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Shri Lemdeo Patil Mahavidyalaya, Mandhal
Tah. Kuhi, Dist. Nagpur.

(Affiliated to RTM Nagpur University, Nagpur, Recognized by State Government NAAC Accredited Institution)



STEREOCHEMISTRY

B.Sc. II Semester
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INTRODUCTION

What is stereochemistry ?

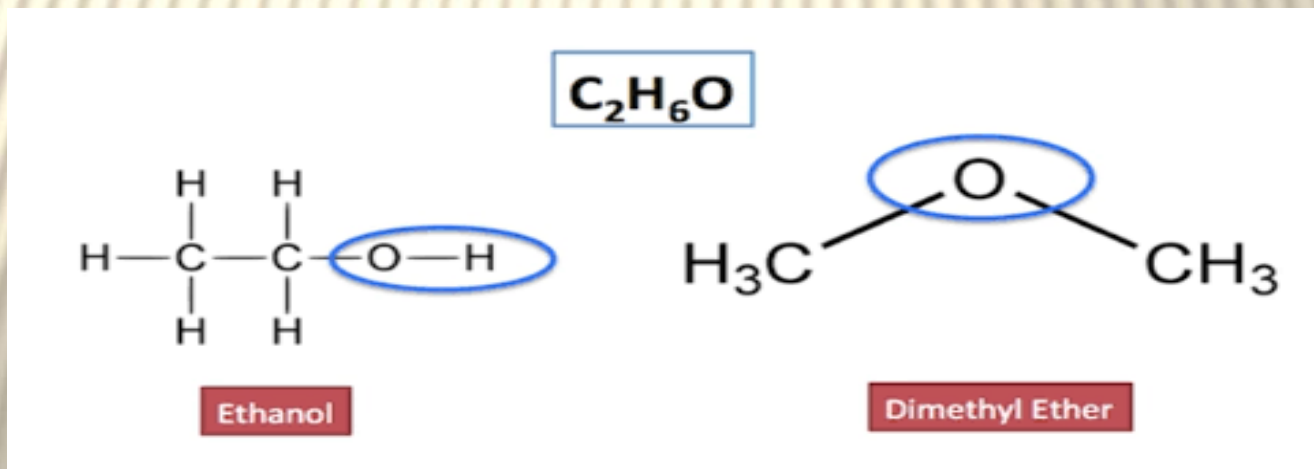
- The study of arrangement of different atoms of group in a molecule in space and their effect on chemical and physical properties .
- The study of stereochemistry focuses on stereoisomers
- It is also known as 3D chemistry—the prefix "stereo-" means “three-dimensionality”.
- Louis Pasteur could rightly be described as the first stereochemist, having observed in 1842



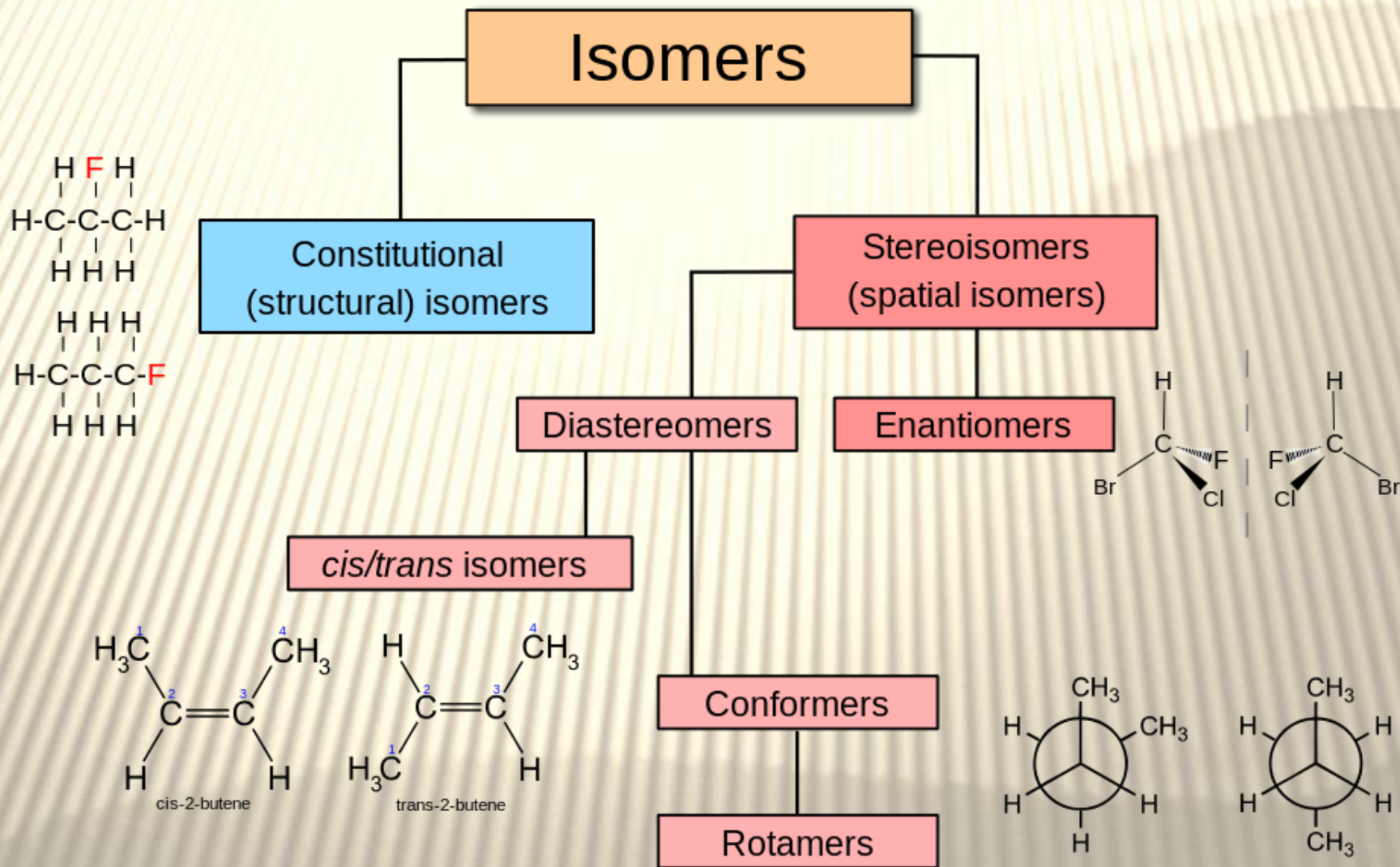
ISOMERISM

What is isomerism ?

- Various organic compounds represented by the same molecular formula are called “ Isomers ” or isomerides. While the existence of isomers is a phenomenon called “Isomerism”.
- Isomers do not necessarily share similar properties
- For example :- Ethanol and dimethyl ether has same molecular formula but they are different compounds.

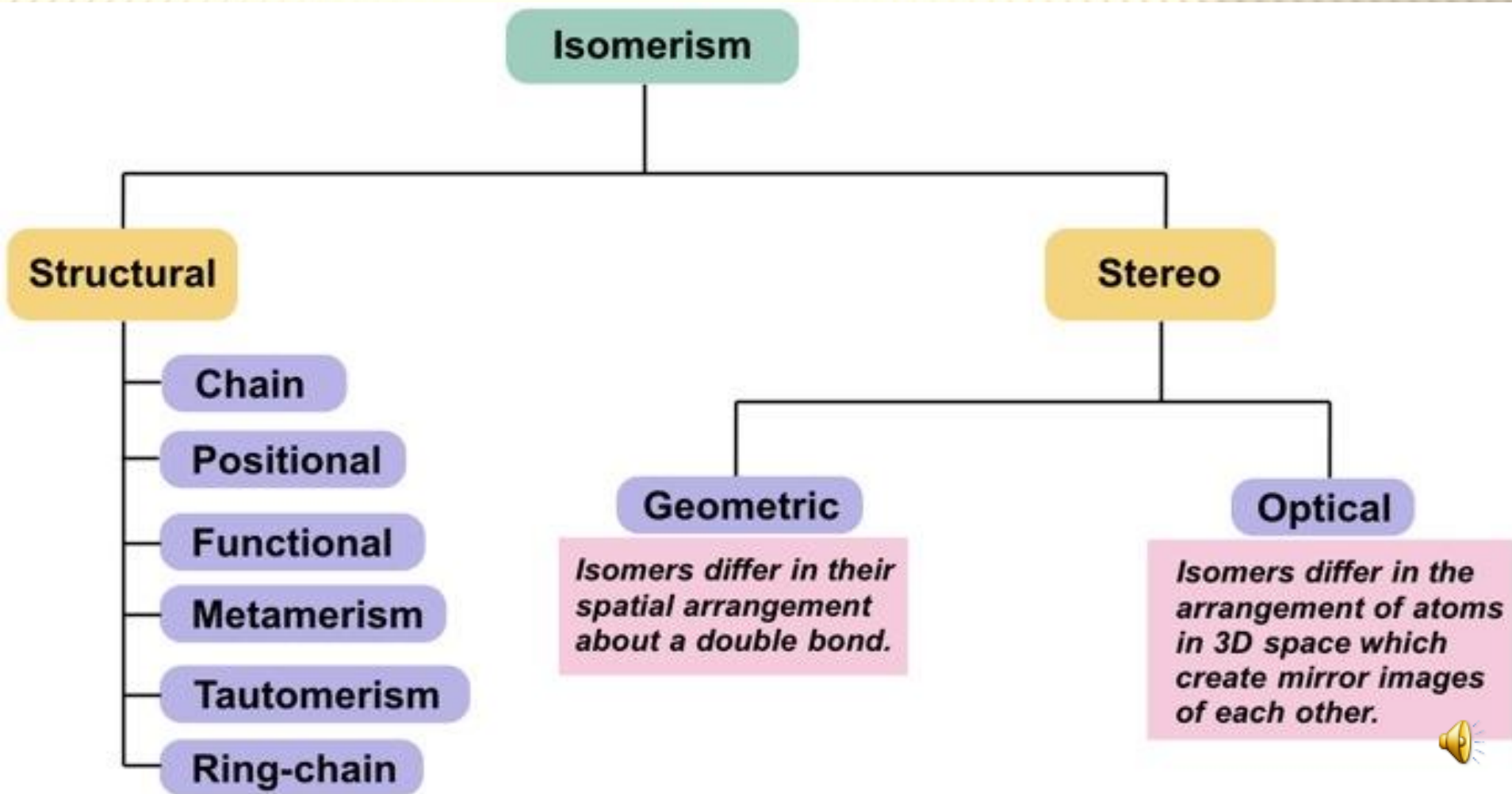


CLASSIFICATION OF ISOMERISM



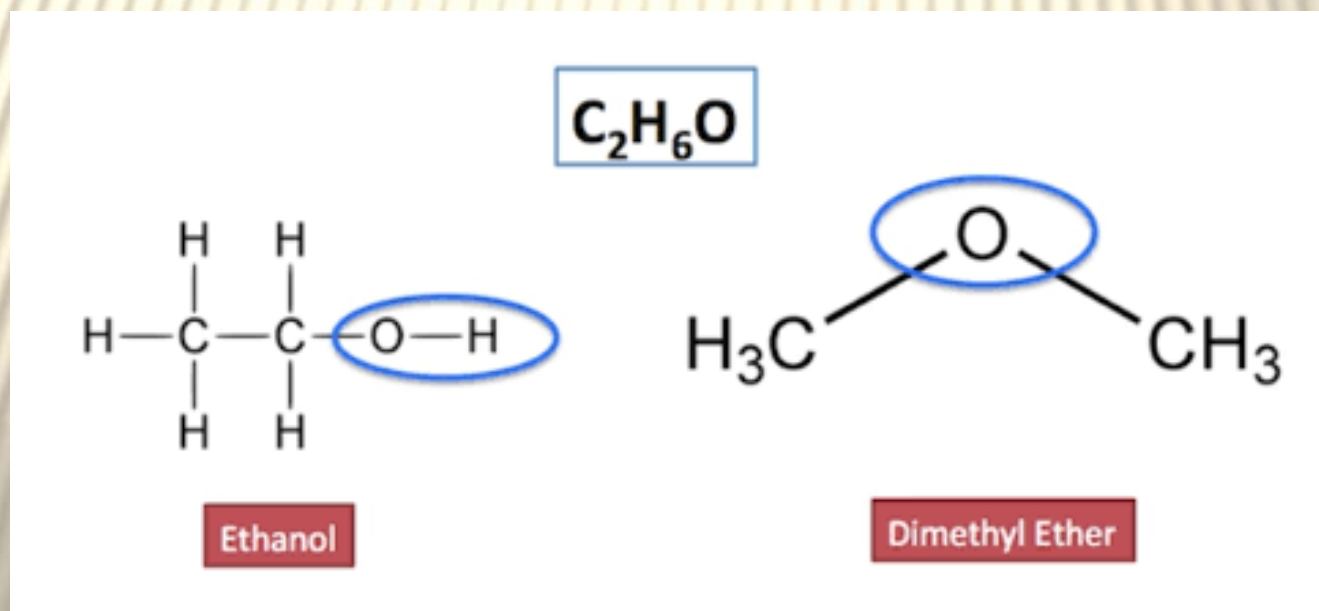
Isomerism is broadly divided into two types

- 1) Structural isomerism
- 2) Stereoisomerism



STRUCTURAL ISOMERISM :-

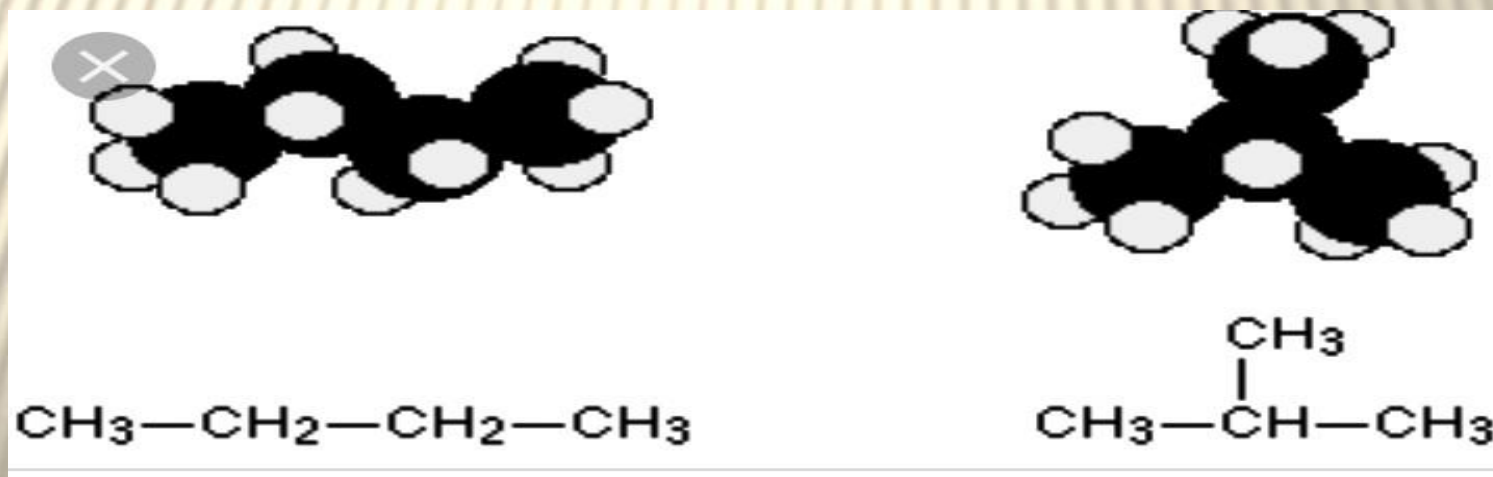
- Compound have same molecular formula but different structures are called as structural isomerism. There are various types of structural isomerism
- For example :- The molecular formula of ethanol & dimethyl ether is same but they are different compounds and there structures are also different.



CHAIN ISOMERISM

➤ The compounds having same molecular formula but difference in carbon chain in the molecules called as chain isomerism i.e. Either it contains straight chain or branch chain.

➤ For example :- Butane molecule having molecular formula C_4H_{10} but structures are different.

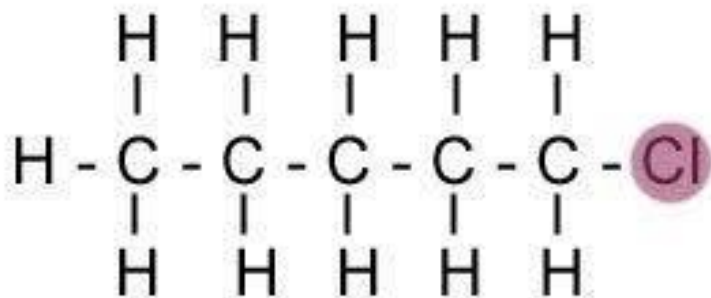


POSITIONAL ISOMERISM

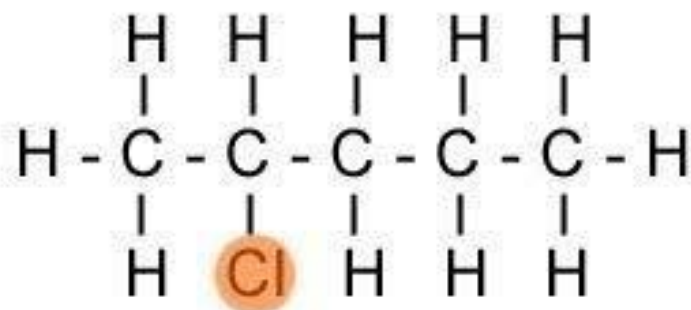
➤ Positional isomers have same molecular formula but differ in the position of a functional group or position of double bond of carbon chain or substituents.

For example :-

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1-Chloropentane

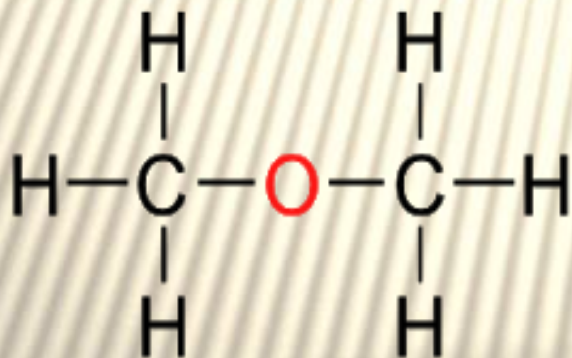


2-Chloropentane

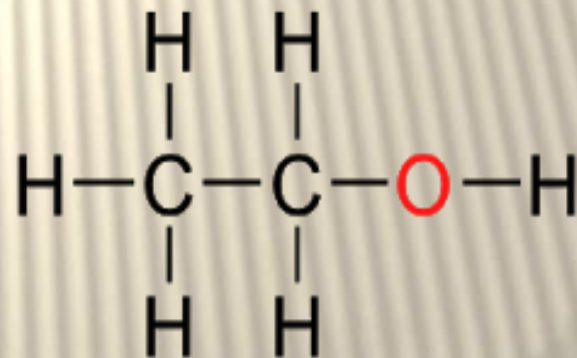


FUNCTIONAL ISOMERISM :-

- Molecules having same molecular formula but difference in the functional group present in two isomers, it is known as functional isomers.
- For example :- Dimethyl ether and ethanol has same molecular formula but both the compounds containing different functional group.



dimethyl ether



ethanol



RING CHAIN ISOMERISM

➤ When molecules have same molecular formula but one is open chain while the other is ring structure, it is called as ring chain isomerism.

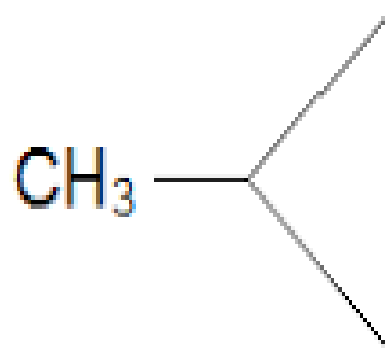
For example :-



Butene



Cyclobutane

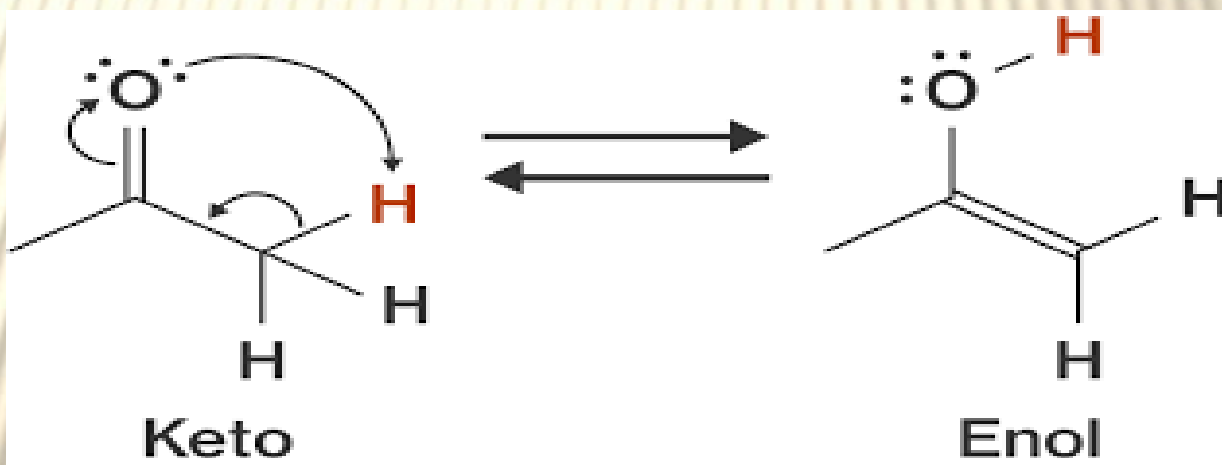


Methylcyclopropane



TAUTOMERISM

- When molecules have same molecular formula but different functional group and they are in dynamic equilibrium (inter convertible with each other).
- It is a special type of functional isomerism.



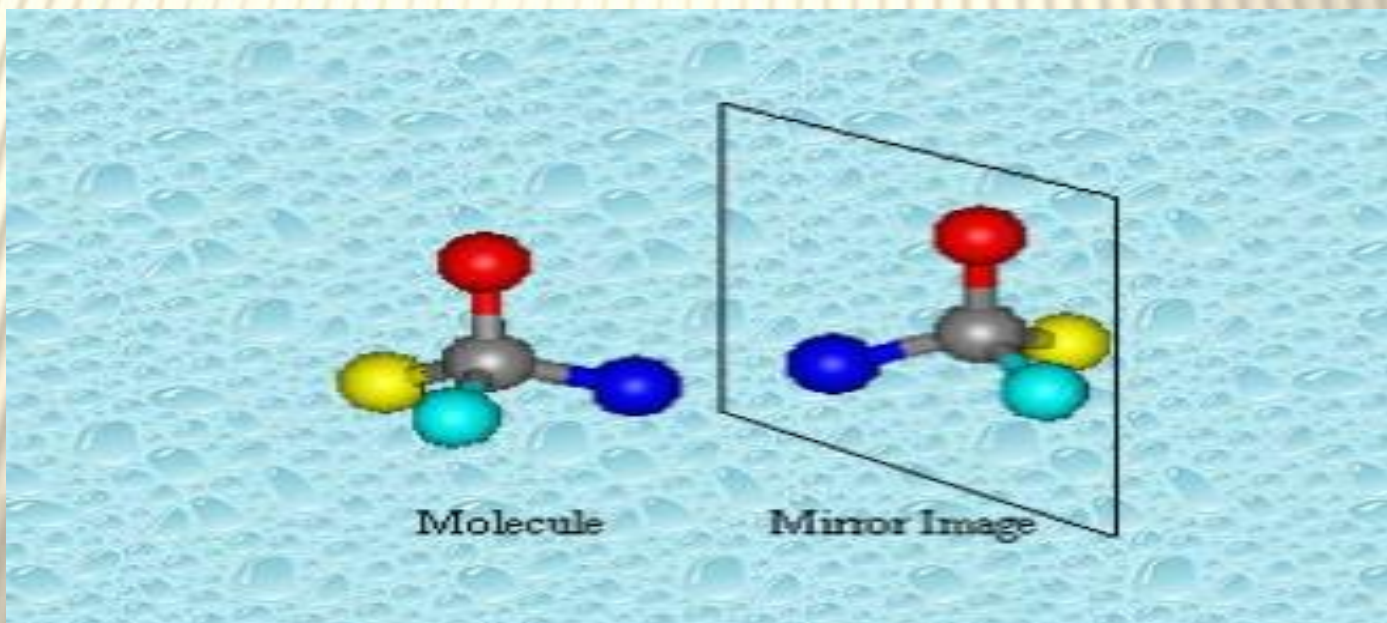
STEREOMERISM

- Molecules having same molecular formula but difference relative arrangement of substituent atom or groups in the space called as stereo isomerism.
- There are three main types of stereo isomerism
 - 1) Optical isomerism
 - 2) Geometrical isomerism
 - 3) Conformational isomerism



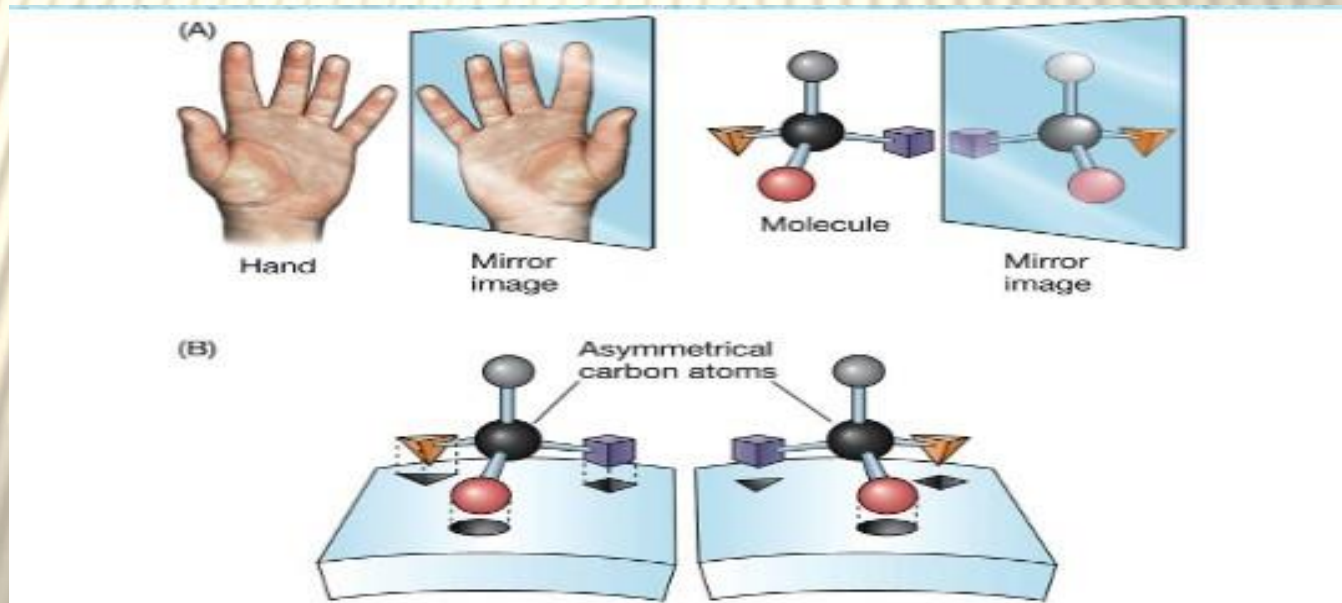
OPTICAL ISOMERISM

➤ The compounds with similar physical & chemical properties due to structural similarities but differ in their action on plane polarized light are known as optical isomerism .



MOLECULAR CHIRALITY

➤ A molecule is considered chiral if there exist another molecule that is of identical composition but which is arranged in a non - superimposable mirror image. The presence of an asymmetric carbon atom is often the feature that causes chirality in molecules .



TERMS OF OPTICAL ISOMERISM

There are two terms of optical isomerism ,

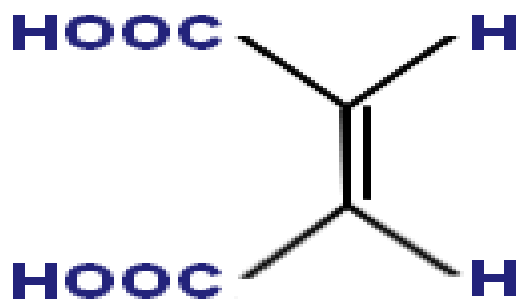
1) **Enantiomerism** :- The optical isomers which are non - superimposable mirror images of each other are called as enantiomers.

➤ If one of them is dextro - rotatory ,other is levo - rotatory.

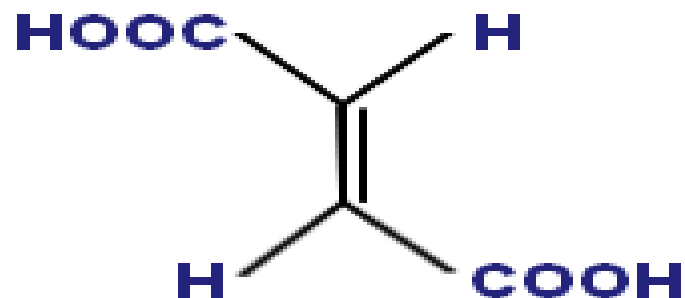


2) Diastereomerism

- The optical isomers which are non - superimposable & not mirror images of each other are called as diastereomers.
- For example : - Maleic acid & fumaric acid both these structures are not superimposable of each other .



**cis-butenedioic
(maleic acid)**



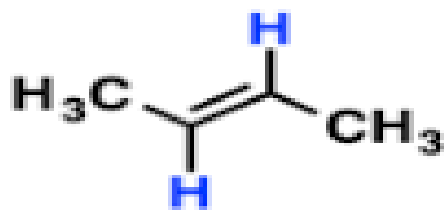
**trans-butenedioic acid
(fumaric acid)**



GEOMETRICAL ISOMERISM

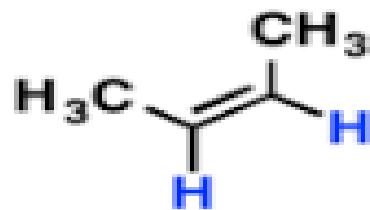
➤ When two dissimilar atoms or groups are attached to doubly bonded carbon atom, the compound exhibit geometrical isomerism and the isomers obtained are called geometrical isomerism.

For example :-



trans-2-butene

boiling point: 3.7 °C



cis-2-butene

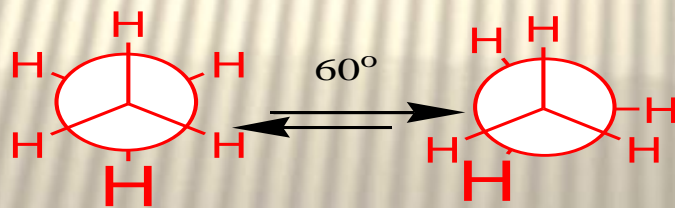
boiling point: 0.9 °C



CONFORMATIONAL ISOMERISM

- The different arrangement of the atoms that result from the rotation of groups about C-C bond axis are called conformation or conformational isomers.
- Changing the configuration of a molecule always means that bonds are broken.
- A different configuration is a different molecules. Changing the conformation of a molecule means rotating about bonds , but not breaking them.

Newnan Projection



Staggared

Eclipsed



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- 3) Organic Chemistry – Clayden , Greeves, warren & Wolthers
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Thank you...

