

Exercise walk-through

18.1

Carboxylic acids

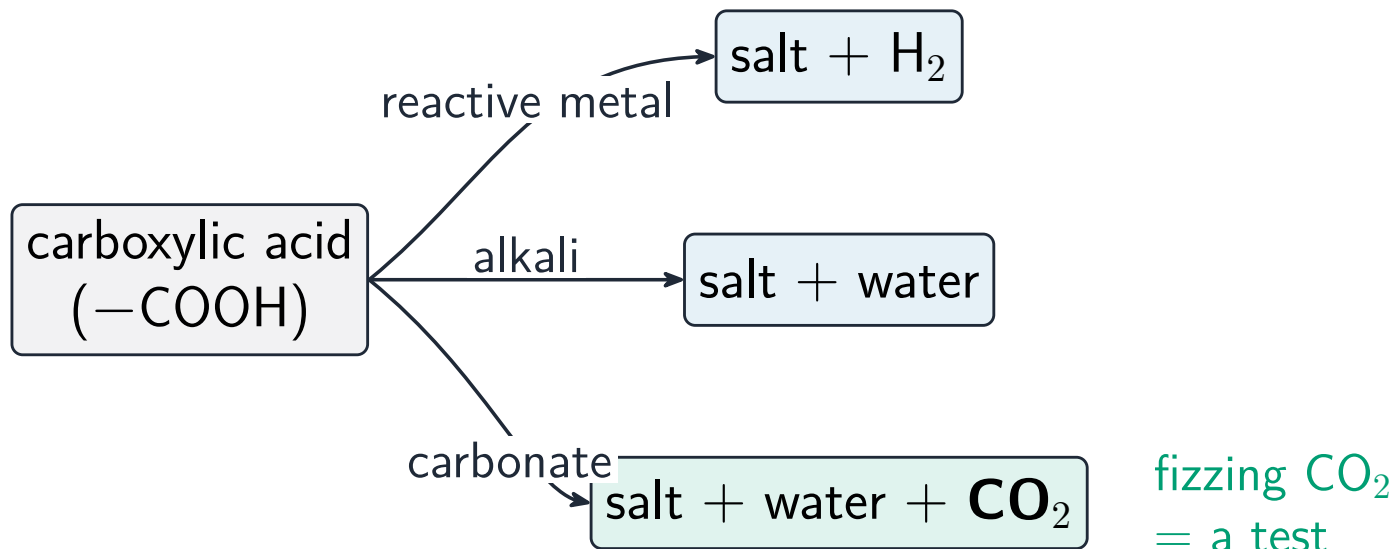
A-Level Chemistry

Carboxylic acid reactions

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

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

Carboxylic acid reactions, in detail



Carboxylic acids behave as acids: a salt with a metal (+ H_2), with an alkali (+ water), or with a carbonate (+ water + CO_2 – the fizz is a test)

Two reactions that change the group, and three that prove it is an acid

Reactive metal

A **redox** reaction: salt + hydrogen. $2\text{CH}_3\text{COOH} + \text{Mg} \rightarrow (\text{CH}_3\text{COO})_2\text{Mg} + \text{H}_2$

Alkali

A **neutralisation** : salt + water.

Carbonate

Salt + water + carbon dioxide – the **fizz** is the test for a carboxylic acid.

Esterification

With an alcohol and concentrated H_2SO_4 as catalyst: an ester.

Reduction

Reduction by LiAlH_4 takes it back to a **primary alcohol**.

The first three are acid behaviour; the last two rebuild the functional group. Sort any reaction into that pair first.

Exercises 2.1·2.2

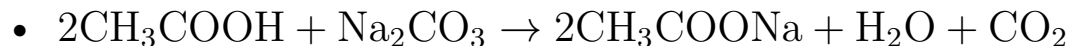
2.1 Write the equation for ethanoic acid reacting with sodium carbonate. [1]

2.2 State a chemical test, with result, that shows a compound is a carboxylic acid. [2]

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2.1



2.2 State a chemical test, with result, that shows a compound is a carboxylic acid. [2]

2.2

- add a carbonate (e.g. sodium carbonate); effervescence / fizzing of CO_2 is seen

Exercises 3.1·3.2

3.1 Which reagent reduces a carboxylic acid to a primary alcohol?

[1]

☐

A NaBH_4

B LiAlH_4

C acidified $\text{K}_2\text{Cr}_2\text{O}_7$

D concentrated H_2SO_4

3.2 Ethanoic acid reacts with magnesium to give:

[1]

☐

A an ester and water

B a salt and hydrogen

C a salt, water and CO_2

D no reaction

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3.1 B

- LiAlH_4 reduces a carboxylic acid to a primary alcohol

3.2 Ethanoic acid reacts with magnesium to give:

[1]

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A an ester and water

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C a salt, water and CO_2

D no reaction

3.2 B

- A reactive metal gives a salt and hydrogen

Exercise 3.3

3.3 (a) Write the equation for the reaction of ethanoic acid with sodium hydroxide and name the type of reaction. [2]

(b) State the reagents and conditions to make ethanoic acid from ethanol. [2]

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3.3

(a)

- $\text{CH}_3\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$; neutralisation

(b)

- acidified $\text{K}_2\text{Cr}_2\text{O}_7$ (or KMnO_4); heat under reflux

Exercise 3.4

3.4 Explain why carboxylic acids fizz with a carbonate but alcohols do not. [2]

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3.4

- carboxylic acids are acidic – they release H^+ which reacts with the carbonate to give CO_2 ; alcohols are not acidic enough to react with a carbonate