

Exercise walk-through

11.1

Organic structures and reaction pathways

International Baccalaureate · IB Diploma · Chemistry · HL

11.1 Organic structures and reaction pathways

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS functional group • isomer

Objective

Organic structures and reaction pathways. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

1 Key knowledge and worked examples

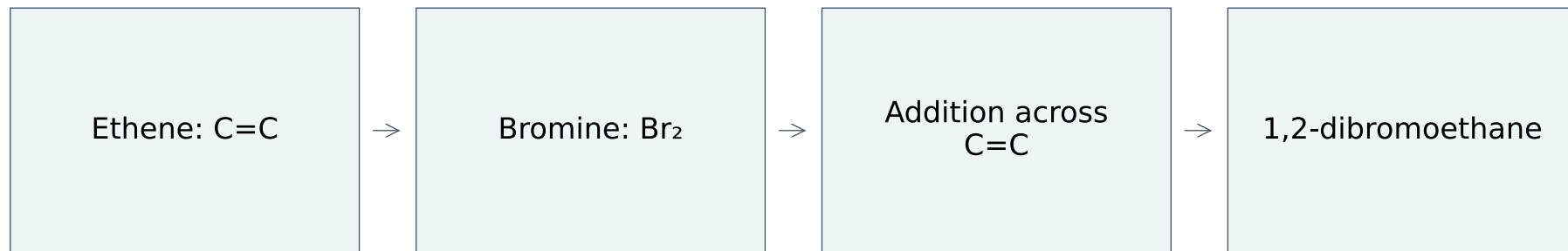
■ What would explain this observation?

- Two compounds can have the same molecular formula but different structures. Their **functional groups** help predict which reactions they undergo.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- A homologous series shares a functional group and general formula. Structural **isomers** share a molecular formula but differ in atom connections. Alkenes contain a carbon-carbon double bond.

- functional group: An atom group determining characteristic reactions; isomer: A compound sharing a formula but differing in structure.



■ Choose evidence that can test it

- Distinguish addition, substitution, oxidation and polymerization by tracing bonds before and after reaction. Conditions and reagents belong to the reaction arrow; they are not interchangeable labels.
- Draw displayed or structural formulae with the correct number of bonds at each carbon. Use a carbon count to check a proposed synthesis. At advanced level, track reagents and conditions through multistep routes.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions

fit this case, then rearrange before substitution.

- Known: ethene adds bromine across its double bond. The two-carbon skeleton stays intact and each carbon gains one bromine atom, giving 1,2-dibromoethane. One mole of ethene reacts with one mole of bromine in this addition reaction.

Example:

How many moles of bromine react completely with 0.15 mol ethene? Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- Bromine decolourization provides evidence of unsaturation in an appropriate test. It is not proof that an unknown sample is specifically ethene.

- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Compounds with the same molecular formula always have identical properties. This claim is false: Bromine decolourization provides evidence of unsaturation in an appropriate test. It is not proof that an unknown sample is specifically ethene.

Key:

Organic structures and reaction pathways: Distinguish addition, substitution, oxidation and polymerization by tracing bonds before and after reaction. Conditions and reagents

belong to the reaction arrow; they are not interchangeable labels.

Exercises 2.1-2.3

2.1 What happens to the carbon skeleton when bromine adds to ethene? Choose one answer.

- **A** It remains two carbons long
- **B** It becomes one carbon long
- **C** It becomes a six-carbon ring

[1]

2.2 How many moles of bromine react completely with 0.15 mol ethene? Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: Compounds with the same molecular formula always have identical properties.

[2]

Exercises 2.1·2.3

2.1 What happens to the carbon skeleton when bromine adds to ethene? Choose one answer.

- **A** It remains two carbons long
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[1]

2.1 A Distinguish addition, substitution, oxidation and polymerization by tracing bonds before and after reaction. Conditions and reagents belong to the reaction arrow; they are not interchangeable labels.

2.2 How many moles of bromine react completely with 0.15 mol ethene? Show the relation, substitution and units.

[2]

2.2 Ethene:Br₂ mole ratio 1:1, so 0.15 mol ethene needs 0.15 mol Br₂.

2.3 Decide whether this claim is true and justify: Compounds with the same molecular formula always have identical properties.

[2]

2.3 False. Bromine decolourization provides evidence of unsaturation in an appropriate test. It is not proof that an unknown sample is specifically ethene.

Exercises 2.4·3.1

2.4 An atom group determining characteristic reactions: write the technical term. [1]

3 Exam-style questions

3.1 For $\text{CH}_2=\text{CH}_2 + \text{Br}_2 \rightarrow \text{CH}_2\text{BrCH}_2\text{Br}$, 0.20 molethene meets 0.12 mol Br_2 . Find product and excess reagent, and explain why this is addition rather than substitution. [4]

Exercises 2.4·3.1

2.4 An atom group determining characteristic reactions: write the technical term. [1]

3 Exam-style questions

2.4 functional group. functional group means An atom group determining characteristic reactions.

3.1 For $\text{CH}_2=\text{CH}_2 + \text{Br}_2 \rightarrow \text{CH}_2\text{BrCH}_2\text{Br}$, 0.20 mol ethene meets 0.12 mol Br_2 . Find product and excess reagent, and explain why this is addition rather than substitution. [4]

3.1 Product 0.12 mol; ethene remaining 0.08 mol. Atoms add across $\text{C}=\text{C}$ with no small molecule replaced in this stated reaction. This is a paper model, not an instruction to handle bromine.