

Exercise walk-through

Esters ■ 18.2

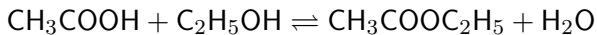
eXercise

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

Method — Making esters

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

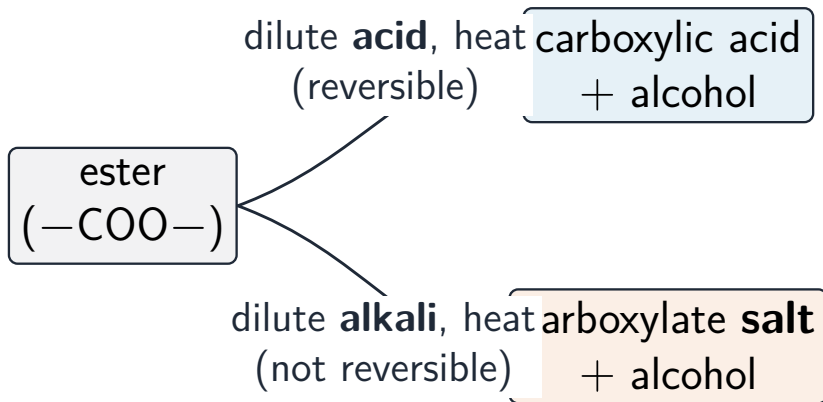


Method — Making esters



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

Method — Hydrolysis of esters



Practice 2.1 ■ 2 marks

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

Solution 2.1

Method: Making esters

Worked steps

an alcohol and a carboxylic acid **B1**; concentrated sulfuric acid catalyst **B1**.

Practice 2.2 ■ 1 mark

Name the small molecule lost when an ester is formed.

Solution 2.2

Worked steps

water **B1**.

Exam-style 3.1 ■ 1 mark

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

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

Solution 3.1

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



Worked steps

- B. Esterification is a condensation reaction.

Exam-style 3.2 ■ 1 mark

Hydrolysis of an ester with dilute **alkali** gives an alcohol and:

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

Solution 3.2

Method: Hydrolysis of esters

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

Worked steps

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

Exam-style 3.3 ■ 2 marks

- (a) Write the equation for the formation of ethyl ethanoate from ethanol and ethanoic acid.
- (b) State the products of the hydrolysis of ethyl ethanoate by dilute sulfuric acid.

Solution 3.3

Method: Hydrolysis of esters

Worked steps

(a) $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$ **M1** **A1** *products, reversible/balanced.*

(b) ethanoic acid and ethanol **B1** **B1**.

Exam-style 3.4 ■ 2 marks

Explain why hydrolysis with dilute alkali is **not** reversible, but hydrolysis with dilute acid is.

Solution 3.4

Method: Hydrolysis of esters

Worked steps

with alkali the carboxylic acid is converted to its carboxylate salt, which does not react back **M1**, so the reaction goes to completion; with acid the products are the acid and alcohol, which can re-esterify, so it is reversible **A1**.