Stereoisomerism.

Isomerism exhibited by the two or more compounds with the same molecular formula and structural formula but different spatial arrangement of atom or groups is termed as stereoisomerism.

Stereoisomerism.

Geometrical Isomerism

optical Isomerism

Constitutional Isomers differ in the way their atoms are connected because they have the same molecular formula but their atoms are connected differently.

Constitutional Isomers

CH_3CH_2OH and CH_3OCH_3

ethanol

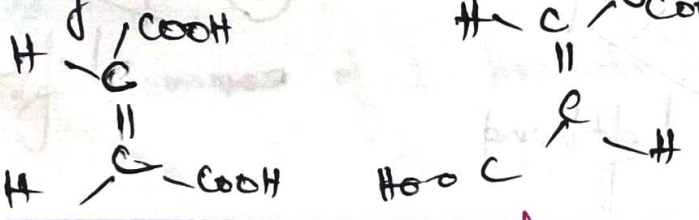
Dimethyl ether.

$CH_3CH_2CH_2CH_2Cl$ and $CH_3CH_2-\underset{Cl}{CH}-CH_3$

1-chlorobutane

2-chlorobutane

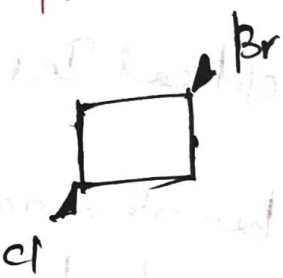
Stereoisomers [also called Configurational Isomers] differ in the way their atoms are arranged in space.



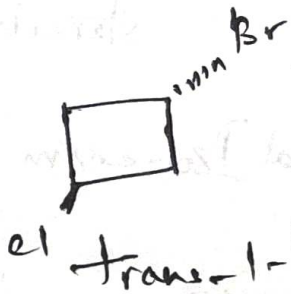
Maleic acid

Fumaric acid

Geometrical Isomers are connected to the double bond in the spatial arrangement of the Compounds. the cis Isomer has its substituents on the same side of the ring; the trans Isomer has its substituents on opposite side of the ring.



cis-1-bromo-3-chlorocyclobutane



trans-1-bromo-3 chlorocyclobutane

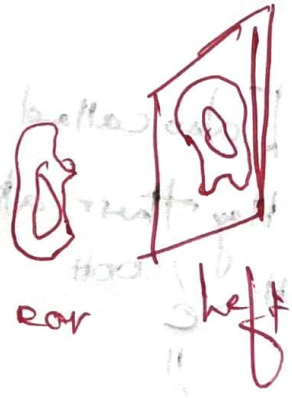
cis-1,4, dimethylcyclohexane

trans-1,4-dimethyl cyclohexane

Chiral object has a Non-Superimposable Mirror Image.

A chiral object has Nonsuperimposable mirror Image In otherwords it Not the same as the orginal mirror Image

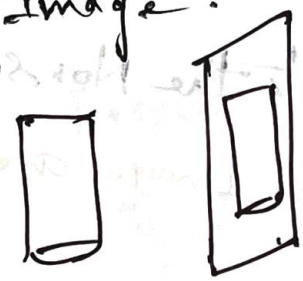
Right Hand left hand



ear left ear.

Achiral object:

An Achiral object has a superimposable mirror Image.



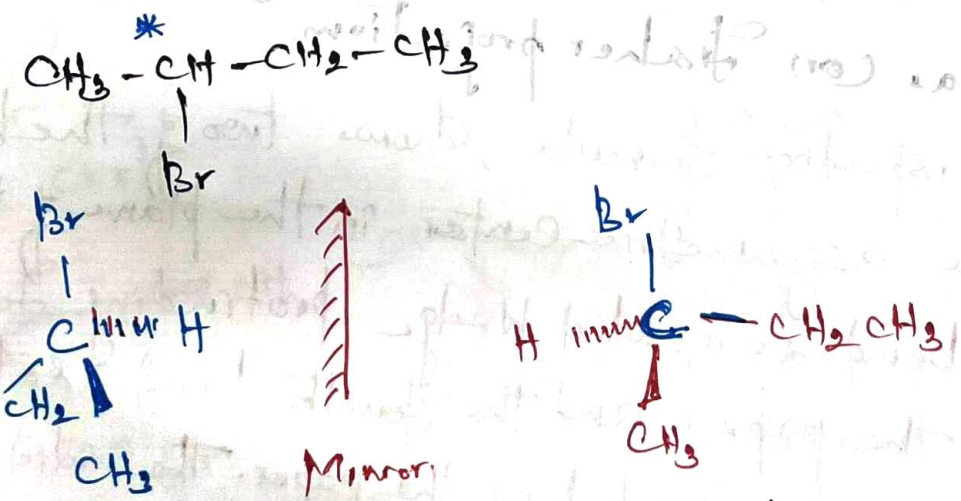
Cup.

chair.

Enantiomers:

Molecules that are Non superimposable mirror images like an object that of each other. Called enantiomers. [Greek word Enantion which means opposite] example

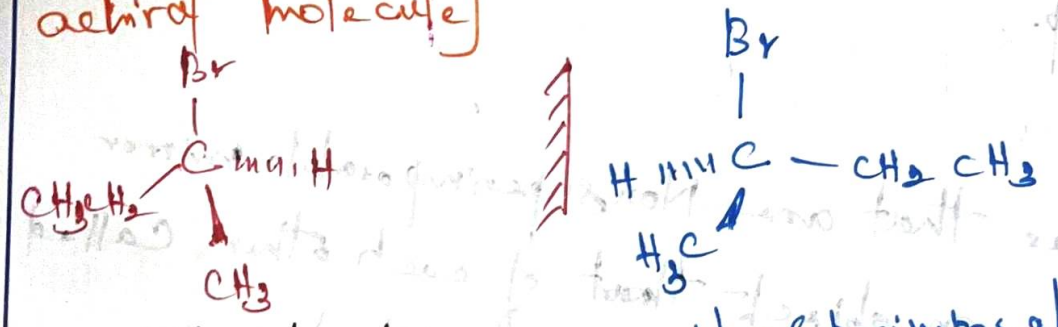
2-bromobutane



Two stereoisomers of 2-bromobutane are called enantiomers.

If a molecule posses the Non superimposable mirror images of each other are called chiral. that molecule are called enantiomers.

A molecule should Not exhibit the Non superimpose (ie) [it has superimposable mirror Images are called achiral molecule]



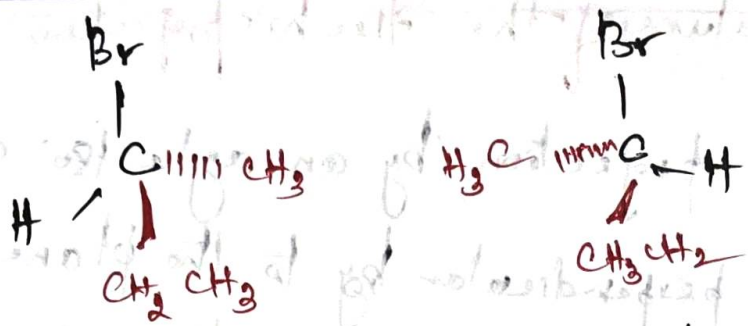
Chiral Molecule

Non superimposable mirror Images

How to Draw Enantiomers:-

Chemists draw enantiomers using either perspective formulas (or) fisher projection

A perspective formula shows two of the bonds to the assymmetric center in the plane of the paper. One bond as a solid wedge protruding forward out of the paper, and the fourth bond as a hatched wedge extending behind the paper. The solid wedge and the hatched wedge must be adjacent to one another.

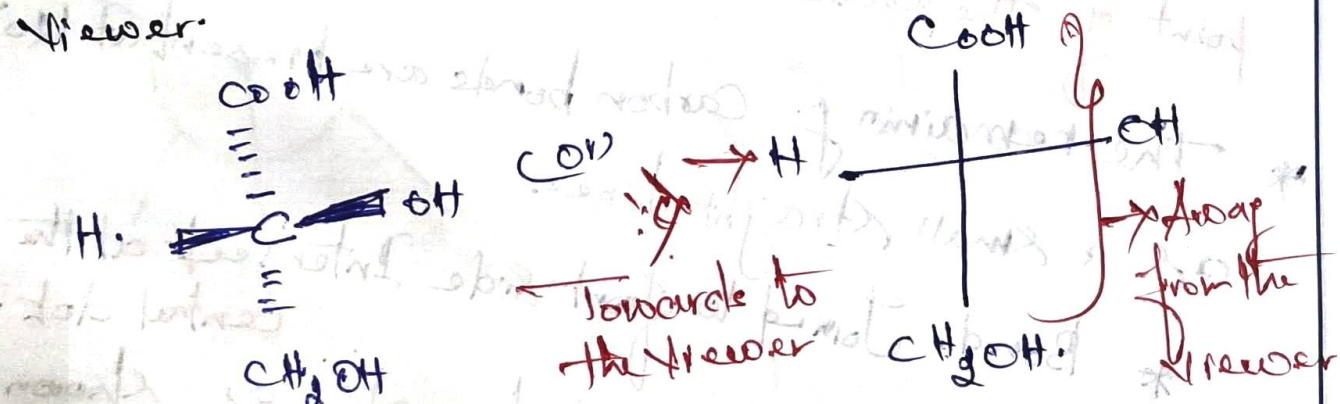


Perspective formulae of the enantiomers of 2-bromobutane

Fischer projection

It is represented by two Intersecting perpendicular lines.

Horizontal lines represent the bonds that project out of the plane of the paper. toward the viewer, and the Vertical lines represent the bonds that extend back from the plane of the paper. away from the viewer.

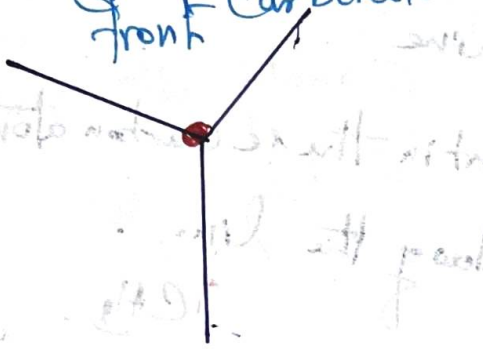


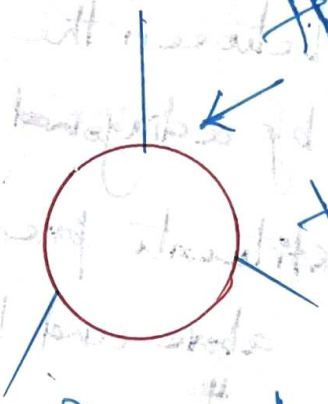
Characteristic features of the Fischer projection

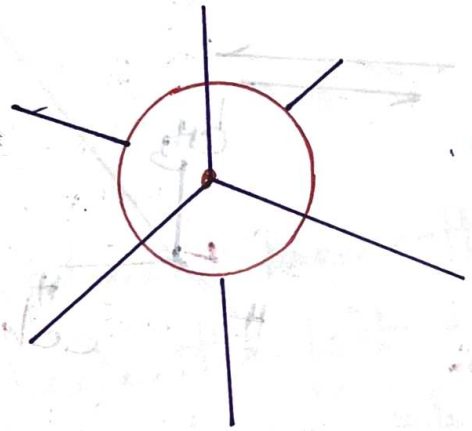
Rotation of the fischer projection by an angle 180° about the axis which is perpendicular to the plane of the paper gives identical structure. However similar rotation by an angle of 90° produces Non-identical structure.

Newmann projection

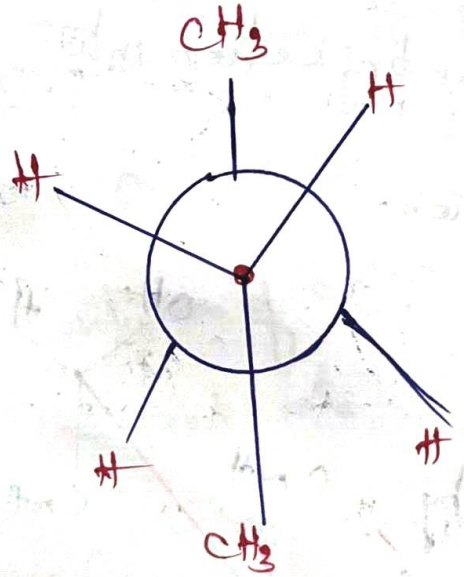
* In Newmann projection the carbon atom away from the viewer called the rearer carbon atom and it is represented by circle.
* the carbon atom facing the viewer called the front carbon atom and it is represented by centre point of the above circle shown by dot.
* the remaining carbon bonds are present at 120° as a small straight lines.
  * Bonds joined to front side Intersect at the central dot.
  * Bonds at the rear carbon atom as shown as emanating from the circumference of the circle.



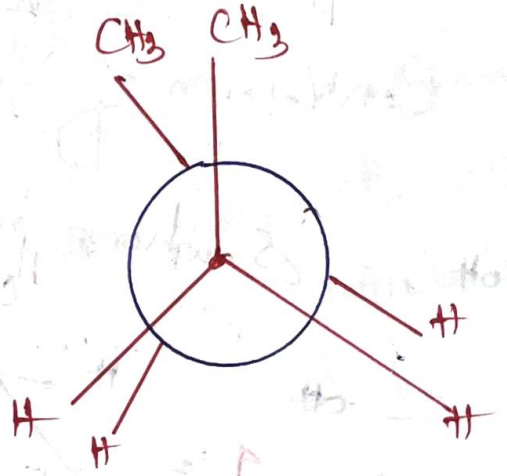




Newmann projection



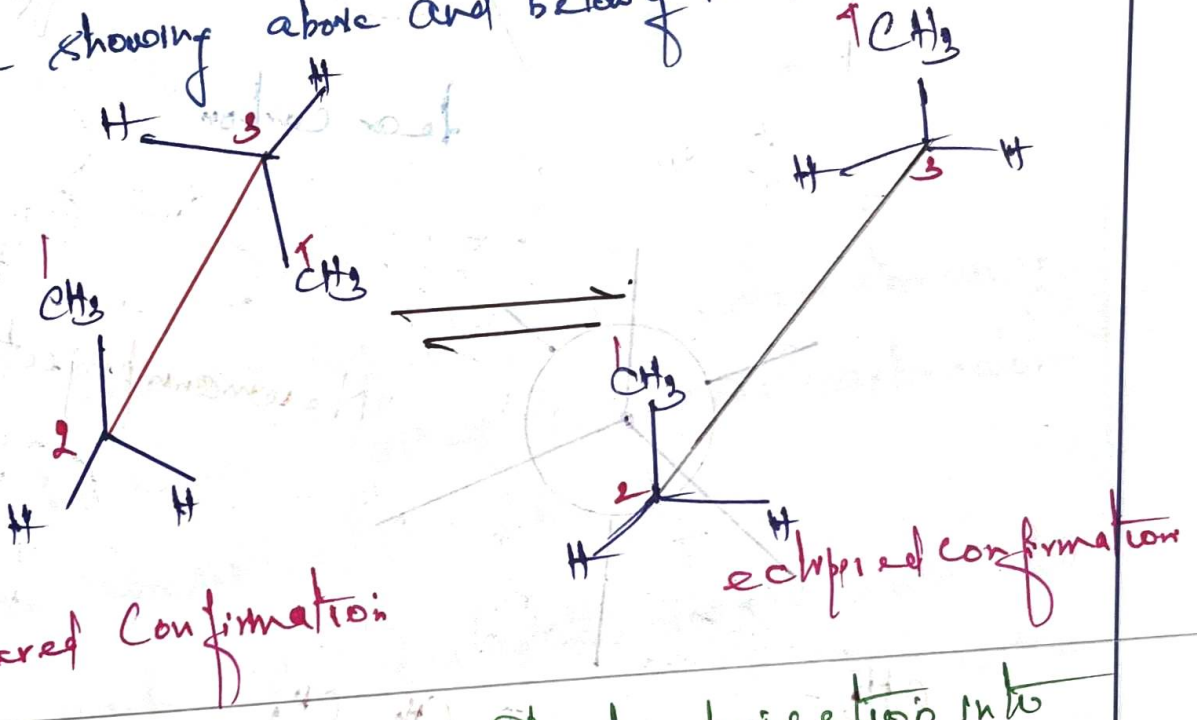
staggered



eclipsed conformation

Sawhorse Projection

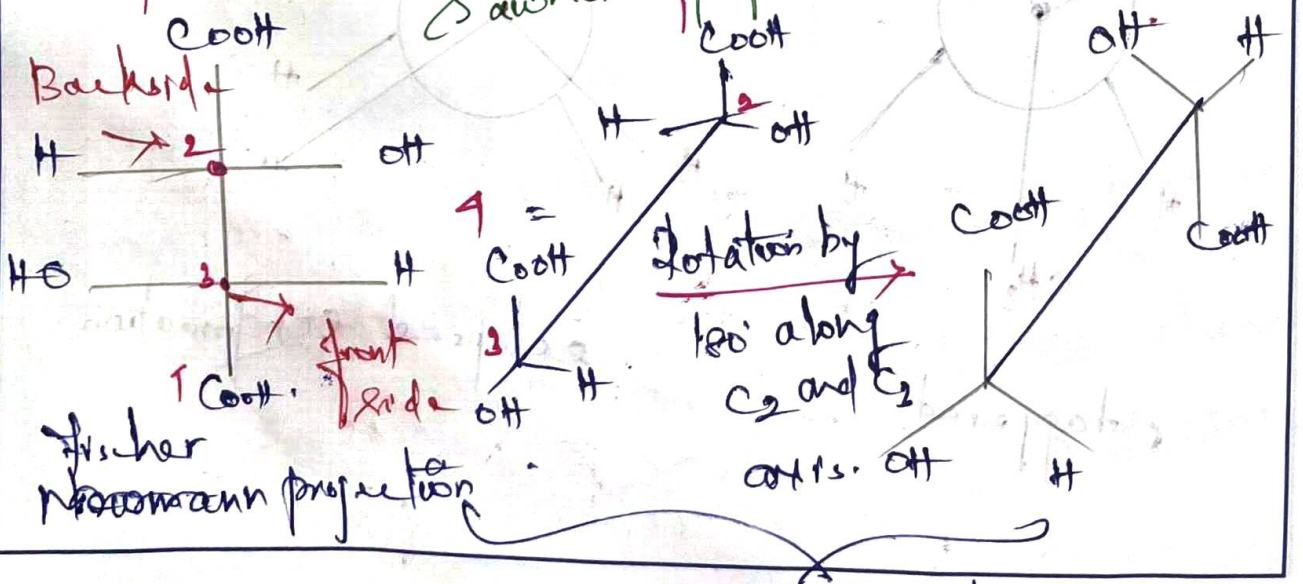
* The bond between the two carbon atoms are represented by a diagonal line
* Other substituents present in these carbon atoms are showing above and below of the line.



Staggered Confirmation

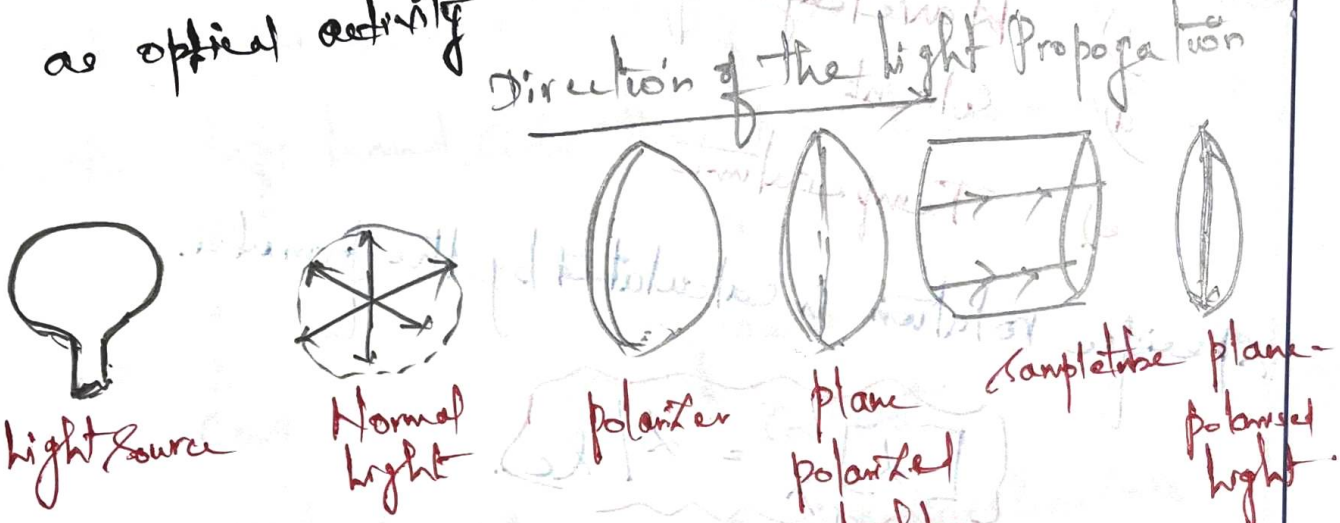
eclipsed confirmation

Conversion of Fischer projection into Sawhorse projection



Plane Polarised light

The property by virtue of which the substances rotate the plane of the polarised light is referred to as optical activity.



When plane polarized passes through a solution of achiral molecule the light emerges from the solution with its plane of polarized unchanged.

On the otherhand if the plane polarized light a solution of chiral molecules passes then the solution changed into clockwise and anticlockwise direction If one enantiomer rotate in the clockwise direction then the other enantiomer rotate in the anticlockwise direction. If a Compound rotates the plane of polarised light in a clockwise direction called optically active.

Optical measurements are measured by polarimeter

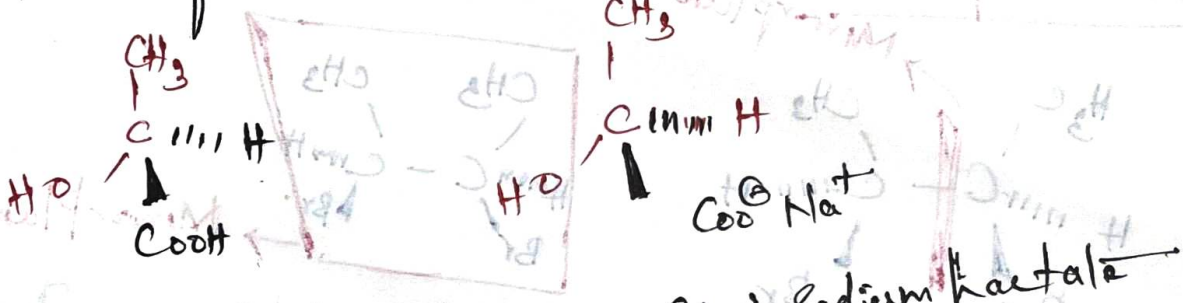
a) Concentration of the sample
b) Length of the sample cell
c) Wavelength of the Incident light.
d) Solvent
e) Temperature

Specific rotation is calculated by the formula.

$$[\alpha]_{\lambda} = \alpha / lc$$

$\alpha \rightarrow$ optical rotation
$l \rightarrow$ path length (dm)
$c \rightarrow$ Concentration (g/mL)

If an optically active compound rotates the plane of polarization in a clockwise, then the compound is said to be dextrorotatory, which can be indicated in the Compound Name (+). If the plane of polarization on the left hand side then it is laevorotatory (−)



S (+) - lactic acid

Rotates in the clockwise direction

S (−) Sodium lactate

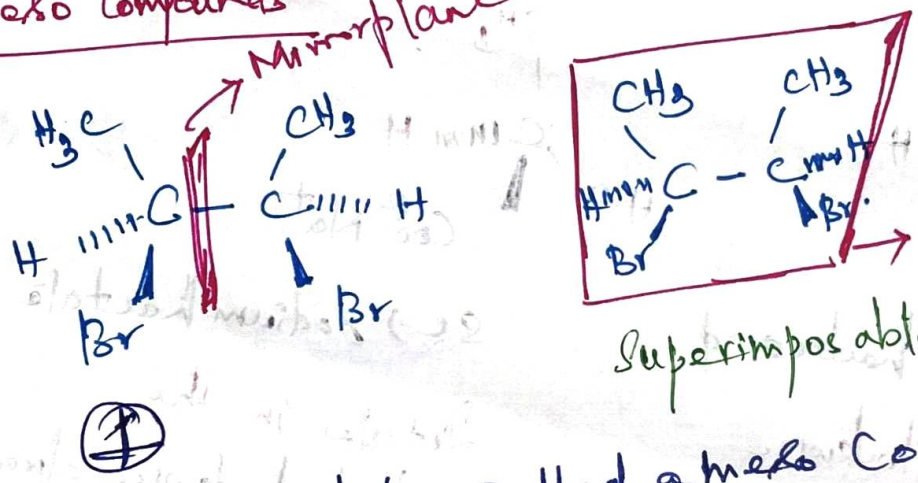
Rotates in the Anticlockwise direction

Racemic Mixture (or) Racemate

A mixture of equal amounts of two enantiomers such as R (−) Lactic acid and S (+) Lactic acid called Racemic mixture (or) Racemate. Racemic mixtures are optically inactive because every molecule rotates the plane of polarization in only one direction.

The the symbol (±) represents the racemic mixture
(±) 2-bromobutane indicates the mixture of 50%
(+) 2-bromobutane and 50% other indicates
the mixture of (−) 2-bromobutane

Meso Compounds

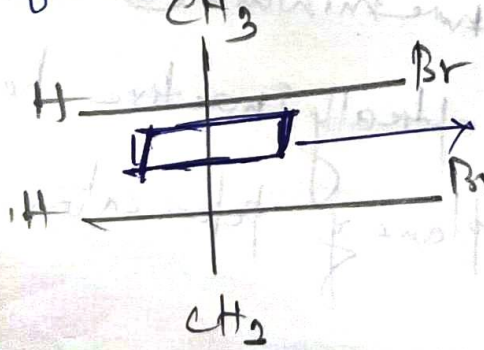


Superimposable mirror Image.

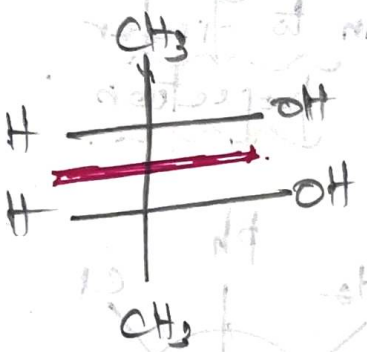
Stereoisomer I is called a meso Compound.

Meso Compounds are achiral because they are all superimposable on its mirror images.

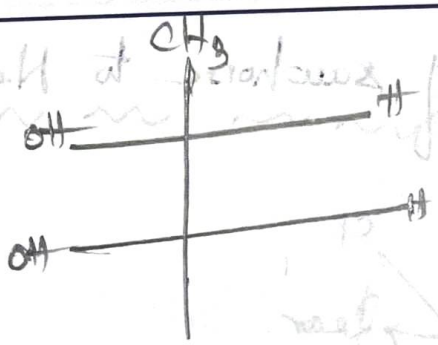
Plane of Symmetry cuts the Meso Compounds in half- to that one half is the mirror image of the other Half



SRM

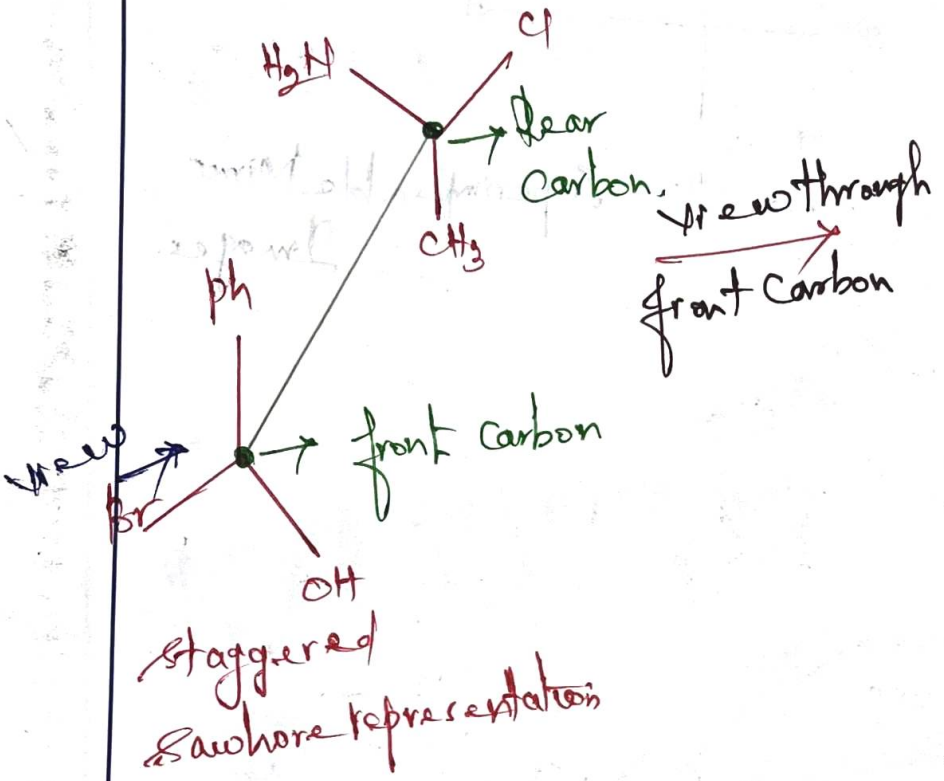


Meso Compound

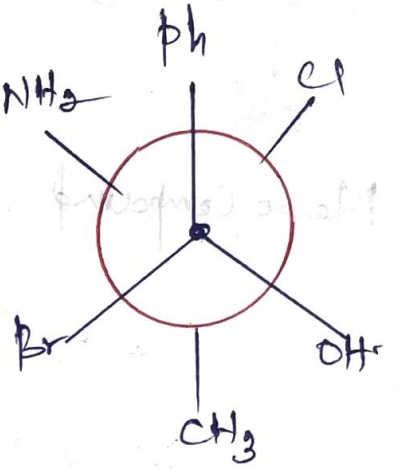


Superimposable Mirror Images.

Conversion of sawhorse to Newmann to Fischer projection.

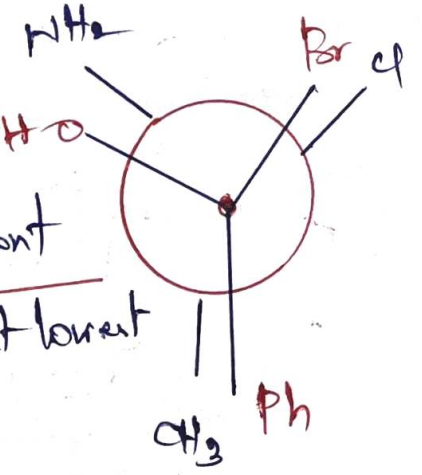


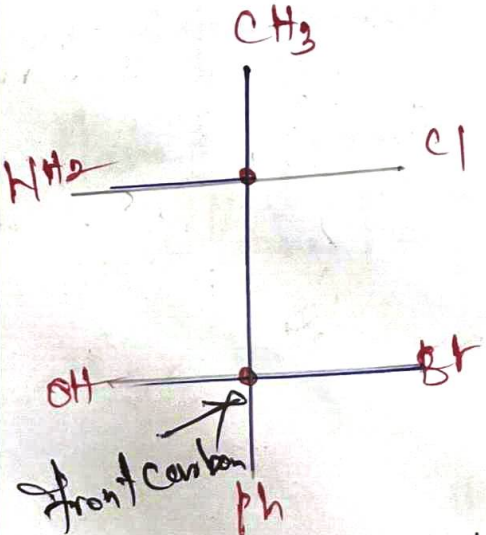
Staggered sawhorse representation



Staggered Newmann projection

Rotate the front Carbon atom by 180°





Fischer projection

Elements of Symmetry

- Plane of symmetry (σ)
- Centre of symmetry (i)
- Proper Axis of Symmetry (C_n)
- Alternating Axis of Symmetry (S_n)