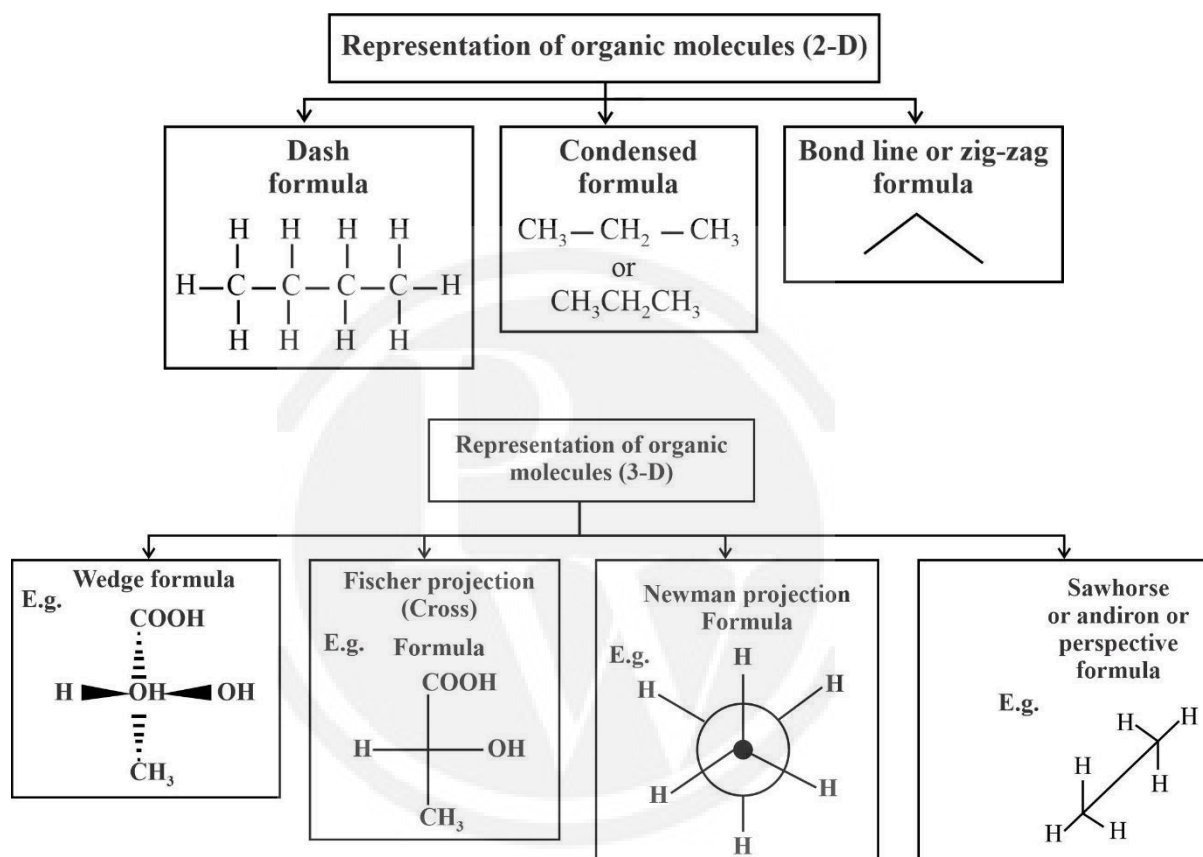


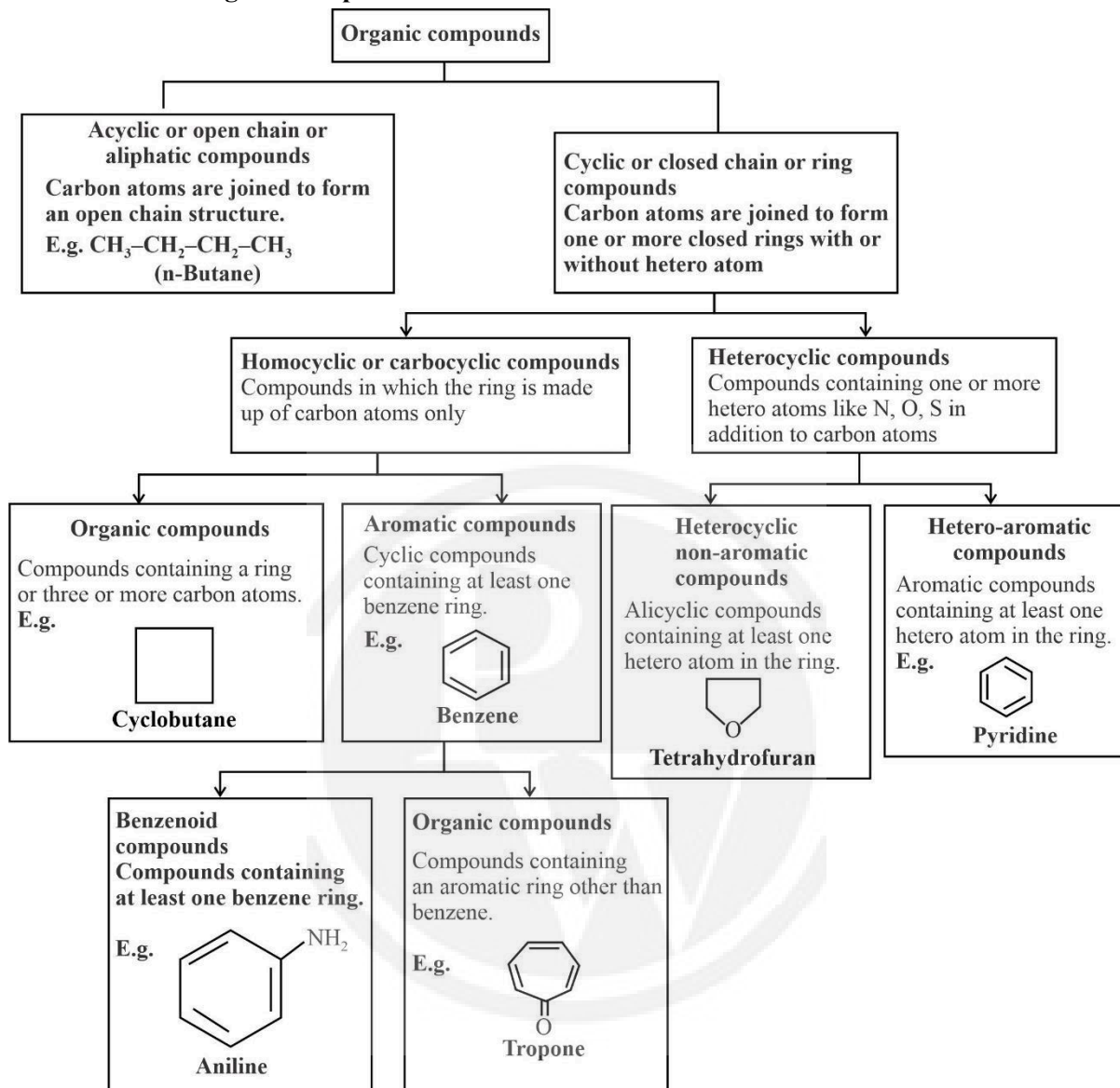
**Principles of Organic Chemistry**

- Representation of organic molecules:





Classification of organic compounds on the basis of structure:





Classification of organic compounds on the basis of their functional group:

S. No.	Name of the family / Functional group	Structure of the functional group	Examples
1.	Alkane (Saturated hydrocarbon)	$\text{CH}_3\text{--CH}_3$ Ethane	$\text{CH}_3\text{--CH}_3$ Ethane
2.	Alkene / Olefin (Unsaturated hydrocarbon)	>C=C<	$\text{H}_2\text{C}=\text{CH}_2$ Ethylene
3.	Alkyne (Unsaturated hydrocarbon)	$\text{--C}\equiv\text{C--}$	$\text{HC}\equiv\text{CH}$ Acetylene
4.	Alkyl halide	--X (Halide)	CH_3Br Methyl bromide
5.	Alkyl cyanide or nitrile	$\text{--C}\equiv\text{N}$ (Cyano or cyanide or nitrile)	$\text{CH}_3\text{--CN}$ Methyl cyanide or Acetonitrile
6.	Isocyanide or isonitrile	$\text{--N}^+\equiv\text{N}^-$	CH_3NC Methyl isocyanide
7.	Nitro group/compound	--NO_2 (Nitro)	CH_3NO_2 Nitromethane
8.	Alcohol	--OH (Hydroxyl)	CH_3OH Methyl alcohol
9.	Phenol	Ar--OH (Phenolic)	$\text{C}_6\text{H}_5\text{OH}$ Phenol



10.	Primary amine	-NH, (Amino)	CH_2NH_2 Ethylamine
11.	Secondary amine	-NH-	$\text{CH}_3\text{-NH-CH}_3$
12.	Tertiary amine	$\text{-}\underset{\text{ }}{\text{N}}\text{-}$	$(\text{CH}_3)_3\text{N}$ Trimethylamine
13.	Ether	$\begin{array}{c} \text{---C---O---C---} \\ \text{ } \qquad \qquad \text{ } \\ \text{(Ether)} \end{array}$	$\text{CH}_3\text{-O-CH}_3$ Dimethyl ether
14.	Aldehyde	$\begin{array}{c} \text{---C---H} \\ \parallel \\ \text{O} \end{array}$ (Formyl or aldehydic)	$\begin{array}{c} \text{CH}_3\text{---C---H} \\ \parallel \\ \text{O} \end{array}$ Acetaldehyde
15.	Ketone	$\begin{array}{c} \text{---C---} \\ \parallel \\ \text{O} \end{array}$ (Keto or Oxo)	$\begin{array}{c} \text{CH}_3\text{---C---CH}_3 \\ \parallel \\ \text{O} \end{array}$ Acetone
16.	Carboxylic acid	$\begin{array}{c} \text{---C---OH} \\ \parallel \\ \text{O} \end{array}$ (Carboxyl group)	$\begin{array}{c} \text{H---C---OH}_3 \\ \parallel \\ \text{O} \end{array}$ Formic acid
17.	Ester	$\begin{array}{c} \text{---C---O---} \\ \parallel \\ \text{O} \end{array}$ (Ester group)	$\begin{array}{c} \text{CH}_3\text{---C---OC}_2\text{H}_5 \\ \parallel \\ \text{O} \end{array}$ Ethyl acetate
18.	Amide	$\begin{array}{c} \text{---C---NH}_2 \\ \parallel \\ \text{O} \end{array}$ (Amido group)	$\begin{array}{c} \text{CH}_3\text{---C---NH}_2 \\ \parallel \\ \text{O} \end{array}$ Acetamide



19.	Secondary amide	$\begin{array}{c} \text{—C—NH—} \\ \\ \text{O} \end{array}$	$\text{CH}_3\text{—CO—NH—CH}_3$ N-Methyl acetamide
20.	Tertiary amide	$\begin{array}{c} \text{—C—N—} \\ \\ \text{O} \end{array}$	$\text{CH}_3\text{—CO—N(CH}_3)_2$ N, N-Dimethyl acetamide
21.	Acid anhydride	$\begin{array}{c} \text{—C—O—C—} \\ \quad \quad \\ \text{O} \quad \quad \text{O} \end{array}$ (Anhydride group)	$\text{CH}_3\text{—C—O—C—CH}_3$ $\begin{array}{c} \quad \quad \\ \text{O} \quad \quad \text{O} \end{array}$ Acetic anhydride
22.	Acyl halide	$\begin{array}{c} \text{—C—X} \\ \\ \text{O} \end{array}$ (Acyl halide group)	$\text{CH}_3\text{—C—Cl}$ $\begin{array}{c} \\ \text{O} \end{array}$ Acetyl chloride
23.	Sulphonic acid	$\text{—SO}_3\text{H}$ (Sulphonic acid group)	$\text{C}_6\text{H}_5\text{—SO}_3\text{H}$ Benzene sulphonic acid

IUPAC prefixes and suffixes:

- i. Functional groups which can appear only as prefix:
 - a. Nitro group (—NO_2)
 - b. Halides (—X): Represented by prefix "halo" (like fluoro, chloro, bromo, iodo).
 - c. Alkoxy group (—OR): Groups like methoxy (—OCH_3), ethoxy ($\text{—OC}_2\text{H}_5$), etc.
- ii. Functional groups appearing as prefix and suffix:

Functional group	Prefix	Suffix
—COOH	Carboxy	—oic acid
—COOR	Alkoxycarbonyl	—oate
—COCl	Chlorocarbonyl	—oyl chloride
—CONHH_2	Carbamoyl	—amide
—CN	Cyano	—nitrile
—CHO	Formyl	—al
—CO—	Oxo	—one
—OH	Hydroxy	—ol

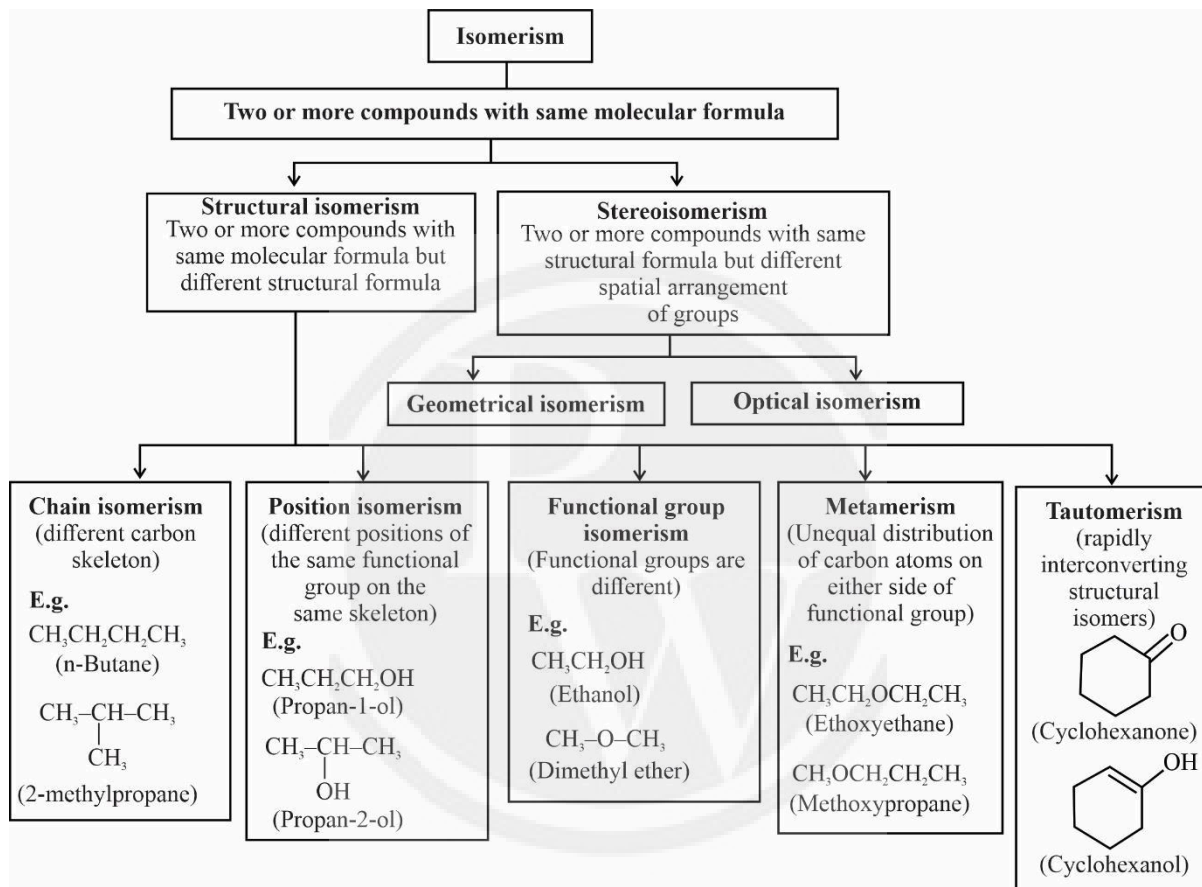
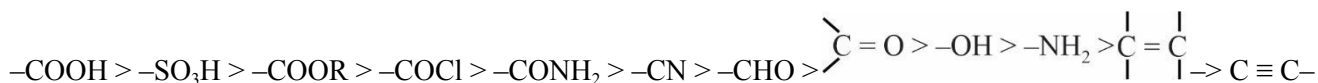


$-\text{NH}_2$

Amino

-amine

Order of priority for selection of principal functional group:



Types of cleavage of covalent bond:

Homolytic cleavage	Heterolytic cleavage
The symmetrical breaking of a covalent bond between two atoms such that each atom retains one electron of the shared pair.	The unsymmetrical breaking of a covalent bond between two atoms in such a way that the more electronegative atom acquires both the electrons of the shared pair.
Formation of free radicals (uncharged species) bearing unpaired electrons takes place.	Formation of charged species called ions, like carbocation or carbanion takes place.
$\text{A} \cdot \cdot \text{B} \xrightarrow[\text{homolysis}]{\text{UV Light}} \text{A}^\bullet + \text{B}^\bullet$ <p style="text-align: center;">Free radicals</p>	$\text{A} - \text{B} \xrightarrow[\text{heterolysis}]{\text{Polar solvent}} \text{A}^+ + \text{B}^-$ <p style="text-align: center;">Cation Anion</p> <p>Where B is more electronegative than A.</p>
Favourable in a non-polar solvent.	Favourable in a polar solvent.



Comparison of free radical, carbocation and carbanion:

Characteristic	Free radical		Carbocation
Nature	Neutral species having unpaired electron	Carbon atom with positive charge i.e., C^+	Carbon atom with negative charge i.e. \ddot{C}^-
Stability order	$(CH_3)_3\dot{C} >$ $(CH_3)_2\dot{C}H >$ $CH_3CH_2\dot{C} > \dot{C}H_3$	$(CH_3)_3C^+ >$ $(CH_3)_2CH^+ >$ $CH_3CH_2C^+ > CH_3^+$	$\bar{C}H_3 > CH_3CH_2\bar{C} >$ $(CH_3)_2\bar{C}H >$ $(CH_3)_3\bar{C}$

Inductive effect:

Substituents having +I effect	Substituents having -I effect
Alkyl groups such as $-CH_3$, $-CH_2CH_3$, $-CH(CH_3)_2$, $-C(CH_3)_3$, $-C(C_2H_5)_3$, etc.	$-F$, $-Cl$, $-Br$, $-I$, $-NO_2$, $-CN$, $-COOH$, $-COOR$, $-OAr$, etc.

Resonance effect:

Substituents having +R effect	Substituents having -R effect
Halogen, $-OH$, $-OR$, $-O^-$, $-NH_2$, $-NHR$, $-NR_2$, $-NHCOR$, $-OCO$, etc.	$-COOH$, $-CHO$, $-CO-$, $-CN-$, $-NO_2$, $-COOR$, etc.

