

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.

## 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	
<b>TOTAL</b>	



J U N 2 3 8 4 6 4 C 1 F 0 1

**There are no questions printed on this page**

*Do not write  
outside the  
box*

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**



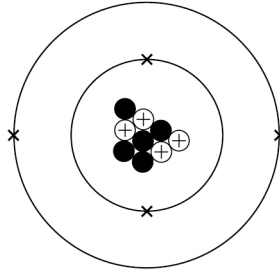
0 1

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]**

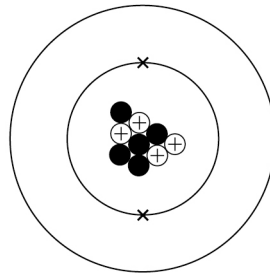
Number of protons \_\_\_\_\_

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.

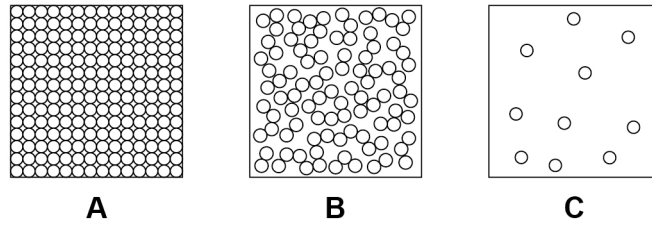
0       +1       +2

Turn over ►



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



**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**

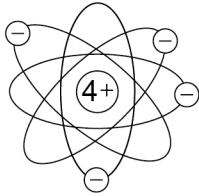
**Turn over ►**



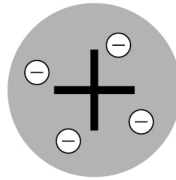
Experimental evidence led to the scientific model of the atom changing over time.

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

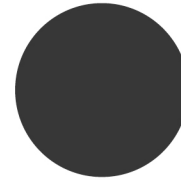
**Figure 4**



**Nuclear model**



**Plum pudding model**

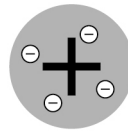
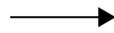
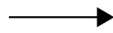
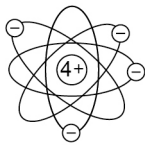


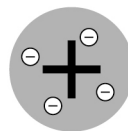
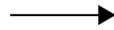
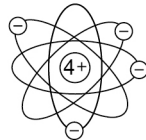
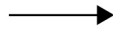
**Tiny spheres model**

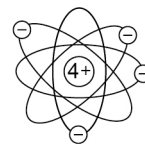
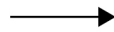
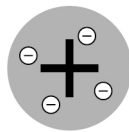
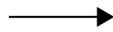
What is the order for the development of the model of the atom?

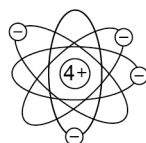
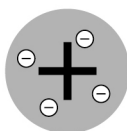
**[1 mark]**

Tick (✓) **one** box.











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

Turn over ►

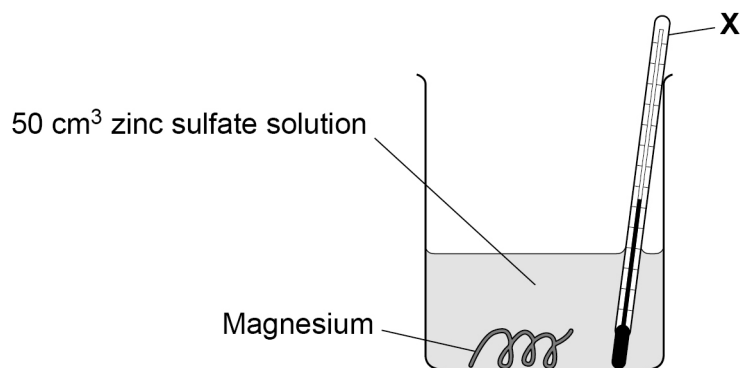


0 2

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





The student added 1.0 g of magnesium to 50 cm<sup>3</sup> 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<sup>3</sup> 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<sup>3</sup> of zinc sulfate solution.

**[2 marks]**

---



---



---

Temperature increase = \_\_\_\_\_ °C

**Turn over ►**



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<sup>3</sup> of zinc sulfate solution.

The temperature did **not** increase.

Give **one** reason why.

[1 mark]

---

---

8



**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

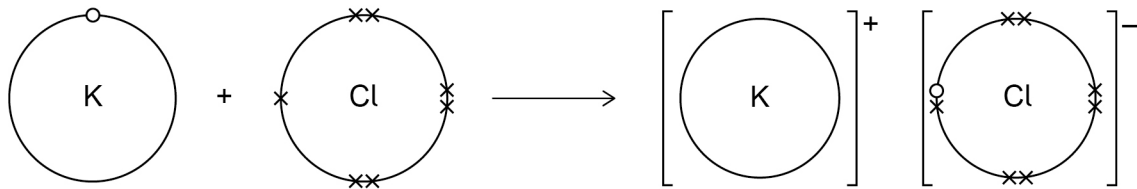
**Question 3 continues on the next page****Turn over ►**

**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 (x) 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]**

---



---



---



---



---



---



---



---



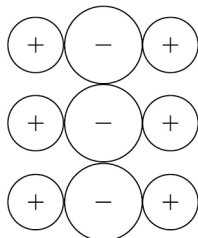
0 3 . 3

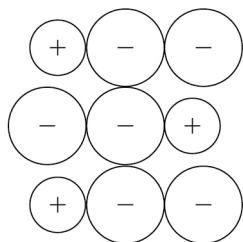
In solid ionic compounds, oppositely charged ions attract to form a giant structure.

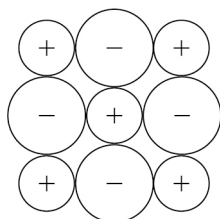
Which structure represents the arrangement of ions in solid potassium chloride?

[1 mark]

Tick (✓) **one** box.








Question 3 continues on the next page

Turn over ►



Non-metal atoms share electrons to form covalent bonds.

**0 3 . 4** Water ( $\text{H}_2\text{O}$ ) 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

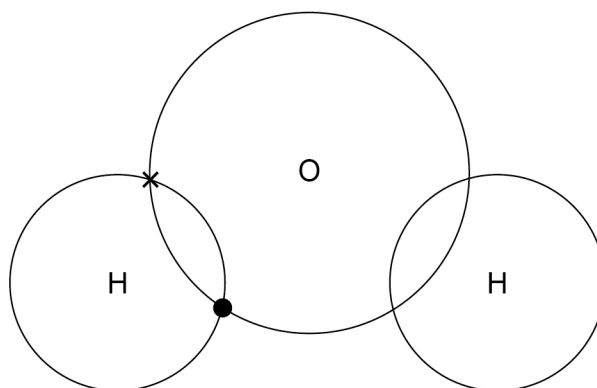
**Figure 7** shows part of a dot and cross diagram for a molecule of water.

Complete the dot and cross diagram.

You should only show electrons in the outer shells.

**[2 marks]**

**Figure 7**



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]

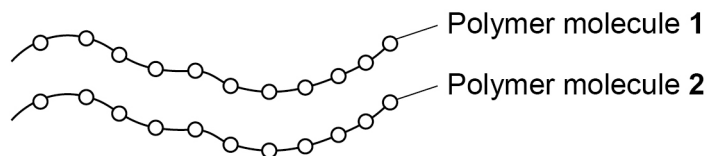
\_\_\_\_\_ Si : \_\_\_\_\_ O

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

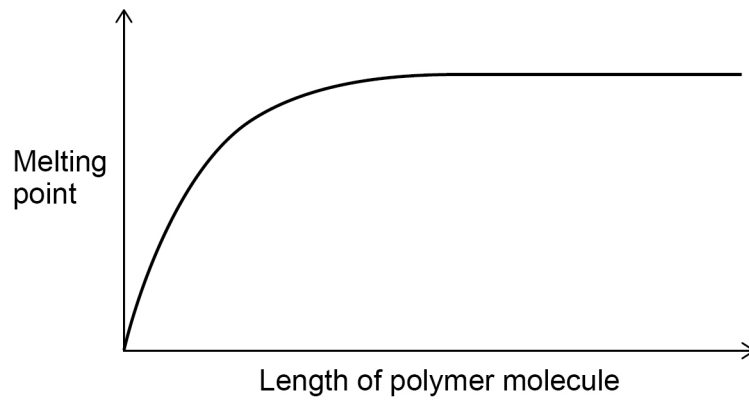
Turn over ►



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



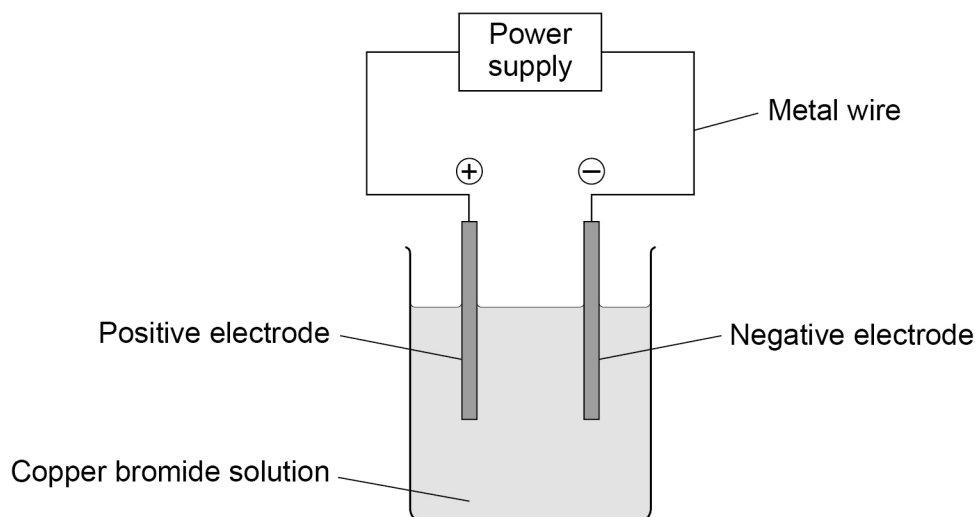


0 4

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

Turn over ►



There are four ions in copper bromide solution:

- $\text{Cu}^{2+}$
- $\text{Br}^-$
- $\text{H}^+$
- $\text{OH}^-$

**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:



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

**[2 marks]**

water  $\rightarrow$  \_\_\_\_\_ ion + \_\_\_\_\_ ion

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

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

The formula of a bromide ion is  $\text{Br}^-$

What is the formula of copper bromide?

**[1 mark]**

Tick (✓) **one** box.

CuBr

$\text{Cu}_2\text{Br}$

$\text{CuBr}_2$



0 4 . 4 Explain why copper ions ( $\text{Cu}^{2+}$ ) 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 ►



There are four ions in copper bromide solution:

- $\text{Cu}^{2+}$
- $\text{Br}^-$
- $\text{H}^+$
- $\text{OH}^-$

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



**Turn over for the next question**

*Do not write  
outside the  
box*

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**

**Turn over ►**



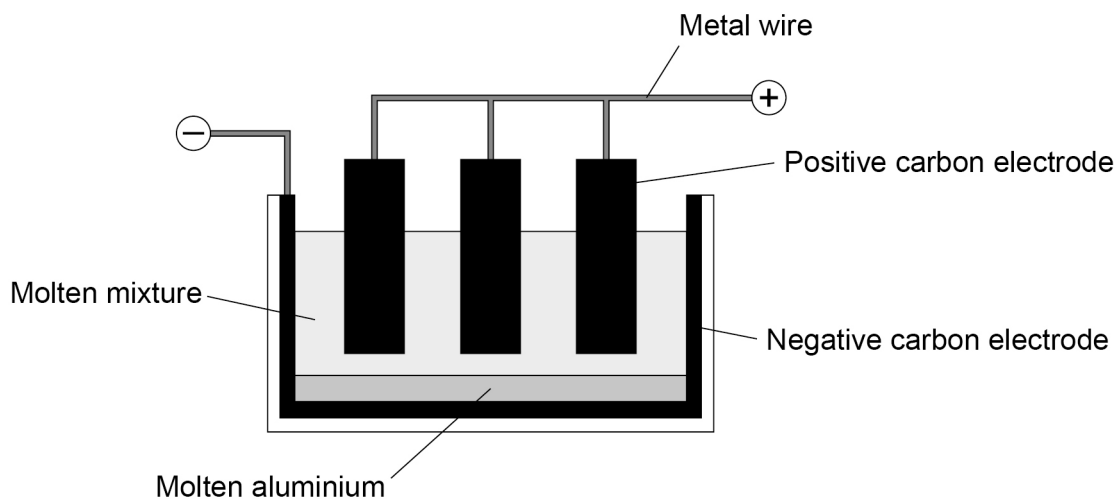
0 5

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]

\_\_\_\_\_



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]

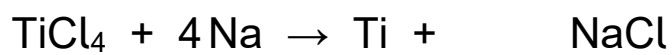
argon	chlorine	hydrogen
-------	----------	----------

The gas used for the inert atmosphere is \_\_\_\_\_.

0 5 . 5

Balance the equation for the reaction.

[1 mark]



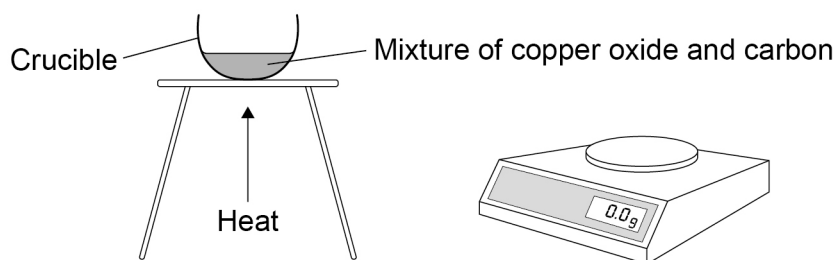
Turn over ►



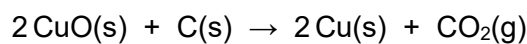
Copper is extracted from copper oxide by reacting copper oxide with carbon.

Figure 13 shows the apparatus.

Figure 13



The equation for the reaction is:



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]

---



---



---



---





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

Turn over ►



**There are no questions printed on this page**

*Do not write  
outside the  
box*

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**



**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 \_\_\_\_\_

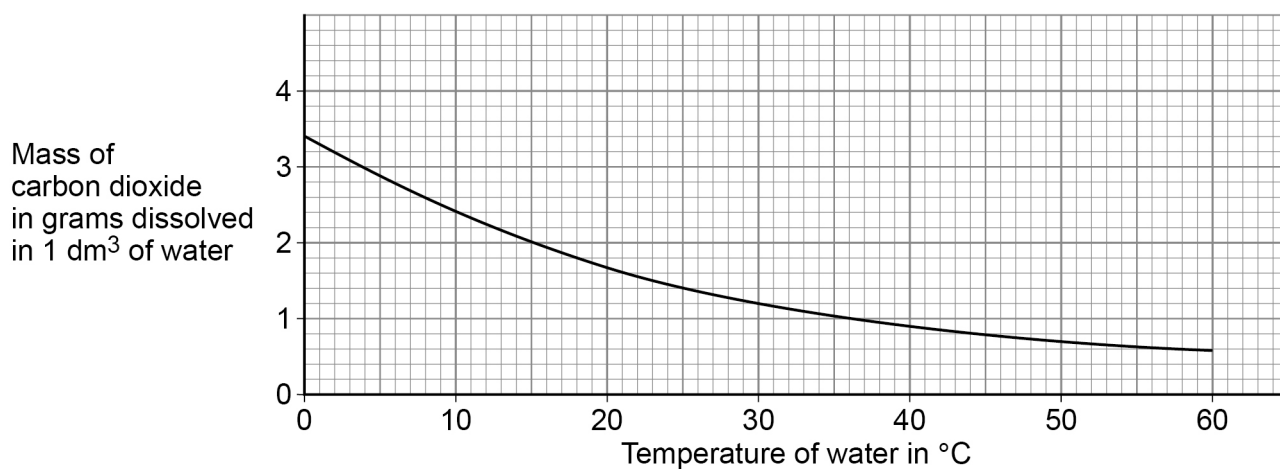
---

**Question 6 continues on the next page**

**Turn over ►**

**Figure 14** shows the mass of carbon dioxide that will dissolve in 1 dm<sup>3</sup> 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



**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.

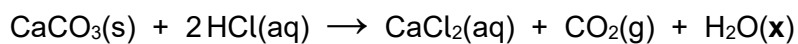
pH of the solution decreases

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:



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

**[1 mark]**

Tick (✓) **one** box.

(aq)

(g)

(l)

(s)

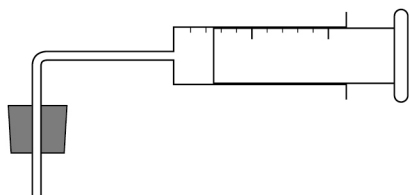
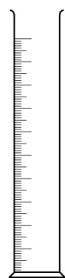
**Question 6 continues on the next page**

**Turn over ►**

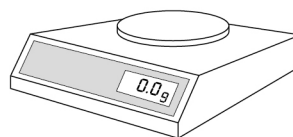


0 6 . 6 Figure 15 shows equipment a student used for an investigation.

Figure 15



Gas syringe



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**

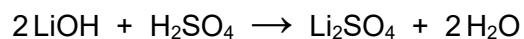
**Turn over ►**



**0 7**

Lithium hydroxide reacts with sulfuric acid to produce lithium sulfate.

The equation for the reaction is:

**0 7 . 1**

What type of reaction is this?

**[1 mark]**

---

**0 7 . 2**

Calculate the relative formula mass ( $M_r$ ) of sulfuric acid ( $\text{H}_2\text{SO}_4$ ).

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

**[2 marks]**

---

---

---

Relative formula mass ( $M_r$ ) = \_\_\_\_\_





**0 7 . 3** Calculate the percentage by mass of oxygen in lithium sulfate ( $\text{Li}_2\text{SO}_4$ ).

Relative atomic mass ( $A_r$ ): O = 16

Relative formula mass ( $M_r$ ):  $\text{Li}_2\text{SO}_4 = 110$

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  $25 \text{ cm}^3$ .

Calculate the concentration of lithium sulfate in  $\text{g/dm}^3$ .

**[3 marks]**

---

---

---

---

---

---

Concentration = \_\_\_\_\_  $\text{g/dm}^3$

**10**

**END OF QUESTIONS**



**There are no questions printed on this page**

*Do not write  
outside the  
box*

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**





