

GCSE



CCEA GCSE TEACHER GUIDANCE

Chemistry Practical Manual

Unit 3: Practical Skills

C7: Investigate the reactions of
carboxylic acids

For first teaching from September 2017



Investigate the reactions of carboxylic acids

A carboxylic acid is one which contains -COOH as its functional group. In comparison to mineral acids, carboxylic acids show some similarities, but also, some important differences.

Remember:

- All acids are soluble in water
- They release H^+ ions in water
- They release H_2 gas when reacted with a metal
- They release CO_2 gas when reacted with a metal carbonate
- They have pH values less than 7
- In this practical you will compare the reactions of a carboxylic acid (Ethanoic acid) with the reactions of Hydrochloric Acid.

Reaction 1 The pH of Carboxylic Acids

Apparatus and Chemicals

Test-tubes (x2)

Measuring cylinder (10 cm^3)

Universal indicator or pH meter

ethanoic acid 0.1 mol/dm^3

hydrochloric acid 0.1 mol/dm^3

Method

- 1) Using a measuring cylinder, measure 5 cm^3 of hydrochloric acid and add to a test-tube
- 2) Repeat step 1 with ethanoic acid into a separate test-tube
- 3) Add 5 drops of Universal Indicator to each test-tube and record the pH, or use a pH meter to record the pH

You should find that hydrochloric acid has a lower pH than ethanoic acid.

This tells us that the hydrochloric acid released more H^+ ions than the ethanoic acid, even though they are both the same concentration.

We can say that ethanoic acid is a weaker acid than hydrochloric acid as it only partly ionises in water. Hydrochloric acid is a strong acid and completely ionises in water.

Reaction 2 Comparison of the reaction of magnesium with both acids

Remember that an acid reacts with a metal to produce hydrogen gas.

Apparatus and Chemicals

boiling tubes

delivery tube

test tube

basin

boiling tube rack

measuring cylinder (25 cm³) safety glasses, wooden splint

1 mol/dm³ hydrochloric acid

1 mol/dm³ ethanoic acid

2 x 1 cm strips of magnesium ribbon

Method

- 1) Fill the basin and test-tube with water, let the test tube rest on the bottom of the basin
- 2) Measure 20 cm³ of ethanoic acid using the measuring cylinder and add to the boiling tube
- 3) Repeat step 2 with hydrochloric acid, place both boiling tubes in the boiling tube rack
- 4) Add the magnesium strip to each boiling tube – ensuring that the Mg is fully immersed in the acid, allow the reaction to proceed for 10 seconds and record your observations.

Is there any difference in the reaction of both acids?

- 5) After 10 s, place the delivery tube onto the boiling tube with the ethanoic acid and place the end of the glass tube underneath the test-tube. Hold the test-tube upright and collect the gas produced. Once the test-tube is full, stopper the tube and place it in the test-tube rack
- 6) Carefully light a splint and hold it over the top of the test-tube. Now remove the stopper of the test-tube and place the lit splint inside.

Record your observations:

What did you observe when the Mg reacted with the both acids?

What did you observe when you collected and tested the gas?

In this reaction it is very obvious that a gas is produced in both tubes– you can see fizzing in the boiling tubes.

The magnesium also disappears, it is being chemically changed and forming a soluble product. However, the reaction is much slower in the ethanoic acid tube.

Using collision theory, can you explain why the reaction is slower?

You may have also noticed that the boiling tube with the hydrochloric acid becomes warm, this is evidence that heat is given off during the reaction.

Why is this heat change harder to detect in the ethanoic acid reaction?

Hopefully, when you tested the gas produced you will have heard a squeaky pop when the lit splint is placed into the test-tube. How could you prove that this gas is also produced in the other boiling tube?

For each reaction, write the balanced symbol equation:

For each reaction, write the ionic equation including state symbols:

Reaction 3 Reaction of ethanoic acid with calcium carbonate

In this reaction we will investigate the reaction between ethanoic acid and calcium carbonate. All acids produce carbon dioxide gas when reacted with a metal carbonate.

Apparatus and chemicals

Measuring cylinder (25 cm³)

boiling tube

test-tube

disposable pipette/dropper

test-tube rack

ethanoic acid 0.5 mol/dm³

calcium carbonate (3 g)

Universal Indicator

Limewater (5 cm³)

Method

- 1) Using a measuring cylinder, measuring 15 cm³ of ethanoic acid and place into the boiling tube
- 2) Add 5 drops of universal indicator to the acid
- 3) Using a clean measuring cylinder, measure 5 cm³ of limewater and place into a test-tube. Place the test-tube and boiling tube side by side in a test-tube rack.
- 4) Carefully add the calcium carbonate to the acid – record your observations, especially any colour changes to the indicator.
- 5) Using the disposable pipette/dropper, collect the gas produced by opening and closing the dropper above the reaction in the boiling tube.
- 6) Once the gas has been collected in the disposable pipette/dropper, bubble the gas through the limewater and record your observations.

As the reaction proceeds there is a gradual increase in the pH value of the solution. Can you explain why this is?

Write the balanced symbol equation for the reaction between the ethanoic acid and the calcium carbonate.
