

3.

NOMENCLATURE OF ORGANIC COMPOUNDS

There are two general ways of naming organic compounds;

- (i) Common or trivial and (ii) Systematic names (IUPAC names).

3.1. Trivial Or Common names

During the first half of the nineteenth century, chemists discovered many new compounds and named them with little or no structural significance. Such *common* or *trivial* names might reflect the source of the compound, the method of its preparation or the name of the person working on it. For example, acetic acid can be obtained from vinegar, it got its name from the Latin word for vinegar, *acetum*. Formic acid, HCOOH , was so named as it was obtained by distillation of red ants (Latin, *formica* = ants). Ethylene chloride got its name because it was made by the reaction of ethylene with chlorine. Barbituric acid is said to perpetuate the name of woman *barbara*. Some names, refer to distinctive properties that characterize the compound, e.g; acrolein (Latin *acris*; pungent); chrysene (Greek *chrysos*, golden); glucose (Greek *glucose*, sweet) refer to attributes of odour, colour and taste.

*An ordinary name given to a compound without reference to its structure is called a **Common name** or **Trivial name**. The common names are like nicknames.*

Common or trivial names are still widely used by chemists, biochemists and the companies that sell chemicals. For this reason, trivial names have a firm place in the literature and language of organic chemistry and hence it is still necessary to learn the common names for some of the common compounds.

3.2. Systematic Naming of Organic Compounds by IUPAC System

With the rapid growth of organic chemistry, the number of compounds increased fantastically (now about 3 million). It becomes impossible to give common names to such a large number of organic compounds.

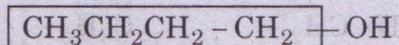
*In 1957, the International union of Pure and Applied chemistry evolved a scheme for giving systematic names to organic compounds on the basis of structure. This is known as the **IUPAC System**. The systematic name of a compound derived from its structural formula by applying IUPAC rules, is referred to its as **IUPAC Name**. One organic compounds can have only one IUPAC name. It is superior to a common name as it gives an insight into the structure of the molecule. Knowing the IUPAC name of a compounds, we can at once write its structural formula. *Remember that the common names identify compounds while the IUPAC names represent structures.**

The IUPAC system of nomenclature is based upon the following principles for assignment of substitutive names.

1. The longest continuous carbon chain (the parent chain) containing the functional group is the parent structure of aliphatic (acyclic) compounds.
2. The common names of familiar cyclics are frequently chosen as parent structures of compounds containing cyclic structures.
3. An order of preference is assigned to various functional groups. The groups higher in the order are given preference in the definition of parent structures. Some functional groups are always considered as substituents.

Functional Group

A functional group is an atom or group of atoms in a molecule that gives the molecule its characteristic chemical properties. Double and triple bonds are functional groups. Other examples include $-\text{Cl}$, $-\text{Br}$, $-\text{OH}$, $-\text{NH}_2$, $-\text{COOH}$, $>\text{C}=\text{O}$ groups.



Hydrocarbon portion Functional group

The concept of functional group is important to organic chemistry for three reasons:

1. Functional groups serve as basis for nomenclature.
2. Functional groups serve to classify organic compounds into classes / families. All compounds with the same functional group belong to the same class.
3. Functional group is a site of chemical reactivity in a molecule. Compounds in the same class have similar chemical properties.

Alkyl groups

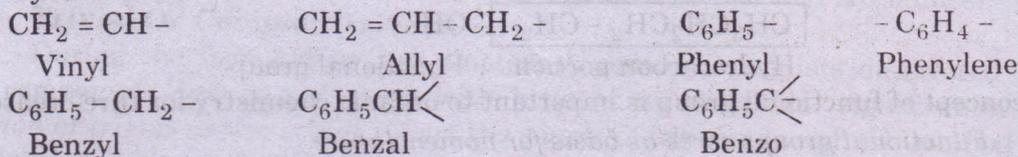
Radicals which are derived by the removal of one hydrogen atom from an alkane are called **alkyl radicals** and are expressed by general formula, $\text{C}_n\text{H}_{2n+1}$. The names of the alkyl groups are derived by replacing the ending-ane of the corresponding alkane by -yl. An alkyl group is represented by a general symbol R-. Two different alkyl groups (n-propyl and isopropyl) are derived from propane depending on whether the hydrogen atom is removed from the terminal or the middle carbon of propane. Similarly, two alkyl groups are obtained from each of n-butane and isobutane. Some of the common alkyl groups are given below:

Methyl	$\text{CH}_3 -$	Ethyl	$\text{CH}_3\text{CH}_2 -$
n-propyl	$\text{CH}_3\text{CH}_2\text{CH}_2 -$	Isopropyl	$\text{CH}_3 - \overset{ }{\text{CH}} - \text{CH}_3$
n-butyl	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2 -$	Sec butyl	$\text{CH}_3 - \text{CH}_2 - \overset{ }{\text{CH}} - \text{CH}_3$
Isobutyl	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{CH} - \text{CH}_2 - \end{array}$	tert-butyl	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} - \\ \\ \text{CH}_3 \end{array}$
n-pentyl	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2 -$	Isopentyl	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_2 - \end{array}$
tert.pentyl	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{CH}_2 - \text{C} - \\ \\ \text{CH}_3 \end{array}$	Neopentyl	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} - \text{CH}_2 - \\ \\ \text{CH}_3 \end{array}$

An alkyl group is known as primary if its carbon of attachment is bonded to only one other carbon atom, secondary if bonded to two other carbon atoms, and tertiary if

bonded to three other carbon atoms. Thus isopropyl group is a secondary alkyl group but isobutyl group is a primary alkyl group.

Unsaturated hydrocarbon groups are called *alkenyl groups*, while the aromatic hydrocarbon groups are called *aryl groups* and are represented by the general symbol Ar.



1. Alkanes

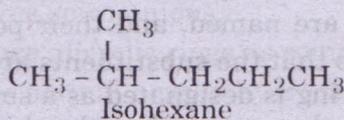
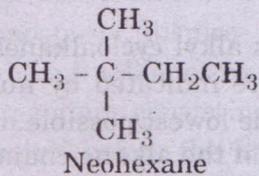
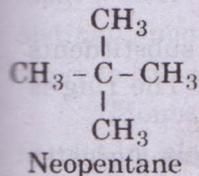
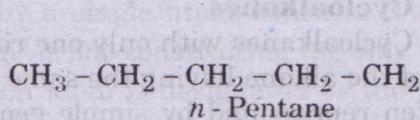
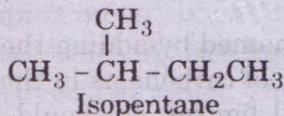
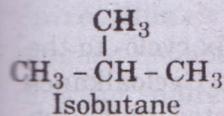
Hydrocarbons that contain only single bonds are called alkanes. Hydrocarbons are compounds that contain only carbon and hydrogen. The first four members of the series are known by their common names; methane, ethane, propane and butane. The names of higher alkanes are derived from the Greek prefixes that indicate the number of carbon atoms in the molecule. Thus *pentane* has 5 carbons, *hexane* has 6 and so on.

Table 3.1. Names of the unbranched alkanes

Name	No. of Carbons	Structure	Name	No. of Carbons	Structure
Methane	1	CH_4	Eicosane	20	$\text{CH}_3(\text{CH}_2)_{18}\text{CH}_3$
Ethane	2	CH_3CH_3	Heneicosane	21	$\text{CH}_3(\text{CH}_2)_{19}\text{CH}_3$
Propane	3	$\text{CH}_3\text{CH}_2\text{CH}_3$	Docosane	22	$\text{CH}_3(\text{CH}_2)_{20}\text{CH}_3$
Butane	4	$\text{CH}_3(\text{CH}_2)_2\text{CH}_3$	Triacontane	30	$\text{CH}_3(\text{CH}_2)_{28}\text{CH}_3$
Pentane	5	$\text{CH}_3(\text{CH}_2)_3\text{CH}_3$	Hentriacontane	31	$\text{CH}_3(\text{CH}_2)_{29}\text{CH}_3$
Hexane	6	$\text{CH}_3(\text{CH}_2)_4\text{CH}_3$	Tetracontane	40	$\text{CH}_3(\text{CH}_2)_{38}\text{CH}_3$
Heptane	7	$\text{CH}_3(\text{CH}_2)_5\text{CH}_3$	Pentacontane	50	$\text{CH}_3(\text{CH}_2)_{48}\text{CH}_3$
Octane	8	$\text{CH}_3(\text{CH}_2)_6\text{CH}_3$	Hexacontane	60	$\text{CH}_3(\text{CH}_2)_{58}\text{CH}_3$
Nonane	9	$\text{CH}_3(\text{CH}_2)_7\text{CH}_3$	Heptacontane	70	$\text{CH}_3(\text{CH}_2)_{68}\text{CH}_3$
Decane	10	$\text{CH}_3(\text{CH}_2)_8\text{CH}_3$	Octacontane	80	$\text{CH}_3(\text{CH}_2)_{78}\text{CH}_3$
Undecane	11	$\text{CH}_3(\text{CH}_2)_9\text{CH}_3$	Nonacontane	90	$\text{CH}_3(\text{CH}_2)_{88}\text{CH}_3$
Dodecane	12	$\text{CH}_3(\text{CH}_2)_{10}\text{CH}_3$	Hectane	100	$\text{CH}_3(\text{CH}_2)_{98}\text{CH}_3$
Tridecane	13	$\text{CH}_3(\text{CH}_2)_{11}\text{CH}_3$			

In the **common** system all isomeric alkanes have the same parent name. The name of various isomers are distinguished by prefixes. The prefix indicates the type of branching present in the molecule.

The prefix *n*-(normal) denotes an unbranched chain of C atoms. The prefix *iso*-indicates a CH_3 branch on the second carbon from the end. The prefix *neo*-indicates two methyl groups attached to the second carbon from the end of the continuous chain.

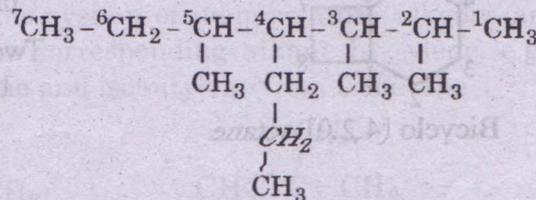
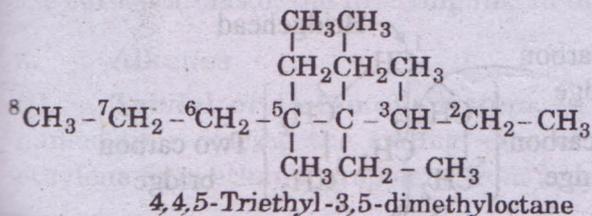
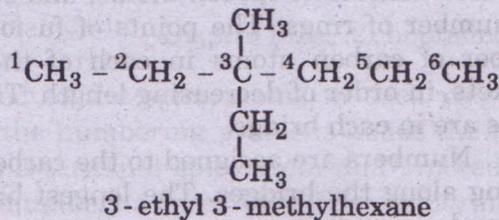
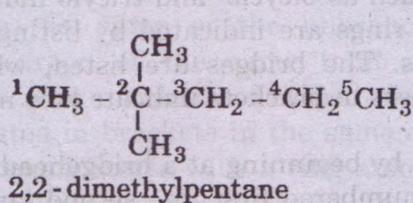


IUPAC Rules for Naming Alkanes

The IUPAC system is much the same for all classes of organic compounds.

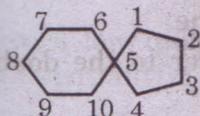
Branched-chain alkanes are named according to the following rules:

1. Find the longest continuous carbon chain in the molecule and name the alkane corresponding to this number of carbon atoms.
2. Number the carbon atoms of the longest chain starting from that end so as to assign the lowest possible total number to the substituents. If there are more than one longest chain, select the chain with greatest number of substituents.
3. The position of each substituent is specified by the number of carbon to which it is attached in the longest continuous chain.
4. When two or more substituents are present on the same carbon, use the number twice
5. When two or more substituents are identical, indicate this by the use of prefixes di-, tri-, tetra-, and so on.
6. The substituents are written in alphabetical order before the parent name. Each substituent is prefixed by the number assigned to it and separated from the name by a hyphen. If several identical radicals are present, their numbers are listed together, separated each number by commas. Some examples are given below to illustrate the system.

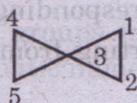


Spiroalkanes: A "spiro union" is one formed by a single atom which is the only common member of two rings. A "free Spiro union" is one constituting the only union direct or indirect between two rings. The common atom is designated as the "spiro atom". According to the number of spiro atoms present, the compounds are distinguished as monospiro-, dispiro-, trispirocompounds, etc. The following rules apply to the naming of spiroalkanes containing free spiro unions.

Monospiro compounds consisting of only two alicyclic rings as components are named by placing "spiro" before the name of the normal acyclic hydrocarbon of the same total number of carbon atoms. The number of carbon atoms linked to the spiro atom in each ring is indicated in ascending order in brackets placed between the spiro prefix and the alkane (hydrocarbon) name. The carbon atoms in monospiroalkanes are numbered consecutively starting with a ring atom next to the spiro atom, first through the smaller ring (if such be present) and then through the spiro atom and around the second ring.



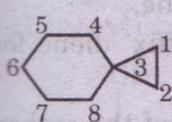
Spiro [4.5] decane



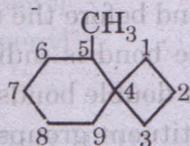
Spiro [2.2] pentane



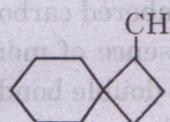
Spiro [3.3] heptane



Spiro [2.5] octane



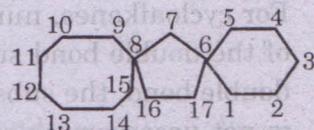
5-methylspiro [3.5] nonane



1-methylspiro [3.5] nonane

Polyspiro compounds consisting of a linear assembly of three or more alicyclic systems are named by placing "dispiro-", "trispiro-", "tetrspiro-" etc., before the name of the unbranched-chain acyclic hydrocarbon of the same total number of carbon

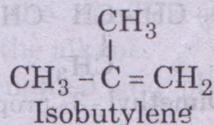
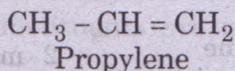
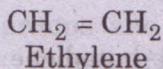
atoms. The numbers of carbon atoms linked to the spiro atoms in each ring are indicated in brackets in the same order as the numbering proceeds about the ring. Numbering starts with a ring atom next to a terminal spiro atom and proceeds in such a way as to give the spiro atoms as low numbers as possible after numbering all the carbon atoms of the first ring linked to the terminal spiro atom.



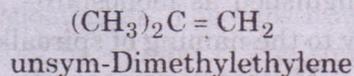
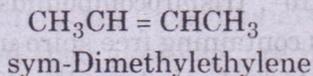
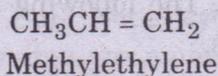
Dispiro [5.1.7.2] heptadecane

3. Alkenes

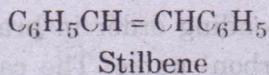
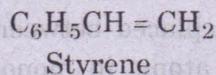
(i) **Trivial or Common System.** In this system of nomenclature alkenes are named by replacing the ending **-ane** of the corresponding alkane by **-ylene**, e.g., ethylene from ethane, propylene from propane and isobutylene from isobutane



The use of trivial names becomes difficult for individual alkenes having four or more carbon atoms because of the large number of isomers possible. So the common names are used only for the above three alkenes. However, a few simple alkenes may be named as derivatives of ethylene, e.g.,

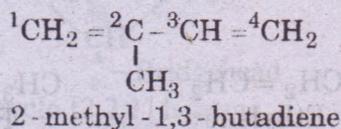
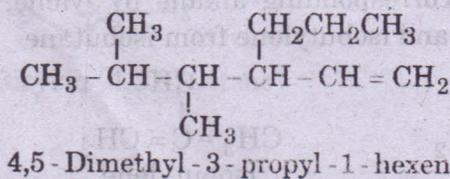
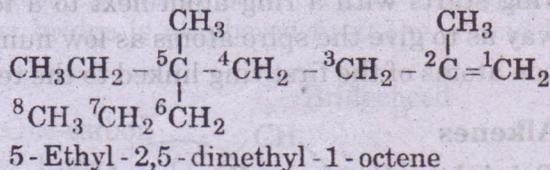
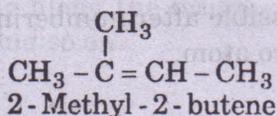


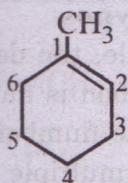
A few special trivial names are also in common use, e.g.,



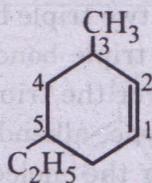
- (ii) **IUPAC System.**
1. Select the longest continuous chain containing the carbon - carbon double bond as the parent chain which is then named by replacing the ending -ane of the corresponding alkane by -ene.
 2. The parent chain is numbered starting from the end nearer to the double bond.
 3. The position of the double bond is indicated by putting the number of lower numbered carbon of the double bond before the name of the alkene.
 4. Presence of more than one double bond is indicated by the suffix -diene for two double bonds, -triene for three double bonds and so on.
 5. Indicate the locations of the substituent groups by the number of the carbon atoms to which they are attached.
 6. For cycloalkenes, numbering is always started from one of the carbon atoms of the double bond such that when continued toward the other carbon of the double bond, the substituents (if any) are given the lowest sum of numbers. It is not necessary to specify the position of the double bond (unless there are more than one double bond in the ring) because it is always 1.

When a geometric isomer is to be specified, a prefix *cis* or *trans* is added.

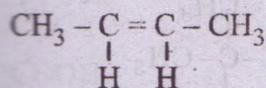




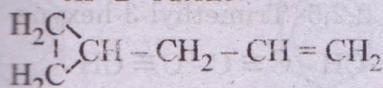
1-Methylcyclohexene



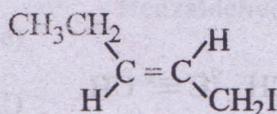
5-Ethyl-3-methylcyclohexene



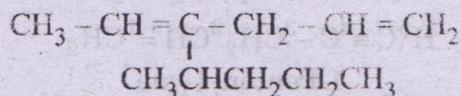
cis-2-butene



3-Cyclopropyl-1-propene

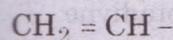
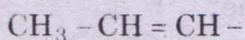
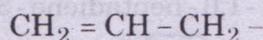
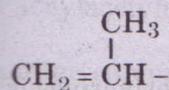
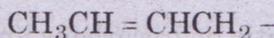


trans-1-Iodo-2-pentene



4-(1-Methylbutyl)-1,4-hexadiene

There are a few important alkenyl groups for which trivial (common) names are used preferentially in place of systematic names. These are

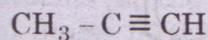
Vinyl
(Ethenyl)Propenyl
(1-Propenyl)Allyl
(2-Propenyl)Isopropenyl
(1-Methylethenyl)Crotyl
(2-Butenyl)

4. Alkynes

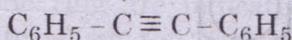
Hydrocarbons that contain a carbon-carbon triple bond are called alkynes.

The simplest alkyne, $\text{HC} \equiv \text{CH}$ is commonly called **acetylene**.

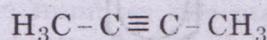
The simple alkynes are named in the common system as derivatives of acetylene.



Methylacetylene



diphenylacetylene

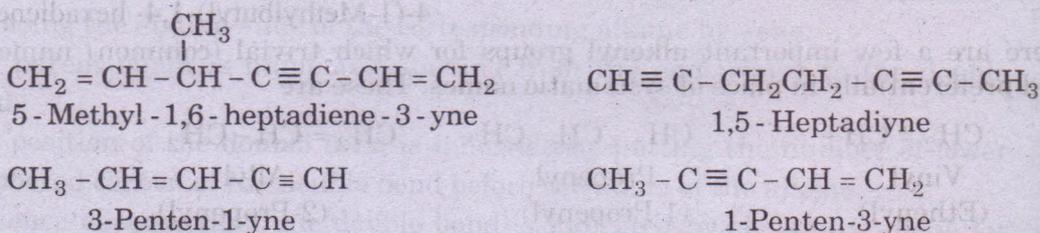
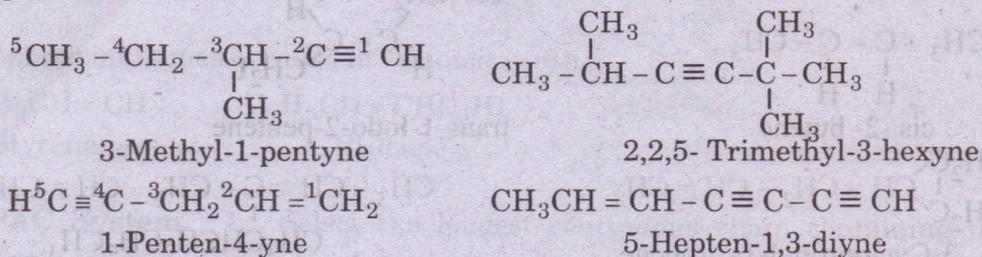


dimethylacetylene

The IUPAC rules for naming alkynes are analogous to those for alkenes.

- (i) Select the longest continuous carbon chain containing the triple bond as the parent chain which is then named by replacing the ending -ane of the corresponding alkane by -yne.
- (ii) Number the parent chain from the end nearer to the triple bond.
- (iii) Indicate the position of the triple bond by putting the number of lower numbered carbon of the triple bond before the name of the alkyne.
- (iv) Alkyl groups and other substituents are numbered, named and placed as prefixes in alphabetic order.

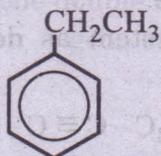
- (v) Alkynes containing two triple bonds are named as **alkadiynes**.
- (vi) If both double and triple bonds are present in a molecule, the double bond takes precedence over the triple bond, then the hydrocarbon is named as an alkenyne, alkadienyne, alkendiyne, etc., depending on the number of double and triple bonds in the molecule. The numbers to the multiple bonds are assigned in such a way that the total of the number remain as low as possible.



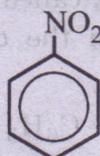
5. Aromatic Hydrocarbons

The nomenclature of the aromatic hydrocarbons and their derivatives is more complex than that of the aliphatic compounds. The system used for naming the benzene derivatives generally depends on the number of substituents on the benzene ring.

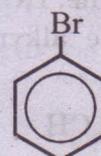
1. Monosubstituted benzene derivatives are systematically named as one word by combining the name of the substituent as a prefix with the word benzene, e.g.,



Ethylbenzene

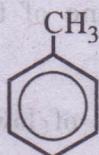
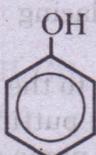
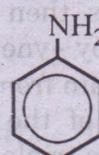
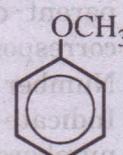


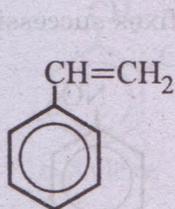
Nitrobenzene



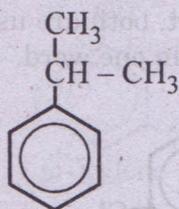
Bromobenzene

A number of monosubstituted benzene derivatives have common names which are currently accepted. The IUPAC names are given in brackets.

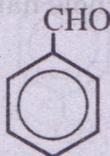
Toluene
(Methylbenzene)Phenol
(Hydroxybenzene)Aniline
(Aminobenzene)Anisole
(Methoxybenzene)



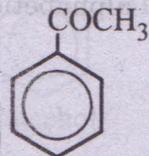
Styrene
(Phenylethylene)



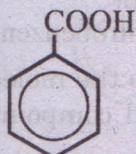
Cumene
(Isopropylbenzene)



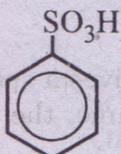
Benzaldehyde



Acetophenone

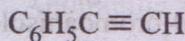


Benzoic acid

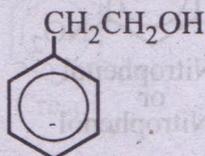


Benzenesulphonic acid

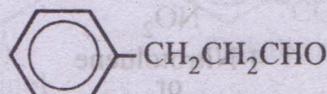
Sometimes, it is more convenient to name the benzene ring as a substituent, the phenyl group, C_6H_5



Phenylacetylene

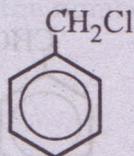


2-Phenylethanol

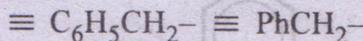
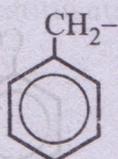


3-Phenylpropanal

Another common aromatic substituent is Benzyl group which is abbreviated as $C_6H_5CH_2-$.

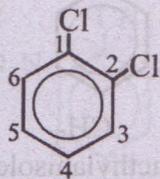


Benzyl chloride

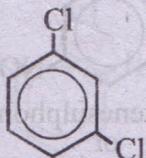


Benzyl

2. In disubstituted benzene derivatives, the relative positions of the substituents in the benzene ring are indicated by the numbers allocated to the carbon atoms of the ring to which the substituents are attached or by using the prefixes ortho (*o*-), meta (*m*-), and para (*p*-) for the 1,2-, 1,3-, and 1,4- substituents, respectively. For example,



1,2-Dichlorobenzene
or
o-Dichlorobenzene

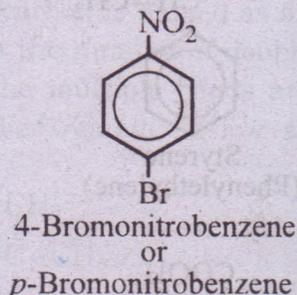
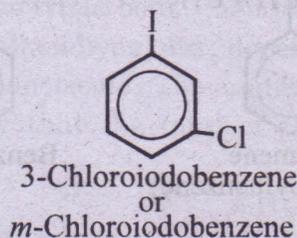
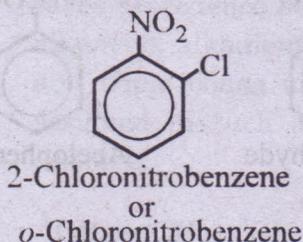


1,3-Dichlorobenzene
or
m-Dichlorobenzene

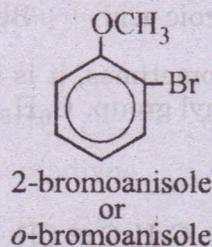
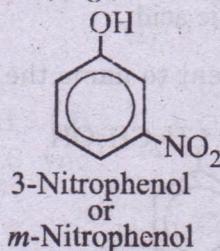
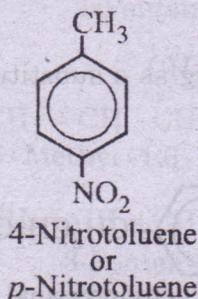


1,4-Dichlorobenzene
or
p-Dichlorobenzene

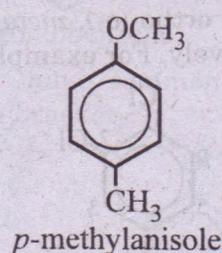
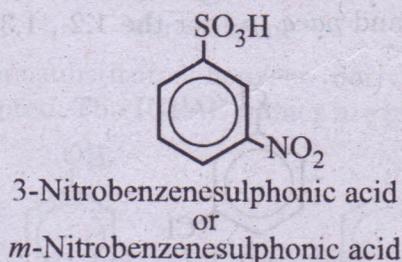
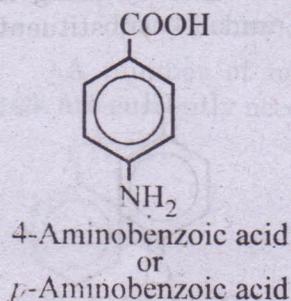
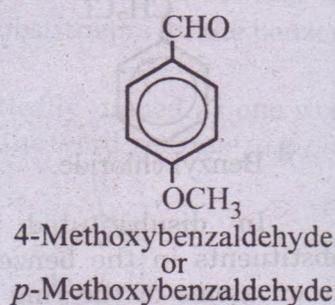
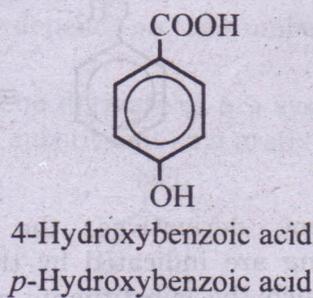
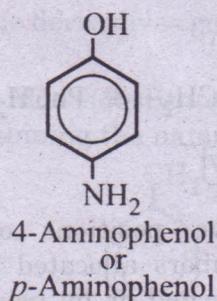
If the two substituents are different, both are used as prefixes successively in alphabetic order. The whole name is used in one word.



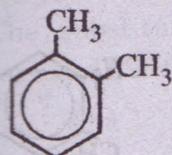
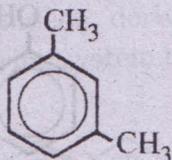
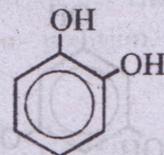
If one of the substituents is such that it gives a special name to the molecule, then the special name is used as the parent name, the disubstituted compound is named as a derivative of that parent, e.g.,



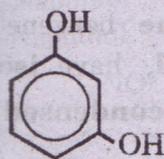
If both substituents are such that they independently give a special name to the molecule, then the substituent which is normally treated as suffix gives the parent name to the molecule.



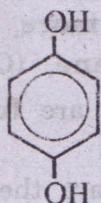
Some disubstituted benzene derivatives also have special names that represent the benzene ring together with both the substituents, e.g.,

*o*-Xylene*m*-Xylene*p*-Xylene

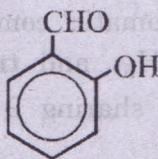
Catechol



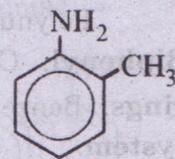
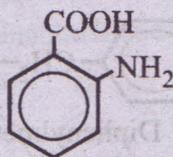
Resorcinol



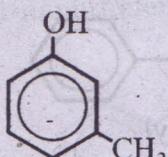
Hydroquinone



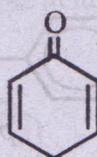
Salicylaldehyde

*o*-Toluidine

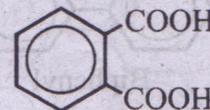
Anthranilic acid



Cresol

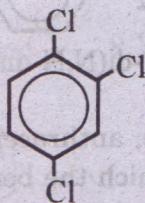


Quinol

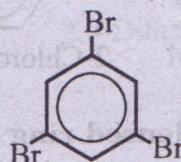


Phthalic acid

Polysubstituted Benzenes. When three or more substituents are attached to the benzene ring, numbers must be used to designate their positions. If all the substituents are the same, the benzene ring is numbered so as to give the lowest total of the numbers assigned to the substituents, e.g.,

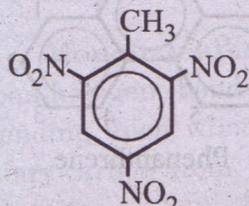


1,2,4-Trichlorobenzene

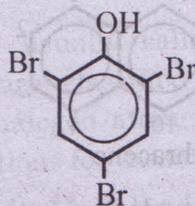


1,3,5-Tribromobenzene

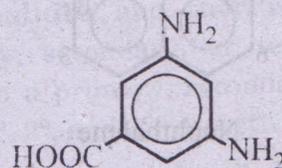
If one of the substituents gives a special name to the molecule, then only the remaining positions of substituents are mentioned.



2,4,6-Trinitrotoluene

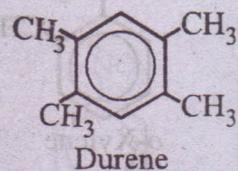
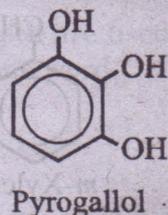
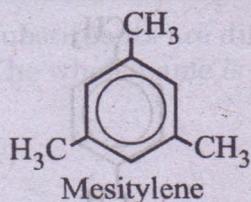
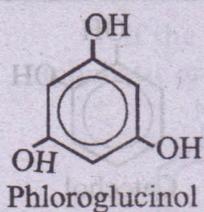


2,4,6-Tribromophenol



3,5-Diaminobenzoic acid

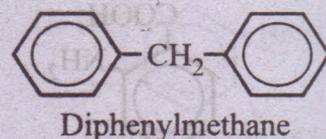
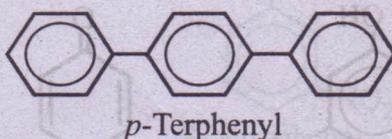
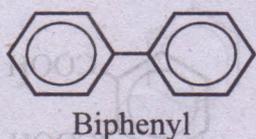
Some Polysubstituted benzene derivatives also have special names.



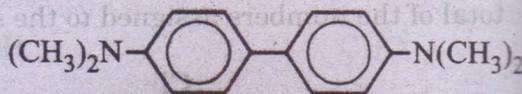
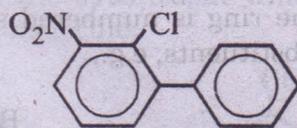
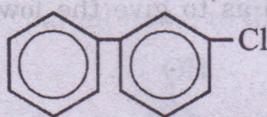
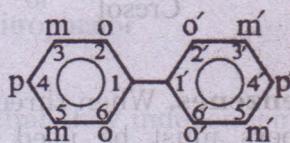
Polynuclear Aromatic Hydrocarbons

Polynuclear aromatic compounds have **more than one** benzene ring. **Biphenyl**, $C_6H_5 - C_6H_5$, and **triphenylmethane**, $(C_6H_5)_3CH$, have **isolated rings**. Benzene rings sharing 2 ortho carbons are **fused or condensed ring system**.

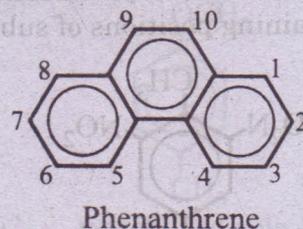
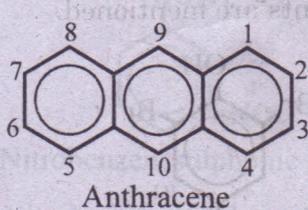
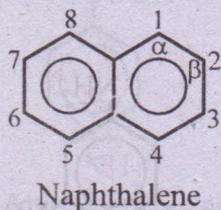
Isolated ring systems. The following are the important compounds of isolated ring systems.



The numbering system in biphenyl is:

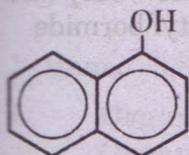


Fused or Condensed ring systems. Naphthalene, anthracene and phenanthrene are the most important members of this class, in which the benzene rings are fused together at ortho positions so that the adjacent rings have a common carbon-carbon bond.

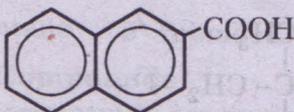


In the IUPAC system of nomenclature, numbers are assigned only to those positions of the fused ring aromatic hydrocarbons at which substitution can take place as shown in the above structures.

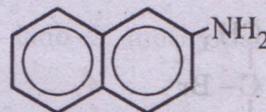
The substituted naphthalene derivatives are usually designated by the prefixes α - and β -. The numbering system begins with number 1 at the α - position.



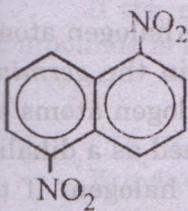
α -Naphthol
1-Naphthol



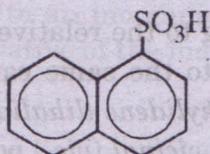
β -Naphthoic acid
2-Naphthoic acid



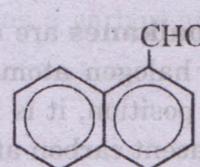
β -Naphthylamine
2-Naphthylamine



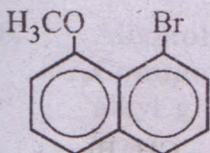
1,5-dinitronaphthalene



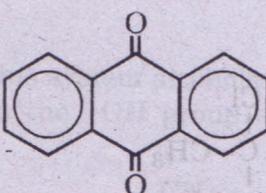
α -naphthalenesulphonic acid
1-naphthalenesulphonic acid



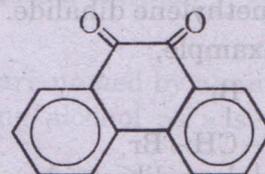
α -naphthaldehyde
1-naphthaldehyde



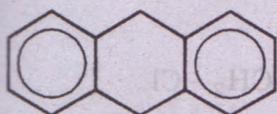
1-Bromo-8-methoxynaphthalene



9,10-Anthraquinone



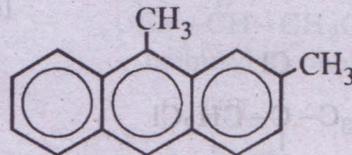
9,10-phenanthraquinone



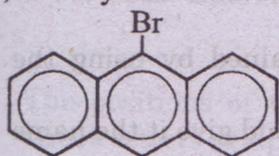
9,10-Dihydroanthracene



9,10-Dihydrophenanthrene



2,9-Dimethylanthracene

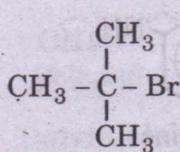
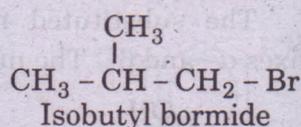
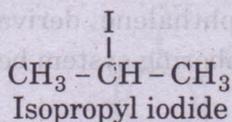
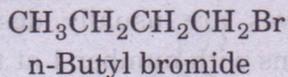
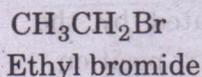


9,10-Dibromoanthracene

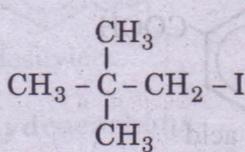
6. Alkyl Halides

Monohaloalkanes are usually called **alkyl halides** and they contain carbon-halogen bonds. They are classified as primary, secondary, or tertiary, depending upon whether the halogen atom is bonded to a primary, secondary, or tertiary carbon atom. Abbreviations for these terms are 1° , 2° , and 3° respectively.

The common names of alkyl halides are obtained by naming the alkyl group attached to the halogen and adding the name of halide corresponding to halogen as a separate word.



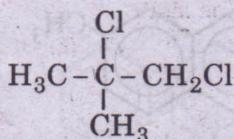
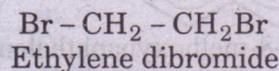
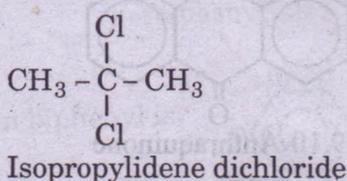
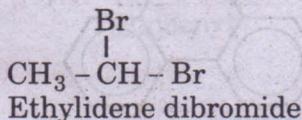
tert. Butyl bromide



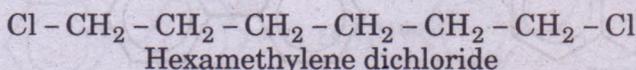
Neopentyl iodide

Dihaloalkanes are named according to the relative positions of the halogen atoms. If two halogen atoms are attached to the same carbon atom, i.e. in the *geminal* (*gem-*) position, it is named as an *alkylidene dihalide*. If the two halogen atoms are on adjacent carbon atoms, i.e., in the *vicinal* (*vic-*) position, it is named as a dihalide of the alkane from which it may be prepared by the addition of halogen. If the halogen atoms are on the terminal carbon atoms of the chain it is named as the polymethylene dihalide.

For example,

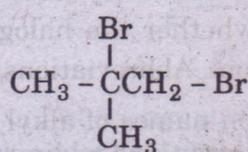
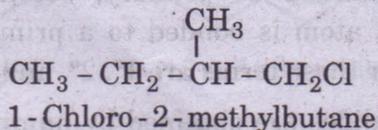
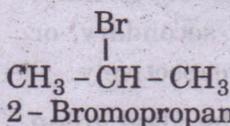


Isobutene dichloride

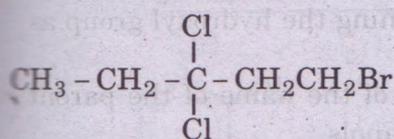


IUPAC System: The IUPAC names of alkyl halides are obtained by using the following rules:

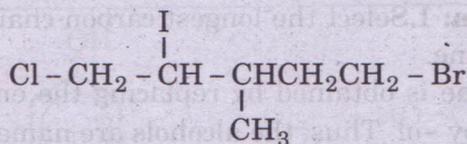
1. Select the longest chain to which the halogen is attached and give it the name of the corresponding alkanes.
2. Prefix the name of alkane by halo; i.e., chloro, bromo, iodo or fluoro.
3. Number the chain so as to give the carbon carrying the halogen atom the lowest possible number.
4. Other substituents are numbered, named and placed as prefixes in alphabetic order. For example



1,2-Dibromo-2-methylpropane



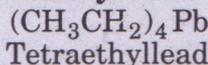
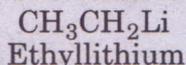
1-Bromo-3,3-dichloropentane



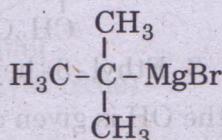
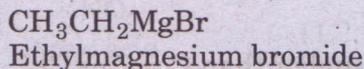
5-Bromo-1-chloro-2-iodo-3-methylpentane

7. Organometallic Compounds

Organometallic compounds are named as **alkylmetals**.



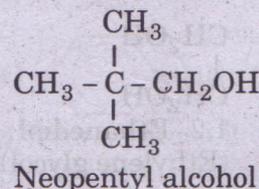
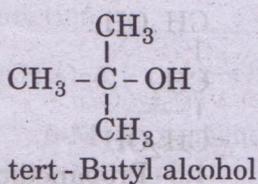
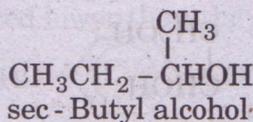
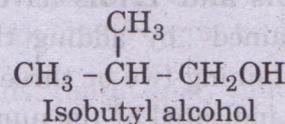
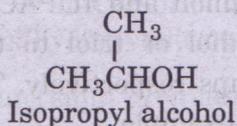
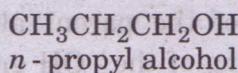
If the metal is bonded to an inorganic anion as well as a carbon atom, the compound is named as a derivative of the inorganic salt.



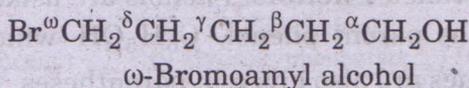
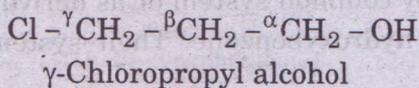
tert-butylmagnesium bromide

8. Alcohols

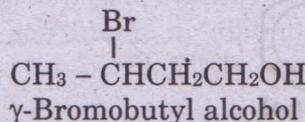
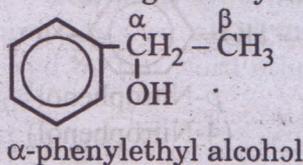
Common System: In this system alcohols (R-OH) are named by naming the alkyl group attached to the -OH group and adding alcohol as a separate word.



The positions of the other substituents in the alkyl groups are indicated by the Greek letters α (alpha), β (beta), γ (gamma), and δ (delta). The carbon atom bearing the hydroxyl group is named as α , next carbon atoms named as β, γ, δ and so on respectively.

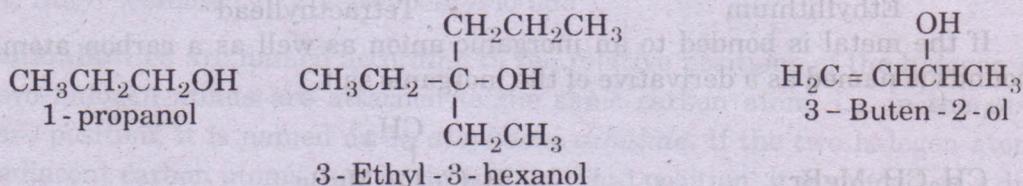


An alcohol, $\text{C}_5\text{H}_{11}\text{OH}$ containing five carbons is commonly called amyl alcohol and the end carbon is generally named as ω (omega).

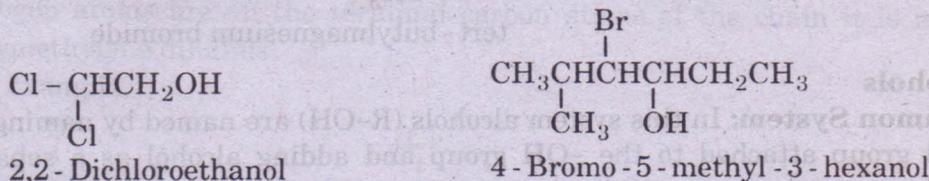


IUPAC System: 1. Select the longest carbon chain containing the hydroxyl group as the parent alkane.

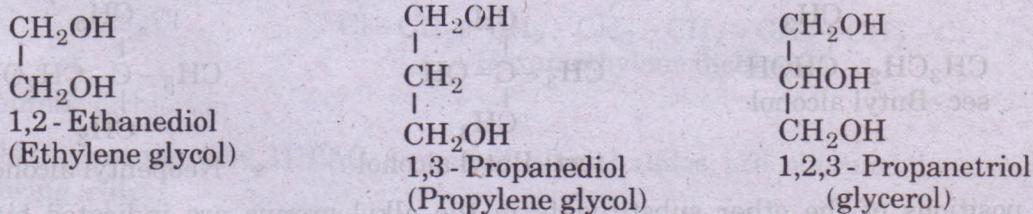
- The name is obtained by replacing the ending -e of the name of the parent alkane by -ol. Thus, the alcohols are named as alkanols.
- The position of the hydroxyl group is indicated by the number of the carbon attached to the -OH group, and is written before the name of the alkanol.
- Other substituents are numbered, named and placed as prefixes in alphabetic order.



Note that in IUPAC system the OH is given a lower number than C = C or Cl.

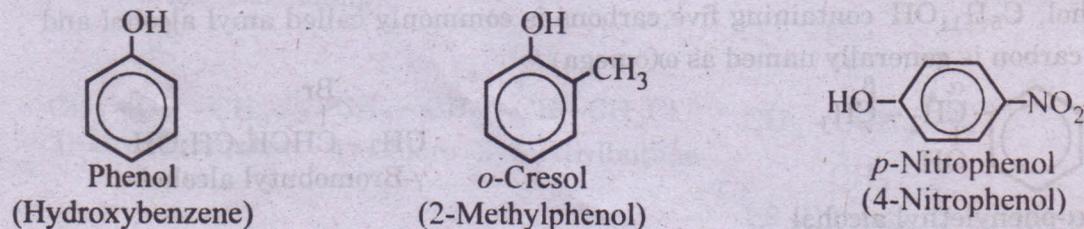


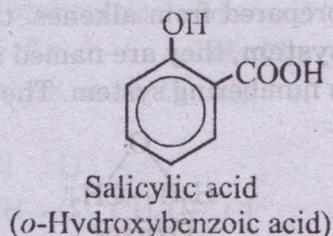
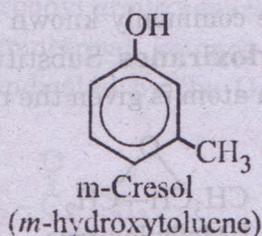
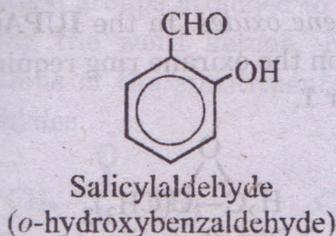
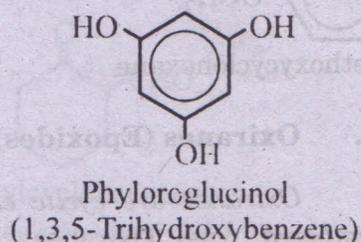
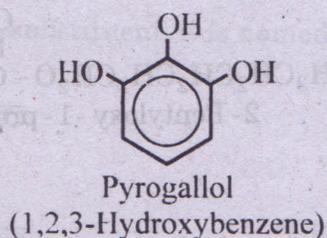
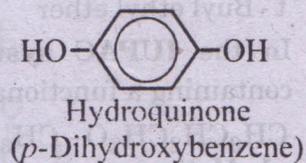
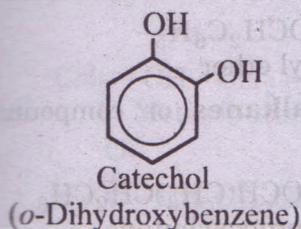
Diols and Triols have both common and IUPAC names. The IUPAC names are obtained by adding the suffix diol or triol to the name of the parent alkane containing two or three -OH groups respectively. The positions of the -OH groups are indicated by the numbers. For example



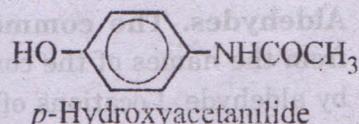
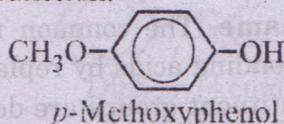
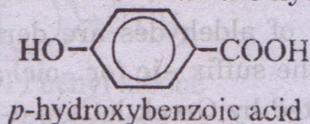
9. Phenols

Compounds containing an -OH group attached directly to an aromatic ring are called **Phenols**. Phenols are usually named by common system or as derivatives of the parent phenol, $\text{C}_6\text{H}_5\text{OH}$ which is called hydroxybenzene. Their systematic names are also given in parentheses.

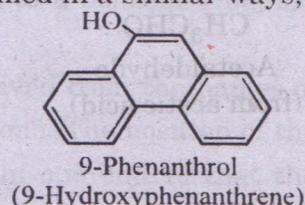
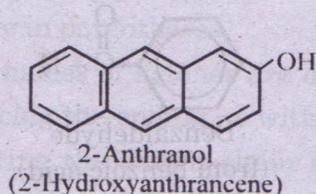
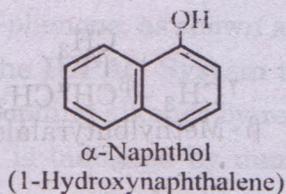




While naming the polyfunctional aromatic compounds, the hydroxy function is usually placed low in order precedence; only the amino and the ether functions are placed lower than the hydroxy function.

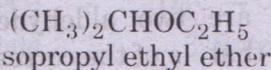
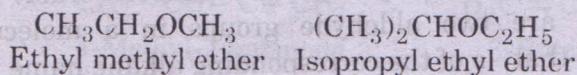
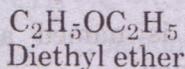


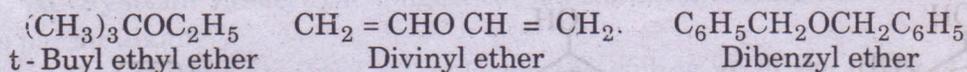
Compounds with the hydroxyl group attached to a polycyclic benzenoid ring system also belong to the phenol family and they are named in a similar way;



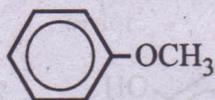
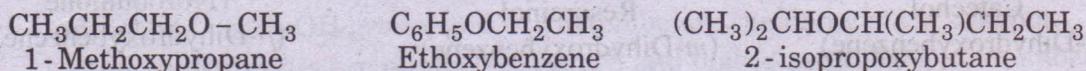
10. Ethers

Common system. In the common system, the names of ethers are derived by naming the two alkyl groups attached to the oxygen atom, in alphabetic order, followed by the word ether. If the groups are same, the prefix di- is used with the group.

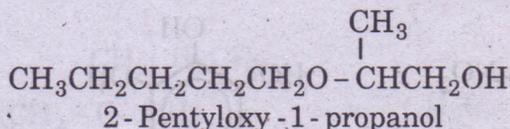




In the **IUPAC system**, ethers are named as **Alkoxyalkanes** or compounds containing a functional group of higher priority than ether.



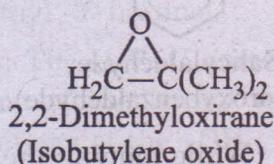
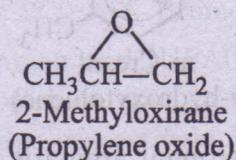
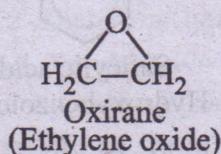
Methoxycyclohexane



2-Pentyloxy-1-propanol

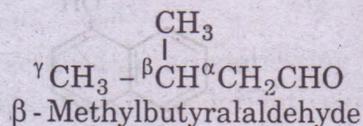
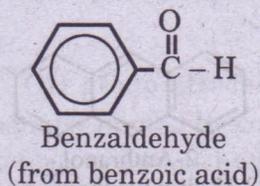
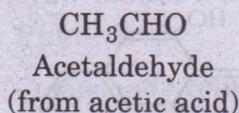
11. Oxiranes (Epoxides)

Oxiranes are cyclic ethers in which the ether oxygen is part of the three membered ring. Oxiranes are also called *epoxides*. Because they are readily prepared from alkenes, they are commonly known as *alkene oxides*. In the **IUPAC system**, they are named as **alkyloxiranes**. Substituents on the oxirane ring require a numbering system. The oxygen atom is given the number 1.



12. Aldehydes and Ketones

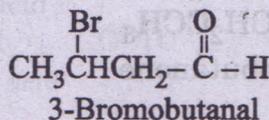
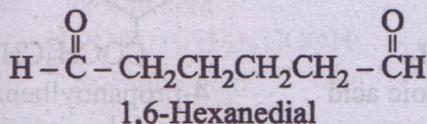
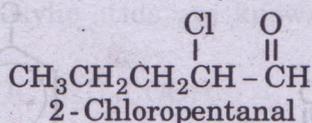
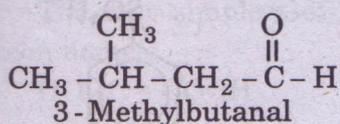
Aldehydes. The common name. The common names of aldehydes are derived from the names of the corresponding acids by replacing the suffix **-ic** (or **-oic**) acid by aldehyde. Locations of substituent groups are designated by Greek letters α -, β -, γ - and so on, beginning with the carbon next to carbonyl group.



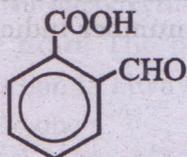
IUPAC System. In the IUPAC system, aldehydes are named as **alkanals**.

Select the longest chain containing the aldehyde group and replace the final **-e** from the name of the corresponding alkane by the suffix **-al**. The C of CHO is number 1. Since the aldehyde group is always at the end of the chain, there is no need to indicate its position. However, the positions of the substituents are indicated by number, named and placed as prefixes in alphabetic order.

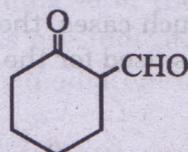
When there are two aldehyde groups in a molecule it is named as **Alkanedial**. Notice that **-e** of the corresponding alkane name is retained.



When -CHO group is used as substituent, it is named as a formyl group.

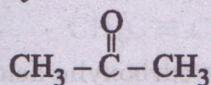


o-Formylbenzoic acid

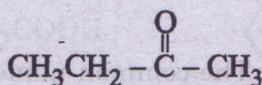


2-Formylcyclohexanone

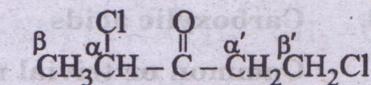
Ketones. Common name. The common names of ketones are obtained by naming the alkyl groups attached to the carbonyl group separately in alphabetical order and adding the word ketone. For symmetrical ketones the prefix di- is used. The positions of the substituents are indicated by the Greek letters as in the case of aldehydes.



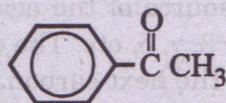
Dimethyl ketone
(Acetone)



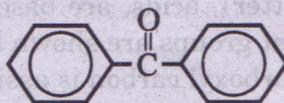
Ethyl methyl ketone



α, β' -Dichlorodiethyl ketone



Methyl Phenyl ketone
(Acetophenone)

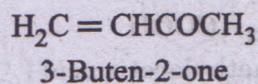
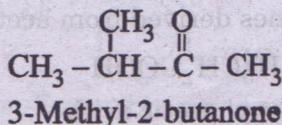
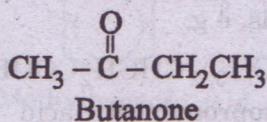


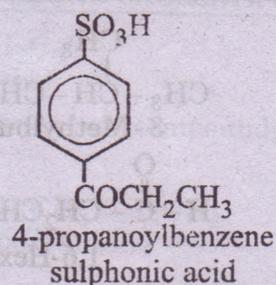
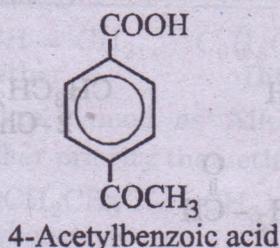
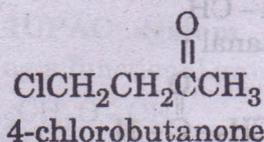
Diphenyl ketone
(Benzophenone)

The ketones in which the carbonyl group is attached to a benzene ring, are named as -phenone, as shown above in parentheses.

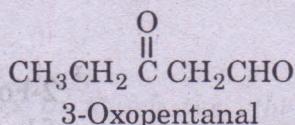
In the **IUPAC System** the names of ketones are derived from the names of the corresponding alkanes by replacing the ending -e with -one. The position of the keto group is indicated by numbering the parent chain from the end so that the carbonyl group gets the lowest possible number. The substituents are numbered, named and placed as prefixes in alphabetic order.

When there are two carbonyl groups in a molecule, it is named as **Alkanedione**.





Sometimes a carbonyl compound also contains a more important functional group. In such cases, the prefix **oxo-**, along with a number indicating its position in the chain, is used for the carbonyl group.



The general order of precedence of the functional group in naming the compound is: acid anhydride > carboxylic acid > sulphonic acid > ester > acid halide > amide > aldehyde > ketone > alcohol \approx phenol > ether > amine

The C=O group has numbering priority over the C=C group.

13. Carboxylic acids

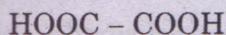
Common or trivial names. The common names of the carboxylic acids are usually derived from the Latin or Greek words that indicate one of their original source. All common names of acids end in -ic acid. Common names, such as formic (ant) and **butyric** (butter) acids, are based on the natural source of the acid. The positions of substituent groups are shown by Greek letters α , β , γ , δ , etc. The carbon atom adjacent to the carboxyl carbon is assigned the letter α , the next carbon on the chain β , the next one γ , and so on. Some common names of carboxylic acids are given below:

CH_3COOH	$\text{CH}_3\text{CH}_2\text{COOH}$	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
acetic acid	Propionic acid	Butyric acid
$\text{CH}_3(\text{CH}_2)_4\text{COOH}$	$(\text{CH}_3)_3\text{CCOOH}$	$(\text{CH}_3)_2\text{CH}^\beta\text{CH}_2^\alpha\text{CH}_2\text{COOH}$
Caproic acid	Pivalic acid	γ -methylvaleric acid
$\text{CH}_3(\text{CH}_2)_3\text{COOH}$	$\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$	$\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$
Valeric acid	Palmitic acid	Stearic acid
$\text{C}_6\text{H}_5\text{COOH}$	$o\text{-HOC}_6\text{H}_4\text{COOH}$	$\text{C}_6\text{H}_5\text{CH}_2^\beta\text{CH}_2^\alpha\text{CH}_2\text{COOH}$
Benzoic acid	Salicylic acid	γ -Phenylbutyric acid
$\text{C}_{10}\text{H}_7\text{COOH}$	$\text{CH}_3(\text{CH}_2)_8\text{COOH}$	$(\text{CH}_3)_2\text{C}(\text{OH})\text{COOH}$
Naphthoic acid	Capric acid	α -Hydroxyisobutyric acid

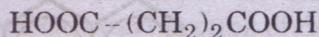
Some carboxylic acids have names derived from acetic acids, e.g.

$(\text{CH}_3)_3\text{COOH}$	$\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$	$(\text{CH}_3)_2\text{CHCH}_2\text{COOH}$
Trimethylacetic acid	Phenyl acetic acid	Isopropylacetic acid

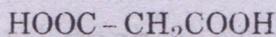
The four simplest of the dicarboxylic acids are known exclusively by their common names.



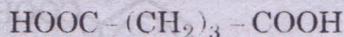
Oxalic acid



Succinic acid

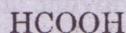


Malonic acid

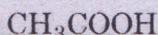


Glutaric acid

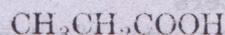
IUPAC System. In the IUPAC system, the name of the carboxylic acid is obtained from the chain of carboxylic acid, by replacing the ending -e of the corresponding alkane by **-oic acid**. The positions of the substituents are indicated by numbers. The carboxyl carbon is always given number 1, the carbon adjacent to it is given the number 2, and so on.



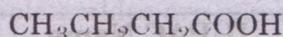
Methanoic acid



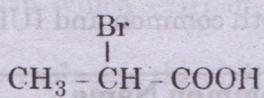
Ethanoic acid



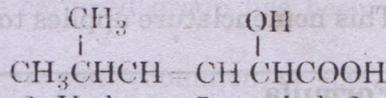
Propanoic acid



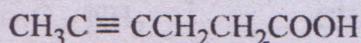
Butanoic acid



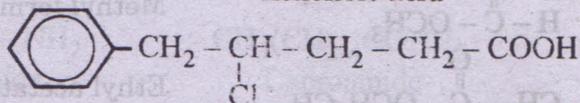
2-Bromopropanoic acid



2-Hydroxy-5-methyl-3-hexenoic acid

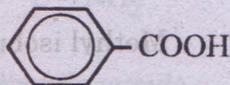


4-Hexynoic acid

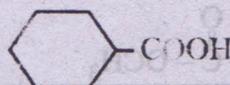


4-chloro-5-phenylpentanoic acid

It is not convenient to name a cyclic carboxylic acid by IUPAC system, however, occasionally they are named as carboxylic acids, e.g.



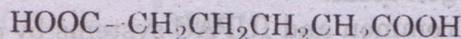
Benzene carboxylic acid



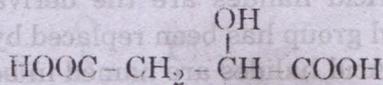
Cyclohexanecarboxylic acid

The common names acceptable in the IUPAC system are acetic acid and benzoic acid, although most of the common names are still in use.

Dicarboxylic acids are named by adding the suffix **-dioic** and the word **acid** to the longest chain with the two COOH's.

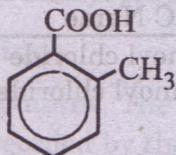


1,6-hexanedioic acid

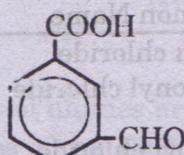


2-Hydroxybutanedioic acid

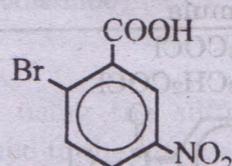
Aromatic carboxylic acids are usually named as derivatives of benzoic acid, e.g.



o-Methylbenzoic acid

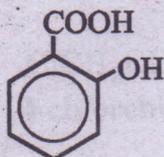


m-Formylbenzoic acid

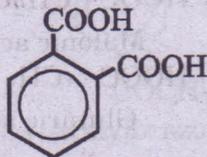


2-Bromo-5-nitrobenzoic acid

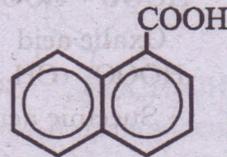
The names of some important acids are given below. Their common names are given in parentheses.



2-Hydroxybenzene
carboxylic acid
(Salicylic acid)



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



Naphthalene-1-carboxylic acid
(α -Naphthoic acid)

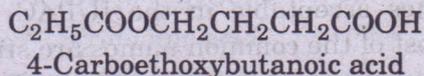
Derivatives of Carboxylic Acids

14. Esters

The names of esters are derived by writing the name of alkyl group of the alcohol, followed by the name of the acid with the ending **-ic acid** replaced by **-ate**. This nomenclature applies to both common and IUPAC names of esters.

Formula	Common Name	IUPAC Name
$\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OCH}_3$	Methyl formate	Methyl methanoate
$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{OCH}_2\text{CH}_3$	Ethyl acetate	Ethyl ethanoate
$\text{CH}_3\text{CH}_2\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OCH}_3$	Methyl butyrate	Methyl butanoate
$\text{CH}_3-\overset{\text{CH}_3}{\underset{ }{\text{CH}}}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OCH}_3$	Methyl isobutyrate	Methyl isobutanoate

If the ester function ($-\text{COOR}$) is to be treated as a substituent, it is treated as a carboalkoxy group.



15. Acid Halides

Acid halides are the derivatives of carboxylic acids in which the $-\text{OH}$ of carboxyl group has been replaced by a halogen atom.

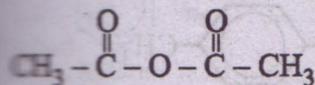
Acid halides are named in both the common and IUPAC systems by dropping the ending 'ic acid' from the name of the parent acid and adding the suffix '-yl halide'.

Formula	Common Name	IUPAC Name
CH_3COCl	Acetyl chloride	Ethanoyl chloride
$\text{CH}_3\text{CH}_2\text{COCl}$	Propionyl chloride	Propanoyl chloride
	Benzoyl chloride	

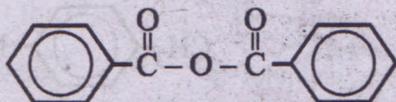
16. Acid Anhydrides

Acid anhydrides are the compounds which are obtained after the elimination of a water molecule from the carboxyl groups of two carboxylic acid molecules (or from the two carboxyl groups of dicarboxylic acids).

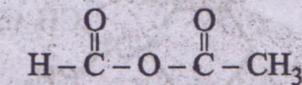
Acid anhydrides are named by replacing the word 'acid' in the name of parent acid by 'anhydride'. For mixed acid anhydrides, the parent name of each acid is written in alphabetical order, followed by the word anhydride.



Acetic anhydride
(Ethanoic anhydride)



Benzoic anhydride

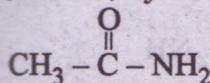


Acetic formic anhydride

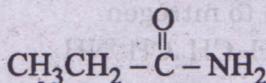
17. Amides

Amides are the compounds in which -OH of the carboxyl group has been replaced by an amino group, -NH₂.

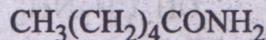
Simple amides are named by replacing the ending '-ic acid' (Common) or '-oic acid' (IUPAC) by the word 'amide'. The IUPAC names are given in parentheses.



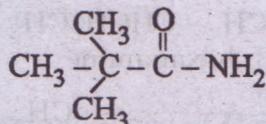
Acetamide
(Ethanamide)



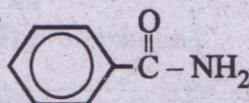
Propionamide
(Propanamide)



Caproamide
(Hexanamide)

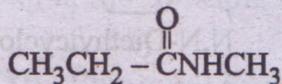


2,2-dimethylpropionamide
(2,2-dimethyl propanamide)

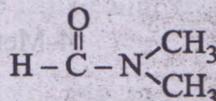


Benzamide

When nitrogen is substituted, this is indicated by prefixing the name of a simple amide by N-, followed by the name of the substituent group. This method is used for both systems of nomenclature.



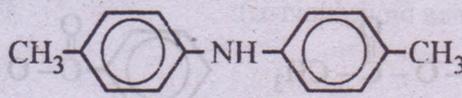
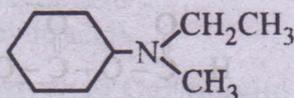
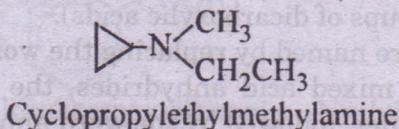
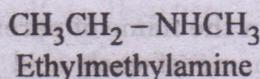
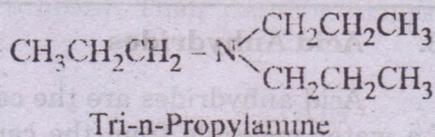
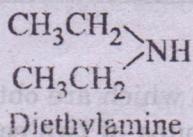
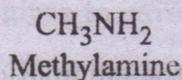
N-methyl propionamide
(N-methyl propanamide)



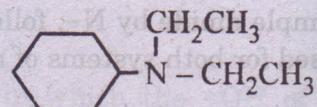
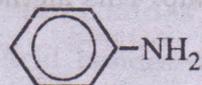
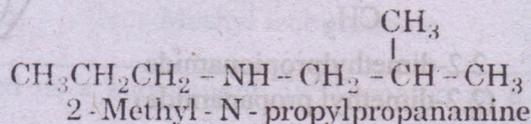
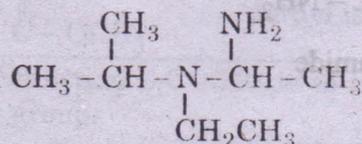
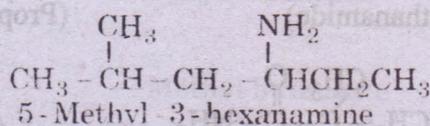
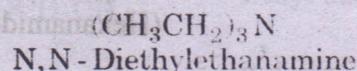
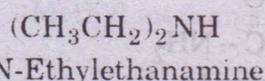
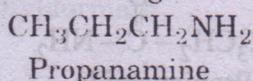
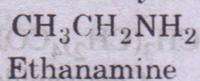
N,N-dimethyl formamide
(N,N-dimethyl methamide)

18. Amines

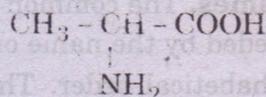
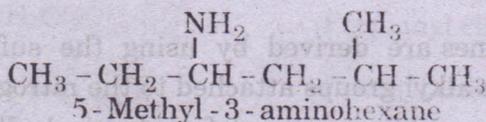
Common Names. The common names of amines are derived by using the suffix -amine, preceded by the name or names of the alkyl groups attached to the nitrogen atom, in alphabetical order. The prefixes di- or tri- are used for identical alkyl groups. The name is written as one word.

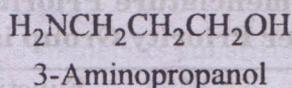
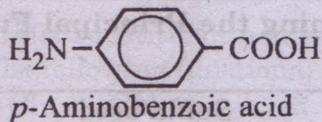


IUPAC System. In the IUPAC system, the ending -e of the name of the parent hydrocarbon containing the $-\text{NH}_2$ group, is replaced by -amine. For secondary and tertiary amines, the longest chain is selected as the parent alkane; in case of equal chain -lengths the parent alkane is the one with the greater number of substituents. The remaining alkyl groups are named as substituents by using the prefix N- to indicate that they are attached to nitrogen.

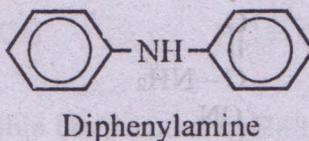
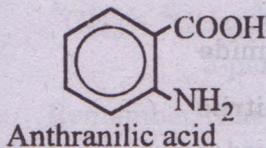
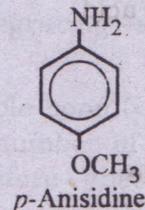
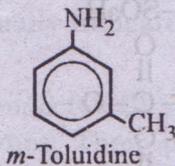
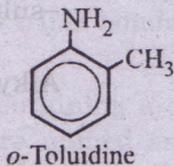


In more complicated amines, the $-\text{NH}_2$ group is considered as a substituent on a hydrocarbon, and its position on the chain is indicated by the lowest possible number.

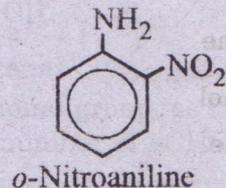
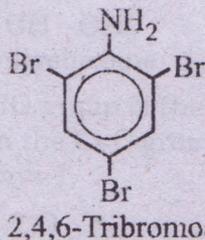
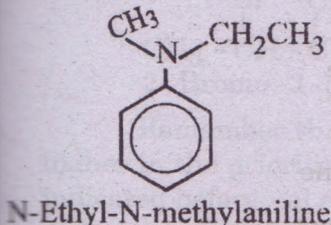




A number of aromatic amines have special names that have been accepted by IUPAC.



Some of the aromatic amines are named as derivatives of aniline.



3.3 Nomenclature of Polyfunctional Compounds

The functional group present in a compound determines its class. When a compound contains two or more different types of functional groups (polyfunctional compound), the functional group which specifies its class is the **principal functional group**. The other functional groups are considered as substituents. For example, the compounds $\text{HOCH}_2\text{CH}_2\text{COCH}_3$ must be named 4-hydroxy-2-butanone, not 4-butanol-2-one. The name 3-oxo-1-butanol is not preferred because the $\text{C}=\text{O}$ group is the principal functional group as it ranks higher in the priority table.

Selection of the Principal Functional Group

The IUPAC system has established the priority of functional groups for determining the class of a polyfunctional compound. Table 3.2 gives a list of functional groups in decreasing order of priority for citation as the principal functional group. That is, the functional group which occurs higher up in the priority table is the principal functional group and specifies the class. Therefore, by having a look at the priority table, one can at once know the class of a polyfunctional structure.

Table 3.2 Nomenclature Priority for Determining the Principal Functional Group. Higher Priority Group is at the Top

Class	Functional group	Suffix used
Carboxylic acid	$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{OH} \end{array}$	-oic acid
Sulphonic acid	$-\text{SO}_3\text{H}$	-sulphonic acid
Ester	$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{O}- \end{array}$	Alkyl -oate
Acid halide	$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{X} \end{array}$	-oyl halide
Amide	$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{NH}_2 \end{array}$	-amide
Nitrile	$-\text{CN}$	-nitrile
Aldehyde	$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{H} \end{array}$	-al
Ketone	$\begin{array}{c} \text{O} \\ \\ -\text{C}- \end{array}$	-one
Alcohol	$-\text{OH}$	-ol
Amine	$\begin{array}{c} \\ -\text{N}- \end{array}$	Amine
Ethers	$-\text{O}-$	(ether)
Alkene	$\begin{array}{c} \quad \\ -\text{C}=\text{C}- \end{array}$	-ene
Alkyne	$-\text{C}\equiv\text{C}-$	-yne

Table 3.3 Prefixes used for Functional Groups

-Br	Bromo	-R	Alkyl	$\begin{array}{c} \text{O} \\ \\ -\text{C}- \end{array}$	Oxo
-Cl	Chloro	-OR	Alkoxy	$-\text{NO}_2$	Nitro
-F	Fluoro	-OH	Hydroxy	$-\text{NO}$	Nitroso
-I	Iodo	$-\text{NH}_2$	Amino	$-\text{CN}$	Cyano

IUPAC Rules for Naming Polyfunctional Compounds

1. Identify the principal functional group and this gives the class name of the structure.
2. Number the longest chain containing the principal functional group from the end nearer to it.
3. Write the parent name corresponding to the number of carbons in the longest chain.
4. Arrange the substituent names with position numbers in alphabetical order.

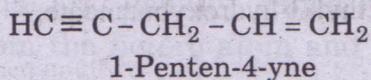
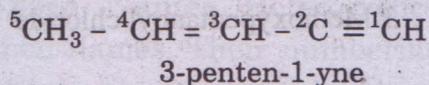
Prefix substituent names with the parent name.

The following functional groups are always named as substituents.

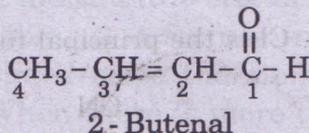
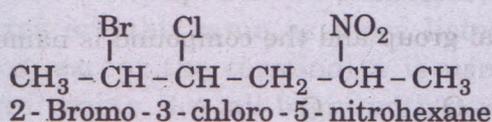
-Cl	Chloro	-R	Alkyl	-NO ₂	Nitro
-Br	Bromo	-OR	Alkoxy	-NO	Nitroso
-I	Iodo	-NH ₂	Amino		
-F	Fluoro	-CN	Cyano		

C-C double or triple bonds are usually indicated by integrating -en- or -yne- into the suffix.

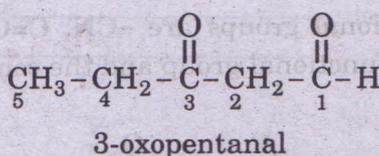
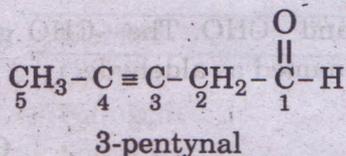
Compounds containing a double bond (C=C) and a triple bond (C≡C) in the main chain are named as alkenynes. Their position number of the double bond is inserted before -alken- and that of triple bond before -yne.



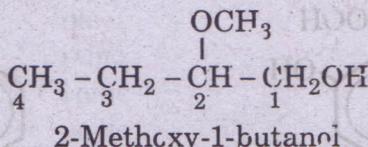
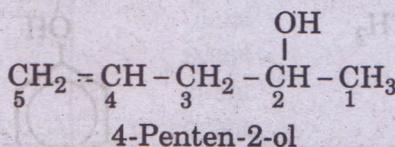
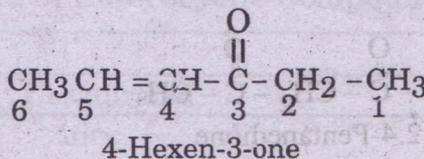
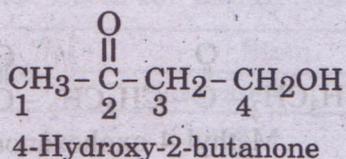
Remember that when a double bond and a triple bond can be given the same position number, the chain is numbered from the end closer to double bond.



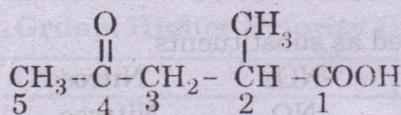
Remember that the -CHO group is the principal functional group, as it ranks higher in the priority table than the C=C group. The position number of -CHO is not indicated before -al as it is always 1.



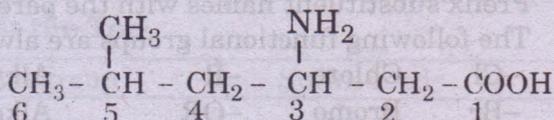
Both C=O and -CHO form part of the longest chain. The -CHO group is the principal functional group as it ranks higher in the priority table. The ketonic carbonyl group, C=O, is indicated by the prefix oxo.



In both the above compounds, the -OH group is the principal functional groups. The -OCH₃ is always treated as a substituent and is indicated by the prefix methoxy.

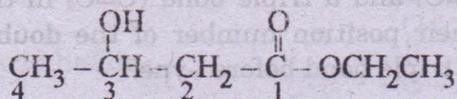


2-Methyl-4-oxopentanoic acid

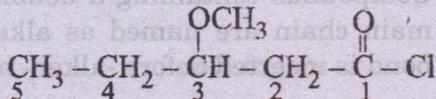


3-Amino-5-methylhexanoic acid

In both the above compounds, the $-\text{COOH}$ groups is the functional group as it ranks highest in the Priority table. The ketonic carbonyl group ($\text{C}=\text{O}$) is indicated by the prefix oxo. The $-\text{NH}_2$ group is indicated by the prefix amino.



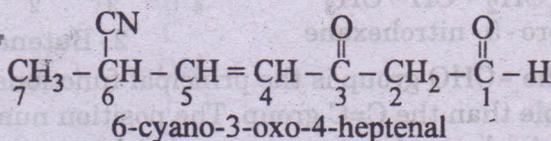
Ethyl-3-hydroxybutanoate



3-Methoxypentanoyl chloride

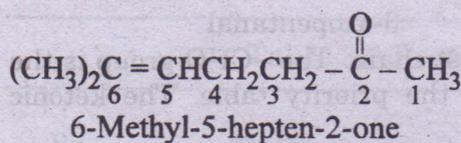
The $-\text{C}(=\text{O})-\text{O}$ group is the principal functional group and the compound is named as

ester. The $-\text{C}(=\text{O})-\text{Cl}$ is the principal functional group and the compound is named as an acid halide.

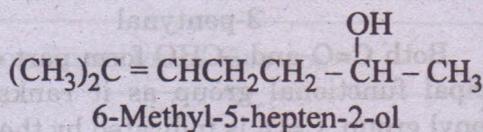


6-cyano-3-oxo-4-heptenal

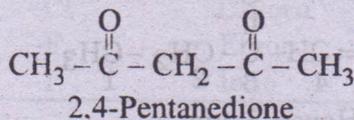
The functional groups are $-\text{CN}$, $\text{C}=\text{C}$, $-\text{CO}-$, and $-\text{CHO}$. The $-\text{CHO}$ group is the principal functional group and the compound is named as aldehyde.



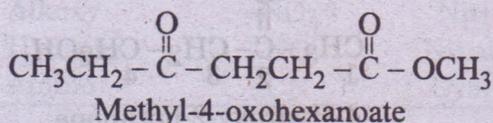
6-Methyl-5-hepten-2-one



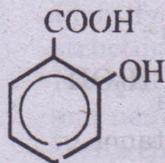
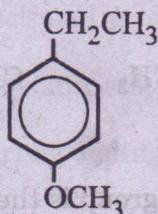
6-Methyl-5-hepten-2-ol



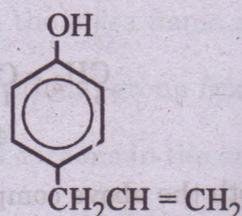
2,4-Pentanedione



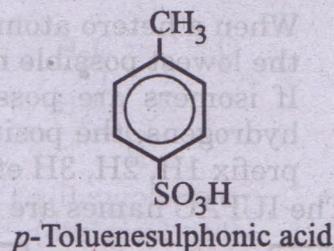
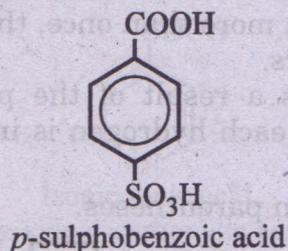
Methyl-4-oxohexanoate

o-Hydroxybenzoic acid
(Salicylic acid)

p-Methoxyethylbenzene



p-allylphenol



3.4 Heterocyclic Compounds

Those cyclic compounds which, in addition to carbon, have at least one atom of another element (heteroatom) in the ring are called **heterocyclic compounds** or simply **heterocycles**.

Common Names Heterocyclic compounds are usually called by their common names. Their numbering starts from the hetero atom and proceeds around the ring so as to give the substituents the lowest number.

IUPAC System. The system combines prefixes, which indicate the nature of the hetero atom present, with stems, which indicate the size of the ring. The prefixes are the same as those listed in table 3.4 for use in substitution names, except the terminal a is usually elided since the stems, which are listed in table 3.5, all begin with vowels. When there is more than one kind of ring hetero atom, the atom of higher atomic number receives the lower number in naming the compound.

Table.3.4 Characteristic Prefixes for Replacement Names

Element	Prefix
Oxygen	oxa-
Nitrogen	aza-
Sulphur	Thia
Phosphorus	Phospha
Silicon	Sila

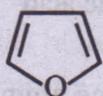
Table. 3.5. Stem for use in Nomenclature of Heterocyclic Compounds

Ring size	Stem	
	Saturated	Unsaturated
3	Irane	irine
4	etane	ete
5	olane	ole
6	ixane	ixine
7	epane	epine
8	ocane	ocine

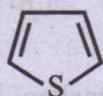
- (i) In numbering rings, a single hetero atom is given number 1. The substituents are then numbered in the usual manner.

- (ii) When a hetero atom occurs more than once, the hetero atoms are given the lowest possible numbers.
- (iii) If isomers are possible as a result of the positions of one or more hydrogens, the position of each hydrogen is indicated by means of the prefix 1H, 2H, 3H etc.

The IUPAC names are given in parentheses.



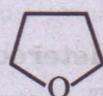
Furan
(oxole)



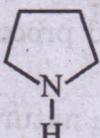
Thiophene
(Thiole)



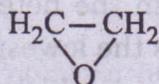
Pyrrole
(azole)



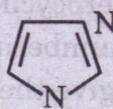
tetrahydrofuran
(oxolane)



Pyrrolidine
(azolidine)



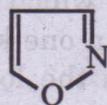
Ethylene oxide
(oxirane)



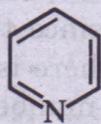
imidazole
(1,3-diazole)



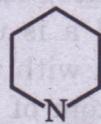
(1,3-thiazole)



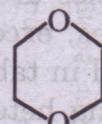
(1,2-oxazole)



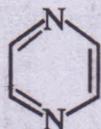
Pyridine
(azine)



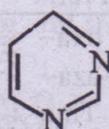
Piperidine
(perhydroazine)



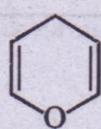
dioxane
(1,4-dioxane)



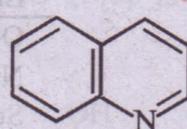
Pyrazine
(1,4-diazixine)



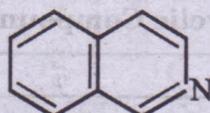
Pyrimidine
(1,3-diazixine)



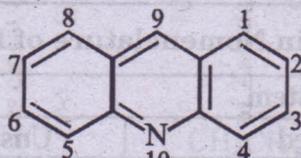
Pyran
(4H-oxirine)



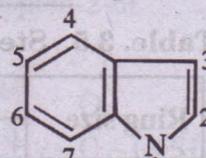
quinoline
(1-azanaphthalene)



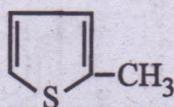
isoquinoline
(2-azanaphthalene)



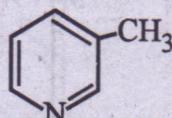
acridine
(10-azananthracene)



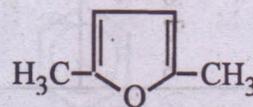
indole
(1-azindene)



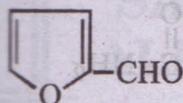
2-methylthiophene
(2-methylthiole)



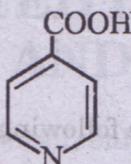
3-methyl pyridine
(3-methyl-azine)



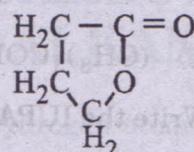
2,5-dimethylfuran
(2,5-dimethyloxole)



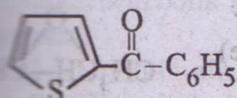
Furfural
(2-formyloxole)



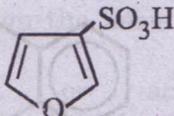
Isonicotinic acid
(azixine-4-carboxylic acid)



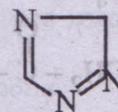
γ -Butyrolactone
(oxalane-2-one)



2-benzoylthiophene
(2-benzoylthiole)

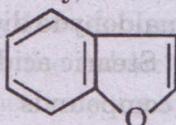


3-furansulphonic acid

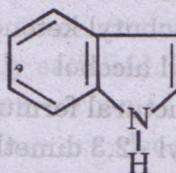


(3H-1,2,4-triazole)

Heterocyclic compounds containing more than one ring are conveniently named by combining the names of the indicated rings, e.g.,



benzofuran



benzopyrrole

Questions

Name the following alkyl groups: (a) CH_3 - (b) CH_3CH_2 - (c) $\text{CH}_3\text{CH}_2\text{CH}_2$ -
(d) $(\text{CH}_3)_2\text{CH}$ - (e) $(\text{CH}_3)_3\text{C}$ -

Write the structural formulas for the following compounds:

- | | |
|------------------------------|----------------------------|
| (a) 2-Buten-1-ol | (b) 6-Methyl-5-hepten-2-ol |
| (c) 2-Pentanone | (d) 1,3-Butadiene |
| (e) 3-Hydroxypropanoic acid | (f) 4-penten-2-one |
| (g) 6-cyano-3-oxo-4-heptenal | (h) 4-oxopentanoic acid |

Write structural formulas for the following compounds.

- | | | |
|--------------------------|-----------------------|----------------|
| (a) p-Nitroaniline | (b) Mesitylene | (c) Durene |
| (d) Biphenyl | (e) Cumene | (f) Anthracene |
| (g) Triphenylmethanol | (h) 3-oxopentanal | |
| (i) 4-Acetylbenzoic acid | (j) Benzoic anhydride | |

Write the IUPAC names of the following compounds.

