

Exercise walk-through

21.1

Organic synthesis

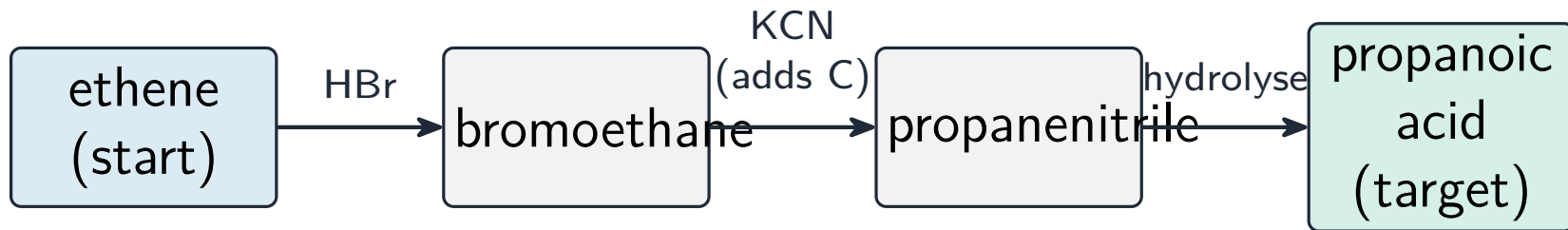
A-Level Chemistry

Planning a route

To devise a **synthetic route** :

- compare target vs start (group? carbons?)
- work **backwards**, one reaction at a time
- write each step's **reagent** & conditions

plan backwards from the target

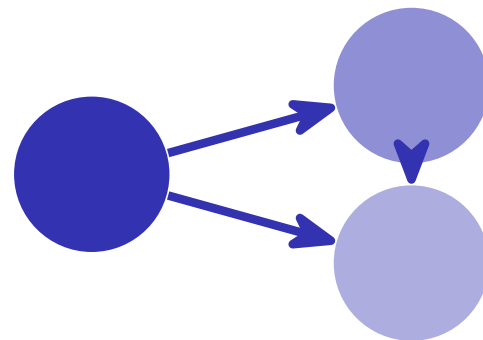


Exam tips

- Learn the **reagents and conditions** for each conversion – that is exactly what synthesis questions test.
- Plan multi-step routes by functional group and watch the **carbon count** (KCN adds one carbon).
- Choose the **shortest valid route** and state every reagent and condition.

Check yourself

- 1 What test confirms a carboxylic acid?
- 2 Which way should you plan a synthesis?
- 3 Which reagent lengthens the carbon chain?
- 4 What must you state for each step?



Answers 1. fizz (CO_2) with a carbonate 2. backwards from the target 3. KCN
4. the reagent and conditions

Exercises 2.1·2.2

2.1 State the test and result that identifies a carboxylic acid. [2]

2.2 State the reagent and condition to convert an alkene into an alcohol. [2]

Exercises 2.1·2.2

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2.1

- add a carbonate (e.g. sodium carbonate); fizzing / effervescence of CO_2

2.2 State the reagent and condition to convert an alkene into an alcohol. [2]

2.2

- steam (H_2O gas) with a phosphoric acid (H_3PO_4) catalyst

Exercise 3.1

3.1 A compound decolourises bromine water and gives an orange precipitate with 2,4-DNPH. It contains: [1]

☐

A a C=C bond and a carbonyl group

B an alcohol only

C a carboxylic acid only

D a halogenoalkane only

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3.1 A

- Bromine water
- C=C; 2,4-DNPH
- a carbonyl group

Exercises 3.2-3.3

3.2 Which reagent adds **one** carbon to a chain?

[1]

☐

A NaOH(aq)

B KCN in ethanol

C H_2 / Ni

D concentrated H_2SO_4

3.3 Devise a two-step synthesis of propan-1-ol from 1-bromopropane that adds **no** carbons. Give the reagents and conditions for each step.

[2]

Exercises 3.2-3.3

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[1]

☐

A NaOH(aq)

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C H₂ / Ni

D concentrated H₂SO₄

3.2 B

- KCN adds one carbon (forming a nitrile)

3.3 Devise a two-step synthesis of propan-1-ol from 1-bromopropane that adds **no** carbons. Give the reagents and conditions for each step.

[2]

3.3

- react 1-bromopropane with NaOH(aq) and heat
- propan-1-ol (nucleophilic substitution). (*One step suffices; a longer route via the alkene then steam also scores.*)

Exercise 3.4

3.4 Devise a synthesis of propanoic acid ($\text{CH}_3\text{CH}_2\text{COOH}$) from bromoethane ($\text{C}_2\text{H}_5\text{Br}$), giving the reagents for each step. (*Hint: you need to add one carbon.*) [3]

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3.4

- step 1: react bromoethane with KCN in ethanol, heat
- propanenitrile, $\text{C}_2\text{H}_5\text{CN}$ (adds one carbon); step 2: warm the nitrile with dilute acid (hydrolysis)
- propanoic acid