Carbon & Its Compounds
Homologous Series

❖ HOMOLOGOUS SERIES

A homologous series may, thus, be defined as a group of structurally similar compounds each member of which differs from the proceeding or succeeding, member by CH_2. The members of a series are called **homologous**.

➢ **Characteristics of Homologous Series**

(i) All members of a particular homologous series can be represented by the general formula. For example, alkane (C_nH_{2n+2}), alkenes (C_nH_{2n}) and alkynes (C_nH_{2n-2}).

(ii) Each member of the homologous series differs from the members above or below the series only by one CH_2 group.

(iii) The molecular weight of two adjacent members of a homologous series differs by 14
(i.e., $CH_2 = (12 \times 1) + (1 \times 2) = 14$).

(iv) All members of a homologous series can be prepared by the same general methods.

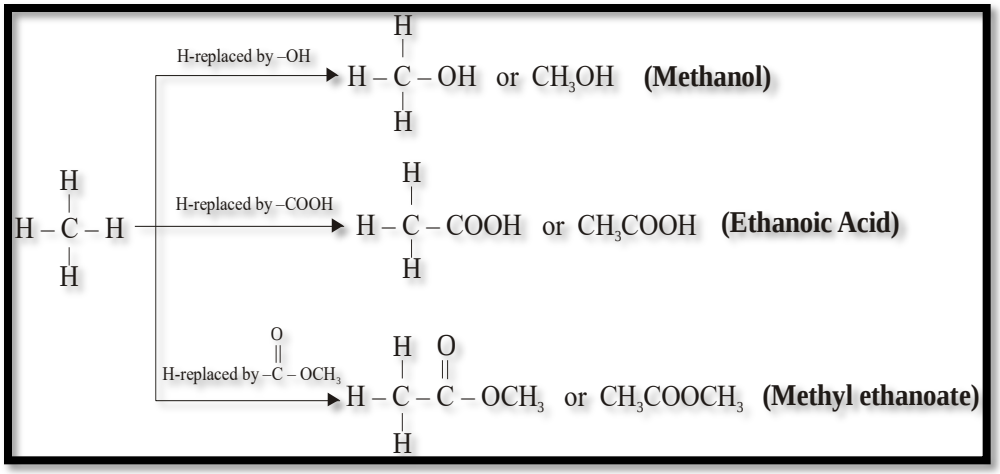
(v) All members of a homologous series have same chemical properties due to same functional group.

Illustration 1

Name some organic compounds with oxygen containing functional groups that have been derived from methane.

Solution

Methane (CH_4) is the simplest saturated hydrocarbon. When one hydrogen atom of methane is replaced by a functional group, a compound belonging to the characteristic family of the functional group is obtained. Various compounds containing different functional groups obtained from methane are given below



❖ NOMENCLATURE OF ORGANIC COMPOUND

Naming of organic compound is called nomenclature. There are two main systems of Nomenclature.

(1) TRIVIAL SYSTEM OR COMMON NAMES

These names were given after the source from which the organic compounds were first isolated.

- Acetic acid (CH_3COOH) got its name from acetum (means vinegar) because it is present in vinegar.
- Formic acid (HCOOH) got its name from formica (means red ant) because it is present in Red ant.
- Marsh gas (CH_4) got its name because it is obtained from marshy land.

S.N.	Organic Compound	Trivial Name	Source
1.	CH_3OH	Wood spirit or Methyl spirit	Obtained by destructive distillation of wood.
2.	NH_2CONH_2	Urea	Obtained from urine.
3.	CH_4	Marsh gas (Fire damp)	It was produced in marsh places.
4.	CH_3COOH	Vinegar	Obtained from Acetum - i.e., Vinegar.
5.		Oxalic acid	Obtained from oxalis plant.
6.	HCOOH	Formic acid	Obtained from formicus (Red ant)
7.	Lactic acid		Obtained from sour milk.

8.	Malic acid		Obtained from apples.
9.	$CH_3CH_2CH_2COOH$	Butyric acid	Obtained from butter.
10.	$CH_3(CH_2)_4COOH$	Caproic acid	Obtained from goats

(2) IUPAC NAME:

In order to solve the problem of naming of organic compounds, organisation called international chemical congress for the first time met at Geneva in 1892. They developed a certain system called Geneva system. Since then, the system of naming has been improved from time to time by the international union of pure and Applied chemistry and the new system is called IUPAC system of naming. This system of nomenclature was introduced in 1947. This latest IUPAC system is based on the recommendation made in 1993.

The IUPAC name of any organic compound can be derived by using the following rules. It mainly consists of three parts:

(i) Word Root

(ii) Suffix

(iii) Prefix

(i) Word Root: The number of carbon atoms present in the linear continuous chain (main chain or present chain) of the molecule is denoted by word Root.

It is generally indicated as 'alk'

Chain length	**Word Root (Alk)**
One carbon (C_1)	Meth
Two Carbon (C_2)	Eth
Three Carbon (C_3)	Prop
Four Carbon (C_4)	But
Five Carbon (C_5)	Pent
Six Carbon (C_6)	Hex
Seven Carbon (C_7)	Hept

Eight Carbon (C_8)	Oct
Nine Carbon (C_9)	Non
Ten Carbon (C_{10})	Dec
Eleven carbon (C_{11})	Undec
Twelve carbon (C_{12})	Dodec

(ii) Suffix: Suffixes are of two types: primary and secondary suffixes.

(a) Primary Suffix: Primary suffix is always added after the word root to indicate whether carbon chain is saturated or unsaturated.

Nature of Carbon Chain	Primary suffix	Name
(i) Saturated i.e. Contain C – C single covalent bond only	ane	Alkane
(ii) Unsaturated i.e. Contains at least one C = C double covalent bond	ene	Alkene
(iii) Unsaturated i.e. Contain at least one C ≡ C triple covalent bond	yne	Alkyne

(b) Secondary Suffix: Secondary suffix is added after primary suffix to indicate the presence of particular functional group in the carbon chain. While adding secondary suffix to the primary suffix, the terminal 'e' of the primary suffix (i.e. ane, ene, yne) is dropped if secondary suffix begins with vowels **(a, e, i, o, u)** but it is retained if the secondary suffix begins with consonant.

Family	Functional Group	Secondary suffix	IUPAC Name
Alcohol	—O—H	—ol	Alkane-ol= Alkanol
Aldehyde	—al	Alkane-al = Alkanal	
Ketone	—one	Alkane-one = Alkanone	Carboxylic
acid	—oic acid	Alkane-oic acid = Alkanoic acid	
Amine	$-NH_2$	—amine	Alkane-amine = Alkanamine
Amide	–amide	Alkane-amide = Alkanamide	
Cyanides	—C ≡ N	—nitrile	Alkane + nitrile = Alkane nitrile
Ester	Alkyl-oate	Alkyl/ Alkane-oate =	Alkyl alkanoate

Ex.

Linear Continuous Chain :

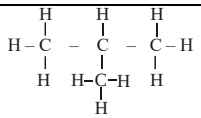
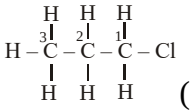
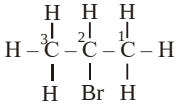
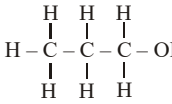
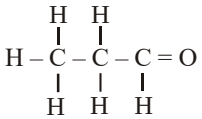
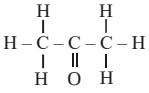
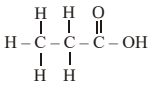
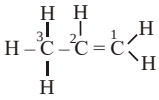
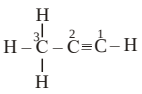
Family - Carboxylic acid; Word Root = 4, Carbon atom i.e. '**But**' primary Suffix - '**ane**'.

Functional group i.e. secondary suffix = oic acid

Hence name is, But + ane + oic acid = Butanoic acid

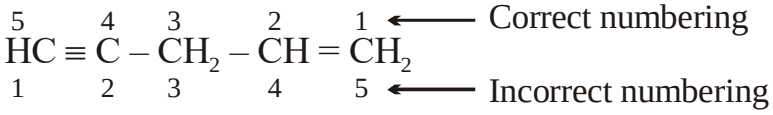
Groups given below does not have any Suffix :

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

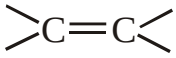
S.N.	Functional group	Prefix / Suffix	Example
1.	Alkyl group (as a side chain)	Prefix-Alkyl	 (Methylpropane)
2.	Halogen	Prefix – chloro, bromo etc.	 (1-Chloropropane)
			 (2-Bromopropane)
3.	Alcohol	Suffix - ol	 (Propan-1-ol)
4.	Aldehyde	Suffix - al	 (Propanal)
5.	Ketone	Suffix - one	 (Propanone)
6.	Carboxylic acid	Suffix - oic acid	 (Propanoic acid)
7.	Double bond (alkenes)	Suffix - ene	 (Prop-1-ene)
8.	Triple bond (alkynes)	Suffix - yne	 (Prop-1-yne)

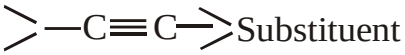
If both double and triple bonds are present, the double bond is always, given preference over the triple bond.

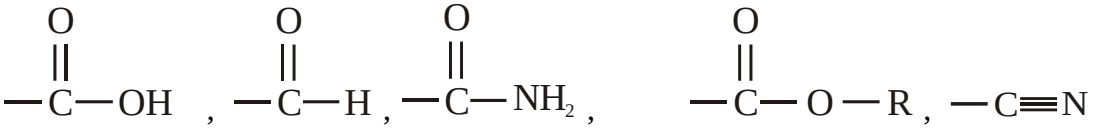
For example,



Priority order :





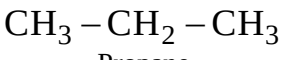
Note: 

Functional group containing carbon always get number one during carbon chain numbering, hence their location is not require to write in the IUPAC name.

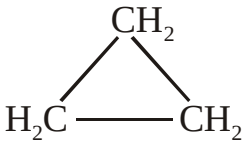
(iii) ***Prefix:*** Prefix is added before word root to indicate side chains or substituents group present in the linear carbon chain of the molecule.

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

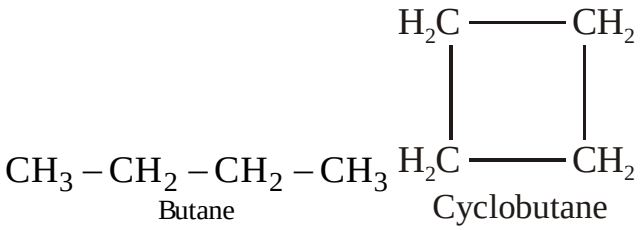
For example,



Propane



Cyclopropane



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

Group	**Secondary Prefix**
—F	Fluoro
— Cl	Chloro
—Br	Bromo
—I	Iodo
$—NO_2$	Nitro
—O—R [R(CH_3,C_2H_5 etc.)]	Alkoxy (methoxy (O-CH_3) Ethoxy (O-C_2H_5)
R — (CH_3, —C_2H_5)	Alkyl [methyl (CH_3), Ethyl (C_2H_5)]
—NO	Nitroso
—C_6H_5	Phenyl