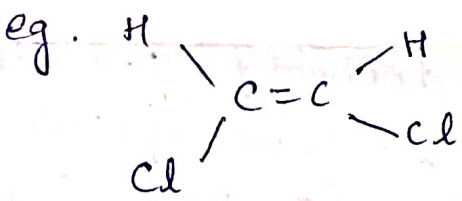
Optical Isomerism :→ Compounds possessing identical molecular & structural formula and identical physical and chemical properties but differ in action towards plane polarized light, then they are known as optical isomers or enantiomers or antipodes, & the phenomenon is known as **optical Isomerism**

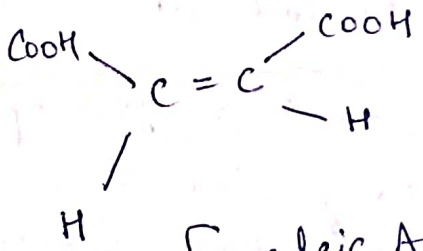
Geometrical Isomerism :→ When two compounds, which possess the same structural and ~~for~~ molecular formula but differ in arrangement of atoms or groups in space around the carbon - carbon double bond. Such isomers are called geometrical isomers, and the phenomenon is called geometrical isomerism.

These are of two types :→

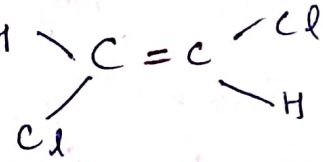
(1.) **Cis-isomer** :→ which have similar group on same side

eg. 

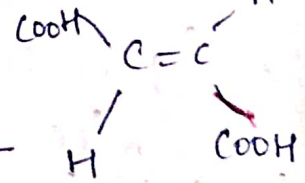
1,2 chloroethene (cis-form)



[maleic Acid]

(2.) **Trans-form** :→ which have similar groups on opposite side (1.) 

1,2, dichloro ethene

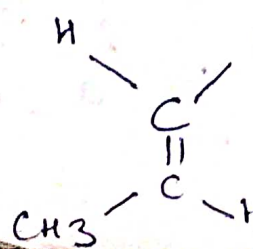
(2.) 

fumaric Acid

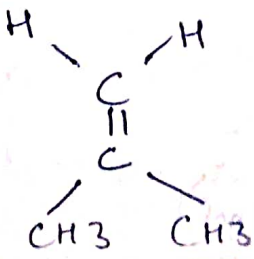
Conditions for Geometrical Isomerism :

(A.) There should be a double bond in the molecule (C=C)

(B.) There must be two different atoms or groups attached to each carbon atom of the double bond.



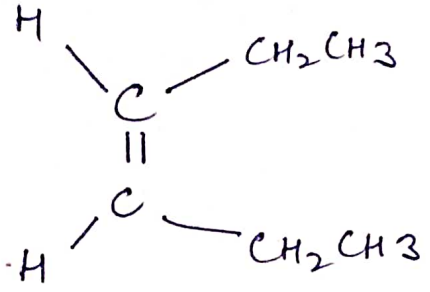
Propylene



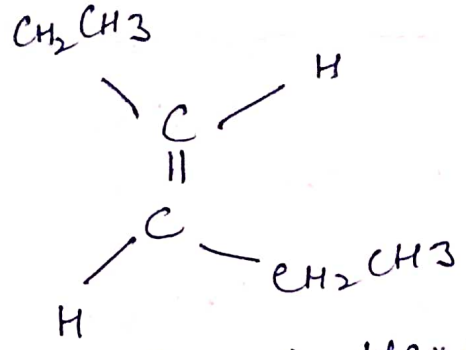
Isobutylene

No. geometrical Isome

Examples of geometrical Isomers



Cis Hexene



Trans Hexene

Geometrical Isomers.

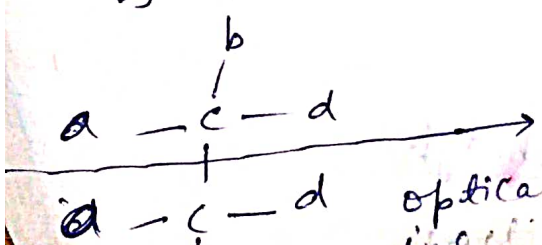
* **Chiral Carbon atom or Asymmetric Carbon atom** :→ A Carbon atom attached to four different groups is called asymmetric Carbon atom or **Chiral Carbon atom**.

Now-a-days the term di-symmetry or chiral molecules are often used for asymmetric molecule

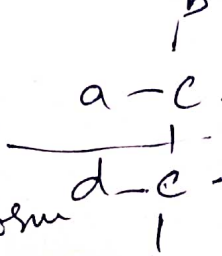
* **Conditions for optical activity** :→ The condition necessary for a molecule to show optical activity is that the molecule should not superimposed on its mirror image.
Further a compound is optically active if it does not possess any **element of symmetry**.

* **Elements of Symmetry** :→ There are generally three elements of symmetry.

(1.) **Plane of Symmetry** :→ It is a real or imaginary plane, which divides the molecule into two identical halves, & each half of the molecule is the mirror image of other half.



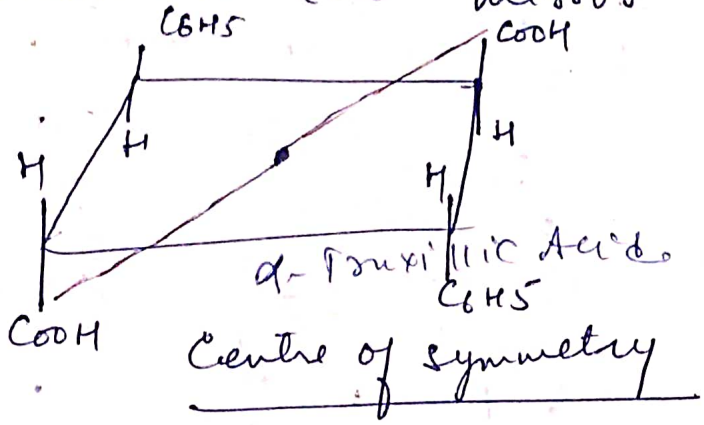
optically inactive (meso form



No plane of Symmetry.

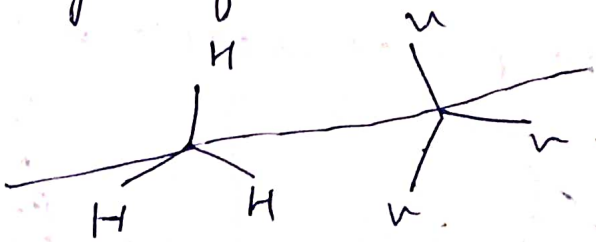
optical

Centre of Symmetry :→ It is an imaginary point the centre of the molecule from which if lines are drawn on both sides to an equal distance divides the molecule into two equal halves, which are the mirror images of each other.



α-Truxillic Acid.

Centre of symmetry



Centre of symmetry (Ci)

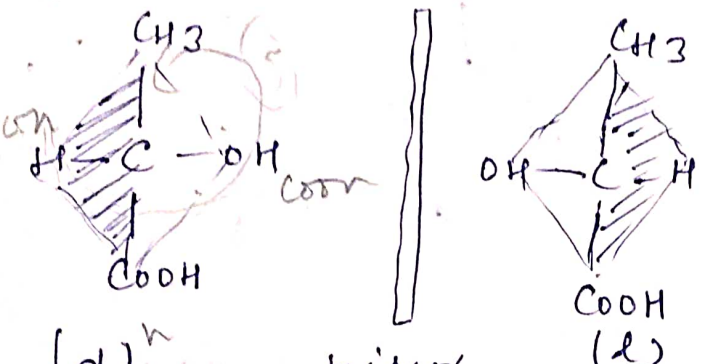
(3.) Axis of Symmetry :→ A molecule is said to possess n-fold axis of symmetry, if on rotating the molecule about its axis through 360°, the same arrangement is repeated n times. n

Two fold axis
(C_2 axis)

COMPOUNDS CONTAINING ONE ASYMMETRIC CARBON

According to the following formula, the No. of isomers formed $= 2^n$, where n = No. of asymmetric carbon atoms. Compounds containing 1 asymmetric carbon atom exist in two ($2^n = 2^1 = 2$) forms.

example; → Lactic Acid : $[CH_3 \cdot CHOH \cdot COOH]$



The two stereoisomers of lactic acid are mirror images of each other & are not superimposable & possess di-symmetry in molecule

These two forms are (d) & (l) form

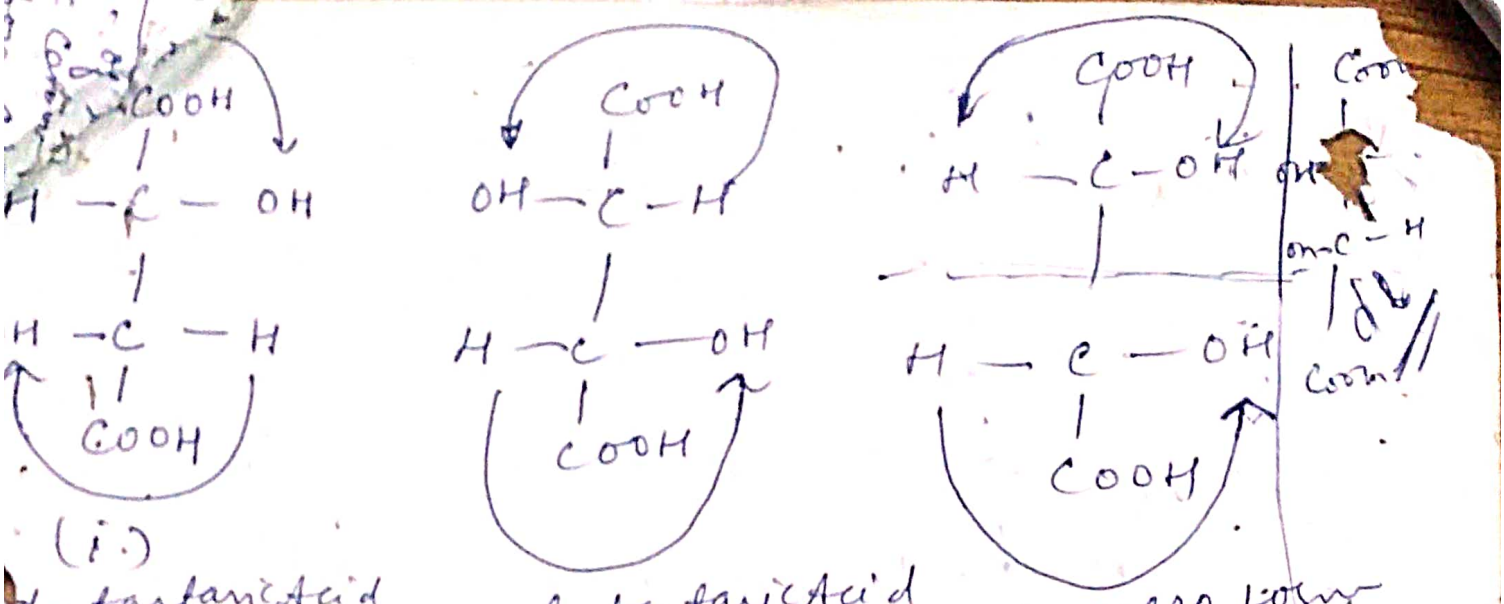
Racemic mixture :→ when these two forms are mixed in equi-molecular quantities. Such a mixture is optically inactive due to external compensation and is called racemic mixture. or racemic form. The racemic mixture of a particular sample is represented as prefix (±dl)

COMPOUNDS Containing two Similar asymmetric Carbon atoms :→

For Compounds containing two Similar asymmetric Carbon atom the No. of possible stereo-isomers are slightly less than 2^n

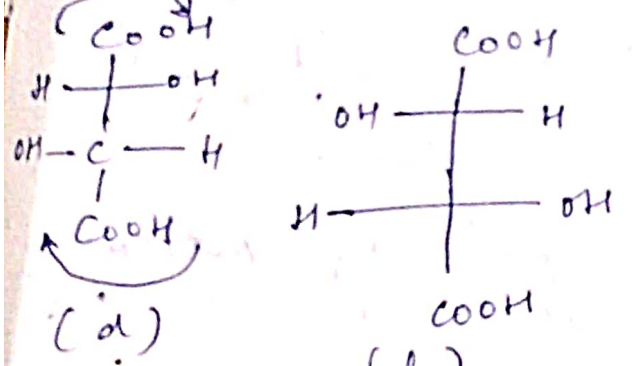
e.g. - Tartaric Acid $COOH \cdot CHOH \cdot CHOH \cdot COOH$ exist in three forms - (d) & (l) optically active form & meso (optically inactive) form

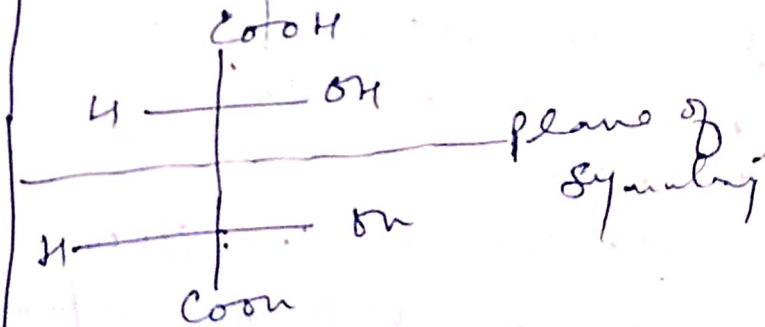
meso form :→ It is an optical inactive variety of Stereoisomer, which is formed by internal compensation. i.e. rotation due to lower half & upper-half of which are equal & opposite. Apart from these there is a racemic mixture ±dl form formed by mixing equimolar amount of d & l.



Difference between Racemic mix & meso form

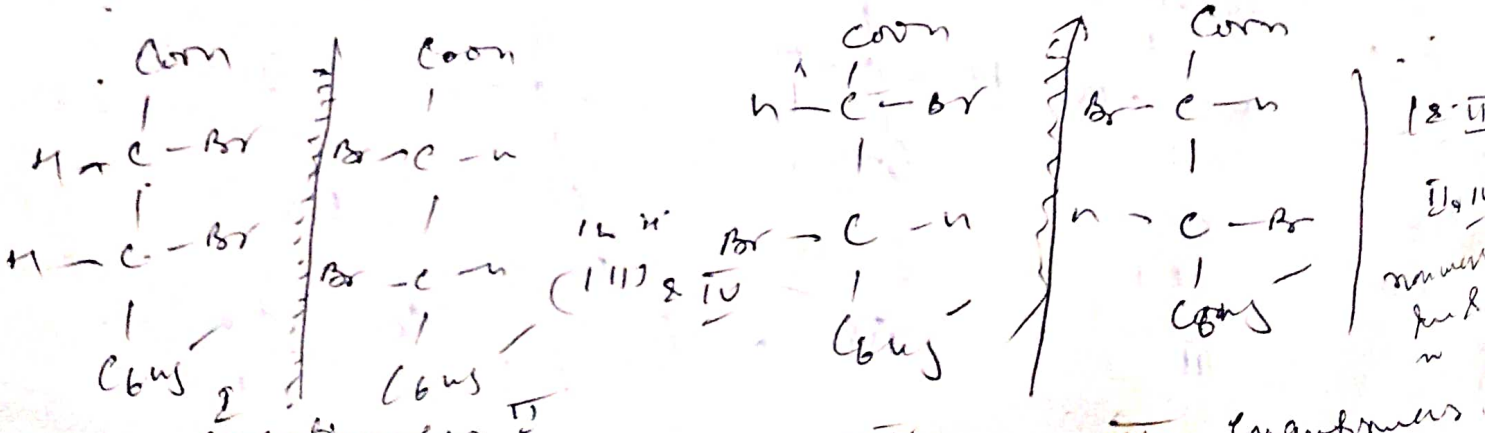
Racemic mixture	meso Compounds
1.) Equi-molar mixture of dextro & levo-rotatory isomer	(1.) meso Compound possess plane of symmetry
2.) They are externally compensated	(2.) They are internally compensated.
3.) designated as ± or dl	3) Designated as meso Compound





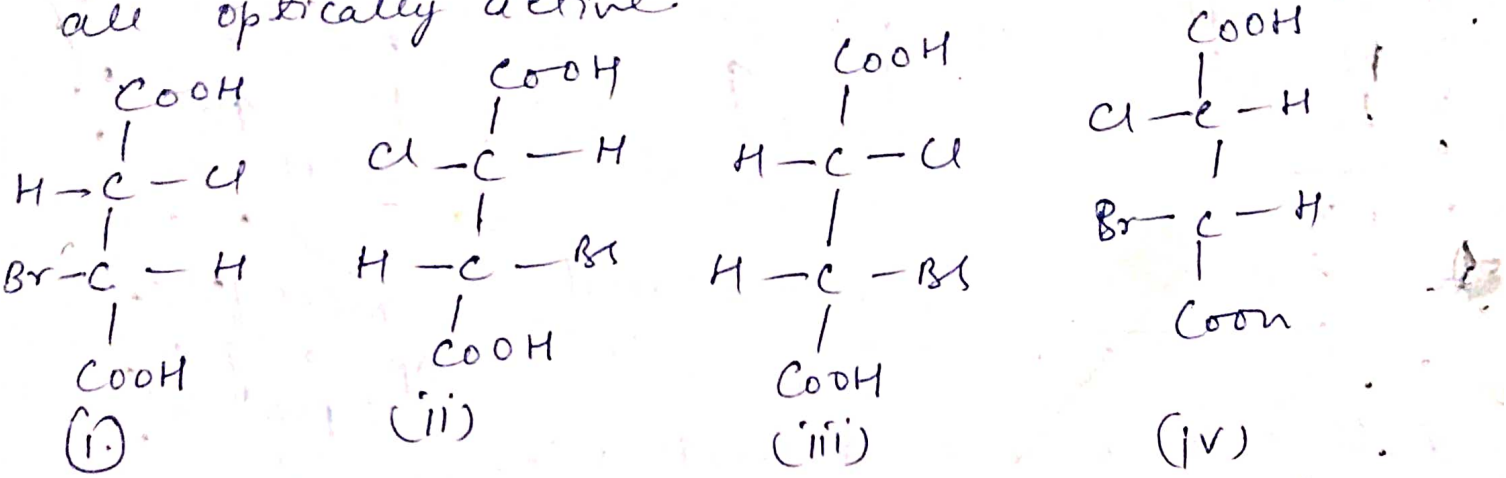
Compounds Contain 2 or more dissimilar Carbon atom

Eg. Cinnamic Acid di-bromide.



compounds containing two dissimilar asym Carbon atoms ; Such compounds exist in 2^n stereoisomeric forms $2^n (2^2) = 4$

eg. Bromo-chloro Succinic Acid has 4 stereoisomers all optically active



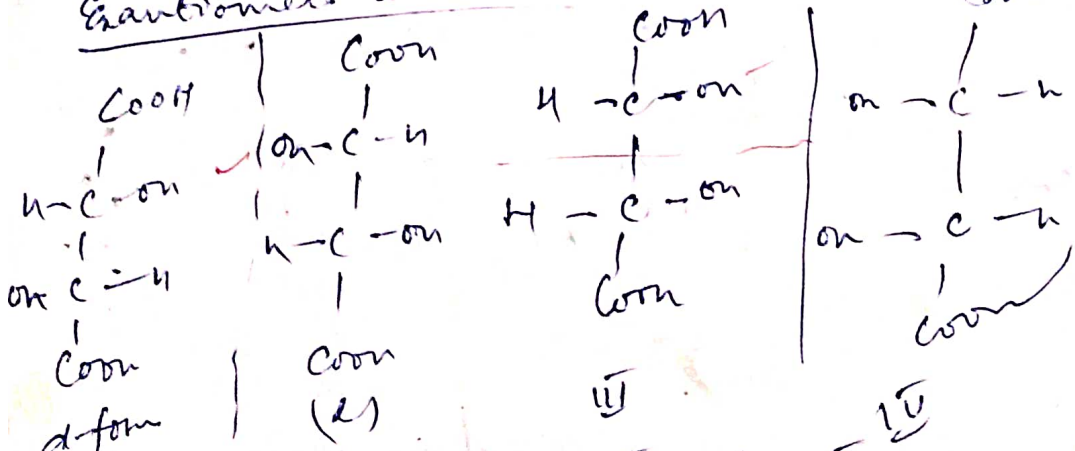
of these 4 stereoisomers (i) & (ii) are enantiomers or enantiomorphs (iii) & iv are also as (i) & (ii) ; (iii) & iv are non superimposable mirror images.

However (i) & (iii), (i) & (iv) & (ii) & (iii) & (ii) & (iv) are not the mirror images. Such pairs are called diastereoisomers

Enantiomers :→ Enantiomers are pair of optically active compounds, which are mirror images & are non-superimposable to each other.

Diastereoisomers :→ These are pair of optically compounds which non-superimposable & not the mirror images of each other

Enantiomers & diastereomers of Tartaric Acid



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