NOMENCLATURE OF ORGANIC COMPOUNDS

❑ HISTORY :

In 1675, Nicholas Lemery had devided chemical substances into 3 parts.

(i) **Mineral substance :** which are obtained from minerals. eg. gold, silver, iron etc.

(ii) **Vegetable substance :** which are obtained from vegetables. eg. sugar, citric acid etc.

(iii) **Animal substance :** which are obtained from animals. eg. albumin, gilatin etc.

After some time when many of the chemical substance were discovered, it was found that some of them can be obtained from both vegetables and animals. So this classification was failed. So chemical substance were then divided into two parts :

(i) **Organic compounds :** which are obtained from living organism.

(ii) **Inorganic compounds :** compounds which are obtained from any other sources except living organisms.

VFT(Vital Force Theory) : By Berzelius in 1815. Upto 1815, any organic compound could not be synthesized in lab. So Berzelius suggested that there is a mysterious force in living organisms which was named as Vital Force and said that organic compounds cannot be synthesized in lab. This theory was called as VFT.

But in 1828 a German scientist Wholar synthesized an organic compound in lab. Which was 'urea'. So VFT was failed. Urea was synthesized in lab by heating of Ammonium cyanate (NH_4CNO).

$$NH_4\ CNO \xrightarrow[\text{Rearrangement}]{\Delta} NH_2-\underset{\underset{O}{\|}}{C}-NH_2$$

Ammonium cyanate Urea

Organic Compounds : Hydrocarbons and their derivatives are called as organic compounds.

Ex : Why are organic compounds found in larger no.? or Why are they studied as a separate subject ?

Sol. **(i) Catenation Property :** Carbon atom has a property by which it can join with other C–atoms and form a long chain or a ring of different size and shapes.If covalency of atom is more, then catenation property is also more.

(ii) Organic compound shows **isomerism**.

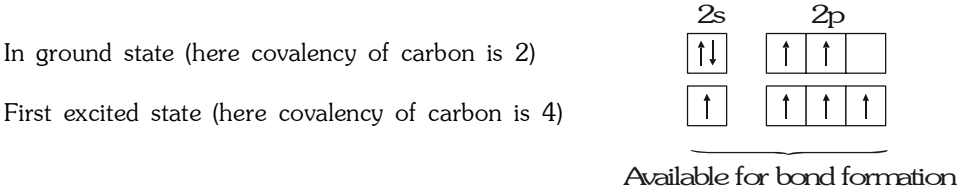
(iii) Exhibits **Homologous Series.**

(iv) Same **Empirical Formulae.**

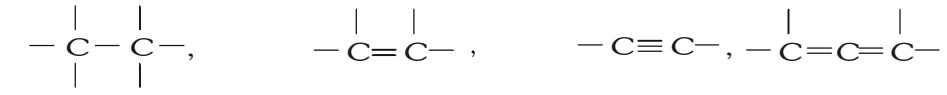
(v) Polymerisation.

❑ Characteristics of C-Atoms

(a) **Tetra valency :** Atomic number of carbon atom is 6 and it have four valency electrons so C-Atom is tetravalent. It is explained by promotion rule

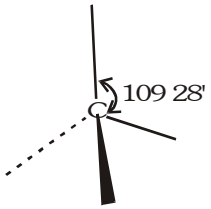


(b) **Tendency to form multiple bonds :** Carbon atom forms following type of bonds, such as



(c) **Tetrahedral shape :** The four covalent bond are directed towards the four corners of a regular tetrahedron

Bond angle $109^0 28'$ or 109.5'



(d) **Catenation :** Self linking property of C-atom is known as catenation. It is responsible for the variety and large number of organic compounds. It may also give rise to open chain and closed chain nature of compounds. Bond energy for catenation of C is maximum.

Bond energy in Kcal :	C—C	Si—Si	N—N	P—P
	85	54	39	50

(e) **Hybridisation :** The orbitals of different shape but almost of equal energies blend up to give the same number of new orbitals of another shape and of identical energies.

Structure	σ & π bonds	Hybridisation	Bond angle	Shape
$-\overset{\vert}{\underset{\vert}{C}}-$	4,0	sp^3	109 28'	Tetrahedral
$-\overset{\vert}{C}=$	3,1	sp^2	120	Planar (Trigonal)
$-C\equiv$	2,2	sp	180	Linear
$=C=$	2,2	sp	180	Linear

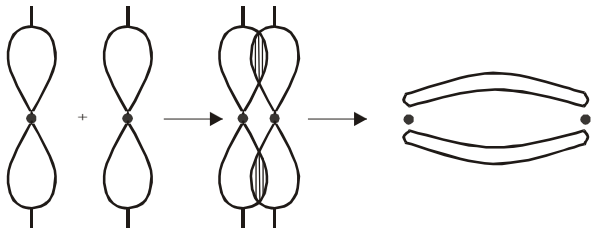
σ - (sigma) bonds : The molecular orbital formed by the overlapping of two-s atomic orbtials or one s and one p atomic orbitals or co-axial overlapping of p-orbitals is called a σ bond.

Note : (i) Overlapping of hybrid orbitals also give σ bonds. σ bonds are stronger, as they are resulted from the effective axial overlapping.

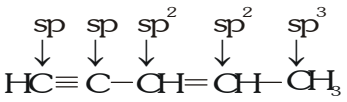
(ii) More the directional character (p) in covalent bond more is the strength of the bond.

$$sp^3 - sp^3 > sp^3 - sp^2 > sp^2 - sp^2 > sp - sp$$

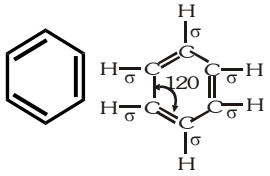
π(Pi) bonds : π bond is formed by the lateral overlapping of two p-atomic orbitals. It is weaker than σ bond, as there is only partial overlapping.



Ex. 1



Ex. 2



Flat hexagonal structure due to sp^2 hybridised C-atom in benzene

◆ **Note :**

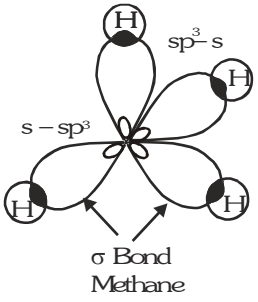
(A) π electrons are mobile hence π bond is more reactive. π bond is formed by the collateral overlapping of sp^2 orbitals.

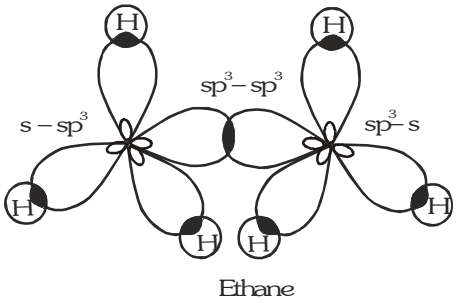
(B) sp^2 hybridised orbitals overlap with each other and with s orbitals of six H-atoms forming C–C and C-H σ bonds.

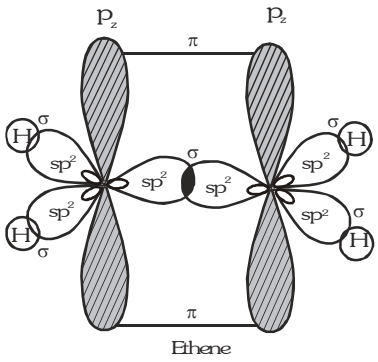
(C) Six 2p unhybridised orbitals of 6 C-atom in benzene form 3 π bonds by lateral overlapping with each other. These six π electrons are free to move over all the six carbon atoms. Since delocalised electrons have lower energy than localised.

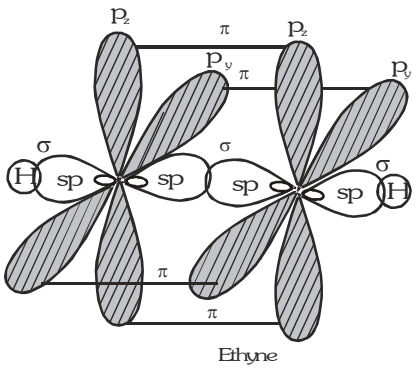
(D) The relative sizes of hybrid orbital follows the order $sp^3 > sp^2 > sp$

(E) The electronegativity of hybrid orbitals follows the order $sp > sp^2 > sp^3$



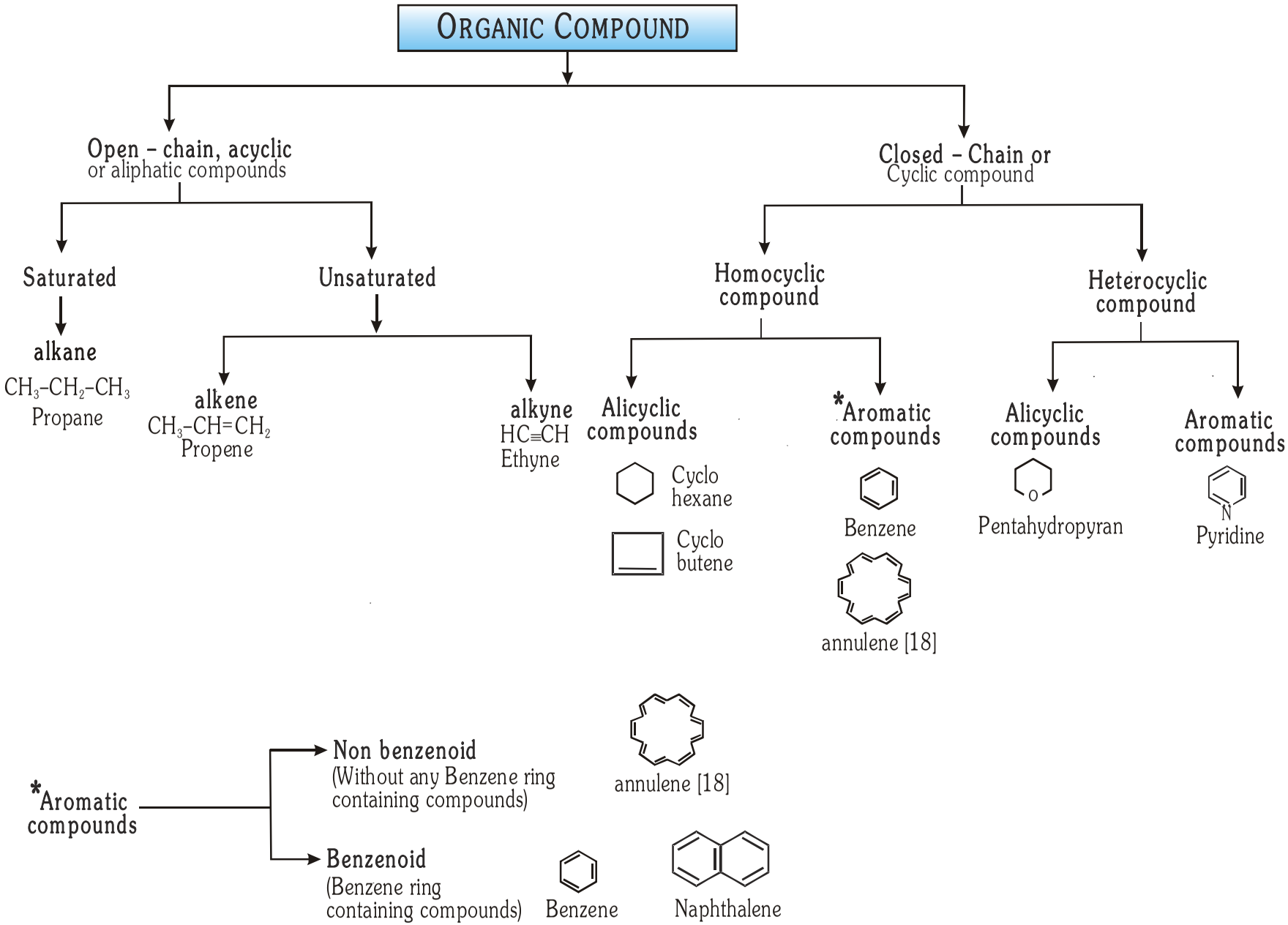






(Orbital diagram of methane, ethane, ethene and ethyne)

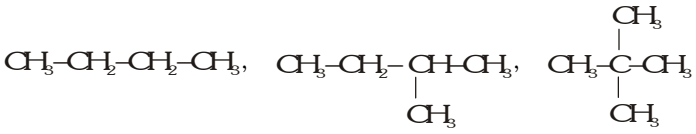
CLASSIFICATION OF ORGANIC COMPOUNDS



◆ **Aliphatic or Open chain compounds :**

Those compounds in which first & last carbon atoms are not connected with each other. Branched or unbranched chains are possible in these compounds.

For example :



(Unbranched) (Branched)

There are two varieties in these compounds -

◆ **Saturated Hydrocarbons :**

(a) In such type, adjacent carbon are attached with single bonds.

Example - $CH_3–CH_2–CH_3$

(b) General formula of these compounds are C_nH_{2n+2}

(c) These are also called as paraffins (Parum + Affins i.e. little reactivity) because these are less reactive due to absence of π-bonds.

◆ **Unsaturated Hydrocarbons :**

(a) There will be a double bond or a triple bond between any two carbon atoms,

$CH_2 = CH - CH_3$ Propene

$CH \equiv C - CH_3$ Propyne

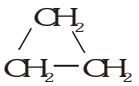
(b) General formula is C_nH_{2n} or $C_n H_{2n-2}$

(c) These are also called as olefins because they reacts with halogens to form oily substances olefins (Oleum + fines i.e. Oil forming).

(d) Due to presence of π bonds these are more reactive.

◆ **Closed chain compounds :**

In these compounds first & last carbon are attached with each other.

Example.  cyclopropane.

◆ **Homocyclic compounds :**

These are the compounds in which the complete ring is formed by carbon atoms only. These are also of two types

(A) Alicyclic compounds : These are the compounds having the properties like aliphatic compounds. These may be saturated or unsaturated like aliphatic compounds.

cyclopropane cyclopropene cyclobutene

(B) Aromatic compounds : Conditions for a compound to be aromatic -

(i) Compound should be cyclic.

(ii) Compound should be planar. (All carbon in ring should be sp^2 hybridised)

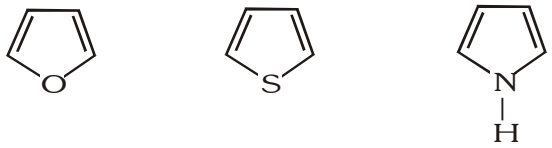
(iii) It follow Huckel's Rule :- [4n + 2] π electrons. (Odd number of π electron pairs)

n = 0	2π electrons	or 1 pair
n = 1	6π electrons	or 3 pairs
n = 2	10π electrons	or 5 pairs
n = 3	14π electrons	or 7 pairs

(iv) There should be cyclic resonance in ring.

◆ **Heterocyclic Compounds :**

These are cyclic compounds having ring and rings builts up of more than one kind of atoms.



Furan Thiophene Pyrrole

◆ **Normal Groups :**

(a) It is represented by 'n' :

(b) Straight chain of carbon atoms is known as normal group.

(c) Free bond will come either on Ist carbon atom or on last carbon atom.

n – propyl $CH_3-CH_2-CH_2-$

n – butyl $CH_3-CH_2-CH_2-CH_2-$

◆ **Iso group :**

(a) It is represented by following structure

$$CH_3-\underset{\displaystyle CH_3}{\overset{|}{CH}}-$$

(b) When methyl groups are attached to the second last carbon atom, group is named as iso.

$CH_3-\underset{\displaystyle CH_3}{\overset{|}{CH}}-$ $CH_3-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_2-$ $CH_3-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_2-CH_2-$

Iso propyl Iso butyl Isopentyl

◆ **Neo group :**

(a) When two methyl group are attached to second last carbon atom group is named neo group.

(b) It is represent by following structure -

for Ex. $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2-$ Neo pentyl

◆ **Secondary group :**

(a) When two alkyl groups attached to the same carbon atom, group is named as secondary.

Ex.

$CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{|}{CH}}-$ $CH_3-CH_2-CH_2-\underset{\displaystyle CH_3}{\overset{|}{CH}}-$

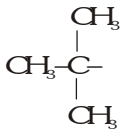
Secondary butyl Active Secondary pentyl

(b) It is represented by following structure.

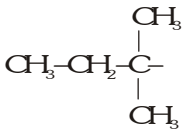
$$CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_3$$

◆ **Tertiary group :**

(a) When three alkyl groups (similar or dissimilar) are attached to the same carbon atom, group is name as tertiary.

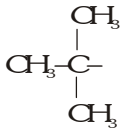


Tertiary butyl



Tertiary pentyl

(b) It is represented by following structure -

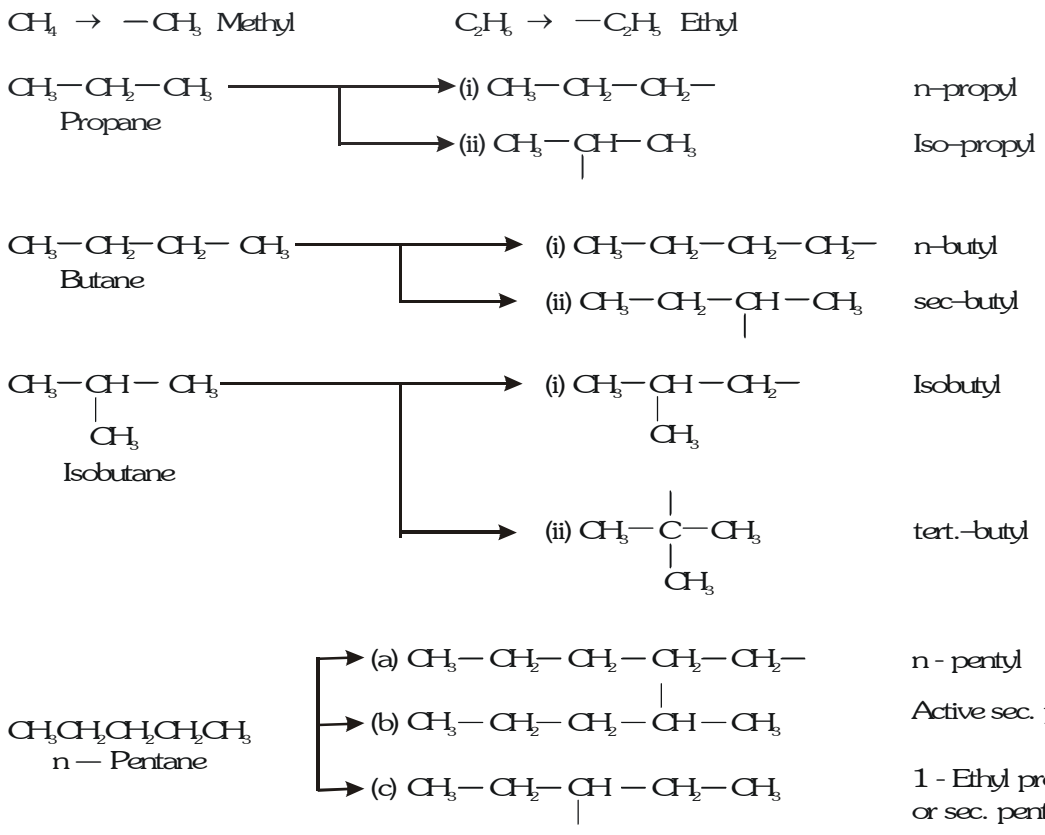


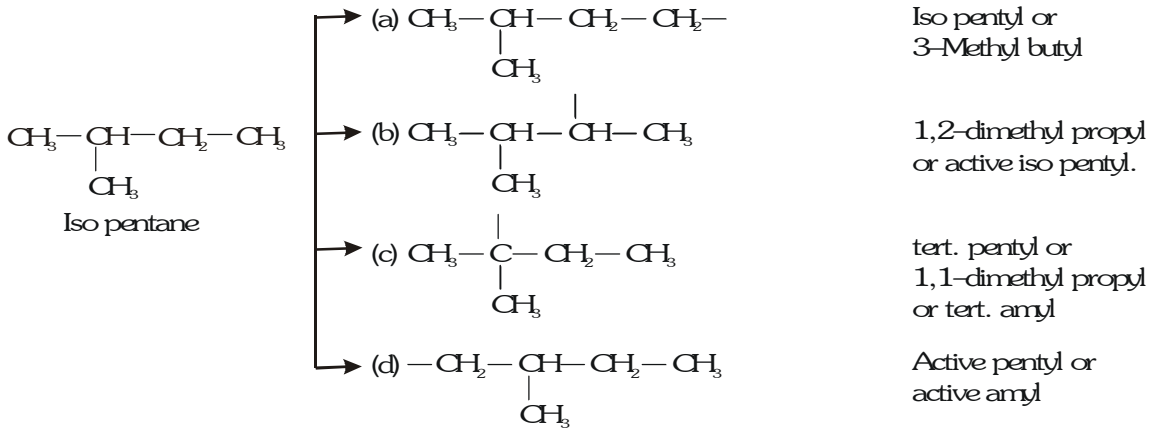
❑ **Groups :**

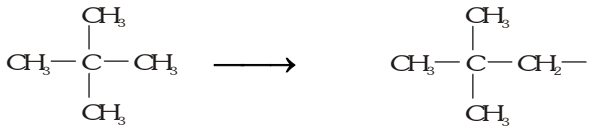
When a hydrogen is removed from saturated hydrocarbon then alkyl group is formed. It is represented by R & its general formula is C_nH_{2n+1}. A bond is vacant on alkyl group, on which any functional group may come.

◆ **Alkyl groups :**

Alkane $\xrightarrow{-H}$ Alkyl (monovalent radical) $\xrightarrow{-H}$ Bivalent radical $\xrightarrow{-H}$ Trivalent radical







neo-pentane neo-pentyl

Note : Pentyl is also called amyl group.

(a) Alkene $\xrightarrow{-H}$ Alkenyl

Ex. $CH_2=CH_2 \longrightarrow CH_2=CH-$ Ethenyl (vinyl)

$CH_3-CH=CH_2 \longrightarrow$ (1) $CH_3-CH=CH-$ 1-propenyl

(2) $CH_3-\overset{|}{C}=CH_2$ Iso propenyl or 1-methyl ethenyl

(3) $-CH_2-CH=CH_2$ 2-Propenyl (Allyl)

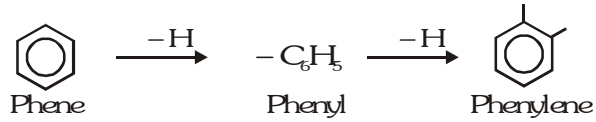
(b) Alkyne $\xrightarrow{-H}$ Alkynyl

Ex. $CH\equiv CH \longrightarrow CH\equiv C-$ Ethynyl

$CH_3-C\equiv CH \longrightarrow CH_3-C\equiv C-$ 1 – Propynyl

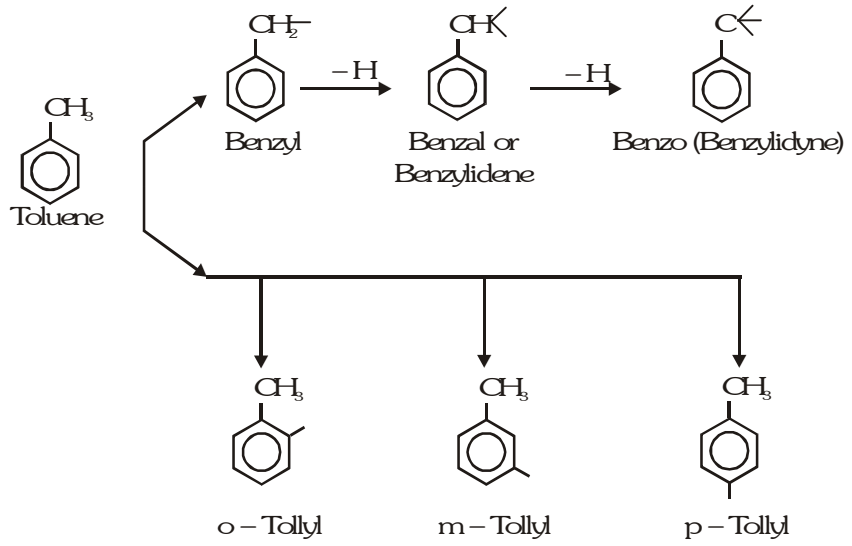
$\longrightarrow -CH_2-C\equiv CH$ 2 - Propynyl (Propargyl)

◆ **Aryl Radical -**

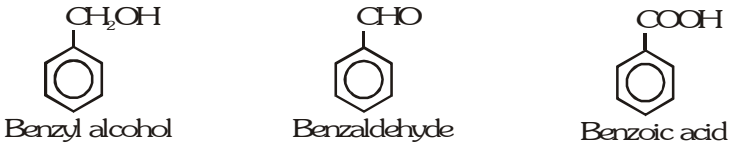
(i) 

Phene Phenyl Phenylene

(ii)



Ex.



- **NOMENCLATURE :**

Mainly three systems are adopted for naming an organic compound -

(i) Common names or Trivial system

(ii) Derived system

(ii) IUPAC system or Jeneva system

Trivial System : Initially organic compounds are named on the basis of source from which they were obtained for

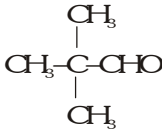
S. No.	Organic Compound	Trivial Name	Source
1	CH_3OH	Wood spirit or Methyl spirit	Obtained by destructive distillation of wood
2	NH_2CONH_2	Urea	Obtained from urine
3	CH_4	Marsh gas (fire damp)	It was produced in marshy places
4	CH_3COOH	Vinegar	Obtained from Acetum –i.e. Vinegar
5	$\begin{matrix}COOH\\ \vert \\ COOH\end{matrix}$	Oxalic acid	Obtained from oxalis plant
6	$HCOOH$	Formic acid	Obtained from formicus [Red ant]
7	$CH_3-\underset{\underset{OH}{\vert}}{CH}-COOH$	Lactic acid	Obtained from sour milk
8	$\begin{matrix}CH_2-COOH\\ \vert \\ CH(OH)COOH\end{matrix}$	Malic acid	Obtaied from apples
9	$CH_3CH_2CH_2COOH$	Butyric acid	Obtained from butter
10	$CH_3(CH_2)_4COOH$	Caproic acid	Obtained from goats

Some typical compounds in which common & trivial names are also differ.

S. No.	Compound	Trivial Name	Common name
1	CH_4	Marsh gas	Methane
2	CH_3OH	Wood spirit	Methyl alcohol
3	CH_3COOH	Vinegar	Acetic acid
4	$CH_3-\underset{\underset{O}{\|}}{C}-CH_3$	Acetone	Dimethyl ketone
5	$CH_2=CH-\overset{\overset{O}{\|}}{C}-H$	Acrolein	Acryl Aldehyde
6	$CH_3-\underset{\underset{CH_3}{\|}}{\overset{H_3C}{\|}}{C}-\overset{\overset{O}{\|}}{C}-H$	Pyvaldehyde	Tertiary valer aldehyde

◆ **Trivial Names :**

Ex : The trivial name of the following compounds is :



(A) Pyvaldehyde

(B) Trimethyl acetaldehyde

(D) α, α, α- trimethylacetaldehyde

(C) t-butyl formaldehyde

Sol. (A)

Ex : Acrolein is :

(A) An unsaturated aldehyde

(B) A saturated aldehyde

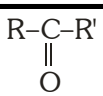
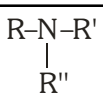
(C) A polymer

(C) An alkene

Sol. (A)

◆ **Comman Name :** R is termed as alkyl.

S. No.	Compound	Name
1	R – X	Alkyl halide
2	R – OH	Alkyl alcohol
3	R – SH	Alkyl thio alcohol
4	$R-NH_2$	Alkyl amine
5	R – O – R	Dialkyl ether
6	R – S – R	Dialkyl thioether
7	$R-\underset{\underset{O}{\|}}{C}-R$	Dialkyl keone

S. No.	Compound	Name
8	R–NH–R	Dialkyl amine
9		Trialkyl amine
10	R–O–R'	Alkyl alkyl' ether
11		Alkyl alkyl' ketone
12	R–S–R'	Alkyl alkyl' thio ether
13	R–NH–R'	Alkyl alkyl' amine
14		Alkyl alkyl' alkyl'' amine

Ex : The common name of the compounds $CH_2 = CH - CH_2 - NH_2$ is -

(A) Vinyl amine (B) Allyl amine (C) Divinyl amine (D) Diallyl amine

Sol. (B)

Ex : Ethyl methyl ether is :

(A) $CH_3 - CH_2 - O - CH_3$ (B) $CH_3 - O - CH_2 - CH_3$

(C) Both A & B (D) $CH_3 - CH_2 - O - CH_2 - CH_3$

Sol (C)

◆ **Position of double bond :**

In an unsaturated hydrocarbon if the position of double bond is on Ist or last carbon then it's prefix will be α (alpha) if it is on 2nd carbon it is termed as β (Beta) & then γ (gamma) & δ (delta) and so on.

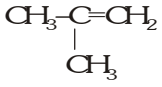
Example :

$H_2C=CH-CH_2-CH_3$ α-butylene

$H_3C-CH=CH-CH_3$ β-butylene

$H_3C-CH_2-CH=CH_2$ α-butylene

$H_2C=CH-CH_3$ or propylene [Both are same positions propylene, isobutylene]



Isobutylene

$CH_3-CH_2-CH=CH-CH_2-CH_3$ γ-hexylene

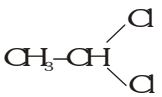
$CH_3-CH_2-CH_2-CH=CH-CH_2-CH_2-CH_3$ δ-octylene

◆ **Common - Naming of dihalides :**

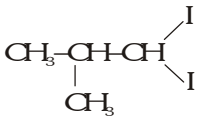
(a) When two same halogen atoms are attached to the same carbon such compounds are called **Gemdihalides.**

(b) Common names of such compounds are alkylidene halides.

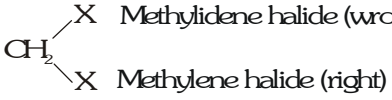
Example :



Ethylidene chloride

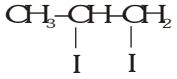


Isobutylidene Iodide

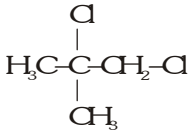
Exception : 

Methylidene halide (wrong)
Methylene halide (right)

(c) When two same halogen atoms are attached to adjacent carbon, these are called as vicinal dihalides. Common names of such compounds are alkylene halide.



Propylene Iodide



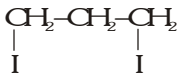
Isobutylene chloride

(d) When two same halogen atoms are attached at the two ends of a carbon chain its common naming will be polymethylene halide.

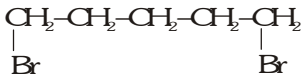
'poly' word indicates the number of $-CH_2-$ groups.

$-CH_2-$	2	3	4	5	6
Poly	di	tri	tetra	penta	Hexa

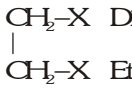
Example :



Trimethylene Iodide ,



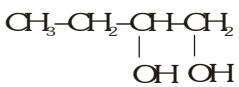
Pentamethylene Bromide

Exception : 

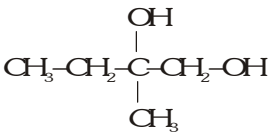
Dimethylene halide (wrong)
Ethylene halide (right)

◆ **Common - Naming of di-hydroxy compounds :**

(a) When two –OH groups are attached to adjacent carbon's they are termed as alkylene glycol.



Butylene glycol

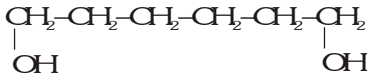


Secondary pentylene glycol

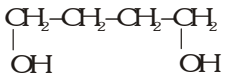
(b) When two –OH groups are attached at the two ends of a carbon chain, these compounds are named as polymethylene glycol.

Poly → Number of $>CH_2$ groups.

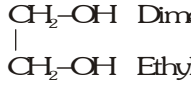
Example :



Hexamethylene glycol



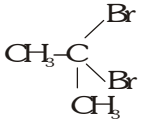
Tetra methylene glycol

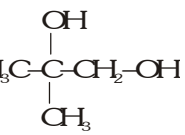
Exception : 

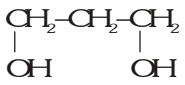
Dimethylene glycol (wrong)
Ethylene glycol (right)

Ex : Make the structure of following organic compounds -

1. Isopropylidene Bromide 2. Isobutylene glycol 3. Trimethylene glycol

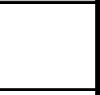
Sol. 1. 

2. 

3. 

◆ **Common - Naming of the functional group having carbon :**

Chart - 1

S. No.	Functional Group	Suffix
1		Aldehyde
2		ic acid
3		yl halide
4		Amide
5	$-C \equiv N$	o-nitrile
6	$-N \overset{+}{=} C$	o-isonitrile
7		ate
8		ic-anhydride

◆ **Prefix :**

1 Carbon ⟶ Form

2 Carbon ⟶ Acet

3 Carbon ⟶ Propion

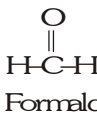
4 Carbon ⟶ Butyr → Normal, Iso

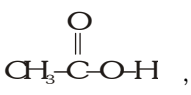
5 Carbon ⟶ Valer → Normal, Iso, Secondary, Tertiary

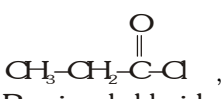
3C + (=) double bond = Acryl

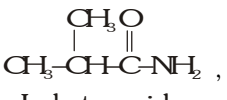
4C + double bond = Croton

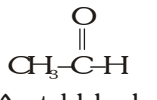
Example :

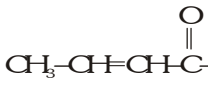

Formaldehyde ,


Acetic Acid ,


Propionyl chloride ,


Isobutyramide ,

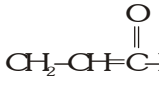

Acetaldehyde

Ex : Common name of the compound :  is -

(A) Crotonic acid (B) Acrylic acid

(C) Allylic acid (D) None

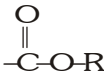
Sol. (A)

Ex : Common name of the compound :  is -

(A) Croton aldehyde (B) Acryl aldehyde

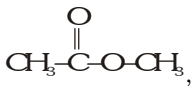
(C) Propion aldehyde (D) Butyr aldehyde

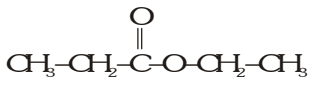
Sol. (B)

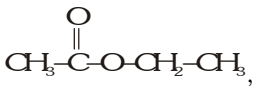
Nomenclature of Ester : 

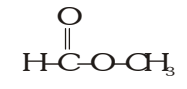
The group which is attached to the oxygen is written as alkyl & the remaining structure is named same as defined in chart-1.

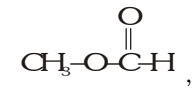
Example :

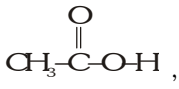

Methyl acetate

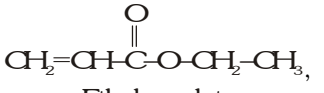

Ethyl propionate

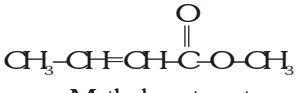

Ethyl acetate

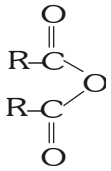

Methyl formate


Methyl formate


Acetic acid

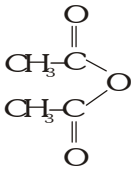

Ethyl acrylate


Methyl crotonate

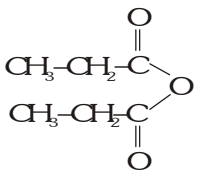
Nomenclature of Anhydride : 

Rule : Add the total number of carbon atoms & divide by 2, the quotient will give you the number of carbon atom now name it according to Chart-1.

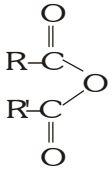
$$\frac{\text{Total}}{2} = \text{Quotient} = \text{Number of C atom}$$

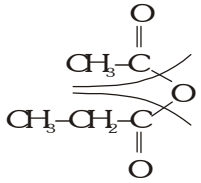

$\frac{4}{2} = 2$

Acetic anhydride


$\frac{6}{2} = 3$

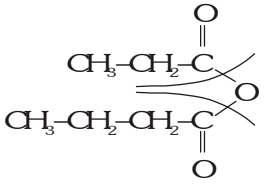
Propionic anhydride

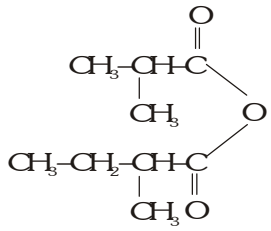
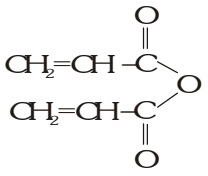
In  If R ≠ R', You need not to find out Quotient. Divide it in two parts as above & name it by suffixing ic anhydride (alphabetically)

Ex. : 

Acetic propionic anhydride (right)

Propionic acetic anhydride (wrong)


Butyric propionic anhydride

eg. :  , 

Isobutyric secondary valeric anhydride Acrylic anhydride

Derived System : According to this system any compound is given name according to the parent name of the homologous series. This system is reserved for the following nine homologous series.

Chart - 2

S. No.	Name of Homologous Series	Derived Name	Structure of group
1	Alkane	Methane	$-\overset{|}{\underset{|}{C}}-$
2	Alkene	Ethylene	$>C=C<$
3	Alkyne	Acetylene	$-C\equiv C-$
4	Alkanol	Carbinol	$-\overset{|}{\underset{|}{C}}-OH$
5	Alkanal	Acetaldehyde	$-\overset{|}{\underset{|}{C}}-CHO$
6	Alkanoic acid	Acetic acid	$-\overset{|}{\underset{|}{C}}-COOH$
7	Alkanoyl halide	Acetyl	$-\overset{|}{\underset{|}{C}}-COX$
8	Alkanamide	Acetamide	$-\overset{|}{\underset{|}{C}}-CONH_2$
9	Alkanone	Acetone	$-\overset{|}{\underset{|}{C}}-\overset{||}{C}(=O)-\overset{|}{C}-$

◆ **IUPAC system of Nomenclature :**

The basic criterion for naming a structure by IUPAC system is choice of a parent name of the basic carbon skeleton.

Nomenclature of alkanes is fundamental to naming whole class of organic compounds because it helps us identify the basic carbon skeleton.

◆ **General rules for IUPAC nomenclature :**

The IUPAC system is the most rational and widely used system of nomenclature in organic chemistry. The most important feature of this system is that any given molecular structure has only one IUPAC name and any given IUPAC name denotes only one molecular structure.

The IUPAC name of any organic compound essentially consists of five parts, i.e.

1. Word root 2. Primary Suffix 3. Secondary Suffix 4. Primary Prefix
5. Secondary Prefix

Thus, a complete IUPAC name of an organic compound consists of the following parts : Secondary prefix +Primary prefix + Word root + Primary suffix + Secondary suffix

1. **Word root :** It is the basic unit of the name. It denotes the number of carbon atoms present in the principal chain (the longest possible continuous chain of carbon atoms including the functional group and based upon the common names of alkanes) of the organic molecules.

Root word : According to number of carbon's in parent C–chain.

Number of carbons	Root word
1	Meth
2	Eth
3	Prop
4	But
5	Pent

Number of carbons	Root word
6	Hex
7	Hept
8	Oct
9	Non
10	Dec

Number of carbons	Root word
11	Undec
12	dodec
13	tridec
20	Eicos

2. **Primary Suffix :** A primary suffix is always added to the word root to indicate whether the carbon chain is saturated or unsaturated. The three basic primary suffixes are given below :

S. No.	Type of carbon chain	Primary Suffix	General Name
1	(a) Saturated	-ane	Alkane
2	(b) Unsaturated with one double bond	-ene	Alkene
3	(c) Unsaturated with one triple bond	-yne	Alkyne

If the parent carbon chain contain two, three or more double or triple bond, numerical prefix such as di (for two), tri (for three), tetra (for four) etc. are added to the primary suffix. For example.

S. No.	Type of carbon chain	Primary Suffix	General Name
1	(a) Unsaturated with two double bonds	-diene	Alkadiene
2	(b) Unsaturated with two triple bonds	-diyne	Alkadiyne

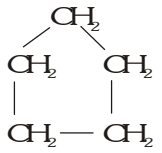
3. **Secondary Suffix :** A secondary suffix is always added to the primary suffix to indicate the nature of the functional group present in the organic compounds. Secondary suffix of some important functional groups are given below.

S. No.	Class of organic compounds	Functional group	Secondary Suffix
1	Alcohols	– OH	- ol
2	Aldehydes	–CHO	- al
3	Ketones	> C = O	- one
4	Carboxylic acids	– COOH	- oic acid
5	Acid amides	$-CONH_2$	- amide
6	Acid chlorides	– COX	- oyl halide
7	Esters	– COOR	alkanoate
8	Nitriles	– CN	- nitrile
9	Thioalcohols	– SH	- thiol
10	Amines	$-NH_2$	- amine

The following examples illustrate the use of word root, primary suffix and secondary suffix in naming of organic compounds.

S. No.	Organic Compounds	Word root	Primary suffix	Secondary suffix	IUPAC name
1	CH_3CH_2OH	Eth	an (e)	ol	Ethanol
2	$CH_3CH_2CH_2NH_2$	Prop	an (e)	Amine	Propanamine
3	$CH_3CH_2CH_2COOH$	But	an (e)	Oic acid	Butanoic acid
4	CH_3CH_2CN	Prop	an(e)	Nitrile	Propanenitrile
5	$CH_2 = CHCHO$	Prop	en(e)	al	Propenal
6	$HC \equiv CCOOH$	Prop	yn(e)	oic acid	Propynoic acid

4. **Primary prefix :** A primary prefix is used simply to distinguish cyclic from acyclic compounds. For example, in case of carbocyclic compounds.(cyclic compounds containing only carbon atoms in the ring.), a primary prefix, **cyclo** is used immediately before the word root. Thus.

eg. : 

Cyclo + Pent + ane = Cyclopentane

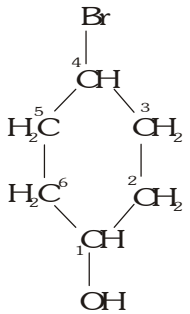
Primary prefix + Word root + primary suffix = IUPAC

If the prefix cyclo is not used, it simply indicates that the compound is acyclic or open chain.

5. **Secondary Prefix :** In IUPAC system of nomenclature, certain groups are not considered as functional groups but instead are treated as substituents. These are called secondary prefixes and are added immediately before the word root (or the primary prefix in case of carbocyclic compounds) in alphabetical order to denote the side chains or substituent groups. The secondary prefixes for some groups which are always treated as substituents groups (regardless of the fact whether the organic compound is monofunctional or polyfunctional) are given below :

S. No.	Organic Compounds	Secondary prefix	Word root	Word root	IUPAC name
1	CH_3CH_2–Br	Bromo	eth	ane	Bromoethane
2	CH_3–NO_2	Nitro	meth	ane	Nitromethane
3	C_2H_5–OC_2H_5	Ethoxy	eth	ane	Ethoxyethane

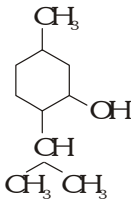
In case of carbocylic compounds, primary prefixes are also used.

Ex : 

4-Bromo + Cyclo + hex + an (e) + 1- ol

Secondary prefix | Primary prefix | Word root | Primary suffix | Secondary suffix

Ex. Write the IUPAC name of the compound

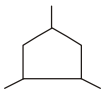


Sol. 2 - Isopropyl-5-methylcyclohexanol or 2-(1-methylethyl)-5-methyl cyclohexanol

Here

Secondary prefix	=	2 - Isoprypyl 5–methyl
Prim aryprefix	=	Cyclo
Word root	=	hex
Primary suffix	=	an (e)
Secondary suffix	=	ol

Ex. The correct IUPAC of the following compound is -



(A) 1, 3, 4-trimethyl cyclopentane

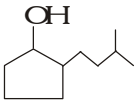
(B) 1, 3, 5-trimethyl cyclopentane

(C) 1, 3, 5-trimethyl cyclobutane

(D) 1, 2, 4-trimethyl cyclopentane

Sol. (D)

Ex. The correct statement is about following compound is -



(A) word root is But

(B) secondary prefix is cyclo

(C) primary suffix is ol

(D) primary prefix is cyclo

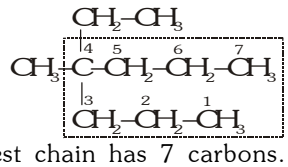
Sol. (D)

❑ **IUPAC Nomenclature of Branched/Complex Alkanes :**

(1) (a) Select the longest chain of carbon atoms in the molecule.

(b) Count the number of carbon atoms in that chain and name according to the following rules.

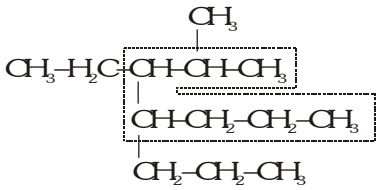
Example :



Longest chain has 7 carbons.

$\therefore$ It is a $\frac{\text{hept}}{\text{word root}} + \frac{\text{ane}}{\text{primary suffix}}$

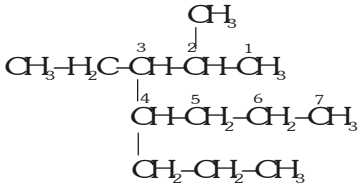
When chains of equal lengths are competing for selection, that chain is selected which has more number of subtituents.



Here the chain shown is selected.

(2) Carbon atoms in the longest chain selected as above in numbered consecutively form one end to the other such that the substituents attached get the lowest number.

In the above example, according to this rule, the numbering will be done as :



By this numbering, locant (substituents) get the number 2, 3 and 4 compared to 4, 5 and 6 if numbering is done from other end.

(3) Each substituent, which obviously, is an alkyl group is named according to number of carbon atoms present in it and it is prefixed by the number to which it is located in the main chain. In the above example, substituents are as following:

- CH_3 (methyl) group at carbon NO. 2 $\Rightarrow$ 2-methyl
- C_2H_5 (ethyl) group at carbon NO. 3 $\Rightarrow$ 3-ethyl
- $CH_2CH_2CH_3$ (propyl) group at carbon NO. 4 $\Rightarrow$ 4-propyl

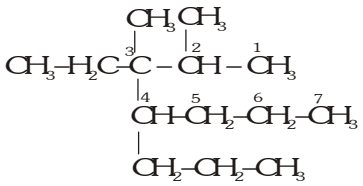
Hence, the above compound is named as :

3-Ethyl-2-methyl-4-propylheptane

(4) If the same substituent occurs more than once in the molecule, the prefix di (for two), tri (for three), etc. used to indicate how many times it appears.

The above example can be written with a little modification as :

Example :



Methyl at No. 2, 3, Ethyl at no. 3, propyl at no.4

This will be named as : **3-Ethyl-2,3-dimethyl-4-propylheptane**

(5) The name of the compound is composed in such a manner that each substituent with its number and name is written alphabetically just before the parent name. Prefixes di, tri, tetra etc. are not considered in deciding alphabetical order.

$\therefore$ Ethyl will be written before methyl which will be written before propyl.

Note that in the above examples, this pattern has been compiled with.

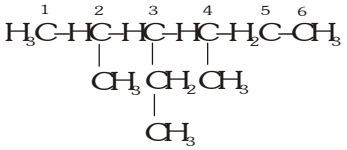
*Also, as per convention,

(i) numbers are separated each other by commas.

(ii) numbers are separated from words by hyphens and

(iii) write the name of the compound as a single word (with no space between)

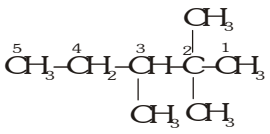
Ex. Write the IUPAC name of

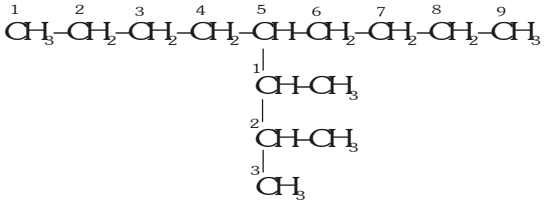


1. Primary suffix is ane as all are single bonds.
2. Chain is numbered as shown.
3. Root word is hex
4. Prefixes methyl appears twice ∴ It is 2, 4-dimethyl and 3-ethyl
5. While arranging in alphabetical order Replicators di, tri, tetra, are not considered.

∴ **3-Ethyl-2,4-dimethylhexane**

Ex : Write the IUPAC name of the following compounds.

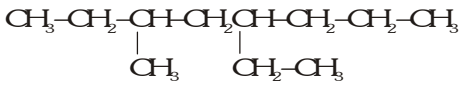
(i) 

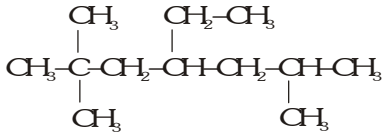
(ii) 

Sol. (i) 2, 2, 3-trimethylpentane

(ii) 5-(1,2-dimethylpropyl)nonane

Ex : Write IUPAC name of the following compounds :-

(a) 

(b) 

(c) 

Sol. (a) 5-Ethyl-3-methyloctane

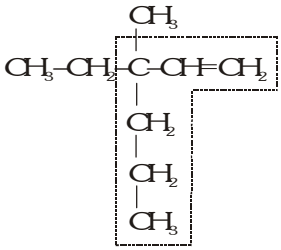
(b) 4-Ethyl-2, 2, 6-trimethylheptane

(c) 3-Methylhexane

❑ IUPAC NOMENCLATURE OF ALKENES :

Functional group : –C=C–

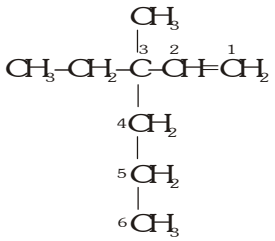
(1) Select the longest chain containing carbon-carbon double bond. This need not be the longest chain in the compound as a whole. Parent name will be alkene corresponding to number of carbon atoms in the longest chain.



Longest chain is as shown above it has 6 atoms ⇒ hexene = parent name

(2) Carbon atoms in the longest chain is numbered so that doubly bonded carbon atom gets the lowest number. The position of double bond is indicated by the smaller of the numbers assigned to two carbon atoms of double bond.

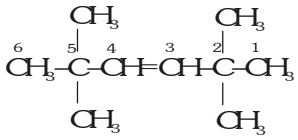
∴ The above example can be rewritten as,



Position of double bond will be indicated as no. 1.

Hence, name will be, 3-Ethyl–3–Methylhex–1–ene

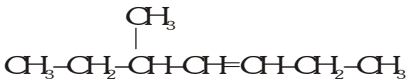
Example :



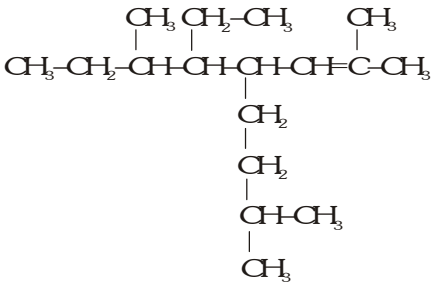
2, 2, 5, 5-tetramethylhex-3-ene

Ex : Write the IUPAC name of the following compounds :

(a)



(b)



Ans. (a) 5–Methyl–3–heptene

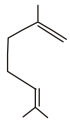
(b) 5–Ethyl–2,6–dimethyl–4–(3–methylbutyl)oct–2–ene

Ex : Draw the bond line structures of the following compounds.

(a) 2–Methyl–3–heptene (b) 2, 6–Dimethyl hept –1, 5–diene

Sol. (a)

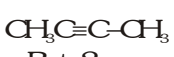
(b)



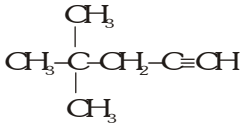
❑ **IUPAC nomenclature of alkynes (– C ≡ C – group)**

Numbering of longest chain is exactly same as that for naming alkenes.

Example



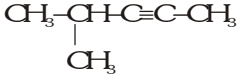
But–2–yne



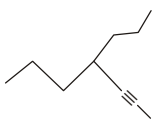
4,4–dimethylpent–1–yne

Ex. : Write the IUPAC name of the following compounds :

(a)



(b)

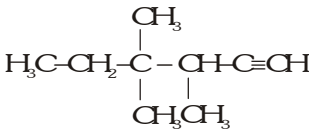


Sol. (a) 4–Methyl–2–Pentyne

(b) 4–Propyl–2–heptyne

Ex. : Write the IUPAC name of the following compounds :

(a) $CH_3-C \equiv CCH(CH_3)_2$

(b) 

Sol. (a) 4–methyl–2–pentyne, (b) 3, 4, 4–trimethyl–1–hexyne

◆ **IUPAC nomenclature of hydrocarbons containing both double and triple bonds occurring only once :**

(i) Such hydrocarbon is named as alkenyne (not alkynene).

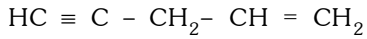
(ii) Numbering is done in a manner that double and triple bonds get the lowest possible number. In case of a choice, the double bond is given preference over triple bond.

Example : 

5 4 3 2 1 ⇒ multiple bonds at (1) & (C)

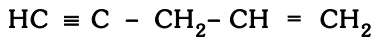
Note 1 2 3 4 5 ⇒ multiple bonds at (B) & (D)

∴ Name will be Pent –3–en–1–yne



5 4 3 2 1 ⇒ Pent–1–en–4–yne

(Here there is a choice : if we number from other side)

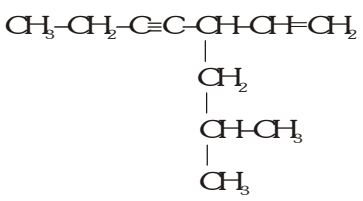


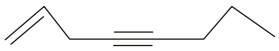
1 2 3 4 5

again multiple bonds are at numbers (1) and (D)

So, here we will give preference to double bond over triple bond.

Ex : Write IUPAC name of the following compounds.

(a) 

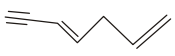
(b) 

Sol. (a) 3–(2–Methyl propyl)–1–hepten–4–yne

(b) Oct–1–en–4–yne

Ex : Write IUPAC name of the following compounds.

(a) $H-C\equiv CCH_2CH=CH_2$

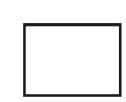
(b) 

Sol. (a) pent–1–en–4–yne

(b) 1,4–heptadiene–6–yne

❑ IUPAC NOMENCLATURE OF ALICYCLIC COMPOUNDS :

(1) The names of alicylic compounds are obtained by adding the prefix "cyclo"

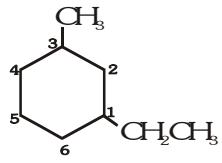


Cyclobutane

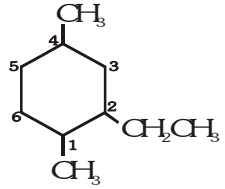
Cyclopentene

(2) The numbering of the carbon atoms in the ring is done in such a way that the substituent which comes first in the alphabetical order is given the lowest possible number provided it does not violate the lowest set of locants rule

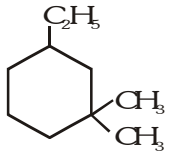
Example :



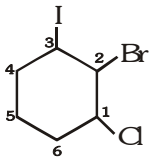
1–Ethyl–3–methyl cyclohexane



2–Ethyl–1,4–dimethyl cyclohexane



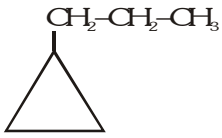
3–Ethyl–1,1–dimethyl cyclohexane



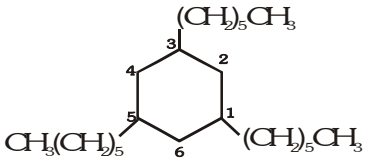
2–Bromo–1–chloro –3–iodocyclohexane

(3) When the ring contains more or equal number of carbon atoms than the alkyl group attached to it, then it is named as a derivative of cycloalkane and the alkyl group is treated as substituent

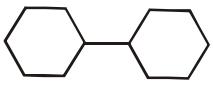
Example :



Propylcyclopropane



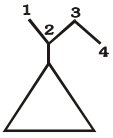
1, 3, 5–Trishexylcyclohexane



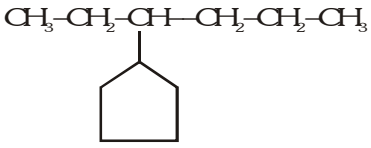
Cyclohexylcyclohexane

(4) The alkane chain contains greater number of carbon atoms than present in the ring, the compound is considered as the derivative of alkane and the ring is designated as substituent.

Example :



2-Cyclopropylbutane



3–Cyclopentylhexane

(5) If ring has unsaturation and side chain is saturated then ring is selected as parent chain.

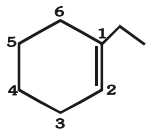
If side chain has unsaturation and ring is saturated then side chain is selected as parent chain.

If both have unsaturation the chain with maximum unsaturation has selected as parent chain.

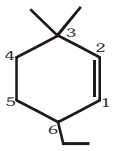
If equal unsaturation then longest chain is selected as parent chain.

If unsaturation and number of carbon atoms both are equal then ring is selected as parent chain.

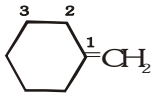
Example :



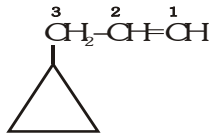
1–Ethyl Cyclohex–1–ene



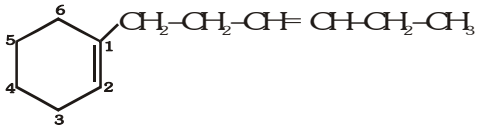
6–Ethyl–3,3–dimethyl cyclohex–1–ene



Methylene Cyclohexane



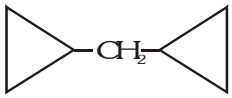
3–Cyclopropyl prop–1–ene



1–(Hex–3–ene) Cyclohex–1–ene

(6) If, more than one alicyclic ring is attached to a single chain, the compound is named as a derivative of alkane and the ring is treated as a substituent group.

Example

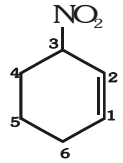


Dicyclopropylmethane

1,3-Dicyclohexyl propane

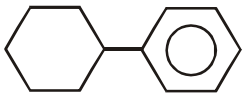
1–Cyclohexyl–4–cyclopropylbutane

(7) If a multiple bond and some other substituents are present in the ring, the numbering is done in such a way that the multiple bond gets the lowest number. **Example :**

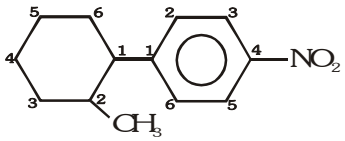


3–Nitrocyclohex–1–ene

(8) If a compound contains an alicyclic ring directly linked to the benzene ring. It is named as a derivative of benzene. **Example :**

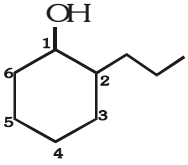


Cyclo hexyl benzene

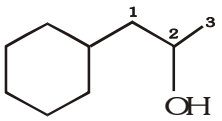


1–(2–Methylcyclohexyl)–4–nitrobenzene

(9) If functional group is present in cyclic compounds the main chain is taken there principal functional is lie, if the principal functional group is present in ring also then main chain will be taken for the maximum no. of carbon atoms.



2–propylcyclohexan–1–ol

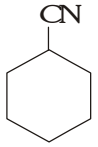


1–Cyclohexyl propan–2–ol

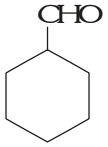
(10) When chain terminating functional group is directly attached with ring then ring is taken as parent chain & special suffix used for functional group.

S. No.	Functional Group	Suffix
1	– CHO	Carbaldehyde
2	– COOH	Carboxylic acid
3	– COX	Carbonyl halide
4	– COOR	Alkyl Carboxylate
5	– $CONH_2$	Carboxamide
6	– CN	Carbonitrile

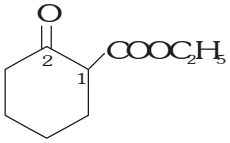
Example :



Cyclohexane Carbonitrile



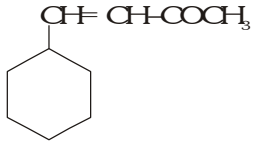
Cyclohexane Carbaldehyde



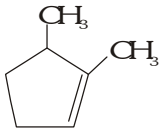
Ethyl–(2–oxo)cyclohexane–1–carboxylate

Ex : Write the IUPAC name of the following compound :

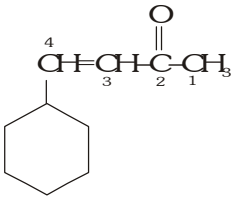
(i)



(ii)

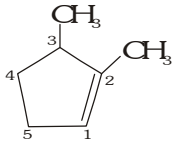


Sol. (i)



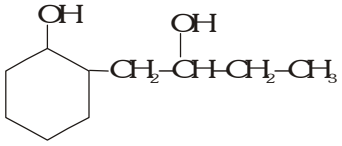
4–Cyclohexylbut–3–en–2–one

(ii)



2,3–Dimethyl cyclopent–1–ene

Ex : The correct IUPAC name of the following compound is :



(A) 1–(2–hydroxy cyclohexane) butan–2–ol

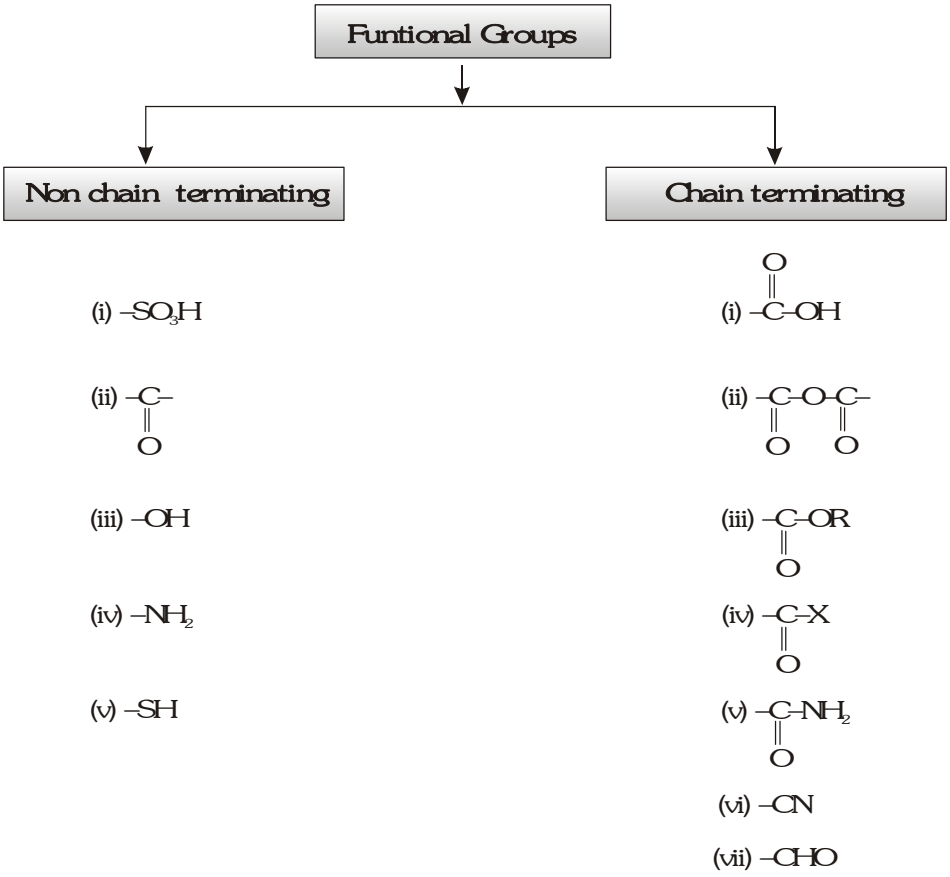
(B) 4–(2–hydroxy cyclohexane) butan–3–ol

(C) 1–(2–hydroxy but–1–yl) cyclohexan–2–ol

(D) 2–(2–hydroxy butyl) cyclohexan–1–ol

Sol. (D)

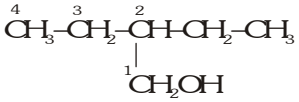
IUPAC NOMENCLATURE OF COMPOUNDS CONTAINING FUNCTIONAL GROUPS



◆ **Rules for non chain terminating functional groups :**

(A) Parent chain :

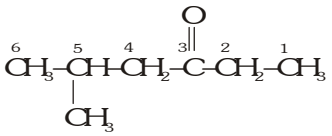
Select the longest possible chain with maximum functional group and maximum unsaturation with out caring whether it also denotes the longest possible chain or not.

Example : 

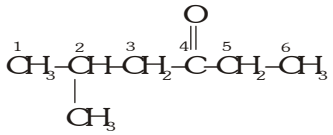
(Parent chain contains four rather than five carbon atoms)

(B) Lowest number for the functional group :

Numbering is done from that side of the chain which gives lowest locant to the principle functional group followed by double and triple bonds.

Example : 

(I) correct



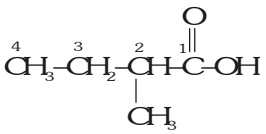
(II) wrong

($>C=O$ group gets lowest number 3) ($>C=O$ group gets number 4 which is not lowest)

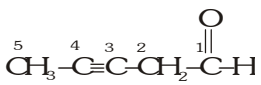
◆ **Rules for chain terminating functional groups :**

(1) When a chain terminating functional group such as –CHO, –COOH, – COOR, $-CONH_2$, –COCl, – C≡N etc. is present, it is always given number 1 (one.)

Example : :



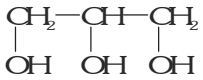
2–Methylbutan–1–oic acid



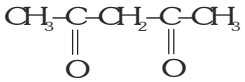
Pent–3–yn–1–al

(2) If a compound contains two or more like groups, the numerical prefixes di, tri, tetra etc. are used

Example : :



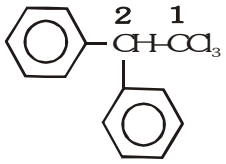
Propane –1,2,3–triol



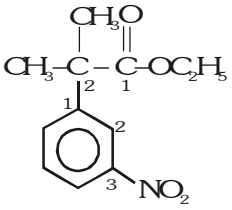
Pentane–2, 4–dione

(3) The name for benzene as substituent is phenyl. In case the phenyl ring is further substituted, the carbon atoms of the ring directly attached to the parent chain in such a ways that the substituent on the ring gets the least possible number.

Example : :



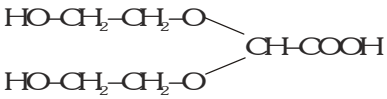
1,1,1–Trichloro–2,2–diphenyl ethane



Ethyl–2–methyl–2–(3–nitrophenyl) propanoate

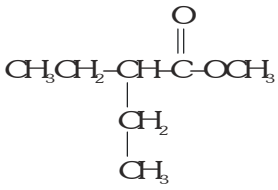
(4) If the organic molecule contain more than one similar complexes subtitutents, then the numerical prefixes such as di, tri, tetra etc. are replaced by bis, tris, tetrakis etc. respectively.

Example : :

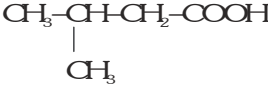


2,2–Bis–(2–hydroxyethoxy) ethanoic acid

Ex : Write IUPAC name of the following compounds :

(i) 

(ii) $(CH_3)_3COH$

(iii) 

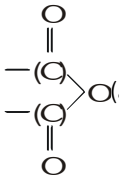
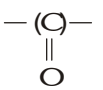
Sol. (i) Methyl–2–ethylbutanoate

(ii) 2–Methylpropan–2–ol

(iii) 3–Methylbutanoic acid

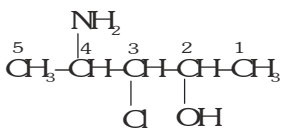
◆ **Rules for IUPAC nomenclature of polyfunctional compounds :**

1. When an organic compound contains two or more different functional groups is selected as the principal functional group while other groups are treated as substituents.

S. NO.	Functional group	Prefix	Suffix
1.	– (C) OOH (carboxylic acid)		oic acid
	– COOH	carboxy	carboxylic acid
2.	– SO_3H (sulphonic acid)	sulpho	sulphonic acid
3.	 (anhydride)		oic anhydride
4.	– (C)OOR (ester)		alkyl ------ oate
	– COOR	alkoxy carbonyl or carbalkoxy	alkyl ----- carboxylate
5.	– (C)OX (acid halide)		oyl halide
	– COX	halo formyl	carbonyl halide
6.	– (C)ONH_2 (amide)		amide
	– $CONH_2$	carbamoyl	carboxamide
7.	– (C)N (cyanide)		Nitrile
	– CN	cyano	carbonitrile
8.	– N ≡ (C) (isocyanide)		isonitrile
	– NC	isocyano/carbyl amino	
9.	– (C)HO (aldehyde)	oxo	al
	– CHO	formyl	carbaldehyde
10.	 (Ketone)	keto/oxo	one
11.	– OH (alcohol)	hydroxy	ol
12.	– SH (thio alcohol)	mercapto	thiol
13.	– NH_2 (amine)	amino	amine
14.	– OR (ether)	alkoxy	

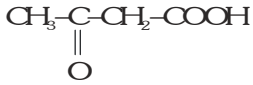
2. Some functional group such as all halo groups. (Fluoro, bromo, chloro, iodo) nitrosol, (NO) nitro (–NO_2)

Example :

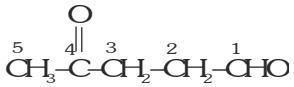


4–Amino–3–chloropentan–2–ol
(–NH_2 & –Cl group treat as substituent)

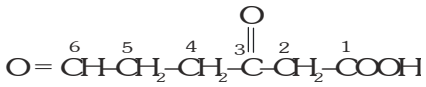
Numbering the principal chain order is
[Principal functional group > double bond > triple bond > substituents]
Example :



3–Oxobutan–1–oic acid
[–COOH > – CO]



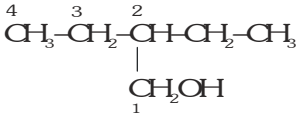
4–Oxopentan–1–al
[–CHO > C=O]



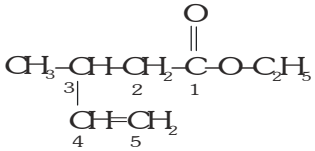
3,6–Dioxohexanoic acid
or 5-formyl–3–oxopentanoic acid

[COOH > C & CHO]

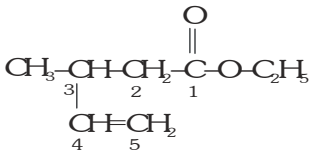
3. The longest possible chain of carbon atoms containing the functional group the maximum number of multiple bonds is selected as parent chain.
Example :

(a) 

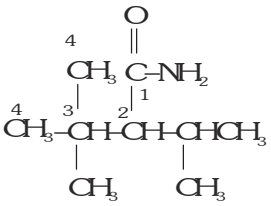
parent chain contains four rather than five carbon atoms.

(b) 

parent chain contains four rather than six carbon atoms.

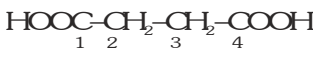
(c) 

Ethyl–3–methyl–4–pentenoate

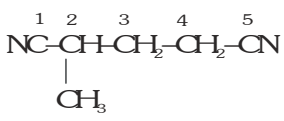
(d) 

3,3–Dimethyl–2–(1–methylethyl) butanamide

4. If more than one same chain terminating group are present then the principal chain is selected including the functional groups and numbering is done from that side which gives lowest locant to unsaturation substituent.

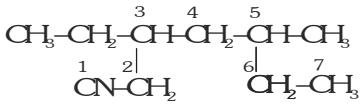
Example : 

Butan–1,4–dioic acid



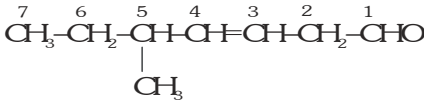
2-Methylpentanedinitrile

Example : Write the IUPAC name of



1. The longest chain containing functional group is of 7 carbon atoms. Therefore, the word root is hept & the chain is numbered as shown.
2. There is no multiple bond in it. Hence, the primary suffix is ane.
3. The functional groups is –CN. Hence , secondary suffix is nitrile.
4. Moreover, there is a methyl groups on carbon 5 and ethyl group on carbon 3.
5. The IUPAC name is ,therefore, **3–Ethyl–5–methylheptanenitrile**

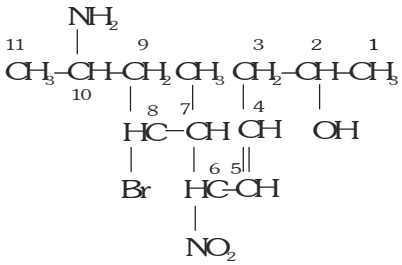
Example : Write the IUPAC name of



1. The longest chain containing functional group is of seven carbon atoms. Therefore, word root is hept.
2. As C=C double bond is present in the molecule. Thus, primary suffix is **ene**.
3. The secondary suffix is **al** because of presence of –CHO group.
4. The chain is numbered as shown so that carbon atoms of –CHO group gets number 1. The methyl group is present on carbon 5 while position of double bond is 3. Thus , IUPAC name is

5–Methylhept–3–en–1–al

Example : Write the IUPAC name of

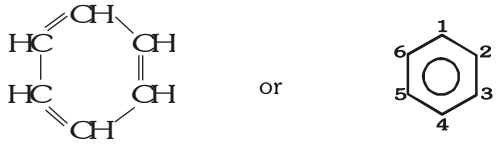


1. Primary suffix is ene, due to presence of double bond between C_4 & C_5
2. Senior functional group is alcohol hence secondary suffix is –ol
3. Root word is undec.
4. Chain is numbered as shown.
5. 6–Nitro–7–methyl–8–bromo–10–amino are prefixes. Arrange them in alphabetical order & give the name

10–Amino–8–bromo–7–methyl–6–nitroundec–4–en–2–ol

- **Nomenclature of Aromatic Compounds :**

The aromatic compounds are cyclic compounds contains one or more benzene type rings. Benzene is the simplest hydrocarbon of aromatic series which has planar cyclic ring of six carbon atoms having three double bonds in alternate positions as shown below.



(A) Nuclear Substituted –

The functional group is directly attached to benzene ring in the IUPAC system, they are named as derivative of benzene. The position of the substituents in disubstituted benzenes are indicates either by prefixes such as o–(ortho) for 1, 2, m–(meta) for for 1, 3 and p (para) for 1, 4 position. However, many of their common names have also been adopted by the IUPAC system.

(B) Side–Chain Substituted –

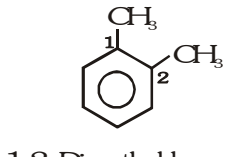
The functional group is present in the side chain of the benzene ring in the IUPAC systems, these are usually named as phenyl derivatives of the corresponding aliphatic compounds.

The IUPAC and common names of a few important members of each formly are given below :

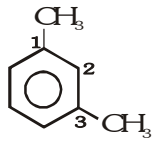
(a) Aromatic hydrocarbons (arenes) : Hydrocarbons which contain both aliphatic and aromatic units are called arenes. These are of two types

(i) Hydrocarbon containing one ring only.

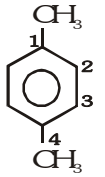
Example :



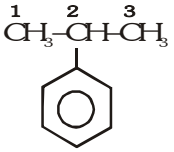
1,2–Dimethyl benzene
(o–Xylene)



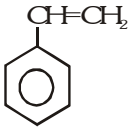
1,3–Dimethyl benzene
(m–Xylene)



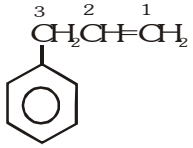
1,4–Dimethyl benzene
(p–Xylene)



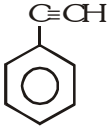
Isopropyl benzene
(Cumene)



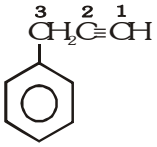
Ethenyl benzene
(Styrene)



3–propenyl benzene
(Allyl benzene)

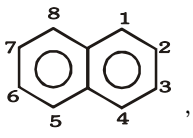


Ethynyl benzene
(Phenyl acetylene)

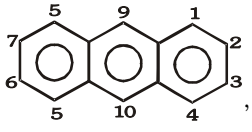


3–propynyl benzene
(Propargyl benzene)

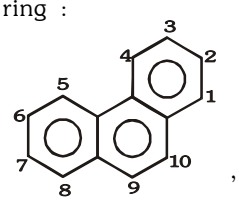
(ii) Hydrocarbon containing condensed or fused ring :



Naphthalene

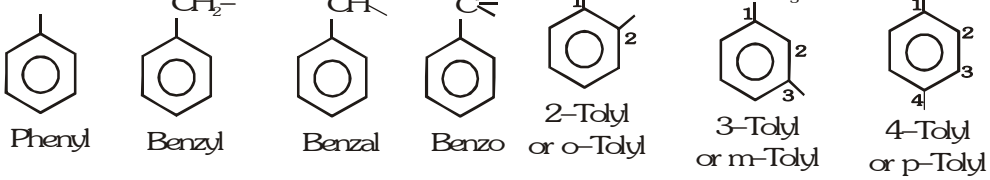


Anthracene



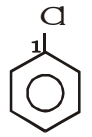
Phenanthrene

◆ **Aryl Groups :**

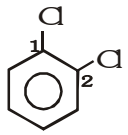


Phenyl | Benzyl | Benzal | Benzo | 2–Tolyl or o–Tolyl | 3–Tolyl or m–Tolyl | 4–Tolyl or p–Tolyl

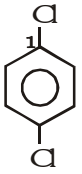
◆ **Halogen derivatives :**



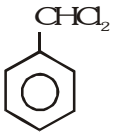
Chloro benzene ,



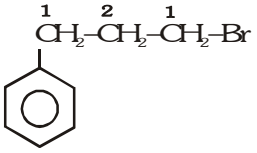
1,2–Dichlorobenzene or o–Dichlorobenzene ,



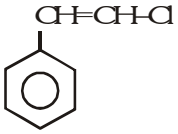
1,4–Dichlorobenzene or p–Dichlorobenzene



Phenyldicholoromethane (Benzyl chloride) ,



1–Bromo–3–phenyl propane ,

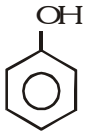


1–chloro–2–phenyl ethene

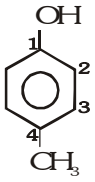
◆ **Hydroxy derivatives :**

The nuclear hydroxy derivatives are called phenols while the side chain substituted hydroxy derivatives are called aromatic alcohols.

(i) Phenols–monohydric

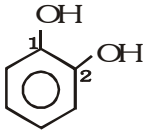


Hydroxybenzene (phenol) ,

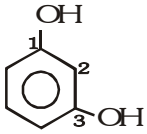


4–methyl phenol (p-cresol) ,

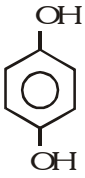
(ii) Dihydric and polyhydric phenols



Benzene–1,2–diol (Catechol)

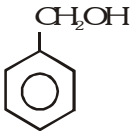


Benzene–1,3–diol (Resorcinol)

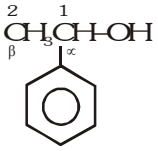


Benzene–1,4–diol(Quinol)

(iii) Aromatic Alcohols :

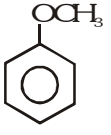


Phenyl methanol (Benzyl alcohol)

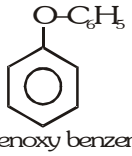


1–phenyl ethanol (∝–phenyl ethyl alcohol)

(iv) Aromatic ethers

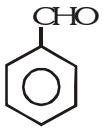


Methoxy benzene (Anisol)

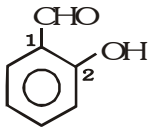


Phenoxy benzene (Diphenyl ether)

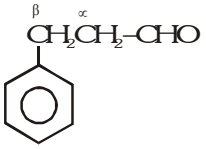
(v) Aldehydes



Benzaldehyde

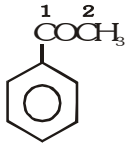


2–Hydroxy benzaldehyde
(Salicylaldehyde)

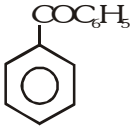


3–phenylpropanal
(β–phenylpropionaldehyde)

(vi) Ketones

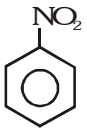


1–phenyl ethanone
(Acetophenone)

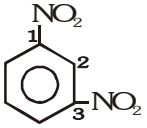


Diphenylmethanone
(Benzophenone)

(vii) Nitro Compounds



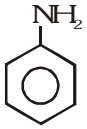
Nitrobenzene



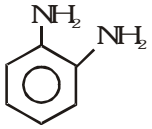
1, 3–Dinitrobenzene
(m-Dinitrobenzene)

(viii) Amines

(a) Aryl amines

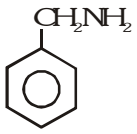


Benzenamine
(Aniline)

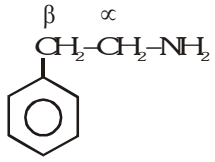


Benzene–1,2-diamine
(o-phenylenediamine)

(b) Aryl alkyl amine

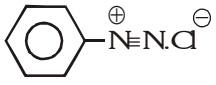


Phenyl methanamine
(Benzylamine)

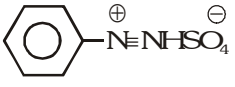


2–Phenyl ethanamine
(β–phenyl ethyl amine)

(ix) Arenediazonium Salts :

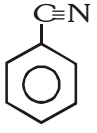


Benzene diazonium chloride

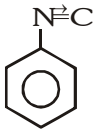


Benzene diazonium hydrogen sulphate

(x) Cyanides and Isocyanides

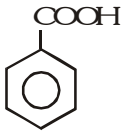


Benzonitrile
or Phenyl Cyanide

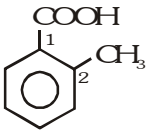


Phenyl isocyanide or
Phenyl carbylamine

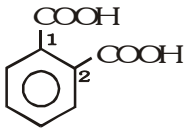
(xi) Carboxylic Acids



Benzoic acid

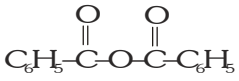


2–Methyl benzoic acid
(o–toluic acid)



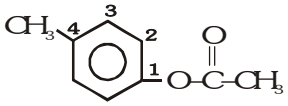
Benzene–1,2–dicarboxylic acid
(Pthalic acid)

(xii) Anhydrides



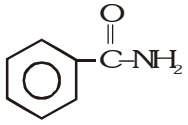
Benzoic anhydride

(xiii) Esters



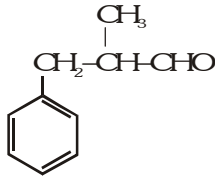
4–Methyl phenyl ethanoate

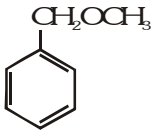
(xiv) Amides



Benzamide

Ex. Write IUPAC name of the aromatic compounds

(i) 

(ii) 

Sol. (i) 2-methyl -3-phenylpropanal, (ii) Methoxyphenylmethane (Benzylmethyl ether)

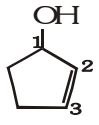
❑ **Some Important 1993 Recommendations of IUPAC Nomenclature of Organic Compounds :**

1. Locants (numerals and / or letters) are placed immediately before the part of the name to which they relate. For example :

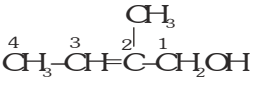
$CH_3CH_2CH = CH_2$ should be named as but–1–ene

CH_3CH_2OH should be named as ethan–1–ol

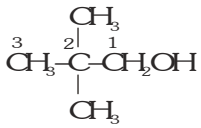
Similarly , a few more examples are given as following :



Cyclopent–2–en–1–ol



2–Methylbut–2–en–1–ol



2,2–Dimethylpropan–1–ol

2. The locant 1 is often omitted when there is no ambiguity. For example.

$CH_3CH_2CH_2COOH$	CH_3CH_2CHO	$CH_3CH_2CH_2CN$
Butanoic acid	Propanal	Butanentrile

In all the above examples locant 1 for the functional group is omitted because the position of the functional group is unambiguous. However, in the following cases the position of the functional group must be mentioned.

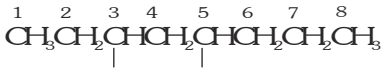
$CH_3CH_2CH_2OH$	$CH_3CH_2CH_2NH_2$
Propan–1–ol	Propan-1- amine

Here, we cannot write simply propanol (or propanamine) because there are two propanols ; propan–1–ol and propan–2–ol.

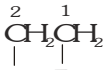
3. Arrangement of Prefixes :

◆ Simple prefixes such as methyl, ethyl chloro, nitro, hydroxy, etc. are arranged alphabetically.
The prefixes di, tri, etc. are however not considered for comparison.

Example :



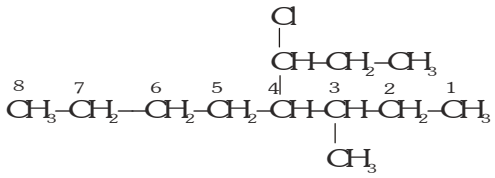
5–Ethyl–3–methyl octane



1–Bromo–2–chloroethane

(ii) The name of a prefix for a substituted substituent is considered to begin with the first letter of its complete name.

Example :

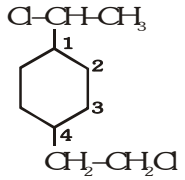


4–(1–Chloropropyl)–3–methyloctane

for the substituted 1–chloropropyl, 'C' is taken as the first letter.

(iii) When two or more prefixes consist of identical roman letters priority for citation is given to the group which contains the lowest locant at the first point of difference.

For example



1–(chloroethyl)–4–(2–chloroethyl) cyclohexane

Here, 1–chloroethyl gets priority over 2–chloroethyl.

◆ **Bicyclic :**

Bicyclo : When two rings are fused at two carbon then prefix Bicyclo is used.(Carbon chain should be taken in decreasing order)

(i) Two fused or bridged rings are called bicycloalkanes.

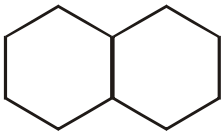
(ii) Total number of carbon atoms present in both the rings is considered as parent alkane.

(iii) Common carbon atoms present in both the rings are referred as principal points of the bridge.

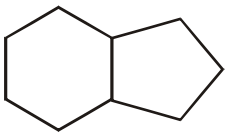
(iv) The line joining the principal points is called the bridge line. Bridge line can have 0. 1. 2 etc carbon atoms.

(v) The name is written as bicyclo [x. y. z] alkane. x. y. z are in the decreasing order.

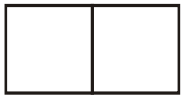
(vi) The numbers are separated by full stops.



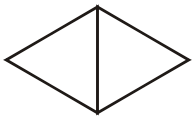
Bicyclo [4.4.0] decane



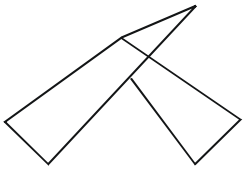
Bicyclo [4.3.0] nonane



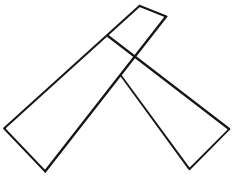
Bicyclo [2.2.0] hexane



Bicyclo [1.1.0] butane



Bicyclo [2.2.1] heptane



Bicyclo [2.2.2] octane

◆ **Spiro :** When two rings are fused at one carbon the prefix spiro is used (Carbon chain should be taken in increasing order)

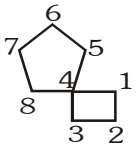
1. A molecule that has two rings sharing a single atom is called spirocyclic.

2. The numbers of skeletal atoms linked to the spiro atom are indicated by arabic numbers, separated by a full stop.

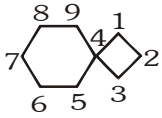
3. The numbers are written in ascending order and enclosed in square brackets.

4. Numbering of a spiro bicyclic hydrocarbon starts with a ring carbon next to the spiro atom and proceeds first through the smaller ring and then through the spiro atom and around the second ring.

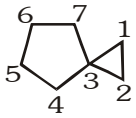
Example :



Spiro[3.4] octane

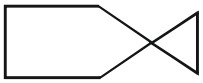


Spiro[3.5] nonane

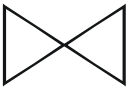


Spiro[2.4] heptane

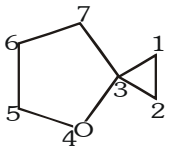
Spiro [4.4] nonane



Spiro [2.4] heptane

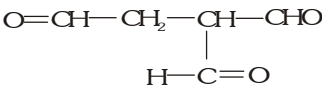


Spiro [2.2] pentane

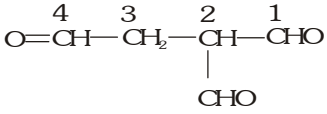


4–oxa spiro [2.4] heptane

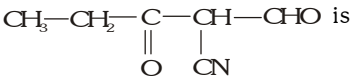
SOLVED EXAMPLES

Ex.1 The correct IUPAC name of the following compound is 

(A) 1,1–diformyl propanal
(B) 3–formyl butanedial
(C) 2–formyl butanedial
(D) 1,1,3–ethane tricarbaldehyde

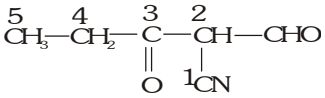
Sol. (C) The principal functional group is – CHO.  .

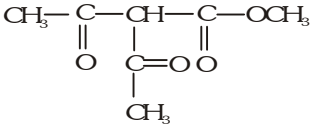
2–formyl butanedial

Ex.2 The correct IUPAC name of compound  is

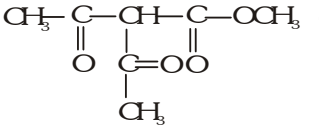
(A) 2–cyano–3–oxopentanal
(B) 2–formyl–3–oxopentanenitrile
(C) 2–cyano–1, 3–pentanedione
(D) 1, 3–dioxo–2–cyanopentane

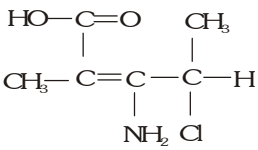
Sol. (B) Here the main functional group is – CN, which had nitrile suffix and CHO and CO are taken as substituents.

 (2-formyl-3-oxopentanenitrile)

Ex.3 IUPAC name of 

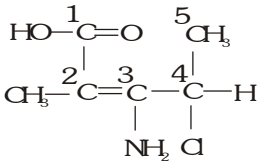
(A) Methyl-2, 2-acetyl ethanoate
(B) 2, 2-acetyl-1-methoxy ethanone
(C) Methyl-2-acetyl-3-oxobutanoate
(D) none of these

Sol. (C) The principal functional group is ester group.  (Methyl-2-acetyl-3-oxobutanoate)

Ex.4 The IUPAC name of compound  is

(A) 2-amino-3-chloro-2-methyl-2-pentenoic acid
(B) 3-amino-4-chloro-2-methyl-2-pentenoic acid
(C) 4-amino-3-chloro-2-methyl-2-pentenoic acid
(D) none of these

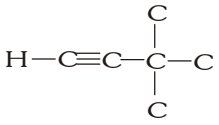
Sol. (B) The principal functional group is carboxylic acid (–COOH)



3-amino-4-chloro-2-methyl-2-pentenoic acid

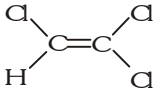
Ex.5 How many carbons are in simplest alkyne having two side chanis ?

(A) 5 (B) 6 (C) 7 (D) 8

Sol. (B) 

Ex.6 The compound name trichloroethene is

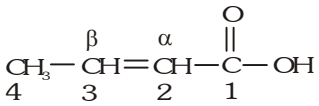
(A) Westron (B) Perclene (C) Westrosol (D) Orlone

Sol. (C) Trichloroethene is westrosol  1,1,2-trichlorethene(westrosol)

Ex.7 The type of unsaturation present in crotonic acid is -

(A) α, β (B) β, α (C) α, α (D) β, β

Sol. (A) The type of unsaturation present in crotonic acid is α, β

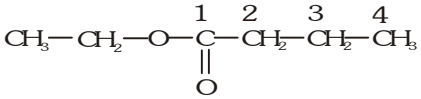


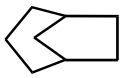
Crotonic acid or (2-Butenoic acid)

Ex.8 IUPAC name of compound  is

(A) Propyl propanoate (B) Ethyl butanoate

(C) Propyl butanoate (D) Ethyl propanoate

Sol. (B)  Ethyl butanoate

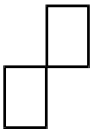
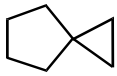
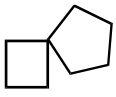
Ex.9 The IUPAC name of the compound given below is 

(A) Bicyclo [3.2.1] octane (B) Bicyclo [3.2.2] octane

(C) Spiro [2.2] octane (D) None of these

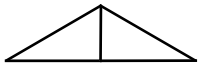
Sol. (A)

Ex. 10 The structure of spiro [3.3] heptane is

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

Sol. (B)

Ex.11 The structure of bicyclo [1.1.0] butane is

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

Sol. (D)