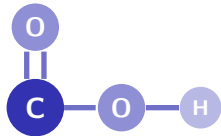


Carboxylic Acids & Derivatives

A-Level Chemistry ■ Topic 18

A-Level Chemistry



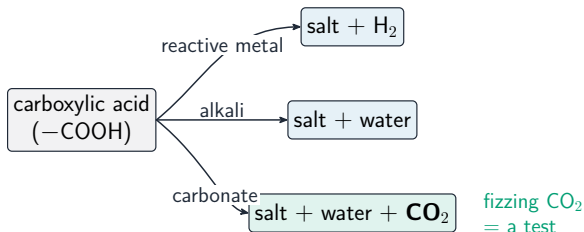
What we will cover

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



vinegar is ethanoic acid

Carboxylic acid reactions



A **carboxylic acid** 羧酸 ($-\text{COOH}$) is a weak acid:

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

Esterification



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

An **ester** 酯 forms by **condensation** 缩合 of an alcohol + a carboxylic acid (conc. H_2SO_4 catalyst).

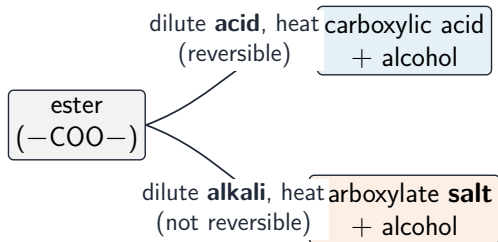
The -OH (acid) and -H (alcohol) leave as water, making the C-O-C ester link. The reaction is reversible.

Esters



Esters have the —COO— group and often smell sweet or fruity. They give many fruits and perfumes their scent, and are used as solvents and flavourings.

Hydrolysis of esters



Hydrolysis 水解 splits the ester apart:

- dilute **acid** (reversible) → the acid + alcohol
- dilute **alkali** (not reversible) → the carboxylate **salt** 盐 + alcohol

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

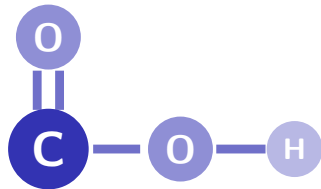
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Hydrolysis

acid (reversible) vs alkali (salt)

Check yourself

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



Answers 1. carbon dioxide 2. water 3. —COO— 4. a carboxylate salt and an alcohol