

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

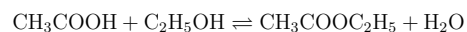
1 Worked examples

■ Making esters

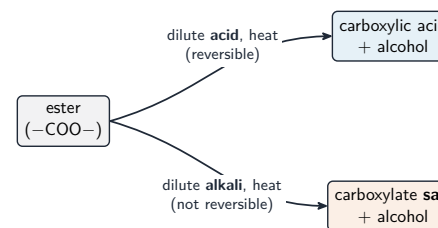


the $-\text{OH}$ (acid) and $-\text{H}$ (alcohol) leave as **water**; the **C–O–C** ester link forms
(concentrated H_2SO_4 catalyst; reversible)

*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	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]

(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]

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]

(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]

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

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