AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE CHEMISTRY

F

Foundation Tier Paper 1

Monday 19 May 2025 Morning Time allowed: 1 hour 45 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. Do not write outside the box around each page or on blank pages.
- 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.

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- In all calculations, show clearly how you work out your answer.
- 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	
8	
9	
10	
TOTAL	

Do not write outside the box

0 1 This question is about elements and compounds.

0 1 . 1 What is the name of the compound with the formula $ZnBr_2$?

Use the periodic table.

[1 mark]

Tick (✓) **one** box.

Zinc bromide ☐

Zinc chloride ☐

Zinc iodide ☐

0 1 . 2 A compound has the formula C_2H_6O

Table 1 shows information about a molecule of C_2H_6O

Table 1

Symbol of element	Name of element	Number of atoms of the element in a molecule of C_2H_6O
C		2
H	Hydrogen	
	Oxygen	1

Complete **Table 1**.

Use the periodic table.

[3 marks]

Do not write outside the box

0 1 . 3 Potassium and sulfur react to produce potassium sulfide.

Write the word equation for this reaction.

[1 mark]

_____ + _____ ⟶ _____

0 1 . 4 Aluminium reacts with fluorine to produce aluminium fluoride.

Balance the equation for this reaction.

[2 marks]

_____ Al + _____ F_2 ⟶ 2 AlF_3

7

Turn over for the next question

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There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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0 2 Metals react with acids to produce a salt and a gas.

0 2 . 1 Which salt is produced when magnesium reacts with hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

Magnesium chloride ☐

Magnesium nitrate ☐

Magnesium sulfate ☐

0 2 . 2 Which gas is produced when magnesium reacts with hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

Carbon dioxide ☐

Chlorine ☐

Hydrogen ☐

Oxygen ☐

Question 2 continues on the next page

Do not write outside the box

A student investigated the temperature change in the reaction between metals and hydrochloric acid.

This is the method used.

1. Measure 25 cm^3 of hydrochloric acid at 20 °C into a container.

2. Add 1 g of a metal.

3. Record the temperature change.

4. Repeat steps 1 to 3 using a different metal.

0 2 . 3 Draw **one** line from the type of variable to the name of the variable in the investigation.

[2 marks]

Type of variable	**Name of variable**
	Mass of metal
Dependent variable	Temperature change
Independent variable	Type of metal
	Volume of hydrochloric acid

Do not write outside the box

0 2 . 4 Which container would be the most suitable to reduce energy transfer with the surroundings?

[1 mark]

Tick (✓) **one** box.

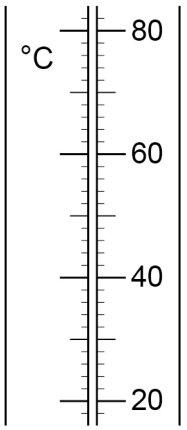
A copper can ☐

A glass beaker ☐

A polystyrene cup ☐

0 2 . 5 **Figure 1** shows part of the scale of the thermometer used in the investigation.

Figure 1



What is the resolution of the thermometer?

[1 mark]

Tick (✓) **one** box.

1 °C ☐ 2 °C ☐ 10 °C ☐ 20 °C ☐

Do not write outside the box

0 2 . 6 The reaction between a metal and an acid is exothermic.

What happens to the temperature of the mixture during the reaction?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

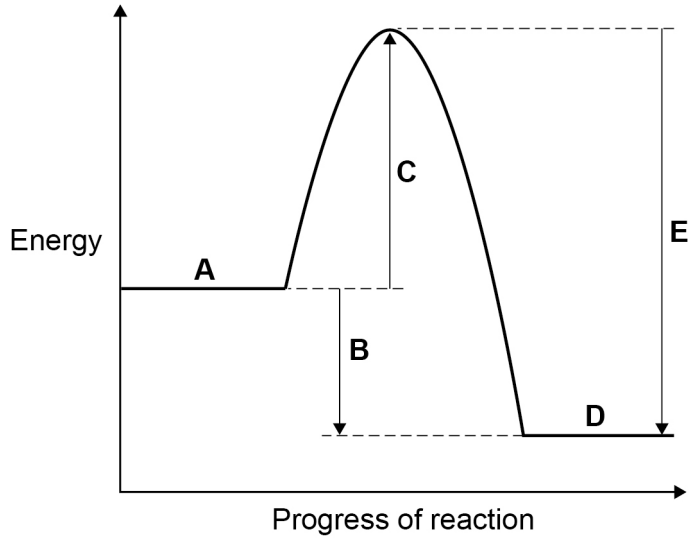
Stays the same ☐

Increases ☐

Do not write outside the box

Figure 2 shows the reaction profile for the reaction between a metal and an acid.

Figure 2



0 2 . 7 Which letter in **Figure 2** represents the reactants?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

0 2 . 8 Which letter in **Figure 2** represents the activation energy?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

0 2 . 9 Which letter in **Figure 2** represents the overall energy change?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

10

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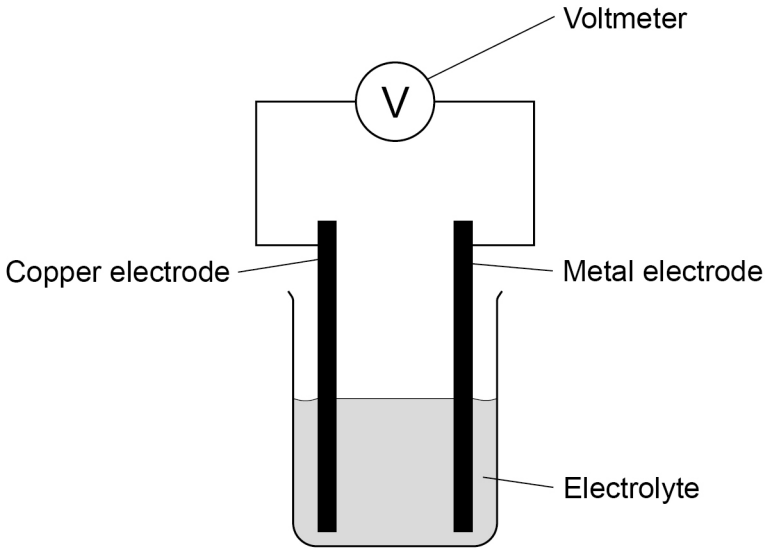
0 3 Cells contain chemicals that react to produce electricity.

A student investigated the voltage produced by four different cells.

Figure 3 shows the apparatus.

Figure 3



This is the method used.

1. Measure the voltage produced by the cell using metal **A** as the metal electrode.
2. Repeat using different metals as the metal electrode.

Table 2 shows the results.

Table 2

Metal electrode	Voltage in volts
A	1.1
B	0.0
C	0.8
D	2.7

Do not write outside the box

0 3 . 1 Which substance could be used as the electrolyte in the cell in **Figure 3**?

[1 mark]

Tick (✓) **one** box.

Pure water ☐

Sodium chloride solution ☐

Solid potassium bromide ☐

0 3 . 2 Which metal **A**, **B**, **C** or **D** was copper?

Give **one** reason for your answer.

Use **Figure 3** and **Table 2**.

[2 marks]

Metal _____

Reason _____

_____

0 3 . 3 Write the four metals **A**, **B**, **C** and **D** in order of reactivity.

Use **Table 2**.

[1 mark]

Most reactive _____

_____

_____

Least reactive _____

Do not write outside the box

0 3 . 4 A battery consists of several cells connected together in series.

Each cell has a voltage of 3.6 V.

Calculate the number of cells needed to make a battery of voltage 14.4 V.

[2 marks]

Number of cells = _____

0 3 . 5 Fuel cells can be used to power electric cars.

Complete the sentence.

Choose the answer from the box.

[1 mark]

ammonia	**methane**	**water**

The overall reaction in a hydrogen fuel cell involves the oxidation of

hydrogen to produce _____.

0 3 . 6 Rechargeable cells can be recharged when an external electrical current is supplied.

Complete the sentence.

[1 mark]

When an external electrical current is supplied to a rechargeable cell,

the chemical reaction is _____.

8

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 4 A student did an experiment to find the volume of an acid that neutralised 25.0 cm^3 of an alkali.

This is the method used.

1. Measure 25.0 cm^3 of the alkali into a conical flask.
2. Add a few drops of substance **X** to the alkali.
3. Place the conical flask on a white tile.
4. Add the acid to the alkali until a colour change is seen.
5. Measure the volume of acid added.
6. Repeat steps 1 to 5 three more times.

0 4 . 1 What is the name of this experiment?

[1 mark]

Tick (✓) **one** box.

Crystallisation ☐

Distillation ☐

Electrolysis ☐

Titration ☐

0 4 . 2 Substance **X** is used in step 2 of the method.

What type of substance is **X**?

[1 mark]

Do not write outside the box

0 4 . 3 Which piece of equipment is used to add the acid to the alkali in step 4?

[1 mark]

Tick (✓) **one** box.

Beaker ☐

Burette ☐

Test tube ☐

0 4 . 4 Suggest **one** improvement to step 4 of the method.

[1 mark]

_____

_____

Question 4 continues on the next page

Do not write outside the box

0 4 . 5 **Table 3** shows the results.

Table 3

	Trial 1	Trial 2	Trial 3	Trial 4
Volume of acid in cm^3	8.95	9.00	8.85	8.45

Calculate the mean volume of the acid needed to neutralise 25.0 cm^3 of the alkali.

Give your answer to 3 significant figures.

Do **not** include the anomalous result.

[4 marks]

Mean volume (3 significant figures) = _____ cm^3

Do not write outside the box

0 4 . 6 Aqueous solutions of acids and alkalis contain ions.

Draw **one** line from each type of aqueous solution to the ion that is **always** in the aqueous solution.

[2 marks]

Type of aqueous solution	**Ion**
	Cl^-
Acid	H^+
Alkali	Na^+
	OH^-

10

Turn over for the next question

Do not write outside the box

0 5 This question is about electrolysis.

0 5 . 1 **Table 4** shows some of the products of electrolysis of two molten compounds.

Complete **Table 4**.

[2 marks]

Table 4

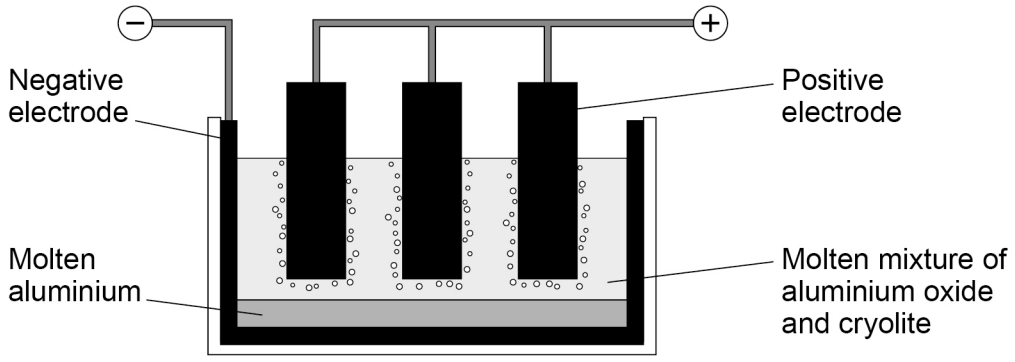
Molten compound	**Product at the negative electrode**	**Product at the positive electrode**
Copper chloride		Chlorine
Potassium bromide	Potassium	

Aluminium is extracted by electrolysis of a molten mixture of aluminium oxide and cryolite.

The products are molten aluminium and oxygen gas.

Figure 4 shows the electrolysis cell.

Figure 4



0 5 . 2 What is the formula of oxygen gas?

[1 mark]

Tick (✓) **one** box.

O ☐ O_2 ☐ O^2 ☐ 2O ☐

Do not write outside the box

0 5 . 3 Aluminium oxide contains the ions Al^{3+} and O^{2-}

Explain why aluminium is produced at the **negative** electrode.

[2 marks]

0 5 . 4 The melting point of aluminium oxide is 2045 °C.

The melting point of the mixture of aluminium oxide and cryolite is 950 °C.

Explain why the electrolysis uses the mixture instead of pure aluminium oxide.

[2 marks]

0 5 . 5 The positive electrodes in the electrolysis cell are made of carbon.

Why do the positive electrodes need to be continually replaced?

[1 mark]

Tick (✓) **one** box.

Carbon reacts with the aluminium oxide. ☐

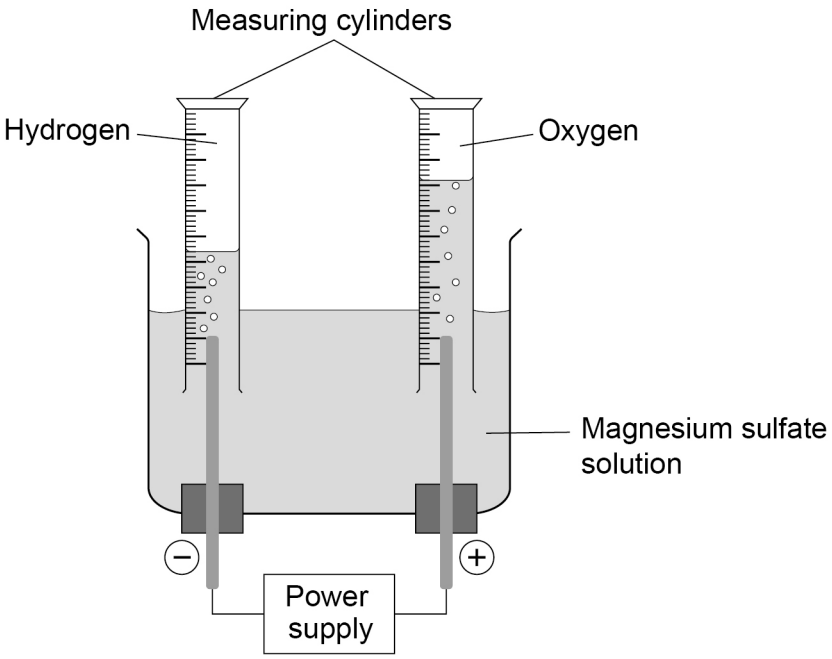
Carbon reacts with the aluminium produced. ☐

Carbon reacts with the oxygen produced. ☐

A student investigated the electrolysis of magnesium sulfate solution.

Figure 5 shows the apparatus.

Figure 5



This is the method used.

1. Set the power supply to give a current of 0.05 A.

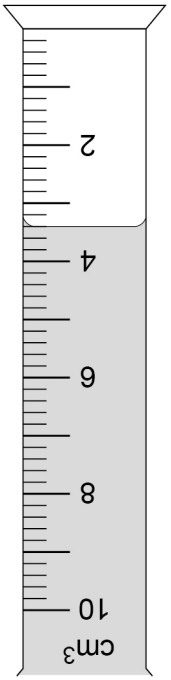
2. Measure the volume of each gas every minute for 5 minutes.

3. Repeat steps 1 and 2 using a current of 0.10 A in step 1.

Do not write outside the box

0 5 . 6 **Figure 6** shows a measuring cylinder during the electrolysis.

Figure 6



What is the volume of gas in the measuring cylinder?

[1 mark]

Tick (✓) **one** box.

2.7 cm^3 ☐ 3.4 cm^3 ☐ 4.6 cm^3 ☐

0 5 . 7 Hydrogen is produced instead of magnesium at the negative electrode.

Why is hydrogen produced at the negative electrode?

[1 mark]

Tick (✓) **one** box.

Hydrogen is less reactive than magnesium. ☐

Hydrogen has the same reactivity as magnesium. ☐

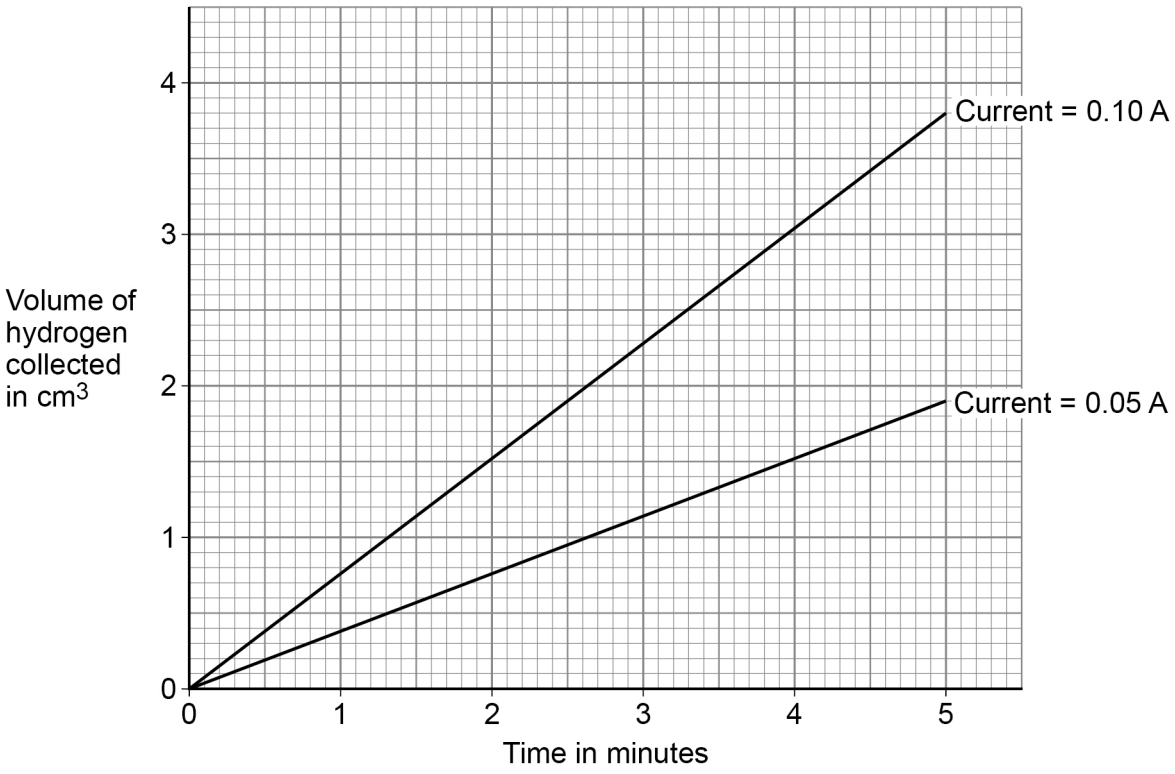
Hydrogen is more reactive than magnesium. ☐

Turn over ►

Do not write outside the box

0 5 . 8 **Figure 7** shows the results for the volume of hydrogen collected.

Figure 7



Which hypothesis explains the results in **Figure 7**?

[1 mark]

Tick (✓) **one** box.

The volume of hydrogen collected depends on **both** the current and the time. ☐

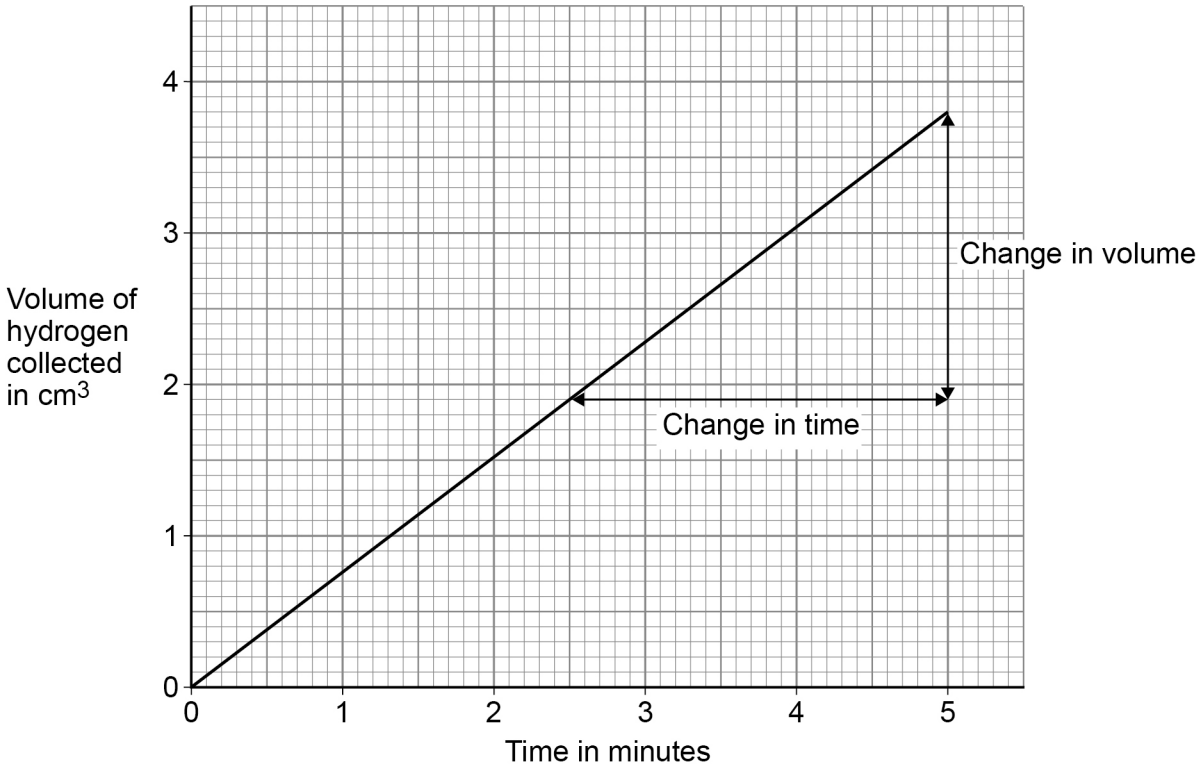
The volume of hydrogen collected depends on the current but **not** the time. ☐

The volume of hydrogen collected depends on the time but **not** the current. ☐

Do not write outside the box

0 5 . 9 **Figure 8** is a repeat of part of the graph for current = 0.10 A in **Figure 7**.

Figure 8



Determine the gradient of the graph in **Figure 8**.

Use the equation

$$\text{gradient} = \frac{\text{change in volume}}{\text{change in time}}$$

[4 marks]

Change in volume = _____ cm^3

Change in time = _____ min

Gradient = _____ cm^3/min

15

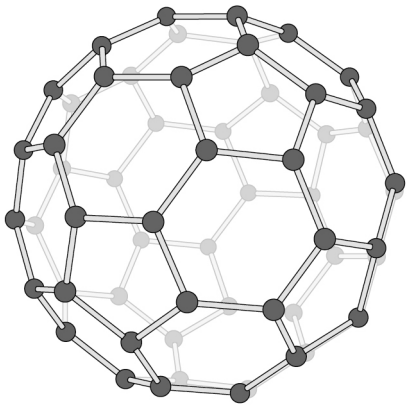
Turn over ►

Do not write outside the box

0 6 This question is about nanoparticles.

Figure 9 represents a type of nanoparticle made of carbon atoms.

Figure 9



0 6 . 1 What is the name of the type of nanoparticle in **Figure 9**?

[1 mark]

Tick (✓) **one** box.

Buckminsterfullerene ☐

Carbon nanotube ☐

Graphene ☐

0 6 . 2 Nanoparticles of the type in **Figure 9** are slippery.

Which structural feature of these nanoparticles makes them slippery?

[1 mark]

Tick (✓) **one** box.

The nanoparticles are hollow. ☐

The nanoparticles are made of carbon atoms. ☐

The nanoparticles are spherical. ☐

Do not write outside the box

0 6 . 3 A nanoparticle of a metal has a diameter of 15 nm.

A fine particle of the metal has a diameter of 1500 nm.

How many times larger is the diameter of the fine particle than the diameter of the nanoparticle?

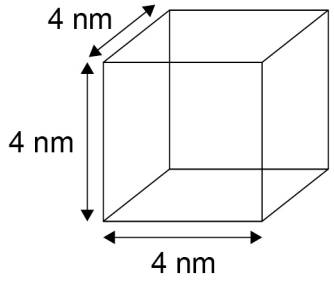
[1 mark]

Tick (✓) **one** box.

10 ☐ 10^2 ☐ 10^3 ☐ 10^4 ☐

0 6 . 4 **Figure 10** represents a cubic nanoparticle.

Figure 10



The surface area of the cubic nanoparticle is 96 nm^2.

Calculate:

- the volume of the cubic nanoparticle
- the simplest whole number ratio of surface area : volume for the cubic nanoparticle.

The volume of a cube = (length of side)^3

[4 marks]

Volume of nanoparticle = _____ nm^3

Ratio of surface area : volume = _____ : _____

Simplest whole number ratio of surface area : volume = _____ : _____

Turn over ►

Do not write outside the box

0 6 . 5 A substance can be used to provide a scratchproof coating on reading glasses.

The coating is a single layer of particles of the substance.

Nanoparticles are used instead of normal-sized particles.

Complete the sentences.

[2 marks]

When using nanoparticles instead of normal-sized particles, the thickness of the layer that can be used is much _____.

This means the amount of light passing through the layer is _____.

9

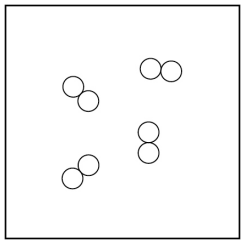
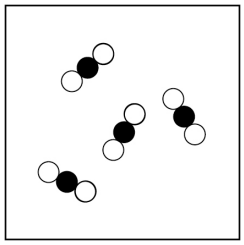
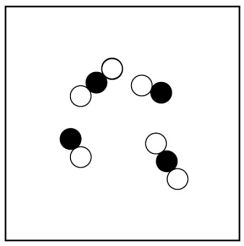
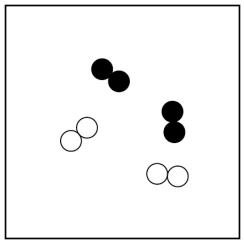
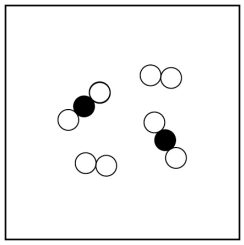
Do not write outside the box

0 7 This question is about mixtures.

0 7 . 1 Draw **one** line from each type of mixture to the representation of that mixture.

○ and ● represent atoms of different elements.

[2 marks]

Type of mixture	**Representation**
Mixture of compounds	
	
Mixture of a compound and an element	
	
	

Turn over ►

Do not write outside the box

0 7 . 2 A student had a mixture of salt and sand.

Salt is soluble in water.

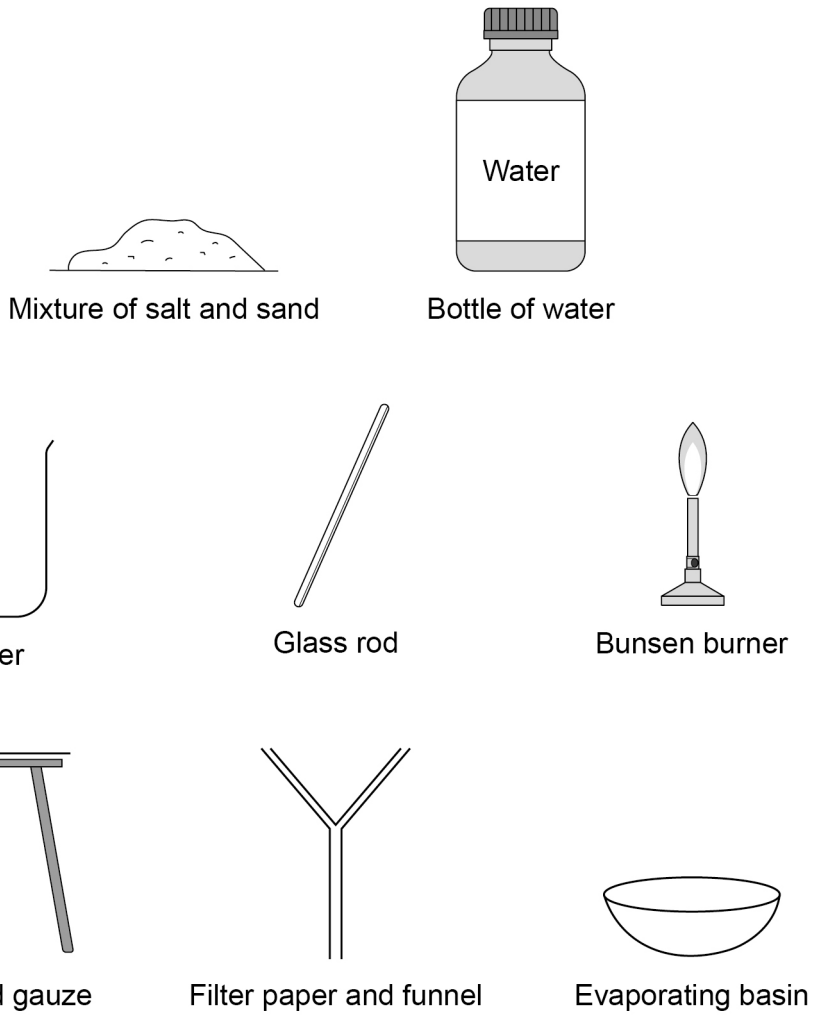
Sand is insoluble in water.

Plan a method to obtain pure dry samples of salt and of sand from the mixture.

Figure 11 shows the chemicals and equipment that can be used.

[6 marks]

Figure 11



Do not write outside the box

Extra space

0 7 . 3 A mixture of salt and sand contained 16.0 g of salt.

The student obtained 13.6 g of salt after separation from the mixture.

Calculate the percentage yield of the salt.

Use the equation

$$\% \text{ yield} = \frac{\text{mass of salt obtained}}{\text{mass of salt in mixture}} \times 100$$

[2 marks]

% yield = _____ %

10

Do not write outside the box

0 8 This question is about elements in the periodic table.

0 8 . 1 Describe where the non-metallic elements are found in the periodic table.

[1 mark]

0 8 . 2 Gallium (Ga) is a metallic element in Group 3.

Which of these properties of gallium is **not** typical of most metals?

[1 mark]

Tick (✓) **one** box.

A boiling point above 1000 °C ☐

A melting point below 100 °C ☐

Conducts electricity when solid ☐

Forms positive ions ☐

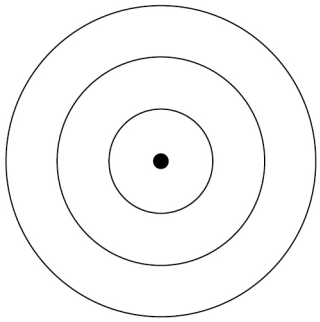
Do not write outside the box

0 8 . 3 A sodium atom can be represented as $^{23}_{11}Na$

Complete **Figure 12** to show the electronic structure of a sodium atom.

[1 mark]

Figure 12



0 8 . 4 Mendeleev created an early periodic table.

Mendeleev placed most of the elements in order of atomic weight.

Tellurium and iodine were not placed in order of atomic weight.

Why did Mendeleev **not** place tellurium and iodine in order of atomic weight?

[1 mark]

0 8 . 5 Argon is an element in Group 0 of the periodic table.

Explain why argon is unreactive.

[2 marks]

Do not write outside the box

An element **X** consists of two isotopes.

0 8 . 6 What is meant by 'isotopes'?

Answer in terms of subatomic particles.

[2 marks]

0 8 . 7 **Table 5** shows the mass numbers and percentage abundances of the isotopes of **X**.

Table 5

Mass number	Percentage abundance (%)
113	4
115	96

Which is the closest estimate to the relative atomic mass of **X**?

[1 mark]

Tick (✓) **one** box.

~113 ☐ ~114 ☐ ~115 ☐

9

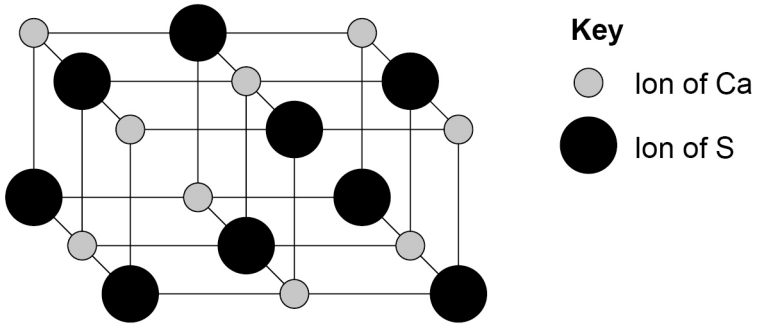
Do not write outside the box

0 9 This question is about structure and bonding.

Calcium sulfide is an ionic compound.

Figure 13 represents the structure of calcium sulfide.

Figure 13



0 9 . 1 Determine the empirical formula of calcium sulfide.

[1 mark]

Empirical formula _____

Question 9 continues on the next page

Do not write outside the box

0 9 . 2 Calcium is in Group 2 of the periodic table.

Sulfur is in Group 6 of the periodic table.

Describe what happens when a calcium atom reacts with a sulfur atom.

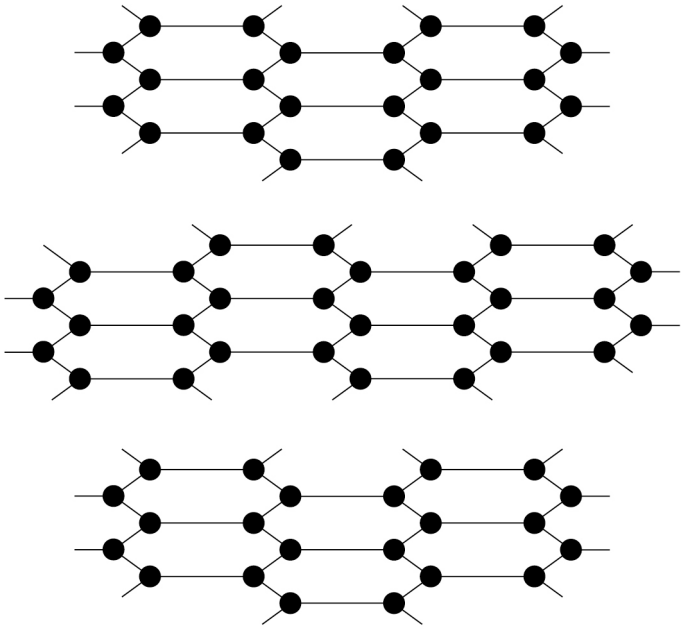
Answer in terms of electrons and ions.

[4 marks]

Do not write outside the box

Figure 14 shows the structure of graphite.

Figure 14



Key

● Carbon atom

0 9 . 3 Describe the structure and bonding of graphite.

[4 marks]

Extra space

Do not write outside the box

0 9 . 4 Substances that consist of small molecules do **not** conduct electricity.

Give **one** reason why.

[1 mark]

0 9 . 5 Methane consists of small molecules.

Poly(ethene) is a polymer.

Why does poly(ethene) have a higher melting point than methane?

[1 mark]

Tick (✓) **one** box.

Poly(ethene) has more covalent bonds to break than methane. ☐

Poly(ethene) has no intermolecular forces to overcome. ☐

Poly(ethene) has stronger covalent bonds to break than methane. ☐

Poly(ethene) has stronger intermolecular forces to overcome than methane. ☐

11

Do not write outside the box

1 0 This question is about metals and metal oxides.

Tin (Sn) is extracted from tin oxide using carbon.

The equation for the reaction is:

$$SnO_2 + C \longrightarrow Sn + CO_2$$

1 0 . 1 Which substance is reduced in this reaction?

Give **one** reason for your answer.

Answer in terms of oxygen.

[2 marks]

Substance reduced _____

Reason _____

_____

1 0 . 2 Why can carbon be used to extract tin from tin oxide?

[1 mark]

_____

_____

Question 10 continues on the next page

Do not write outside the box

1 0 . 3 Cadmium (Cd) can be extracted by the reaction of cadmium oxide with carbon.

The equation for the reaction is:

$$CdO + C \longrightarrow Cd + CO$$

Calculate the percentage atom economy for the production of cadmium in this reaction.

Relative atomic masses (A_r): C = 12 Cd = 112

Relative formula mass (M_r): CdO = 128

[3 marks]

Percentage atom economy = _____ %

1 0 . 4 Tungsten is a transition metal.

Potassium is a Group 1 metal.

Give **two** differences between the properties of tungsten and the properties of potassium.

[2 marks]

1 _____

2 _____

Do not write outside the box

Tungsten oxide reacts with hydrogen to give tungsten (W) and water.

1 0 . 5 The equation for the reaction is:

$$WO_3 + 3\,H_2 \longrightarrow W + 3\,H_2O$$

The law of conservation of mass states:

> 'The mass of the products equals the mass of the reactants during a chemical reaction.'

Show that the equation obeys the law of conservation of mass.

Relative atomic mass (A_r): W = 184

Relative formula masses (M_r): H_2 = 2 WO_3 = 232 H_2O = 18

[2 marks]

1 0 . 6 The reaction producing tungsten has a high atom economy.

Why is it important to use reactions with a high atom economy in industry?

[1 mark]

11

END OF QUESTIONS

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