

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

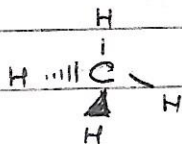
→ **Skeletal formula**

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

→ **3D formula**

: displayed formula in 3D.

eg: CH₄

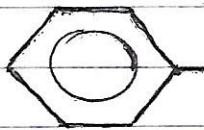


Q-2) What is a functional group?

> 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	$\begin{array}{c} \diagup & \diagdown \\ C & = C \\ \diagdown & \diagup \end{array}$	$C_n H_{2n}$	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 a.k.a Cynides	$R-C \equiv N$	$C_n H_{2n+1} CN$	ethanenitrile
Alkynes	$-C \equiv C-$	$C_n H_n$	ethyne

Ethers	$R-O-R'$	$C_nH_{2n+2}O$	dimethylether
Arenes		C_6H_5-	benzyl
Amides	$ \begin{array}{c} O \\ \\ R-C-N-H \\ \\ H \end{array} $ $ \begin{array}{c} O \quad H \\ \quad \\ R-C-N-R' \end{array} $		ethanamide methyl ethanamide

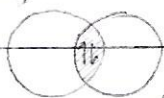
Q 3) Naming organic compounds - nomenclature

- ① select the longest chain of C-atoms, and name it as the parent alkane
- ② Number the chain in such a way that the side chain / functional group gets ~~last~~ least no.
- ③ If there are similar substituents, use prefix di, tri...
If there are different substituents, use alphabetical order.

Q-4) Sigma and Pi bonds

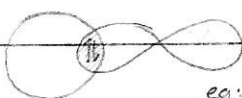
> Sigma bonds are formed between single covalent bonds

S-S overlap



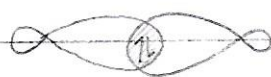
eg: H_2

S-p overlap



eg: HCl

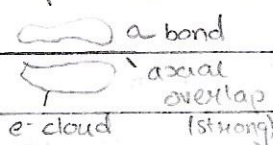
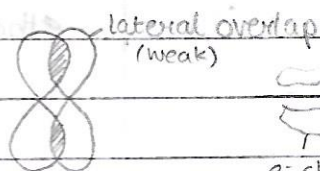
p-p overlap



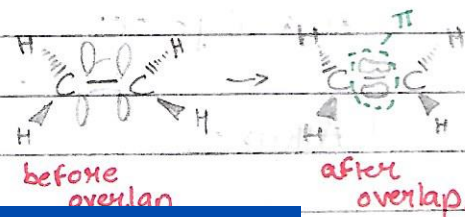
eg: Cl_2

Pi bonds are formed between double covalent bonds

p-p overlap

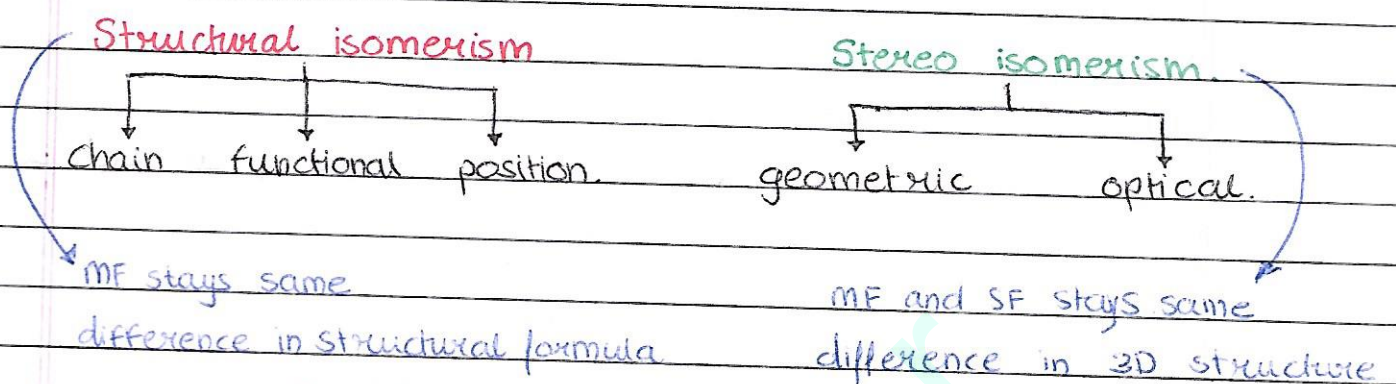


eg: C_2H_4



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

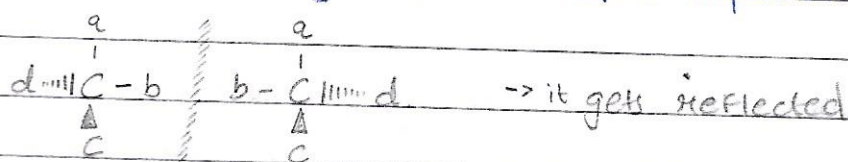
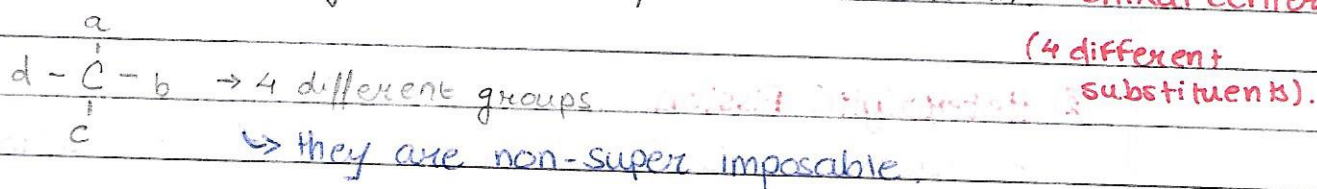
Difference in functional group

Position isomerism

Difference in position of functional group

Optical isomerism

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

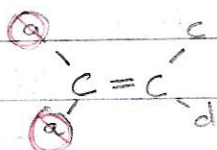


Geometric isomerism

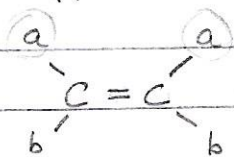
For it to occur, you need • double bonds



but not

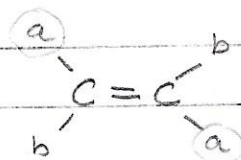


It happens due to restricted rotation of double bonds.



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.

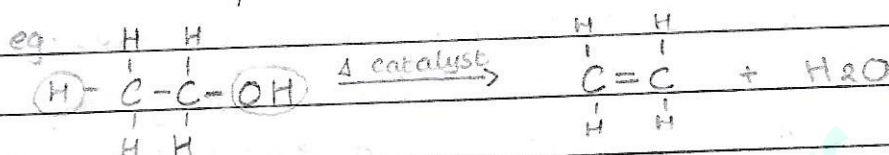
* Addition reaction.

- 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 one or more ^{atom group of} atoms by another atom(s).



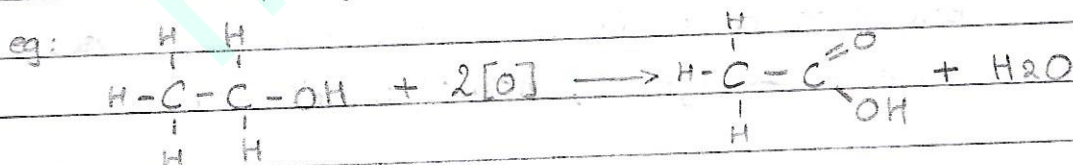
* Hydrolysis.

- 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

