

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>       |      |

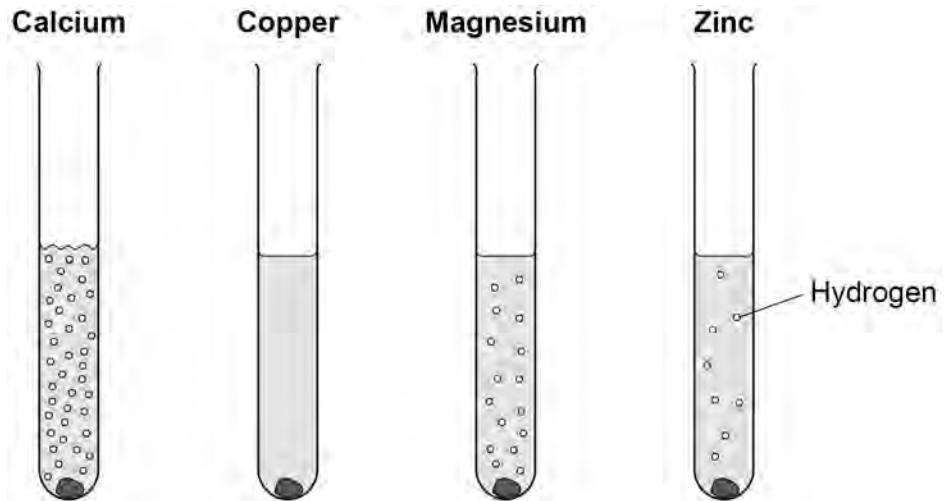


0 1

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>

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 ►





**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 ►**

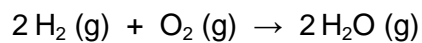


0 3

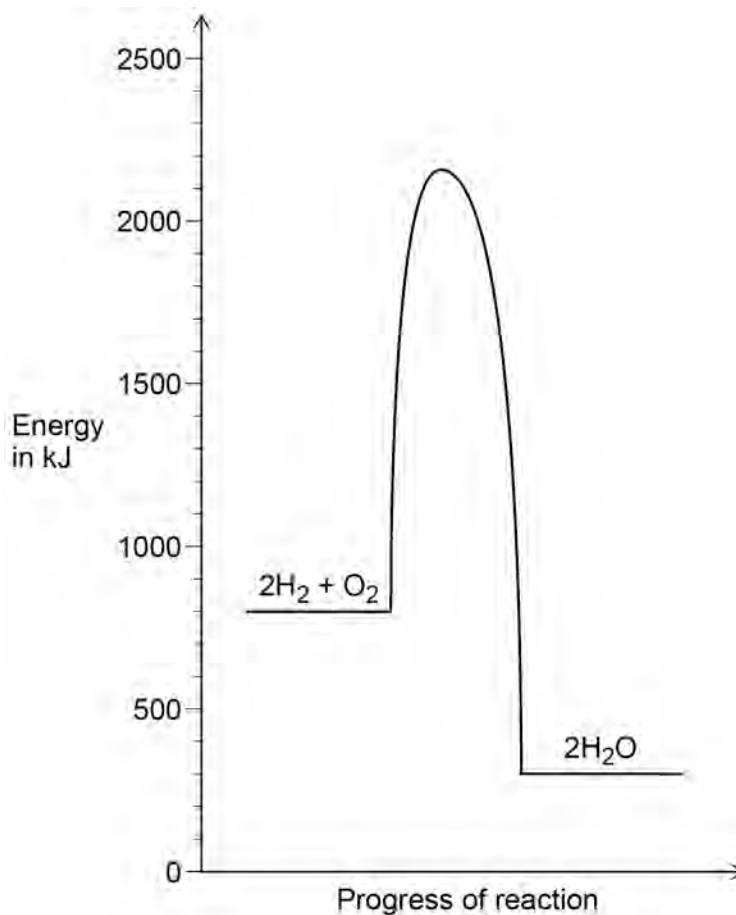
This question is about oxygen.

0 3 . 1

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

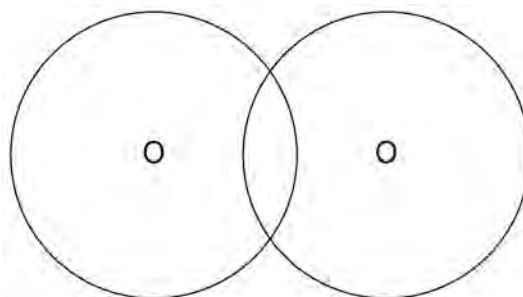
**0 3 . 3** Oxygen is in Group 6 of the periodic table.

**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 |
|---|---|

This question is about elements in the periodic table.

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|---|---|---|---|
| 0 | 4 | . | 1 |
|---|---|---|---|

What order did scientists use to arrange elements in early periodic tables?

[1 mark]

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|   |   |   |   |
|---|---|---|---|
| 0 | 4 | . | 2 |
|---|---|---|---|

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** Explain why neon is unreactive.

Give the electronic structure of neon in your answer.

**[2 marks]**

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**0 4 . 6** 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

**Turn over for the next question**

**Turn over ►**



**0 5**

This question is about electrolysis.

**0 5 . 1**

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**

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**

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

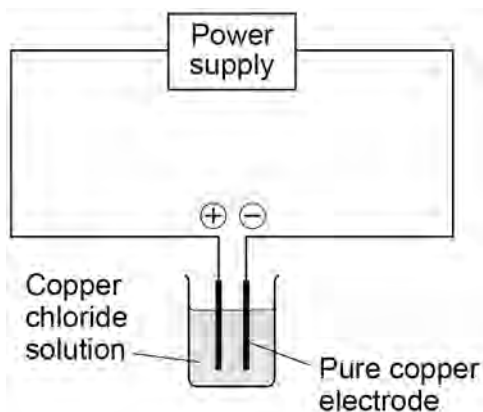


Half equation at positive electrode



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

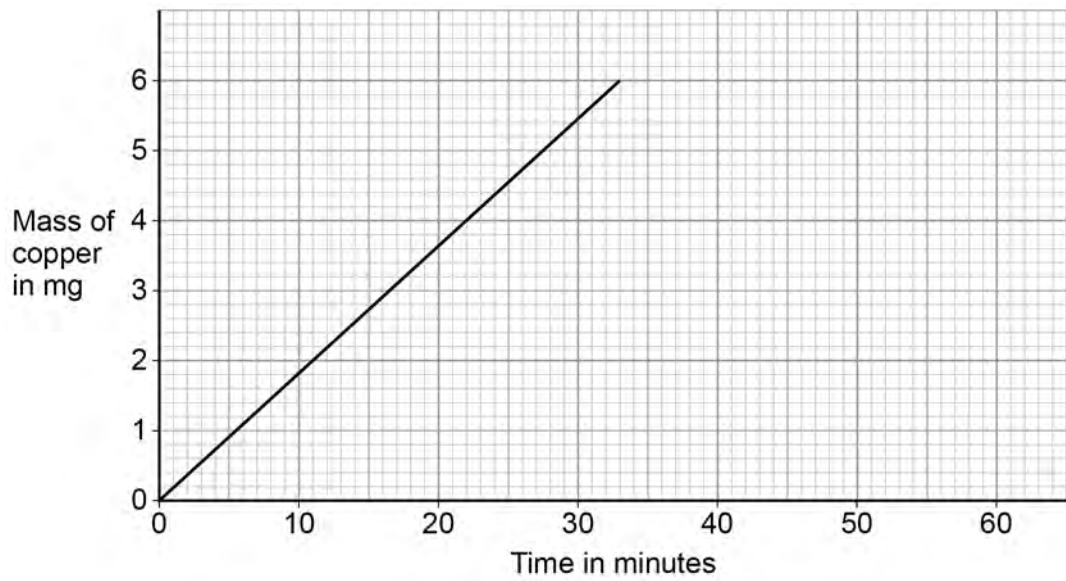
Turn over ►



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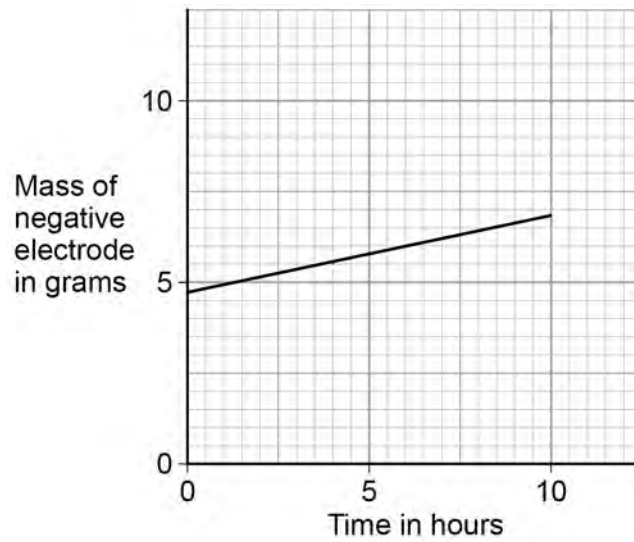
Mass = \_\_\_\_\_ mg



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 \_\_\_\_\_



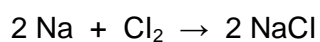
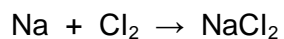
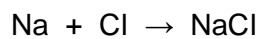
**0 6**

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

Explain why sodium is less reactive than potassium.

**[4 marks]**

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**Question 6 continues on the next page****Turn over ►**

