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EB Education Revision Guide

How to work with Required Practicals: Part 2
Combined (AQA Chemistry Paper 1)

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Assessed Required Practical Activities
Paper 1
Foundation & Higher

Required practical activity 8: preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate
Required practical activity 9: investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis.
Required practical activity 10: investigate the variables that affect temperature changes in reacting solutions

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Hydrochloric Acid makes Metal Chlorides
Sulfuric Acid makes Metal Sulphates
Nitric Acid makes Metal Nitrates

Practical 8: Making Salts

What you need to know

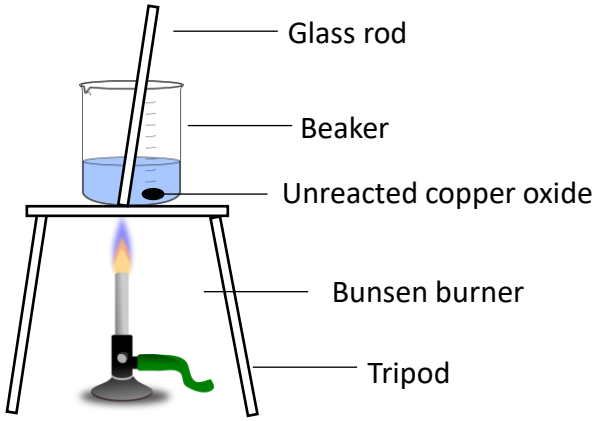
- Be able to explain how to make a pure dry sample of a soluble salt from an insoluble carbonate or oxide and why some of the steps are followed.

- You need to add an excess of metal oxide to acid to ensure that the acid has fully reacted with the metal oxide.
- You need to heat the solution gently to speed up the reaction.
- You then filter the solution to remove the excess metal oxide.
- You heat the filtered solution (filtrate) gently to slowly evaporate off some but not all of the water and stop when crystals start to form.
- Leave the solution to cool and allow the salt to crystallise (this will happen as the salt becomes insoluble in the cold highly concentrated solution.
- Filter the crystals out of the solution and leave them in a warm place to dry.

- Be able to describe the risks and safety precautions
- Be able to name the salt produced – or decide which chemicals should be reacted to make a particular salt

Acid + metal carbonate → metal salt + water + carbon dioxide
Acid + metal oxide → metal salt + water

Diagram



Practical 9: Electrolysis

What you need to know

- **Be able to explain what electrolysis is and what can be made at the electrodes.**

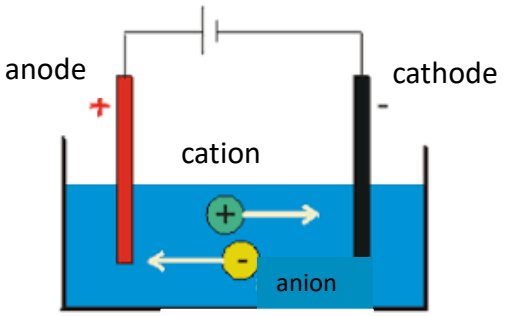
a) Using molten compounds or less reactive [than hydrogen] salt solutions

- Positive ions (metal ions) move to the negative electrode (cathode)
- Negative ions move to the positive electrode (anode)

b) More reactive [than hydrogen] metal solutions e.g. sodium chloride solution

- If the metal is more reactive than hydrogen then hydrogen is produced at the negative electrode instead of the metal
- Metal hydroxide is produced in the solution. This means if universal indicator is added it will go blue/purple.

Diagram



You may be asked:

How could you test what gas is produced?

Hydrogen – squeaky pop

Chlorine – bleaches damp litmus paper

What happens to the ions at the electrodes?

Positive ions are reduced, this means they gain electrons. Negative ions are oxidised, this means they lose electrons. If you are taking the higher paper you will need to complete half equations.

In molten substances:

Molten substances can be electrolysed because the ions can move freely. Molten compounds are always broken up into the elements present in the ionic compound.

In aqueous substances:

As well as the ions from the ionic compound, there will be hydrogen ions and hydroxide ions from the water.

At the anode – if halide ions are present (Cl^-, Br^-, I^-), then molecules of chlorine, bromine or iodine will be formed. If no halide ions are present then oxygen will be formed.

Practical 10: Temperature Changes

What you need to know

This practical investigates changes in temperature in different reactions.

- You add different chemicals together and measure the change in temperature. Each experiment should be repeated at least 3 times, and the mean (average) calculated.
- A polystyrene cup and a lid is used to reduce the temperature loss to the surroundings. This increases the accuracy of the results.

If there is an increase in temperature, the reaction is exothermic.

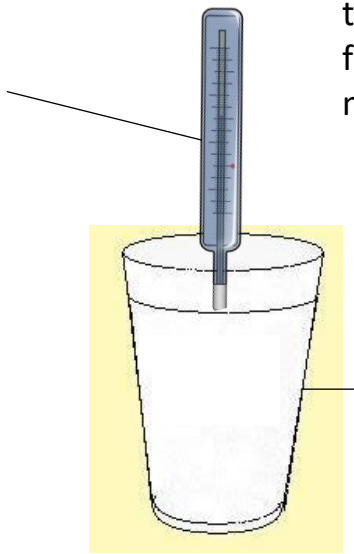
If there is a decrease in temperature the reaction is endothermic.

Displacement reactions are exothermic
Most neutralisation reactions are exothermic
Precipitation reactions are exothermic
Dissolving salts can be exothermic or endothermic.

Diagram

Reactants are mixed together in the cup. The polystyrene cup provides insulation, reducing energy transfer rate to or from the reaction mixture.

The thermometer is used to measure the temperature change which takes place during the reaction



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Your turn:

1. Reacting metal oxides with acids produces soluble salts.

a) Name one other substance which can react with an acid to form a soluble salt.

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b) The ions Ca^{2+} and NO_3^- are found in calcium nitrate.
What is the formula of calcium nitrate?

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c) Describe how you could make pure, dry crystals of magnesium sulphate from a dilute acid and a metal oxide.

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2. Gabbie is planning a method to prepare pure crystals of copper sulphate.
Her method is below:

1. Add two spatulas of sodium carbonate to dilute nitric acid in a beaker.
2. Once the fizzing has stopped, use a Bunsen burner to heat the solution until all the liquid has evaporated.

There are a number of errors in her method.
Explain what improvements could be made to ensure that she produces pure crystals of copper sulphate.

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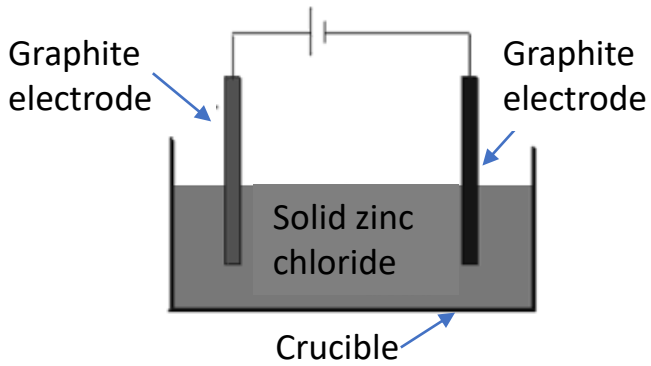
Your turn:

3. Imogen decided to investigate the electrolysis of different substances.



a) Explain why electrolysis would not take place in the apparatus shown above.

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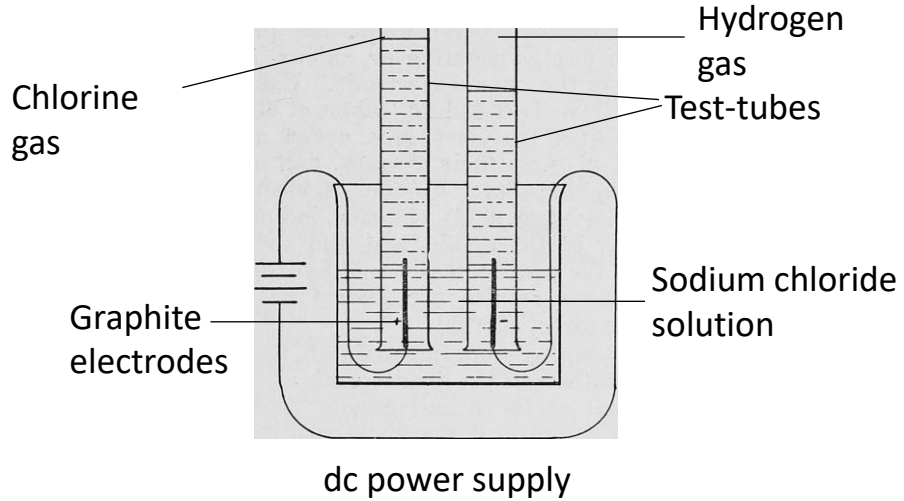
She also investigated how the volume of gases produced can change with time when sodium chloride solution is electrolysed.



b) Imogen made a mistake when she was choosing the apparatus for this investigation.
How should she change the apparatus to improve the investigation?

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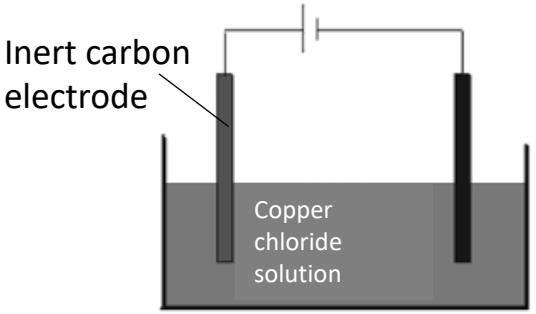
Your turn:

4. Liam investigates the mass of copper which is produced during the electrolysis of copper chloride solution.



a) Which gas will be produced at the positive electrode (anode)?

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b) Copper will be produced at the negative electrode. What does this tell you about the reactivity of copper?

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The results of Liam's experiments are below:

	Total mass of copper produced in mg			
Time in mins	**Experiment 1**	**Experiment 2**	**Experiment 3**	**Mean**
1	0.58	0.62	0.60	0.60
2	1.21	1.22	1.17	1.20
4	2.40	2.39	2.41	2.40
5	3.02	X	3.01	3.06

c) Calculate the mean mass of copper produced after 3 minutes.

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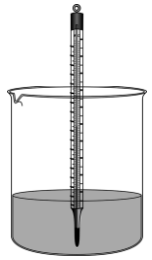
Your turn:

5. Ollie conducted an experiment to determine the energy change when hydrochloric acid reacts with sodium hydroxide. The equation for the reaction is shown below.

$HCl + NaOH \longrightarrow NaCl + H_2O$

Ollie used the apparatus in the diagram in his experiment.



He placed 50cm^3 of hydrochloric acid in a beaker and measured the temperature.
He then added 50cm^3 of sodium hydroxide solution and stirred the mixture with the thermometer. He recorded the highest temperature the mixture reached.
Ollie then repeated the experiment, calculating the temperature change each time

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Initial temperature in °C	22.0	19.0	19.2	19.0
Highest temperature in °C	29.0	26.2	26.0	23.5
Temperature change in °C	7.0	7.2	6.8	4.5

The biggest error in this experiment is loss of heat.

a) How could the apparatus be modified to reduce heat loss?

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b) Why is it important to stir the chemicals?

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c) Which one of the experiments do you think Ollie carried out on a different day to the others? Explain why.

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d) Explain why Ollie should not use Experiment 4 to calculate the average temperature change.

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e) Using the first three experiments, calculate the average temperature change.

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f) Use this equation to calculate the energy change for the reaction.
Energy change in joules = 100 x 4.2 x average temperature change

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Your turn:

g) Which of these energy level diagrams represents the energy change for this reaction?
Explain why.

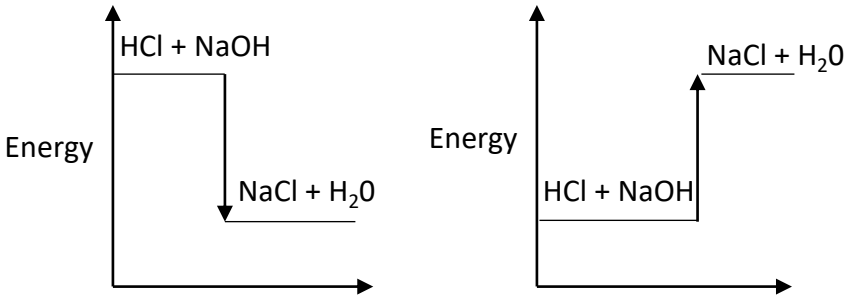

Diagram A

Diagram B

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Answers:

1. Reacting metal oxides with acids produces soluble salts.

a) Name one other substance which can react with an acid to form a soluble salt.

Metal carbonates/metal hydroxide/metal/alkali solution

b) The ions Ca^{2+} and NO_3^- are found in calcium nitrate.
What is the formula of calcium nitrate?

$Ca(NO_3)_2$

c) Describe how you could make pure, dry crystals of magnesium sulphate from a dilute acid and a metal oxide.

Use magnesium oxide and sulphuric acid to react together. Add sulphuric acid to a beaker and warm it. Add magnesium oxide in excess and stir it. Filter using a filter paper and funnel to remove the excess magnesium oxide. Heat in an evaporating basin to crystallisation point (do not evaporate all the water). Leave to crystallise and pat dry with filter paper

2. Gabbie is planning a method to prepare pure crystals of copper sulphate.
Her method is below:

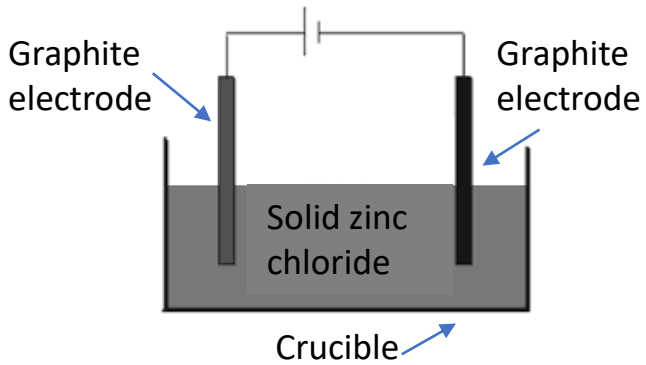
1. Add two spatulas of sodium carbonate to dilute nitric acid in a beaker.
2. Once the fizzing has stopped, use a Bunsen burner to heat the solution until all the liquid has evaporated.

There are a number of errors in her method.
Explain what improvements could be made to ensure that she produces pure crystals of copper sulphate.

Use sulphuric acid not nitric acid
Use copper carbonate/oxide not sodium carbonate
Add solid until it is in excess/no more remains so that all of the acid reacts
Filter to remove excess solid
Heat gently/partially evaporate or leave until crystals start to appear.

Answers:

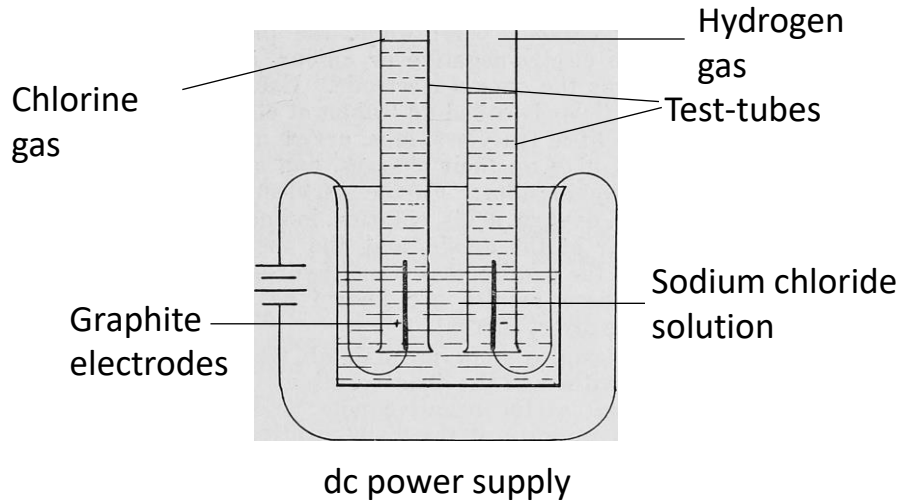
3. Imogen decided to investigate the electrolysis of different substances.



a) Explain why electrolysis would not take place in the apparatus shown above.

Solid zinc chloride does not conduct electricity as the ions are not free to move

She also investigated how the volume of gases produced can change with time when sodium chloride solution is electrolysed.



b) Imogen made a mistake when she was choosing the apparatus for this investigation.

How should she change the apparatus to improve the investigation?

Use measuring cylinders/gas syringe because test tubes cannot measure volume accurately

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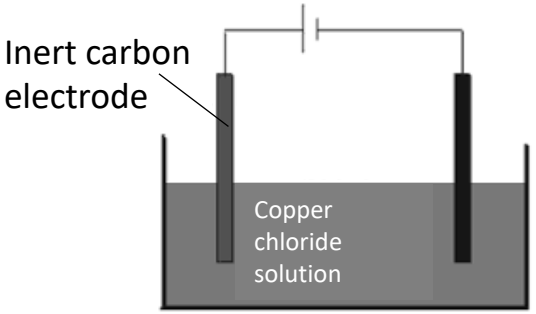
Answers:

4. Liam investigates the mass of copper which is produced during the electrolysis of copper chloride solution.



a) Which gas will be produced at the positive electrode (anode)?

Chlorine

b) Copper will be produced at the negative electrode. What does this tell you about the reactivity of copper?

Copper is less reactive than hydrogen

The results of Liam's experiments are below:

	Total mass of copper produced in mg			
Time in mins	**Experiment 1**	**Experiment 2**	**Experiment 3**	**Mean**
1	0.58	0.62	0.60	0.60
2	1.21	1.22	1.17	1.20
4	2.40	2.39	2.41	2.40
5	3.02	X	3.01	3.06

c) Estimate the mean mass of copper produced after 3 minutes.

1.8 mg

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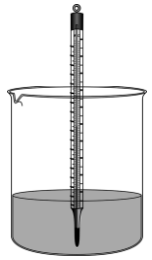
Answers:

5. Ollie conducted an experiment to determine the energy change when hydrochloric acid reacts with sodium hydroxide. The equation for the reaction is shown below.

$HCl + NaOH \longrightarrow NaCl + H_2O$

Ollie used the apparatus in the diagram in his experiment.



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Temperature change in °C	7.0	7.2	6.8	4.5

The biggest error in this experiment is loss of heat.

a) How could the apparatus be modified to reduce heat loss?

Use a plastic beaker/lid/insulation

b) Why is it important to stir the chemicals?

So all the substances react fully/to distribute heat

c) Which one of the experiments do you think Ollie carried out on a different day to the others? Explain why.

Experiment 1 – as it has a different starting temperature

d) Explain why Ollie should not use Experiment 4 to calculate the average temperature change.

It is anomalous – the temperature change does not fit the pattern

e) Using the first three experiments, calculate the average temperature change.

7°C

f) Use this equation to calculate the energy change for the reaction.

Energy change in joules = 100 x 4.2 x average temperature change

100 x 4.2 x 7 = 2940 J

Your turn:

g) Which of these energy level diagrams represents the energy change for this reaction?
Explain why.

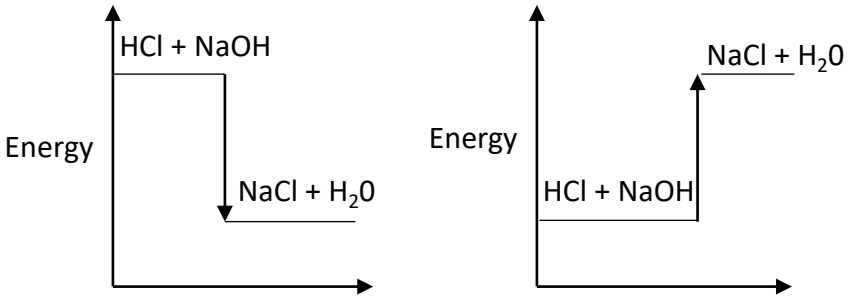

Diagram A

Diagram B

Diagram A as the reaction is exothermic/temperature increases. There is more energy in the bonds of the reactants than that of the bonds of the products

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