

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.

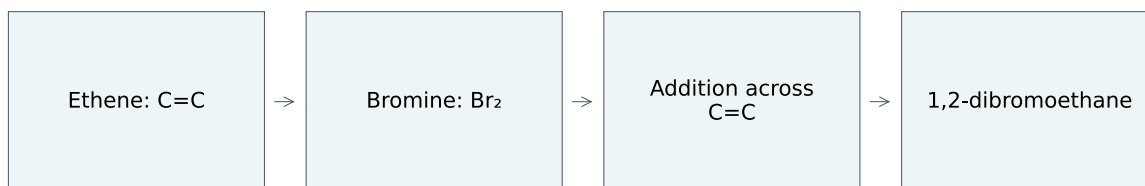
1 Key knowledge and worked examples

■ 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 → model → relation → substitution → 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.

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

Solutions

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

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

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

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