

Exercise walk-through

Isomerism: structural isomerism and stereoisomerism ■ 13.4

eXercise

You must be able to

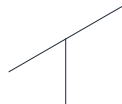
- describe structural isomerism and its three kinds
- explain cis/trans isomerism in terms of restricted rotation at a C=C bond
- identify chiral centres and the geometrical isomerism in a given structure

Method — Structural isomerism

chain

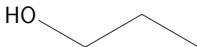


butane

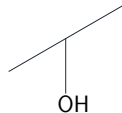


2-methylpropane

positional



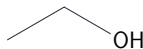
propan-1-ol



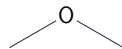
OH

propan-2-ol

functional



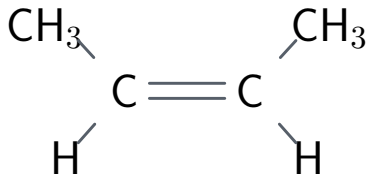
ethanol (alcohol)



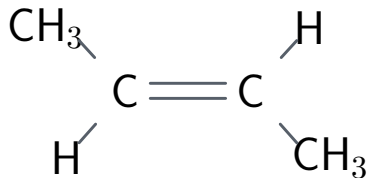
methoxymethane (ether)

Method — Stereoisomerism

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



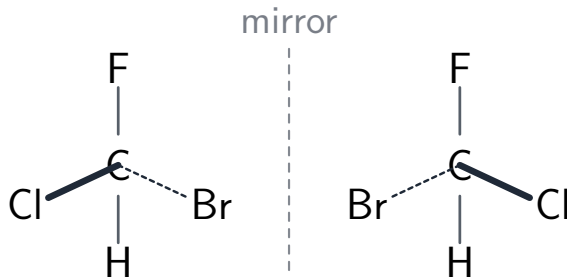
cis: both CH₃ on
the same side



trans: CH₃ on
opposite sides

But-2-ene drawn cis (methyls same side) and trans (opposite sides)

Method — Stereoisomerism



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

Practice 2.1 ■ 3 marks

Name the three kinds of structural isomerism.

Solution 2.1

Method: Structural isomerism

Worked steps

chain; positional; functional group isomerism **B1** *each*.

Practice 2.2 ■ 1 mark

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

Solution 2.2

Method: Stereoisomerism

Worked steps

a carbon atom bonded to four different groups **B1**.

Exam-style 3.1 ■ 1 mark

Cis/trans isomerism is possible because:

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

Solution 3.1

Method: Stereoisomerism

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

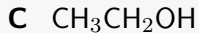
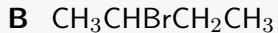
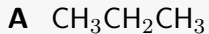


Worked steps

- B. The π bond in the $\text{C}=\text{C}$ prevents rotation.**

Exam-style 3.2 ■ 1 mark

Which compound has a chiral centre?



Solution 3.2

Method: Stereoisomerism

A $\text{CH}_3\text{CH}_2\text{CH}_3$

B $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$



C $\text{CH}_3\text{CH}_2\text{OH}$

D CH_2Cl_2

Worked steps

B. The second carbon in $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$ has four different groups.

Exam-style 3.3 ■ 2 marks

- (a) Draw the cis and trans isomers of but-2-ene, $\text{CH}_3\text{CH}=\text{CHCH}_3$.
- (b) Explain why but-2-ene shows cis/trans isomerism but but-1-ene does not.

Solution 3.3

Worked steps

(a) cis — both CH_3 groups on the same side of the $\text{C}=\text{C}$; trans — on opposite sides

M1 *each correct structure, 2 marks.*

(b) but-2-ene has a different group (H and CH_3) on each double-bond carbon, so cis/trans is possible **M1**; but-1-ene has two H atoms on the end carbon, so the groups can be swapped without making a new isomer **A1**.

Exam-style 3.4 ■ 2 marks

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

Solution 3.4

Method: Stereoisomerism

Worked steps

yes **B1**; the second carbon is bonded to four different groups (CH_3 , OH , H , COOH), so it is a chiral centre **B1**.