A

AQA

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Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier

Chemistry Paper 2H

H

8464/C/2H

Time allowed: 1 hour 15 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

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.**
- **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.**

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.**

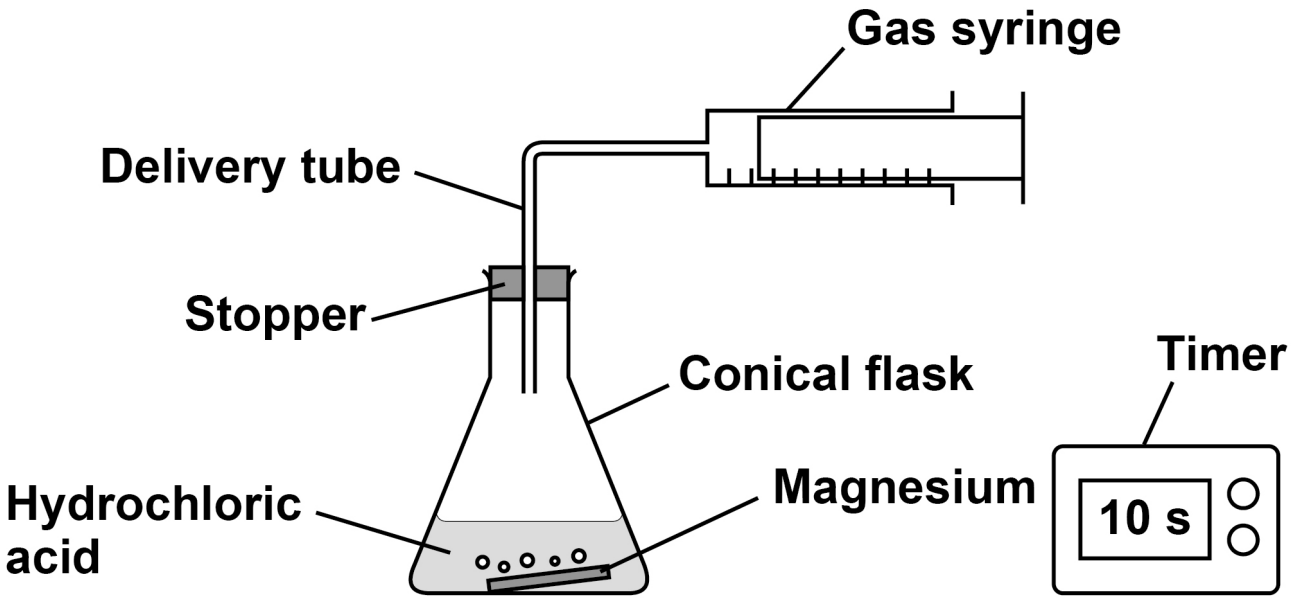
DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1

A student investigated the reaction between magnesium and excess hydrochloric acid.

FIGURE 1 shows the apparatus.

FIGURE 1



This is the method used.

1. **Pour 50 cm^3 of hydrochloric acid into a conical flask.**
2. **Add a piece of magnesium.**
3. **Insert stopper and delivery tube and start a timer.**
4. **Collect the gas produced in a gas syringe.**
5. **Record the volume of gas produced every 20 seconds for 2 minutes.**
6. **Repeat steps 1 to 5 with higher concentrations of hydrochloric acid.**

0 1 . 1

Give the independent variable and ONE control variable in this investigation. [2 marks]

Independent variable _____

_____

Control variable _____

_____

[Turn over]

TABLE 1 shows the results from the first experiment using hydrochloric acid with a low concentration.

TABLE 1

Time in seconds	0	20	40	60	80	100	120
Volume of gas in cm^3	0	48	72	90	97	98	98

0 1 . 2

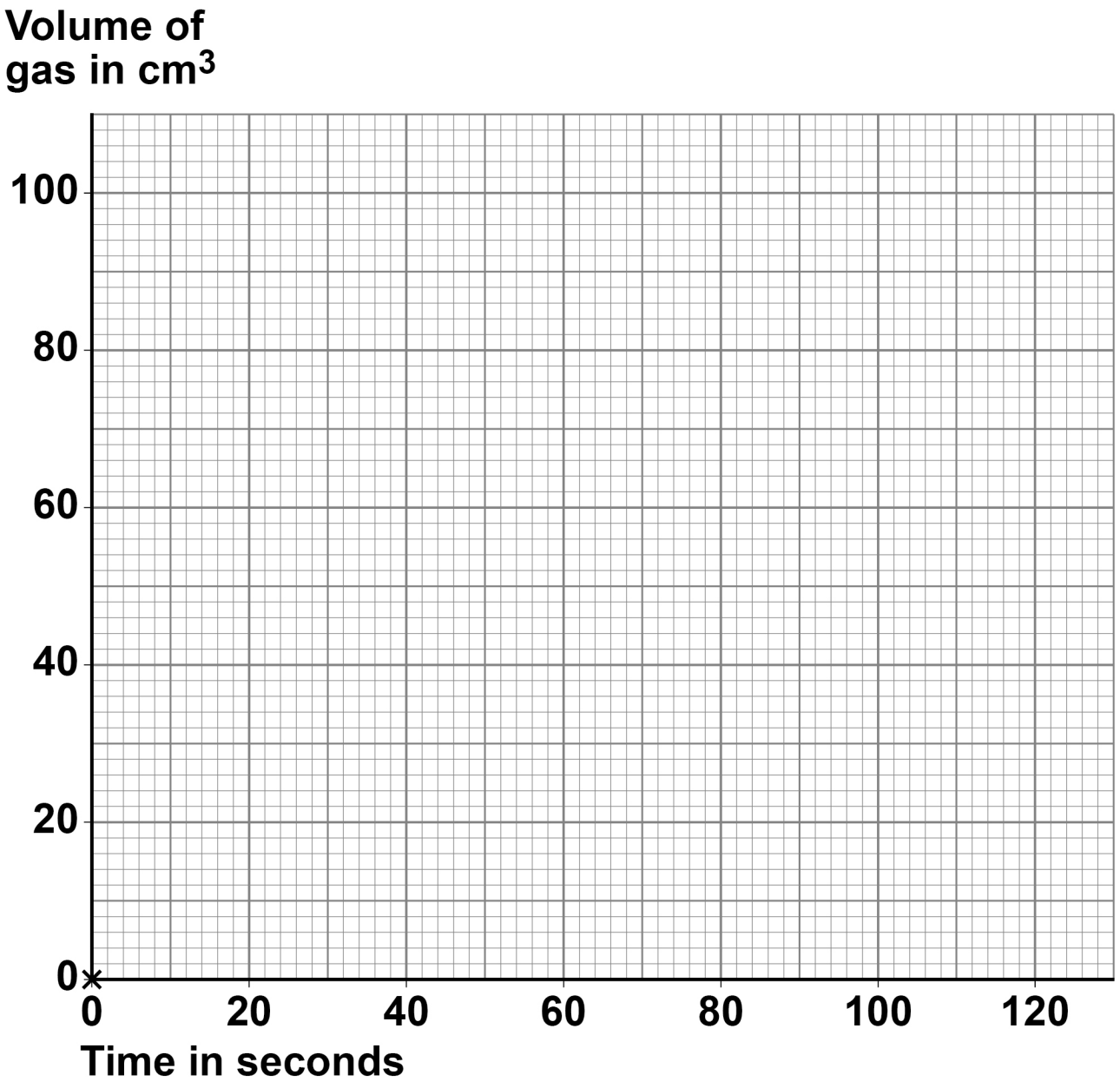
Complete FIGURE 2, on the opposite page.

You should:

- **plot the data from TABLE 1 (the point 0,0 has been plotted for you)**
- **draw a line of best fit.**

[3 marks]

FIGURE 2



[Turn over]

REPEAT OF TABLE 1

Time in seconds	0	20	40	60	80	100	120
Volume of gas in cm^3	0	48	72	90	97	98	98

0 1 . 3

How does the RATE of this reaction change with time? [1 mark]

Use TABLE 1.

Tick (✓) ONE box.

☐ **The rate decreases.**

☐ **The rate stays the same.**

☐ **The rate increases.**

0 1 . 4

The student repeated the experiment using hydrochloric acid with a higher concentration.

Which statement is correct? [1 mark]

Tick (✓) ONE box.

- ☐ **The activation energy for the reaction was higher.**
- ☐ **The magnesium reacted more quickly.**
- ☐ **The reaction finished at the same time.**
- ☐ **The total volume of gas collected was smaller.**

[Turn over]

0 1 . 5

Temperature also affects the rate of the reaction.

Explain how increasing the temperature affects the RATE of the reaction.

You should refer to particles and collisions. [3 marks]

10

0 2

Crude oil is a resource found in rocks.

Most of the compounds in crude oil are hydrocarbons.

0 2 . 1

Complete the sentence. [1 mark]

Crude oil is formed by the decomposition of

_____ .

0 2 . 2

Alkanes are hydrocarbons.

Give the name of the alkane molecule that has three carbon atoms. [1 mark]

_____

_____

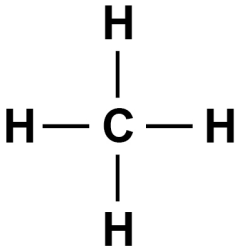
[Turn over]

0 2 . 3

FIGURE 3 shows two alkane molecules.

FIGURE 3

Methane



Hexane

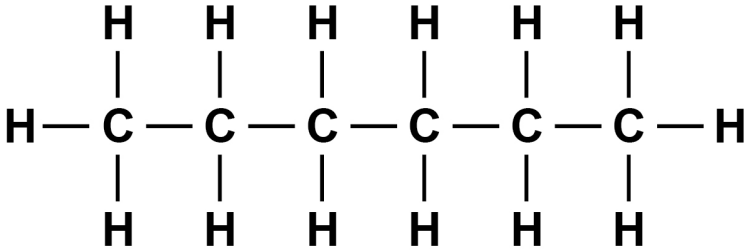


TABLE 2 shows the melting points and boiling points of methane and hexane.

TABLE 2

	Melting point in °C	Boiling point in °C
Methane	−183	−162
Hexane	−95	69

Compare the structure and properties of methane and hexane. [6 marks]

Hydrocarbons are cracked to produce more useful alkanes and alkenes.

0 2 . 4

Decane ($C_{10}H_{22}$) is cracked to produce TWO products.

Complete the equation for the reaction. [1 mark]

$C_{10}H_{22} \longrightarrow$ _____ + C_2H_4

0 2 . 5

C_2H_4 is an alkene.

What is the test for alkenes?

Give the result of the test if an alkene is present.
[2 marks]

Test _____

_____

Result _____

_____

[Turn over]

11

0 3

The methods used to produce potable water depend upon available sources of water.

0 3 . 1

Suggest how copper sulfate can be used as a test for the presence of water. [3 marks]

The boiling point is used to check the purity of a sample of water.

0 3 . 2

In chemistry, what is meant by a 'pure substance'?
[1 mark]

_____

_____

_____

[Turn over]

0 3 . 3

The boiling point of a 250 g sample of water was 100.60 °C.

The boiling point of pure water in a data book is 100.00 °C.

Each 1% of impurity increases the boiling point of water by 0.12 °C.

Calculate the mass of the impurity in the sample of water. [3 marks]

Mass of the impurity = _____ **g**

[Turn over]

0 3 . 4

Explain how distillation is used to obtain potable water from salty water. [4 marks]

0 3 . 5

Obtaining potable water from salty water is more expensive than obtaining potable water from ground water.

Explain why.

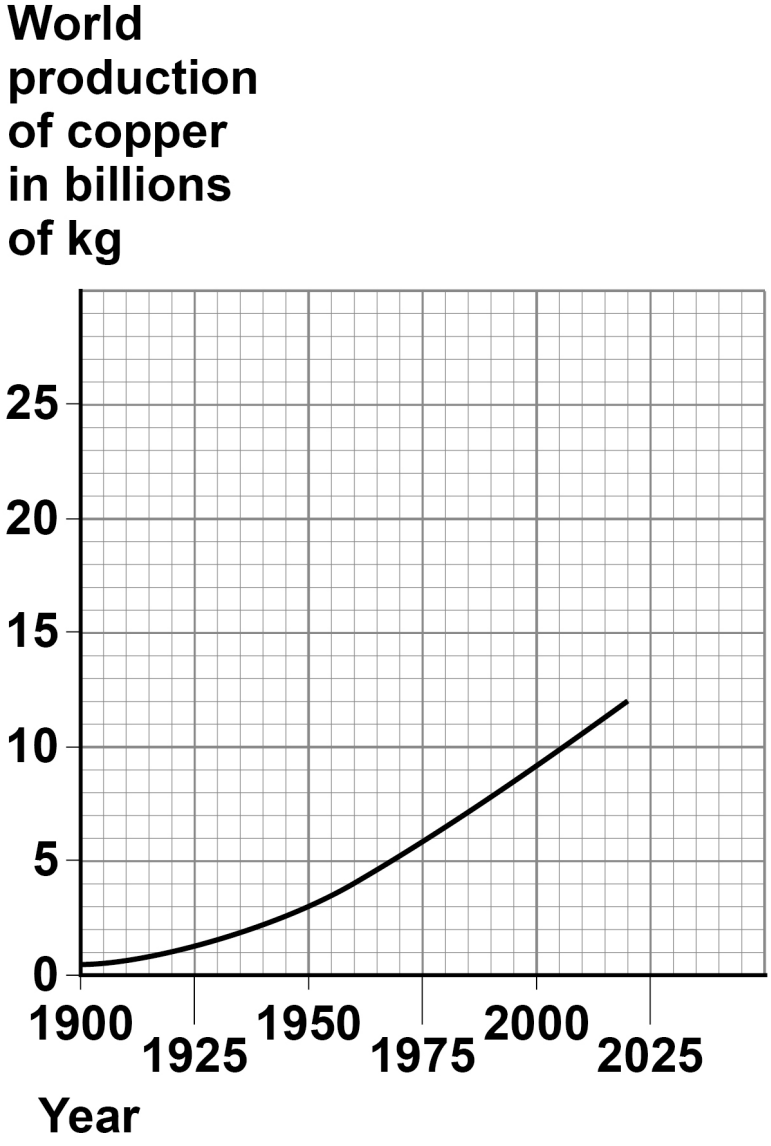
Refer to the processes used in both methods in your answer. [2 marks]

0 4

Industries use the Earth's natural copper resources to produce useful products.

FIGURE 4 shows the world production of copper from 1900 to 2020.

FIGURE 4



0 4 . 1

Describe the trend shown by the graph in FIGURE 4.
[2 marks]

0 4 . 2

Suggest ONE reason for the trend in FIGURE 4.
[1 mark]

[Turn over]

0 4 . 3

Suggest ONE reason why the trend cannot be used to accurately predict the future world production of copper. [1 mark]

0 4 . 4

High-grade copper resources are now difficult to find.

Phytomining is used to extract copper from low-grade ores.

There are five stages, A, B, C, D and E, in phytomining.

The stages are NOT in the correct order.

Stage A Copper compounds from ash are dissolved in acid.

Stage B Plants absorb metal compounds.

Stage C Plants are burned.

Stage D Plants are harvested.

Stage E Solution of copper compound is electrolysed.

What is the correct order of stages A, B, C, D, and E?
[1 mark]

Tick (✓) ONE box.

- ☐ **B, C, D, E, A**
- ☐ **B, D, C, A, E**
- ☐ **D, B, C, E, A**
- ☐ **D, C, B, A, E**

[Turn over]

0 4 . 5

Give TWO disadvantages of phytomining compared with traditional mining methods.

Do NOT refer to cost in your answer. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 4 . 6

In one year, 8.89×10^9 kg of copper was produced.

41.0% of this copper was produced from recycled copper.

The energy needed to produce 1 kg of copper from copper ore is 70.4 MJ.

The energy needed to produce 1 kg of recycled copper is 27.2 MJ.

Calculate the difference in energy used if all the copper was produced from recycling.

Give your answer to 3 significant figures. [5 marks]

Difference in energy used (3 significant figures) =

_____ **MJ**

0 5

Atmospheric pollution is emitted by cars.

Some car emissions contain nitrogen dioxide.

0 5 . 1

Describe how nitrogen dioxide (NO_2) is produced in the engine of a car that burns fossil fuels. [3 marks]

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[Turn over]

TABLE 3 shows the concentration of nitrogen dioxide in the air in three different areas for 1 week.

TABLE 3

	Concentration of nitrogen dioxide in the air in micrograms per m^3		
Day	**City centre**	**Countryside**	**Motorway**
Monday	**35**	**8**	**22**
Tuesday	**37**	**8**	**23**
Wednesday	**37**	**8**	**23**
Thursday	**34**	**8**	**23**
Friday	**37**	**8**	**23**
Saturday	**29**	**7**	**20**
Sunday	**X**	**6**	**17**

0 5 . 2

The mean value for nitrogen dioxide in the air for the whole week in the city centre is 33 micrograms per m^3.

Calculate the value (X) for the concentration of nitrogen dioxide in the air in the city centre on Sunday.
[2 marks]

X = _____ micrograms per m^3

[Turn over]

0 5 . 3

Each value in TABLE 3, on page 30, has an uncertainty of ± 2 micrograms per m^3.

Explain why this uncertainty is MOST significant for countryside data. [2 marks]

Nitrogen dioxide is removed from car emissions by catalytic converters.

0 5 . 4

In a catalytic converter nitrogen dioxide (NO_2) reacts to produce nitrogen and oxygen.

Complete the equation for the reaction.

You should balance the equation. [2 marks]

_____ $NO_2 \longrightarrow$ _____ + _____

0 5 . 5

The catalyst in a catalytic converter contains platinum.

Platinum is a finite resource.

What is meant by a 'finite resource'? [1 mark]

_____

_____

_____

[Turn over]

0 5 . 6

Emissions from cars contain carbon dioxide.

Explain why carbon dioxide emissions during use and operation are NOT the total carbon footprint for a car.

Refer to the stages of the life cycle assessment of a car in your answer. [3 marks]

13

0 6

Ammonia is produced when a mixture of nitrogen and hydrogen reacts.

The equation for the reaction is:

$$N_2\,(g) + 3\,H_2\,(g) \rightleftharpoons 2\,NH_3\,(g)$$

0 6 . 1

Nitrogen is obtained from the air.

The mixture of nitrogen and hydrogen must NOT contain carbon dioxide and oxygen.

Explain how a sample can be tested to show that carbon dioxide is NOT present in the mixture. [2 marks]

0 6 . 2

A catalyst is used in the reaction.

Explain how a catalyst increases the rate of a reaction. [2 marks]

The equation for the reaction to produce ammonia is repeated here.

$$N_2\,(g) + 3\,H_2\,(g) \rightleftharpoons 2\,NH_3\,(g)$$

0 6 . 3

The reaction reaches equilibrium.

Explain how an equilibrium is reached. [2 marks]

0 6 . 4

Suggest how the catalyst affects the equilibrium position.

Give ONE reason for your answer. [2 marks]

0 6 . 5

What is the effect of increasing the pressure on the reaction to produce ammonia? [1 mark]

Tick (✓) ONE box.

- ☐ **The yield of ammonia decreases.**
- ☐ **The yield of ammonia stays the same.**
- ☐ **The yield of ammonia increases.**

[Turn over]

0 6 . 6

The forward reaction is exothermic.

Explain the effect of increasing the temperature on the yield of ammonia gas produced at equilibrium.
[2 marks]

END OF QUESTIONS

11

Additional page, if required.
Write the question numbers in the left-hand margin.

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Additional page, if required.

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For Examiner's Use	
Question	Mark
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