THEORY - NOMENCLATURE OF ORGANIC COMPOUNDS

Nomenclature means the "system of naming organic compounds based on certain guidelines".
In order to solve the problem of naming of organic compounds, an organisation called international chemical congress for the first time met at Geneva in 1892. They developed a certain system called Geneva system. This system was modified as I.U.C. system in a meeting of international Union of Chemistry held in Liege (Belgium) in 1930 and later on it gave to another modified system known as IUPAC system which is a system adopted by the International Union of Pure and Applied Chemistry. The latest IUPAC system is based on the recommendations made in 1993.

IUPAC system of nomenclature of Aliphatic compounds

According to IUPAC system, the name of an organic compound consists of three parts
(i) Word root (ii) Suffix (iii) Prefix

(i) Word root –

Word root denotes the number of carbon atoms present in the principal chain which is the longest possible chain of carbon atoms.
According to chain length word root name up C_{12} are given below.

Chain Length	***Word root***	***Chain Length***	***Word Root***
C_1	Meth	C_7	Hept (a)
C_2	Eth	C_8	Oct(a)
C_3	Prop	C_9	Non(a)
C_4	But(a)	C_{10}	Dec(a)
C_5	Pent(a)	C_{11}	Undec (a)
C_6	Hex(a)	C_{12}	Dodec(a)

Note. Extra 'a' given in parenthesis is used only if the primary suffix (discussed later) to be added to the word root starts with a consonant.
Consonant – di, tri, tetra etc are not started with vowel, then extra 'a' has been added to the word root.

(ii) Suffix – Suffixes are of two types. Primary and secondary suffixes.

(a) Primary suffix – A primary suffix indicates the type of linkage in the carbon atoms. If the carbon atoms are linked by single covalent bonds, the primary suffix is 'ane'. If these are linked by double and triple bonds, the primary suffixes 'ene' and 'yne' are respectively used to represent them. Thus,
ane : primary suffix for C – C bond
ene : primary suffix for C = C bond
yne : primary suffix for C ≡ C bond
If the parent chain of carbon atoms contains more than one double or triple bonds, numerical prefixes like di (for two), tri (for three) tetra (for four) etc. are added to primary suffix.
Example –

Hydrocarbon	**Word root**	**Primary suffix**	**IUPAC Name**
$CH_3–CH_2–CH_2–CH_3$	But	ane	Butane

$CH_2 = CH - CH = CH_2$	Buta*	diene	Butadiene
$CH_3 - C \equiv CH$	Prop	yne	Propyne

(b) Secondary suffix

A secondary suffix is used to represent the functional group if present in organic molecule and is attached to the primary suffix while writing its IUPAC name. Secondary suffixes of some of the functional groups are listed –

Functional group	**Symbol**	**Suffix**	**Prefix**
Sulphonic	$-SO_3H$	sulponicacid	sulpho
Carboxylic	–COOH	–oic acid	carboxy
Ester	$R-\overset{\overset{O}{\|\|}}{C}-OR$	Alkyl - Alkanonate	alkyl carboxylate or alkoxy carbonyl
Acid halide	$-\overset{\overset{O}{\|\|}}{C}-Cl$	- oylhalide	Halo formyl
Acid Amide	$-\overset{\overset{O}{\|\|}}{C}-NH_2$	amide	carbamoyl
Aldehyde	$-\overset{\overset{O}{\|\|}}{C}-H$	–al	Formyl/ Aldo
cynide	$-C \equiv N$	–nitrile	Cyano
isocynide	$N \equiv C$	–isocynide	Isocyano
ketone	$> C = O$	– one	keto, oxo
hydroxy	–OH	–ol	hydroxy
Thioalcohol	– SH	–Thiol	mercapto
Amine	$-NH_2$	–Amine	amino
Secondary amine	$-N\begin{matrix}R\\H\end{matrix}$	N-Alkyl-amine	N-alkyl-amine
Tertiaryamine	$-N\begin{matrix}R\\R\end{matrix}$	N-alkyl-N-alkyl-amine	N-alkyl-N-alkyl-amine
Nitro	$-N^{+}\overset{\overset{O}{\|\|}}{}O^{-}$	nitrite	nitro

Groups given below does not have any Suffix

Ether	–OR	.....	alkoxy
Epoxide	– O –	.....	epoxy
Azo	– N = N –	.....	azo
Nitroso	– NO	.....	nitroso
Halogen	– X (F, Cl, Br, I)	.....	halo

While adding a secondary suffix to the primary suffix, the terminal 'e' of the primary suffix (ane, ene,

or yne) is dropped if the secondary suffix begins with 'a', 'i' 'o' 'u' or 'y'. In case, it begins with consonant, then the terminal 'e' of the primary suffix is retained.

Example

Organic compounds	Word root	Primary suffix	Secondary suffix	IUPAC Name
CH_3CH_2OH	Eth	an(e)*	ol	Ethanol
CH_3CH_2CHO	prop	ane(e)*	al	Propanal
$CH_3CH_2CH_2NH_2$	prop	ane(e)*	amine	Propanamine
CH_3CH_2CN	Prop	ane	nitrile	Propanenitrile

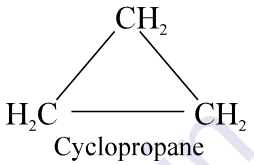
(iii) Prefix –

Prefix is a part of IUPAC name which appear before the word root. Prefixes are of two types.

(a) Primary prefix – A primary prefix "cyclo" is used in order to differentiate a cyclic compound from an acyclic compound.

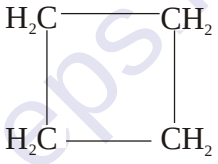
For example

$CH_3 - CH_2 - CH_3$
Propane



Cyclopropane

$CH_3 - CH_2 - CH_2 - CH_3$
Butane



Cyclobutane

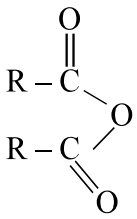
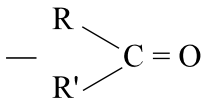
Propane and butane are the IUPAC names of acyclic compounds while cyclopropane and cyclobutane are for cyclic compounds.

(b) secondary prefix – In the IUPAC system of nomenclature, certain characteristic groups are not considered as or secondary suffixes. These are regarded as substituents and are denoted by secondary prefixes. The secondary prefixes of a few substituents are given –

Substituent Group	Secondary prefix	Substituent group	Secondary prefix
–F	Fluoro	$-NO_2$	Nitro
–Cl	Chloro	$-CH_3$	Methyl
–Br	Bromo	$-C_2H_5$	Ethyl
–I	Iodo	$-OCH_3$	Methoxy
– NO	Nitroso	$-OC_2H_5$	Ethoxy

Besides these, some other functional groups are also treated as substituents in case of poly functional organic compounds. These are listed as

Functional group	Name	Secondary prefix
SO_3H	sulphonyl	sulpho
–COOH	carboxylic acid	carboxylic
$R-\overset{\overset{O}{\|}}{C}-O-OR'$	Ester	alkyl carboxylate or alkoxy carboyl
–COX	Acid halides	Halo formyl

– $CONH_2$	Acid amide	Carbamoyl
	Acid unhydride	Oic anhydride
– CHO	Aldehyde	Formyl
– CN	Cynide	Cyano
– -N≡C	Isocynide	Iso Cyano
	Ketone	Keto, oxo
– OH	Alcohol	Hydroxy
–SH	Thioalcohol	Mercapto
– NH_2	Amine	Amino
–O–	Epoxy	Epoxide

General rules for naming long chain aliphatic compounds

Many organic compounds contain long chains which may include substituents, multiple bonds and functional groups. The IUPAC names of such compounds are based on certain general rules.

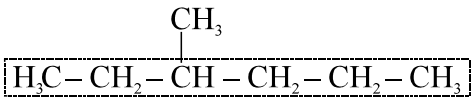
Rules for IUPAC nomenclature of saturated Branched chain Hydrocarbons (Alkanes)

The nomenclature of branched chain alkanes is based on the following rules –

In writing the IUPAC name of an aliphatic compounds the following sequence is used

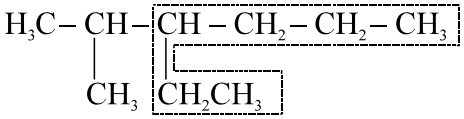
Secondary prefix + primary prefix + word root + primary suffix + secondary suffix

1. ***Longest chain rule –*** Select the longest continuous chain of carbon atoms in a given molecule of alkane which need not be straight. It is known as parent chain or principal chain. All other carbon atoms which are not covered into he parent chain constitute branched chains or side chains or substituents. For example –

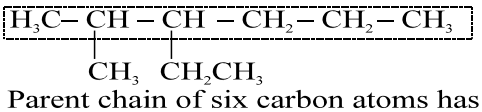


Parent chain has six carbon atoms and CH_3 group represents the substituent

If two chains of equal lengths are possible, then the one with more number of side chains (or substituents) represents the parent chain. For example,

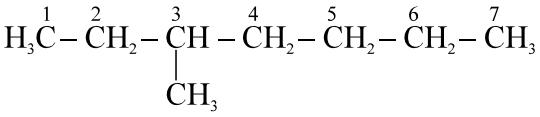


(Parent chain of six carbon atom has one substitute) Wrong

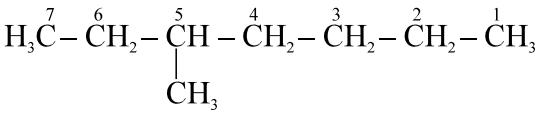


Parent chain of six carbon atoms has two substitute (Right)

Lowest number rule – For molecules with only one substituent, number the carbon atoms as 1, 2, 3, 4 ..... etc. in the parent chain starting from one end in such a way that the carbon atom carrying the substituent gets the lowest number.



The numbering of parent chain is correct because CH_3 group is attached to C–3 atom

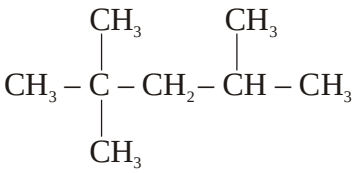


The numbering of parent chain is incorrect

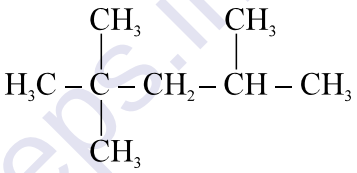
The number which indicates the position of the substituent (or side chain) in the parent chain is called its position number or locant.

The name of the substituents is separated from its locant by hyphen (-) and the final name of the alkane is always written as one word i.e. 3-methylheptane. In case, same alkyl group occurs more than once at different positions in the parent chain, the positional number of each alkyl group is separated by commas and suitable prefixes like di (for two), tri (for three) tetra (for four) etc. are attached to the name of the alkyl groups.

3. ***Lowest set of locants rule –*** In case, there are two or more substituents, then the parent or principal chain is numbered from the end which gives the lowest set of locants. The rule is known as the lowest set of locant rules and according to it, when two or more different sets of locants containing the same number of terms are possible, the that set of locants is the lowest, which when compared term by term with other sets, each in order of increasing magnitude has the lowest term at the first point of difference.



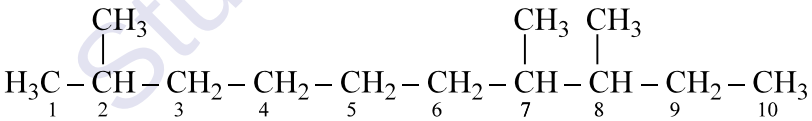
2, (4) , 4 (wrong)



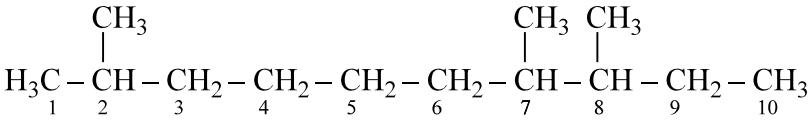
2, (2) , 4 (correct) lower locant

* Earlier lowest sum rule was followed and according to it the numbering of the chain was done in such a way that the total sum of the locants must be lowest but actual emphasis must be laid to have the lowest locant for the first selected term.

e.g.,

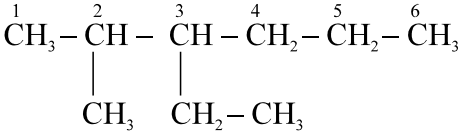


Set of locant - (2, 7, 8) Sum = 2 + 7 + 8 = 17



Set of locant - (3, 4, 9) Sum = 3 + 4 + 9 = 16

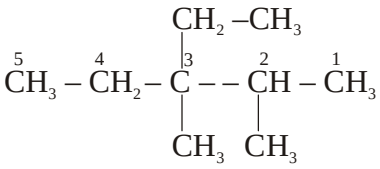
4. ***Alphabetical order for the side chain (or substituents) –*** When two or more different alkyl groups (side chains or substituents) are present on the parent chain. Such groups prefixed by their locants (or positional numbers) are arranged in alphabetical order irrespective of their positional number, before the name of the parent alkane. For example,



2-Methyl-3-ethylhexane (wrong)

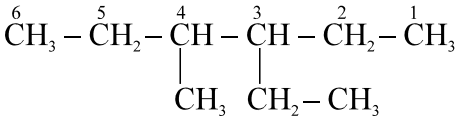
3-ethyl-2-methylhexane (correct)

It may be remember that the prefixes di, tri, tetra are not considered in case the same alkyl group occurs more than on the parent chain at different positions while arranging them in an alphabetical order. For example



3-Ethyl-2,3-dimethylpentane

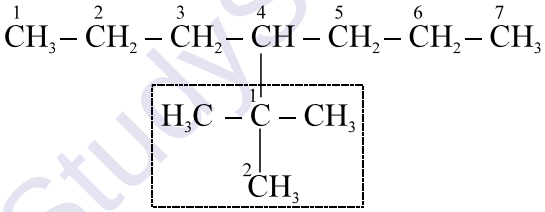
5. **Naming the different substituents at equivalent positions –** If two different substituents are present at equivalent positions from the two ends in the parent chain, then the numbering of the chain is done in such a way that the substituent which comes first in the alphabetical order gets the lower number. For example



3-Ethyl-4-methylhexane

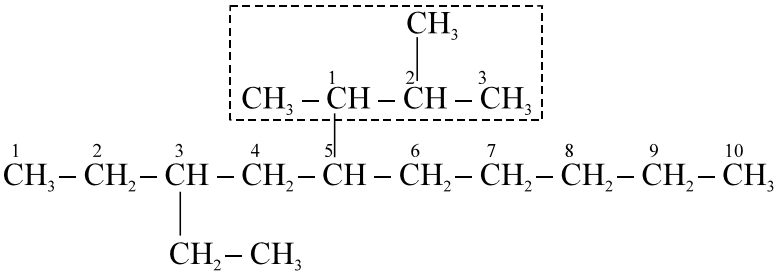
6. **Naming the complex substituents or alkyl groups.**

(a) An alkyl group is said to be complex in case one or more carbon atoms in it are further substituted i.e., it is a substituted substituent (or alkyl group). It is named as a substituted alkyl group by numbering from the carbon atom of this group attached to the parent chain as "1". The name of the complex substituent is generally enclosed in brackets in order to avoid any confusion with either numbering the parent chain or naming the other substituents attached to the chain. For example -



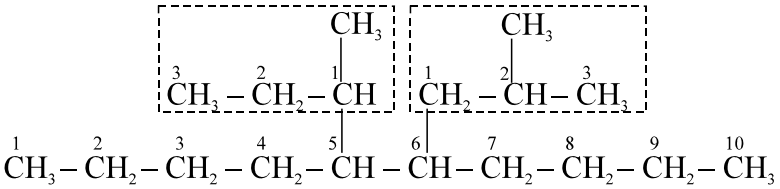
4-(1,1-dimethylethyl) heptane

(b) It may be noted that while deciding the alphabetical order of the various substituents, the name of the complex substituent is considered to begin with the first letter of its complete name. For example-



5-(1,2-Dimethylpropyl)-3-ethyldecane

(c) When the names of the complex substituents are composed of identical words, the priority is decided by comparing the locant at the first cited point within the complex substituents. This means that the complex substituent gets lower priority which has the lowest locant. For example

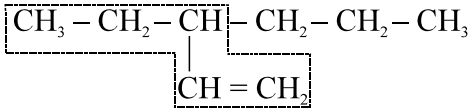


5-(1-methylpropyl)–6–(2-methyl propyl) decane

In this case, 1-methylpropyl gets priority over 2-methylpropyl since the locant for the methyl substituent in the first case is less.

Rule in IUPAC nomenclature of unsaturated hydrocarbons (alkenes and alkynes)

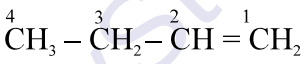
1. The parent chain must include the multiple bond regardless of the fact whether it is longest continuous chain or not. For example,



2. In writing the IUPAC name of a particular member of the alkene or alkyne family, the primary suffix, 'ane' of corresponding in alkane is replacing by the correct 'ene' or 'yne' respectively.

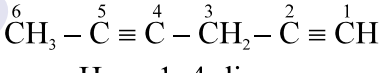
3. The numbering of the parent chain must be done in such a way that the first C-atom involved in the multiple bond gets the lowest number.

According to the latest IUPAC convention, the locants for the multiple bonds (double or triple bonds) are placed immediately before the primary suffixes (ene or yne) which they represent. The earlier practice was to place the locant either before the word root or after the name of the primary suffix but it is not regarded as proper. For example,



But-2-ene

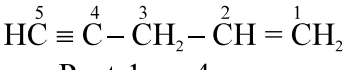
4. If the selected principal or parent chain contains two (or three) double or triple bonds, then the primary suffix -diyne (or triene) or -diene (or triyne) are used to represent these. In all these cases, terminal 'a' is also added to the word root. For example,



Hexa-1, 4-diyne

5. If the parent chain includes both double and triple bonds, then the following points must be kept in mind.

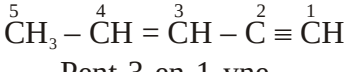
(a) the unsaturated compound is always named as a derivative of alkyne i.e., primary suffix 'ene' always comes before 'yne'. In all such cases, the terminal 'e' of 'ene' is dropped if it is followed by the suffix starting with a, i, o, u or y. For example,



Pent-1-en-4-yne

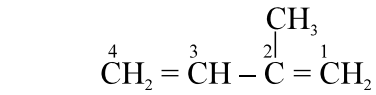
(Preference to the locant for ene)

(b) In case, the numbering from two different ends gives two different sets of locants, then the lower set of locants is preferred. For example,



Pent-3-en-1-yne

6. If the unsaturated hydrocarbon contains a side chain (or substituent) along with the multiple bonds, then the numbering of the parent or principal chain is done in such a way that the multiple bonds gets the lowest set of locants. However, if the numbering from both ends gives the same set of locants to the multiple bonds, then the locant for the substituent must be minimum. For example,



2-Methylbuta-1,3-diene
(Minimum locant for the CH_3 substituent)

In some cases, more than two double bonds are present in the hydrocarbon and it is not possible to include all of them in the parent chain. In such cases, the following prefixes are used for the double bonded groups not involved in the chain.

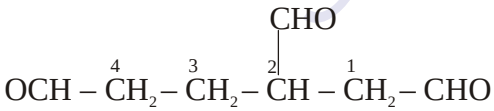
$CH_2 =$	$CH_3 - CH =$	$CH_2 = CH_2 -$	$CH_2 = CH - CH_2 -$
(Methylidene)	(Ethylidene)	(Vinyl or ethenyl)	(Allyl)

IUPAC Nomenclature of the compounds containing one functional group or secondary suffix.

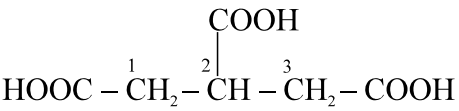
1. Select the longest chain containing the carbon atom to which the maximum number of functional group are attached. This is known as parent chain or principal chain. Where the further rules are followed as mentioned earlier.
IUPAC names for compounds containing more than two similar terminal groups (special cases)
If the organic compound contains more than two similar terminal groups and all of them are directly attached to the parent or principal chain, then none of them forms a part of the parent chain. Special suffixes are used to name these.

Functional group	**Special suffix**
$- COOH$	Carboxylic acid
$- CHO$	Carbaldehyde
$- C \equiv N$	Carbonitrile
$- CONH_2$	Carboxamide

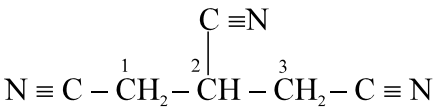
It may be noted that the carbon atoms of these terminal groups are not counted in the principal or parent chain.
A few examples of such compounds are given –



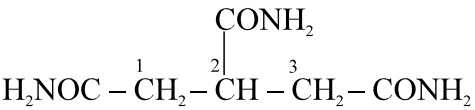
Butane-1, 2, 4-tricarbaldehyde



Propane-1,2,3-tricarboxylic acid



Propane-1, 2, 3-carbonitrile



Propane-1, 2, 3-tricarboxamide

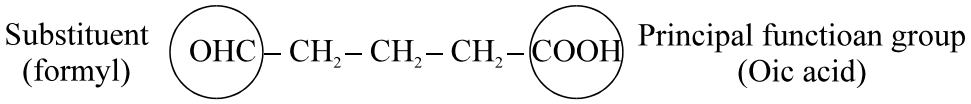
IUPAC Nomenclature for compounds containing more than one different functional groups (Poly functional compounds)

1. When an organic compound contains two or more different functional groups, then one of these is selected as principal functional group while the others are called secondary functional groups and are treated as substituents. The choice of the principal functional group is made on the basis of the of preferences. (As preference table is given on ***page 2***)

In writing the IUPAC name of a poly functional compound, the functional group with the maximum preference (principal functional group) is represented by the secondary suffix which is added to the word root along with the primary suffix. All other secondary functional groups if present, are indicated by suitable prefixes which are added to the root word. (In alphabatic order)

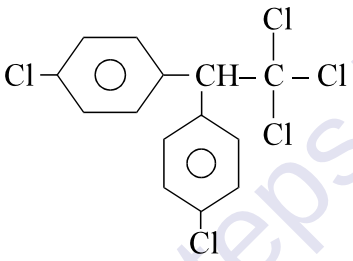
Thus, a functional group can act either as a secondary suffix or a prefix depending upon its priority in the priority sequence. A functional group, in fact, has two names; one while acting as secondary suffix and the other while acting as a prefix.

Suppose an organic compound contains both –CHO and –COOH groups attached on both sides of the carbon atom chain. Then –COOH group is regarded as the principal functional group and its secondary suffix is oic acid. At the same time, –CHO group is the substituent and its prefix is formyl as shown below :



The IUPAC name of the compound is : 4-Formylbutanoic acid.

2. If the organic compound more than one similar complex substitute than the numerical prefix di, tri, tetra, extra replaced by bis, tris, tetrakis, etc. respectively.

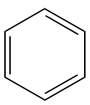


1, 1, 1 - Trichloro-2,2-bis
(4-chlorophenyl) ethane

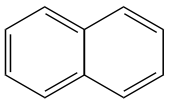
Nomenclature of aromatic compounds

Aromatic is regarded as aroma means pleasant smell. Aromatic compounds may be classified into two main types. These are benzenoids and non-benzenoids.

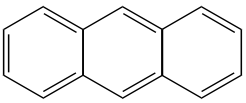
BENZENOIDS : These are cyclic compounds which contains in them either one or more benzene rings. A few examples benzenoids are as follows.



Benzene

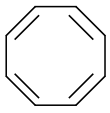


Napthalene



Anthrancene

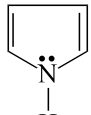
It may be noted that the presence of double bonds in the alternate positions is note the sole criteria for a compound to be aromatic. For example, cyclooctatetraene. (that contain alternative single double bond but non aromatic)



Cyclooctatetraene

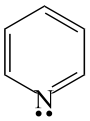
Non-benzenoics –

Certain compounds do not contain a benzene ring but they fulfil the characteristics of aromatic compounds. These are called non-benzenoids. Some heterocyclic compounds belongs to this class of aromatic compounds. For example,

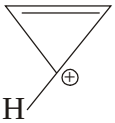

Pyrrole


Furan


Thiophene


Pyridine

Certain ions can also behave as aromatic compound. For example


Cyclopropenecation
2π-electron

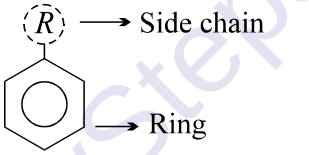

Cyclopentadiene
Anion
(6π-electrons)


Cycloheptatriene
Cation
(6π-electrons)

Nomenclature of Benzenoids –

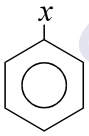
Benzene (C_6H_6) is a hexagonal ring of carbon atoms with single and double bonds in the alternate positions.

This ring is also called nucleus. In case any one or more hydrogen atoms attached to the carbon atoms of the ring are substituted by some alkyl (R) groups or other functional group then such groups form the side chains.



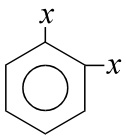
Monosubstituted –

Since all the carbon atoms in the ring are identical, by replacing a hydrogen atom attached to any of them only one mono substituted derivative will be formed –

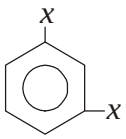
e.g. 

Disubstituted –

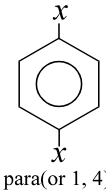
A disubstituted derivative can be formed by substituting any of the five available hydrogen atoms in the monosubstituted derivative by suitable substituents (x).



ortho(or 1,2)
(I)



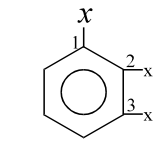
metaortho(or 1, 3)
(II)



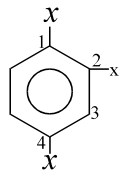
para(or 1, 4)
(III)

It may be noted that the arabic numerals are used in the IUPAC names while the specific prefixes ortho (o–), meta (m–), para(p-) are used for the common names. The aromatic compounds are generally known by their common names or by commercial names in some cases.

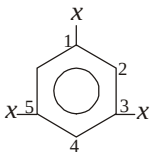
Tri and higher substituted – These are generally represented by the arabic numerals as shown below



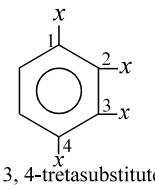
1, 2, 3-trisubstituted



1, 2, 4-trisubstituted



1, 3, 5-trisubstituted

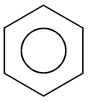


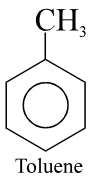
1, 2, 3, 4-tretasubstituted

Now let us write the IUPAC and common names (given in brackets) of a few important members of different families of aromatic compounds.

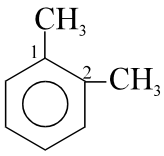
1. *Aromatic hydrocarbons (arenes) –*

The parent member is benzene and the substituted benzene derivatives are called arenes.

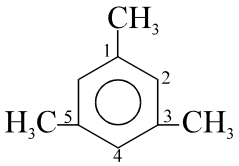

Benzene



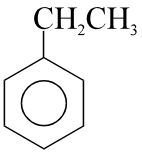
Toluene



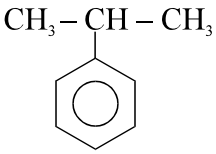
1,2-Dimethylbenzene
(o-Xylene)



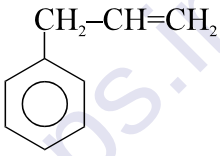
1,3, 5 -Trimethylbenzene
(Mesitylene)



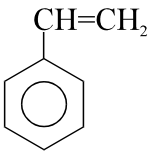
Ethylbenzene



Isopropylbenzene
(Cumene)

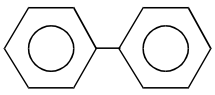


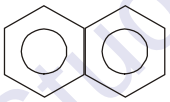
Allybenzene

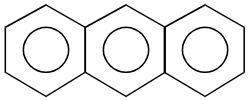


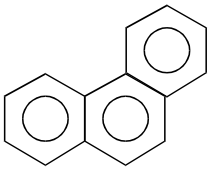
Styrene

Aromatic hydrocarbons may also contain more than one ring either fused with each other or attached by a covalent bond as shown below –


Diphenyl


Naphthalene


Antharancene

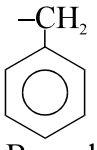

Phenanthrene

In diphenyl, the two rings are linked by one single covalent bond, but in napthalene, are fused at two adjacent position.

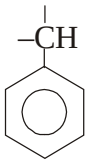
2. *Aryl group –*

An aryl group is obtained by removing one or more hydrogen atoms in the ring or side chain. For example,

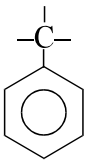

Phenyl(C_6H_5)



Benzyl



Benzal

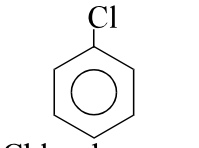


Benzo

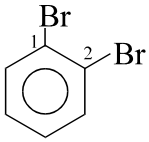
3. ***Halogen derivatives –***

The halogen derivatives may be either nuclear substituted or side chain substituted depending upon whether hydrogen atoms of the ring or the alkyl side chain have been substituted.

Nuclear substituted :

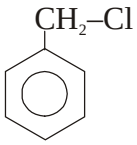


Chlorobenzene

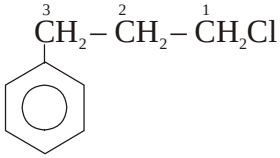


1, 2-dibromobenzene
(o-Dibromobenzene)

Side chain substituted :

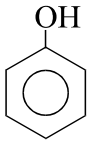


Chloro benzyl

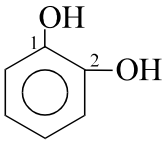


1-chloro-3-phenyl propane

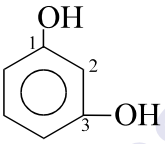
4. **Hydroxy derivatives –** The nuclear substituted hydroxy derivatives are called phenols while the side substituted are known as aromatic alcohols.



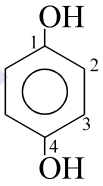
Phenol



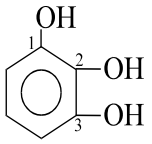
1,2-Dihydroxybenzene
(Catechol)



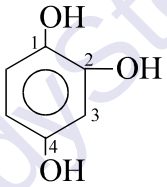
1,3-Dihydroxybenzene
(Resorcinol)



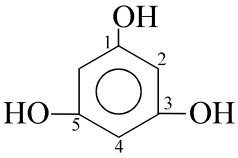
1,4-Dihydroxybenzene
(p-Quinol or hydroquinone)



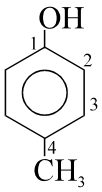
1, 2, 3- Trihydroxybenzene
(Pyrogallol)



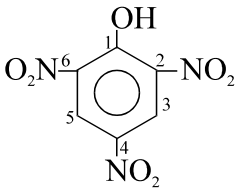
1,2, 4- Trihydroxybenzene
(Hydroquinol)



1,2, 5- Trihydroxybenzene
(Phloroglucinol)

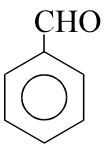


4-Methylphenol
(p-Cresol)

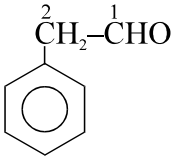


2, 4, 6-Trinitrophenol
(Picric acid)

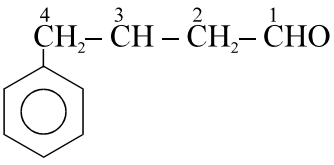
5. **Aldehydes –**



Benzaldehyde

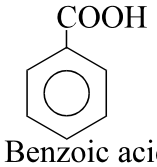


2-Phenylethanal
(Phenylacetaldehyde)

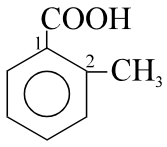


4-Phenylbutanal

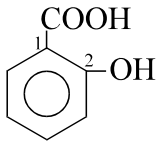
6. Carboxylic acid –



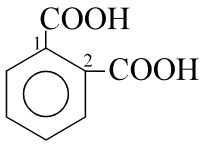
Benzoic acid



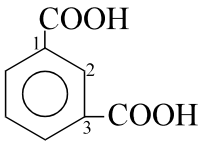
2-Methylbenzoic acid
(o-Toluic acid)



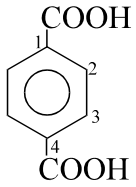
2-Hydroxybenzoic acid
(o-salicylic acid)



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

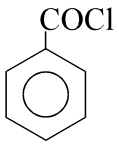


Benzene-1,3-dicarboxylic acid
(Isophthalic acid)

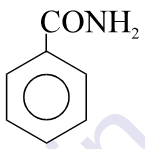


Benzene-1, 4-dicarboxylic acid
(Terephthalic acid)

7. Acid derivatives –

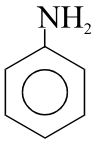


Benzoyl chloride

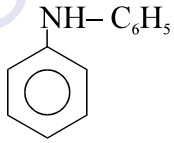


Benzamide

8. Amines –

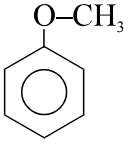


Benzenamine
(Aniline or aminobenzene)

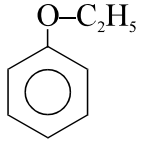


N-Phenylbenzenamine
(N-phenylaniline)

9. Ethers –

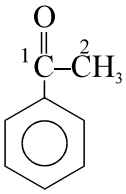


Methoxybenzene
(Anisole)

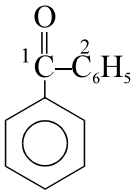


Ethoxybenzene
(Phenetole)

10. Ketones –

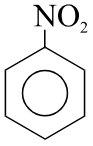


1-Phenylethan-1-one
(Methyl phenyl ketone or Acetophenone)

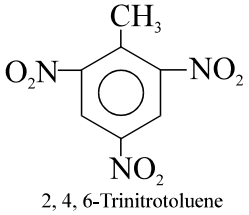


Dilphenylmethanone
(Diphenyl ketone or Benzophenone)

11. Nitro compounds –

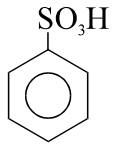


Nitrobenzene



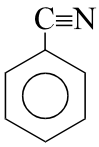
2, 4, 6-Trinitrotoluene
(T. N. T.)

12. Sulphonic acids –

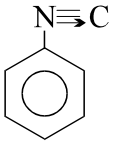


Benzensulphonic acid

13. Cyanides & Isocyanides –

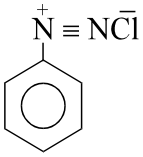


Phenylcyanide

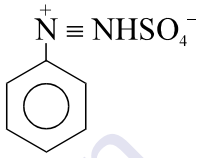


Phenylisocyanide
(Phenylcarbylamine)

14. Diazonium salts –

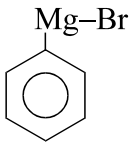


Benzenediazonium
chloride



Benzene diazonium
hydrogen sulphate

15. Grignard's reagent –



Phenyl magnesium bromide

Nomenclature of Alicyclic compounds –

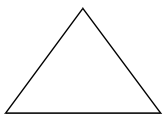
These compounds contain one or more rings of three or more carbon atoms and resemble aliphatic compounds in their characteristics. These are, therefore, called aliphatic cyclic or alicyclic compounds

Monocyclic compounds –

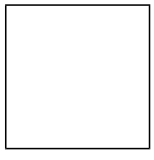
The name of alicyclic compounds are based on the following rules.

1. The names of the alicyclic compound are obtained by adding there primary prefix 'cyclo' to the word root that corresponds to the number of carbon atoms in the ring.

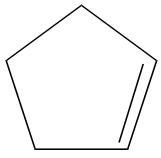
For the cyclic compounds containing all single bonds in the ring, primary suffix 'ane' is added to the word root. For those containing one double or triple bond, the primary suffix ene or yen is added.



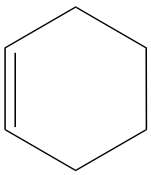
Cyclopropane



Cyclobutane

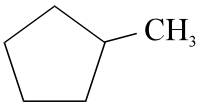


Cyclopentene

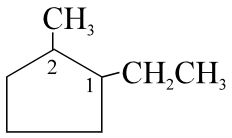


Cyclohexene

2. If only one substituent is attached to the ring, its position is note mentioned. If two or more substituents are present, their positions are indicated by arabic numerals i.e., 1,2,3,4 ..... etc. which are used for numbering the carbon atoms in the ring. The numbering is done in such a way (clockwise or anticlockwise) that the substituents get the lowest set of locants. All other rules relating to aliphatic or acyclic compounds are then followed. For example.

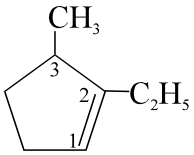


Methylcyclopentane

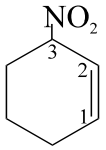


1-Ethyl-2-methylcyclopentane

3. If a multiple bonds and some other substituents are present in the ring, the numbering is done in such a way so as to assign lowest number to the multiple bond. For example

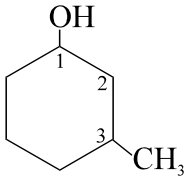


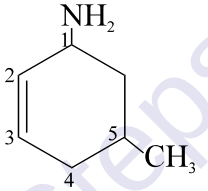
3-Ethyl-3-methylcyclopent-1-ene

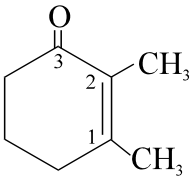


3-Nitrocyclohex-1-ene

4. In case, some functional group along with some substituents are present in the ring, the numbering of the carbon atoms should be done in such a way so that the functional group gets lowest number.



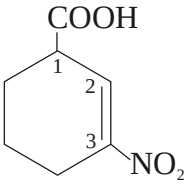




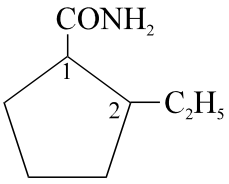
In case, the functional group directly attached to the ring contains carbon atom, suitable suffixes are used to represent such a group.

Functional group	**Suffix**
–COOH	Carboxylic acid
–CHO	Carbaldehyde
–C≡N	Carbonitrile
–COCl	Carbonylchloride
$-CONH_2$	Carboxamide
–COOR	R—Carboxylate

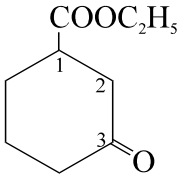
A few example are given to represent these :



3-Nitrocyclohex-2-ene-1-carboxylic acid

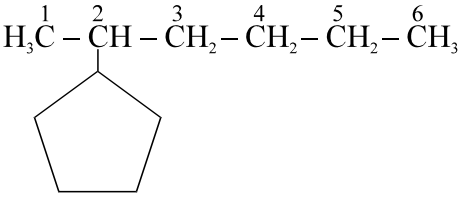


2-Ethylcyclopentane-1-carboxamide

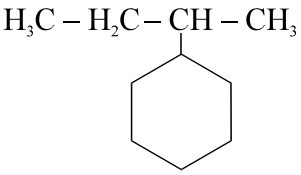


Ethyl-3-oxocyclohexane-1-carboxylate

5. If the ring contains lesser carbon atoms than the alkyl group attached to it, the compound is named as the derivative of alkane and the ring is treated as cycloalkyl substituent. Otherwise, it is named as the derivative of cycloalkane. For example.

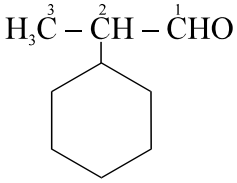


2-cyclopentylhexane

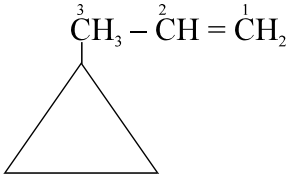


Sec-Butylcyclohexane

In case, the side chain contains a multiple bond or a functional group, the alicyclic ring is treated as the substituent irrespective of its size. For example,



2-Cyclohexylpropane



3-Cyclopropylprop-1-ene

6. If the ring contains fewer carbon atoms than the alkyl group attached to it or when more than one ring system is attached to a single chain the compound is named as a derivative of alkane and the ring is treated as cycloalkyl substituent.

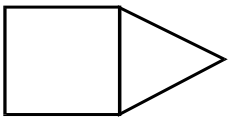
7. When both ring as well as side chain contains the same functional group, then the parent hydrocarbon is decided on the basis of the number of carbon atom.

8. If a compound contains an a cyclic ring as well as a benzene ring, it is named as a derivative of benzene.

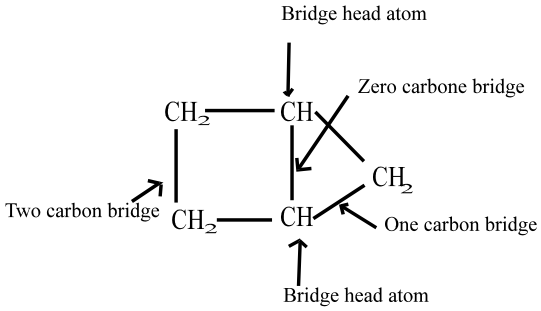
IUPAC Names of Polycyclic compounds

Certain cyclic compounds contain two or more rings . The IUPAC names of each compounds are based upon the following guidelines .

1. The carbon atoms common to the two rings are known as bridge head atoms . Each bond or chain of carbon atoms which connects the bridge head atoms is known as **bridge.** The bridge may contain either no carbon atom (0) or carbon atom (1) or two carbon atoms (2).
This may be illustrated by the following e.g.,

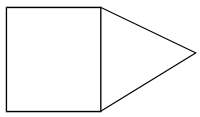


or

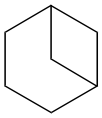


2. The bicyclic compound is named by attaching the prefix `bicyclo` to the name of the hydrocarbon in which the root word contains the total number of carbon atoms involved in the two rings. The number of the carbon atoms in the different bridges are represented by arabic numerals 0,1,2,3, etc. These are arranged in a descending order separated by full stops [•] and enclosed in square brackets.

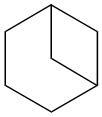
The complete name of the hydrocarbon is written by placing the bracket between the prefix and the name of the hydrocarbon. For example,



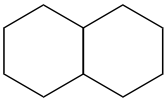
Bicyclo [2.1.0] pentane



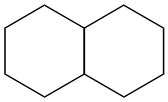
Bicyclo [3.1.1.] heptane



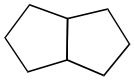
Bicyclo [3.1.1.] heptane



Bicyclo [4,3,0,] nonane

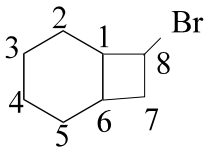


Bicyclo [4,4,0,] decane

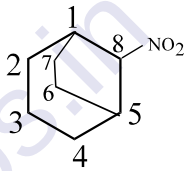


Bicyclo [3.3.0.] nonane

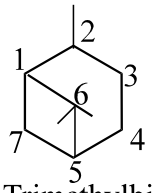
If a substituent or double bond is present in one of the rings, then the bicyclic ring is numbered in order to ascertain its position. The numbering begins with one of the bridge head atoms, proceeds first along the longest bridge to the seconds bridge head atoms, continues along the next longest bridge to the first bridge head and finally ends at the substituted carbon along the shortest path. For example,



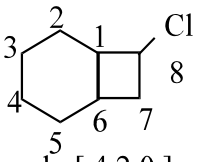
8 - Bromobicyclo [4.2.0] octane



8 - Nitrobicyclo [3.2.1] octane



2,6,6 - Trimethylbicyclo [3.1.1] heptane

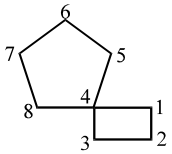


8 - Chlorobicyclo [4.2.0] oct -2 - ene

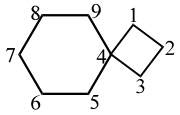
NAMES OF SPIRO BICYCLIC HYDROCARBONS

Spiro bicyclic hydrocarbons contain two rings consisting of carbon atoms only the two rings are linked by a common carbon. These compounds are named by placing prefix 'spiro' before the name of the acyclic parent hydrocarbon with same number of skeleton carbon atoms. The numbers of skeleton atoms linked to the spiro atom are indicated by arabic numbers, separated by a full stop. The numbers are written in ascending order and enclosed in square brackets.

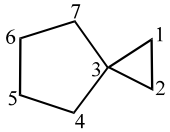
Numbering of a spiro bicyclic hydrocarbon starts with a ring carbon next to the spiro atoms and proceeds first through the small ring and then through the spiro atom and around the second ring. Some examples are given below :



spiro [3.4]octane



Spiro [3.5] nonane



Spiro [2.4] heptane