

10. ORGANIC CHEMISTRY

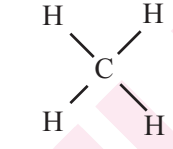
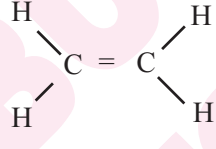
1VSAQ + 1LAQ =10 Marks

DETAILED SYNOPSIS

1.0 The compounds of carbon and hydrogen are known as **Hydrocarbons**. Organic chemistry mainly deals with the study of Carbon compounds containing Hydrocarbons & their derivatives.

There are three major reasons for the existence of millions of carbon compounds. They are (i) Tetravalency (ii)Catenation (iii) Isomerism of carbon.

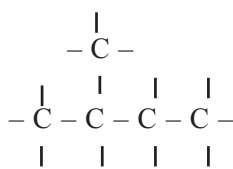
1.1 Tetravalency: The valency of carbon is 4 . Hence , every carbon atom always tends to form 4 bonds with other atoms. Also, between any two carbon atoms 3 types of bonds are possible.

S.No	Name Type	Examples	Structure Hybridisation	Bond angle bond length	Remarks
1)	Single bond C – C 1 σ bond	Methane CH_4 Ethane C_2H_6	 SP^3 – Tetrahedral	$109^\circ 28'$ $1.54 \text{ \AA}$	Saturated compound and Stable
2)	Double bond C = C 1 σ & 1 π bond	Ethene C_2H_4 Propene C_3H_6	 SP^2 – Trigonal planar	120° $1.34 \text{ \AA}$	Unsaturated compound and Active
3)	Triple bond C $\equiv$ C 1 σ & 2 π bonds	Ethyne C_2H_2	$\text{H} - \text{C} \equiv \text{C} - \text{H}$ SP – Linear	180° $1.20 \text{ \AA}$	Unsaturated compound and Active

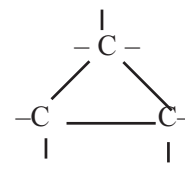
1.2 Catenation: Formation of long chains or rings by the linking of similar atoms is called Catenation. Carbon atom has very high catenation power, due to its high C–C bond dissociation energy. Carbons form 3 types of chains. They are (i) Straight chains (ii) Branched chains (iii) Ring structures



Straight Chain



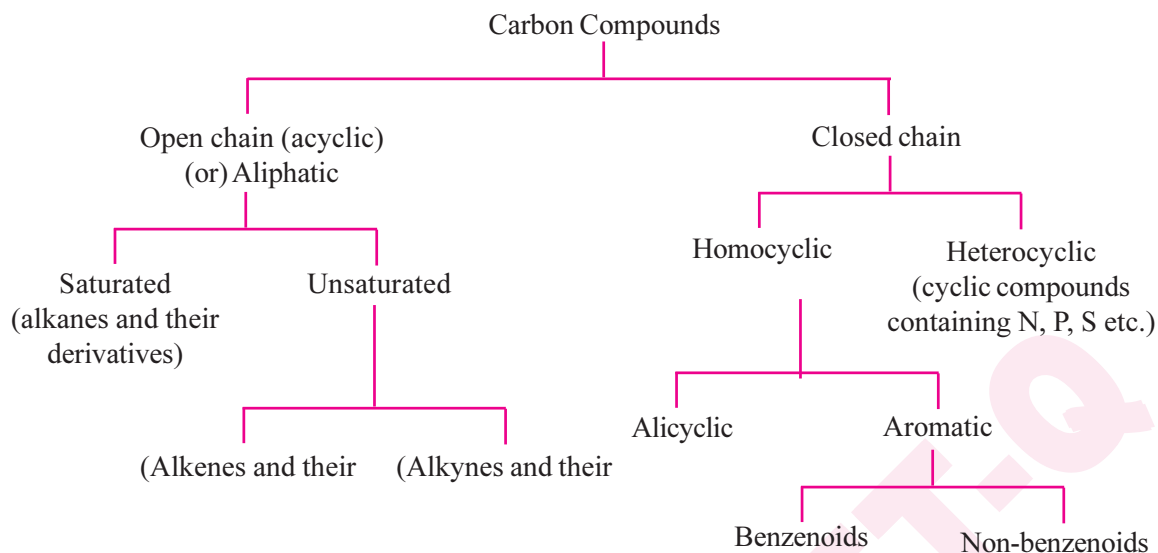
Branched Chain



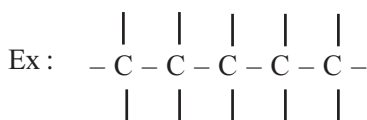
Ring Structure

1.3 Isomerism : Compounds having same molecular formula, but different structures are called isomers and the phenomenon is called isomerism.

In this chapter, we mainly study (i) Classification of Hydrocarbons (ii) Nomenclature of Organic compounds (iii) Isomerism (iv) Types of Organic reactions (v) Alkanes, Alkenes, Alkynes and Benzene-Preparation and Properties (vi) Some other concepts.

2. CLASSIFICATION OF CARBON COMPOUNDS- ON THE BASIS OF 'CARBON CHAIN STRUCTURES'**I. Open chain compounds**

These have straight or branched chains

**1.1 Saturated compounds :**

These compounds contain single bonds.

These are very saturated and stable.

Ex : Methane, Ethane

1.2 Unsaturated compounds:

These compounds contain double or triple bonds. These are unsaturated and hence very active.

Ex : Ethene, Ethyne

1.3 Alkenes:

These compounds contain double bonds.

Ex : Ethene, Propene

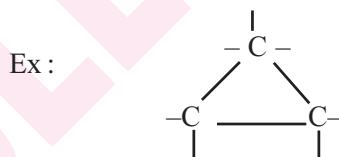
1.4 Alkynes :

These compounds contain triple bonds.

Ex : Ethyne , Butyne

II. Closed chain compounds

These compounds have ring structures.

**2.1 Homocyclic compounds:**

Only carbon atoms are present in the rings.

2.2 Heterocyclic compounds:

Other than carbon atoms are also present in rings.

2.3 Alicyclic compounds :

Cycloalkanes, Cycloalkenes, Cycloalkynes

2.4 Aromatic compounds :

'Aroma' means 'pleasant odour'. According to Huckel's rule planar ring structures with $(4n+2) \pi$ electrons are called aromatic compounds.

Majority of these compounds contain benzene rings.

2.5 Benzenoids:

These compounds contain benzene rings, which are very unstable.

2.6 Non-Benzenoids:

These aromatic compounds do not contain benzene rings.

3.0 Important concepts

3.1 Homologous series: A series of compounds having similar chemical properties, with successive compounds differing by a ' $-\text{CH}_2$ ' group, is called a homologous series.

A particular group of a homologous series is called **homologue**. **Ex:** Alkanes, Alkenes, Alkynes

Characteristics of homologous series :

- 1) All the homologues of a given series can be represented by a general formula.
- 2) The chemical properties of homologues are almost similar.
- 3) Homologues show a regular gradation in their physical properties.
- 4) Homologues have same general methods of preparation.

3.2 Alkanes, Alkenes, Alkynes:

Alkanes : Alkanes are saturated hydrocarbons with general formula $\text{C}_n\text{H}_{2n+2}$.

Ex: : Methane CH_4 , Ethane C_2H_6 .

Alkenes : Alkenes are unsaturated hydrocarbons having general formula C_nH_{2n} .

Ex : Ethene C_2H_4 , Propene C_3H_6 .

Alkenes mainly participate in addition reactions.

Alkynes: Alkynes are unsaturated hydrocarbons having general formula $\text{C}_n\text{H}_{2n-2}$.

Ex : Ethyne (or) acetylene C_2H_2 , Propyne C_3H_4 .

Note: Cycloalkanes: Cyclo alkanes are cyclic hydrocarbons having general formula C_nH_{2n} .

3.3 Functional group: An 'atom' or a 'group of atoms', which is responsible for the **characteristic** properties of an organic compound, is called functional group.

Functional groups play 'more reactive part' in chemical properties of organic compounds.

Organic compounds (different) with **same functional group** exhibit **similar properties**.

The Functional group $-\text{OH}$ is called **Hydroxyl group** (or) **Alcoholic group**.

The Functional group $-\text{CHO}$ is called **Aldehyde group**.

The Functional group $-\text{CO}$ is called **Ketone group**.

The Functional group $-\text{NO}_2$ is called **Nitro group**.

The Functional group $-\text{NH}_2$ is called **Amino group**.

The Functional group $-\text{Cl}$, $-\text{Br}$ etc is called **Halogen group**.

The Functional groups are classified into 2 types.

i) **Principal functional groups :** Esters, Carboxylic acids, Aldehydes, Ketones, Alcohols ..

Note: The functional groups are given 'a priority order' for Nomenclature, in case of compounds containing poly functional groups

ii) **Secondary functional groups :** Amines, Halides, Cyanides ,Nitro compounds etc.,

Note: These are to follow the **alphabetical** order , for Nomenclature.

3.4 Alkyl group : The group which is formed by removing one H atom from an **Alkane** molecule is called **Alkyl group**. Its general formula is $\text{C}_n\text{H}_{2n+1}$. Alkyl group is generally denoted by **-R**

Note : Alkane $-\text{H} = \text{Alkyl}$

Ex1: $\text{CH}_4 - \text{H} = -\text{CH}_3$
Methane Methyl

Ex2: $\text{C}_2\text{H}_6 - \text{H} = -\text{C}_2\text{H}_5$
Ethane Ethyl.

3.5 Substituent : An atom or group used to replace another atom or group in organic compounds is called a substituent.

4. Classification of organic compounds based on functional groups

Class	Functional group	General formula	Example	Common name	IUPAC name
Alkanes	C – C	$C_n H_{2n+2}$	CH_4 C_2H_6	Methane Ethane	Methane Ethane
Alkenes	C=C	$C_n H_{2n}$	$CH_2 = CH_2$	Ethylene	Ethene
Alkynes	C≡C	$C_n H_{2n-2}$	$H-C\equiv C-H$	Acetylene	Ethyne
Alkyl halides	-X	R-X	C_2H_5Cl	Ethyl chloride	Chloroethane
Alcohols (or) Alkanols	-OH	R-OH	CH_3OH CH_3CH_2OH $CH_3CH_2CH_2OH$ C_4H_9OH	Methyl alcohol Ethyl alcohol Propyl alcohol Butyl alcohol	Methanol Ethanol Propanol Butanol
Ethers (or) Alkoxyalkanes	-O-	R-O-R	CH_3-O-CH_3 $C_2H_5-O-C_2H_5$	Dimethyl ether Di ethyl ether	Methoxy methane Ethoxyethane
Aldehydes (or) Alkanals	-CHO	R-CHO	$HCHO$ CH_3CHO	Formaldehyde Acetaldehyde	Methanal Ethanal
Ketones (or) Alkanones	$\begin{array}{c} O \\ \\ -C- \end{array}$	$\begin{array}{c} O \\ \\ R-C-R \end{array}$	$CH_3-CO-CH_3$ $CH_3-CO-C_2H_5$	Acetone Ethyl methyl ketone	Propanone Butanone
Acids (or) Alkanoic acids	-COOH	R-COOH	$HCOOH$ CH_3COOH C_2H_5COOH C_3H_7COOH	Formic acid Acetic acid Propionic acid Butyric acid	Methanoic acid Ethanoic acid Propanoic acid Butanoic acid
Esters (or) Alkyl alkanoates	-COO-	R-COO-R	$HCOOCH_3$ CH_3COOCH_3 $C_2H_5COOC_2H_5$	Methyl formate Methyl acetate Ethyl acetate	Methyl methanoate Methyl ethanoate Ethyl propanoate
Amines (or) Amino alkanes	-NH ₂	R-NH ₂	CH_3-NH_2	Methyl amine	Amino methane
Cyanides	-CN	R-CN	CH_3CN	Methyl cyanide	Ethane nitrile
Isocyanides	-N=C	R-N=C	CH_3NC	Methyl iso cyanide	Methyl carbylamine

5.0 IUPAC SYSTEM OF NOMENCLATURE

Naming of organic compounds using certain rules prescribed by IUPAC (International Union of Pure and Applied Chemistry) is called IUPAC system of nomenclature:

5.1 Naming of straight chain hydro carbons .

(i) **Root word** : This denotes the number of carbon atoms present in the parent carbon chain.

No. of carbons	1	2	3	4	5	6	7	8	9	10
Root word	Meth	Eth	Prop	But	Pent	Hex	Hept	Oct	Non	Dec

(ii) **Suffix** : A suffix comes after the root word. It denotes the nature of carbon chain or functional group of the compound. Suffix may be i) Primary suffix ii) Secondary suffix

Primary Suffix (P.S) : This denotes whether the compound is saturated (or) unsaturated.

(a) For saturated compounds with C-C bonds the P.S is 'ane'

Ex : $\text{H}_3\text{C}-\text{CH}_3$, (C_2H_6) ; Eth + ane = Ethane.

(b) For unsaturated compounds with C=C bonds, the P.S is 'ene'

Ex : $\text{H}_2\text{C}=\text{CH}_2$, (C_2H_4) ; Eth + ene = Ethene.

(c) For unsaturated compounds with C $\equiv$ C bonds, the P.S is 'yne'.

Ex : $\text{HC}\equiv\text{CH}$, (C_2H_2) ; Eth + yne = Ethyne.

S.No.	Group	Molecule	Root word	Primary suffix	IUPAC name
1	Alkane	CH_4	Meth -	- ane	Methane
2	Alkane	C_2H_6	Eth -	- ane	Ethane
3	Alkene	C_3H_6	Prop -	- ene	Propene
4	Alkene	C_4H_8	But -	- ene	Butene
5	Alkyne	C_5H_8	Pent -	- yne	Pentyne
6	Alkyne	C_6H_{10}	Hex -	- yne	Hexyne

5.2 Naming of simple compounds containing Functional groups.

Here, we use Secondary Suffix (S.S)

Secondary Suffix (S.S): This denotes the nature of functional group present in the compound. Naming of simple compounds containing 'one functional group' can be derived from the name of an 'Alkane'. Here 'e' in alkane is replaced by appropriate secondary suffix.

Thus, Alkane $\Rightarrow$ Alkanol; Alkanal; Alkanone; Alkanoic Alkanoate

Ex1: Alkanol / Alcohol ($-\text{OH}$) $\Rightarrow$ CH_3OH Methanol, $\text{C}_2\text{H}_5\text{OH}$ Ethanol, $\text{C}_3\text{H}_7\text{OH}$ Propanol

Ex2: Alkanoic / Acid ($-\text{COOH}$) $\Rightarrow$ HCOOH Methanoic acid, CH_3COOH Ethanoic acid, $\text{C}_2\text{H}_5\text{COOH}$ Propanoic acid, $\text{C}_3\text{H}_7\text{COOH}$ Butanoic acid

Note: The following 'priority order' has to be followed, for nomenclature, in case of compounds containing poly 'primary functional groups'.

Priority order : Esters, Carboxylic acids, Aldehydes, Ketones, Alcohols ..

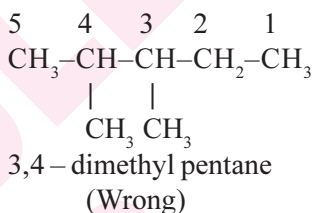
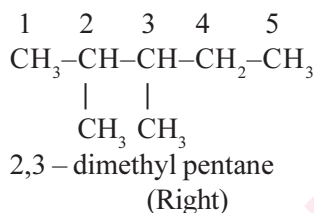
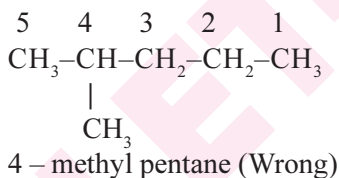
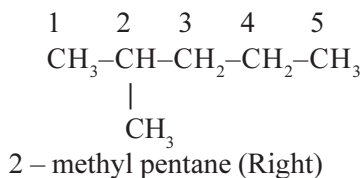
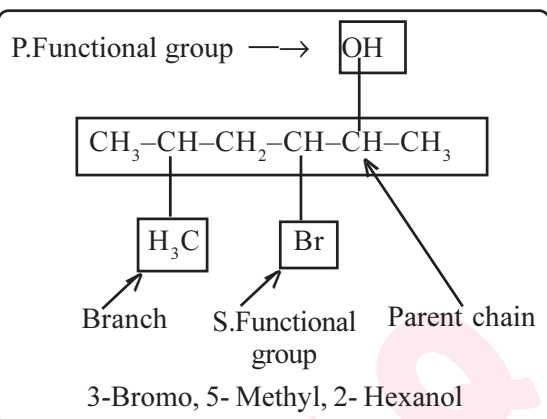
In case of **Secondary functional groups**, the **alphabetical** order has to be followed.

Ex : Amine ($-\text{NH}_2$), Halo - X [$-\text{Br}$ bromo, $-\text{Cl}$ chloro, $-\text{F}$ Fluoro etc],

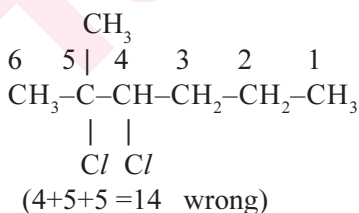
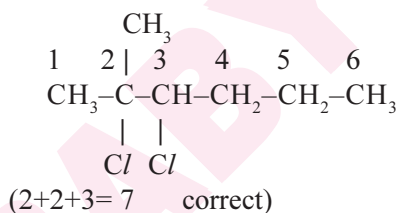
Cyano - CN (Nitrile), Isocyano - NC (Carbyl amine), Nitro - NO_2

5.3 Nomenclature for Branched chain Hydro carbons – Rules / Steps

- First of all, longest possible continuous chain of carbon atoms has to be identified. It is called **main chain** (or) **parent chain**.
- Identify the branches on the main chain, like functional group (or) alkyl substituents.
- If more than one **similar** substituents (or) functional groups are present then numerical prefixes like di (for 2), tri (for 3) etc are to be used.
- Numbering to Carbon atoms :** The carbon atoms of main chain are given numbers such that the substituents should get lowest possible number.



- Lowest sum rule :** On main chain the numbers are given to carbon atoms (barring substituents) from left to right (or) right to left, such that 'on adding numbers of carbons', it should give the lowest sum possible.



- Multiple bonds rule:** If the chain contains multiple bonds then priority should be given to a **double bond** for assigning lowest number.

5.4 Nomenclature of Cyclic compounds or groups with Secondary Functional group.

Prefix: A prefix comes before the root word of a cyclic compound or complex compound.

- A primary prefix is used for cyclic compounds [Begins with *cyclo*]
- A secondary prefix is used to represent substituent (Secondary functional group in alphabetical order)

The **sequence** of Nomenclature: **Prefix + Rootword + Suffix**

5.5 Few more Common Groups:

Primary, secondary..... 1) A carbon attached to one more carbon is called primary carbon (1^0)	EXAMPLES $\begin{array}{c} 1^0 \quad 1^0 \\ \text{CH}_3 - \text{CH}_3 \end{array}$
2) A carbon attached to two more carbons is called secondary carbon (2^0)	$\begin{array}{c} 1^0 \quad 2^0 \quad 1^0 \\ \text{CH}_3 - \text{CH}_2 - \text{CH}_3 \end{array}$
3) A carbon attached to three more carbons is called tertiary carbon (3^0)	$\begin{array}{c} 3^0 \\ \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_3 \\ \\ \text{CH}_3 \end{array}$
4) A carbon attached to 4 other carbons is called quaternary carbon (4^0).	$\begin{array}{c} \text{CH}_3 \\ \quad 4^0 \\ \text{CH}_3 - \text{CH} - \text{C} - \text{CH}_3 \\ \quad \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$
5) Isopropyl group $\begin{array}{c} \text{CH}_3 \quad \diagdown \\ \quad \quad \text{CH} - \\ \diagup \quad \quad \\ \text{CH}_3 \end{array}$	$\begin{array}{c} \text{CH}_3 \quad \diagdown \\ \quad \quad \text{CH} - \text{OH} \\ \diagup \quad \quad \\ \text{CH}_3 \end{array}$ Isopropyl alcohol (2 – propanol) $\begin{array}{c} \text{CH}_3 \quad \diagdown \\ \quad \quad \text{CH} - \text{CH}_3 \\ \diagup \quad \quad \\ \text{CH}_3 \end{array}$ Isobutane (2 – methyl propane)
6)Neo pentyl group $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} - \text{CH}_2 - \\ \\ \text{CH}_3 \end{array}$	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} - \text{CH}_2 - \text{Cl} \\ \\ \text{CH}_3 \end{array}$ Neopentyl chloride (2,2 – dimethyl – 1– chloro propane)
7) SKELTON STRUCTURES 	$\begin{array}{c} \text{CH}_3 - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_3 \\ \\ \text{CH}_3 \end{array}$ 3 – methyl pentane.
	$\begin{array}{c} \text{CH}_3 - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_3 \\ \\ \text{CH} \\ / \quad \backslash \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$ 3 – ethyl – 2 – methyl pentane.

5.6 NOMENCLATURE -I: STRUCTURAL Formulae to IUPAC names

Structural formula	IUPAC name
1) $ \begin{array}{ccccccc} 7 & 6 & 5 & 4 & 3 & 2 & 1 \\ \text{CH}_3 - & \text{CH}_2 - & \text{CH} - & \text{CH} = & \text{CH} - & \text{CH} - & \text{CH}_3 \\ & & & & & & \\ & & \text{I} & & & \text{Cl} & \end{array} $	2-chloro-5-iodo-hept-3-ene.
2) $ \begin{array}{cc} \text{CH}_2 - & \text{CH}_2 \\ & \\ \text{OH} & \text{OH} \end{array} $	Ethane-1,2-diol.
3) $ \begin{array}{ccc} 3 & 2 & 1 \\ \text{CH}_2 - & \text{CH} - & \text{COOH} \\ & & \\ \text{OH} & \text{NH}_2 & \end{array} $	2-Amino-3-hydroxy propanoic acid.
4) $ \begin{array}{ccccccc} & & \text{CH}_3 & & & & \\ & & & & & & \\ 5 & 4 & 3 & 2 & 1 & & \\ \text{CH}_3 - & \text{C} - & \text{CH} = & \text{CH} - & \text{CHO} \\ & & & & & & \\ & \text{CH}_3 & & & & & \end{array} $	4,4-dimethyl pent-2-enal.
5) $ \begin{array}{ccccccc} 6 & 5 & 4 & 3 & 2 & 1 \\ \text{CH}_3 - & \text{CH} = & \text{CH} - & \text{CH}_2 - & \text{C} - & \text{CH}_3 \\ & & & & & \\ & & & & \text{O} & \end{array} $	2-Hexanone-4-ene. (or) Hex-4-en-2-one
6) $ \begin{array}{ccccccc} 6 & 5 & 4 & 3 & 2 & 1 \\ \text{CH}_3 - & \text{CH} - & \text{CH} - & \text{CH}_2 - & \text{CH} - & \text{CH}_3 \\ & & & & & \\ & \text{CH}_3 & \text{C}_2\text{H}_5 & & \text{OH} & \end{array} $	4-ethyl-5-methyl-2-hexanol.
7) $ \begin{array}{ccccccc} & & \text{CH}_3 & & & & \\ & & & & & & \\ 6 & 5 & 4 & 3 & 2 & 1 \\ \text{CH} \equiv & \text{C} - & \text{C} - & \text{CH}_2 - & \text{CH} = & \text{CH}_2 \\ & & & & & \\ & & \text{CH}_3 & & & \end{array} $	4,4-dimethyl-hex-1-en-5-yne.
8) $ \begin{array}{ccc} & \text{NO}_2 & \\ & & \\ \text{CH}_3 - & \text{C} - & \text{CH}_2 \\ & & \\ & \text{Cl} & \text{NH}_2 \end{array} $	2-chloro-2-nitro propanamine.

5.7 NOMENCLATURE -II: IUPAC names to STRUCTURAL formulae

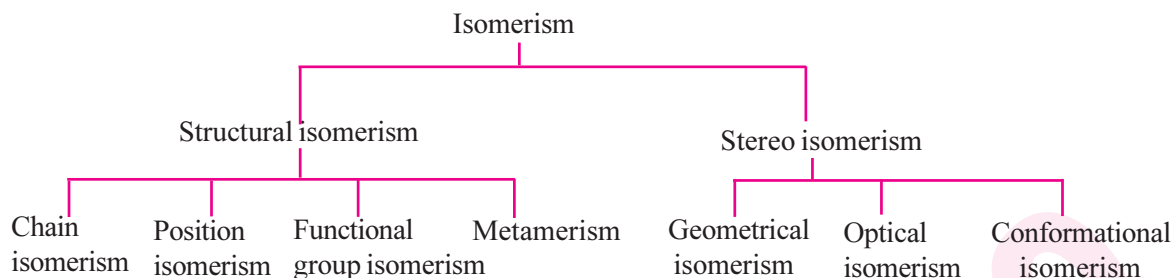
IUPAC name	Structural formula
1) 2,3 - dimethylhexane	$ \begin{array}{ccccccc} & \text{CH}_3 & \text{CH}_3 & & & & \\ & & & & & & \\ \text{CH}_3 & -\text{CH} & -\text{CH} & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_3 \end{array} $
2) 1-propyne	$\text{CH}_3-\text{C}\equiv\text{CH}$
3) 2,2 -dichloro -3-methylheptane	$ \begin{array}{ccccccc} & \text{Cl} & & & & & \\ & & & & & & \\ \text{CH}_3 & -\text{C} & -\text{CH} & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_3 \\ & & & & & & \\ & \text{Cl} & \text{CH}_3 & & & & \end{array} $
4) 3,4 - dichloro - 2,2 dimethyl heptane	$ \begin{array}{ccccccc} & \text{CH}_3 & & & & & \\ & & & & & & \\ \text{CH}_3 & -\text{C} & -\text{CH} & -\text{CH} & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_3 \\ & & & & & & \\ & \text{CH}_3 & \text{Cl} & \text{Cl} & & & \end{array} $
5) 2-methyl-1-butene	$ \begin{array}{cccc} \text{CH}_3 & -\text{CH}_2 & -\text{C} & =\text{CH}_2 \\ & & & \\ & & \text{CH}_3 & \end{array} $
6) 4-ethyl-3-methylheptane	$ \begin{array}{ccccccc} \text{CH}_3 & -\text{CH}_2 & -\text{CH} & -\text{CH} & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_3 \\ & & & & & & \\ & & \text{CH}_3 & \text{C}_2\text{H}_5 & & & \end{array} $
7) 3,4-dimethylhexane	$ \begin{array}{ccccccc} \text{CH}_3 & -\text{CH}_2 & -\text{CH} & -\text{CH} & -\text{CH}_2 & -\text{CH}_3 \\ & & & & & \\ & & \text{CH}_3 & \text{CH}_3 & & \end{array} $
8) 3-chloro - 4 - methylhexane	$ \begin{array}{ccccccc} \text{CH}_3 & -\text{CH}_2 & -\text{CH} & -\text{CH} & -\text{CH}_2 & -\text{CH}_3 \\ & & & & & \\ & & \text{Cl} & \text{CH}_3 & & \end{array} $
9) 2,3,5 - trimethylhexanoicacid	$ \begin{array}{ccccccc} \text{CH}_3 & -\text{CH} & -\text{CH}_2 & -\text{CH} & -\text{CH} & -\text{COOH} \\ & & & & & \\ & \text{CH}_3 & & \text{CH}_3 & \text{CH}_3 & \end{array} $
10) 5-ethyl-2,6-dimethyl-3-heptanone	$ \begin{array}{ccccccc} & \text{O} & & & \text{CH}_3 & & \\ & & & & & & \\ \text{CH}_3 & -\text{CH} & -\text{C} & -\text{CH}_2 & -\text{CH} & -\text{CH} & -\text{CH}_3 \\ & & & & & & \\ & \text{CH}_3 & & & \text{C}_2\text{H}_5 & & \end{array} $

5.8 PRACTICE SET of IUPAC names

Structural formula	Structural formula
1) $\begin{array}{ccccccc} & 5 & 4 & 3 & 2 & 1 & \\ & \text{CH}_3 & -\text{CH} & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_2 & -\text{OH} \\ & & & & & & \\ & \text{CH}_3 & & & & & \end{array}$ Name : 4-Methyl pentan-1-ol	9) $\begin{array}{ccccccc} & 2 & 3 & 4 & & & \\ & \text{CH}_3 & -\text{CH} & -\text{CH}_2 & -\text{CH}_3 & & \\ & & & & & & \\ & \text{CH}_2\text{OH} & & & & & \end{array}$ Name : 2-Methyl butan-1-ol
2) $\begin{array}{ccccccc} & 3 & 2 & 1 & & & \\ & \text{CH}_3 & -\text{CH} & -\text{CH}_2 & -\text{OH} & & \\ & & & & & & \\ & \text{Br} & & & & & \end{array}$ Name :2- Bromopropan-1-ol	10) $\begin{array}{ccccccc} & & & & & & \\ & \text{CH}_3 & -\text{CH} & -\text{CH}_3 & & & \\ & & & & & & \\ & \text{CH}_3 & & & & & \end{array}$ Name :2 Methyl propane
3) $\begin{array}{ccccccc} & 4 & 3 & 2 & & & \\ & \text{CH}_3 & -\text{CH}_2 & -\text{CH} & -\text{NH}_2 & & \\ & & & & & & \\ & & & \text{CH}_3 & & & \end{array}$ Name : Butan-2-amine	11) $\begin{array}{ccccccc} & & 3 & 4 & 5 & & \\ & & \text{CH}_3 & -\text{CH} & -\text{CH}_2 & -\text{CH}_3 & \\ & & & & & & \\ & & \text{CH}_2 & & & & \\ & & / \quad \backslash & & & & \\ & & \text{H}_3\text{C} \quad \text{CH}_3 & & & & \end{array}$ Name :2,3-dimethyl pentane
4) $\begin{array}{ccccccc} & & & & & & \\ & \text{CH}_3 & -\text{CH}_2 & -\text{CH} & =\text{CH}_2 & & \\ & 4 & 3 & 2 & 1 & & \end{array}$ Name :1-Butene	12) $\begin{array}{ccccccc} & & 1 & & & & \\ & & \text{CH}_3 & & & & \\ & 3 & & & & & \\ & \text{CH}_3 & -\text{C} & -\text{CH}_3 & & & \\ & & & & & & \\ & & \text{OH} & & & & \end{array}$ Name :2-Methyl propan-1-ol
5) $\begin{array}{ccccccc} & 4 & 3 & 2 & 1 & & \\ & \text{CH}_3 & -\text{CH}(\text{CH}_3) & -\text{CH}_2 & -\text{CH}_2 & -\text{Cl} & \end{array}$ Name :3-Methyl 1-chloro butane	13) $\begin{array}{ccccccc} & & & & \text{H} & & \\ & & & & & & \\ & 4 & 3 & 2 & 1 & & \\ & \text{H}_3\text{C} & -\text{CH}_2 & -\text{CH} & -\text{C} = \text{O} & & \\ & & & & & & \\ & & & \text{C}_2\text{H}_5 & & & \end{array}$ Name :2-Ethyl butanal
6) $\begin{array}{ccccccc} & 6 & 5 & 4 & 3 & 2 & 1 \\ & \text{CH}_3 & -\text{CH} & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_2 & -\text{COOH} \\ & & & & & & \\ & \text{CH}_3 & & & & & \end{array}$ Name :5-Methyl hexanoic acid	14) $\begin{array}{ccccccc} & 5 & 4 & 3 & 2 & 1 & \\ & \text{CH}_3 & -\text{CH}_2 & -\text{CH} & =\text{CH} & -\text{CH}_3 & \end{array}$ Name :Pent-2-ene
7) $\begin{array}{ccccccc} & & & \text{CH}_3 & & & \\ & & & & & & \\ & 1 & 2 & 3 & 4 & 5 & 6 \\ & \text{CH}_3 & -\text{CH}_2 & -\text{C} & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_3 \\ & & & & & & \\ & & & \text{CH}_3 & & & \end{array}$ Name :3,3-dimethyl hexane	15) $\begin{array}{ccccccc} & 3 & 2 & 1 & & & \\ & \text{CH}_3 & -\text{CH}_2 & -\text{COOH} & & & \end{array}$ Name :Propanoic acid
8) CH_3CHO Name :Ethanal	

6.0 Isomerism : Compounds having same molecular formula but different structures/properties are called isomers. This phenomenon is called isomerism.

6.1 TYPES OF ISOMERISMS



6.2 ISOMERISMS – DEFINITIONS, PROPERTIES

Structural isomerism	Stereo isomerism
This isomerism arises due to difference in arrangement of atoms (or) groups in a molecule. These isomers differ in physical and chemical properties. Separation of these isomers in a mixture is easy. 1.1 Chain isomerism : This isomerism arises due to difference in the lengths of carbon chains 1.2 Position isomerism : This isomerism arises due to difference in the position of functional group/ substituent 1.3 Functional group isomerism : This isomerism arises due to difference in the nature / type of functional group 1.4 Metamerism : This isomerism arises due to difference in the nature / type of alkyl groups attached to the same functional group.	This isomerism arises due to difference in spacial arrangement of atoms (or) groups around carbons. These isomers differ in physical properties. Most of chemical properties are same. Separation of these isomers in a mixture is difficult. 2.1 Geometrical isomerism : This isomerism is generally observed in alkenes ($C=C$). This isomerism arises due to difference in spatial arrangement of atoms (or) groups around a $C=C$ bond or a ring structure 2.2 Optical isomerism: This isomerism arises due to the rotation of plane polarised light (light particles vibrate in only one plane). Here, two isomers are mirror images to each other. 2.3 Conformational isomerism : This isomerism arises due to the rotation of $C-C$ bond in alkanes.

6.3 STRUCTURAL ISOMERISMS – ILLUSTRATIONS

ISOMERISMS	ILLUSTRATIONS
1. Chain isomerism : Compounds having same molecular formula but differ in the length of carbon chain are called chain isomers and the phenomenon is called chain isomerism. Note : 4 or more carbons are required to form a chain isomerism.	Ex 1: $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ $\text{CH}_3 - \text{CH} - \text{CH}_3$ n – butane $\begin{array}{c} \\ \text{CH}_3 \end{array}$ Isobutane Ex 2: $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ (n – pentane) $\text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_3$ $$ CH_3 CH_3 $$ CH_3 (Isopentane) 2-methyl butane $\text{CH}_3 - \text{C} - \text{CH}_3$ $$ CH_3 (Neopentane) 2,2 - dimethyl propane
2. Position isomerism : Compounds having same molecular formula but differ in the position of functional group / substituent / double / triple bonds are called position isomers and the phenomenon is called position isomerism.	Ex1: $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH}_3$ $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$ 1 – butene 2 – butene Ex2: $\text{CH}_3 - \text{CH}_2 - \text{CH}_2$ $\text{CH}_3 - \text{CH} - \text{CH}_3$ $$ OH (n – propyl alcohol) 1 – propanol $$ OH (Isopropyl alcohol) 2 – propanol
3. Functional group isomerism: Compounds having same molecular formula but differ in nature of functional group are called functional isomers and the phenomenon is called functional isomerism.	Ex1: $\text{CH}_3 - \text{CH}_2 - \text{OH}$ $\text{CH}_3 - \text{O} - \text{CH}_3$ (Ethyl alcohol) Ethanol (Dimethyl ether) Methoxy methane Ex2: (i) $\text{CH}_3\text{CH}_2\text{CHO}$ (Acetaldehyde) propanal (ii) CH_3COCH_3 (Acetone) Propanone
4. Metamerism: Compounds having same molecular formula but differ in nature of alkyl groups attached to same functional group are called metamers and the phenomenon is called Metamerism.	Ex1: $\text{CH}_3 - \text{CH}_2 - \text{O} - \text{CH}_2 - \text{CH}_3$ Diethyl ether $\text{CH}_3 - \text{O} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ Methyl-n-propyl ether Ex2: $\text{CH}_3 - \text{CH}_2 - \text{NH} - \text{CH}_2 - \text{CH}_3$ Diethyl amine $\text{CH}_3 - \text{NH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ Methyl-n-propyl amine

Simple Synopsis Points at a Glance

1. Compounds containing only Carbon & Hydrogen atoms are known as **Hydro carbons**. Hydrocarbons & their derivatives are called **Organic compounds**
2. **Methods of purification of Organic compounds:**
(i) Crystallisation (ii) Sublimation
(iii) Distillation (Fractional, Steam, Reduced pressure distillation)
(iv) Solvent extraction (v) Chromotography techniques.
3. **Types of Organic reactions:** (i) Addition reaction (ii) Substitution reaction (iii) Elimination reaction
(iv) Molecular rearrangements
4. A series of compounds in which two successive compounds differ by a $-\text{CH}_2-$ group is called a **Homologous series**. **Ex:** Alkanes, Alkenes, Alkynes
5. **Alkanes** are saturated hydro carbons having C–C single bonds.
The general formula is $\text{C}_n\text{H}_{2n+2}$. **Ex:** CH_4 Methane, C_2H_6 Ethane
Alkanes are also known as Paraffins (Parafin means lack of ability).
Alkanes are stable and Inert towards many other substances.
Alkanes mainly participate in substitution reactions. **Ex :** Chlorination of ethane
6. **Alkenes** are unsaturated hydrocarbons having $\text{C}=\text{C}$ double bonds.
The general formula is C_nH_{2n} . **Ex :** C_2H_4 Ethene, C_3H_6 Propene
Alkenes are also known as Olefins. Alkenes are unstable and are active.
Alkenes mainly participate in addition reactions.
7. **Alkynes** are also unsaturated hydrocarbons having $\text{C}\equiv\text{C}$ triple bond
The general formula is $\text{C}_n\text{H}_{2n-2}$. **Ex:** C_2H_2 Ethyne, C_3H_4 Propyne
The hydrogens present on triple bonded carbons are acidic in nature.
Alkynes mainly participate in addition reactions.
8. **Cyclo alkanes** are cyclic hydrocarbons having general formula C_nH_{2n} .
Lower cyclo alkanes are unstable due to **Angle strain**.
Hence they participate in addition reactions which is due to cleavage of ring.
Higher cyclo alkanes are stable and participate in substitution reactions.
9. **Benzene** is **aromatic** hydrocarbon having formula C_6H_6 .
The structure of benzene is a **resonance hybrid** with 6 delocalised pi electrons.
The formula resembles unsaturated hydrocarbon. But unlike unsaturated hydrocarbons it participate in **electrophilic substitution** reactions rather than addition reactions.
This is because, **Benzene is stabilised due to resonance**.
Benzene is mainly extracted from **coal tar**.
10. Compounds with the same molecular formula but having different properties are called isomers and the phenomenon is called **Isomerism**.
11. Isomerism due to the difference in the nature of carbon chain is called **Chain isomerism**.
12. Isomerism due to the difference in the position of a substituent, a functional group or a multiple bond is called **Position isomerism**.

13. **Functional group isomerism** arises due to the difference in the nature of functional group.
14. Isomerism due to the difference in the number of the alkyl groups attached on either side of the same functional group is called **Metamerism**.
15. The replacement of H - atoms by halogen atoms is called **Halogenation**.
16. The replacement of H - atoms by a nitro group is called **Nitration**.
17. The replacement of H - atoms by a sulphonic acid group is called **Sulphonation**.
18. Replacement of H - atoms by an alkyl group is called **Alkylation**.
19. Elimination of halogen molecule is called **dehalogenation**.
20. Elimination of hydrogen and halogen atoms together is called **dehydrohalogenation**.
21. Addition of hydrogen is called **Hydrogenation**.
22. Removal of water molecule is called **dehydration**.
23. Alkyl magnesium halide is called **Grignard reagent**. Ex : $R Mg X$
24. Cold and dilute alkaline $KMnO_4$ solution is called **Baeyer's reagent**.
25. Alkyl halides on heating with sodium metal in presence of dry ether gives an alkane with twice the number of carbon atoms. This reaction is known as **Wurtz reaction**.
26. Electrolysis of a concentrated aqueous solution of sodium or potassium salt of carboxylic acid gives a hydrocarbon at anode. This reaction is called **Kolbe's electrolysis**.
27. Aromatic compounds are cyclic, planar and obey **Huckle's rule**.
28. A mixture of sodium hydroxide and calcium oxide is called **soda - lime**.
29. **Chromatography** is a method of separation of components of a mixture between a stationary phase and a mobile phase reagent.
30. Inductive effect is defined as the polarization of σ bond caused by the polarization of adjacent σ bond.
31. **Electromeric effect** is defined as the complete transfer of a shared pair of π electrons to one of the two atoms joined by a multiple bond on the demand of an attacking group.
32. The electron pair displacement caused by an atom or group along a chain by a conjugative mechanism is called the **mesomeric effect** of that atom or group.
33. **Hyperconjugation** is also called **no-bond resonance**.
34. **Elimination reaction** is one, in which two or more atoms or groups of a substrate are removed to form multiple bonds.
35. **Conformational isomers** of an alkane are obtained by rotation about C - C bond.
36. **Markownikoff's rule** : When HX adds to an unsymmetrical alkene, the halide (X) part of HX attaches itself to the double bonded carbon having less number of hydrogens.
37. Anti Markownikoff's addition takes place, in presence of a peroxide. This is called, **Kharsch effect**.
38. A substance which rotates the plane polarised light is called an '**optically active substance**'.
39. Organic compound exhibits optical activity when it is **chiral**.
40. The chiral molecule and its mirror image are **not superimposable**. They are called **enantiomers**.
41. Enantiomers are a pair of isomers which are non-super imposable mirror images of each other.

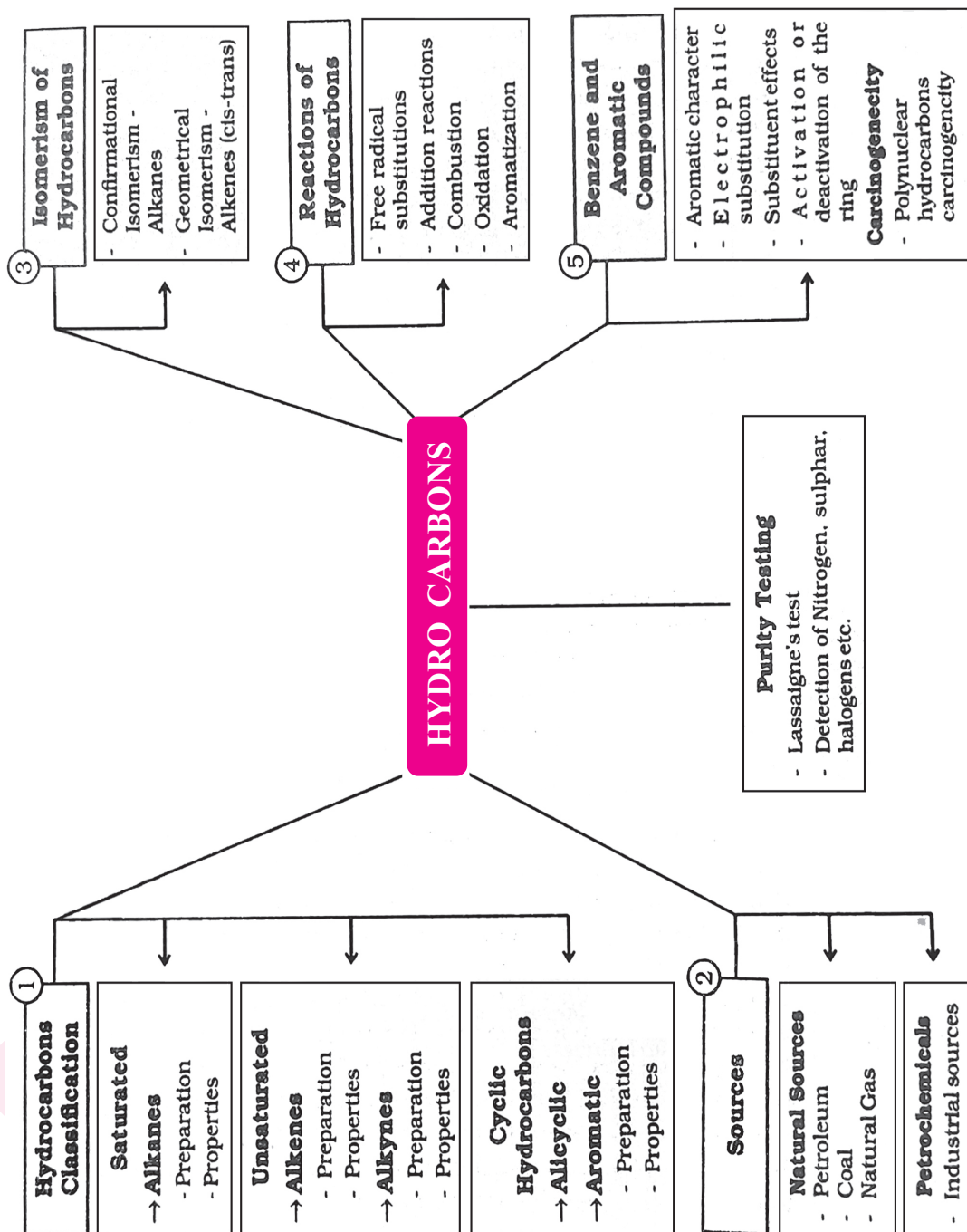
☛ For **Chem Beats** of this chapter Refer Page No.251 to 253

Prefix			Word root			Suffix				
Secondary prefix		Primary prefix	Continuous longest carbon chain		Primary suffix	Secondary prefix				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Number ↓ 1, 2, 3...	Numerical Designation ↓ Di Tri Tetra	Halide/ Alkyl/ secondary functional group Halide → Fluoro → Chloro → Bromo → Iodo - R-Alkyl → -CH ₃ - Methyl → -C ₂ H ₅ - Ethyl → -C ₃ H ₇ - Propyl	(Only for cyclic compounds) → Cyclo	Number of Carbons → 1 - Meth → 2 - Eth → 3 - Prop → 4 - But → 5 - Pent → 6 - Hex → 7 - Hept → 8 - Oct → 9 - Non → 10 - Dec	Number ↓ 1, 2, 3...	Numerical Designation ↓ Di Tri Tetra	Nature of Saturation ↓ C-C - ane C=C - ene C≡C - yne	Number ↓ 1, 2, 3...	Numerical Designation ↓ Di Tri Tetra	Functional Group ↓ - CH - Hydrocarbon - 'e' - OH - Alcohol - 'ol' - CHO - Aldehyde - 'al' - C=O - Ketone - 'one' - COOH - Carboxylic acid - 'oic acid' - NH ₂ - Amine - 'amine' - CONH ₂ - Amide - COOR - Ester - 'oate'

If functional groups as substituents

→ NO₂ - Nitro
 → NO - Nitroso
 → OR - Alkoxy
 → OH - Hydroxy
 → NH₂ - Amino
 → CHO - Formyl
 → C=O - Oxo
 → COOH - Carboxyl

CONCEPT MAP OF HYDROCARBONS



CONCEPT MAP OF BASIC PRINCIPLES OF ORGANIC COMPOUNDS

