OPTICAL ISOMERISM

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OPTICAL ACTIVITY

- Optical activity of a compound is detected and measured by means of Polarimeter.
- When a solution of known concentration of an optically active material is placed in a polarimeter, the beam of polarized light is rotated through a certain number of degrees, either to right (clockwise) or to the left (anticlockwise).
- The compound which rotates the plane of polarized light to the right is dextro rotatory and is indicated by the sign (+). The compound which rotates the plane of polarized light to the left (anticlockwise) is said to be levorotatory and is indicated by the sign (-).

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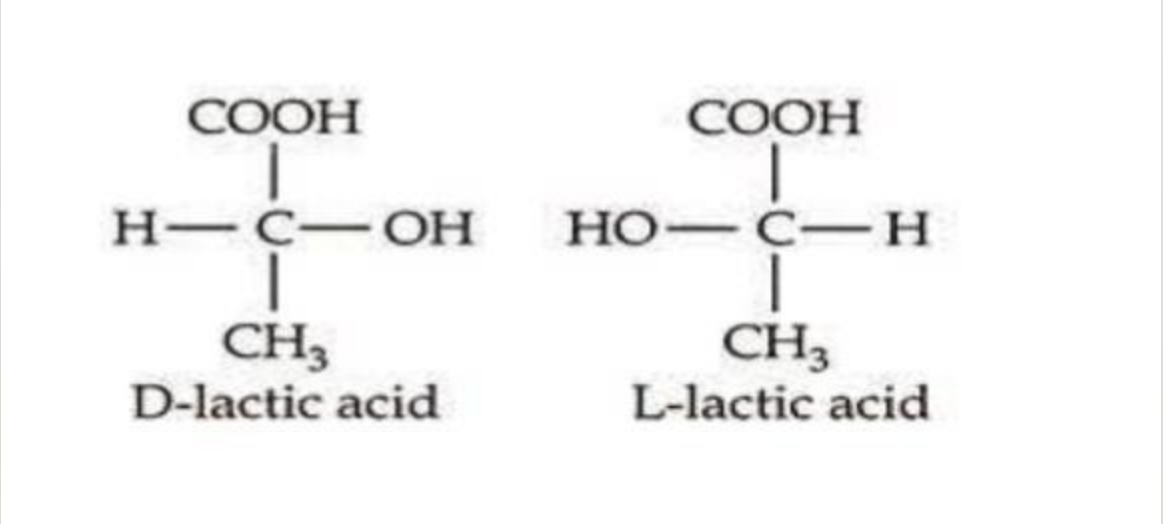
- The magnitude of rotation in degrees is referred to as observed rotation.
- E.g. Lactic acid rotates the plane to the right and is termed as (+) lactic acid.



- The necessary and sufficient condition for the optically active compound is chirality
- A carbon atom to which four different groups are attached is a chiral carbon. Molecules which contain chiral carbon are non superimposable on their mirror images are called chiral molecules.
- Greek word "chiros" means hand and chirality means handedness, meaning not superimposable with their mirror images.

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- A molecule having plane of symmetry or centre of symmetry or an alternating axis of symmetry is superimposable on its mirror image and hence is achiral.
- The molecule which does not possess elements of symmetry is non superimposable on its mirror image and is chiral or asymmetric.
- Many of the compounds associated with living organisms are chiral, for example DNA, enzymes, antibodies and hormones.
- Biology is very senesitive to chirality and most drugs consist of chiral centres.

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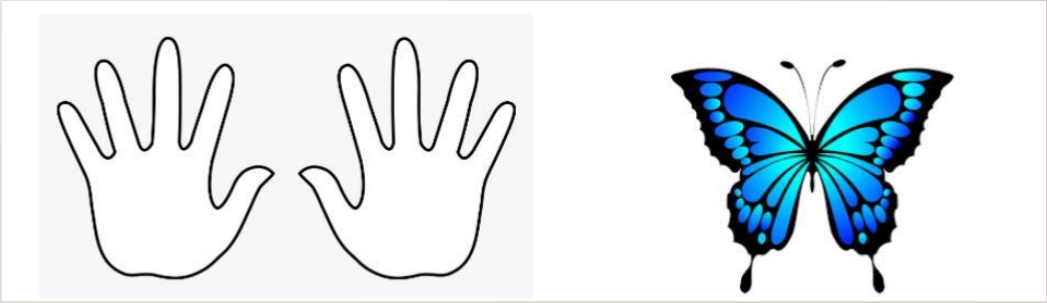
- Achiral means that the object has the plane of symmetry.
- Hands are the prime example of chiral objects. They have a "left" and "right" version.
- Butterfly is an example of achiral as its mirror image is superimposable on its original image.
- Organic molecules can be chiral or achiral.



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ORIGIN OF CHIRALITY

- Vant Hoff and Le Bel showed in 1873 that the origin of dissymmetry in carbon compounds is due to the terahedral nature of carbon.
- They considered various possibilities and concluded that all the experimental results available at the time could be explained by assuming that a saturated carbon forms four bonds directed towards the corners of tetrahedron.
- Using methane and its derivatives as examples it can be easily seen that dissymmetry is possible only if four different atoms or groups are attached to the carbon atom.

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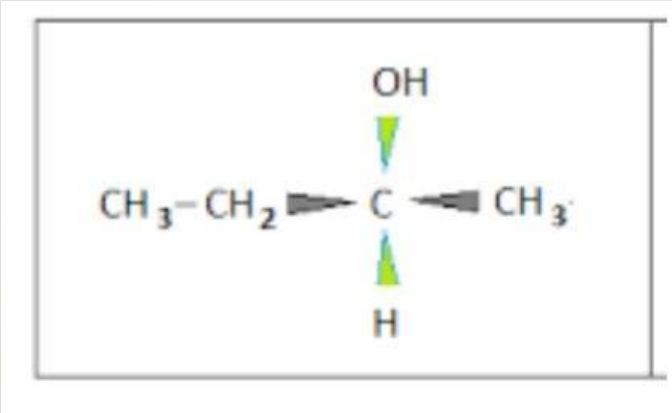
- The term assymmetric carbon is being used to refer to a carbon atom bonded to four different atoms or groups of atoms.
- For example there is one chiral centre in 2 butanol.



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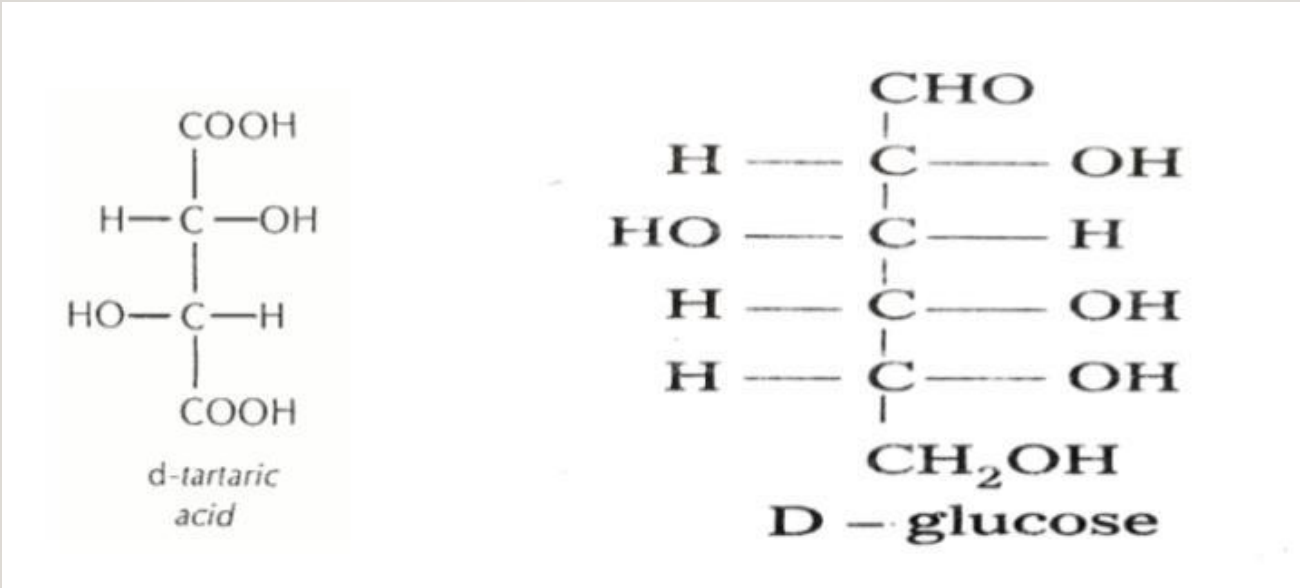
- 2 chiral centres in tartaric acid and 4 chiral centres in glucose molecule



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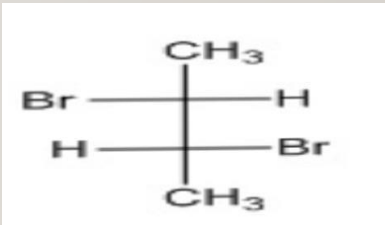
FISHCER PROJECTION FORMULA

- The chiral molecules containing several stereocentres are sometimes represented by two dimensional formulae.
- These two dimensional formulae are known as Fischer projection formulae.
- E.g: 2,3 dibromo butane
- In Fischer projection formula the main carbon chain extends from top to bottom.
- Vertical line represent bonds that project behind the plane of the paper.
- Horizontal lines represent bonds that project out of the plane of the paper.
- The intersection of vertical and horizontal lines represent a carbon atom.



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ELEMENTS OF SYMMETRY

The optically inactive molecules have one or more elements of symmetry.

These molecules are also known as achiral molecules.

There are three main elements of symmetry.

1. Plane of symmetry
2. Centre of symmetry
3. Alternating axis of symmetry

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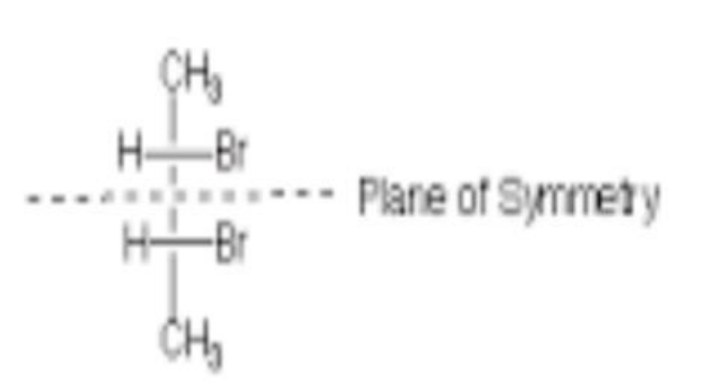
PLANE OF SYMMETRY

- A plane of symmetry is an imaginary plane that bisects a molecule in such a way that the two halves of the molecule are mirror images of each other.
- The plane may pass through atom, between atoms or both. The molecules with a plane of symmetry are achiral.
- E.g. 2,3 dibromo butane.



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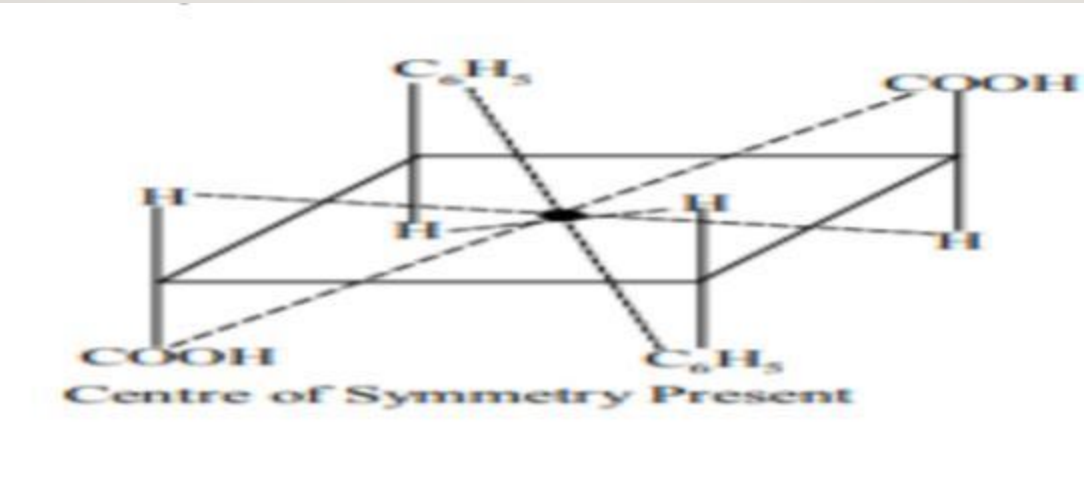
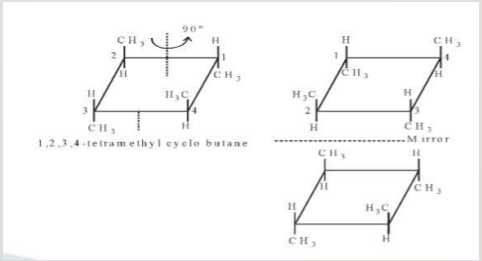
CENTRE OF SYMMETRY

- Centre of symmetry is a point in the centre of a molecule from which the line drawn through the molecule finds the same environment in opposite direction.
- E.g: 2,3 diphenyl cyclobutane 1,3 dicarboxylic acid



ALTERNATING AXIS OF SYMMETRY

- t is a line which passes through the molecule so that a rotation of 360 o/n about this axis leads to a three dimensional structure, which is similar to the original one.
- All molecules possess a one fold axis of symmetry (n=1) since rotation of 360 o about an axis leads to the identical structure.
- The alternating axis of symmetry is known as rotation reflection axis of symmetry.
- E.g: 1,2,3,4 tetramethyl cyclobutane.



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Thank You