A-LEVEL CHEMISTRY • EXERCISE SHEET

33.2 Esters

Name: _____ Class: _____ Date: _____ **Total: 22 marks**

KEY WORDS acyl chloride酰氯 • ester酯 • phenol苯酚 • benzoic acid苯甲酸 • alcohol醇

Objective

Build the skills to answer exam questions on **esters** 酯 — how they are made from an acyl chloride, naming them, and recognising the ester link.

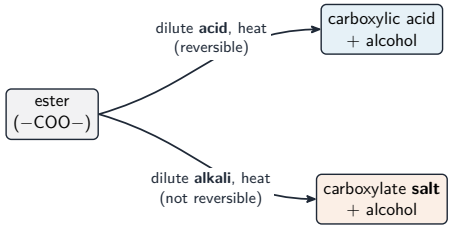
You must be able to:

- make an ester from an alcohol (or phenol) and an acyl chloride
- name an ester from its structure (and vice versa)
- write equations for ester formation

1 Worked examples

■ Making and naming esters

Alcohol (or phenol) + acyl chloride → ester + HCl, at room temperature



Esters are hydrolysed back to acid and alcohol

- **alcohol/phenol + acyl chloride → ester + HCl.**
- e.g. ethanol + ethanoyl chloride → ethyl ethanoate; phenol + benzoyl chloride → phenyl benzoate.

- **naming:** the alcohol part gives the first word ("ethyl"), the acid part gives the second ("…anoate").

2 Practice

2.1 Name the ester $CH_3COOCH_2CH_3$. [1]

2.2 Name the two organic starting materials (an acyl chloride + an alcohol) for ethyl ethanoate. [2]

3 Exam-style questions

3.1 The ester $HCOOCH_3$ is named: [1]

- **A** methyl methanoate
- **B** methyl ethanoate
- **C** ethyl methanoate
- **D** methanoyl methane

3.2 Phenyl benzoate is made from benzoyl chloride and: [1]

- **A** benzene
- **B** phenol
- **C** benzoic acid
- **D** phenylamine

3.3 Methanol reacts with ethanoyl chloride.

(a) Write the equation. [2]

(b) Name the ester formed. [1]

3.4 Draw the structure of propyl methanoate and circle the **ester link**. [2]

3.5 Ethanoyl chloride, CH_3COCl, reacts with propan-1-ol.

(a) Write the equation, name the ester formed, and state one observation. [3]

(b) Explain why an acyl chloride is used rather than the carboxylic acid when a high yield is wanted. [3]

(c) Draw the ester link, and give the systematic name of the ester made from **propanoyl chloride and ethanol**. [3]

(d) The ester in (a) is refluxed with dilute sulfuric acid. Name the two organic products, and explain why an excess of water is used. [3]

Solutions

2.1 ethyl ethanoate.

2.2 ethanoyl chloride; ethanol.

3.1 A. HCOO– is methanoate; $–CH_3$ is methyl → methyl methanoate.

3.2 B. Phenol + benzoyl chloride → phenyl benzoate + HCl.

3.3 (a) $CH_3COCl + CH_3OH \rightarrow CH_3COOCH_3 + HCl$.
(b) methyl ethanoate.

3.4 $HCOOCH_2CH_2CH_3$ drawn out; the –COO– ester link circled.

3.5 (a) $CH_3COCl + CH_3CH_2CH_2OH \rightarrow CH_3COOCH_2CH_2CH_3 + HCl$; the ester is **propyl ethanoate**; steamy white fumes of hydrogen chloride are seen.
(b) The acyl chloride reaction goes essentially to **completion** — it is not an equilibrium — because the HCl escapes as a gas and cannot react back; esterification with the acid is reversible and stops at about 65% conversion.
(c) The ester link is $-C(=O)-O-$ drawn with the carbonyl double bond and the single bond to the second oxygen; the ester from propanoyl chloride and ethanol is **ethyl propanoate**.
(d) **Ethanoic acid** and **propan-1-ol**; acid hydrolysis is reversible, so a large excess of water pushes the equilibrium towards the products.