Exercise walk-through

Isomerism: structural isomerism and stereoisomerism ▪ 13.4

eXercise

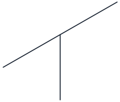
You must be able to

- 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

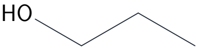
chain

butane

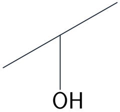


2-methylpropane

positional

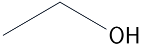


propan-1-ol

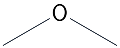


propan-2-ol

functional



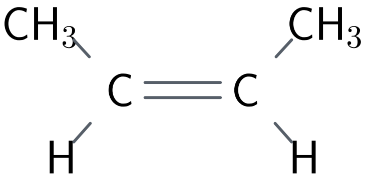
ethanol (alcohol)



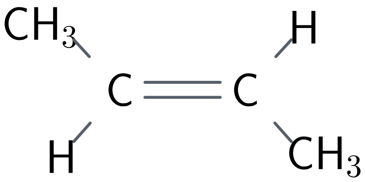
methoxymethane (ether)

Method — Stereoisomerism

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



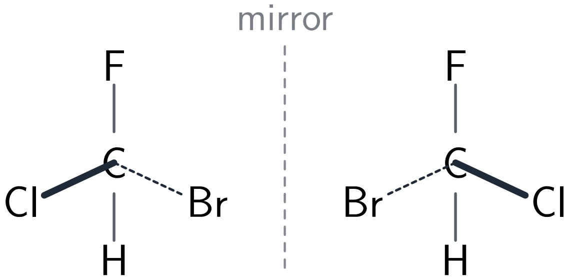
cis: both CH_3 on the same side



trans: CH_3 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 C=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 C=C prevents rotation ✓

C the molecule is ionic

D the carbons are sp^3 hybridised

Worked steps

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

Exam-style 3.2 ▪ 1 mark

Which compound has a chiral centre?

A $CH_3CH_2CH_3$

B $CH_3CHBrCH_2CH_3$

C CH_3CH_2OH

D CH_2Cl_2

Solution 3.2

Method: Stereoisomerism

A $CH_3CH_2CH_3$

B $CH_3CHBrCH_2CH_3$ ✓

C CH_3CH_2OH

D CH_2Cl_2

Worked steps

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

Exam-style 3.3 ▪ 2 marks

(a) Draw the cis and trans isomers of but-2-ene, $CH_3CH{=}CHCH_3$.

(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 groups on the same side of the C=C; trans — on opposite sides **M1** *each correct structure, 2 marks*.

(b) but-2-ene has a different group (H and CH) 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 $CH_3CH(OH)COOH$. 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 , OH, H, COOH), so it is a chiral centre **B1**.