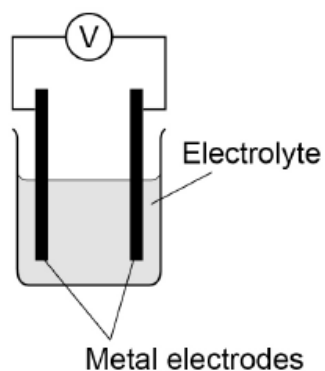


AQA - Chemical changes – GCSE Chemistry Paper 2

1. June/2021/Paper_1F/No.2(2.3)

Figure 4 shows a chemical cell.

Figure 4

0	2	3
---	---	---

 The order of reactivity of three metals is shown below.

Iron	(Most reactive)
Tin	↑
Copper	(Least reactive)

Which combination of metal electrodes would give the highest voltage in the chemical cell in **Figure 4**?

[1 mark]Tick (✓) **one** box.

Copper and iron

Iron and tin

Tin and copper

2. June/2021/Paper_1F/No.4

0 4

A student investigated the reactivity of metals with hydrochloric acid.

This is the method used.

1. Measure 50 cm³ of hydrochloric acid into a polystyrene cup.
2. Measure the temperature of the hydrochloric acid.
3. Add one spatula of metal powder to the hydrochloric acid and stir.
4. Measure the highest temperature the mixture reaches.
5. Calculate the temperature increase for the reaction.
6. Repeat steps 1 to 5 three more times.
7. Repeat steps 1 to 6 with different metals.

Table 4 shows the student's results.

Table 4

Metal	Temperature increase in °C				Mean temperature increase in °C
	Trial 1	Trial 2	Trial 3	Trial 4	
Cobalt	6	7	5	9	7
Magnesium	54	50	37	55	X
Zinc	18	16	18	20	18

0 4 . 1

Calculate the mean temperature increase **X** for magnesium in Table 4.

Do not include the anomalous result in your calculation.

[2 marks]

X = _____ °C

0 4 . 2 Determine the order of reactivity for the metals cobalt, magnesium and zinc.

Use Table 4.

[1 mark]

Most reactive _____

Least reactive _____

0 4 . 3 The range of measurements either side of the mean shows the uncertainty in the mean temperature increase.

Complete the sentence.

Use Table 4.

[1 mark]

The mean temperature increase for zinc is $18 \pm$ _____ °C

0 4 . 4 What type of variable is the volume of hydrochloric acid in this investigation?

[1 mark]

Tick (✓) **one** box.

Control

Dependent

Independent

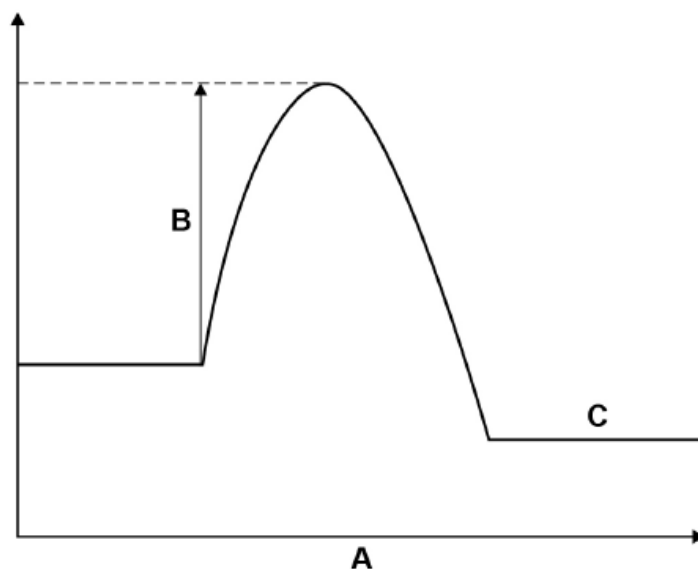
0 4 . 5 Suggest **one** way of improving **step 3** in the method to give results which are more repeatable.

[1 mark]

0 4 . 6

Figure 6 shows a reaction profile for the reaction of magnesium with hydrochloric acid.

Figure 6



What do labels **A**, **B** and **C** represent on **Figure 6**?

Choose answers from the box.

[3 marks]

activation energy	energy	overall energy change
products	progress of reaction	reactants

A _____

B _____

C _____

3. June/2021/Paper_1F/No.5

0 5

This question is about acids and alkalis.

0 5

. 1

Which ion do acids produce in aqueous solution?

[1 mark]

Tick (✓) **one** box.H⁺ OH⁻ O²⁻

0 5

. 2

Acids react with alkalis.

What is the name of this type of reaction?

[1 mark]

Tick (✓) **one** box.

Decomposition

Electrolysis

Neutralisation

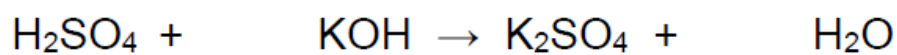
Redox

0 5

. 3

Balance the equation for the reaction between sulfuric acid and potassium hydroxide.

[1 mark]



0 5

. 4

Universal indicator turns purple in potassium hydroxide solution.

What is the pH of the solution?

[1 mark]

Tick (✓) **one** box.

1

4

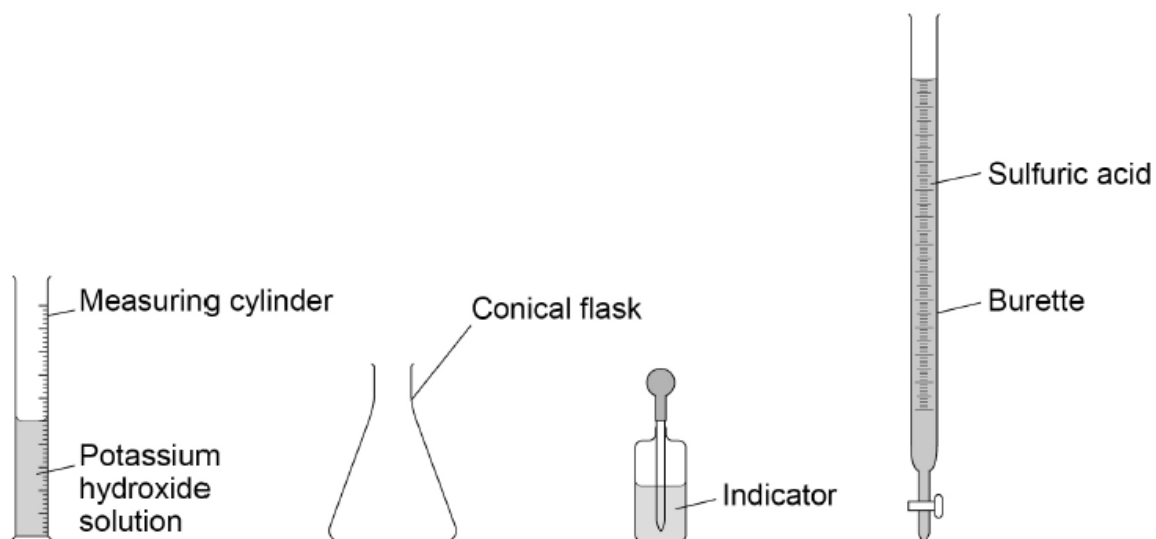
7

14

A student does a titration to find the volume of sulfuric acid that reacts with 25 cm³ of potassium hydroxide solution.

Figure 7 shows the equipment used.

Figure 7



0 5 . 5 The 25 cm³ of potassium hydroxide solution is measured with the measuring cylinder.

Which piece of equipment could the student use to measure the 25 cm³ of potassium hydroxide solution more accurately?

[1 mark]

Tick (✓) **one** box.

Beaker

Evaporating basin

Pipette

Test tube

4. June/2021/Paper_1F/No.6

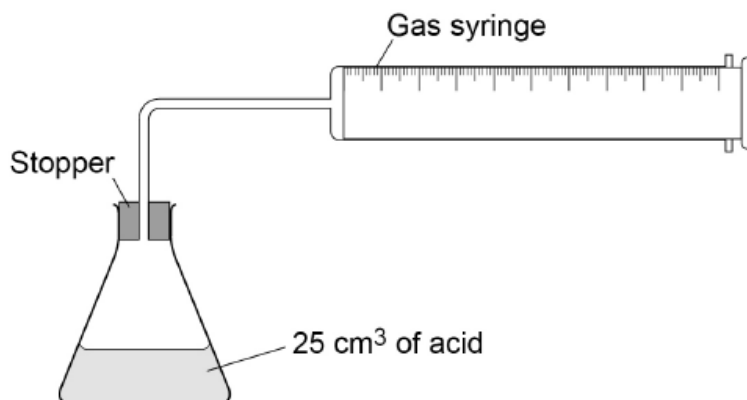
0 6

This question is about metal carbonates.

A student investigated the reaction of copper carbonate with an acid.

Figure 8 shows the apparatus.

Figure 8



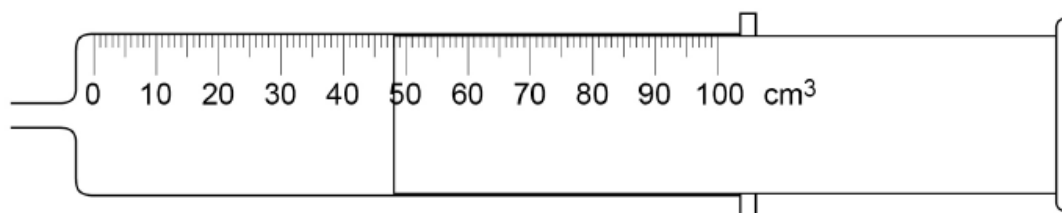
This is the method used.

1. Pour 25 cm³ of the acid into a conical flask.
2. Weigh 0.10 g of copper carbonate.
3. Remove the stopper and add the copper carbonate to the flask.
4. Quickly replace the stopper.
5. Record the maximum volume of gas collected in the gas syringe.
6. Repeat steps 1 to 5 with different masses of copper carbonate.

0 6 . 1

Figure 9 shows the gas syringe during the experiment.

Figure 9



What is the reading on the gas syringe?

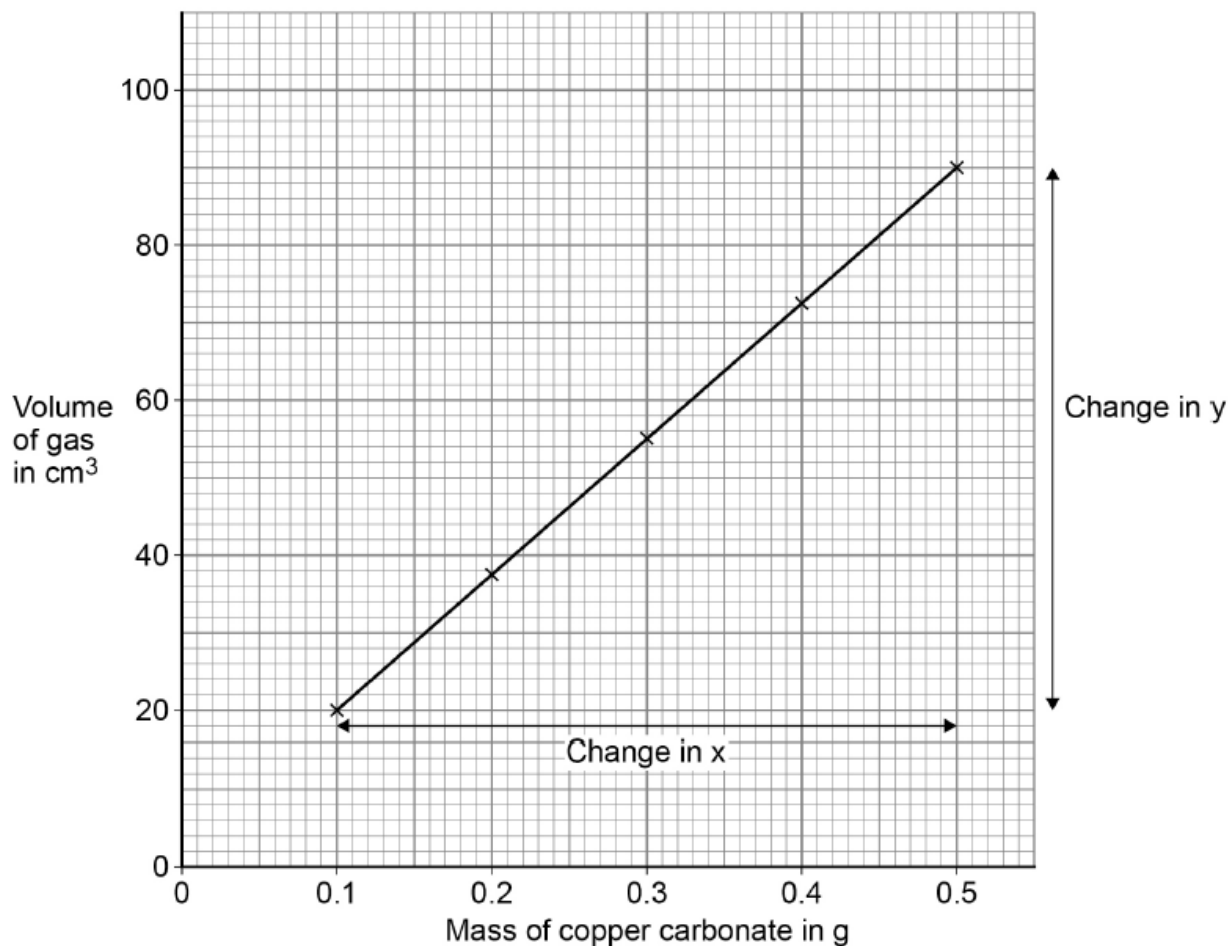
[1 mark]

_____ cm³

0 6 . 2 The student plotted the results on a graph.

Figure 10 shows the student's graph.

Figure 10



Determine the gradient of the line of best fit.

You should:

- calculate the values of the change in y and the change in x
- calculate the gradient of the line of best fit.

[4 marks]

Change in y = _____ cm³

Change in x = _____ g

Gradient _____

Gradient = _____ cm³/g

0 6 . 3 Copper chloride was produced in the reaction.

Which acid reacts with copper carbonate to produce copper chloride?

[1 mark]

Tick (✓) **one** box.

Hydrochloric acid

Nitric acid

Sulfuric acid

0 6 . 4 The reaction between copper carbonate and the acid produced a gas.

What was the gas?

[1 mark]

Tick (✓) **one** box.

Carbon dioxide

Chlorine

Hydrogen

Oxygen

A different student produced a pure, dry sample of copper chloride using the same reaction.

This is the method used.

1. Add excess copper carbonate to the acid.
2. Filter the mixture.
3. Heat the solution gently until crystals start to form.
4. Leave for 24 hours.
5. Remove the crystals.
6. Rinse with water and dry the crystals.

0 6 . 5 Why was the solution heated gently in step 3?

[1 mark]

Tick (✓) **one** box.

To evaporate acid

To evaporate copper carbonate

To evaporate water

0 6 . 6 How should the solution be heated gently in step 3?

[1 mark]

5. June/2021/Paper_1F/No.7

07

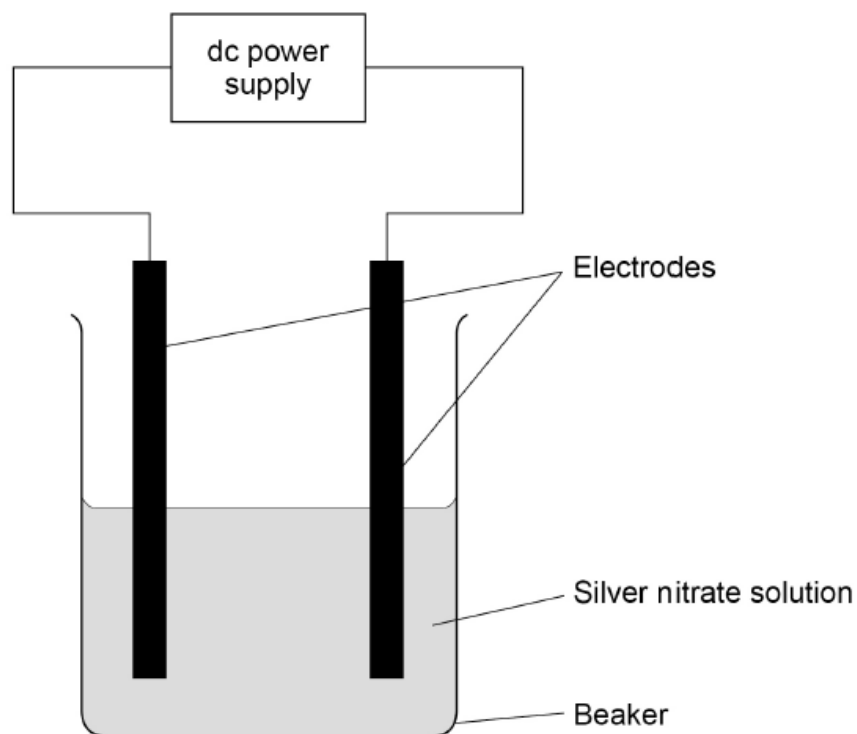
This question is about electrolysis.

Some students investigated the electrolysis of silver nitrate solution.

This electrolysis produces silver at the negative electrode.

Figure 11 shows the apparatus.

Figure 11



This is the method used.

1. Weigh the negative electrode.
2. Set up the apparatus shown in **Figure 11**.
3. Switch on the power supply.
4. Switch off the power supply after five minutes.
5. Rinse the negative electrode with water and allow to dry.
6. Reweigh the negative electrode.
7. Repeat steps 1 to 6 for different times.

07.1

Some silver did not stick to the negative electrode but fell to the bottom of the beaker.

The students needed to weigh this silver.

How could the students separate the silver from the silver nitrate solution?

[1 mark]

Tick (✓) **one** box.

By chromatography

By crystallisation

By distillation

By filtration

Table 5 shows the students' results.

Table 5

Time in minutes	Mass of silver in g
0	0.00
5	0.06
10	0.12
15	0.18
20	0.24
25	0.30

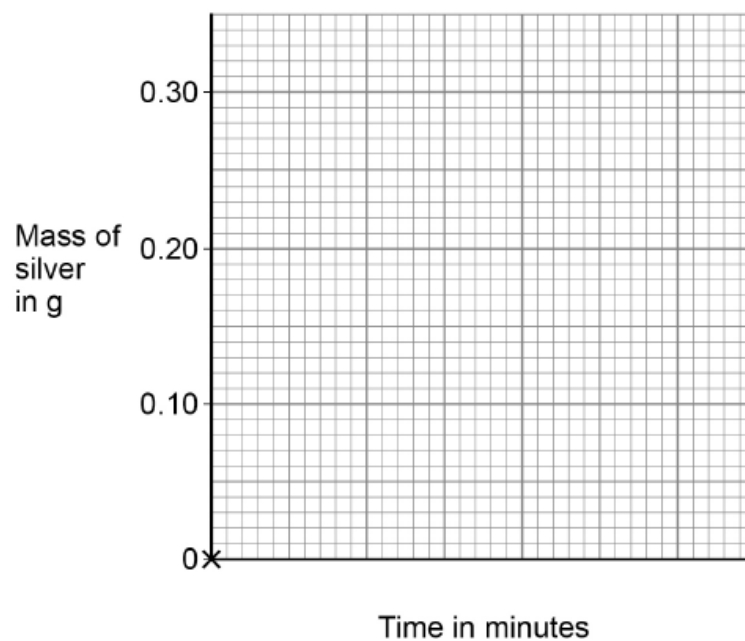
0 7 . 2 Draw a graph on **Figure 12**.

You should:

- use a suitable scale for the x-axis
- plot the data from **Table 5**
- draw a line of best fit.

[4 marks]

Figure 12



0 7 . 3 Determine the mass of silver that would be produced after 12 minutes.

Use **Figure 12**.

[1 mark]

Mass of silver = _____ g

07.4 A student investigated the electrolysis of two aqueous salt solutions.

Hydrogen is produced at the negative electrode when the metal in the salt solution is more reactive than hydrogen.

Complete **Table 6** to show what the student would **observe** at the negative electrode for each salt solution.

[2 marks]

Table 6

Salt solution	Observation at negative electrode
Copper sulfate	
Sodium chloride	

07.5 A teacher demonstrates the electrolysis of molten lead bromide.

The products at the electrodes are lead and bromine.

Why should the teacher do the demonstration in a fume cupboard?

[1 mark]

07.6 Two other molten compounds are electrolysed.

Complete **Table 7** to show the molten compounds and the products.

[3 marks]

Table 7

Molten compound electrolysed	Product at the negative electrode	Product at the positive electrode
Zinc chloride		
	Potassium	Iodine

6. June/2021/Paper_1F/No.10(10.4)

1 0 . **4** Tungsten (W) is a metal.

Tungsten is extracted from tungsten oxide (WO_3).

All other solid products from the extraction method must be separated from the tungsten.

Table 9 shows information about three possible methods to extract tungsten from tungsten oxide.

Table 9

Method	Reactant	Relative cost of reactant	Products
1	Carbon	Low	Tungsten solid Carbon dioxide gas Tungsten carbide solid
2	Hydrogen	High	Tungsten solid Water vapour
3	Iron	Low	Tungsten solid Iron oxide solid

Evaluate the three possible methods for extracting tungsten from tungsten oxide.

[4 marks]

7. June/2021/Paper_1H/No.3(3.4)

0	3	.	4
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 Tungsten (W) is a metal.

Tungsten is extracted from tungsten oxide (WO_3).

All other solid products from the extraction method must be separated from the tungsten.

Table 2 shows information about three possible methods to extract tungsten from tungsten oxide.

Table 2

Method	Reactant	Relative cost of reactant	Products
1	Carbon	Low	Tungsten solid Carbon dioxide gas Tungsten carbide solid
2	Hydrogen	High	Tungsten solid Water vapour
3	Iron	Low	Tungsten solid Iron oxide solid

Evaluate the three possible methods for extracting tungsten from tungsten oxide.

[4 marks]

8. June/2021/Paper_1H/No.5

0 5

This question is about salts.

0 5 . 1

Name the salt produced by the neutralisation of hydrochloric acid with potassium hydroxide.

[1 mark]

0 5 . 2

Write an ionic equation for the neutralisation of hydrochloric acid with potassium hydroxide.

[1 mark]



0 5 . 3

Soluble salts can be produced by reacting dilute hydrochloric acid with an insoluble solid.

Copper, copper carbonate and copper oxide are insoluble solids.

Which of these insoluble solids can be used to make a copper salt by reacting the solid with dilute hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

Copper and copper carbonate only

Copper and copper oxide only

Copper carbonate and copper oxide only

Copper, copper carbonate and copper oxide

A student makes crystals of magnesium sulfate.

This is the method used.

1. Add sulfuric acid to a beaker.
2. Warm the sulfuric acid.
3. Add a spatula of magnesium oxide to the beaker.
4. Stir the mixture.
5. Repeat steps 3 and 4 until there is magnesium oxide remaining in the beaker.
6. Filter the mixture.
7. Evaporate the filtrate gently until crystals start to form.
8. Leave the solution to finish crystallising.

0 5 . 4

Give **one** reason for:

- step 2
- step 5
- step 6.

[3 marks]

Step 2 _____

Step 5 _____

Step 6 _____

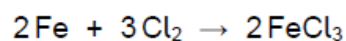
0 5 . 5

How should the filtrate be evaporated gently in **step 7**?

[1 mark]

0 5 . 6 Iron chloride is produced by heating iron in chlorine gas.

The equation for the reaction is:



Calculate the volume of chlorine needed to react with 14 g of iron.

You should calculate:

- the number of moles of iron used
- the number of moles of chlorine that react with 14 g of iron
- the volume of chlorine needed.

Relative atomic mass (A_r): Fe = 56

The volume of 1 mole of gas = 24 dm³

[3 marks]

Volume of chlorine = _____ dm³

9. June/2021/Paper_1H/No.6

0 6

This question is about metals.

0 6

. 1

Table 3 shows information about four substances.

Table 3

Substance	Melting point in °C	Boiling point in °C	Does it conduct electricity in the solid state?	Does it conduct electricity in the liquid state?
A	-117	79	No	No
B	801	1413	No	Yes
C	1535	2750	Yes	Yes
D	1610	2230	No	No

Which substance could be a metal?

[1 mark]

Tick (✓) **one** box.

A

B

C

D

0 6

. 2

Explain why alloys are harder than pure metals.

[3 marks]

0 6 . 3

A student wants to compare the reactivity of an unknown metal, **Q**, with that of zinc.

Both metals are more reactive than silver.

The student is provided with:

- silver nitrate solution
- metal **Q** powder
- zinc powder
- a thermometer
- normal laboratory equipment.

No other chemicals are available.

Describe a method the student could use to compare the reactivity of metal **Q** with that of zinc.

Your method should give valid results.

[4 marks]

10. June/2021/Paper_1H/No.7

07

This question is about chemical reactions and electricity.

07.1

Electrolysis and chemical cells both involve chemical reactions and electricity.

Explain the difference between the processes in electrolysis and in a chemical cell.

[2 marks]

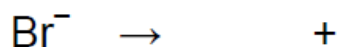
07.2

A teacher demonstrates the electrolysis of molten lead bromide.

Bromine is produced at the positive electrode.

Complete the half equation for the production of bromine.

You should balance the half equation.

[2 marks]

07.3

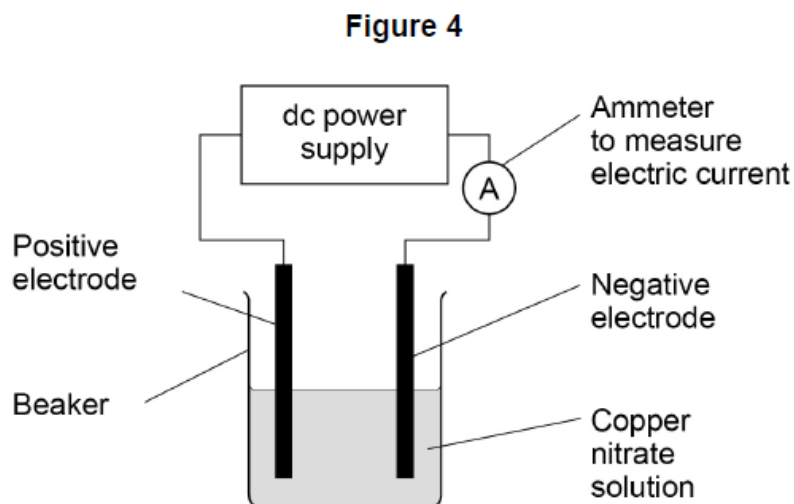
Two aqueous salt solutions are electrolysed using inert electrodes.

Complete **Table 4** to show the product at each electrode.**[3 marks]****Table 4**

Salt solution	Product at positive electrode	Product at negative electrode
Copper nitrate		copper
Potassium iodide		

Some students investigated the electrolysis of copper nitrate solution using inert electrodes.

Figure 4 shows the apparatus.



The students investigated how the mass of copper produced at the negative electrode varied with:

- time
- current.

This is the method used.

1. Weigh the negative electrode.
2. Set up the apparatus shown in **Figure 4**.
3. Adjust the power supply until the ammeter shows a current of 0.3 A
4. Switch off the power supply after 5 minutes.
5. Rinse the negative electrode with water and allow to dry.
6. Reweigh the negative electrode.
7. Repeat steps 1 to 6 for different times.
8. Repeat steps 1 to 7 at different currents.

0	7	.	4
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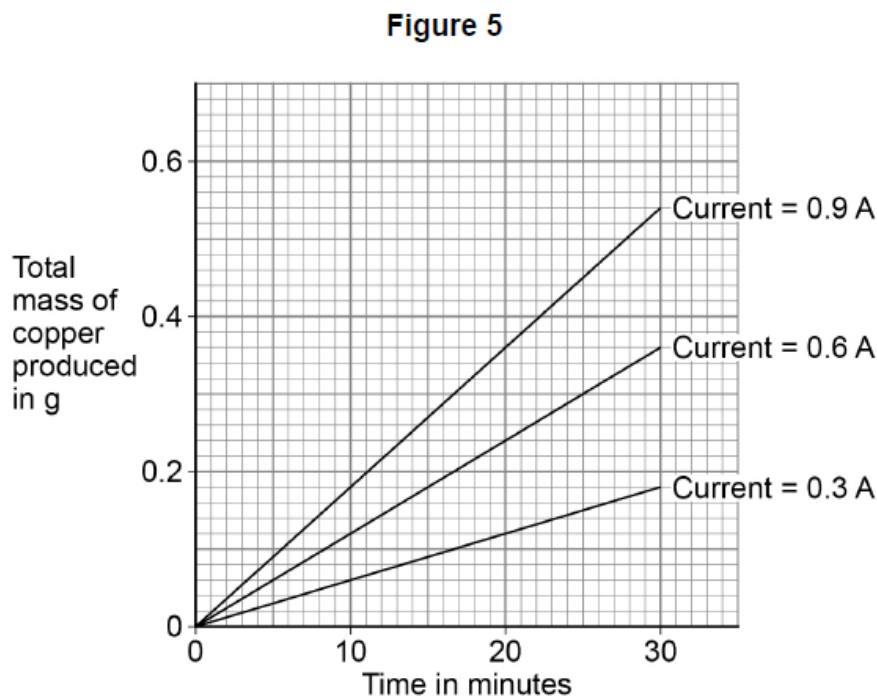
Some of the copper produced did not stick to the negative electrode but fell to the bottom of the beaker.

Suggest how the students could find the total mass of copper produced.

[4 marks]

The students plotted their results on a graph.

Figure 5 shows the graph.



A student correctly concluded that the total mass of copper produced is directly proportional both to the time and to the current.

07.5

How do the results in **Figure 5** support the conclusion that the total mass of copper produced is directly proportional to the time?

[1 mark]

07.6

How do the results in **Figure 5** support the conclusion that the total mass of copper produced is directly proportional to the current?

Use data from **Figure 5** in your answer.

[1 mark]

0 7 . 7 Copper nitrate solution is blue.

Suggest why the blue colour of the copper nitrate solution fades during the electrolysis.

[1 mark]

0 7 . 8 Determine the number of atoms of copper produced when copper nitrate solution is electrolysed for 20 minutes at a current of 0.6 A

Give your answer to 3 significant figures.

Use **Figure 5**.

Relative atomic mass (A_r): Cu = 63.5

The Avogadro constant = 6.02×10^{23} per mole

[3 marks]

Number of atoms (3 significant figures) = _____

11. June/2021/Paper_1H/No.9

0 9

This question is about acids.

Hydrogen chloride and ethanoic acid both dissolve in water.

All hydrogen chloride molecules ionise in water.

Approximately 1% of ethanoic acid molecules ionise in water.

0 9 . 1

A solution is made by dissolving 1 g of hydrogen chloride in 1 dm³ of water.

Which is the correct description of this solution?

[1 mark]

Tick (✓) **one** box.

A concentrated solution of a strong acid

A concentrated solution of a weak acid

A dilute solution of a strong acid

A dilute solution of a weak acid

0 9 . 2

Which solution would have the lowest pH?

[1 mark]

Tick (✓) **one** box.0.1 mol/dm³ ethanoic acid solution0.1 mol/dm³ hydrogen chloride solution1.0 mol/dm³ ethanoic acid solution1.0 mol/dm³ hydrogen chloride solution

A student investigated the concentration of a solution of sodium hydroxide by titration with a 0.0480 mol/dm^3 ethanedioic acid solution.

This is the method used.

1. Measure 25.0 cm^3 of the sodium hydroxide solution into a conical flask using a 25.0 cm^3 pipette.
2. Add two drops of indicator to the sodium hydroxide solution.
3. Fill a burette with the 0.0480 mol/dm^3 ethanedioic acid solution to the 0.00 cm^3 mark.
4. Add the ethanedioic acid solution to the sodium hydroxide solution until the indicator changes colour.
5. Read the burette to find the volume of the ethanedioic acid solution used.

0 9 . 3

Suggest two improvements to the method that would increase the accuracy of the result.

[2 marks]

1 _____

2 _____

0 9 . 4 Ethanedioic acid is a solid at room temperature.

Calculate the mass of ethanedioic acid ($\text{H}_2\text{C}_2\text{O}_4$) needed to make 250 cm^3 of a solution with concentration 0.0480 mol/dm^3

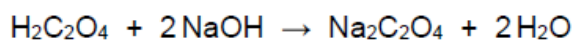
Relative formula mass (M_r): $\text{H}_2\text{C}_2\text{O}_4 = 90$

[2 marks]

Mass = _____ g

0 9 . 5 The student found that 25.0 cm^3 of the sodium hydroxide solution was neutralised by 15.00 cm^3 of the 0.0480 mol/dm^3 ethanedioic acid solution.

The equation for the reaction is:



Calculate the concentration of the sodium hydroxide solution in mol/dm^3

[3 marks]

Concentration = _____ mol/dm^3