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

F

Foundation Tier
Chemistry Paper 1F

Monday 22 May 2023 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.

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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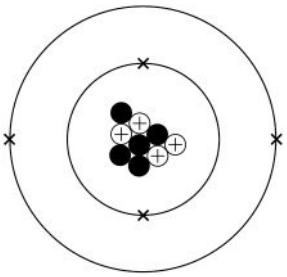
0 1 All substances are made from atoms.

0 1 . 1 **Figure 1** represents a beryllium atom.

Figure 1



What is the number of protons and the number of neutrons in the beryllium atom?

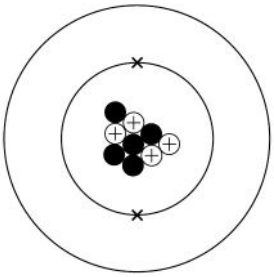
[2 marks]

Number of protons _____

Number of neutrons _____

0 1 . 2 **Figure 2** represents a beryllium **ion**.

Figure 2



What is the relative charge on a beryllium ion?

[1 mark]

Tick (✓) **one** box.

0 ☐ +1 ☐ +2 ☐

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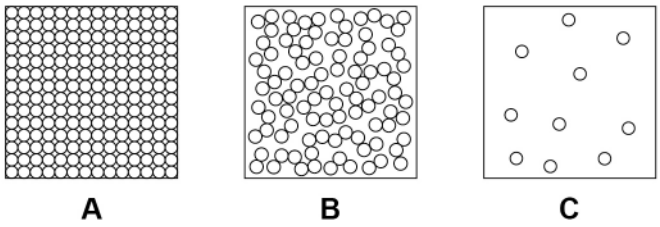
Figure 3 shows the arrangement of atoms in the three states of matter.

Figure 3



0 1 . 3 What state of matter is represented by state **C** in **Figure 3**?

[1 mark]

Tick (✓) **one** box.

Gas ☐

Liquid ☐

Solid ☐

Do not write outside the box

0 1 . 4 What is the name of the process when state **B** changes into state **A**?

Use **Figure 3**.

[1 mark]

Tick (✓) **one** box.

Condensing ☐

Freezing ☐

Melting ☐

0 1 . 5 How can state **B** be changed into state **C**?

Use **Figure 3**.

[1 mark]

_____

_____

Question 1 continues on the next page

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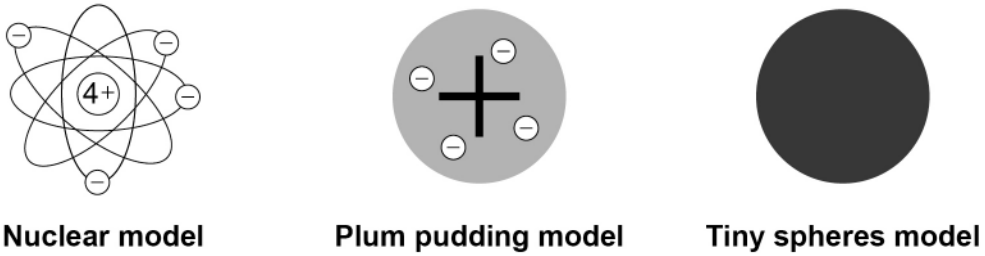
Experimental evidence led to the scientific model of the atom changing over time.

0 1 . 6 **Figure 4** shows three models for the atom.

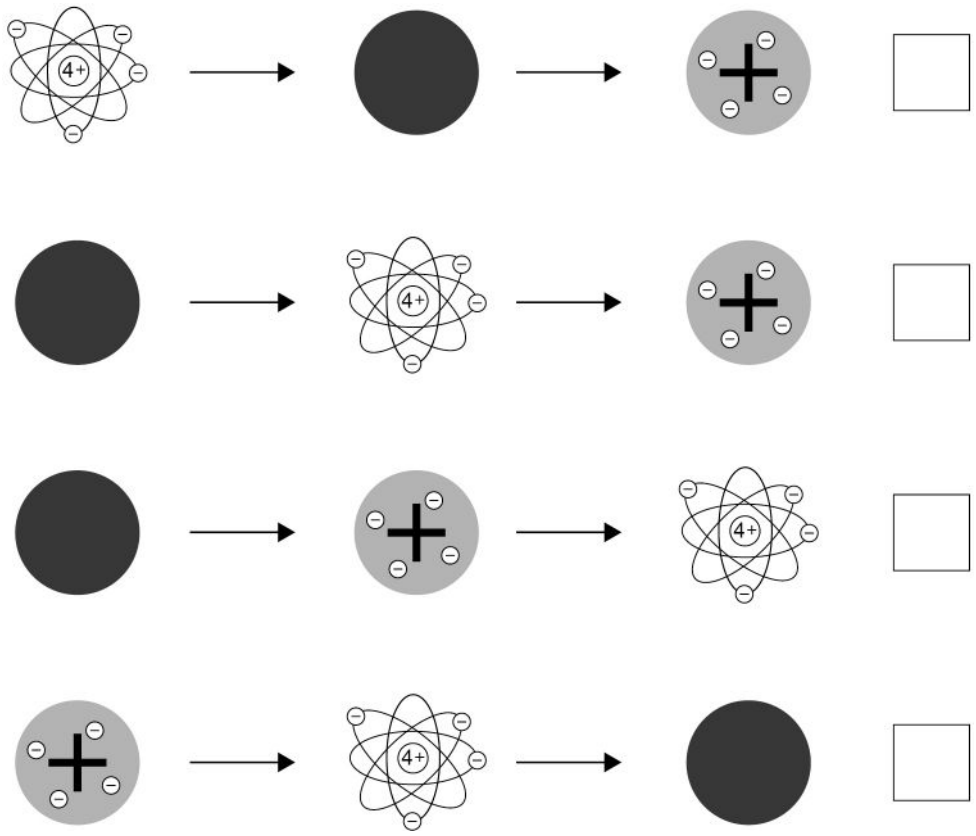
Figure 4



What is the order for the development of the model of the atom?

[1 mark]

Tick (✓) **one** box.



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0 1 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

Bohr	**Chadwick**	**Mendeleev**

The existence of neutrons was discovered by _____.

8

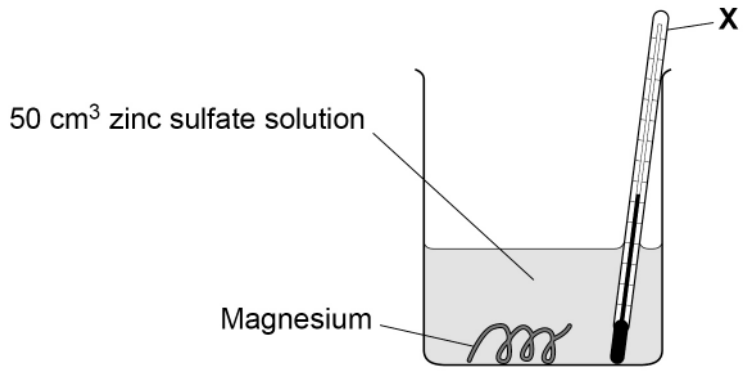
Turn over for the next question

Do not write outside the box

0 2 A student investigated the temperature change when magnesium was added to zinc sulfate solution.

Figure 5 shows the apparatus.

Figure 5



0 2 . 1 Which piece of equipment is labelled **X**?

[1 mark]

Tick (✓) **one** box.

Beaker ☐

Ruler ☐

Thermometer ☐

0 2 . 2 Which piece of equipment is the best to use to measure volumes of solution?

[1 mark]

Tick (✓) **one** box.

Conical flask ☐

Evaporating basin ☐

Measuring cylinder ☐

Do not write outside the box

The student added 1.0 g of magnesium to 50 cm^3 of zinc sulfate solution and measured the temperature increase.

The student repeated the experiment two more times.

Table 1 shows the results.

Table 1

Temperature increase in °C			
Experiment 1	**Experiment 2**	**Experiment 3**	**Mean**
7.6	7.3	7.6	**Y**

0 2 . 3 Calculate value **Y** in **Table 1**.

[2 marks]

Y = _____ °C

0 2 . 4 The student then added 1.2 g of magnesium to 50 cm^3 of zinc sulfate solution.

The temperature increased by 9.0 °C.

Calculate the temperature increase when the student adds 0.40 g of magnesium to 50 cm^3 of zinc sulfate solution.

[2 marks]

Temperature increase = _____ °C

Do not write outside the box

0 2 . 5 What is the name given to a reaction which causes the temperature to increase?

[1 mark]

Tick (✓) **one** box.

Endothermic ☐

Exothermic ☐

Thermal decomposition ☐

0 2 . 6 The student repeated the experiment with 1.2 g of copper and 50 cm^3 of zinc sulfate solution.

The temperature did **not** increase.

Give **one** reason why.

[1 mark]

_____

_____

8

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0 3 Structure and bonding is used to explain properties of compounds.

Metal atoms react with non-metal atoms to form ions.

0 3 . 1 Which group of elements does **not** form ions?

[1 mark]

Tick (✓) **one** box.

Alkali metals ☐

Halogens ☐

Noble gases ☐

Question 3 continues on the next page

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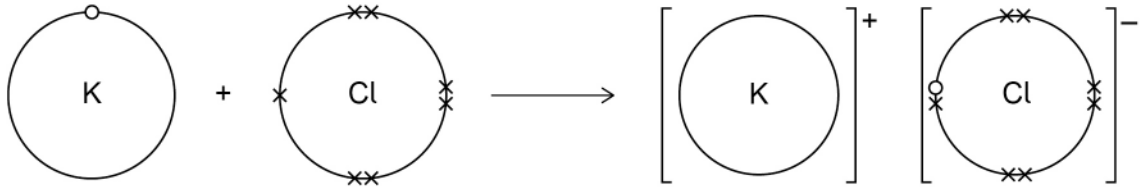
0 3 . 2 Potassium reacts with chlorine to produce potassium chloride (KCl).

Figure 6 shows what happens to the electrons in the outer shells when a potassium atom reacts with a chlorine atom.

The dots (o) and crosses (×) represent electrons.

Figure 6



Describe what happens when a potassium atom reacts with a chlorine atom to produce potassium chloride.

Answer in terms of electrons.

[4 marks]

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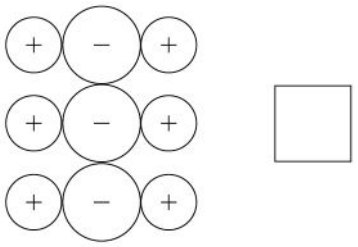
0 3 . 3 In solid ionic compounds, oppositely charged ions attract to form a giant structure.

Which structure represents the arrangement of ions in solid potassium chloride?

[1 mark]

Tick (✓) **one** box.



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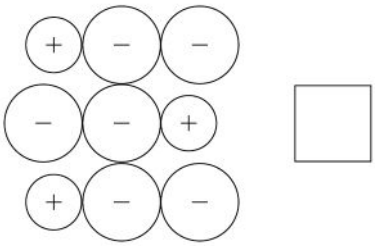

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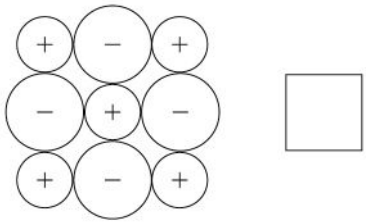

☐

Question 3 continues on the next page

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Non-metal atoms share electrons to form covalent bonds.

0 3 . 4 Water (H_2O) is a covalent molecule.

Table 2 shows the number of electrons in the outer shells of hydrogen atoms and of oxygen atoms.

Table 2

Element	Number of electrons in the outer shell of an atom
Hydrogen	1
Oxygen	6

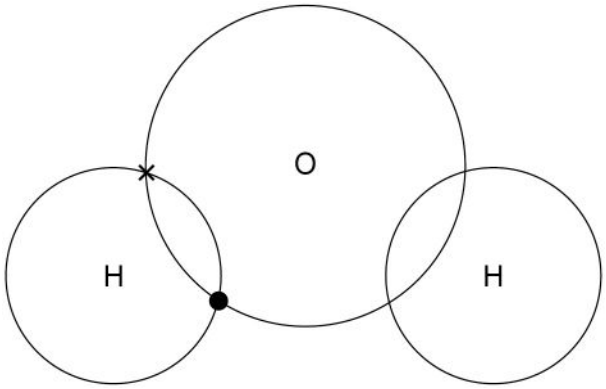
Figure 7 shows part of a dot and cross diagram for a molecule of water.

Complete the dot and cross diagram.

You should only show electrons in the outer shells.

[2 marks]

Figure 7



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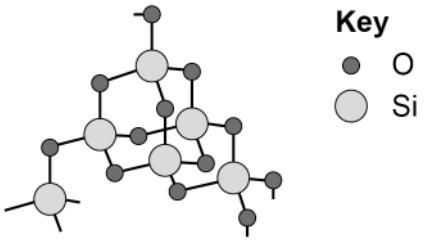
0 3 . 5 Silica has a giant covalent structure.

Figure 8 represents the structure of silica.

Figure 8



Determine the ratio of silicon (Si) atoms to oxygen (O) atoms in silica.

Use **Figure 8**.

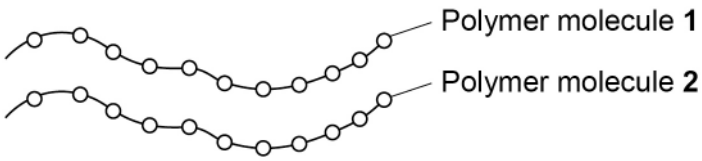
[1 mark]

_____ Si : _____ O

0 3 . 6 Polymers have very large molecules.

Figure 9 represents part of the structure of a polymer.

Figure 9



What holds polymer molecule **1** and polymer molecule **2** together in a polymer?

[1 mark]

Tick (✓) **one** box.

Covalent bonds ☐

Electrostatic attraction between ions ☐

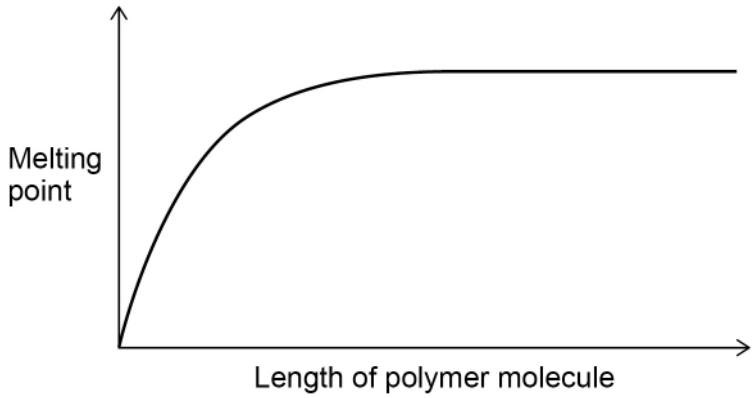
Weak intermolecular forces ☐

Turn over ►

Do not write outside the box

0 3 . 7 **Figure 10** shows the melting point of a polymer as the length of the polymer molecule increases.

Figure 10



Describe the trend shown in **Figure 10**.

[3 marks]

13

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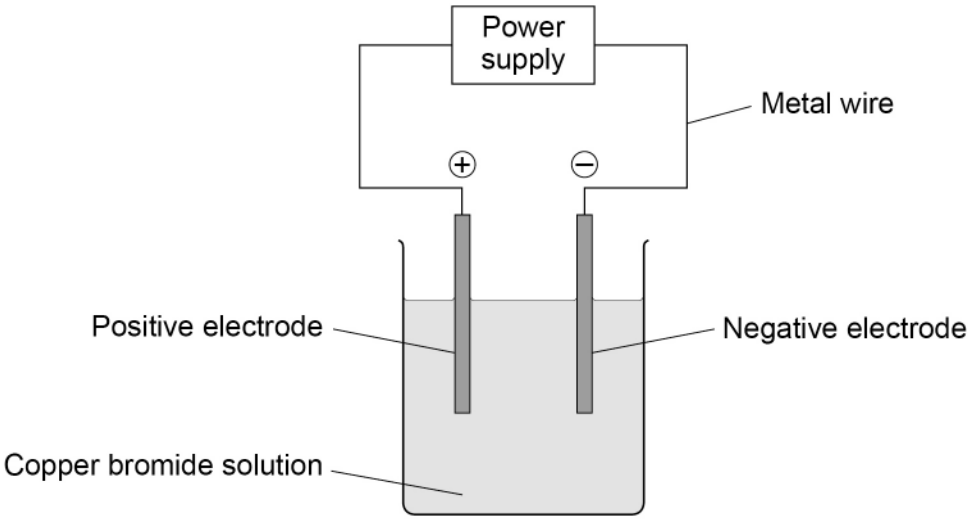
0 4 Copper bromide solution is electrolysed using inert electrodes.

Figure 11 shows the apparatus.

Figure 11



0 4 . 1 Which particles carry the electrical charge through the metal wire?

[1 mark]

Tick (✓) **one** box.

Electrons ☐

Neutrons ☐

Protons ☐

Question 4 continues on the next page

Do not write outside the box

There are four ions in copper bromide solution:

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

0 4 . 2 Two of these ions are formed when a water molecule breaks down.

The symbol equation when a water molecule breaks down is:

$$H_2O \rightarrow H^+ + OH^-$$

Complete the **word** equation for the breakdown of a water molecule.

[2 marks]

water → _____ ion + _____ ion

0 4 . 3 Copper ions and bromide ions carry the electrical charge through the solution.

The formula of a copper ion is Cu^{2+}

The formula of a bromide ion is Br^-

What is the formula of copper bromide?

[1 mark]

Tick (✓) **one** box.

CuBr ☐

Cu_2Br ☐

$CuBr_2$ ☐

Do not write outside the box

0 4 . 4 Explain why copper ions (Cu^{2+}) move to the negative electrode.

[2 marks]

0 4 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

decomposed	**discharged**	**distilled**

At the negative electrode copper metal is produced when the

copper ions are _____ .

0 4 . 6 What happens to the mass of the **negative** electrode during electrolysis?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

No change ☐

Increases ☐

Turn over ►

Do not write outside the box

There are four ions in copper bromide solution:

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

0 4 . 7 What is produced at the **positive** electrode when copper bromide solution is electrolysed?

[1 mark]

Tick (✓) **one** box.

Bromine ☐

Hydrogen ☐

Oxygen ☐

9

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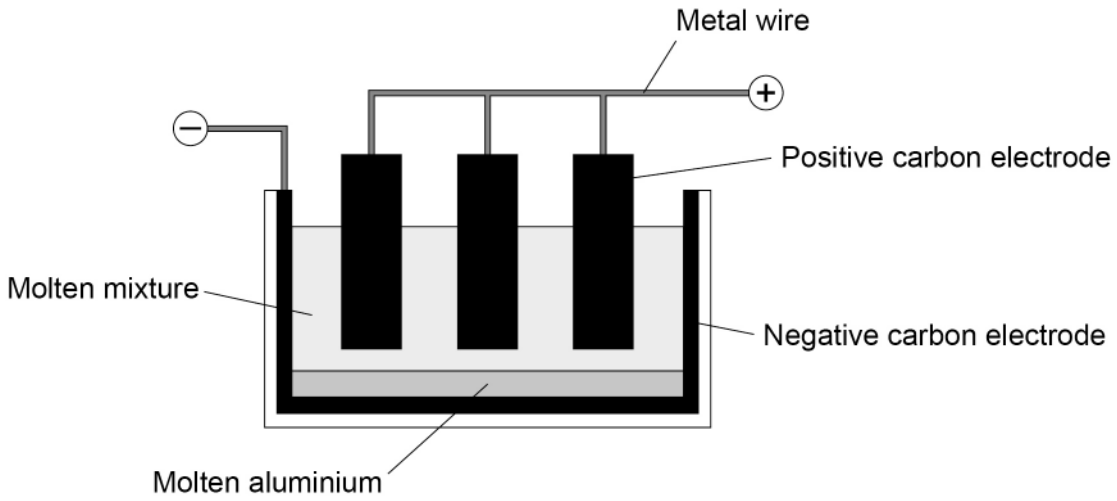
0 5 This question is about extraction of metals.

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

Figure 12 shows the electrolysis cell.

Figure 12



0 5 . 1 Complete the sentence.

[1 mark]

The extraction of aluminium is expensive because the process uses

large amounts of _____ .

0 5 . 2 Oxygen is produced at the positive carbon electrodes.

The oxygen reacts with the carbon electrodes.

Which gas is produced when oxygen reacts with the positive carbon electrodes?

[1 mark]

_____

Do not write outside the box

Titanium is extracted from titanium chloride by reacting titanium chloride with sodium.

The reaction between titanium chloride and sodium is carried out in an inert atmosphere.

0 5 . 3 Suggest why the reaction is carried out in an inert atmosphere.

[1 mark]

0 5 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

argon	**chlorine**	**hydrogen**

The gas used for the inert atmosphere is _____ .

0 5 . 5 Balance the equation for the reaction.

[1 mark]

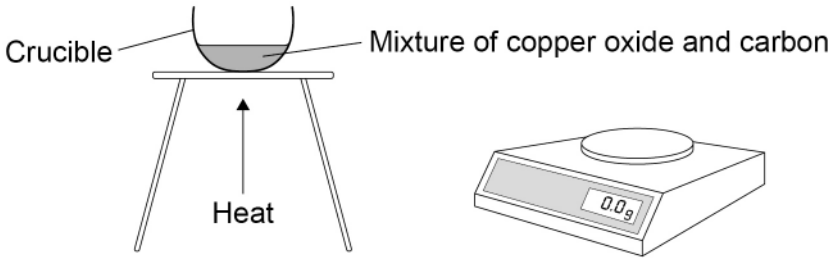
$$TiCl_4 + 4\,Na \rightarrow Ti + ____\ NaCl$$

Do not write outside the box

Copper is extracted from copper oxide by reacting copper oxide with carbon.

Figure 13 shows the apparatus.

Figure 13



The equation for the reaction is:

$$2\,CuO(s) + C(s) \rightarrow 2\,Cu(s) + CO_2(g)$$

In an experiment 15.9 g of copper oxide and 1.2 g of carbon reacted.

12.7 g of copper was produced in the reaction.

0 5 . 6 Calculate the mass of carbon dioxide produced in this experiment.

[1 mark]

Mass of carbon dioxide = _____ g

0 5 . 7 Explain why the mass of the contents in the crucible changed during the experiment.

[2 marks]

Do not write outside the box

0 5 . 8 What happens to copper oxide in the reaction?

Give **one** reason for your answer.

Use the equation for the reaction.

[2 marks]

Tick (✓) **one** box.

The copper oxide is dissolved ☐

The copper oxide is oxidised ☐

The copper oxide is reduced ☐

Reason _____

_____

10

Turn over for the next question

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0 6 This question is about carbon dioxide.

Carbon dioxide is soluble in water and forms an acidic solution.

0 6 . 1 Which ion makes the solution acidic?

[1 mark]

_____

0 6 . 2 Name an indicator that could be used to test if the solution is acidic.

Give the result of the test.

[2 marks]

Indicator _____

Result _____

_____

Question 6 continues on the next page

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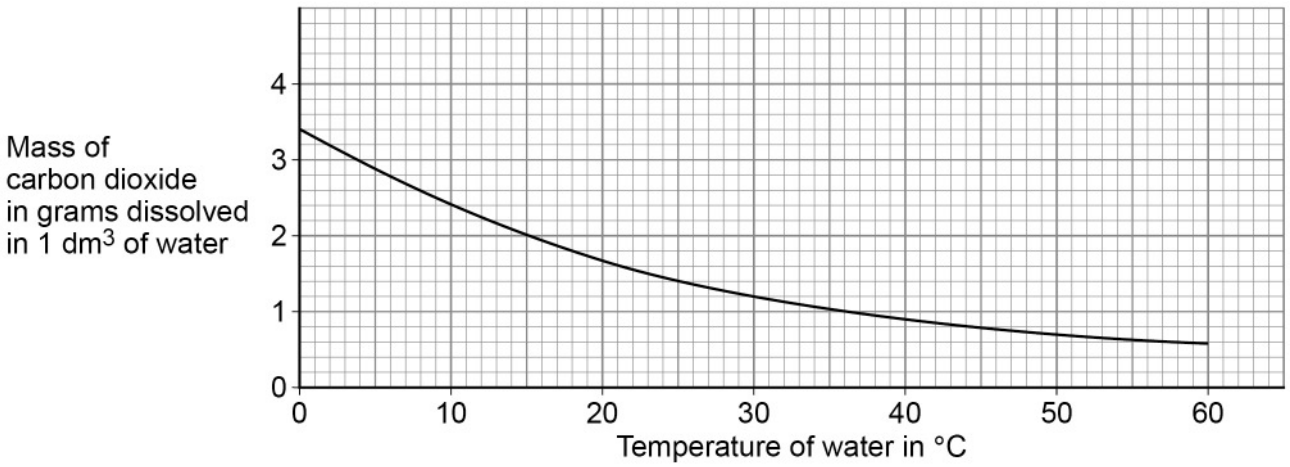
Figure 14 shows the mass of carbon dioxide that will dissolve in 1 dm^3 of water at different temperatures.

Figure 14



0 6 . 3 How does the solubility of carbon dioxide change as the temperature of the water increases?

[1 mark]

Tick (✓) **one** box.

The solubility decreases ☐

The solubility does not change ☐

The solubility increases ☐

Do not write outside the box

0 6 . 4 Carbon dioxide dissolves in water to form an acidic solution.

How does the pH of the solution change as the temperature of the water increases?

Use **Figure 14**.

[1 mark]

Tick (✓) **one** box.

pH of the solution decreases ☐

pH of the solution does not change ☐

pH of the solution increases ☐

Calcium carbonate reacts with hydrochloric acid to produce carbon dioxide.

The equation for the reaction is:

$$CaCO_3(s) + 2\,HCl(aq) \longrightarrow CaCl_2(aq) + CO_2(g) + H_2O(\mathbf{x})$$

0 6 . 5 What is the state symbol (**x**) in the equation?

[1 mark]

Tick (✓) **one** box.

(aq) ☐ (g) ☐ (l) ☐ (s) ☐

Question 6 continues on the next page

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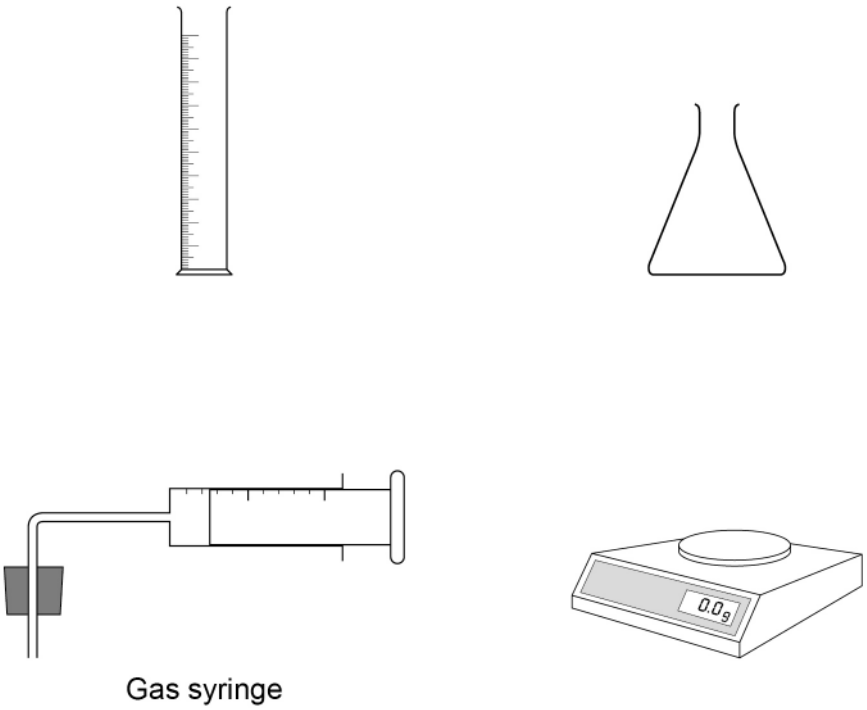
0 6 . 6 **Figure 15** shows equipment a student used for an investigation.

Figure 15



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The student investigated the volume of carbon dioxide produced when different masses of calcium carbonate react with hydrochloric acid.

Describe a method the student could use.

[6 marks]

12

Turn over for the next question

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0 7 Lithium hydroxide reacts with sulfuric acid to produce lithium sulfate.

The equation for the reaction is:

$$2\,LiOH + H_2SO_4 \longrightarrow Li_2SO_4 + 2\,H_2O$$

0 7 . 1 What type of reaction is this?

[1 mark]

0 7 . 2 Calculate the relative formula mass (M_r) of sulfuric acid (H_2SO_4).

Relative atomic masses (A_r): H = 1 O = 16 S = 32

[2 marks]

Relative formula mass (M_r) = _____

Do not write outside the box

0 7 . 3 Calculate the percentage by mass of oxygen in lithium sulfate (Li_2SO_4).

Relative atomic mass (A_r): O = 16

Relative formula mass (M_r): Li_2SO_4 = 110

Give your answer to 2 significant figures.

[4 marks]

Percentage by mass of oxygen (2 significant figures) = _____ %

0 7 . 4 A solution of lithium sulfate contains 0.30 g of lithium sulfate in 25 cm^3.

Calculate the concentration of lithium sulfate in g/dm^3.

[3 marks]

Concentration = _____ g/dm^3

10

END OF QUESTIONS

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