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

Thursday 14 May 2020 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	
8	
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.

Do not write outside the box

0 1 This question is about acids and bases.

0 1 . 1 What is the pH of sulfuric acid?

[1 mark]

Tick (✓) **one** box.

1 ☑ 7 ☐ 14 ☐

0 1 . 2 An acid reacts with zinc to produce zinc chloride and hydrogen.

Which acid reacts with zinc to produce zinc chloride?

[1 mark]

Tick (✓) **one** box.

Hydrochloric acid ☑

Nitric acid ☐

Sulfuric acid ☐

0 1 . 3 What type of substance is zinc chloride?

[1 mark]

Tick (✓) **one** box.

Alkali ☐ Base ☐ Salt ☑

Do not write outside the box

0 1 . 4 An alkali is a base in solution.

Which compound is an alkali?

[1 mark]

Tick (✓) **one** box.

Sodium hydroxide ☑

Sodium nitrate ☐

Sodium sulfate ☐

0 1 . 5 The formula of the copper ion is Cu^{2+}

The formula of the oxide ion is O^{2-}

What is the formula of copper oxide?

[1 mark]

Tick (✓) **one** box.

Cu_2O_2 ☐ CuO_2 ☐ CuO ☑

Question 1 continues on the next page

A student reacts an acid with copper oxide.

0 1 . 6 The reaction between the acid and copper oxide is very slow at room temperature.

How could the student speed up the reaction?

[1 mark]

• increase the concentration of the acid

0 1 . 7 Complete the sentence to show how the student makes sure that **all** the acid reacts.

Choose the answer from the box.

[1 mark]

in excess	**in solution**	**molten**	**soluble**

The student adds copper oxide to the acid until the

copper oxide is in excess .

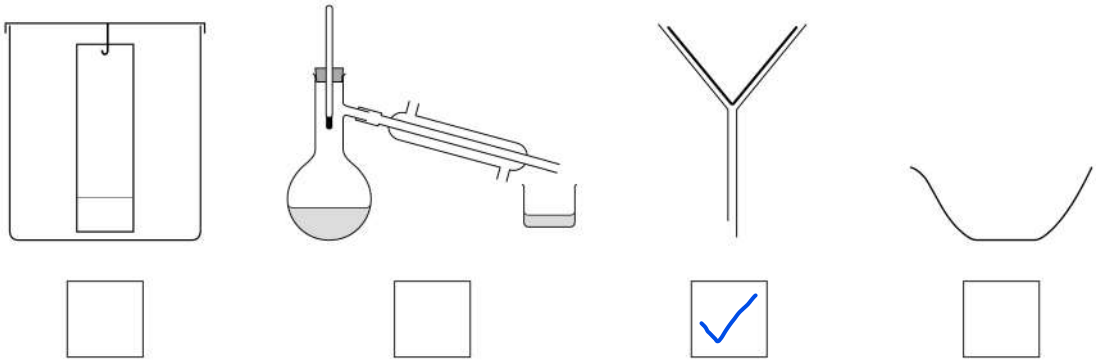
Do not write outside the box

0 1 . 8 The student filters the unreacted copper oxide from the solution.

Which apparatus does the student use?

[1 mark]

Tick (✓) **one** box.



☐ ☐ ☑ ☐

0 1 . 9 What process is used to produce crystals of a salt from a salt solution?

[1 mark]

crystallisation

9

Turn over for the next question

Do not write outside the box

0 2 A student investigated the temperature change when metal **X** was added to copper sulfate solution.

This is the method used.

1. Add 25 cm^3 of copper sulfate solution to a beaker.

2. Measure the temperature of the copper sulfate solution.

3. Add 1.0 g of metal **X** and stir.

4. Measure the highest temperature reached when metal **X** is added to copper sulfate solution.

5. Repeat steps 1 to 4 with different metals.

Figure 1 shows the apparatus used.

Figure 1

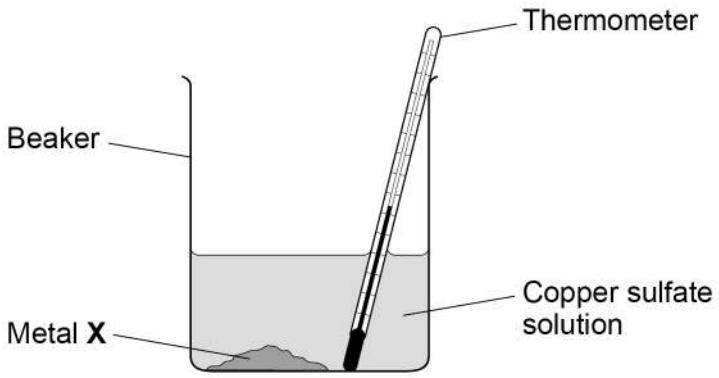
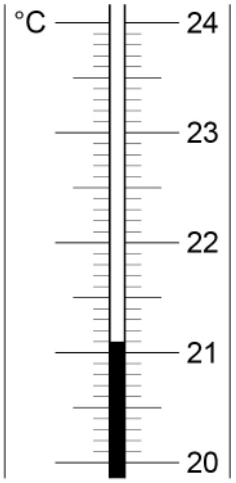


Figure 2 shows the thermometer reading of the copper sulfate solution at the start of the investigation.

Figure 2



Do not write outside the box

0 2 . 1 The highest temperature reached when metal **X** was added to copper sulfate solution was 35.5 °C

Determine the temperature change when metal **X** is added to copper sulfate solution.

Use **Figure 2**.

[2 marks]

Highest temperature = 35.5 °C

Temperature at start = 21.1 °C

Temperature change = 14.4 °C

0 2 . 2 Give **two** variables the student should keep the same in this investigation.

[2 marks]

1 surface area of metal

• 25 cm3 / volume of copper sulfate solution

2

0 2 . 3 The student repeated the experiment with metal **Y**.

Table 1 shows four results for metal **Y**.

Table 1

	Test 1	Test 2	Test 3	Test 4
Temperature change in °C	9.2	7.3	9.5	9.2

Calculate the mean temperature change for metal **Y**.

Do **not** include the anomalous result in your calculation.

[2 marks]

$\frac{9.2 + 9.5 + 9.2}{3}$ or $\frac{27.9}{3}$

= 9.3 (°C)

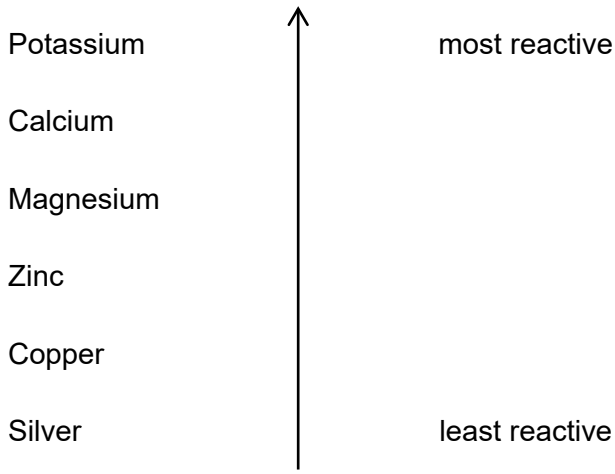
Mean temperature change = 9.3 °C

Turn over ►

The more reactive the metal added to copper sulfate solution, the greater the temperature change.

Figure 3 shows a reactivity series.

Figure 3



0 2 . 4 The student repeated the experiment.

The student added:

- magnesium to copper sulfate solution
- an unknown metal **A** to copper sulfate solution.

Table 2 shows the results.

Table 2

Metal	**Temperature change in °C**
Magnesium	12
Metal **A**	8

The student concludes metal **A** is zinc.

Give **one** reason why the student is correct.

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

[1 mark]

(metal A / zinc) is less reactive (than magnesium)

Do not write outside the box

0 2 . 5 The student did the experiment with silver and copper sulfate solution.

What happens to the temperature of the mixture?

Use **Figure 3**.

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Increases ☐

Stays the same ☑

0 2 . 6 Suggest **one** reason why the student should **not** add potassium metal to copper sulfate solution.

[1 mark]

too dangerous
or
too reactive

0 2 . 7 100 cm^3 of the copper sulfate solution contains 1.8 g of copper sulfate.

Calculate the mass of copper sulfate in 25 cm^3 of this copper sulfate solution.

[2 marks]

$\frac{25}{100} \times 1.8$

or

$\frac{1}{4} \times 1.8$

Mass = 0.45 g

11

Turn over for the next question

Do not write outside the box

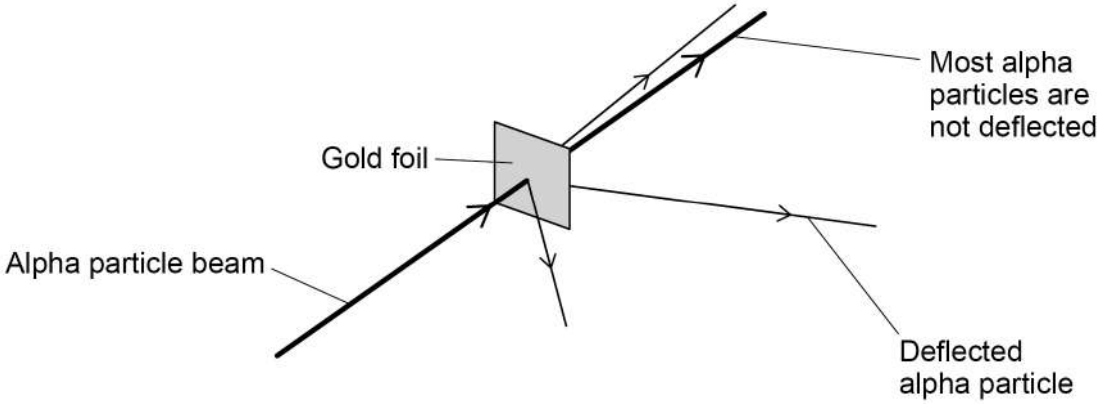
0 3 This question is about gold and compounds of gold.

In the alpha particle scattering experiment alpha particles are fired at gold foil.

Alpha particles are positively charged.

Figure 4 shows the results.

Figure 4



0 3 . 1 Some alpha particles are deflected.

Complete the sentence.

Choose the answer from the box.

[1 mark]

negatively charged	**not charged**	**positively charged**

Some alpha particles are deflected because

the nucleus of the atom is positively charged.

Do not write outside the box

0 3 . 2 Why are most alpha particles **not** deflected?

[1 mark]

Tick (✓) **one** box.

The atom is a tiny sphere that cannot be divided. ☐

The atom is mainly empty space. ☑

The electrons orbit the nucleus at specific distances. ☐

0 3 . 3 What was **one** conclusion from the alpha particle scattering experiment?

[1 mark]

Tick (✓) **one** box.

The mass is concentrated at the centre of the atom. ☑

The mass is concentrated at the edge of the atom. ☐

The mass is spread evenly throughout the atom. ☐

Gold reacts with the elements in Group 7 of the periodic table.

0 3 . 4 What are Group 7 elements known as?

[1 mark]

Tick (✓) **one** box.

Alkali metals ☐

Halogens ☑

Noble gases ☐

Do not write outside the box

0 3 . 5 Fluorine, chlorine and bromine react with gold.

Which element will be the most reactive with gold?

[1 mark]

Tick (✓) **one** box.

Fluorine ☑ Chlorine ☐ Bromine ☐

0 3 . 6 3.94 g of gold reacts with chlorine to produce 6.07 g of gold chloride.

The word equation for the reaction is:

gold + chlorine → gold chloride

Calculate the mass of chlorine that reacts with 3.94 g of gold.

[1 mark]

2.13 (g)

Mass = 2.13 (g) g

0 3 . 7 Calculate the relative formula mass (M_r) of gold chloride ($AuCl_3$).

Relative atomic masses (A_r): Cl = 35.5 Au = 197

[2 marks]

197 + (3 × 35.5)

or

197 + 106.5

Relative formula mass (M_r) = 303.5

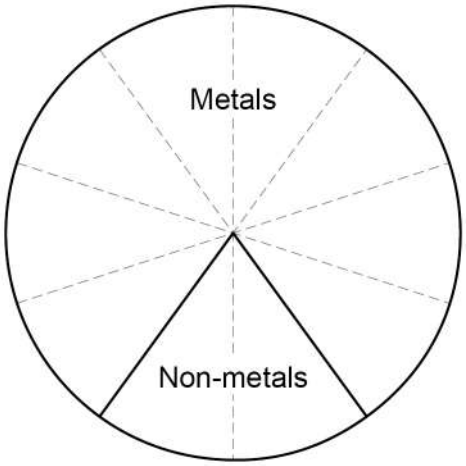
8

Do not write outside the box

0 4 This question is about elements and compounds.

0 4 . 1 **Figure 5** shows the proportion of elements in the periodic table that are metals and non-metals.

Figure 5



Determine the percentage of the elements in **Figure 5** that are metals.

[2 marks]

$\frac{8}{10} \times 100$

or 0.8×100

Percentage = 80 %

0 4 . 2 Give **two** physical properties of metals.

[2 marks]

1 conducts electricity

2 • conducts thermal energy

0 4 . 3 Sodium reacts with chlorine to produce sodium chloride.

Balance the equation for the reaction.

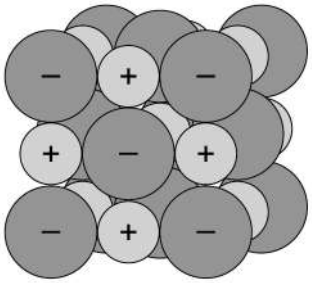
[1 mark]

$2\ Na + Cl_2 \rightarrow 2\ NaCl$

Do not write outside the box

Figure 6 shows part of the structure of sodium chloride (NaCl).

Figure 6



Sodium chloride

0 4 . 4 What holds the particles together in sodium chloride?

Use **Figure 6**.

[1 mark]

Tick (✓) **one** box.

Electrostatic attractions ✓

Intermolecular forces

Metallic bonds

0 4 . 5 Solid sodium chloride does not conduct electricity.

Give **two** ways in which sodium chloride can be made to conduct electricity.

[2 marks]

1 (heat sodium chloride until) molten / liquid

2 dissolve in water

8

Do not write outside the box

0 5 This question is about elements in the periodic table.

0 5 . 1 What property was used to arrange elements in early periodic tables?

[1 mark]

Tick (✓) **one** box.

Atomic number ☐

Atomic weight ☑

Mass number ☐

0 5 . 2 In early periodic tables, iodine (I) was placed before tellurium (Te).

Mendeleev placed iodine after tellurium.

Figure 7 shows part of Mendeleev's periodic table.

Figure 7

16 **O**	19 **F**
32 **S**	35.5 **Cl**
79 **Se**	80 **Br**
128 **Te**	127 **I**

Suggest **one** reason why Mendeleev placed iodine in the column shown in **Figure 7**.

[1 mark]

(because) properties were similar

Do not write outside the box

Table 3 shows the melting points of three Group 1 metals.

Table 3

Metal	Melting point in °C
Lithium	180
Sodium	98
Potassium	63

0 5 . 3 What state is lithium at 100 °C?

Use **Table 3**.

[1 mark]

Tick (✓) **one** box.

Gas ☐ Liquid ☐ Solid ☑

0 5 . 4 Complete the graph in **Figure 8**.

Use **Table 3**.

You should:

- complete the scale on the y-axis
- draw bars to show the melting points of sodium and potassium.

[3 marks]

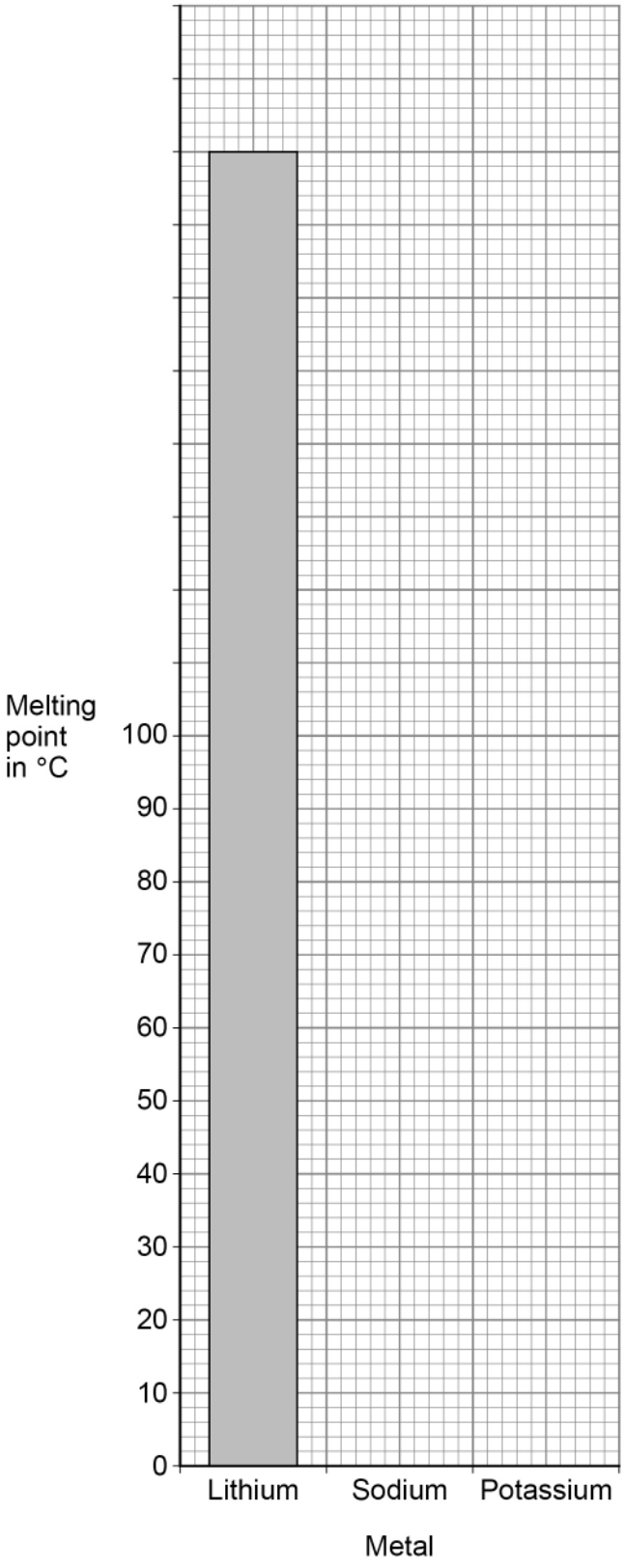
scale on the y-axis up to 180

bar for sodium at 98 (oC)

bar for potassium at 63 (oC)

Do not write outside the box

Figure 8



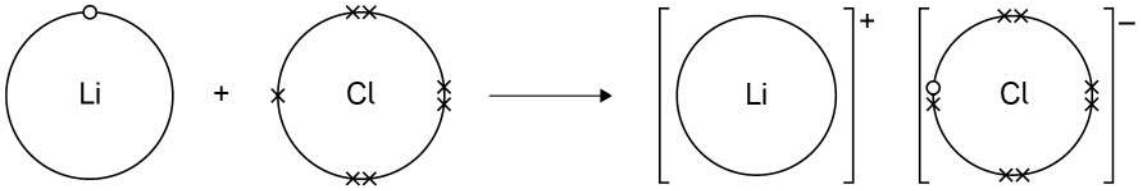
Do not write outside the box

0 5 . 5 Lithium reacts with chlorine to produce lithium chloride.

Figure 9 shows what happens to the electrons in the outer shells when a lithium atom reacts with a chlorine atom.

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

Figure 9



Describe what happens to a lithium atom and to a chlorine atom when they react.

Use **Figure 9** to answer in terms of electrons.

[3 marks]

lithium (atom) loses one electron

chlorine (atom) gains one electron

any one from:

• ions are formed

• lithium forms positive ion

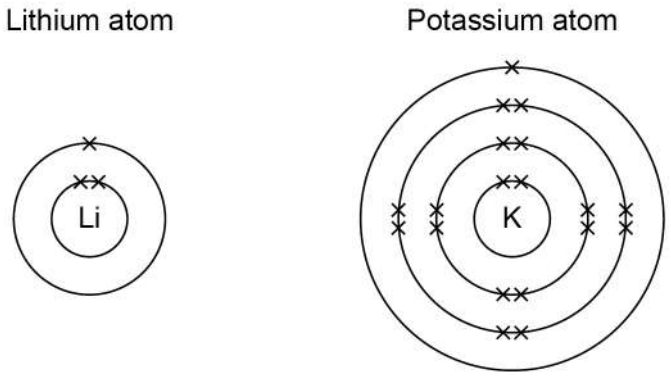
• chlorine forms negative ion

Do not write outside the box

0 5 . 6 Lithium and potassium are in the same group of the periodic table.

Figure 10 represents the electronic structures of a lithium atom and of a potassium atom.

Figure 10



Give **two** reasons why potassium is more reactive than lithium.

[2 marks]

1 reactivity of elements increases going down the group

2 • potassium has more shells

11

Turn over ►

Do not write outside the box

0 6 This question is about the extraction of aluminium.

0 6 . 1 An aluminium atom is represented as:

$$^{27}_{13}Al$$

Give the number of electrons and neutrons in the aluminium atom.

[2 marks]

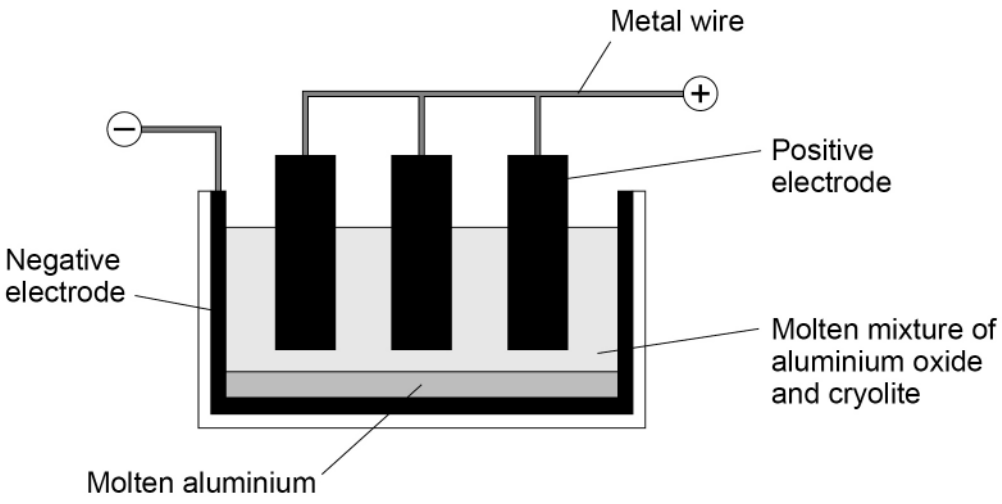
Number of electrons 13

Number of neutrons 14

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

Figure 11 shows the cell used for the electrolysis.

Figure 11



0 6 . 2 Aluminium is produced by the reduction of aluminium oxide (Al_2O_3).

What is meant by the term reduction?

[1 mark]

loss of oxygen

Do not write outside the box

0 6 . 3 Oxygen is formed at the positive carbon electrodes.

Explain why the positive carbon electrodes must be continually replaced.

[3 marks]

at high temperature) oxygen reacts with carbon / electrode

(so the positive) electrode burns / wears away

to produce carbon dioxide

0 6 . 4 A substance conducts electricity because of free moving, charged particles.

What are the free moving, charged particles in a:

- carbon electrode (made from graphite)
- molten mixture of aluminium oxide and cryolite
- metal wire?

[3 marks]

Carbon electrode (made from graphite) (delocalised) electron(s)

Molten mixture of aluminium oxide and cryolite ion(s)

Metal wire (delocalised) electron(s)

9

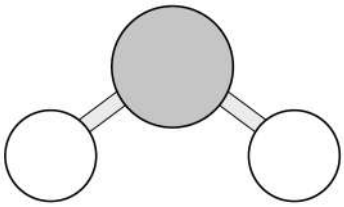
Turn over for the next question

Do not write outside the box

0 7 This question is about substances with covalent bonding.

0 7 . 1 **Figure 12** shows a ball and stick model of a water molecule (H_2O).

Figure 12



Suggest **one** limitation of using a ball and stick model for a water molecule.

[1 mark]

not 3 dimensional / D

0 7 . 2 Ice has a low melting point.

Water molecules in ice are held together by intermolecular forces.

Complete the sentence.

[1 mark]

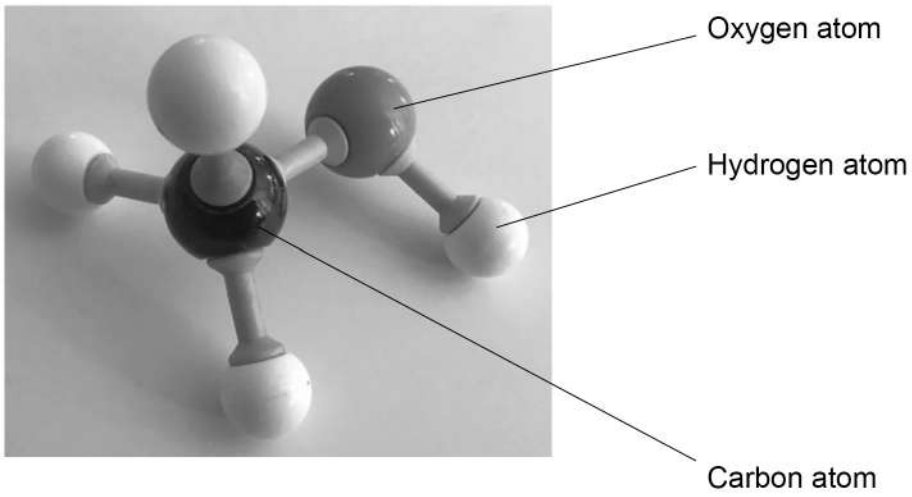
Ice has a low melting point because the

intermolecular forces are weak .

Do not write outside the box

0 7 . 3 **Figure 13** shows the structure of a molecule.

Figure 13



What is the molecular formula of the molecule in **Figure 13**?

[1 mark]

CH4O or CH3OH

Question 7 continues on the next page

Do not write outside the box

Diamond has a giant covalent structure.

0 7 . 4 What is the number of bonds formed by each carbon atom in diamond?

[1 mark]

Tick (✓) **one** box.

2 ☐ 3 ☐ 4 ☑ 8 ☐

0 7 . 5 Give **two** physical properties of diamond.

[2 marks]

1 (very) hard

2 • (very) high melting point

0 7 . 6 Name **two** other substances with giant covalent structures.

[2 marks]

1 (very) hard

2 • (very) high melting point

8

Do not write outside the box

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 8 Some students investigated the thermal decomposition of metal carbonates.

The word equation for the reaction is:

metal carbonate → metal oxide + carbon dioxide

The students made the following hypothesis:

'When heated the same mass of any metal carbonate produces the same mass of carbon dioxide.'

The students heated a test tube containing copper carbonate.

Table 4 shows their results.

Table 4

Time the test tube containing copper carbonate was heated in mins	0	2	4	6
Mass of test tube and contents in g	17.7	17.1	17.0	17.0

Do not write outside the box

Plan a method the students could use to test their hypothesis.

You should show how the students use their results to test the hypothesis.

You do **not** need to write about safety precautions.

[6 marks]

Indicative content:

- weigh test tube
- add metal carbonate
- weigh test tube and metal carbonate

- heat
- allow to cool
- weigh test tube and metal oxide
- repeat (heat, cool and weigh) until no change in mass

- determine mass of metal carbonate used
- determine mass of carbon dioxide produced
- repeat with different metal carbonate(s)

an alternative method can be based on any mass of metal

carbonates and at end divide by this mass to find

mass carbon dioxide per gram metal carbonate

6

END OF QUESTIONS

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