What is Isomerism in Organic Compounds?

Worksheet

Isomers are compounds with the same molecular formula (e.g., CHO) but different structural or spatial arrangements. Main types: structural isomers (chains, position, functional group), geometric isomers (cis-trans alkenes), and optical isomers (enantiomers).

Questions

1. Which CH isomer has the higher boiling point: n-butane or isobutane?

A) isobutane
B) n-butane
C) Equal
D) Cannot determine

2. Can but-1-ene show geometric isomerism?

A) Yes
B) No
C) Only in polar solvents
D) With catalysts only

3. How many stereoisomers does 2,3-dichlorobutane have?

A) 1
B) 2
C) 3
D) 4

4. What does 'non-superimposable' mean?

A) Cannot be rotated
B) Cannot be reflected
C) Cannot be overlaid to match exactly
D) Cannot dissolve

5. CH has two structural isomers. Name them and explain why their boiling points differ.

6. Draw or describe both isomers of but-2-ene and explain why they cannot interconvert at room temperature.

7. Identify the chiral center in 2-bromo-3-methylbutane and draw both enantiomers.

8. Define: What are isomers?

9. Define: What is a structural isomer?

10. Define: What is a geometric isomer?

Answer Key

1. B) n-butane - n-butane (straight chain) has greater surface area and stronger London forces higher bp.

2. B) No - but-1-ene (CH=CHCHCH) has two identical H atoms on C1 no cis-trans.

3. D) 4 - Two chiral centers (C2 and C3) 2 = 4 stereoisomers (two enantiomeric pairs).

4. C) Cannot be overlaid to match exactly - Enantiomers are mirror images that cannot be overlaid; they differ in 3D space.

5. Molecular formula CH can form: 1. n-butane: CHCHCHCH (straight chain, bp = 0.5C) 2. isobutane (2-methylpropane): C(CH) (branched, bp = 11.7C) Difference: straight-chain n-butane has stronger London forces (larger surface area). Result: n-butane has higher boiling point.

6. 1. Cis-but-2-ene: CH and H on same side of C=C double bond 2. Trans-but-2-ene: CH and H on opposite sides Why no interconversion: -bond in C=C has restricted rotation. Breaking the double bond requires ~60 kcal/mol activation energy. At room temperature, thermal energy insufficient geometric isomers persist.

7. 2-bromo-3-methylbutane: (CH)CHCHBrCH Chiral center: the carbon with Br, connected to 4 different groups (Br, H, CH, CHBr). Enantiomers: (R) and (S) configurations (determined by Cahn-Ingold-Prelog rules). They are non-superimposable mirror images.

8. Compounds with the same molecular formula but different structural or spatial arrangements.

9. Isomers that differ in the sequence/arrangement of atoms (e.g., chain, branching, functional group position).

10. Isomers with restricted rotation (usually around C=C) leading to different spatial arrangements (cis and trans).