

## Introduction to Organic Chemistry

Q-1) Representing organic molecules.

→ **Empirical formula**

: smallest ratio of atoms of each kind present in a molecule.

→ **molecular formula**

: actual no. of atoms of each kind present in a molecule

→ **Structural formula**

: Shows the arrangement of C-atoms, and the no. of H-atoms linked to each carbon.

→ **Displayed formula**

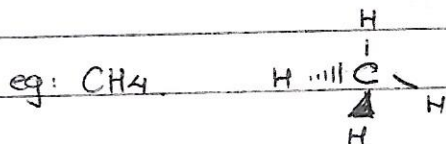
: shows all the bonds within a molecule

→ **Skeletal formula**

: simplified version of the displayed formula, without the C- and H atoms.

→ **3D formula**

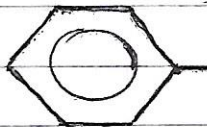
: displayed formula in 3D.



Q-2) What is a functional group?

> An atom, or a group of atoms that gives characteristic property to the organic compound is called a functional group.

Name	Structure of functional group	General Formula	Example
Alkanes	$\begin{array}{c}   &   \\ -C & - & C- \\   &   \end{array}$	$C_n H_{2n+2}$	methane
Alkenes	$\begin{array}{c} \diagdown & \diagup \\ C & = & C \\ \diagup & \diagdown \end{array}$	$C_n H_{2n}$	ethene
Halogenoalkanes	$R-X$ $X = F, Cl, Br, I$	$C_n H_{2n+1} X$	chloromethane
Alcohols	$R-OH$	$C_n H_{2n+1} OH$	methanol
Aldehydes	$\begin{array}{c} O \\    \\ R-C-H \end{array}$	$C_n H_{2n+1} CHO$	methanal
Ketones	$\begin{array}{c} O \\    \\ R-C-R' \end{array}$	$C_n H_{2n} O$	propanone
Carboxylic acids	$\begin{array}{c} O \\    \\ R-C-OH \end{array}$	$C_n H_{2n+1} COOH$	methanoic acid
Esters	$\begin{array}{c} O \\    \\ R-C-O-R' \end{array}$	$C_n H_{2n+1} COO$	methyl methanoate
Amines	$R-NH_2$	$C_n H_{2n+1} NH_2$	methylamine
Nitriles aka Cyanides	$R-C \equiv N$	$C_n H_{2n+1} CN$	ethanenitrile
Alkynes	$-C \equiv C-$	$C_n H_n$	ethyne

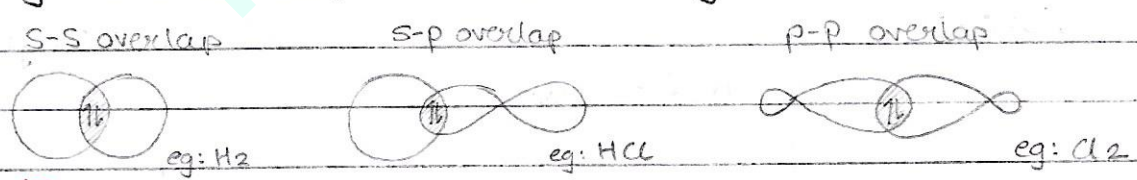
Ethers	$R-O-R'$	$C_nH_{2n+2}O$	dimethylether
Arenes		$C_6H_5^-$	benzyne
Amides	$R-\overset{O}{\parallel}C-N\begin{matrix} H \\ H \end{matrix}$		ethanamide
	$R-\overset{O}{\parallel}C-N\begin{matrix} H \\   \\ R' \end{matrix}$		methyl ethanamide

Q 3) Naming organic compounds - nomenclature

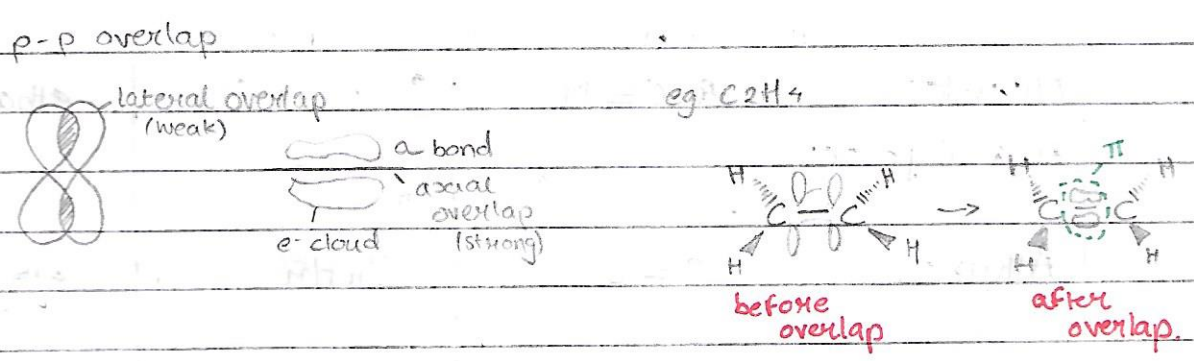
- select the longest chain of C atoms, and name it as the parent alkane
- Number the chain in such a way that the side chain / functional group gets ~~last~~ least no.
- If there are similar substituents, use prefix di, tri...  
If there are different substituents, use alphabetical order.

Q-4) Sigma and Pi bonds

> Sigma bonds are formed between single covalent bonds

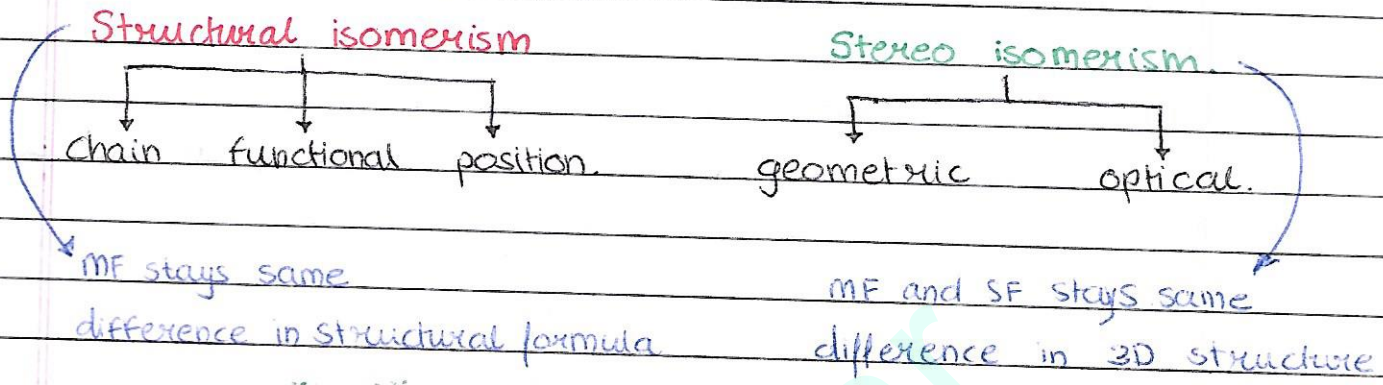


Pi bonds are formed between double covalent bonds



Q-5) What is isomerism?

> Compounds having the same molecular formula but different structural formula are isomers.



### Chain isomerism

Difference in arrangement of C-chains.

### Functional isomerism

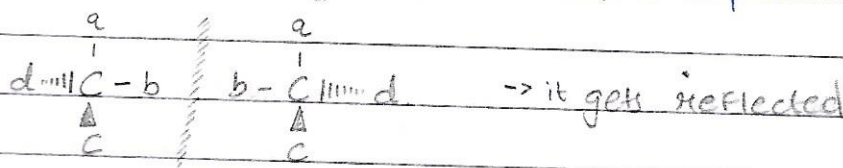
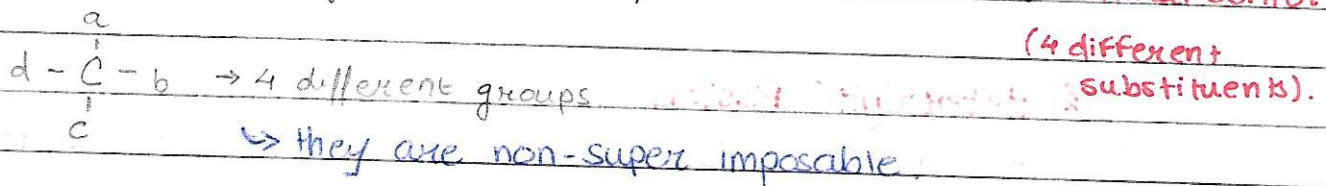
Difference in functional group

### Position isomerism

Difference in position of functional group

### Optical isomerism

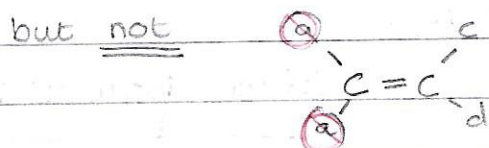
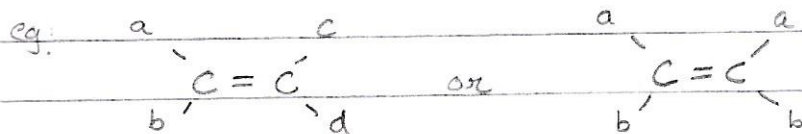
For it to occur, you need an asymmetric C-atom - **chiral center**



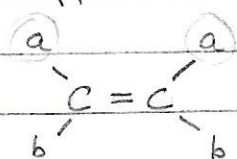
### Geometric isomerism

For it to occur, you need • double bonds

• different substituents attached to each carbon.

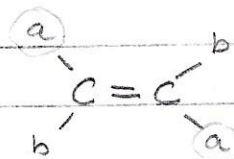


It happens due to restricted rotation of double bonds.



cis-isomer

↳ straight



trans-isomer.

↳ diagonal

Q-6) Types of fission?

> There are two ways in which covalent bonds can break. Homolytic and Heterolytic fission.

① Homolytic fission.

↳ Breaking of bonds in such a way that one  $e^-$  is retained with each atom.

This results in the formation of free radicals.



② Heterolytic fission

↳ Breaking of bonds in such a way that one atom gets both  $e^-$

This results in positive and negative ions



Q-7) Types of organic reactions.

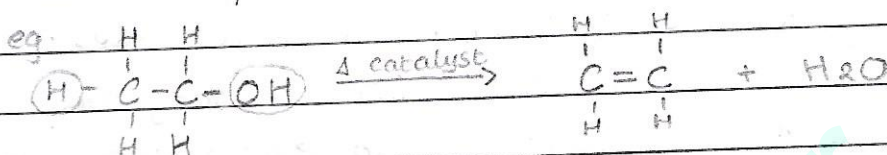
### \* Addition reaction.

- Formation of a single product from 2 or more molecules
- takes place in compounds containing multiple bonds



### \* Elimination reaction.

- Removal of small molecules (eg:  $H_2O$ ,  $CO_2$ ) from larger ones.



### \* Substitution reaction

- replacement of <sup>atom group of</sup> one or more atoms by another atom(s).



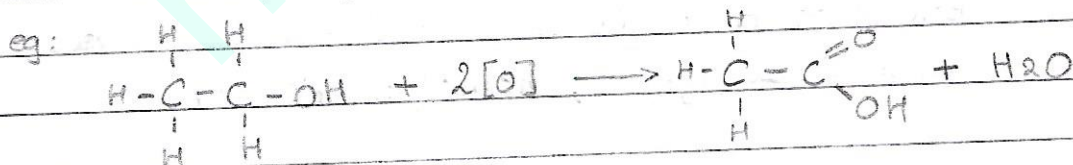
### \* Hydrolysis.

- reaction with  $H_2O$  (often speeded up by an acid or alkali)



### \* Oxidation reaction

- addition of oxygen + removal of hydrogen atoms from a molecule



### \* Reduction reaction.

- addition of hydrogen + removal of oxygen atoms from a molecule

