

Please write clearly in block capitals.

Centre number

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Candidate signature

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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	
<b>TOTAL</b>	



J U N 2 0 8 4 6 4 C 1 H 0 1

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]

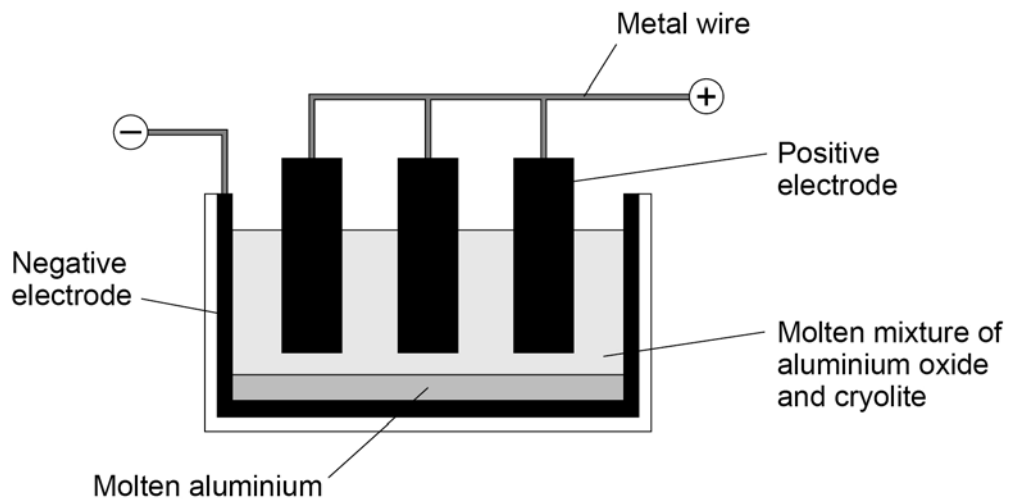
Number of electrons \_\_\_\_\_

Number of neutrons \_\_\_\_\_

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 ( $\text{Al}_2\text{O}_3$ ).

What is meant by the term reduction?

[1 mark]

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

Explain why the positive carbon electrodes must be continually replaced.

[3 marks]

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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) \_\_\_\_\_

Molten mixture of aluminium oxide and cryolite \_\_\_\_\_

Metal wire \_\_\_\_\_

9

Turn over for the next question

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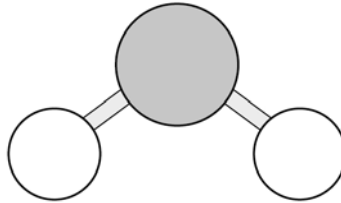
0 2

This question is about substances with covalent bonding.

0 2 . 1

**Figure 2** shows a ball and stick model of a water molecule ( $\text{H}_2\text{O}$ ).

**Figure 2**



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

[1 mark]

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0 2 . 2

Ice has a low melting point.

Water molecules in ice are held together by intermolecular forces.

Complete the sentence.

[1 mark]

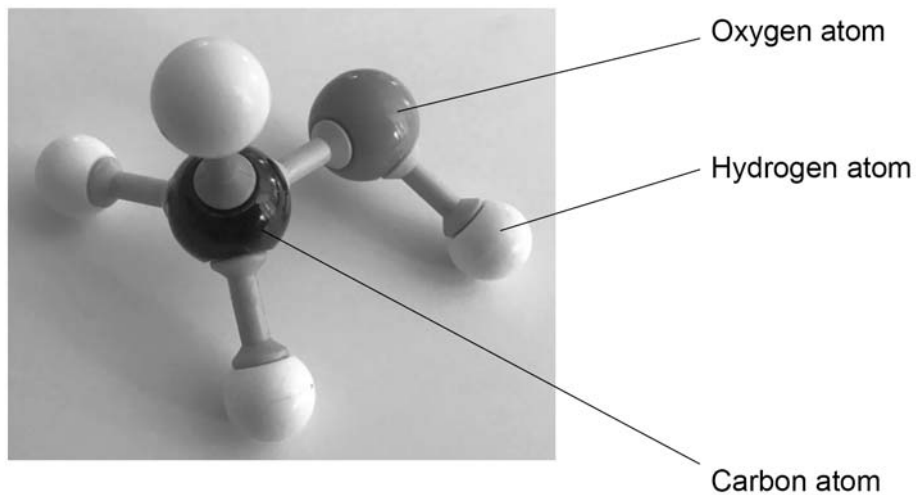
Ice has a low melting point because the

intermolecular forces are \_\_\_\_\_.



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

Figure 3



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

[1 mark]

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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       3       4       8

**0 2 . 5** Give **two** physical properties of diamond.

**[2 marks]**

1 \_\_\_\_\_  
2 \_\_\_\_\_

**0 2 . 6** Name **two** other substances with giant covalent structures.

**[2 marks]**

1 \_\_\_\_\_  
2 \_\_\_\_\_

8



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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





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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]**

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**6**

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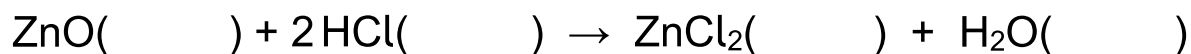
0 4

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]**

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Hydrochloric acid was the limiting reactant.

0 4 . 3

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

**[1 mark]**

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0 4 . 4

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

**[1 mark]**

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

[2 marks]

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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 = \_\_\_\_\_

pH at end = \_\_\_\_\_

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  $1.0 \text{ mol/dm}^3$

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  $\text{mol/dm}^3$

10  $\text{mol/dm}^3$

0.10  $\text{mol/dm}^3$

0.010  $\text{mol/dm}^3$

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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 cm<sup>3</sup> 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]**

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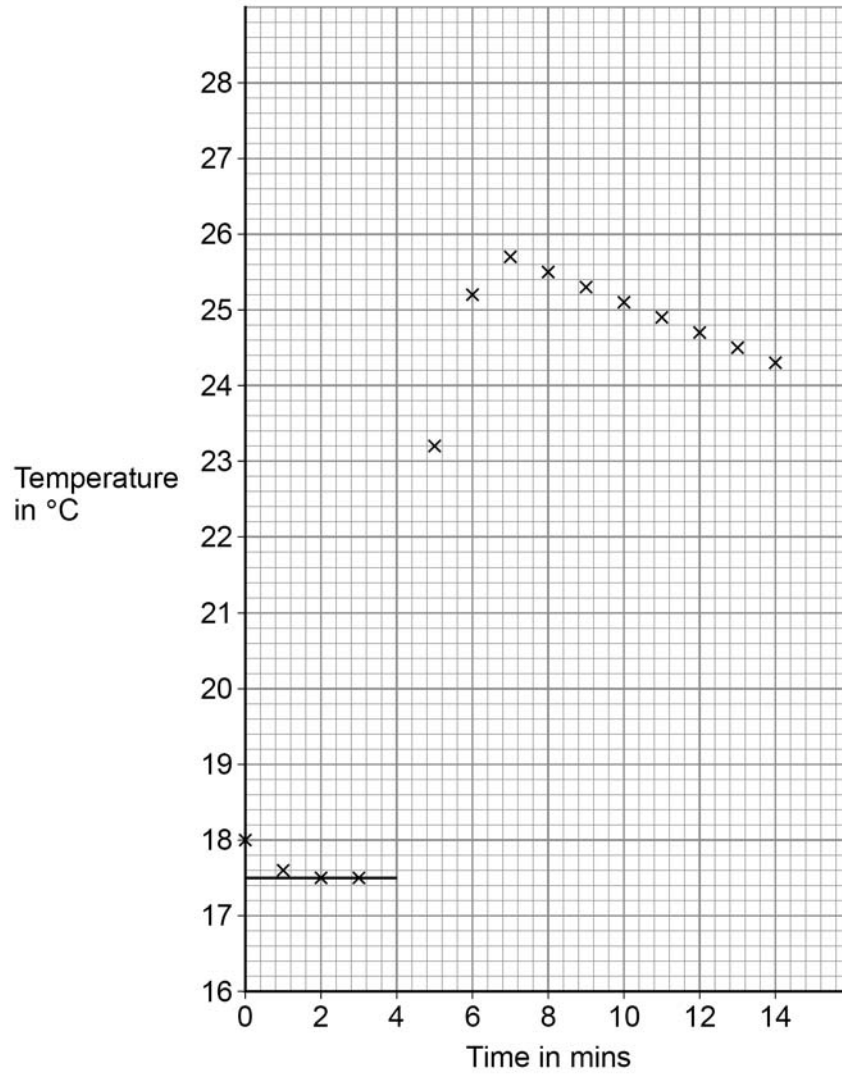
**Question 5 continues on the next page**

**Turn over ►**

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]**

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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]**

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Temperature change = \_\_\_\_\_ °C

0 5 . 5

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

**[2 marks]**

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

Reason \_\_\_\_\_

\_\_\_\_\_

0 5 . 7

A copper sulfate solution contained 0.100 moles of copper sulfate dissolved in 0.500 dm<sup>3</sup> of water.

Calculate the mass of copper sulfate in 30.0 cm<sup>3</sup> of this solution.

Relative formula mass ( $M_r$ ): CuSO<sub>4</sub> = 159.5

**[4 marks]**

\_\_\_\_\_

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Mass = \_\_\_\_\_ g

**14**



0 6

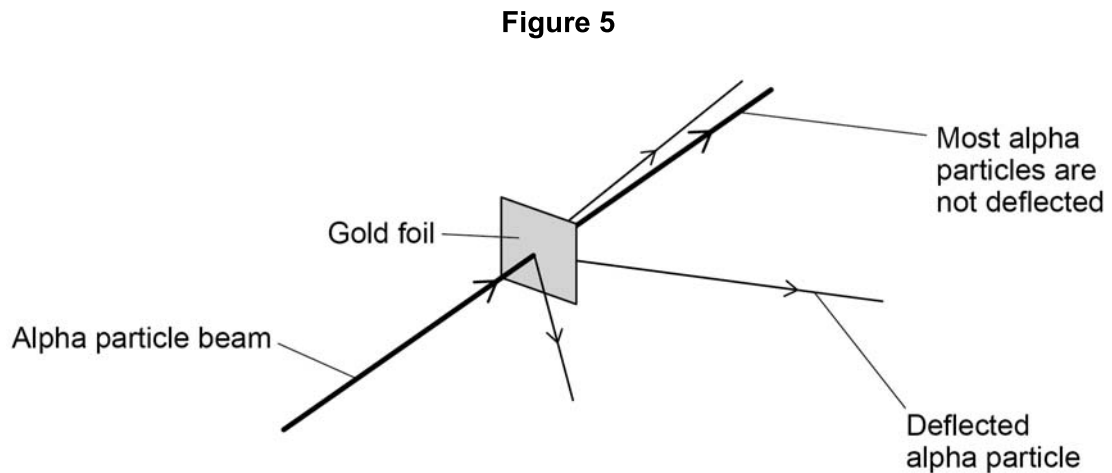
This question is about gold and compounds of gold.

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.



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:

- $4.00 \times 10^{-7}$  metres thick
- 2400 atoms thick.

What is the diameter of one gold atom in metres?

Give your answer to 3 significant figures.

**[3 marks]**

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Diameter of one gold atom (3 significant figures) = \_\_\_\_\_ m

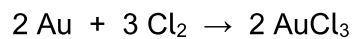


**06.3**

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]**


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Mass of chlorine = \_\_\_\_\_ mg

**10**

**Turn over for the next question**

Turn over ►



**0 7**

This question is about elements.

Caesium is in Group 1 of the periodic table.

**0 7 . 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]**

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**0 7 . 2**

Explain why caesium is more reactive than sodium.

You should answer in terms of electrons.

**[4 marks]**

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

**Figure 6**

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

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

**[3 marks]**

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11

**END OF QUESTIONS**



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