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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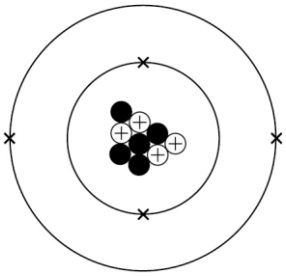
0 1 All substances are made from atoms.

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?

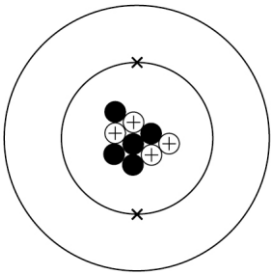
[2 marks]

Number of protons 4

Number of neutrons 5

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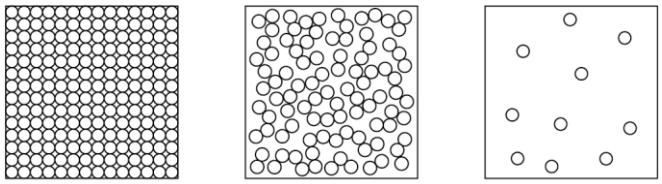
Figure 3 shows the arrangement of atoms in the three states of matter.

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]

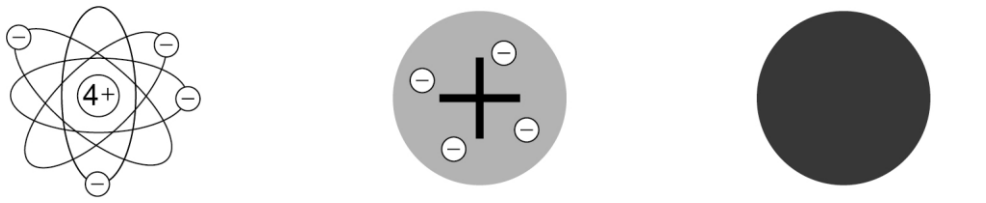
heat

Question 1 continues on the next page

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

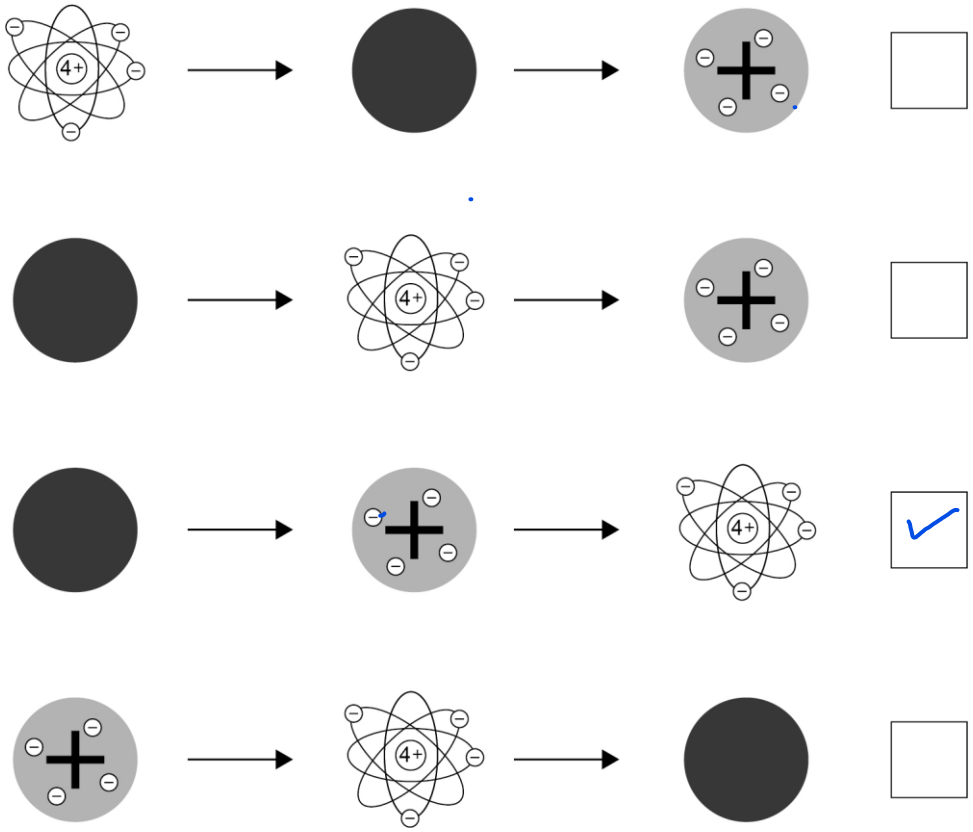


Nuclear model **Plum pudding model** **Tiny spheres model**

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 chadwick .

8

Turn over for the next question

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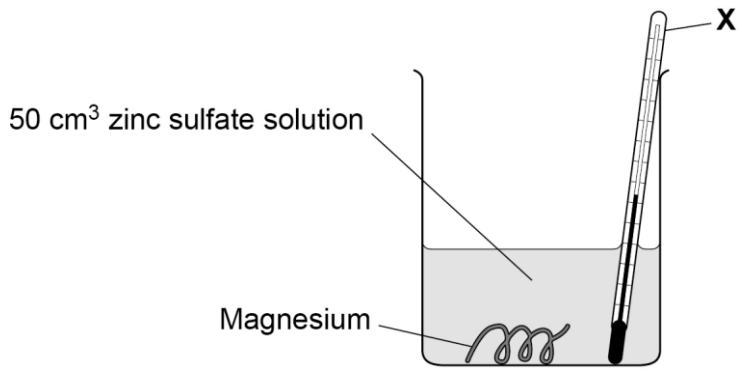
0 2 A student investigated the temperature change when magnesium was added to zinc sulfate solution.

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 ☑

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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 =) $\frac{7.6 + 7.3 + 7.6}{3}$

= 7.5 (°C)

Y = 7.5 °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 =) $\frac{0.40}{1.2} \times 9.0$

= 3.0 (°C)

Temperature increase = 3.0 °C

Turn over ►

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]

copper did not react (with zinc sulfate)

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 ☑

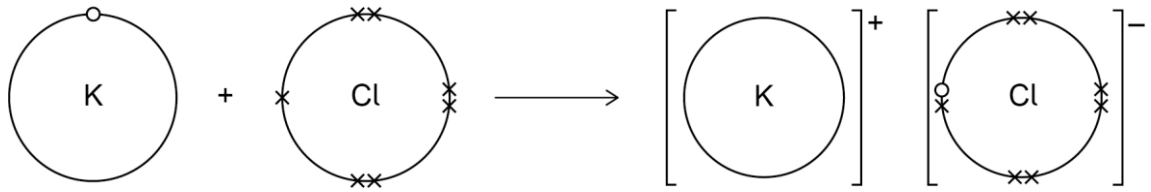
Question 3 continues on the next page

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]

potassium (atoms) lose electrons

chlorine (atoms) gain electrons reference to one electron

• to form ions

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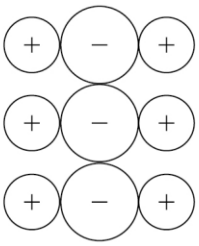
0 3 . 3 In solid ionic compounds, oppositely charged ions attract to form a giant structure.

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

[1 mark]

Tick (✓) **one** box.



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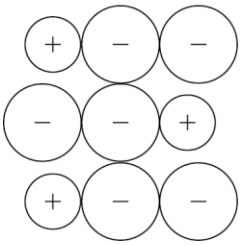

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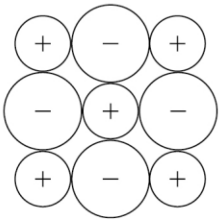


☑

Question 3 continues on the next page

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

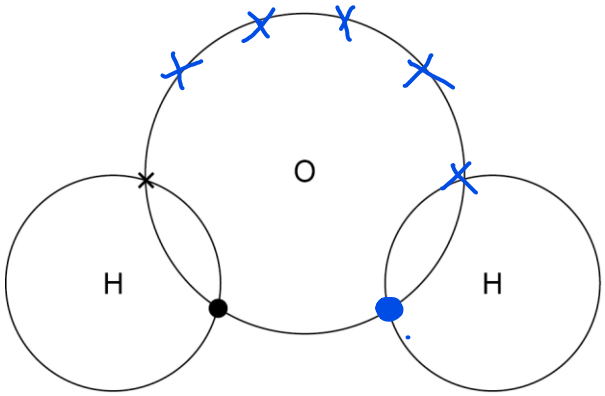
Figure 7 shows part of a dot and cross diagram for a molecule of water.

Complete the dot and cross diagram.

You should only show electrons in the outer shells.

[2 marks]

Figure 7



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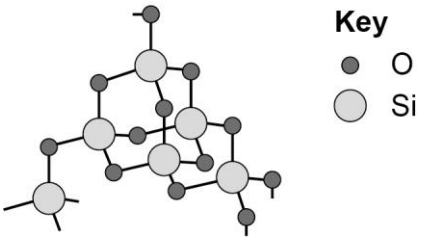
0 3 . 5 Silica has a giant covalent structure.

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**.

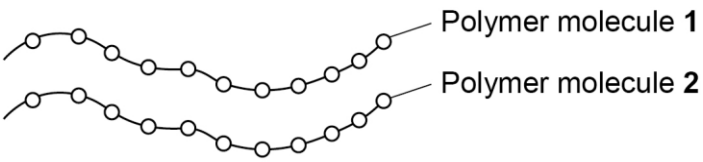
[1 mark]

1 Si : 2 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 ►

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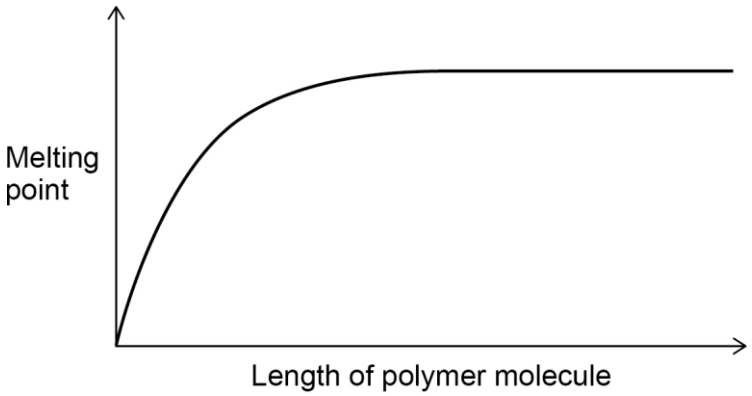
0 3 . 7 **Figure 10** shows the melting point of a polymer as the length of the polymer molecule increases.

Figure 10



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

[3 marks]

the melting point increases as the length of the polymer molecule increases

(then the) melting point levels off (as the polymer molecule length increases)

13

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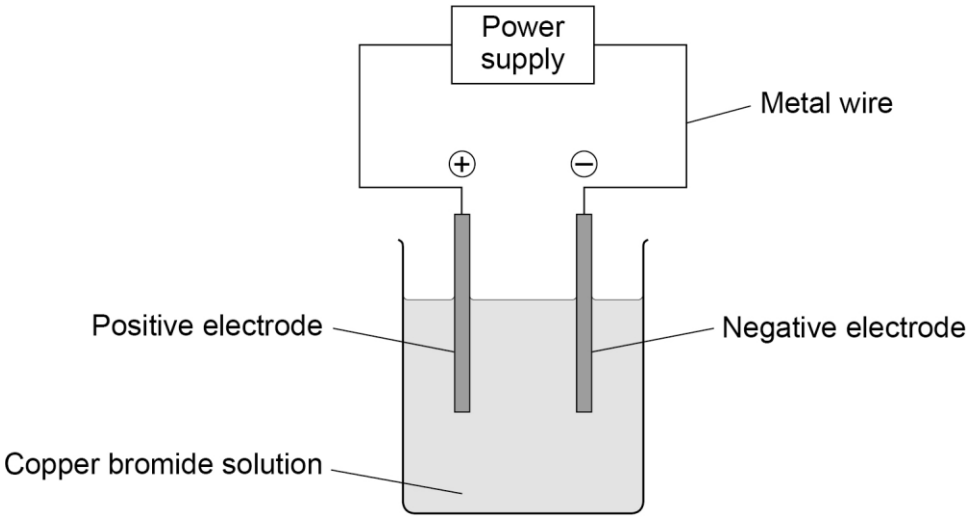
0 4 Copper bromide solution is electrolysed using inert electrodes.

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

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 → hydrogen ion + hydroxide 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 ☐
- $CuBr_2$ ☑

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

[2 marks]

copper ions are positively charged

so are attracted to the negative electrode

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 discharged .

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

[1 mark]

Tick (✓) **one** box.

- Decreases ☐
- No change ☐
- Increases ☑

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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ANSWER IN THE SPACES PROVIDED

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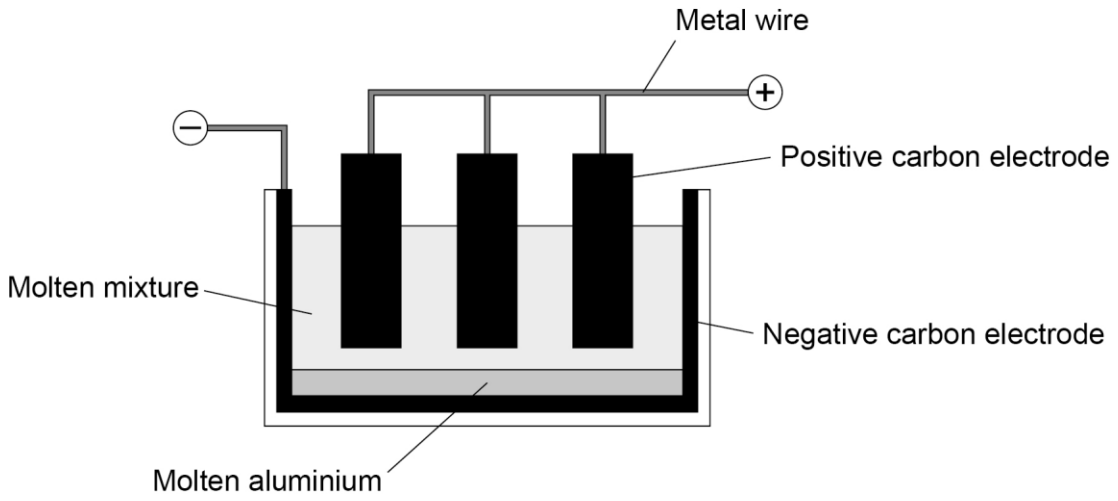
0 5 This question is about extraction of metals.

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 energy .

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]

carbon dioxide

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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]

sodium reacts with air

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 argon .

0 5 . 5 Balance the equation for the reaction.

[1 mark]

$$TiCl_4 + 4\,Na \rightarrow Ti + \underline{4}\ NaCl$$

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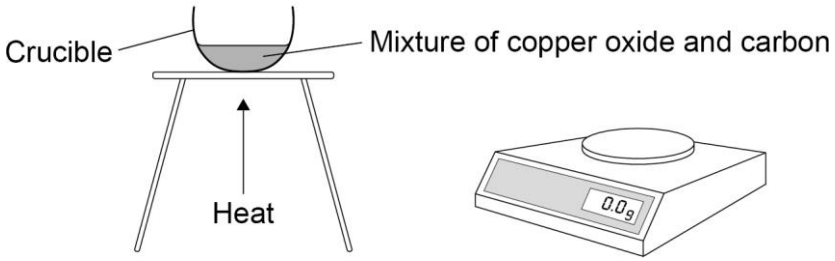
Copper is extracted from copper oxide by reacting copper oxide with carbon.

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]

4.4 (g)

Mass of carbon dioxide = _____ g

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

[2 marks]

the mass decreased because carbon dioxide escapes into the atmosphere

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 copper oxide loses oxygen

10

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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]

hydrogen / H+

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 universal

Result green to red / orange / yellow

Question 6 continues on the next page

Turn over ►

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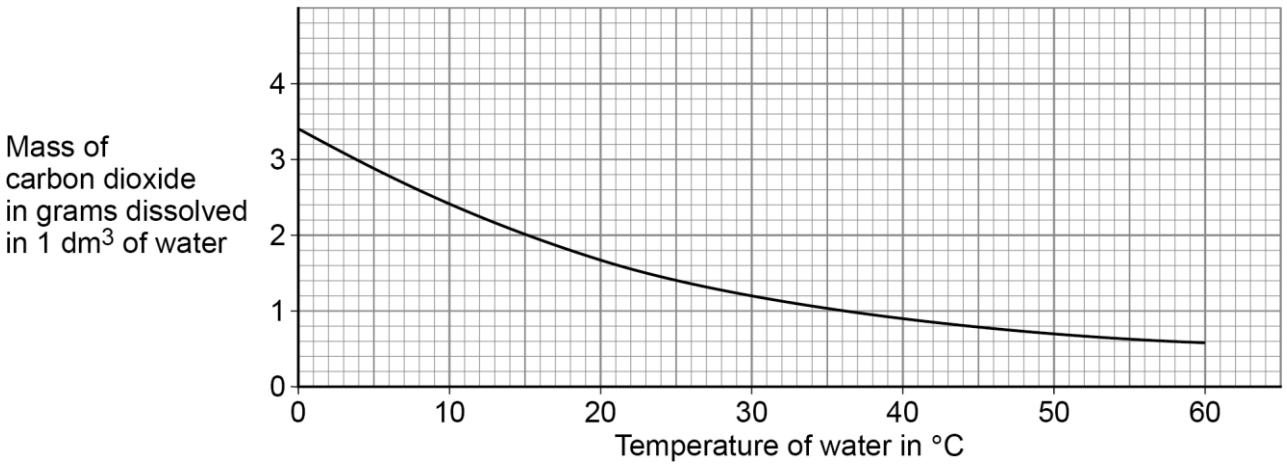
Figure 14 shows the mass of carbon dioxide that will dissolve in 1 dm^3 of water at different temperatures.

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

Turn over ►

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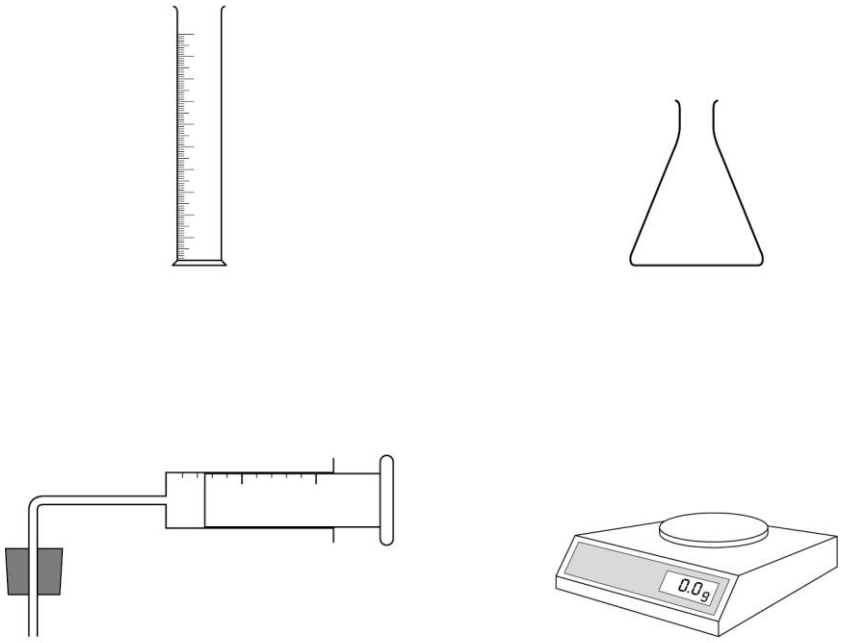
0 6 . 6 **Figure 15** shows equipment a student used for an investigation.

Figure 15



Gas syringe

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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]

- measure a stated mass of calcium carbonate
- use a balance
- add calcium carbonate into a conical flask
- measure a stated volume of hydrochloric acid
- use a measuring cylinder
- add hydrochloric acid to the conical flask
- immediately place the stopper and delivery tube in the conical flask
- record the total volume of carbon dioxide gas
- collected in the gas syringe
- repeat method with different masses of calcium carbonate

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]

neutralisation

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]

Mr = (1 × 2) + 32 + (4 × 16)
= 98

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]

4 × 16 = 64

(percentage of oxygen =) $\frac{64}{110} \times 100$

= 58.18

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]

(unit conversion) (25 cm3 ÷ 1000) = 0.025 dm3

(conc =) $\frac{0.30}{0.025}$

= 12 (g/dm3)

Concentration = _____ g/dm^3

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