

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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# GCSE COMBINED SCIENCE: TRILOGY

# H

Higher Tier  
Chemistry Paper 1H

Thursday 16 May 2019

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.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- 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	
<b>TOTAL</b>	



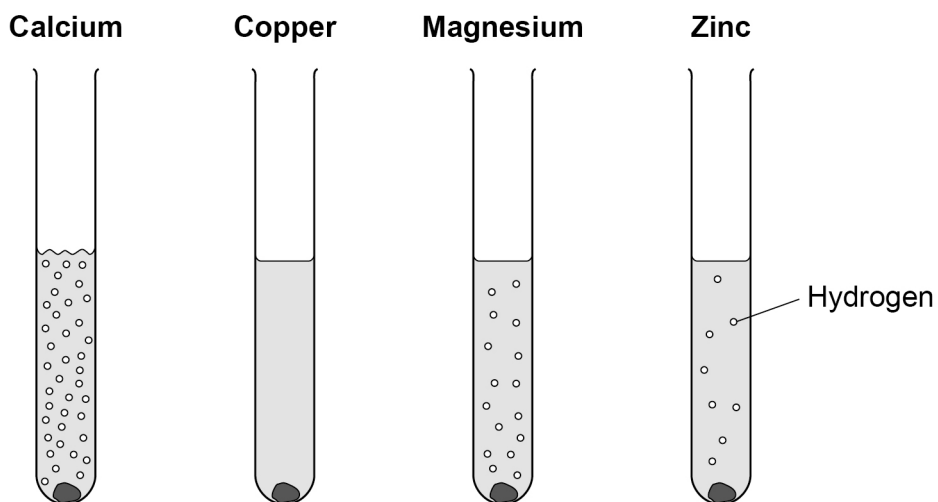
J U N 1 9 8 4 6 4 C 1 H O 1

**0 1**

This question is about reactions of metals.

**Figure 1** shows what happens when calcium, copper, magnesium and zinc are added to hydrochloric acid.

**Figure 1**

**0 1 . 1**

What is the order of decreasing reactivity of these four metals?

**[1 mark]**

Tick (✓) **one** box.

Zn Ca Cu Mg

☐

Ca Cu Mg Zn

☐

Cu Zn Ca Mg

☐

Ca Mg Zn Cu

☐

A student wants to make a fair comparison of the reactivity of the metals with hydrochloric acid.

0 1 . 2

Name **two** variables that must be kept constant.

[2 marks]

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

0 1 . 3

What is the independent variable in this reaction?

[1 mark]

\_\_\_\_\_

\_\_\_\_\_

0 1 . 4

Predict the reactivity of beryllium compared with magnesium.

Give a reason for your answer.

Use the periodic table.

[2 marks]

\_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

0 1 . 5

A solution of hydrochloric acid contains 3.2 g of hydrogen chloride in 50 cm<sup>3</sup>

Calculate the concentration of hydrogen chloride in g per dm<sup>3</sup>

[3 marks]

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Concentration = \_\_\_\_\_ g per dm<sup>3</sup>

9

Turn over ►



**0 2**

This question is about salts.

Ammonium nitrate solution is produced when ammonia gas reacts with nitric acid.

**0 2 . 1**

Give the state symbol for ammonium nitrate solution.

**[1 mark]**

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**0 2 . 2**

What is the formula of nitric acid?

**[1 mark]**Tick (✓) **one** box.

HCl

☐HNO<sub>3</sub>☐H<sub>2</sub>SO<sub>4</sub>☐NH<sub>4</sub>OH☐**0 2 . 3**

Ammonia gas dissolves in water to produce ammonia solution.

Ammonia solution contains hydroxide ions, OH<sup>-</sup>

A student adds universal indicator to solutions of nitric acid and ammonia.

What colour is observed in each solution?

**[2 marks]**

Colour in nitric acid

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Colour in ammonia solution

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0 2 . 4

The student gradually added nitric acid to ammonia solution.

Which row, **A**, **B**, **C** or **D**, shows the change in pH as the nitric acid is added until in excess?

[1 mark]

Tick (✓) **one** box.

	pH of ammonia solution at start	pH after addition of excess nitric acid	
<b>A</b>	10	7	<input type="checkbox"/>
<b>B</b>	2	10	<input type="checkbox"/>
<b>C</b>	7	1	<input type="checkbox"/>
<b>D</b>	10	2	<input type="checkbox"/>

0 2 . 5

Calculate the percentage by mass of oxygen in ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ).

Relative atomic masses ( $A_r$ ): H = 1 N = 14 O = 16

Relative formula mass ( $M_r$ ):  $\text{NH}_4\text{NO}_3 = 80$

[3 marks]

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Percentage by mass of oxygen = \_\_\_\_\_ %

Question 2 continues on the next page

Turn over ►



Describe a method to investigate how the temperature changes when different masses of ammonium nitrate are dissolved in water.

**[6 marks]**

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

14



**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 ►**

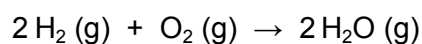


0	3
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This question is about oxygen.

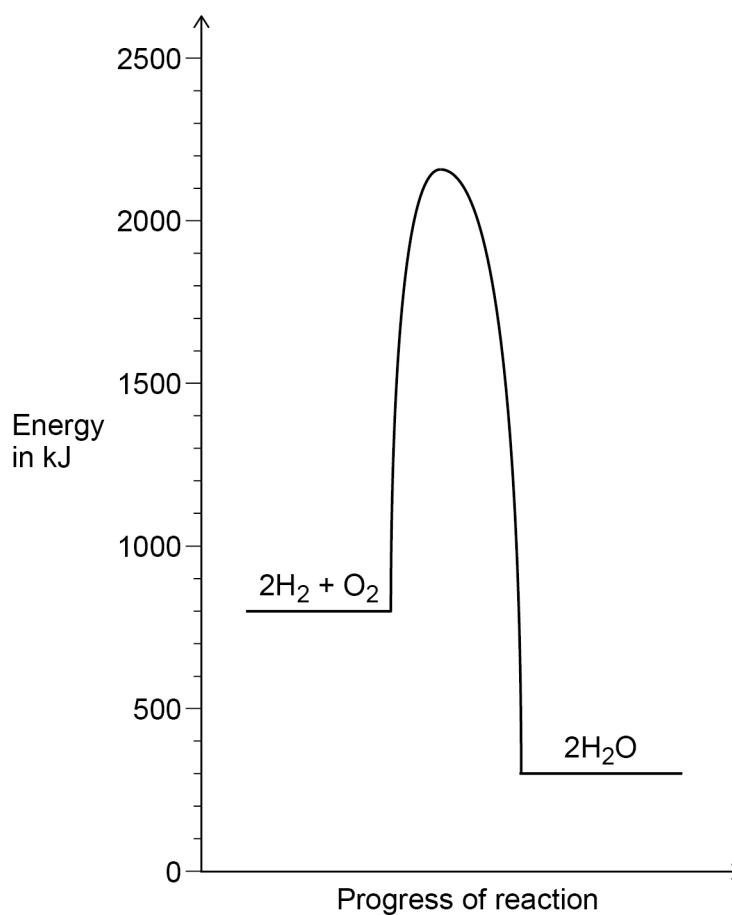
0	3	.	1
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Hydrogen reacts with oxygen.



**Figure 2** shows the relative energies of the reactants and products at a certain temperature.

**Figure 2**

Label the activation energy on **Figure 2**.**[1 mark]**



**0 3 . 2**

Determine the overall energy change for the reaction between hydrogen and oxygen shown in Question **03.1**

Use **Figure 2**.

**[2 marks]**

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Energy change = \_\_\_\_\_ kJ

**0 3 . 3**

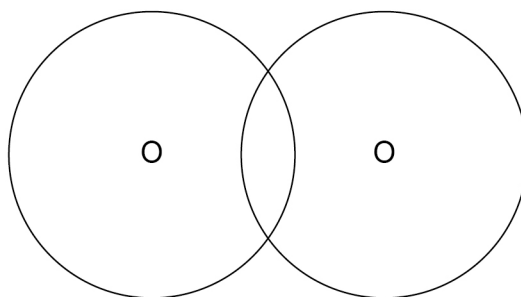
Oxygen is in Group 6 of the periodic table.

**Figure 3** shows the outer energy levels in one molecule of oxygen ( $O_2$ ).

Draw the electrons in the outer energy levels in **Figure 3**.

**[2 marks]**

**Figure 3**



**Question 3 continues on the next page**

**Turn over ►**



0 3 . 4

The equation shows the decomposition of hydrogen peroxide.



Table 1 shows the bond energies.

Table 1

Bond	O–O	O=O	O–H
Bond dissociation energy in kJ per mole	138	496	463

Calculate the overall energy change for the reaction.

[3 marks]

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Energy change = \_\_\_\_\_ kJ

8



0	4
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This question is about elements in the periodic table.

0	4	.	1
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What order did scientists use to arrange elements in early periodic tables?

[1 mark]

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0	4	.	2
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In the early periodic tables some elements were placed in the wrong groups.

Mendeleev overcame this in his periodic table.

Give **one** way Mendeleev did this.

[1 mark]

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**Question 4 continues on the next page**

**Turn over ►**



**Table 2** shows the boiling points of fluorine, chlorine and bromine.

**Table 2**

Element	Boiling point in °C
Fluorine	−186
Chlorine	−34
Bromine	+59

**0 4 . 3** Explain why the boiling points in **Table 2** are low.

**[2 marks]**

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**0 4 . 4** Explain the trend in the boiling points in **Table 2**.

**[3 marks]**

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0	4	.	5
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Explain why neon is unreactive.

Give the electronic structure of neon in your answer.

**[2 marks]**

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0	4	.	6
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How many atoms are there in 1 g of argon?

The Avogadro constant is  $6.02 \times 10^{23}$  per mole.Relative atomic mass ( $A_r$ ): Ar = 40**[2 marks]**

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Number of atoms in 1 g = \_\_\_\_\_

11
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**Turn over for the next question****Turn over ►**

0	5
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This question is about electrolysis.

0	5	.	1
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Some metals are extracted from molten compounds using electrolysis.

Why is electrolysis used to extract some metals?

[1 mark]

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0	5	.	2
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Aluminium is produced by electrolysis of a molten mixture.

What **two** substances does the molten mixture contain?

[2 marks]

1 

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2 

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0	5	.	3
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Copper and chlorine are produced when molten copper chloride is electrolysed.

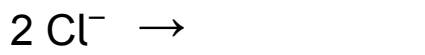
Complete the half equation for the reaction at each electrode.

[2 marks]

Half equation at negative electrode

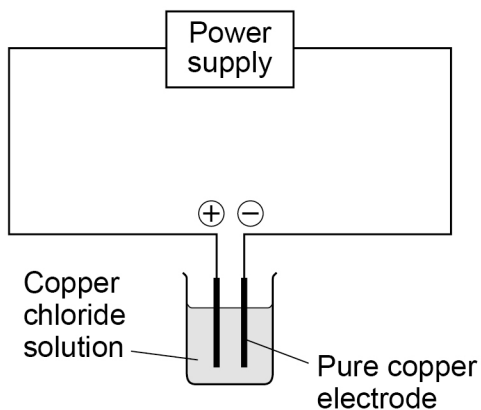


Half equation at positive electrode



**Figure 4** shows the apparatus a student used to electrolyse copper chloride solution.

**Figure 4**



The student:

- measured the mass of copper deposited on the negative electrode after 60 minutes
- compared the mass deposited with the expected value.

0 5 . 4

Suggest **two** reasons why the mass deposited was different from the expected value.

**[2 marks]**

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

**Question 5 continues on the next page**

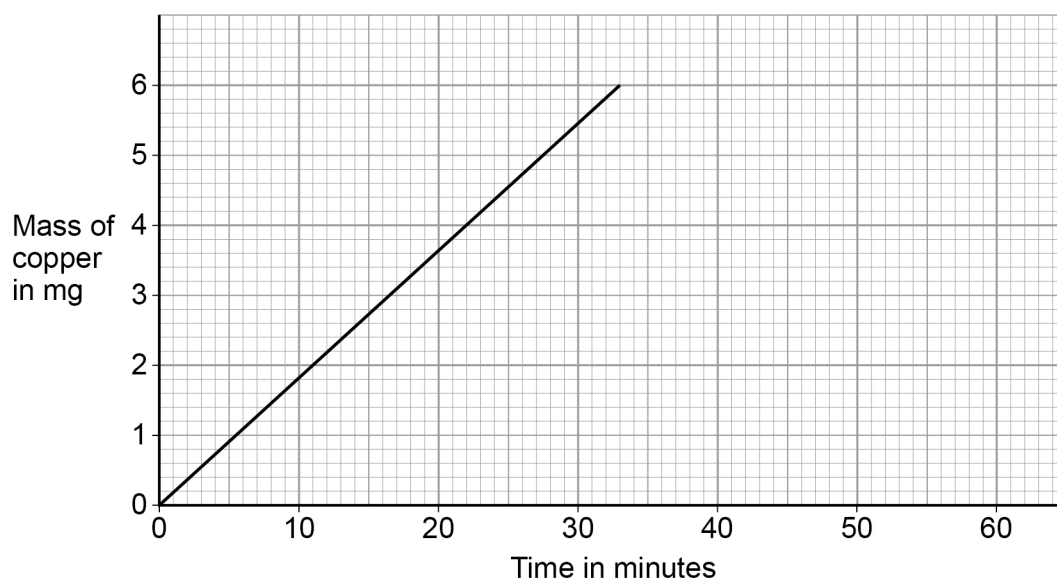
**Turn over ►**



0 5 . 5

**Figure 5** shows the expected mass of copper produced each minute.

**Figure 5**



Determine the expected mass of copper after 24 hours.

Use **Figure 5**.

**[3 marks]**

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Mass = \_\_\_\_\_ mg

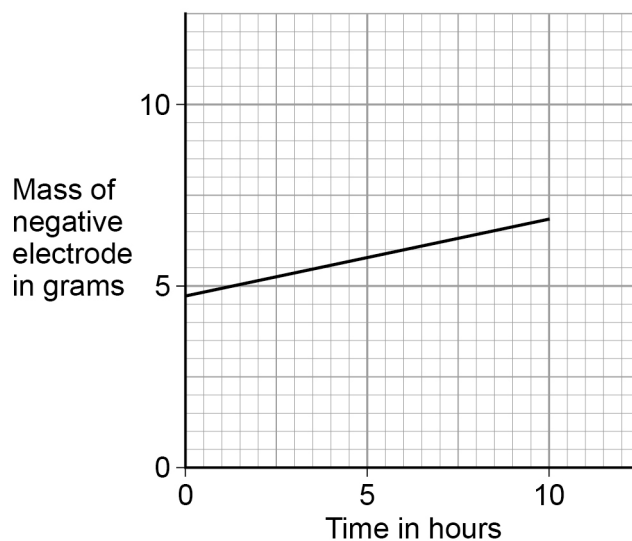




Silver nitrate solution is electrolysed.

**Figure 6** shows the change in mass of the negative electrode over 10 hours.

**Figure 6**



**0 5 . 6** Determine the mass of the negative electrode at the start of the experiment.

Use **Figure 6**.

**[1 mark]**

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**0 5 . 7** Calculate the gradient of the line in **Figure 6**.

Give the unit.

**[3 marks]**

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Gradient \_\_\_\_\_

Unit \_\_\_\_\_



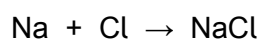
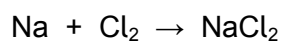
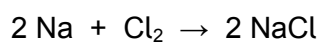
**0 6**

This question is about sodium.

**0 6 . 1**

Sodium reacts with chlorine.

What is the balanced equation for the reaction?

**[1 mark]**Tick (✓) **one** box.☐☐☐☐**0 6 . 2**

Hot sodium is put in a gas jar of chlorine.

Describe the observations made before, during and after the reaction.

**[3 marks]**

Before reaction \_\_\_\_\_

\_\_\_\_\_

During reaction \_\_\_\_\_

\_\_\_\_\_

After reaction \_\_\_\_\_

\_\_\_\_\_



0	6	.	3
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Explain why sodium is less reactive than potassium.

**[4 marks]**

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**Question 6 continues on the next page**

**Turn over ►**



Chlorine reacts with sodium and with hydrogen.

**[6 marks]**

[illegible]

14

