Additional Problems for Self Practice (APSP)

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

PART - I : PRACTICE TEST PAPER

Max. Marks : 120 **Max. Time : 1 Hr.**

Important Instructions

1. The test is of **1 hour** duration.

2. The Test Booklet consists of **30** questions. The maximum marks are **120.**

3. Each question is allotted **4 (four)** marks for correct response.

4. Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question.
¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

5. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 4 above.

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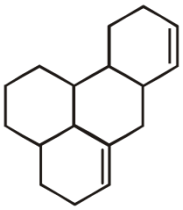
1. Degree of unsaturation of product form after complete hydrogenation of the following compound :

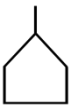
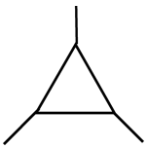
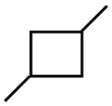


(1) 0 (2) 2 (3) 6 (4) 4

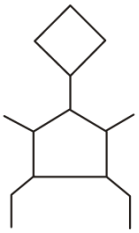
2. How many isomeric structural alkene on catalytic hydrogenation gives 3-Methyl hexane.

(1) 3 (2) 4 (3) 5 (4) 6

3. Compound A (C_6H_{12}) does not absorb H_2 in presence of Ni. It forms two monochloro isomers on photochemical chlorination. Its structure can be :

(1)  (2)  (3)  (4) 

4. How many cyclo alkenes (structural only) on hydrogenation can give following compound.

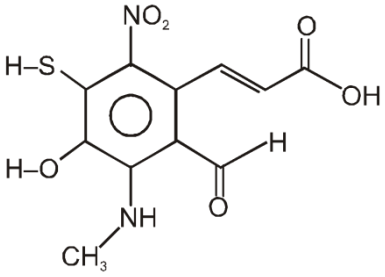


(1) 7 (2) 8 (3) 9 (4) 10

5. How many structural isomers of C_5H_{10} give bromine water test ?

(1) 1 (2) 3 (3) 5 (4) 10

6. When one mole of the given compound reacts with sodium metal then how many moles of H_2 gas will release?



(1) 1 mole (2) 1.5 mole (3) 2.0 mole (4) 2.5 mole

7. Which of the following compounds will give a positive iodoform test ?

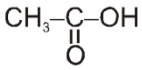
(1) methanol (2) 2,2-dimethylpropanol

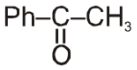
(3) α-haloethanol (4) methanal

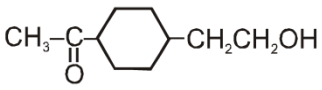
8. Which of the following reagent is used to distinguish between benzylamine and aniline ?

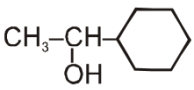
(1) $CHCl_3$ + alc. KOH (2) Azodye test (3) $HgCl_2 + CS_2$ (4) Tollen's test

9. Which of the following compound can not give Iodoform when react with IO^-(hypoiodite).

(1) 

(2) 

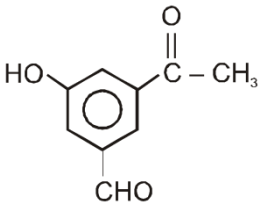
(3) 

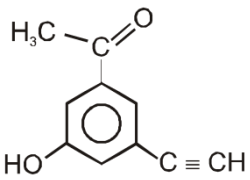
(4) 

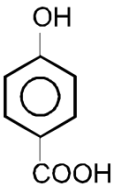
10. How many structural isomeric ketones having molecular formula ($C_5H_{10}O$) give iodoform test ?

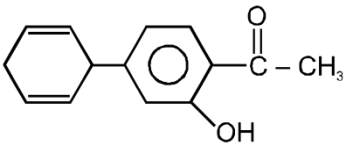
(1) 1 (2) 2 (3) 3 (4) 4

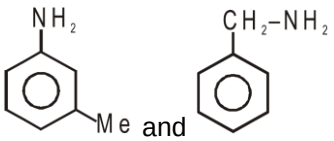
11. A compound which can give iodoform test, bromine water test, $FeCl_3$ test but not Tollen's test.

(1) 

(2) 

(3) 

(4) 

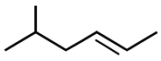
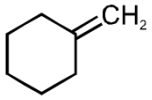
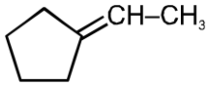
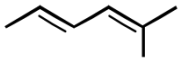
12.  can be distinguish by

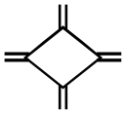
(1) $CHCl_3$ + KOH (2) $NaNO_2$ + HCl followed by β-Napthol

(3) $CS_2 + HgCl_2$ (4) Na Metal

13. (x) $C_7H_{12} \xrightarrow[Me_2S]{O_3}$ P + Q

Compound P responds to Tollen's test and iodoform test but Q does not respond with both the reagents. Structure of compound (x) is :

(1)  (2)  (3)  (4) 

14.  $\xrightarrow{H_2/Ni}$ P $\xrightarrow{Cl_2/h\nu}$ Q (Total number of monochloro structural products).

(1) 2 (2) 3 (3) 4 (4) 5

15. Yellow precipitate obtained during the test of halogen by lassaigne's test is due to the formation of

(1) AgF (2) AgCl (3) AgBr (4) None of these

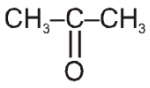
16. A research scholar get a mixture of three product during an experiment with ammonia. In product I only one H of ammonia is replaced by ethyl group and in II two H atoms of ammonia are replaced by ethyl groups and in III all the H-atoms are replaced by ethyl groups . Which test he should use to distinguish or separate the products :

(1) Carbyl amine test (2) Iodoform test (3) Fehling solution test (4) Hinsberg test

17. How many alcohols give immediate turbidity with Lucas reagent having molecular formula ($C_5H_{12}O$):

(1) 1 (2) 2 (3) 3 (4) 4

18. Which of the following compound can give test with Tollen's reagent and yellow precipitate with iodine in NaOH ?

(1) $CH_2=O$ (2) $CH_3–CH=O$ (3) $CH_3–CH_2–CH=O$ (4) 

19. Which is incorrect match with respect to the reagent used for lab test ?

(1) Carbohydrates → α–Naphthol (Molish reagent)

(2) Nitro ethane → Zn, NH_4Cl and $AgNO_3$ (Muliken Barker test)

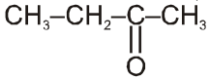
(3) Phenol → Anhydrous $ZnCl_2$ + Conc. HCl (Lucas Reagent)

(4) Benzoic acid → $NaHCO_3$

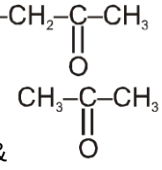
20. How many hydrocarbons having molecular mass 68 can give white precipitate with Tollen's reagent ?

(1) 1 (2) 2 (3) 3 (4) 4

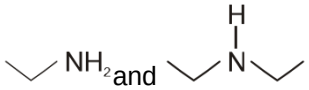
21. On oxidative ozonolysis of 3-Methylhex-3-ene, two products A & B are formed. A gives CO_2 gas with sodium bicarbonate, but B can not. The structures of A & B are respectively :

(1)  & $CH_3–CH_2–COOH$

(2) $CH_3–CH_2–COOH$ & $CH_3–CH_2–CH=O$

(3) $CH_3–CH_2–COOH$ & 

(4) $CH_3–CH_2–CH_2–COOH$ &

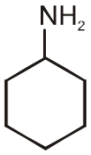
22.  and can be differentiated by :

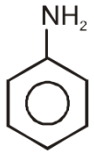
(1) Carbylamine reaction (2) Iodoform test (3) Cold $KMnO_4$ (4) Br_2–H_2O

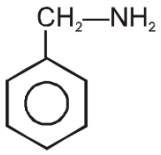
23. In the Dumas method for the estimation of nitrogen, 0.0237 grams of an organic compound gave 2.21 mL of nitrogen at 754.32 mm of Hg pressure at 18°C. (Aqueous tension at 18°C is 15.4 mm of Hg.) Therefore the percentage of nitrogen in the compound is

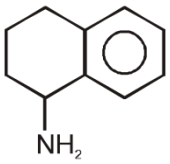
(1) 20.67% (2) 10.6% (3) 11.2% (4) 13.9%

24. Which of the following compound gives azo dye test ?

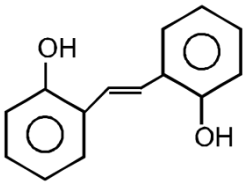
(1) 

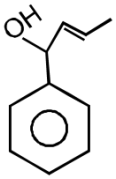
(2) 

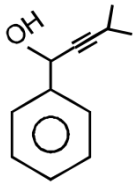
(3) 

(4) 

25. A compound (P), obtained as an ozonolysis product of (Q) gives brisk effervescence with Na, violet coloration with neutral $FeCl_3$ and silver mirror with Tollen's reagent. (Q) may be :

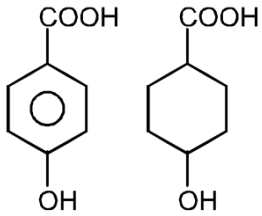
(1) 

(2) 

(3) 

(4) All of these

26. Which of the following reagent can distinguish the given compound I & II ?



I & II

(1) Na metal (2) $NaHCO_3$ (3) Lucas Reagent (4) 2, 4-D.N.P

27. The percentage of nitrogen in a compound is determined by

(1) Nessler`s method

(2) Kjeldahl`s method

(3) Carius method

(4) taking the difference between total percentage and the sum of percentages of all other elements present.

28. Fehlings solution is

(1) $AgNO_3$ solution + NaOH solution + NH_4OH

(2) Alkaline solution of Cupric ion complexed with citrate ion

(3) Copper sulphate + sodium potassium tartarate + NaOH

(4) Copper sulphate solution

29. Identify a reagent from the following list which can easily distinguish between 1-butyne and 2-butyne.

(1) bromine, CCl_4 (2) H_2/Ni

(3) dilute $KMnO_4$ (4) ammonical Cu_2Cl_2 solution

30. Acetaldehyde and Propyne can be distinguish by :

(i) Tollen's reagent (ii) I_2/NaOH (iii) Lucas reagent (iv) neutral $FeCl_3$

(1) (i) , (ii) & (iii) (2) (ii) & (iii) (3) (i) & (ii) (4) (iii) & (iv)

Practice Test (JEE-Main Pattern)

OBJECTIVE RESPONSE SHEET (ORS)

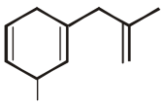
Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

PART - II : PRACTICE QUESTIONS

1. Quinine is the most important alkaloid obtained from Cinchona bark. It's molecular formula is $C_{20}H_{24}N_2O_2$. It may contain

(1) 5 double bond & 6 ring (2) 6 double bond & 4 ring

(3) 6 double bond & 3 ring (4) 7 double bond & 5 ring

2.  (P) $\xrightarrow{H_2/Ni}$ Q

Which of the following is the correct statement about P & Q.

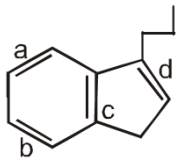
(1) Product will be 1-Methyl-3-(2-methylpropyl)cyclohexane.

(2) Product will be 3-Methyl-1-(2-methylpropyl)cyclohexane.

(3) DU of reactant P is 3.

(4) DU of product Q is zero.

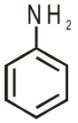
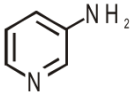
3. If 1 mole H_2 is reacted with 1 mole of the following compound.



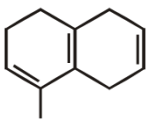
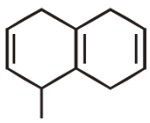
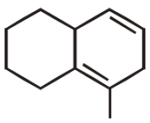
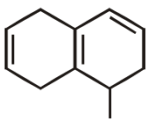
Which double bond will be hydrogenated ?

(1) c (2) b (3) a (4) d

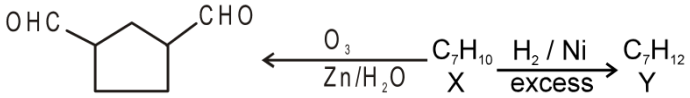
4. Which of the following compound is/are having D.U. more than or equal to 4.

(1)  (2)  (3)  (4) All of these

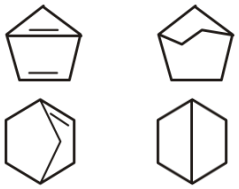
5. Which of the following compound on reductive ozonolysis gives 3, 4-Dioxopentanal and 3-Oxohexane-1,6-dial.

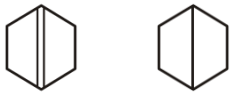
(1)  (2)  (3)  (4) 

6. For the following reactions sequence



The structures of X and Y are :

(1) 

(2) 

(3)

(4) 

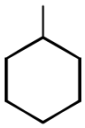
7. An alkane with the molecular formula C_7H_{16} forms seven monochlorinated products. The name of the alkane is :

(1) Heptane (2) 2-Methylhexane

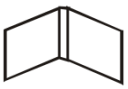
(3) 3-Methylhexane (4) 2,3-Dimethylpentane

8. $X \xrightarrow{Cl_2/h\nu}$ 4-structural products.

Identify 'X'

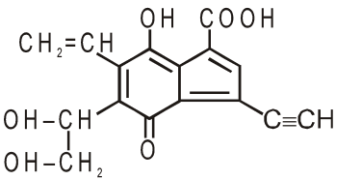
(1)  (2)  (3)  (4) 

9. A organic compound (C_6H_8) gives only one symmetrical diketone on ozonolysis. The product diketone gives 2,4-DNP test but does not give iodoform test. Structure of organic compound can be :

(1)  (2)  (3)  (4) 

10. Compound 'A' gives red precipitate with Cu_2Cl_2 / NH_4OH solution and decolourises bromine water. The compound 'A' can be :

(1) $CH_2 = CH - \overset{\overset{O}{\|}}{C} - CH_3$ (2) $CH_2 = CH - \overset{\overset{O}{\|}}{C} - H$ (3) $CH_3 - C \equiv CH$ (4) PhCHO

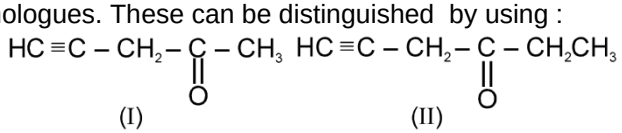
11. 

$\xrightarrow{Na-Metal}$ Number of Hydrogen mole = x

then find the value of 2x.

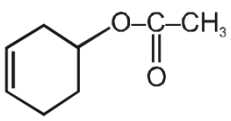
(1) 5 (2) 4 (3) 6 (4) 3

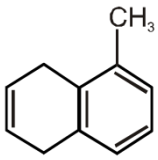
12. I and II are homologues. These can be distinguished by using :

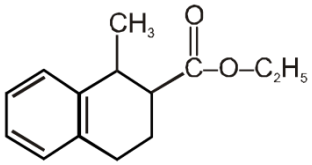


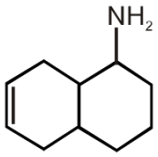
(1) Tollen's reagent (2) 2, 4 – DNP (3) Baeyer's reagent (4) I_2 + NaOH

13. Which amongs the following will give test of both acidic hydrogen and unsaturation test.

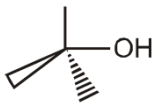
(1) 

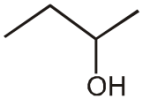
(2) 

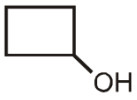
(3) 

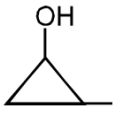
(4) 

14. Alcohol X having four carbon atoms. It gives Lucas test in 10 min. Which cannot be the alcohol X.

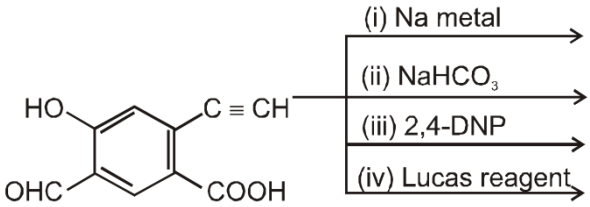
(1) 

(2) 

(3) 

(4) 

15. Observe the following compound and select +ve & – ve test respectively.



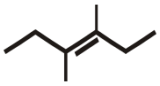
(1) + + + – (2) + + + + (3) + – + – (4) + – – +

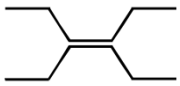
16. How many structural isomers of molecular formula $C_5H_{10}O$ give chloroform with NaOCl ?

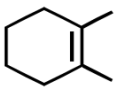
(1) 2 (2) 3 (3) 4 (4) 6

17. A alkene on ozonolysis give only one product(X). x does not respond with Tollen's reagent and NaOI but give yellow precipitate with 2,4-DNP, The structure of alkene can be-

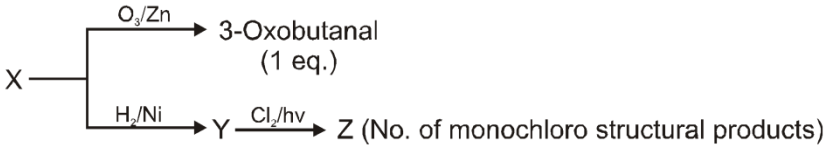
(1) 

(2) 

(3) 

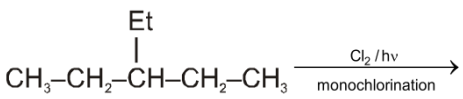
(4) 

18.



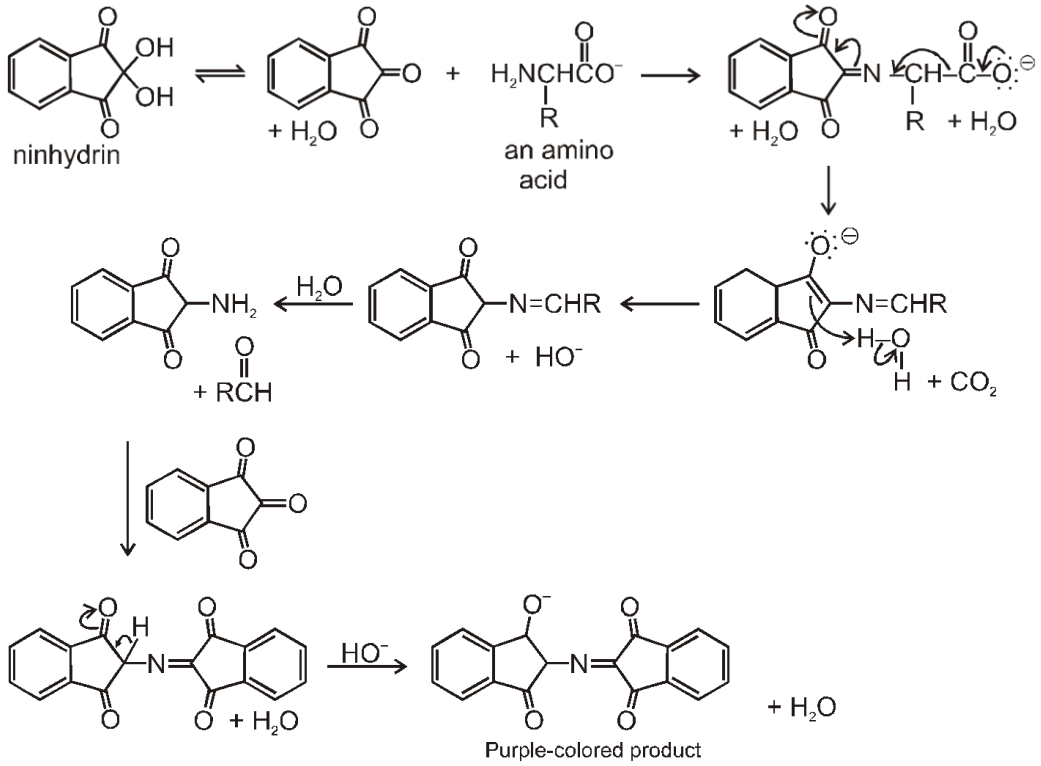
Number of Z are :

(1) 2 (2) 3 (3) 4 (4) 5

19.  products (only structural isomers).

(1) 5 (2) 4 (3) 3 (4) 2

20. The given below reaction of ninhydrin with amino acid is used to test for :



(1) Proteins (2) Carbohydrates (3) Ketones (4) Carboxylic acids

ADDITIONAL THEORY

1. Quantitative analysis :

After the detection of various elements in the organic compound, the next step is the determination of their percentage composition. The determination of the percentage of various elements is also referred to as **estimation of elements.** The different methods employed for the estimation of various elements are being discussed as follows :

(1) Estimation of Carbon and Hydrogen :

(Liebig's Method)

Carbon and hydrogen in the organic compound are estimated together.

Principle :

A known mass of the organic compound is heated with dry copper oxide in an atmosphere of air or oxygen free from moisture and carbon dioxide. The carbon and hydrogen of the organic compounds are oxidized to carbon dioxide and water respectively.

$$C + 2CuO \longrightarrow CO_2 + 2Cu$$

$$2H + CuO \longrightarrow H_2O + Cu$$

Carbon dioxide produced is collected in potash bulbs (containing KOH) whereas water is absorbed in calcium chloride tube (containing $CaCl_2$). The respective masses of CO_2 and H_2O are determined by difference.

Knowing the masses of CO_2 and water vapours formed and the mass of the compound taken, the percentage of carbon and hydrogen can be calculated.

Calculations :

Let the mass of the organic compound taken = *w g*
Mass of water formed = x g
(Indicated by increase in the mass of U tube)
Mass of carbon dioxide formed = y g
(Indicated by increase in the mass of potash bulb)

(i) Percentage of Carbon :

44 g of CO_2 (G.M.M.) contains carbon = 12 g

y g of CO_2 contains carbon = $\frac{12y}{44}$ g

Now, $\frac{12y}{44}$ g of carbon is present in w g of organic compound.

∴ Percentage of carbon in the organic compound = $\frac{12y}{44 \times w} \times 100$

(ii) Percentage of Hydrogen :

18 g of H_2O (G.M.M) contains hydrogen = 2g

x g of H_2O contains hydrogen = $\frac{2x}{18}$ g

Now, $\frac{2x}{18}$ g of hydrogen is present in w g of organic compound.

∴ Percentage of hydrogen in the organic compound = $\frac{2x}{18w} \times 100$

In Short, %C = $\frac{12 \times W_{CO_2} \times 100}{44 \times W_{substance}}$ and **%H =** $\frac{2 \times W_{H_2O} \times 100}{18 \times W_{substance}}$

Que. 0.378 g of an organic acid gave on combustion 0.264 g of carbon dioxide and 0.162 g of water vapour. Calculate the percentage of C and H.

Ans. Mass of organic compound **=** 0.378 g
Mass of CO_2 formed = 0.264 g
Mass of H_2O formed = 0.162 g

(i) Percentage of carbon

44 g of CO_2 contains carbon = 12 g

0.264 g of CO_2 contains carbon = $\frac{12}{44} \times 0.264 = 0.072$ g

Percentage of carbon = $\frac{0.072}{0.378} \times 100 = 19.04\%$

(ii) Percentage of hydrogen

18 g of H_2O contains hydrogen = 2 g

0.162 g of H_2O contains hydrogen = $\frac{2}{18} \times 0.162 = 0.018$ g

Percentage of hydrogen = $\frac{0.018}{0.378} \times 100 = 4.76\%$

(2) Estimation of Nitrogen :

There are two methods in use for the estimation of nitrogen. These are :

(A) Duma's Method (B) Kjeldahl's Method.

(A) Duma's Method : This method is applicable to nitrogenous compounds.

Principle :

A known mass of the organic compound is heated strongly with excess of copper oxide in an atmosphere of carbon dioxide. The carbon and hydrogen are converted to CO_2 and water. Nitrogen is set free as dinitrogen. If any oxide of nitrogen is produced, it is reduced to dinitrogen by passing over hot reduced copper spiral. The dinitrogen is collected over the concentrated solution of potassium hydroxide and its volume is measured at room temperature and atmospheric pressure.

The chemical reaction can be represented as :

$$\underbrace{C + 2H}_{\text{Organic compound}} + 3CuO \longrightarrow CO_2 + H_2O + 3Cu$$

$$\underbrace{2N}_{\text{Organic compound}} + Cu \longrightarrow N_2 + \text{oxides of nitrogen}$$

$$\text{Oxides of nitrogen} + Cu \longrightarrow N_2 + CuO$$

(Reduced copper gauze)

Calculations :

Let the mass of the organic compound taken = W g

Volume of moist N_2 collected = v cm^3

Barometric pressure = P mm

Room temperature = T K

Pressure of water vapours at T K = p mm

Pressure of dry N_2 = (P – p) mm

Step I. To reduce the volume of N_2 to S.T.P.

$V_1 = v\ cm^3$, V_2 = ?

$P_1 = (P - p)$, P_2 = 760 mm

$T_1 = T$, T_2 = 273 K

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_2 = \frac{P_1V_1}{T_1} \times \frac{T_2}{P_2} = \frac{(P-p)v \times 273}{T \times 760}$$

Step II. Calculation of percentage of nitrogen

22400 cm^3 of N_2 at S.T.P. weights = $\frac{28\,V_2}{22400}$ g

Now amount of nitrogen present in W g of organic compound = $\frac{28\,V_2}{22400}$ g

Percentage of N in organic compound = $\frac{28\,V_2}{22400} \times \frac{100}{W}$.

In Short, % N = $\frac{28 \times V_{N_2}(\text{S.T.P.}) \times 100}{22400 \times W_{\text{Substance}}}$

Questions based on Duma's Method :

Que. 0.25 g of an organic compound gave 30 cm^3 of moist dinitrogen at 288 K and 745 mm pressure. Calculate the percentage of nitrogen. (Aq tension of 288 K = 12.7 mm).

Ans. Mass of the substance = 0.25 g
Volume of moist dinitrogen = 30 cm^3
Temperature = 288 K
Pressure = 745 –12.7 = 732.3 mm

Step I. To reduce the volume of N_2 at S.T.P.

We know , $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

P_2, T_2, V_2 refer to S.T.P. conditions)

$V_2 = \frac{P_1V_1}{T_1} \times \frac{T_2}{P_2} = \frac{732.3 \times 30 \times 273}{288 \times 760}$ = 27.4 cm^3.

Step II. Calculation of percentage of nitrogen.

22400 cm^3 of dinitrogen at S.T.P. weighs = 28 g

27.4 cm^3 of dinitrogen at S.T.P. weighs = $\frac{28 \times 274}{22400} = 0.034$ g

Percentage of nitrogen in organic compound = $\frac{0.034}{0.25} \times 100$ = 13.6.

(B) **Kjeldahl's Method :**

This method is simpler and convenient. It is largely used for the estimation of nitrogen in food, fertilizers and drugs. The method is however not applicable to compounds containing nitrogen in the ring like pyridine or quinoline etc, and the compounds, containing nitro (–NO_2) and diazo (–N = N–) groups.

Principle :

A known mass of the organic compound is heated with concentrated sulphuric acid. The nitrogen in the organic compound is quantitatively converted into ammonium sulphate. The resulting liquid is then distilled with excess of sodium hydroxide solution and the ammonia evolved is passed into a known but excess volume of the standard acid (HCI or H_2SO_4). The acid left unused is estimated by titration with some standard alkali. The amount of acid used against ammonia can thus, be known and from this, the percentage of nitrogen in the compound can be calculated.

Chemical reactions involved are :

$$\underbrace{C + H + S}_{\text{Organic compound}} \xrightarrow[H_2SO_4]{\text{conc.}} CO_2 + H_2O + SO_2$$

$$N \xrightarrow[H_2SO_4]{\text{conc.}} (NH_4)_2SO_4$$

$$(NH_4)_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2NH_3 + 2H_2O$$

$$2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$

Calculation :

Let the mass of organic compound = W g
Volume of standard acid (say HCI) taken = V cm^3
Let molarity of acid = M_1
Let volume of acid unused be = v_1
Let volume of alkali (say NaOH) of molarity M_2 used for neutralising unused acid = v_2

Chemical equation for titration involved is

$$NaOH + \underset{\text{unused}}{HCl} \longrightarrow NaCl + H_2O$$

∴ According to molarity relation

$$\frac{M_2 v_2}{1} = \frac{M_1 v_1}{1} \quad \text{or} \quad v_1 = \frac{M_2 v_2}{M_1}$$

Volume of acid used by ammonia = $(V - v_1)$ cm^3

Millimoles of acid used by ammonia = $(V - v_1) \times M_1$

Milimoles of NH_3 formed = Millimoles of acid used up

= $(V - v_1) \times M_1$

Mass of NH_3 formed = Millimoles $\times 10^{-3} \times$ Molar mass

$= (V - v_1) \times M_1 \times 10^{-3} \times 17$g

$$= \frac{(V - v_1) M_1 \times 10^{-3} \times 17 \times 14}{17}$$

Mass of N = a g (say)

$$\text{Percentage of N} = \frac{a \times 100}{W}$$

In Short % N $= \dfrac{1.4 \times M_{(acid)} \times \text{basicity of acid} \times V_{(acid\ used)}}{W_{Substance}}$ or $= \dfrac{1.4 \times N_{(acid)} \times V_{(acid\ used)}}{W_{Substance}}$

Questions based on Kjeldahl's Method :

Que. During nitrogen estimation in an organic compounds by Kjeldahl's method, the ammonia evolved from 0.5 g of the compound neutralised 10 ml, of 1 M H_2SO_4, What is the % of N in the organic compound ?

Ans. Volume of 1 M H_2SO_4 used by NH_3 = 10 ml,

Millimoles of H_2SO_4 used = 10 × 1 = 10 m. moles

Millimoles of NH_3 produced = 2 × millimoles of H_2SO_4

= 2 ×10 = 20

(2 mol of NH_3 neutralise 1 mol of H_2SO_4)

Mass of NH_3 formed = Moles of NH_3 × Molar mass = $20 \times 10^{-3} \times 17$ g

$$\text{Mass of N} = \frac{20 \times 10^{-3} \times 17 \times 14}{17} = 0.28 \text{ g}$$

$$\% \text{ of N} = \frac{0.28 \times 100}{0.5} = 56.0\%.$$

(3) Carius Method

It is used for the estimation of halogen, sulphur and phosphorus.

Estimation of Halogens : Halogen is estimated as silver halides.

In the process 'w' g of organic halide is treated with acidified silver nitrate solution to silver halide which is washed, dried and weighed. Let 'a' g of AgX is obtained.

$$\% X = \frac{\text{Atomic mass of X}}{\text{Molecular mass of AgX}} \times \frac{\text{Wt. of AgX}}{\text{Wt. of organic halide}} \times 100$$

Thus,

$$\% Cl = \frac{35.5}{143.5} \times \frac{\text{Wt. of AgCl}}{\text{Wt. of organic halide}} \times 100$$

$$\% Br = \frac{80}{188} \times \frac{\text{Wt. of AgBr}}{\text{Wt. of organic halide}} \times 100$$

$$\% I^- = \frac{127}{235} \times \frac{\text{Wt. of AgI}}{\text{Wt. of organic halide}} \times 100$$

Estimation of Sulphur :

Sulphur is estimated as barium sulphate. In the process 'w' g of organic compound having sulphur is taken in carius tube containing HNO_3 where sulphur is finally converted into sulphuric acid. This sulphuric acid is passed through excess $BaCl_2$ to get $BaSO_4$ which is washed dried & weighed. Let 'a' g of $BaSO_4$ is obtained

$$\% S = \frac{\text{Atomic mass of sulphur}}{\text{Molecular mass of } BaSO_4} \times \frac{\text{Wt. of } BaSO_4}{\text{Wt. of organic compound}} \times 100$$

$$\% S = \frac{32}{233} \times \frac{\text{Wt. of } BaSO_4}{\text{Wt. of organic compound}} \times 100$$

Estimation of Phosphorus :

A known mass of the organic compound is heated with fuming nitric acid. The phosphorus present in the organic compound is oxidised to phosphoric acid (H_3PO_4). The phosphoric acid, thus formed is treated with magnesia mixture to get the precipitate of magnesium ammonium phosphate ($MgNH_4PO_4$). The precipitate is separated, dried and ignited to get magnesium pyrophosphate ($Mg_2P_2O_7$). The chemical reactions involved are :

$$\underbrace{P}_{\text{From organic compound}} + 3H + \underbrace{4O}_{\text{From } NHO_3} \xrightarrow{HNO_3} H_3PO_4$$

$$H_3PO_4 + \text{Magnesia mixture} \longrightarrow MgNH_4PO_4$$

$$2MgNH_4PO_4 \longrightarrow \underset{\text{White ppt.}}{Mg_2P_2O_7} + 2NH_3 + H_2O$$

Calculations :

Let the mass of the organic compound = W g

Mass of $Mg_2P_2O_7$ obtained= x g

Now, 222 g (G.M.M.) of $Mg_2P_2O_7$ Contains P = 62 g

x g of $Mg_2P_2O_7$ contains P = $\frac{62x}{222}$ g

Percentage of P in organic compound = $\frac{62x}{222W} \times 100$

$$\% \text{ of } P = \frac{62 \times W_{Mg_2P_2O_7} \times 100}{222 \times W_{\text{Substance}}}$$

Que. (i) In sulphur estimation, 0.157 g of organic compound gave 0.4813 g of $BaSO_4$. What is the percentage of sulphur is organic compound ?
(ii) 0.092 g of organic compound on heating is carius tube and susequent ignition gave 0.111 g of $Mg_2P_2O_7$. Calculate the percentage of phosphorus in organic compound.

Ans. (i) Mass of $BaSO_4$ = 0.4813 g
mass of organic compound. = 0.157 g

$$\% S = \frac{32 \times W_{BaSO_4} \times 100}{233 \times W_{\text{Substance}}} = \frac{32 \times 0.4813 \times 100}{233 \times 0.157} = 42.10$$

(ii) Mass of organic compound = 0.092 g

Mass of $Mg_2P_2O_7$ = 0.111 g

$$\% \text{ of P} = \frac{62 \times W_{Mg_2P_2O_7} \times 100}{222 \times W_{Substance}} = \frac{62 \times 0.111 \times 100}{222 \times 0.092} = 33.69$$

2. Separation techniques :

Purification :

Purification means the removal of undersirable impurities associated with a particular organic compound, i.e. to obtained the organic compound in pure state.

Methods empolyed for purification of solids

Crystallisation

Crystallisation is based on the principles of solubility of compound (solutes). solute tend to be more soluble in hot liquid (solvent) than they are in cool liquid. If a saturated hot solution is allowed to cool, the solute is no longer soluble in the solvent and form crystals of pure compound. Solid is filtered and dried.

Examples :

(a) Sugar mixed with common salt can be purified with ethanol.

(b) Phthallic acid mixed with naphthalene can be purified with hot water.

Sublimation

Certain organic substances pass directly from solid to vapour state on heating and vice-versa on cooling. This is called sublimation and the process is very useful for separation of substance which sublime on heating from non volatile substance.

Examples :

Benzoic acid, naphthalene, anthracene, camphor, indigo, anthraquinone.

Solid $\underset{\text{cool}}{\overset{\text{Heat}}{\rightleftharpoons}}$ Vapours

(1) Distillation : It is used to purify liquid on the basis of difference in boiling points.

(a) Simple distillation :

It is applied only for volatile liquids which boil without decomposition at atmospheric pressure and contains non-volatile impurities. It can also be used for separating liquids having sufficient difference in their boiling point.

Ex. (i) Benzene (b.pt. 80ºC) and aniline (b.pt. 184ºC)
(ii) Chloroform (b.pt. 61ºC) and aniline (b.pt. 184ºC)
(iii) Ether (b.pt. 35ºC) and toluene (b.pt. 114ºC)

(b) Fractional distillation :

If boiling points of liquids to be separated are closed to each other then fractional distillation is carried out by using fractionating column.

Ex. (i) Distillation of petroleum, coal tar and crude oil.
(ii) Mixture of methanol (b.pt. 65ºC) and propanone (b.pt. 57ºC).
(iii) Mixture of benzene and toluene.

(c) Vacuum distillation (Distillation under reduced pressure) :

The compounds which decomposes on a temperature below their normal boiling points can not be distilled at atmospheric pressure. If atmospheric pressure is reduced the liquid will boil earlier than its normal boiling point.

Ex. (i) Glycerine can be distilled at 180ºC (b.pt. 280ºC) under a pressure 10-12 mm.
(ii) In soap industry, the separation of glycerol from the spent-lye as carried out by this technique.

(d) Steam distillation :

Those compounds which are steam volatile and are sparingly soluble in water can be separated by steam distillation by passing steam through a heated flask containing the liquid to be distilled. Thus in steam distillation the liquid gets distilled at a temperature lower than its boiling point and any chances of decomposition are avoided.

The proportion of water and liquid in the mixture that distills over is given by the relation

$$\frac{\omega_1}{\omega_2} = \frac{p_1 \times 18}{p_2 \times M}$$

where ω_1 and ω_2 stand for the masses of water and the organic liquid that distills over;

p_1 and p_2 represent the vapour pressures of water and the liquid at the distillation temperature and M is molecular mass of the liquid (molecular mass of water being 18).

Ex. o-, m-, p-chlorotoluenes, o-, p-nitrobenzene.

(2) Solvent Extraction :

The process of separation of organic compound from its aqueous solution by shaking with a suitable organic solvent is termed solvent extraction. The solvent should be immisible with water and the organic compound to be separated should be highly soluble in it.

Ex. Benzoic acid can be extracted from water solution by using benzene.

(3) Chromatography :

It is an extremely valuable method for separation, isolation, purification and identification of constituents of mixture and it is based on the general principle of phase distribution.

This technique is used for the separation of components of a mixture because of the distribution of components between a liquid as gaseous phase (mobile phase) and a solid phase (stationary phase).

Separation of compounds of mixture takes place as a result of differential adsorption - on adsorption column. After the separation, the substances are extracted from the adsorbent with suitable solvent which is called **elusion**.

Common forms of chromatograph

Type	Mobile / Stationary phase	Use
Column	Liquid / Solid	Large scale separation
High performance liquid (HPLC)	Liquid / Solid	Qualitative and Quantitative analysis
Thin layer (TLC)	Liquid / Solid	Qualitative analysis
Gas liquid (GLC)	Gas / Liquid	Qualitative analysis
Paper	Liquid / Solid	Qualitative and Quantitative analysis of polar organic and inorganic compounds.

ADDITIONAL EXERCISE

Section (A) : Separation and purification

1. Chromatography is a valuable method for the separation, isolation, purification and identification of the constituents of a mixture and it is based on general principle of

(1) Phase rule (2) Phase distribution

(3) Interphase separation (4) Distillation

2. Aniline is usually purified by

(1) Chromatographic technique (2) Steam distillation
(3) By addition of oxalic acid (4) Fractional crystallisation

3. Latest technique for purification, isolation and separation of organic compounds is :
(1) chromatography (2) steam distillation (3) crystallisation (4) vacuum distillation

4. Steam distillation is applied to those organic compounds which are steam volatile and :
(1) soluble in water (2) insoluble is water
(3) sparingly soluble in water (4) insoluble in all solvents

5. The most satisfactory method for separating sugars is :
(1) fractional distillation (2) vacuum distillation (3) chromatography (4) steam distillation

6. Distillation involves all the following processes except :
(1) change of state (2) boiling (3) condensation (4) evaporation

7. Oils are purified by :
(1) fractional distillation (2) steam distillation
(3) vacuum distillation (4) simple distillation

8. Chromatography technique is used for the separation of :
(1) small samples of mixtures (2) plant pigments
(3) dye stuffs (4) all of the above

9. Two volatile and miscible liquids can be separated by fractional distillation into pure components under the conditions when :
(1) they have low boiling points
(2) the difference in their boiling points is large
(3) the boiling points of the liquids are close to each other
(4) they do not form azeotropic mixture

10. A fractional column is used in :
(1) sublimation (2) distillation
(3) fractional distillation (4) chromatography

11. Glycerol is purified by :
(1) Steam distillation (2) Vacuum distillation under pressure
(3) Fractional distillation (4) Simple distillation

12. The boiling points of two miscible liquids, which do not form azeotropic mixture, are close to each other. Their separation is best carried out by :
(1) Vacuum distillation (2) Fractional distillation
(3) Steam distillation (4) Redistillation

13. Two immiscible liquids are separated by :
(1) Separating funnel (2) Fractional distillation
(3) Chromatrography (4) Sublimation

14. Sublimation is a process in which a solid :
(1) changes into another allotropic form
(2) changes into liquid form
(3) changes into vapour form directly from solid form
(4) None of the above

15. Anthracene is purified by :
(1) Filtration (2) Distillation (3) Crystallisation (4) Sublimation

Section (B) : Quantitative analysis

16. In Kjeldahl's method, nitrogen present in estimated as :
(1) N_2 (2) NH_3 (3) NO_2 (4) None of these

17. Molecular mass of a volatile organic solid can be determined by :
(1) Silver chloride method (2) Platinic chloride method
(3) Victor Mayer's method (4) Kjeldahl's method

18. Catalyst used in Kjeldahl's method for the estimation of nitrogen is :
(1) Sodium (2) Magnesium (3) Mercury (4) Copper

19. 6 g of the organic compound on heating with NaOH gave NH_3 which is neutralised by 200 mL of 1NHCl. Percentage of nitrogen is :
(1) 12% (2) 60% (3) 46.67% (4) 26.67%

20. The dessicants used for absorbing water during Liebig's method for estimation of carbon and hydrogen are:
(1) $CaCl_2$ (2) Na_2SO_4 (3) $MgSO_4.7H_2O$ (4) $Mg(ClO_4)_2$

21. 0.16 g of a dibasic organic acid required 25 cm^3 of 0.1M NaOH for complete neutralization. The molecular mass of the acid is :
(1) 45 (2) 90 (3) 64 (4) 128

22. 0.28g of a nitrogenous compound was subjected to Kjeldahl's process to produce 0.17 g of NH_3. The percentage of nitrogen in the organic compound is :
(1) 5 (2) (3) 50 (4) 80

23. The equivalent weight of an acid is equal to
(1) Molecular weight × acidity (2) Molecular weight × basicity
(3) Molecular weight/basicity (4) Molecular weight/acidity

24. In Dumas' method for estimation of nitrogen, 0.3 g of an organic compound gave 50 mL of nitrogen collected at 300 K temperature and 715mm pressure. What will be the percentage composition of nitrogen in the compound. (Aqueous tension at 300K=15 mm)
(1) 22.38% (2) 17.46% (3) 55.11% (4) 82.74%

25. Liebig test is used to estimate :
(1) H (2) C (3) C and H both (4) N

26. Copper wire test of halogens is known as :
(1) Liebig's test (2) Lassaigne's test (3) Fusion test (4) Beilstein's test

27. During estimation of nitrogen present in an organic compound by Kjeldahl's method, the ammonia evolved from 0.5 g of the compound in Kjeldahl's estimation of nitrogen, neutralized 10 mL of 1 M H_2SO_4. What is the percentage of nitrogen in the compound.
(1) 84% (2) 56% (3) 72% (4) 91%

28. In Carius method of estimation of halogen, 0.15 g of an organic compound gave 0.12 g of AgBr. What is the percentage of bromine in the compound.

(1) 18% (2) 94% (3) 63% (4) 34%

29. In sulphur estimation, 0.157 g of an organic compound gave 0.4813 g of barium sulphate. What is the percentage of sulphur in the compound ?

(1) 38.7% (2) 18.5% (3) 42.1% (4) 1.9%

30. An organic compound having molecular mass 60 is found to contain C = 20%, H = 6.67% and N = 46.67% It gives violet colour with alkaline copper sulphate solution. The compound is

(1) CH_3NCO (2) CH_3CONH_2 (3) $(NH_2)_2CO$ (4) $CH_3CH_2CONH_2$

31. A gaseous hydrocarbon has 85%carbon and vapour density of 28. The possible formula of the hydrocarbon will be.

(1) C_3H_6 (2) C_2H_4 (3) C_2H_2 (4) C_4H_8

32. Two elements X (atomic weight = 75) and Y (atomic weight = 16) combine to give a compound having 75.8% X. The formula of the compound is :

(1) XY (2) X_2Y (3) X_2Y_2 (4) X_2Y_3

33. Quantitative measurement of nitrogen in an organic compounds is done by the method.

(1) Berthelot method (2) Belstein method

(3) Lassaigne test (4) Kjheldahl's method

APSP Answers

PART - I

1.	(4)	**2.**	(4)	**3.**	(3)	**4.**	(3)	**5.**	(3)
6.	(3)	**7.**	(3)	**8.**	(2)	**9.**	(1)	**10.**	(2)
11.	(4)	**12.**	(2)	**13.**	(3)	**14.**	(1)	**15.**	(3)
16.	(4)	**17.**	(1)	**18.**	(2)	**19.**	(3)	**20.**	(2)
21.	(3)	**22.**	(1)	**23.**	(2)	**24.**	(2)	**25.**	(1)
26.	(3)	**27.**	(2)	**28.**	(3)	**29.**	(4)	**30.**	(3)

PART - II

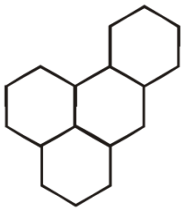
1.	(2)	**2.**	(1)	**3.**	(4)	**4.**	(4)	**5.**	(1)
6.	(4)	**7.**	(3)	**8.**	(4)	**9.**	(4)	**10.**	(3)
11.	(1)	**12.**	(4)	**13.**	(4)	**14.**	(1)	**15.**	(1)
16.	(4)	**17.**	(3)	**18.**	(2)	**19.**	(3)	**20.**	(1)

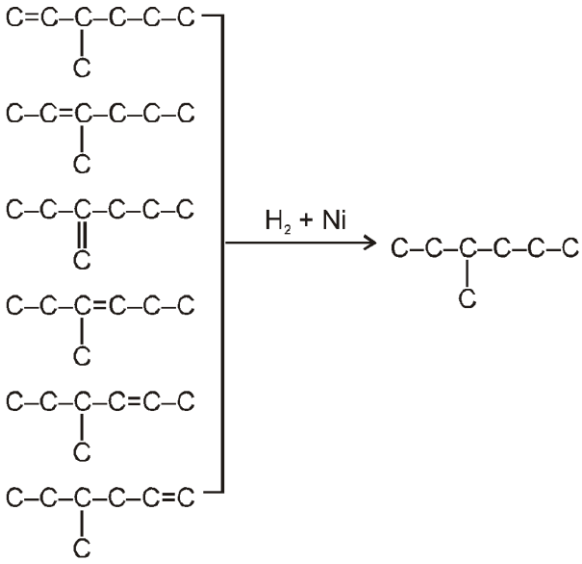
ADDITIONAL EXERCISE

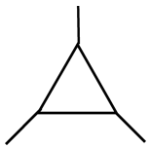
1.	(1)	**2.**	(2)	**3.**	(1)	**4.**	(2)	**5.**	(3)
6.	(4)	**7.**	(2)	**8.**	(4)	**9.**	(4)	**10.**	(3)
11.	(2)	**12.**	(2)	**13.**	(1)	**14.**	(3)	**15.**	(4)
16.	(2)	**17.**	(3)	**18.**	(3)	**19.**	(3)	**20.**	(1)
21.	(4)	**22.**	(3)	**23.**	(3)	**24.**	(2)	**25.**	(3)
26.	(4)	**27.**	(2)	**28.**	(4)	**29.**	(3)	**30.**	(3)
31.	(4)	**32.**	(4)	**33.**	(4)				

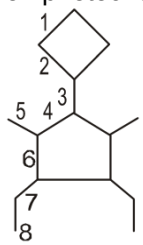
APSP Solutions

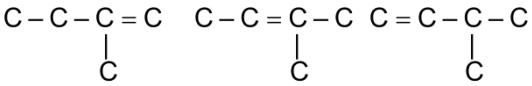
PART - I

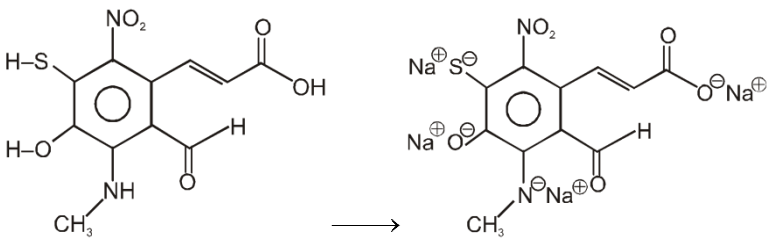
1.  has four rings so Degree of unsaturation = 4

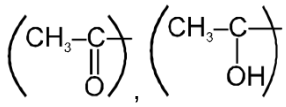
2. 

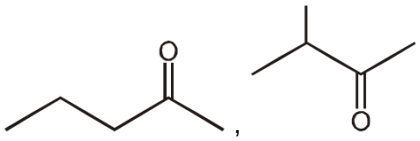
3.  have two types of chemically different hydrogen atom so it forms two monochloro isomers on photochemical chlorination.

4. 

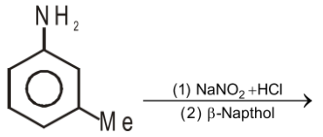
5. C–C–C–C=C, C–C–C=C–C,  , , ,

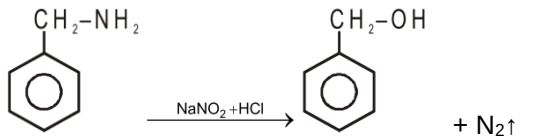
6. 

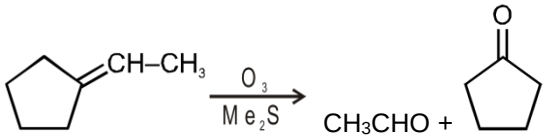
9.  groups gives positive iodoform test.

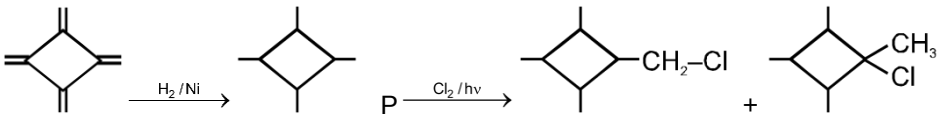
10. 

11. Aldehydes gives positive test with tollen's reagent.

12.  Orange–Red dye

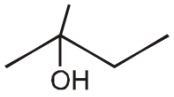


13. 

14. 

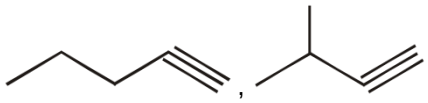
15. $NaBr + AgNO_3 \longrightarrow AgBr$ (yellow)

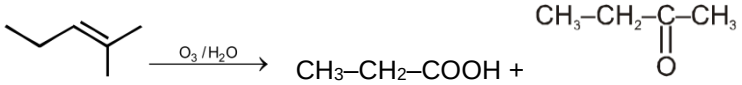
16. 1º, 2º and 3º amine mixture can be seperated by Hinsberg reagent.

17. 

18. Acetaldehyde is the only aldehyde which gives haloform test.

19. Phenol does not gives Lucas reagent test.

20. C_5H_8  (Molecular Mass = 68)

21. 

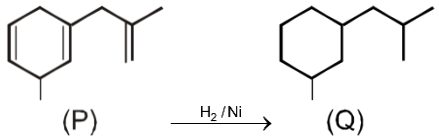
28. Fehlings solution is alkaline solution of $CuSO_4$ with rochell salt i.e. sodium potassium tartarate.

29. $CH_3–CH_2–C\equiv CH \xrightarrow[NH_4OH]{Cu_2Cl_2} \underset{\text{Blood red Colour}}{CH_3–CH_2–C\equiv\overset{\ominus}{C}\overset{\oplus}{Cu}} + NH_4Cl + H_2O$

30. Acetaldehyde and Propyne can be distinguish by tollen's reagent and Iodoform test.

PART - II

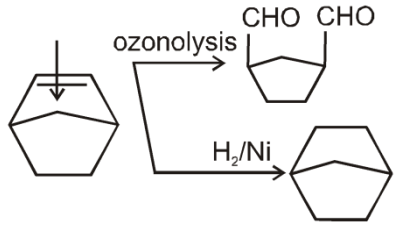
1. For $C_xH_yO_zX_aN_b$ Du = $\frac{2x+2-y-a+b}{2}$ ∴ For $C_{20}H_{24}N_2O_2$ Du = 10 = 6db + 4 ring.

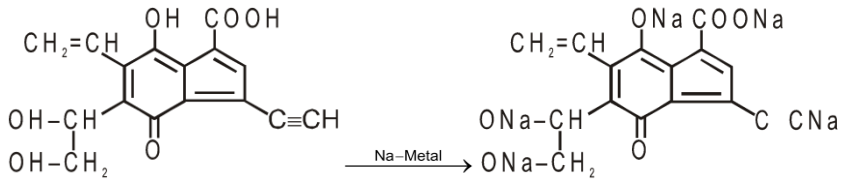
2. 

4. (A) D.U. = $\frac{(6\times2+2)-(7-1)}{2} = \frac{14-6}{2} = 4$

(B) D.U. = $\frac{(5\times2+2)-(15-1)}{2} = \frac{12-4}{2} = 4$

(C) D.U. = $\frac{(5\times2+2)-(6-2)}{2} = \frac{12-4}{2} = 4$

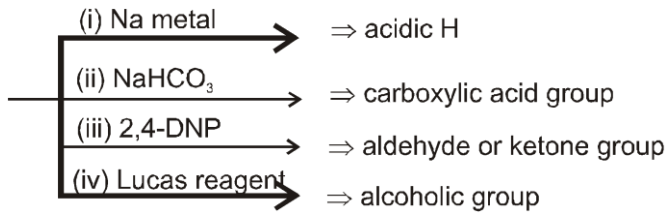
6. 

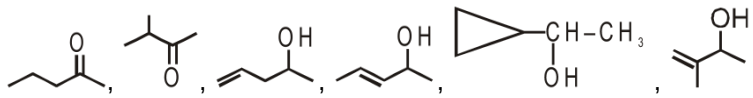
11. 

+ $\frac{5}{2}$ $H_2(g)$

so, value of 2x = $\frac{5}{2}\times2 = 5$

14. 3º alcohol gives instant turbidity with Lucas reagent.

15. 

16. 

ADDITIONAL EXERCISE

11. Because glycerine decomposes at its boiling point.

12. If boiling points are closer then best separation is done by fractional distillation.

14. Solid substances are directly converted into vapour during sublimation.

16. In this method the nitrogen present is quantitatively converted into $(NH_4)_2SO_4$ on heating with conc. H_2SO_4. The $(NH_4)_2SO_4$ is then treated with standard alkali solution to liberate NH_3, which is absorbed in H_2SO_4 to obtain precentage of nitrogen.]

17. Molecular mass of a volatile organic solid can be detemined by Victor Mayer's method.
∴ option (3) is correct.

18. Catalyst used in Kjeldahl's method for the estimation of nitrogen is mercury.
∴ option (3) is correct.

20. Anhydrous $CaCl_2$ and $Mg(ClO_4)_2$ are used as desiccants because they are efficient absorbent of water.

21. 2.5 m mol NaOH ⇒ 1.25 m mol dibasic acid reqd.
1.25×10^{-3} mol = 0.16 g

1 mol = $\frac{0.16}{1.25 \times 10^{-3}}$ g = 128 g

22. 0.17g NH_3 will contain $\left(\frac{14}{17} \times 0.17\right)$ g of nitrogen, i.e. 0.14g of nitrogen

% Nitrogen = $\frac{\text{Mass of nitrogen}}{\text{Mass of compound}} \times 100 = \frac{0.14}{0.28} \times 100 = 50\%$

24. Volume of nitrogen collected at 300K and 715 mm pressure is 50 mL
Actual pressure = 715 – 15 = 700 mm

Volume of nitrogen at STP = $\frac{273 \times 700 \times 50}{300 \times 760}$ = 41.9 mL

22,400 mL of N_2 at STP weighs = 28 g

41.9 mL of nitrogen weighs = $\frac{28 \times 41.9}{22400}$ g

Percentage of nitrogen = $\frac{28 \times 41.9 \times 100}{22400 \times 0.3}$ = 17.46%

31. Mol. wt. = 2 × Vapour density
= 2 × 28 = 56