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

Monday 19 May 2025 Morning 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.

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.

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

Do not write outside the box

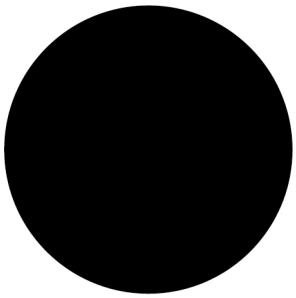
0 1 This question is about atoms and ions.

The model of the atom has changed over time.

0 1 . 1 In an early model, scientists thought the atom was a tiny sphere that could **not** be divided.

Figure 1 represents this early model of the atom.

Figure 1



The discovery of a subatomic particle led to a change in the model in **Figure 1**.

Which was the first subatomic particle to be discovered?

[1 mark]

Tick (✓) **one** box.

Electron ☐

Neutron ☐

Proton ☐

Do not write outside the box

0 1 . 2 In a later model of the atom, most of the mass was concentrated in the centre of the atom.

What is the name of the centre of an atom?

[1 mark]

_____

0 1 . 3 Atoms contain three types of subatomic particle.

Draw **one** line from each subatomic particle to the relative charge of the particle.

[2 marks]

Subatomic particle	Relative charge of the particle
Electron	+1
Neutron	0
Proton	–1

0 1 . 4 What is meant by the 'atomic number of an atom'?

[1 mark]

Tick (✓) **one** box.

- The number of neutrons only ☐
- The number of protons only ☐
- The number of neutrons + the number of protons ☐

Question 1 continues on the next page

Do not write outside the box

0 1 . 5 **Table 1** shows information about two isotopes of an element.

Table 1

	Mass number	**Percentage (%) abundance**
Isotope **A**	10	19.7
Isotope **B**	11	80.3

Calculate the relative atomic mass (A_r) of the element.

Use the equation:

$$A_r = \frac{\text{(mass number × percentage) of isotope } \mathbf{A} + \text{(mass number × percentage) of isotope } \mathbf{B}}{100}$$

Give your answer to 1 decimal place.

[3 marks]

_____

_____

_____

_____

_____

A_r (1 decimal place) = _____

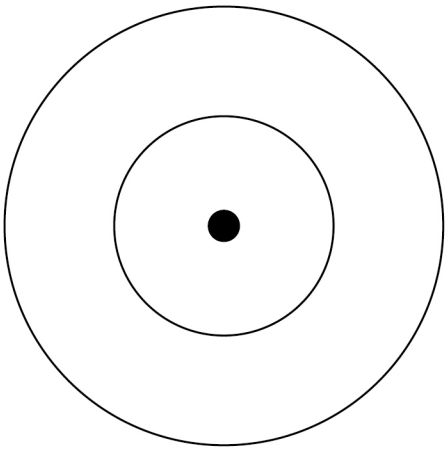
Do not write outside the box

0 1 . 6 An oxygen atom has eight electrons.

Complete **Figure 2** to show the electronic structure of an oxygen atom.

[1 mark]

Figure 2

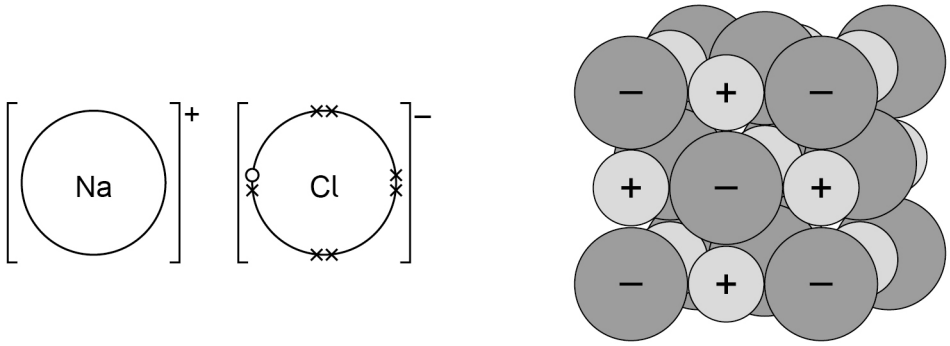


Question 1 continues on the next page

Do not write outside the box

0 1 . 7 **Figure 3** represents two models of sodium chloride.

Figure 3



Model **A** Model **B**

What are **two** advantages of model **B** compared with model **A**?

[2 marks]

Tick (✓) **two** boxes.

Model **B** shows the 3D arrangement of the ions. ☐

Model **B** shows the charges on the ions. ☐

Model **B** shows the electronic structures of the ions. ☐

Model **B** shows the relative sizes of the ions. ☐

Model **B** shows which elements are present. ☐

11

Do not write outside the box

0 2 Lithium, carbon, nitrogen, fluorine and neon are elements in the same row of the periodic table.

0 2 . 1 What is the chemical symbol of lithium?

Use the periodic table.

[1 mark]

_____

0 2 . 2 Lithium has metallic bonding.

Which electrons are involved in metallic bonding?

[1 mark]

Tick (✓) **one** box.

Delocalised electrons from the inner shell ☐

Delocalised electrons from the outer shell ☐

Fixed electrons in the inner shell ☐

Fixed electrons in the outer shell ☐

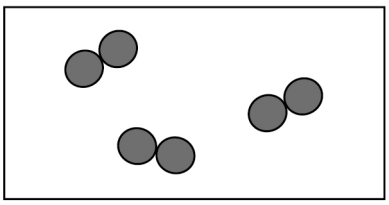
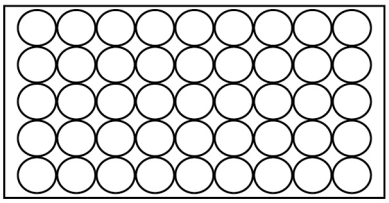
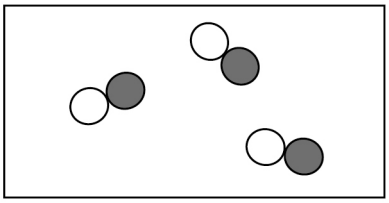
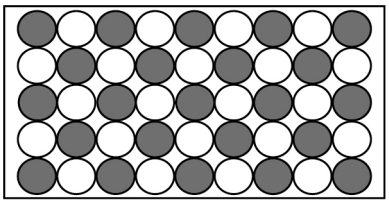
Question 2 continues on the next page

Do not write outside the box

0 2 . 3 Lithium reacts with fluorine to produce lithium fluoride.

Draw **one** line from each substance to the particle diagram that represents the substance.

[3 marks]

Substance	**Particle diagram**
Lithium solid	
Fluorine gas	
Lithium fluoride solid	
	

Do not write outside the box

0 2 . 4 **Table 2** shows the electrical conductivity of three substances.

Table 2

Substance	Electrical conductivity when solid	Electrical conductivity when liquid
C	Poor	Poor
D	Poor	Good
E	Good	Good

Lithium fluoride is an ionic compound.

Which substance is lithium fluoride?

[1 mark]

Tick (✓) **one** box.

C ☐ **D** ☐ **E** ☐

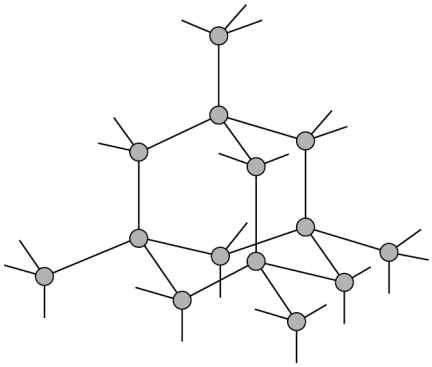
Question 2 continues on the next page

Do not write outside the box

0 2 . 5 Carbon can exist in different forms.

Figure 4 represents one form of carbon.

Figure 4



What is the name of the form of carbon in **Figure 4**?

[1 mark]

Tick (✓) **one** box.

Buckminsterfullerene ☐

Diamond ☐

Graphite ☐

0 2 . 6 Carbon and fluorine form a compound with the formula CF_4

Calculate the relative formula mass (M_r) of CF_4

Relative atomic masses (A_r): C = 12 F = 19

[2 marks]

_____

_____

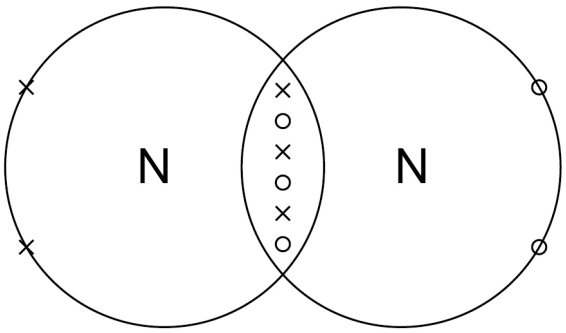
_____

Relative formula mass (M_r) = _____

Do not write outside the box

0 2 . 7 **Figure 5** represents a molecule of nitrogen.

Figure 5



What is the total number of shared electrons in the covalent bond shown in **Figure 5**?

[1 mark]

_____

0 2 . 8 Lithium and nitrogen form a compound with the formula Li_3N

Complete the sentence.

Choose the answer from the box.

[1 mark]

nitrate	**nitride**	**nitrogen**

The name of the compound with the formula Li_3N is lithium _____.

Question 2 continues on the next page

Do not write outside the box

0 2 . 9 Neon does **not** react with other elements to form compounds.

Why is neon unreactive?

[1 mark]

Tick (✓) **one** box.

Neon has a stable arrangement of electrons. ☐

Neon is a gas at room temperature. ☐

Neon is a non-metallic element. ☐

12

Do not write outside the box

Turn over for the next question

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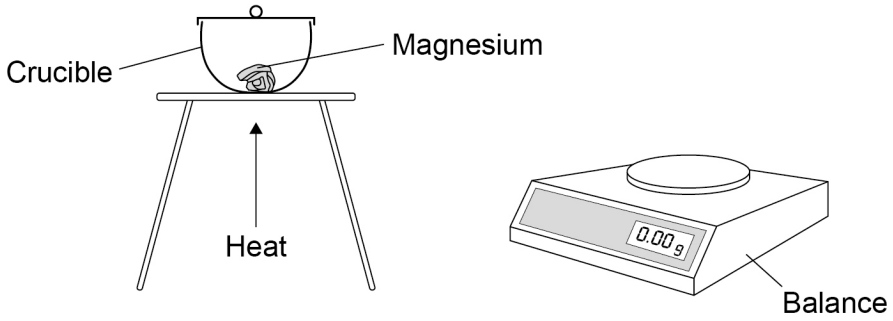
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 3 A student investigated the reaction of magnesium with oxygen.

Figure 6 shows the apparatus.

Figure 6



This is the method used.

1. Measure the mass of an empty crucible.
2. Add 0.10 g of magnesium to the crucible.
3. Heat the crucible and contents for 5 minutes.
4. Allow to cool and measure the mass of the crucible and contents.
5. Repeat steps 1 to 4 using different masses of magnesium.

0 3 . 1 Complete the word equation for the reaction.

[1 mark]

magnesium + oxygen ⟶ _____

0 3 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

decomposed	**oxidised**	**reduced**

When magnesium reacts with oxygen, the magnesium is _____.

Do not write outside the box

Table 3 shows the measurements for one of the experiments.

Table 3

	Mass in grams
Empty crucible	20.25
Crucible and magnesium **before** heating	20.55
Crucible and contents **after** heating	20.75

0 3 . 3 Calculate the mass of magnesium in the crucible **before** heating.

[1 mark]

Mass of magnesium = _____ g

0 3 . 4 Why does the reaction result in an increase in the mass of the contents of the crucible?

[1 mark]

Tick (✓) **one** box.

A solid reacts with a gas to produce a solid. ☐

Some of the product escapes from the crucible. ☐

The reactants have a greater mass than the product. ☐

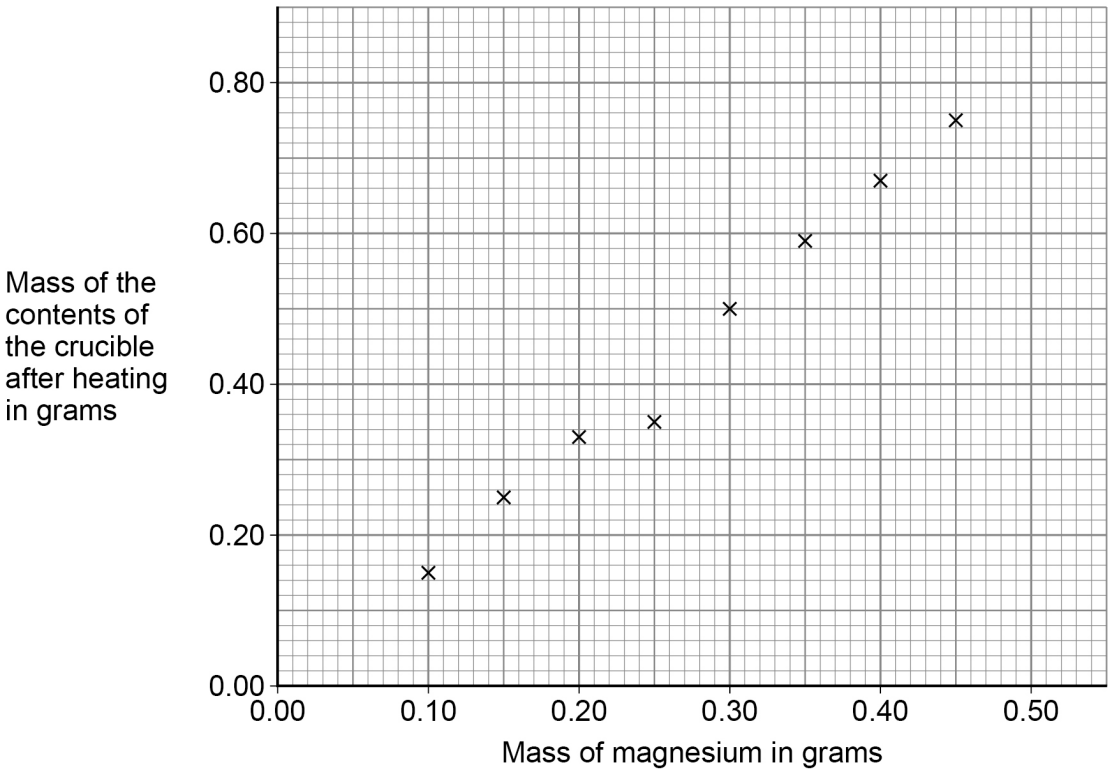
Question 3 continues on the next page

Do not write outside the box

0 3 . 5 The student determined the mass of the contents of the crucible after heating each mass of magnesium.

Figure 7 shows the results.

Figure 7



Draw a ring around the anomalous result in **Figure 7**.

[1 mark]

Do not write outside the box

0 3 . 6 The student did the experiment using 0.60 g of magnesium four times.

Table 4 shows the results.

Table 4

	Test 1	Test 2	Test 3	Test 4	Mean
Mass of the contents of the crucible after heating in grams	0.96	0.93	0.92	0.95	**X**

Calculate mean value **X**.

[2 marks]

_____

_____

_____

Mean value **X** = _____ g

0 3 . 7 The student used a Bunsen burner instead of a water bath to heat the crucible.

Why did the student use a Bunsen burner?

[1 mark]

Tick (✓) **one** box.

A Bunsen burner heats up the crucible more slowly. ☐

A water bath is not hot enough. ☐

The crucible would dissolve in a water bath. ☐

Question 3 continues on the next page

Do not write outside the box

0 3 . 8 A different student did the investigation.

The student heated the crucible for 1 minute instead of for 5 minutes.

The student obtained different results.

Suggest **one** reason why the student obtained different results.

[1 mark]

_____

_____

9

Do not write outside the box

0 4 This question is about metals.

0 4 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

compounds	**elements**	**polymers**

Most metals are found in the Earth as _____.

0 4 . 2 Iron is extracted from iron oxide by reduction with carbon.

Why is iron extracted by reduction with carbon?

[1 mark]

Tick (✓) **one** box.

Iron is less reactive than carbon. ☐

Iron has the same reactivity as carbon. ☐

Iron is more reactive than carbon. ☐

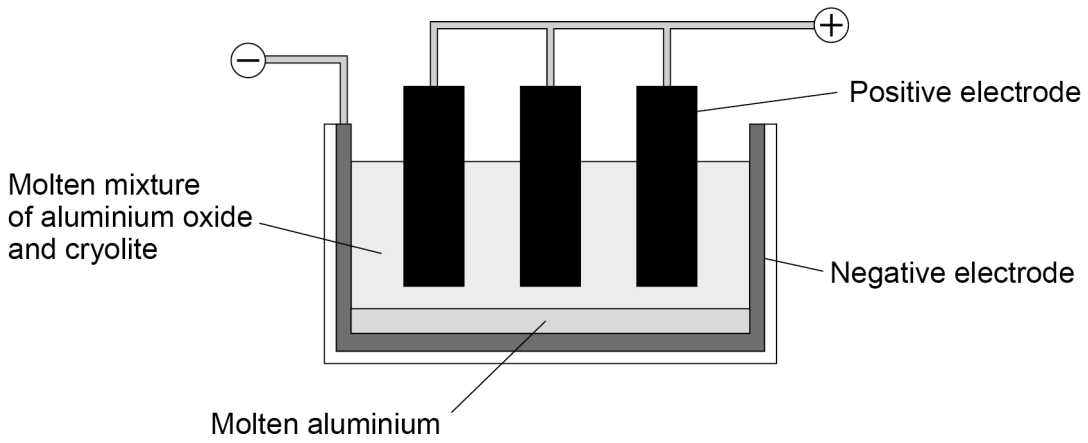
Question 4 continues on the next page

Do not write outside the box

Aluminium is extracted by the electrolysis of aluminium oxide.

Figure 8 shows the apparatus used to extract aluminium.

Figure 8



0 4 . 3 The mixture of aluminium oxide and cryolite has a lower melting point than aluminium oxide alone.

Why is the melting point lowered?

[1 mark]

Tick (✓) **one** box.

To reduce the amount of energy used ☐

To reduce the purity of the aluminium formed ☐

To reduce the rate of reaction ☐

Do not write outside the box

0 4 . 4 After some time, the positive electrodes need to be replaced.

Why must the positive electrodes be replaced?

[1 mark]

Tick (✓) **one** box.

The electrodes dissolve in the molten mixture. ☐

The electrodes melt in the molten mixture. ☐

The electrodes react with aluminium. ☐

The electrodes react with oxygen gas. ☐

Question 4 continues on the next page

Do not write outside the box

Aluminium can be mixed with other metals to form alloys.

0 4 . 5 How does the hardness of an alloy of aluminium compare with the hardness of pure aluminium?

[1 mark]

Tick (✓) **one** box.

The alloy is harder than the pure metal. ☐

The alloy and the pure metal have the same hardness. ☐

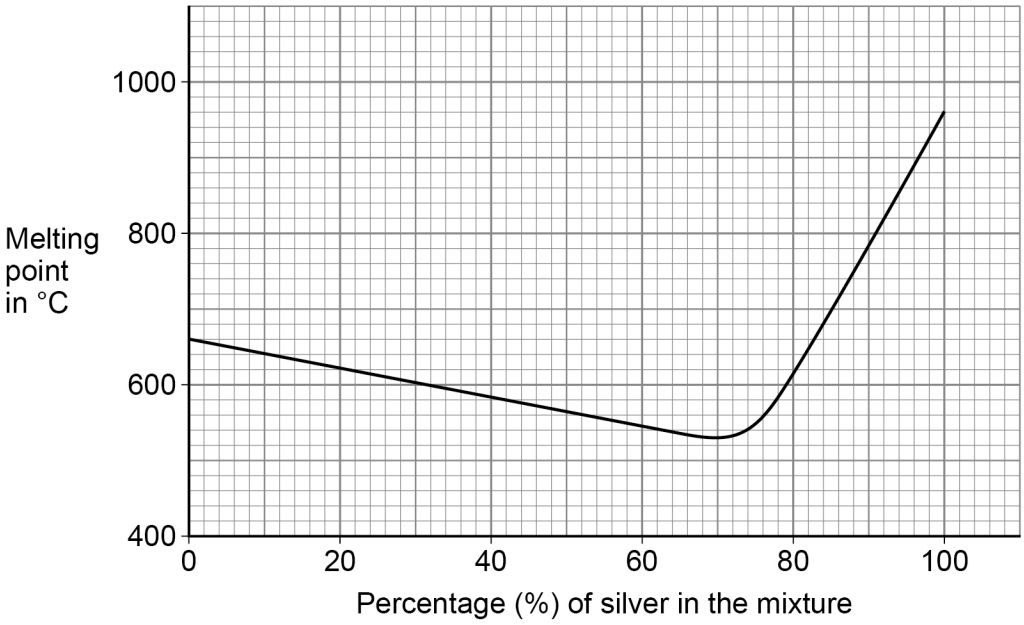
The alloy is less hard than the pure metal. ☐

Do not write outside the box

0 4 . 6 Aluminium can form an alloy with silver.

Figure 9 shows how the melting point of the alloy changes with the percentage (%) of silver in the mixture.

Figure 9



Describe how the melting point of the alloy changes as the percentage of silver in the mixture increases.

Use data from **Figure 9**.

[3 marks]

8

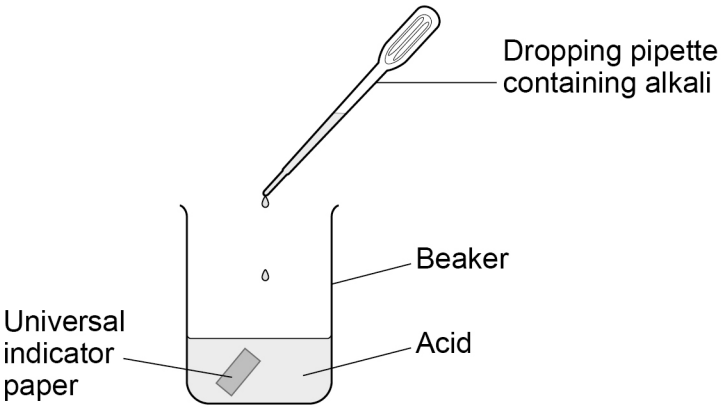
Do not write outside the box

0 5 This question is about acids.

A student investigated the volume of an alkali needed to react completely with 25 cm^3 of an acid.

Figure 10 shows the apparatus.

Figure 10



This is the method used.

1. Add 25 cm^3 of the acid to a beaker.

2. Add a piece of universal indicator paper to the acid.

3. Add the alkali drop by drop to the acid until the universal indicator paper changes colour to green.

4. Record the number of drops of alkali added.

0 5 . 1 The method does **not** give an accurate volume of alkali needed to react completely with the acid.

Suggest **two** improvements to the method.

[2 marks]

1 _____

_____

2 _____

_____

Do not write outside the box

0 5 . 2 What is the pH of the solution when the universal indicator paper turns green?

[1 mark]

Tick (✓) **one** box.

1 ☐ 5 ☐ 7 ☐ 9 ☐

0 5 . 3 What name is given to the reaction between an acid and an alkali?

[1 mark]

Tick (✓) **one** box.

Combustion ☐

Displacement ☐

Neutralisation ☐

0 5 . 4 Which ion do all acids contain?

[1 mark]

Tick (✓) **one** box.

Cl^- ☐ H^+ ☐ Na^+ ☐

0 5 . 5 Name the acid that reacts with sodium hydroxide to produce sodium nitrate.

[1 mark]

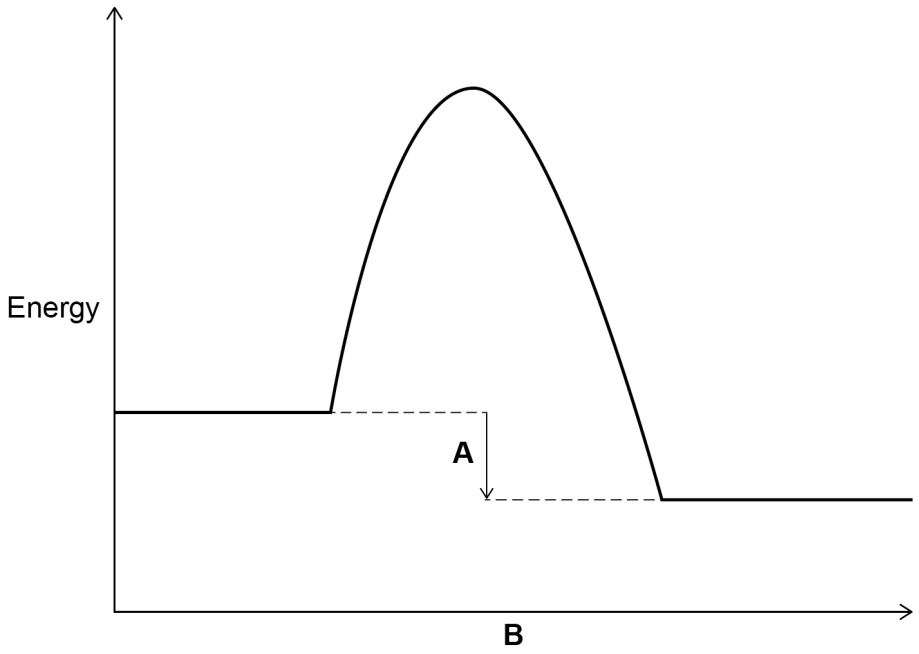
_____

Question 5 continues on the next page

Do not write outside the box

0 5 . 6 **Figure 11** shows a reaction profile for the reaction between an acid and an alkali.

Figure 11



What do labels **A** and **B** represent on **Figure 11**?

Choose the answers from the box.

[2 marks]

activation energy	**overall energy change**	**products**
progress of reaction	**reactants**	

A _____

B _____

Do not write outside the box

Acids also react with insoluble solid substances to produce salt solutions.

0 5 . 7 When making a salt solution, excess solid is added to the acid.

Draw the apparatus used to separate the excess solid from the salt solution by filtration.

The apparatus should collect:

- the excess solid
- the salt solution.

[2 marks]

0 5 . 8 Solid **X** reacts with hydrochloric acid to produce zinc chloride and hydrogen gas.

Name solid **X**.

[1 mark]

11

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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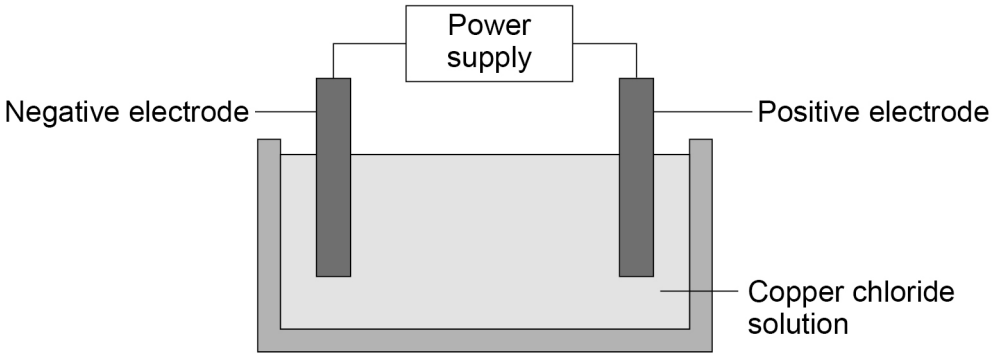
0 6 A teacher demonstrated the electrolysis of copper chloride solution.

Figure 12 shows the apparatus.

Figure 12



The teacher measured the mass of the negative electrode every 60 seconds.

0 6 . 1 Chlorine gas is given off during the electrolysis of copper chloride solution.

Chlorine gas is poisonous.

Give **one** way of reducing the risk of harm.

[1 mark]

_____

_____

Question 6 continues on the next page

Do not write outside the box

Table 5 shows the results.

Table 5

Time in seconds	Mass of negative electrode in grams
0	20.2
60	22.0
120	23.4
180	24.2
240	24.8
300	25.2
360	25.2

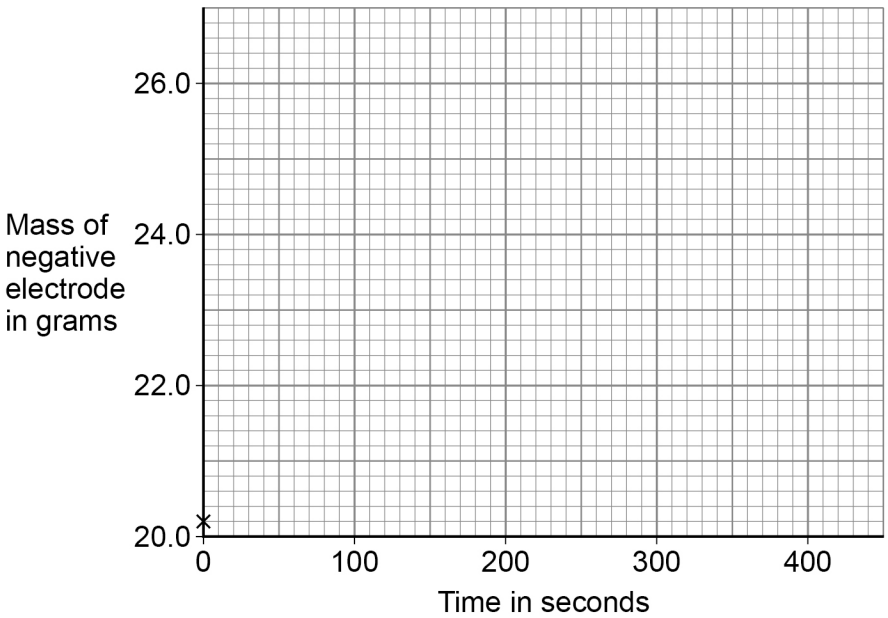
0 6 . 2 Plot the data from **Table 5** on **Figure 13**.

Draw a line of best fit.

The first point has been plotted for you.

[3 marks]

Figure 13



Do not write outside the box

0 6 . 3 A student made the hypothesis:

'The negative electrode will increase by a constant mass every 60 seconds.'

How do the results in **Table 5** show that the hypothesis is **not** correct?

[1 mark]

_____

_____

0 6 . 4 25 cm^3 of the solution of copper chloride contained 5.5 g of copper chloride.

Calculate the concentration of the solution in g/dm^3.

1 dm^3 = 1000 cm^3

[3 marks]

_____

_____

_____

_____

_____

Concentration = _____ g/dm^3

Question 6 continues on the next page

Do not write outside the box

0 6 . 5 The teacher also electrolysed potassium chloride solution.

Hydrogen gas was given off at the negative electrode.

Why was hydrogen gas given off?

[1 mark]

Tick (✓) **one** box.

Hydrogen is less reactive than potassium. ☐

Hydrogen has the same reactivity as potassium. ☐

Hydrogen is more reactive than potassium. ☐

9

Do not write outside the box

0 7 A student investigated an exothermic reaction.

The student reacted solid calcium oxide with water to produce calcium hydroxide.

0 7 . 1 What is meant by an 'exothermic' reaction?

[1 mark]

_____

_____

0 7 . 2 The formula of calcium hydroxide is $Ca(OH)_2$

Calculate the percentage by mass of oxygen in calcium hydroxide.

Relative atomic mass (A_r): O = 16

Relative formula mass (M_r): $Ca(OH)_2$ = 74

[3 marks]

_____

_____

_____

_____

_____

Percentage = _____ %

Question 7 continues on the next page

Do not write outside the box

0 7 . 3 When solid calcium oxide is added to water, the temperature of the reaction mixture changes.

Plan a method to investigate how changing the mass of calcium oxide affects the temperature change of the reaction mixture.

[6 marks]

Extra space

10

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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

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