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

F

Foundation Tier
Chemistry Paper 1F

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.

Do not write outside the box

0 1 Magnesium is in Group 2 of the periodic table.

1.0 g of magnesium reacted with chlorine to produce magnesium chloride.

0 1 . 1 Which types of element react when magnesium reacted with chlorine?

[1 mark]

Tick (✓) **one** box.

- A metal and a metal ☐
- A metal and a non-metal ☑
- A non-metal and a non-metal ☐

0 1 . 2 Write the word equation for the reaction when magnesium reacts with chlorine.

[1 mark]

magnesium + chlorine → magnesium chloride

0 1 . 3 What apparatus was used to measure the mass of 1.0 g of magnesium?

[1 mark]

Tick (✓) **one** box.

- Balance ☑
- Beaker ☐
- Ruler ☐

Do not write outside the box

0 1 . 4 What mass of magnesium chloride was produced?

[1 mark]

Tick (✓) **one** box.

Less than 1.0 g ☐

1.0 g ☐

More than 1.0 g ☑

0 1 . 5 Magnesium reacts with oxygen to produce magnesium oxide.

Calculate the percentage mass of magnesium in magnesium oxide (MgO).

Relative atomic mass (A_r): Mg = 24

Relative formula mass (M_r): MgO = 40

[2 marks]

$$(\% =) \frac{24}{40} \times 100$$

Percentage mass of magnesium = 60 %

Question 1 continues on the next page

Do not write outside the box

Magnesium carbonate decomposes to produce magnesium oxide and carbon dioxide.

The word equation for the reaction is:

magnesium carbonate → magnesium oxide + carbon dioxide

Four students heated 2.00 g of magnesium carbonate for 10 minutes.

Table 1 shows the results.

Table 1

Mass of carbon dioxide produced in g				
Student 1	**Student 2**	**Student 3**	**Student 4**	**Mean**
0.97	0.91	0.50	0.95	**X**

0 1 . 6 What is the most likely reason for **Student 3**'s anomalous result?

[1 mark]

Tick (✓) **one** box.

The student heated more than 2.00 g of magnesium carbonate. ☐

The student heated the magnesium carbonate for less than 10 minutes. ☑

The student used a higher temperature. ☐

0 1 . 7 Calculate value **X** in **Table 1**.

Do **not** use the anomalous result.

Give your answer to 2 significant figures.

[3 marks]

$\frac{0.97 + 0.91 + 0.95}{3}$

or $\frac{2.83}{3}$

= 0.943333 (g)

X (2 significant figures) = 0.94 g

10

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 2 This question is about electrolysis.

0 2 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

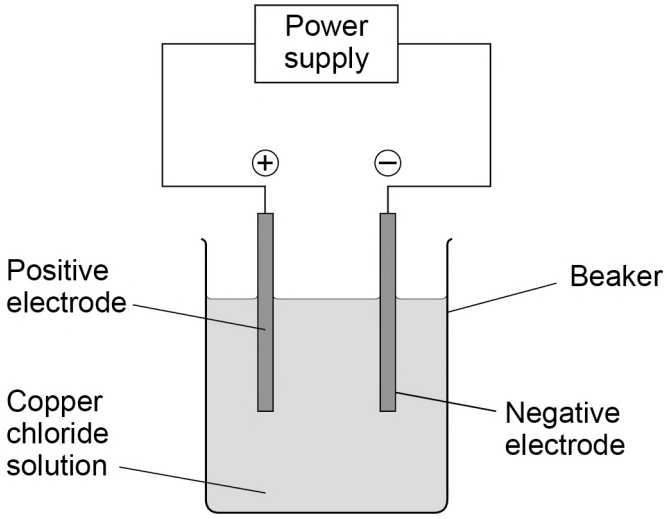
gaseous	**molten**	**solid**

Copper chloride can conduct electricity when in solution or

when molten .

Figure 1 shows the apparatus used for the electrolysis of copper chloride solution.

Figure 1



There are four ions in copper chloride solution:

- Cu^{2+}
- Cl^{-}
- H^{+}
- OH^{-}

Do not write outside the box

0 2 . 2 Why do Cl^- ions and OH^- ions move to the positive electrode?

[1 mark]

opposite (charges) attract or

(the ions) are negatively charged

0 2 . 3 Where do the H^+ and OH^- ions come from in the electrolysis of copper chloride solution?

[1 mark]

Tick (✓) **one** box.

- Air ☐
- Copper chloride ☐
- Water ☑

0 2 . 4 Which ion produces a metal?

[1 mark]

Tick (✓) **one** box.

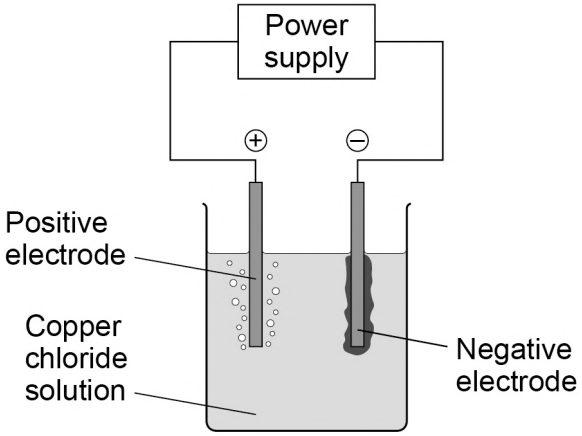
- Cu^{2+} ☑
- Cl^- ☐
- H^+ ☐
- OH^- ☐

Question 2 continues on the next page

Do not write outside the box

0 2 . 5 **Figure 2** shows the apparatus during the electrolysis of copper chloride solution.

Figure 2



Describe what is seen at each electrode during the electrolysis of copper chloride solution.

[2 marks]

Positive electrode bubbles / effervescence / fizzing

Negative electrode (pink / orange / red / brown) solid

0 2 . 6 500 cm^3 of copper chloride solution contains 6.50 g of copper chloride.

Calculate the mass of copper chloride in 40.0 cm^3 of this copper chloride solution.

[2 marks]

$\frac{40.0}{500} \times 6.50$

Mass = 0.52 g

8

Do not write outside the box

0 3 Carbon can exist in a number of different structures.

0 3 . 1 What is the approximate radius of a carbon atom?

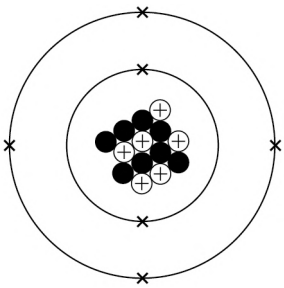
[1 mark]

Tick (✓) **one** box.

0.1 m ✓ 0.1 mm ☐ 0.1 nm ☐

0 3 . 2 **Figure 3** shows an atom of carbon.

Figure 3



Describe the atomic structure of this carbon atom.

You should include the number of electrons, neutrons and protons.

[6 marks]

~~6 protons~~

8 neutrons

6 electrons

~~protons in nucleus~~

neutrons in nucleus

electrons (around nucleus) in energy levels / shells

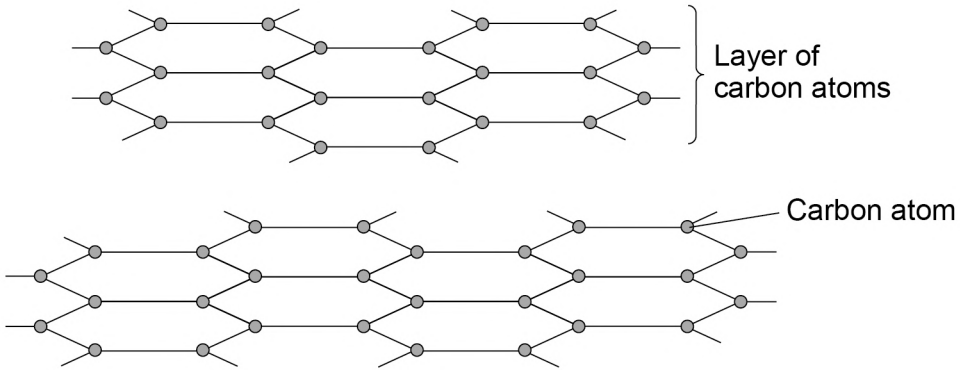
Turn over ►

Do not write outside the box

In graphite the carbon atoms are held together by bonds.

Figure 4 represents part of the structure of graphite.

Figure 4



0 3 . 3 How many bonds does each carbon atom have in graphite?

Use **Figure 4**.

[1 mark]

Tick (✓) **one** box.

1 ☐ 2 ☐ 3 ☑ 4 ☐

0 3 . 4 What type of bonds hold the carbon atoms together in graphite?

[1 mark]

Tick (✓) **one** box.

Covalent ☑

Ionic ☐

Metallic ☐

Do not write outside the box

0 3 . 5 Lubricants allow objects to slide over each other easily.

Suggest why graphite can be used as a lubricant.

Use **Figure 4**.

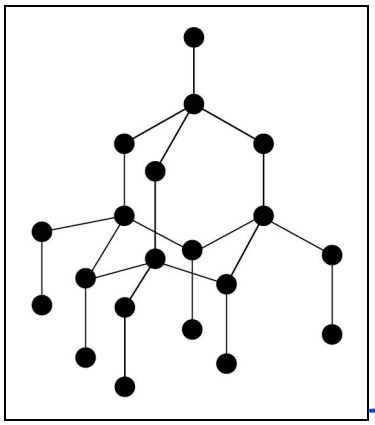
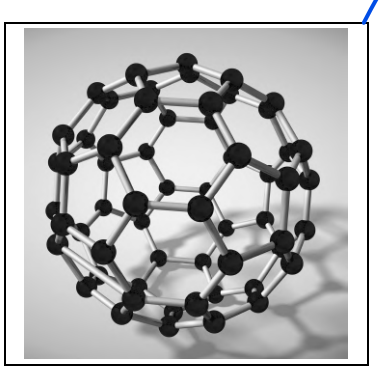
[1 mark]

layers slide (over each other)

0 3 . 6 The two structures represent different forms of carbon.

Draw **one** line from each structure to the form of carbon.

[2 marks]

Structure	**Form of carbon**
	Buckminsterfullerene
	Diamond
	Graphene
	Nanotube

12

Turn over ►

Do not write outside the box

0 4 Sodium and potassium are Group 1 elements.

0 4 . 1 What is the name of Group 1 elements?

[1 mark]

Tick (✓) **one** box.

Alkali metals ☑

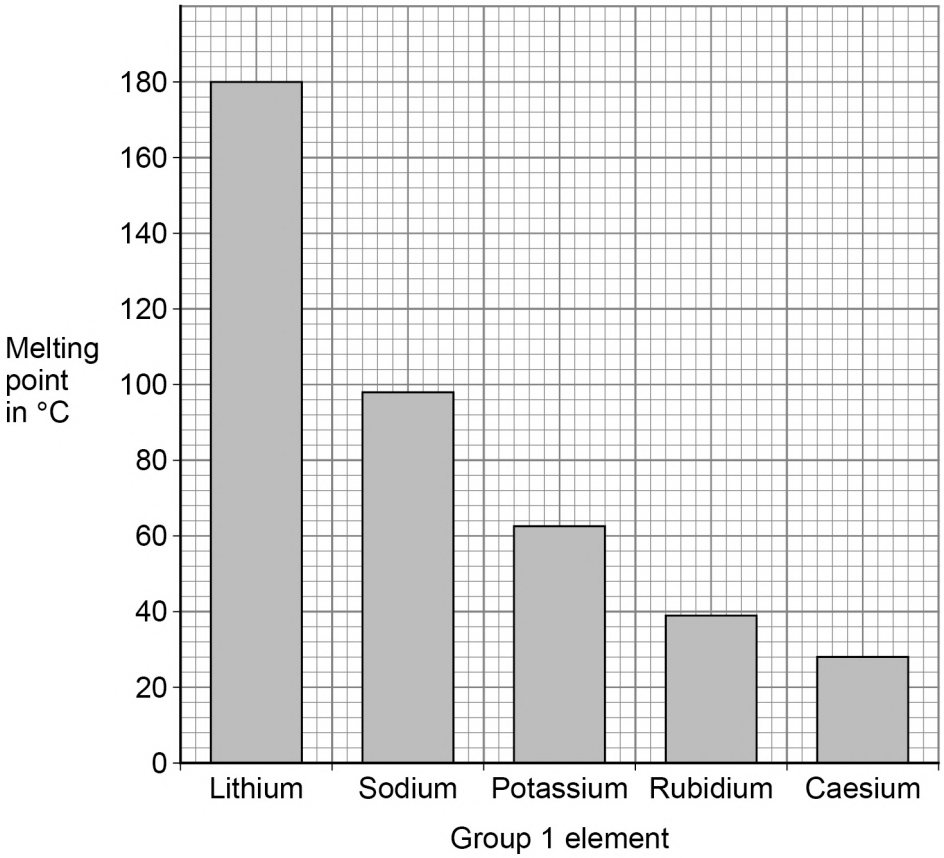
Halogens ☐

Noble gases ☐

Do not write outside the box

0 4 . 2 **Figure 5** represents the melting points of Group 1 elements.

Figure 5



What is the melting point of sodium?

[1 mark]

Melting point of sodium = 98 °C

0 4 . 3 Sodium reacts with water to produce sodium hydroxide and hydrogen.

Balance the equation for the reaction.

[1 mark]

$$\underline{2}\ Na + 2H_2O \rightarrow 2NaOH + H_2$$

Do not write outside the box

0 4 . 4 Calculate the relative formula mass (M_r) of sodium hydroxide (NaOH).

Relative atomic masses (A_r): H = 1 O = 16 Na = 23

[2 marks]

(Mr =) 23 + 16 + 1

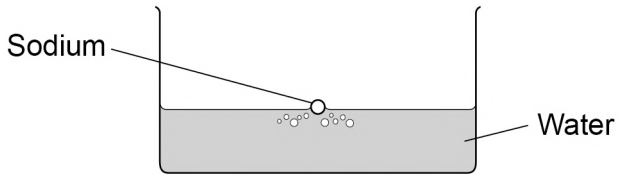
= 40

Relative formula mass (M_r) = 40

0 4 . 5 Sodium and potassium both react with water.

Figure 6 shows sodium reacting with water.

Figure 6



Compare what is seen when sodium reacts with water and when potassium reacts with water.

[4 marks]

Indicative Content:

Similarities – sodium and potassium both:	Differences – potassium:
• float	• moves faster
• move	• bubbles faster
• ~~bubble / effervesce / fizz~~	• reacts faster
• ~~melt~~	• disappears faster
• form a ball	• catches fire
• get smaller or disappear	• lilac flame
• lilac flame	

9

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 5 A student investigated the change in temperature when different masses of zinc were added to copper sulfate solution.

This is the method used.

1. Measure the volume of copper sulfate solution using a measuring cylinder.

2. Pour the copper sulfate solution into a metal container.

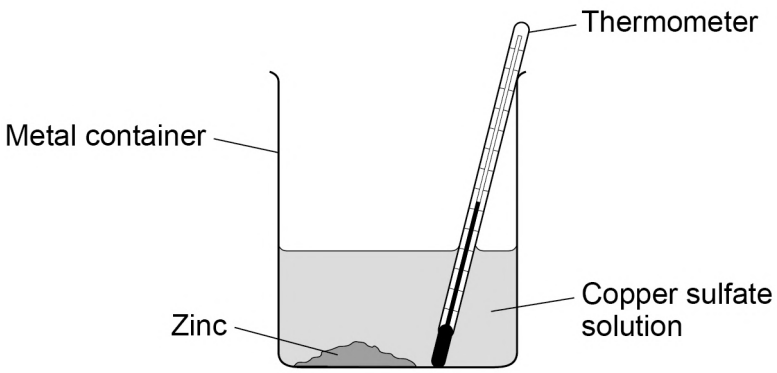
3. Add 2 g of zinc.

4. Measure the temperature of the solution.

5. Repeat steps 1 to 4 with different masses of zinc.

Figure 7 shows the apparatus.

Figure 7



0 5 . 1 Give **three** improvements to the investigation to make the results more accurate.

[3 marks]

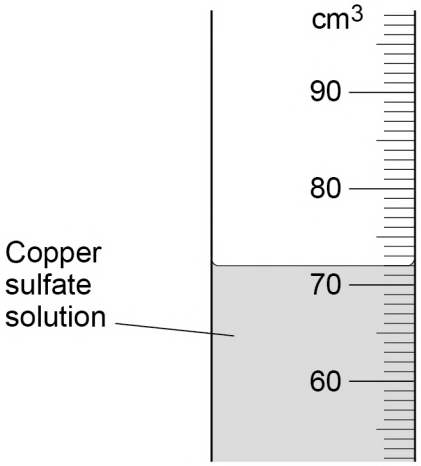
1 use a (glass) beaker or use a polystyrene cup

2 • insulate the metal container

3 • add a lid

0 5 . 2 **Figure 8** shows part of the measuring cylinder.

Figure 8



What is the volume of copper sulfate solution in **Figure 8**?

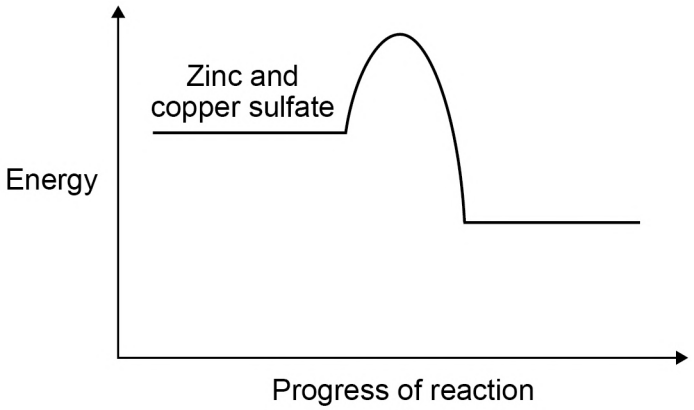
[1 mark]

Volume = 72 cm^3

0 5 . 3 When zinc was added to copper sulfate solution the temperature increased.

Figure 9 shows the reaction profile.

Figure 9



What type of reaction is shown in **Figure 9**?

[1 mark]

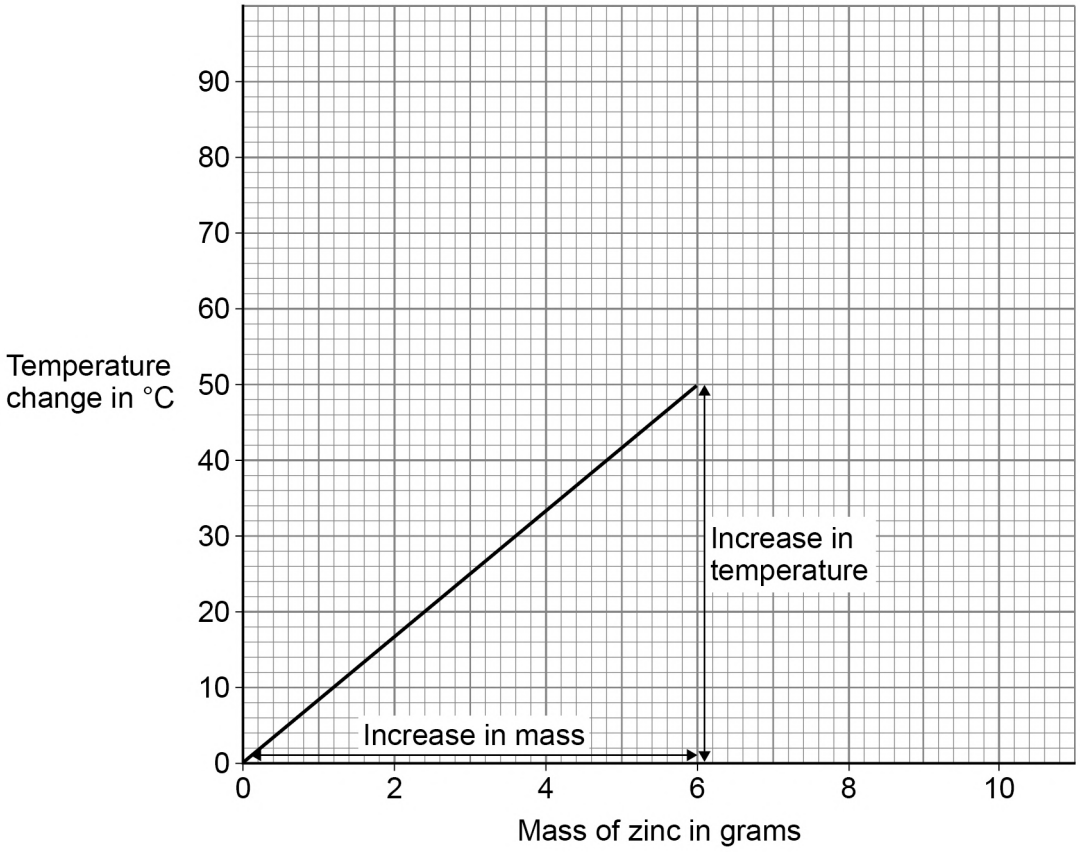
Tick (✓) **one** box.

Endothermic ☐ Exothermic ☑ Neutralisation ☐

Do not write outside the box

Figure 10 shows the results.

Figure 10



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0 5 . 4 Determine the gradient of the line in **Figure 10**.

Use the equation:

$$\text{gradient} = \frac{\text{increase in temperature in °C}}{\text{increase in mass in grams}}$$

[4 marks]

(increase in temperature =) 50 (°C)

increase in mass = 6 (g)

(gradient =) $\frac{50}{6}$

Gradient = 8.33 °C per g

0 5 . 5 Suggest why the student should **not** use more than 10 g of zinc.

Use **Figure 10**.

You should extend the graph line.

[2 marks]

extends line on graph to 10 g of zinc

any one from:

- temperature (change) of 84 (°C)
- (so the solution will be) too hot

11

Turn over for the next question

Do not write outside the box

0 6 This question is about the periodic table.

0 6 . 1 **Figure 11** shows part of Mendeleev's version of the periodic table.

Figure 11

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K Cu	Ca Zn		Ti	V As	Cr Se	Mn Br	Fe Co Ni
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	I	Ru Rh Pd

Which group of elements had **not** been discovered when Mendeleev's version of the periodic table was published?

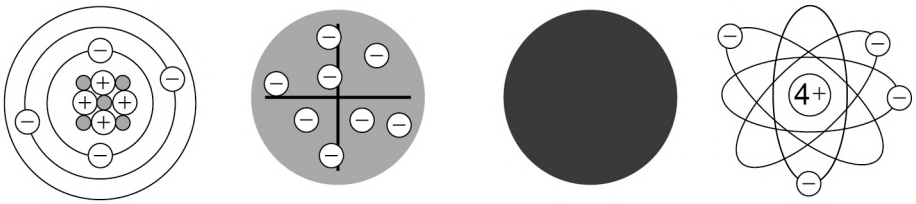
[1 mark]

(Group) 0 or noble gases

Do not write outside the box

Figure 12 represents different models of the atom.

Figure 12



A **B** **C** **D**

0 6 . 2 Which model represents the plum pudding model?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☑ **C** ☐ **D** ☐

0 6 . 3 Which model resulted from Chadwick's experimental work?

[1 mark]

Tick (✓) **one** box.

A ☑ **B** ☐ **C** ☐ **D** ☐

Question 6 continues on the next page

Do not write outside the box

Potassium has different isotopes.

0 6 . 4 What is meant by 'isotopes'?

You should refer to subatomic particles.

[2 marks]

(atoms with the) same number of protons

(but with) different numbers of neutrons

0 6 . 5 **Table 2** shows the mass numbers and the percentage abundance of two isotopes of potassium.

Table 2

Mass number	Percentage abundance
39	93.1
41	6.9

Calculate the relative atomic mass (A_r) of potassium.

Give your answer to 1 decimal place.

[3 marks]

$$\frac{(39 \times 93.1) + (41 \times 6.9)}{100}$$

$$= 39.138$$

Relative atomic mass (1 decimal place) = 39.1

8

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 7 Acids react to produce salts.

Universal indicator is added to water and then nitric acid is added to the mixture.

0 7 . 1 Give the colour change when nitric acid is added to the mixture of universal indicator and water.

[1 mark]

Tick (✓) **one** box.

- Blue to red ☐
- Green to purple ☐
- Green to red ☑
- Red to purple ☐

0 7 . 2 What happens to the pH of water when nitric acid is added?

[1 mark]

Tick (✓) **one** box.

- Decreases ☑
- Stays the same ☐
- Increases ☐

0 7 . 3 What is the state symbol for nitric acid?

[1 mark]

(aq)

Do not write outside the box

Zinc carbonate reacts with nitric acid.

The word equation for the reaction is:

zinc carbonate + nitric acid → zinc nitrate + water + carbon dioxide

white solid — colourless solution

0 7 . 4 Give **two** observations that would be made when zinc carbonate is added to nitric acid until the zinc carbonate is in excess.

[2 marks]

1 (white) solid disappears

2 • fizzing or bubbles (of gas) or effervescence

0 7 . 5 The formula of the zinc ion is Zn^{2+}

The formula of the nitrate ion is NO_3^-

What is the formula for zinc nitrate?

[1 mark]

Tick (✓) **one** box.

- $ZnNO_3$ ☐
- $Zn(NO_3)_2$ ☐
- Zn_2NO_3 ☐
- $Zn_2(NO_3)_2$ ☑

Question 7 continues on the next page

Do not write outside the box

0 7 . 6 Acids react with insoluble metal oxides to produce salts.

Plan a method to produce a pure, dry sample of the soluble salt copper chloride from an acid and a metal oxide.

[6 marks]

Indicative Content:

- react hydrochloric acid
- (with) copper oxide
- in a suitable container
- warm (hydrochloric) acid
- add copper oxide
- until is in excess or until solid remains
- stir
- filter excess copper oxide
- pour solution / filtrate into evaporating basin
- use of water bath or use of electric heater
- to heat gently or partially evaporate
- leave to cool / crystallise

12

END OF QUESTIONS

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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