

**AQA**

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

GCSE COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 1H

Time allowed: 1 hour 15 minutes

Materials

For this paper, you must have:

- A scientific calculator
- A ruler
- A periodic table

Instructions

- Use black ink or a black- ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer 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 got your answer.

Information

- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.

Advice

- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

0 1

A student investigated the temperature change when hydrochloric acid is added to sodium hydroxide solution.

This is the method they used:

1. Place a polystyrene cup into a cotton wool filled glass beaker.
2. Add 25 cm³ of the sodium hydroxide solution into the polystyrene cup.
3. Measure and record the temperature of the sodium hydroxide solution.
4. Add 5 cm³ of the hydrochloric acid to the polystyrene cup and stir.
5. Cover the polystyrene cup with a lid.
6. Measure and record the highest temperature reached by the mixture.
7. Repeat steps 1-6 increasing the volume of acid added by 5 cm³ each time.

Figure 1 shows the apparatus the student used.

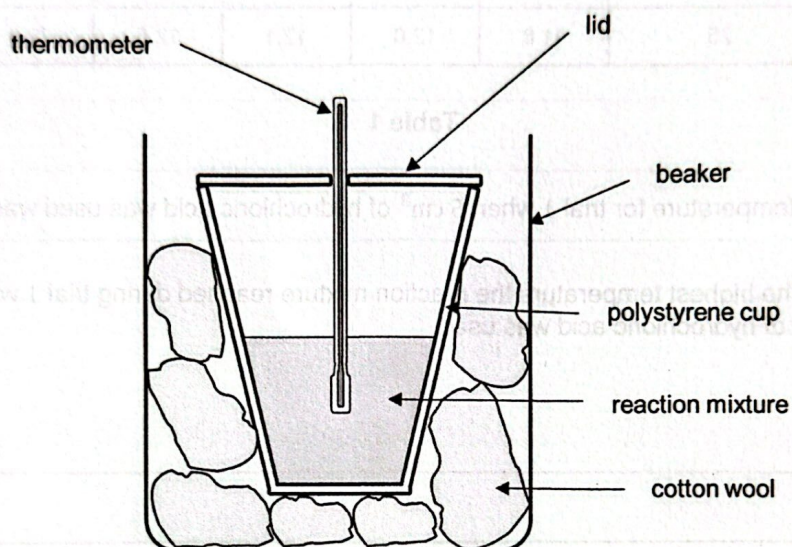


Figure 1

0 1.1

Why did the student put the polystyrene cup in a beaker of cotton wool and keep a lid on the cup?

[1 mark]

0 1.2

Give **two** variables the student should have kept the same in this investigation.

[2 marks]

1.

2.

Question continues on next page

The student repeated the method three more times, and recorded their results in Table 1.

Volume of hydrochloric acid (cm ³)	Temperature change (°C)				
	Trial 1	Trial 2	Trial 3	Trial 4	Mean
5	4.0	4.4	4.1	4.2	4.2
10	6.5	6.2	6.8	6.9	6.6
15	8.3	8.0	8.1	8.0	8.1
20	10.1	10.6	10.3	10.6	X
25	11.8	12.0	12.1	12.5	12.1

Table 1

- 0 1.3** The initial temperature for trial 1 when 5 cm³ of hydrochloric acid was used was 20.2°C.

Calculate the highest temperature the reaction mixture reached during trial 1 when only 5 cm³ of hydrochloric acid was used.

[2 marks]

Highest temperature = _____ °C

- 0 1.4** Calculate the value of X in Table 1.

[2 marks]

X = _____

0 1.5 Describe the results seen in Table 1.

[1 mark]

0 1.6 State whether the reactions in this investigation were endothermic or exothermic.
Explain your answer.

[2 marks]

Question continues on next page

Figure 2 shows a reactivity series of metals.

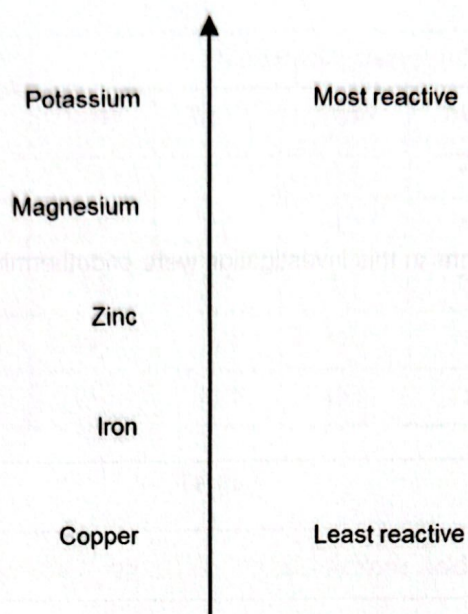


Figure 2

- 0 1.7** Explain how you could adapt the student's investigation to verify the reactivity series of metals seen in Figure 2.

[4 marks]

Turn over ►

0 2 This question is about bonding and structure.

0 2.1 Which of these substances are simple molecular substances?

Tick the relevant boxes.

[1 mark]

Iron

☐

Methane

☐

Water

☐

Magnesium oxide

☐

0 2.2 Explain why metals are good conductors of electricity.

[2 marks]

0 2.3 What is an *alloy*?

[1 mark]

0 2.4 Explain why an alloy of iron, instead of pure iron, is used to make tools.

[1 mark]

Question continues on next page

Turn over ►

0 2.5

Figure 3 shows the proportion of iron and chromium in a metal alloy.

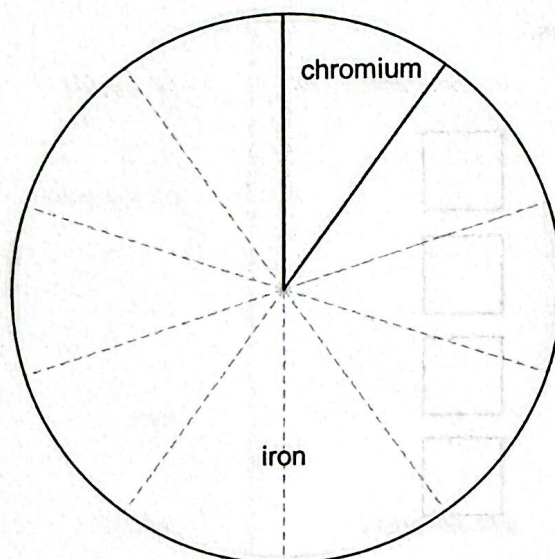


Figure 3

Calculate the percentage of iron in this metal alloy.

[2 marks]

Percentage = _____ %

Substance	Melting point (°C)
Water	0
Sodium chloride	801
Diamond	3550

Explain the results in Table 2.

Refer to the structure and bonding of each substance in your answer.

[6 marks]

[illegible]

Turn over for next question

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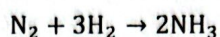
7979

0 3.2

Explain the difference between the strength and concentration of an acid.

[2 marks]

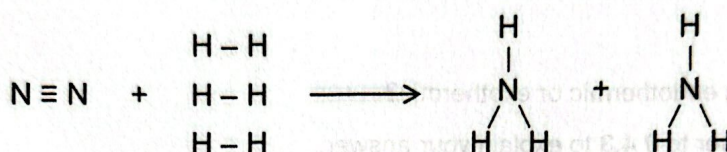
0 4 The symbol equation shows the reaction between nitrogen and hydrogen.



0 4.1 Name the product in this reaction.

[1 mark]

The structural formulae in the equation below show the bonds in each molecule involved in this reaction.



The bond energies for these molecules are given in Table 3.

Bond	Bond energy (kJ/mol)
$\text{N} \equiv \text{N}$	941
$\text{H} - \text{H}$	436
$\text{N} - \text{H}$	391

Table 3

0 4.2 Write down the number of each bond broken and bond formed during this reaction.

[2 marks]

Question continues on next page

0 4.3 Using the figures in Table 3, calculate the overall energy change for this reaction.

[3 marks]

Energy Change = _____ kJ/mol

0 4.4 Is this reaction endothermic or exothermic?

Use your answer to **0 4.3** to explain your answer.

[2 marks]

0 4.5 In the space provided below, draw a reaction profile for this reaction.

[3 marks]

0 4.6 On your diagram in 0 4.5, draw an arrow representing the activation energy.

[1 mark]

Turn over for next question

0 5 This question is about electrolysis.

0 5.1 What is meant by an *electrolyte*?

[2 marks]

0 5.2 Explain why the electrodes used in electrolysis are inert.

[1 mark]

0 5.3 Hydrogen and chlorine are produced when a solution of sodium chloride is electrolysed.

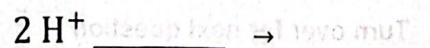
Explain why hydrogen is produced instead of a solid layer of pure sodium.

[1 mark]

0 5.4 Complete the half equation for the reaction at each electrode.

[2 marks]

Negative electrode:



Positive electrode:



0 5.5

Draw a complete diagram for the production of hydrogen and chlorine via electrolysis of a solution of sodium chloride.

Include the ions and products.

Label your diagram.

Use the space provided below.

[4 marks]

Turn over for next question

0 6 Group 1 metal carbonates decompose when they are heated to produce a metal oxide and a gas.

0 6.1 What gas is produced when sodium carbonate (Na_2CO_3) is heated?

[1 mark]

Figure 4 shows the volume of gas when a Group 1 metal carbonate, X, is heated.

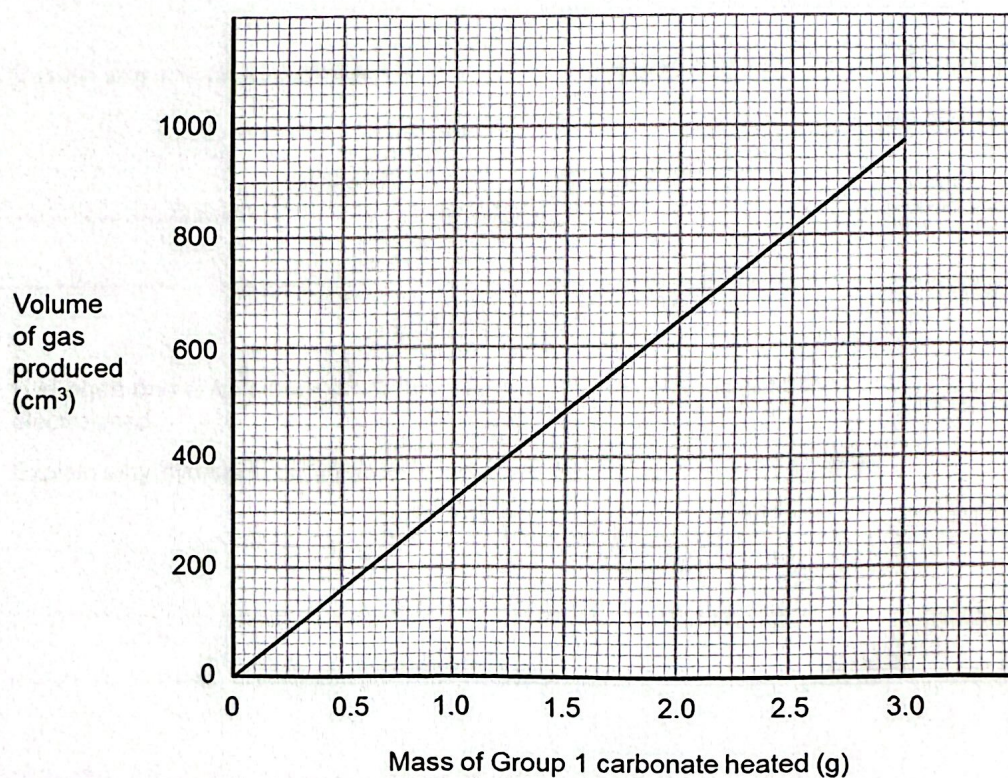


Figure 4

0 6.2 Calculate the gradient of the line in Figure 4

Give the units.

[3 marks]

Gradient = _____ Units _____

0 6.3 24 dm³ of gas is produced when one mole of a Group 1 carbonate is heated.

Using Figure 4, determine the relative formula mass (M_r) of the Group 1 carbonate, X.

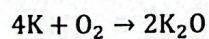
[4 marks]

Relative formula mass (M_r) = _____

Question continues on next page

0 6.4 Potassium burns in air to form potassium oxide.

The balanced chemical equation for this reaction can be seen below:



Calculate the mass of potassium oxide formed when 117 g of potassium is burned in air.

Relative atomic masses (A_r): K = 39 O = 16

[5 marks]

Mass of potassium oxide = _____ g

End of Questions