

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

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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

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.



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

IB/M/Jun22/E10

8464/C/1H

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ANSWER IN THE SPACES PROVIDED**



0 2

IB/M/Jun22/8464/C/1H

0 1

This question is about salts.

Green copper carbonate and sulfuric acid can be used to produce blue copper sulfate crystals.

0 1 . 1

Excess copper carbonate is added to sulfuric acid.

Give **three** observations you would make.

[3 marks]

1 _____

2 _____

3 _____

0 1 . 2

How can the excess copper carbonate be removed?

[1 mark]

0 1 . 3

The pH of the solution changes during the reaction.

What is the pH of the solution at the end of the reaction?

[1 mark]

pH = _____

0 1 . 4

Copper carbonate and sulfuric acid react to produce copper sulfate.

What type of reaction is this?

[1 mark]

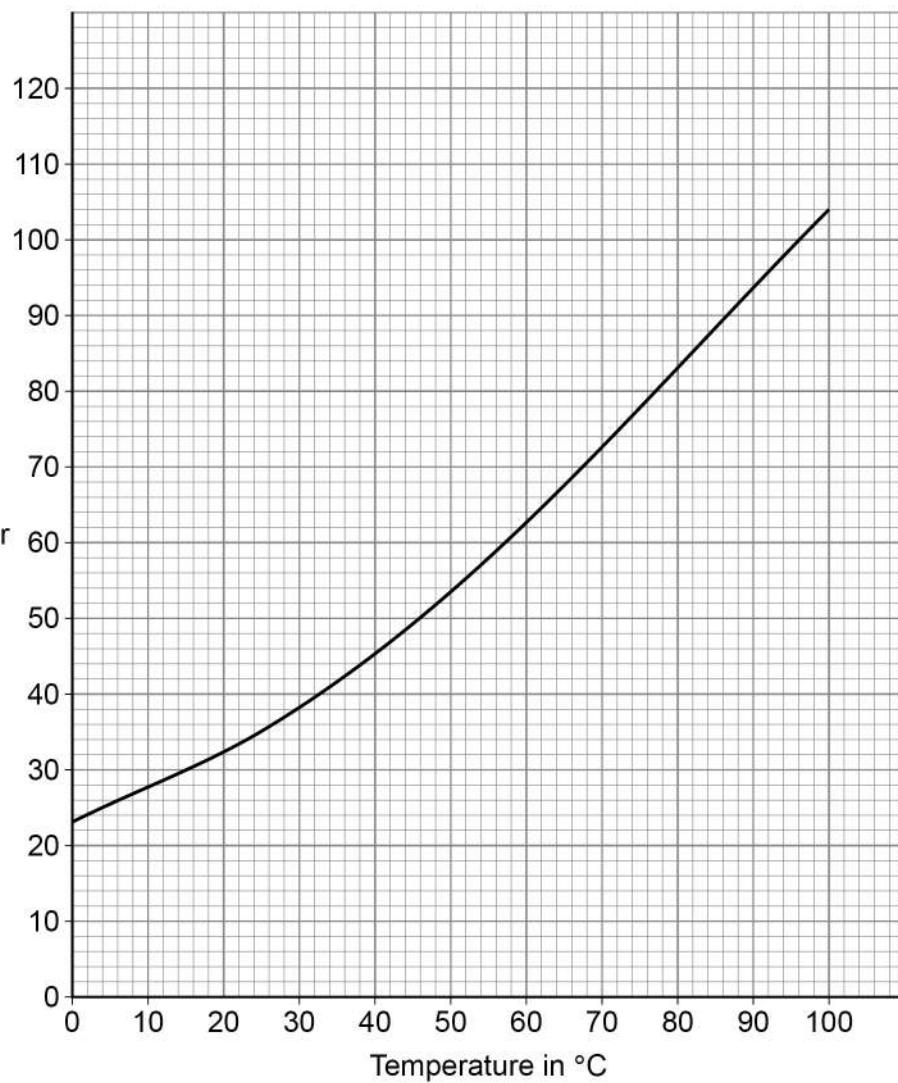
Turn over ►

0 1 . 5 Ammonium nitrate is a salt.

Figure 1 shows the maximum mass of ammonium nitrate that can dissolve in 100 cm³ of water at different temperatures.

Figure 1

Maximum mass
of ammonium
nitrate that can
dissolve in grams per
100 cm³ of water



A student adds ammonium nitrate to water at 80 °C until no more dissolves.

The student cools 100 cm³ of this solution of ammonium nitrate from 80 °C to 20 °C to produce crystals of ammonium nitrate.

Determine the mass of ammonium nitrate that crystallises on cooling 100 cm^3 of this solution from $80\text{ }^\circ\text{C}$ to $20\text{ }^\circ\text{C}$

[3 marks]

Mass = _____ g

9

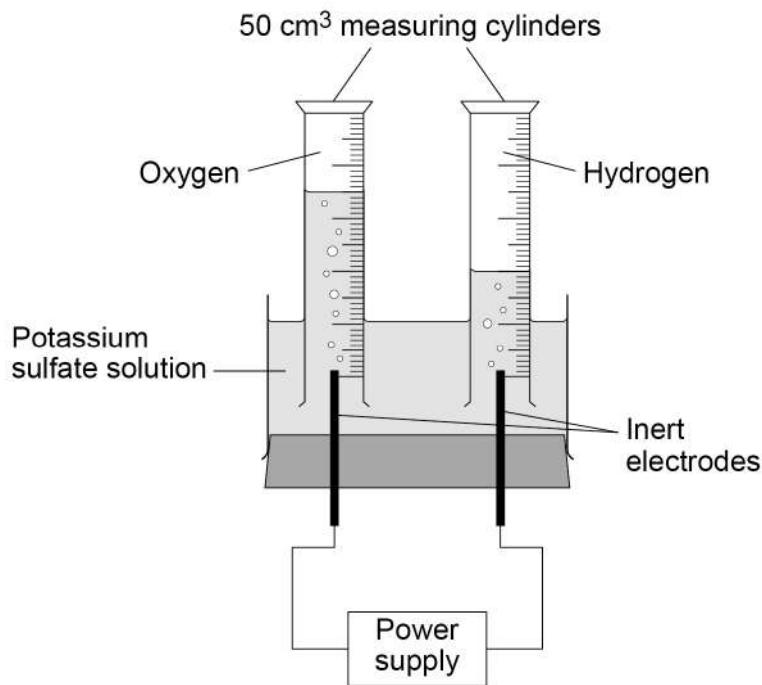
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0 2

This question is about electrolysis.

Figure 2 shows the apparatus used to investigate the electrolysis of potassium sulfate solution.

Figure 2**0 2 . 1**

Potassium sulfate contains K⁺ and SO₄²⁻ ions.

What is the formula of potassium sulfate?

[1 mark]

Tick (✓) one box.

KSO₄

K₂SO₄

K(SO₄)₂

K₂(SO₄)₂



0 6

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0 2 . 2 What are the volumes of gases collected in the electrolysis experiment?

Use Figure 2.

[1 mark]

Volume of hydrogen = _____ cm³

Volume of oxygen = _____ cm³

0 2 . 3 A student made the following hypothesis:

'The volumes of gases collected in this electrolysis experiment are in the same ratio as hydrogen atoms to oxygen atoms in a water molecule.'

Explain how the volumes of gases collected in the experiment in **Figure 2** support the student's hypothesis.

Use your answer to Question **02.2**

[2 marks]

Question 2 continues on the next page

Turn over ►



0 2 . 4 The experiment is repeated 4 times.

The volumes of oxygen collected in the 4 experiments are:

6 cm³ 9 cm³ 10 cm³ 11 cm³

The mean volume of oxygen collected in the 4 experiments is 9 cm³

The measure of uncertainty is the range of a set of measurements about the mean.

What is the measure of uncertainty in the 4 experiments?

[1 mark]

Tick (✓) one box.

$9 \pm 1 \text{ cm}^3$

$9 \pm 2 \text{ cm}^3$

$9 \pm 3 \text{ cm}^3$

0 2 . 5 The potassium sulfate solution has 0.86 g of potassium sulfate dissolved in 25 cm³ of water.

Calculate the mass of potassium sulfate needed to make 1.0 dm³ of solution.

[3 marks]

Mass = _____ g

8



0 8

0 | 3

Plan an investigation to find the order of reactivity of three metals.

You should use the temperature change when each metal reacts with hydrochloric acid.

[6 marks]

6

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1 0

0 4

This question is about Group 7 elements.

0 4 . 1

What are the Group 7 elements known as?

[1 mark]

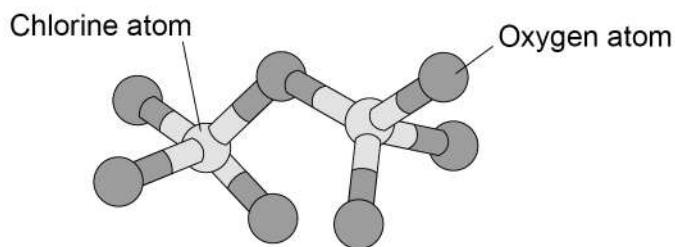
0 4 . 2

Why do Group 7 elements react in similar ways?

[1 mark]

0 4 . 3

Figure 3 shows the structure of a molecule of chlorine oxide.

Figure 3

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

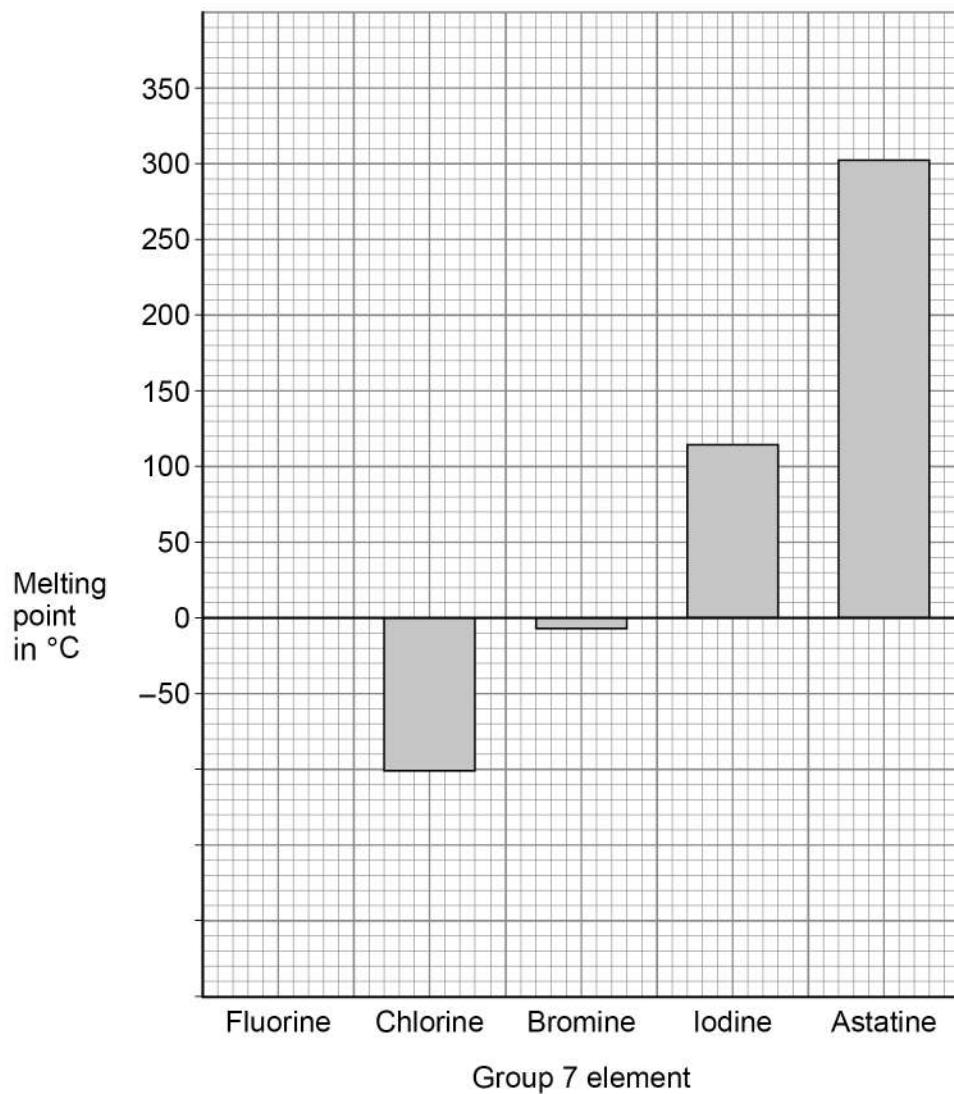
[1 mark]

Question 4 continues on the next page

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Figure 4 shows the melting points of some Group 7 elements.

Figure 4



0 4 . 4 The melting point of fluorine is $-220\text{ }^{\circ}\text{C}$

Complete **Figure 4**.

You should:

- complete the scale on the y-axis
- draw the bar for the melting point of fluorine.

[2 marks]



0 4 . 5 Explain the trend in the melting points of the Group 7 elements.

Use **Figure 4**.

[3 marks]

0 4 . 6 What is the state symbol for bromine at -50°C ?

Use **Figure 4**.

[1 mark]

Tick (\checkmark) **one** box.

(aq)

(g)

(l)

(s)

0 4 . 7 Evaporation and boiling occur at the surface of bromine at its boiling point.

Name **one** more process that happens at the surface of bromine at its boiling point.

[1 mark]

10

Turn over for the next question

Turn over ►



1 3

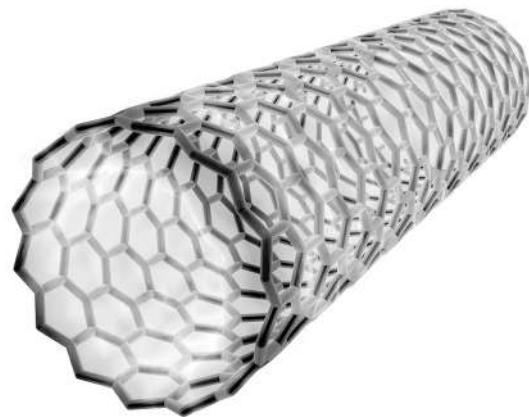
0 5

This question is about structure and bonding.

0 5

1 **Figure 5** represents part of a carbon molecule.

Figure 5



Name the type of carbon molecule in **Figure 5**.

[1 mark]

0 5

2 Suggest **one** property that makes the carbon molecule in **Figure 5** useful in nanotechnology.

[1 mark]



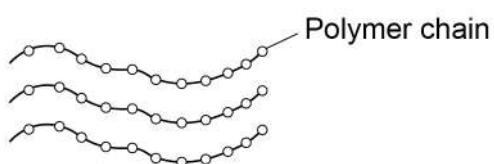
0 5 . 3 An alloy of aluminium contains small amounts of other metals.

Explain why other metals are added to aluminium.

[4 marks]

0 5 . 4 **Figure 6** represents part of the structure of a polymer.

Figure 6



Compare the bonding within the chains with the forces between the chains in this polymer.

[3 marks]

9

Turn over ►



1 5

0 6

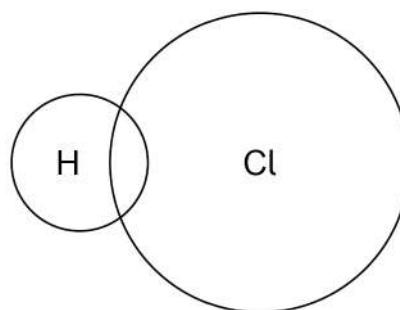
This question is about hydrogen chloride and hydrochloric acid.

0 6 . 1

Complete the dot and cross diagram to represent the bonding in hydrogen chloride on **Figure 7**.

Use dots (o) and crosses (x) to represent electrons.

You should show only the electrons in the outer shells.

[2 marks]**Figure 7****0 6 . 2**

Hydrogen chloride dissolves in water to produce hydrochloric acid.

Hydrochloric acid is a strong acid.

What is meant by the term strong acid?

[1 mark]

0 6 . 3

Describe how magnesium can be used to distinguish between a strong acid and a weak acid of the same concentration.

[2 marks]



0 6 . 4 The concentration of hydrochloric acid is increased by a factor of 100

What is the change in pH?

[2 marks]

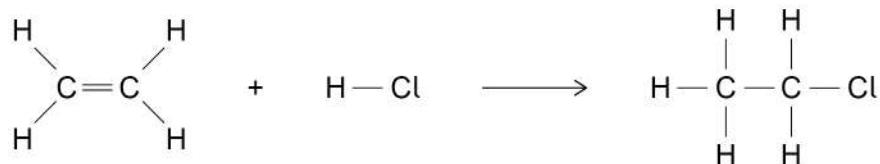
Question 6 continues on the next page

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0 6 . 5 Ethene and hydrogen chloride react to produce chloroethane.

The displayed formulae equation for the reaction is:



The reaction is exothermic.

In the reaction the energy released forming new bonds is 56 kJ/mol greater than the energy needed to break existing bonds.

Table 1 shows some bond energies.

Table 1

Bond	H–C	C=C	H–Cl	C–C	C–Cl
Bond energy in kJ/mol	413	X	431	346	339

Calculate the bond energy X.

[4 marks]

X = _____ kJ/mol

11



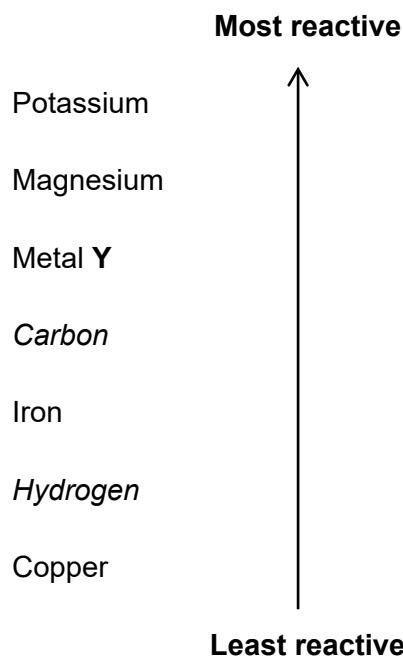
1 8

0 7

This question is about elements and compounds.

0 7 . 1

Figure 8 shows a reactivity series.

Figure 8

Give the method and conditions used to extract metal Y from a compound of metal Y.
[2 marks]

Question 7 continues on the next page

Turn over ►



Sodium reacts with titanium chloride (TiCl_4) to produce titanium.

0 7. 2 Complete the equation.

You should balance the equation.

[2 marks]



0 7. 3 The reaction between sodium and titanium chloride is a redox reaction.

Write a half-equation to show that sodium is oxidised in this reaction.

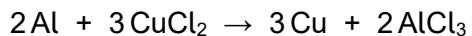
[2 marks]



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0 7 . 4 108 g of aluminum reacts with 1.21 kg of copper chloride to produce copper.

The equation for the reaction is:



Calculate the maximum mass of copper produced in grams (g).

You should determine the limiting reactant.

Relative atomic masses (A_r): Al = 27 Cu = 63.5

Relative formula masses (M_r): $\text{CuCl}_2 = 134.5$ $\text{AlCl}_3 = 133.5$

[6 marks]

Limiting reactant is _____

Mass of copper = _____ g

Question 7 continues on the next page

Turn over ►



Sodium metal and sodium chloride are both able to conduct electricity.

0 7 . 5 Describe how sodium metal conducts electricity.

[2 marks]

0 7 . 6 Explain how sodium chloride can conduct electricity.

[3 marks]

17

END OF QUESTIONS



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2 8



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