

18.2 Esters

Name: _____ Class: _____ Date: _____

Total: 11 marks

Objective

Build the skills to answer exam questions on **esters** 酯—their formation by **esterification** 酯化 and their **hydrolysis** 水解.

You must be able to:

- recall how esters are made (condensation of an alcohol and a carboxylic acid)
- describe the hydrolysis of esters by dilute acid and by dilute alkali

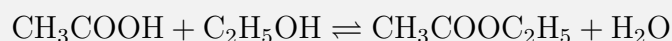
1 Worked examples

■ Making esters

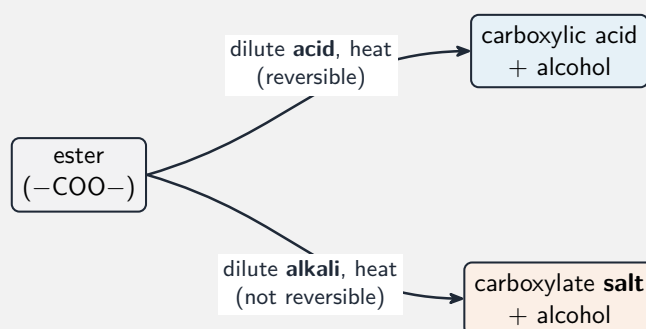


the $-\text{OH}$ (acid) and $-\text{H}$ (alcohol) leave as **water**; the $\text{C}-\text{O}-\text{C}$ ester link forms
(concentrated H_2SO_4 catalyst; reversible)

*Esterification is a reversible **condensation**: alcohol + carboxylic acid (conc. H_2SO_4 catalyst) $\rightarrow$ ester + water*



■ Hydrolysis of esters



Dilute acid (reversible): carboxylic acid + alcohol. Dilute alkali (not reversible): the carboxylate salt + alcohol

2 Practice

2.1 State the reagents and catalyst needed to make an ester from an alcohol and a carboxylic acid. [2]

2.2 Name the small molecule lost when an ester is formed. [1]

3 Exam-style questions

3.1 The type of reaction by which an ester is formed from an alcohol and a carboxylic acid is: [1]

- **A** addition
 - **B** condensation
 - **C** elimination
 - **D** free-radical substitution
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3.2 Hydrolysis of an ester with dilute **alkali** gives an alcohol and: [1]

- **A** the carboxylic acid
 - **B** the salt of the carboxylic acid (carboxylate)
 - **C** carbon dioxide
 - **D** an aldehyde
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3.3 (a) Write the equation for the formation of ethyl ethanoate from ethanol and ethanoic acid. [2]

(b) State the products of the hydrolysis of ethyl ethanoate by dilute sulfuric acid. [2]

3.4 Explain why hydrolysis with dilute alkali is **not** reversible, but hydrolysis with dilute acid is. [2]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **18.2 Esters** past-paper sheet in the Library, or try these in **Practice mode**:

- 9701/11 N25 —Q35 (esters)
- 9701/14 N25 —Q36 (ester hydrolysis)
- 9701/33 N25 —Q3 (esters, calculation)

Solutions

2.1 an alcohol and a carboxylic acid; concentrated sulfuric acid catalyst.

2.2 water.

3.1 B. Esterification is a condensation reaction.

3.2 B. Alkaline hydrolysis gives the carboxylate salt (plus the alcohol).

3.3 (a) $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$.

(b) ethanoic acid and ethanol.

3.4 with alkali the carboxylic acid is converted to its carboxylate salt, which does not react back, so the reaction goes to completion; with acid the products are the acid and alcohol, which can re-esterify, so it is reversible.