



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

GCSE COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 1H

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.

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	
TOTAL	



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IB/M/Jun20/E9

8464/C/1H

0 1

This question is about the extraction of aluminium.

0 1 . 1

An aluminium atom is represented as:



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

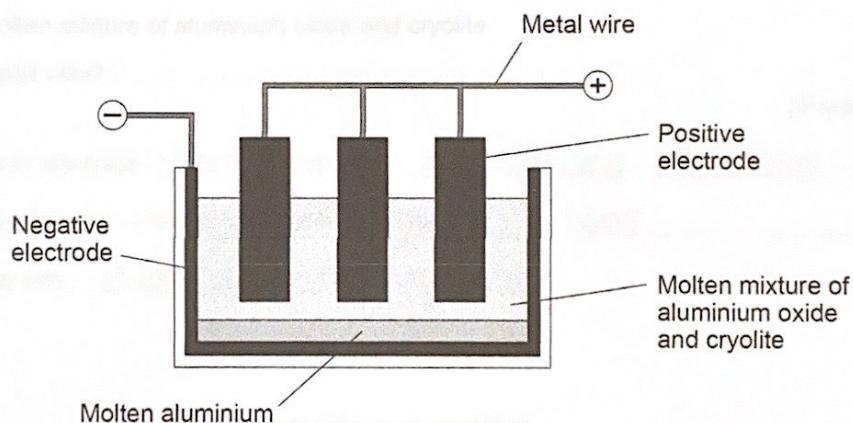
[2 marks]

Number of electrons 13Number of neutrons 14

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

Figure 1 shows the cell used for the electrolysis.

Figure 1



0 1 . 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



0 2

0 1 . 3 Oxygen is formed at the positive carbon electrodes.

Explain why the positive carbon electrodes must be continually replaced.

[3 marks]

At high temperatures the oxygen reacts with the carbon electrode which wears away and produces CO_2 .

0 1 . 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 electrons

Molten mixture of aluminium oxide and cryolite ions

Metal wire delocalised electrons

9

Turn over for the next question

Turn over ►



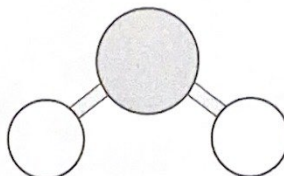
0 2

This question is about substances with covalent bonding.

0 2 . 1

Figure 2 shows a ball and stick model of a water molecule (H_2O).

Figure 2

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

[1 mark]

It is not 3 dimensional so incorrect
arrangement in space

0 2 . 2

Ice has a low melting point.

Water molecules in ice are held together by intermolecular forces.

Complete the sentence.

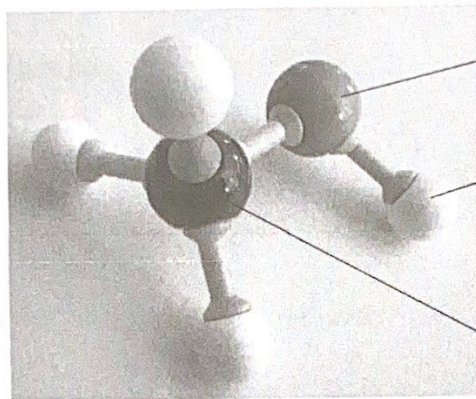
[1 mark]

Ice has a low melting point because the

intermolecular forces are weak.

0 2 . 3 Figure 3 shows the structure of a molecule.

Figure 3



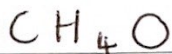
Oxygen atom

Hydrogen atom

Carbon atom

What is the molecular formula of the molecule in Figure 3?

[1 mark]



Question 2 continues on the next page

Turn over ►



Diamond has a giant covalent structure.

0 2 . 4

What is the number of bonds formed by each carbon atom in diamond?

[1 mark]

Tick (✓) **one** box.

2	<input type="checkbox"/>	3	<input type="checkbox"/>	4	<input checked="" type="checkbox"/>	8	<input type="checkbox"/>
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0 2 . 5

Give **two** physical properties of diamond.

[2 marks]

- 1 Very hard
- 2 Very high melting point

0 2 . 6

Name **two** other substances with giant covalent structures.

[2 marks]

- 1 graphite
- 2 Silicon dioxide

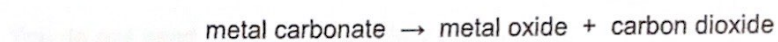
8



0 3

Some students investigated the thermal decomposition of metal carbonates.

The word equation for the reaction is:



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 1 shows their results.

Table 1

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

Turn over for the next question



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]

First, weigh the test tube then add metal carbonate and weigh again in order to determine the amount of metal carbonate used. Heat the test tube over a bunsen burner for a short while then allow to cool and re-weigh the test tube. Repeat this step until there is no change in the mass of the test tube. Use the initial mass and final mass to calculate the mass of carbon dioxide produced. Complete the whole process ~~is~~ ~~determine~~ ~~is~~ with different metal carbonates in order to determine if the hypothesis is correct

6

Turn over for the next question

Turn over ►



0 4

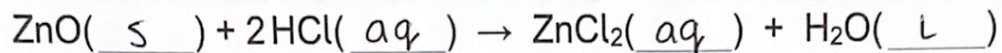
This question is about acids, alkalis and bases.

A student reacted zinc oxide powder with hydrochloric acid to produce zinc chloride solution.

0 4 . 1

Complete the equation for the reaction by writing the state symbols.

[2 marks]



0 4 . 2

Give **one** way that the student could speed up the reaction between zinc oxide powder and hydrochloric acid.

[1 mark]

heat the mixture

Hydrochloric acid was the limiting reactant.

0 4 . 3

How could the student know when all the hydrochloric acid has reacted?

[1 mark]

solid zinc oxide remains

0 4 . 4

How could the student obtain zinc chloride solution from the reaction mixture when all the hydrochloric acid has reacted?

[1 mark]

filter



0 4 . 5 Describe how zinc chloride crystals are produced from zinc chloride solution.

[2 marks]

First you would heat the solution then
leave it to cool and crystallise.

Sulfuric acid and sodium hydroxide react to produce sodium sulfate.

0 4 . 6 Sulfuric acid is gradually added to sodium hydroxide solution.

The pH of the mixture changes as the sulfuric acid is added until in excess.

Suggest the pH at:

- the start before sulfuric acid is added
- the end when sulfuric acid is in excess.

[2 marks]

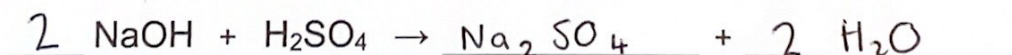
pH at start = 13

pH at end = 1

0 4 . 7 Complete the symbol equation for the preparation of sodium sulfate.

You should balance the equation.

[2 marks]



Question 4 continues on the next page

Turn over ►



0 4 . 8

A solution of hydrochloric acid had a hydrogen ion concentration of 1.0 mol/dm^3

Water was added to the hydrochloric acid until the pH increased by 1

What was the hydrogen ion concentration of the hydrochloric acid after water had been added?

[1 mark]

Tick (✓) **one** box.

100 mol/dm^3

☐

10 mol/dm^3

☐

0.10 mol/dm^3

☒

0.010 mol/dm^3

☐

12



0 5

A student investigated the temperature change when magnesium was added to copper sulfate solution.

This is the method used.

1. Pour 30 cm³ of copper sulfate solution into a polystyrene cup.
2. Measure the temperature of copper sulfate solution every minute for 3 minutes.
3. Add magnesium on the fourth minute.
4. Measure the temperature of the mixture at 5 minutes and then every minute up to 14 minutes.

0 5 . 1

What is the dependent variable in this investigation?

[1 mark]

Temperature change

Question 5 continues on the next page



Turn over ►

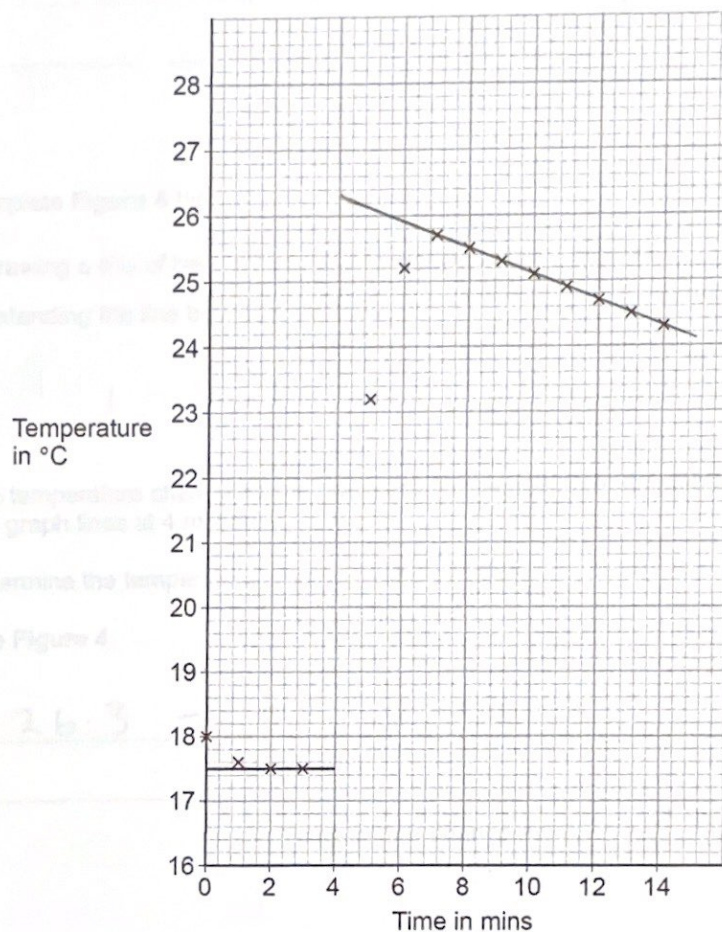


1 3

The student used the results to plot a graph.

Figure 4 shows the graph.

Figure 4



0 5 . 2

Suggest why the copper sulfate solution was left for four minutes before adding the magnesium.

[1 mark]

To reach a constant temperature

0 5 . 3

Complete **Figure 4** by:

- drawing a line of best fit through all the points after 7 minutes
- extending the line back to 4 minutes.

[2 marks]

0 5 . 4

The temperature change for the reaction is the temperature difference between the two graph lines at 4 minutes.

Determine the temperature change for the reaction.

Use **Figure 4**.

[2 marks]

$$26.3 - 17.5 = 8.8$$

Temperature change = 8.8 °C

0 5 . 5

Explain why the temperature of the mixture decreases after 7 minutes.

[2 marks]

The reaction has stopped so the solution cools and energy is lost into the atmosphere

Turn over ►



- 0 5 6 The student repeated the experiment with an unknown metal Q instead of magnesium.

All the other variables were kept the same.

The student recorded a smaller temperature change.

Suggest the identity of metal Q.

Give one reason for your answer.

[2 marks]

Metal Q Aluminium

Reason Aluminium is less reactive than magnesium

- 0 5 7 A copper sulfate solution contained 0.100 moles of copper sulfate dissolved in 0.500 dm³ of water.

Calculate the mass of copper sulfate in 30.0 cm³ of this solution.

Relative formula mass (M_r): $\text{CuSO}_4 = 159.5$

[4 marks]

$$30 \text{ cm}^3 = 0.03 \text{ dm}^3$$

$$\text{moles} = \frac{0.03}{0.5} \times 0.1 = 0.006$$

$$\text{mass} = \text{moles} \times M_r$$

$$\text{mass} = 0.006 \times 159.5 = 0.957$$

$$\text{Mass} = 0.957 \text{ g}$$

14



0 6

This question is about gold and compounds of gold.

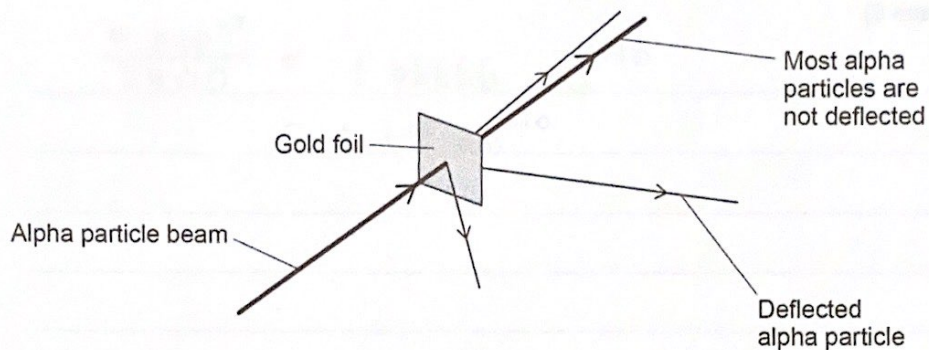
0 6 . 1

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

Alpha particles are positively charged.

Figure 5 shows the results.

Figure 5

What **two** conclusions can be made from the results?

[2 marks]

Tick (✓) **two** boxes.

Atoms are balls of positive charge with embedded electrons.

☐

Atoms are tiny spheres that cannot be divided.

☐

Atoms have a positively charged nucleus.

☒

Mass is concentrated in the nucleus in the centre of atoms.

☒

Neutrons exist within the nucleus.

☐

Question 6 continues on the next page

Turn over ►



0 6 . 2

The gold foil is:

- 4.00×10^{-7} metres thick
- 2400 atoms thick.

What is the diameter of one gold atom in metres?

Give your answer to 3 significant figures.

[3 marks]

$$\frac{4 \times 10^{-7}}{2400} = 1.66666 \times 10^{-10}$$

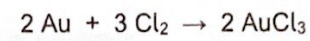
$$= 1.67 \times 10^{-10}$$

Diameter of one gold atom (3 significant figures) = 1.67×10^{-10} m

0 6 . 3 Gold reacts with the elements in Group 7 of the periodic table.

0.175 g of gold reacts with chlorine.

The equation for the reaction is:



Calculate the mass of chlorine needed to react with 0.175 g of gold.

Give your answer in mg

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

[5 marks]

$$\text{moles} = \frac{\text{mass}}{M_r} \quad \text{moles of Au} = \frac{0.175}{197} = 0.000888$$

$$\begin{array}{l} \text{ratio Au:Cl}_2 \\ 2:3 \\ \text{(from equation)} \end{array} \quad \text{moles of Cl}_2 = 0.000888 \times \frac{3}{2} = 0.00133$$

$$\begin{array}{l} \text{mass of Cl}_2 = 0.00133 \times (35.5 \times 2) \\ = 0.0946 \text{ g} \\ \times 1000 \\ = 94.6 \text{ mg} \end{array}$$

Mass of chlorine = 94.6 mg

10

Turn over for the next question

Turn over ►



07

This question is about elements.

Caesium is in Group 1 of the periodic table.

07.1

Explain what happens to caesium atoms and to oxygen atoms when caesium reacts with oxygen to produce caesium oxide.

You should answer in terms of electrons.

[4 marks]

Caesium atom loses one electron and oxygen atom gains two electrons so 2 caesium atoms react with 1 oxygen atom to form caesium oxide. The caesium and oxide ions produced have full outer shells.

07.2

Explain why caesium is more reactive than sodium.

You should answer in terms of electrons.

[4 marks]

Caesium has more shells than sodium so the outer electron is further away from the nucleus. This means there is a weaker attraction between the nucleus and outer electron in caesium and so the outer electron is more easily lost.



0 7 . 3 Figure 6 shows part of Mendeleev's periodic table.

Figure 6

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

Explain why the early periodic tables placed iodine (I) before tellurium (Te), but then Mendeleev placed tellurium before iodine.

[3 marks]

~~Early~~ Early periodic tables were arranged with elements in order of atomic weights and iodine has a lower atomic weight than tellurium but Mendeleev placed iodine with elements with similar properties

11

END OF QUESTIONS

