

Isomerism Chemistry Questions with Solutions

Q1. What are isomers?

Answer: Isomers are pairs of molecules having the same chemical formula but different chemical structures.

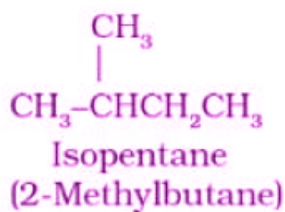
Q2. What are the different types of isomers?

Answer: We can predominantly classify isomers into two classes, i.e. structural isomers and stereoisomers. In structural isomers, the bond between the atoms is different, whereas in stereoisomers, the bond between atoms is the same, but the relative positions of the atoms are different.

Q3. What is a structural isomer? How can you classify it?

Answer: Structural isomers are pairs of molecules having the same chemical formula but distinct arrangements of atoms.

Example:



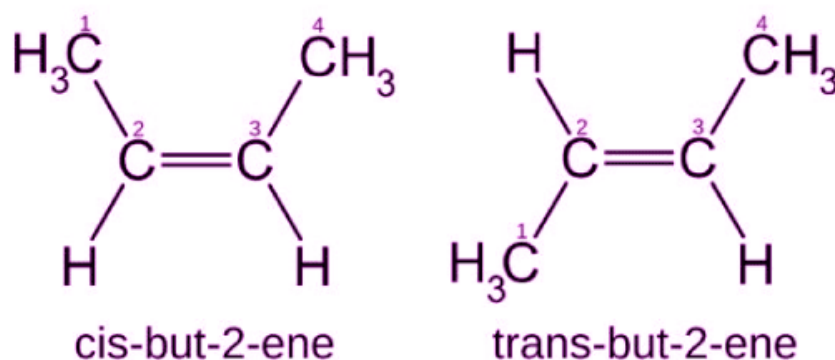
We can further classify structural isomers into six classes.

- Chain Isomer
- Functional Isomer
- Position Isomer
- Ring-chain isomer
- Metamerism
- Tautomerism

Q4. What is a stereoisomer? How can you classify it?

Answer: Stereoisomers are pairs of molecules having the same chemical formula distinct orientations of the atoms in 3-D space.

Example:



We can further classify stereoisomer into two classes.

- Geometric Isomers
- Optical Isomers

Q5. If a compound has two chiral carbon. What is the number of optically active isomers?

- (a) Two
- (b) Three
- (c) Four
- (d) Five

Answer: ©, If a compound has two chiral carbon, then it will have four optically active isomers.

Explanation: The number of optically active isomers is equivalent to 2^n , where n is the number of chiral carbon atoms. So, 2^2 , would be equal to 4. Thus two chiral carbon will have four optically active isomers.

Q6. A compound with the same molecular formula exists in two forms one is alcohol and the other is ether. What type of isomerism does it exhibit?

- (a) Chain Isomerism
- (b) Functional Isomerism
- (c) Position Isomerism
- (d) None of the above

Answer: (b), A compound with the same molecular formula but different functional groups exhibits functional isomerism.

Q7. How many planes of symmetry do meso compounds have?

- (a) One
- (b) Two
- (c) Three
- (d) Four

Answer: (a), A meso compound has only one plane of symmetry.

Q8. A racemic mixture is formed by mixing two

- (a) Optically Active compounds
- (b) Chiral compounds
- (c) Meso Compounds
- (d) Any compound

Answer: (a), A racemic mixture is formed by mixing two optically active compounds.;

Q9. Which one of the following conformations of cyclohexane is chiral?

- (a) Boat
- (b) Twist Boat
- (c) Chair
- (d) None of the above

Answer: (b), A twist boat conformation of cyclohexane is chiral.

Q10. How many chain isomers does butylene have?

Answer: A butylene molecule has two chain isomers: n-butane and isobutylene.

Q11. Differentiate between enantiomers and diastereomers.

Answer:

S. No.	Enantiomer	Diastereomer
1.	Enantiomers are the stereoisomers having non-superimposable mirror images.	Diastereomers are the stereoisomers having non-superimposable non-mirror images.
2.	They have proximate melting and boiling points.	They have distinct melting and boiling points.
3.	They have identical physical properties except for the ability to rotate plane-polarised light.	They have different physical properties.
4.	They are present in pairs.	They are not present in pairs.
5.	They have similar molecular shapes.	They have different molecular shapes.

Q12. What is a structural isomer? Explain the classification of structural isomers in detail.

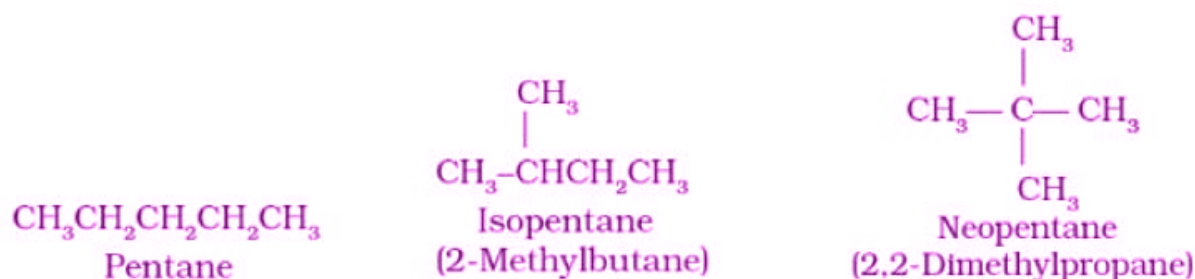
Answer: Structural isomers are pairs of molecules having the same chemical formula but distinct arrangements of atoms.

We can further classify structural isomers into six classes, i.e.

- Chain Isomer
- Functional Isomer
- Position Isomer
- Ring-chain isomer
- Metamer
- Tautomer.

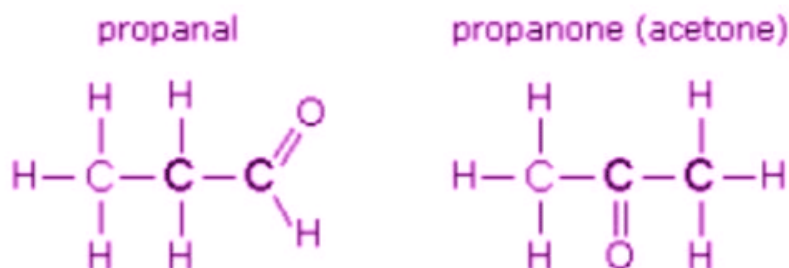
Chain Isomers: It is also known as skeletal isomers. They are the pairs of molecules having the same molecular formula but differently branched structures.

Example:



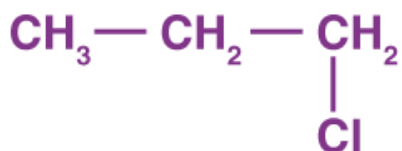
Functional Isomers: Functional isomers are the pairs of molecules having the same molecular formula but different functional groups attached to them.

Example:

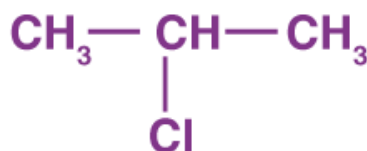


Position Isomers: Position isomers are the pairs of molecules having the same molecular formula but the different positions of functional groups or substituents.

Example:



1-Chloropropane



2-Chloropropane

Ring-Chain Isomer: Ring-Chain isomers are the pairs of molecules having the same molecular formula, but different structures, i.e. one of the isomers has an aliphatic structure whereas the other has a cyclic structure.

Example:



and

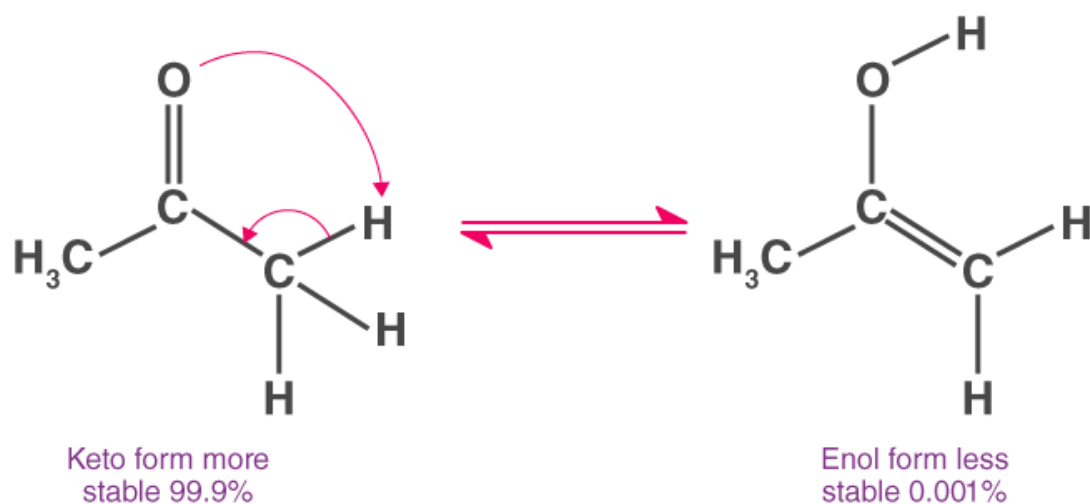


Metamers: Metamers are the pairs of molecules having the same molecular formula but different alkyl chains on each side of the functional group.

Example: A pair of ethoxyethane ($\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$) and methoxy propane ($\text{CH}_3\text{OC}_3\text{H}_7$).

Tautomers: Tautomers are the pairs of molecules having the same molecular formula but the different positions of protons and electrons.

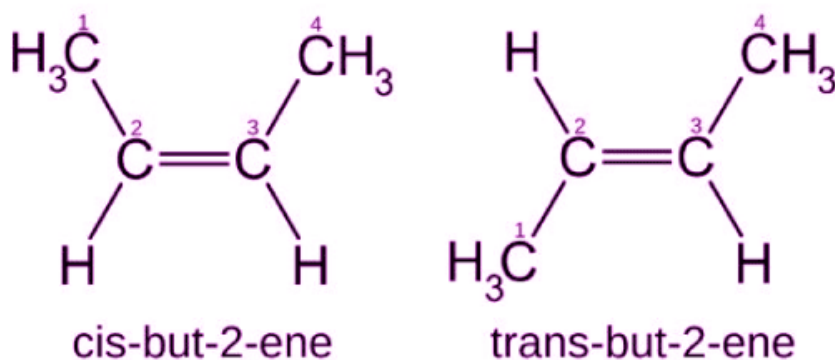
Example:



Q13. What is a stereoisomer? Explain the classification of stereoisomer in detail.

Answer: Stereoisomers are pairs of molecules having the same chemical formula distinct orientations of the atoms in 3-D space.

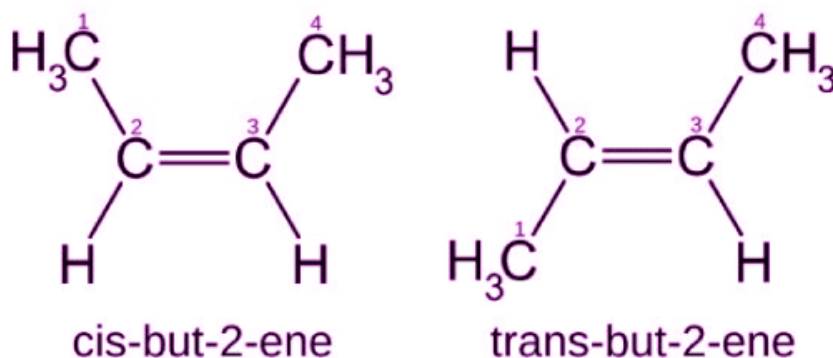
Example:



We can further classify stereoisomer into two classes.

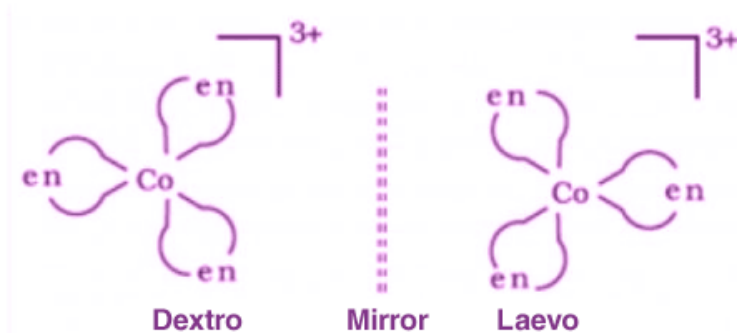
- Geometric Isomers
- Optical Isomers

Geometric Isomers: It is also known as cis-trans isomers. They are the pairs of molecules having the same molecular formula but different spatial arrangements of atoms in three-dimensional space.



Optical Isomers: Optical Isomers are the pair of molecules having the same molecular formula but different spatial arrangements of atoms forming non-superimposable mirror images.

Example:



Q14. What is an ionisation isomer?

Answer: Ionisation isomers are pairs of molecules with the same molecular composition but give different ions in the solution.

Example: $[\text{Co}(\text{NH}_3)_5(\text{SO}_4)]\text{Br}$ and $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$.

- It arises when the counter ion replaces the ligand.

Q15. What is a racemic mixture?

Answer: A racemic mixture is the homogenous mixture of two enantiomers in a comparable amount. A racemic mixture shows different properties from enantiomers.

Practise Questions on Isomerism

Q1. Differentiate between chiral and achiral molecules.

Answer:

S No.	Chiral	Achiral
1	They are asymmetric.	They are symmetric.
2	They are non-superimposable mirror images of each other.	They are superimposable mirror images of each other.
3	They rotate plane polarised light in a clockwise or anticlockwise direction.	They don't rotate plane polarised light in any direction.
4	The mirror image of a chiral molecule is a different molecule.	The mirror image of an achiral molecule is an identical molecule.

Q2. What are threo and erythro?

Answer: Erythro and threo are two configurations of molecules with a chiral carbon atom. Erythro is the configuration when the identical groups are on the same side of the carbon atom, and Threo is when the identical groups are on the opposite side of the carbon atom.

Q3. Identify the compound that exhibits tautomerism

- (a) 2-Pentanone
- (b) Phenol
- (c) 2-Butene
- (d) Lactic acid

Answer: (a), 2-Pentanone exhibits tautomerism. Tautomers are the pairs of molecules having the same molecular formula but the different positions of protons and electrons.

Q4. Which types of isomerism are shown by 2,3-dichlorobutane?

- (a) Diastereomerism
- (b) Optical Isomerism
- (c) Geometric Isomerism
- (d) Structural Isomerism

Answer: (b), 2,3-dichlorobutane has 2 chiral centres which are non-superimposable mirror images. Thus it shows optical isomerism.

Q5. Which of the following alkenes exhibit geometrical isomerism?

- (a) Propene
- (b) 2-Methylpropene

(c) 2-Butene

(d) 2-Methyl -2-butene

Answer: ©, 2-Butene exhibits geometrical isomerism.

