ORGANIC CHEMISTRY

LEARNING OBJECTIVES

- Classification of organic compounds
- Homologous series
- Characteristics of a homologous series
- Nomenclature,IUPAC System
- Nomenclature of Branched hydrocarbons
- Nomenclature of (A) Cyclo-alkanes, Cyclo-alkenes , Cyclo-alkynes
- Isomerism, structural isomerism types.

Real life applications:

Organic chemistry is a subject with which many people struggle.It is important because it impacts our every day lifes.

Classification of organic compounds

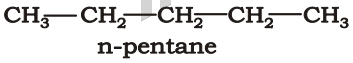
(A) Classification based on structure : The simplest organic compounds containing only carbons and hydrogens are called hydrocarbons. Other organic compounds are thought to have been derivative of hydrocarbons. All the known organic compounds have been broadly divided into two categories depending upon the nature of their carbon skeleton.

(A) Open-chain or Acyclic compounds.

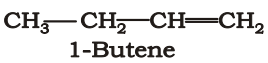
(B) Closed-chain or Cyclic compounds.

(A) Open-chain or Acyclic compounds : These are the compounds in which the carbon atoms are linked to each other in such a manner that the molecule is having an open-chain structure. The carbon chain may be either straight chain or branched-chain. Such compounds are known as aliphatic compounds.

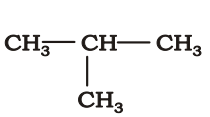
Examples are :



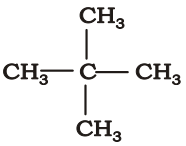
n-pentane



1-Butene



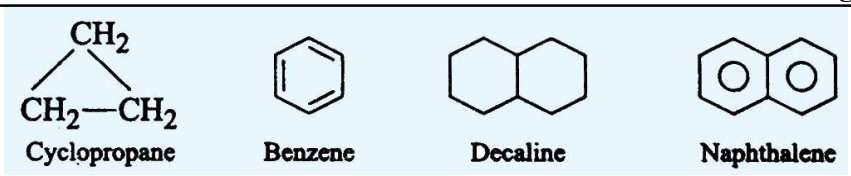
Isobutane



Neopentane

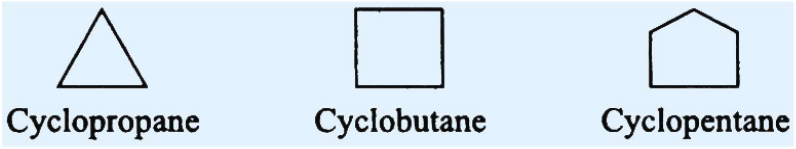
(B) Closed-chain or Cyclic compounds : Compounds containing atleast one ring in their structure are called cyclic compounds. If the ring contains one type of atoms, the compound is homocyclic, and if the ring contains atleast one hetero atom, the compound is called heterocyclic. Depending upon the nature of the ring, these compounds are further divided into the following two categories

(i) Homocyclic or Carbocyclic compounds : When all the atoms of the ring are carbons, the cyclic compounds are known as homocyclic compounds. For example,



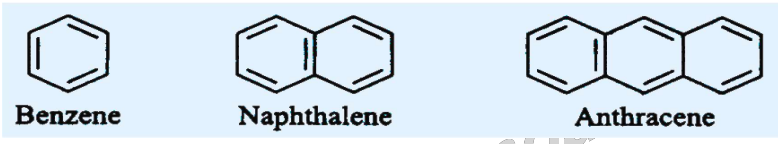
Homocyclic compounds are further divided into two categories :

(i) Alicyclic homocyclic compounds: Homocyclic compounds which resemble aliphatic compounds are called alicyclic compounds. Some of the examples are :



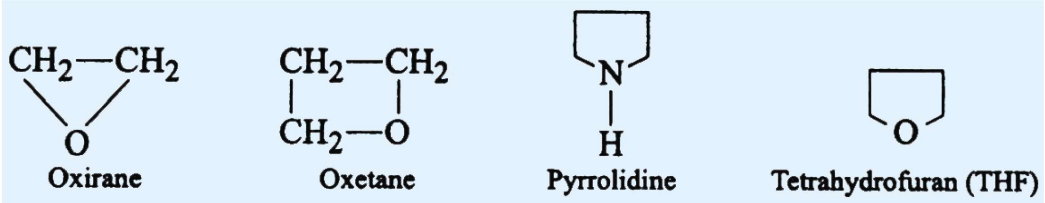
(ii) **Aromatic compounds :** Compounds containing one or more fused or isolated benzene rings (a six membered ring of carbon atoms with alternate single and double bonds) are called aromatic compounds.

Examples :

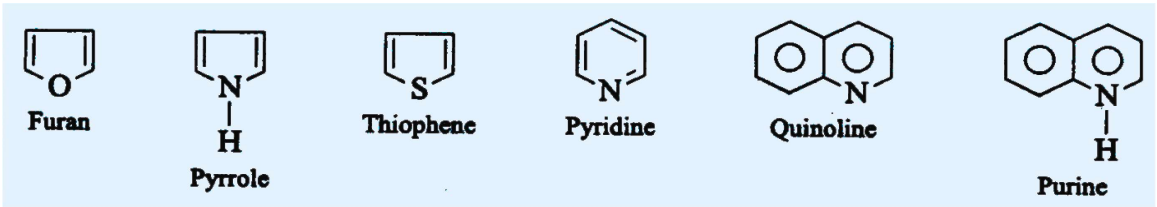


(B) **Heterocyclic compounds :** Cyclic compounds having at least one heteroatom (atom other than carbon) in the ring are heterocyclic compounds. Heterocyclic compounds can be classified into two categories :

(i) **Alicyclic heterocyclic compounds :** Heterocyclic compounds which resemble aliphatic compounds in their properties are called alicyclic heterocyclic compounds.



(ii) **Aromatic heterocyclic compounds :** Heterocyclic compounds which resemble aromatic compounds in most of their properties are called aromatic heterocyclic compounds.



Classification of organic compounds based on type of bond present

Hydrocarbons

A compound made up of hydrogen and carbon only is called hydrocarbon.

(Hydrogen + Carbon = Hydrocarbon).

Example : Methane(CH_4), Ethane(C_2H_6), Ethene(C_2H_4), and Ethyne (C_2H_2).

The most important natural source of hydrocarbons is petroleum which is obtained from underground oil deposits by drilling oil wells.

Types of hydrocarbons

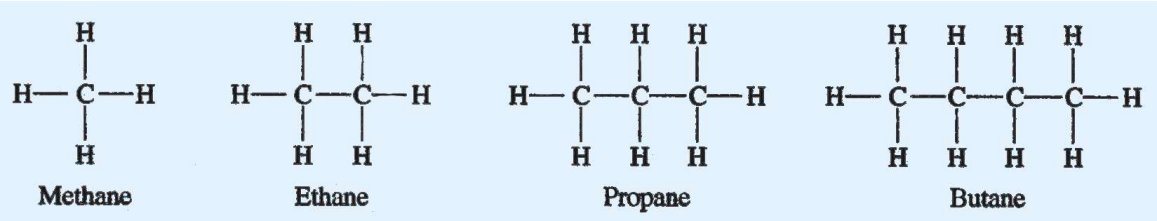
Hydrocarbons are of two types : (i) Saturated hydrocarbons

(ii) Unsaturated hydrocarbons.

(i) Saturated hydrocarbons : A hydrocarbon in which caron atoms are connected by only single bonds is called a saturated hydrocarbon. Saturated hydrocarbons are also called alkanes.

Alkanes : An alkane is a hydrocarbon in which carbon atoms are connected by only single covalent bonds. The names of all these saturated hydrocarbons end with 'ane'.

Example : Methane(CH_4), Ethane(C_2H_6), Propane(C_3H_8) etc.



The general formula of saturated hydrocarbons is C_nH_{2n+2} where n is the number of carbon atoms in one molecule of alkane.

(i) If an alkane has one carbon atom in its molecule, then n = 1 and its molecular formula will be CH_4.

(ii) If an alkane has two carbon atoms in its molecule, then n = 2 and its molecular formula will be C_2H_6.

Alkane	Number of carbon atoms	Formula (C_nH_{2n+2})
Methane	1	CH_4
Ethane	2	C_2H_6
Propane	3	C_3H_8
Butane	4	C_4H_{10}
Pentane	5	C_5H_{12}
Hexane	6	C_6H_{14}
Heptane	7	C_7H_{16}
Octane	8	C_8H_{18}
Nonane	9	C_9H_{20}
Decane	10	$C_{10}H_{22}$

The saturated hydrocarbons are chemically not very reactive.

(ii) Unsaturated hydrocarbons : A hydrocarbon in which two carbon atoms are connected by a double bond or a triple bond is called an unsaturated hydrocarbon. Alkenes and alkynes are called unsaturated hydrocarbons.

Example : Ethene(C_2H_4), Propene(C_3H_6), Butene(C_4H_8)

Alkenes : An alkene is a hydrocarbon in which carbon atoms are connected by double bonds. The names of alkenes end with 'ene'.

The general formula of alkenes is C_nH_{2n} where n is the number of carbon atoms in one

molecule of alkane.

(i) If an alkene has two carbon atoms in its molecule, then n = 2 and its molecular formula will be C_2H_4.

(ii) If an alkene has three carbon atoms in its molecule, then n = 3 and its molecular formula will be C_3H_6.

Alene	Number of carbon atoms	Formula (C_nH_{2n})
Ethene	2	C_2H_4
Propene	3	C_3H_6
Butene	4	C_4H_8
Pentene	5	C_5H_{10}
Hexene	6	C_6H_{12}
Heptene	7	C_7H_{14}
Octene	8	C_8H_{16}
Nonene	9	C_9H_{18}
Decene	10	$C_{10}H_{20}$

Alkynes : An unsaturated hydrocarbons in which the two carbon atoms are connected by a triple bond is called an alkyne. The names of alkynes and with 'yne'.

Example : Ethyne(C_2H_2), Propyne(C_3H_4), Butyne(C_4H_6) etc.

The general formula of alkynes is C_nH_{2n-2} where n is the number of carbon atoms in one molecule of alkane.

(i) If an alkyne has two carbon atoms in its molecule, then n = 2 and its molecular formula will be C_2H_2.

(ii) If an alkane has three carbon atoms in its molecule, then n = 3 and its molecular formula will be C_3H_4.

Alkyne	Number of carbon atoms	Formula (C_nH_{2n-2})
Ethyne	2	C_2H_2
Propyne	3	C_3H_4
Butyne	4	C_4H_6
Pentyne	5	C_5H_8
Hexyne	6	C_6H_{10}
Heptyne	7	C_7H_{12}
Octyne	8	C_8H_{14}
Nonyne	9	C_9H_{16}
Decyne	10	$C_{10}H_{18}$

Alkyl group : By removing a hydrogen atom from an alkane, alkyl group is obtained.

Alkyl group is represented by R –.

While deriving the name of an alkyl group "ane" of alkane is replaced with "yl". Thus

Alkane – H atom = Alkyl group

A unit called methylene group - CH_2

The difference between carbon and hydrogen atoms in the first four members of alkanes is,

1. Difference between ethane and methane = $[C_2H_6 - CH_4) = CH_2$
2. Difference between propane and ethane = $[C_3H_8 - C_2H_6] = CH_2$
3. Difference between butane and propane = $[C_4H_{10} - C_3H_8] = CH_2$

The difference of carbon and hydrogen atoms between two consecutive members of alkanes is CH_2. This —CH_2 unit is called methylene group.

By removing one or more CH_2 groups from a given saturated hydrocarbon, we can obtain another saturated hydrocarbon with lesser number of carbon atoms.

Similarly, by adding one or more CH_2 groups in a given saturated hydrocarbon, we can obtain another hydrocarbon with more number of carbon atoms.

Furthermore, there is a difference of 14 amu (molecular mass of CH_2 is 14) between two consecutive hydrocarbons.

Homologous series

Alkanes have a general formula $C_n H_{2n+2}$ and each member differs from the next by a fixed group — CH_2 — (the methylene group), even they have similar chemical properties.

In other classes of compounds like alkenes, alkynes, alcohols or acids, the same thing happens. Such a series of compounds is known as a homologous series and the individual members are homologues.

Compounds having the same functional group and similar properties that differ from the adjacent members by a — CH_2 — group constitute a homologous series and the phenomenon is called homology.

The members of the same class of organic compounds, when arranged in the order of ascending molecular weights such that they differ from each other by – CH_2 group, are collectively called homologues.

Example of a homologous series for each class (or family) of compounds are :

Compound	Formula (C_nH_{2n+2})	Difference in formulae
Methane	CH_4	CH_2
Ethane	C_3H_8	CH_2
Propane	C_2H_6	CH_2
Butane	C_4H_{10}	CH_2
Pentane	C_5H_{12}	CH_2

Compound	Formula (C_nH_{2n})	Difference in formulae
Ethene	C_2H_4	CH_2
Propene	C_3H_6	CH_2
Butene	C_4H_8	CH_2
Pentene	C_5H_{10}	

Compound	Formula (C_nH_{2n-2})	Difference in formulae
Ethyne	C_2H_2	CH_2
Propyne	C_3H_4	CH_2
Butyne	C_4H_6	CH_2
Pentyne	C_5H_8	

Compound	Formula (C_nH_{2n+2})	Difference in formulae
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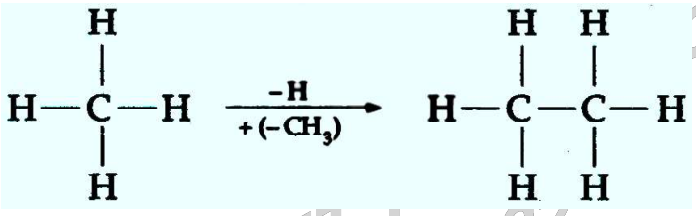
Butane	C_4H_{10}	CH_2
Pentane	C_5H_{12}	CH_2

Characteristics of a homologous series

The members of a homologous series can be represented by a general formula, e.g., the alkanes by C_nH_{2n+2}, alkenes by C_nH_{2n}, alkynes by C_nH_{2n-2} and alcohols by $C_nH_{2n+1}OH$, where 'n' stands for number of carbon atoms in one molecule of alkane.

Every member of a homologous series differs from the adjacent ones in composition by CH_2.

This is because every succeeding member of a homologous series arises by the replacement of an H atom in the preceding member by a CH_3 group. For example, C_2H_6 (ethane) may be thought to arise from CH_4 (methane) as follows.



The molecular masses of two consecutive members of a homologous series differ by 14 amu (equivalent to one CH_2 group).

Generally, similar methods may be employed to prepare all the compounds belonging to a homologous series.

The physical properties of the compounds of a homologous series change gradually as the molecular mass changes. For example, the melting point, boiling point and density increase with molecular mass.

The chemical properties of the compounds belonging to the same homologous series are similar.

Nomenclature Of Organic Compounds

Naming of organic compounds is an important aspect in the study of organic chemistry. since some millions of compounds are present, remembering their names is an herculean task. There are mainly three types of naming.

They are i) Trivial naming, ii) Derived naming and iii) Systematic naming.

Trivial names are also called common names. In this system the compound is named after the source from which it is obtained. For instance citric acid (obtained from citrus plant), uric acid (obtained from urine), formic acid (obtained from red ants, formica means ants in Latin) et.

Derived names are based on the recognition of certain familiar common names. Thus $CH_3.OH$ is called carbinol and $CH_3.CH_2.OH$ is called methylcarbinol.

II. IUPAC System

With the rapid growth of organic chemistry, it was realised that the nomenclature of fast increasing number of organic compounds should be related to their structures in a systematic manner as to avoid undue strain on memory. The first rational system of naming organic compounds was evolved in 1892 by the International Chemical Congress at Geneva under the name of Geneva system of nomenclature. However, the system could not be successfully applied to complicated and multifunctional organic compounds. This system was partially revised in 1931 and the revised system was referred to IUPAC system.

Modifications in this system have been made from time to time by the International Union of Pure and Applied Chemistry and in its present form, the system is known as IUPAC system (pronounced as eye-you-pack). It is the most modern and largely used system. This system has been evolved in 1957 and some additions and subtractions were done in 1967. The IUPAC system has set rules for naming organic compounds on the basis of their structures.

These rules underwent further modifications in 1979 and later revised in 1993 (A Guide to IUPAC Nomenclature of Organic Chemistry by R. Panico, W.H. Powell and J.C. Richer). The name assigned on the basis of latest IUPAC rules to an organic compound is known as its systematic name.

Salient Features of IUPAC System

1. A given compound can be assigned only one name.
2. A given name can clearly direct in writing of one and only one molecular structure.
3. The system can be applied in naming complex organic compounds.
4. The system can be applied in naming multifunctional organic compounds.
5. This is a simple, systematic and scientific method for nomenclature of organic compounds.

Basic rules of nomenclature : For naming simple aliphatic compounds, the normal saturated hydrocarbons have been considered as the parent compounds and the other compounds as their derivatives obtained by the replacement of one or more hydrogen atoms with various functional groups. Each systematic name has two or three of the following parts:

(i) Root word, (ii) Primary suffix (iii) Secondary suffix.

Which indicate linear or continous chains or carbon atoms are known by special root words while chains from C_5 onwards are known by Greek number roots.

Chain length	Root word	Chain length	Root word
C_1	Meth-	C_{11}	Undec-
C_2	Eth-	C_{12}	Dodec
C_3	Prop-	C_{13}	Tride-
C_4	But-	C_{14}	Tetradec-
C_5	Pent-	C_{15}	Pentadec-
C_6	Hex-	C_{16}	Hexadec-
C_7	Hept-	C_{20}	Eicos-
C_8	Oct-	C_{30}	Tnacont-
C_9	Non-	C_{40}	Tetracont-
C_{10}	Dec-	C_{50}	Pentacont-

In general, the root word for any carbon chain is alk-. (ii) Primary suffixes: Primary suffixes are added to the root words to show saturation or unsaturation in a carbon chain.

Classification of Nomenclature of organic compound

Nature of carbon chain	Primary suffix	IUPAC name
Saturated (C-C)	-ane	Alkane
unsaturated (C = C) with one double bond	-ene	Alkene
unsaturated (C = C) with one triple bond	-yne	Alkyne
unsaturated with two (C = C) bonds	-adiene	Alkadiene
unsaturated with two (C = C) bonds	-adiyne	Alkadiyne
unsaturated with three (C = C) bonds	-atriene	Alkatriene

Naming of hydrocarbons

i) The number of carbon atoms in a hydrocarbon is indicated as

Number of carbon atoms	Name	Number of carbon atoms	Name
1	Meth	6	Hex
2	Eth	7	Hept
3	Prop	8	Oct
4	But	9	Non
5	Pent	10	Dec

ii) A saturated hydrocarbon containing single bonds is indicated by writing the word 'ane' at the end.

iii) An unsaturated hydrocarbon containing double bonds is indicated by writing the word 'ene' at the end.

iv) An unsaturated hydrocarbon containing triple bonds is indicated by writing the word 'yne' at the end.

All isomeric paraffins have same parent name. The names of various isomers are distinguished by prefixes.

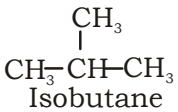
(a) Prefix n- is used for those paraffins in which all the carbon atoms are in one continuous chain. The prefix n-stands for normal or stright chain

Ex: $CH_3CH_2CH_2CH_3$, n-Butane

$CH_3CH_2CH_2CH_2CH_3$, n-Pentane

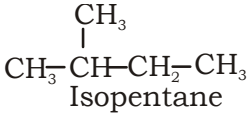
$CH_3CH_2CH_2CH_2CH_2CH_3$ n-Hexane

(b) Prefix iso- is used fro those paraffins in which methyl group is attached to the second last carbon atom of the continous chain.

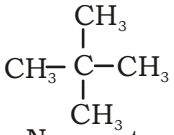


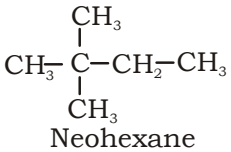
Isobutane

continuous chain,


Isopentane continuous chain,

(C) Prefix neo- is used for those paraffins in which two methyl groups are attached to the second last carbon atom of the continuous chain.


Neopentane continuous chain,


Neohexane continuous chain,

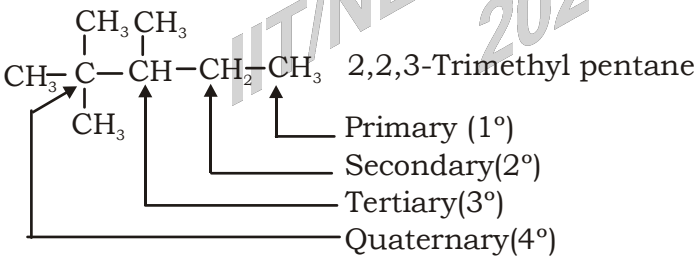
There are four types of carbons in the carbon chain.

(i) Primary carbon: A carbon atom attached to one (or no) other carbon atom is termed primary carbon or 1º carbon carbon atom.

(ii) Secondary carbon: A carbon atom attached to two other carbon atom is termed secondary carbon or 2º carbon carbon atom.

(iii) Tertiary carbon: A carbon atom attached to three other carbon atom is termed tertiary carbon or 3º carbon carbon atom.

(iv) Quaternary carbon: A carbon atom attached to four other carbon atom is termed secondary carbon or 4º carbon carbon atom.



[The hydrogen atoms attached to primary, secondary and tertiary carbon atoms are correspondingly termed as primary, secondary and tertiary hydrogen atoms respectivel.]

Normal hydrocarbons contain either only primary or both primary and secondary carbon atoms. No branching is present.

Iso-hydrocarbons contain a quaternary carbon atom, i.e., $(CH_3)_2CH$-

Neo-hydrocarbons contain a quaternary carbon atom, i.e., $(CH_3)_3C$-.

The isomers of butanes (2) and pentanes (3) can be named by using prefixes (n-,iso-,neo-) but it will be difficult to name properly all the hexanes (5), heptanes (9) and decanes (75) by this method.

Alkyl groups: These are univalent groups or radicals obtained by the removal of one hydrogen atom from a molecule of a paraffin. The symbol 'R' is often used to represent an alkyl group.

$$(\text{Alkane})\underset{(\text{R-H})}{C_nH_{2n+2}} \xrightarrow{-H} \underset{(\text{R-})}{C_nH_{2n+1}}\ (\text{Alkyl group})$$

Nomenclature of Branched hydrocarbons

IUPAC Rules

1. For saturated hydrocarbons and their substituent derivatives

(i) Longest chain rule :

(a) The longest continuous chain of carbon atoms is selected as the parent hydrocarbon. The compound is then named as a derivative of the parent hydrocarbon.

(b) If more than one set of longest possible chain are possible then the selected longest chain should have(i) maximum number of side chains, or (ii) minimum number of branched side chains.

1 2 3 4 5 6

$CH_2-CH-CH_2-CH_2-CH_2-CH_3$ (Wrong)

CH_2

CH_3

$CH_3-{}^{3}CH-{}^{4}CH_2-{}^{5}CH_2-{}^{6}CH_2-{}^{7}CH_3(Right)$

$2\,CH_2$

$1\,CH_3$

7 Carbon atom chain with one side chains or 7 carbon atoms chain with one side chains having no branching (right)

6 Carbon atom chain with one side chains or 6 carbon atoms chain with one branched side chain (wrong)

ii) Lowest sum rule:

(a) The selected chain is numbered in terms of arabic numbers one end to other 1 2 3 4 (Right)

CH_3-CH_2-CH_2-CH_3 (Right)

4 3 2 1

(b) Lowest number is assigned to the first side chain (alkyl group) or a substitutent (Cl,-Br,-I,-NO_2)

(c) If two different alkyl groups are at the same position from opposite ends, lowest number is given in order of their alphabets (IUPAC 1993)

eg: 1 2 3 4 5 6 7

CH_3-CH_2-CH-CH_2-CH-CH_2-CH_3 (Wrong)

7 6 5 4 3 2 1 (Right)

CH_3 C_2H_5

(d) If two different substitutents are at the same position from opposite ends, lowest number is assigned in order of their alphabets,

eg: 1 2 3 4
CH_3-CH-CH-CH_3 (Wrong)
4 3 2 1 (Right)
Cl Br

(e) If a substitutents and side chains are at the same position ends, opposite eneds, lowest number is assigned to the substitutents.

(f) If more than two substitutents and side chain are present, the sum of their numbers should be lowest at the first preference , irrespective of the naturte of

4 3 2 1
CH_3-CH-CH-CH_3 (Right)
1 2 3 4 (Wrong)
CH_3 Cl

side chain or substitutents.

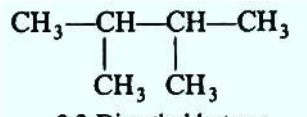
Note: See lowest sum at the first preference, as over lined and never see total sum of the numbers.

(iii) Arrangements of prefixes:

(a) The names of a saturated hydrocarbon in general, may be divided into two parts: word root and suffix. The word root designates table1) the number of carbon atoms in the chain. The suffix (ane) is added to the word to indicate the saturation in hydrocarbon

(b) Alkyl nature of side chain or substituent gp. is identified and reported as prefix (table 4 and 5) with its number (locant) in hydrocarbon name in alphabatic order and while doing so prefixes, di, tri, tetra are not to be considered.

(c) If more than one similar alkyl chains or substituents are present, prefix names are suitably modified by putting di, tri....terms.



2,3-Dimethyl butane

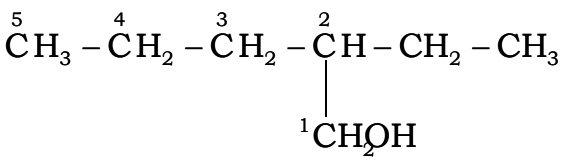
(d) If more than one similar alkyl gps. or substituents are present, at same position,their no. is also repeated.

(e) In case side chain is also branched, it is also numbered from the carbon atom attached to main chain and reported in paran thesis.

Rules for Naming Complex Aliphatic Compounds Containing One Functional Group:

(A) Longest chain:

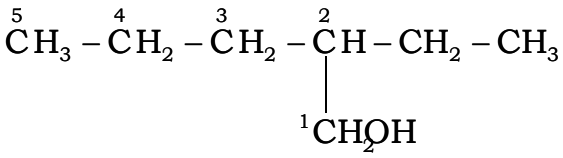
The parent carbon chain in so chosen as to include the functional group even if it is not the actual longest continuous chain.



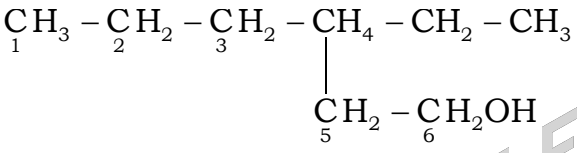
The longest chain (horizontal) consists of six carbon atoms but this does not include the functional group. This chain is rejected and the chain having five carbon atoms is selected as parent chain as it includes the functional group.

(B) Numbering of parent chain:

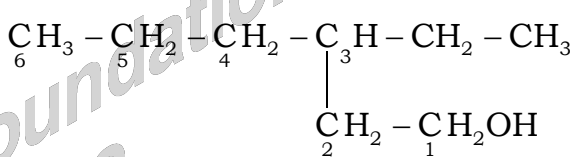
The numbering of the parent carbon chain is done in such as way that the carbon linking to functional group gets the lowest number even if there is violation of saturated hydrocarbon rules.



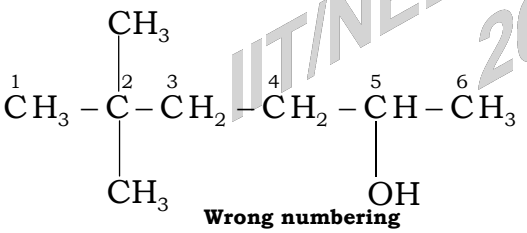
The longest chain (horizontal) consists of six carbon atoms but this does not include the functional group. This chain is rejected and the chain having five carbon atoms is selected as parent chain as it includes the functional group. Hence, named as, Numbering of parent chain: The numbering of the parent carbon chain is done in such as way that the carbon linking to functional group gets the lowest number even if there is violation of saturated hydrocarbon rules.



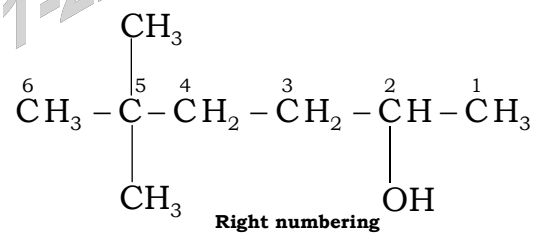
Wrong numbering



Right numbering
(3–Ethylhexan-01)

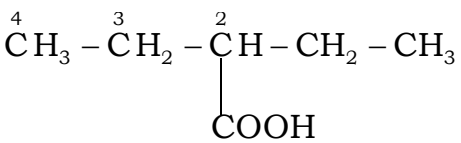


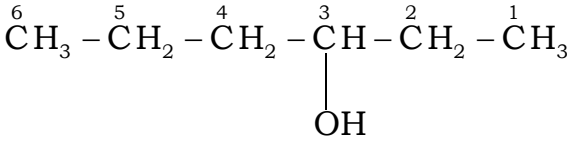
Wrong numbering



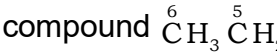
Right numbering
(5,5 - Dimethylhexan - 2-01)

Note: When a chain terminating group such as – CHO, –COOH, COOR, – $CONH_2$ – C ≡ N, etc., is present as the functional group, it must be assigned number 1. This does not apply to non-terminal groups such as >CO, – NH_2 and – OH which may or may not be assigned 1.





(C) The last 'e' of the primary suffix is dropped and the secondary suffix representing the functional group is added. The number giving the position of the functional group is inserted in the name.

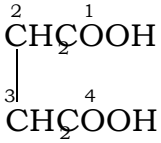
The compound  is named as:Hexan-2-one

Similarly, the compound  may be named as: Pental-3-ol

(D) The names of the substituents are prefixed to the parent hydrocarbon according to IUPAC rules with alphabetical order without considering the presence of functional group. Halo and nitro groups are considered as substituents.

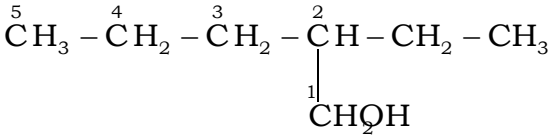
(E) Numerical prefixes di–, tr–, tetra–, etc., are attached before the designations of functional group if two or more identical groups are present, e.g.,

$\overset{1}{C}H_2OH-\overset{2}{C}H_2OH$ is named Ethane-1, 2- diol.

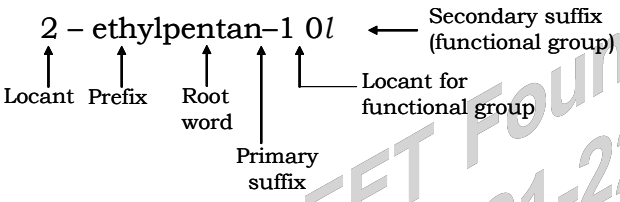


is named Butane - 1, 4 - dioic acid.

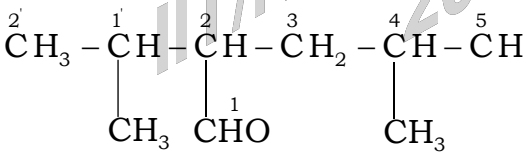
Examples:

(A) 

The name of the compound is given in the following way:



i.e., 2-Ethylpentan-1-ol.



2(1′–Methyl ethyl)–4–methylpentanal
or 2–Isopropyl–4–methylpentanal

Rules for Naming Aliphatic Compounds Having Polyfunctional Groups.

A compound is said to be polyfunctional compound if it contains more than one functional group. The multiple bond $(>C=C<$ or $-C\equiv C-)$ is also considered as a functional group. In IUPAC system, one of the functional groups is chosen as the principal functional group (secondary suffix) and the remaining functional groups (secondary functional groups) are treated as substituents and indicated by prefixes. For example, in the following structure.

The – COOH group is the principal functional group, while the –OH group is a substituent. The principal functional group is mentioned with its suffix name while secondary functional groups are mentioned only with their prefix name.

The choice of the principal functional group is made on the basis of the following order of preference.

[Carboxylic acids > sulphonic acids > acid anhydrides > esters > acid chlorides > acid amides > cyanides > aldehydes > ketones > alcohols, phenols, thiols > amines > ethers > alkenes, alkynes > halo, nitro, alkyl.]

The order of seniority among the principal groups is given according to the following table along with their prefix and suffix names. The functional group which occurs higher up in the table is the principal functional group.

Seniority Table for Principal Groups

(Higher Priority Group at the Top)

Group	Prefix name	Suffix name
– COOH	Carboxy	–oic acid
– SO_3H	Sulpho	sulphonic acid
– COOR	Alkoxy carbonyl or Carbalkoxy	alkyl oate
– COX	Haloformyl or halocarbonyl	–oyl halide
– $CONH_2$	Carbamoyl	amide
– CN	Cyano	nitrile
– NC	Isocyano	carbylamine
– CHO	Formyl or aldo	–al
$>C=O<$	Keto or oxo	–one
– OH	Hydroxy	–ol
– SH	Mercapto	thiol
– NH_2	Amino	amine
– OR	Alkoxy	—
– C – C – (O)	Epoxy	—
$>C=C<$	—	– ene
– C ≡ C –	—	– yne
– N = N –	Azo	—
– NO_2	Nitro	—
– NO	Nitroso	—
– X	Halo (Chloro, bromo, iodo)	—

1. The first step in the naming of polyfunctional compounds is the selection of principal functional group. The principal functional group gives the class name of the structure.
2. The second step is the selection of parent chain. The parent chain is so elected that it includes the maximum number of functional groups including the principal group.
3. The third step is the numbering of parent chain. The parent chain is numbered from the side of principal functional group, i.e., it gets lowest number. The following decreasing order of preference for giving the lowest numbers is followed.

   Principal functional group > Double bond or Triple bond > Substituents

4. Substituents, side chains and secondary functional groups are named in alphabetical order.

On the basis of the above rules, the following general procedure is followed in naming an aliphatic compound.

(a) Locate the longest chain containing the principal functional group and as many of the secondary functional groups and multiple bonds are possible.

(b) Select the corresponding root word for the chain selected.

(c) Number the carbon atoms of the chain selected from the end so that the various groups get as small numbers as possible and the principal functional group gets the lowest number. The number of chain terminating group (i.e.,–COOH, –COOR, –COCl, – $CONH_2$, – CHO, or –CN) must always be 1. When no functional group is present, the substituents should get the lowest numbers.

(d) Attach to the root word, the primary suffix (-ane, -ene or -yne) representing the nature of carbon-carbon bonds in the selected chain.

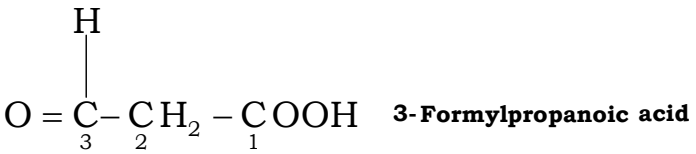
(e) Add suitable prefixes (alphabetical order) and secondary suffixes with their respective numbers of attachment to parent chain as to denote the number and position for each substituent or functional group.

(f) In case the substituent has a branched chain, number the carbon atoms in the chain also from the carbon atom attached to the main chain. The name of such substituent is written in bracket and a hyphen (-) is put between the locant and the bracket. In such cases carbon of substituent attached to main chain is given number 1', next one number 2 and so on.

(g) Write the name of the compound as one word, separating the numbers from the designations or prefixes or suffixes by hyphens and separating the numbers from each other by commas.

Some Specific Rules for IUPAC Nomenclature

1. If the substituent group is named as an oxygen derivative of CH_3 – or CH_2 group, the carbon atom of the substituent group is also counted towards parent chain. example:



3-Formylpropanoic acid

2. Nomenclature of polyfunctional compounds containing more than two like functional groups.

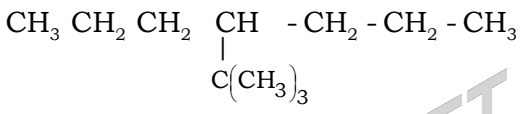
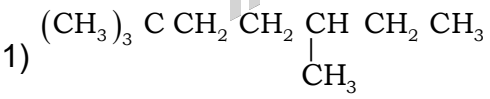
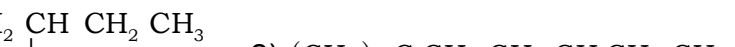
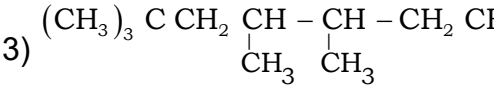
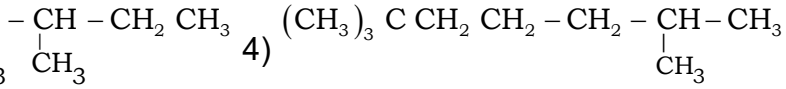
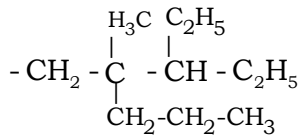
According to IUPAC convention 1993, if an unbranched carbon chain is directly linked to more than two like functional groups, the organic compound is named as a derivative of parent alkane which does not include the carbon atom of the functional groups. These are named by use of suffix such as tricarboxylic acid (for three –COOH groups), tricarbaldehyde (for three – CHO – groups) or tricarbonitrile (for three – CN groups).

e.g:

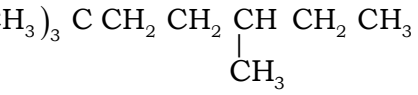
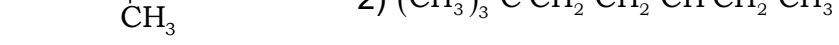
Butane – 1, 2, 4 – tricarbonitrile
(formely 3–cyanohexane –1, 6–dinitrile)

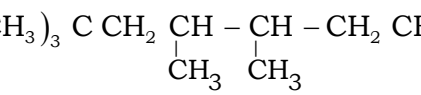
TEACHING TASK-I

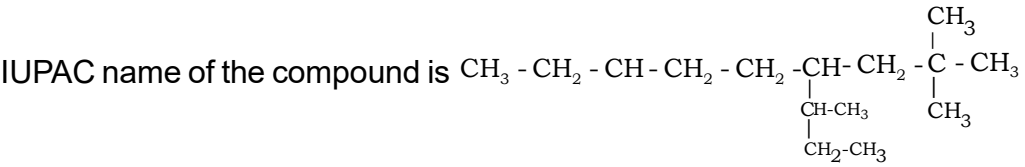
I. Single Correct Choice Type:

1. An example of an acyclic compound is :
   1) Benzene 2) n-pentane 3) Cyclobutane 4) Pyrrole
2. Which of the following is an aromatic compound?
   1) Benzene 2) Naphthalene 3) Furan 4) All of these
3. Which of the following properties is not true regarding organic compounds?
   1) They are generally covalent compounds 2) They have high melting and boiling points
   3) They are generally insoluble in water 4) They usually show isomerism.
4. 
   1) 4 – (1, 1– Dimethylethyl) heptane 2) 4–diemthyl heptane
   3) 3 – dipropyl (1 – dimethyl ethane 4) 4 – (3, 4 – dimethyl (ethyn) heptane
5. 2,2,4,5 tetra methyl heptane
   1)  2) 
   3)  4) 
4. Which of the following is not a carbocyclic compound?
   1) Cyclopentane 2) Naphthalene 3) Thiophene 4) Benzene
5. The number of carbon atoms present in compound containing meth as priffix is
   1) One 2) Two 3) Three 4) Four
6. IUPAC name of  is:
   1) 3, ethyl 4-methyl pentane 2) 3, 4 - diethyle-4-methyl heptane
   3) 3-methyl, 4, 5 diethyl Hexane 4) 3, methyl propyl, 4-ethyl pentane

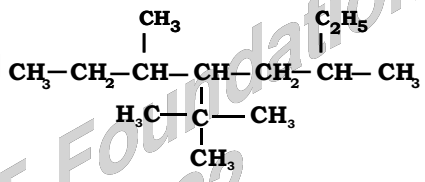
7. Which of the following structure is 2, 2, 5-trimethyle heptane?

1) 
2) 

3) 
4)

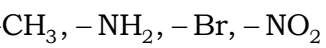
8. The IUPAC name of the compound is 

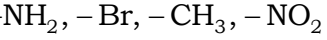
1) 2, 2, 5 – trimethyl – 4 – (1 – methyl propyl) hexane
2) 2, 2, 7 – trimethyl – 4 – (1 – methyl propyl) nonane
3) 2, 2, 7 – dimethyl – 4 – (1 – methyl propyn) octane
4) 2, 2, 5 – trimethyl– 4 – (1 – methyl propyn) oxtane

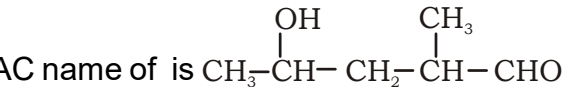
9. The IUPAC name of the compound  is

1) 4 – (1, 2 – Dimethyl ethyl) – 5 – ethyl (– 2 – methyl octane
2) 4 – (1, 1 – Dimethyl ethyl) – 3,6 – dimethyl octane
3) 5 – (1, 1 – Dimethyl ethyl) – 6 – ethyl (– 5 – methyl octane
4) 4 – (1, 2 – Dimethyl ethyl) – 6 – ethyl (– 4 – methyl octane

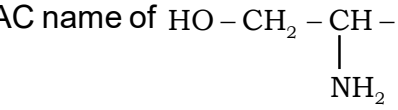
10. .The substituent group for prefixes Amino, Bromo, Methyl, Nitro are respectively,

1) 
2)

3) 
4)

IUPAC name of is 

1) 4–hydroxy–2–methyl pentanal
2) 2–hydroxy–4–methyl pentanal
3) 4–hydroxy–2–methyl pentanol
4) 2–hydroxy–4–methyl pentanol

11.. IUPAC name of  is :

1) 3–hydroxy–2–amino butanoic acid
2) 2–amino–3–carboxy propanal
3) 2–amino–3–hydroxy propanoic acid
4) 2–amino–3–hydroxy butanoic acid

II. Multi Correct Answer Type:

12. Next homologous compound of $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$

1) $CH_3-CH_2-CH_2-CH_2-OH$ 2) $CH_3-CH_2-CH_2-CH_2-X$

3) $CH_3-CH_2-CH_2-CH_2-CH_2-OH$ 4) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$

13. Which one is/are correct statement? 1)

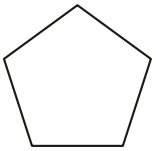
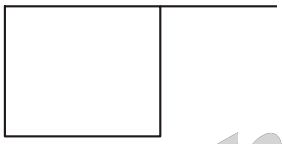
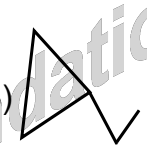
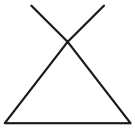
Open chain compounds are called aliphatic compounds.

2) Unsaturated hydrocarbons contain double or triple bond between carbon atoms

3) Aromatic compounds possess a characteristic aroma.

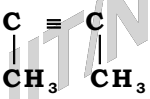
4) None of these

14. Which of the following polygon having C_5H_{10} molecular formula?

1)  2)  3)  4) 

15. The valency of carbon is 4 in which of the following compound.

1) CH_4 2) C_2H_2 3) C_6H_6 4) None

16. The compound  can be named as

1) Dimethyl Acetylene 2) Crotonylene

3) But–2–yne 4) Allylene

17. Name of the compound CH_2OH-CH_2OH is

1)Ethylene glycol 2) Ethane -1, 2 diol

3)Ethane 1, 2 – dial 4) Glycerol

III. Reasoning Type:

1) Both Statements are true, Statement II is the correct explanation of Statement I.
2) Both Statements are true, Statement II is not correct explanation of Statement I.
3) Statement I is true, Statement II is false.
4) Statement I is false, Statement II is true.

18. Statement I: In Homologous series two succesive members differ in theiratomic mass by 14 atomic units

Statement II: Homologous series of structurally similar compounds having same functional group in increasing by one carbon and two hydrogen atoms

19. Statement I: The IUPAC name of $CH_3 - C(CH_3)_2 - CH_2 - CH = CH_2$ is 4,4 – dimethyl-1–pentene.

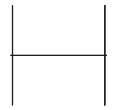
Statement II: The IUPAC name of $C_2H_5 - \underset{\underset{CH_2}{\|}}{C} - CH_2 - OH$ is 2–ethyl prop–2–en–1– ol.

IV. Matrix Match Type:

20.

Column-I	Column-II
a) Next homologous compound of CH_4	1) C_2H_4O
b) Next homologous compound of C_2H_5Cl	2) $C_5H_{11}O$
c) Next homologous compound of HCHO	3) C_2H_6
d) Next homologous compound of 	4) C_3H_7Cl
	5) C_2H_4

21.

Column-I	Column-II
a) 	1) Pentane
b) 	2) 2 – methyl butane
c) 	3) Nonane
d) 	4) 2,3 dimethyl butane

V. Comprehension Type:

A. Homologous series is a series of structurally similar compounds having same functional group in increasing number of carbon atoms.

23. The molecular weight of one compound is 16. Next homologous compound weight will beolecular weight of one compound is 16.

1) 28 2) 30 3) 32 4) 29

24. Next homologous compound of $CH_3 - CH = CH_2$ is

1) $CH_3 - CH = CH - CH_3$ 2) $CH_3 - CH = CH_2$

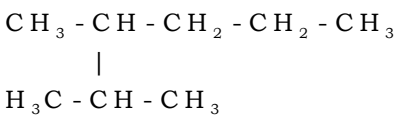
3) $CH_2 = C = CH_2$ 4) $CH_2 = CH_2$

25. Next homologous compound of $CH_2 = CH - OH$ is

1) $CH_3 - CH = CH - OH$ 2) $CH_3 - CH_2 - CH_2 - OH$

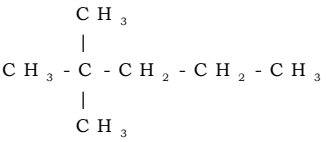
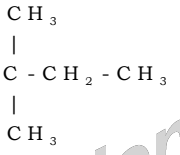
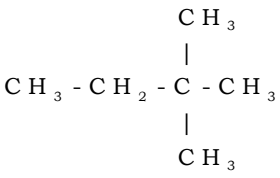
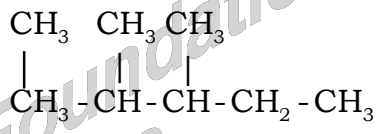
3) $CH_3 - CH_2 - CH = CH - OH$ 4) $CH_3 - CH_2 - OH$

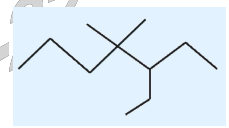
B. I.U.P.A.C System is a conference of the well known chemists of nearly all the Scientifically advanced countries was convened in Geneva in 1892 to derive a uniform scheme of naming aliphatic organic compounds. This international body was eventually formalised as the International Union of Pure Applied Chemistry (IUPAC) at a meeting in Paris in 1957. This official system of naming organic compounds is referred to as IUPAC System of Nomenclature or simply IUPAC Nomenclature.

26. The IUPAC name of the following compound is 

1) 2– isopropyl pentane
2) 2, 3 – dimethyl hexane
3) isononane
4) 2, 4 – dimethyl hexane

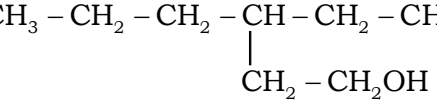
27. Which of the following compound is 2, 2 – di methyl pentane

1) 
2) 
3) 
4) 

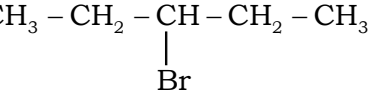
28. The IUPAC name of the following compound is 

1) 1, 1 – diethyl 1–2, 2– dimethyl pentane
2) 4, 4 dimethyl 5, 5 – diethyl pentane
3) 5, 5 – diethyl 4, 4 diemthyl pentane
4) 3 – ethyl 4, 4 – dimethyl heptane

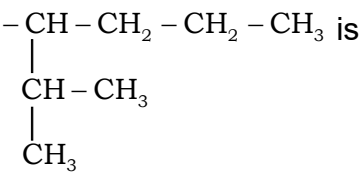
C. The numbering of the parent carbon chain is done in such a way that the carbon linking to funcitonal group gets the lowest number even of there is violation of saturated hydrocarbon rules.

29. The IUPAC name of  is

1) 4–Ethyl–6–hexan–1–ol
2) 3–Ethyl–3–propyl propanol
3) Octanol
4) 3–Ethyl hexan–1–ol

30. The IUPAC name of  is

1) 1–Bromo pentane 2) 3–Bromo pentane
3) 2–Bromo pentane 4) 4–Bromo pentane

31. The IUPAC name of  is

1) 4–(1[1]–methyl ethyl) heptane 2) 4–(2[1]–methyl ethyl) heptane
3) 4–(3[1]–methyl ethyl) heptane 4) 4–(4[1]–methyl ethyl) heptane

LEARNER'S TASK- I

BEGINNERS (Level - I)

1. An example of alicyclic compound is
   1) Benzene 2) Hexane 3) Cyclohexane 4) Furan
2. Which of the following is an aromatic compound?
   1) Benzene 2) Anthracene 3) Pyridine 4) All
3. Which of the following is an aromatic compound?
   1) Benzene 2) Anthracene 3) Pyridine 4) All
4. Primary suffix for unsaturated hydrocarbons is/are:
   1) -ane 2) -ene 3) -yne 4) Both 2&3
5. The alkanes have a general formula
   1) C_nH_{2n} 2) C_nH_{2n+4} 3) C_nH_{2n-2} 4) C_nH_{2n+2}
6. The alkenes have a general formula
   1) C_nH_{2n} 2) C_nH_{2n+2} 3) C_nH_{2n-2} 4) $C_{2n}H_{2n+1}$
7. Which of the following statement is correct?
   1) The IUPAC name of alkenes ends with suffix -ene
   2) The IUPAC name of alkynes ends with suffix -yne
   3) The IUPAC name of alkanes ends with suffix -ane
   4) All of these
8. Formula of alkane — IUPAC name of alkyl radical formed

i)	CH_4	p)	Butyl
ii)	C_2H_6	q)	Methyl
iii)	C_3H_8	r)	Ethyl
iv)	C_4H_{10}	s)	Propyl

	(i)	(ii)	(iii)	(iv)
1)	p	q	r	s
2)	q	r	s	p

3) s r p q

4) p r s q

9. IUPAC names of $CH_3 - \underset{\underset{C_2H_5}{|}}{CH} - \underset{\underset{C_2H_5}{|}}{CH} - CH_3$ is:

1) 3, 4 dimethyl hexane 2) 2, 3 diethyl butane
3) 2, ethyl 3-isopropyl propane 4) 2, 3 dimethyl heptane

10. The hydrocarbon residue derived by removing a hydrogen atom from an alkene is called :
1) Alkenyl group 2) Alkyle group 3) Alkynyl group 4) Aryl group

11. The unsaturated hydrocarbons with C = C are called _____.
1) Alkanes 2) Alkenes 3) Alkynes 4) None

12. The correct order of arrangement of rootword, suffixes and prefixes is ____
1) Primary prefix+Rootword+Primarysuffix+Secondarysuffix+Secondaryprefix .
2) Secondary prefix+Primaryprefix+Rootword Primarysuffix+Secondarysuffix.
3) Secondary prefix+Rootword+Primaryprefix+Primarysuffix+Secondary suffix.
4) None

13. CH_3COCH_2CN has the IUPAC name
1) 3–oxo–butane nitrile 2) 1–cyando propane
3) 2–oxo propane 4) 1–cyano butanone

14. Structure of prop–2–ynal is :
1) $CH_3 - C \equiv C - OH$ 2) $CH \equiv C - CH_2OH$
3) $CH \equiv C - CHO$ 4) $CH_2 = CH - CHO$

ACHIEVERS (Level - II)

II. Multi Correct Choice Type:

15. Which of the following is/are aromatic heterocyclic compound(s)?
1) Furan 2) Pyrrole 3) Thiophene 4) None

16. Primary suffix for unsaturated hydrocarbons
1) ane 2) ene 3) yne 4) none

17. Which of the following is/are common names?
1) Acetic acid 2) Oxalic acid 3) Formic acid 4) 1-butene

18. The compound $(CH_3)_2 – C(OH) – CH_2 – CH_3$ is called
1) 2 – methyl butan – 2 – ol 2) Isoamyl alcohol
3) Ethyl dimethyl carbinol 4) tert – pentyl alcohol

19. $C_n H_{2n}$ is the general formula of
1) Alkynes 2) Alkenes 3) Cyclo Alkanes 4) Cyclo Alkenes

20. Which one is correct for a homologus series?
1) All members have a general formula.
2) All members have similar chemical properties.
3) All members have same physical properties.
4) All members have same functional group.

III. Reasoning Type:

21. Statement I:When two or more substituents are present at the end of the parent chain which gives the lowest set of the locants is preffered for numbering
Statement II: Priority order will be given according to lowest locant rule.

22. Statement I: The IUPAC name of $CH_3 - CH = CH - C \equiv C - H$ is pent–3– en–1–yne
Statement II: Lowest Locant rule for multiple bond is preferred.

23. Statement I: Isopropanol is a secondary alcohol.
Statement II: HCHO is called ethanol

V. Matrix Match Type:

24.

Column-I	**Column-II**
Common name	
a) Acetic acid	1) Red ants
b) Formic acid	2) Vinegar
c) Oxalic acid	3) Oxalus
d) Maleic acid	4) Pyrus malus

25.

Column-I	**Column-II**
a) $CH_3 - CH_2 - CH_2 - \underset{\displaystyle CH_3}{\underset{\vert}{CH}} - C \equiv CH$	1) One tertiary carbon atom
b) $CH_2 = C = \underset{\displaystyle CH_3}{\underset{\vert}{CH}} - CH - CH_3$	2) sp–hybridization
c) $CH_3 - CH = CH - CH = CH - CH_3$	3) Ten hydrogen atoms
d) $CH_2 = CH - CH_2 - CH_2 - CH = CH_2$	4) **2Π – bonds**

26.

Column-I	**Column-II**
a) 2,3–pentanedione	1) Alcohol
b) 3,5–octadiene	2) Alkyne
c) propane 1,2–diol	3) Alkene
d) 1,3–pentadiyne	4) Ketone

27.

Column-I	**Column-II**
a) Alcohols	1) –oic acid
b) Ketones	2) –ol
c) Aldehydes	3) –one
d) Acids	4) –al

V. Comprehension Type:

A. Depending on the nature of the ring carbon compounds are divided into carbo cyclic and heterocyclic compounds.

28. Which of the following is an example of alicyclic homocyclic compound?

1) Benzene 2) Pentane 3) Cyclo pentane 4) Furan

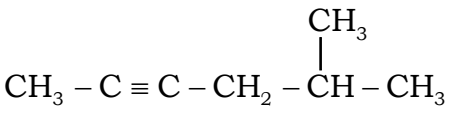
29. Which of the following are aromatic heterocyclic compound?

1) Furan 2) Pyrrole 3) Thiophene 4) All

30. Which of the following is/are alicylic heterocyclic compound?

1) Pyrrole 2) Pyrrolidine 3) Benzene 4) Butane

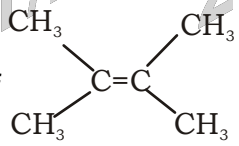
B. The parent carbon chain is numbered in a manner so as to give lowest number to that carbon atom linked by double (or) triple bond even if it Violates the rules of saturated hydrocarbons.

31. The IUPAC name of  is

1) 5 – Methyl – 2 – Hexyne 2) 2 – Methyl – 4 – Hexyne
3) 2 – yne – 5 – Methyl Hexane 4) 1,1 – Dimethyl – 3 – Pentyne

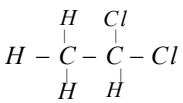
32. The IUPAC name of  is

1) 3 – Methyl buta – 1,3 – diene 2) 2 – Methyl buta – 1,3 – diene
3) Penta diene 4) 2 – Methyl pentene

33. The IUPAC name of  is

1) 2,3 – dimethyl but – 3 – ene 2) 2,3 – dimethyl but – 2 – ene
3) 2,3 – dimethyl but – 1 – ene 4) 2,3 – dimethyl but – 4 – ene

C. According to IOPAC system of nomenclature; the longest possible continous chain of carbon atioms containing the funthonal group and carbon - carbon muthple bonds is first selected and the root word corresponding to it is noted.

34. IUPAC name of  is

1) 1,2 - dichloro ethane 2) 2,2 - dichloro ethane
3) 1,1 - dichloro ethane 4) Dichloro ethane

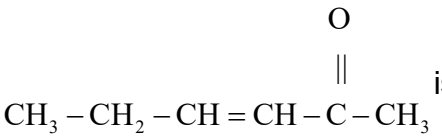
35. IUPAC name of $CH_2 = CH - CH(CH_3)_2$ is

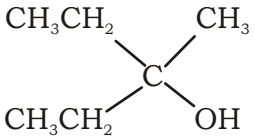
1) 1,2 - dimethyl - 2 - propene 2) 3 - methyl - 1 - butene
3) 2. vinyl propane 4) 1-isoprophyl ethylene

36. Isobutyl chloride is?
1) $CH_3CH_2CH_2Cl$ 2) $(CH_3)_2CHCH_2Cl$
3) $CH_3CH_2CHClCH_3$ 4) $(CH_3)_3C-Cl$

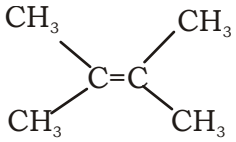
D. If the given Organic Compound contains functional group, then the main chain should include the functional group and the lowest locant should be given to the functional group.

37. The systematic name of $(CH_3)_2CH-COOH$ is
1) 2 – Propanoic acid 2) isobutanoic acid
3) 2 – methyl butanoic acid 4) 2 – methyl propanoic acid

38. The IUPAC name of the compound  is
1) Pent – 3 – 3ene – 5 – one 2) 3 – hexen – 5 – one
3) Hex – 3 – ene – 2 – one 4) Hex – 3 – ene – 5 – one

39. The IUPAC name of  is
1) 2 – ethyl – 2 butanol 2) 3 – methyl – 3 – Pentanol
3) 3 – ethyl – 3 – methyl – 3 – Pentanol 4) 1, 1 – diethyl ethanol

EXPLORERS (Level - III)

1. 1,2- disubstitutedbenzene compounds are given the prefix
1) Meta 2) Para 3) Ortho 4) Di
2. 1,3- disubstitutedbenzene compounds are given the prefix
1) Meta 2) Para 3) Ortho 4) Di
3. The correct IUPAC name of the organic compound with molecular formula $(CH_3)_3C-CH_3$ is
1) Pentane 2) 1,1,1-trimethylethane
3) 2,2-dimethylpropane 4) Neopentane
4. The correct decreasing order of priority for functional group of organic compounds in IUPAC system of nomenclature is
1) -COOH,-SO3H,-CONH2,-CHO 2) -SO3H,-COOH,-CONH2,-CHO
3) -CHO,-COOH,-SO3H,-CONH2, 4) -CONH2,-CHO,-SO3H,-COOH
5. The IUPAC name of  is
1) 2,3 – dimethyl but – 3 – ene 2) 2,3 – dimethyl but – 2 – ene
3) 2,3 – dimethyl but – 1 – ene 4) 2,3 – dimethyl but – 4 – ene

Nomenclature of (A) Cyclo-alkanes, Cyclo-alkenes , Cyclo-alkynes

Nomenclature of alicyclic compounds containing functional groups

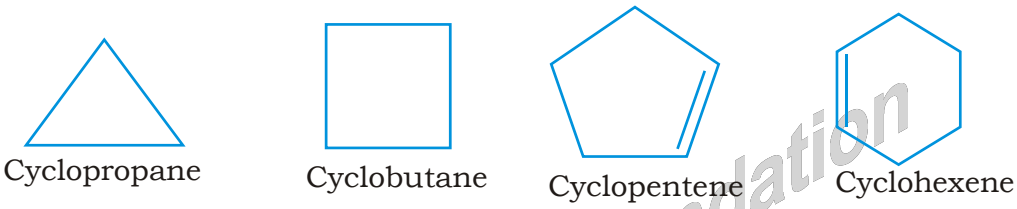
Nomenclature of Alicyclic compounds : These compounds contain one or more rings of three or more carbon atoms and resemble aliphatic compounds in their characteristics. These are, therefore, called aliphatic cyclic or alicyclic compounds

Monocyclic compounds :

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

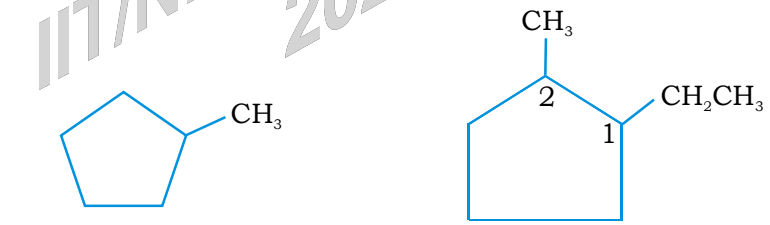
1. The names of the alicyclic compound are obtained by adding there primary prefix 'cyclo' to the word root that corresponds to the number of carbon atoms in the ring.

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



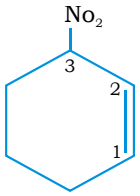
Cyclopropane Cyclobutane Cyclopentene Cyclohexene

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



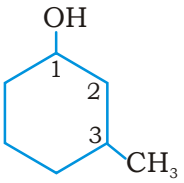
Methylcyclopentane 1-Ethyl-2-Methylcyclopentane

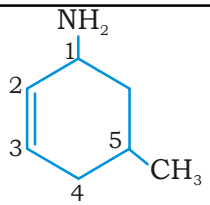
3. If a multiple bonds and some other substituents are present in the ring, the numbering is done in such a way so as to assign lowest number to the multiple bond. For example

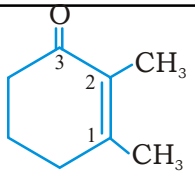


3-Nitrocyclohex-1-ene

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



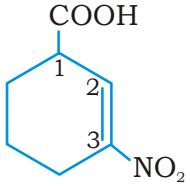




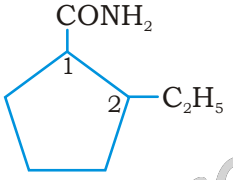
In case, the functional group directly attached to the ring contains carbon atom, suitable suffixes are used to represent such a group.

Functional group		Suffix
–COOH	1	Carboxylic acid
–CHO		Carbaldehyde
–C≡N		Carbonitrile
–COCl		Carbonylchloride
$–CONH_2$		Carboxamide
–COOR		R—Carboxylate

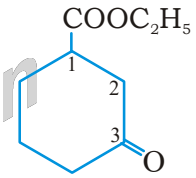
A few example are given to represent these :



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

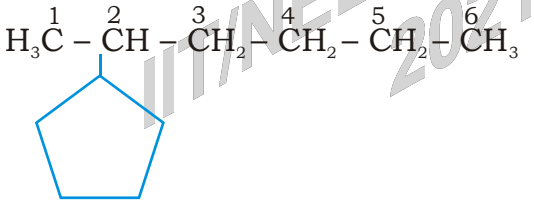


2-Ethylcyclopentane-1-carboxamide

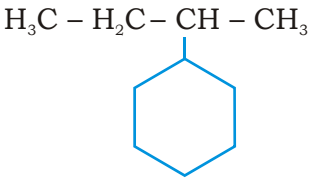


Ethyl-3-oxocyclohexane-1-carboxylate

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

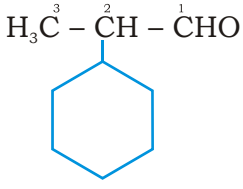


2-cyclopentylhexane

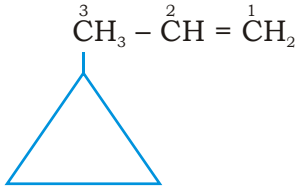


Sec-Butylcyclohexane

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



2-Cyclohexylpropane



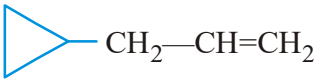
3-Cyclopropylprop-1-ene

6. If the ring contains fewer carbon atoms than the alkyl group attached to it or when more than one ring system is attached to a single chain the compound is named as a derivative of alkane and the ring is treated as cycloalkyl substituent.
7. When both ring as well as side chain contains the same functional group, then the parent hydrocarbon is decided on the basis of the number of carbon atom.
8. If a compound contains an a cyclic ring as well as a benzene ring, it is named as a derivative of benzene.

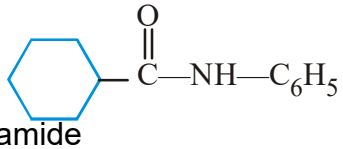
TEACHING TASK-2

LEVEL - I

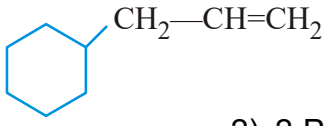
I. Single Correct Choice Type:

1. The IUPAC name of the given compound 

1) 3-Cyclopropane-1-propene
2)3-Cyclopropyl-1-propene
3) 1-Allycyclopropane
4)3-Allylcyclopropane

2. The IUPAC name of  is:

1) N-Cyclohexyl benzamide
2) N-Phenyl-N-cyclohexylmethanamide
3) N-Phenylcyclohexane carboxamide
4) N-Cyclohexyl-N-Phenylmethylamide

3. IUPAC name of the following 

1) 1-Cyclohexyl-3-propene
2) 2-Propenylcyclohexane
3) Allylcyclohexane
4) 3-cyclohexyl-1-propene

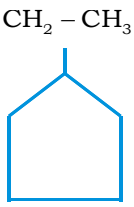
II. Multi Correct Choice Type:

4. Which of the following are cyclo alkanes.

1) Cyclopropane 2)  3)  4) Cyclohexane

III. Reasoning Type:

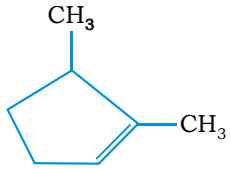
1) Both Statements are true, Statement - II is the correct explanation of Statement - I
2) Both Statements are true, Statement - II is not correct explanation of Statement - I
3) Statement I is true, Statement II is false.
4) Statement I is false, Statement II is true.

5. Statement I:  is ethyl cyclopentane.

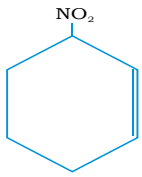
Statement II: When the ring contains more or equal number of carbon atoms than the alkyl group attached to it, then it is named as a derivativeof cycloalkane and the alkyl group is treated as substituent.

IV. Comprehension Type:

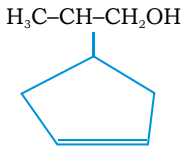
If only one substituent is attached to the ring, its position is note mentioned. If two or more substituents are present, their positions are indicated by arabic numerals i.e., 1,2,3,4 .....etc.which are used for numbering the carbon atoms in the ring. The numbering is done in such a way (clockwise or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

6. 

1) 1,2–dimethyl cyclo pent–1–ene
2) 2,3–dimethyl cyclo pent–1–ene
3) 1,2–dimethyl cyclo pentene
4) All

7. 

1) nitro cyclo hex–2–ene
2) 2–nitro cyclo hex–1–ene
3) 3–nitro cyclo hex–1–ene
4) All

8. 

1) 2–cyclo pentenyl propanol
2) 2–hydroxy–2–cyclo pentnenyl propane
3) 1–hydroxy–2–cyclo pentenyl propane
4) 2–(cyclo pent–3–en–1–yl) propan–1–ol

V. Matrix Match Type:

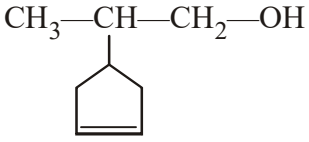
9.

Column-I	Column-II
a) cycloalkanes	1) cyclopentyne
b) cycloalkenes	2) cyclopentane
c) cycloalkynes	3) cyclohexene
d) 	4) cyclobutyne
	5) 

LEARNER'S TASK-2

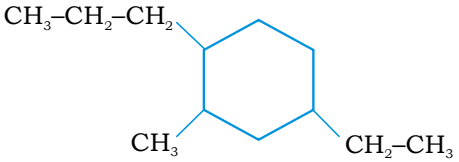
BEGINNERS (Level - I)

I. Single Correct Choice Type:

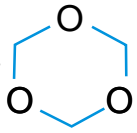
10. The IUPAC name of the compound 

1) 4-(1-methyl-2-hydroxypropyl)-1-cyclopentene
2) 3-(1-hydroxy-2-methylpropyl)-1-cyclopentane

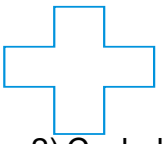
3) 2-(cyclopent-3-enyl)-1-propanol
4) 2-(cyclopent-3-enyl)-1-hydroxypropane

11. The IUPAC name of the compound 

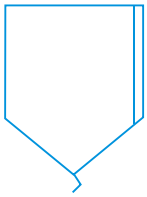
1) 1-Ethyl-3-methyl-4-propyl cyclohexane
2) 4-Ethyl-2-methyl-1-propyl cyclohexane
3) 1-Ethyl-5-methyl-4-propyl cyclohexane
4) 1-Ethyl-5-methyl-4-propyl cyclohexane

12. The correct IUPAC name of 

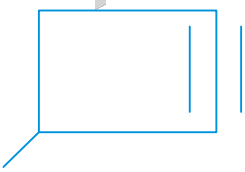
1) Trioxancyclopropane
2) 1, 3, 5 - Trioxohexane
3) 1,3,5 - Trioxacyclohexane
4) None of these

13. The IUPAC name of 

1) Cyclodecane 2) Cyclododecane 3) Cyclotridecane 4) None

14.  IUPAC name of the compound.

1) 1–ethyl cyclopentene
2) cyclopentenyl ethane
3) 4–ethyl cyclopentene
4) 3–ethyl cyclopentene

15. IUPAC of 

1) 2–methyl cyclobutyne
2) 1–methyl cyclobutyne
3) 3–methyl cyclobutyne
4) 3–methyl cyclopentyne

ACHIEVERS (Level - II)

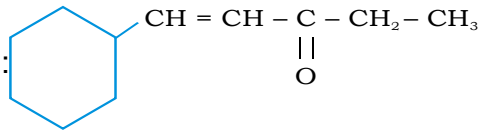
II. Multi Correct Choice Type:

16. Hybridisation of carbon atoms in  is/are

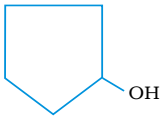
1) sp^3 2) sp^2 3) sp 4) sp^3d

III. Reasoning Type:

1) Both Statements are true, Statement II is the correct explanation of Statement I.
2) Both Statements are true, Statement II is not correct explanation of Statement I.
3) Statement I is true, Statement II is false.
4) Statement I is false, Statement II is true.

17. Statement I : 

is 1–cyclohexyl pent–1–en–3–one.

Statement II: 

is hydroxy cyclopentane.

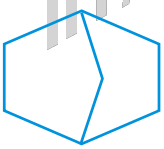
V. Matrix Match Type:

18.

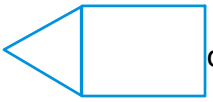
Column-I		Column-II
Functional group		Suffix
a)	–COOH	1) Carboxylic acid
b)	–CHO	2) Carbaldehyde
c)	–C≡N	3) Carbonitrile
d)	–COCl	4) Carbonylchloride
e)	$–CONH_2$	5) Carboxamide
f)	–COOR	6) R—Carboxylate

V. Comprehension Type:

In case substituents are present, numbering is done from the longest bridged ring system, begining at one bridge head.

19. The name of  is _____

1) Bicyclo [2, 2] heptane
2) Bicyclo [1, 2, 2] heptane
3) Spiro [2, 2, 1] heptane
4) Bicyclo [2, 2, 1] heptane

20.  compound has _____ bridge heads

1) 2 2) 3 3) 4 4) 5

21. In naming the bicyclo compounds the numbering is done from _____

1) Shortest bridged ring system 2) Langest bridged system
3) From any carbon 4) From left side

EXPLORERS (Level - III)

DESCRIPTIVE TYPE

1. Write the cyclic compounds of the following IUPAC names.
   1) 2–methyl cyclobutyne 2) 1–methyl cyclobutyne
   3) 3–methyl cyclobutyne
   4) 3–methyl cyclopentyne) 4-(1-methyl-2-hydroxypropyl)-1-cyclopentene
   2) 3-(1-hydroxy-2-methylpropyl)-1-cyclopentane
   3) 2-(cyclopent-3-enyl)-1-propanol
   4) 2-(cyclopent-3-enyl)-1-hydroxypropane
2. Write the rules for writing IUPAC names Of cyclic compounds.

RESEARCHERS (Level - IV)

1. Which of the following compounds has wrong IUPAC name (AIEEE2002)
   1) CH3-CH2-CH2-COO-CH2CH3 Ethylbutanoate
   2) CH3-CH(CH3)-CH2-CHO 3-Methylbutanal
   3) CH3CH(OH)-CH(CH3)-CH3 2-Methyl-3-butanol
   4) CH3CH(CH3)-CO-CH2-CH3 2-Methyl-3-pentanone
2. The functional group which is found in Amino Acid is (AIEEE2008)
   1) -COOH 2) -NH2 3) -CH3 4) both 1&2
3. In which of the following species is the under lined carbon having sp3 hybridisation (AIEEE2008)
   1) CH3COOH 2) CH3C H2OH 3) CH3COCH3 4) CH3=CH-CH3
4. In allene (C3H4), the type of hybridisation of the carbon atom is (IIT-JEE -2011)
   1) sp & sp3 2) sp & sp2 3) only sp3 4) sp2 & sp3
5. An isomer of ethanol is(EAMCET-93)(IIT-86)
   1) Methanol 2) Diethyl ether 3) Acetone 4) Dimethyl ether
6. n-Propyl alcohol & iso propyl alcohol are example of--isomerism (AIEEE2012)
   1) Position 2) Chain 3) Functional 4) Tautomers
7. The IUPAC name of neopentane is (AIEEE2009)
   1) 2,2-Dimethylpropane 2) 2-Dimethylpropane
   3) 2,2-Dimethylbutane 4) 2-Dimethylbutane

KEY

ΦΦ TEACHING TASK - I :

1-2 2-4 3-2 4-1 5-3 6-3 7-1 8-2 9-1 10-2 11-2 12-3

13-1 14-3 15-3&4 16-1,2,3 17-1,2,3,4 18-1,2,3 19-1,3,4, 20-1,2,4

21-B 22-B 23-3,4,1,2 24-2,3,4,1 25-2 26-1 27-1 28-2 29-1 30-4 31-4 32-2 33-1.

ΦΦ LEARNER'STASK - I :

1-3 2-4 3-4 4-4 5-3 6-1 7-4 8-4 9-1 10-1 11-2 12-2 13-1 14-3 15-1,2,3 16-2,3 17-1,2,3 18-2 19-2,3 20-2,3,4

21-1 22-1 23-3 24-2,1,3,4 25-2,1,4,3 26-4,3,1,2 27-2,3,4,1 28-3 29-4 30-2 31-1 32-2 33-2 34-3 35-2 36-2 37-2 38-3 39-2.

☐ EXPLORERS :

1-3 2-1 3-3 4-1 5-2

ΦΦ TEACHING TASK-2 :

1-2 2-2 3-4 4-1,2,3,4 5-1 6-2 7-2 8-1 9-5,3,4,2

ΦΦ LEARNER'STASK - 2 :

10-3 11-1 12-1 13-2 14-4 15-3 16-1,2 17-2 18-1,2,3,4,5,6 19-4 20-2, 21-2

☐ RESEARCHERS :

1-1 2-4 3-2 4-1 5-4 6-2 7-1