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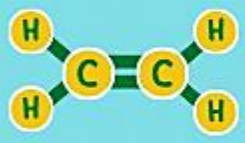
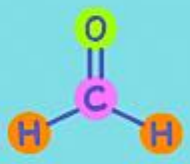
01 X CBSE

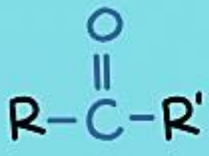
CHEMISTRY

CARBON COMPOUNDS

CARBON AND ITS COMPOUNDS







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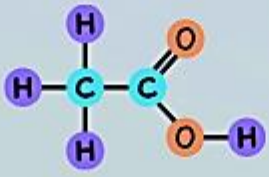
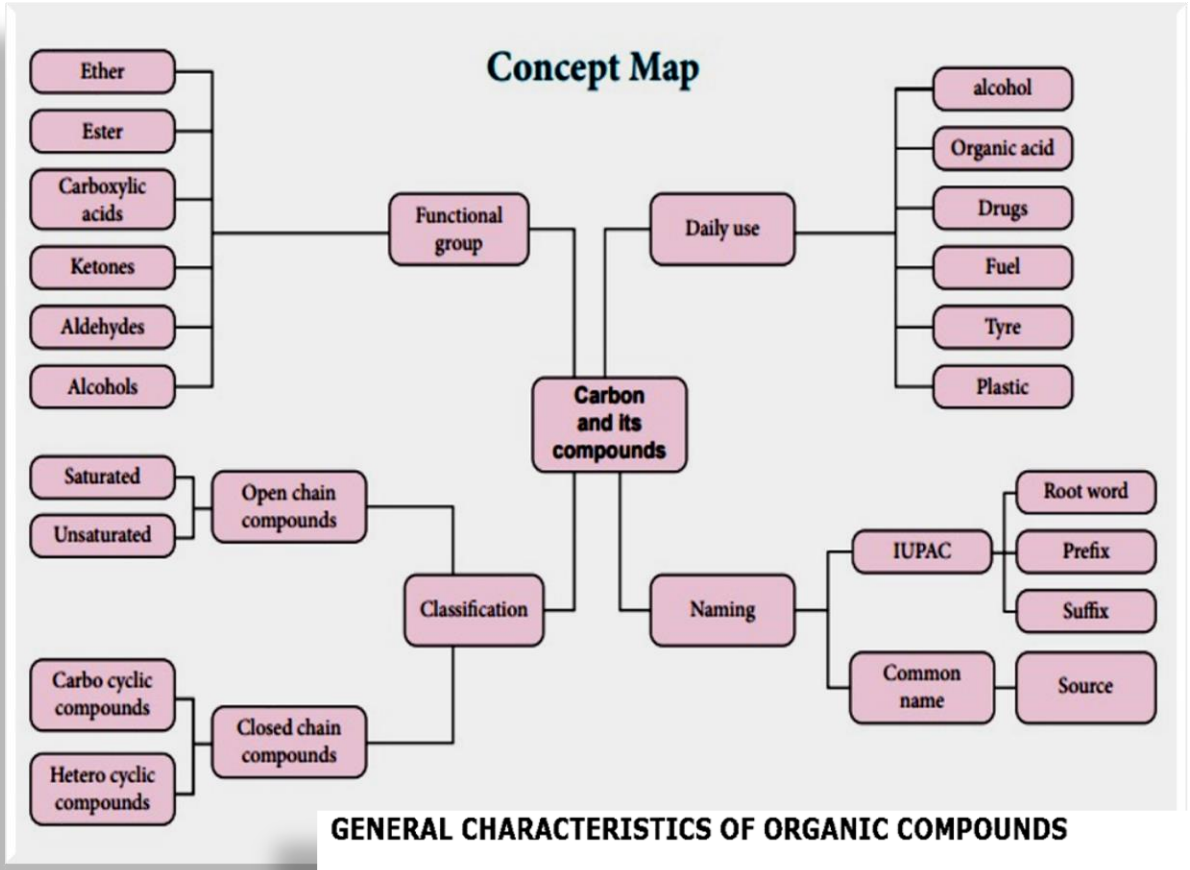


CONTACT US:
+91-9939586130
+91-9955930311

www.aepstudycircle.com

aepstudycircle@gmail.com

2ND FLOOR, SATKOUDI COMPLEX, THANA CHOWK, RAMGARH - 829122-JH



GENERAL CHARACTERISTICS OF ORGANIC COMPOUNDS

Everything in this world has unique character, similarly organic compounds are unique in their characteristics. Some of them are given below:

- Organic compounds have a high molecular weight and a complex structure.
- They are mostly insoluble in water, but soluble in organic solvents such as ether, carbon tetrachloride, toluene, etc.
- They are highly inflammable in nature
- Organic compounds are less reactive compared to inorganic compounds. Hence, the reactions involving organic compounds proceed at slower rates.
- Mostly organic compounds form covalent bonds in nature.
- They have lower melting point and boiling point when compared to inorganic compounds
- They exhibit the phenomenon of isomerism, in which a single molecular formula represents several organic compounds that differ in their physical and chemical properties
- They are volatile in nature.
- Organic compounds can be prepared in the laboratory

Organic chemistry is the chemistry of catenated carbon compounds. The carbon atoms present in organic compounds are linked with each other through covalent bonds and thus exist as chains. By this way, organic compounds are classified into two types as follows:

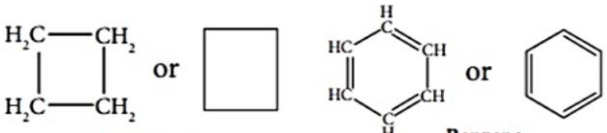
1. Acyclic or Open chain compounds: These are the compounds in which the carbon atoms are linked in a linear pattern to form the chain. If all the carbon atoms in the chain are connected by single bonds, the compound is called as **saturated.** If one or more double bonds or triple bonds exist between the carbon atoms, then the compound is said to **unsaturated**.

CH_3-CH_2-CH_3 Propane — Saturated compound

CH_3-CH=CH_2 Propene — Unsaturated compound

2. Cyclic Compounds: Organic compounds in which the chain of carbon atoms is closed or cyclic are called **cyclic compounds.** If the chain contains only carbon atoms, such compounds are called **carbocyclic compounds.** If the chain contains carbon and other atoms like oxygen, nitrogen, sulphur, etc., these compounds are called **heterocyclic compounds.** Carbocyclic compounds are further subdivided into **alicyclic** and**aromatic compounds.** Alicyclic compounds contain one or more carbocyclic rings which may be saturated or unsaturated whereas aromatic compounds contain one or more benzene rings (ring containing alternate double bonds between carbon atoms). E.g.

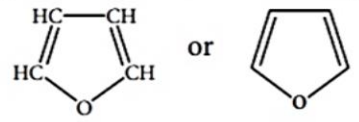
Carbo cyclic compounds



Cyclobutane — Alicyclic Compound

Benzene — Aromatic Compound

Hetrocyclic compounds



Furan

- Carbon has a unique property (self-Linkage property) to form a large no. of compounds, as a result of this, Carbon forms a large no. of compounds with Hydrogen.
- In addition to hydrogen, carbon compounds may also contain other element such as O_2 , Halogens (Cl_2 , I_2Br_2 etc) N_2 and Sulphur etc.
- "The compounds of Carbon and Hydrogen are **Hydrocarbon**."
- Carbon compounds are being used in our everyday life in the form of medicines, plastics, textile, dyes, food preservatives, soaps, and detergent, fuels etc.

ORGANIC COMPOUNDS – ***"The compounds of carbon and Hydrogen only are called organic compounds".***

- The study of Carbon compounds is called ***organic Chemistry.***

- **Hydrocarbon** – **(**Compounds containing Hydrogen and Carbon). –

  Hydrocarbon can be classified as -------

  - (i) Saturated Hydrocarbon (—).
  - (ii) Unsaturated Hydrocarbon (=) Or (≡)

[A]SATURATED HYDROCARBON [(ALKANES) (C_nH_{2n+2})]

Saturated hydrocarbon contains only single carbon –carbon (C-C) covalent bonds.

☑ ----- These are also called **alkanes.**

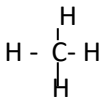
☑ ----- General formula -- C_nH_{2n+2} ; where **n =** no. of carbon atoms in the molecules.

☑ ----- Suffix = *- 'ane'.*

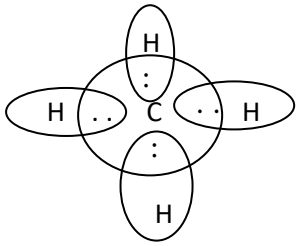
➢ **Examples of saturated hydrocarbon** ----------

✪ [1] **Methane (n = 1)**

- Molecular formula = $C_nH_{2n+2} = C_1H_{2\times1+2} = CH_4$
- Structural Formula- -------- -



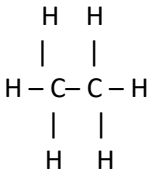
- Electron dot representation - - - - - - - -



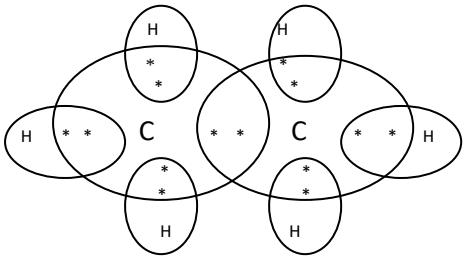
- Condensed structural formula - - - - - - CH_4

✪ [2] **Ethane : (n = 2)**

- **Molecular** Formula = $C_2H_{2n+2} = C_2H_{2\times2+2} = C_2H_6$
- Structural formula -------- -- - - - - -- - -- - - - - - - - - -- -- - - --



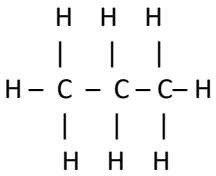
- Electron dot formula - - - - - - - - -



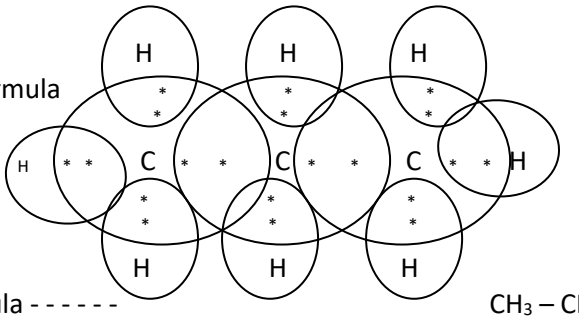
- Cond. structural formula - - - - - $CH_3 – CH_3$.

✪ [3] **Propane: (n = 3)**

- Mol. formula = $C_nH_{2n+2} = C_3H_{2\times3+2} = C_3H_6$
- Structural Formula - - - - - - - - -



- Electron dot formula



- Cond. st. formula - - - - - -

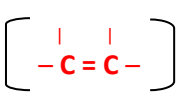
$CH_3 – CH_2 – CH_3$

{B} UN SATURATED HYDROCARBON: [(=) Alkenes or (≡) Alkynes]

"Un saturated Hydrocarbon are Hydrocarbons which contains constant double or triple bond between carbon atoms."

✪[A] **Compound containing carbon – carbon double bond.**

[ALKANES] General formula = C_nH_{2n}



➢---- **The name of Alkenes are derived by replacing Suffix - ane' (of Alkane) by '-ene'** .

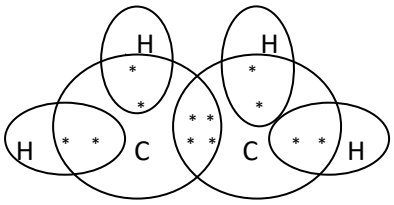
1.) Ethane - ane + ene = Ethene. **(n = 2)**

- Mol. formula ---- $C_nH_{2n} = C_2H_{2\times2} = C_2H_4$

- St. formula ----

```
        H   H
        |   |
H –C = C– H
```

- Electron dot Representation -- - - - -



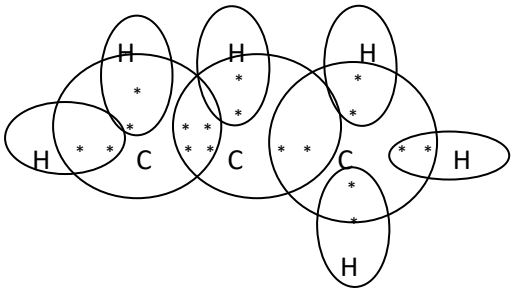
- Cond. St. Formula -- $H_2C = CH_2$
- Common name -- Ethylene.

2.) Propane - ane + ene = propene (n = 3)

- Mol. formula --- $C_nH_{2n} = C_3H_{2\times3} = C_3H_6$
- Structural formula ---

```
        H   H   H
        |   |   |
H –C = C – C – H
            |
            H
```

- Electron dot. Repr



- Cond. St. formula -- $H_2C = CH – CH_3$
- Common name – Propylene.

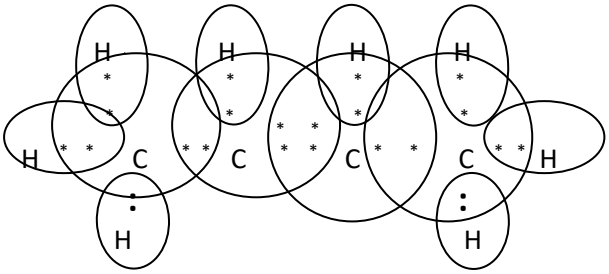
3.) Butane – ane + ene = Butene (n = 4)

- Mol. formula --- $C_nH_{2n} = C_4H_{2\times4} = C_4H_8$.
- Structural formula ---

```
        H   H   H   H
        |   |   |   |
H –C – C = C – C – H
        |           |
        H           H
```

- Cond. st. formula -- $CH_3 – CH_2 = CH_2 – CH_3$

- Electron dot. Repr



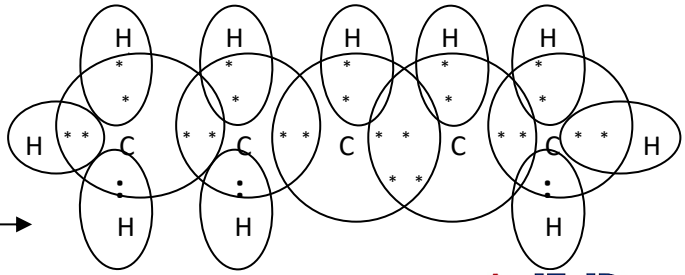
- Common name -- Butylene.

4.)Pantane – ane + ene = pentene (n = 5)

- Mol. formula -- $C_nH_{2n} = C_5H_{2\times5} = C_5H_{10}$
- Structural formula ---

```
        H   H   H   H   H
        |   |   |   |   |
H – C – C – C = C – C – H
        |   |       |
        H   H       H
```

- Cond. st. formula -- $CH_3 – CH_2 – CH = CH – CH_3$.
- Electron dot. Repr



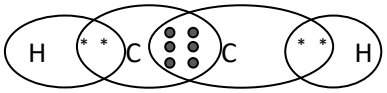
✪✪[B] Compounds Containing Carbon – Carbon triple bond (– C ≡ C –)

{ ALKAYNES }

☑ Suffix = '– yne' .
☑ General formula = C_nH_{2n-2}.
☑ The name of alkynes are derived by replacing '– ane'of the corresponding Alkane by '– yne'.

✪1.) Ethane – ane + yne = Ethyne (n = 2.)

- Mol. formula - $C_nH_{2n-2} = C_2H_{2\times2-2} = C_2H_2$.
- Structural formula -- H – C ≡ C – H .
- Electron dot repr



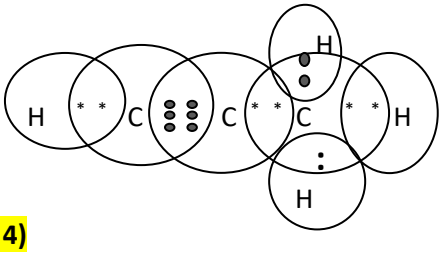
- Common name--- Acetylene .

✪2.) Propane – ane + yne = Propyne (n = 3.)

- Mol. formula -- $C_nH_{2n-2} = C_2H_{2\times3-2} = C_3H_{6-2} = C_3H_4$.
- Structural formula ---

```
        H
        |
H – C ≡ C – C – H
```

- Electron dot repr.---------



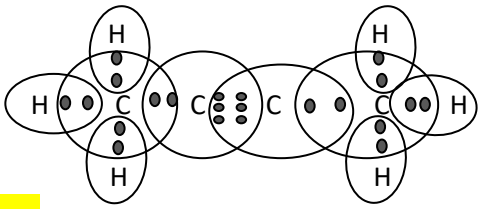
- Common name—Methyl Acetylene .

✪4.) Butane – ane + yne = Butyne (n = 4)

- Mol. formula -- $C_nH_{2n-2} = C_2H_{2\times4-2} = C_4H_6$.
- Structural formula ---

```
        H       H
        |       |
H – C – C ≡ C – C – H
        |       |
        H       H
```

- Electron dot repr



◘ Alkyl Group

" The group formed by removal of one Hydrogen atom from alkane molecule is called group ."

▶ The name of alkyl group is written by replacing the suffix – 'ane' of Alkane by – 'yl' .
i.e. **Alkane – ane + yl = Alkyl .**

▶ **General formula = C_nH_{2n+1}.**

Ex--	CH_3 -	C_2H_5 -	C_3H_7 -
	Methyl	ethyl	propyl
	(from Methane)	(from ethane)	(from propane)

➲ BRANCHED CHAIN HYDROCARBON

[I] Nomenclature of Alkanes

Common name --According to common system of nomenclature , un-branched Alkanes are named according to the no.. of atoms .The prefix 'n' is used for ***Normal*** i.e., no branching.

➢ **(Rule I) : Select the straight chain hydrocarbon.**

Example – $CH_3\ CH_2\ CH_2\ CH_3$ $CH_3\ CH_2\ CH_2\ CH_2\ CH_3$
n – Butane (normal means no branching) n – pentane

➢ **(Rule II) :The prefix Iso – is used for those Alkanes in which one Methyl is attached to the next – to – end Carbon atom of the continuous chain .**

Ex- $CH_3 - CH(CH_3) - CH_3$ **Iso Butane.**

$CH_3 - CH(CH_3) - CH_2 - CH_3$ **Iso Pentane.**

$CH_3 - CH(CH_3) - CH_2 - CH_2 - CH_3$ **Iso Hexane.**

➢ **(Rule III): If the Alkanes has two Methyl group ($CH_3 -$) attached to the 2nd – to – end carbon atom of the continuous chain the prefix neo is used.**

Ex- $CH(CH_3)_3 - CH_3$ **Neo – Pentane.**

$CH(CH_3)_3 - CH_2 - CH_3$ **Neo – Hexane**

IUPAC NAMES

For Un Branched chain -- According to IUPAC system , unbranched chain are named according to the no. of carbon atom .

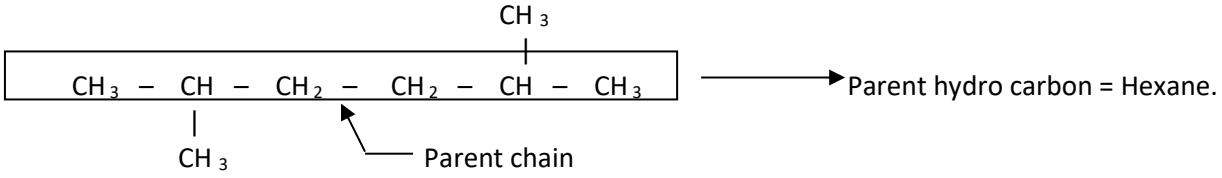
➢ Ex - C_6H_{14} ; n = 6 ; Therefore, Hexane.

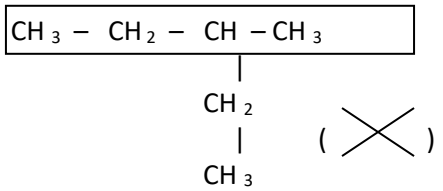
For Branched chain --

➢ **(Rule I) *Select the longest continuous chain of Carbon atom.***

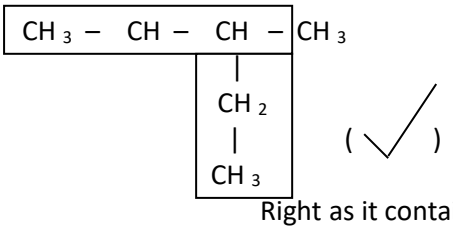
----- This chain is regarded as the parent chain and it gives the name of the parent hydrocarbon.

----- The Carbon atoms which are not included in the parent chain are regarded as substituent or branched chain .





Wrong as it contains only 4 atoms.



Right as it contains 5 carbon atoms.

➢ **(Rule II) (*Naming the side chain*)**

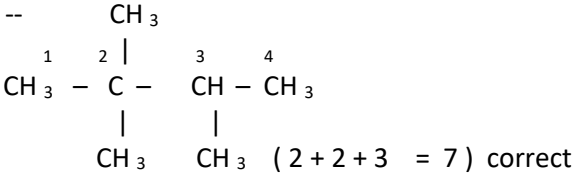
Number of the carbon atoms in the parent chain as 1, 2, 3 - - - - etc starting from the end which gives lower no. to the carbon atoms carrying the substituent (Alkyl group).

Ex – $CH_3 - {}^{2}CH_2 - {}^{3}CH(CH_3) - {}^{4}CH_3$ (in correct)

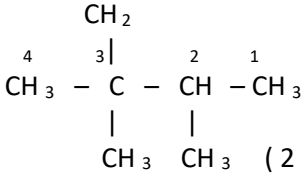
$CH_3 - {}^{3}CH_2 - {}^{2}CH(CH_3) - {}^{1}CH_3$ (correct)

If there are two or more substituent attached to the parent chain , than the end of parent chain which gives lowest sum of the no. is selected for numbering --

Example --



(2 + 2 + 3 = 7) correct

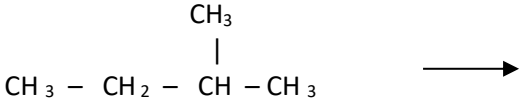


(2 + 3 + 3 = 8) in correct.

➢ (**Rule III**) ***The position of each substituent is designated by the no. of carbon atom to which it is attached.***

---- ***The position no. is written before the name of the Alkyl group which is separated by using hyphen. (–)***

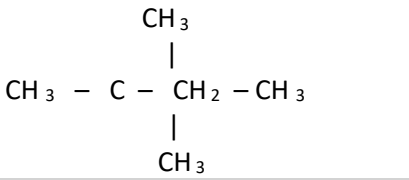
EX-



⟶ 2 – Methyl Butane .

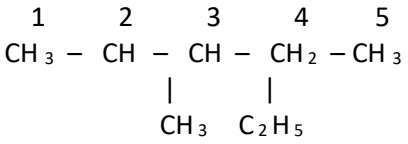
➢ (**Rule IV**) ***If the compound contains more than one Alkyl group , then their position are indicated separately and a prefix (di – for two) , tri – (for three), tetra – (for four) etc is used before the Alkyl group separated by commas***

Example -



⟶ 2 , 2 – Dimethyl Butane

➢ (**Rule V**) ***If the compound contains different Alkyl group , they are named in alphabetical order*** **(Ethyl before Methyl)**

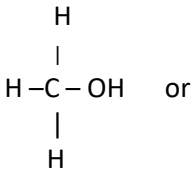
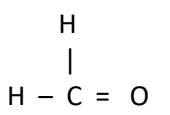
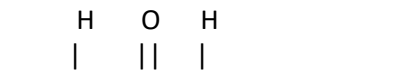
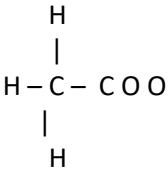


⟶ 3 , – Ethyl – 2 Methyl Butane.

FUNCTIONAL GROUP - We know that unsaturated Hydrocarbon are more reactive than saturated Hydrocarbon. | |

----- The reactivity of the unsaturated Hydrocarbon is due to the presence of double bond (– C = C –) or a triple bond (– C ≡ C –) between their carbon atom.

" An atom or a group of atoms which makes a carbon compound (or Organic compound) reactive and decides its properties (or function) is called functional group."

Function group	Family	Examples
➢ – OH, (Alcoholic group)	Alcohols	 or CH 3 OH (Methyl alcohol)
➢  – CHO (or –C – H) (Aldehydic group)	Aldehydes	 or, CH = O (Formaldehyde)
➢  – C = O (or – C –) (or – CO –) (Ketonic group)	Ketones	 (Acetone)
➢  – C O O H (or – C – OH) (Carboxylic group)	Carboxylic group	 (Acetic acid)

➢ – C O O R (or, – C – OR) (Esters)	**Esters**	H – C – C – O C H 3 (Methyl Acetate)
➢ --X(X can be Cl, Br, or I) (Halogen group)	**Halogens**	$CH_3 – Cl$ (Chromo methane)
➢ --N H 2 (Amino group)	**Amines**	$CH_3 – NH_2$ (Methanamines)
➢ -- NO 2 (Nitro group)	**Nitro**	**CH 3 – NO 2 (Nitro methane)**

In an organic compound , the Alkyl group determines the physical properties whereas the functional group determines the chemical properties of the compound .

Example = CH_3OH → Physical properties decides – CH_3
Chemical ,, ,, – OH.

ALCOHOLS (– OH) "The Organic compound containing Hydroxyl group (– OH) as the functional group are called Alcohols ."

In these compounds , the Hydroxyl group is joined to Carbon atom of the Alkyl group .

Ex- Methane —(replace H by OH)→ Methyl Alcohol (Methanol)

HOMOLOGOUS SERIES -- "A group of Organic compounds having similar structure and similar chemical properties in which the successive compound differ by CH_2 group is called Homologous series."

Homologous series of Alcohol - Alcohol forms Homologous series.

--- **General Formula** = $C_nH_{2n+1}OH$ n = no. of Carbon atom .

--- **Common Name** = Common name are generally used for simpler members having one to four Carbon atoms.

Ex – 1.) CH_3OH (Methyl Alcohol) ; 2.) CH_3CH_2OH (C_2H_5OH)Ethyl Alcohol etc.

--- IUPAC name = According to IUPAC system , Alcohols are named as Alkanols

i.e.,

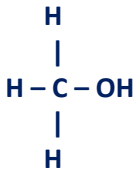
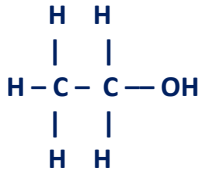
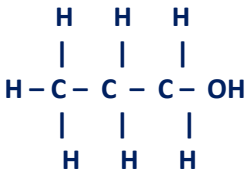
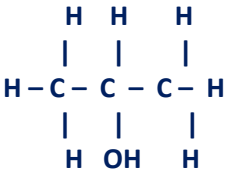
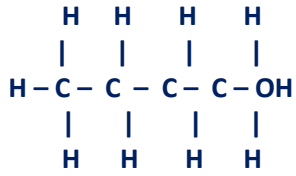
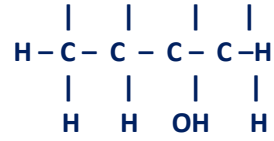
Alkane – e + Ol = Alkanol

If – OH group is attached in between the chain, then the carbon atom is numbered in such a way that the carbon carrying the – OH group gets the lowest possible no.

Ex- [1] Ethanol (Ethane – e + ol)

[2] 2 – Propanol (Propane – 2 – Ol) (Iso – Propyl Alcohol)

[3] 3 – Pentanol (Pentane – 3 – Ol) (Iso Pentyl Alcohol)

Molecular formula	Structural formula	Common name	IUPAC name
CH_3OH		Methyl Alcohol	Methanol.
C_2H_5OH		Ethyl Alcohol	Ethanol .
C_3H_7OH i.)		n – Propyl Alcohol	1 – Propanol.
ii.)		Iso propyl Alcohol	2 – Propanol .
C_4H_9OH i.)		n – Butyl Alcohol	1 – Butanol .
ii.)		Iso – Butyl Alcohol	2 – Butanol .

FERMENTATION:-

" The slow chemical change produced in an organic compound by the action of enzymes , leading to formation of smaller molecules is called Fermentation ."

Ex- Fermentation of sugar changing milk into curd.

Ethanol (Ethyl Alcohol) C_2H_5OH.

Ethanol is most important member of series . It is commonly known as **Ethyl Alcohol** or simply as **Alcohol.**

PREPARATION OF ETHANOL –

Ethanol may be prepared by following methods :-

By fermentation of sugar :-- Ethanol is prepared in large scale by the fermentation of sugar present in molasses. Molasses is dark coloured syrup like liquid left after the crystallization of sugar from the concentrated sugar-cane juice . *Molasses contain 30 % of sugar – cane* .

Molasses is a cheap source of sugar and it forms an excellent raw material for making Alcohol .

The fermentation of sugar is done by adding yeast . The yeast plants secretes the enzymes called ' **INVERTASE'** and '**ZYMASE**' which acts as catalyst in converting sugar into Ethanol and CO_2 . The fermentation of sugar to produce Ethanol takes place into two steps --------

IN FIRST STEP --

Sugar is converted into a mixture of sugar called glucose and fructose by the action of enzymes called invertase.

$$\underset{\text{sugar}}{C_{12}H_{22}O_{11}} + \underset{\text{water}}{H_2O} \xrightarrow{\text{invertase}} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose .}}{C_6H_{12}O_6}$$

Glucose and fructose have the same molecular formula but they have different structures .

IN SECOND STEP –

Both glucose and fructose are converted into Ethanol and CO_2 by the action of enzyme called Zymase .

$$\underset{\text{glucose or fructose}}{C_6H_{12}O_6} \xrightarrow[\text{(present in yeast)}]{\text{Zymase}} \underset{\text{Ethanol .}}{\boxed{C_2H_5OH}} + 2CO_2$$

- Fermentation of sugar is an exothermic reaction in which heat is evolved .
- Fermentation of sugar is carried out at a controlled temperature of $20\,^0C$ to 30^0 C(293 K to 303 K).
- The vessel used for Fermentation is such that it allows CO_2 produced during the fermentation to go out but does not allow the air to enter.

  This is necessary because if air is present during Fermentation of sugar, then it will oxidized Ethanol into Acetic acid (CH_3COOH).
- Fermentation of sugar produced a dilute solution of Ethanol in water . This solution is separated by fractional distillation and the solution contain 95 % Ethanol and 5% water .
- Ethanol can also be prepared from starch containing material like potatoes , maize, barley etc. The starch present in these materials in first converted into sugar which is then fermented by yeast .

Industrial methods of preparation

By Hydration of Ethene :--

Ethanol can be prepared from Ethene by reacting with water is the presence of sulfuric acid at a 75 ^{0}C (348K).

$$\underset{\text{Ethene}}{H_2C = CH_2} + H_2O \xrightarrow[75\,^0C]{\text{Conc . } H_2SO_4} \underset{\text{Ethanol}}{CH_3CH_2OH}$$

Infact it is an indirect hydration of Ethene and involves two steps.------

IN FIRST STEP

$$CH_2 = CH_2 + H_2SO_4 \xrightarrow{75\,^0C} CH_3 - CH_2 - H_2SO_4 \text{ -------- (i)}$$

Ethyl hydrogen Sulphate .

IN SECOND STEP

$$CH_3 - CH_2 - H_2SO_4 + H - OH \longrightarrow CH_3CH_2 * OH + H_2SO_4 \text{ -------(ii)}$$

According to (i) & (ii)

H_2SO_4 and $CH_3 - CH_2 - H_2SO_4$ Cancel out from both sides and we get Ethanol.

By the Hydrolysis of Alkyl Halides

Ethyl Bromide when boiled with aqueous (Potassium hydroxide { KOH}) .

$$\underset{\text{Ethyl Bromide}}{C_2H_5Br} + KOH \longrightarrow \underset{\text{Ethanol.}}{C_2H_5OH} + KBr$$

Physical Properties

1.] It is colourless liquid, pleasant smell but burning taste .
2.] Boiling point - 351 K (78 ^{0} C).
3.] It is lighter than water and mines with water in any proportion.
4.] Ethanol does not contain any ions, so it is a neutral compound and has no effect in litmus.
5.] The solubility of Ethanol in water is due to the presence of Hydroxyl group in it.

Chemical Properties of Alcohol --- (Ethanol)

1.] Combustion

Ethanol is highly inflammable liquid. It catches fire easily and starts burning with a blue flame to form CO_2 and water vapour (H_2O).

$$C_2H_5OH + 3O_2 \xrightarrow{\text{Combustion}} 2CO_2 + 3H_2O + \text{Heat .}$$

2.] Reaction with Sodium metal

Ethanol reacts with sodium metal to form sodium ethoxide and H_2 gas is liberated.

$$2\,C_2H_5OH + 2Na \longrightarrow 2\,C_2H_5ONa + H_2$$

Sodium ethoxide.

** (Test) when we add a small place of sodium metal to the organic compound (to be tested) in a dry test tube, If the Bubbles of H_2 gas are produced it indicates the presence of Ethanol.

3.] Oxidation

Ethanol can be readily oxidized to Ethanol CH_3CHO (Acetaldehyde) and Ethanoic Acid (CH_3COOH) with different oxidizing agent .

CH_3CH_2OH oxidation

- Cr_2O_3 in CH_3COOH → CH_3CHO Ethanol
- Alkaline $KMNO_4$ → CH_3COOH Ethanoic acid.

(i) When ethanol is treated with chromic hydride then its partial oxidation takes place and Ethanol is formed.

$$CH_3CH_2OH + [O] \xrightarrow[(\text{in } CH_3COOH)]{Cr_2O_3} CH_3CHO + H_2O$$

Oxygen — Ethanol

☞ **All Alcohol forms Aldehyde on partial oxidation**.

(ii) When ethanol is heated with Alkaline Potassium Permanganate ($KMnO_4$ in NaOH sol^n) ,its complete oxidation takes place and Ethanoic acid is formed .

$$C_2H_5OH + 2[O] \xrightarrow[KMnO_4]{\text{Alkaline}} CH_3COOH + H_2O$$

Nascent oxygen

4.] Reaction with Ethanoic Acid (Formation of esters)

Ethanol reacts with Ethanoic Acid or warming in the presence of a few drop of concentrated Sulphuric Acid to form a. sweet smelling ester , Ethyl Ethanoate .

$$CH_3COOH + C_2H_5OH \underset{}{\overset{\text{Conc. } H_2SO_4}{\rightleftharpoons}} CH_3COOC_2H_5 + H_2O$$

Ethanoic Acid — Ethanol — Ethyl Ethanoate

☞ ***"The* reaction in which a carboxyl acid combines with an alcohol to form an ester is called esterification ."**

☞ Esterification takes place in the presence of a dehydrating agent like Conc . H_2SO_4.

Test – The formation of sweet smelling agent ester is used as test for alcohol as well as Carboxyl Acid.

$$\text{Alcohol} + \text{Carboxyl Acid} \xrightarrow{\text{Conc. } H_2SO_4} \text{Esters} + H_2O$$

5.] Reaction with Sodium Hydroxide

Sodium Hydroxide to form Sodium Ethoxide .

$$C_2H_5OH + NaOH \longrightarrow C_2H_5ONa + H_2O$$

Sodium Ethoxide .

USES OF ALCOHOL

1.] It is used in the manufacture of paints , varnishes , Medicines , perfumes , dyes soap , synthetic rubber etc.
2.] It is used in the preparation of organic compounds , like ether , chloroform etc.
3.] It is a constituent of Alcoholic drink, beer, whisky , wine etc.
Ex- whisky = 35 % ; wine = 10 – 20 % ; beer = 6 – 7 % .
4.] It is used as anti-freeze in radiators of vehicle in cold countries.
5.] It is used as antiseptic to sterilize wound and syringe in hospitals.
6.] It is used as a solvent for fats, oils, hydrocarbon etc.

Denatured Alcohol-- Denatured Alcohol is Ethyl Alcohol which has been made unfit for drinking purposes by adding poisonous substance like Methanol , $CuSO_4$ etc.

Power Alcohol – It is a mixture of 20 % Ethanol and 50% gasoline and a solvent (Benzene), It is a substitute for gasoline.

Nomenclature of Alkenes and Alkynes

Common names:

Most of the alkenes and alkynes are known by their systematic IUPAC names. Some of these are known by common names and should be remembered .

➢ **Alkenes : Molecules containing carbon – carbon double bond.**

$CH_2 = CH_2$	$CH_3 - CH = CH_2$	$CH_2 = CH - CH_2 - CH_3$	$CH_3 - CH = CH - CH_3$
Ethylene	Propylene	α – Butylene	β- Butylene

➢ **Alkynes : Molecules containing carbon – carbon triple bond .**

$HC \equiv CH$	$H_3C - C \equiv CH$	$H_3C - C \equiv C - CH_3$
Acetylene	Methyl acetylene	Dimethyl acetylene.

IUPAC names

The IUPAC names of the alkenes and alkynes are derived by modified tar nomenclature of alkanes . The parent chain is named by replaced the *suffix – ane in the name of the corresponding alkanes by – ene (alkenes) and – yne (for alkynes).*

$CH_3 - CH = CH - CH_3$ Corresponding alkane : Butane (4 carbon atom)
Name of alkene : **Butane**

$H_3C - CH_2 - C \equiv CH$ Corresponding alkane : Butane (4 carbon atom)
Name of alkyne : **Butyne**

The rules for writing IUPAC names are :

1. Select the longest continuous chain containing the carbon atoms forming the double or triple bond.

This gives the **parent name** of the alkene or alkyne . For example , in the following structure , the longest chain has four carbon atoms .

$CH_3 - CH(CH_3) - CH = CH_2$ Parent chain contains 4 C – atoms
Parent name is butane.

While writing the name of the alkene or alkyne, the suffix *– ane* of the corresponding alkane is replaced by *– ene* (for alkenes) and *– yne* for (alkynes) .

2. The carbon atoms in the chain are numbered in such a way that the carbon atom carrying double or triple bond gets the lowest number . The position of the double or triple bond is then indicated by using the number of the first C – atom of the double or triple bond .

It may be noted that we give lowest number to the carbon atom having double or triple bond and not any side chain (as in Alkanes).

For Example , 4 3 2 1
$CH_3 - CH_2 - CH = CH_2$
Correct numbering
(double bond gets number 1)
Correct name is
1 – Butene
↑
Position of double bond .

1 2 3 4
$CH_3 - CH(CH_3) - CH = CH_2$
Wrong numbering
(double bond gets number 3)

3. *The position of each substituent is designated by the number of carbon atom to which it's attached.* The position number *is* written before the name of alkyl group which is separated by using hyphens.

4. If the compounds contains more than one alkyl group , their positions are specified separately and a prefix di- (for two), tri – (for three), etc is used before the name of the substituent. The numbers for the substituent are separated by commas.

For example-

1 2 3 4
$CH_2 = CH\ CH_2\ CH_3$
1- Butene
↑
Position of double bond .

1 2 3 4
$CH_3\ CH = CHCH_3$
2 – Butene.
↑
position of double bond.

4 3 2 1
$CH_3 - CH_2 - C \equiv CH$
1 – Butyne
↑
Position of triple bond

1 2 3 4
$CH_3\ C \equiv CCH_3$
2 – Butyne
↑
Position of triple bond.

CH_3
4 3 | 2 1
$H_3C - CH - C \equiv CH$
3 – Methyl – 1 – Butyne
↑
Position of methyl group

Position of triple bond

The substituent is written before the name

CH_3
5 4 | 3 2 1
$CH_3 - CH - CH - CH = CH_3$
|
CH_3

3, 4 – Dimethyl –1 pentene

Two methyl group at carbon 3 and 4

Position of double bond.

ALDEHYDES AND KETONES

Aldehydes and Ketones are organic compounds containing ----

O
| ||
– CO or – C – groups .So, they are **collectively known as 'Carbonyl compounds'.**

In Aldehydes , the carbonyl group is attached to one Hydrogen atom (H) or one Alkyl group (R) .

So, **general formula** of **Aldehydes** ⟶

O
||
R – C – H ***or,*** ***R CHO*** ***or,*** ***R – CHO***

☞**R** is Alkyl group like Methyl ($CH_3 -$) ($C_2H_5 -$) .

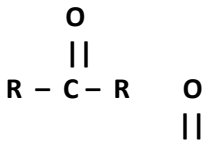
Ex – O
||
$CH_3 - C - H$ or, CH_3CHO or, $CH_3 - CHO$.
Acetaldehydes (Ethanal) (**n = 2**)

Exception: - In the case of the simplest aldehyde called **Formaldehyde (or methanal), there is no alkyl group at all .**
The simplest aldehyde has **a Hydrogen atom (H) in place of Alkyl group .**

i.e. , O or, H – CHO or, H CHO
||
H – C – H
H
|

→ The functional group of Aldehydes **– C = O** is called Aldehydic group .

► **In Ketones,** the carbonyl group is attached to two Alkyl group (R) , so-
General formula of **KETONES –**



(Here two Alkyl group are the ***same*** **.**)

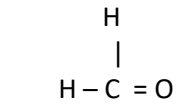
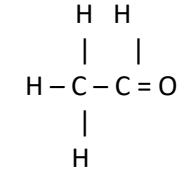
or, **R – C – R'** (,, ,, ,, ,, ,, ,,***different.***)

=> R – C – R' can also be written as R – CO – R' or R CO R' .

EX:- (i) CH_3– C O– CH_3 Dimethyl Ketones.

(ii) CH_3– C O– C_2H_5 = CH_3– C O– CH_2 – CH_3 -- Ethyl Methyl Ketones.

Homologous series of Aldehydes and their nomenclature

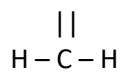
Molecular formula	structural formula	Common name	IUPAC name
HCHO		Formaldehyde	Methanal
CH_3 CHO		Acetaldehyde	Ethanal
C_2H_5 CHO	$CH_3 – CH_2 – CHO$	Propionaldehyde	Propanal
C_3H_7 CHO	$CH_3 – CH_2 – CH_2 – CHO$	Butyraldehyde	Butanal.

General Formula → $C_nH_{2n+1}CHO$

IUPAC name → ***Alkane – e + al***
= ***Alkanal*** .

All the member of Aldehyde homologous series have same functional group – CHO .

METHANOL (Formaldehyde)

► Simplest aldehyde
► Molecular Formula = HCHO
► Structural Formula = H – CHO or 

Physical Properties

- (i) Colourless gas with pungent smell .
- (ii) It can be easily condensed into liquid.
- (iii) Boiling point = 252 K.
- (iv) Highly soluble in water .
- (v) It cause irritation to skin , eyes, nose and throat.
- (vi) Powerful disinfectant and antiseptic.

Preparation of Methanal

1.By Oxidation of Methanol – Methanal is prepared by the controlled oxidation of Methanol by oxygen in the presence of a catalyst like silver or Iron – oxide at 873 – 923 K.

$$2\,CH_3OH + O_2 \xrightarrow[873-923\ K]{\text{Catalyst}} \boxed{\text{2 HCHO}} + 2\,H_2O$$

Methanal

☞ The presence of air results in further oxidation of Methanal to Methanoic acid .

$$2\,HCHO + O_2 \longrightarrow 2\,HCOOH$$

Methanoic acid.

--- The amount of Methanal and air must be carefully controlled to stop the reaction at Methanal stage .

2. By the dehydrogenation of Methanol

When vapour of Methanal are passed over copper or silver at **575 – 675 K** , Hydrogen is removed with the formation of Methanal .

$$CH_3OH \xrightarrow[575-675\ K]{Cu \text{ or } Ag} HCHO + H_2\uparrow.$$

Chemical Properties

●Methanal is a neutral substance (neither acidic nor basic). (Infact all the aldehydes are neutral) .
Methanal is structurally different from other Aldehydes because it does not have any alkyl group attached to the carbonyl group (– CHO) .In place of alkyl group, it has hydrogen atom.

●● I.] **Addition of Hydrogen** Methanal is added with H_2 in the presence of metal such as finely divided Platinum (Pt), Nickel (Ni) to form Methanol .

$$HCHO + H_2 \xrightarrow{Ni} CH_3OH \text{ (Methanol)}$$

●●II.] **Oxidation**--Methanal can be oxidized very easily to form Methanoic Acid . The oxidation of Methanal can be done by a no. of oxidizing agent like Alkaline or Potassium permanganate , **Tollen's reagent** , **Fehling reagent** or **Benedict reagent** .

● (i) **Alkaline Potassium paramagnet :--** Methanal is oxidized by alkaline potassium permanganate to Methanoic Acid. As soon as Methanoic Acid is formed it react with Sodium Hydroxide (Present in Alkaline $KMnO_4$) to form Sodium Methanoate .

$$\underset{\text{Methanal}}{HCHO} + [O] \xrightarrow{Alk.\ KMnO4} \underset{\text{Sodium Methanoate}}{HCOONa} \xrightarrow[HCl]{\text{acidify}} \underset{\text{Methanoic Acid .}}{HCOOH}.$$

The solution containing Sodium Methanoate is then acidified by adding dilute hydrochloric acid to obtain free Methanoic Acid .
All the aldehyde can be oxidized to the corresponding carboxylic acid . Ex:- Ethanal (CH_3CHO) oxidized to Ethanoic acid (CH_3COOH) .

● (ii) **Tollens's Reagent :-** ***(Ammonical Silver Nitrate)***
Ammonical Silver Nitrate solution containing sliver nitrate ($AgNO_3$) with excess of ammonium hydroxide (NH_4OH)
Ammonical Silver Nitrate solution is prepared by adding **NH_4OH slowly to $AgNO_3$ till the black precipitate of silver oxide** formed first is redissolved in excess of NH_4OH .

$$AgNO_3 + 2\,NH_4OH \longrightarrow \underset{\text{Diamine silver nitrate}}{[Ag(NH_3)_2]NO_3} + 2\,H_2O.$$

(Ammonical silver nitrate) or (Tollen's reagent)

In Tollen's reagent , silver ion (Ag +) dissolved in NH_4OH and these Ag+ ion acts as an oxidizing agent .

➔ Methanal reduces Ammonical Silver Nitrate Solution (Tollen's reagent) to silver metal which form a **shining silver mirror** on the inner side of the test tube.

$$HCHO + 2\,[Ag(NH_3)_2]NO_3 + 2\,NH_4OH \longrightarrow HCOOH + 2\,Ag + 2\,NH_4NO_3 + 4\,NH_3 + H_2O.$$

---- Methanal reduces silver ion (Ag+) of Ammonical Silver Nitrate and itself oxidized to Methanoic Acid . Infact all the aldehyde reduces Tollen's reagent to form a silver mirror. Thus, ***Silver mirror test is used for aldehyde***.

• (iii **Benedict's Solution (reagent): - [*Copper sulphate dissolved in water containing citric acid and Sodium carbonate*]**.
Benedict use *Benedict's solution to test the presence of glucose into urine of a person.*

Explanation- Benedict's reagent is added to sample of urine taken in a test tube , the test tube is then heated . If red colur is produced on heating , then glucose sugar (Aldehydic sugar) is present in the given sample of the urine And the person concerned is suffering from **diabetes** .

Sugar is tested in the human urine is based on the reduction of blue coloured Copper (II) ion of the Benedict's reagent to red coloured Copper (I) ion.

3. Reduction – (Addition of Hydrogen)

When ***Methanal*** is reacted with H_2 gas in the presence of finely divided ***Palladium catalyst*** , it is reduced to ***Methanol***

$$HCHO + H_2 \xrightarrow{Pd} CH_3OH \text{ (Methanol).}$$

4. Addition of Hydrogen Cyanide (HCN)

Methanal reacts with ***hydrogen Cyanide*** to form ***Methanal cyanohydrin*** .

Hydrogen cyanide — Methanal cyanohydrin

Infact all the aldehydes form Cyanohydrins on reacting with HCN . EX- Ethanal cyanohydrin .

5. Polymerization

When aqueous solution of Methanal is evaporated to dryness, a white crystalline solid is obtained known as para-Formeldehyde. Polymerize

$$n\,HCHO \longrightarrow (HCHO)_n * H_2O$$,where n = 6 – 50

Para formal dehyde

USES –[1.] Methanal is sold a 40% aqueous solution under the name 'formalin'. Formalin is used as disinfectant , germicides, antiseptic.

[2.] Formalin is also used for the preservation of biological specimens.

[3] Methanal (formaldehyde) is use with Phenol (C_6H_5OH) in the manufacture of Bakelite Plastics.

[4] It is used for silvering mirror.**[5.]**Methanal (or formaldehyde) is used with ammonia is producing urotropine [$(CH_2)_6N_4$, Hexa methyline tetra amine] which is used as a medicine for urine infections .

[6.] It is used in the preparation of dyes.

[7.] It is used in leather industry for tanning .

[8.] Formalin is also used as an antiseptic in sterilizing surgical instruments.

KETONES

Ketones are the carbon compound containing group ***Ketonic group*** **– CO –** group .

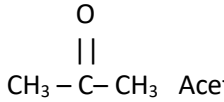
A Ketone must contain at least three carbon atoms in its molecule. **One carbon** of the Ketonic group and **two carbon atom** of alkyl group .

• ➢ **There can be no Ketone with less than three carbon atoms in it** .

• ➢ **General formula --** $C_nH_{2n+1} – CO – C_mH_{2m+1}$

If **m = n** Ketones are called **simple Ketone** .

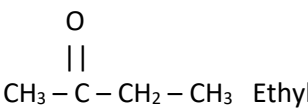
Ex-



Acetone.

If **m ≠ n** Ketones are called **mixed Ketone .**

Ex-



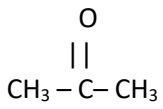
Ethyl Methyl Ketone .

Homologous series of Ketones:-

Ketones form the homologous series in which all the members have the same functional group **– C –** (**O**)

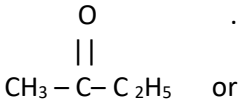
General formula -- $C_nH_{2n+1} – CO – C_mH_{2m+1}$

1.] .

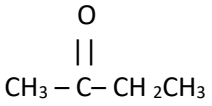


- **Common name --** Acetone or Dimethyl Ketone .
- **IUPAC name --** **Propanone** .

2.] .

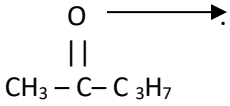


or



- **Common name --** Ethyl Methyl Ketone .
- **IUPAC name** -- Butane – e + one = **Butanone**

3.] (i)



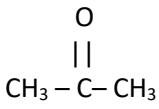
- **Common name -** Methyl Propyl Ketone
- **IUPAC name -** 2 Pentanone

(ii) $CH_3 - CH_2 - CO - CH_2 - CH_3$ ⟶ **Common name -** Diethyl Ketone

IUPAC name - 3 – Pentanone .

Propanone

- Molecular formula -- C_3H_6O or $CH_3CO CH_3$.
- Simplest Ketone ----



- Structural formula --

- Common name -- Acetone (or Dimethyl Ketone)

Preparation of Propane

1.] By heating Calcium Acetate

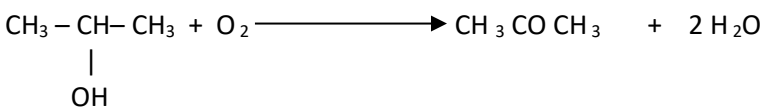
Acetone is prepared in the lab. by heating Calcium Acetate .

$$(CH_3\ COO)_2\ Ca \xrightarrow{\text{Heat}} CH_3\ CO\ CH_3 + Ca\ CO_3$$

Calcium Acetate — Acetone — Cal. carbonate.

2.] Manufacture of Propanone by the oxid ^{n} of isopropyl Alcohol

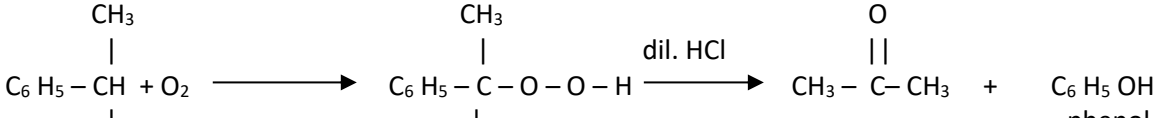
Acetone is manufacture by the air oxidation of isopropyl Alcohol at 775 K .



3.] Manufacture of Propanone from 'Cumene

Cumene is Isopropyl Benzene [$C_6H_5 - CH\ (CH_3)_2$].

Cumene is oxidized by the oxygen of air to form Cumene hydro peroxide. This Cumene hydro peroxide on treatment with dil. HCl acid produces ***Propanone*** and ***phenol*** .



Cumene — Cumene hydro peroxide — Acetone — phenol

Physical Properties

- 1.] Colourless volatile liquid
- 2.] Boiling point = 56^0 C
- 3.] Highly Inflammable
- 4.] Ether like smell
- 5.] It is miscible with water in all proportions.

Chemical Properties

1.] Reduction: Propanone is Reduced to 2- propanol with Hydrogen in the presence of finely divided Nickel or Palladium .

$$CH_3 - CO - CH_3 + H_2 \xrightarrow{Pd.} CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$$

2- Propanol

However, Propane can also be reduced by using Sodium borohydride ($Na\,BH_4$) as reducing agent .

$$CH_3 - CO - CH_3 \xrightarrow{Na\,BH_4} CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$$

2.] Addition of Hydrogen Cyanide (H – CN): Propanone reacts with HCN to form Propanone Cyanohydrin .

$$CH_3 - \overset{\displaystyle O}{\overset{||}{C}} - CH_3 + H - CN \longrightarrow CH_3 - \underset{\displaystyle CN}{\underset{|}{\overset{\displaystyle OH}{\overset{|}{C}}}} - CH_3$$

Cyanohydrin .

3.] Oxidation : Propanone is not readily oxidized , however, with strong oxidizing agents such as cone . Hydrochloric Acid, alkaline potassium permanganate , it gets oxidized to Ethanoic acid .

$$\underset{\text{Propanone}}{CH_3\,CO\,CH_3} \xrightarrow{\text{alk. } KMnO_4} \underset{\text{Sodium Ethanoate}}{CH_3\,COO\,Na} \xrightarrow{\text{Dil. } HCl} \underset{\text{Ethanoic acid .}}{CH_3\,COOH}$$

USES : It is used as -----

----●**i.)** Solvent in lab. ----●**ii)** As nail polish remover ----●**iii)** Solvent for acetylene , Cellulose , Plastic etc

----●**iv)** For making artificial leather and resin . ----●**v)** in the formation of Chloroform .

----●**vi)** It is used for the manufacture of smokeless powder explosive (Called cordite).

Carboxylic acid

Carboxylic Acids are organic acids containing carboxylic acid group , **– COOH** or $-\overset{\displaystyle O}{\overset{||}{C}}-OH$. Their general formula is $\mathbf{C_n H_{2n+1} COOH}$ or it may be written as **RCOOH** where R is an **alkyl group** . The first member of this series is formic acid , HCOOH . The most common organic acid is ***acetic acid , CH_3 COOH*** .

Homologous Series of Carboxylic Acids and their Nomenclature :

Organic acids are represented by the general formula $C_n H_{2n+1} COOH$ or it may be written as RCOOH where R is an alkyl group such as methyl , (CH_3-) , (C_2H_5-), etc. The simplest acid is formic acid , H – COOH in which R is a hydrogen atom, H.

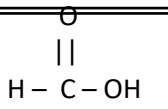
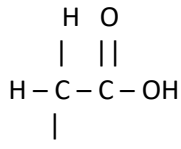
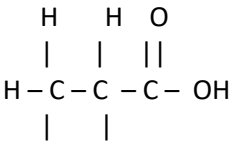
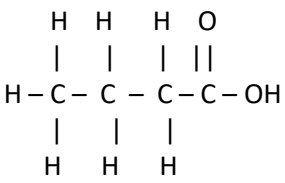
Common names : The common names of first four members are :

HCOOH	CH_3COOH	CH_3CH_2COOH	$CH_3CH_2CH_2COOH$
Formic acid	Acetic acid	Propionic acid	Butyric acid

IUPAC names : In the IUPAC system , the carboxylic acids are named as **alkanoic acid** . The IUPAC name of a compound is obtained by replacing **'e'** of the corresponding alkane by **'oic'** and **adding the word 'acid'** . For example --- CH_3COOH corresponding alkane CH_3CH_3 ,IUPAC group is also counted .

For ex- : the above compound contain two carbon atoms and not one . Therefore, its name is derived from ethane.

HOMOLOGOUS SERIES OF CARBOXYLIC ACID

Molecular formula	Structural formula	Common name	IUPAC name
➢ HCOOH		Formic acid	Methanoic acid .
➢ CH_3COOH		Acetic acid	Ethanoic acid .
➢ C_2H_5COOH		Propionic acid	Propanoic acid .
➢ C_3H_7COOH		Butyric acid	Butanoic acid .

Preparation of Carboxylic acids

The carboxylic acids are prepared by the oxidation of alcohols. The oxidation of alcohols is done by using acidified potassium dichromate ($K_2CR_2O_7$) or by using heated copper as catalyst .

For example,

$$CH_3OH + 2[O] \xrightarrow[H_2SO_4]{K_2CR_2O_7} \underset{\text{Methanoic acid or Formic acid}}{HCOOH} + H_2O$$

Methanol

$$CH_3CH_2OH + 2[O] \xrightarrow[H_2SO_4]{K_2CR_2O_7} \underset{\text{Ethanoic acid or Acetic acid}}{CH_3COOH} + H_2O$$

Ethanol

By Fermentation: Acetic acid is manufacture in dilute form (Called vinegar) by the fermentation of ethyl alcohol with Bacteria, acetobacter in the presence of air .

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + O_2 \xrightarrow{\text{Acetobacter}} \underset{\text{vinegar}}{CH_3COOH} + H_2O$$

Properties of Carboxylic acids

Physical Properties

1. Physical State :-- The first three carboxylic acids (Formic acid , acetic acid and propionic acid) are colourless liquids with pungent smell . The next six carboxylic acids having carbon atoms from four to none are oily liquids having odour of rancid butter . The higher members are colourless, odourless waxy solids.

2. Solubility : -- The first four members are very soluble in water . The solubility of higher acids decreases with increase in molecular weight . The organic acids containing more than ten carbon atoms are practically insoluble in water .

3. Boiling point:-- The carboxylic acids have quite high boiling points. This is due to strong intermolecular forces (known as hydrogen bonding) between carboxylic acid molecules.

Chemical Properties :

1. Acidic nature :-- All the carboxylic acids are acidic in nature and turn blue litmus red . For example, when blue litmus solution is added to Ethanoic acid , the solution turns red . This test can be used as a test for identification of carboxylic acids.

The acidic character can be justified by the following chemical reactions :--

----● **(a) Reaction with Metals** -- Carboxylic acids reacts with metals such as Sodium (Na) , Potassium (K) or zinc (Zn) and Liberate hydrogen gas.

$$2\,CH_3COOH + 2\,Na \longrightarrow \underset{\text{Sodium acetate}}{2\,CH_3COONa} + H_2$$

----● **(b) Reaction with alkalies** -- carboxylic acids react with alkalies (NaOH or KOH) forming salt and water .

$$CH_3COOH + NaOH \longrightarrow \underset{\text{Sodium acetate}}{CH_3COONa} + H_2O$$

----● **(c) Reaction with bicarbonates and carbonates**:-- carboxylic acids react with bicarbonates and carbonates giving brisk effervescence due to liberation of CO_2 .

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2 + H_2O$$

2. Reaction with Alcohol --carboxylic acids reacts with alcohols in the presence of concentrated Sulphuric acid to form esters which have very pleasant smell .

$$CH_3COOH + C_2H_5OH \longrightarrow CH_3COOC_2H_5 + H_2O$$

TEST FOR CARBOXYLIC ACIDS

The carboxylic acids can be tested by following tests:-

----●**a]. Litmus test :-** Add small amount of blue litmus solution to given compound . If the blue litmus solution terns red , It indicates that the organic compound is a carboxylic acid .

----●**b]. Sodium bicarbonate test :--** To a small portion of the organic compound in a test tube add a pinch of slid sodium bicarbonate. Evolution of carbon dioxide with brisk effervescence shows the presence of carboxylic acids.

----●**c]. Ester test :-** Warm the organic compound with some ethanol and a few drops of concentrated Sulphuric acid A sweet smell (due to formation of ester)shows the presence of carboxylic acids .

USES OF CARBOXYLIC ACID

----●**I.]** Organic acids are used in **food, cold drinks,** etc. For Example, acetic acid is used as vinegar for preparing pickles And food dressing . Sodium salt of organic acid is used as preservatives.

----●**II.]** Higher fatty acids are used **in the manufacture of soaps.** Soaps are sodium or potassium salts of higher fatty acids such palmitic acid, stearic acid .

----●**III.]** Organic acids are used for the **preparation of many drugs** such as aspirin, phenacetin , etc.

----●**IV.]** Organic acids are used in manufacture of **various dyes, perfumes, rayon, rubber,** etc.

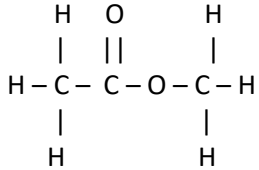
ESTERS

Esters are derivatives of carboxylic acids in which the hydrogen atom is replaced by an alkyl group . Therefore, they are generally represented by as :--

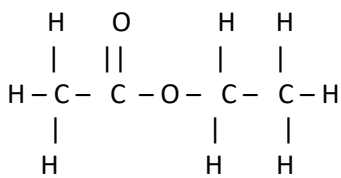
Where R *is alkyl group such as* CH_3 , C_2H_5 , etc.

Therefore, the esters have functional group ***– C – O – (or – COO –)*** .

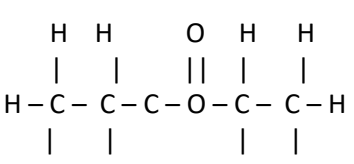
The structural formulae of some esters are :--



or CH_3COOCH_3 — Methyl acetate or Methyl ethanoate



or $CH_3COOC_2H_5$ — Ethyl acetate or Ethyl ethanoate



or $CH_3CH_2COOC_2H_5$ — Ethyl propionate or Ethyl propanoate

The common names of esters are written by replacing '**–ic acid'** by acid by '**ate'** proceeded by the name of alkyl group . For example ,

$CH_3\ COO\ C_2\ H_5$: Acid is $CH_3\ COOH$ Acetic acid

Alkyl group is $C_2\ H_5$ Ethyl

Change acetic acid to acetate (**acetic acid – ic acid +ate**)

.'. the name of $CH_3\ COO\ C_2\ H_5$ is **Ethyl acetate.**

In **IUPAC** system, the esters are named by written the name of the alkyl group before the name of the parent acid and replacing the suffix '***oic acid'*** of the name of aid by '**oate'.** For example,

$CH_3\ COO\ C_2\ H_5$: Alkyl group is ethyl .

Acid is $CH_3\ COOH$: Ethanoic acid .

Change Ethanoic acid to Ethanoate (**Ethanoic acid – oic acid + oate**)

. '. the name of $CH_3\ COO\ C_2\ H_5$ is **Ethyl Ethanoate .**

Preparation of Esters

Esters are prepared by the reaction between an alcohol and a carboxylic acid in the presence of concentrated Sulphuric acid as catalyst .

$$CH_3\ COOH + C_2\ H_5OH \xrightarrow{H_2SO_4} CH_3\ COO\ C_2\ H_5 + H_2O$$

Properties of Esters

1. Esters are colourless, oily liquid with characteristic fruity smell. The higher esters are colourless wax like solids.

2. Esters are fairly soluble in water but the solubility decreases with increase in molecular weight. They are quite soluble in most organic solvents like benzene , ethanol and ethers. Most of the esters are themselves very good solvents.

3. The boiling points of esters are always less than the corresponding carboxylic acids. This is due to the fact that esters do not form hydrogen bonds like carboxylic acids.

4. Hydrolysis of Esters -- Esters are slowly hydrolysed by water to the parent acid and alcohol. The reaction is catalysed by small amount of acid or base.

$$\underset{\text{Ethyl Ethanoate or Ethyl acetate}}{CH_3\ COO\ C_2\ H_5} + H_2O \xrightarrow{HCl} \underset{\text{Ethanoic Acid or Acetic acid}}{CH_3\ COOH} + \underset{\text{Ethanol or Ethyl alcohol .}}{C_2\ H_5OH}$$

$$\underset{\text{Ethyl acetate}}{CH_3\ COO\ C_2\ H_5} + H_2O \xrightarrow{NaOH} \underset{\text{Sodium acetate}}{CH_3\ COONa} + \underset{\text{Ethyl alcohol}}{C_2\ H_5OH}$$

The basic hydrolysis of esters (using alkali like sodium hydroxide is known as **saponification (**or **soap making).** This is because of the fact this reaction is used for the preparation of soaps. When the esters of higher fatty acids and glycerol (oils and fats) are hydrolysed with sodium hydroxide solution , we get sodium salt of higher fatty acids which are called **soap.**

TESTS FOR ESTERS

To the organic compound , add 1 m/ of 10% solution of sodium hydroxide and a drop of phenolphthalein . The solution will become pink . If on warming the pink colur disappears , it shows the presence of an ester .

USES OF ESTERS

----●**I.)** Ester are used making **Artificial flavours and essences** These are used in cold drinks , ice creams, sweets etc. Some common esters and the fruit colour are :

Amyl acetate	Bananas
Octyl acetate	orange
Methyl Acetate	Pine apple
Isomyl acetate	Apples
Methyl butyl acetate	pears

----●**II.)** Esters are used as **solvents for oils , facts, gums, cellulose, paints , varnishes** , etc.

----●**III.)** Esters are used for **making perfumes.** This is because of the fact that esters have sweet smell .

----●**IV.)** Esters are used as **plasticizers (softening agent) for resins and plastics.**

Soaps AND Detergents

Detergents are substances which are used for cleaning. Soaps are very popular detergents which have been used for more than two thousand years .

➢ There are **two** types of detergents : **1. Soaps** **2. Synthetic detergents .**

➢➢ **SOAPS:** **Soaps are sodium or potassium salts of higher fatty acids.** The fatty acids contain long chains of **16** to **18** carbon atoms . For example,

----●**Sodium palmitate soap** is a sodium salt of long chain saturated carboxylic acid called **palmitic acid ($C_{15}H_{31}COOH$).**

----●**Sodium stearate** is a sodium salt of long chain saturated fatty acid called **stearic acid ($C_{17}H_{35}COOH$).**

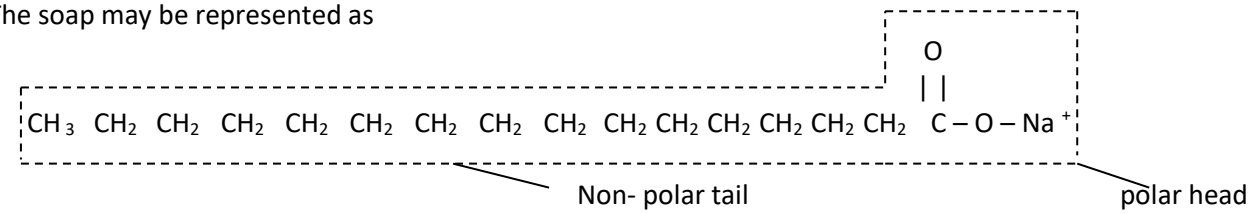
----●**Sodium oleate soap** is a sodium salt of long chain unsaturated fatty acid called **oleic acid ($C_{17}H_{33}COOH$).**

➢➢ **STRUCTURE OF SOAPS :** Soaps consists of ***two*** parts :--

----● **i.)** ***a long hydrocarbon chain which is water repelling (called hydrophobic) . It is called non- polar tail.***

----● **ii.)** ***an ionic part which is water attracting (called hydrophilic) . It is also called polar head.***

The soap may be represented as



➢ **Different soaps vary in their composition. The toilet soaps contains mainly sodium oleate where soaps used for other household purposes generally consists of a mixture of sodium palmitate and sodium stearate. Shaving soaps and other soft soaps are the mixture of potassium salts of higher fatty acids .**

➢ **Soaps are made from animal fats or vegetable oils. Fats and oils are esters of higher fatty acids and glycerol. The esters of glycerol and higher fatty acids are called glycerides .For example , the tristearate of glycerol is called tristearin , a tripalmitate of glycerol is called tripalmitin .**

$CH_2OCOC_{17}H_{35}$
|
$CHOCOC_{17}H_{35}$
|
$CH_2OCOC_{17}H_{35}$
Tri stearate
(Tristearin)

$CH_2OCOC_{15}H_{31}$
|
$CHOCOC_{15}H_{31}$
|
$CH_2OCOC_{15}H_{31}$
Tripalmitin of glycerol
(Tripalmitin)

CH_2OCOR
|
$CHOCOR$
|
CH_2OCOR
Glyceride
General formula
(R = $-C_{15}H_{31}$, $-C_{17}H_{33}$, $-C_{17}H-$)

When oils and fats are heated with a solution of sodium hydroxide, they break down to sodium salt of the respective fatty. acid (called soap) and glycerol . This process of making soap by the hydrolysis of fats and oils with alkalies is called **Saponification .**

$CH_2OCOC_{15}H_{31}$
|
$CHOCOC_{15}H_{31}$ + 3 NaOH ⟶ CH_2OH + 3 $C_{15}H_{31}COONa$
|
$CH_2OCOC_{15}H_{31}$
Oil or fat
(Tripalmitin)

CH_2OH
|
$CHOH$
|
CH_2OH
Glycerol

Soap
(Sodium palmitate)

The soap is separated from the solution by the addition of common salt (NaCl) . Salt is added to decrease the solubility of soap and it helps to precipitate out (or salt out) from the aqueous solution . Soap is lighter than water and it floats on the surface from where it is removed. The solution remaining behind contains glycerol and sodium chloride. Glycerol is recovered from the solution as it is very useful chemical used in drugs , cosmetics , explosives and paints.
soap is then mixed with desired colours, perfumes and chemicals of medicinal importance (ex- in neem soap)
Then it is cast into desired shapes for our use.

➤➤ **LIMITATION OF SOAPS**:- Soap is not suitable for washing clothes with hard water because of the following reasons :-

➤ (I) Hard water contains salt of calcium and magnesium. When soap is added to hard water , calcium and magnesium ions of hard water reacts with soap forming insoluble calcium and magnesium salt of fatty acid .

$C_{17}H_{35}COONa$ + $MgCl_2$ ⟶ $(C_{17}H_{35}COO)_2Mg$ + 2NaCl
Sodium stearate soap — from hard water — Magnesium stearate

$C_{17}H_{35}COONa$ + $CaCl_2$ ⟶ $(C_{17}H_{35}COO)_2Ca$ + 2NaCl
Sodium stearate — from hard — Calcium stearate — water

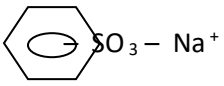
Therefore, a lot of soap is wasted if water is hard.

➤ (II) When hard water is used, soap forms insoluble precipitates of calcium and magnesium salts, which strikes to the cloth being washed. Therefore, it interferes with cleaning ability of the soap and makes the cleaning process difficult.

SYNTHETIC DETERGENTS

Synthetic detergents have structures similar to those soaps.They are called **soap less soap** because though behave like soap in having cleaning properties , yet they do not contain the usual soaps like sodium salt of fatty acids . They are better cleansing agents than soap because they do not form insoluble calcium or magnesium salts with hard water . Therefore, they can be used even hard water.

Detergent are sodium salts of long chain sulphonates or sulphate . These are generally sodium salts of long chain benzene sulphonic acid or the sodium salt of a long chain alkyl hydrogen sulphate . The common examples of detergents are :-



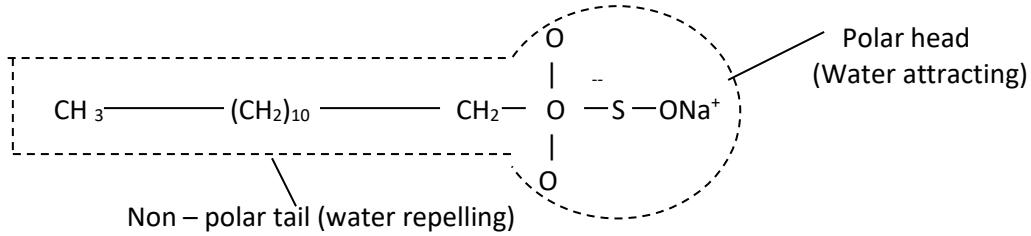
Sodium – *p* – dodecyl benzene

$C_{12}H_{25}OSO - Na^+$
Sodium dodecyl sulphate

The structure of detergents is similar to that of soaps. It also consists of two parts :

➤ *(i) a long hydrocarbon chain which water repelling (hydrophobic). It is also called non – polar tail .*

➤ *(ii) a ionic part which is water attracting (hydrophilic), It is also called polar head.*



The washing powders available in the market contain about 15 – 30 % detergents by weight. The remaining part of washing powders contain other chemicals which are added to impart its other desired properties. For example,

➤1.) Sodium sulphate and sodium silicate are added to keep washing powder dry .

➤2.) Sodium tripolyphosphate or sodium carbonate is added to maintain alkalinity of soaps which is helpful in removing dirt . It also softens water.

➤3.) Carboxylic methyl cellulose (CMC) is added to washing powder to keep the dirt particles suspended in water . This helps the cleaning of clothes .

➤4.) A mild bleaching agent such as sodium perborate is added to washing powders to produce whiteness of clothes.

➤➤ **DEFFERENCE BETWEEN SOAPS AND DETERGENTS**➤➤

SOAPS	SYNTHETIC DETERGENTS
I.] Soaps are sodium salts of long chain fatty acids	Synthetic detergents are sodium salts of long chain alkyl sulphates or long chain alkyl benzene sulphonates.
II.] They cannot be used in acidic solutions.	They can be used even in acidic solutions.
III.] They cannot be used in hard water as they produce precipitates with Ca^{2+}, Mg^{2+} ions.	They can be used even in hard water as they do not form any precipitates with Ca^{2+}, Mg^{2+} ions .
IV.] Soaps are biodegradable. Therefore, they do not cause any pollution problems	Some of the synthetic detergents are not biodegradable. Therefore, they pollute river and lake water.

ADVANTAGES AND DISADVANTAGES OF SYNTHETIC DETERGENTS OVER SOAPS

Advantages of Synthetic detergents

a.) Synthetic detergents can be used for washing even in hard water. On the other hand, soaps are not suitable for use with hard water .

b.) Synthetic detergents can be used even in acidic solutions because they are not readily decomposed in acidic medium. On the other hand , soaps cannot be used in acidic medium because they are decomposed into carboxylic acids in acidic medium.

c.) Synthetic detergents more soluble in water than soaps.

d.) Synthetic detergents have a stronger cleansing action than soaps.

Disadvantages of Synthetic detergents

Some of the synthetic detergents are not biodegradable. Therefore, they are not decomposed or broken down by microorganism like bacteria present in water bodies like lakes and rivers . Therefore, they tend to remain in water bodies for a long time and make the water unfit for aquatic life. For example, detergents containing phosphates can cause rapid growth of algae and therefore deplete the dissolved oxygen present in the water of lakes and rivers. As a result of lack of oxygen , fish and other aquatic animals may die.

To solve these problems, detergents are prepared from those hydrocarbons which form biodegradable detergents. For example, if straight chain hydrocarbons are used instead of branched chain hydrocarbons, then the detergent is biodegradable.

Cleansing Action Soaps and Detergents

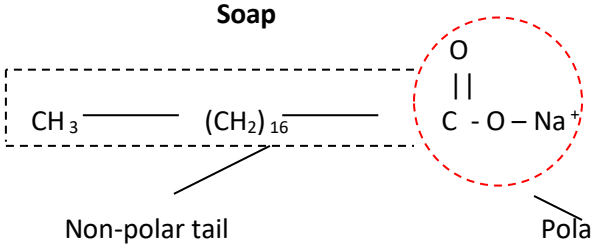
The cleansing action of soaps and detergents is same. Soaps and detergents consist of two parts:-

(i) a non-polar part which consists of long chain hydrocarbon part. It is called non-polar tail. This part is soluble in water but soluble in oil and grease. This is also called water repelling or hydrophobic part.

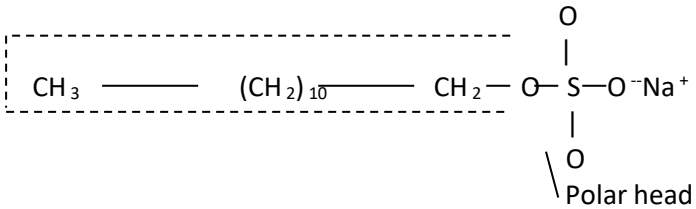
(ii) an ionic part which consists of carboxylate ion (in case of soaps) or sulphonates or sulphates(in case of detergents). This is also called polar head . It is soluble in water but insoluble in oil or grease. The ionic part is called water attracting or hydrophilic part.

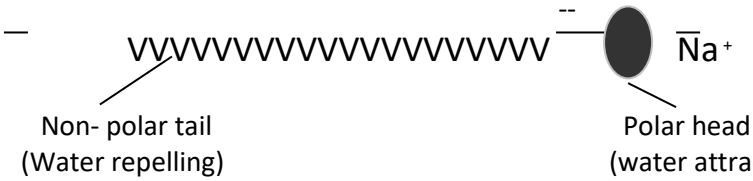
These two parts of soap and detergents may be represented as :

Soap

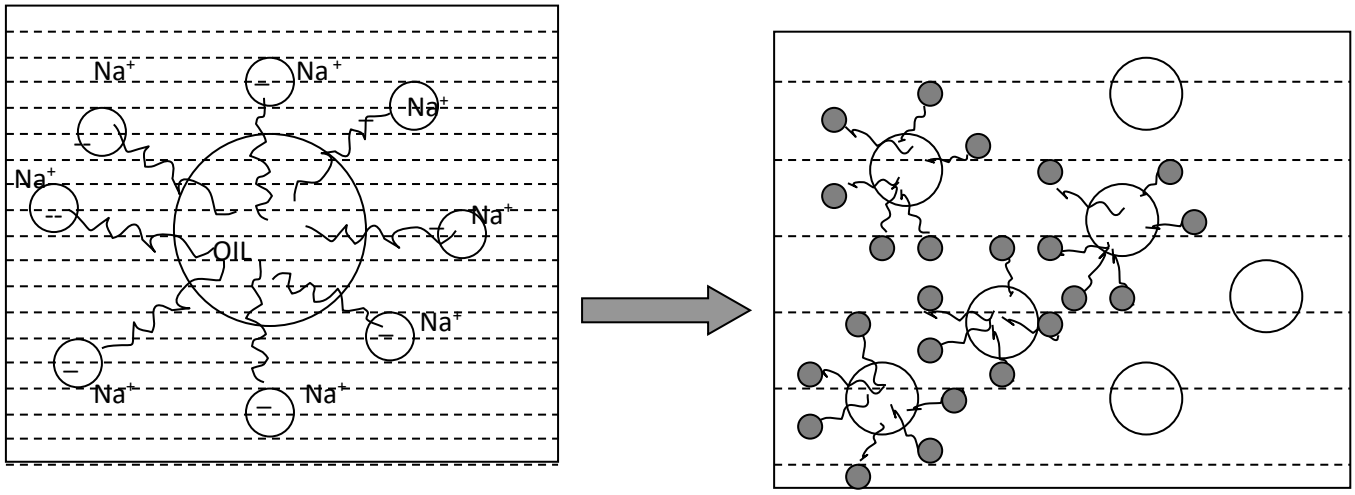


Synthetic detergents





The dirt in the cloth is due to the presence of dust particles in fat or grease which stick to the clothes. When the dirty cloth is dipped in soap or detergent solution, the soap and dirt particles come in contact with each other . The non-polar tails of the soap begin to dissolve in non-polar oil or grease while the polar head part remains directed in water . As more and more soap particles enter the grease, each fat or oil particle is surrounded by a number of negatively charged ends. Since the similar charges repel each other, the oil or grease droplets break of and are still surrounded by the negatively charged polar heads of the soap molecules. This prevents the grease particles from coming together to form bigger particles. The rubbing by hands or mechanical stirring also help to break the grease particles. In this manner, the grease particle can be completely broken up and it forms emulsion of grease or oil contained in dirt water. As a result , the cloth gets free from the dirt and the droplets are washed away with water.



Cleansing action of soap .

CONCEPTUALS

Section A

1.Which of the following compounds contains a carboxyl group ?
CH_3OH, CH_3COOH, CH_3CHO, CH_3COCH_3
Ans. CH_3COOH.

2. Write the formula of the functional group present in carboxylic acids.
Ans. – COOH

3. Write the formula of ethanol.
Ans. C_2H_5OH

4. What is the next higher homologue of methanol (CH_3OH) ?
Ans. Ethanol (C_2H_5OH)

5. Name the next higher homologue of C_2H_5OH.
Ans. Propanol (C_3H_7OH)

6. Give the common name and IUPAC name of C_2H_5OH.
Ans. Common name : Ethyl alcohol ; IUPAC name : Ethanol.

7. Give the IUPAC name of the compound C_3H_7OH.
Ans. Propanol.

8. Give IUPAC names of the following compounds :
(a) C_4H_9OH (b) $C_5H_{11}OH$
Ans. (a) Butanol (b) Pentanol
9. What is the common name of methanol?
Ans. Methyl alcohol.

10. What is the molecular formula of the alcohol which is derived from pentane ?
Ans. $C_5H_{11}OH$.

11. Write the molecular formulae of the fourth and fifth members of the homologous series of carbon compounds represented by the general formulae C_nH_{2n+1}-OH .
Ans. Fourth member: C_4H_9OH ; Fifth member : $C_5H_{11}OH$.

12. Which gas is evolved during the process of fermentation ?
Ans. Carbon dioxide.

13. What product is formed when ethanol is oxidised with :
(a) chromic anhydride (in glacial ethanoic acid) ?
(b) Alkaline potassium permanganate ?
Ans. (a) Ethanal (b) Ethanoic acid

14. Name the oxidising agent which can oxidise :
(a) ethanol to ethanoic acid. (b) ethanol to ethanal.
Ans. (a) Alkaline potassium permanganate. (b) Chromic anhydride .

15. What is rectified spirit ?
Ans. Ethanol containing 5 per cent water is known as rectified spirit.

16. Name the gas evolved when ethanol reacts with sodium.
Ans. Hydrogen .

17. A neutral organic compound is warmed with some ethanoic acid and a little of conc. H_2SO_4. Vapours having sweet smell are evolved. What type of functional group is present in this organic compound ?
Ans. Alcoholic group, - OH.

18. Give the common name and IUPAC name of HCHO.
Ans. Common name : Formaldehyde ; IUPAC name : Methanal.

19. What is the common name of methanal ?
Ans. Formaldehyde.

20. Give the IUPAC name of formaldehyde.
Ans. Methanal.

21. Which the IUPAC names of the following :
(i) CH_3CHO (ii) CH_3COCH_3
Ans. (i) Ethanal (ii) Propanone.

22. Which of the following substances can reduce Fehling's reagent ?
CH_3OH, HCHO, CH_3COOH, C_2H_5OH, CH_3CHO, CH_3COCH_3
Ans. HCHO and CH_3CHO

23. Name two substances which are used in making bakelite plastic.
Ans. Formaldehyde and phenol.

24. Which class of carbon compounds gives positive Fehling's test ?
Ans. Aldehydes.

25. What type of carbon compounds gives positive Tollen's test ?
Ans. Aldehydes.

26. An organic compound gives a red precipitate on heating with Benedict's reagent. Name the functional group present in this organic compound.
Ans. Aldehydic group, - CHO

27. Name two regents for testing aldehydes.
Ans. Tollen's reagent and Fehling's reagent.
28. Give the name of formula of an aldehyde derived from ethane.
Ans. Ethanal. CH_3-CHO.
29. Name the simplest Ketone.
Ans. Propanone (Acetone).
30. Give the common name and IUPAC name of the compound CH_3COCH_3.
Ans. Common name : Acetone ; IUPAC name : propane.

31. What is the IUPAC name of acetone ?
Ans. Propanone.

32. What is the common name of propanone ? Ans. Acetone.
33. Write the IUPAC name of the following :
(i) CH_3COCH_3 (ii) $C_2H_5COCH_3$
Ans. (i) Propanone (ii) Butanone.

34. Give the name and formula of a Ketone derived from butane.
Ans. Butanone, $CH_3COCH_2CH_3$

35. Name the product formed by reacting CH_3COCH_3 and HCN.
Ans. Propanone cyanohydrin.

36. Which of the two is a strong reducing agent – an aldehyde or a Ketone ?
Ans. An aldehyde is a strong reducing agent.

37. Write the name and chemical formula of the simplest organic acid.
Ans. Methanoic acid, HCOOH.

38. Give the IUPAC names of formic acid and acetic acid.
Ans. Formic acid : Methanoic acid ; Acetic ; Ethanoic acid.

39. Write the formula of ethanoic acid.
Ans. CH_3COOH.

40. Give the IUPAC names of the following compounds :
(a) CH_3COOH (b) C_2H_5COOH
Ans. (a) Ethanoic acid (b) Propanoic acid.

41. Write the common name and IUPAC name of the compound $CH_3COO_2H_5$.
Ans. Common name : Methanoic acid ; Acetic acid : Ethanoic acid.

42. Give the name and formula of one homologue of the following : HCOOH.
Ans. Ethanoic acid, CH_3COOH.

43. An organic compound ǿ of molecular formula $C_2H_4O_2$ gives brisk effervescence with sodium hydrogen carbonate. Give the name and formula of X.
Ans. Ethanoic acid, CH_3COOH.

44. (a) What is the physical state of CH_3COOH ?
(b) What substance should be oxidised to prepare CH_3COOH ?
Ans. (a) Liquid (b) Ethanol, CH_3CH_2OH.

45. What is the action of ethanoic acid on litmus ?
Ans. Being acidic in nature, ethanoic acid turns blue litmus solution red.

46. Name the reaction which takes place when ethanoic acid reacts with ethanol. What is the general name of the product obtained in this reaction ?
Ans. Esterification ; Ester.

47. Name the compound obtained by the oxidation of methanol by chromic anhydride(CrO_3).
Ans. Methanal .

48. Name the substance formed by the catalytic hydrogenation of methanal.
Ans. Methanol .

49. The molecular formula of an ester is $C_3H_7COOC_2H_5$. Write the molecular formula of the acid and the alcohol from which it might be prepared.
Ans. Acid : C_3H_7COOH ; Alcohol : C_2H_5OH.

50. An organic compound X has the molecular formula C_2H_4O. It reduces Fehling's reagent. On reduction, the compound forms ethanol. What is the compound X ?
Ans. Compound X is ethanal, CH_3CHO.

51. An organic liquid 'A' has the molecular formula C_3H_6O. It reacts with HCN to form a cyanohydrin but does not reduce Tollen's reagent. On reduction, liquid 'A' forms propan - -ol. What is the liquid 'A' ?
Ans. Liquid A is Propanone , CH_3COCH_3.

52. Name the product formed when methanol undergoes controlled oxidation.
Ans. Methanal .

53. Name the compound formed when ethanoic acid reacts with ethanol in the presence of concentrated sulphuric acid
Ans. Ethyl ethanoate.

54. Name the compound formed when propanone is reduced. Which reducing agent is generally used in this process ?
Ans. Propan -2-o*l* ; sodium borohydride ($NaBH_4$)

55. An organic compound is a constituent of beer, whisky and some cough syrups. It is produced by the fermentation of sugar. Identify the organic compound.
Ans. Ethanol.

56. Write the full name of PVC.
Ans. Poly- Vinyl Chloride.

57. Name the polymer whose monomer is $CF_2 = CF_2$.
Ans. Teflon.

58. Name the polymer which is used to give a nonstick coating on kitchen utensils.
Ans. Teflon.

59. Name the polymer which is used for making floor tiles ?
Ans. Poly- Vinyl Chloride (PVC).

60. Why natural rubber cannot be used for making foot ball bladders ?
Ans. Natural rubber cannot be used for making football bladders because it is soft and stickly having low elasticity and low tensile strength.

61. Give the name of the monomer of the polymer called natural rubber. Also write its formula.
Ans. Monomer of natural rubber : Isoprene (2 – methyl butadiene).
Formula : $CH_2=\underset{\displaystyle CH_3}{\overset{|}{C}}-CH=CH_2$

62. Name two synthetic rubbers.
Ans. (i) Neoprene (ii) Butadiene rubber

63. Name the monomer of neoprene. Also write its formula.
Ans. Monomer of neoprene : Chloroprene (2-chlorobutadiene).
Formula : $CH_2=\underset{\displaystyle CH_3}{\overset{|}{C}}-CH=CH_2$

64. Name the monomer of butadiene rubber. Also write its formula.
Ans. Monomer of butane rubber : 1,3-butadiene.
Formula : $CH_2=CH-CH=CH_2$

65. What type of polymer is :
(a) natural rubber ? (b) synthetic rubber (neoprene)?
Ans. (a) Addition polymer (b) Addition polymer.
66. Name one synthetic rubber containing chlorine.
Ans. Neoprene.

67. What is the raw material for getting neoprene ?
Ans. Chloroprene (2-chlorobutadiene).
68. Which of the following produces neoprene rubber on polymerization ?
Chloroprene or Isoprene
Ans. Chloroprene.

69. Name the substance with which natural rubber is heated during vulcanization ?
Ans. Sulphur.

70. Name the form in which natural rubber is obtained from rubber trees.
Ans. Natural rubber is obtained as latex from rubber trees.

71. State the uses of vulcanized rubber.
Ans. Vulcanized rubber is used for making rubber bands, tubes and trees for cycles, scooters, etc.

72. What type of polymer is :
(a) polyamide (or nylon) ? **(b) polyester (or terylene) ?**
Ans. (a) Condensation polymer (b) Condensation polymer
73. Give two examples of synthetic fibres.
Ans. (i) Polyamide (Nylon) (ii) Polyester (Terylene)

Section B.

1. What is meant by a functional group ? Give two examples of functional groups.
Ans. An 'atom' or 'a group of atoms' which makes a carbon compound (or organic compound) reactive and decides its functions (or properties) is called a functional group. An example of functional group is : Alcoholic group, - OH. It is present in ethanol, C_2H_5-OH. Another example of functional group is: Aldehydic group – CHO. It is present in methanal , H-CHO.

2. Give the names of the following functional groups :
(i) –CHO **(ii)**  **(iii) –COOH**
Ans. (i) Aldehydic group (ii) Ketonic group
(iii) Alcoholic group (iv) Carboxyl group.

3. Write the names of the following functional groups :
(a) – NH_2 **(b) - NO_2** **(c) –Cl** **(d) –COOR**
Ans. (a) Amino group (b) Nitro group
(c) Chloro group (a halogen group) (d) Ester group.

4. Name the functional groups present in the following compounds :
(i) $CH_3 – CH_2 – OH$ **(ii) $CH_3 – COOH$**
(iii) $CH_3 – CH_2 – CHO$ **(iv)$CH_3 – CO – CH_2 – CH_3$**
Ans. (i) Alcoholic group (ii) Carboxyl group
(iii) Aldehydic group (iv) Ketonic group

5. Give the names of the functional groups in the following compounds :
(i) $C_2H_5NH_2$ **(ii) CH_3NO_2**
(iii) CH_3CH_2Cl **(iv) $CH_3COOC_2H_5$**
Ans. (a) Amino group (b) Nitro group (c) Chloro group (d) Ester group.

6. Write the name and formula of one organic compound each containing the following functional groups :
(i) Ketonic group **(ii) Aldehydic group**
(iii) Carboxyl group **(iv) Halogen group**
Ans. (i) Propanone, CH_3-CO-CH_3 (ii) Ethanal, CH_3-CHO (iii) Ethanoic acid, CH_3-COOH (iv) Chloromethane, CH_3-Cl

7. Give the name and formula of one organic compound each having the following functional groups :
(a) Alcoholic group **(b) Nitro group** **(c) Amino group** **(d) Ester group**
Ans. (a) Methanol, CH_3-OH (b) Nitromethane, CH_3-NO_2 (c) Methenamine, CH_3-NH_2 (d) Ethly ethanoate, $CH_3COOC_2H_5$

8. How is ethanol produced from ethane ? Explain with the help of equation of the reaction which takes place.

Ans. A large amount of ethanol used for commercial purposes is prepared by the hydration of ethene obtained from the cracking of petroleum. (Addition of water to a compound is called hydration).

When ethane is heated with concentrated sulphuric acid at 75^0C (348K), and then treated with water, ethanol is produced. In this reaction, A water molecule gets added across the double bond of ethane converting it into ethanol :

$CH_2{=}{=}CH_2$ + H-OH $\xrightarrow{H_2SO_4}$ CH_3-CH_2-OH

Ethene Water Ethanol

9. What are enzymes ? Name the enzymes required for the fermentation of sugrance to ethanol.

Ans. The catalysts which bring about biochemical changes are called enzymes. In other words, enzymes are biological catalysts. The enzymes required for the fermentation of sugarcane to ethanol are : invertase and zymase.

10. What happens when ethanol burns in air ? Write the chemical equation of the reaction which takes place during the burning of ethanol in air.

Ans. Ethanol is a highly inflammable liquid. It catches fire easily and starts burning . Ethanol burns readily in air with a blue flame to form carbon dioxide and water vapour :

C_2H_5OH + $3O_2$ $\xrightarrow{\text{Combustion}}$ $2CO_2$ + $3H_2O$

Ethanol oxygen (Burning) Carbon dioxide Water vapour

A lot of heat is produced during the combustion (burning) of ethanol.

11. What happens when ethanol reacts with sodium metal ? Give equation of the reaction involved.

Ans. Ethanol reacts with sodium to form sodium ethoxide and hydrogen gas:

$2C_2H_5OH$ + 2Na $\longrightarrow$ $2C_2H_5ONa$ + H_2

Ethanol Sodium Sodium ethoxide Hydrogen

The hydrogen gas produced burns with a 'pop' sound.

12. What happens when a piece of sodium metal is put into a test tube containing ethanol ?

Ans. When a small piece of sodium metal is put into ethanol in a dry test tube, rapid effervescence due to the evolution of hydrogen gas is produced. The hydrogen gas produced can be tested by burning. When a burning splinter is brought near the mouth of the test – tube, the gas burns with a 'pop' sound, which is a characteristic of hydrogen gas. This shows that the gas produced by the action of sodium metal on ethanol is hydrogen.

13. What happens when ethanol is oxidised with chromic anhydride in glacial ethanoic acid ? Write the equation of the reaction.

Ans. When ethanol is treated with chromic anhydride (in glacial ethanoic acid), then its partial oxidation takes place and ethanal is formed :

CH_3CH_2OH + [O] $\xrightarrow{CrO_3}$ CH_3CHO + H_2O

Ethanol Nascent oxygen (in CH_3COOH) Ethanal Water

Chromic anhydride is a mild oxidising agent which converts ethanol into ethanal.

14. What happens when ethanol is heated with alkaline potassium permanganate ? Give equation of the reaction which takes place.

Ans. When ethanol is heated with alkaline potassium permanganate solution its complete oxidation takes place and ethanoic acid is formed : CH_3CH_2OH + 2[O] $\xrightarrow{\text{Alkaline } KMnO_4}$ CH_3COOH + H_2O

Ethanol Nascent oxygen Ethanoic acid Water

Alkaline potassium permanganate is a strong oxidising agent which converts ethanol into ethanoic acid.

15. What happens when ethanol is heated with ethanoic acid in the presence of a few drops of concentrated sulphuric acid ? Give equation of the reaction which takes place.

Ans. Ethanol reacts with ethanoic acid on warming in the presence of a few drops of concentrated sulphuric acid to form a sweet smelling ester, ethyl ethanoate :

CH_3COH + C_2H_5OH $\underset{}{\overset{\text{Conc. } H_2SO_4}{\rightleftharpoons}}$ $CH_3COOC_2H_5$ + H_2O

Ethanoic acid Ethanol Ethyl ethanoate Water

16. What is meant by denatured alcohol ? What is the need to denature alcohol?

Ans. Denatured alcohol is ethyl alcohol which has been made unfit for drinking purpose by adding poisonous substances like methanol, pyridine, copper sulphate, etc. A lot of ethyl alcohol is used in industry for manufacturing various products, so it is subjected to very small excise duty. Now, if pure ethyl alcohol is supplied to industries, it can be sold in black market or the workers will start drinking it. To prevent its misuse ethyl alcohol used for industrial purposes is denatured by adding some poisonous substance like methanol, pyridine or copper sulphate, etc. The addition of these poisonous substances makes the ethyl alcohol unfit fir drinking.

17. How is methanal prepared (or manufactured) ? Write equation of the reaction involved.

Ans. Methanal is prepared (or manufactured) by the controlled oxidation of methanol with air at a temperature of 600^0C to 650^0C(873 K to 923 K) in the presence of silver catalyst :

$$2CH_3OH + O_2 \xrightarrow[873K - 923\ K]{Ag} 2HCHO + 2H_2O$$

Methanol — Oxygen(from air) — Methanal — Water

Instead of using silver as catalyst in this reaction , 'iron oxide-molybdenum oxide' can also be used as a catalyst.

18. State the physical properties of methanal (formaldehyde).

Ans. (i) Methanal (or formaldehyde) is a colourless and pungent smelling gas at room temperature.

(ii) Methanal (or formaldehyde) is highly soluble in water. A 35 to 40 percent solution of formaldehyde (or methanal) in water is called formalin.

(iii) Methanal (or formaldehyde) is a powerful disinfectant and antiseptic (germicide).

19. What happens when methanal is oxidised ? Suggest the various oxidising agents which can be used for the oxidation of methanal.

Ans. Methanal is oxidised to Methanoic acid in the presence of oxidising of agents :

$$HCHO + [O] \longrightarrow HCOOH + 2H_2O$$

Methanal — Oxygen (from oxidising agent) — Methanal — Water

The various oxidising agents which can be used for the oxidation of methanal are :

(i) Tollen's reagent (Ammoniacal silver nitrate solution)

(ii) Fehling's reagent. (iii) Alkaline potassium permanganate.

20. What happens when methanal is reduced ? Name the reducing agent used and write the equation of the reaction which takes place.

Ans. When methanal is reacted with hydrogen gas in the presence of finely divided palladium catalyst, it is reduced to methanal :

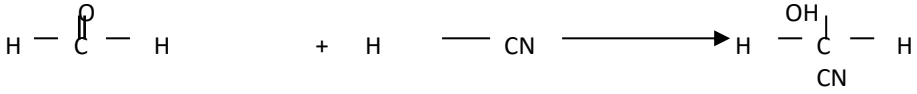
$$HCHO + H_2 \xrightarrow{pd} CH_3OH$$

Methanal — Hydrogen — Methanol

This is the catalytic reduction (or catalytic hydrogenation) of methanal. In this reaction, a hydrogen molecule gets added across the carbon oxygen double bond of methanal to form methanol.

21. What happens when methanal is treated with hydrogen cyanide ? Give equation of the reaction involved.

Ans. Methanal reacts with hydrogen cyanide to form methanal cyanohydrin :



Methanal — Hydrogen cyanide — Methanal cyanohydrin

This is an addition reaction of methanal. In this reaction, a molecule of H – CN is added across the carbon oxygen double bond of methanal.

22. Give any two uses of methanal (formaldehyde).

Ans. (i) An aqueous solution of methanal (called formalin) is used for preserving biological specimens. This is because methanal is a disinfectant.

(ii) Methanal is used for making Bakelite plastic (which is used for making electrical switches, etc.).

23. What type of the substance is formed by the oxidation of an aldehyde ? What will be the action of the substance formed on the litmus solution ?

Ans. A carboxylic acid is formed by the oxidation of an aldehyde. This carboxylic acid will turn blue litmus to red.

24. What is a carbonyl group ? What are the two types of carbonyl compounds ? Give one example of each type of carbonyl compounds ? Give one example of each type of carbonyl compound.

Ans. The carbonyl group is : $\diagdown C = O \diagup$. The two types of carbonyl compounds are aldehydes and ketones. Ethanal, $CH_3 - CO - CH_3$, is a ketone.

25. What is formation ? Name the precipitate formed when it is heated with Fehling's reagent.

Ans. A 35 to 40 per cent solution of methanal in water is called formalin. In other words, formalin is an aqueous solution of methanal (or formaldehyde). When formalin is heated with Fehling's reagent, a red precipitate of copper (I) oxides formed.

26. How is methanal converted into methanol ?

Ans. Methanal is converted into methanol by heating with hydrogen gas in the presence of finely divided palladium as catalyst.

$$\underset{\text{Methanal}}{HCHO} + \underset{\text{hydrogen}}{H_2} \xrightarrow{pd} \underset{\text{Methanol}}{CH_3OH}$$

27. Which of the following will not give a positive test with Fehling's reagent ?

CH_3COCH_3 or CH_3CH_2CHO

Give reason for your answer.

Ans. CH_3COCH_3 will not give a positive test with Fehling's reagent. This is because it is a kitone. Only aldehydes give a positive test [a red precipitate of copper (I) oxide] with Fehling's reagent.

28. Which of the following will not produce a silver mirror with Tollen's reagent (ammoniacal silver nitrate solution)?

HCHO or $CH_3CH_2CH_2CHO$

Give reason for your answer.

Ans. $CH_3COCH_2CH_3$ will not produce a silver mirror with Tollen's reagent. This is because it is a ketone. Only aldehydes give a silver mirror test with Tollen's reagent because they are reducing agents.

29. Which of the following will not reduce Benedict's reagent to form a red precipitate of copper (I) oxide ?

$CH_3COCH_2CH_3$ or $CH_3CH_2CH_2CHO$

Give reason for your answer .

Ans. $CH_3COCH_2CH_3$ will not reduce Benedict's reagent to form a red precipitate of copper (1) oxide. This is because it is a ketone and ketones are not reducing agents. Only aldehydes reduce Benedict's reagent.

30. Give the important physical properties of propanone (or acetone).

Ans. (i) Propanone (or acetone) is a colourless volatile liquid (having a low boiling point of 56^0 C or 329 K).

(ii) Propanone is a highly inflammable liquid. It catches fire very easily.

(iii) Propanone is miscible with water in all proportions.

31. What happens when propanone is reduced ? Write equation of the reaction which takes place.

(This equation can also be asked as : How is propanone converted to propan -2-ol ?)

Ans. Propanone is reduced to propan -2-ol on treatment with sodium borohydride ($NaBH_4$):

$$\underset{\text{Propanone}}{CH_3-CO-CH_3} \xrightarrow{NaBH_4} \underset{\text{Propan -2-ol}}{CH_3-\underset{OH}{CH}-CH_3}$$

32. What happens when propanone is oxidised with alkaline potassium permanganate ? Give equation of the reaction which takes place .

(This equation can also be asked as : How is propanone converted into ethanoic acid ?)

Ans. Propanone is oxidised to ethanoic acid on heating with alkaline potassium permanganate :

$$\underset{\text{propanone}}{CH_3COCH} \xrightarrow[\text{(oxidation)}]{\text{alkaline } KMnO_4} \underset{\text{Sodium ethanoate}}{CH_3COONa} \xrightarrow[\text{(Dilute HCL)}]{\text{Acidify}} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

33. What happens when propanone reacts with hydrogen cyanide ? Give equation of the reaction which takes place.

(This equation can also be asked as : Give an example of an addition reaction of propanone).

Ans.

$$\underset{\text{Propanone}}{CH_3-\overset{O}{\overset{\|}{C}}-CH_3} + \underset{\text{Hydrogen cyanide}}{H-CN} \longrightarrow \underset{\text{propanone cyanohydrin}}{CH_3-\underset{CN}{\overset{OH}{\overset{|}{C}}}-CH_3}$$

This is an addition reaction of propanone. In this reaction, a molecule of hydrogen cyanide (H- CN) is added across the carbon oxygen double bond of propanone.

34. State two uses of propanone (or acetone).

Ans. (i) Propanone is used as a solvent in laboratory and industry, and as a nail polish remover.

(ii) Propanone is used for making chloroform, artificial leather and a plastic called Perspex.

35. How will you distinguish between an aldehyde and a Ketone? Give two tests.

Ans. We can distinguish between an aldehyde and a ketone by using Tollen's reagent or Fehling's reagent. For example ,

If we are given two organic compounds one of which is an aldehyde and the other one is a ketone, then :

(i) The organic compound which on warming with Tollen's reagent (ammoniacal silver nitrate solution) forms a silver mirror will be an aldehyde. On the other hand, the organic compound which does not form a silver mirror on warming with Tollen's reagent will be a ketone.

(ii) The organic compound which on heating with Fehling's reagent produces a red precipitate (of CuO_2) will be an ' aldehyde. On the other hand, the organic compound which does not produce a red precipitate on heating with Fehling's reagent, will be a ketone.

36. Match the formulae in group A with appropriate names from group B :

Group A : CH_3COOH,CH_3OH,HCHO,$CH_3COCH_2CH_3$

Group B : Methanal, Methanol, Butanone, Ethanoic acid

Ans. CH_3COOH : Ethanoic acid; CH_3OH : Methanol ; HCHO : Methanal ; $CH_3COCH_2CH_3$: Butanone

37. Describe a commercial method for the preparation of ethanoic acid. (This question can also be asked as : How is ethanoic acid prepared commercially from methanol ?)

Ans. Ethanoic acid is prepared commercially by the reaction between methanol and carbon monoxide in the presence of iodine rhodium catalyst :

$$\underset{\text{Methanol}}{CH_3OH} + \underset{\text{Carbon monoxide}}{CO} \xrightarrow{I_2\text{- Rh catalyst}} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

38. What happens when ethanoic acid reacts with sodium metal ? Give equation of the reaction which takes place.

Ans. Ethanoic acid reacts with sodium metal to form sodium ethanoate and hydrogen gas :

$$\underset{\text{Ethanoic acid}}{2CH_3COOH} + \underset{\text{Sodium}}{2Na} \longrightarrow \underset{\text{Sodium ethanoate}}{2CH_3COONa} + \underset{\text{Hydrogen}}{H_2}$$

Thus, ethanoic acid liberates hydrogen gas with sodium metal.

39. What happens when ethanoic acid reacts with sodium carbonate ? Write equation of the reaction involved.

Ans. Ethanoic acid reacts with sodium carbonate to form sodium ethanoate and carbon dioxide gas :

$$\underset{\text{Ethanoic acid}}{2CH_3COOH} + \underset{\text{sodium carbonate}}{Na_2CO_3} \longrightarrow \underset{\text{sodium ethanoate}}{2CH_3COONa} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O}$$

When sodium carbonate is added to a solution of ethanoic acid., brisk effervescence of carbon dioxide in – COOH p group is acidic in nature.

40. What happens when ethanoic acid reacts with sodium hydroxide ? Give equation of the reaction which takes place.

Ans. Ethanoic acid reacts with sodium hydroxide to form a salt called sodium ethanoate and water :

$$\underset{\text{Ethanoic acid}}{CH_3COO_4} + \underset{\text{Sodium hydroxide}}{NaOH} \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + \underset{\text{Water}}{H_2O}$$

The reaction shows that the hydrogen atom present in —— COOH group is acidic in nature.

41. What happens when ethanoic acid reacts with an alcohol in the presence of a little of concentrated sulphuric acid ?

Ans. Ethanoic acid reacts with alcohols in the presence of a little of concentrated sulphuric acid to form esters . For example:

When ethanoic acid is warmed with ethanol in the presence of a few drops of concentrated sulphuric acid, a sweet smelling ester called ethyl ethanoate is formed :

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow{\text{CONC. } H_2SO_4} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + \underset{\text{Water}}{H_2O}$$

This reaction with an alcohol in which a sweet smelling ester is formed, is used as a test for ethanoic acid.

42. Explain the term 'esterification'.

Ans. The reaction in which a carboxylic acid combines with an alcohol to form an ester is called esterification .Esterification takes place in the presence of a little of a dehydrating agent like concentrated sulphuric acid. The formation of sweet smelling esters is used as a test for carboxylic acids as well alcohols.

43. How will you convert ethanoic acid into methane ? Explain with the help of equations of the reactions involved.

Ans. Ethanoic acid can be converted into methane in two steps :

(i) First, ethanoic acid is reacted with sodium hydroxide to get sodium ethanoate :

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Sodium hydroxide}}{NaOH} \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + \underset{\text{Water}}{H_2O}$$

(ii) Then sodium ethanoate is heated with soda lime (NaOH + CaO) to get methane :

$$\underset{\text{Sodium ethanoate}}{CH_3COONa} + \underset{\text{Sodium hydroxide}}{NaOH} \longrightarrow \underset{\text{Methane}}{CH_4} + \underset{\text{Sodium carbonate}}{Na_2CO_3}$$

44. How could you test the presence of an alcoholic group in a organic compound ?
(This question can also be asked as : How would test for an alcohol ?)

Ans. The presence of an alcoholic group in an organic compound (or an alcohol) can be tested as follows :

(i) Sodium Metal Test. Add a small piece of sodium metal to the organic liquid (to be tested), taken in a dry test tube. If bubbles of hydrogen gas are produced (which burns with a pop sound), it indicates the presence of alcoholic groups (—OH group) in the organic liquid or organic compound . And the compound itself will be an alcohol.

(ii) Ester test for Alcohols. The organic compound (to be tested) is warmed with some glacial ethanoic acid drops of concentrated sulphuric acid. A sweet smell (due to the formation of easter) indicates the presence of alcoholic group (—OH group) in the organic compound. In other words, a sweet smell of ester indicates that the organic compound is an alcohol .

45. How would you test the presence of a carboxyl group in a organic compound ?
(This question can also be asked as : How would you test for a carboxylic acid ?)

Ans. The presence of a carboxyl group in an organic compound (or a carboxylic acid) can be tested as follows :

(i) Ester test for Acids. The organic compound (to be tested) is warmed with some ethanol and a few drops of concentrated suphuric acid. A sweet smell (due to the formation of ester) shows the presence of carboxyl group (—— COOH group) in the organic compound is a carboxylic acid.

(ii) Litmus Test. Some blue litmus solution is added to the organic compound (to be tested). If the blue litmus solution turns red, it shows that the organic compound is acidic in nature, it is a carboxylic acid and hence contains a carboxyl group (—— COOH group) .

46. Explain the term 'saponification'.

Ans. When an ester is heated with sodium hydroxide solution then the ester gets hydrolysed to form the sodium salt of carboxylic acid and the parent alcohol. For example, when ethyl ethanoate ester is boiled with sodium hydroxide solution , then sodium ethanoate and ethanol are produced :

$CH_3COOC_2H_5$ + NaOH $\xrightarrow{\text{Heat}}$ CH_3COONA + C_2H_5OH

ethyl ethanoate — sodium hydroxide — sodium ethanoate — Ethanol

The alkaline hydrolysis of esters is known as saponification (soap keeping) . This is because of the fact that this reaction is used for the preparation of soaps. When the esters of higher fatty acids with glycerol are hydrolysed with sodium hydroxide solution, we get sodium salts of higher fatty acids which are called soaps.

47. An organic compound A has the molecular formula $C_2H_4O_2$ and acidid in nature. On heating with ethanol and conc. H_2SO_4, vapours with pleasant and fruity smell are given out. What is the compound A and what is the chemical equation involved in this reaction ?

Ans. Compound A is ethanoic acid. The chemical equation involved this reraction is :

CH_3COOH + C_2H_5OH $\xrightarrow{\text{Conc. } H_2SO_4}$ $CH_3COOC_2H_5$ + H_2O

Ethanoic acid — Ethanol — Ethyl ethanoate — Water

48. Give chemical tests to detect the presence of ethanol.

Ans. The presence of ethanol can be detected by performing any one of the following two tests :

(i) Sodium Metal Test. Add a small clean piece of sodium metal to 2 ml of ethanol taken in a test tube. Bubbles of hydrogen gas are produced which burn with a pop sound. This shows that the given compound is ethanol.

(ii) Ester Test. Warm 2 ml of ethanol with some glacial ethanoic acid and a few drops of concentrated sulphuric acid . A sweet smell shows that the given compound is ethanol.

49. Give chemical tests to show that methanal contains an aldehyde group.

Ans. The presence of an aldehyde group in methanal can be detected by performing any one of the following two tests :

(i) Tollen's Test. We take some aqueous of methanal in a clean test tube and add Tollen's reagent to it. On warming the test tube in a hot water bath, a shining white deposit of silver metal is formed on the inner sides of the tube.

(ii) Fehling's Test. We take some formalin in a test tube and add freshly prepared Fehling's reagents to it . A and Fehling's solution B. On heating the test tube for a few minutes, red precipitate of copper (I) oxide is produced.

50. What are polymers ? How are they classified ?

Ans. A polymer is a very big molecule formed by the combination of a large number of small molecules . Polythene, polyvinyl chloride, can be prepared by two types of chemical reactions : addition reactions and condensation reactions So, depending upon the type of chemical reaction involved in their preparation, we can classify polymers in to two types : (i) Addition polymers and (ii) Condensation polymers .

51. What are addition polymers and condensation polymers ? Give two examples of addition polymers and two of condensation polymers :

Ans. (i) Addition polymers are obtained by the addition reactions of unsaturated compounds. The two examples of addition polymers are : Polythene and Polyvinyl chloride (PVC).

(ii) Condensation polymers are obtained by the condensation reactions between two different organic compound posse - ssing two functional groups in the same molecule. A simple molecule is eliminated during this process .The two examples of condensation polymers are : Polyamide and Polyester.

52. Classify the following into addition and condensation polymers :
(i) Polypropene (ii) polyester (iii) Polyvinyl chloride (iv) Polyamide
Ans. (a) Addition polymers : Polypropene and polyvinyl chloride.
(b) Condensation polymers : Polyester and Polyamide.

53. Give the names and formulae of the monomers of the following polymers :
(a) Polythene (b) PVC (c) Polypropene (c) Teflon
Ans. (a) Ethane , $CH_2 = CH_2$ (b) Vinyl chloride, $CH_2=CH—Cl$
(c) Propene, $CH_2 = CH—CH_3$ (d) Tetrafluoroethene, $CF_2=CF_2$

54. State one use each of the following polymers :
(a) Polythene (b) Polypropene (c) Polyvinyl chloride (d) Teflon
Ans. a) Polythene is used for making bags.
(b) Polypropene is used for making fibres of carpets.
(c) Polyvinyl chloride is used for making floor tiles.
(d) Teflon is used for giving a nonstick coating on kitchen utensils.

55. What is the advantage of using vulcanized rubber over raw natural rubber ?
Ans. Vulcanised rubber retains its shape over a wide temperature range. So, vulcanised rubber can be used over a wide range of temperature. On the other hand, raw natural rubber can be used over a narrow range of temperature . This is because raw natural rubber becomes soft and sticky in a warm weather and brittle in cold.

56. State the important property of neoprene rubber. Name the substance which imparts this property to neoprene.
Ans. Neoprene is non inflammable has a higher temperature resistance. This property of neoprene is due to the presence of a large number of chlorine atoms in it.

57. Give the names of the monomers of the following polymers :
(i) Polyamide (ii) Polyester
Ans. (i) Monomers of polyamide : Adipic acid and Hexamethylene diamine.
(ii) Monomers of polyester : Terephthalic acid and Ethylene glycol.

58. Give the uses of polyester.
Ans. Polyester polymer is used for making fibres. These polyester fibres are used in making textiles, sarees, suits, dress materials and curtains. It is also mixed with natural fibres like cotton for making blended textiles.

59. What is soap ? Explain with examples.
Ans. A soap is the sodium salt of a long chain carboxylic acid which has cleansing properties in water. A soap has a large non-ionic hydrocarbon group and an ionic group, COO^-Na^+ . Examples of the soaps are : sodium stearate ($C_{17}H_{35}COO^-Na^+$), sodium oleate ($C_{17}H_{33}COO^-Na^+$) and sodium palmitate ($C_{15}H_{31}COO^-Na^+$).

60. Give the name of an important by product of the soap industry. How is it formed during the manufacture of soap ?
Ans. An important by product of the soap manufacture in industry is glycerol. Glycerol is formed by the hydrolysis of fat when it is heated sodium hydroxide solution during the preparation of soap :
Fat (or oil) + sodium hydroxide $\xrightarrow{\text{Heat}}$ Soap + Glycerol

61. What is a synthetic detergent ? Name two synthetic detergents.
Ans. A synthetic detergent is the sodium salt of a long chain benzene sulphonic acid which has cleansing properties in water. A synthetic detergent has a large non-ionic hydrogen group and an ionic group like sulphonate group, $SO_3^-Na^+$, or sulphate group $SO_4^-Na^+$. Examples of synthetic detergents are : sodium n dodecyl benzene sulphonate and sodium n-dodecyl sulphate. These are shown below :

$CH_3—(CH_2)_{11}—C_6H_4—SO_3^-Na^+$ $CH_3—(CH_2)_{10}—CH_2—SO_4^-Na^+$

sodium n-dodecyl benzene sulphonate (A common synthetic detergent)

sodium n-dodecyl sulphate (Another synthetic detergent)

62. Differentiate between soap and synthetic on the basic of their chemical constitution.
Ans. A soap and a synthetic detergent molecule both consist of two parts : A long hydrocarbon chain which is water repelling

and a short ionic part which is water attracting . The soap and synthetic detergent differ in their ionic groups . The ionic group in a soap in the sodium carboxylate group (COO^-Na^+) whereas the ionic group in a synthetic detergent can be sodium sulphate group ($SO_3^-Na^+$) or sodium sulphate group ($SO_4^-Na^+$).

63. Give any two differences between a soap over and a synthetic detergent.

Ans.

Soaps	Synthetic detergent
(i) Soaps are the sodium salts of long chain carboxylic acids . The ionic group in soaps, —— COO^-Na^+	(i) Synthetic detergents are the sodium salts of long chain benzene sulphonic acids or long chain alkyl hydrogen sulphates. The ionic group in a synthetic detergent is —— $SO_3^-Na^+$ or —— $SO_4^-Na^+$
(ii) Soaps ate not suitable for washing purposes when the water is hard. This is because they from insoluble calcium and magnesium salts with hard water.	(ii) Synthetic detergents can be used for washing even the water is hard. This is because they do not form insoluble calcium and magnesium salts with hard water.

64. State one advantage of soap over synthetic detergents over soaps.

Ans. Soaps are biodegradable which can be decomposed by microorganisms like bacteria easily and hence do not cause water pollution. On the other hand, some of synthetic detergents are non-biodegradable which cause water pollution is lakes and rivers.

65. Give two advantages of synthetic detergents over soaps.

Ans. (i) Synthetic detergents can be used for washing purposed even with hard water. This is because they do not from insoluble calcium and magnesium salts with hard water. Soaps, however, from insoluble for washing with hard water .

(ii) Synthetic detergents are more soluble in water and have a stronger cleansing action than soaps.

66. Why is soap not suitable for washing clothes when the water is hard ?

Ans. Hard water contains calcium and magnesium salts. Soap is not suitable for washing clothes with hard water because of two reasons :

(i) When soap is used for washing clothes with hard water, a large amount of soap wasted in reacting with the calcium and magnesium ions of hard water to form an insoluble precipitate called scum, before it can be used for the real purpose of washing.

ii) The scum formed by the action of hard water on soap, sticks to the cloths being washed and interferes with the cleaning ability of the additional soap. This makes the cleaning of clothes difficult.

67. Explain why, the detergents made of molecules in which branching is the minimum, are preferred these days.

Ans. The detergents made of molecules having minimum branching are preferred because they can be decomposed more easily by the microorganisms like bacteria and hence cause less pollution in lakes in rivers. On the other hand, the the detergents made of molecules having more branching are decomposed less readily, they persist in lakes and rivers for longer time and render their water unfit for aquatic life.

Section C.

1. An organic compound 'A' is a constituent of wine and beer. This compound, on heating with alkaline potassium permanganate forms another organic compound 'B' which turns blue litmus to red. Identify the compound 'A' . Write the chemical equation of the reaction that takes place to form the compound 'B'. Name the compound 'B'.

Ans. The organic compound which is a constituent of wine and beer is ethanol. Thus, the compound 'A' is ethanol. Now, ethanol on oxidation with alkaline potassium permanganate produces an acid known as ethanoic acid .This ethanoic acids turns blue litmus to red. Thus, the compound 'B' is ethanoic acid. The chemical reaction which takes place to form compounds B is :

$$\underset{\text{Ethanol (A)}}{CH_3CH_2OH} + 2[O] \xrightarrow{\text{Alkaline } KMnO_4} \underset{\text{Ethanoic Acid (B)}}{CH_3COOH} + H_2O$$

2. Sugar cane juice mixed with yeast is kept in an air tight pot. After a few days, this juice started to give a strong smell. Name and explain the process involved. Name the method used for separating the main produce from this mixture.

Ans. Sugar cane juice contains sugar ($C_{12}H_{22}O_{11}$) and yeast contains the enzymes invertase and zymes. So, when sugar cane juice mixed with yeast is kept for a few days, then fermentation of sugar takes place with the production of ethanol and carbon dioxide. The strong smell is due to the formation of ethanol. The main product of this fermentation process, ethanol, is separated from the mixture by the process of fractional distillation.

3. State the important uses of ethyl alcohol (ethanol) .

Ans. Ethyl alcohol is used :

(i) as a solvent for lacquers, varnishes, perfumes, and medicines, etc.
(ii) as an antiseptic to sterilize wounds and syringes in hospitals and dispensaries.
(iii) in alcoholic drinks like whisky, wine ,beer and other liquors.
(iv) in the preparation of organic compounds like ether, chloroform and iodoform.
(v) for making antifreeze mixtures.

4. Give the harmful effects of drinking alcohol.

Ans. (i) Alcohol is an intoxicant, so under the influence of alcohol, a person loses his sense of discrimination. He cannot distinguish between good and bad, right and wrong. This increases the crime in society.
(ii) Alcohol drinking ruins the health of the person concerned . It damages the liver and makes the brain dull.
(iii) The drinking of adulterated alcohol containing methyl alcohol, causes severe poisoning leading to blindness and even death.
(iv) Alcohol drinking by the head of a family worsens the economic condition of the family.
(v) The alcohol drinking by the head of a family has a very bad effect on the psychological development of the children.

5. What happens when methanal is warmed with ammoniacal silver nitrate solution (or Tollen's reagent)? Give equation of the reaction which takes place.

Ans. Methanal reduces ammoniacal silver nitrate solution to silver metal which forms a shining silver mirror on the sides of the test tube. This reaction can be represented as :

$$\underset{\text{Methanal}}{HCHO} + \underset{\text{Ammoniacal silver nitrate}}{2[Ag(NH_3)_2]NO_3} + \underset{\text{Ammonium hydroxide}}{2NH_4OH} \longrightarrow \underset{\text{Methanoic acid}}{HCOOH} + \underset{\text{silver metal}}{{}_2Ag} + \underset{\text{Ammonium nitrate}}{2NH_3NO_3} + \underset{\text{Ammonia}}{4NH_3} + \underset{\text{Water}}{H_2O}$$

In this reaction, methanol reduces silver ions (Ag^+ ions) present in ammoniacal silver nitrate solution (or Tollen's reagent) to silver metal and is itself oxidised to Methanoic acid. This reaction can be used as a test for methanal (or any other aldehyde).

6. Describe the Tollen's test (silver mirror test) for methanal.

Ans. The tollen's test for methanol (or silver mirror test for methanol) can be performed as follows (The methanol or formaldehyde for this test is taken in the form of its aqueous solutions called formalin and Tollen's reagent to be used is obtained by adding ammonium hydroxide to silver nitrate solution drop wise till the precipitate formed first is redissolved in excess of ammonium hydroxide).

We take some formalin in a clean test tube and add Tollen's reagent (Ammonical silver nitrate solution) to it. On warming the test tube in a hot water bath, a shining white deposit of silver metal is formed on the inner sides of the test tube. (For equation of the reaction taking place in Tollen's test,)

7. What happens when methanal is heated with Fehling's reagent ? Write equation of the reaction involved. (This equation can also be asked as : How is cumene converted into propanone ? Explain with the help of an equation).

Ans. Methanal reduces Fehling's reagent to give a red precipitate of copper (I) oxide, Cu_2O :

$$\underset{\text{Methanal}}{HCHO} + \underbrace{\underset{\text{Copper(II) hydroxide}}{2Cu(OH)_2} + \underset{\text{Sodium hydroxide}}{NaOH}}_{\text{From Fehling's reagent}} \longrightarrow \underset{\text{Sodium methanoate}}{HCOONa} + \underset{\text{copper (I) Oxide}}{Cu_2O} + \underset{\text{Water}}{3H_2O}$$

In this reaction, methanal reduces copper (II) ions (Cu_2+ions) present Fehling's reagent to red coloured copper (I) oxide, and is itself oxidised to Methanoic acid (which is obtained in the form of its sodium salt, sodium methanoate. This reaction can be used as a test for methanal (or any other aldehyde).

9. What is vinegar ? How is ethanoic acid prepared in the form of vinegar ? Write equation of the reaction involved. (This equation can also be asked as : What is vinegar ? How is vinegar prepared from ethanol ? Write equation of the reaction involved).

Ans. A dilute solution of ethanoic acid in water is called vinegar. Vinegar contains about 5 to 8 per cent ethanoic acid. Ethanoic acid is prepared in the form of vinegar by the bacterial oxidation of ethanol . Ethanol is oxidised by the oxygen of air in the presence of acetobacter bacteria to form a dilute solution of ethanoic acid called vinegar:

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + \underset{\text{Oxygen}}{O_2} \xrightarrow{\text{Acetobacter (bacteria)}} \underset{\text{Ethanoic Acid}}{CH_3COOH} + \underset{\text{Water}}{H_2O}$$

10. What happens when sodium salt of ethanoic acid (or sodium ethanoate) is heated with soda-lime ? Give equation of the reaction which takes place.(This question can also be asked as: Explain the term 'decarboxylation').

Ans. When sodium salt of ethanoic acid (called sodium ethanoate) is heated with soda lime, then methane gas is formed:

$$\underset{\text{Sodium ethanoate}}{CH_3COONa} + \underset{\text{sodium hydroxide}}{NaOH} \xrightarrow{\text{Heat}} \underset{\text{Methane}}{CH_4} + \underset{\text{sodium carbonate}}{Na_2CO_3}$$

The process in which the carboxyl group of an organic acid is removed so that the carboxylic acid is converted in to an alkaline is called decarboxylation . Thus, decarboxylation means removal of carboxyl group. The above reaction is an example of decarboxylation because in this reaction carboxyl group is removed from ethanoic acid so that it is converted into a hydrocarbon called methane . Decarboxylation is carried out by heating the sodium salt an acid with soda lime. (Soda lime is a mixture of 3 parts of NaOH and 1 part of CaO).

11. State any three uses of ethanoic acid.

Ans. (i) Dilute ethanoic acid (in the form of vinegar) is used as a food preservative in the preparation if pickles and sauces (like tomato sauce). As vinegar, it is also used as an appetiser for dressing food dishes.
(ii) Ethanoic acid is used in making white lead ,$2PbCO_3.pb(OH)_2$(which is used as a white paint), ester used in perfumes, dyes, plastic and pharmaceuticals.
(iii) Ethanoic acid is used as a reagent in laboratory.

12. An organic compound A having the molecular formula $C_2H_4O_2$ reacts with sodium metal and envolves a gas B which readily catches fire. A with sodium metal and evolves a gas B which readily catches fire. A also reacts with ethanol in the presence of concentrated sulphuric acid to form sweet smelling substance C used in makingperfumers.
(i) Identify the compounds A, B and C. (ii) Write balanced chemical equations to represent the conversion of :
(a) Compound A into compound B. (b) Compound A into compound C.

Ans. (i) A is ethanoic acid; Bis hydrogen; C is ethyl ethanoate.
(ii) (a) Conversion of compound A (ethanoic acid) into compound B (hydrogen) :

$2CH_3COOH + 2Na \longrightarrow 2CH_3COONa + H_2$
compound A Sodium Compound B

(b) Conversion of compound A (ethanoic acid) into compound C (ethyl ethanoate):

$CH_3COOH + C_2CH_5OH \xrightarrow{\text{Conc. } H_2SO_4} CH_3COOC_2H_5 + H_2O$
Compound A Ethanol (Compound C)

16. Synthetic detergents are better than shops, but their excessive use is discouraged. Why ?

Ans. The excessive use of synthetic detergents is discouraged because they can cause water pollution in lakes and rivers which harm the aquatic life. This happens allows : some of the synthetic detergents are non-boidegradable which are not broken down easily by micro – organisms present in water bodies for a long time and make the water unfit for aquatic life. For example, synthetic detergents containing phosphates cause a rapid growth of algae in water bodies like lakes and rivers which leads to deoxygenation of water. Due to depletion of oxygen in water, the aquatic animals like fish can die.

Section D.

1. What is fermentation ? How is ethanol prepared by fermentation ? Write the equations of the reactions involved.

Ans. The slow chemical change produced in an organic compound by the action of enzymes, leading to the formation of smaller molecules is called fermentation . Ethanol is prepared on a large scale by the fermentation of sugar with the enzymes present in yeast. Molasses is a cheap source of sugar and it forms an excellent raw material for making ethanol. Ethanol is prepared on large scale by the fermentation of sugar present in molasses. The fermentation of sugar is done by adding yeast. The yeast plants secrete the enzymes called invertase and zymase which act as catalyst in converting sugar into ethanol and carbon dioxide. The fermentation of sugar to produce ethanol takes place in two steps :
(i) In the first step, sugar is converted into a mixture of simple sugars called glucose and fructose by the action of enzyme called invertase :

$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase (present in yeast)}} C_6H_{12}O_6 + C_6H_{12}O_6$
Sugar water Glucose Frutose

(ii) In the second step, both glucose and fructose are converted into ethanol and carbon dioxide by the action of enzyme called zymase :

$C_6H_{12}O_6 \xrightarrow{\text{Zymase (Present in yeast)}} 2C_2H_5OH + 2CO_2$
Glucose and Fructose Ethanol Carbon dioxide

Fermentation of sugar is an exothermic reaction in which heat is evolved. Fermentation of sugar is carried out at a controlled temperature of 20^0 to 30^0 C (293 to 303K)

4. How is soap manufactured in soap industry ? Explain with the help of equation of the reaction involved.

Ans. The main raw materials required for the manufacture of ordinary soap are :
(i) Animal fat or vegetable oil
(ii) Sodium hydroxide (caustic soda)
(iii) Sodium chloride (common salt)

Soap is made by heating animal fat or vegetable oil with concentrated sodium hydroxide solution. The fats or oils react with sodium hydroxide to from soap and glycerol :

Fat or oil + Sodium hydroxide $\xrightarrow{\text{Heat}}$ Soap + Glycerol
(An ester) (An alkali or base) (Sodium salt of fatty acid) (An alcohol)

The process of making soap by the hydrolysis of fats and oils with alkalis is called saponification. The above reaction is an example of saponification. Here is an example of the soap manufacture starting from animal fat.

Animal fat contains the ester called glycertl stearate. To make soap, animal fat is heated with concentrated sodium hydroxide solution. In this way, glyceryl stearate gets hydrolysed to from sodium steatite and glycerol. This reaction can be represented as :

$C_{17}H_{35}COO-CH_2$
$C_{17}H_{35}COO-CH_2$ + 3NaOH $\xrightarrow{\text{Heat}}$ $3C_{17}H_{35}COONa$ + CH_2-OH
$C_{17}H_{35}COO-CH_2$ CH_2-OH
CH_2-OH
Glyceryl stearate (A glyceride) sodium hydroxide Sodium stearate

When the saponification process is complete, some sodium chloride is added to solution to cause the precipitation of soap. That is, soap is separated from the solution by the addition of sodium chloride. When add sodium chloride to the soap solution, then the solubility of soap decreases due to which soap separates out from the solution in the form of a solid and starts floating on the surface. The crust of soap thus formed is removed and put in moulds to get soap cakes. The various colours and perfumes are also added during the preparation of soap.

The solution left behind after the removal of soap contains glycerol and sodium chloride . Glycerol is a very valuable chemical. So, glycerol is recovered from this solution and used in making drugs, cosmetics, explosives and paints, etc.

5. Describe a method for the preparation of soap in a school laboratory or at home.

Ans. The main raw materials required for preparing soap in a school laboratory or at home are :

(i) Vegetable oil (like castor oil, Cotton seed oil, Linseed oil or soyabean oil)(ii) Sodium hydroxide (Caustic soda)
(iii) Sodium chloride (Common salt)

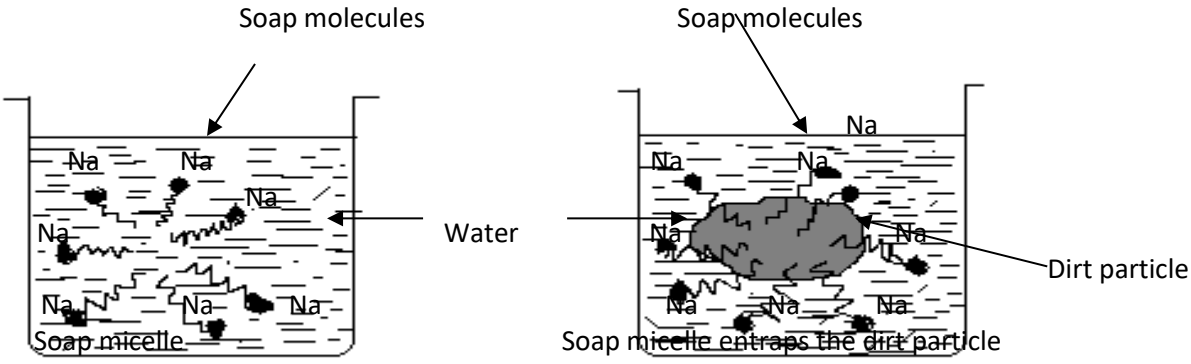
Procedure. Some castor oil is taken in a beaker and an equal volume of concentrated sodium hydroxide solution is added to it. This mixture is heated with stirring till a paste of soap is formed. The caster oil contains 'glyceryl oleate' ester. So, the soap formed will be sodium oleate, $C_{17}H_{33}COONa$:

Glycerly oleate + Sodium hydroxide $\xrightarrow{\text{Heat}}$ Sodium oleate + Glycerol
(From castor oil) (Soap)

Through most of the soap separates out but some of it remains dissolved in solution. Sodium chloride is then added to precipitate out all the soap from the aqueous solution. On cooling the solution, solid separates out. The modern commercial soaps contain disinfectants, medicaments, perfumes, colour, etc., to increase their utility for specific purposes.

6. Explain the cleansing action of soap.

Ans. When soap is dissolved in water, it forms a colloidal suspension in which the soap molecules cluster together to form micelles. The micelles remain suspended in water because the similar negative charges at the end of each soap molecule repel each other. In a micelle, the soap molecules are arranged radially, with the hydrocarbon end directed towards the centre and the ionic end directed outwards. Now, when dirty clothes are put in this soap solution, then the soap micelle entraps the dirt particles by attaching the hydrocarbon part of the soap molecule to the greasy or oily particles [as shown in Fig.] Since the ionic part of the soap molecules remains attached to water molecules, therefore, the greasy dirt particles get dispersed in water and the cloth gets cleaned.



7. Explain the cleansing action of detergents.

Ans. When a detergent is dissolved in water, it forms a colloidal solution in which the detergent molecules cluster together to form micelles. . The micelles remain suspended in water because the similar negative charges at the end of each detergent molecule repel each other. In a micelle, the detergent molecules are arranged radially, with the hydrogen end directed towards the centre and the ionic end directed outwards. Now, when dirty clothes are put in this detergent solution, then the detergent molecule to the entraps the dirt particles by attaching the hydrocarbon part of the detergent molecule to the greasy or oily particles. Since the ionic part of the detergent molecules remains attached to water molecules, therefore, the greasy particles get dispersed in water and the cloth gets cleaned.

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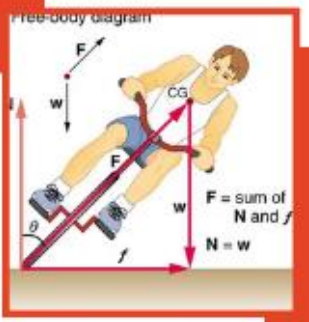

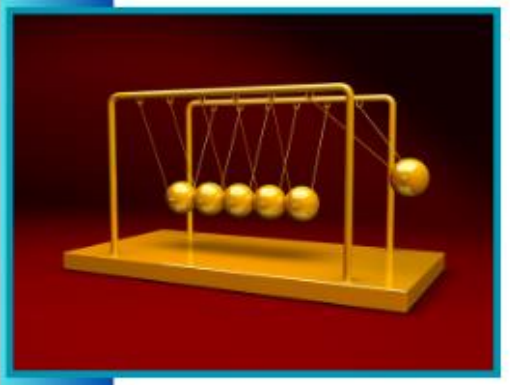

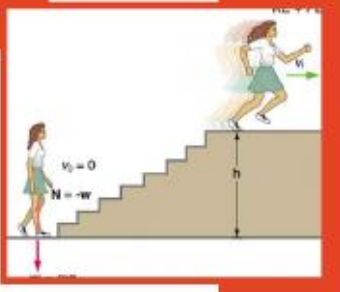

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