SEMESTER VI

ISOMERISM

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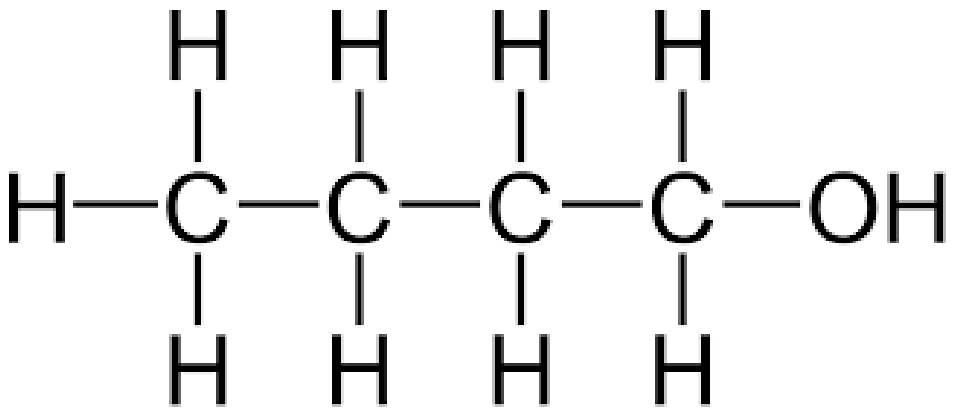
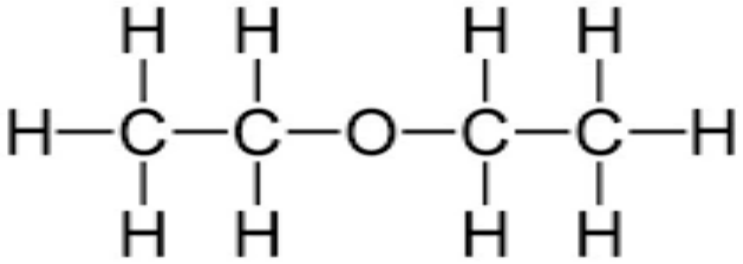
ISOMERISM

- Phenomenon of existence of two or more compounds with same molecular formula but different structure or spatial arrangement of atoms
- Molecules exhibit isomerism are called isomers
- Example butyl alcohol and ethyl ether both have same molecular formulae $C_4H_{10}O$ but they are different in their molecular configuration
- Classified into two structural isomerism and stereo isomerism



Butyl alcohol



Ethyl ether

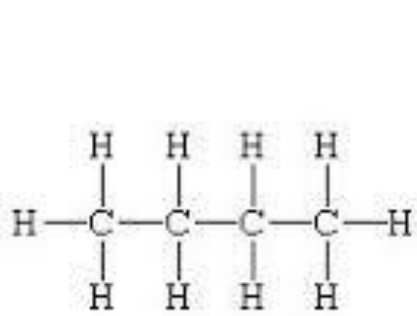
both have same molecular formulae $C_4H_{10}O$ but they are different in their molecular configuration

STRUCTURAL ISOMERISM

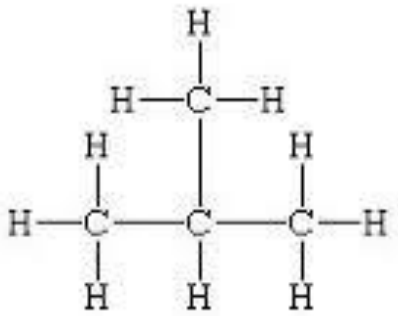
- Isomers have same molecular formula ,but have different structures
- They differ from each o0ther in the order in which they are bonded together
- There are 5 types of structural isomerism ,they are chain isomerism, position isomerism, functional isomerism, metamerism and tautomerism

1.Chain isomerism or nuclear isomerism

- Isomers differ from each other in the arrangement of the carbon chain within the molecules
- Ex. Butane and isobutane (Both have molecular formula C_4H_{10})



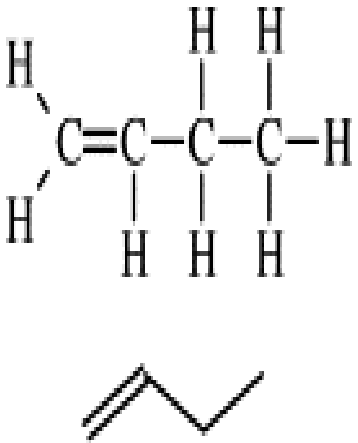
n-butane, $CH_3CH_2CH_2CH_3$



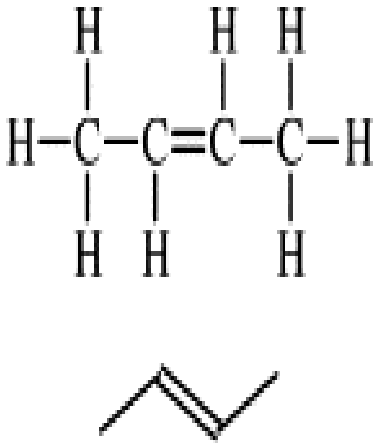
isobutane, $(CH_3)_3CH$

2.Position Isomerism

- Isomers ahev same carbon chain but they are different in the position of a structural entity ,such as a multiple bond, functional group etc.
- Ex. 1- Butene and 2 – Butene (Both have molecular formula C_4H_8)



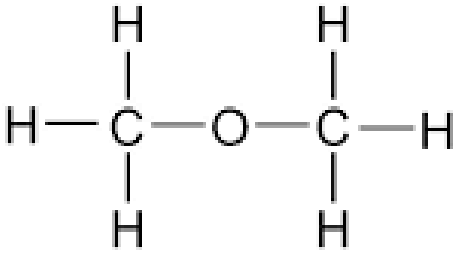
1-Butene



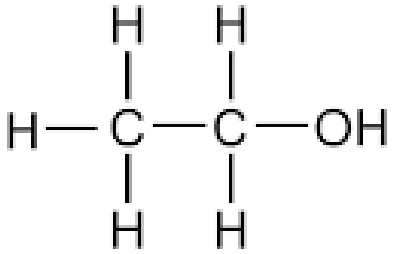
2-Butene

3.Functional isomerism

- Isomers differ from each other with respect to their functional groups
- Ex. Ethanol and dimethyl ether (molecular formula C_2H_6O)



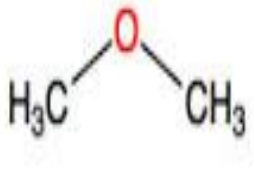
Dimethyl Ether



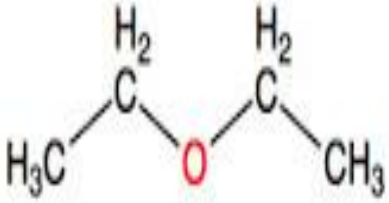
Ethanol

4. Metamerism

- The isomers are belonging to same homologous series ,but differ in the number of alkyl groups attached to the two sides of the bivalent functional group
- Ex. Ethoxymethane and methoxymethane



dimethyl ether
(Methoxymethane)

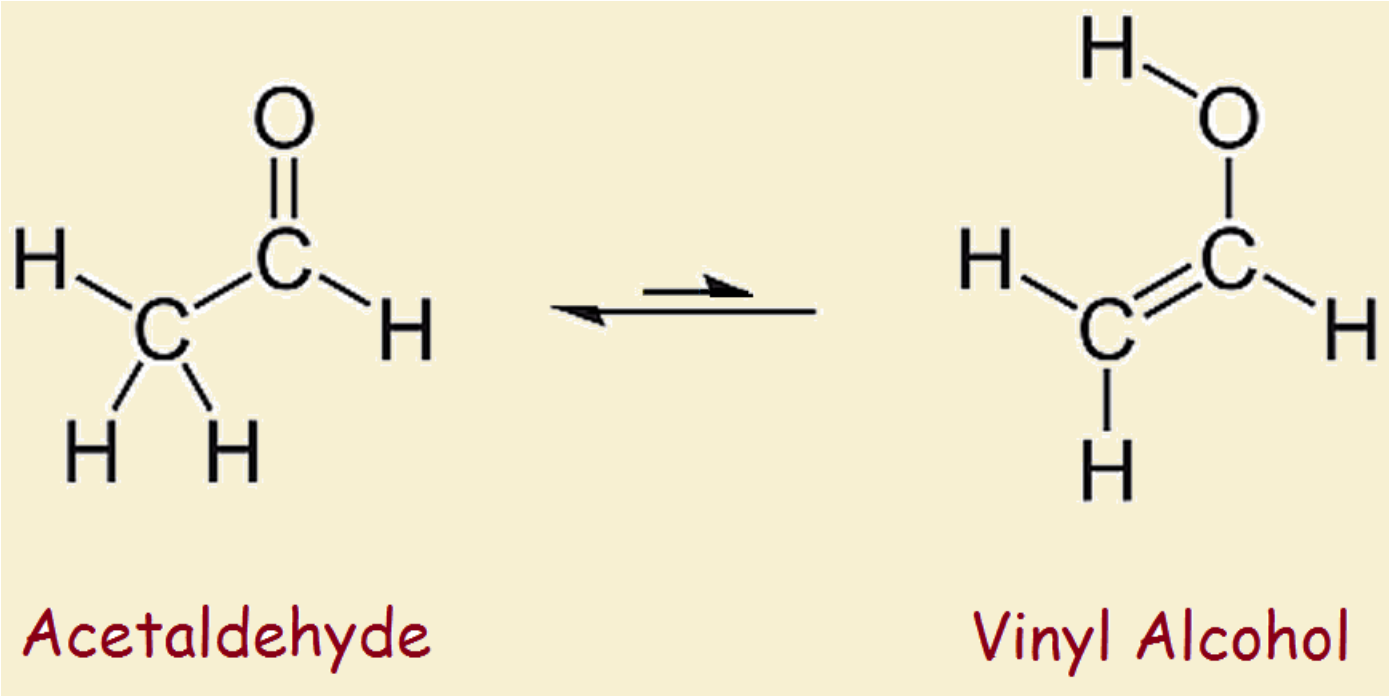


diethyl ether
(Ethoxyethane)

5.Tautomerism

- **Tautomers** are isomers of a compound which differ only in the position of the protons and electrons.
- They are interconvertible and they can transform to each other
- In most cases it occures due to the migration of H atom and a change in the location of the double bond .such tautomerism is called proton tautomerism.

- Ex. acetaldehyde and vinyl alcohol



Keto form

Enol form

STEREO ISOMERISM

- Isomerism in which compounds have identical chemical composition but have different arrangement of atoms or groups in space.
- Stereo isomerism is mainly of two kinds ,conformational isomerism and configurational isomerism

1. Conformational isomerism

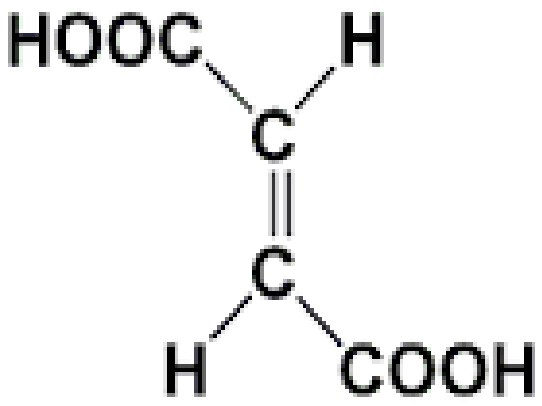
- Isomers differ from each other in their conformation due to conformation due to differences in the spatial arrangement of their atoms or groups
- Results due to free rotation of atoms or groups around single bonds

2.Configurational isomerism

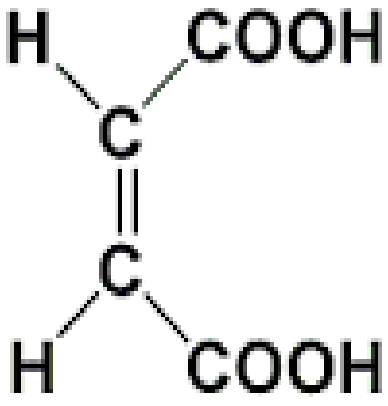
- Isomers differ in each other by their configuration
- Two types : Geometrical and optical

a) Geometrical or cis –trans isomerism

- Isomers have different spatial arrangement of atoms or groups around a non – rotating double bond
- Result due to restricted rotation around double bond
- **cis** indicates that the functional groups are on the same side of the carbon chain
  while **trans** conveys that functional groups are on opposing sides of the carbon chain



Fumaric Acid

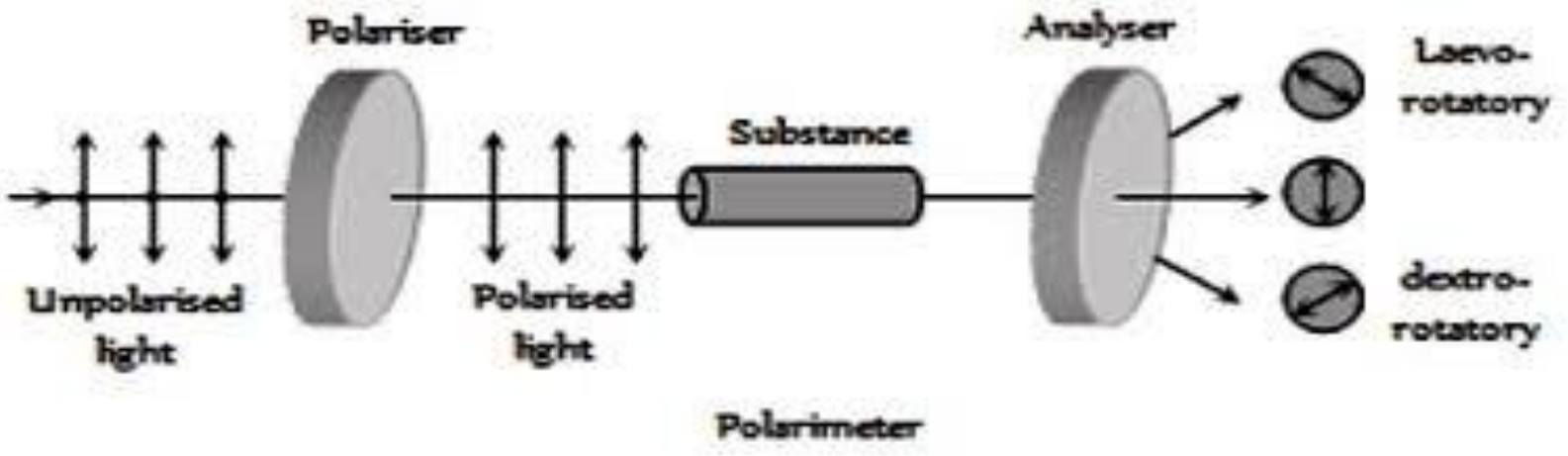


Maleic Acid

b) Optical isomerism

- Isomers differ from each other in their optical activity or behaviour towards plane polarized light

Optical activity



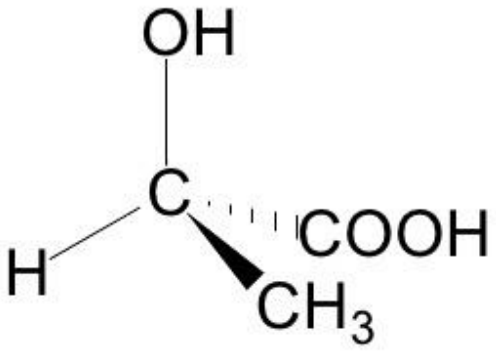
- Ability of a molecule to rotate the plane polarised light either to left or right
- Exhibited only by molecules having asymmetric carbon
- Change in direction of plane polarised light is called optical rotation
- Degree of rotation depends upon the concentration of the compound

- The number of optical isomers depends on the number of asymmetric carbon atoms .It is always equal to 2^n

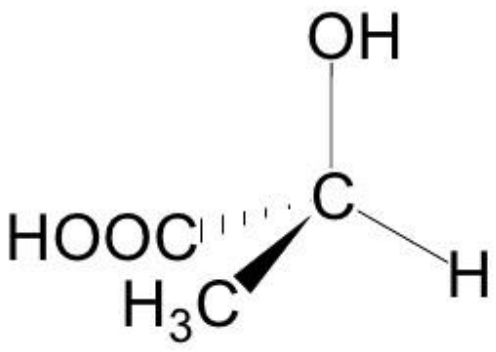
Where n = no. of asymmetric C atoms

- The form which rotate light to right is called dextro rotatory (d OR +) which rotate light to left is called left is called levorotatory (L or -).
- The two mirror image forms of an asymmetric molecule are optical isomers

- A mixture of d and l forms in equal forms will not show any optical activity .such a mixture is called **racemic mixture**.



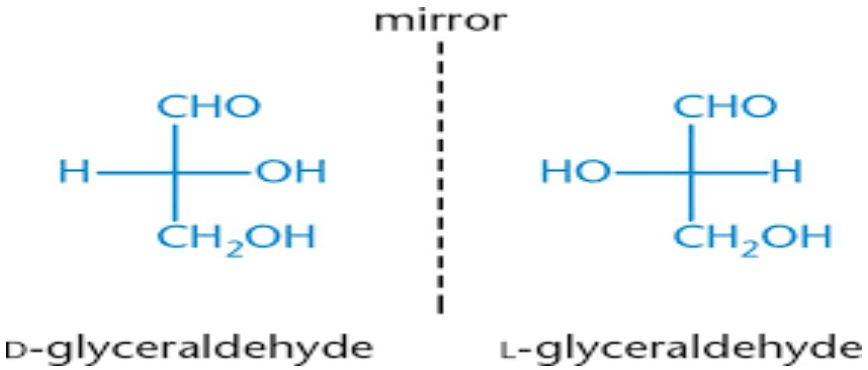
(-) lactic acid
in sour milk



(+) lactic acid
in muscles

Enantiomers

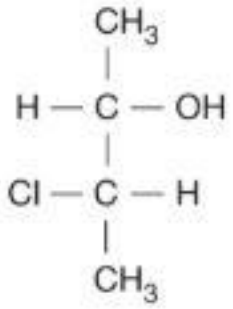
- Non super impossible mirror images
- They are a pair of optical isomers whose molecular configurations have right handed and left handed forms
- Usually found in compounds with only one asymmetric C atom
- Ex. enantiomers of glyceraldehyde



Diasteriomers

- They are a group of four optical isomers occurring in compounds with two asymmetric C atoms
- The four isomers include two pairs of enantiomers a pair of D form and a pair of L form

3-chloro-2-butanol affords another example of a compound having two dissimilar chiral carbon atoms and can exist in four stereoisomeric forms as given below.



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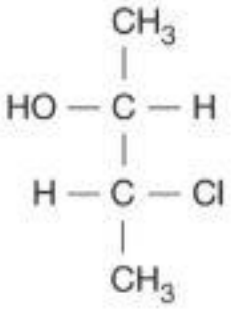

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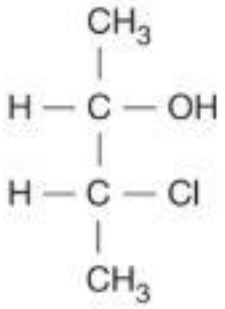

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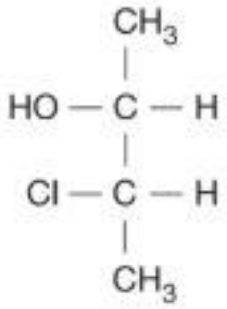

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