AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 1H

Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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ANSWER IN THE SPACES PROVIDED

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0 1 This question is about salts.

Green copper carbonate and sulfuric acid can be used to produce blue copper sulfate crystals.

0 1 . 1 **Excess** copper carbonate is added to sulfuric acid.

Give **three** observations you would make.

[3 marks]

1 green solid / powder

2 colourless solution

3 blue solution formed

0 1 . 2 How can the excess copper carbonate be removed?

[1 mark]

filtration

0 1 . 3 The pH of the solution changes during the reaction.

What is the pH of the solution at the end of the reaction?

[1 mark]

pH = 7

0 1 . 4 Copper carbonate and sulfuric acid react to produce copper sulfate.

What type of reaction is this?

[1 mark]

neutralisation

Turn over ►

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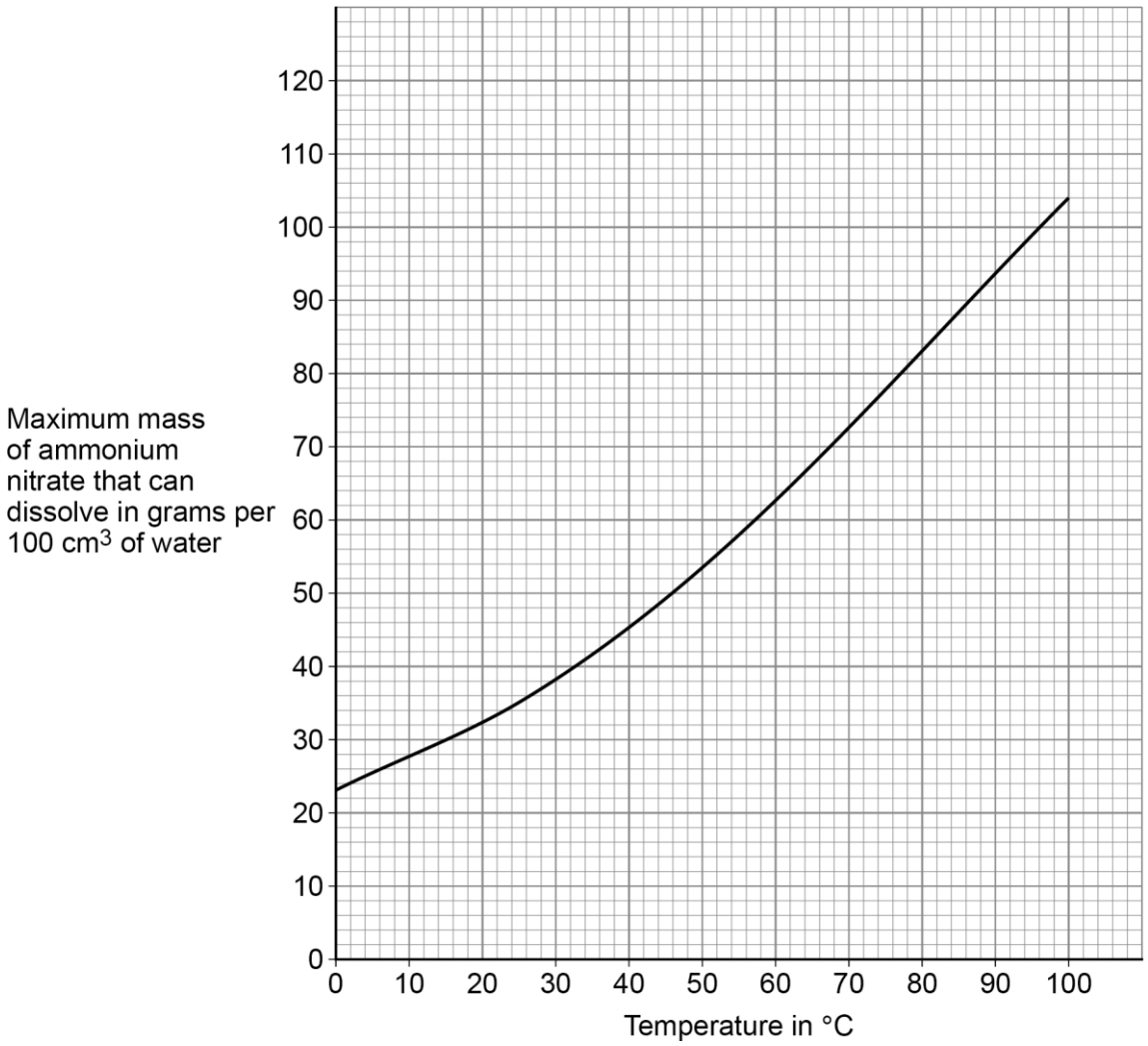
0 1 . 5 Ammonium nitrate is a salt.

Figure 1 shows the maximum mass of ammonium nitrate that can dissolve in 100 cm^3 of water at different temperatures.

Figure 1



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A student adds ammonium nitrate to water at 80 °C until no more dissolves.

The student cools 100 cm^3 of this solution of ammonium nitrate from 80 °C to 20 °C to produce crystals of ammonium nitrate.

Determine the mass of ammonium nitrate that crystallises on cooling 100 cm^3 of this solution from 80 °C to 20 °C

[3 marks]

83 (g at 80 °C)

32 (g at 20 °C)

(83–32 =) 51 (g)

Mass = _____ g

9

Turn over for the next question

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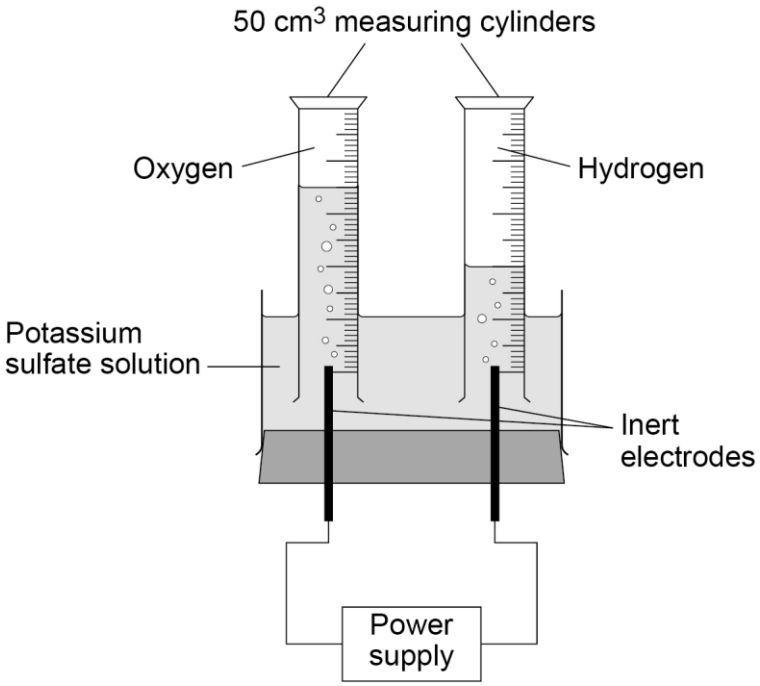
0 2 This question is about electrolysis.

Figure 2 shows the apparatus used to investigate the electrolysis of potassium sulfate solution.

Figure 2



0 2 . **1** Potassium sulfate contains K^+ and SO_4^{2-} ions.

What is the formula of potassium sulfate?

[1 mark]

Tick (✓) **one** box.

KSO_4 ☐

K_2SO_4 ☑

$K(SO_4)_2$ ☐

$K_2(SO_4)_2$ ☐

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0 2 . 2 What are the volumes of gases collected in the electrolysis experiment?

Use **Figure 2**.

[1 mark]

Volume of hydrogen = 30 cm^3

Volume of oxygen = 15 cm^3

0 2 . 3 A student made the following hypothesis:

'The volumes of gases collected in this electrolysis experiment are in the same ratio as hydrogen atoms to oxygen atoms in a water molecule.'

Explain how the volumes of gases collected in the experiment in **Figure 2** support the student's hypothesis.

Use your answer to Question **02.2**

[2 marks]

the ratio of volume of hydrogen : oxygen is 2 : 1

and this is the same as the ratio of hydrogen (atoms) : oxygen (atoms)

in (formula of) H_2O

Question 2 continues on the next page

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0 2 . 4 The experiment is repeated 4 times.

The volumes of oxygen collected in the 4 experiments are:

6 cm^3 9 cm^3 10 cm^3 11 cm^3

The mean volume of oxygen collected in the 4 experiments is 9 cm^3

The measure of uncertainty is the range of a set of measurements about the mean.

What is the measure of uncertainty in the 4 experiments?

[1 mark]

Tick (✓) **one** box.

9 ± 1 cm^3 ☐

9 ± 2 cm^3 ☐

9 ± 3 cm^3 ☑

0 2 . 5 The potassium sulfate solution has 0.86 g of potassium sulfate dissolved in 25 cm^3 of water.

Calculate the mass of potassium sulfate needed to make 1.0 dm^3 of solution.

[3 marks]

conversion= $\frac{25}{1000}$

0.025 (dm3)

concentration = $\frac{0.86}{0.025}$

= 34.4 (g per dm3)

Mass = _____ g

8

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0 3 Plan an investigation to find the order of reactivity of three metals.

You should use the temperature change when each metal reacts with hydrochloric acid.

[6 marks]

- measure volume of (hydrochloric) acid
- into a suitable container eg polystyrene cup
- measure the initial temperature (of hydrochloric acid) with a thermometer
- add stated mass of one metal
- stir
- measure the highest temperature reached of the solution
- determine the temperature difference
- repeat
- repeat for each metal
- with same mass
- in same physical state (powder, lump, etc)
- with the same volume and / or concentration of (hydrochloric) acid
- use results to arrange metals in order of reactivity
- most reactive metal has the largest temperature change

6

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0 4 This question is about Group 7 elements.

0 4 . 1 What are the Group 7 elements known as?

[1 mark]

halogens

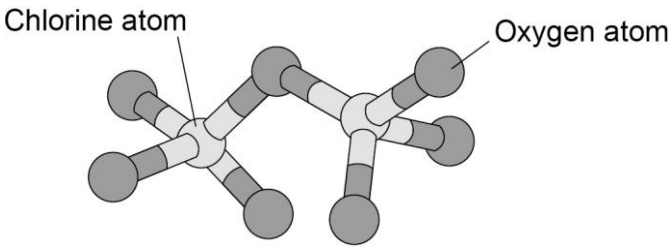
0 4 . 2 Why do Group 7 elements react in similar ways?

[1 mark]

all have 7 electrons in outer shell

0 4 . 3 **Figure 3** shows the structure of a molecule of chlorine oxide.

Figure 3



What is the molecular formula of the chlorine oxide molecule in **Figure 3**?

[1 mark]

Cl2O7

Question 4 continues on the next page

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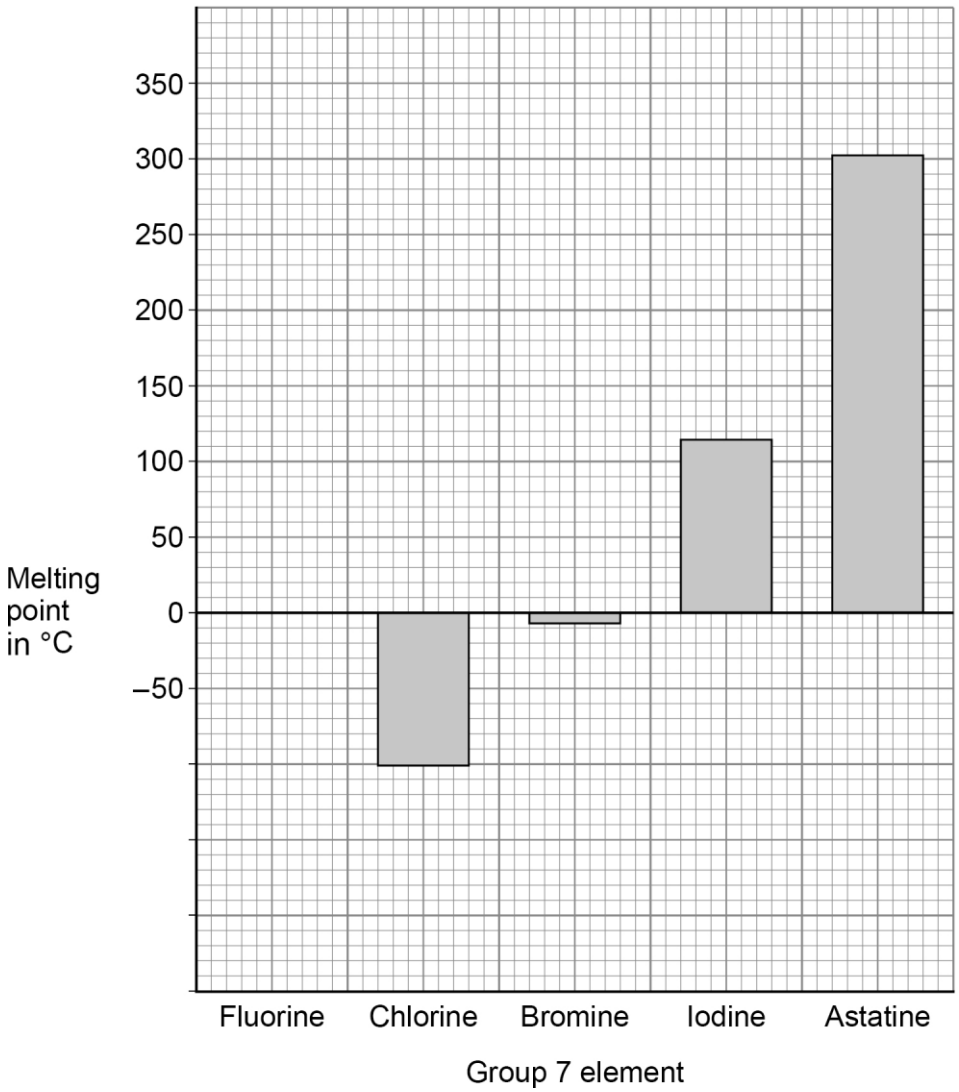
Figure 4 shows the melting points of some Group 7 elements.

Figure 4



0 4 . 4 The melting point of fluorine is –220 °C

Complete **Figure 4**.

You should:

- complete the scale on the y-axis
- draw the bar for the melting point of fluorine.

y-axis scale correct from –100 to –250 °C

bar correctly plotted at –220 °C

[2 marks]

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0 4 . 5 Explain the trend in the melting points of the Group 7 elements.

Use **Figure 4**.

[3 marks]

the molecules increase in size going down the group

so the forces between the molecules increase and the melting points increase going down the group

0 4 . 6 What is the state symbol for bromine at –50 °C?

Use **Figure 4**.

[1 mark]

Tick (✓) **one** box.

(aq) ☐ (g) ☐ (l) ☐ (s) ☑

0 4 . 7 Evaporation and boiling occur at the surface of bromine at its boiling point.

Name **one** more process that happens at the surface of bromine at its boiling point.

[1 mark]

condensation

10

Turn over for the next question

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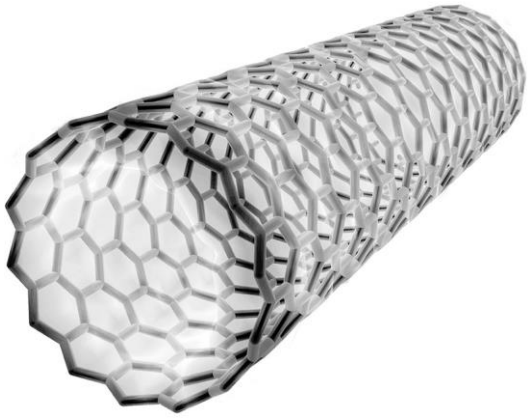
0 5 This question is about structure and bonding.

0 5 . 1 **Figure 5** represents part of a carbon molecule.

Figure 5



Name the type of carbon molecule in **Figure 5**.

[1 mark]

fullerene

0 5 . 2 Suggest **one** property that makes the carbon molecule in **Figure 5** useful in nanotechnology.

[1 mark]

conducts heat

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0 5 . 3 An alloy of aluminium contains small amounts of other metals.

Explain why other metals are added to aluminium.

[4 marks]

other metal atoms have different sizes to aluminium atoms

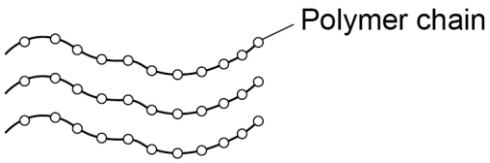
(so) the layers of aluminium atoms are distorted

(so) the layers cannot slide

(which) makes the alloy harder

0 5 . 4 **Figure 6** represents part of the structure of a polymer.

Figure 6



Compare the bonding within the chains with the forces between the chains in this polymer.

[3 marks]

covalent bonds (between atoms) in the chain

intermolecular forces between the chains

covalent bonds are strong

9

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0 6 This question is about hydrogen chloride and hydrochloric acid.

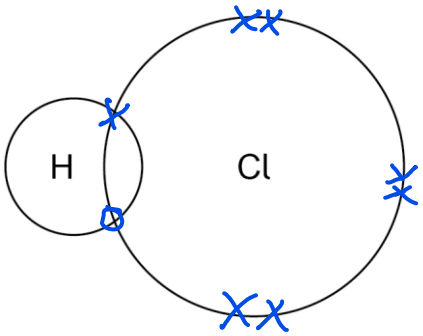
0 6 . 1 Complete the dot and cross diagram to represent the bonding in hydrogen chloride on **Figure 7**.

Use dots (o) and crosses (x) to represent electrons.

You should show only the electrons in the outer shells.

[2 marks]

Figure 7



0 6 . 2 Hydrogen chloride dissolves in water to produce hydrochloric acid.

Hydrochloric acid is a strong acid.

What is meant by the term strong acid?

[1 mark]

completely ionises in aqueous solution

0 6 . 3 Describe how magnesium can be used to distinguish between a strong acid and a weak acid of the same concentration.

[2 marks]

magnesium disappears

at a greater rate with a strong acid

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0 6 . 4 The concentration of hydrochloric acid is increased by a factor of 100

What is the change in pH?

[2 marks]

(pH) decreases by (a unit of) 2

Question 6 continues on the next page

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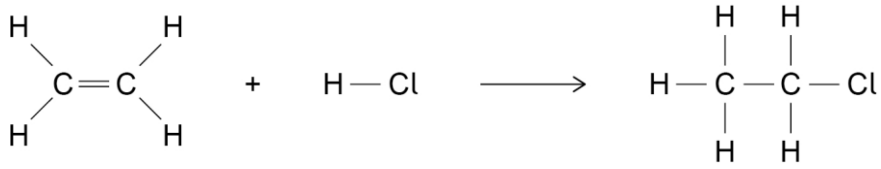
0 6 . 5 Ethene and hydrogen chloride react to produce chloroethane.

The displayed formulae equation for the reaction is:



The reaction is exothermic.

In the reaction the energy released forming new bonds is 56 kJ/mol greater than the energy needed to break existing bonds.

Table 1 shows some bond energies.

Table 1

Bond	**H–C**	**C=C**	**H–Cl**	**C–C**	**C–Cl**
Bond energy in kJ/mol	413	**X**	431	346	339

Calculate the bond energy **X**.

[4 marks]

bonds broken = (4 × 413) + C=C + 431

=2083 + C=C

bonds made = 346 + 339 + (5 × 413)

= 2750

energy released = bonds made – bonds broken =56 = 2750 – [2083 + C=C]

(C=C) = 611 (kJ/mol)

X = _____ kJ/mol

11

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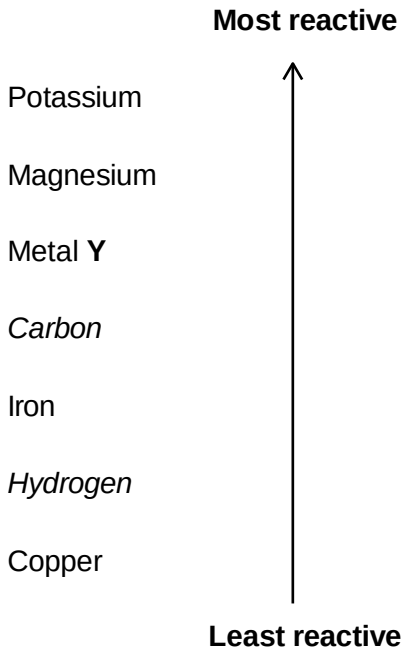
0 7 This question is about elements and compounds.

0 7 . 1 **Figure 8** shows a reactivity series.

Figure 8



Give the method and conditions used to extract metal **Y** from a compound of metal **Y**.
[2 marks]

electrolysis of molten compound (of metal Y)

Question 7 continues on the next page

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Sodium reacts with titanium chloride ($TiCl_4$) to produce titanium.

0 7 . 2 Complete the equation.

You should balance the equation.

[2 marks]

4 Na + $TiCl_4$ → 4 NaCl + Ti

0 7 . 3 The reaction between sodium and titanium chloride is a redox reaction.

Write a half-equation to show that sodium is oxidised in this reaction.

[2 marks]

$Na \rightarrow Na^+ + e^-$

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0 7 . 4 108 g of aluminum reacts with 1.21 kg of copper chloride to produce copper.

The equation for the reaction is:

$$2\,Al + 3\,CuCl_2 \rightarrow 3\,Cu + 2\,AlCl_3$$

Calculate the maximum mass of copper produced in grams (g).

You should determine the limiting reactant.

Relative atomic masses (A_r): Al = 27 Cu = 63.5

Relative formula masses (M_r): $CuCl_2$ = 134.5 $AlCl_3$ = 133.5

[6 marks]

method 1:

moles of Al = $\frac{108}{27}$

= 4

moles CuCl2 = $\frac{1210}{134.5}$

=8.996

identifying limiting reactant

4 moles Al gives 6 moles Cu

8.996 moles CuCl2 gives 8.996 moles Cu

therefore aluminium is the limiting reactant

mass of Cu = 2 × 3 × 63.5 = 6 × 63.5 = 381 (g)

Limiting reactant is aluminium

Mass of copper = 381 g

Question 7 continues on the next page

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Sodium metal and sodium chloride are both able to conduct electricity.

0 7 . 5 Describe how sodium metal conducts electricity.

[2 marks]

delocalised electrons carry (electrical) charge through the metal / sodium

0 7 . 6 Explain how sodium chloride can conduct electricity.

[3 marks]

conducts electricity when liquid / molten because are free to move

17

END OF QUESTIONS

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