NOMENCLATURE OF ORGANIC COMPOUNDS

HISTORY AND INTRODUCTION

Nicholas Lemrey, in 1675 had divided chemical substance into 3 parts.

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

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

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

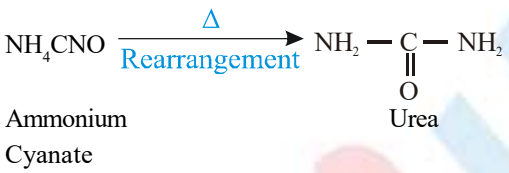
After some time when many of the chemical substance were discovered, it was found that some of them can be obtained from both vegetables and animals. So this classification was failed. So chemical substance were then divided into two parts :

(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)

- Berzilius in 1815 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. Before this any organic compound could not be synthesized in lab.
- In 1828 Wholar (German Scientist) synthesized an organic compound in lab which was urea.
- Urea was synthesized in lab by heating of Ammonium cyanate (NH_4CNO). So VFT was failed.



Kekules's Principle

- Carbon has four valencies.
- Carbon has a property of catenation. It can make large chain with addition of other carbons.
- A carbon atom can share, 2, 4 or 6 electrons with other carbons & can form single, double or triple bond.
- For a carbon atom, it is not possible to make more than 3 bonds with adjacent carbon atom because a carbon atom complete its octet from overlapping which consists directional property.

SOME IMPORTANT DEFINITIONS

(1) **Catenation** : The property of atoms of an element to link with one another forming chains of identical atoms is called catenation.

(2) **Homologous series** : Homologous series may be defined as

(a) series of similarly constituted compounds in which the members possess the same functional group.

(b) have similar chemical characteristics and

(c) have a regular gradation in their physical properties.

(d) The two consecutive members differ in their molecular formula by CH_2.

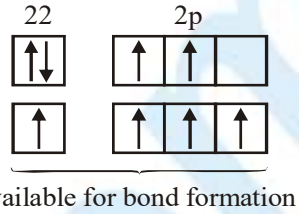
(3) **Isomerism** : The name was given by Berzilius. The organic compounds having the some molecular formula and molecular weight but different properties (chemical and physical) and the phenomenon is called isomerism. Isomerism is actually permutation and combination of arrangement of atoms in different style either structurally or 3 –dimensionally to form molecules by the nature.

CHARACTERISTICS OF C-ATOM

(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.

In ground state (here covalency of carbon is 2)

First excited state (here covalency of carbon is 4)



(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°28' or 10**9.**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
	4, 0	sp^3	109°28'	Tetrahedral
	3, 1	sp^2	120°	Planar (Trigonal)
	2, 2	sp	180°	Linear
	2, 2	sp	180°	Linear

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

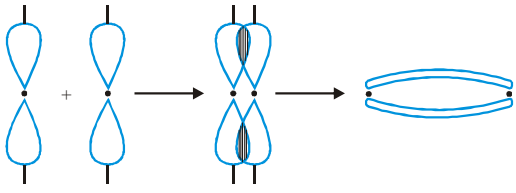
ETOOS KEY POINTS

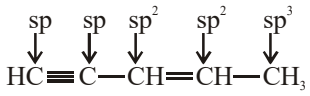
(i) Overlapping of hybrid orbitals also give σ bonds. σ bonds are stronger, as they are resulted from the effective axial overlapping.

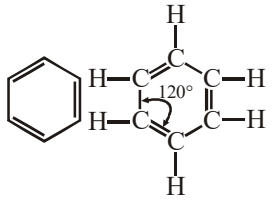
(ii) More the directional character (p) in covalent bond more is the strength of the bond.

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

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. 

Ex. 

Flat hexagonal structural due to sp^2 hybridised

C-atom in benzene

EDUBULL KEY POINTS

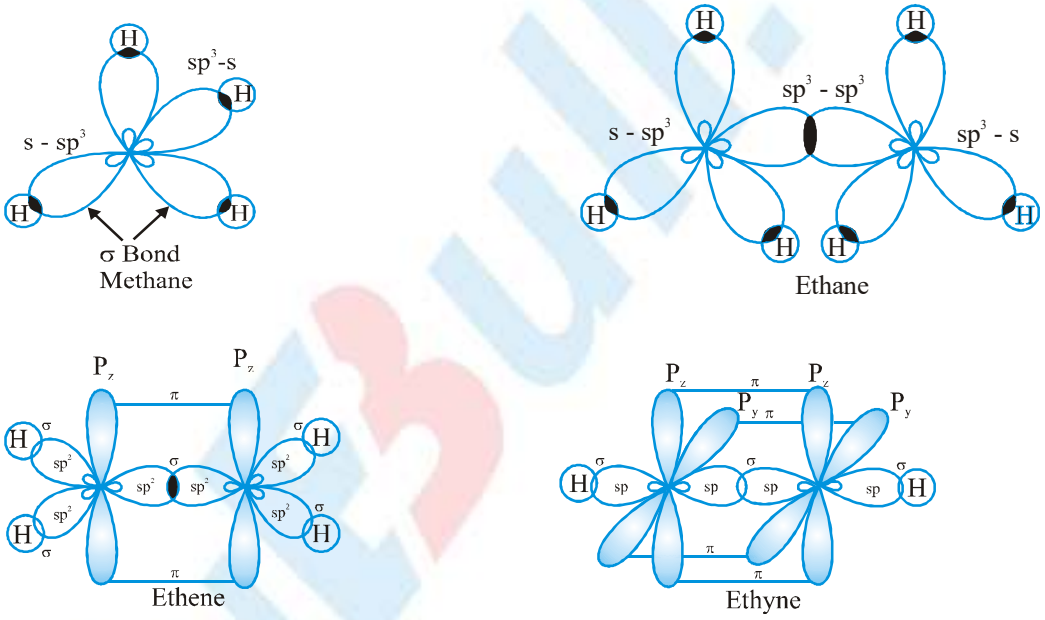
(i) π electrons are mobile hence π bond is more reactive. π bond is formed by the collateral overlapping of sp^2 orbitals.

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

(iii) Six 2p unhybridised orbitals of 6 C-atom in benzene form 3π 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.

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

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



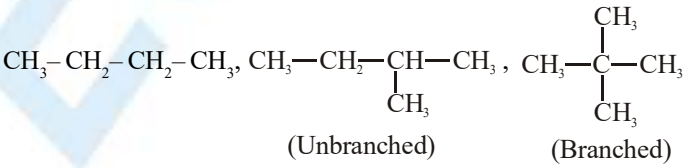
(Orbital diagram of methane, ethane, ethene and ethyne)

CLASSIFICATION OF ORGANIC COMPOUNDS

Aliphatic or Open chain compounds

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

For example :



(Unbranched) (Branched)

There are two varieties in the compounds :-

- **Saturated Hydrocarbons**

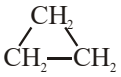
(a) In such type, adjacent carbon are attached with single bonds.
Example : $CH_3-CH_2-CH_3$
(b) General formula of these compounds are C_nH_{2n+2}
(c) These are also called as paraffins (Parum + Affins i.e. little reactivity) because these are less reactive due to absence of π-bonds.

- **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_nH_{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.

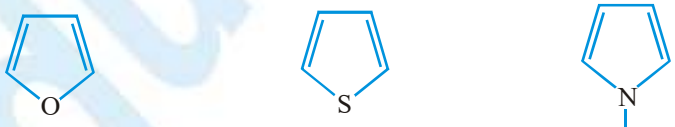

cyclopropane cyclopropene cyclobutene

(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 allow Huckels' 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

- **Heterocyclic Compounds**

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



Furan Thiophene Pyrrole

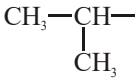
- **Normal Groups**

(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.

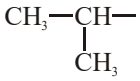
n- propyl	$CH_3-CH_2-CH_2-$
n - butyl	$CH_3-CH_2-CH_2-CH_2-$

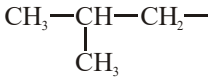
- **Iso group**

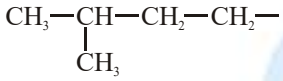
(a) It is represented by following structure



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


Iso propyl

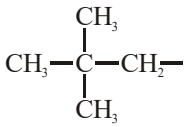

Iso butyl


Isopentyl

- **Neo group**

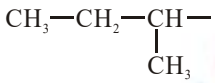
(a) When two methyl group are attached to second last carbon atom group is named neo group.

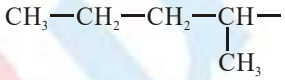
(b) It is represent by following structure :

for example  Neo pentyl

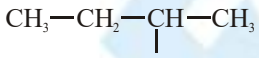
- **Secondary group**

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

Ex. 
Secondary butyl

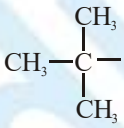

Active Secondary pentyl

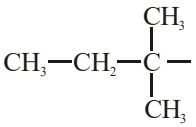
(b) It is represented by following structure.



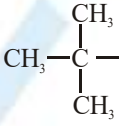
- **Tertiary group**

(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**

$CH_4 \rightarrow -CH_3$ Methyl $\qquad$ $C_2H_6 \rightarrow -C_2H_5$ Ethyl

$CH_3-CH_2-CH_3$ Propane
- (i) $CH_3-CH_2-CH_2-$ — n-propyl
- (ii) $CH_3-\underset{}{CH}(-CH_3)-$ — Iso-propyl

$CH_3-CH_2-CH_2-CH_3$ Butane
- (i) $CH_3-CH_2-CH_2-CH_2-$ — n-butyl
- (ii) $CH_3-CH_2-\underset{}{CH}(-CH_3)-$ — sec-butyl

$CH_3-\underset{}{CH}(-CH_3)-CH_3$ Isobutane
- (i) $CH_3-\underset{}{CH}(-CH_3)-CH_2-$ — Isobutyl
- (ii) $CH_3-\underset{}{C}(-CH_3)(-CH_3)-$ — tert. - butyl

$CH_3CH_2CH_2CH_2CH_3$ n- Pentane
- (a) $CH_3-CH_2-CH_2-CH_2-CH_2-$ — n- pentyl
- (b) $CH_3-CH_2-CH_2-\underset{}{CH}(-CH_3)-$ — Active sec. pentyl
- (c) $CH_3-CH_2-\underset{}{CH}(-CH_2-CH_3)-$ — 1 - Ethyl propyl or sec. pentyl

$CH_3-\underset{}{CH}(-CH_3)-CH_2-CH_3$ Iso pentane
- (a) $CH_3-\underset{}{CH}(-CH_3)-CH_2-CH_2-$ — Iso pentyl or 3- Methyl butyl
- (b) $CH_3-\underset{}{CH}(-CH_3)-\underset{}{CH}(-CH_3)-$ — 1, 2- dimethyl propyl or active iso pentyl.
- (c) $CH_3-\underset{}{CH}(-CH_3)-CH_2-CH_3$ — tert. pentyl or 1, 1- dimethyl propyl or tert. amyl
- (d) $-CH_2-\underset{}{CH}(-CH_3)-CH_2-CH_3$ — Active pentyl or active amyl

$CH_3-\underset{}{C}(-CH_3)(-CH_3)-CH_3$ neo-pentane $\longrightarrow$ $CH_3-\underset{}{C}(-CH_3)(-CH_3)-CH_2-$ neo-pentyl

ETOOS KEY POINTS

Pentyl is also called amyl group.

(i) 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)** $CH_3-\underset{}{C}(=CH_2)-$ — Iso propenyl or 1-methyl ethenyl
- **(3)** $-CH_2-CH=CH_2$ — 2-Propenyl (Allyl)

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

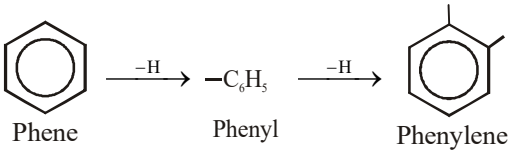
Ex. $CH \equiv CH \longrightarrow CH \equiv C-$ Ethynyl

$CH_3-C\equiv CH \rightarrow CH_3-C\equiv C-$ 1 - Propynyl

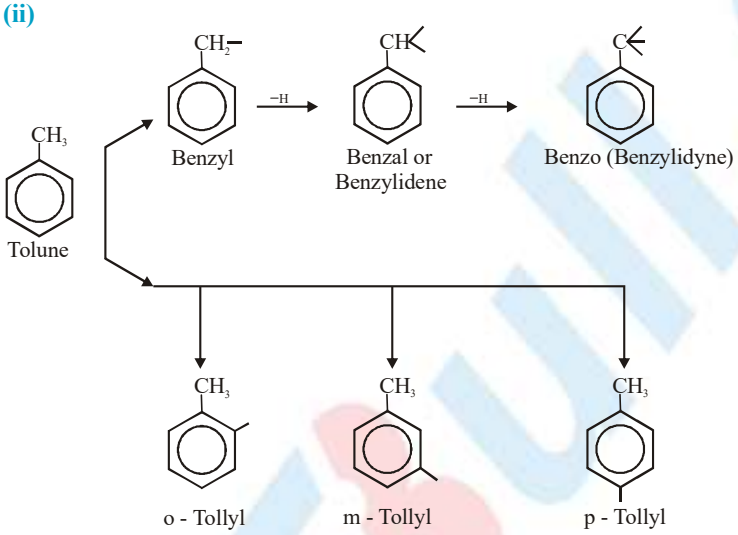
$\rightarrow -CH_2-C\equiv CH$ 2 - Propynyl (Propargyl)

- **Aryl Radical**

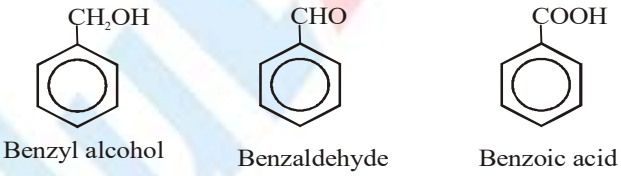
(i)



(ii)



Ex.



HOMOLOGOUS SERIES

The organic compounds which are structurally similar having same functional groups, combinedly gives a series known as homologous series and the members as **homologues**. The homologous series is characterised by :

(i) The two adjacent members are differ by a – CH_2 – group or 14 atomic mass unit.

(ii) All the members of a series have same general formula, general methods of preparation and similar chemical properties due to same functional group.

(iii) The homologues shows difference in physical properties due to change in molecular mass and structural arrangement of molecule.

Some standard Homologous Series Are

S.No.	Name of Series	General Formula	I-homologue	II-homologue
1	Alkane	C_nH_{2n+2}	CH_4	$CH_3–CH_3$
2	Alkene	C_nH_{2n}	$CH_2=CH_2$	$CH_2=CH-CH_3$
3	Alkyne	C_nH_{2n-2}	$HC\equiv CH$	$HC\equiv C-CH_3$
4	Halo alkane	$C_nH_{2n+1}X$	CH_3-X	CH_3-CH_2-X
5	Alcohol	$C_nH_{2n+2}O$	CH_3-OH	CH_3-CH_2-OH
6	Ether	$C_nH_{2n+2}O$	CH_3-O-CH_3	$CH_3-O-CH_2-CH_3$
7	Aldehyde	$C_nH_{2n}O$	H–CHO	CH_3-CHO
8	Ketone	$C_nH_{2n}O$	$CH_3-\overset{\overset{O}{\|}}{C}-CH_3$	$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$
9	Carboxylic acid	$C_nH_{2n}O_2$	H–COOH	$CH_3–COOH$
10	Ester	$C_nH_{2n}O_2$	$H-\overset{\overset{O}{\|}}{C}-O-CH_3$	$H-\overset{\overset{O}{\|}}{C}-O-CH_2CH_3$ & $CH_3-\overset{\overset{O}{\|}}{C}-O-CH_3$
11	Amide	$C_nH_{2n+1}NO$	$H–CONH_2$	CH_3-CONH_2
12	Nitro alkane	$C_nH_{2n+1}NO_2$	$CH_3-N\overset{O}{\rightarrow}O$	$CH_3-CH_2-N\overset{O}{\rightarrow}O$
13	Amine	$C_nH_{2n+3}N$	$CH_3–NH_2$	$CH_3–CH_2–NH_2$

NOMENCLATURE OF ORGANIC COMPOUND

Mainly three system are adopted for naming of an organic compound :

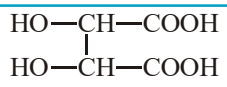
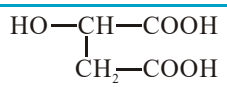
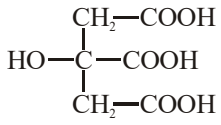
(a) Common Name or Trivial Name System

(b) Derived Name System

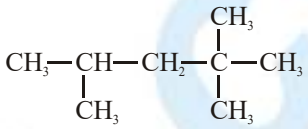
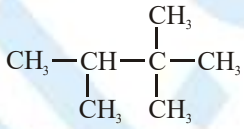
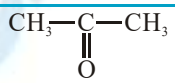
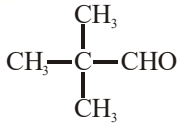
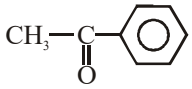
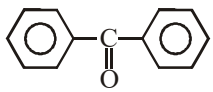
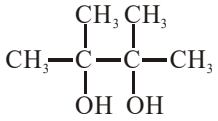
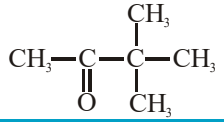
(c) IUPAC name of Geneva name System

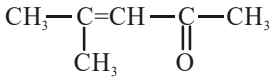
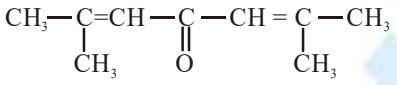
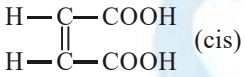
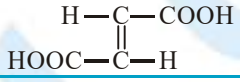
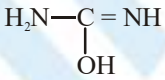
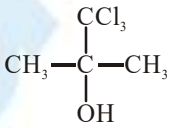
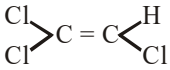
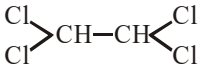
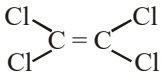
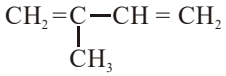
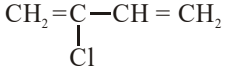
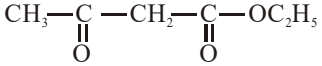
Some Common Names Based and Source

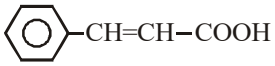
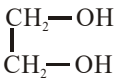
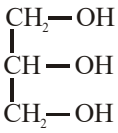
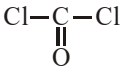
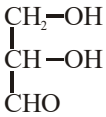
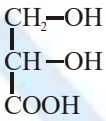
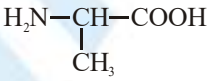
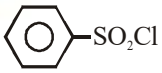
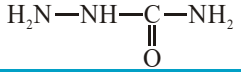
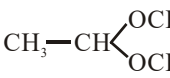
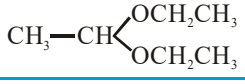
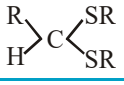
S.No.	Compound	Common Name	Source
1	CH_4	Marsh gas (Free damp)	Marshy places
2	CH_3OH	Wood spirit (Carbinol)	Destructive distillation of wood
3	CH_3CH_2OH	Grain alcohol	Grain
4	$NH_2-\overset{\overset{O}{\|}}{C}-NH_2$	Urea (Carbamide)	Urine
5	HCOOH	Formic acid	Formica (Red ants)
6	CH_3COOH	Acetic acid	Acetum (Vinegar)
7	HOOC–COOH	Oxalic acid	Oxalis plant
8	$CH_3-\underset{\underset{OH}{\|}}{CH}-COOH$	Lactic acid	Lactum (Milk)
9	$CH_3CH_2CH_2COOH$	Butyric acid	Butter

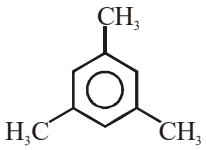
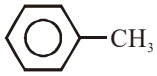
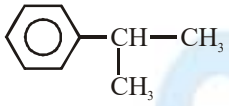
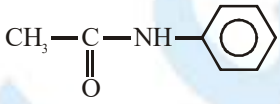
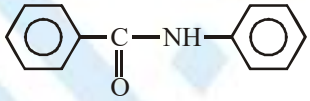
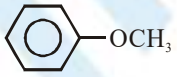
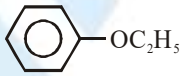
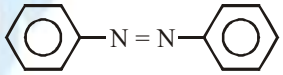
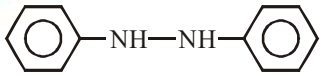
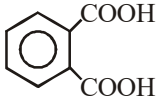
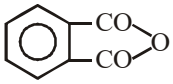
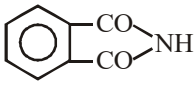
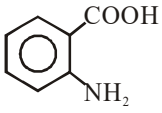
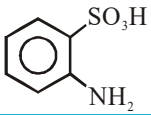
10		Tartaric acid	Tamarind
11		Malic acid	Malum (Apple)
12		Citric acid	Citron (Lemon)

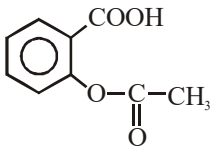
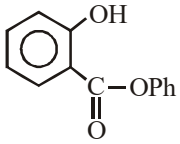
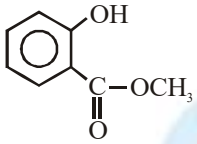
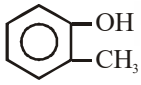
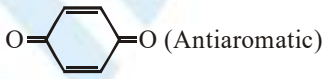
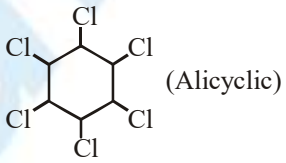
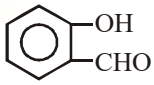
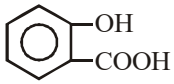
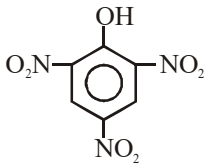
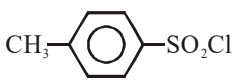
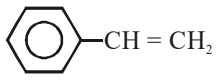
Some Frequently Used Common Names (To be Remember)

S.No.	Common Name	Structure Formula
1	Isooctane	
2	Triptane	
3	Ethylene	$H_2C=CH_2$
4	Acetylene	$HC\equiv CH$
5	Allylene	$HC\equiv C-CH_3$
6	Crotonylene	$CH_3-C\equiv C-CH_3$
7	Allene	$CH_2=C=CH_2$
8	Ketene	$CH_2=C=O$
9	Acetone or Dimethyl Ketone	
10	Pivaldehyde	
11	Chloral	Cl_3C-CHO
12	Acrolein or Acryl aldehyde	$CH_2=CH-CHO$
13	Acetophenone or Methyl phenyl Ketone	
14	Benzophenone or Diphenyl Ketone	
15	Pinacol	
16	Pinacolone	

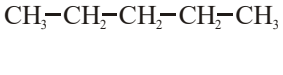
17	Mesityl oxide (Dimer of acetone)	
18	Phorone (Trimer of acetone)	
19	Oxalic acid	HOOC–COOH
20	Malonic acid	HOOC–CH_2–COOH
21	Succinic acid	HOOC–$(CH_2)_2$–COOH
22	Gluteric acid	HOOC–$(CH_2)_3$–COOH
23	Adipic acid	HOOC–$(CH_2)_4$–COOH
24	Pimelic acid	HOOC–$(CH_2)_5$–COOH
25	Maleic acid	 (cis)
26	Fumaric acid	 (trans)
27	Cyanic acid	HO–C≡N
28	Isocyanic acid (Tautomer of cyanic acid)	O=C=NH
29	Isourea (Tautomer of urea)	
30	Chloroform (Anaesthetic agent)	$CHCl_3$
31	Chloropicrin (Nitro Chloroform)	$Cl_3C–NO_2$
32	Chloretone (Chloroform + acetone)	
33	Pyrene (Fire - extinguisher)	CCl_4
34	Westrosol or Triclene	
35	Westron	
36	Tetraclene or Perclene	
37	Isoprene	
38	Chloropene (Monomer of Neoprene Polymer)	
39	AAE (Aceto acetic ester) or EAA (Ethyl aceto acetate)	
40	Acrylic acid	CH_2=CH–COOH
41	Crotonic acid	CH_3–CH=CH–COOH

42	Cinnamic acid	
43	Glycol	
44	Glycerol	
45	Phosgene or Carbonyl chloride	
46	Glyceraldehyde	
47	Glyceric acid	
48	Glyoxal	
49	Glycine	$H_2N–CH_2–COOH$
50	α-Alanine	
51	Tilden reagent	Cl–N=O
52	Grignard reagent	R–MgX
53	Frankland reagent	R–Zn–R
54	Hinsberg reagent (used in N-compounds)	
55	Mustard Gas (Explosive used in I-world war)	$Cl–CH_2–CH_2–S–CH_2–CH_2–Cl$
56	Lewisite (Explosive used in II-world war)	$Cl–CH=CH–AsCl_2$
57	Semicarbazide	
58	Schiff's Base of Anil	R–CH=N–R
59	Methylal	
60	Ethylal	
61	Mercaptal	
62	Mercaptol	

63	Mercaptan	R–SH
64	Mercaptide	R–S–R
65	Mesitylene	
66	Toluene	
67	Cummene or Isopropyl benzene	
68	Acetanilide	
69	Benzanilide	
70	Anisole	
71	Phenetole	
72	Azo benzene	
73	Hydrozo benzene	
74	Phthalic acid	
75	Phthalic anhydride	
76	Phthalimide	
77	Anthranilic acid	
78	Sulphanilic acid (Forms zwitter ion)	

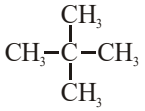
79	Aspirin (Analgesic) or o-Acetoxy benzoic acid	
80	Salol (Antiseptic) or Phenyl salicylate	
81	Oil of wintergreen or Methyl salicylate	
82	o-Cresol	
83	o-Toluic acid	
84	o-Toluidene	
85	p-Benzoquinone	
86	Gammexane or Lindane or BHC (Benzene hexachloride)	
87	Salicylaldehyde	
88	Salicylic acid	
89	Picric acid	
90	Tosyl chloride	
91	Styrene	
92	o-Xylene	

Systematic common name of hydrocarbons

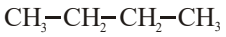


n-Pentane

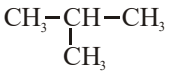
Isopentane



Neopentane

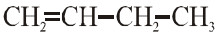


n-Butane

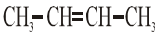


Isobutane

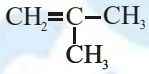
Propane



α-Butylene



β-Butylene



Isobutylene

ETOOS KEY POINTS

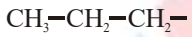
(i) prefix "n" is used for unbranched carbon chain.

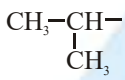
(ii) prefix 'iso' is used when one methyl groups are attached on 2nd carbon from either terminal.

(iii) prefix "neo' is used when two methyl groups are attached on 2nd carbon from either terminal.

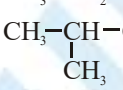
(iv) Prefix "α/β" is used to locate the position of double bond.

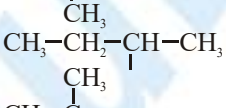
Common names of hydrocarbon radicals

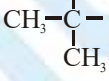
n-Propyl 

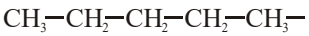
Iso propyl 

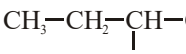
n-butyl 

Isobutyl 

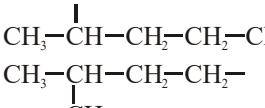
s-butyl 

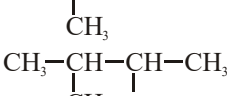
t-Butyl 

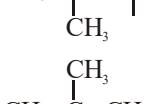
n-Pentyl 

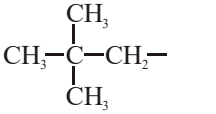
s-Pentyl 

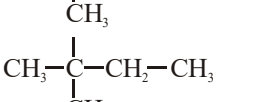
Active s-pentyl

Isopentyl 

Active isopentyl 

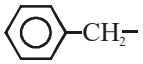
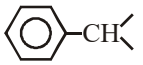
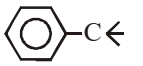
Neopentyl 

t-pentyl 

Active pentyl 

Vinyl	$CH_2=CH-$
Allyl	$CH_2=CH-CH_2-$
Propargyl	$HC\equiv C-CH_2-$

CH_2-CH_2	Ethylene
$CH_3-CH<$	Ethylidene
$CH_3-C\equiv$	Ethylidyne

Phenyl	 or Ph–
Benzyl	
Benzal of Benzylidene	
Benzo of Benzylidyne	

Common Names of hydrocarbon derivatives

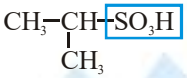
For systematic common names of these compounds we are dividing whole functional groups in following two system

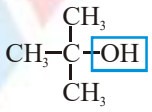
System – I

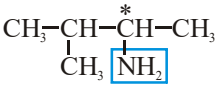
In this system prefix is decided by hydrocarbon radical (as discussed above) and suffix is given by following table

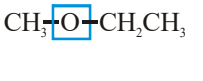
S. No.	Functional Group	Suffix
1	$-SO_3H$	sulphonic acid
2	–OH	alcohol
3	–SH	thioalcohol
4	$-NH_2/-NH-/-\underset{|}{N}-$	amine
5	–O–	ether
6	–S–	thioether
7	–X	halide
8	$-\underset{\underset{O}{\|\|}}{C}-$	ketone
9	-C≡N	cyanide
10	$-N\overset{\rightarrow}{\equiv}C$	isocyanide

Ex.

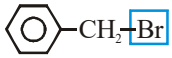

Isopropyl sulphonic acid

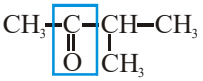

t-Butyl alcohol

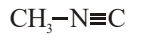

Active isopentyl amine
or
Active isoamyl amine


Ethyl methyl ether

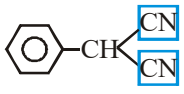

Triethyl amine

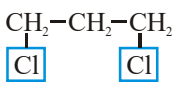

Benzyl bromide

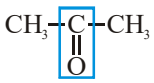

Isopropyl methyl ketone


Methyl isocyanide


Propargyl vinyl thioether


Benzal (di) cyanide


Trimethylene
chloride

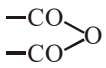
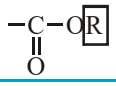

Dimethyl ketone
or
Acetone

System - II

In this system prefix is decided by total number of carbon atoms in the compound

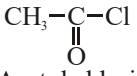
If total carbon	⇒	One	Two	Three	Four	Five
Prefix	⇒	Form	Acet	Propion	Butyr	Valer

And suffix is given following table :

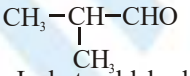
S. No.	Functional Group	Suffix
1	–COOH	ic acid
2		ic anhydride
3		Alkyl..... ate
4	–COX	yl halide
5	$-CONH_2$	amide
6	–CHO	aldehyde
7	–C≡N	onitrile
8	–N⇉C	oisonitrile

Ex.

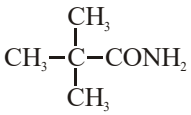
Formic Acid



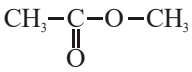
Acetyl chloride



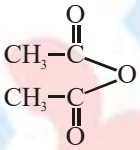
Isobutyraldehyd



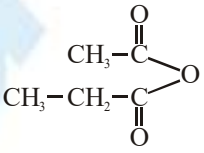
Neovaleramide



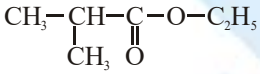
Methyl acetate



Acetic anhydride



Acetic propionic anhydride



Ethyl isobutyrate

EDUBULL KEY POINTS

(i) Prefix "Acryl" is used for the compounds which have total three carbon atoms and double bond is on 2nd carbon. (only for system II groups)

Ex.

$CH_2=CH-COOH$	Acrylic acid
$CH_2=CH-CHO$	Acryl aldehyde
$CH_2=CH-CONH_2$	Acrylamide

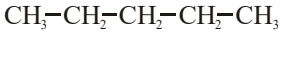
(ii) Prefix "Croton" is used for the compounds which have total four carbon atoms and double bond is on 2nd carbon. (only for System groups)

Ex.

$CH_3-CH=CH-COOH$	Crotonic acid
$CH_3-CH=CH-CHO$	Croton aldehyde
$CH_3-CH=CH-COCl$	Crotonyl chloride

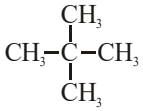
(iii) Prefix "Pyruv" is used when is directly attached with (system II) functional groups.

Systematic common name of hydrocarbons

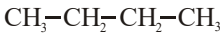


n-Pentane

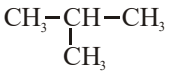
Isopentane



Neopentane

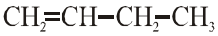


n-Butane

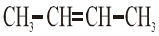


Isobutane

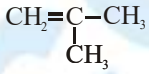
Propane



α-Butylene



β-Butylene



Isobutylene

EDUBULL KEY POINTS

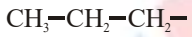
(i) prefix "n" is used for unbranched carbon chain.

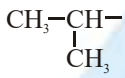
(ii) prefix 'iso' is used when one methyl groups are attached on 2nd carbon from either terminal.

(iii) prefix "neo' is used when two methyl groups are attached on 2nd carbon from either terminal.

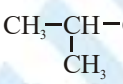
(iv) Prefix "α/β" is used to locate the position of double bond.

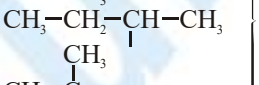
Common names of hydrocarbon radicals

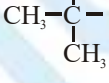
n-Propyl 

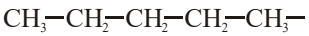
Iso propyl 

n-butyl 

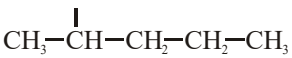
Isobutyl 

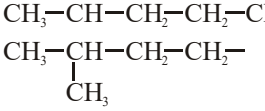
s-butyl 

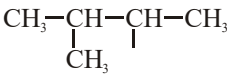
t-Butyl 

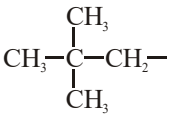
n-Pentyl 

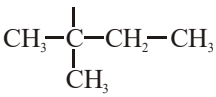
s-Pentyl 

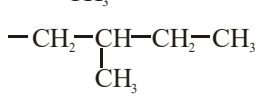
Active s-pentyl 

Isopentyl 

Active isopentyl 

Neopentyl 

t-pentyl 

Active pentyl 

Alkenes : Alkenes are open chain unsaturated hydrocarbons and having carbon-carbon double bonds (C = C). They have the general formula C_nH_{2n} where n = 2, 3, 4, ... etc. These are also called alkylenes or olefins. The first three members are generally named by their common names.

Ex.

$CH_2=CH_2$	$CH_3-CH=CH_2$	$CH_3-CH_2-CH=CH_2$	$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH_2$
ethylene	propylene	butylene	Isobutylene

Alkenyl groups : Like alkyl groups (alkane – H), there are three commonly encountered alkenyl groups which are given common names.

Ex. $CH_2=CH_2 \xrightarrow{\text{remove H}} \underset{\text{vinyl group}}{CH_2=CH-}$

$\overset{1}{CH_2}=\overset{2}{CH}-\overset{3}{CH_3}$ — remove H from C_3 → $CH_2=CH-CH_2-$ allyl group; remove H from C_2 → $CH_2=\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}-$ Isopropenyl group

Alkynes : Unsaturated aliphatic hydrocarbons containing a carbon – carbon triple bond are called alkynes. In the common system, they are called acetylenes, after the name of the first member of this family. (i.e. acetylene)

General formula : C_nH_{2n-2}
where n = 2, 3, 4, ... etc.

Common Names : Acetylene and its alkyl derivatives.

IUPAC names : Alkane – ane + yne = Alkyne

The position of the triple bond on the parent chain is designated by lowest possible arabic numerals

The common names of a few simple alkynes are given below.

$n=2 \longrightarrow CH\equiv CH$	Acetylene
$n=3 \longrightarrow CH_3-C\equiv CH$	Methyl acetylene
$n=4 \longrightarrow CH_3-CH_2-C\equiv CH$	Ethylacetylene
$n=6 \longrightarrow CH_3-C\equiv C-CH\begin{matrix}\nearrow CH_2\\ \searrow CH_3\end{matrix}$	Methyl isopropyl acetylene

Alkynyl groups

$HC\equiv CH \xrightarrow{-H} \underset{\text{(-e+yl=Ethynyl)}}{HC\equiv C-}$

$H_3C-C\equiv CH \xrightarrow{-H} \underset{\text{(-e+yl=propynyl)}}{H_3C-C\equiv C-}$

FUNCTIONAL GROUP AND RESIDUE

The characteristic group of atom which decided the physical and chemical properties of an organic molecule is called functional group.

Functional group is that portion of molecule which is highly reactive and takes part in chemical reactions. Rest of the molecule is called Residue.

Ex. $\underset{\text{Residue}}{CH_3CH_2CH_2CH_2-}\underset{\text{Functional Group}}{COOH}$

Examples of Compound containing different functional groups with common /trivial names

No. of carbon atoms	Prefix	–CHO (Aldehyde)	–COOH(–ic acid)	–COCl.(–yl chloride)	$-CONH_2$ (Amide)
1	Form	HCHO Formaldehyde	HCOOH Formic acid	HCOCl Formyl chloride	$HCONH_2$ Formamide
2	Acet	CH_3CHO Acetaldehyde	CH_3COOH Acetic acid	CH_3COCl Acetyl chloride	$CH3CONH_2$ Acetamide
3	Propion	CH_3CH_2CHO Propion aldehyde	CH_3CH_2COOH Propionic acid	CH_3CH_2COCl Propionyl chloride	$CH_3CH_2CONH_2$ Propionamide
4	Butyr	$CH_3CH_2CH_2CHO$ n-Butyraldlehyde	$CH_3CH_2CH_2COOH$ n-Butyric acid	$CH_3CH_2CH_2COCl$ n-Butyryl chloride	$CH_3CH_2CH_2CONH_2$ n-Butyramide
5	Valer	$CH_3CH_2CH_2CH_2CHO$ n-Valeraldlehyde	$CH_3CH_2CH_2CH_2COOH$ n-Valeric acid	$CH_3CH_2CH_2CH_2COCl$ n-Valeryl chloride NH_2	$CH_3CH_2CH_2CH_2CO$ n-Valeramide
3C+1 Double bond	Acryl	CH_2=CH–CHO Acrylaldehyde	CH_2=CH–COOH Acrylic acid	CH_2=CH–COCl Acryl chloride	CH_2=CH–$CONH_2$ Acrylamide
4C + 1 Double bond (at 2nd carbon atom)	Croton	CH_3–CH=CH–CHO Crotonaldehyde	CH_3CH_2= CH–COOH Crotonic acid	CH_3CH_2=CH–COCl Crotonyl chloride	CH_3CH_2= CH–$CONH_2$ Crotonamide

No. of Carbon atoms	Prefix	–CN(–O nitrile)	–N≅C (Oisonitrile) If Suffix isocyanide is is used than. Carbon atom of –NC not counted. If suffix carbyl amine is used. Carbon atom of –NC not counted. If O-isonitrile is used→ Carbon atom of –NC counted.	–COOR Ester
1	Form	H–C≡N Formonitrile	H–N≅C Formoisonitrile	$HCOOCH_3$ Methyl formate
2	Acet	CH_3C≡N Acetonitrile	CH_3–N≅C Acetoisonitrile	CH_3COOCH_3 Methyl acetate
3	Propion	CH_3CH_2C≡N Propionitrile	CH_3CH_2N≅C Propionisonitrile	$CH_3CH_2COOCH_3$ Methyl propionate
4	Butyr	$CH_3CH_2CH_2$ C≡N n-Butyronitrile	$CH_3CH_2CH_2$ N≅C n-Butyroisonitrile	$CH_3CH_2CH_2COOCH_3$ Methyl n-butyrate

5	Valer	$CH_3CH_2CH_2CH_2C{\equiv}N$ n-Valeronitrile	$CH_3CH_2CH_2CH_2N{\equiv}C$ n-Valeroisonitrile	$\left[\begin{array}{l}CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-COOCH_3\end{array}\right]$ Methyl isovalerate
3C+1 Double bond	Acryl	$CH_2{=}CH{-}C{\equiv}N$ Acrylonitrile	$CH_2=CH{-}NC$ Acrylisonitrile	$CH_2=CHCOOCH_3$ Methyl acrylate
4C + 1 Double bond (at 2nd carbon atom)	Croton	$CH_3CH{=}CH{-}C{\equiv}N$ Crotononitrile	$CH_3{-}CH{=}CH{-}NC$ Crotonoisonitrile	$CH_3CH{=}CHCOOCH_3$ Methyl crotonate

Other Example

1. $H-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-H$ Formic anhydride

2. $CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3$ Acetic anhydride

3 $H-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3$ Acetic formic anhydride

4 $H-\overset{O}{\overset{\|}{C}}-O-C_2H_5$ Ethyl formate

5 $CH_3-\underset{\displaystyle O}{\overset{\displaystyle O}{\overset{\|}{C}}}-CH_3$ Dimethyl ketone or acetone

6 $CH_3-\underset{\displaystyle O}{\overset{\displaystyle O}{\overset{\|}{C}}}-CH_2-CH_3$ Ethylmethyl ketone

7 $CH_3{-}CH_2{-}NH{-}CH_3$ Ethyl methyl amine or N–Methylaminoethane

8 $(CH_3)_3N$ Trimethylamine or, N, N–Dimethyl aminomethane

SOME COMMON NAME OF HYDROCARBON ALKYL GROUPS

(A) Iso alkyl group

A compound having $-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_3$ group is called iso alkyl group

Ex.

$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-$ Iso propyl

$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-$ Iso butyl

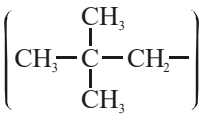
$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-CH_3$ Iso pentane

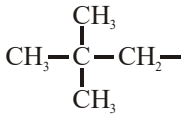
Note : Iso alkyl group name can be used in IUPAC Nomenclature and its first letter 'I' is consider for alphabetical seniority.

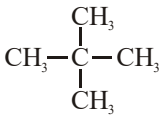
Ex. $\overset{1}{CH_3}-\underset{\displaystyle CH_3}{\overset{2}{\underset{\vert}{CH}}}-\overset{3}{\underset{\displaystyle CH}{\underset{\vert}{CH}}}-\overset{4}{CH_2}-\overset{5}{CH_2}-\overset{6}{CH_3}$ 3-Isopropyl-2-methylhexane

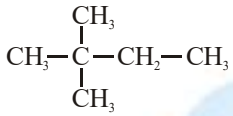
CH_3-CH_3

(B) Neo alkyl group

Compound having  group is called neo alkyl group.

Ex.  Neopentyl

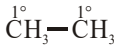
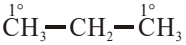
 Neopentane

 Neohexane

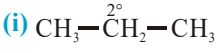
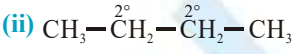
(C) Type of carbon and hydrogen atoms in alkanes

The carbon atoms in an alkane molecule may be classified into four types as primary (1°), secondary (2°), tertiary (3°) and quaternary (4°) as follows

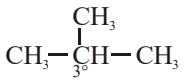
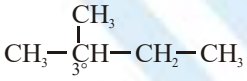
(a) A carbon atom attached to one another (or no other) carbon atom is called a primary carbon atom and is designated as 1° carbon.

Ex. **(i)**  **(ii)** 

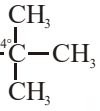
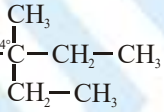
(b) A carbon atom attached to two other carbon atom is called a secondary carbon atom and is designated as 2° carbon.

Ex. **(i)**  **(ii)** 

(c) A carbon atom attached to three other carbon atoms is called a tertiary carbon atom and is designated as 3° carbon.

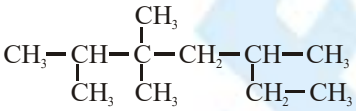
Ex.  **(ii)** 

(d) A carbon atom attached to four other carbon atom is called a quaternary carbon atom and is designated as 4° carbon.

Ex. **(i)**  **(ii)** 

The hydrogen atoms attached to 1°, 2°, and 3° carbon atoms are called primary (1°) secondary (2°) and tertiary (3°) hydrogen atoms. It may be rotated here that there is nothing like quaternary hydrogen atom. Since a quaternary carbon does not carry any hydrogen.

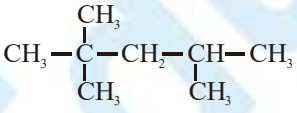
Ex. How many 1°, 2°, 3° and 4° carbon atoms are present in following molecule.

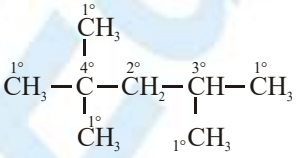


Sol. 1° Carbon atoms = 6, 2° Carbon atoms = 2, 3° Carbon atoms = 2, 4° Carbon atom = 1

Note : Primary, secondary, tertiary & quaternary carbon atoms in a molecule are denoted by the letters p, s, t and q respectively.

Ex. How many 1°, 2°, 3° and 4° carbon atoms are present in following molecule.



Sol. 

1° Carbon atoms = 5, 2° Carbon atom = 1, 3° Carbon atom = 1, 4° Carbon atom = 1

Alkylidene group

alkane $\xrightarrow[\text{from same carbon}]{-2H}$ Alkylidene -

Alkylene group

alkane $\xrightarrow[\text{from different carbon}]{-2H}$ Alkylene -

Position of double bond

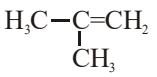
In an unsaturated hydrocarbon if the position of double bond is on 1st or last carbon then it's prefix will be α (alpha) if it is on 2nd carbon it is termed as β (Beta) & the γ (gamma) & δ (delta) and so on.

Ex. $H_2C = CH - CH_2 - CH_3$ α = butylene

$H_3C - CH = CH - CH_3$ β = butylene

$H_3C - CH_2 - CH = CH_2$ α - butylene

$H2C = CH - CH_3$ or $H_3C = CH = CH_2$ (Both are same positions, propylene)



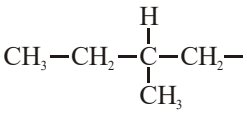
Isobutylene

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

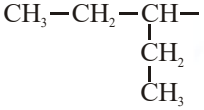
$CH_3 - CH_2 - CH_2 - CH = CH - CH_2 - CH_2 - CH_3$

δ - octylene

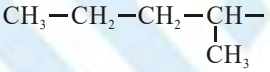
Amyl group



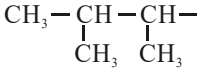
Active amyl



Secondary amyl



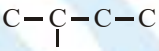
Active secondary amyl

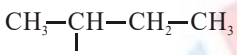


Active iso secondary amyl

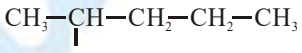
Secondary group

(a) The carbon having free valency attached to two carbon is called secondary carbon.

(b) It is represented by following structure . 

Ex. **(i)** 

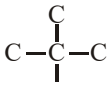
(secondary butyl)

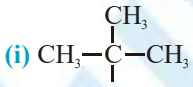
(ii) 

(secondary pentyl)

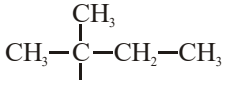
Tertiary group

(a) The carbon having free valency attached to three other carbon.

(b) It is represented by following structure - 

Ex. **(i)** 

(Tertiary butyl)

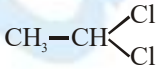


(Tertiary pentyl)

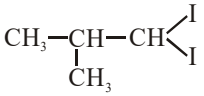
Common – Naming of Dihalides

(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.

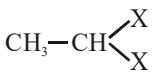
Ex. 

Ethylidene chloride



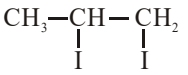
Isobutylidene Iodide

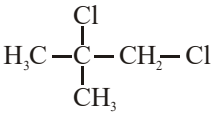
Exception : Methylidene halide (wrong)



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.

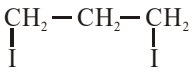
Ex.  Propylene Iodide

 Isobutylene chloride

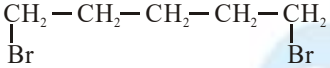
(d) When two same halogen atoms are attached at the two ends of a carbon chain its common naming will be polymethylene halide.

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

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

Ex. 

Trimethylene Iodide



Pentamethylene Bromide

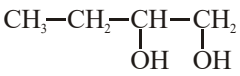
Exception :

CH_2-X dimethylene halide (wrong)

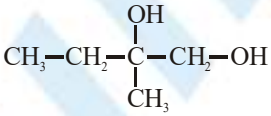
CH_2-X ethylene halide (right)

Common – Naming of Di–Hydroxy Compounds

(a) When two-OH groups are attached to adjacent carbon atoms they are termed as alkylene glycol.



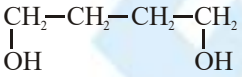
Butylene glycol



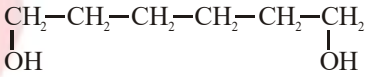
Active amylene glycol

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

Poly → Number of CH_2 groups.

Ex. 

Tetra methylene glycol



Hexamethylene glycol

Exception :

CH_2-OH Dimethylene glycol (wrong)

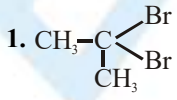
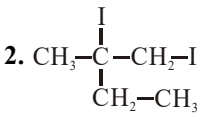
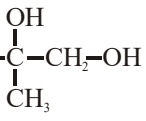
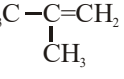
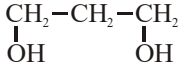
CH_2-OH Ethylene glycol (right)

PROBLEMS

Make the structure of following organic compounds –

1. Isopropylidene Bromide
2. Active amylene Iodide
3. Isobutylene glycol
4. Isobutylene
5. Trimethylene glycol

ANSWERS

1. 
2. 
3. 
4. 
5. 

Common - Naming of the Functional Group Having Carbon

(Common naming for Hydrocarbon derivatives)

S. No.	Functional group	Suffix
(i)	$-\overset{\overset{O}{\|\|}}{C}-OH$	-ic Acid
(ii)	$-\overset{\overset{O}{\|\|}}{C}-O-\overset{\overset{O}{\|\|}}{C}-$	- ic anhydride
(iii)	$-\overset{\overset{O}{\|\|}}{C}-O-R$	-ate
(iv)	$-\overset{\overset{O}{\|\|}}{C}-NH_2$	amide
(v)	$-\overset{\overset{O}{\|\|}}{C}-X$	-yl halide
(vi)	$-\overset{\overset{O}{\|\|}}{C}-H$	-aldehyde
(vii)	$-C\equiv N$	-o-nitrile
(viii)	$-N\rightleftharpoons C$	-o-isonitrile

Prefix

1 Carbon → Form –

2 Carbon → Acet –

3 Carbon → Propion –

4 Carbon → Butyr → Normal, Iso

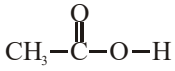
5 Carbon → Valer → Normal-, Iso, Secondary-, Tertiary-

3 X + (=) double bond = Acryl -

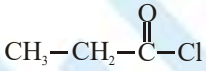
4 C + double bond = Croton-

Ex.

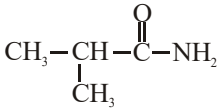
Formaldehyde



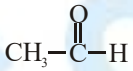
Acetic Acid



Propionyl chloride

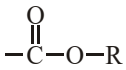


Isobutyramide



Acetaldehyde

Nomenclature of Ester



The group which is attached to the oxygen is written as alkyl & the remaining structure is named on the basis of Functional Group suffix.

Ex. (i)  Methyl formate

(ii)  Methyl formate

(iii)  Acetic acid

(iv)  Methyl acetate

(v)  Ethyl acetate

(iv)  Ethyl propionate

(vii)  Ethyl acrylate

(viii)  Methyl crotonate

Nomenclature of Anhydride

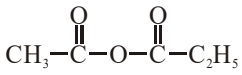
Rule : Add the total number of carbon atoms & divide it by 2, the substrate will give you the number of C- atom. Now name it according to suffix use for anhydride.

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

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

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

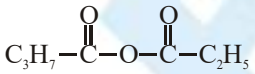
If $R \neq R'$, You need to find out substrate.

Ex. 

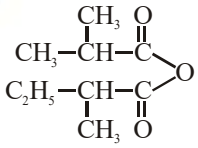
Acetic propionic anhydride (right)

Propionic Acetic anhydride (wrong)

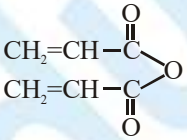
Divide it in two parts as above & name it by suffixing ic anhydride (alphabetically)

Ex. 

Butyric propionic anhydride

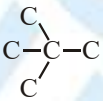
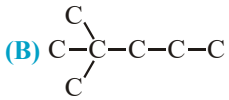
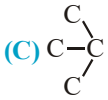
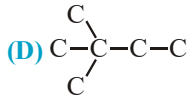


Isobutyric Secondary valeric anhydride



Acrylic anhydride

Ex. Which of the following is not a neo structure –

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

Ans. C

Sol. A carbon must be a attached with four carbons.

Ex. Acryl aldehyde is -

(A) Asaturated aldehyde **(B)** An alkene

(C) A polymer **(D)** An unsaturated aldehyde

Ans. **(D)**

Sol. $CH_2 = CH - CHO$ unsaturated aldehyde.

Ex. The common name of the compound $CH_2=CH-\overset{\overset{O}{\|}}{C}-CH=CH_2$ is -

(A) Divinyl ketone **(B)** Diallyl ketone **(C)** Both A and B **(D)** None

Ans. **(A)**

Sol. $CH_2 = CH-$ is called as vinyl group.

Ex. Common name of $CH_2 = CH - CN$ is :

(A) acrylonitrile **(B)** vinyl cyanide **(C)** allyl cyanide **(D)** allyl nitrile

(A) a, b and d **(B)** a and b **(C)** only b **(D)** a, b and c

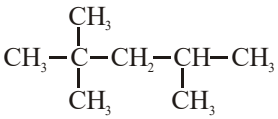
Ans. **(B)**

Ex. The number of possible alkyl groups of iso octane are –

(A) 1 **(B)** 3 **(C)** 5 **(D)** 6

Ans. **(B)**

Sol.

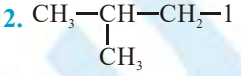


$1 + 1 + 1 = 3$

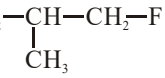
Ex. Write the common names of the followig compounds

1. $CH_3 - CH_2 - CN$

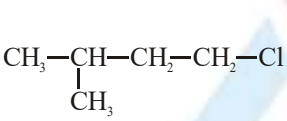
2.



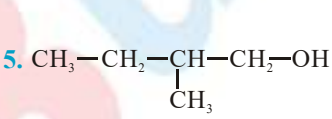
3.



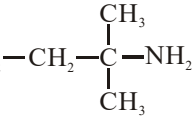
4.



5.

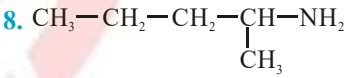


6.

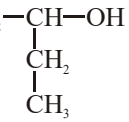


7. $CH_2 = CH - SH$

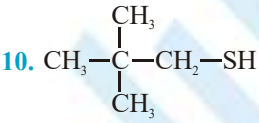
8.



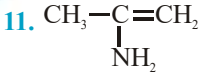
9.



10.



11.



12. $CH \equiv C - CH_2 - Br$

ANSWERS

Sol. 6 ⇒ **1.** Ethyl cyanide

2. Isobutyl Iodide

3. Active amyl fluoride

4. Iso pentyl chloride

5. Active amyl alcohol

6. Tertiary hexyl amine

7. Vinyl thio alcohol

8. Active seoncdary amyl amine

9. Secondary amyl alcohol.

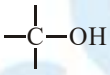
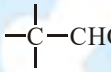
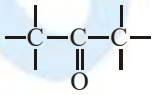
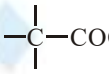
10. Neopentyl thio alcohol

11. Isopropenyl amine

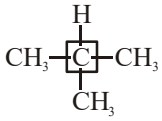
12. Propargyl Bromide

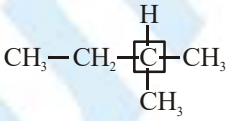
Derived Name System

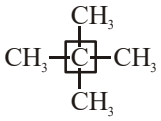
According to this system name of any compound is given according to the representative compound of the homologous series. This system is reserved for following homologous series :

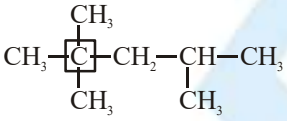
Series	Name of Homologous series	Name of Representative compound	Structure of group
1	Alkane	Methane	
2	Alkene	Ethylene	>C=C<
3	Alkyne	Acetylene	–C≡C–
4	Alcohol	Carbinol	
5	Aldehyde	Acetaldehyde	
6	Ketone	Acetone	
7	Carboxylic acid	Acetic acid	

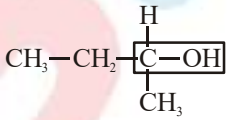
Ex.

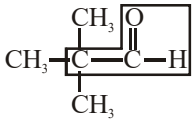

Trimethyl methane

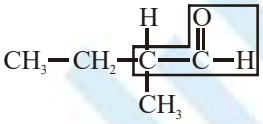

Ethyl dimethyl methane

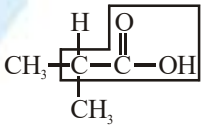

Tetramethyl methane

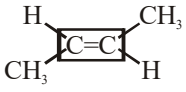

Isobutyl Isopropyl methane

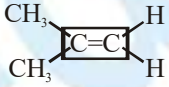

Ethylmethyl carbinol

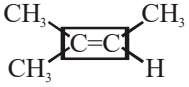

Trimethyl acetaldehyde

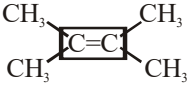

Ethylmethyl acetaldehyde

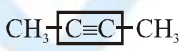

Dimethy acetic acid


Symmetrical dimethyl ethylene


Unsymmetrical dimethyl ethylene


Trimethyl ethylene


Tetramethyl ethylene


Dimethyl acetylene

Types of Ethylene :- (Symmetrical & Unsymmetrical)

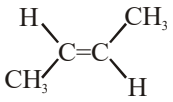
(a) **Symmetrical** : - In the given two alkyl groups one group is attached to the one carbon of ethylene & next on the carbon.

(b) **Unsymmetrical** : - When both the given groups are attached on the same carbon.

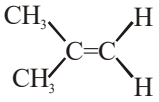
Note : Symmetrical & Unsymmetrical : Terms are used only when two alkyl groups are given.

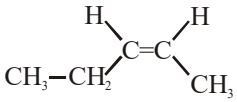
Ex.

Symmetrical dimethyl ethylene

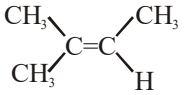


Unsymmetrical dimethyl ethylene

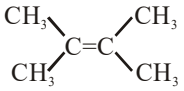




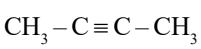
Symmetrical ethyl methyl ethylene



Tri methyl ethylene



Tetra methyl ethylene

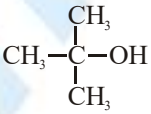


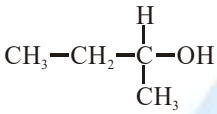
Dimethyl acetylene

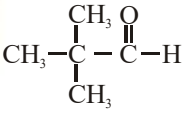
PROBLEMS

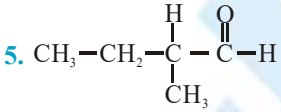
Write down the derived names of the following compounds

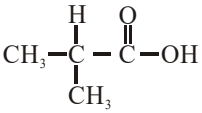
1.

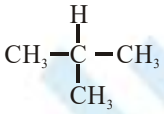
2. 

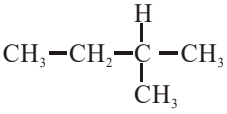
3. 

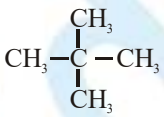
4. 

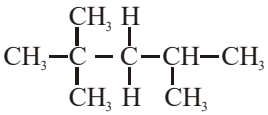
5. 

6. 

7. 

8. 

9. 

10. 

ANSWERS

1. Allyl acetylene
2. Tri methyl carbinol
3. Ethyl methyl carbinol
4. Tri methyl acetaldehyde
5. Ethyl methyl acetaldehyde
6. Di methyl acetic acid
7. Tri methyl methane
8. Ethyl di methyl methane
9. Tetra methyl methane
10. Tertiary butyl Isopropyl methane.

IUPAC NOMENCLATURE OR GENEVA NAME SYSTEM

- 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**

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

The name consists of three parts :-

Prefix + **Word root** + **Suffix**

Prefix		Word root	Suffix	
Secondary [Detail of substituents]	Primary [Nature of Carbon chain cyclic/acylic]	[No. of carbon atoms in the principal chain]	Primary [Nature of carbon carbon bond]	Secondary [Details of functional group]

Primary Prefix : It represents the nature of the principle /parent chain.

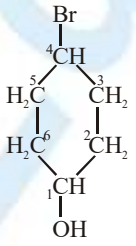
Nature of chain	Primary Prefix
Acyclic /Non-cyclic	–
Cyclic	Cyclo
Bicyclic	Bicyclo
Tricyclic	Tricyclo
Spiro	Spiro

Secondary Prefix : In IUPAC system of nomenclature, certain groups are not considered as functional groups but 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 substituent groups (regardless of the fact whether the organic compounds is monofunctional or polyfunctional) are given below :

Substituent group	Secondary prefix	Substituent group	Secondary prefix
– F	Fluoro	$-OCH_3$ (– OMe)	Methoxy
– Cl	Chloro	$-OC_2H_5$(–OEt)	Ethoxy
– Br	Bromo	– R	Alkyl
– I	Iodo	$-CH_3$ (– Me)	Methyl
$-NO_2$	Nitro	$-C_2H_5$ (– Et)	Ethyl
– NO	Nitroso	$-CH_2CH_2CH_3$(n-Pr)	n-Propyl
$-\overset{\oplus}{N}\equiv N$	Diazo	$-CH(CH_3)_2$ (–iPr)	Isopropyl
– OR	Alkoxy	$-C(CH_3)_3$ (t-Bu)	t-Butyl

Organic compounds	Secondary Prefix	Word root	Primary suffix	IUPAC name
CH_3CH_2-Br	Bromo	eth	ane	Bromoethane
CH_3-NO_2	Nitro	meth	ane	Nitromethane
$C_2H_5-OC_2H_5$	Ethoxy	eth	ane	Ethoxyethane

Ex.

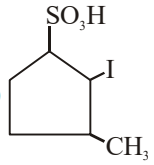


4-Bromo + cyclo + hex + an(e) + 1-ol

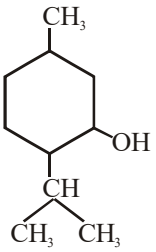
Secondary prefix + Primary prefix + Word root + Primary suffix + Secondary suffix

Ex. Write IUPAC name of following compound

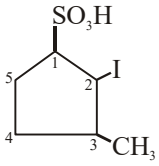
(a)



(b)



Sol. **(a)**



2-lodo-3-methylcyclopentanesulfonic acid.

Here
Secondary prefix	=	2 - lodo - 3- methyl
Primary prefix	=	cyclo
Word root	=	pent
Primary suffix	=	ane
Secondary suffix	=	sulfonic acid

(b) 2- Isopropyl - 5- methylcyclohexanol

Here
Secondary prefix	=	2-Isopropyl-5-methyl
Primary prefix	=	cyclo
Word root	=	hex
Primary suffix	=	an(e)
Secondary suffix	=	ol

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.

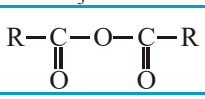
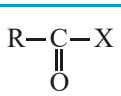
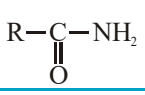
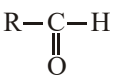
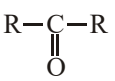
Chain length	Word root	Chain length	Word root	Chain length	Word root
C_1	Meth	C_9	Non	C_{20}	Icos
C_2	Eth	C_{10}	Dec	C_{30}	Triacont
C_3	Prop	C_{11}	Undec	C_{40}	Tetracont
C_4	But	C_{12}	Dodec	C_{50}	Pentacont
C_5	Pent	C_{13}	Tridec	C_{60}	Hexacont
C_6	Hex	C_{14}	Tetradec	C_{70}	Heptacont
C_7	Hept	C_{15}	Pentadec	C_{80}	Octacont
C_8	Oct	C_{16}	Hexadeca	C_{100}	Cent & Hect

Primary Suffix : It represents the nature of C–C bonds in the principal/parent chain (whether single bond, double bond or triple bond).

Nature of bond	Primary suffix
Saturated	
C–C single bond	ane
Nature of bond	**Primary suffix**
Unsaturated	
C = C bond	ene
C ≡ C bond	yne
2C = C bonds	diene
2C ≡ C bonds	diyne
C = C + C ≡ C	ene + yne = enyne

- If secondary suffix starts from a vowel or y then the last 'e' of first is omitted.

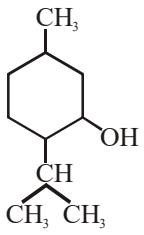
Secondary Suffix : A secondary suffix is then added to the primary suffix to indicate the nature of the functional group present in the organic compounds. Secondary suffix of important functional groups are given below in their decreasing order of seniority.

Class	Name	Suffix	Prefix
1. R – COOH	Alkanoic Acid	– oic acid (carboxylic acid)	carboxy
2. R – SO_3H	Alkane sulphonic acid	– sulphonic acid	sulpho
3. 	Alkanonic Anhydride	– oic anhydride (carboxylic anhydride)	_____
4. R – COOR	Alkyl alkanoate	–oate (carboxylate)	alkoxy carbonyl or alkanoyl oxy
5. 	Alkanoyl halide	–oyl halide (carbonyl halide)	halo carbonyl
6. 	Alkanamide	–amide (carboxamide)	carbomoyl
7. R – C ≡ N	Alkanenitrile	– nitrile (carbonitrile)	cyano
8. 	Alkanal	–al (carbaldehyde)	formyl / oxo
9. 	Alkanone	–one	oxo
10. R – OH	Alkanol	–ol	hydroxy
11. R – SH	Alkanethiol	–thiol	mercapto
12. R – NH_2	Alkanamine	– amine	amino

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

Organic compounds	Word root	Primary suffix	Secondary suffix	IUPAC name
CH_3CH_2OH	Eth	an(e)	ol	Ethanol
$CH_3CH_2CH_2NH_2$	Prop	an(e)	amine	Propanamine
$CH_3CH_2CH_2COOH$	But	an(e)	oic acid	Butanoic acid
CH_3CH_2CN	Prop	an(e)	nitrile	Propanentrile
$CH_2=CHCHO$	Prop	en(e)	al	Propenal
$HC\equiv CCOOH$	Prop	yn(e)	oic acid	Propynoic acid

Ex. Write the IUPAC name of the compound

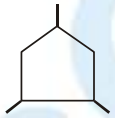


Sol. 2 – Isopropyl - 5- methylcyclohexanol or 2-(1-methylethyl)-5-methyl cyclohexanol

Here

Secondary prefix	=	2 - Isopropyl 5 – methyl
Primary prefix	=	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

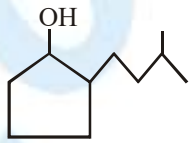
(B) 1, 3, 5-trimethyl cyclopentane

(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 Saturated Unbranched Hydrocarbon

IUPAC name = Word Root + Primary Suffix

Ex.

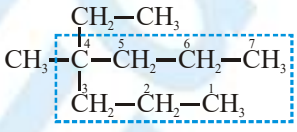
CH_4	Meth + ane	=	Methane
CH_3-CH_3	Eth + ane	=	Ethane
$CH_3-CH_2-CH_3$	Prop + ane	=	Propane
	But + ane	=	Butane
	Pent + ane	=	Pentane
	hex + ane	=	Hexane
$CH_3(CH_2)_9CH_3$	Undec + ane	=	Undecane
$CH_3(CH_2)_{28}CH_3$	Triacont + ane	=	Triacontane

IUPAC Nomenclature of Saturated Branched Chain Hydrocarbon /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.

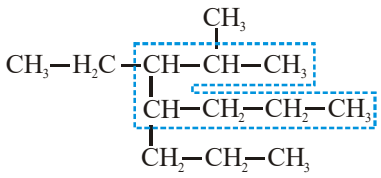
Ex.



Longest chain has 7 carbons.

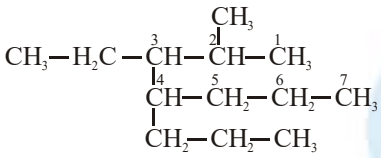
$\therefore$ It is a $\frac{\text{hept}}{\text{word root}} + \frac{\text{ane}}{\text{primary suffix}}$

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



Here the chain shown is selected.

2. Carbon atoms in the longest chain selected as above in numbered consecutively form on end to the other such that the substituents attached get the lower 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

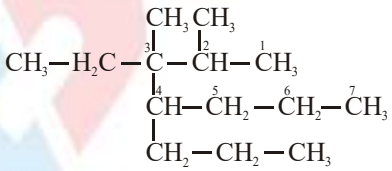
Hence, the above compound is named as :

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 :

Ex.



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.

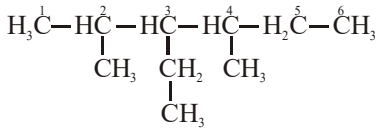
*Also, as per convention

(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)

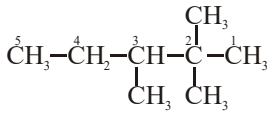
Ex. Write the IUPAC name of

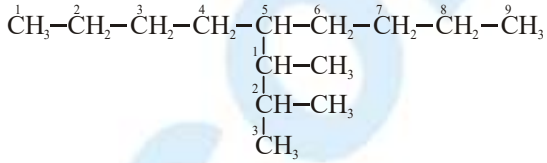


1. Primary suffix is ane as all are single bonds.
2. Chain is numbered as shown.
3. Root word is hed
4. Prefixes methyl appears twice ∴ Its is 2, 4-dimethyl and 3-ethyl
5. While arranging in alphabetical order Replicators di, tri, tetra, are not considered.

∴ **3-Ethyl-2, 4-dimethylhexane**

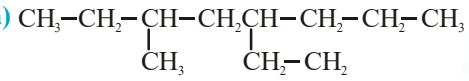
Ex. Write the IUPAC name of the following compounds.

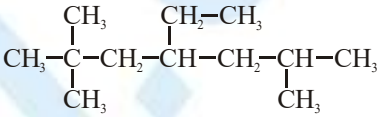
(i) 

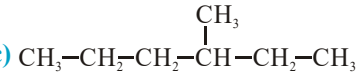
(ii) 

Sol. **(i)** 2, 2, 3-trimethylpentane
(ii) 5-(1,2-dimethylpropyl)nonane

Ex. Write IUPAC name of the following compounds –

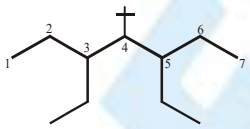
(a) 

(b) 

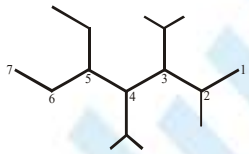
(c) 

Sol. **(a)** 5-Ethyl-3-methyloctane
(b) 4-Ethyl-2, 2, 6-trimethylheptane
(c) 3-Methylhexane

6. If Di, tri, tetra etc. are part of name of complex name then they considered in alphabetical order.



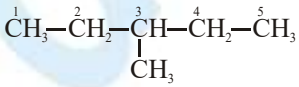
4-(1,1-Dimethyl)-3, 5-diethylheptane

7. 

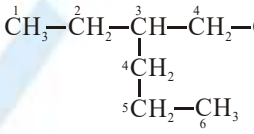
5-Ethyl-3,4-bis(1-methylethyl)-2-methylheptane

bis, tris, tetrakis are used for complex, alkyl substituents]

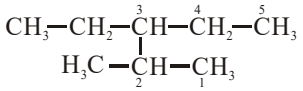
Ex.

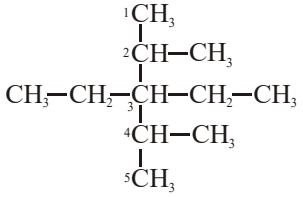
(i) 

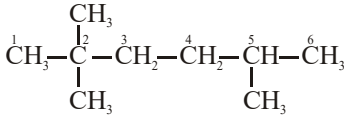
3-methylpentane

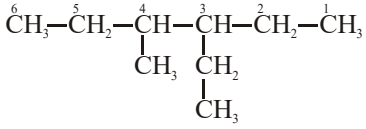
(ii) 

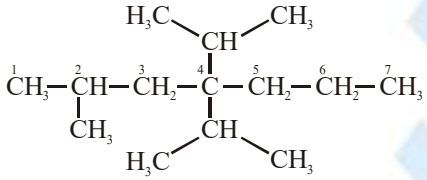
3-ethylhexane

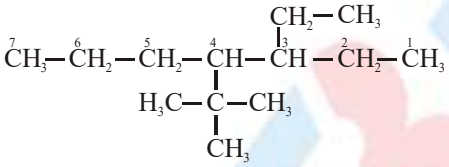
(iii)  3-ethyl-2-methylpentane

(iv)  3,3-diethyl-2,4-dimethyl-pentane

(v)  2,2,5-trimethylhexane

(vi)  3-Ethyl-4-methylhexane

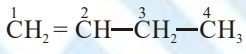
(vii)  2-methyl-4-bis(1-methyethyl)heptane

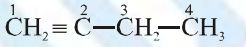
8.  4-(1,1-dimethylethyl)-3-ethylheptane

IUPAC NOMENCLATURE OF UNBRANCHED UNSATURATED HYDROCARBON (ALKENE/ALKYNE)

Numbering of carbon chain

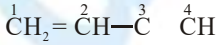
Rule :1 If unsaturated bond is present in the molecule at the terminal carbon, then numbering done from the side of unsaturated carbon.

Ex.  But -1-ene

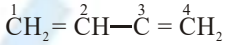
Ex.  But-1-yne

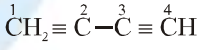
Rule:2 If unsaturated bonds like double bond and triple bond is present at terminal carbon, then numbering always done from double bonded terminal carbon.

(Double bond preferred over triple bond when both bonds are at same position)

Ex.  But-1-en-3-yne

Rule :3 If unsaturated bonds like double bond or triple bond is present at terminal carbon, then numbering is done from either way.

Ex.  But-1, 3-diene

Ex.  But-1, 3-diyne

Rule :4 If triple bond is present at terminal carbon and double bond is located at any carbon except other terminal carbon. Then numbering is done from triple bond.

$^{1}CH \equiv {}^{2}C - {}^{3}CH = {}^{4}CH - {}^{5}CH_3$ Pent -1 - en - 3- yne

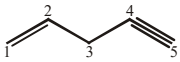
PROBLEMS

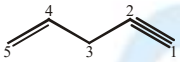
1. Correct IUPAC nomenclature of the given compound 

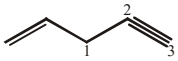
(A) Hexa-1, 5-dien-3-yne **(B)** Hex-3-yn-1, 5-diene

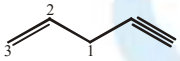
(C) Hex dieneyne **(D)** Hexeneyne

2. Which is the correct order for numbering in the given compound.

(A) 

(B) 

(C) 

(D) 

3. Write correct IUPAC name for given compound.

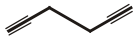
(A) Hexa-2,4-diyne **(B)** But-2,4-diyne **(C)** Pent-2,4-diyne **(D)** Tetra-2,4-diyne

4. Which is correct structure for penta-1,4-diyne

(A) 

(B) 

(C) 

(D) 

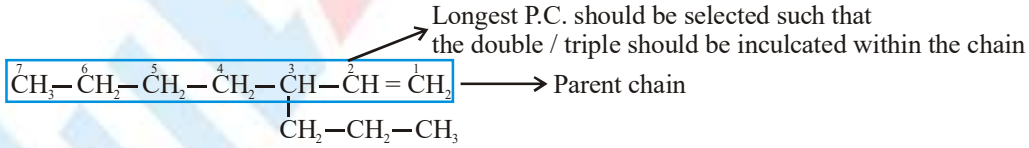
ANSWERS

1. (A) **2.** (A) **3.** (A) **4.** (A)

IUPAC NOMENCLATURE OF BRANCHED UNSATURATED HYDROCARBON (ALKENE/ALKYNE)

Longest chain

Rule - 1 If unsaturated bonds like double bond or triple bond is present in the molecule, then that parent chain is considered which is containing unsaturated bonds like double bond or triple bond.

Ex. 

Ex. $^{6}CH_3 - {}^{5}CH = {}^{4}CH - {}^{3}CH(CH_2 - CH_2 - CH_3) - {}^{2}CH = {}^{1}CH_2$

Rule : 2 A primary suffix is added to the word root to indicate presence at double or triple bond in the parent chain.

For one double bond = **Word root + locant + ene**

For one triple bond = **Word root + locant + yne**

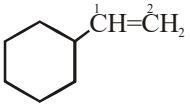
In case the parent chain contains two or more double bonds, the prefixes di, tri, tetra, etc. are used before primary suffix.

For two double bonds, = **Word root + locant + diene**

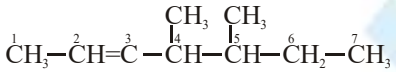
For two triple bonds = **Word root + locant + diyne**

Numbering of carbon chain

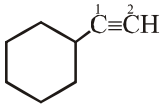
Rule : 1 In branched alkene, select that parent chain which is containing maximum unsaturated double bond or triple bond and follow property of lowest locant rule.

Ex. 

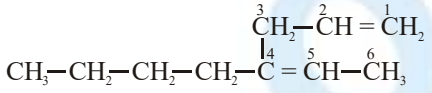
Cyclohexyl eth-1-ene

Ex. 

4, 6-dimethyl hept-2-ene

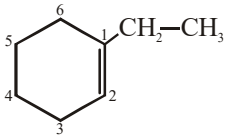
Ex. 

Cyclohexyl eth-1-yne

Ex. 

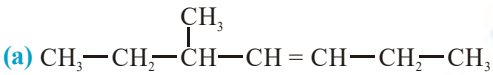
4-Butylhexa-1-4-diene

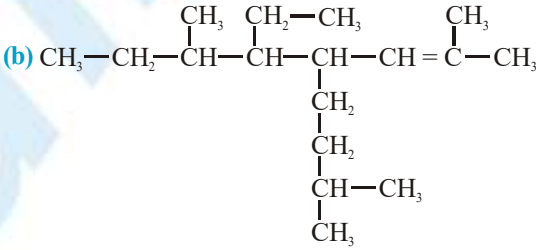
Rule : 2 In branched alkene, if unsaturated double bond or triple bonds is present in the cyclic ring, then numbering is done from double bonded carbon of the cyclic ring and follow lowest locant rule properly.

Ex. 

1-ethyl cyclohex-1-ene

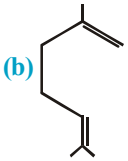
Ex. Write the IUPAC name of the following compounds :

(a) 

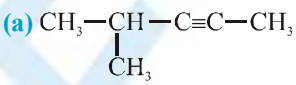
(b) 

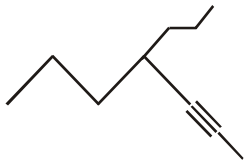
Ans. **(a)** 5-Methyl-3-heptene
(b) 5-Ethyl-2,6-dimethyl-4-(3-methylbutyl)oct-2-ene

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)** 

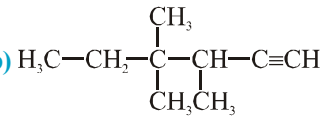
Ex. Write the IUPAC name of the following compounds :

(a) 

(b) 

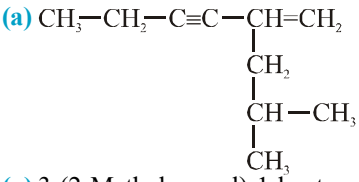
Sol. **(a)** 4-Methyl-2-Pentyne **(b)** 4-Propyl-2-heptyne

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

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

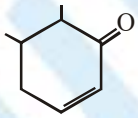
Ex. Write IUPAC name of the following compounds.

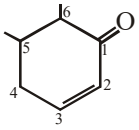
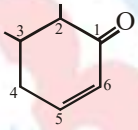
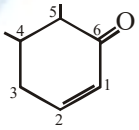
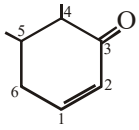
(a) $H-C\equiv CCH_2CH=CH_2$ **(b)** 

Sol. **(a)** pent-1-en-4-yne
(b) 1, 4-heptadiene-6-yne

PROBLEMS

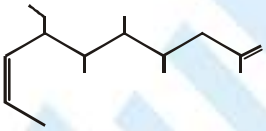
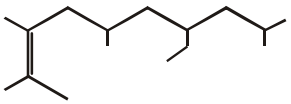
1. Which is the correct way of number in the given compound.

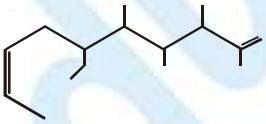
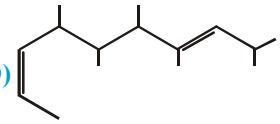


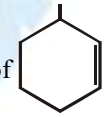
(A)  **(B)**  **(C)**  **(D)** 

2. Which is the correct structure for given IUPAC name.

7-ethyl-2, 4, 5, 6-tetramethyl deca-1, 8-diene

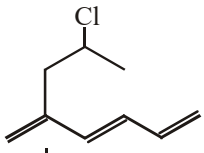
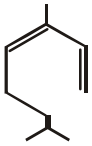
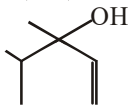
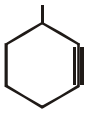
(A)  **(B)** 

(C)  **(D)** 

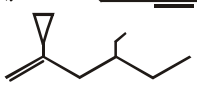
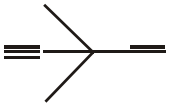
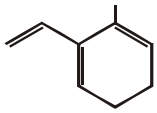
3. The IUPAC name of  is

(A) 3-methyl cyclohexene
(B) 1-methyl cyclohex-2-ene
(C) 6-methyl cyclohexene
(D) 1-methyl cyclohex-5-ene

4. Which is correct match.

	IUPAC Name	Structure
(A)		2–(2' -chloropropyl) hexa-1,3,5-triene
(B)		3, 7 - dimethyl hepta - 1, 3-6-triene
(C)		3, 4- dimethyl pent -1-en-2-ol
(D)		3-methyl cyclopent-1-yne

5. Which is incorrect match in the following –

	Structure	IUPAC Name
(A)		Octa-1-en-4-yne
(B)		4-Ethyl-2-Cyclopropylhex-1-ene
(C)		3, 3-dimethyl pent -1-en-4-yne
(D)		2-methyl-3-ethenyl cyclohexa-1,3-diene

ANSWER

1. (A) **2.** (A) **3.** (A) **4.** (A) **5.** (D)

IUPAC NOMENCLATURE OF COMPOUNDS CONTAINING FUNCTIONAL GROUPS

Functonal Groups

Non chain terminating

(i) $-SO_3H$
(ii) $-\overset{\overset{O}{\|}}{C}-$
(iii) $-OH$
(iv) $-NH_2$
(v) $-SH$

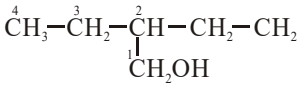
Chain terminating

(i) $-\overset{\overset{O}{\|}}{C}-OH$
(ii) $-\overset{\overset{O}{\|}}{C}-O-\overset{\overset{O}{\|}}{C}-$
(iii) $-\overset{\overset{O}{\|}}{C}-OR$
(iv) $-\overset{\overset{O}{\|}}{C}-X$
(v) $-\overset{\overset{O}{\|}}{C}-NH_2$
(vi) $-CN$
(vii) $-CHO$

Rule 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.

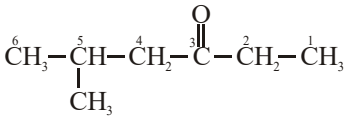
Ex.



(Parent chain contains four rather than five carbon atoms)

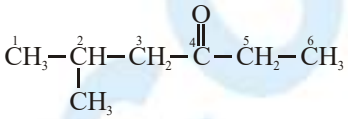
(B) **Lowest number for the functional group** : Numbering is done from that side of the chain which gives lowest locant to the principle functional group followed by double and triple bonds.

Ex.



(I) correct

(>C=O group gets lowest number 3)



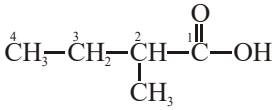
(II) wrong

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

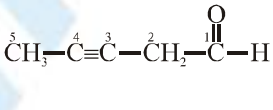
Rules for chain terminating functional groups

(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).

Ex.



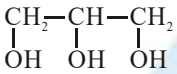
2-Methylbutan-1-oic acid



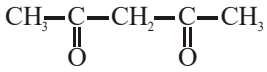
Pent-3-yn-1-al

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

Ex.



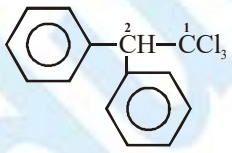
Propane -1,2,3-triol



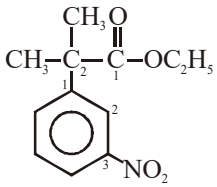
Pentane-2, 4-dione

(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.

Ex.



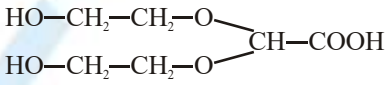
1, 1,1-Trichloro-2,2-diphenyl ethane



Ethyl-2-methyl-2-(3-nitrophyenyl) propanoate

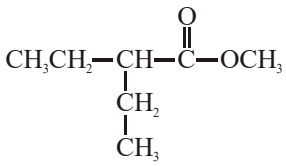
(4) If the organic molecule contain more than one similar complex substituents, then the numerical prefixes such as di, tri, tetra etc. are replaced by bis, tis, tetrakes etc. respectively.

Ex.

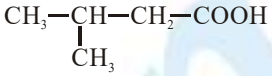


2,2-Bis-(2-hydroxyethoxy) ethanoic acid

Ex. Write IUPAC name of the following compounds :

(i) 

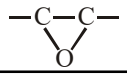
(ii) $(CH_3)_3COH$

(iii) 

Sol. **(i)** Methyl-2-ethylbutanoate
(ii) 2-Methylpropan-2-ol
(iii) 3-Methylbutanoic acid

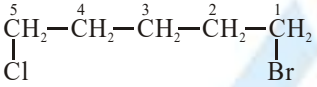
NAMING OF NORMAL FUNCTIONAL GROUPS

Type I : Groups of this type are not considered as functional groups in IUPAC nomenclature. They are considered as substituents & there fore represented by prefix. type I functional group & their prefix are shown below :

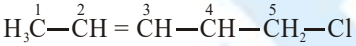
Groups	Prefix
– F	fluoro
– Cl	chloro
– Br	bromo
– I	iodo
$-NO_2$	nitro
– NO	nitroso
– OR	alkoxy
	epoxy

Rule for their nomenclature

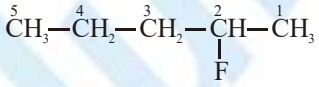
Rule I : If two substituents are present on same position from different ends, then priority is decided on the basis of alphabetical order.

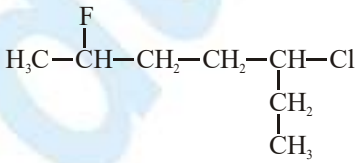


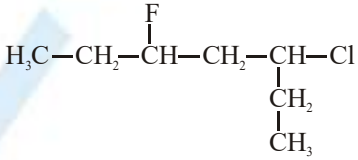
Rule II : If multiple bond and type I functional group both are present, the priority is given to multiple bond.

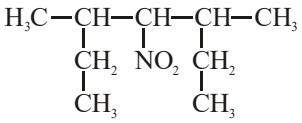


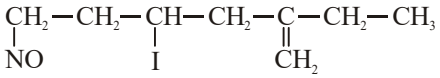
Rule III : These groups are written is alphabetical order in IUPAC name.

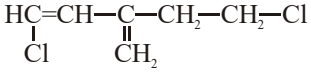
Ex. **(i)**  2-flouoropentane

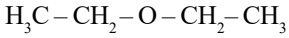
(ii)  5-chloro-2-flouoroheptane

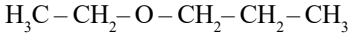
(iii)  3-chloro-5-flouoroheptane

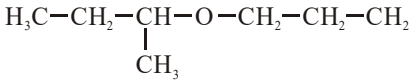
(iv)  3, 5-dimethyl-4-nitro heptane

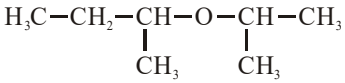
(v)  2-ethyl-4-iodo-6-nitroso hex-1-ene

(vi)  1-chloro-3-chloroethylbuta-1, 3-diene

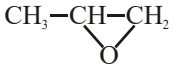
(vii)  ethoxy ethane

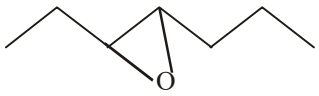
(viii)  1-ethoxy propane

(ix)  2-propoxy butane

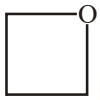
(x)  2-(methyl ethoxy) butane or 2-isopropoxy butane

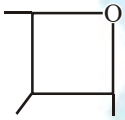
Expoxides

(1)  1, 2-epoxy propane

(2)  3, 4-epoxy heptane

(3)  2-chloro-5, 6-epoxy octane

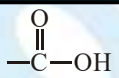
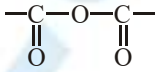
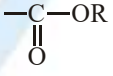
(4)  1, 3-epoxy propane

(5)  2, 4-epoxy-3-methyl pentane

NAMING OF DON FUNCTIONAL GROUPS

Type - II : Groups of this type are treated as functional groups and represented by suffix in IUPAC nomenclature.

Priority table for functional group.

S. No.	Functional group	Name	Suffix	Prefix
(1)		Carboxylic acid	oic acid	Carboxy
(2)		Sulphonic acid	sulphonic acid	Sulpho
(3)		Acid anhydride	oic anhydride	–
(4)		Ester	oate (alkyl + w.r.+oate)	Alkoxy carbonyl

(5)	$-\overset{\overset{O}{\|\|}}{C}-Cl$	Acid chloride	oyl chloride	Chlorocarbonyl
(6)	$-\overset{\overset{O}{\|\|}}{C}-NH_2$	Amide	amide	Carbamoyl
(7)	$-C \equiv N$	Cyanide	nitrile	Cyano
(8)	$-N \equiv C$	Isocyanide	isonitrile	Isocyano
(9)	–CHO	Aldehyde	al	oxo/formyl
(10)	$-\overset{\overset{O}{\|\|}}{C}-$	Ketone	one	Oxo/keto
(11)	–OH	Alcohol	ol	Hydroxy
(12)	– SH	Thio-alcohol	thiol	Mercapto
(13)	$-NH_2$	Amine	amine	Amino
(14)	(=)		ene	
(15)	(≡)		yne	

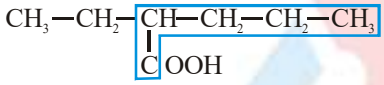
EDUBULL KEY POINTS

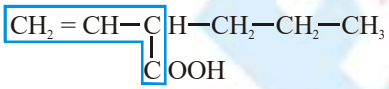
Functional groups are the group of molecules that are bonded to carbon atoms of the parent chain. Double bond and triple bond are present in the parent chain only, in max. no. of cases. That's why **Double bond** & **Triple bond** are **not true functional groups.**

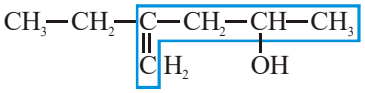
w.r. → Word Root

Rule for their nomenclature

(1) Selection of parent 'C' chain : longest possible 'C' chain with functional group and having maximum number of multiple bonds is selected as parent 'C' chain.





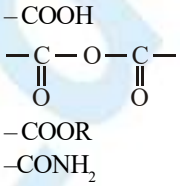


(2) Numbering

(a) Numbering starts from the side of functional group for numbering priority order is given below :

Functional group > Multiple bonds > Substituents

(b) If chain ending 'C' containing functional group is present then numbering starts from the 'C' of functional group these functional groups are knows as DON category functional groups functional groups of this category are shown below :



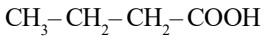
–CN

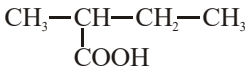
–CHO

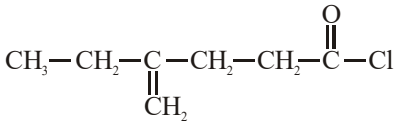
–COCl

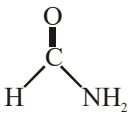
Rule 3 : 'e' of primary suffix is dropped if secondary suffix starts from a vowel.

Example of compounds having don category functional groups :

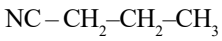
(i)  Butanoic acid

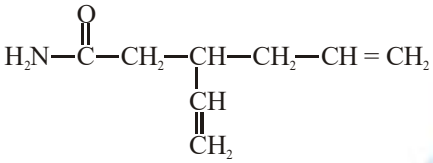
(ii)  2-methyl butanoic acid

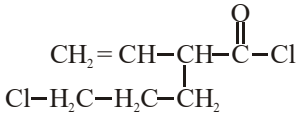
(iii)  4-ethyl pent-4-en-1-oylchloride

(iv)  methanamide

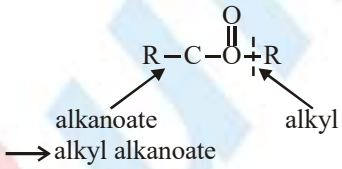
(v)  ethandial

(vi)  butane nitrile

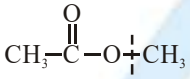
(vii)  3-ethenyl hex-5-en-1-amide

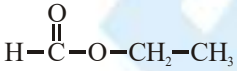
(viii)  2-(3-chloropropyl) but-3-en-1-oyl chloride

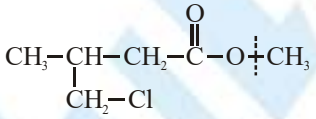
Ester

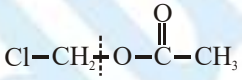


Ex.

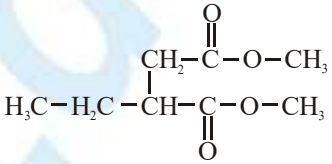
(i)  Methyl ethanoate

(ii)  ethyl methanoate

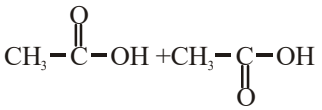
(iii)  methyl-4-chloro-3-methyl butanoate

(iv)  chloromethylethanoate

(v)  methyl ethanoate

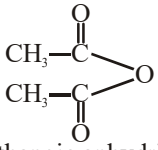
(vi)  methyl-2-ethyl butane-1,4-dialte

Anhydride : Nomenclautre of anhydride is done on the basis of the carboxylic acid from which it is obtained.

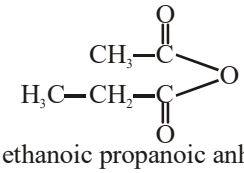


ethanoic acid

$\xrightarrow{-H_2O}$

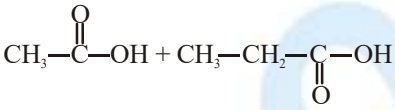


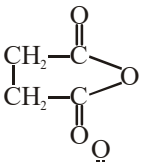
ethanoic anhydride



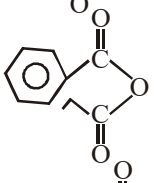
ethanoic propanoic anhydride

$\xrightarrow{H_2O}$

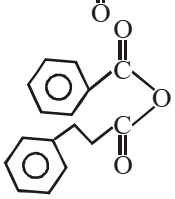




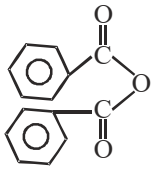
butanedioic anhydride



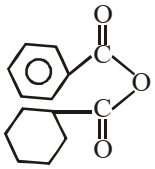
Benzene carboxylic
propanoic anhydride



Benzene carboxylic-3-phenyl propanoic anhydride

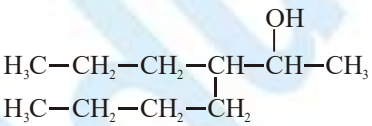


Benzene carboxylic anhydride

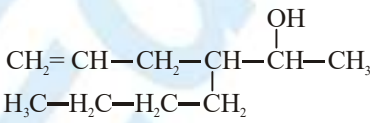


Benzene carboxylic cyclohexyl
carboxylic anhydride

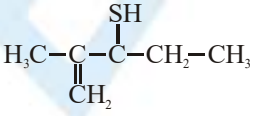
Example of compounds having functional group other than DON category

1. 

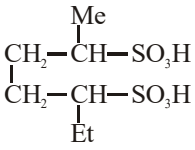
3-propylheptan-2-ol

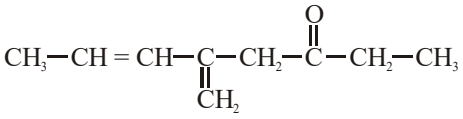
2. 

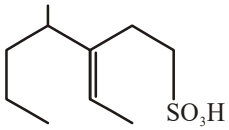
3-butyl hex -5-en-2-ol

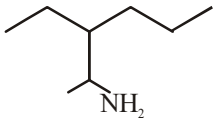
3. 

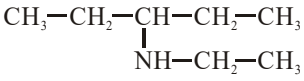
2-methyl pent-1-ene-3-thiol

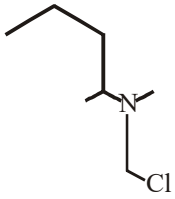
4. 
heptane-2, 5-disulphonic acid

5. 
5-methylene oct-6-en-3-one

6. 
3-(1-methyl butyl)pent -3-ene-1-sulphonic acid

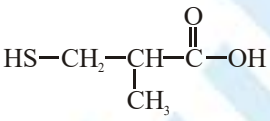
7. 
3-ethylhexan-2-amine

8. 
N-ethyl pentan-3-amine

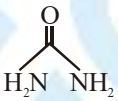
9. 
N-Chloromethyl-N-methyl pentan-2-amine

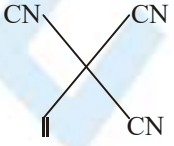
IUPAC NOMENCLATURE OF COMPOUNDS CONTAINING POLYFUNCTIONAL GROUPS

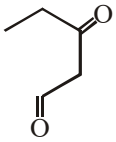
Rule - I : If more than one functional groups are present then one is selected as principal functional group and represented by suffix. Other functional groups are treated as substituents & represented by prefix.
Selection of principal functional group is done according to priority table.

1. 
(3-mercapto-2-methylpropanoic acid)

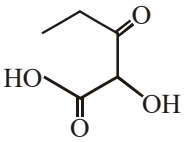
2. 
chloromethanoylchloride

3. 
amino methanomide (Urea)

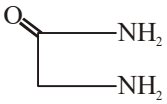
4. 
2-ethyl-2-isocyano propane-1,3-dinitrile

5. 

3-oxo pentanal

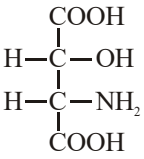
6. 

2-hydroxy-3-oxo pentanoic acid

7. 

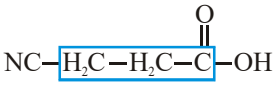
2-amino ethanomide

Rule-II : When principal groups is selected then there is no use of priority table.

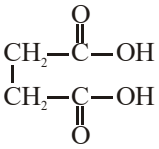
8. 

3-amino-2-hydroxy butane-1, 4-dioic acid (Incorrect)
2-amino-3-hydroxy butane-1, 4-dioic acid (correct)

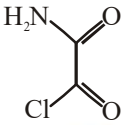
Rule III : If any DON functional group is present as sec. functional group then its 'c' is not included in principal 'c' chain except –CHO group.

9. 

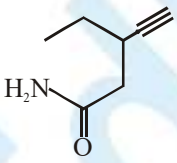
3-cyanopropanoic acid

10. 

3-Chloro carbonylpropanoic acid

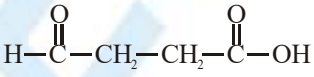
11. 

Carbamoylmethanoyl chloride

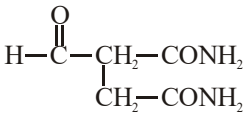
12. 

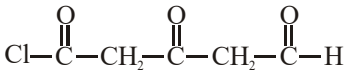
3-Ethylpent-4-yn-1-amide

Rule IV: As secondary functional group, if'C' of –CHO group is included in percent 'c' chain then oxo is used as prefix, otherwise we use formyl group as prefix.

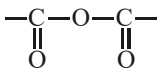
13. 

4-oxobutanoic acid

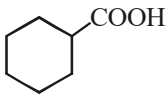
14.  2-formyl butane-1, 4-diamide

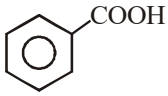
15.  3,5-dioxopentanoyl chloride

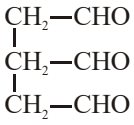
IUPAC nomenclature if DON category functional group is present as principal functional group & its'c' is not included in parent 'c' chain →

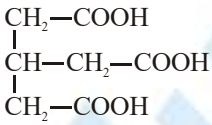
–COOH	Carboxylic acid
	Carboxylic anhydride
–COOR	Carboxylate
–COCl	Carbonyl chloride
$-CONH_2$	Carboxamide
–CN	Carbonitrile
–CHO	Carbaldehyde

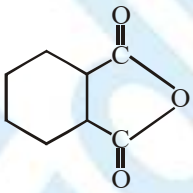
Ex.

1.  Cyclohexane carboxylic acid

2.  Benzene carboxylic acid

3.  Propane-1,2,3-tricarbadehyde

4.  3-Carboxymethyl pentane-1,5-dioic acid

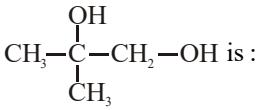
5.  Cyclohexane-1,2-dicarboxylic anhydride

PROBLEMS

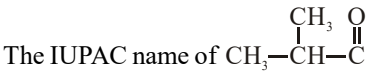
1. The IUPAC name of the compound having structure $ClCH_2–CH_2–COOH$ is :

(A) 3-Chloro propanoic acid **(B)** 2-Chloropropanoic acid

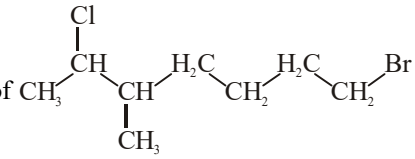
(C) 2-Chloro ethanoic acid **(D)** Chloro succinic acid

2. The IUPAC name of compound  is :

(A) 2-Methyl-1, 2-propanediol
(B) Isobutylene glycol
(C) 1-2-Dihydroxy-2-Methyl propane
(D) 2-Hydroxy methyl-2-propanol

3. The IUPAC name of  is -

(A) 1-Hydroxy-4-methyl-3-pentanone
(B) 2-Methyl-5-hydoxy-3-pentanone
(C) 4-Methyl-3-oxo-1-pentanol
(D) Hexanol-1-one-3

4. IUPAC name of 

(A) 2-Chloro-3-methyl-7-bromo heptane
(B) 7-Bromo-2-chloro-3-methyl heptane
(C) 1-Bromo-5-methyl-6-chloro heptane
(D) 1-Bromo-6-chloro-5-methyl heptane

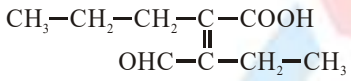
5. IUPAC name of $CH_2=CH-CH_2-Cl$ is :

(A) Allyl chloride
(B) 1-Chloro-3-propene
(C) 3-Chloro-1-propene
(D) Vinyl chloride

6. The correct IUPAC name for $CH_3CH=C(COOH)CH_2CH_3$ is :

(A) 3-Carboxy-2-pentene
(B) 2-Ethylidene butanoic acid
(C) 2-Ethyl-2-butenoic acid
(D) 3-Ethyl-2-buten-4-oic acid

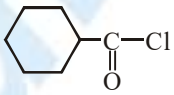
7. The number of carbon atoms in the principal chain of the given compound are :



(A) 7 **(B)** 5 **(C)** 4 **(D)** 6

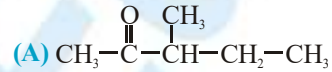
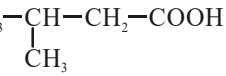
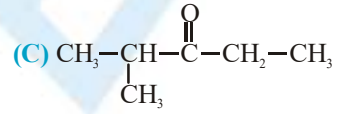
8. The IUPAC name of $CH_3-CH_2-NH-CH_3$ is :

(A) Methyl ethyl amine
(B) 1-methyl ethan amine
(C) N-methyl ethan amine
(D) N-ethyl methanamine

9. The name for the structure 

(A) Cyclo hexanoyl chloride
(B) Cyclohexane carbonyl chloride
(C) 1-Chloro cyclohexnal
(D) Chloro cyclohexyl methanal

10. 3-Methyl-2-pentanone is :

(A) 
(B) 
(C) 
(D) $CH_3-CH_2-CH=CH_2$

11. The name of $ClH_2C-\underset{\underset{Br}{|}}{C}=\underset{\underset{Br}{|}}{C}-CH_2Cl$ according to IUPAC nomenclature system is :

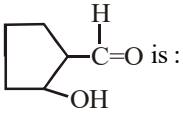
(A) 2, 3-Dibromo-1, 4-dichloro-2-butene
(B) 1, 4-Dichloro-2, 3-dibromobutene-2
(C) Dichloro dibromo butene
(D) Dichloro dibromo butene

12. The systematic IUPAC name for $CH_3-\overset{\overset{O}{\|}}{C}-NH_2$ and $CH_3-\overset{\overset{O}{\|}}{C}-Cl$ are :

(A) 1-Amino-1-oxo ethane, 1-chloro ethanal
(B) 1-Amono ethanal, acetoy chloride
(C) 1-Oxoethanamine, ethanoyl chloride
(D) Ethanamide, Ethanoyl chloride

13. The IUPAC name of the compound $\underset{\underset{NH_2}{|}}{CH_2}-\underset{\underset{OCH_3}{|}}{C}=CH-\overset{\overset{O}{\|}}{C}-NH_2$ is :

(A) 4-Amino-2-methoxy-1-amino-2-butene
(B) 4-Amino-3-methoxy-2-butenamide
(C) 2-Methoxy-1, 4-diamino-2-butenal
(D) 1-Amino-2-methoxy-3-amido propene

14. The correct name for  is :

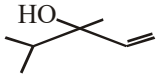
(A) 2-Hydroxy cyclopentanal
(B) 2-Formyl-1-hydroxy cyclopentane
(C) 2-Hydroxy cyclopentane carbaldehyde
(D) Cyclopentane-2-ol-1-al

15. The IUPAC name of $Cl-\overset{\overset{O}{\|}}{C}-OC_2H_5$ is :

(A) Ethoxy formyl chloride
(B) Ethoxy methanoyl chloride
(C) Ethyl chloro methanoate
(D) Ethoxy carbonyl chloride

16. IUPAC name of $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-\underset{\underset{CN}{|}}{CH}-CH_3$ is :

(A) 2-cyano-3-methyl hexane
(B) 3-methyl-5-ctabigexabe
(C) 2-4-Dimethyl pentanentrile
(D) 2-cyano-3-methyhexane

17.  has the IUPAC name :

(A) 3,4-Dimethyl-1-penten-3-ol
(B) Isopropyl-3-methyl vinyl carbinol
(C) 2, 3-Dimethyl-4-penten-3-ol
(D) None of the above

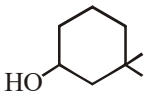
18. Which of the following compound has wrong IUPAC name ?

(A) $CH_3CH_2-CH_2COO-CH_2CH_3$
(Ethyl butanoate)

(B) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CHO$
(3-Methylbutanal)

(C) $CH_3-\underset{\underset{OH}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-CH_3$
(2-Methyl-3-butanol)

(D) $CH_3-\underset{\underset{OH}{|}}{CH}-\underset{\underset{O}{\|}}{C}-CH_2-CH_3$
(2-Methyl-3-pentanone)

19. The IUPAC name of the compound 

(A) 1, 1-dimethyl-3-cyclohexanol
(B) 1,1-dimethyl-3-hydroxy cyclohexane
(C) 3,3-dimethyl-1-cyclohexanol
(D) 3, 3- dimethyl-1-hydroxy cyclohexane

ANSWERS

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

IUPAC NOMENCLATURE OF ALICYCLIC COMPOUNDS

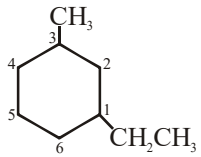
(1) The names of alicyclic compounds are obtained by adding the prefix "cyclo"

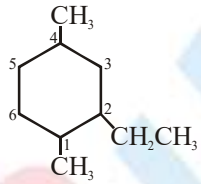

Cyclobutane

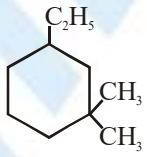

Cyclopentene

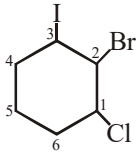
(2) The numbering of the carbon atoms in the ring is done is such a way that the substituent which comes first in the alphabetical order is given the lowest possible number provided it does not violate the lowest set of locants rule

Ex.


1-Ethyl-3-methyl cyclohexane

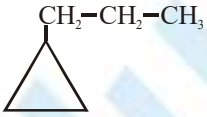

2-Ethyl-4, dimethyl cyclohexane

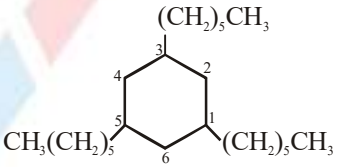

3-Ethyl-1, 1-dimethyl cyclohexane

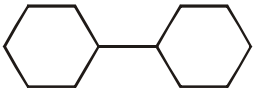

2-Bromo-1- chloro -3-iodocyclohexane

(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 derivate of cycloalkane and the alkyl group is treated as substituent.

Ex.

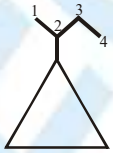

Propylcyclopropane

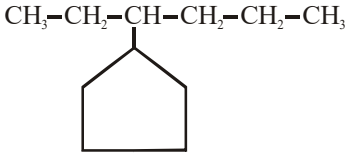

1, 3, 5- Trishexylcyclohexane


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.

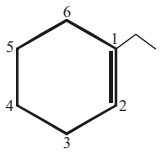
Ex.


2-Cyclopropylbutane

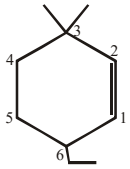

3-Cyclopentylhexane

(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.

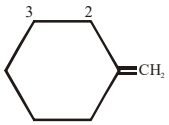
Ex.



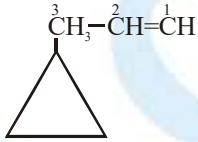
1-Ethyl Cyclohex-1-ene



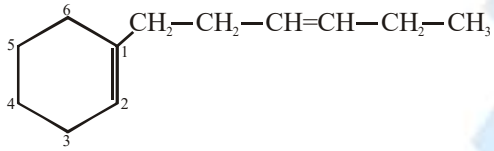
6-Ethyl-3,3-dimethyl cyclohex-1-ene



Methylene Cyclohexane



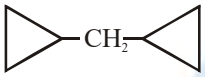
3-Cyclopropyl prop-1-ene



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 treated as a substituent group.

Ex.



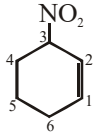
Dicyclopropylmethane

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.

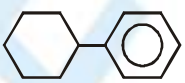
Ex.



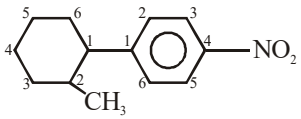
3-Nitrocyclohex-1-ene

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

Ex.

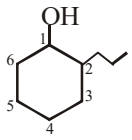


Cyclo hexyl benzene

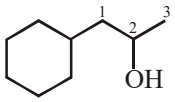


1-(2-Methylcyclohexyl)-4-nitrobenzene

(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

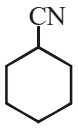


1-Cyclohexyl propane-2-ol

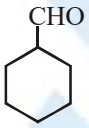
(10) When chain terminating functional group is directly attached with ring then ring is taken as parent chain & special suffix used for functional group.

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

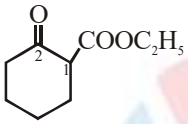
Ex.



Cyclohexane Carbonitrile



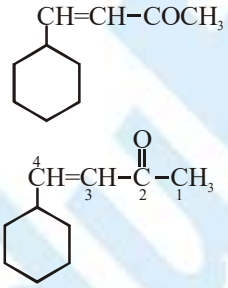
Cyclohexane Carbaldehyde



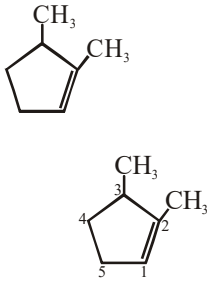
Ethyl-(2-oxo)cyclohexane-1-carboxylate

Ex. Write the IUPAC name of the following :

(i)

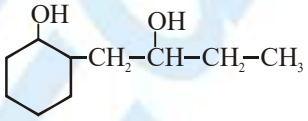


(ii)



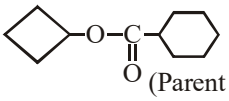
Sol. **(i)** 4-Cyclohexylbut-3-ene-2-one **(ii)** 2, 3-Dimethylcyclopent-1-ene

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



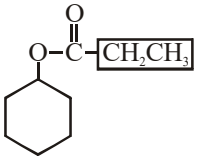
(A) 1-(2-hydroxy cyclohexane) butan-2-ol
(B) 4-(2-hydroxy cyclohexane) butan-3-ol
(C) 1-(2-hydroxy but-1-yl) cyclohexan-2-ol
(D) 2-(2-hydroxy butyl) cyclohexan-1-ol

Sol. **(D)**

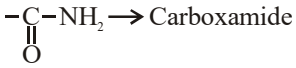


(Parent chain)

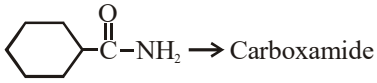
Cyclobutyl cyclohexane carboxylate



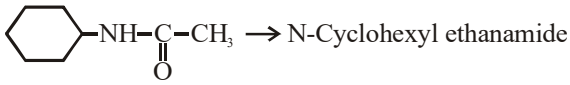
Cyclohexyl ethane carboxylate



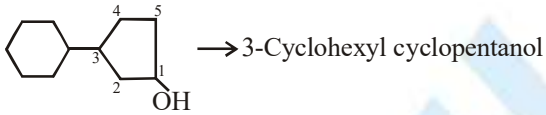
Carboxamide

Ex. 

Carboxamide

Ex. 

N-Cyclohexyl ethanamide



3-Cyclohexyl cyclopentanol

Methylene cyclohexane

IUPAC 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 derivate 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 1, 3 and p(para) for 1, 4 position. However, many of their common names have also been adopted by the IUPAC system.

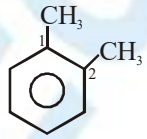
(B) **Side-Chain Substituted** – The functional group is present in the side chain of the benzene ring in the IUPAC systems, these are usually named as phenyl derivatives of the corresponding aliphatic compounds.

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

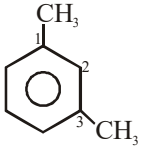
(a) Aromatic hydrocarbons (arenes) : Hydrocarbons which contain both aliphatic and aromatic units are called arenes. These are of two types

(i) Hydrocarbon containing one ring only.

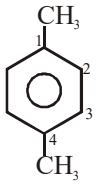
Ex.



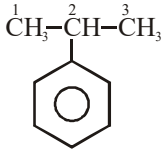
1, 2-Dimethyl benzene
(o-Xylene)



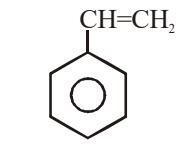
1, 3-Dimethyl benzene
(m-Xylene)



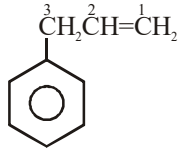
1, 4-Dimethyl benzene
(p-Xylene)



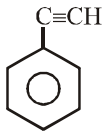
Isopropyl benzene
(Cumene)



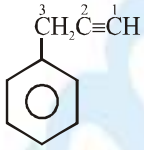
Ethenynl benzene
(Styrene)



3-propenyl benzene
(Allyl benzene)

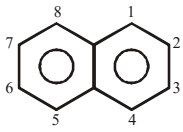


Ethynyl benzene
(Phenyl acetylene)

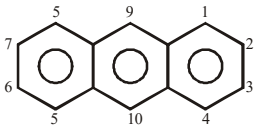


3-propynyl benzene
(Propargyl benzene)

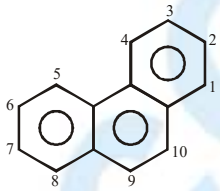
(ii) Hydrocarbon containing condensed or fused ring :



Naphthalene

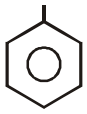


Anthracene

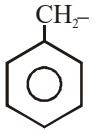


Phenanthrene

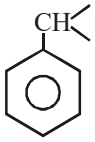
- **Aryl Groups**



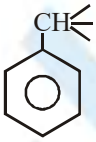
Phenyl



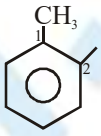
Benzyl



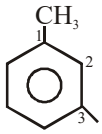
Benzal



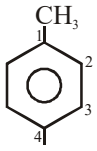
Benzo



2-Tolyl
or o-Tolyl

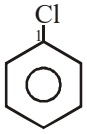


3-Tolyl
or m-Tolyl

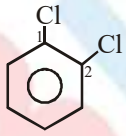


4-Tolyl
or p-Tolyl

- **Halogen derivatives**

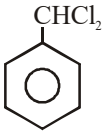


Chloro benzene

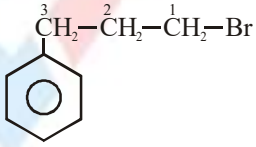


1, 2-Dichlorobenzene
or o-Dichlorobenzene

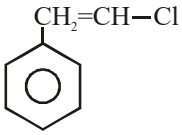
1, 4-Dichlorobenzene
or p-Dichlorobenzene



Phenyldichloromethane
(Benzyl chloride)



1-Bromo-3-phenyl propane

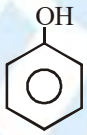


1-chloro-2-phenyl ethene

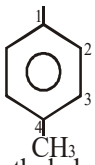
- **Hydroxy derivatives**

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

(i) Phenols - monohydric

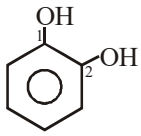


Hydroxybenzene
(phenol)

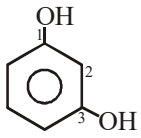


4-methyl phenol
(p-cresol)

(ii) Dihydric and polyhydric phenols



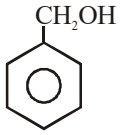
Benzene-1, 2-diol
(Catechol)



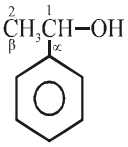
Benzene-1, 3-diol
(Resorcinol)

Benzene-1, 4-diol**(Quinol)**

(iii) Aromatic Alco hols

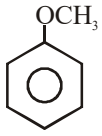


Phenyl methanol
(Benzyl alcohol)

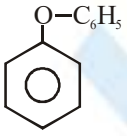


1-phenyl ethanol
(∝- phenyl ethyl alcohol)

(iv) Aromatic ethers

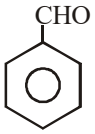


Methoxy benzene
(Anisol)

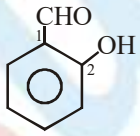


Phenoxy benzene
(Diphenyl ether)

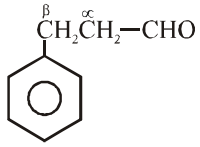
(v) Aldehydes



Benzaldehyde

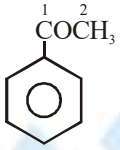


2-Hydroxy benzaldehyde
(Salicylaldehyde)

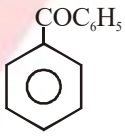


3-phenylpropanal
(β-phenylpropionaldehyde)

(vi) Ketones

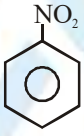


1-phenyl ethanone
(Acetophenone)

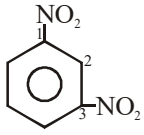


Diphenylmethanone
(Benzophenone)

(vii) Nitro Compounds



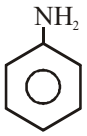
Nitrobenzene



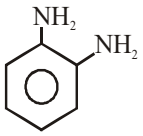
1, 3-Dinitrobenzene
(m-Dinitrobenzene)

(viii) Amines

(a) Aryl amines

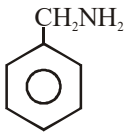


Benzenamine
(Aniline)

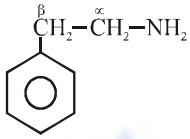


Benzene-1,2-diamine
(o-phenylenediamine)

(b) Aryl alkyl amine

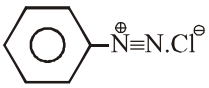


Phenyl methanamine
(Benzylamine)

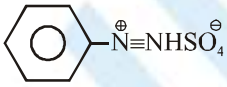


2-Phenyl ethanamine
(β-phenyl ethyl amine)

(ix) Arenediazonium Salts

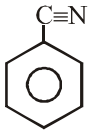


Benzene diazonium chloride

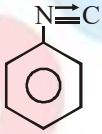


Benzene diazonium hydrogen sulphate

(x) Cyanides and Isocyanides

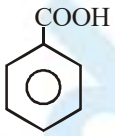


Benzonitrile
or Phenyl Cyanide

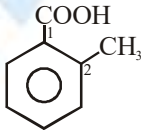


Phenyl isocyanide or
Phenyl carbylamine

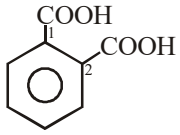
(xi) Carboxylic Acids



Benzoic acid

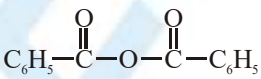


2-Methyl benzoic acid
(o-toluic acid)



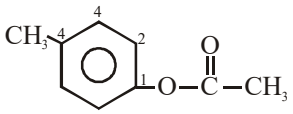
Benzene-1, 2-dicarboxylic acid
(Pthalic acid)

(xii) Anhydrides



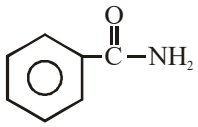
Benzoic anhydride

(xiii) Esters



4-Methyl phenyl ethanoate

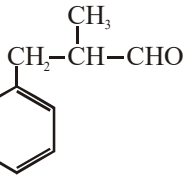
(xiv) Amides



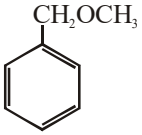
Benzamide

Ex. Write IUPAC name of the aromatic compounds

(i)



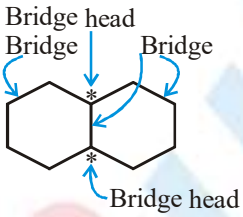
(ii)



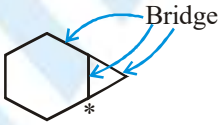
Sol. **(i)** 2-methyl -3-phenylpropanal, **(ii)** Methoxyphenylmethane (Benzylmethyl ether)

Nomenclalture of Bicyclo Compounds

Bicyclo compounds : If two rings are fused at two common carbon atoms then compound are known as bicyclic compound.



Two common carbon

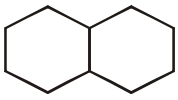


Bridge should bd present

(i) Unsubstituted bicyclo compounds

Prefix + Numbering of + Suffix

Bicyclo — carbon atoms in each bridge in decreasing order

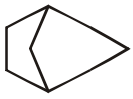


Bicyclo (4.4.0) decane
(Bridge head C not considered)

Ex.

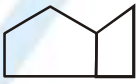
Bicyclo [2. 2. 0] Hexane

Ex.



Bicyclo n[2. 1. 1] Hexane

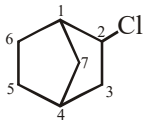
Ex.



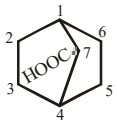
Bicyclo [3.2.0] Heptane

(ii) Substituted bicyclo [Bicyclo with substitution or functional group]

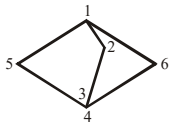
In substituted bicyclo compounds numbering starts from a bridge head carbon atom and proceeds towards longest bridge then small bridge & then smallest bridge.



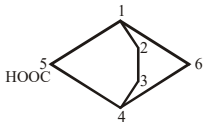
2-Chloro bicylo [2.2.1] heptane

Ex. 

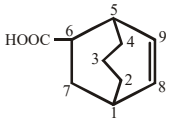
bicylo [2,2,1]heptane-7-carboxylic acid

Ex. 

Bicylo [2,1,1] hexane



Bicyclo [2,1,1] hexane-5-carboxylic acid

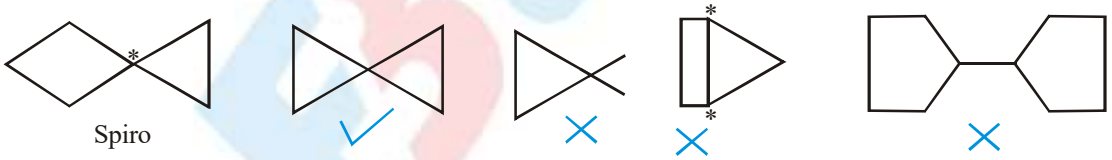


F.G. is preferred over double bond.
Bicylo [3,2,2] dec-9-en-carboxylic acid

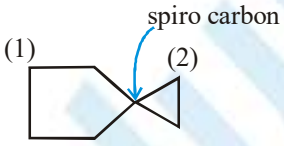
Bicylo [3.2.2] non-8-ene-6-carboxylic acid

Nomenclature of Spiro Compounds

Spiro compound – Two cyclic rings are fused at one common carbon (only one bridge head)

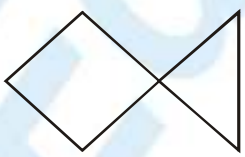


Spiro

Ex. 

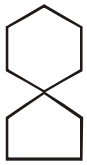
Name : Prefix + no. of carbon in bridges in increasing order + suffix

Spiro [2. 4] heptane

Ex. 

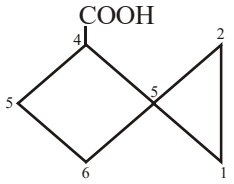
Spiro

Spiro [2, 3] hexane

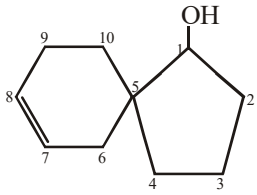


Spiro [4. 5] decane

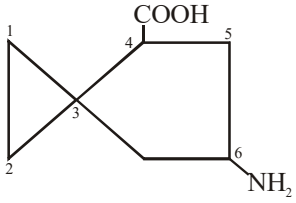
Rule of numbering : In spiro compounds numbering starts from carbon of small ring which is next to spiro carbon proceeds towards other carbon atoms of smaller ring then towards larger rings via spiro carbon atom.

Ex. 

Spiro [2, 3] hexane - 4- carboxylic acid

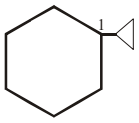
Ex. 

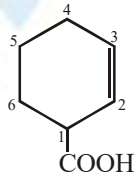
Spiro [4, 5] dec-7-en-1-ol

Ex. 

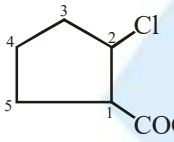
6-amino spiro [2, 4] hptane-4-carboxylic acid

Ex.

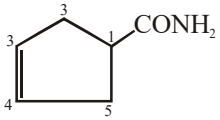
(1) 
Ccyclopropyl cyclohexane

(2) 

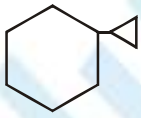
Cyclohex-2-ene-1-carboxylic acid

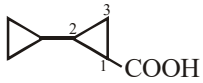
(3) 

2-Chloro cyclopentane carboxylic acid

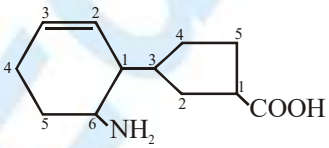
(4) 

Cyclopent-3-ene-1-carboxamide

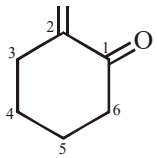
(5) 
Cyclopropyl cyclohexane

(6) 

2-cyclopropyl cyclopropane carboxylic acid

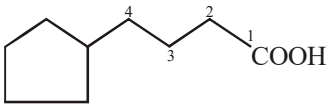
(7) 

3-(6-amino cyclohex-2-enyl) cyclopentane carboxylinc acid

(8) 

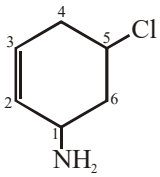
2-methylene cycloehexan-1-one

(9)



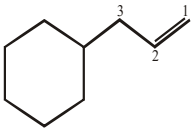
4-Cyclopentyl butanoic acid

(10)



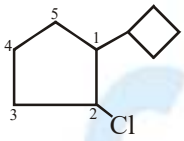
5-Chloro cyclohex-2-en-amine

(11)



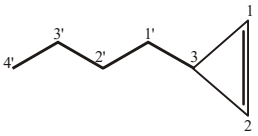
3-cyclohexyl prop-1-ene

(12)



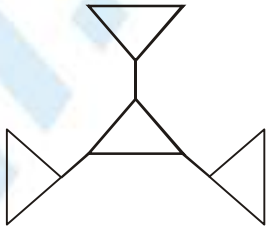
1-cyclobutyl-2-chloro cyclopentane

(13)



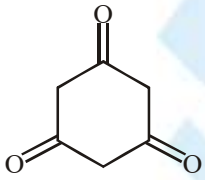
3-butyl cyclopropene

(14)



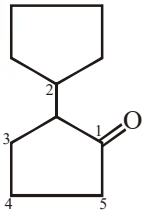
1,2,3-tricyclopropyl cyclopropane

(15)



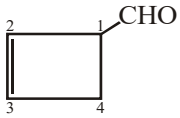
Cyclohexane-1,3,5-trione

(16)



2-cyclopentyl cyclo pentanone

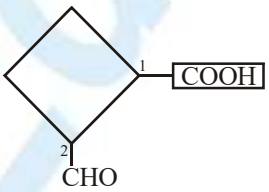
(17)



Cyclobut-2-ene-carbaldehyde

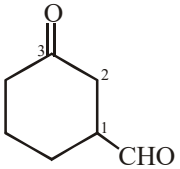
Rule : If more than one functional groups is present at cyclic chain, ten principal function group (PFG) is selected

Ex.



2-formyl cyclobutane carboxylic acid

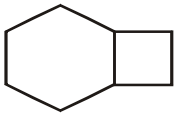
Ex.

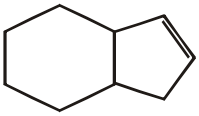


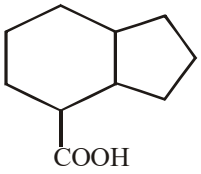
3-oxo cyclohexane carbaldehyde

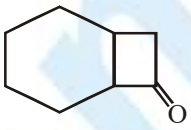
PROBLEMS

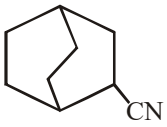
Write the IUPAC Nomenclature of following compounds :

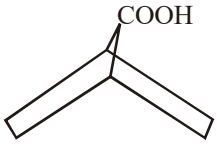
(1) 

(2) 

(3) 

(4) 

(5) 

(6) 

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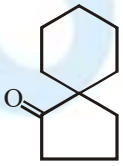
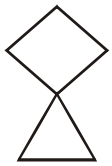
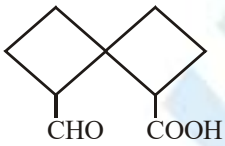
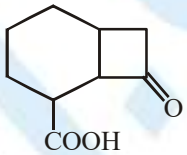
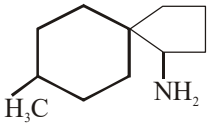
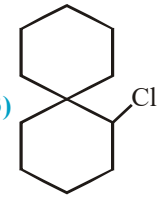
(8) 

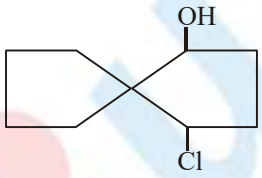
(9) 

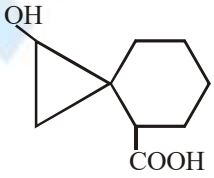
(10) 

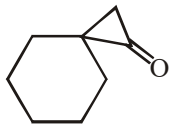
(11) 

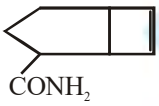
(12) 

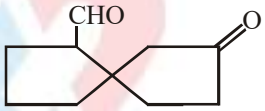
(13) 

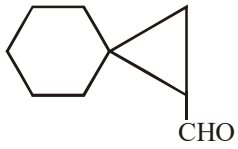
(14) 

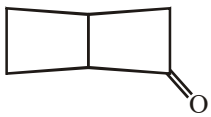
(15) 

(16) 

(17) 

(18) 

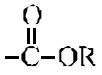
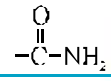
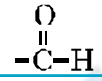
(19) 

(20) 

ANSWERS

(1) bicyclo [4.2.0] octane
(2) bicyclo [4.3.0] non-7-ene
(3) bicyclo [4.3.0] nonane2-carboxylic acid
(4) bicyclo [4.2.0] octane-7-one
(5) bicyclo [2.2.2] octane-2-carbnitrile
(6) bicyclo [2.2.1] heptane-7-carboxylic acid
(7) spiro [2.2.0] penta-1, 4-diene
(8) spiro [4.5] decan-1-one
(9) spiro [2.3] hexane
(10) 5-formyl spiro [3.3] heptane-1-carboxylic acid
(11) 8-oxo bicyclo [4.2.0] octane-2-carboxylic acid
(12) 8-methyl spiro [4.5] decan-1-amine
(13) 1-chloro spiro [5.5] undecane
(14) 4-chloro spiro [4.4] nonan-1-ol
(15) 1-hydroxy spiro [2.5] octane-4-carboxylic acid
(16) spiro [2.5] octan-1-one
(17) bicyclo [3.2.0] hept-6-ene-2-carboxamide
(18) 7-oxo spiro [4.4] nonane-1-carbaldehyde
(19) spiro [2.5] octane-1-carbaldehyde
(20) bicyclo [2.2.0] hexan-2-one

The order of priority of functional groups used in IUPAC nomenclature of organic compounds.

Functional Group	Structure	Prefix	Suffix
Carboxylic acid		Carboxy	- oic acid
Sulphonic acid	$-SO_3H$	Sulpho	sulphonic acid
Ester		Alkoxy carbonyl	alkyl...oate
Acid chloride		Chloroformyl or Chlorocarbonyl	- oyl chloride
Acid amide		Carbamoyl/Amido	- amide
Carbonitrile/Cyanide	$-C \equiv N$	Cyano	nitrile
Aldehyde		Formyl or Oxo	- al
Ketone		Keto or oxo	- one
Alcohol	–OH	Hydroxy	- ol
Thio alcohol	–SH	Mercapto	thiol
Amine	$-NH_2$	Amine	amine
Ether	–O–R	Alkoxy	-
Oxirane		Epoxy	-
Nitro derivative	$-NO_2$	Nitro	-
Nitroso derivative	–NO	Nitroso	-
Halide	–X	Halo	-
Double bond	C = C	-	ene
Triple bond	C ≡ C	-	yne