

Please write clearly in block capitals.

Centre number

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Candidate signature

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I declare this is my own work.

# GCSE COMBINED SCIENCE: TRILOGY

# H

Higher Tier  
Chemistry Paper 2H

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.

## 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>	



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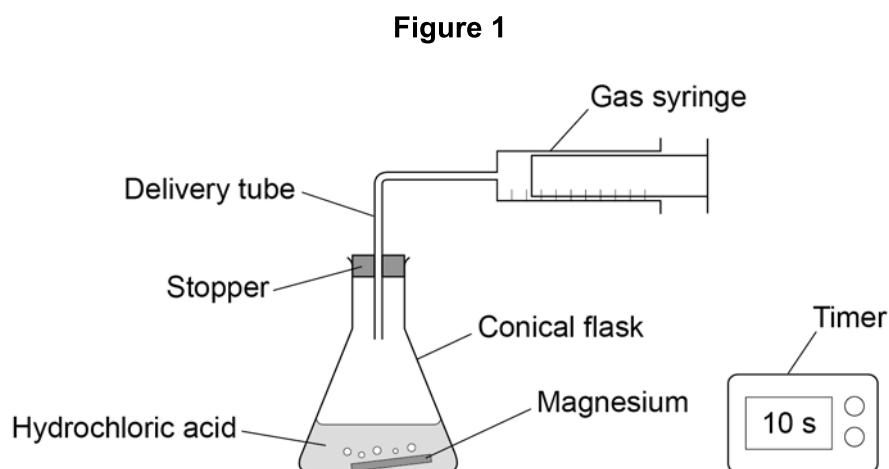
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ANSWER IN THE SPACES PROVIDED**



0 1

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

Figure 1 shows the apparatus.



This is the method used.

1. Pour 50 cm<sup>3</sup> 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 \_\_\_\_\_

**Question 1 continues on the next page**

**Turn over ►**



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

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**Table 1**

<b>Time in seconds</b>	0	20	40	60	80	100	120
<b>Volume of gas in cm<sup>3</sup></b>	0	48	72	90	97	98	98

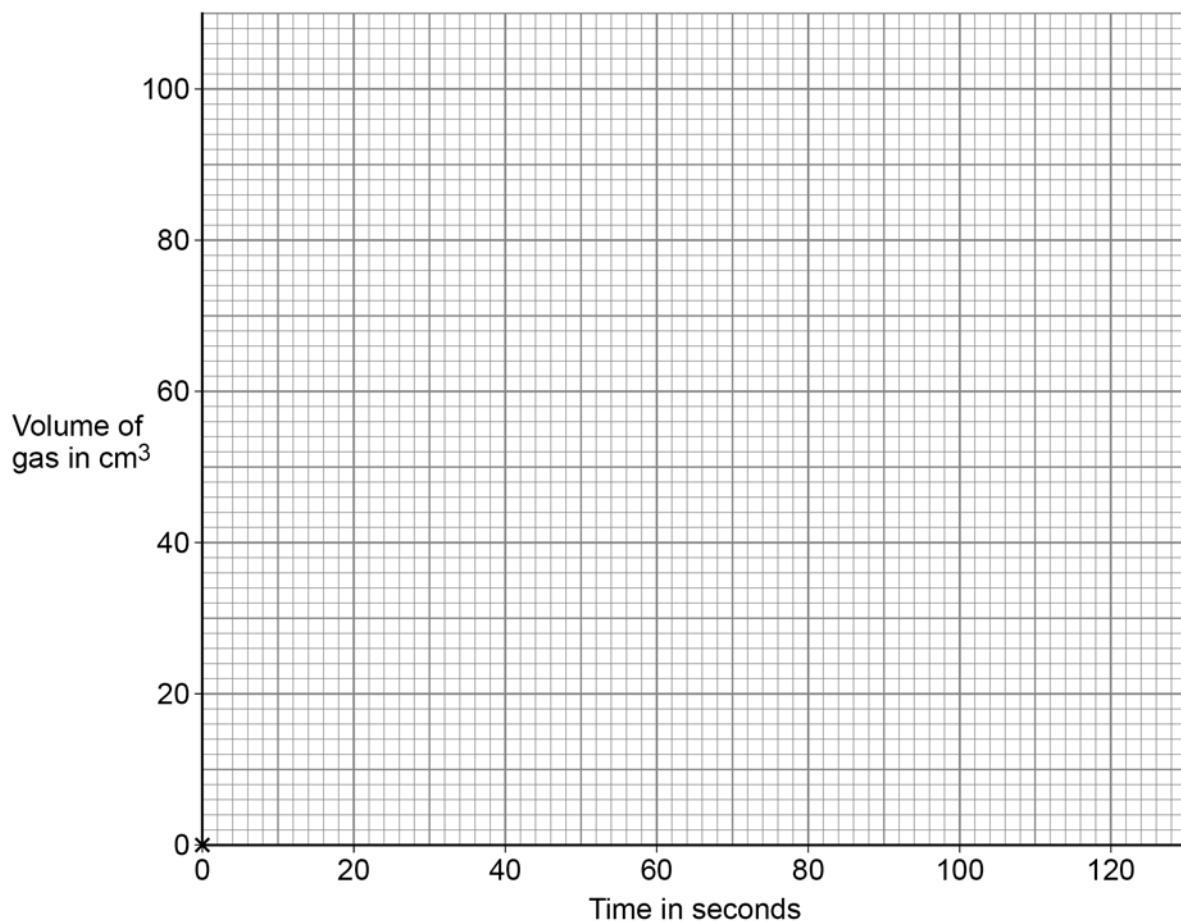
**0 1 . 2** Complete **Figure 2**.

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**



0 1 . 3 How does the **rate** of this reaction change with time?

Use **Table 1**.

[1 mark]

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.

**Question 1 continues on the next page**

**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]

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10



0	2
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Crude oil is a resource found in rocks.

Most of the compounds in crude oil are hydrocarbons.

0	2	.	1
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Complete the sentence.

[1 mark]

Crude oil is formed by the decomposition of \_\_\_\_\_.

0	2	.	2
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Alkanes are hydrocarbons.

Give the name of the alkane molecule that has three carbon atoms.

[1 mark]

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**Question 2 continues on the next page**

**Turn over ►**



0 2 . 3 Figure 3 shows two alkane molecules.

Figure 3

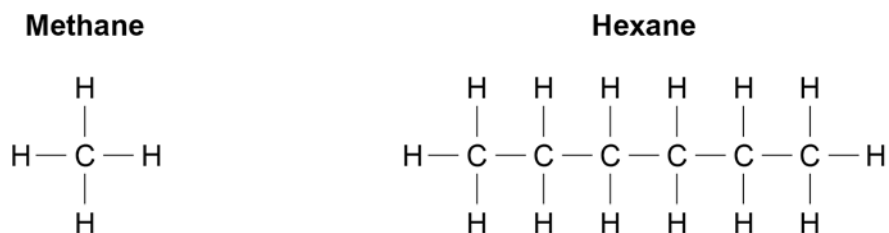


Table 2 shows the melting points and boiling points of methane and hexane.

Table 2

	Melting point in °C	Boiling point in °C
<b>Methane</b>	-183	-162
<b>Hexane</b>	-95	69

Compare the structure and properties of methane and hexane.

[6 marks]

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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]**



**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 \_\_\_\_\_

\_\_\_\_\_

**11**

**Turn over for the next question**

**Turn over ▶**



**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]**

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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]**

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**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]**

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Mass of the impurity = \_\_\_\_\_ g

**0 3 . 4**

Explain how distillation is used to obtain potable water from salty water.

**[4 marks]**

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**Question 3 continues on the next page**

**Turn over ►**

0	3	.	5
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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]**

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13
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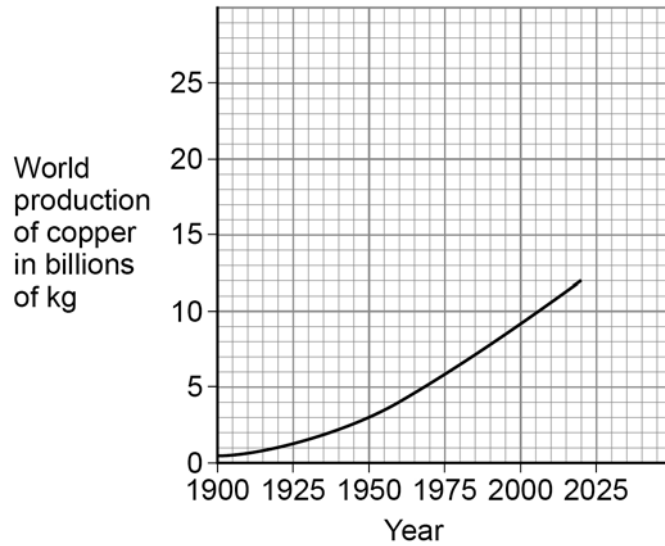


0 4

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]

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0 4 . 2

Suggest one reason for the trend in Figure 4.

[1 mark]

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0	4	.	3
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Suggest **one** reason why the trend cannot be used to accurately predict the future world production of copper.

**[1 mark]**

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**Question 4 continues on the next page**

**Turn over ►**



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**





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,  $8.89 \times 10^9$  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]

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Difference in energy used (3 significant figures) = \_\_\_\_\_ MJ

12

Turn over ►



0 5

Atmospheric pollution is emitted by cars.

Some car emissions contain nitrogen dioxide.

0 5 1

Describe how nitrogen dioxide ( $\text{NO}_2$ ) is produced in the engine of a car that burns fossil fuels.

[3 marks]

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

**Table 3**

Day	Concentration of nitrogen dioxide in the air in micrograms per $\text{m}^3$		
	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<sup>3</sup>.

Calculate the value (**X**) for the concentration of nitrogen dioxide in the air in the city centre on Sunday.

**[2 marks]**

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**X** = \_\_\_\_\_ micrograms per m<sup>3</sup>

0 5 . 3

Each value in **Table 3** has an uncertainty of  $\pm 2$  micrograms per m<sup>3</sup>.

Explain why this uncertainty is **most** significant for countryside data.

**[2 marks]**

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**Question 5 continues on the next page**

**Turn over ►**

Nitrogen dioxide is removed from car emissions by catalytic converters.

**0 5 . 4** In a catalytic converter nitrogen dioxide (NO<sub>2</sub>) reacts to produce nitrogen and oxygen.

Complete the equation for the reaction.

You should balance the equation.

**[2 marks]**



**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]**

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**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]**

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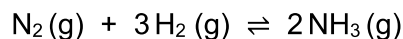
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**0 6**

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

The equation for the reaction is:

**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]**

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**0 6 . 2**

A catalyst is used in the reaction.

Explain how a catalyst increases the rate of a reaction.

**[2 marks]**

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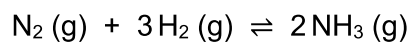
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**Question 6 continues on the next page**

**Turn over ►**

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



**0 6 . 3** The reaction reaches equilibrium.

Explain how an equilibrium is reached.

**[2 marks]**

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**0 6 . 4** Suggest how the catalyst affects the equilibrium position.

Give **one** reason for your answer.

**[2 marks]**

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**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.



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]**

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**11****END OF QUESTIONS**

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2 8



2 1 6 G 8 4 6 4 / C / 2 H

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