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.
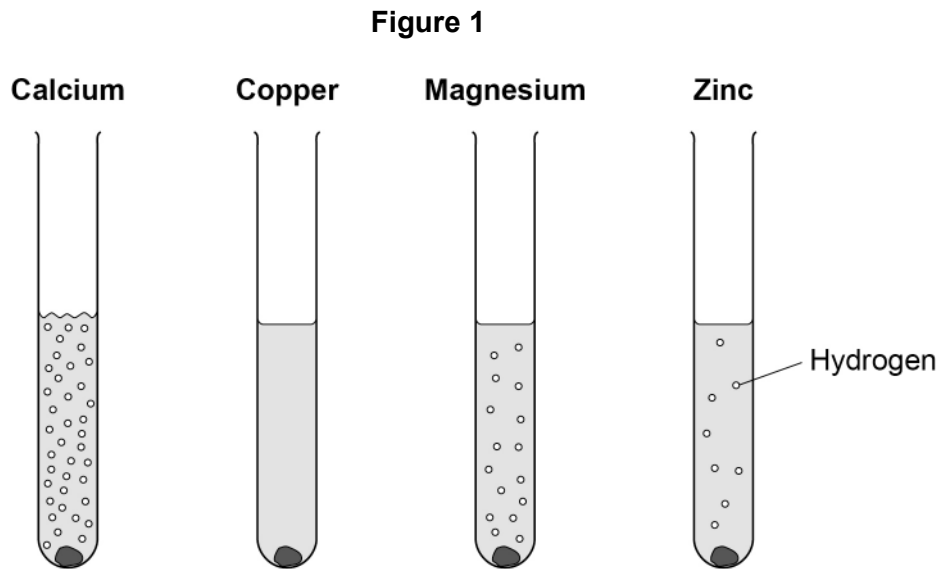
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

| 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^3

Calculate the concentration of hydrogen chloride in g per dm^3

[3 marks]

_____

_____

_____

_____

Concentration = _____ g per dm^3

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]

_____

0 2 . 2 What is the formula of nitric acid?

[1 mark]

Tick (✓) **one** box.

HCl ☐

HNO_3 ☐

H_2SO_4 ☐

NH_4OH ☐

0 2 . 3 Ammonia gas dissolves in water to produce ammonia solution.

Ammonia solution contains hydroxide ions, OH^-

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 _____

Colour in ammonia solution _____

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	
A	10	7	
B	2	10	
C	7	1	
D	10	2	

0 2 . 5 Calculate the percentage by mass of oxygen in ammonium nitrate (NH_4NO_3).

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

Relative formula mass (M_r): NH_4NO_3 = 80

[3 marks]

_____

_____

_____

_____

_____

_____

Percentage by mass of oxygen = _____ %

Question 2 continues on the next page

Turn over ▶

0 2 . 6 Describe a method to investigate how the temperature changes when different masses of ammonium nitrate are dissolved in water.

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

[6 marks]

_____

_____

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14

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Turn over ▶

0 3 This question is about oxygen.
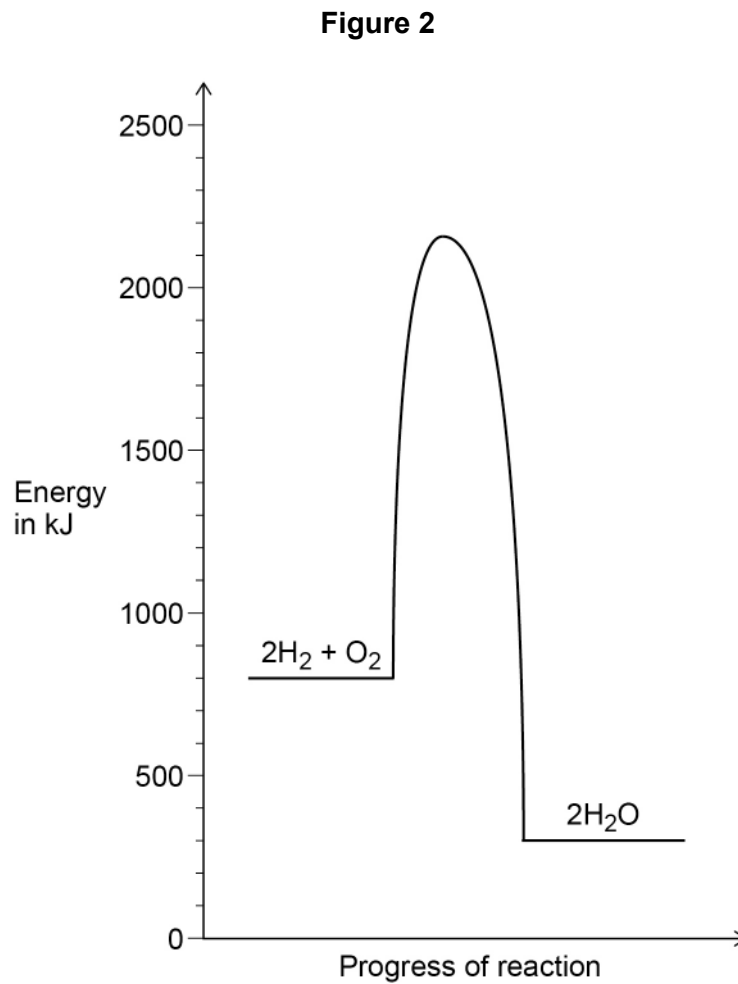
0 3 . 1 Hydrogen reacts with oxygen.

$$2\,H_2\,(g)\ +\ O_2\,(g)\ \rightarrow\ 2\,H_2O\,(g)$$
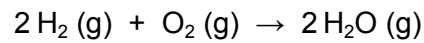
Figure 2 shows the relative energies of the reactants and products at a certain temperature.

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**

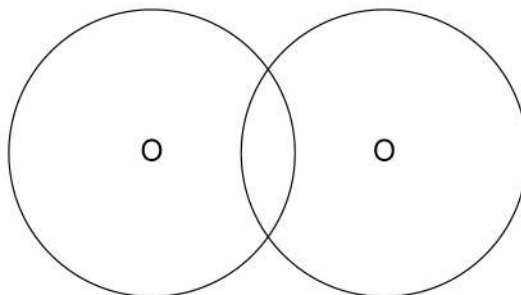Use **Figure 2**.

[2 marks]

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**.
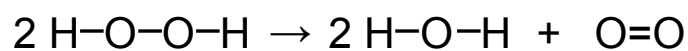
[2 marks]

Figure 3

Question 3 continues on the next page

Turn over ▶

0 3 . 4 The equation shows the decomposition of hydrogen peroxide.

$$2 \text{ H−O−O−H} \rightarrow 2 \text{ H−O−H} + \text{ O=O}$$

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]

Energy change = _____ kJ

8

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

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

[1 mark]

_____

_____

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]

_____

_____

Question 4 continues on the next page

Turn over ▶

Do not write outside the box

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]

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 6.02×10^{23} per mole.

Relative atomic mass (A_r): Ar = 40

[2 marks]

_____

_____

_____

_____

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]

_____

_____

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

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

[2 marks]

1 _____

2 _____

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]
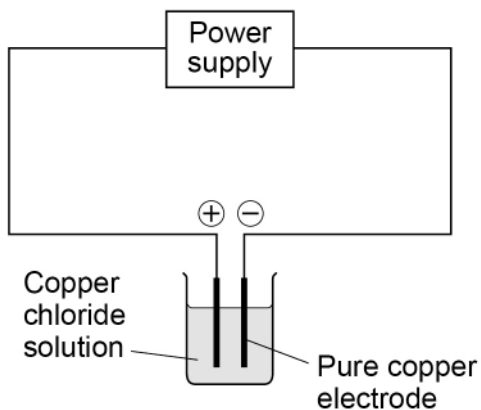
Half equation at negative electrode

$$Cu^{2+} \ \underline{\qquad} \ \rightarrow \ \underline{\qquad}$$

Half equation at positive electrode

$$2 \ Cl^- \ \rightarrow \ \underline{\qquad}$$

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 _____

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2 _____

_____

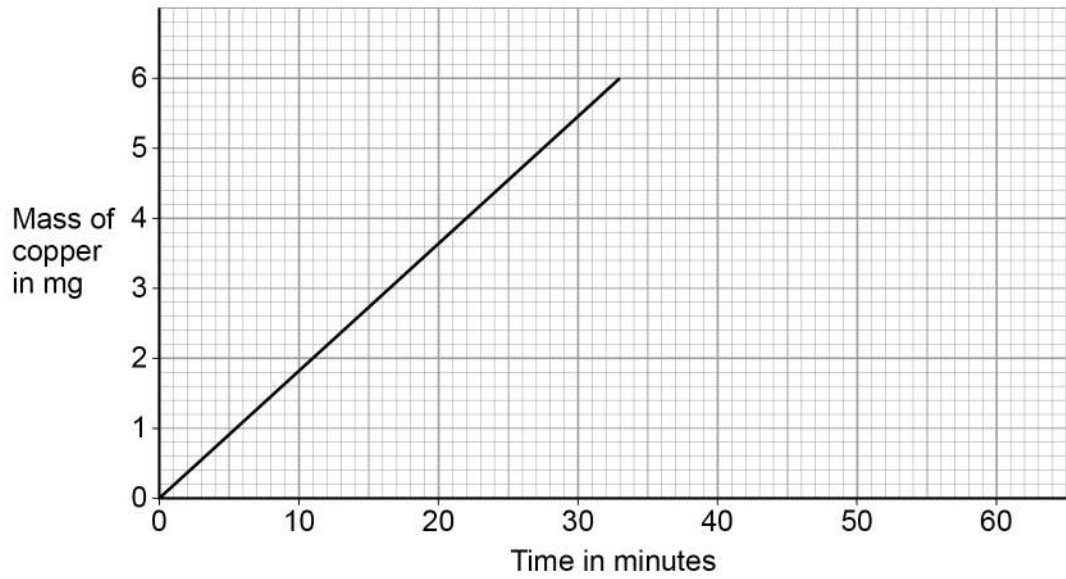**Question 5 continues on the next page**

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]

_____

_____

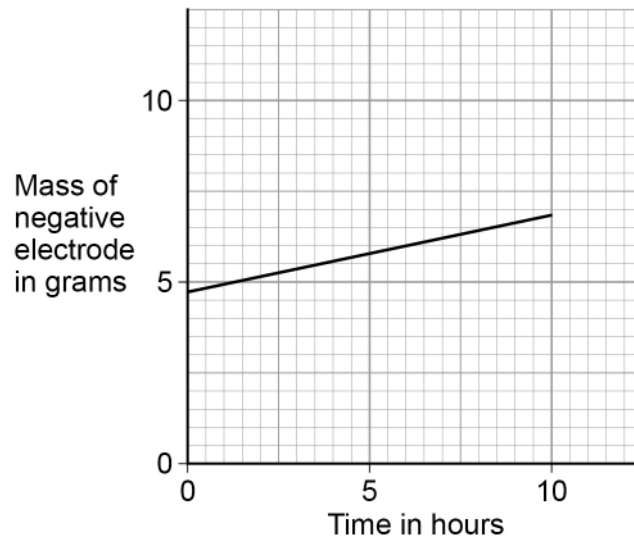_____

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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]

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

Give the unit.

[3 marks]

Gradient _____
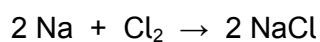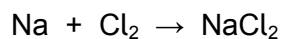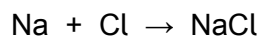
Unit _____

14

Turn over ▶

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.

Na + Cl → NaCl ☐

Na + Cl_2 → $NaCl_2$ ☐

2 Na + Cl_2 → 2 NaCl ☐

2 Na + Cl → Na_2Cl ☐

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 ▶

0 6 . 4 Chlorine reacts with sodium and with hydrogen.

Compare the structure and bonding in sodium chloride and hydrogen chloride.

[6 marks]

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END OF QUESTIONS

14