GCSE

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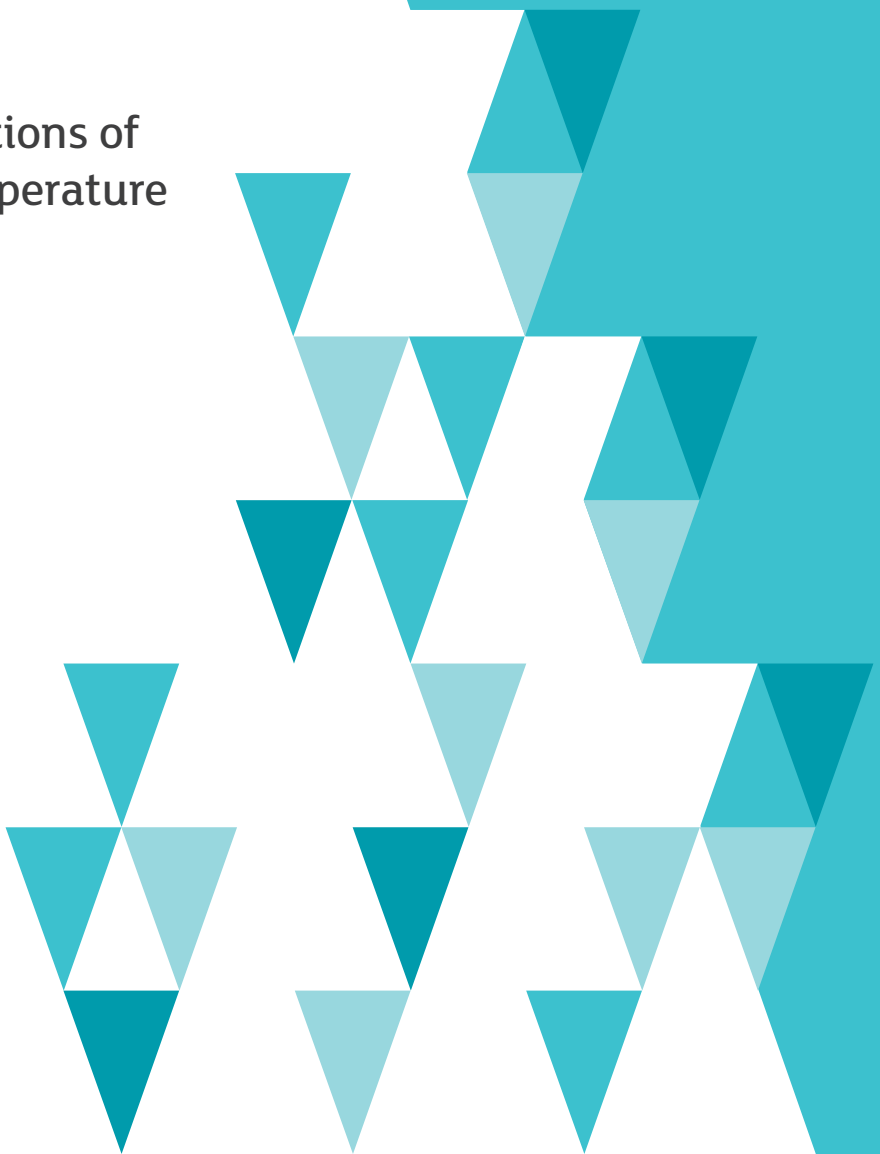
Double Award Science Practical Manual

Unit 7: Practical Skills

C1: Investigate the reactions of acids, including temperature changes that occur



For first teaching from September 2017

Investigate the reactions of acids, including temperature changes that occur

Acids are very specific chemicals:-

- They are soluble
- *They release H^+ ions when dissolved in water*
- They all have a pH less than 7 – find out why at A Level!

Due to their ability to release H^+ ions, all acids have characteristic reactions. In this experiment you will investigate these reactions, record observations and write balanced symbol equations for the reactions involved.

In all reactions, follow the safety advice of your teacher.

Reaction 1

An acid will release hydrogen gas when reacted with a metal

Apparatus and Chemicals:

Boiling tube, delivery tube, test tube, basin, test-tube rack, measuring cylinder (25 cm^3), safety glasses, wooden splint

1 mol/dm^3 hydrochloric acid (15 cm^3)
2 cm strip of magnesium

Method

1) Fill the basin and test-tube with water, let the test tube rest on the bottom of the basin
2) Measure 15 cm^3 of hydrochloric acid using the measuring cylinder and add to the boiling tube
3) Add the magnesium strip to the boiling tube – ensuring that the magnesium is fully immersed in the acid by swirling and allow the reaction to proceed for 10s
4) After 10s, place the delivery tube onto the boiling tube 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.
5) Light a splint. Remove the stopper of the test-tube and hold the lit splint at the top of the test tube.

Record your observations:-

What did you observe when the magnesium reacted with the acid?

1. _____

2. _____

3. _____

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

1. _____

2. _____

3. _____

In this reaction it is very obvious that a gas is produced – you can see fizzing in the boiling tube. The magnesium also disappears, it is being chemically changed and forming a soluble product. You may have also noticed that the boiling tube becomes warm, this is evidence that heat is given off during the reaction. We will look at this observation more fully in a later test.

When you collected the gas you should have noticed that it rises to the top of the test-tube and also that the water in the basin has no effect on the gas. This is because hydrogen is less dense than air and is insoluble in water. You will also have heard a squeaky pop when the lit splint is placed into the test-tube. This is actually a mini explosion! The hydrogen is reacting with the oxygen in the air and making water- you may have seen little droplets of water on the side of the test-tube after the reaction.

Write both the word and symbol equation for the reaction of magnesium with hydrochloric acid.

Word equation _____

Balanced symbol equations _____

Write the ionic equation for the reaction and include state symbols.

Reaction 2

An acid will react with metal oxides.

In this reaction, we are going to use sulfuric acid and copper(II) oxide. This time there will be no gas produced. However, there will be other evidence that a chemical reaction is taking place.

Apparatus and Chemicals

Kettle
250 cm^3 beaker
100 cm^3 beaker
Measuring cylinder
Spatula, watch glass, glass rod
Heatproof mat
Safety goggles
Sulfuric acid 0.5 mol/dm^3
Copper(II) oxide (2 g)
pH paper

Method

1. Using pH paper determine the pH of the acid at the start, record this in your results.
2. Using a measuring cylinder, measure out 25 cm^3 of sulfuric acid into the small beaker
3. Collect approximately 2 g of copper(II) oxide on a watch glass
4. Using hot water from a kettle, fill 1/3 of the larger beaker with hot water.
5. Warm the sulfuric acid beaker by letting it rest (carefully) in the hot water bath (leave for 2 min).
6. Carefully remove the small beaker and add copper(II) oxide to the acid slowly, stir with a glass rod
7. Keep adding the copper(II) oxide, until there is some left over at the bottom of the beaker. Let the beaker sit for 2 min to allow the black powder to settle.

Record your observations

_____

_____

Finally, using pH paper, record the pH of the solution that remains.

_____

In this experiment, you should be able to observe that at the start the acid has a pH of about 1-2. Also, although there is no gas produced, there is a chemical reaction taking place as the solution changes from colourless to a pale blue, you should also notice that the copper(II) oxide disappears at the start. However, once all the acid has reacted, the copper(II) oxide remains behind as seen by black powder at the bottom of the beaker. The blue colour is due to the formation of a soluble salt –can you name it?

At the end of the experiment, you were asked to test the pH again – did you find that the pH is now higher? Why do you think this is?

Write the balanced symbol equation for the reaction between copper(II) oxide and sulphuric acid.

Reaction 3

An acid will usually release heat when it reacts

In this reaction we are going to react an acid with an alkali and measure the temperature change during the reaction. The acid will react to produce a salt and water – no gas is produced. Also, in this reaction there is no colour change. However, the pH will change –you could measure this as described in the previous reaction.

Apparatus and Chemicals

Polystyrene cup and lid
250 cm^3 beaker
Thermometer
Measuring cylinder (25cm^3)
1 mol/dm^3 HCl (25cm^3)
1 mol/dm^3 NaOH (25cm^3)

Method

1. Place the polystyrene cup into the 250 cm3 beaker to stabilise it.
2. Carefully measure 25 cm^3 of hydrochloric and place it in the polystyrene cup
3. Take the initial temperature of the hydrochloric acid and record it in the results table
4. Wash out the measuring cylinder and rinse it with a little sodium hydroxide solution
5. Then measure 25 cm^3 of sodium hydroxide solution into the measuring cylinder
6. Add the sodium hydroxide solution to the acid, stir with the thermometer, measure and record the highest temperature reached during the reaction.

Initial temperature of hydrochloric acid (°C)	Highest temperature reached in reaction (°C)	Temperature change (°C)

During this reaction the H^+ ions from the acid and the OH^- ions from the alkali react together to form water. As this happens, energy is released which is detected by the thermometer. The term we use to describe the release of energy is a chemical reaction is exothermic (the 'exit' of energy).

Why do you think we use a polystyrene cup to carry out this reaction?

_____

_____

Reaction 4

The final characteristic reaction of an acid is that it will produce carbon dioxide gas when reacted with a metal carbonate. The carbon dioxide gas which is released during the reaction will cause limewater to change from a colourless solution to milky.

Apparatus and Chemicals

Measuring cylinder
Boiling tube, test-tube
Disposable pipette/dropper
Test-tube rack
HCl 0.5 mol/dm^3
Calcium carbonate (3 g)
Limewater (5 cm^3)

Method

1. Using a measuring cylinder, measuring 15 cm^3 of hydrochloric acid and place into the boiling tube
2. Using a clean measuring cylinder, measure 5 cm^3 of limewater and place into a test-tube. Place the test-tube and boiling tube side by side in a test-tube rack.
3. Carefully add the calcium carbonate to the acid – record your observations
4. Using the disposable pipette/dropper, collect the gas produced by opening and closing the dropper above the reaction in the boiling tube.
5. Once the gas has been collected in the disposable pipette/dropper, bubble the gas through the limewater and record your observations.

Observations

_____

_____

During this reaction, it is very obvious that gas is produced as the reaction fizzes vigorously. The carbon dioxide gas is more dense than air which allows us to use a dropper to collect it – it will not rise out of the boiling tube quickly and so can be collected and bubble through the limewater. Once the carbon dioxide gas goes through the limewater it reacts with it and makes a solid (precipitate), this causes the limewater to go 'milky'.

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

_____

Write the equation for the reaction of carbon dioxide with limewater. Include state symbols.

_____