4 CARBON & ITS COMPOUNDS

4.1 INTRODUCTION

Now a days material like food, cosmetics, furnitures, clothes, medicines, books and many other things contain the versatile element **carbon**.

In addition all living structures (human beings, animals, birds, insects, plant kingdom etc) are made up of **carbon compounds** (Such as fats, carbohydrates, proteins, vitamins, harmones, etc.)

The amount of carbon present in the earth's crust are in the atmosphere is low.

The earth's crust has **0.02% carbon** form of salt, like carbonates, bicarbonates metallic cynides, coal, petroleum, graphite etc.

Earth's the atmosphere has **0.03% of carbon dioxide**.

4.2 BONDING IN CARBON COMPOUND

We know that the reactivity of elements is explained as their tendency to attain a full filled outer shell, that is, attain **noble gas configuration**.

Elements forming ionic compounds achieve this by either gaining or losing electrons from the outermost shell.

In the case of carbon, it has four electrons in its outermost shell and needs to gain or lose four electrons to attain noble gas configuration.

(i) If it gains four electrons forming C^{4-} anion. It would be difficult for the nucleus with six protons to hold on to ten electrons, means attraction force of 6 electrons is not sufficient to hold 8 electrons in valence shell.

(ii) If it loses four electrons forming C^{4+} cation. It would require a large amount of energy to remove four electrons from its valence shell that is not easily available in chemical reaction.

Carbon overcomes this problem by sharing its valence electrons with other atoms of carbon or with atoms of other elements. Not just carbon, but many other elements form molecules by sharing electrons in this manner.

The shared electrons 'belong' to the outer shells of both the atoms and lead to both atoms attaining the noble gas configuration.

Covalent bond

When two atoms share 1, 2 or 3 electrons from each atom, and shared electrons fulfill the

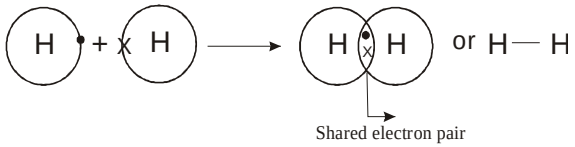
Some simple examples of covalent bonded compounds are:

Single Covalent Bond:

When one electron is shared from both atoms a single covalent bond is formed. This bond is indicated by a single line (–) between two bonding atoms.

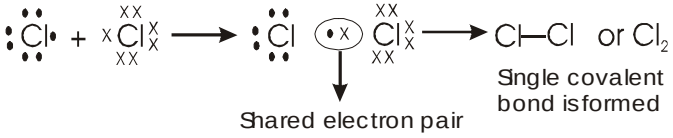
(a) Formation of Hydrogen molecule. Atomic number (Z) of H is one. Electronic configuration $_1$H=K(1).

$H^{\bullet} + \overset{\times}{H} \rightarrow H \underset{\times}{\bullet} H \rightarrow H - H$ or H_2 molecule.



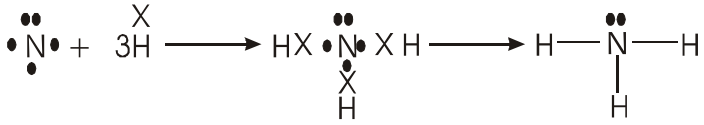
(b) Formation of chlorine molecule.

At.no. (Z) of Cl = 17 Electronic configuration = K(2) L(8) M(7)



(c) Formation of Ammonia :-

At. no. (Z) of N = 7 Electronic configuration of N = K(2) L (5)



or NH_3 (Three single bond are formed)

Double Covalent Bond:

When two electrons from each atom are shared between two atoms a double covalent bond is formed. This bond is indicated by a double line (=) between two bonding atoms.

Ex. Formation of oxygen molecues :-

At.no. of O (Z) = 8 Electronic configuration of O = K(2) L (6)

or O_2 (double bond is formed)

Other examples are CO_2, C_2H_4 etc.

Triple Covalent Bond:

When three electrons from each atom are shared between two atom a triple bond is formed some examples of triple covalent bond are C_2H_2 (acetylene), Hydrocyanic acid. Formation of Nitrogen molecule:

At. no. of N(Z)= 7 Electronic configuration of N = K(2) L(5)

or (N_2 triple bond is formed)

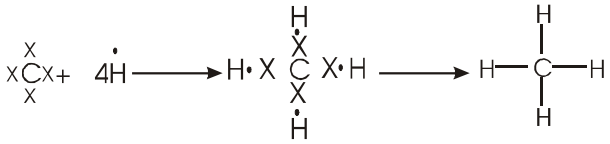
Some more examples of molecules having single, double and triple covalent bonds

Ex. Formation of methane (CH_4)

At. no. of C(Z) = 6

At. no. of H(Z) = 1

Electronic configuration of C = K(2) L(4) Electronic configuration of H = K (1)

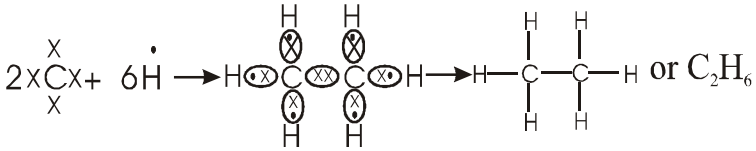


or CH_4

Ex. Formation of Ethane (C_2H_6)

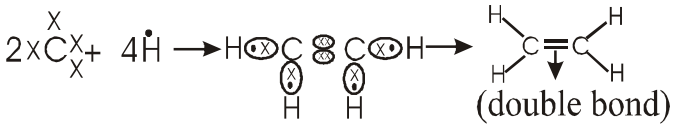
At.no. of C (Z) = 6 , Electronic configuration of C = K (2) L (4)

At. no. of H(Z) = 1 Electronic configuration of H = K (1)



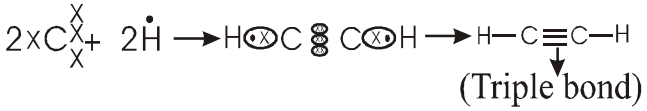
or C_2H_6

Ex. Formation of Acetylene (C_2H_4):



or C_2H_6

Ex. Forcnation of Acetylene (C_2H_2):



or C_2H_2

4.3 ALLOTROPY

The property of an element as a result of which it exists more than one form having different physical but same chemical properties is called **Allotropy**.

Carbon, Sulphur, phosphorus etc show allotropy.

Allotropic forms of carbon are graphite , diamond and fullerenes.

Diamond

Occurence of Diamond: It is the hardest crystalline form of carbon. It mainly found in South Africa, Brazil, Australia, British Guana etc.

In India is mainly found in Golconda, and Panna.

Diamonds can be synthesised by subjecting pure carbon to very high pressure and temperature. These synthetic diamonds are small but are otherwise indistinguishable from natural diamonds.

Structure: In diamond each carbon atom is sp^3 hybridised and linked to four other carbon atoms by single covalent bond. This results the tetrhadral three dimensional structure.

C-C bond angle is 109°28'.

Each C-C atom bond length is 1.54 Å means it is very closely packed in space that's why it is very hard having density 3.51 g/cm^3.

It's refractive index is 2.42 which is very high due to this is produces maximum total internal reflection which is responsible for its bluish green colour.

Since all four valance es^- of carbon are bonded by other four carbon atoms electrons so there is no any free electrons. Due to absence of free es^- diamond is bad conductor of electricity and heat energy.

Uses of Diamond:

(i) Due to its hardness it is used for cutting marbles, granites and glass as diamond knives.

(ii) Used as an abrasive and for polishing hard surfaces.

(iii) Used to make special surgical knives.

(iv) Dies made from diamond are used for drawing wires from the metals.

(v) Diamonds when properly cut and polished are used as precious stones or gems. Which are used in ornaments.

Occurence of graphite:

Graphite occurs in free state in nature.

It can be prepared artificially by heating a mixture of same and coke in electric furnance at about 3300 K temperature.

Structure:

In graphite each carbon atoms is linked to three other carbon atoms by single covalent bond resulting in hexagonal ring which are arranged in a layer.

- The C-C bond length is 1.42 Å. C-C bond angle is 120°.

- These layer are bonded together by weak Vander Waals force of attraction shown in figure by dotted lines.

- Distance between two layers is 3.35 Å.

Properties: Graphite is

(i) Relatively soft and is greasy because its hexagonal layer structure.

(ii) Has metallic lusture.

(iii) Colour varies from gay to black depends upon the origin.

(iv) Is opaque.

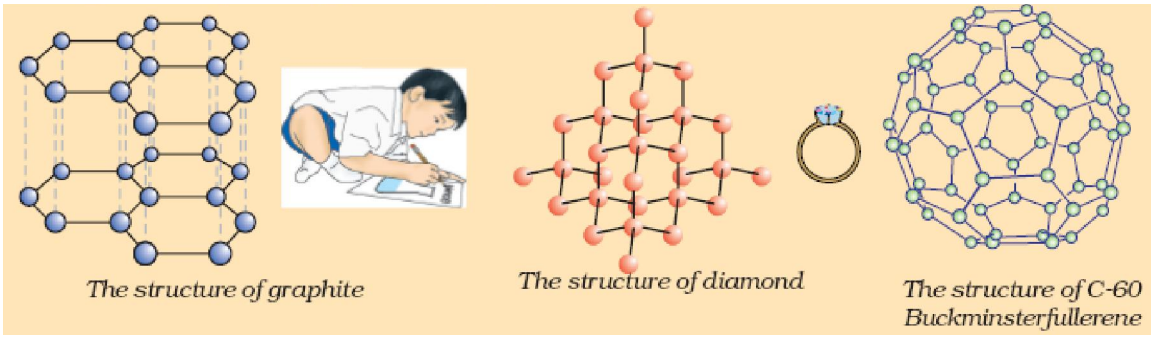
(v) Density varies from 2.0 to 2.25 gm/scm^3.

Differences between Diamond and Graphite

Property	Diamond	Graphite
1. Appearance	Transparent and colourless when pure	Dark grey and opaque
2. Crystal form	Octahedral giant structure	Hexagonal plates
3. Hardness	Hardest natural substance known	Soft and slippery
4. Impression	Does not mark paper	Leaves impression on paper
5. Conductivity (a) Electrical (b) Thermal	 Bad conductor Very high	 Good conductor Moderate
6. Density at 20 ºC	3.51 g per cm^3	2.26 g per cm^3
7. Combustion	Burns in air above 900 ºC and gives CO_2	Burns in air at about 700 ºC and gives CO_2

Fullerene

Fullerenes form another class of carbon allotropes. The first one to be identified was C - 60 which has carbon atoms arranged in the shape of a football. Since this looked like the geodesic dome designed by the US arachited Buckminster Fuller, the molecule was named fullerene.



Differences between graphite and Fullerene

Graphite	Fullerene
1. Graphite has extended crystal structure in which C-atoms are bonded in hexagonal layers. These layers are held by weak **Vander Waals forces**	1. Fullerene is a spherical molecule like a cage in which the C atoms are arranged in mixed hexagons and pentagons. In solid state these molecules are attached to each other by weak **van der Waals forces**.
2. Graphite is insoluble in water, acids and any other solvent.	2. Fullerene is soluble in benzene and forms deep violet colour solution.
3. Graphite is a good conductor of electricity.	3.Crystalline fullerene has semi conducting properties.
4. The compounds of graphite with metals are called carbides. They are hard materials.	4. Compounds of fullerene with alkali metals are called fullerides and they are superconductors.

4.4 VERSATILE NATURE OF CARBON

The number of carbon compounds which are know today is approximately three million. This number for exceeds the total number of compounds formed by all other elements. The five main reasons for this are as discussed below:

(i) **Catenation:** The property of self linking of carbon atoms through covalent bonds form long straight and branched chains and rings of different sizes is called **catenation**.

The property of catenation is probably due to :

(a) Small size (b) Great strength of carbon-carbon bonds.

(ii) **Tetra Covalency of Carbon:** Carbon has valency four. It is capable of bonding four other atoms of carbon or some other elements.

(iii) **Tendency to Combine other hetero atom:** (like N, O, S, P, F, Cl, Br, I etc) :- Due to small size of carbon atom it can form very strong bonds with many elements such as O, N, S, F, Cl, Br, I, P etc.

(iv) **Tendency to form multiple bond:** Due to its small size carbon also forms multiple (double, triple bonds, with other carbon atoms, oxygen, nitrogen etc.

(v) **Isomerism:** Covalently bonded carbon compounds show isomerism.

If a given molecular formula represents two are more structures having different properties is called **isomerism** and compounds are called **isomers**.

Illustration 1

What are the two properties of carbon which lead to huge number of carbon compounds?

Solution

(i) Catenation (ii) Tetravalency of carbon.

4.5 ORGANIC COMPOUNDS

Compounds like urea, sugar, oils, fats, dyes, proteins, vitamin, hormones etc, which were isolated directly or indirectly from living organisms such as animals and plants are called **organic compounds** and the branch of chemistry which deals with the study of these compounds called **organic chemistry.**

Compounds like common salt (NaCl) blue vitriol $(CuSO_4 \cdot 5H_2O)$, green vitriol ($FeSO_4.7H_2O$) white vitriol ($ZnSO_4.7H_2O$), CaO, $Ca(OH)_2$ etc. which were isolated from non-living sources such as rocks and minerals are called **inorganic compound** and the branch of chemistry which study about those compounds is called **inorganic chemistry**.

Vital Force Theory :- According to this theory organic compounds are produced only under the influence of some mysterious force existing in the living organisms. This misterious force was called the vital force. This theory was proposed by Berzelius in 1815.

Since such vital force can not be created artificially, so organic compounds cannot be prepared artificialy in the laboratory.

Rejection of Vital force Theory : In 1828 Wholer accidentlaly prepared urea by heating Potassium cynate and Ammonium sulphate

$$\underset{\text{(Potassium Cynate)}}{KCNO} + \underset{\text{(Ammonium sulphate)}}{(NH_4)_2SO_4} \rightarrow \underset{\text{(Ammonium cynate)}}{NH_4CNO} + \underset{\text{(Potassium sulphate)}}{K_2SO_4}$$

$$\underset{\text{(Ammonium cynate)}}{NH_4CNO} \xrightarrow{\Delta} \underset{\text{(Urea)}}{H_2N-\overset{\overset{O}{\|}}{C}-NH_2}$$

(Inorganic Compound) (Organic Compound)

This synthesis discarded to vital force theory and clearly demonstrated that no mysterious force was required in the formation of organic compounds in the laboratory.

Modern definition of organic compound:

All covalent bonded carbon compounds (except oxides of carbon (CO, CO_2), carbonates, bicarbonates, (Metal Cynides & carbides) are called **organic compound**.

Hydrocarbons

Compounds made up of carbon and hydrogen are called **hydrocarbons** and all other compounds may be regarded to have been derived from them by replacement of one or more of their hydrogen atoms by other atom or group of atoms. These can be divide into two parts:

(a) Saturated Hydrocarbon

Compounds of carbon which have only single bonds between carbon atoms are called saturated compounds. These are also known as alkanes. Example- ethane, propane, methane etc.

(b) Unsaturated Hydrocarbon

Compounds of carbon which contain one or more double or triple bonds between C-C atoms are called unsaturated compounds. These compounds can be further divide into two parts:

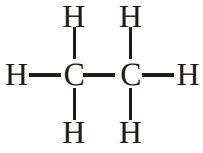
(i) Alkene: If there is atleast one double bond between (C = C) such hydrocarbons are known as alkenes example of alkenes are Ethene (ethylene), Butene, Propene etc.

(ii) Alkyne: If there is atleast one triple bond between (C ≡ C) such hydrocarbons are known as alkynes example of alkynes are Ethyne (acetylene), Butyne, Propyne etc.

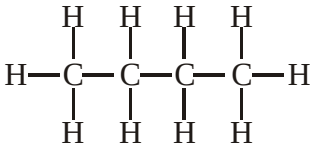
Open Chain Compound and closed Chain or Cyclic Compound

Open Chain Compounds: The organic compounds in which the carbon atoms are linked to each other in such a manner that the molecules having an open chain structure are called **open chain** or **acyclic** or **aliphatic compound.**

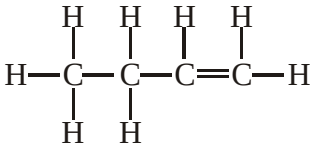
This may be of two types **straight chain** and **Branched chain** compound.



Ethane (C_2H_6)



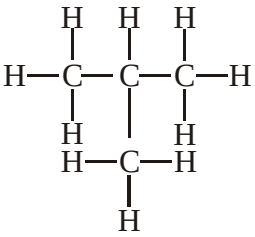
Propane (C_3H_8)



Butyene (C_4H_8)

Branched Chain Compounds: The carbon compounds in which at least one carbon of the chain is linked to three or four other carbon atoms are called branched chain compound.

Example of Branched chain compound :

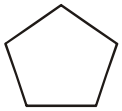


C_4H_{10} (Iso butane)

Cyclic Compounds: Compounds of carbon in, which carbon atoms are arranged in a ring are called **cylic compounds**.


(Cyclo propane)


(Cyclo butane)


(Cyclo pentane)

Derivatives of Hydrocarbon

If hydrogen of a hydrocarbon is displaced from other atoms or group of atoms such compounds are known as derivative of hydrocarbons. Examples alcohol, ether, aldehyde etc. Such compounds can be divide into two parts:

(a) Hydrocarbon Group (Radical): When one hydrogen is removed from hydrocarbon rest species is known as hydrocarbon radical. It determines the physical properties of an organic compound. It is donated by **R**.

On the basis of parent hydrocarbon it can be named as below:

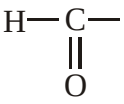
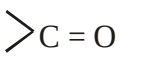
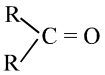
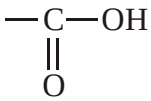
Hydrocarbon	**Formula**	**Name of radical**	**Formula**
Alkane	C_nH_{2n+2}	Alkyl group	C_nH_{2n+1}
Alkene	C_nH_{2n}	Alkenyl group	C_nH_{2n-1}
Alkyne	C_nH_{2n-2}	Alkynyl group	C_nH_{2n-3}

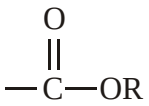
(b) Functional Groups: An atom or a group of atoms which displaces the hydrogen atom from hydrocarbon molecule is called **Functional Group.** It determines the characteristic chemical properties of an organic compound. It is denoted by **G**.

Some examples of function group are given below

All compounds with same functional group belong the same family.

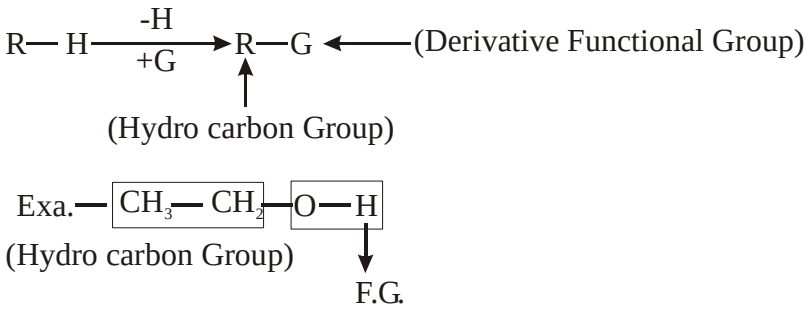
Example:- Alcohol family contains -OH group.

Formula of Function group	**Name of Functional group**	**Types of organic compound**	**Family**
— Cl	Chloro	R-Cl	Halogen
— Br	Bromo	R-Br	Halogen
— I	Iodo	R-I	Halogen
— F	Fluro	R-F	Halogen
— OH	Hydroxyl	R-OH	Alochol
	Aldehydic	R-CHO	Aldehyde
	Ketonic		Ketone
	Carboxyl	R-COOH	Carboxylic acid
— NH_2	Amino	RNH_2	Amine
—OR	Alkoxy	R-O-R	ether



Ester R-COOR Ester

Notation of a hydrocarbon derivative



4.6 HOMOLOGOUS SERIES

A homologous series may, thus, be defined as a group of structurally similar compounds each member of which differs from the proceeding or succeeding, member by CH_2. The members of a series are called **homologous**.

Characteristics of Homologous Series

A homologous series is characterised by the following points :

(i) All members of a particular homologous series can be represented by the general formula. For example, alkane C_nH_{2n+2}, alkenes (C_nH_{2n}) and alkynes (C_nH_{2n-2}).

(ii) Each member of the homologous series differs from the members above or below the series only by one CH_2 group.

(iii) The molecular weight of two adjacent members of a homologous series differs by 14 (i.e., CH_2 = $(12 \times 1) + (1 \times 2) = 14$).

(iv) All members of a homologous series can be prepared by the same general methods.

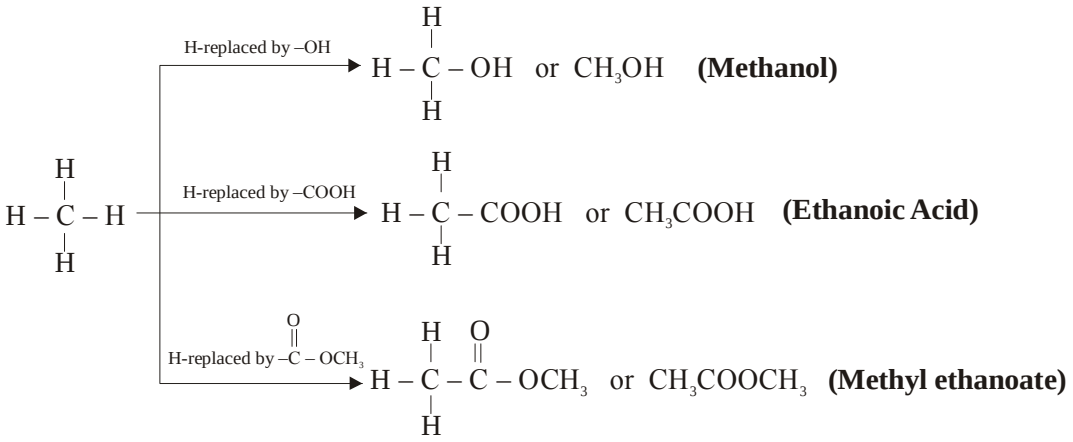
(v) All members of a homologous series have same chemical properties due to same functional group.

Illustration 11

Name some organic compounds with oxygen containing functional groups that have been derived from methane?

Solution

Methane (CH_4) is the simplest saturated hydrocarbon. When one hydrogen atom of methane is replaced by a functional group, a compound belonging to the characteristic family of the functional group is obtained. Various compounds containing different functional groups obtained. Various compounds containing different functional groups obtained from methane are given below



4.7 NOMENCLATURE OF ORGANIC COMPOUND

Naming of organic compound is called nomenclature. There are two main systems of Nomenclature.

(1) Trivial System or common names

These name were given after the source from which the organic compounds were first isolated.

Ex. Acetic acid (CH_3COOH) got its name from acetum (means vinegar) because it is present in vinegar.

Formic acid (HCOOH) got its name from formica (means red ant) because it is present in Red ant.

Marsh gas (CH_4) got its name because it is obtained from marshy land.

(2) IUPAC Name:- International union of pure and applied chemistry has given certain rules to systematize nomenclature of organic compounds.

This is simple, systematic, and scientific method for nomenclature of organic compounds obtained from its structural formula.

IUPAC name is unique.

The IUPAC name of any organic compound can be derived by using the following rules. It mainly consist of three parts :

(i) Word Root (ii) Suffix (iii) Prefix

1. Word Root: The number of carbon atoms present in the linear continuous chain (main chain or present chain) of the molecule is denoted by word Root.

It is generally indicated as 'alk'

Chain length	Word Root (Alk)
One carbon (C_1)	Meth
Two Carbon (C_2)	Eth
Three Carbon (C_3)	Prop
Four Carbon (C_4)	But
Five Carbon (C_5)	Pent
Six Carbon (C_6)	Hex
Seven Carbon (C_7)	Hept
Eight Carbon (C_8)	Oct
Nine Carbon (C_9)	Non
Ten Carbon (C_{10})	Dec

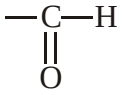
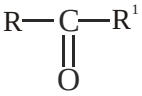
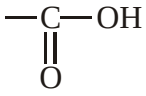
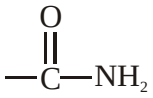
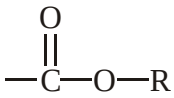
(a) ***Primary Suffix:***

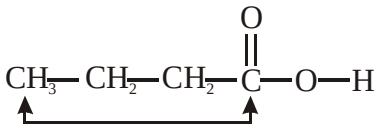
Primary suffix is always added after the word root to indicate whether carbon chain is saturated or unsaturated.

	Nature of Carbon Chain	**Primary suffix**	**Name**
(i)	Saturated i.e. Contain C-C single covalent bond only	ane	Alkane
(ii)	Unsaturated i.e. Contains at least one C=C double covalent bond	ene	Alkene
(iii)	Unsaturated i.e. Contain at least one C≡C triple covalent bond	yne	Alkyne

(b) ***Secondary Suffix*****:** Secondary suffix is added after primary suffix to indicate the presence of particular functional group in the carbon chain.

While adding secondary suffix to the primary suffix, the terminal 'e' of the primary suffix (i.e. ane, ene, yne) is dropped if secondary suffix begins with vowels **(a,e,i,o,u)** but it is retained if the secondary suffix begins with consonant.

Family	**Functional Group**	**Secondary suffix**	**IUPAC Name**
Alcohol	—O—H	—ol	Alkane-ol= Alkanol
Adehyde		—al	Alkane-al = Alkanal
Ketone		—one	Alkane-one = Alkanone
Carboxylic acid		—oic acid	Alkane-oic acid = Alkanoic acid
Amine	$-NH_2$	—amine	Alkane-amine = Alkanamine
Amide		–amide	Alkane-amide = Alkanamide
Cyanides	—C ≡ N	—nitrile	Alkane + nitrile = Alkane nitrile
Ester		Alkyl - oate	Alkyl/ Alkane-oate = Alkyl alkanoate

Ex. 

Linear Continuous Chain

Family-Carboxylic acid

Word Root = 4, Carbon atom i.e. But primary Suffix - ane

Functional group –ane

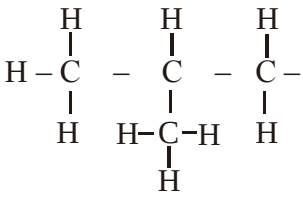
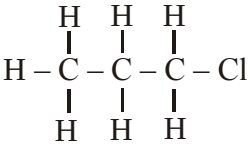
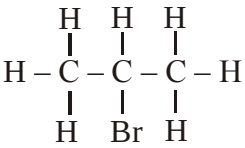
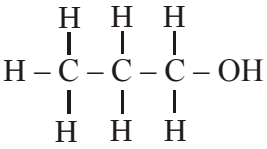
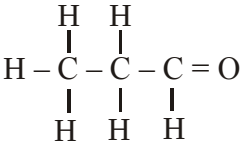
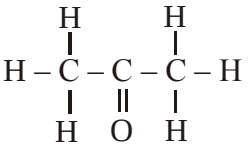
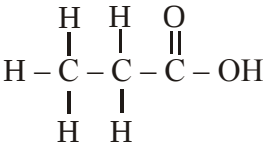
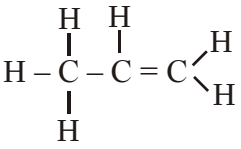
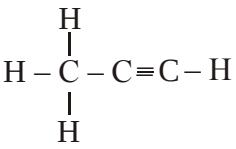
Functional group i.e. secondary.

suffix = oic acid

Hence name is :

But + ane —e + oic acid = Butanoic acid

Functional group	**Prefix / Suffix**	**Example**

1.	Alkyl group (as a side chain)	Prefix-Alkyl	 (Methylpropane)
2.	Halogen	Prefix – chloro, bromo etc.	 (1-Chloropropane)
			 (2-Bromopropane)
3.	Alcohol	Suffix - ol	 (Propan-1-ol)
4.	Aldehyde	Suffix - al	 (Propanal)
5.	Ketone	Suffix - one	 (Propanone)
6.	Carboxylic acid	Suffix - oic acid	 (Propanoic acid)
7.	Double bond (alkenes)	Suffix - ene	 (Prop-1-ene)
8.	Triple bond (alkynes)	Suffix - yne	 (Prop-1-yne)

3. ***Prefix:*** Prefix is added before word root to indicate side chains or substituents group present in the linear carbon chain of the molecule.

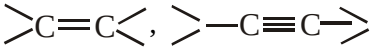
In IUPAC system certain groups are treated as substituent (Prefix) instead of functional group.

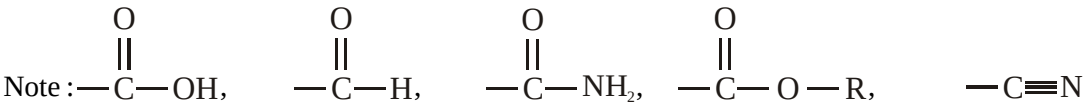
Group	***Prefix***
—F	Fluoro
— Cl	Chloro
—Br	Bromo
—I	Iodo
$—NO_2$	Nitro
—O—R [R(CH_3,C_2H_5 etc.)]	Alkoxy (methoxy (O-CH_3) Ethoxy (O-C_2H_5)
R — (CH_3, —C_2H_5)	Alkyl [methyl, (CH_3), Ethyl (C_2H_5)].
—NO	Nitroso
—C_6H_5	Phenyl

4. ***Numbering of Linear Chain:***

The numbering of linerar carbon chain is done from one end of carbon chain in such a manner to give lowest possible numerical prefix. (i.e. called locant) 1,2,3,4,5 .... etc to functional group, first then to double bond and triple bond.

Priority order is :

Functional group >  Substituent

Note : 

Functional group containing carbon always get number one during carbon chain numbering, hence their location is not require to write in the IUPAC name.

Illustrations

Give IUPAC name of the following compounds

W.R. = Word root, P.S. = Primary suffix, S.S. = Secondary suffix

12. $H_3C — CH_2 – CH_2 —OH$

Word root - Prop.

Primary suffix - ane

Functional group (Secondary suffix) = l-position of OH group in carbon chain

Hence IUPAC Name is :

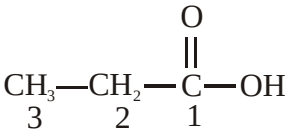
1- Prop + ane - e + ol = **1-propanol**

13. $CH_3 —CH_2 — CH = CH_2$

Word Root but Primary Suffix = ene Position - 1

Name: **1-Butene**

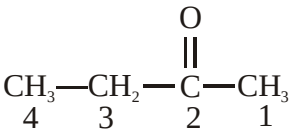
14.



W.R. - Prop, P.S. = ane Secondary Suffix = Oic acid

Position - 1 Name: **Propanoic Acid**

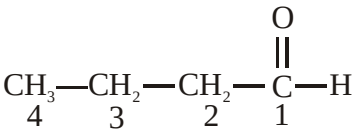
15.



W.R. = But. P.S. = ane S.S. = one

Position-2 Name: **2-Butanone**

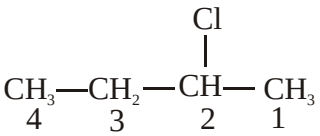
16.



W.R. = But., P.S. = ane, S.S. = al

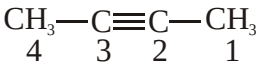
Position-1 Name = Butanal

17.



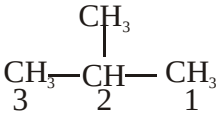
2- Chlorobutane

18.



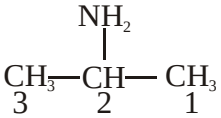
2 - Butyne

19.



2- Methyl propane or Methyl propane

20.



2- Propanamine

4.8 ISOMERISM

Definition: Compounds having same molecular formula show different physical and chemical properties are called isomers and the phenomenon is called isomerism.

The difference in properties of isomers is due to the difference in the relative arrangements of various atoms present in their moleucules.

Organic compound show following types of structural isomersim on the basis of their difference in structural arrangement of atoms.

4.8.1 Chain isomerism

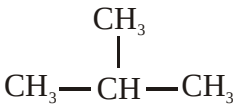
Organic compounds having same molecular formula but difference in the nature of length carbon chain are called **chain isomers**.

For example, Let us consider the molecular formula of an alkane C_4H_{10}.

$CH_3 - CH_2 - CH_2 - CH_3$

(Butane)

(Here linear chain contains 4 carbon atom)



(2-Methylpropane)

(Here the linear chain contains 3 carbon atom)

4.8.2 Position isomerism

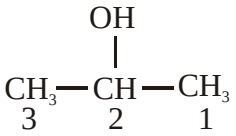
Compounds having same molecular formula but differ in the position of, functional group, double bond or triple bond in the carbon chain are called **position isomers**.

This type of isomerism is shown by Alkene, Alkyne, Alcohol, Amine, Haloalkane etc.

Ex.1 Let us consider the molecular formula of an alcohol ($C_nH_{2n+2}O$)

C_3H_8O $CH_3—CH_2—CH_2—OH$

(1-Propanol)



(2-Propanol)

The difference only in the position of —OH group in the linear Carbon chain).

Ex.2 Let us consider the molecular formula of alkene C_4H_8 (C_nH_{2n})

$H_2C = CH—CH_2—CH_3$ $CH_3—CH = CH—CH_3$

(1 - Butene) (2- Butene)

They are differ in the position of double bond in the linear carbon chain.

4.8.3 Functional isomerism

Compounds having same molecular formula but differ in nature of functional group are called functional isomers.

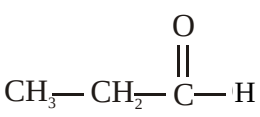
Ex.1 Alcohol and ether have same molecular formula ($C_nH_{2n+2}O$) but have different functional group hence show functional isomerism.

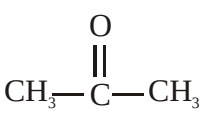
C_2H_6O $CH_3—CH_2—OH$ $CH_3—O—CH_3$

(Ethanol) (Methoxy methane)

Ex.2 Aldehyde and Ketone having same molecular formula ($C_nH_{2n}O$)

C_3H_6O





Give chain isomers in following compound

(A) n-Butane (B) 1-Butanal (C) 1-Butene

Solution

(A) $CH_3–CH_2–CH_2–CH_3$ n-Butane

$(CH_3)_2CHCH_3$/ 2- Methylpropane Isobutane

(B) $CH_3CH_2CH_2CH_2OH$ 1-Butanal

$(CH_3)_2CHCH_2OH$ 2-Methyl-1-butanol

(C) $CH_3CH_2CH = CH_2$ 1-butene

$(CH_3)_2C = CH_2$ 2-Methylpropene

Illustration 25

Give position isomers of the following compounds

(A) 1-Butene (B) 1-Butyne

Solution

(A) $CH_3–CH_2 –C \equiv CH$ 1-Butyne

$CH_3C \equiv C – CH_3$ 2-Butyne

(B) $CH_3–CH_2CH = CH_2$ 1-Butene

$CH_3CH = CH–CH_3$ 2-Butene

4.9 TYPE OF ORGANIC REACTIONS (CHEMICAL PROPERTIES OF ORGANIC COMPOUND)

4.9.1 Combustion Reaction

The reaction in which substance (i.e. element or compound) burn with oxygen gas to form carbondioxide and water with release of a large amount of heat and light is called combustion.

For example,

(i) $C + O_2 \rightarrow CO_2$ + Heat and light

(ii) $CH_4 + O_2 \rightarrow CO_2 + 2H_2O$ Heat and light

(iii) $CH_3—CH_2—OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ + heat and light

Saturated hydrocarbons will generally burn in excess of air or oxygen with a blue flame but unsaturated hydrocarbons burn with a yellow flame with lots of black smoke.

This results sooty deposit on the metal plate. Sooty deposit is actually unburnt carbon which is produced due to incomplete combustion. The reason being that the carbon content of unsaturated compounds is more than the hydrogen contant and hence carbon is not completely burnt and unburnt carbon deposits as a soot.

In addition to that limiting supply of air result in incomplete combustion of even saturated hydro carbon giving a sooty flame.

Fuel such as coal and petroleum have some amount of nitrogen and sulphur in them. Their combustion results in the formation of oxides of sulphur and nitrogen which are one major pollutants in the environment.

Some Examples of pollutant gases are SO_2, SO_3, NO, NO_2 etc.

WHY DO SUBSTANCES BURN WITH OR WITHOUT A FALME?

We have seen above that a candle or the LPG in the gas stove burns with a flame. However we will observe the coal or charcoal in an '**angithi** sometimes just glows red an gives out heat without a flame.

This is because a flame is only produced when gaseous substances burn. When wood or charcoal is ignited, the volatile substances present vapourise and burn with a flame in the beginning.

A luminous flame is seen when the atoms of the gaseous substance are heated and start to glow. The colour produced by each element is a characteristic property of element. When we heat a copper wire in the flame of a gas stove and observe its colour. We can see that incomplete combustion gives soot which is carbon.

FORMATION OF COAL

Coal and petroleum have been formed from biomass which has been subjected various biological and geological processes. Coal is the remains of trees, ferns, or other plants that lived millions of years ago. These were crushed into the earth perhaps by earthquakes or volcanic eruptions. They were pressed down by layers earth and rock. They slowly decayed into coal. The process of coal formation is known as carbonisation.

FORMATION OF PETROLEUM

Oil and gases are the remains of million of tiny plants and animals that lived in the sea. When they died, their bodies sank in the sea bed and were covered by silt. Bacteria attacked the dead remains, forming them into oil and gas under the high pressures they were being subjected to. Meanwhile, the silt was slowly compressed into rock. The oil and gas seeped into the porous parts of the rock, and got trapped like water in a sponge.

4.9.2 Oxidation

Addition of oxygen to any substance or removal of hydrogen from any substance is called **oxidation**.

The substances which are capable of adding oxygen or removal of Hydrogen from other substance are called **oxidising agent**. Example:

Alkaline potassium permagnate and acidfied potassium dichromate are good oxidising agents. These are easily oxidise alcohol to carboxylic acids.

$$CH_3CH_2 - OH + 2[O] \xrightarrow[\text{or acidified } K_2Cr_2O_7 + \Delta]{\text{Alkaline } KMnO_4 + \Delta} CH_3-\overset{\overset{O}{\|}}{C}-OH + H_2O$$

(Ethanol) (Ethanoic acid)

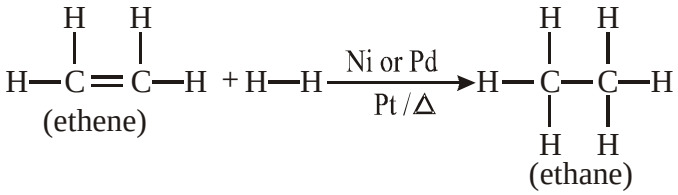
4.9.3 Addition Reaction

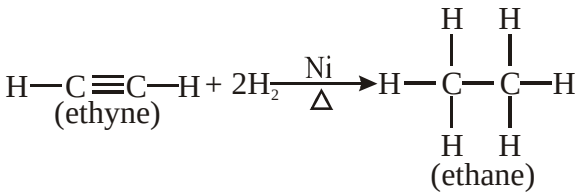
Reactions in which a simple molecule added to an unsaturated compound to form a single product are called **addition reactions**.

Addition of Hydrogen gas:

Unsaturated hydrocarbons add hydrogen in presence of a catalyst such as Nickel, Platinum, or Palladium to form saturated hydrocarbons.

This process is called catalytic hydrogenation.

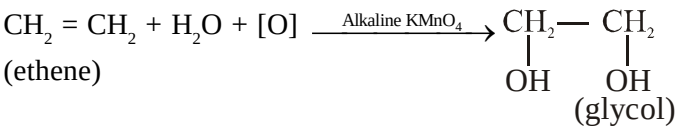




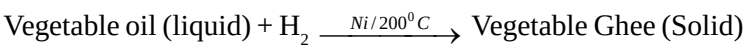
Here Ni, Pd and Pt are catalysts and reducing agents which provide hydrogen to alkene and alkyne.

Test of unsaturated compound

The unsaturation means (C=C or C ≡ C) present in organic compound can be tested by means of Bayer Reagent (1% alkaline $KMnO_4$) by observing the disappearance of colour pink ($KMnO_4$ Solution).



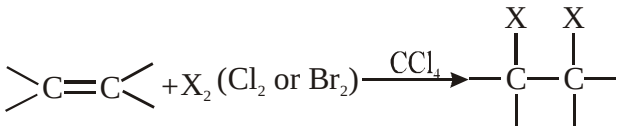
Application of Hydrogenation :- Hydrogenation (addition of H_2) is commonly used in the hydrogenation of vegetable oils. (such as soyabean oil, cotton seed oil, groudnut oil etc.) in presence of Ni as catalyst to form fats (Vegetable oils generally have long unsaturated carbon chains while animal fats have saturated carbon chains).



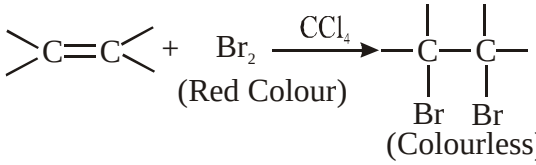
Animal fats generally Contain saturated fatty acids which are said to be harmful for health.Therefore oils containing unsaturated fatty acids should be good for cooking.

Addition of halogen:- (Cl_2, Br_2)

Halogen (Cl_2 and Br_2) can be added to unsaturated (C=C, C ≡ C) compound to form halogenated product.



Application of Bromination*:* Bromination is used to test unsaturation (C=C or C ≡ C) present in the compound by observing the dissapeanance of red colour of Br_2 during reaction with a unsaturated Compound.



4.9.4 Substitution Reaction

Reaction in which involve the direct replacement (displacement or substitution) of an atom or a group of atoms in an organic molecule by another atom or group of atoms without any change in the rest of the molecule are called **substitution reactions**.

R —X + Y → R—Y + X

For Examples,

(i) Halogenation of Alkane

Due to presence of strong carbon - carbon and carbon- Hydrogen bonds, saturated hydro carbons are quite less reactive and are inert to the cation of most of the reagents. Hence alkanes are also called praffins (param means less, affinity means reactivity).

Alkanes react with halogen in presence of light

In presence of heat or light chlorine (F_2, Br_2 or I_2) reacts very rapidly with saturated hydrocarbons to form substitution products.

$$CH_4 + Cl_2 \xrightarrow[\text{on 520-670K}]{\text{Sunlight}} CH_3Cl + HCl$$

(Chloromethane substituted product)

with excess of chlorine all the hydrogen atoms of methane are preplaced by one to form a number of products as shown below:

$$CH_3Cl + Cl_2 \xrightarrow{\text{Sunlight}} CH_2Cl_2 + HCl$$

(Dichloromethane)

$$CH_2Cl_2 + Cl_2 \xrightarrow{\text{Sunlight}} CHCl_3 + HCl$$

(Trichloro methane)

$$CHCl_3 + Cl_2 \xrightarrow{\text{Sunlight}} CCl_4 + HCl$$

(Carbon tetrachloride)

However with higher homologous of alkanes a number of product containing even one chlorine atom are formed.

$$CH_3—CH_2—CH_3 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3—CH_2—CH_2—Cl + CH_3—\underset{\displaystyle Cl}{\underset{|}{CH}}—CH_3$$

(Minor product) (Major Product)

(due to stability of free radical)

(ii) Hydroxylation of Alkyl Halide (Halo alkane)

R—X	+	NaOH	→	R—OH	+	NaX
Halo alkane or Alkyl halide		Sodium Hydroxide		(Alcohol)		X (Cl, Br, I)

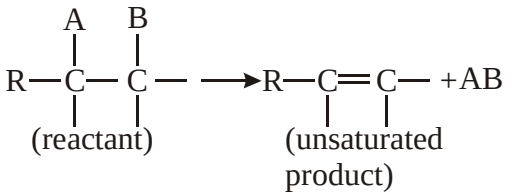
Hence OH^- (Hydroxide ion) substitute halide ion (X^-).

$$CH_3—Cl + \text{aq. NaOH} \rightarrow CH_3—OH + NaCl$$

(Methanol)

4.9.5 Elimination Reaction

Reaction in which a simple molecule like HCl, H_2O, NH_3 etc as removed from bigger molecule to form unsaturated compound is called **ellimination reaction**.

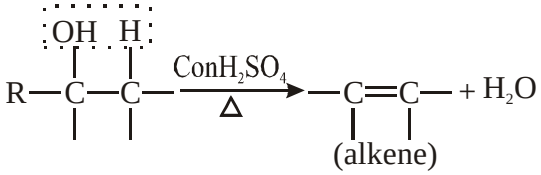


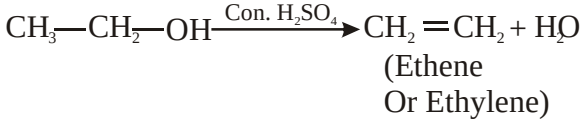
AB is eliminated during reaction.

(i) Dehydration of alcohol :

Removal of water from alcohol is called **dehydration**.

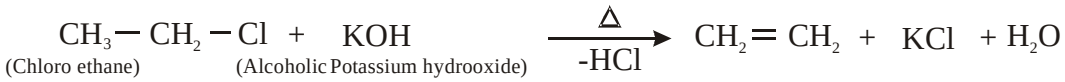
The substance which help in dehydration is known as dehydration agent (Conc. H_2SO_4, P_2O_5, Al_2O_3, etc)





(ii) Dehalogenation of Haloalkane

Removal of HX (Hydrogen halide) from Halo alkane is called **dehalogenation**.



Here HCl is eliminated.

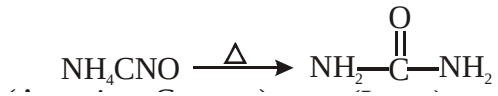
$$HCl + KOH \rightarrow KCl + H_2O$$

4.9.6 Rearrangement Reaction

Reaction in which bigger molecule rearrange to another different molecule without substitution, addition or ellimination is called **rearrangement reaction**.

The molecular formula of reactant and product remain same. In such reactions one compound converts into its isomer so such reactions are also known as **Isomerisation reaction**.

For example,



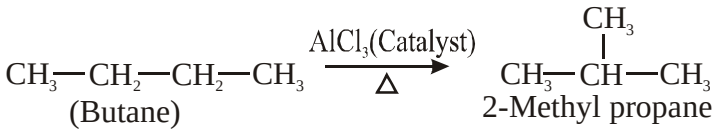


Illustration 26

Alkenes usually show which type of reaction?

Solution

Alkenes usually show addition reaction due to presence of unsaturation in the form of double bond.

Illustration 27

Give a test that can be used to differentiate chemically between butter and cooking oil?

Solution

Butter contains saturated fatty acids, whereas cooking oil contains unsaturated fatty acids. The unsaturation in a carbon compound can be tested with bromine solution.

Take a few drops of oil in a test tube. In another tube melt a little butter. Add a few drops of bromine water into both the test tubes and shake it well. The colour of bromine gets decolourized by cooking oil but remain unaffected by butter.

4.10 SOME IMPORTANT CARBON COMPOUNDS - ETHANOL AND ETHANOIC ACID

4.10.1 Properties of Ethanol

Ethanol is a liquid at room temperature.

Ethanol is commonly called alcohol and is the active ingredient of all alcoholic drinks.

Ethanol is also soluble in water in all proportions.

Reactions of Ethanol

(i) Reaction with sodium

$$2Na + 2CH_3CH_2OH \rightarrow 2CH_3CH_2O^-Na^+ + H_2$$

(Sodium ethoxide)

Alcohols react with sodium leading to the evolution of hydrogen with ethanol and the by- product is sodium ethoxide.

(ii) **Dehydration of Alcohol** Heating ethanol at 443 K with excess of concentrated sulphuric acid results in the dehydration of ethanol to give ethene.

$$CH_3 - CH_2OH \xrightarrow[H_2SO_4]{\text{Hot conc.}} CH_2 = CH_2 + H_2O$$

The concentrated sulphuric acid can be regarded as a dehydrating agent which removes water from ethanol.

HOW DO ALCOHOLS AFFECT LIVING BEINGS?

(i) When large quantities of ethanol are consumed, it tends to slow metabolic processes and to depress the central nervous system. This results in lack of coordination, mental confusion, drowsiness, lowering of the normal inhibitions, and finally stupor.

(ii) The individual may feel relaxed but does not realise that his sense of judgement, sense of timing, and muscular coordination have been seriously impaired.

(iii) Intake of methanol in very small quantities can cause death. Methanol is oxidised to methanal in the liver. Methanal reacts rapidly with the components of cells. It causes the protoplasm to get coagulated, in much the same way an egg is coagulated by cooking.

(iv) Methanol also affects the optic nerve, causing blindness. Ethanol is an important industrial solvent.

To prevent the misuse of ethanol produced for industrial use, it is made unfit for drinking by adding poisonous substances like methanol dyes are also added to colour the alcohol blue so that it can be identified easily. This is called **denatured alcohol**.

(v) Consumption of small quantities of dilute ethanol causes drunkenness. Even though this practice is condemned, it is a socially widespread practice. However, intake of even a small quantity of pure ethanol (called absolute alcohol) can be lethal. Also, long-term consumption of alcohol leads to many health problems.

Ethanol is a good solvent. It is also used in medicines such as tincture of iodine, cough syrups, and many tonics.

ALCOHOL AS A FUEL

Sugarcane plants are one of the most efficient convertors of sunlight into chemical energy. Sugarcane juice can be used to prepare molasses which is fermented to give alcohol (ethanol). Some countries now use alcohol as an additive in petrol.

It is a cleaner fuel which gives rise to only carbon dioxide and water on burning in sufficient air (oxygen). It is known as Power alcohol.

4.10.2 Properties of Ethanoic Acid

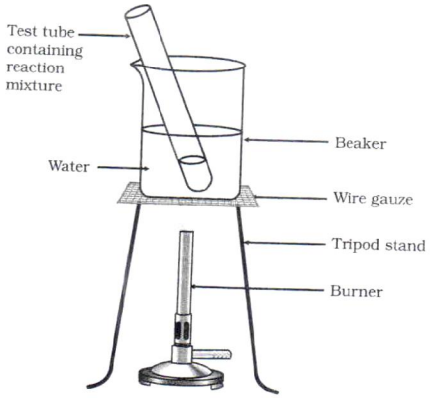
Ethanoic acid is commonly called acetic acid and belongs to carboxylic acid group.

5-8% solution of acetic acid in water is called vinegar and is used widely as a preservative in pickles.

The melting point of pure ethanoic acid is 290 K and hence it often freezes during winter in cold climates. This gave rise to its name glacial acetic acid.

The group carboxylic acids are obviously characterised by a special acidity.

However, unlike mineral acids like HCl, which are completely ionised, carboxylic acids are weak acids because they do not ionised completely.



Formation of ester

REACTIONS OF ETHANOIC ACID

(i) **Esterification reaction**: Esters are most commonly formed by reaction of an acid and an alcohol. Ethanoic acid reacts with absolute ethanol in the presence of an acid catalyst to give an ester -

$$CH_3—COOH + CH_3—CH_2OH \xrightarrow{H_2SO_4} CH_3C(=O)—O—CH_2—CH_3 + H_2O$$

(Ethanoic acid) (Ethanol) (Ester - Ethyl ethanoate)

Uses:

(i) Esters are sweet-smelling substances. These are used in making perfumes and flavouring agents.

(ii) Esters react in the presence of an acid or a base to give back the alcohol and carboxylic acid. This reaction is known as **saponification** because it is used in the preparation of soap.

$$CH_3COOC_2H_5 \xrightarrow{NaOH} C_2H_5OH + CH_3COONa$$

(ii) **Reaction with a base**: Like mineral acids, ethanoic acid reacts with a base such as sodium hydroxide to give a salt (sodium ethanoate is commonly called sodium acetate) and water and heat is evolved.

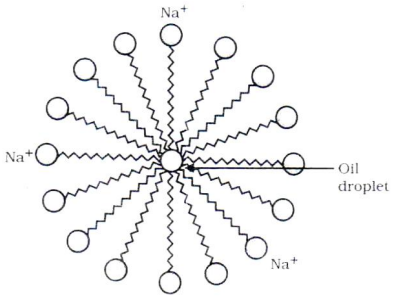
$NaOH + CH_3COOH \rightarrow CH_3COONa + H_2O$

(iii) **Reaction with carbonates and hydrogencarbonates**: Ethanoic acid reacts with carbonates and hydrogencarbonates to give a salt, carbon dioxide and water. The salt producing is commonly called sodium acetate.

$2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2\uparrow$

$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2\uparrow$

Use of sodium salt of long chain carboxylic acids (Soap) as cleaning agent



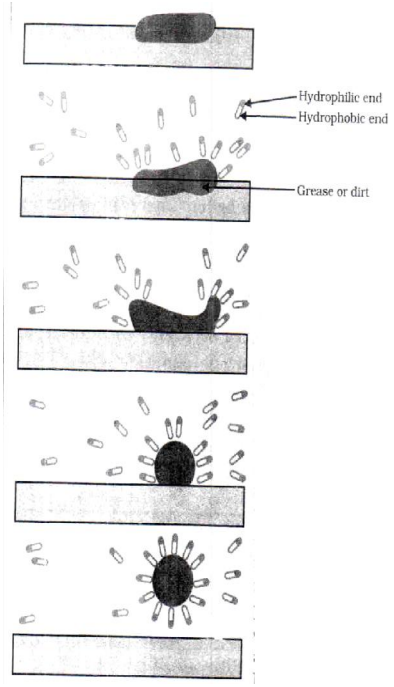
Formation of micelles

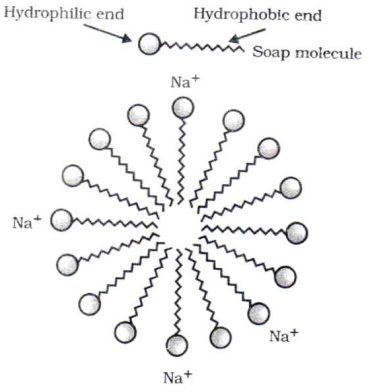
This Activity demonstrates the effect of soap in cleaning. Most dirt is oily in nature and as we know, oil does not dissolve in water. The molecules of soap are sodium or potassium salts of long-chain carboxylic acids. The ionic-end of soap dissolves in water while the carbon chain dissolves in oil. The soap molecules, thus form structures called micelles where one end of the molecules is towards the oil droplet while the ionic-end faces outside. This forms an emulsion in water. When we rub the cloth dirt particles with micelle leave the surface of cloth and it become clean thus the soap micelle thus helps in dissolving the dirt in water and we can wash our clothes clean.

4.11 MICELLES

Soaps are molecules in which the two ends have differing properties, one is hydrophilic, that is, it dissolves in water, while the other end is hydrophobic, that is, it dissolves in hydrocarbons.

When soap is at the surface of water, the hydrophobic 'tail' of soap will not be soluble in water and the soap will align along the surface of water with the ionic end in water and the hydrocarbon 'tail' protruding out of water.





Effect of soap in cleaning

Inside water, these molecules have a unique orientation that keeps the hydrocarbon portion out of the water. This is achieved by forming clusters of molecules in which the hydrophobic tails are in the interior

of the cluster and the ionic ends are on the surface of the cluster. This formation is called a micelle. Soap in the form of a micelle is able to clean, since the oily dirt will be collected in the centre of the micelle. The micelles stay in solution as a colloid and will not come together to precipitate because of ion-ion repulsion. Thus, the dirt suspended in the micelles is also easily rinsed away. The soap micelles are large enough to scatter light. Hence a soap solution appears cloudy.

4.11.1 Detergent

Have you ever observed while bathing that foam is formed with difficulty and an insoluble substance (scum) remains after washing with water? This is caused by the reaction of soap with the calcium and magnesium salts, which cause the hardness of water. Hence you need to use a larger amount of soap. This problem is overcome by using another class of compounds called detergents as cleansing agents. Detergents are generally ammonium or sulphonate salts of long chain carboxylic acids. The charged ends of these compounds do not form insoluble precipitates with the calcium and magnesium ions in hard water. Thus, they remain effective in hard water. Detergents are usually used to make shampoos and products for cleaning clothes.

Illustration 28

Which gas is evolved during the process of fermentation?

Solution

Carbon dioxide gas is evolved during fermentation.

Illustration 29

Explain the formation of scum when hard water is treated with soap.

Solution

When soap solution is added into a sample of hard water, scum is formed. This is due to the formation of calcium or magnesium salts of the fatty acids.

$RCOONa + Ca^{2+} \rightarrow (RCOO)_2Ca \downarrow + Na^+$

(soap present in hard water) scum as precipitate

4.12 SOME IMPORTANT ORGANIC COMPOUNDS (ESSENTIAL FOR STSE & OLMYPIADS)

(I) FULLERENE

– It has spherical tomb like structure.

– The fullerene was named after the famous American architect Buckminster Fuller.

– In one molecule of fullerene there are 60, 70 or more carbon atoms present.

– C_{60} is the most stable fullerene which is also known as buck minister fullerene.

– The structure of C_{60} has 32 faces in which 20 faces are hexagonal and 12 faces are pentagonal. Its structure is similar to foot ball, therefore it is also known as bucky ball.

– C_{60} is a poor conductor of electricity. The C–C bond length is 1.40A.

Uses :

(i) It is important from technical point of view because it is super conductor at high temprature. At normal temperature it is insulator.

(ii) It is used in molecular bearings.

(iii) $C_{60}O$ can be used in cancer as well as AIDS therapy.

(iv) It can catalise the photochemical refining in industries.

(II) CHLORO - FLUORO CARBON OR FREONS

When carbon atom forms compound with chlorine and fluorine, to complete its valencies, then it is known as choro-fiuoro carbon or freons.

OR

Polychloro-Fluoro derivatives of alkanes are known as chloro-Fluoro carbon or freons.

For nomenclature of freons the number of carbon, hydrogen and fluorine atoms are considered.

Example - Freon XYZ

where X = No. of carbon atom present in freon molecule-1

Y = No. of hydrogen atoms + 1

Z = No. of fluorine atoms.

Molecular formula	X	Y	Z	Name
$CFCl_3$	0	1	1	Freon – 11
CF_2Cl_2	0	1	2	Freon – 12
$C_2F_2Cl_4$	1	1	2	Freon – 112
$C_2F_3Cl_3$	1	1	3	Freon – 113
$C_2F_4Cl_2$	1	1	4	Freon – 114

Uses :

(i) Used as refrigerant in refrigerators, air conditioners and cold storage.

(ii) Used as inert solvent.

Note:

CFC's are harmful for ozone layer so now many countries have baned its use as freezing agent.

(III) COMPRESSED NATURAL GAS

C.N.G. is an abbreviation of compressed natural gas.

Gas present above the upper layer of petroleum in earth beds are known as natural gases.

It is different from L.P.G.

During extraction, natural gases are also obtained along with petroleum.

When natural gas is compressed at high temperature, it is known as **Compressed Natural Gas.**

When fractional distillation of petroleum is done then gases released from different constituents are known as petroleum gases. These gases are compressed at high pressure to convert into liquid which is known as **Liquified Petroleum Gas or LPG.**

(IV) MAIN CHARACTERISTIC OF C.N.G.

– C.N.G. mainly contain methane and other hydrocarbons.

– C.N.G. contains lower percentage of carbon; therefore the formation of CO and CO_2 during combustion is very less, so from environment point of view this gas is far better than, the other petroleum products.

– From safety point of view this gas is more useful because in comparison to L.P.G. it is lighter so its rate of diffusion is more and if this gas leaks then due to lighter weight it expands in air while the L.P G due to its heavier weight collects at bottom, so that the chances of accident increases.

(V) POLYMERS

Polymer is a compound of high molecular weight which is formed by combination of one or more molecules of lower molecular weight. In nature many polymer compound like rubber. starch, cellulose are found which are very important in our daily life . In addition to these many ; polymers are formed artificially, they are known as synthetic polymer i.e. synthetic fibres, artificial rubber plastic, resin etc.

(VI) ARTIFICAL FIBRES

(A) Nylon 66: It is formed by condensation of units of adipic acid (6 carbon atom) and hexa methylene diamine (6 carbon atom) so it is known as Nylon 66.

Due to presence of amide bond this polymer is known as polyamide polymer.

$nHOOC - (CH_2)_4 - COOH + nNH_2 - (CH_2)_6 - NH_2 \rightarrow$

Adipic acid Hexa methylene diamine

$[- CO - (CH_2)_4 - CO - NH - (CH_2)_6 - NH -]_n + nH_2O$

Nylon 66

(Polyamide polymer)

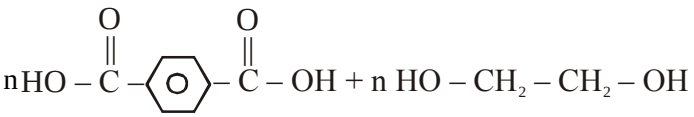
Melting point of nylon is high therefore its fibres have high tensile strength, they are insoluble in many solvents.

Uses :

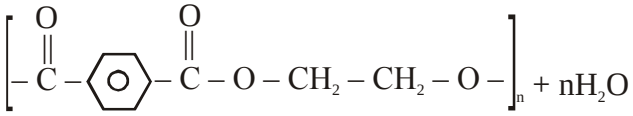
(i) Used for manufacturing of tyres, clothes fibres, ropes brushes etc.

(ii) For manufacturing of gears and bearings in machine.

(B) Terylene: This is obtained by the condensation of ethylene glycol and terphthalic acid.



Terphthalic acid Ethylene glycol



Polyethylene Terphthalate

In terylene many properties like low moisture absorption resistant toward heat, fire, climate are found and it can retain its shape in dry at wet state etc. Thus it is used for manufacturing of fibres for clothes.

It is also known as decron

Uses: Used for manufacturing of cloths, sail of sailing boat, belts and magnetic tapes.

(iv) **Rayon** : It is regenerated cellulose, to manufacture rough paper (cellulose) is washed with sodium hydroxide, after that it is dissolved in carbon disulphide (CS_2) to obtain solution of cellulose. The solution is passed through fine holes in dilute sulphuric acid by which fine shinny rayon fibres are formed

Uses: Used for manufacturing of clothes, threads and carpets etc.

(VII) PLASTICS

Generally plastic are those substances which is be remolded into various desired shape. Some important plastic polymer are as follows.

(i) **Polyethene:** Ethene, in the presence of catalyst, at high temprature and pressure polymeries to form polyethylene.

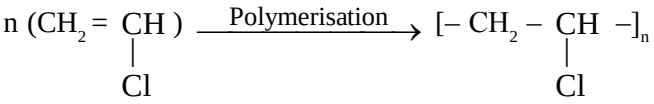
This is flexible and hard plastic.

$n\ (CH_2 = CH_2) \rightarrow\ (- CH_2 - CH_2 -)_n$

Ethene polyethylene

Uses: Used in manufacture of polyethylene bags, mould material, pipes, tubes, bottles etc.

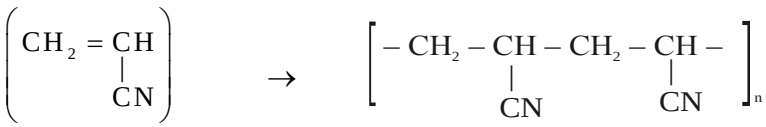
(ii) **Polyvinyl chloride (PVC)**: It is obtained by the polymerisation of vinyl chloride.



Vinyl Chloride **P.V.C.**

Uses: P.V.C. is used in the manufacturing of rain coats, bags, shoes, sleepers, hospital bed sheets, toys pipes, insulation layers, phonogram records etc.

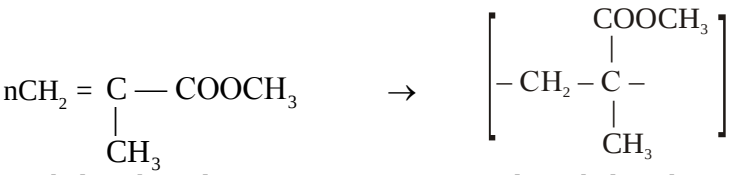
(iii) **Orlon:** It is prepared from vinyl cyanide. It is also known as poly vinyl cyanide or poly acrylonitrile (P AN.) or orlon



Vinyl cyanide or acrylonitrile (ORLON)

Uses: It is used in manufacturing of woolen sweaters, bathing suits,wool like fibre which forms beds and pillows.

(iv) **Polymethyl methacrylate:** It is prepared by the polymerisation of methyl methacrylate.

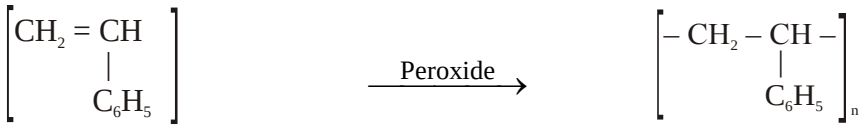


Methyl methacrylate Polymethyl methacrylate (P.M.MA.)

It is hard and transparent, it is used for making covers of car lights and attractive sign boards.

Uses: Used as lenses, ventilators and glasses for aircraft windows.

(v) **Polystyrene:** It is obtained by the polymerisation of styrene.

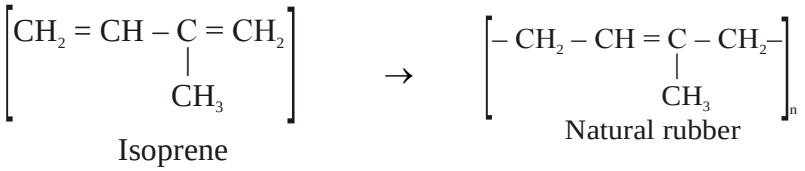


Styrene Polystyrene

Uses: Used for making bottle corks, small radio cabinets, spare parts of refrigerators, combs, toys, ceramic tiles, cups and **packing materials.**

(VIII)RUBBER

Natural rubber is obtained as liquid form which is known as rubber latex. It is polymer of isoprene.



Isoprene Natural rubber

In latex acetic acid is mixed to convert it into solid thus the rubber obtained, does not used to form refined products because it is high elastic and it has low tensile strength.

To increase the effciency and tensile strength, it is mixed and heated with sulphur. This process is known as **Vulcanisation**. The rubber so obtained, is hard, not elastic and resistant to abrassion.

Uses: Rubber is used in manufacturing of tyres and tubes.

(IX) SYNTHETIC RUBBER

During first world war when supply of natural rubber to Germany was banned then scientist tried to discover new sources of rubber and they obtained rubber like substance by the polymerisation of 2, 3 dimethyl 1, 3- butadiene.

For this, 2. 3 dimethyl 1,3 butadiene is exposed to atmosphere of CO_2 and catalyse by sodium to form rubber like substance which is named as BUNA.

which indicates Bu = Butadiene

Na = sodium catalyst

From industrial point of view many synthetic rubber are formed such as

(i) BUNA - S (formed from polymerisation of butadiene and ethylene or styrene)

(ii) BUNA - N (formed from polymerisation of butadiene and nitrile)

Uses : Synthetic rubber is used for the manufacturing of house pipes, oil canes, tyres, tubes, medical equipments, shoe soal etc Neoprene rubber is hard so it is used to manufacture gaskets.

(X) PESTICIDES

Those chemicals used to kill insects and other small organisms which can cause harm to human, and other organism and to agricultural practices, are known as pesticides.

They are classified into following categories :-

1.	Insecticides	used for killing harmful insect
2.	Nematocides	used to kill herbivorous round worms
3.	Rodenticides	used to kill rodents
4.	Molluscides	used to kill molluscs
5.	Fungicides	used to kill fungus
6.	Weedicides	used to destroy weeds.

(XI) INSECTICIDES

Chemical used to kill or repel insect for prevention of agriculture products and stored cereals are known as insecticides.

Important insecticides are :

1. **Stomach poison** :These are effective when entered into stomach of insect along the food and damages the digestive system to kill insect. Zinc phosphide, Monocrotophose. Sodium fluoride, Lead arsenate. Celphos are used to kill insects like grasshopper, sap sucker beetle etc.

2. **Contact poison** : These chemical exerts harmful effect when comes in contact with insects for example DDT, **Maletheon, pyrithrum.** B.H.C., Aldrin, carbyle etc.

3. **Fumigants** : These insecticides are volatile thus releases toxic gases, when inhaled it causes blockage in respiratory tract and ultimately results in death of the insect.

   Example. Phosphene , ethylene dichloride, methyl bromide, aluminium phosphide, hydrogen cyanide.

4. **Protoplasmic poison** : These poison destroys the protein present in protoplasm of insect cell and resulted in death.

   For example - Compound of copper and mercury.

Other pesticides:

1. **Dicophol**: These are effective against all species of mite. It is sprayed on barley, cotton, capsicum and vegetable etc. Comercially they are known as Calthal, Hcllphol. Techophol etc.

2. **Carbofurane**: It is used for destroying herbivorous round worms.
3. **Zinc phosphide**: It is used for killing rat, squarrel and other rodents.

Solved Examples

Example 1

Why are carbon and its compounds used as fuels for most applications?

Solution

This due to two mean reason :

(i) Due to stronger C–C and C–H bonds, most carbon compounds produce large amount of heat during burning. So, carbon and its compounds are used as fuels.

(ii) Hydrogen associated with carbon in case of carbon compound element hydrogen has highest calorific value i.e. 150 k J/g among all the elements.

Example 2

Calculate the difference in the formulae and molecular masses for (a) CH_3OH and C_2H_5OH (b) C_2H_5OH and C_3H_7OH and (c) C_3H_7OH and C_4H_9OH.

(i) Is there any similarity in these three?

(ii) Arrange these alcohols in the order of increasing carbon atoms to get a family. Can we call this family a homologous series?

Solution

Formula		Molecular mass (calculated), u	Difference in	
			Formula	Molecular mass
(a)	CH_3OH C_2H_5OH	12 + 3 + 16 + 1 = 32 24 + 5 + 16 + 1 = 46	$–CH_2$	14
(b)	C_2H_5OH C_3H_7OH	24 + 5 + 16 + 1 = 46 36 + 7 + 16 + 1 = 60	$–CH_2$	14
(c)	C_3H_7OH C_4H_9OH	36 + 7 + 16 + 1 = 60 48 + 9 + 16 + 1 = 74	$–CH_2$	14

(i) Yes, As we go from CH_3OH to C_4H_9OH, for every increase of one carbon in the chain, the formula shows an increase of $–CH_2$ unit, and the molecular mass increases by 14 units.

(ii) The arrangement in the order of increasing carbon atoms is,

CH_3OH, C_2H_5OH, C_3H_7OH and C_4H_9OH

These four compounds form a homologous series.

Example 3

Write the formula of an alkane, and an alkene, with twenty carbon atoms.

Solution

The general formulae for alkane and alkane are

Alkane: C_nH_{2n+2} for n = 20 $C_{20}H_{42}$

Alkene: C_nH_{2n} for n = 20 $C_{20}H_{40}$

Thus, the molecular formulae of an alkane and alkene with twenty carbon atoms are $C_{20}H_{42}$ and $C_{20}H_{40}$ respectively.

Example 4

A neutral organic compound A of the molecular formula C_2H_6O, on oxidation with potassium dichromate and sulphuric acid, gives an acidic compound (B). The compound (A) reacts with (B) on warming in the presence of conc. H_2SO_4 to give a sweet-smelling substance (C). Identify (A),(B) and (C).

Solution

The given information may be written as follows

$$(A) \xrightarrow{K_2Cr_2O_7+H_2SO_4} (B) \xrightarrow[\text{warm, conc. } H_2SO_4]{+(A)} (C)$$

(C_2H_6O) (acidic) (sweet-smelling)
neutral

(B) is an acidic compound which with (A) gives a sweet-smelling compound (C). Therefore, (C) should be an ester and (A) should be an alcohol.

From the molecular formula of (A), and knowing that it is in alcohol, it should be

	(A) is	C_2H_5OH	(ethanol)
Then	(B) is	CH_3COOH	(ethanoic acid)
and	(C) is	$CH_3COOC_2H_5$	(ethyl ethanoate)

Example 5

People use a variety of methods to wash clothes. Usually, after adding the soap, they 'beat' the clothes on a stone, or beat it with a paddle, scrub with a brush or the mixture is agitated in a washing machine. Why is agitation necessary to get clean clothes?

Solution

Agitation helps in the removal of the dirt particles from the surface of the fabric.

Example 6

Which of the following reactions represent hydration of ethene?

(i) $CH_2 = CH_2 + Br_2(aq) \rightarrow BrCH_2 - CH_2Br$

(ii) $CH_2 = CH_2 \xrightarrow{O_3/H_2O} 2HCHO$

(iii) $CH_2 = CH_2 + H_2O \xrightarrow{H_2SO_4} CH_3 - CH_2OH$

Solution

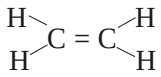
Addition of a molecule of water across a double bond in a molecule is called hydration. So, the reaction (iii) represents hydration of ethene.

Example 7

Give structural formulas of the simplest (i) alkene and (ii) alkyne

Solution

(i) Simplest alkene



ethene
(ethylene)

(ii) Simplest alkyne $H - C \equiv C - H$
ethene
(acetylene)

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EXERCISE-I

1. Why do atoms take part in the bond formation?
2. Are covalent compounds good conductors of electricity?
3. Define a functional group.What is the name of the family in which COOH group is the functional group?
4. In the structural formula CH_3CH_2Cl; predict the nature of 'Cl' whether as prefix or suffix.
5. Which secondary suffixes identify the families of
   (i) Alcohols (ii) Ketones (iii) Esters?
6. What is the nature of combustion reactions?
7. What are contents of rectified spirit?
8. Which of the following compounds will turn blue litmus red?
   CH_3CHO, CH_3CH_2OH, CH_3COOH.
9. Name two fatty acids that are present in soaps.
10. Name the alcohol which constitutes glycerides.
11. Which polar group is present in synthetic detergents?
12. Name the by-product of saponification reaction.
13. What is the molecular formula of alcohol derived from pentane?
14. High temperature is not suitable for the alcoholic fermentation. Assign reason.
15. Name one electrovalent and one covalent compound containing chlorine.
16. An element X has four valence electrons while an element Y has six valence electrons. What type of bond is expected to be formed between the two? Write the structures of the compound.
17. How are the following functional groups named according to IUPAC system?
   (i) OH (ii) CHO (iii) COOH (iv) CO
18. Out of the following which are regarded as prefixes while writing the IUPAC name of the compound?
   (i) OH (ii) NO_2 (iii) Cl (iv) CHO.
19. Write the products of the following reactions:
   (i) Reaction of sodium metal with ethanol.
20. What happen when ethyl acetate is reacted with NaOH ? Give the name of the reaction.
21. Reaction of ethanoic acid with sodium hydrogen carbonate is used as a test for the carboxyl group. Discuss.
22. Give a brief account of esterification reaction. What is typical about esters?
23. What is saponification reaction?
24. Detergents have many advantages over soap but are still quite harmful. Explain.
25. Write the electron dot sturcture of (i) NH_3 (ii) CCl_4

(i) C_4H_{10} (ii) C_5H_{12} (iii) C_6H_{14} (iv) C_3H_4 (v) C_2H_4

27. Starting from the hydrocarbon butane, write the structures and IUPAC names of:
(i) chloroderivative (ii) alcohol (iii) aldehyde (iv) carboxylic acid
(v) amine (vi) ketone.

28. Discuss in brief the fermentation leading to commerical prepartation of ethyl alcohol.

29. What is vinegar? How is it prepared?

30. Enlist the main points of distinction between soaps and detergents.

31. Write the structures of (i) Ethanoic acid (ii) Butanone (iii) Hexanal

32. An organic compound 'A' of molecular formula C_2H_6O on oxidation with dilute alkaline $KMnO_4$ solution gives an acid 'B' with the same number of carbon atoms. Compound 'A' is often used for sterilization of skin by doctors. Name the compounds. Write the chemical equation involved in the formation of 'B' from 'A'.

33. The molecular formula C_3H_6O can represent an aldehyde as well as ketone. Write their structrues and name them. How are they related to each other?

34. Describe the method for the preparation of soap. Name the by - product obtained during soap making.

35. Explain why diamond is hard and graphite is soft?

36. What is essentials for catenation? Why does carbon show catenation?

37. Find saturated and unsaturated hydrocarbon in the following.
(A) C_4H_6 (B) C_4H_{10} (C) C_6H_{10} (D) $C_{10}H_{22}$ (E) C_6H_6 (F) C_6H_{12}
(G) C_3H_4

38. Give the formula of the following functional groups
(A) Ester (B) arbonyl (C) Aldehydic (D) Amine

EXERCISE-II

1. Ethane, with the molecular formula C_2H_6 has
(A) 6 covalent bonds (B) 7 covalent bonds (C) 8 covalent bonds (D) 9 covalent bonds

2. Butanone is a four - carbon compound with the functional group.
(A) carboxylic acid (B) aldehyde (C) ketone (D) alcohol

3. While cooking, if the bottom of the vessel is getting blackened on the outside, it means that
(A) the food is not cooked completely (B) the fuel is not burning completely
(C) the fuel is wet (D) the fuel is burning completely

4. What are the two properties of carbon which lead to the huge number of carbon compounds we see around us?

5. What will be the formula and electron dot structure of cyclopentane?

6. What would be the electron dot structure of carbon dioxide which was the formula CO_2?

7. What would be the electron dot structure of a molecule of sulphur which is made up of eight atoms of sulphur? (Hint – The eight atoms of sulphur are joined together in the form of a ring).

8. Why is the conversion of ethonal to ethanoic acid an oxidation reaction?

9. A mixture of oxygen and ethyne is burnt for welding. Can you tell why a mixture of ethyne and air is not used?

10. What are oxidising agents?

11. Explain the nature of the covalent bond using the bond formation in CH_3Cl.

12. Why are carbon and its compounds used as fuels for most applications? (Refer to sample problem).

13. What change will you observe if you test soap with litmus paper (red and blue)?

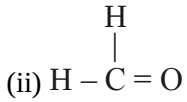
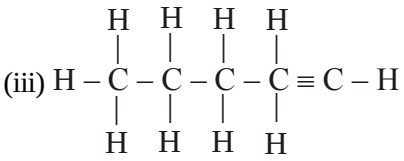
14. What is hydrogenation? What is its industrial application?

15. Give a test that can be used to differentiate chemically between butter and cooking oil.

16. Would you be able to check if water is hard by using a detergent?

17. How many structural isomers can you draw for pentane?

18. How would you name the following compounds?

(i) $CH_3 - CH_2 - Br$ (ii)  (iii) 

19. How would you distinguish experimentally between an alcohol and a carboxylic acid?

20. What is an homologous series? Explain with an example.

21. How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties?

22. Which of the following hydrocarbons undergo addition reactions :
C_2H_6, C_3H_8, C_3H_6, C_2H_2 and CH_4.

23. Explain the mechanism of the cleaning action of soaps.

24. People use a variety of methods to wash clothes. Usually after adding the soap, they 'beat' the clothes on a stone, or beat it with a paddle, scrub with a brush or the mixture is agitated in a washing machine. Why is agitation necessary to get clean clothes? (Sample problem 5)

25. Draw the structure for the following compounds. (Sample problem 8)
(i) Ethanoic acid (ii) Bromopentane (iii) Butanone (iv) Hexanal
Are structural isomers possible for bromo pentane?

26. Draw the electron dot structure for
(a) ethanoic acid (b) H_2S (c) propanone (d) F_2 (e) Cl_2

27. Why does micelle formation take palce when soap is added to water? Will a micelle be formed in other solvents such as ethanol also?

28. Identify the functional groups present in the follwoing compounds and name them according to IUPAC system : (a) CH_3OH, (b) C_3H_7COOH.

29. Write the molecular formula of the third and the fifth members of the homologous series of carbon compounds represented by C_nH_{2n-2}.

30. Two alkanes A and B have 4 and 6 carbon atoms in their molecules respectively in which physical state will they occur at room temperature?

31. Which of the following belong to the same homologous series: C_3H_4, C_3H_6, C_4H_8, C_4H_6?

32. Out of methane, ethane and propane which one has the highest boiling point?

33. Two alkanes 'A' and 'B' have 3 and 5 carbon atoms in their molecules respectively. In which physical state will they occur at room temperature?

34. Which of the following organic compounds is unsaturated? CH_4 or C_2H_4.

35. Write the names of the isomers represented by the molecular formula C_5H_{12}, C_6H_{12}, C_7H_{16}.

36. Why is a mixture of water an alcohol used instead of water in radiators of vehicles in cold countries? Give two reasons.

37. State any five uses of alcohol family and two main uses of ethanol.

38. What is denatured alcohol? What are the harmful effects of drinking this alcohol?

39. How would you test for an alcohol?

40. What happens when ethyl alcohol and acetic acid react together in the presence of conc. H_2SO_4? Write the chemical equation of the reaction.

41. Write the chemical equation of the reaction which takes place during the burning of ethanol in air.

42. Write two tests to demonstrate that acetic acid (CH_3COOH) is acidic in nature.

43. The IUPAC name of CH_3COOH is_____.

44. Write the molecular formula of ethanoic acid.

45. Fermentation of sugar solution with enzymes is being carried out in a vessel at 20–30ºC in the presence of air. Which organic compound will be produced in this process?

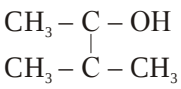
46. Complete the following statement:
Vinegar is prepared by the bacterial oxidation of _____.

47. Why have detergents replaced soaps as a washing agent?

48. Which of the following molecules contain covalent bond only ?
C_2H_5OH, $CaCl_2$. $NaNO_3$, CH_3COOH, SO_2, $NaHCO_3$

49. Which of the following compound contain both covalent and ionic Bond.
NaCl, NaCN, $CaCO_3$, NH_4Cl, $C_6H_{12}O_6$

50. Give IUPAC name of the following

(A)  (B)  (C) 

51. Give structures of following compounds

(A) 3,3,6-trimethyl decane (B) 2,2-Dimethyl propane

(C) Butanone-2 (D) 2-methyl-1-propanol

EXERCISE-III

SECTION-A

- **Fill in the blanks**

1. The number of C–H bonds in ethane molecule is _____.
2. Alcohols can be produced by the hydration of _____.
3. _____ does not contain covalent bond.
4. Vinegar is prepared by the oxidation of _____.
5. The first member of alkene series is _____.

SECTION-B

- **Multiple choice question with one correct answers**

1. In order to form branching, an organic compound must have a minimum of:

(A) four carbon atoms (B) three carbon atoms

(C) five carbon atoms (D) any number of carbon atoms

2. The number of Sigma bond and Pi bond present in Acetylene (CH≡CH) is :

(A) 1,2 (B) 3,2 (C) 2,3 (D) 1,4

3. Alcohols can be produced by the hydration of:

(A) alkenes (B) alkynes (C) alkanes (D) acids

4. IUPAC name of first member of homologous series of ketones is :

(A) ethanone (B) methanone (C) propanone (D) butanone.

5. Enzyme which converts starch into glucose is :

(A) Zymase (B) Maltase (C) Diastase (D) Invertase

6. Rectified spirit is :

(A) 50 percent ethanol (B) 80 percent ethanol (C) 95 percent ethanol (D) 100 percent ethanol.

7. Soaps are formed by the saponification of:

(A) alcohols (B) simple ester (C) carboxylic acids (D) glycerides

8. An example of soap is:

(A) $C_{15}H_{31}COONa$ (B) CH_3COONa (C) C_6H_5COONa (D) $C_{17}H_{35}OSO_3Na$

9. A covalent bond is formed when:
(A) combining atoms share the electron pairs (B) combining atoms are attracted by each other
(C) the ions of the combining atoms are attracted by electrostatic force of attraction.
(D) one atom donates a pair of electrons to another atom.

10. Which of the following compound is covalent ?
(A) H_2 (B) KCl (C) BaC_2 (D) Na_2S

11. Aldehydes show with each other
(A) chain isomers (B) position isomers (C) Functional isomers (D) Both (A) & (C)

SECTION-C

- **Assertion & Reason**

Instructions: In the following questions as Assertion (A) is given followed by a Reason (R). Mark your responses from the following options.
(A) Both Assertion and Reason are true and Reason is the correct explanation of 'Assertion'
(B) Both Assertion and Reason are true and Reason is not the correct explanation of 'Assertion'
(C) Assertion is true but Reason is false
(D) Assertion is false but Reason is true

1. **Assertion:** Carbon form long chain compound.
Reason: Its covalency is four.

2. **Assertion:** Unsaturated hydrocarbon give addition reaction.
Reason: They have pi-bond.

3. **Assertion:** Methane, ethane and propane are said to form a homalogous series.
Reason: They all are hydrocarbons.

SECTION-D

- **Match the following (one to one)**

Column-I and **column-II** contains **four** entries each. Entries of column-I are to be matched with some entries of column-II. Only One entries of column-I may have the matching with the same entries of column-II and one entry of column-II Only one matching with entries of column-I

1.

Column I	**Column II**
(A) Alkane	(P) $C_{12}H_{24}$
(B) Alkene	(Q) C_8H_{14}
(C) Alkyne	(R) $C_8H_{17}OH$
(D) Alcohol	(S) $C_{16}H_{34}$

EXERCISE-IV

SECTION-A

- **Multiple choice question with one correct answers**

1. The IUPAC name of: $CH_3 - C(CH_3)(OH)CH_2 - CH(CH_3)CH_3$ is –

(A) 2,4-dimethyl pentane-2-ol (B) 2,4-dimethyl pentane-4-ol
(C) 2,2-dimethyl butane (D) butanol-2-one

2. The maximum number of carbon atoms arranged linearly in the molecule:
$CH_3—C \equiv C–CH= CH_2$ is
(A) 5 (B) 4 (C) 3 (D) 2

3. The reaction of $C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$ suggests that ethanol is :
(A) Acidic in nature (B) Basic (C) Neutral (D) Amphoteric

4. Glacial acetic acid is a –
(A) frozen acetic acid (B) 5-8% of solution of acetic acid in water
(C) mixture of acetic acid and alcohol (D) None of these

5. Which is not a carbon compound –
(A) wood (B) cooking gas (C) paper (D) cement

6. Which is not a property of graphite –
(A) It melts at 800ºC (B) It is a smooth crystallined form of carbon
(C) It is a good conductor of electricity (D) It forms a black sign on paper

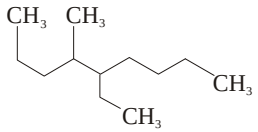
7. Which of the following is the purest form of carbon –
(A) Charcoal (B) Coal (C) Diamond (D) Graphite

8. Alkynes have in their molecule –
(A) Four hydrogen atoms more than in a molecule of corresponding alkane
(B) Two hydrogen atoms less than in a molecule of corresponding alkene
(C) Two hydrogen atoms less than in a molecule of corresponding alkane
(D) Two hydrogen atoms less than in a molecule of corresponding alkene

9. The fruity smell is of a/an –
(A) aldehyde (B) ketone (C) alcohol (D) ester

10. Which of these contains the carbonyl group?
(A) Ketones (B) Aldehydes (C) Esters (D) All of these

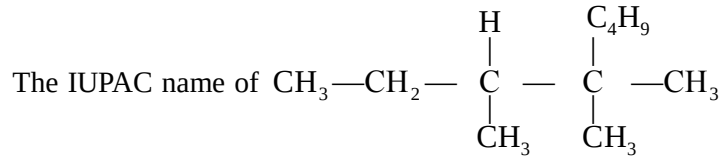
11. Name of the given compound –



(A) 2,3-diethyl heptane (B) 5-Ethyl-4-methyl Nonane
(C) 4-ethyl-3-methyl octane (D) 3-methyl-4-ethyl octane

12. What is the IUPAC Name of t-butyl alcohol.
(A) Butanol-2 (B) 2-Methyl-Propane-2-ol (C) Butanol-1 (D) Propanol-2

13. The IUPAC name of $CH_3COCH(CH_3)_2$ is –
(A) isopropyl methyl ketone (B) 2-methyl-3-butanone
(C) 4-methylisopropyl ketone (D) 3-methyl-2-butanone

14. The IUPAC name of 

(A) 3,4,4-Trimethyl octane (B) 3,4,4-Trimethyl heptane
(C) 2-Ethyl,3-dimethyl heptane (D) 2-Butyl, 2 methyl, 3-ethyl butane

15. The IUPAC name for  is –

(A) 1,1-Dimethylbutane-1, 3-diol (B) 2-Methyl-2,4-pentanediol
(C) 4-Methyl-2,4-pentanediol (D) 1,3,3-Trimethyl-1,3-propanediol

16. General formula of alkenes and alkyl radicals are respectively:
(A) C_nH_{2n} and C_nH_{2n+1} (B) C_nH_{2n} and C_nH_{2n+2} (C) C_nH_{2n-1} and C_nH_{2n} (D) C_nH_{2n+1} and C_nH_{2n+2}

17. Which of the following has highest percentage of hydrogen
(A) CH_4 (B) C_2H_4 (C) C_6H_6 (D) C_2H_2

SECTION-B

- **Multiple choice question with one or more than one correct answers**

1. Which of the following statements are true about ethane?
(A) it can be chlorinated with chlorine (B) it can be catalytically hydrogenated
(C) when oxidised produces CO_2 and H_2O (D) it is a homologous of isobutane

2. Which regent is used to test unsaturation of organic compound :
(A) Cl_2/CCl_4 (B) Br_2/CCl_4 (C) 1% Alkalyne $KMnO_4$ (D) H_2

3. Catalyst required for hydrogenation :
(A) Pt (B) Ni (C) Pd (D) C

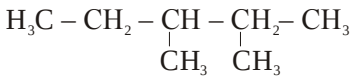
4. Which of the following does contain a multiple bond ?
(A) Ethane (B) Ethene (C) Ethyne (D) Benzene

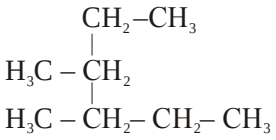
5. Which of the following are correctly matched?
(A) Vinegar $\rightarrow$ Carboxylic acid (B) $C_2H_6 \rightarrow$ alkane
(C) Ethanol $\rightarrow$ alcohol (D) Methanol $\rightarrow$ ketone

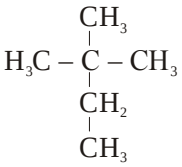
6. Which is the property of diamond?
(A) it is the hardest substance (B) it has high refractive index
(C) like metals, it can produce electricity (D) it forms a black sign on paper

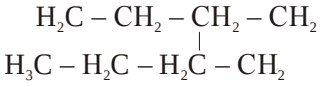
7. Which of the following can be used for raw material for the manufactured of soap
(A) cotton seed oil (B) Linseed oil (C) Diesel oil (D) Soyabean oil

8. Structure for the compound 3,4-Dimethyl hexane is

(A) 

(B) 

(C) 

(D) 

9. Which statements are correct?

(A) Isomers having same molecular formula (B) Isomers having same molar mass

(C) Isomers having same physical properties (D) Isomers having same common name

10. The IUPAC names possible by the chemical formula C_5H_{12}.

(A) n-pentane (B) 2,3-dimethyl propane

(C) 2,2-dimethyl propane (D) 3-methyl butane

SECTION-C

- **Comprehension**

The molecular formula of ethene is C_2H_4. An addition of a water molecule will make ethene into ethanol (C_2H_5OH). Addition of water to a molecule and its assimilation in to the molecular formula is known as hydration. Ethanol is directly produced in this reaction. The double bonded ethene molecule breaks its pi-bond to accommodate one H and one OH group.

1. Ethanol on dehydration gives

(A) Methanol (B) ethene (C) ethane (D) methanol

2. Butene on hydration gives

(A) Butyl alcohol (B) Butanol (C) Butane-1-ol (D) All are correct

3. Ethene undergoes hydration because

(A) due to presence of pi-bond (B) due to presence of sigma bond

(C) due to presence of ionic bond (D) All of the above

SECTION-D

- **Match the following (one to many)**

Column-I and **column-II** contains **four** entries each. Entries of column-I are to be matched with some entries of column-II. One or more than one entries of column-I may have the matching with the same entries of column-II and one entry of column-II may have one or more than one matching with entries of column-I

1.

Column I	**Column II**
(A) C_5H_{10}	(P) Alkadiene
(B) C_4H_6	(Q) Alkene
(C) C_4H_{10}	(R) Alkynes
(D) C_2H_4	(S) Cyclo alkane

*****

Answers

EXERCISE-III

SECTION-A

1. 6 2. alkenes 3. $MgCl_2$ 4. ethanol
5. ethene

SECTION-B

1.	(A)	2.	(B)	3.	(A)	4.	(C)	5.	(A)	6.	(C)
7.	(C)	8.	(C)	9.	(A)	10.	(A)	11.	(D)	12.	(A)
13.	(A)										

SECTION-C

1.	(B)	2.	(A)	3.	(B)

SECTION-D

1. (A–S), (B–P), (C–Q), (D–R)

EXERCISE-IV

SECTION-A

1.	(A)	2.	(D)	3.	(A)	4.	(A)	5.	(D)	6.	(A)
7.	(C)	8.	(B)	9.	(D)	10.	(D)	11.	(C)	12.	(B)
13.	(D)	14.	(A)	15.	(B)	16.	(A)	17.	(A)		

SECTION-B

1.	(ACD)	2.	(BC)	3.	(ABC)	4.	(BCD)	5.	(ABC)	6.	(AB)
7.	(ABD)	8.	(BD)	9.	(AB)	10.	(AC)				

SECTION-C

1.	(B)	2.	(D)	3.	(A)

SECTION-D

1. (A–QS), (B–PR), (C–QS), (D–Q)