Exercise walk-through

11.1 Organic structures and reaction pathways

International Baccalaureate · IB Diploma · Chemistry · HL

INTERNATIONAL BACCALAUREATE · IB DIPLOMA · CHEMISTRY · HL • EXERCISE SHEET

11.1 Organic structures and reaction pathways

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS functional group • isomer

Objective

Organic structures and reaction pathways. Original classroom practice for IB HL; not an official IB paper.

1 Key knowledge and worked examples

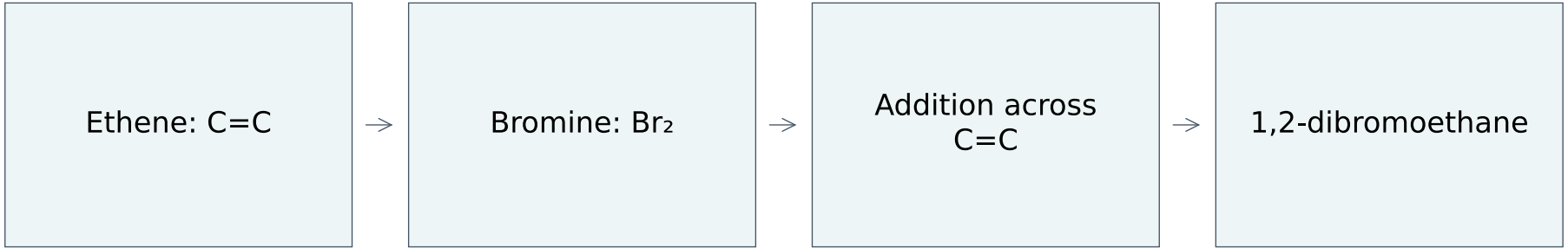
What would explain this observation?

- Two compounds can have the same molecular formula but different structures. Their **functional groups** help predict which reactions they undergo.

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.

In the lab: 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

- 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.

Your turn: How many moles of bromine react completely with 0.15 mol ethene?

■ 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.

Not true: Compounds with the same molecular formula always have identical properties. Same molecular formula is not same compound: isomers such as butane and 2-methylpropane share C4H10 but have different structures and different physical prop-

erties. Structure, not formula alone, sets properties.

Key:

- A homologous series shares a functional group and general formula.
- Distinguish addition, substitution, oxidation and polymerization by tracing bonds before and after reaction.
- Watch for: bromine decolourization provides evidence of unsaturation in an appropriate test.

■ Write from 0.25 mol of bromine

- Ethene adds bromine in a 1 to 1 mole ratio.
- Find the bromine amount that reacts with 0.25 mol of ethene. The same molecular

formula can belong to different compounds.

Exercises 2.1·2.2

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]

Exercises 2.1·2.2

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]

2.1 A Addition across C=C adds one bromine atom to each carbon; the two-carbon skeleton of ethene is untouched, giving 1,2-dibromoethane. No carbon-carbon bonds are broken, so no shortening or ring formation occurs.

2.2 How many moles of bromine react completely with 0.15 mol ethene? Show the relation, substitution and units. [2]

2.2 Ethene:Br_2 mole ratio1:1, so0.15 mol ethene needs0.15 molBr_2.

Exercises 2.3·3.1

2.3 Decide whether this claim is true and justify: Compounds with the same molecular formula always have identical properties. [2]

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

3.1 For $CH_2{=}CH_2 + Br_2 \rightarrow CH_2BrCH_2Br$, 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]

Exercises 2.3·3.1

2.3 Decide whether this claim is true and justify: Compounds with the same molecular formula always have identical properties. [2]

2.3 False. Same molecular formula is not same compound: isomers such as butane and 2-methylpropane share C4H10 but have different structures and different physical properties. Structure, not formula alone, sets properties.

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

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

3.1 For$CH_2{=}CH_2{+}Br_2{\rightarrow}CH_2BrCH_2Br$,0.20 molethene meets0.12 molBr_2. Find product and excess reagent, and explain why this is addition rather than substitution. [4]

3.1 Product0.12 mol;ethene remaining0.08 mol. Atoms add acrossC=C with no small molecule replaced in this stated reaction. This is a paper model, not an instruction to handle bromine.