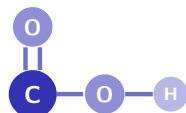


Carboxylic Acids & Derivatives

A-Level Chemistry ■ Topic 18

A-Level Chemistry



Carboxylic Acids & Derivatives

What we will cover

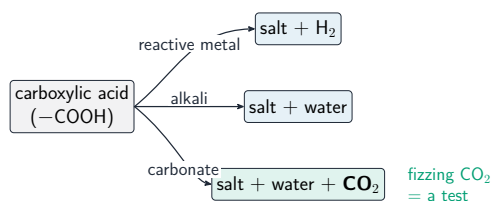
- 1 Carboxylic acid reactions
- 2 Esterification
- 3 Esters
- 4 Hydrolysis of esters



vinegar is ethanoic acid

1 Carboxylic acids

Carboxylic acid reactions



A **carboxylic acid** 羧酸 (-COOH) is a weak acid:

- + metal → salt + H₂
- + alkali → salt + water
- + carbonate → salt + water + CO₂ (the fizz is a test)

2 Esters

Esterification



the -OH (acid) and -H (alcohol) leave as water; the C-O-C ester link forms
(concentrated H₂SO₄ catalyst; reversible)

An **ester** 酯 forms by **condensation** 缩合 of an alcohol + a carboxylic acid (conc. H₂SO₄ catalyst).

The -OH (acid) and -H (alcohol) leave as water, making the C-O-C ester link. The reaction is reversible.

Esters

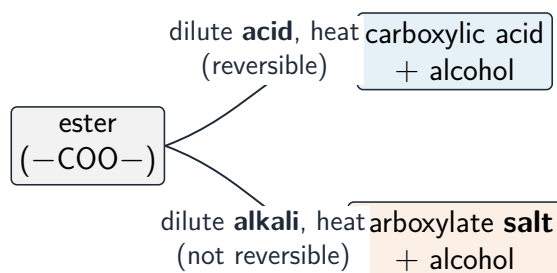
An **ester** 酯 has the —COO— group. Named from the alcohol then the acid: ethanol + ethanoic acid $\rightarrow$ **ethyl ethanoate**. Sweet or fruity smell – flavourings, solvents, perfumes.

Making one: alcohol + carboxylic acid $\rightleftharpoons$ ester + water, with conc. H_2SO_4 as catalyst (and dehydrating agent).

Hydrolysis of esters

Hydrolysis 水解 splits the ester apart:

- dilute **acid** (reversible) $\rightarrow$ the acid + alcohol
- dilute **alkali** (not reversible) $\rightarrow$ the carboxylate **salt** 盐 + alcohol



3

Recap

Worked example – naming an ester

Name the ester from ethanoic acid and propan-1-ol, and give the conditions.

- acid + alcohol $\rightleftharpoons$ ester + water, with concentrated H_2SO_4 catalyst, heated under reflux.
- $\text{CH}_3\text{COOH} + \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \rightleftharpoons \text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3 + \text{H}_2\text{O}$
- The **alcohol** gives the first word, the **acid** the second (ending *-oate*).
- Name: **propyl ethanoate**.

Ester name = **alcohol part first**, acid part second.

The reaction is **reversible**, so the yield is never 100% – acyl chlorides do it better.

Topic 18 – key takeaways

1 Acidity

salt + H_2 /water/ CO_2 with metal/alkali/carbonate

2 Esterification

alcohol + acid $\rightarrow$ ester + water

3 Esters

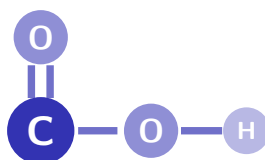
$-\text{COO}-$ group; sweet smell

4 Hydrolysis

acid (reversible) vs alkali (salt)

Check yourself

- What gas tests for a carboxylic acid with a carbonate?
- What small molecule leaves in esterification?
- Which functional group does an ester have?
- Alkaline hydrolysis of an ester gives which two products?



Answers 1. carbon dioxide 2. water 3. $-\text{COO}-$ 4. a carboxylate salt and an alcohol