Carbon

Tetravalency of carbon :

C → 2, 4

Z = 6 A = 12

P or e p + n

Carbon contains 4 electrons in its valence shell. It needs 4 electrons more to complete the octate state. So, its valency is 4. That is carbon is a tetravalency element. In other words carbon can form four single covalent bonds.

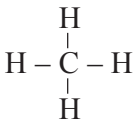
Hydrocarbons : The compounds which are formed of carbon and hydrogen atoms only are called hydrocarbons.

e.g. alkanes, saturated alkene, alkyne.

Q.1. Satisfy the valencies of carbon in following hydrocarbon compounds by using hydrogen atoms

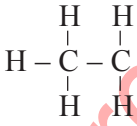
Alkanes :

i) C CH_4



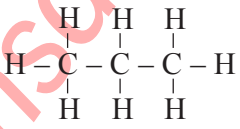
Methane

ii) C - C $CH_3 - CH_3$ or



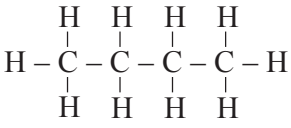
Ethane

iii) C - C - C $CH_3 - CH_2 - CH_3$ or



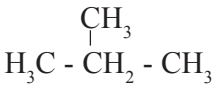
Propane

iv) C - C - C - C $CH_3 - CH_2 - CH_2 - CH_3$ or



n-Butane

iv) C - C - C



Iso-butane

Example of other hydrocarbons :

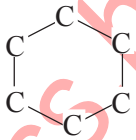
v) C = C $CH_2 = CH_2$ ethylene or ethene

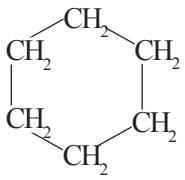
vi) C – C = C $CH_3 - CH = CH_2$ propylene or propene

vii) C ≡ C CH ≡ CH acetylene

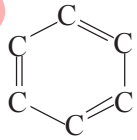
viii) C - C = C - C $CH_3 - CH = CH - CH_3$

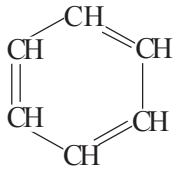
Butylene





Cyclo - hexane





Benzene

Types of carbon atom :

Alkanes :

Alkanes are saturated aliphatic hydrocarbons having general formula C_nH_{2n+2} .

Type of carbon atom in alkane : There are four types of carbon and three types of H.

i) Primary carbon : *The carbon atom which is attached to only one other carbon atom is called as primary carbon, i.e.* 1^0 C.

ii) Secondary carbon : *The carbon atom which is attached to two other carbon atom is called as secondary carbon, i.e.* 2^0 C.

iii) Tertiary carbon : *The carbon atom which is attached to three other carbon atom is called as tertiary carbon, i.e.* 3^0 C.

iii) Quaternary carbon : *The carbon atom which is attached to four other carbon atom is called as quaternary carbon, i.e. 4^0 C.*

There are three types of hydrogen atom

i) Primary hydrogen : *The hydrogen atom which is present on primary carbon atom is called primary hydrogen atom.*

ii) Secondary hydrogen : *The hydrogen atom which is present on secondary carbon atom is called secondary hydrogen atom.*

iii) Tertiary hydrogen : *The hydrogen atom which is present on tertiary carbon atom is called tertiary hydrogen atom.*

e.g. isopentane and neopentane.

Q. What are alkanes ? Give the names and molecular formuale of first alkanes.

Ans : Alkanes are saturated aliphatic hydrocarbons having general formulae C_nH_{2n+2}.

i) Saturated : The compound which contains single covalent bond only.

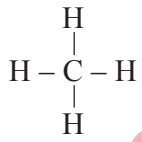
ii) Aliphatic : Open chain compounds

iii) Hydrocarbons : Compound of C and H atoms only

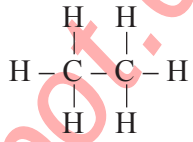
Name	Strucutres
1) Methane	CH_4
2) Ethane	$CH_3 - CH_3$
3) Propane	$CH_3 - CH_2 - CH_3$
4) Butane	$CH_3 - CH_2 - CH_2 - CH_3$
5) Pentane	$CH_3 - CH_2 - CH_2 - CH_2 - CH_3$
6) Hexane	$CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
7) Heptane	$CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
8) Octane	$CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
9) Nonane	
10) Decane	

Structure of first five alkanes :

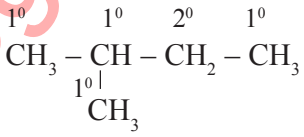
i) Methane (CH_4) :



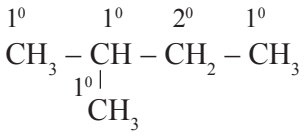
ii) Ethane (C_2H_6) :



iii) Iso - Pentane (Brached) :



iv) Neo - Pentane (Fully branched with quaternary c atom) :



Alkyl group : It is a monovalent group obtained by removing one H atom from alkane.

$RH \xrightarrow{-H} R -$

Alkane $\xrightarrow{-H}$ Alkyl group

Name of alkyl is obtained by replacing last three letters – ane from the name of alkanes with e – yl

Thus, Alkane $\rightarrow$ Alkyl

i) e.g. $CH_4 \xrightarrow{-H} CH_3 -$

Methane Methyl group

ii) $C_2H_6 \xrightarrow{-H} C_2H_5 -$

$CH_3^{1^0} - CH_3^{1^0} \xrightarrow{-H} CH_3 - CH_2 -$

Ethane $\xrightarrow{-H}$ Ethyl

iii) Propane $\xrightarrow{-H}$ Propyl group

$C_3H_8 \xrightarrow{-H} C_3H_7 -$

a) n - propyl group

$CH_3^{1^0} - CH_2^{2^0} - CH_3^{1^0} \xrightarrow{-1^0H} CH_3 - CH_2 - CH_2 -$

b) iso - propyl group or secondary propyl

$$\overset{1^0}{CH_3}-\overset{2^0}{CH_2}-\overset{1^0}{CH_3} \xrightarrow{-2^0H} CH_3-\underset{|}{CH}-CH_3$$

iv) Butane $\xrightarrow{-H}$ Butyl group

$C_4H_{10} \xrightarrow{-H} C_4H_9-$

1) n - butane

a) n- butyl group

$$\overset{1^0}{CH_3}-\overset{2^0}{CH_2}-\overset{2^0}{CH_2}-\overset{1^0}{CH_3} \xrightarrow{-1^0H} CH_2-CH_2-CH_2-CH_3$$

b) Secondary butyl :

$$\overset{1^0}{CH_3}-\overset{2^0}{CH_2}-\overset{2^0}{CH_2}-\overset{1^0}{CH_3} \xrightarrow{-2^0H} CH_3-\underset{|}{CH}-CH_2-CH_3$$

2) *Iso - butane*

a) iso - butyl

$$\overset{1^0}{CH_3}-\underset{\overset{1^0}{|}\,CH_3}{\overset{3^0}{CH}}-\overset{2^0}{CH_2}-\overset{1^0}{CH_3} \xrightarrow{-1^0H} CH_2-\underset{|}{\underset{CH_3}{CH}}-CH_3$$

b) Tertiary butyl

$$CH_3-\underset{\overset{1^0}{|}\,CH_3}{CH}-CH_3 \xrightarrow{-3^0H} CH_3-\underset{|}{\overset{|}{C}}-CH_3 \quad (CH_3)$$

Alcohols :

i) Type or general formula

R – OH [R – is alkyl group]

ii) Functional group : – OH (Hydroxy)

iii) Common name : R – OH (Alkyl alcohol)

	Formula	Common name
1)	CH_3-OH	Methyl alcohol
2)	C_2H_5-OH	Ethyl alcohol
3)	$CH_3-CH_2-CH_2-OH$	n - propyl alcohol
4)	$(CH)_3CHOH$	iso - propyl alcohol
5)	$CH_3-CH_2-CH_2-CH_2OH$	n - butyl alcohol
6)	$\begin{matrix}CH_3\\ \diagdown\\ \quad CH-OH\\ \diagup\\ C_2H_5\end{matrix}$	Sec. butyl alcohol
7)	$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2OH$	iso butyl alcohol
8)	$CH_3-\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$	tertiary butyl alcohol

Alkyl halides :

Type / General formula : R – X

Where – R is alkyl group

Funcationally X – : Halo group

F – : Fluoro group

Cl – : Chloro group

Br – : Bromo group

I – : Iodo group

Common name : RX : Alkyl halide

R – Cl : Alkyl chloride

R – Br : Alkyl bromide

R – I : Alkyl iodine

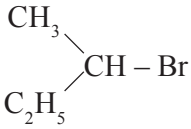
R – F : Alkyl fluoride

Alkyl chloride :

1)	CH_3Cl	Methyl chloride
2)	C_2H_5Cl	Ethyl chloride
3)	$CH_3-CH_2-CH_2Cl$	n - propyl chloride
4)	$CH_3-\underset{\underset{Cl}{|}}{CH}-CH_3$	iso - propyl chloride
5)	$CH_3-CH_2-CH_2-CH_2Cl$	n - butyl chloride
6)	$CH_3-\underset{\underset{Cl}{|}}{CH}-CH_2-CH_3$	Sec. butyl alcohol
7)	$(CH_3)_2CH-CH_2Cl$	iso butyl chloride
8)	$(CH_3)_3C-Cl$	tertiary butyl chloride

Alkyl Bromide :

1)	CH_3Br	Methyl bromide
2)	C_2H_5Br	Ethyl bromide
3)	$CH_3-CH_2-CH_2Br$	n - propyl bromide
4)	$(CH_3)_2CH-Br$	iso - propyl bromide
5)	$CH_3-CH_2-CH_2-CH_2Br$	n - butyl bromide

6)  Sec. butyl bromide

7) $(CH_3)_2CH - CH_2Br$ iso butyl bromide

8) $(CH_3)_3 C - Br$ tertiary butyl bromide

Alkyl iodide :

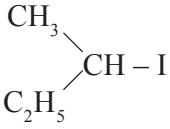
1) CH_3I Methyl iodide

2) C_2H_5I Ethyl iodide

3) $CH_3 - CH_2 - CH_2I$ n - propyl iodide

4) $(CH_3)_2CH - I$ iso - propyl iodide

5) $CH_3 - CH_2 - CH_2 - CH_2I$ n - butyl iodide

6)  Sec. butyl iodide

7) $(CH_3)_2CH - CH_2I$ iso butyl iodide

8) $(CH_3)_3 C - I$ tertiary butyl iodide

Alkyl fluoride :

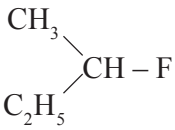
1) CH_3F Methyl fluoride

2) C_2H_5F Ethyl fluoride

3) $CH_3 - CH_2 - CH_2F$ n - propyl fluoride

4) $(CH_3)_2CH - F$ iso - propyl fluoride

5) $CH_3 - CH_2 - CH_2 - CH_2F$ n - butyl fluoride

6)  Sec. butyl fluoride

7) $(CH_3)_2CH - CH_2F$ iso butyl fluoride

8) $(CH_3)_3 C - F$ tertiary butyl fluoride

Amines :

Type / General formula : $R - NH_2$

Where R - is alkyl group

functional group $- NH_2$ (Amino group)

common name : $R - NH_2$ (Alkyl amine)

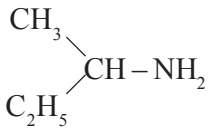
1) $CH_3 - NH_2$ Methylamine [Acetamine]

2) $C_2H_5 - NH_2$ Ethylamine

3) $CH_3 - CH_2 - CH_2 - NH_2$ n - propylamine

4) $(CH_3)_2CH - NH_2$ iso - propylamine

5) $CH_3 - CH_2 - CH_2 - CH_2 - NH_2$ n - butylamine

6)  Sec. butylamine

7) $(CH_3)_2CH - CH_2 - NH_2$ iso butyl amine

8) $(CH_3)_3 C - NH_2$ tertiary butyl amine

Cyanide OR Nitriles :

Type / General formula : $R - C \equiv N$ or RCN

functional group : $- C \equiv N$ / – CN (cyano group)

comman name : R – CN (Alkyl cyanide]

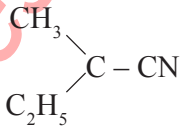
1) CH_3CN methyl cyanide

2) C_2H_5CN ethyl cyanide

3) $CH_3 - CH_2 - CH_2CN$ n - propyl cyanide

4) $(CH_3)_2CH - CN$ iso - propyl cyanide

5) $CH_3 - CH_2 - CH_2 - CH_2CN$ n - butyl cyanide

6)  Sec. butyl cyanide

7) $(CH_3)_2CH - CH_2CN$ iso butyl cyanide

8) $(CH_3)_3 C - CN$ tertiary butyl cyanide

Ethers :

Type / General formula : R – O – R'

where – R and – R' are alkyl groups.

Functional group

$\rightarrow C - O - C \leftarrow$

etherical linkage

Classification : Ethers are of two types

1) Simple ether / symmetrical ether

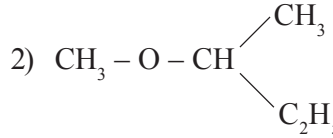
R = R'

2) Mixed ether / unsymmetrical ether

a) Simple ether : R = R' Dialkyl ether

b) Mixed ether : $R \neq R'$ Alkyl alkyl ether

e.g. 1) Ethyl mether ether $CH_3 - O - C_2H_5$

2) 

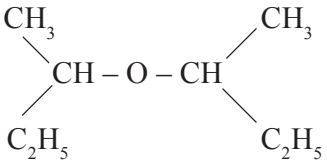
Secondary butyl methyl ether

Simple ether :

1) $CH_3 - O - CH_3$ dimethyl ether

2) $C_2H_5 - O - C_2H_5$ diethyl ether

3) $CH_3–CH_2–CH_2– O – CH_2 – CH_2 – CH_3$
di n- propyl ether

4)  di iso propyl ether

5) $(CH_3)_2CH – O – CH(CH_3)_2$ di iso propyl ether

6) $CH_3–CH_2–CH_2–CH_2–O–CH_2–CH_2–CH_2–CH_3$
di n-butyl ether

7) $(CH_3)_2CH–CH_2–O–CH_2CH(CH_3)_2$
di iso-butyl ether

8) $(CH_3)_3 C – O – C (CH_3)_3$ di tertiary butyl ether

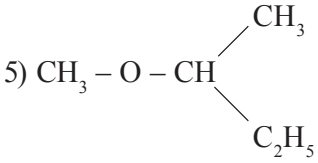
Mixed ether :

1) $CH_3 – O – C_2H_5$ Ethyl methyl ether

2) $CH_3 – O – CH_2– CH_2– CH_3$
Methyl n-propyl ether

3) $CH_3 – O – CH(CH_3)_2$ Methyl isopropyl ether

4) $CH_3– O – CH_2– CH_2CH_2CH_3$
n - butyl methyl ether

5) 
Secondary butyl methyl ether

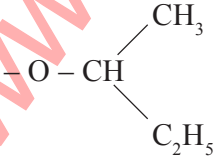
6) $CH_3– O – CH_2 – CH(CH_3)_2$
iso butyl methyl ether

7) $CH_3 – O – C(CH_3)_3$ tertiary butyl methyl ether

8) $C_2H_5 – O – CH_2 – CH_2 – CH_3$
Ethyl n- propyl ether

9) $C_2H_5 – O – CH(CH_3)_2$ Ethyl iso- propyl ether

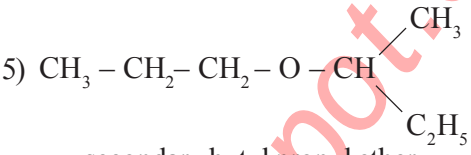
10) $C_2H_5 – O – CH_2CH_2CH_3$ Ethyl isopropyl ether

11)  secondary isopropyl ether

12) $C_2H_5 – O – CH_2CH(CH_3)_2$ Isobutyl ethyl ether

13) $C_2H_5 – O – C(CH_3)_3$ ter.butyl ethyl ether

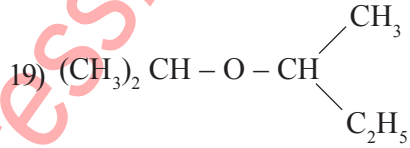
14) $CH_3 – CH_2 – CH_2 – O – CH(CH_3)_2$
Isopropyl n propyl ether

15) 
secondary butyl propyl ether

16) $CH_3 – CH_2 – CH_2 – O – CH_2– CH(CH_3)_2$
iso butyl n-propyl ether

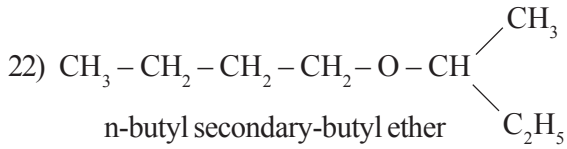
17) $CH_3 – CH_2 – CH_2 – O – C(CH_3)_3$
tertiary butyl n-propyl ether

18) $(CH_3)_2 CH – O – CH_2 – CH_2– CH_3$
n-butyl isopropyl ether

19) 
Sec. butyl isopropyl ether

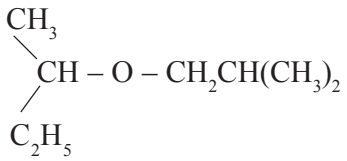
20) $(CH_3)_2 CH – O – CH_2 CH (CH_3)_2$
iso-butyl iso-propyl ether

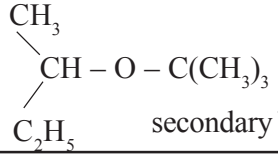
21) $(CH_3)_2 CH – O – C (CH_3)_3$
tertiary-butyl iso-propyl ether

22) 
n-butyl secondary-butyl ether

23) $CH_3 – CH_2 – CH_2 – CH_2 – O – CH_2 CH(CH_3)_2$
iso-butyl n-butyl ether

24) $CH_3 – CH_2 – CH_2 – CH_2 – O – C(CH_3)_3$
n-butyl tertiary-butyl ether

25) 
isobutyl secondary butyl ether

26)  secondary butyl tertiary butyl ether

27) $(CH_3)_2 - CH\ CH_2 - O - (CH_3)_3$

Iso butyl tertiary butyl ether

Ketones :

Type formula : $R - \overset{\overset{O}{\|}}{C} - R'$ OR $\begin{matrix} R \\ \diagdown \\ \quad C = O \\ \diagup \\ R' \end{matrix}$

Functional group : $\begin{matrix} \diagdown \\ \quad C = O \\ \diagup \end{matrix}$ Ketonic group

There are two types of ketones

1) Simple / symmetrical keton

Where R = R'

Comman name : Dialkyl ketone

e.g. $CH_3 - \overset{\overset{O}{\|}}{C} - CH_3$ Dimethyl ketone or Acetone

2) Mixed / unsymmetrical ketone

Where R ≠ R'

Common name : Alkyl alkyl ketone

(in alphabetic order)

Simple ketones

1) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_3$ Dimethyl ketone or Acetone

2) $C_2H_5 - \overset{\overset{O}{\|}}{C} - C_2H_5$ Diethyl ketone

3) $CH_3CH_2CH_2 - \overset{\overset{O}{\|}}{C} - CH_2CH_2CH_3$

di n-propyl ketone

4) $(CH_3)_2CH - \overset{\overset{O}{\|}}{C} - CH(CH_3)_2$ di iso-propyl ketone

5) $CH_3CH_2CH_2CH_2 - \overset{\overset{O}{\|}}{C} - CH_2CH_2CH_2CH_3$

di-secondary butyl ketone

6) $\begin{matrix} CH_3 \\ \diagdown \\ \quad CH \\ \diagup \\ C_2H_5 \end{matrix} - \overset{\overset{O}{\|}}{C} - \begin{matrix} \quad CH_3 \\ \diagup \\ CH \\ \diagdown \\ \quad C_2H_5 \end{matrix}$ di-secondary butyl ketone

7) $(CH_3)_2CHCH_2 - \overset{\overset{O}{\|}}{C} - CH_2CH(CH_3)_2$

di-iso butyl ketone

8) $(CH_3)_3C - \overset{\overset{O}{\|}}{C} - C(CH_3)_3$ di-tertiary butyl ketone

Mixed ketones :

1) $CH_3 - \overset{\overset{O}{\|}}{C} - C_2H_5$ ethyl methyl ketone

2) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2CH_2CH_3$ ethyl n-propyl ketone

3) $CH_3 - \overset{\overset{O}{\|}}{C} - CH(CH_3)_2$ methyl iso-propyl ketone

4) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2CH_2CH_2CH_3$

n-butyl methyl ketone

5) $CH_3 - \overset{\overset{O}{\|}}{C} - \begin{matrix} \quad CH_3 \\ \diagup \\ CH \\ \diagdown \\ \quad C_2H_5 \end{matrix}$

Secondary butyl methyl ketone

6) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2CH(CH_3)_2$

iso-butyl methyl ketone

7) $CH_3 - \overset{\overset{O}{\|}}{C} - C(CH_3)_3$ tertiary-butyl methyl ketone

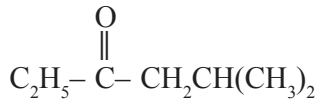
8) $C_2H_5 - \overset{\overset{O}{\|}}{C} - CH_2CH_2CH_3$ Ethyl n-propyl ketone

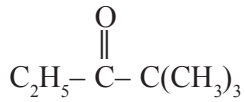
9) $C_2H_5 - \overset{\overset{O}{\|}}{C} - CH(CH_3)_2$ Ethyl sec - propyl ketone

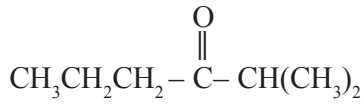
10) $C_2H_5 - \overset{\overset{O}{\|}}{C} - CH_2CH_2CH_2CH_3$

n-butyl ethyl ketone

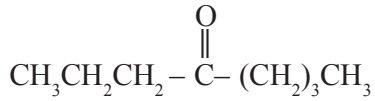
11) $C_2H_5 - \overset{\overset{O}{\|}}{C} - \begin{matrix} \quad CH_3 \\ \diagup \\ CH \\ \diagdown \\ \quad C_2H_5 \end{matrix}$ sec.-butyl ethyl ketone

12)  iso-butyl ethyl ketone

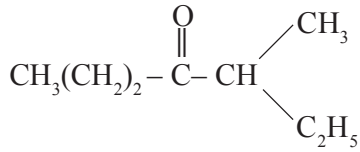
13)  ter.- butyl ethyl ketone

14) 

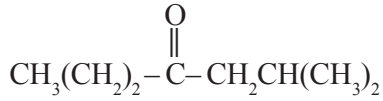
iso- propyl n - propyl ketone

15) 

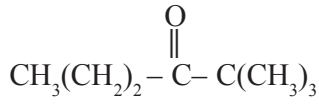
n- propyl n - propyl ketone

16) 

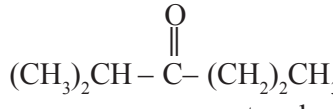
sec.- butyl n - propyl ketone

17) 

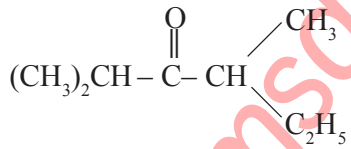
iso.- butyl n - propyl ketone

18) 

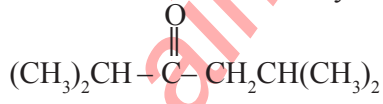
ter.- butyl n - propyl ketone

19) 

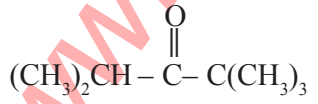
ter.- butyl n - propyl ketone

20) 

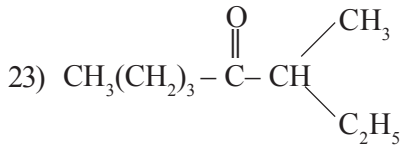
sec.- butyl iso - propyl ketone

21) 

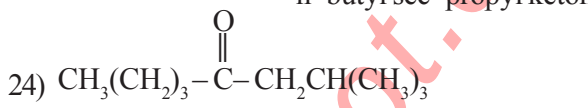
iso - butyl iso - propyl ketone

22) 

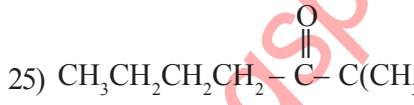
ter.- butyl iso- propyl ketone

23) 

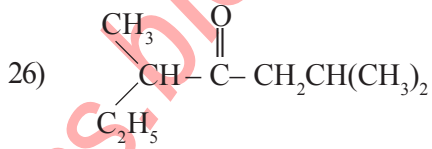
n- butyl sec- propyl ketone

24) 

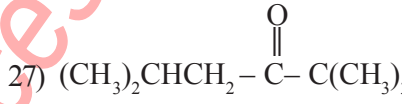
iso- butyl n- butyl ketone

25) 

n - butyl ter- butyl ketone

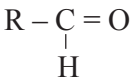
26) 

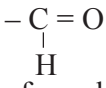
sec - butyl ter- butyl ketone

27) 

iso - butyl ter- butyl ketone

Aldehydes:

Type formula : R – CHO or 

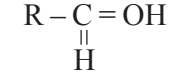
Functional group : – CHO or 

Aldehyde or formyl group

Comman name : From acides

1)	H - CHO	Formaldehyde
2)	CH_3 – CHO	Acetaldehyde
3)	C_2H_5 – CHO CH_3CH_2CHO	Propionaldehyde
4)	$CH_3CH_2CH_2CHO$	n- butylraldehyde
5)	$(CH_3)_2CHCHO$	iso - butylraldehyde

Carboxylic acids :

Type formula : R - COOH or 

Funcational group : – COOH

carboxylic group

Comman name : No perticular rules

Formaldehyde $\xrightarrow{\text{oxidation}}$ Formic acid

'aldehyde' is replaced by 'ic acid'

$HCHO \xrightarrow{O} HCOOH$

1) $HCOOH$ Formic acid
2) CH_3COOH Acetic acid
3) C_2H_5COOH Propionic acid
4) $CH_3CH_2CH_2COOH$ n - butric acid
5) $(CH_3)_2CHCOOH$ iso butric acid

* Carboxylic acid goto acidily due to H atom

Salt acid

$RCOOH \xrightarrow{-H}$