

Week 30

A-Level Chemistry

Homework bundle for this week

本周作业合集

exercises.lol

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21. Organic synthesis

Starter Quiz · 课前小测

A-Level Chemistry

Name: _____ Score: _____

1. A compound that decolourises bromine water contains:
 - ☐ a C=C double bond (an alkene)
 - ☐ an –OH group
 - ☐ a –COOH group
 - ☐ a halogen
2. The best way to plan a multi-step synthesis is to:
 - ☐ work backwards from the target, one reaction at a time
 - ☐ guess random reactions
 - ☐ only work forwards from the start
 - ☐ skip the reagents
3. An orange precipitate with 2,4-DNPH indicates:
 - ☐ an aldehyde or ketone
 - ☐ an alkene
 - ☐ an alcohol
 - ☐ a carboxylic acid
4. If your route needs to add a carbon atom, the key step is:
 - ☐ reaction with KCN
 - ☐ oxidation with dichromate
 - ☐ reduction with NaBH₄
 - ☐ esterification
5. According to the reaction map, an alkene + steam (H₃PO₄) gives:
 - ☐ an alcohol
 - ☐ a nitrile
 - ☐ an ester
 - ☐ a carboxylic acid
6. A reaction map links functional groups by the reactions that interconvert them.
 - ☐ True ☐ False

7. A good synthetic route uses few steps and gives a high overall yield.

☐ True ☐ False

8. When analysing each step of a given route, you should state:

- ☐ the type of reaction and the reagent used
- ☐ only the product name
- ☐ only the colour change
- ☐ nothing

9. Which step lengthens the carbon chain by one?

- ☐ reaction of a halogenoalkane with KCN
- ☐ oxidation of an alcohol
- ☐ reduction of a carbonyl
- ☐ esterification

10. Why is the yield of a simple amine from a halogenoalkane low?

- ☐ the amine reacts further, giving a mixture of more-substituted amines
- ☐ no amine forms at all
- ☐ the halogenoalkane is unreactive
- ☐ the amine evaporates

21. Organic synthesis

A-Level Chemistry

1. a C=C double bond (an alkene)

Decolourising bromine water is the test for a C=C double bond.

2. work backwards from the target, one reaction at a time

Working backwards from the target finds which reaction makes it, and from what, step by step.

3. an aldehyde or ketone

2,4-DNPH detects the carbonyl group (aldehyde or ketone).

4. reaction with KCN

KCN is the only AS reaction that lengthens the carbon chain.

5. an alcohol

Electrophilic addition of water across the C=C gives an alcohol.

6. True

Used to plan and identify reactions.

7. True

Fewer steps means less loss of product.

8. the type of reaction and the reagent used

Identify the reaction type (oxidation, substitution, etc.) and the reagent/conditions for each step.

9. reaction of a halogenoalkane with KCN

KCN adds a CN group (a carbon) — the only AS reaction that lengthens the chain.

10. the amine reacts further, giving a mixture of more-substituted amines

The amine is itself a nucleophile, so it reacts again — a by-product mixture lowers the yield.

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

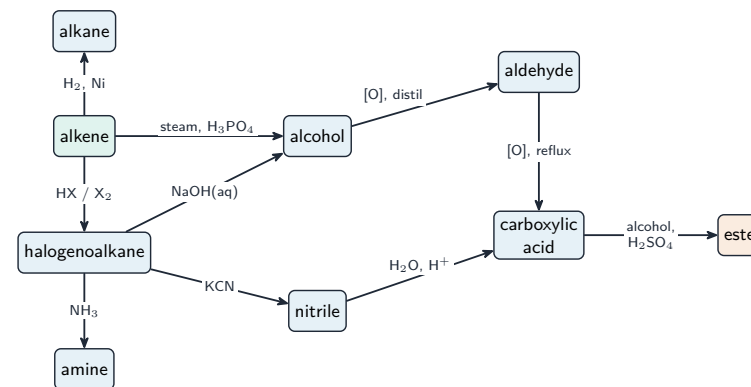
■ Identifying functional groups

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

Each test points to one functional group

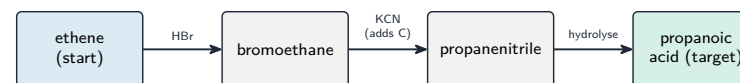
- decolourises bromine water → alkene (C=C); precipitate with AgNO₃ → halogenoalkane; K₂Cr₂O₇ orange→green → primary/secondary alcohol; orange ppt with 2,4-DNPH → carbonyl; fizzes with a carbonate → carboxylic acid.

■ 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

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

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

- **A** NaOH(aq)
- **B** KCN in ethanol
- **C** H₂ / Ni
- **D** concentrated H₂SO₄

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]

3.4 Devise a synthesis of propanoic acid (CH₃CH₂COOH) from bromoethane (C₂H₅Br), giving the reagents for each step. (*Hint: you need to add one carbon.*) [3]

Solutions

2.1 add a carbonate (e.g. sodium carbonate); fizzing / effervescence of CO₂.

2.2 steam (H₂O gas) with a phosphoric acid (H₃PO₄) catalyst.

3.1 A. Bromine water → C=C; 2,4-DNPH → a carbonyl group.

3.2 B. KCN adds one carbon (forming a nitrile).

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.*)

3.4 step 1: react bromoethane with KCN in ethanol, heat → propanenitrile, C₂H₅CN (adds one carbon); step 2: warm the nitrile with dilute acid (hydrolysis) → propanoic acid.