A-LEVEL CHEMISTRY • EXERCISE SHEET

13.4 Isomerism: structural isomerism and stereoisomerism

Name: _____ Class: _____ Date: _____ **Total: 12 marks**

Objective

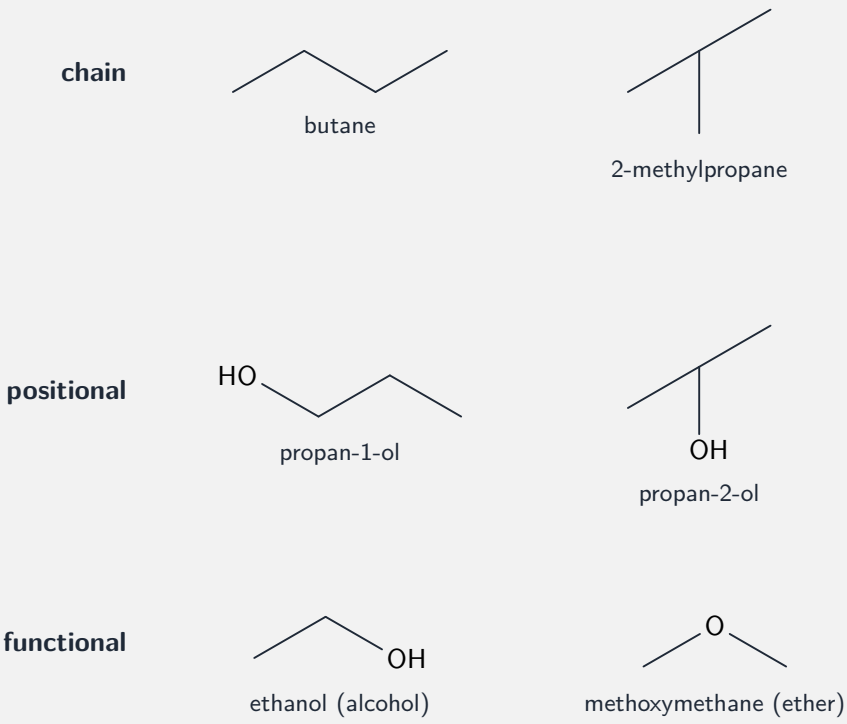
Build the skills to answer exam questions on **isomerism** 异构—**structural** 结构 isomerism (chain, positional, functional group) and **stereoisomerism** 立体异构 (cis/trans and optical).

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

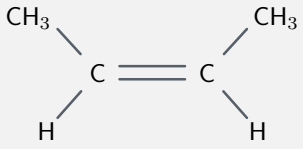
1 Worked examples

Structural isomerism

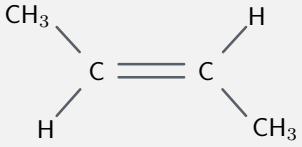


Chain, positional and functional-group isomerism —same molecular formula, different structure

■ Stereoisomerism

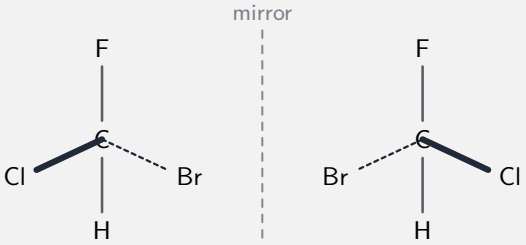


cis: both CH_3 on the same side



trans: CH_3 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, $CH_3CH{=}CHCH_3$. [2]

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

3.4 2-hydroxypropanoic acid is $CH_3CH(OH)COOH$. State, with a reason, whether it has a chiral centre. [2]

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4 Go further

You are now ready for the real exam questions on this subtopic. Open the **13.4 Isomerism** past-paper sheet in the Library, or try these in **Practice mode**:

- 9701/11 N25 —Q25 (isomerism)
- 9701/12 N25 —Q26 (stereoisomerism)
- 9701/21 N25 —Q4 (isomerism, structured)

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 groups on the same side of the C=C; trans —on opposite sides. (b) but-2-ene has a different group (H and CH) 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 , OH, H, COOH), so it is a chiral centre.