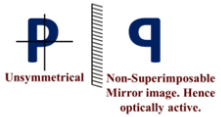
MIND MAP

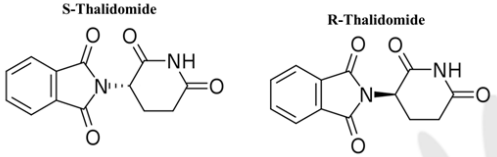
Optical Isomerism

- Stereo Isomerism
  - Conformation
  - Configurational
    - 1. Geometrical
    - 2. Optical

Condition of Optical Activity

Compound must be asymmetrical or Compound should be Non Superimposable on its mirror image.





Optical Isomerism

Compounds which have same molecular and structural formula but have different direction of rotation of PPL (Plane Polarized Light) are known as optical isomers.

Optical activity

Certain substances possess the property to rotate the plane of polarized light. Such substances are called optically active substances and this phenomenon is called optical activity.

If the substance rotates plane-polarised light to the right i.e. in clockwise direction it is called dextrorotatory and indicated by 'd' or (+).

If the substance rotates plane-polarised light to the left i.e. in anti clockwise direction it is called laevorotatory and indicated by 'l' or (–).

The observed rotation of the plane polarized light depends on four factors

a. The amount of the substance in tube
b. The length of the sample tube
c. The temperature of the experiment
d. The wavelength of the light used.

$$[\alpha]_D^t = \frac{\alpha_{obs}}{\ell \times C}$$

α = observed angle of rotation

ℓ = length of polarimeter tube in decimeters

$[\alpha]_D^t$ = specific rotation determined at T°C per unit length at unit concentration, using D–line of sodium light.

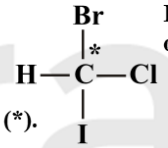
C = concentration of the active compound in grams per millilitre.

Note

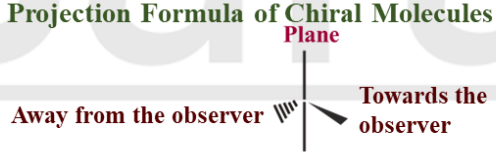
"Optically active compound is considered as chiral compound".
"Optically inactive compound is considered as achiral compound".

Asymmetric Carbon (or) Chiral Carbon

If all the four bonds of carbon are satisfied by four different atoms/groups, it is chiral. Chiral carbon is designated by an asterisk (*).



Projection Formula of Chiral Molecules



Rules for writing Fisher Projection Formula

a. Groups at Vertical line are away from observer.
b. Groups at Horizontal line are towards the observer.
c. Central 'C' atom of the cross is chiral.
d. High priority group lie at the top of vertical line (Numbering starts from top according to IUPAC).
e. Maximum carbon atoms should be on the vertical line

Types of Symmetry

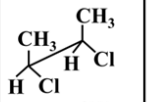
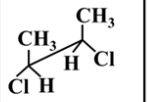
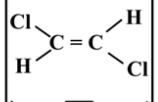
Plane of Symmetry (POS)

An imaginary plane which bisects any object or molecule into two equal parts which are mirror images of each other is known as Plane Of Symmetry.

Center of Symmetry (COS)

It is a point at center of a molecule from which on travelling equal distance in opposite directions one meets the same group or atom.

If a molecule contains either POS or COS or both then it is optically inactive.

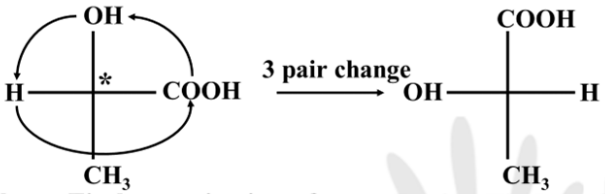
Compound	POS	COS	Optical active / inactive
	Yes	No	Inactive
	No	No	Active
	Yes	Yes	Inactive
	Yes	No	Inactive

MIND MAP

Optical Isomerism

How to correct wrong Fischer/ how to make perfect Fischer

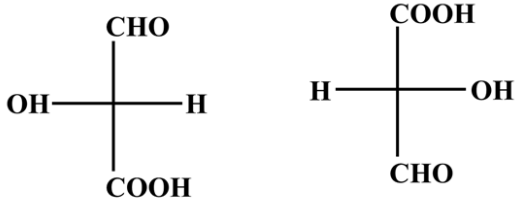
1) If carbon chain is on horizontal line then bring it on vertical line by simultaneous three pair change



Wrong Fischer projection of Lactic acid

Perfect Fischer of Lactic acid

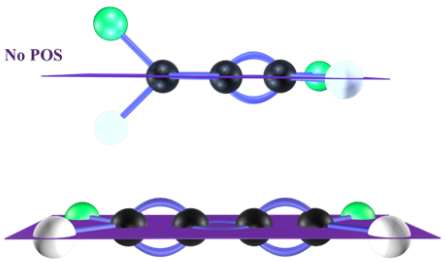
(2) High priority group lies at the top of vertical line (Numbering starts from top according to IUPAC). If not, rotate the complete molecule in the plane of screen by 180°



Wrong Fischer projection

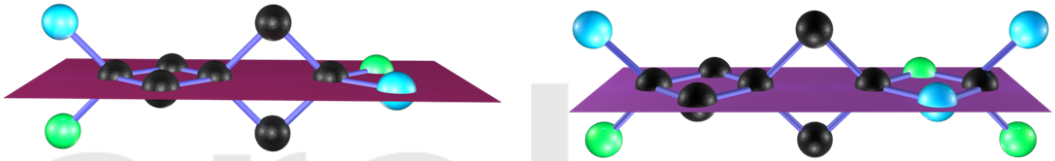
Perfect Fischer projection

Optical Activity In Different Compounds

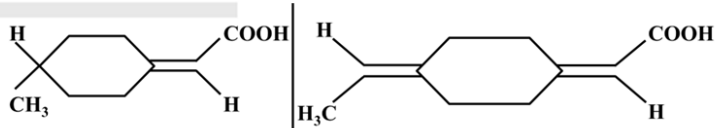


Condition(terminal valencies should be different)

1. Odd no. of π - Bond — G.I. Yes, Optical No
2. Even no. of π - Bond — G.I. No, Optical Yes



Ring + Bond

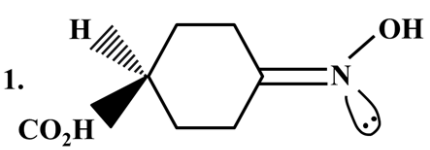


No. of ring + π bond = even

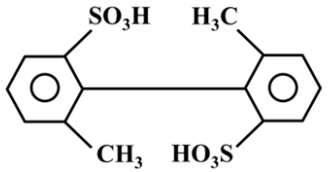
So Optical √ G.I. X

No. of ring + π bond = odd

So G.I √ Optical X



1. Optically active



2. Optically active

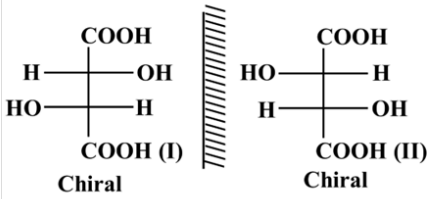
MIND MAP

Optical Isomerism

Enantiomers

Optically active isomers which are non superimposable mirror-images of each other are called Enantiomers.

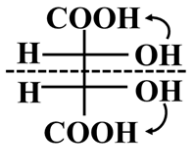
Enantiomers



All the physical and chemical properties of enantiomers are same except that they rotate PPL to the same extent but in opposite direction.

Meso Compounds

Compounds having at least two chiral carbons and have plane of symmetry or center of symmetry or both is called meso compounds.



Plane of symmetry

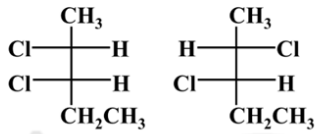
Racemic Mixture

Equimolar mixture of d and ℓ enantiomers is called as racemic mixture (d,ℓ or ±).

Diastereomerism

The stereoisomers (Geometrical and optical) which are not mirror images of each other are called diastereomers.

Diastereomers



Geometrical isomers are also Diastereomers

All the physical and chemical properties of diastereomers are different.

D – L System (Relative Configuration)

This method is used to relate the configuration of carbohydrates and amino acids.

In case of carbohydrates(poly hydroxy aldehyde and ketone) D-L configuration is decided relative to glyceraldehyde.

Important

Note that the designation of a compound as D or L has nothing to do with the sign of rotation.

Important

Note that the designation of a compound as R or S has nothing to do with the sign of rotation, the CIP rule can be applied to any three dimensional representation of a chiral compound to determine whether it is R or S only.

Resolvable and Non-Resolvable Compounds

a. Optically active compounds are considered as resolvable.

b. Optically inactive compounds are considered as non–resolvable.

Calculation of Number of Optical Isomers / Stereo Isomers

Molecule

- **Unsymmetrical**
  - Total no. of Stereoisomers $= 2^n$
- **Symmetrical**
  - **n = even**
    - Total no. of Stereoisomers $= 2^{n-1} + 2^{\frac{n}{2}-1}$
    - Optically active
    - Meso (inactive)
  - **n = odd**
    - Total no. of Stereoisomers $= 2^{n-1} + 2^{\frac{n-1}{2}}$
    - Optically active
    - Meso (inactive)

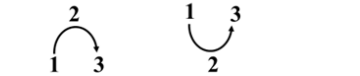
Absolute Configuration (R,S Configuration)

Step 1 Assign priority to the groups which are attached with chiral carbon on the basis of CIP rule.

Step 2 Lowest priority group should be on dash.
If not then bring the lowest priority group to dash by even simultaneous exchanges.

Step 3 Draw an arrow from first priority group to second priority group till third priority group.

Step 4 If the direction of arrow is clockwise the configuration is R and if anticlockwise then it is S.



RS Nomenclature in Fischer formula

1. Assign priority to the groups which are attached with chiral carbon on the basis of atomic number.
2. If lowest priority group is present on vertical line then observed configuration is same as real configuration.
3. If lowest priority group is present on horizontal line then observed configuration is opposite to real configuration.
4. Draw an arrow from first priority group to second priority group till third priority group.
5. If the direction of arrow is clockwise the configuration is R and if anticlockwise it is S.

Rigid Body System

If chiral center is present at bridge head then inversion at that position is not possible, so only two stereo isomer are possible (one itself and another its mirror image).