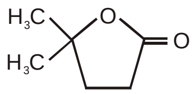
(C) 

(D) 

Q.26 $CH_3\overset{O}{\overset{||}{C}}CH_2CH_2\overset{O}{\overset{||}{C}}OCH_2CH_3 \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } CH_3MgBr\text{(one mole)}}$ A,

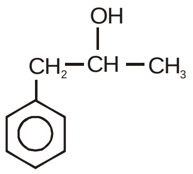
A formed in this reaction is

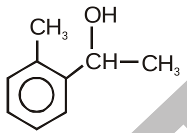
(A) $CH_3\overset{OH}{\underset{CH_3}{C}}CH_2CH_2\overset{O}{\overset{||}{C}}OCH_2CH_3$ (B) $CH_3\overset{O}{\overset{||}{C}}CH_2CH_2\overset{O}{\overset{||}{C}}CH_3$

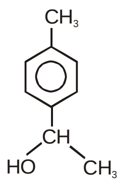
(C) 

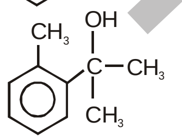
(D) $CH_3\overset{CH_3}{\underset{OH}{C}}CH_2CH_2\overset{CH_3}{\underset{OH}{C}}CH_3$

Q.27 $PhCH_3 \xrightarrow[h\nu]{Cl_2}$ (A) $\xrightarrow[\text{ether}]{Mg}$ (B) $\xrightarrow[NH_4Cl]{CH_3CHO}$ (C)

(A) 

(B) 

(C) 

(D) 

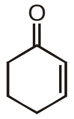
Q.28 Select the correct order of reactivity towards Grignard reagent for nucleophilic attack.

(A) $R-\overset{O}{\overset{||}{C}}-R > R-\overset{O}{\overset{||}{C}}-H$

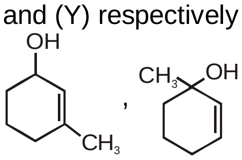
(B) $Cl-CH_2-\underset{O}{\underset{||}{C}}-H > CH_3CH_2-\underset{O}{\underset{||}{C}}-H$

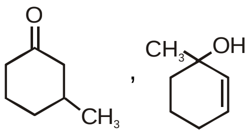
(C) $CH_3-\overset{O}{\overset{||}{C}}-O-C_6H_4-NO_2 < CH_3-\overset{O}{\overset{||}{C}}-O-C_6H_5$

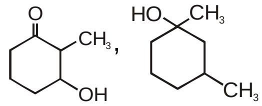
(D) $R-\overset{O}{\overset{||}{C}}-OR > R-\overset{O}{\overset{||}{C}}-NR_2$

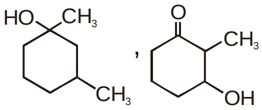
Q.29  $\xrightarrow[\text{(ii) } H_2O/H^+]{\text{(i) } CH_3MgBr/CuCl}$ (X) Major + (Y)

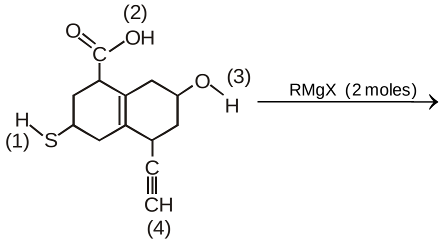
(X) and (Y) respectively are

(A) 

(B) 

(C) 

(D) 

Q.30 

Deprotonation will occur from the following positions:

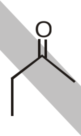
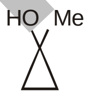
(A) 1, 2 (B) 1, 3

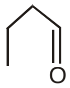
(C) any two positions (D) 1, 4

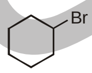
Q.31 

$\xrightarrow[NH_4Cl]{2CH_3MgX}$ $P_1 + P_2$

Identify P_1 & P_2.

(A) CH_4 (B)  (C) 

(D) 

Q.32 

$\xrightarrow{Mg}$ (A) $\xrightarrow[\text{(ii) } H^+/H_2O]{\text{(i) } ^{14}CO_2}$ (B) $\xrightarrow{NaHCO_3}$ (C) gas

Product C is

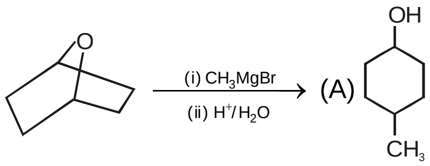
(A) CO (B) $^{14}CO_2$ (C) CO_2

(D) A mixtue of $^{14}CO_2$ and CO_2

Q.33 $2CH_3MgBr \xrightarrow[\text{(ii) } H^+]{\text{(i) } CH_3ONH_2}$

(A) $CH_3-O-NH-CH_3$ (B) $CH_3-NH-CH_3$

(C) CH_3-NH_2 (D) CH_3-OH

Q.34 

(A) The product is optically active

(B) The product contains plane of symmetry

(C) The product shows geometrical isomerism

(D) The product shows optical isomerism

Q.35 Which of the following is incorrect.

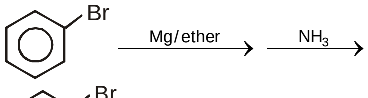
(A) $Cl-\overset{O}{\overset{||}{C}}-OC_2H_5 \xrightarrow[\text{(1 eq)}]{CH_3MgX} CH_3-\overset{O}{\overset{||}{C}}-OC_2H_5$

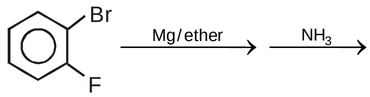
(B) $CH_3-C(OC_2H_5)_3 \xrightarrow[\text{(1 eq)}]{C_2H_5MgX} CH_3-\overset{O}{\overset{||}{C}}-OC_2H_5$

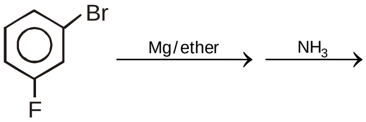
(C) $CH_3MgX + \overset{S}{\overset{||}{C}}=S \xrightarrow{H_3O^+} CH_3-\overset{S}{\overset{||}{C}}-SH$

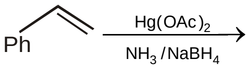
(D) $CH_3MgX + \overset{O}{\overset{||}{C}}=O \xrightarrow{H_3O^+} CH_3-\overset{O}{\overset{||}{C}}-OH$

Q.36 Which reaction gives 1° aromatic amine as major product.

(A) 

(B) 

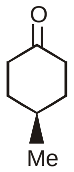
(C) 

(D) 

Q.37 $CH_3MgBr + CH_2 = CH - \overset{O}{\overset{\|}{C}} - H \xrightarrow{H_3O^+}$ Product (1, 4 addition). It is

(A) $CH_2{=}CH - \underset{CH_3}{\overset{OH}{C}} - H$ (B) $\underset{OH}{CH_2}CH = CH - CH_3$

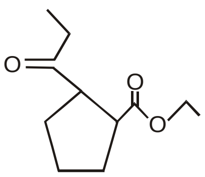
(C) $CH_3CH_2CH_2CHO$ (D) None

Q.38  $\xrightarrow[\text{(ii) } NH_4Cl]{\text{(i) PhMgBr}}$ Product

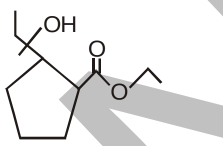
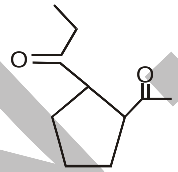
Produtcs in this reaction will be

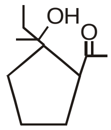
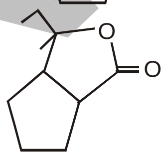
(A) Stereoisomers (B) Enantiomer

(C) Diastereomers (D) Geometrical isomers

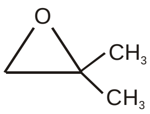
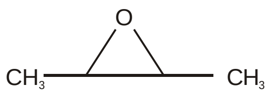
Q.39  $\xrightarrow{CH_3MgBr\ (1\ eq.)}$?

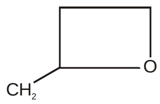
The product is:

(A)  (B) 

(C)  (D) 

Q.40 $CH_2= C = O \xrightarrow[\text{(ii) } CH_3MgBr \text{ (2equi.)}]{\text{(i) } Br_2} C_4H_8O$

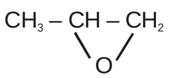
(A)  (B) 

(C)  (D) All of these

Q.41 $RMgX \xrightarrow[\text{(ii)} NH_4Cl]{\text{(i)} CH_3CN} (A) \xrightarrow[NH_4Cl]{RMgX}$ (B) will be

(A) 1°ROH (B) 2°ROH

(C) 3°ROH (D) Alkene

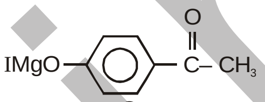
Q.42  $\xrightarrow[\text{(ii)} H_2O]{\text{(i)} CH_3MgCl}$

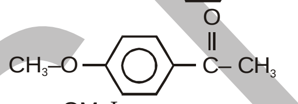
(A) $CH_3-\underset{CH_3}{CH}-CH_2OH$ (B) $CH_3-\underset{OH}{CH}-CH_2-CH_3$

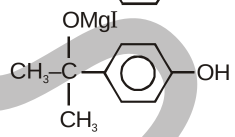
(C) $CH_3-\underset{CH_3}{CH}-CH_3$

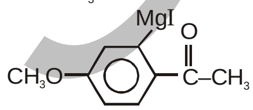
(D) $HO-CH_2-CH_2-CH_2-CH_2-OH$

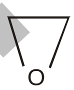
Q.43 The reaction of 1 mole each of p-hydroxy acetophenone and methyl magnesium iodide will give

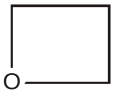
(A) CH_4 + 

(B) 

(C) 

(D) 

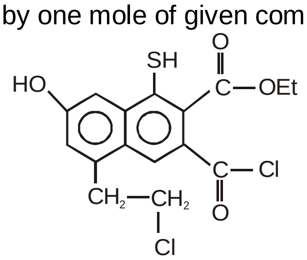
Q.44 (i)  + Ph Mg Br $\xrightarrow{r_1}$ Ph CH_2CH_2OH

(ii)  + Ph Mg Br $\xrightarrow{r_2}$ Ph $CH_2CH_2CH_2OH$

(A) $r_2 > r_1$ (B) $r_1 > r_2$

(C) $r_1 = r_2$ (D) $r_1 = 2r_2$

Q.45 How many moles of Grignard reagent will be required by one mole of given compound?



(A) 7 (B) 6 (C) 8 (D) 5

Q.46 Consider the given organometallic compound.

(I) $(CH_3)_2Hg$ (II) $(CH_3)_2Zn$

(III) $(CH_3)_2Mg$ (IV) CH_3Li

The correct decreasing order of ionic character is

(A) I > II > III > IV (B) II > I > III > IV

(C) I > III > II > IV (D) IV > III > II > I

Q.47 $CH_3CH=CH-\overset{O}{\overset{\|}{C}}-CH_3$ $\xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } CH_3MgBr}$ P

$CH_3CH=CH-\overset{O}{\overset{\|}{C}}-CH_3$ $\xrightarrow[\text{(ii) } H_3O^+]{\text{(i) CuI } CH_3MgBr}$ Q

(A) P is $CH_3CH=CH-C(OH)(Me)-Me$ Q is $CH_3CH(CH_3)-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$

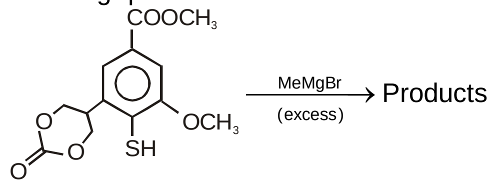
(B) P is $CH_3CH(CH_3)-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$ Q is $CH_3CH=CH-C(OH)(Me)-Me$

(C) P is $CH_3CH=CH-C(CH_3)_2(OH)$ Q is $(CH_3)_2CHCH_2\overset{O}{\overset{\|}{C}}-CH_3$

(D) P is $(CH_3)_2CHCH_2\overset{O}{\overset{\|}{C}}-CH_3$ Q is $CH_3CH=CH-C(CH_3)_2(OH)$

For Q. no. 48 to Q.no.50

Consider the given reaction and answer the following questions



Q.48 No. of RMgX consumed in the reaction is

(A) 4 (B) 5 (C) 6 (D) 7

Q.49 How many product will be formed in given reaction (excluding stereo)

(A) 2 (B) 3 (C) 4 (D) 5

Q.50 Which of the following reaction will give the same Hydrocarbon formed as one of the product in the above reaction.

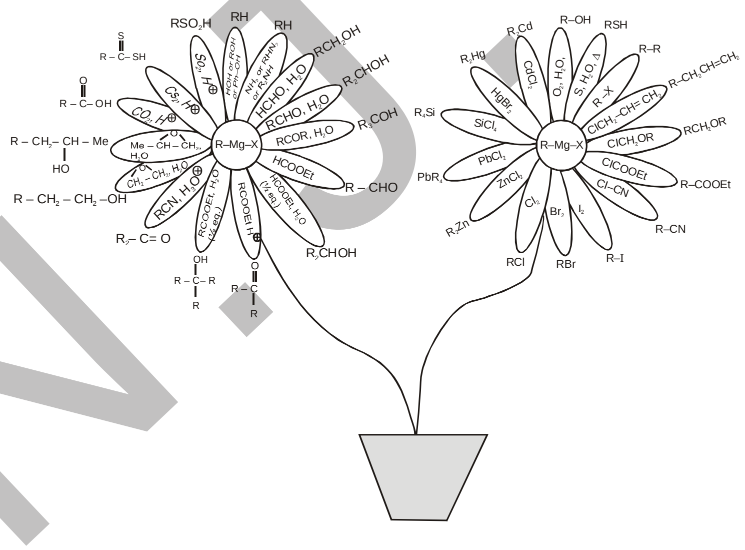
(A) EtMgBr + Me – OH $\rightarrow$

(B) PhMgBr + Me – OH $\rightarrow$

(C) MeMgBr + Ph – OH $\rightarrow$

(D) MeMgBr + CH_3 – CHO $\rightarrow$

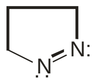
ANSWER KEY

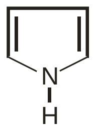


Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	A	D	C	A,B	C	C	A	B,C,D	D	A	A	A,B,C	C	C	A
Q.No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	A,C,D	B	C	C	C,D	A	C	A	B,D	C	C	A,B,C	B	B	A
Q.No.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	A,B	C	C,D	B,C	B	B	C	A,C,D	D	A	C	B	A	B	A
Q.No.	46	47	48	49	50										
Ans.	D	C	C	C	C										

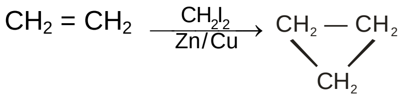
DPP NO- 01 Time: 15 minutes

Explain:

1. $CH_2 = CH_2 \xrightarrow{CH_2N_2}$ 

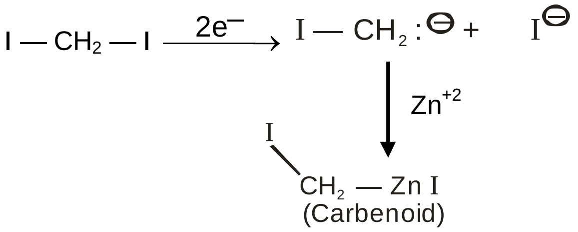
2. $CH \equiv CH \xrightarrow{CH_2N_2}$ 

Simon Smith Reaction:–

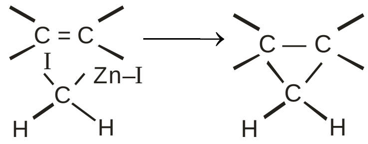


Mechanism:– 1) $Zn \longrightarrow Zn^{+2} + Ze^{-}$

1.



2.

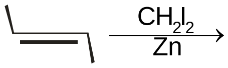


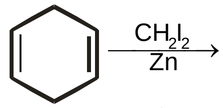
(No bond rotation)

Characteristics :–

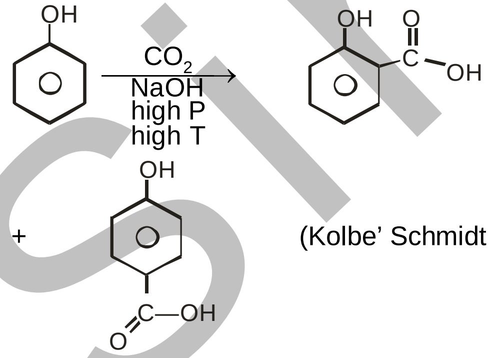
1. The reaction is stereospecific in nature

Q.1 

2. 

3. 

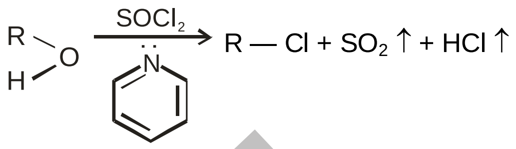
4.



(Kolbe' Schmidt Reaction)

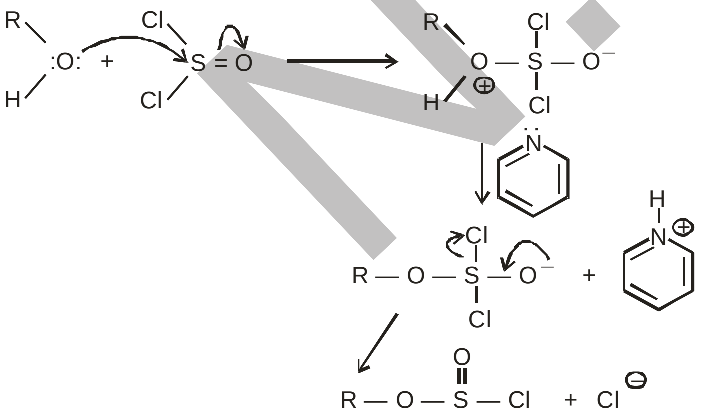
IIT-JEE ChEmistry by N.J. sir ORGANIC chemistry

DPP NO- 02 Time: 15 minutes

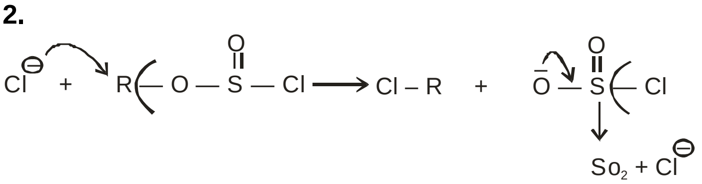


Mechanism: –

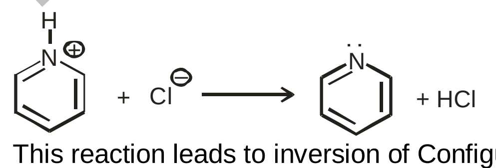
1.



2.

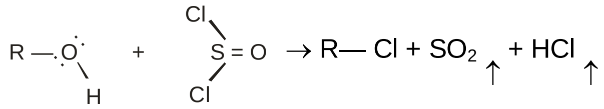


3.



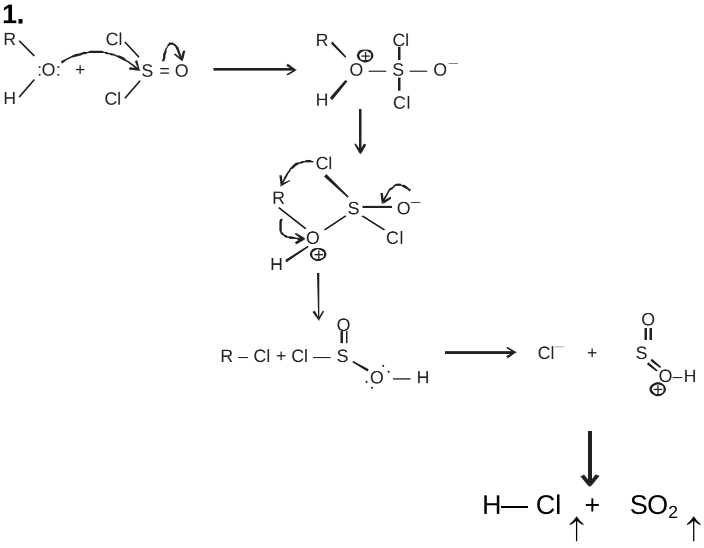
This reaction leads to inversion of Configuration.

Darzen's Process.



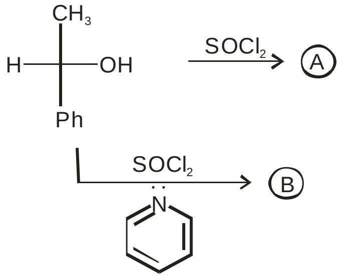
Machanism:–

1.

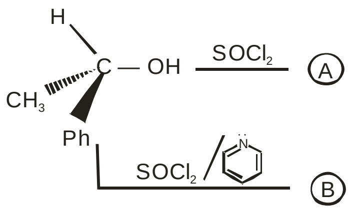


Note: the reaction leads to selection of configuration Retention of configuration.

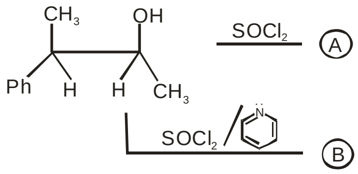
Q.1



Q.2



Q.3



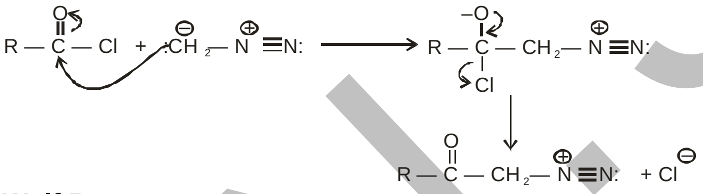
Nucleophilic addition elimination:—

$$R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{CH_2N_2} R-\overset{O}{\overset{\|}{C}}-CH_2-\overset{\oplus}{N}\equiv N: \quad + Cl^{\ominus}$$

Mechanism:—

$$CH_2=\overset{\oplus}{N}=\ddot{N}: \longleftrightarrow :\overset{\ominus}{C}H_2-\overset{\oplus}{N}\equiv N:$$

1.

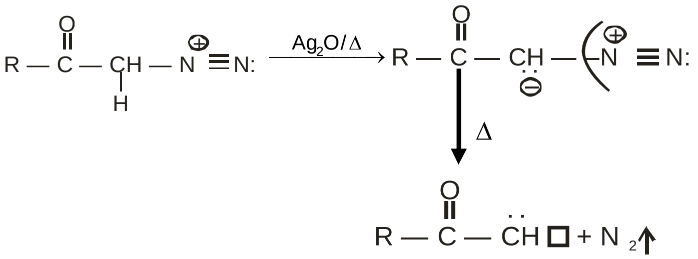


Wolf Rearrangement:—

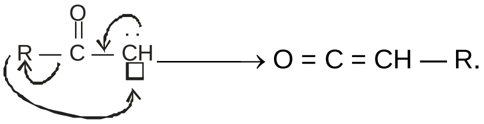
$$R-\overset{O}{\overset{\|}{C}}-\underset{H}{CH_2}-\overset{\oplus}{N}\equiv N: \xrightarrow{Ag_2O/\Delta}$$

Mechanism:—

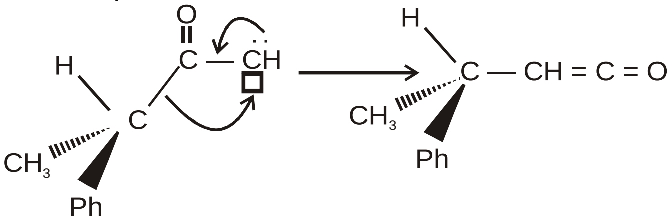
1.



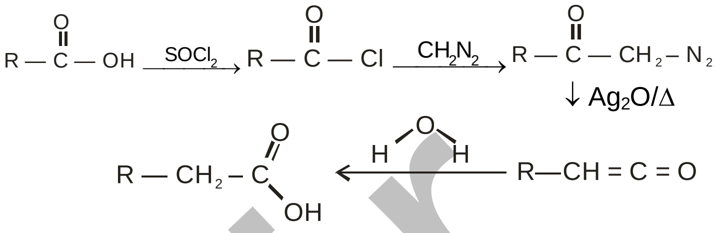
2.

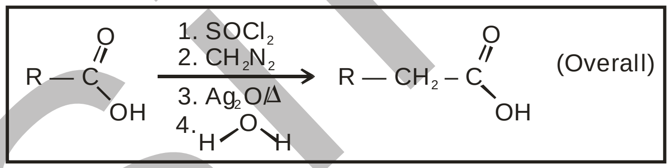


For example:—



Arndt Eistert Reaction:–



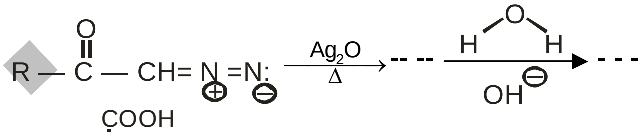


Characteristics:—

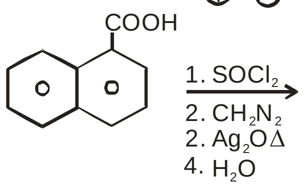
1. The reaction is known as homologation
2. The reaction occurs with relation of configuration.

Ex.1

1.

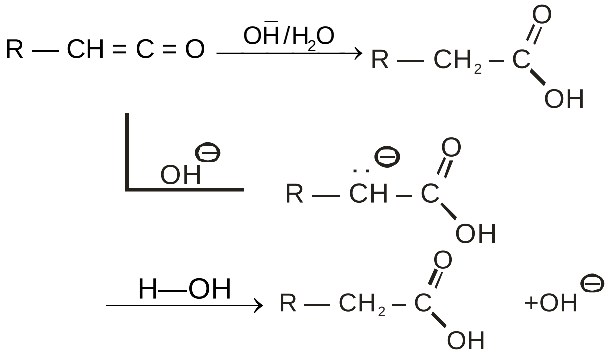


2.



Nucleophilic addition:—

1.



2. $R-CH=C=O \xrightarrow{ROH/RO^-}$

3. $R-CH=C=O \xrightarrow{\overset{\ominus}{N}H_2 / NH_3}$

4. $R-CH=C=O \xrightarrow[R-\ddot{N}H_2]{}$

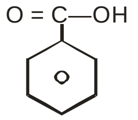
Diazo methane

Acid-Base Reaction:–

1. $CH_2N_2 + HCl \longrightarrow CH_3Cl + N_2\uparrow$

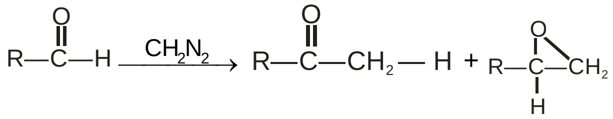
2. $R - OH + CH_2N_2 \longrightarrow$

3. $R-C(=O)-O-H + CH_2N_2 \longrightarrow$

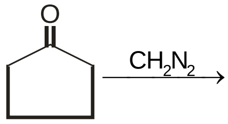
4.  $+ CH_2N_2 \longrightarrow$

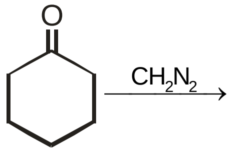
5. $CH_3-C(=O)-OH + CH_2N_2 \longrightarrow$

Homologation Reaction:–

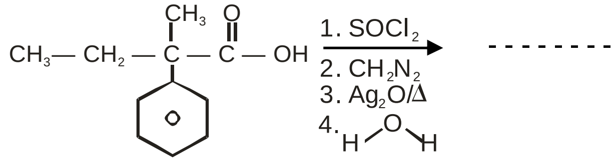
1. 

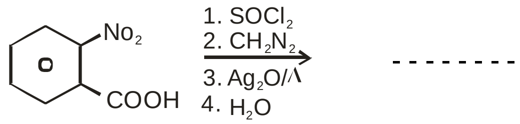
2. $R-\overset{O}{\overset{\|}{C}}-R \xrightarrow{CH_2N_2}$ - - - - - - - - + - - - - - - - - - -

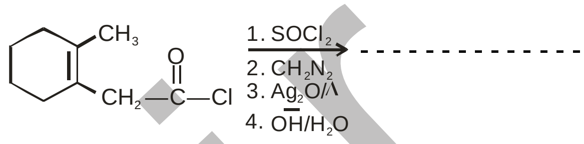
3.  - - - - - - - + - - - - - - - - - -

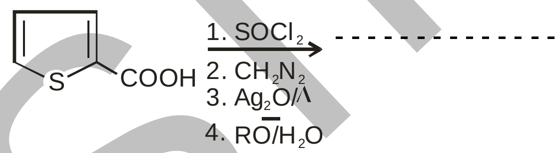
4.  - - - - - - - + - - - - - - - - - -

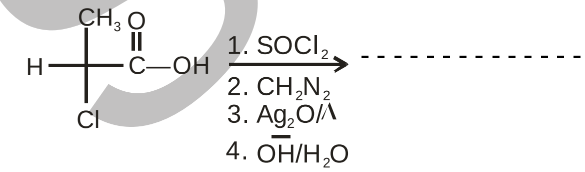
5. $Et-\overset{O}{\overset{\|}{C}}-H \xrightarrow{CH_2N_2}$ - - - - - - - + - - - - - - - - - -

6.  - - - - - - - -

7.  - - - - - - - -

8.  - - - - - - - - - - - - - - -

9.  - - - - - - - - - - - - - - -

10.  - - - - - - - - - - - - - - -

11. $Et-\overset{O}{\overset{\|}{C}}-H \xrightarrow{CH_2N_2}$ - - - - - - - - + - - - - - - - - - - -

12. $Et-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{CH_2N_2}$ - - - - - - - - + - - - - - - - - - - -

IIT-JEE ChEmistry by N.J. sir ORGANIC chemistry

DPP NO- 03 Time: 15 minutes

Nitrenes :–

Q.1 Fill in the blanks:–

(a) $R - \ddot{N} = \overset{\oplus}{N} = \ddot{N}:^{\ominus} \xrightarrow[\Delta]{h\upsilon}$

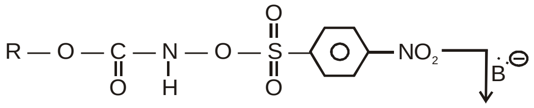
- - - - - - - - - - - + - - - - - - - - - - - - - - (gas)

(b) $R - \overset{O}{\overset{\|}{\underset{O}{\underset{\|}{S}}}} - \ddot{N} = \underset{\oplus}{N} = N:^{\ominus} \xrightarrow[\Delta]{h\upsilon}$

- - - - - - - - - - - + - - - - - - - - - - - - - - (gas)

(c) $R - O - \underset{O}{\underset{\|}{C}} - \ddot{N} = \underset{\oplus}{N} = \ddot{N}:^{\ominus} \xrightarrow[\Delta]{h\upsilon}$

- - - - - - - - - - - + - - - - - - - - - - - - - - (gas)

(d) 

- - - - - - - - + - - - - - - - - - - (gas)

(e) $H- N = \underset{\oplus}{N} = \ddot{N}:^{\ominus} \xrightarrow{h\upsilon}$

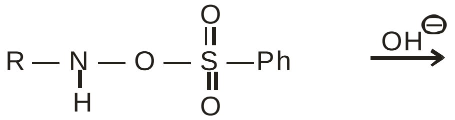
- - - - - - - - - - - + - - - - - - - - - - - - - - (gas)

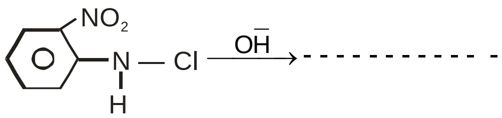
(f) $R-\underset{O}{\underset{\|}{C}}- \ddot{N} = \underset{\oplus}{N} = \ddot{N}:^{\ominus} \xrightarrow{h\upsilon}$

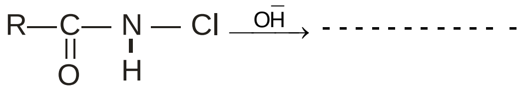
- - - - - - - - - - - + - - - - - - - - - - - - - - (gas)

(g) $H-N=C=O \xrightarrow{h\upsilon}$

----------- + CO ____

(h) 

(i) 

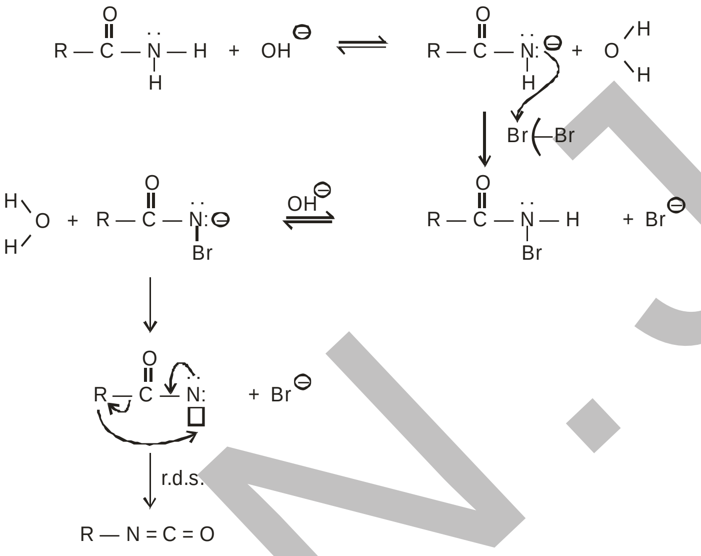
(j) 

Hoffmann Bromanide Reaction:–

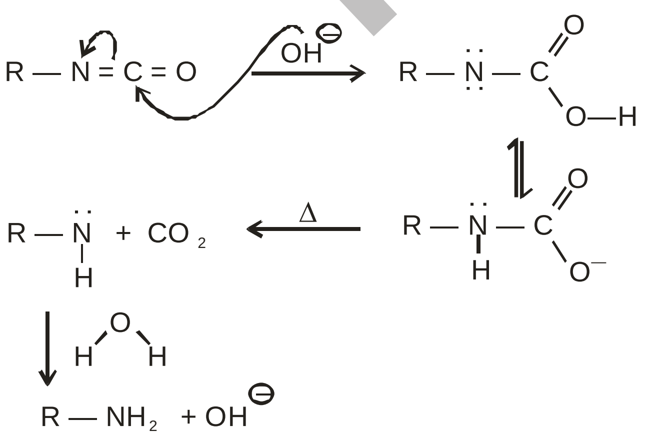
$$R-\overset{O}{\overset{\|}{C}}-NH_2 + Br_2 \xrightarrow{NaOH} R-NH_2 + KBr + k_2CO_3$$

Mechanism:–

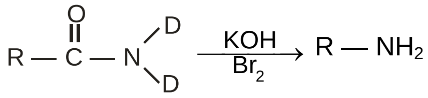
1.



2

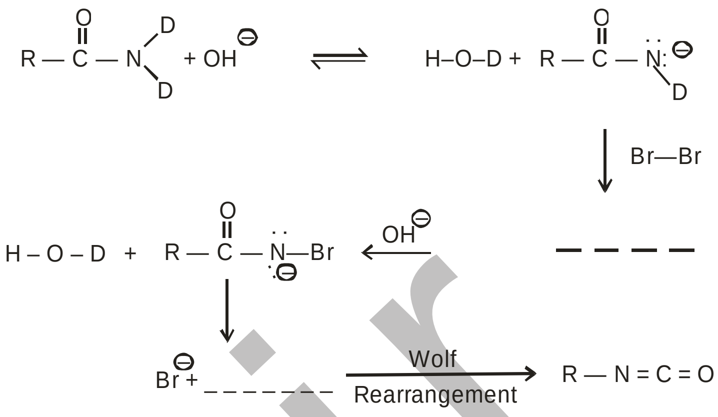


Fill in the blanks:–

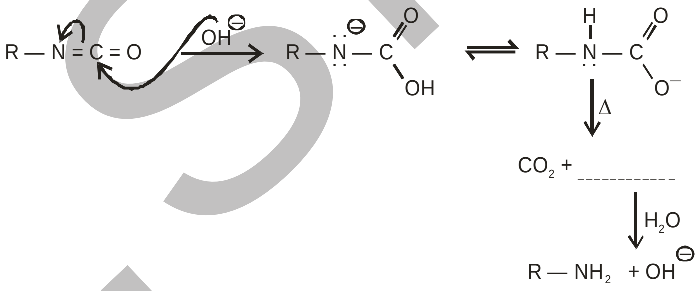


Mechanism:–

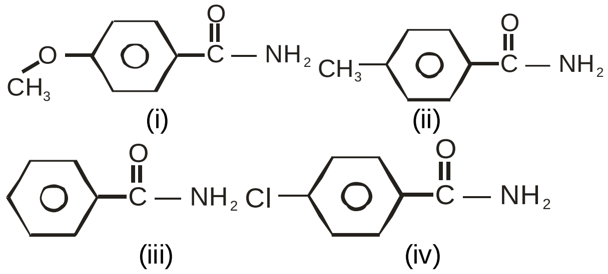
1.



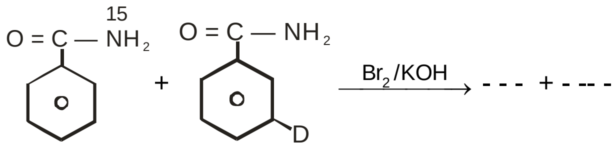
2.

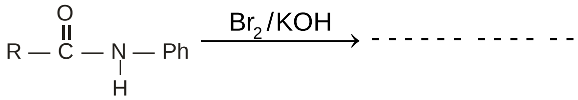


Q.1 Compare rate of reaction:–

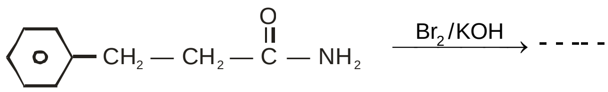
(a) 

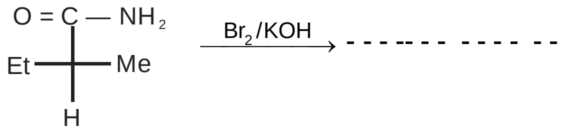
Q.2 Fill in the blanks:–

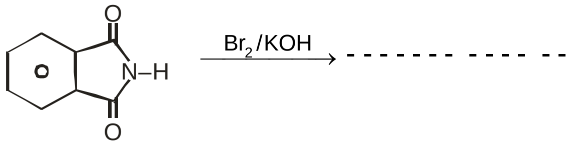
(a) 

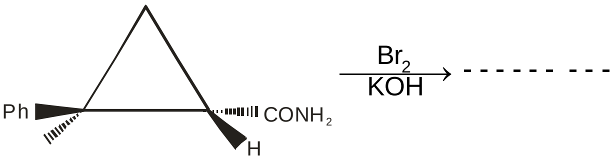
(b) 

Q.3

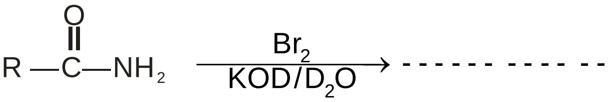
(a) 

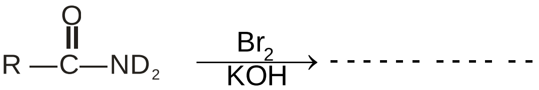
(b) 

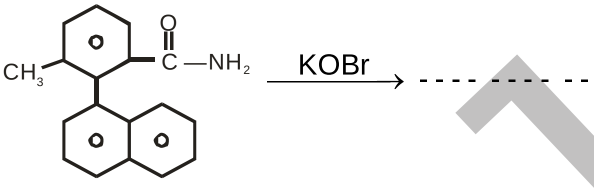
(c) 

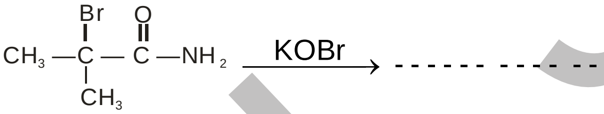
(d) 

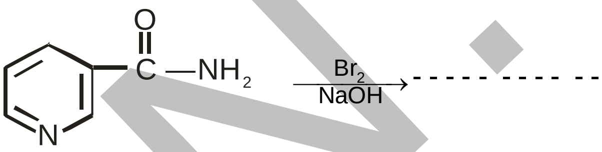
(e) 

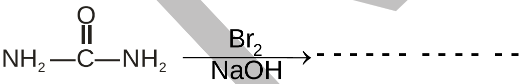
(f) 

(g) 

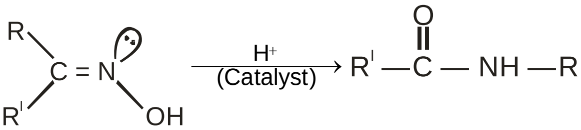
(h) 

(i) 

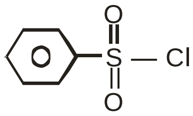
(j) 

(k) 

Beckmann's Rearrangement:—



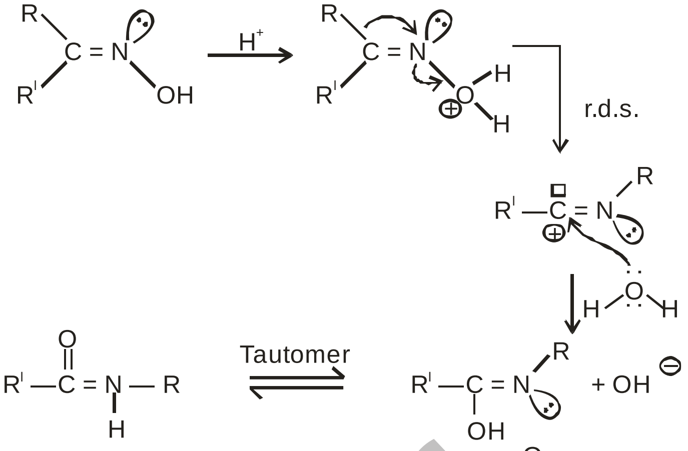
Catalyst:–

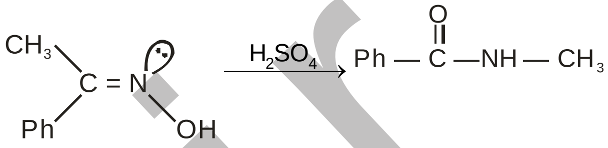
H_2SO_4, $SOCl_2$, SO_3, PCl_5, P_2O_3, PCl_3, BF_3, 

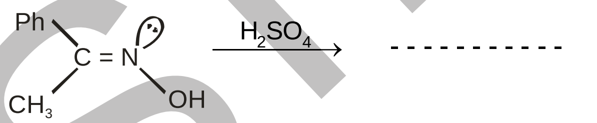
Migration of R is always from anti position.

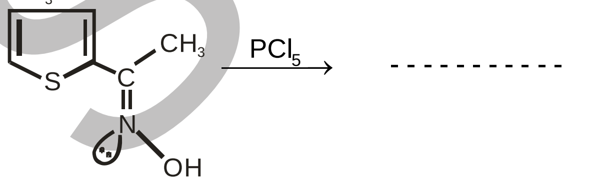
Mechanism:–

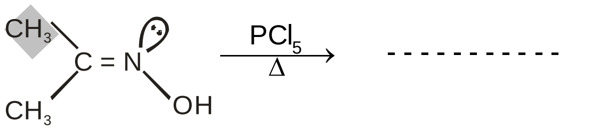
1.

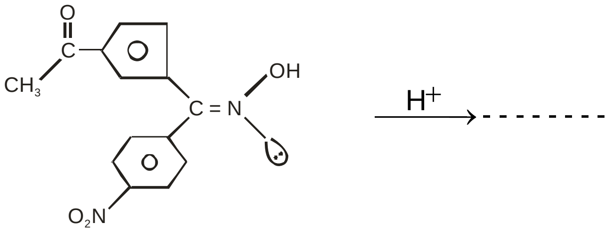


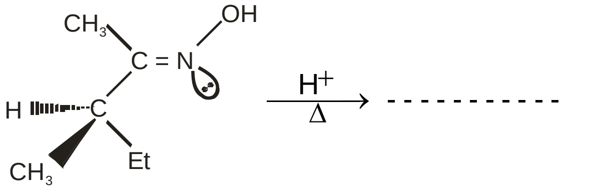
Q.1 

Q.2 

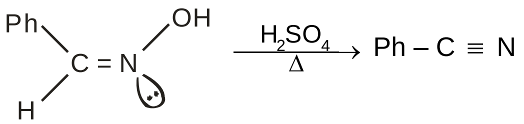
Q.3 

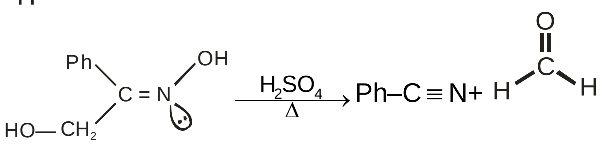
Q.4 

Q.5 

Q.6 

Q.7
Explain:–

(a) 

(b) 

DPP NO- 04 Time: 15 minutes

Curtius reaction:–

$$R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{NaN_3} R-\overset{O}{\overset{\|}{C}}-N=N=N$$

$$R-\overset{O}{\overset{\|}{C}}-O\,CH_2-CH_3 \xrightarrow{NH_2-NH_2}$$

$$R-\overset{O}{\overset{\|}{C}}-NH-NH_2 \xrightarrow{HNO_2} R-\overset{O}{\overset{\|}{C}}-\underset{\oplus}{N}=N=\overset{\ominus}{N}:$$

$$R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[2.\ \Delta]{1.\ NaN_3} R-N=C=O \xrightarrow[\Delta]{\overline{O}H/H_2O} R-NH_2$$

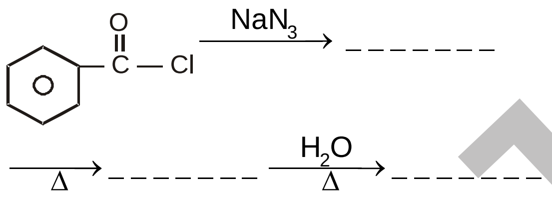
Imp.

$$R-N=C=O \xrightarrow{R'-OH} R-NH-\overset{O}{\overset{\|}{C}}-OR'$$

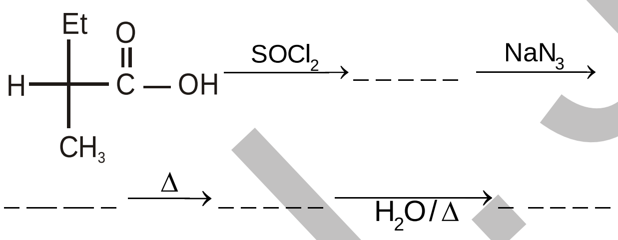
$$R-N=C=O \xrightarrow{R-NH_2} R-\underset{H}{N}-\overset{O}{\overset{\|}{C}}-NH-R$$

$$R-N=C=O \xrightarrow[\Delta]{HOH} R-NH_2+CO_2$$

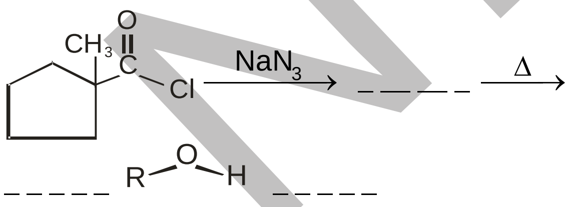
Q.1



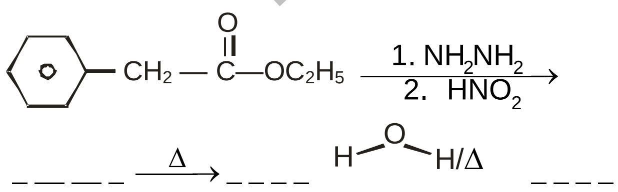
Q.2



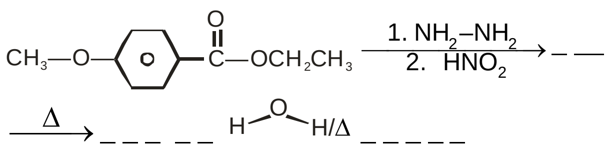
Q.3



Q.4



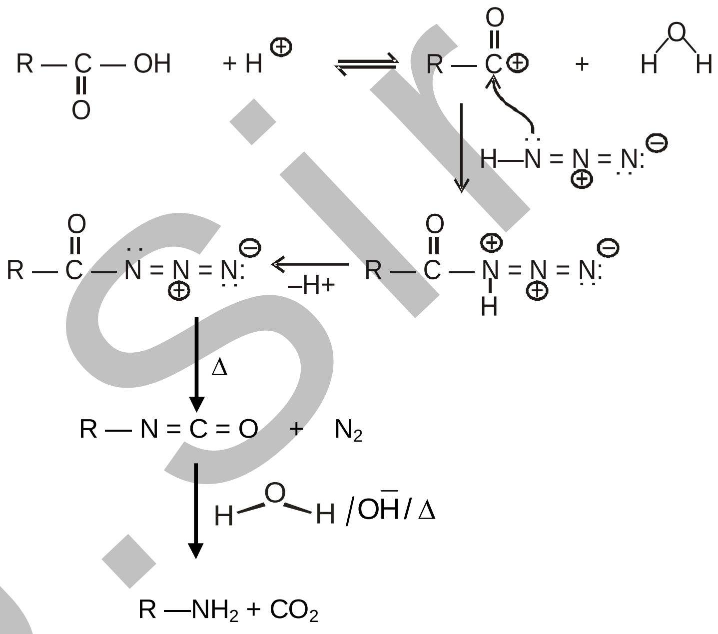
Q.5



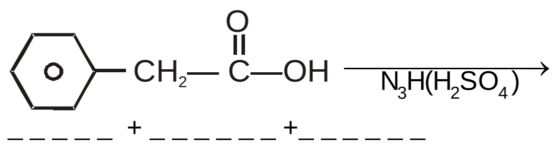
Schmidt Reaction:–

$$R-\overset{O}{\overset{\|}{C}}-O-H + HN_3 \xrightarrow{H_2SO_4} R-NH_2 + CO_2 + N_2.$$

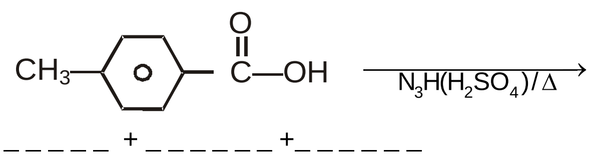
Mechanism:–



Q.1



Q.2



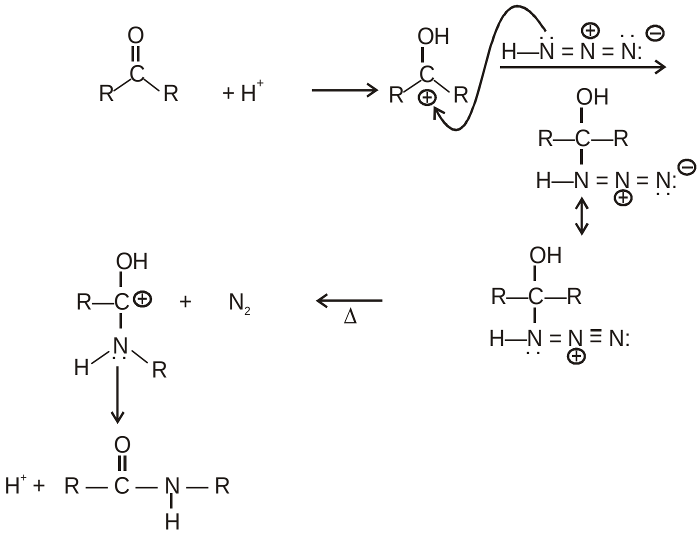
Schimidt miscellaneous:–

$$R-\overset{O}{\overset{\|}{C}}-R \xrightarrow[N_3H/\Delta]{H+} R-\overset{O}{\overset{\|}{C}}-\underset{H}{N}-R$$

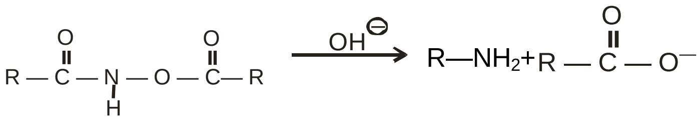
ETOOS Academy Pvt. Ltd.
F-106, Road No. 2, Indraprastha Industrial Area, End of Evergreen Motors (Mahindra Showroom), BSNL Office Lane, KJhalawar Road, Kota, Rajasthan (324005)

Mechanism:–

1.

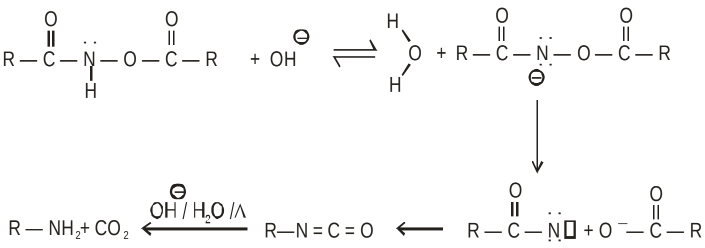


Lossen's Rearrangement:–

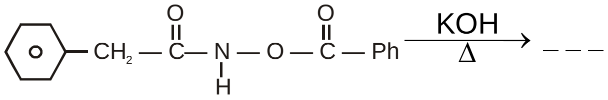


Mechanism:–

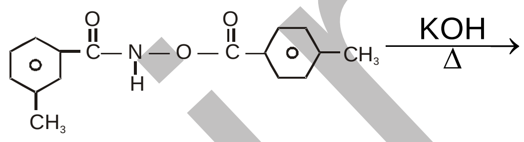
1.



Q.1



Q.2



Reaction Intermediates

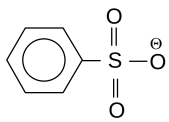
EXERCISE – I

Q.1 2-Chloropentane on halogenation with chlorine gives 2,3-dichloropentane. What will be the structure of free radical species formed in the reaction?

(A) Planar (B) Trigonal planar
(C) Square planar (D) Pyramidal

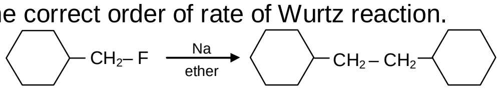
Q.2 Decreasing order of nucleophilicity of the following nucleophile is :

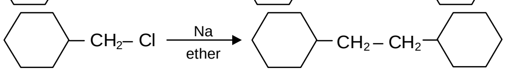
(1) $CH_3O^{\ominus}$ (2) $\overset{\ominus}{C}N$

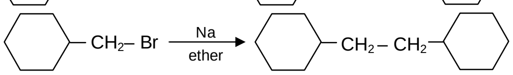
(3)  (4) $CH_3CO_2^{\ominus}$

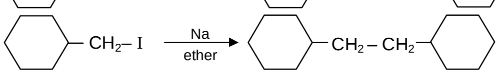
(A) 4 > 3 > 2 > 1 (B) 1 > 2 > 4> 3
(C) 2 > 1 > 3 > 4 (D) 1 > 2 > 3 > 4

Q.3 The correct order of rate of Wurtz reaction.

(I) 

(II) 

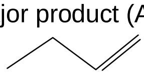
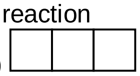
(III) 

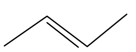
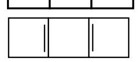
(IV) 

(A) I > II > III > IV (B) II > I > III > IV
(C) IV > III > II > I
(D) In all rate of Wurtz reaction is same

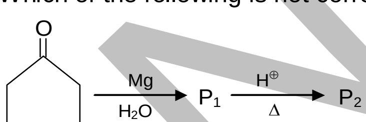
Q.4
$$\begin{array}{l} CH_3 - CH - CO_2K \\ \quad\quad\ | \\ CH_3 - CH - CO_2K \end{array} \xrightarrow{\text{electrolysis}} \text{(A) (Major)}$$

Major product (A) of above reaction

(A)  (B) 

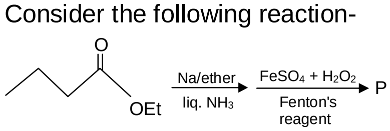
(C)  (D) 

Q.5 Which of the following is not correct about P_2.

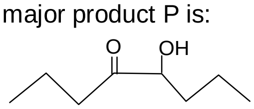


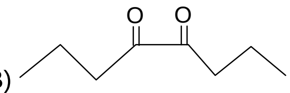
(A) It is a spiro compound
(B) It is a Ketone
(C) It can show tautomerism
(D) It is an alkene

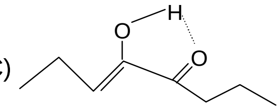
Q.6 Consider the following reaction-

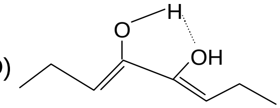


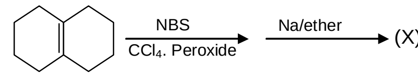
the major product P is:

(A) 

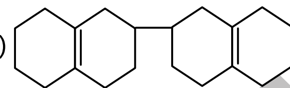
(B) 

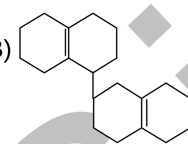
(C) 

(D) 

Q.7 

X is :

(A) 

(B)  (C) 

(D) None of these

Q.8 What will be the major product, when 2-methyl butane undergoes bromination in presence of light?

(A) 1-bromo-2-methyl butane
(B) 2- bromo-2-methyl butane
(C) 2- bromo-3-methyl butane
(D) 1-bromo-3-methyl butane

Q.9 Which can not be the possible product of the given reaction

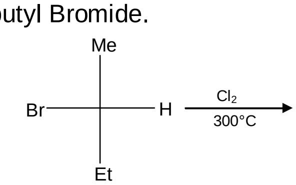
$$CH_3-CH_2-\underset{\underset{O}{||}}{C}-OAg \xrightarrow[CCl_4,\ \Delta]{Br_2} \text{Product (s)}$$

(A) CH_3-CH_2-Br

(B) $CH_3-CH_2-\underset{\underset{O}{||}}{C}-O-CH_2-CH_3$

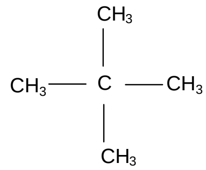
(C) $CH_3-CH_2-CH_2-CH_3$
(D) $CH_3-CH_2-CH_3$

Q.10 Pick the correct statement for monochlorination of R-secbutyl Bromide.



(A) There are five possible product; four are optically active one is optically inactive
(B) There are five possible product; three are optically inactive & two are optically active
(C) There are five possible product; two are optically inactive & three are optically active
(D) None of these

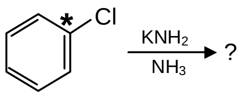
Q.11 Correct order of rate of photochlorination for following compounds is

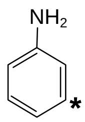
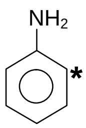
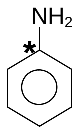
$CH_3 - CH_3$ $CD_3 - CD_3$ 

(I) (II) (III)

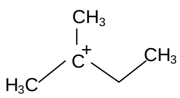
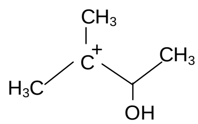
(A) II < I < III (B) I < II < III
(C) III < I < II (D) II < III < I

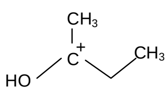
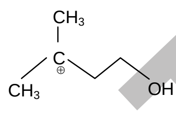
Q.12 Product can be



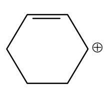
(A)  (B)  (C) 
(D) (B) and (C) both

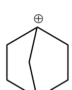
Q.13 Which of the following carbocation is most stable?

(A)  (B) 

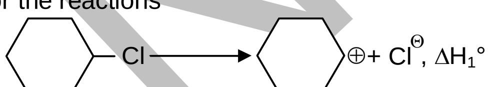
(C)  (D) 

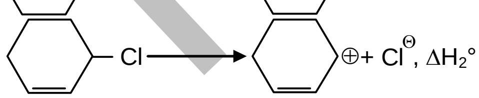
Q.14 Which carbocation is least likely to form as an intermediate?

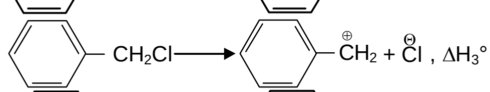
(A) $(C_6H_5)_3\overset{+}{C}$ (B) 

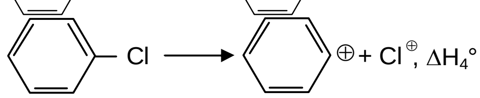
(C)  (D) $CH_2 = \overset{+}{C}H$

Q.15 For the reactions

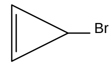
(I) 

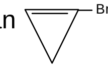
(II) 

(III) 

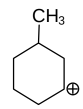
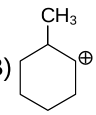
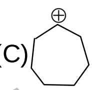
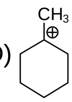
(IV) 

The correct decreasing order of enthalpies of reaction for producing carbocation is:
(A) $\Delta H_1^o > \Delta H_2^o > \Delta H_3^o > \Delta H_4^o$
(B) $\Delta H_4^o > \Delta H_1^o > \Delta H_2^o > \Delta H_3^o$
(C) $\Delta H_3^o > \Delta H_2^o > \Delta H_1^o > \Delta H_4^o$
(D) $\Delta H_2^o > \Delta H_1^o > \Delta H_4^o > \Delta H_3^o$

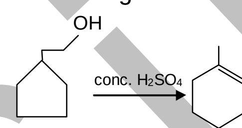
Q.16  , which is not the correct statement

(A) I is more soluble than bromocyclopropane
(B) I gives pale yellow ppt. on addition with $AgNO_3$
(C) I is having lower dipole moment than bromocyclopropane
(D) I is more ionic than 

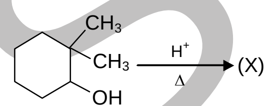
Q.17 Which one of the following carbocation would you expect to rearrange.

(A)  (B)  (C)  (D) 

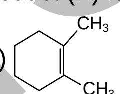
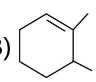
Q.18 How many, 1,2-Shifts are involved during the course of following reaction:

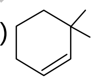
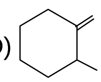


(A) 1 (B) 2 (C) 3 (D) 4

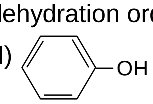
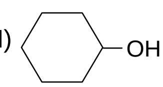
Q.19 

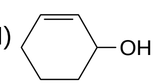
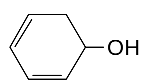
Product (X) is:

(A)  (B) 

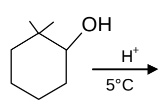
(C)  (D) 

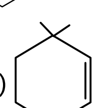
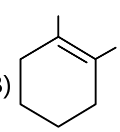
Q.20 Among the given compounds, the correct dehydration order is:

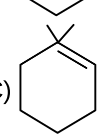
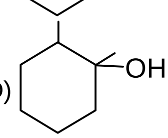
(I)  (II) 

(III)  (IV) 

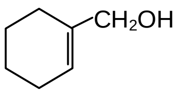
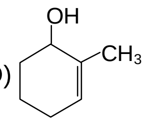
(A) I < II < III < IV (B) II < III < IV < I
(C) I < III < IV < II (D) I < II < III = IV

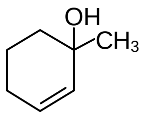
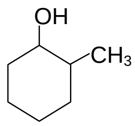
Q.21  P. The product P is

(A)  (B) 

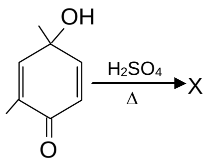
(C)  (D) 

Q.22 Rate of dehydration when given compounds are treated with conc. H_2SO_4.

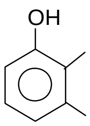
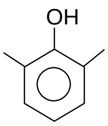
(P)  (Q) 

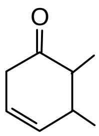
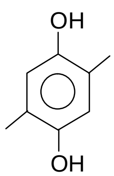
(R)  (S) 

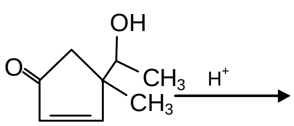
(A) P > Q > R > S (B) Q > P > R > S
(C) R > Q > P > S (D) R > Q > S > P

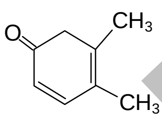
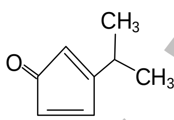
Q.23 

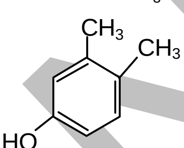
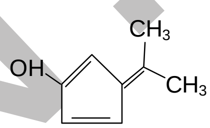
'X' is

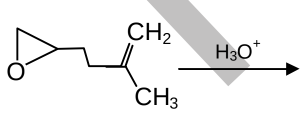
(A)  (B) 

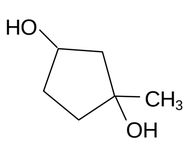
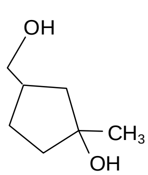
(C)  (D) 

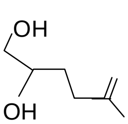
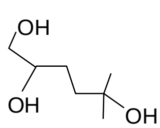
Q.24  major product is

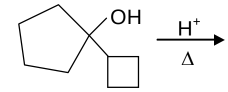
(A)  (B) 

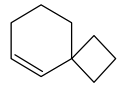
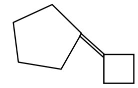
(C)  (D) 

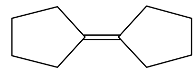
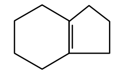
Q.25  A, A is

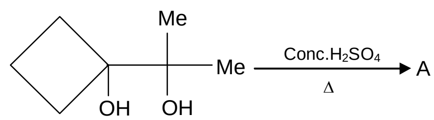
(A)  (B) 

(C)  (D) 

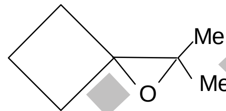
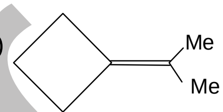
Q.26 

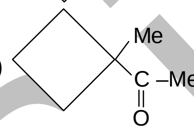
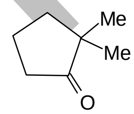
(A)  (B) 

(C)  (D) 

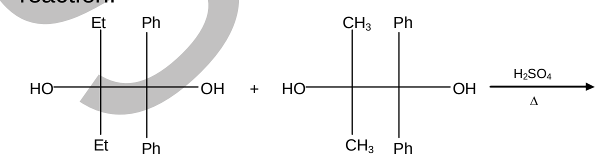
Q.27 

Product 'A' is-

(A)  (B) 

(C)  (D) 

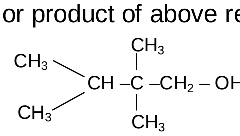
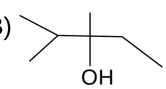
Q.28 How many products are obtained in the given reaction:

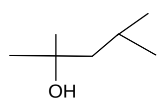
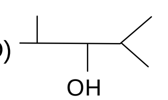


(A) 1 (B) 2 (C) 3 (D) 4

Q.29 $CH_3-\underset{CH_3}{\underset{|}{CH}}-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-CH_2-NH_2 \xrightarrow{HNO_2} (X)$

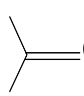
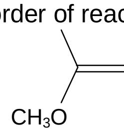
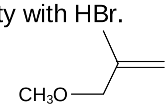
(major)
Major product of above reaction is:

(A)  (B) 

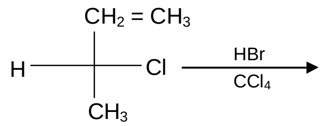
(C)  (D) 

Q.30 Which will dehydrate at fastest rate by H_3PO_4 :
(A) 2-methyl butane-2-ol (B) 3-methyl butane-2-ol
(C) Butane-1-ol (D) 2-methyl butane-1-ol

Q.31 What is the order of reactivity with HBr.

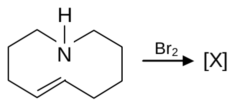
(a)  (b)  (c) 

(A) a > b > c (B) b > a > c
(C) c > b > a (D) b > c > a

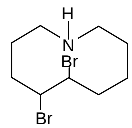
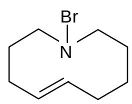
Q.32 

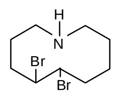
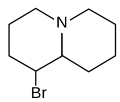
What is stereochemistry of product?
(A) Racemic mixture (B) Optically inactive
(C) Diastereomers (D) Meso product

Q.33 In the given reaction :

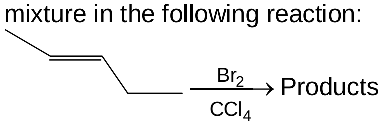


[X] is :

(A)  (B) 

(C)  (D) 

Q.34 Select the incorrect statement about the product mixture in the following reaction:



(A) it is optically active (B) it is racemic mixture
(C) it is a resolvable mixture
(D) it is a mixture of erythro compounds

Q.35 $\overset{3}{C}l_3C - \overset{2}{C}H = \overset{1}{C}H_2$ (I) $\quad H_3\overset{3}{C} - \overset{2}{C}H = \overset{1}{C}H_2$ (II)

In addition of HOBr to (I) and (II)
(A) Br is at C_2 in both cases
(B) Br is at C_2 in II and at C_1 in I
(C) Br is at C_1 in II and C_2 in I
(D) Br is at C_1 in both cases

Q.36 Which of the following compounds yield most stable carbanion after rupture of $(C_1 - C_2)$ bond:

(A) $CH_3 - \underset{1}{\overset{O}{\overset{\|}{C}}} - \underset{2}{CCl_3}$ (B) $CH_3 - \underset{1}{\overset{O}{\overset{\|}{C}}} - \underset{2}{CBr_3}$

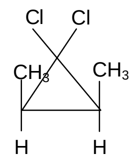
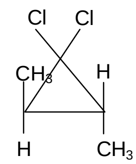
(C) $CH_3 - CH_2 - \underset{1}{\overset{O}{\overset{\|}{C}}} - \underset{2}{CI_3}$ (D) None of these

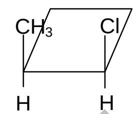
Q.37 $^{14}CH_2 = CH - CH_3 \xrightarrow[CCl_4/\text{Peroxide}]{NBS}$ $\xrightarrow{\text{Mg/ether}} \xrightarrow{D_2O}$ Product(s)

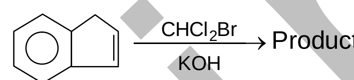
Product(s) is/are :
(A) $^{14}CH_2 = CH{-}CH_2{-}D$ (B) $CH_2 = CH - {}^{14}CH_2 - D$
(C) Both of these (D) None of these

Q.38 Stability order of following singlet halocarbene is
(A) $CF_2 > CCl_2 > CBr_2 > CI_2$
(B) $Cl_2 > CBr_2 > CCl_2 > CF_2$
(C) $CCl_2 > CF_2 > CBr_2 > CI_2$
(D) $CF_2 > CI_2 > CCl_2 > CBr_2$

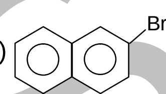
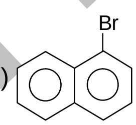
Q.39 Trans-Butene-2 $\xrightarrow[\text{Solvent}]{CHCl_3/KOH}$ Product

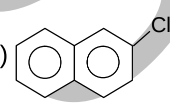
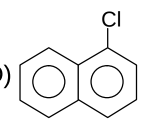
(A)  (B) 

(C)  (D) Both (A) and (B)

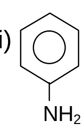
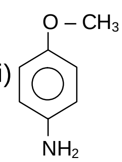
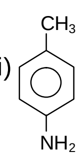
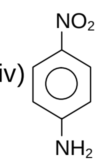
Q.40 

Product is :

(A)  (B) 

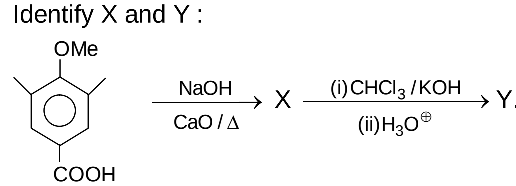
(C)  (D) 

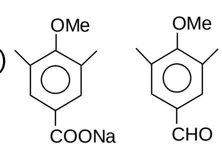
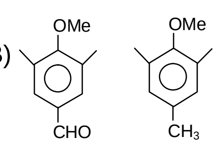
Q.41 The order of rate of reaction of following towards carbylamine reaction:

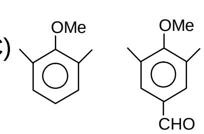
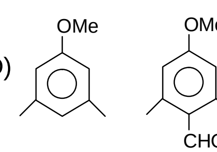
(i)  (ii)  (iii)  (iv) 

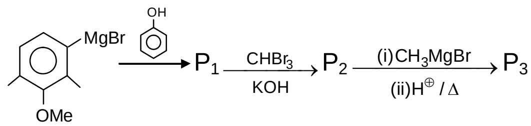
(A) (ii) > (i) > (iii) > (iv) (B) (ii) > (iii) > (i) > (ii)
(C) (iv) > (i) > (iii) > (ii) (D) None

Q.42 Identify X and Y :

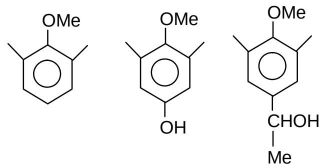


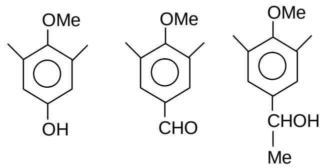
(A)  (B) 

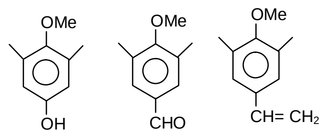
(C)  (D) 

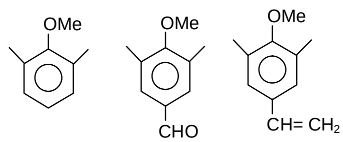
Q.43 

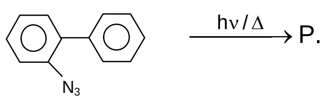
P_1, P_2 and P_3 are

(A) 

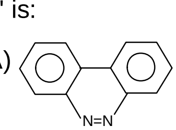
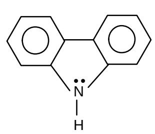
(B) 

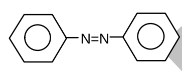
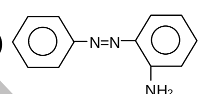
(C) 

(D) 

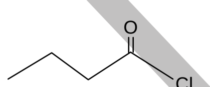
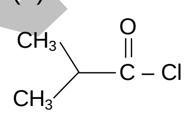
Q.44 

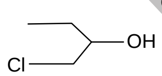
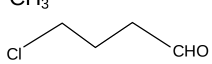
'P' is:

(A)  (B) 

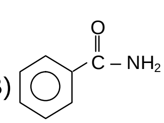
(C)  (D) 

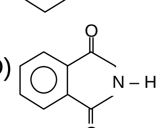
Q.45 (X) $C_4H_7OCl \xrightarrow{NH_3} C_4H_9ON \xrightarrow[KOH]{Br_2}$ $CH_3CH_2CH_2NH_2$. Compound (X) is

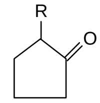
(A)  (B) 

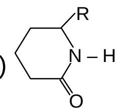
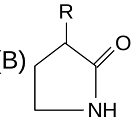
(C)  (D) 

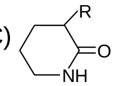
Q.46 Which of the following can not give Hoffmann's bromamide reaction:

(A) $Me-\overset{\overset{O}{\|}}{C}-NH-Br$ (B) 

(C) $Me-\overset{\overset{O}{\|}}{C}-NH-Me$ (D) 

Q.47  $\xrightarrow[H_2SO_4]{HN_3}$ P. Identify P.

(A)  (B) 

(C)  (D) Both (A) and (C)

Q.48 $\begin{matrix} Me_2CH \\ Me \end{matrix}\!\!>C=N\diagdown OH \xrightarrow[\Delta]{conc.H_2SO_4} A$

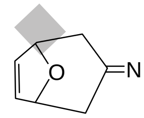
Major product of this reaction is

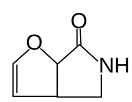
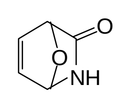
(A) $Me_2CH-NH-\underset{\underset{O}{\|}}{C}-Me$

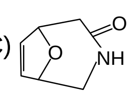
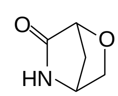
(B) $Me-NH-\underset{\underset{O}{\|}}{C}-CHMe_2$

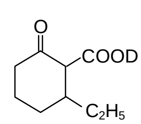
(C) $Me-\overset{\overset{Me}{|}}{\underset{\underset{OH}{|}}{C}}-CH=N-Me$

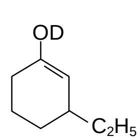
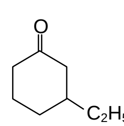
(C) $CH_2=\underset{\underset{Me}{|}}{C}-CH=N-Me$

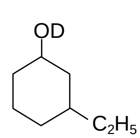
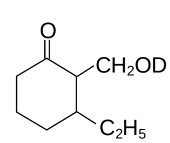
Q.49  $\xrightarrow[\text{Chloride}]{\text{P–Toluene sulphonyl}}$ P. 'P' is

(A)  (B) 

(C)  (D) 

Q.50  $\xrightarrow{\Delta}$ product is

(A)  (B) 

(C)  (D) 

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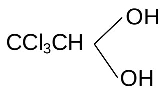
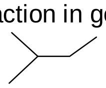
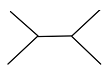
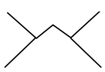
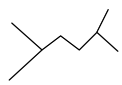
EXERCISE – II

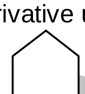
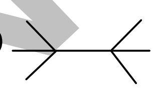
Q.1 Match the column :

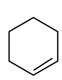
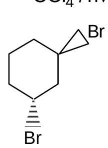
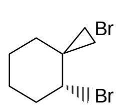
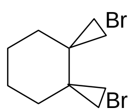
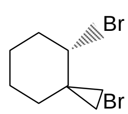
Column-I	Column-II
(A) Electrophile	(P) $CH_3-CH=CH-CH_3$
(B) Nucleophile	(Q) **:**CHCl
(C) Lewis acid	(R) $CH_3-\dot{C}H_2$
(D) Lewis base	(S) Guanidine

Q.2 Select the correct statements :
(A) Protonation increases electrophilic nature of carbonyl group
(B) $CF_3SO_3^-$ is better leaving group than $CH_3SO_3^-$
(C) Benzyl carbocation is stabilized by resonance
(D)  is unstable

Q.3 Which of the following can be produced by Wurtz reaction in good yield.
(A)  (B) 
(C)  (D) 

Q.4 Select **true** statement(s) :
(A) Instead of radical substitution, cyclopropane undergoes electrophilic addition reactions in sun light.
(B) In general, bromination is more selective than chlorination
(C) The2,4,6-tri-tert, butylphenoxy radical is resistant to dimerization
(D) The radical-catalysed chlorination, $ArCH_3 \rightarrow ArCH_2Cl$, occurs faster when Ar= phenyl than when Ar= p-nitrophenyl.

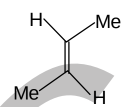
Q.5 Choose all alkane that give only one monochloro derivative upon reaction with chlorine in sun light.
(A)  (B) 
(C)  (D) 

Q.6  $\xrightarrow[CCl_4/h\nu]{NBS}\xrightarrow{HBr}$ (X)+(Y) enantiomeric pair.
(A)  (B) 
(C)  (D) 

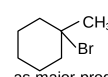
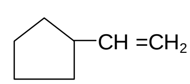
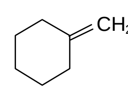
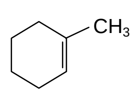
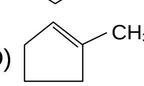
Q.7 $H_3C-CH_2-CH_2-\underset{\underset{OH}{|}}{CH_2}\xrightarrow[\Delta]{conc.\ H_2SO_4}X+Y$

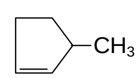
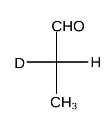
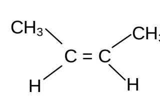
$\xrightarrow[CCl_4/peroxide]{NBS}\xrightarrow{(CH_3-\overset{\overset{CH_3}{|}}{C}H)_2CuLi}$ Product(s)

Product(s) are :
(A) $H_3C-CH=CH-CH(CH_3)_2$
(B) $H_3C-\overset{\overset{CH_3}{|}}{C}H-\underset{\underset{CH_3}{|}}{C}H-CH=CH_2$
(C) $H_3C-\underset{\underset{CH_3}{|}}{C}H-CH_2-CH=CH-CH_3$
(D) $H_3C-\underset{\underset{CH_3}{|}}{C}H-CH=CH-CH_2-CH_3$

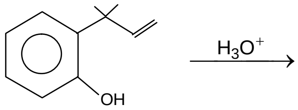
Q.8 Select correct statement about the product (P) of the reaction :
 $\xrightarrow{Br_2/CCl_4}$ P
(A) P is optically inactive due to internal compensation
(B) P is optically inactive due to the presence of plane of symmetry in the molecule
(C) The structure of P can have three optical isomers possible
(D) P can have four possible optical isomers.

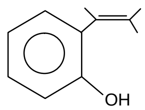
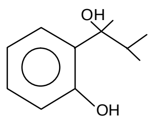
Q.9 Products formed when HCl adds to 2,4-hexadiene is:
(A) 4-chloro-2-hexene (B) 2-chloro-3-hexene
(C) 2-chloro-4-hexene (D) 1-chloro-2-hexene

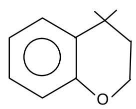
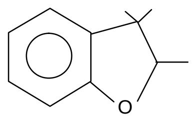
Q.10 In the given reaction C_7H_{12} (A) $\xrightarrow{HBr}$ 
as major product
(A) can be
(A)  (B) 
(C)  (D) 

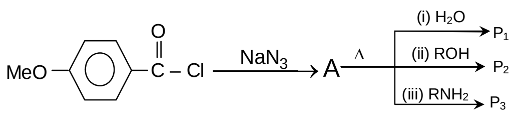
Q.11 Which of following reaction product are diastereomer of each other.
(A)  $\xrightarrow[CCl_4]{Br_2}$ (B)  $\xrightarrow[(ii)\ H^+]{(i)\ NaCN}$
(C)  $\xrightarrow[CCl_4]{HBr}$
(D) $CH_3-\underset{\underset{Et}{|}}{C}H-CH=CH-Ph\xrightarrow[peroxide]{HCl}$

Q.12 Which of the following can be formed during this reaction?

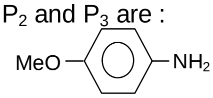


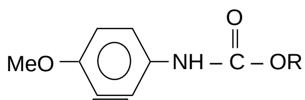
(A)  (B) 

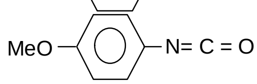
(C)  (D) 

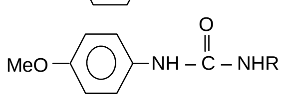
Q.13 

P_1, P_2 and P_3 are :

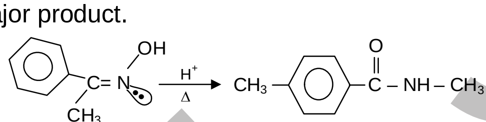
(A) 

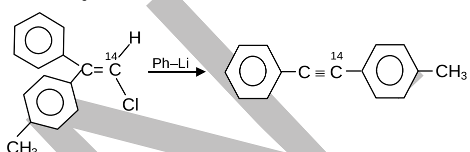
(B) 

(C) 

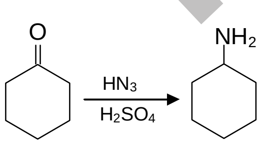
(D) 

Q.14 Which of the following reaction is not representing major product.

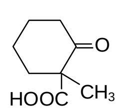
(A) 

(B) 

(C) $Ph-\overset{O}{\overset{||}{C}}-NH_2 \xrightarrow[KOH]{Br_2} Ph-NH_2$

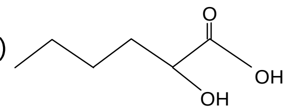
(D) 

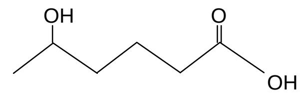
Q.15 In which of following compound chiral center is not affected on heating.

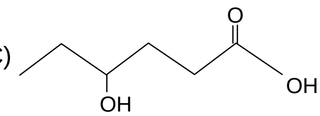
(A) $CH_3-\underset{OH}{\underset{|}{CH}}-COOH$ (B) 

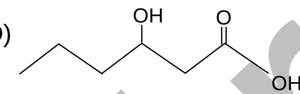
(C) $CH_3-\underset{OH}{\underset{|}{CH}}-CH_2-COOH$ (D) $CH_3-\underset{CH_2COOH}{\underset{|}{CH}}COOH$

Q.16 Which of the following will give cyclic products upon being heated or being treated by an acid?

(A) 

(B) 

(C) 

(D) 

Q.17 Select the correct statements.

(A) methyl malonic acid is converted into propanoic acid on heating

(B) succinic acid forms succinic anhydride on heating

(C) 3-hydroxy propanoic acid forms Lactide on heating

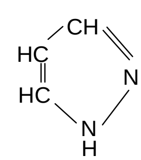
(D) $CH_3-\overset{O}{\overset{||}{C}}-CH_2COOH$ forms acetone on heating

Q.18 $C_5H_8O_4(A) \xrightarrow{\Delta} C_4H_8O_2(B) \xrightarrow[\Delta]{\text{Soda lime}} (C)$

C is a hydrocarbon occupying 0.509 litre per g at NTP approximately. Hence A and B are:
(A) methyl malonic acid, propanoic acid
(B) succinic acid, succinic anhydride
(C) Dimethylmalonic acid, 2-Methylpropanoic acid
(D) Ethyl Malonic acid, Butanoic acid

Q.19 Which of the following reaction **is not incorrectly** formulated.

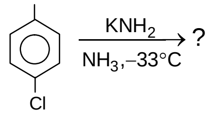
(A) $CH_2=CH-CH_3 \xrightarrow[\text{UV light}]{+SO_2Cl_2} CH_2Cl-CHCl-CH_3$

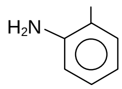
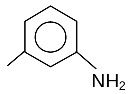
(B) $HC\equiv CH + CH_2N_2 \longrightarrow$ 

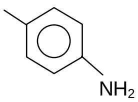
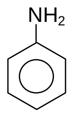
(C) $(CH_3)_3CH+Cl_2 \xrightarrow[\text{halogenation}]{\text{photo}} (CH_3)_3C-Cl$

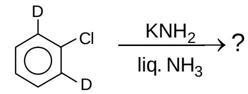
as major product

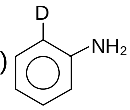
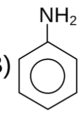
(D) $CH_3-C\equiv C-H \xrightarrow{HCl} CH_3-\underset{Cl}{\underset{|}{CH}}-\underset{Cl}{\underset{|}{CH_2}}$

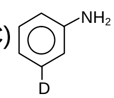
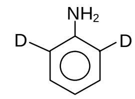
Q.20 

(A)  (B) 

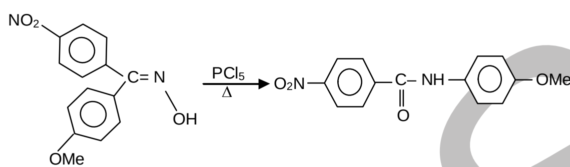
(C)  (D) 

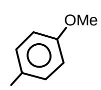
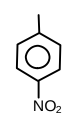
Q.21 

(A)  (B) 

(C)  (D) 

Q.22 This question consist of two statements, printed as assertion and reason, while answering this question you are required to choose any one of the following responses.
(A) If assertion is true but the reason is false.
(B) If assertion is false but the reason is true.
(C) If both assertion and reason are true and the reason is a correct explanation of assertion
(D) If both assertion and reason are true but reason is not a correct explanation of assertion

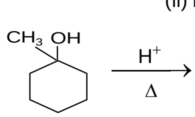
Assertion : 

Reason : Migratory aptitude of  group is greater than migratory aptitude of  group during cation rearrangements.

Q.23 Each of the compounds in Column A is subjected to further chlorination. Match the following for them.

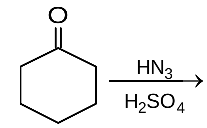
Column-A		**Column-B**
(A) $CHCl_2 - CH_2 - CH_3$	(P)	Optically active original compound
(B) $CH_2Cl - CHCl - CH_3$	(Q)	Only one trichloro product
(C) $CH_2Cl - CH_2 - CH_2-Cl$	(R)	Three trichloro product
(D) $CH_3 - CCl_2 - CH_3$	(S)	Four trichloro product
(E) $CH_3 - \underset{CH_3}{\overset{Cl}{C}} - \underset{CH_3}{\overset{Cl}{C}} - CH_3$	(T)	Atleast one of the trichloro product is optically active
	(U)	Two trichloro products

Q.24 Column-I and Column-II contains four entries each. Entries of column-I are to be matched with some entries of column-II. One or more than one entries of column-I may have the matching with the same entries of column-II and one entry of column-I may have one or more than one matching with entries of column-II.

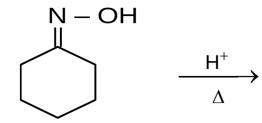
Column-I **(Reaction)**		**Column-II** **(Type of intermediate formed)**
(A) $Ph-CHCl_2 \xrightarrow[\Delta]{HO^{\ominus}}$ (A)	(P)	Carbocation
(B) $R - Br \xrightarrow[\text{dry ether}]{Na}$	(Q)	Carbanion
(C) $CH_3 - \overset{O}{\overset{\Vert}{C}} - CH_3 \xrightarrow[\text{(ii) } H_2SO_4,\ \Delta]{\text{(i) } Mg/H_2O}$	(R)	Free- radical
(D) 	(S)	Carbene

Q.25 **Column-I** **Column-II**

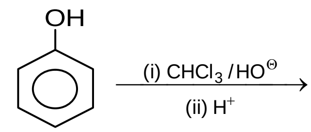
(A) Caprolactum formation take place in

(P) 

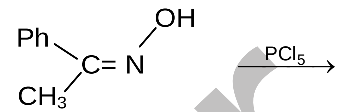
(B) Beckmann rearrangement is

(Q) 

(C) Schmidt reaction is

(R) 

(D) Reaction in which number of carbon increases

(S) 

EXERCISE – III

Q.1 Identify P_1 to P_8.

$CH_3-CH=CH-CH_2-CH(H)(D)-CH_2-CH(H)(T)-CH_3 \xrightarrow{H-Br} P_1 + P_2$

$CH_3-CH=CH-CH_2-\underset{D}{CH}-CH_2-CH(H)(T)-CH_3 \xrightarrow{H-Br}$

$P_1 + P_2 + P_3 + P_4$

$CH_3-CH=CH-CH_2-\underset{D}{CH}-CH_2-\underset{T}{CH}-CH_3 \xrightarrow{H-Br}$

$P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 + P_8$

Q.2 Compare the rate of decarboxylation in sodalime process for the following.

(i) (a) $HC \equiv C-COOH$ (b) $CH_2=CH-COOH$ (c) CH_3-CH_2-COOH

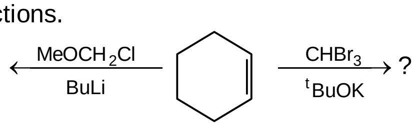
(ii) (a) $\underset{NO_2}{CH_2}-CH_2-COOH$ (b) $F-CH_2-CH_2-COOH$ (c) $Cl-CH_2CH_2-COOH$

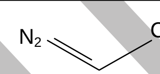
(iii) (a) $CH_3-\underset{F}{CH}-COOH$ (b) $CH_3-\underset{Cl}{CH}-COOH$ (c) $CH_3-\underset{CH_3}{CH}-COOH$

Q.3 Which compound is more stable explain.

(a) $CH_3-\overset{O}{\overset{\|}{C}}-CH=\overset{\oplus}{N}=\overset{\ominus}{N}$ and $CH_3-CH=\overset{\oplus}{N}=\overset{\ominus}{}$

Q.4 Give product and suggest mechanism for these reactions.

(i) 

(ii) $Ph-CH=CH_2 +$ 

$\xrightarrow[Zn]{\Delta}$?

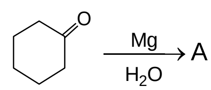
(iii) $Cl_3C-\overset{O}{\overset{\|}{C}}-OH + Na \longrightarrow A \xrightarrow[CH_2=CH_2]{\Delta}$ B. Find out A & B.

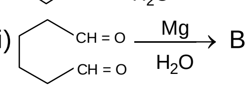
Q.5 (a) Formulate the reactions between but-1-ene in presence of small amount of benzoyl peroxide and (i) CCl_4 (ii) $CBrCl_3$

Give your reasons.

(b) The dichlorocarbene reacts with phenol in base where as it doesn't reacts with benzene explain.

Q.6 Give the product of the following reaction.

(i) 

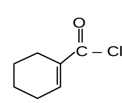
(ii) 

(iii) $Me-\overset{O}{\overset{\|}{C}}-Et \xrightarrow[H_2O]{Mg} \xrightarrow[\Delta]{H_2SO_4} C$

(iv) $Ph-\overset{O}{\overset{\|}{C}}-Me \xrightarrow[H_2O]{Mg} \xrightarrow[\Delta]{H_2SO_4} D$

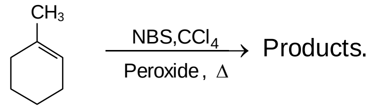
Q.7 Identify missing products in the given reaction sequence.

(a) $CH_3-CH_2-CH_3 \xrightarrow{Br_2/h\nu} (A) \xrightarrow{aq.\,KOH} (B) \xrightarrow[\Delta]{H_2SO_4} (C) \xrightarrow[CCl_4]{Br_2} (D) = ?$

(b) 

$\xrightarrow{NaN_3} (P) \xrightarrow[\Delta]{Ag_2O} (Q) \xrightarrow{H_2O} (R) \xrightarrow[+HCl]{NaNO_2} (S)$

Q.8 Find out the total number of products (including stereo) in the given reaction:



Q.9 With the help of following data show HBr exhibits the peroxide effect.

	$\Delta H_1°$/ kJ mol^{-1}	$\Delta H_2°$/kJ mol^{-1}
H – X	$\dot{X} + CH_2=CH_2 \longrightarrow XCH_2-\dot{C}H_2$	$XCH_2-\dot{C}H_2 + H-X \longrightarrow XCH_2CH_3 + \dot{X}$
HCl	–67	+ 12.6
HBr	–25.1	– 50.2
HI	+46	–117.1

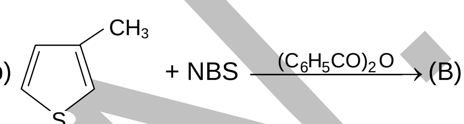
Q.10 Addition of small amount of $(C_2H_5)_4$ Pb to a mixture of methane and chlorine, starts the reaction at 140°C instead of the usual minimum 250°C. Why?

Q.11 On chlorination, an equimolar mixture of ethane and neopentane yields neopentyl chloride and ethyl chloride in the ratio 2.3 : 1. How does the reactivity of 1° hydrogen in neopentane compare with that of a 1° hydrogen in ethane?

Q.12 It required 0.7 g of a hydrocarbon (A) to react completely with Br_2(2.0 g) and form a non resolvable product. On treatment of (A) with HBr it yielded monobromo alkane (B). The same compound (B) was obtained when (A) was treated with HBr in presence of peroxide. Write down the structure formula of (A) and (B) and explain the reactions involved.

Q.13 Give product(s) in each of the following reactions.

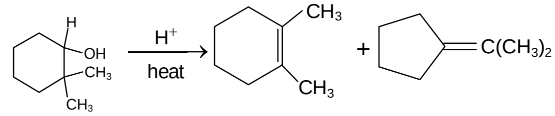
(a) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}H}-CH_2-CH_2-CH_3 \xrightarrow{Br_2/h\nu}$ (A)(major)

(b) 

(c) $CH_3-CH_2-CH=CH_2+Me_3COCl \xrightarrow{h\nu}$ (C) + (D)

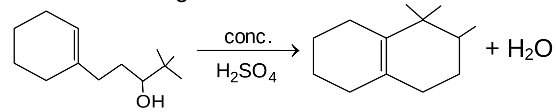
(d) $C_6H_5-CH_2-CH_2-CH_3 \xrightarrow{CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-O-Cl\,/\Delta}$ (E)(major)

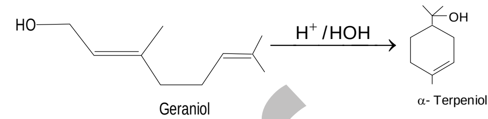
Q.14 We saw that acid-catalyzed dehydration of 2,2-dimethyl-cyclohexanol afforded 1,2-dimethylcyclohexene. To explain this product we must write a mechanism for the reaction in which a methyl shift transforms a secondary carbocation to a tertiary one. Another product of the dehydration of 2,2-dimethylcyclohexanol is isopropylidenecyclopentane. Write a mechanism to rationalize its formation.



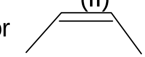
2,2-Dimethylcyclohexanol 1,2-Dimethylcyclohexene Isopropylidenecyclopentane

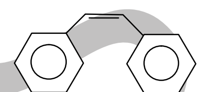
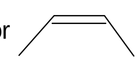
Q.15 (a) Write a reasonable and detailed mechanism for the following transformation.



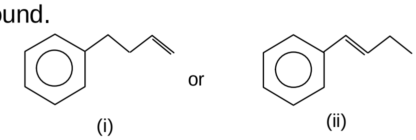
(b) 

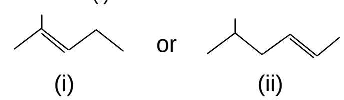
Q.16 Assuming that cation stability governs the barrier for protonation in H–X additions, predict which compound in each of the pairs in parts (a) and (b) will be more rapidly hydrochlorinated in a polar solvent.

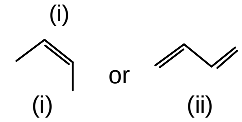
(a) (I) $CH_2 = CH_2$ or (II) 

(b)  or 

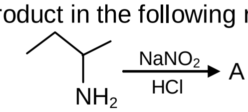
Q.17 Choose the member of the following pairs of unsaturated hydrocarbons that is more reactive towards acid-catalysed hydration and predict the regiochemistry of the alcohols formed from this compound.

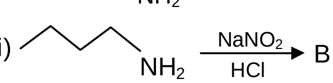
(a) 

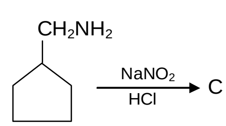
(b) 

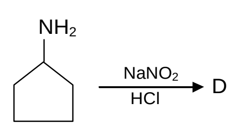
(c) 

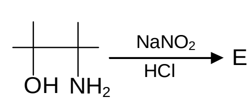
Q.18 Give product in the following reaction.

(i) 

(ii) 

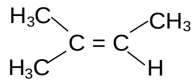
(iii) 

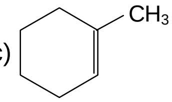
(iv) 

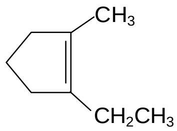
(v) 

Q.19 What are the products of the following reactions?

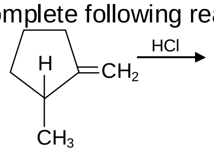
(a) $PhCH = CHCH_3 + HBr \longrightarrow A$

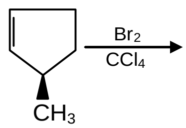
(b)  $+ HI \longrightarrow B$

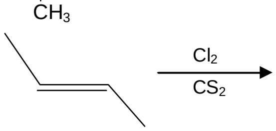
(c)  $+ HBr \xrightarrow{\text{Peroxide}} C$

(d)  $+ HCl \longrightarrow D$

Q.20 Complete following reaction:

(a) 

(b) 

(c) 

Total number of products obtained in this reaction is?

EXERCISE – IV (A)

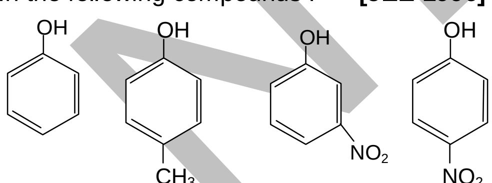
Q.1 Reaction of $R–CO – NH_2$ with a mixture of Br_2 and KOH gives $R – NH_2$ as the main product. The intermediates involved in this reaction are : **[JEE 1992]**

(A) $R –CO –NHBr$ (B) $RNHBr$
(C) $R – N = C = O$ (D) $R.CO.NBr_2$

Q.2 Which one of the following has the smallest heat of hydrogenation per mole? **[JEE 1993]**

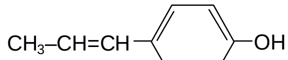
(A) 1-Butene (B) trans-2-Butene
(C) cis-2-Butene (D) 1,3-Butadiene

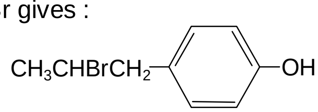
Q.3 In the following compounds : **[JEE 1996]**

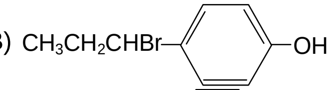


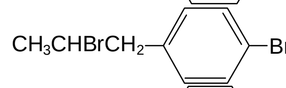
The order of acidity is :

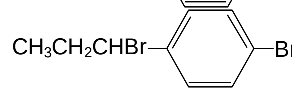
(A) III > IV > I > II (B) I > IV > III > II
(C) II > I > III > IV (D) IV > III > I > II

Q.4 The reaction of  with HBr gives : **[JEE 1998]**

(A) 

(B) 

(C) 

(D) 

Q.5 An aromatic molecule will: **[JEE 1999]**

(A) have 4n π electrons
(B) have (4n +2) π electrons
(C) be planar
(D) be cyclic

Q.6 The enol form of acetone, after Prolonged treatment with D_2O, gives: **[JEE 1999]**

(A) $CH_3 – \overset{\overset{OD}{|}}{C} = CH_2$ (B) $CH_3 – \overset{\overset{O}{\|}}{C} – CH_3$

(C) $CH_2 = \overset{\overset{OH}{|}}{C} – CH_2D$ (D) $CD_2 = \overset{\overset{OD}{|}}{C} – CD_3$

Q.7 A solution of (+) 1-chloro-1-phenylethane in toluene racemizes slowly in the presence of small amount of $SbCl_5$ due to formation of: **[JEE 1999]**

(A) carbanion (B) carbene
(C) free radical (D) carbocation

Q.8 Amongst the following, the most basic compound is : **[JEE 2000]**

(A) $C_6H_5NH_2$ (B) $p\text{-}NO_2–C_6H_4NH_2$
(C) $m\text{-}NO_2–C_6H_4NH_2$ (D) $C_6H_5CH_2NH_2$

Q.9 The correct order of basicities of the following compounds is: **[JEE 2001]**

$CH_3 – C\begin{smallmatrix} \nearrow NH \\ \searrow NH_2 \end{smallmatrix}$ (1) $CH_3CH_2NH_2$ (2) $(CH_3)_2NH$ (3) $CH_3\overset{\overset{O}{\|}}{C}NH_2$ (4)

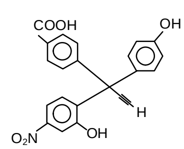
(A) 2 > 1 > 3 > 4 (B) 1 > 3 > 2 > 4
(C) 3 > 1 > 2 > 4 (D) 1 > 2 > 3 > 4

Q.10 Left to right sp^2, sp^2, sp, sp hybridization is present in : **[JEE 2003]**

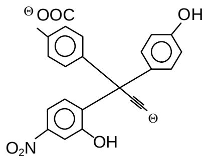
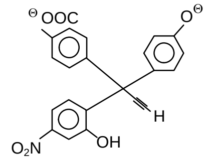
(A) $H_2C = CH – C \equiv N$ (B) $H_2C = C = CH –CH_3$
(C) $HC \equiv C – C \equiv CH$ (D) $HC \equiv C – CH = CH_2$

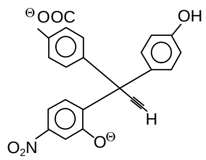
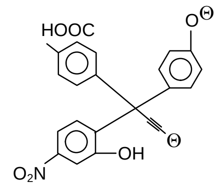
Q.11 Maximum dipole moment will be of: **[JEE 2003]**

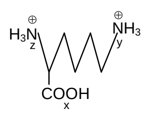
(A) CCl_4 (B) $CHCl_3$ (C) CH_2Cl_2 (D) CH_3Cl

Q.12 

when X is made to react with 2 eq. of $NaNH_2$ the product formed will be : **[JEE 2003]**

(A)  (B) 

(C)  (D) 

Q.13  **[JEE 2004]**

Correct order of acidic strength is:

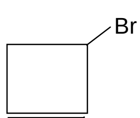
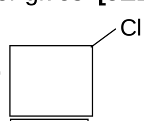
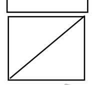
(A) x > y > z (B) z > y > x
(C) y > z > x (D) x > z > y

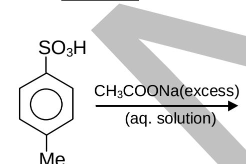
Q.14 Order of rate of reaction of following compound with phenyl magnesium bromide is: **[JEE 2004]**

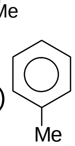
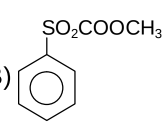
$Ph-\underset{\underset{O}{\|}}{C}-Ph$ (I) $Me-\underset{\underset{O}{\|}}{C}-H$ (II) $Me-\underset{\underset{O}{\|}}{C}-Me$ (III)

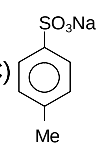
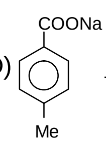
(A) I > II > III (B) II > III > I
(C) III > I > II (D) II > I > III

Q.15 1-Bromo-3-chloro cyclobutane on reaction with 2-equivalent of sodium in ether gives **[JEE 2005]**

(A)  (B) 
(C)  (D) 

Q.16  **[JEE 2005]**

(A)  (B) 

(C)  + CH_3COOH (D)  + H_2SO_4

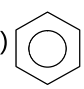
Q.17 Conversion of cyclohexanol into cyclohexene is most effective in: **[JEE 2005]**

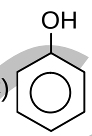
(A) concentrated H_3PO_4 (B) concentrated HCl
(C) concentrated $HCl/ZnCl_2$
(D) concentrated HBr

Q.18 For 1-methoxy-1,3- butadiene, which of the following resonating structure is the least stable? **[JEE 2005]**

(A) $H_2\overset{\ominus}{C}-\overset{\oplus}{C}H-CH=CH-O-CH_3$
(B) $H_2\overset{\ominus}{C}-CH=CH-CH=\overset{\oplus}{O}-CH_3$
(C) $H_2C=CH-\overset{\oplus}{C}H-\overset{\ominus}{C}H-O-CH_3$
(D) $H_2C=CH-\overset{\ominus}{C}H-CH=\overset{\oplus}{O}-CH_3$

Q.19 $Ph-MgBr + CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH \longrightarrow A$

(A)  (B) $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OPh$

(C)  (D) $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-Ph$

Q.20 When benzene sulfonic acid and p-nitrophenol are treated with $NaHCO_3$, the gases released respectively are **[JEE 2006]**

(A) SO_2, NO_2 (B) SO_2, NO
(C) SO_2, CO_2 (D) CO_2, CO_2

Q.21 (I) 1,2-dihydroxy benzene
(II) 1,3-dihydroxy benzene
(III) 1,4-dihydroxy benzene
(IV) Hydroxy benzene **[JEE 2006]**

The increasing order of boiling points of above mentioned alcohols is

(A) I < II < III < IV (B) I < II < IV < III
(C) IV < I < II < III (D) IV < II < I < III

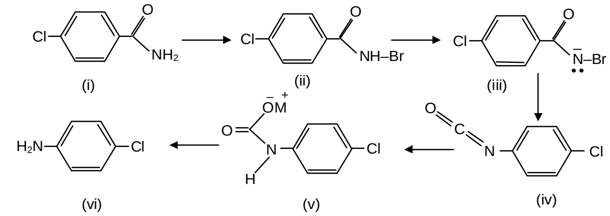
Q.22 $CH_3NH_2 + CHCl_3 + KOH \rightarrow$ Nitrogen containing compound + KCl + H_2O. Nitrogen containing compound is **[JEE 2006]**

(A) $CH_3-C\equiv N$ (B) $CH_3-NH-CH_3$
(C) $CH_3-\overset{-}{N}\equiv\overset{+}{C}$ (D) $CH_3\overset{+}{N}\equiv\overset{-}{C}$

Question No. 23 to 25 (3 questions)

Comprehension I

$RCONH_2$ is converted into RNH_2 by means of Hofmann bromamide degradation.

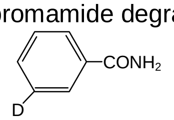


In this reaction, RCONHBr is formed from which this reaction has derived its name. Electron donating group at phenyl activates the reaction. Hofmann degradation reaction is an Intramolecular reaction.

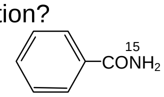
Q.23 How can the conversion of (i) to (ii) be brought about? **[JEE 2006]**
(A) KBr (B) KBr + CH_3ONa
(C) KBr + KOH (D) Br_2 + KOH

Q.24 Which is the rate determining step in Hofmann bromamide degradation? **[JEE 2006]**
(A) Formation of (i) (B) Formation of (ii)
(C) Formation of (iii) (D) Formation of (iv)

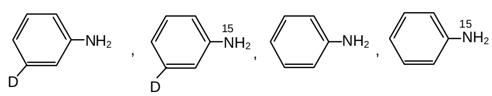
Q.25 What are the constituent amines formed when the mixture of (i) and (ii) undergoes Hofmann bromamide degradation?

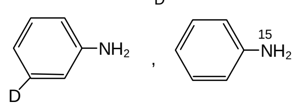


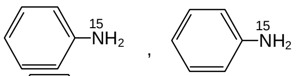
(i)

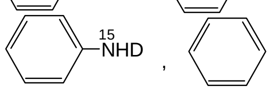


(ii)

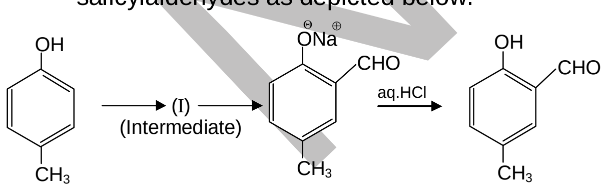
(A) 

(B) 

(C) 

(D)  **[JEE 2006]**

Paragraph for Question Nos. 26 to 28 (3 questions)
Riemer-Tiemann reaction introduces an aldehyde group, on to the aromatic ring of phenol, ortho to the hydroxyl group. This reaction involves electrophilic aromatic substitution. This is a general method for the synthesis of substituted salicylaldehydes as depicted below.

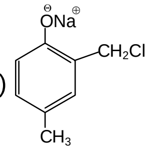
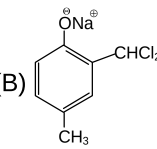


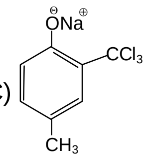
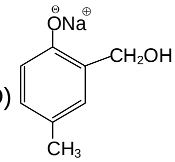
(I) (II) (III)

Q.26 Which one of the following reagents is used in the above reaction? **[JEE 2007]**
(A) aq. NaOH + CH_3Cl (B) aq. NaOH + CH_2Cl_2
(C) aq. NaOH + $CHCl_3$ (D) aq. NaOH + CCl_4

Q.27 The electrophile in this reaction is **[JEE 2007]**
(A) : CHCl (B) $^+CHCl_2$
(C) :CCl_2 (D) •CCl_3

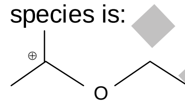
Q.28 The structure of the intermediate I is: **[JEE 2007]**

(A)  (B) 

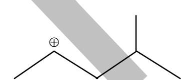
(C)  (D) 

Q.29 Hyperconjugation involves overlap of the following orbitals: **[JEE 2008]**
(A) $\sigma - \sigma$ (B) $\sigma - p$ (C) $p - p$ (D) $\pi - \pi$

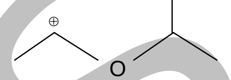
Q.30 The correct stability order for the following species is: **[JEE 2008]**



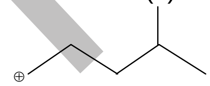
(I)



(II)



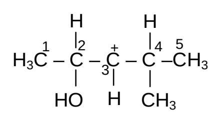
(III)



(IV)

(A) (II) > (IV) > (I) > (III) (B) (I) > (II) > (III) > (IV)
(C) (II) > (I) > (IV) > (III) (D) (I) > (III) > (II) > (IV)

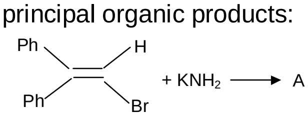
Q.31 In the following carbocation , H/CH_3 that is most likely to migrate to the positively charged carbon is **[JEE 2009]**

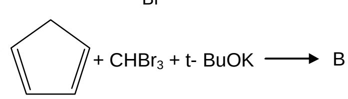


(A) CH_3 at C-4 (B) H at C-4
(C) CH_3 at C-2 (D) H at C-2

EXERCISE – IV (B)

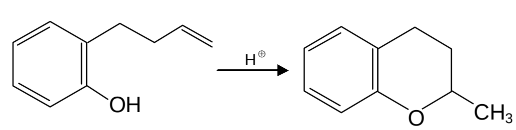
Q.1 Complete the following, giving the structures of the principal organic products: **[JEE 1997]**

(a) 

(b) 

Q.2 Write the intermediate steps for each of the following reaction. **[JEE 1998]**

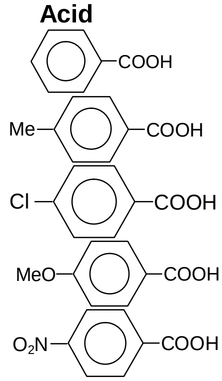
(i) $C_6H_5CH(OH)\,C \equiv CH \xrightarrow{H_3O^{\oplus}} C_6H_5CH = CH - CHO$

(ii) 

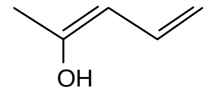
Q.3 Out of anhydrous $AlCl_3$ and hydrous $AlCl_3$ which is more soluble in diethyl ether?
Explain with reason. **[JEE 2003]**

Q.4 Match K_a values with suitable acid: **[JEE 2003]**

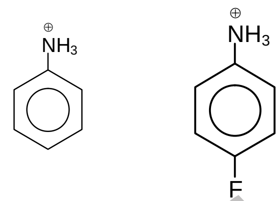
	K_a		Acid
(i)	3.3×10^{-5}	(a)	
(ii)	4.2×10^{-5}	(b)	
(iii)	6.3×10^{-5}	(c)	
(iv)	6.4×10^{-5}	(d)	
(v)	30.6×10^{-5}	(e)	



Q.5 Give resonating structures of the following compound. **[JEE 2003]**



Q.6 Which of the following is more acidic and why? **[JEE 2004]**



ANSWER KEY

EXERCISE-1

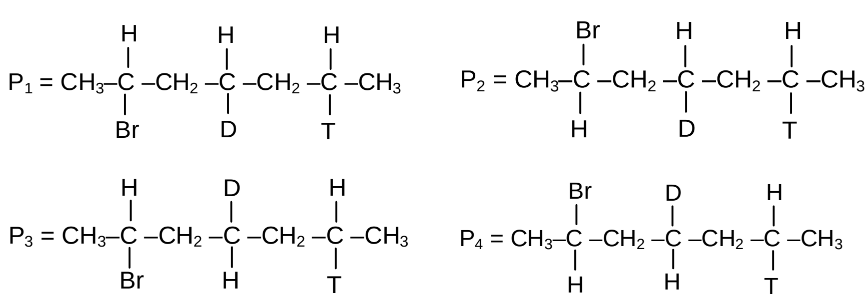
Q.No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Ans.	B	B	C	C	D	B	C	B	D	D	A	D	C	C	B
Q.No.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	C	B	C	A	A	D	C	D	C	B	D	D	B	C	A
Q.No.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Ans.	B	C	D	A	C	A	C	A	B	C	B	C	D	B	A
Q.No.	**46**	**47**	**48**	**49**	**50**										
Ans.	C	D	B	C	A										

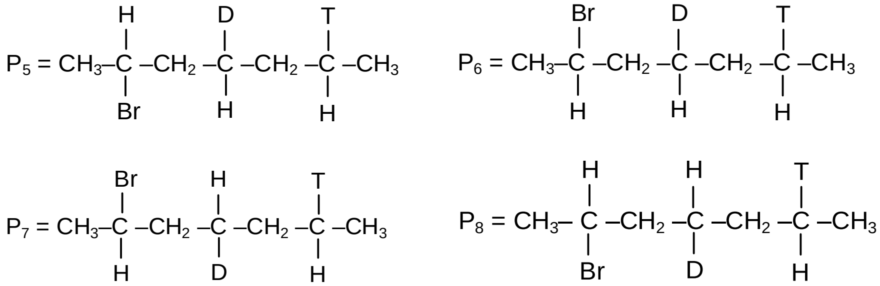
EXERCISE-II

Q.No.	**1**	**A**	**B**	**C**	**D**	**2**	**3**	**4**	**5**	**6**	**7**
Ans.		Q,R	P,S	Q	P,S	A,B,C	B,D	B,C,D	A,B,D	B,D	B,C
Q.No.	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Ans.	A,B,C	A,B	A,B,C	A,B,D	A,B,D	A,B,D	A,B,D	A,B,D	A,B,C	A,B,D	C,D
Q.No.	**19**	**20**	**21**	**22**	**23**	**A**	**B**	**C**	**D**	**E**	
Ans.	A,C,D	B,C	A,C	B		S,T	P,S,T	U	Q	T,U	
Q.No.	**24**	**A**	**B**	**C**	**D**	**25**	**A**	**B**	**C**	**D**	
Ans.		Q,S	Q,R	P,R	P		P,Q	Q,S	P	R	

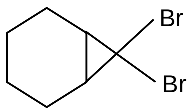
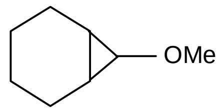
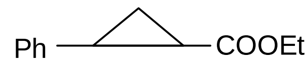
EXERCISE-III

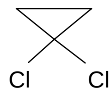
Q.1



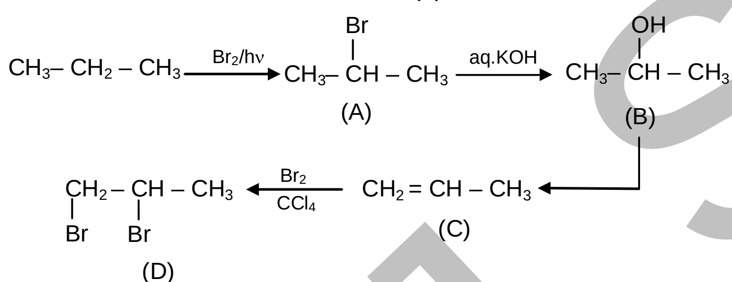


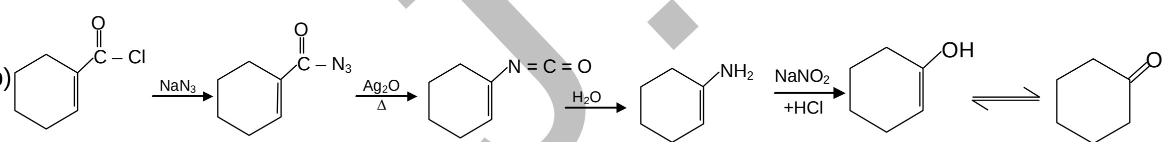
Q.2 (i) a > b > c; (ii) a > b > c ; (iii) b > a > c Q.3 (a) Due to Resonance

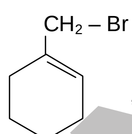
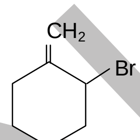
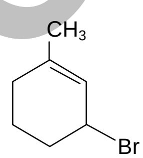
Q.4 (i)  &  (ii) 

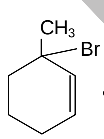
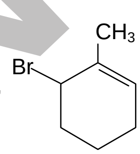
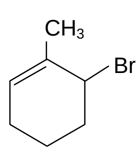
(iii) A : $:CCl_2$ B : 

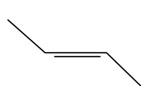
Q.5 (a) Free radical mechanism (b) Due to more electron density

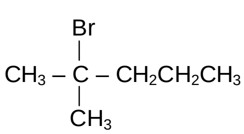
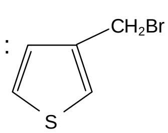
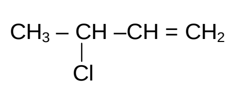
Q.7 (a) 

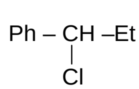
(b) 

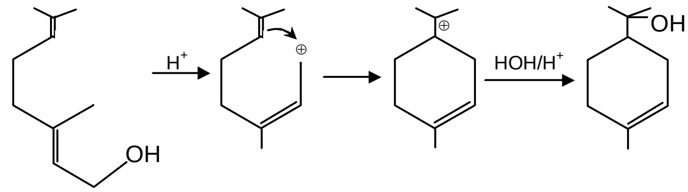
Q.8  ,  and its enantiomer,  and its enantiomer,

 and its enantiomer,  , 

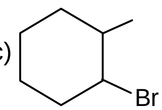
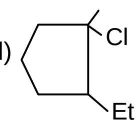
Q.11 1.15 times more reaction Q.12 A = 

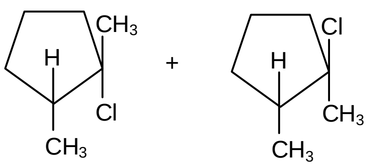
Q.13 (a) A :  (b)B :  (c) C: 

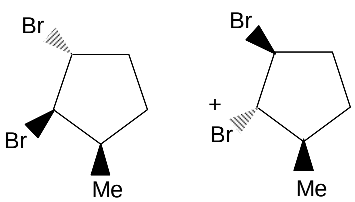
D: CH_3– CH = CH–CH_2Cl (d) E: 

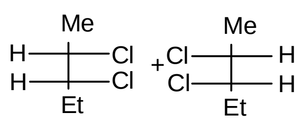
Q.15 (b) 

Q.16 (a) II, (b) I   Q.17 (a) II, (b) I, (c) II

Q.19 (a) Ph –CH(Br) – Et   (b) $Me_2C(I)$ –Et,   (c)    (d) 

Q.20 (a)  (diastereoisomers)

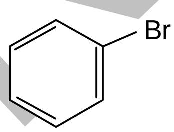
(b)  (diastereoisomers)

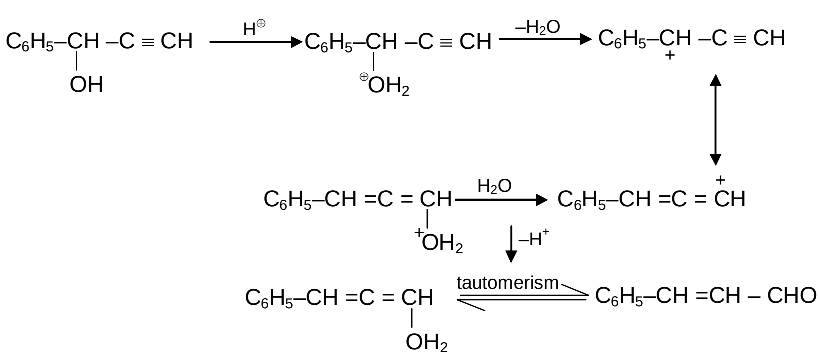
(c)  (Enantiomers)

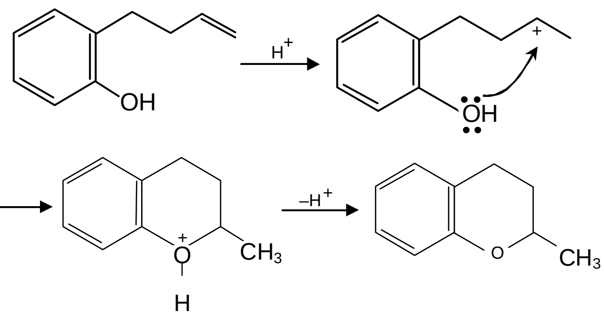
EXERCISE –IV(A)

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	D	D	B	B,C,D	D	D	D	B	A	D	C	D	B	C
Q.No.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	C	A	C	A	D	C	D	D	D	B	C	C	B	B	D
Q.No.	**31**														
Ans.	D														

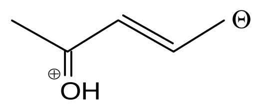
EXERCISE –IV(B)

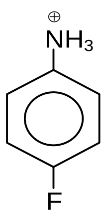
Q.1 (A) PhC ≡ CPh, (B) 

Q.2 

(ii) 

Q.3 Anhydrous $AlCl_3$ is more stable then hydrous $AlCl_3$ because it is having vacant 3p orbital of Al which can accept lone pair of electrons from oxygen of diethylether.

Q.4 (i)-(d), (ii)- (b), (iii) –(a), (iv) –(c), (v)-(e) Q.5 

Q.6  is more acidic as overall effect of –F is electron withdrawing so loss of portion is easier from this compound.