

# 21.1 Organic synthesis

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

**Total: 11 marks**

**KEY WORDS** synthetic route 合成路线 • multi-step 多步 • functional group 官能团  
 • reagent 试剂 • carboxylic acid 羧酸

## Objective

Build the skills to answer exam questions on **organic synthesis** 有机合成 — identifying **functional groups** 官能团 by their test reactions, and devising **multi-step** 多步 synthetic routes.

**You must be able to:**

- identify functional groups in a molecule from the standard tests
- devise multi-step synthetic routes using the reactions in the syllabus
- analyse a route in terms of reaction type and reagents

## 1 Worked examples

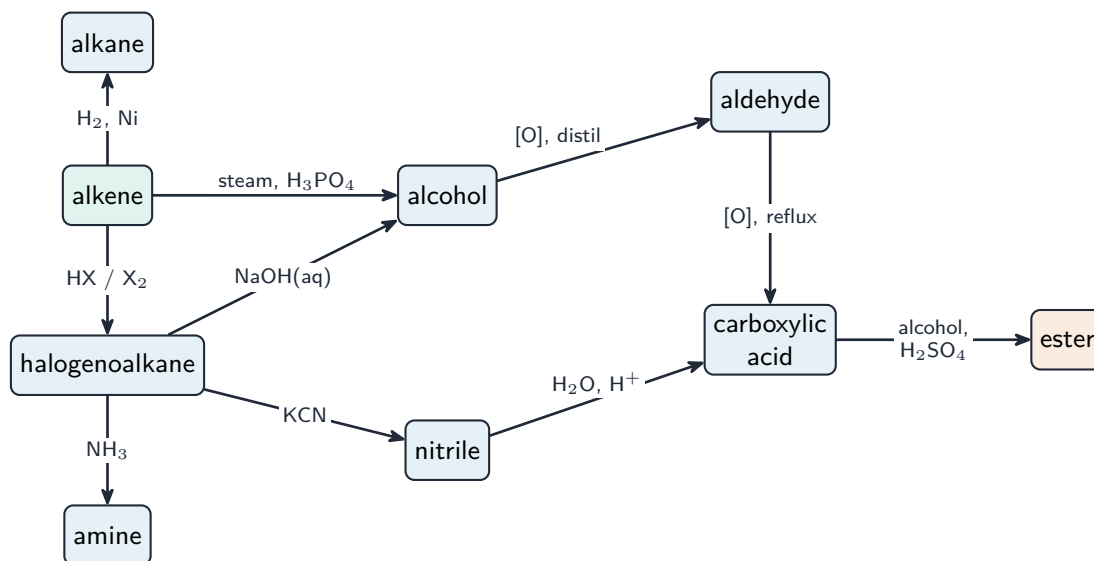
### ■ Identifying functional groups

| add this                                                | you see                            | functional group         |
|---------------------------------------------------------|------------------------------------|--------------------------|
| bromine water                                           | orange → colourless                | <b>C=C (alkene)</b>      |
| silver nitrate                                          | a precipitate forms                | <b>halogenoalkane</b>    |
| acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> | orange → green                     | <b>1°/2° alcohol</b>     |
| 2,4-DNPH                                                | orange precipitate                 | <b>aldehyde / ketone</b> |
| a carbonate                                             | fizzes (CO <sub>2</sub> given off) | <b>carboxylic acid</b>   |

*Each test points to one functional group*

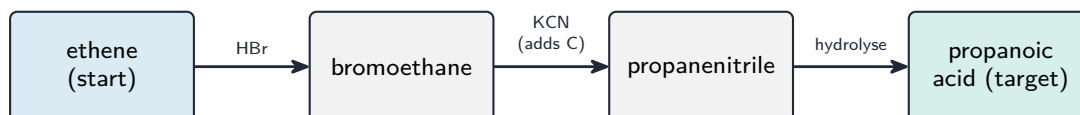
- decolourises bromine water → alkene (C=C); precipitate with AgNO<sub>3</sub> → halogenoalkane; K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> orange→green → primary/secondary alcohol; orange ppt with 2,4-DNPH → carbonyl; fizzes with a carbonate → carboxylic acid.

## ■ The reaction map and planning backwards



*Learn the AS reactions as a map you can travel around to plan a synthesis*

plan backwards from the target



*To plan: work backwards from the target, choosing a known reaction for each step (watch the carbon count — KCN/HCN add one carbon)*

## 2 Practice

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]

### 3 Exam-style questions

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

|   |   |
|---|---|
| A | B |
| C | D |

**A** a C=C bond and a carbonyl group

**B** an alcohol only

**C** a carboxylic acid only

**D** a halogenoalkane only

**3.2** Which reagent adds **one** carbon to a chain? [1]

|   |   |
|---|---|
| A | B |
| C | D |

**A** NaOH(aq)

**B** KCN in ethanol

**C** H<sub>2</sub> / Ni

**D** concentrated H<sub>2</sub>SO<sub>4</sub>

**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]

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**3.4** Devise a synthesis of propanoic acid (CH<sub>3</sub>CH<sub>2</sub>COOH) from bromoethane (C<sub>2</sub>H<sub>5</sub>Br), giving the reagents for each step. (*Hint: you need to add one carbon.*) [3]

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