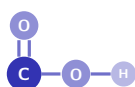


## Carboxylic Acids & Derivatives

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

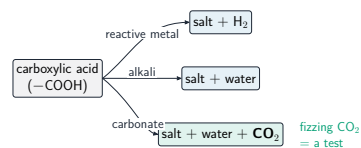
# 1

## Carboxylic acids

### Carboxylic Acids & Derivatives

#### Carboxylic acids

#### Carboxylic acid reactions



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

- + metal  $\rightarrow$  salt +  $\text{H}_2$
- + alkali  $\rightarrow$  salt + water
- + carbonate  $\rightarrow$  salt + water +  $\text{CO}_2$  (the fizz is a test)

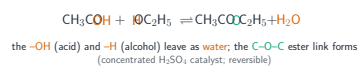
# 2

## Esters

### Carboxylic Acids & Derivatives

#### Esters

#### Esterification



An **ester** 酯 forms by **condensation** 缩合 of an alcohol + a carboxylic acid (conc.  $\text{H}_2\text{SO}_4$  catalyst).

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

## Esters

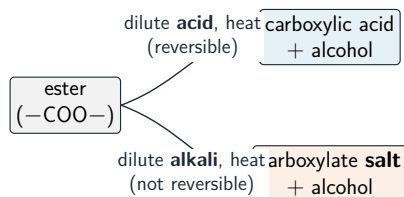
An **ester** 酯 has the  $\text{—COO—}$  group. Named from the alcohol then the acid: ethanol + ethanoic acid  $\rightarrow$  **ethyl ethanoate**. Sweet or fruity smell – flavourings, solvents, perfumes.

Making one: alcohol + carboxylic acid  $\rightleftharpoons$  ester + water, with conc.  $\text{H}_2\text{SO}_4$  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**  $\text{H}_2\text{SO}_4$  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 +  $\text{H}_2\text{/water/CO}_2$  with metal/alkali/carbonate

### 2 Esterification

alcohol + acid  $\rightarrow$  ester + water

### 3 Esters

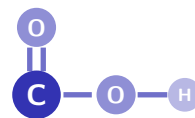
$\text{—COO—}$  group; sweet smell

### 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