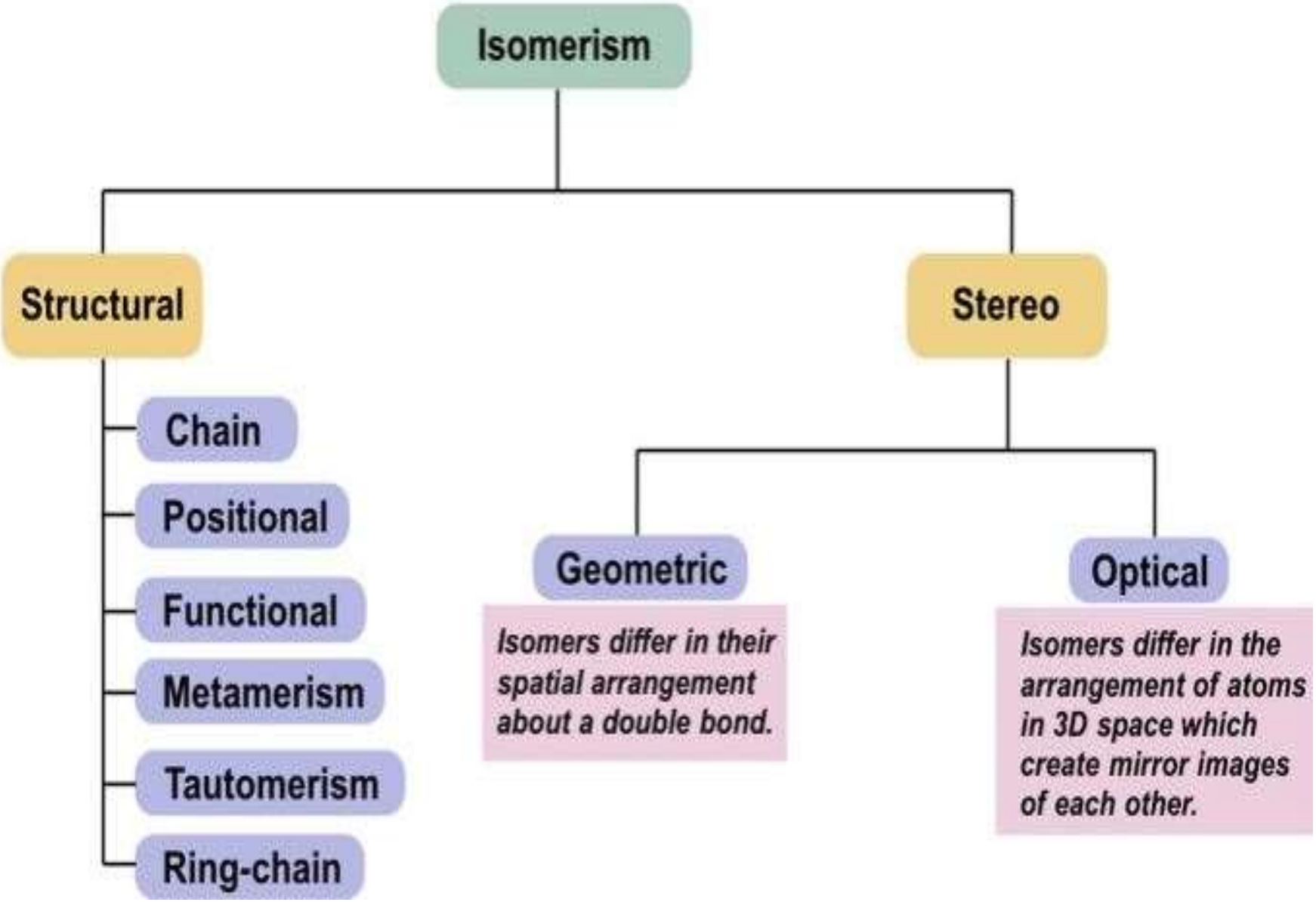
ISOMERISM

Isomerism is the phenomenon in which more than one compounds have the same chemical formula but different chemical structures. Chemical compounds that have identical chemical formula but differ in properties and the arrangement of atoms in the molecule are called **isomers**. Therefore, the compounds that exhibit isomerism are known as isomers.

The word “isomer” is derived from the Greek words “isos” and “meros”, which mean “equal parts”. This term was coined by the Swedish chemist Jacob Berzelius in the year 1830.

Types

There are two primary types of isomerism, which can be further categorized into different subtypes. These primary types are **Structural Isomerism** and **Stereoisomerism**. The classification of different types of isomers is illustrated below.


Isomerism
Structural
Stereo
Chain
Positional
Functional
Metamerism
Tautomerism
Ring-chain
Geometric
Isomers differ in their spatial arrangement about a double bond.
Optical
Isomers differ in the arrangement of atoms in 3D space which create mirror images of each other.

Structural Isomerism

Structural Isomerism

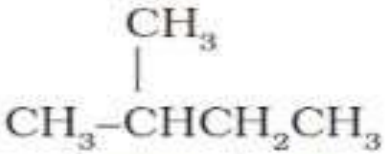
Structural isomerism is commonly referred to as constitutional isomerism. The functional groups and the atoms in the molecules of these isomers are linked in different ways. Different structural isomers are assigned different IUPAC names since they may or may not contain the same functional group. The different types of structural isomerism are discussed below.

1. Chain Isomerism
2. Position Isomerism
3. Functional Isomerism
4. Metamerism
5. Tautomerism
6. Ring Chain isomerism

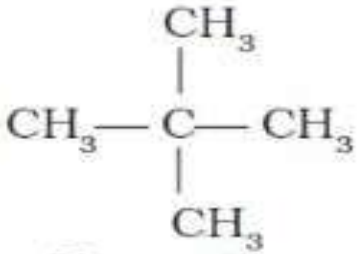
1. Chain Isomerism:

It is also known as skeletal isomerism. The components of these isomers display differently branched structures. Commonly, chain isomers differ in the branching of carbon. An example of chain isomerism can be observed in the compound C_5H_{12}, as illustrated below.

Pentane



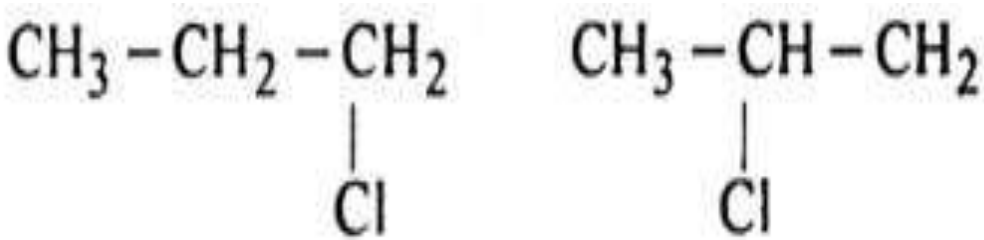
Isopentane
(2-Methylbutane)



Neopentane
(2,2-Dimethylpropane)

2. Position Isomerism

The positions of the functional groups or substituent atoms are different in position isomers. Typically, this isomerism involves the attachment of the functional groups to different carbon atoms in the carbon chain. An example of this type of isomerism can be observed in the compounds having the formula C_3H_7Cl.

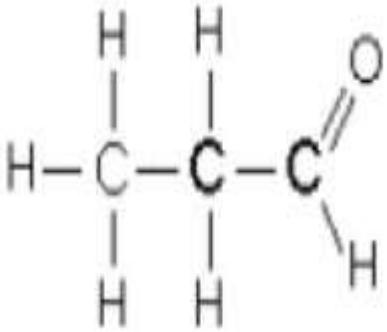


1-Chloropropane 2-Chloropropane

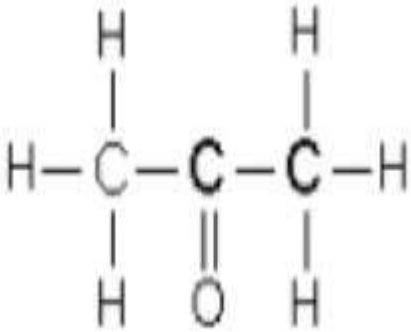
3. Functional Isomerism

It is also known as functional group isomerism. As the name suggests, it refers to the compounds that have the same chemical formula but different functional groups attached to them. An example of functional isomerism can be observed in the compound C_3H_6O.

propanal



propanone (acetone)



4. Metamerism

This type of isomerism arises due to the presence of different alkyl chains on each side of the functional group. It is a rare type of isomerism and is generally limited to molecules that contain a divalent atom (such as sulfur or oxygen), surrounded by alkyl groups.

Example: $C_4H_{10}O$ can be represented as :

ethoxyethane ($C_2H_5OC_2H_5$) and methoxy-propane ($CH_3OC_3H_7$).

5. Tautomerism

Tautomerism is a **dynamic equilibrium** between two compounds with same molecular formula. A tautomer of a compound refers to the isomer of the compound which only differs in the position of protons and electrons. Typically, the tautomers of a compound exist together in equilibrium and easily interchange. It occurs via an intramolecular proton transfer.

The most common form of tautomerism is **keto-enol tautomerism**.

A carbonyl compound containing at least one α-hydrogen atom is converted to an enol by the transfer of an α-hydrogen onto the oxygen atom. For example,

keto form of acetone **enol** form of acetone

6. Ring Chain Isomerism

Compounds having the same molecular formula but possessing open **chain** and cyclic structures are called **ring chain isomers** and the phenomenon is called **ring-chain isomerism**.

For example propene and cyclopropane are **ring chain isomers**.

$CH_3 - CH = CH_2$ and 

Propene Cyclopropane