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 SL; not an official IB paper.

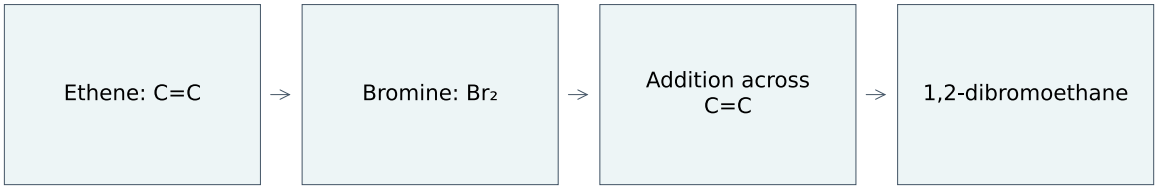
1 Key knowledge and worked examples

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 properties. 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.

2 Practice

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]

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

3 Exam-style questions

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]