

# 18.2 Esters

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

Total: 23 marks

KEY WORDS hydrolysis 水解 • condensation 缩合 • esters 酯 • esterification 酯化 • alcohol 醇

## 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

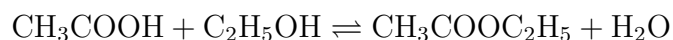
## 1 Worked examples

### ■ Making esters

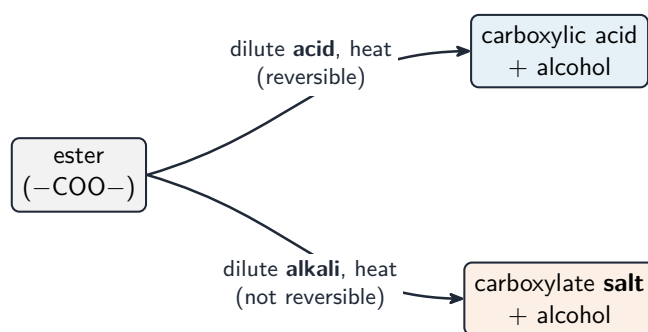


the  $-\text{OH}$  (acid) and  $-\text{H}$  (alcohol) leave as **water**; the  $\text{C}-\text{O}-\text{C}$  ester link forms  
(concentrated  $\text{H}_2\text{SO}_4$  catalyst; reversible)

*Esterification is a reversible **condensation**: alcohol + carboxylic acid (conc.  $\text{H}_2\text{SO}_4$  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 | B |
| C | D |

- A addition
- B condensation
- C elimination
- D free-radical substitution

**3.2** Hydrolysis of an ester with dilute **alkali** gives an alcohol and: [1]

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

- A the carboxylic acid
- B the salt of the carboxylic acid (carboxylate)
- C carbon dioxide
- D an aldehyde

**3.3** (a) Write the equation for the formation of ethyl ethanoate from ethanol and ethanoic acid. [2]

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

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

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**3.5** Ethyl ethanoate is made by refluxing ethanoic acid with ethanol and a few drops of concentrated sulfuric acid.

(a) Write the equation for the esterification, and state the role of the sulfuric acid. [3]

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(b) The reaction reaches equilibrium with a yield of about 65%. State **two** changes that would increase the yield of ester, and justify each. [4]

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(c) The ester is then refluxed with aqueous sodium hydroxide. Write the equation for this hydrolysis and name the organic products. [3]

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(d) Explain why alkaline hydrolysis goes to completion whereas acid hydrolysis does not. [2]

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