

13.4 Isomerism: structural isomerism and stereoisomerism

Name: _____ Class: _____ Date: _____

Total: 12 marks

KEY WORDS isomerism 异构 • structural 结构 • stereoisomerism 立体异构 • trans 反式 • structural isomerism 结构

Objective

Build the skills to answer exam questions on **isomerism** 异构 — **structural** 结构 isomerism (chain, positional, functional group) and **stereoisomerism** 立体异构 (cis/trans and optical).

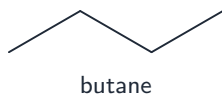
You must be able to:

- describe structural isomerism and its three kinds
- explain cis/trans isomerism in terms of restricted rotation at a C=C bond
- identify chiral centres and the geometrical isomerism in a given structure

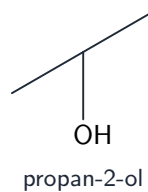
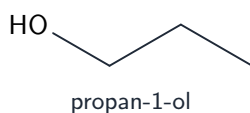
1 Worked examples

■ Structural isomerism

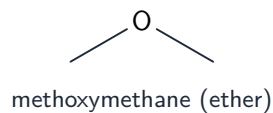
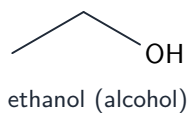
chain



positional

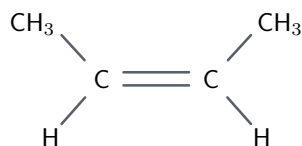


functional

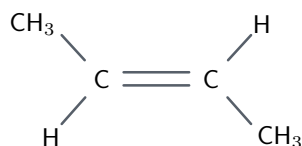


Chain, positional and functional-group isomerism — same molecular formula, different structure

■ Stereoisomerism

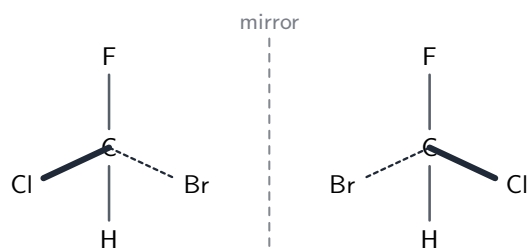


cis: both CH₃ on the same side



trans: CH₃ on opposite sides

Cis/trans isomerism at a C=C: the π bond stops rotation, fixing groups on the same (cis) or opposite (trans) side



enantiomers: mirror images that cannot be superimposed
(the central carbon has 4 different groups)

A **chiral centre** 手性中心 (*carbon with four different groups*) gives two mirror-image **enantiomers** 对映体

2 Practice

2.1 Name the three kinds of structural isomerism.

[3]

2.2 State what is meant by a **chiral centre**.

[1]

3 Exam-style questions

3.1 Cis/trans isomerism is possible because:

[1]

- A single bonds cannot rotate
- B the π bond in $C=C$ prevents rotation
- C the molecule is ionic
- D the carbons are sp^3 hybridised

3.2 Which compound has a chiral centre?

[1]

- A $CH_3CH_2CH_3$
- B $CH_3CHBrCH_2CH_3$
- C CH_3CH_2OH
- D CH_2Cl_2

3.3 (a) Draw the cis and trans isomers of but-2-ene, $\text{CH}_3\text{CH}=\text{CHCH}_3$. [2]

(b) Explain why but-2-ene shows cis/trans isomerism but but-1-ene does not. [2]

3.4 2-hydroxypropanoic acid is $\text{CH}_3\text{CH}(\text{OH})\text{COOH}$. State, with a reason, whether it has a chiral centre. [2]

Solutions

2.1 chain; positional; functional group isomerism.

2.2 a carbon atom bonded to four different groups.

3.1 B. The π bond in the $C=C$ prevents rotation.

3.2 B. The second carbon in $CH_3CHBrCH_2CH_3$ has four different groups.

3.3 (a) cis — both CH_3 groups on the same side of the $C=C$; trans — on opposite sides.
(b) but-2-ene has a different group (H and CH_3) on each double-bond carbon, so cis/trans is possible; but-1-ene has two H atoms on the end carbon, so the groups can be swapped without making a new isomer.

3.4 yes; the second carbon is bonded to four different groups (CH_3 , OH, H, COOH), so it is a chiral centre.