AQA

Please write clearly in block capitals.

Centre number | 1 | 2 | 3 | 4 | 5 | Candidate number | 1 | 2 | 3 | 4 |

Surname EXAMPLE

Forename(s) JOHN

Candidate signature J Evans

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.

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

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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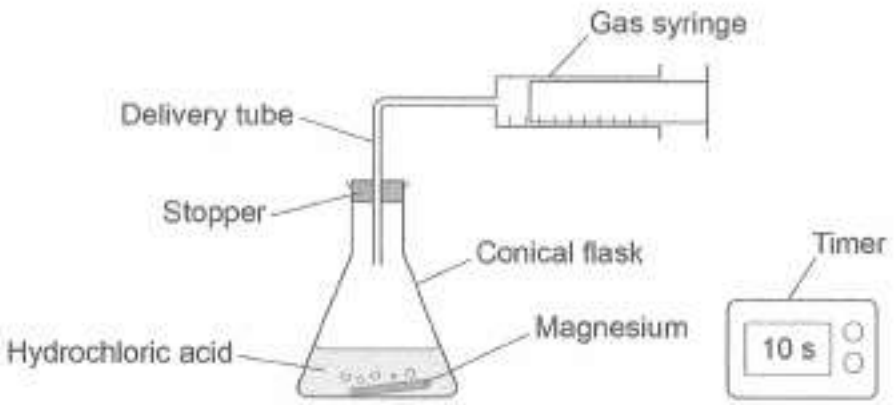
0 1 A student investigated the reaction between magnesium and excess hydrochloric acid.

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: Concentration of Hydrochloric Acid

Control variable: length and Surface area of Magnesium.

Question 1 continues on the next page

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

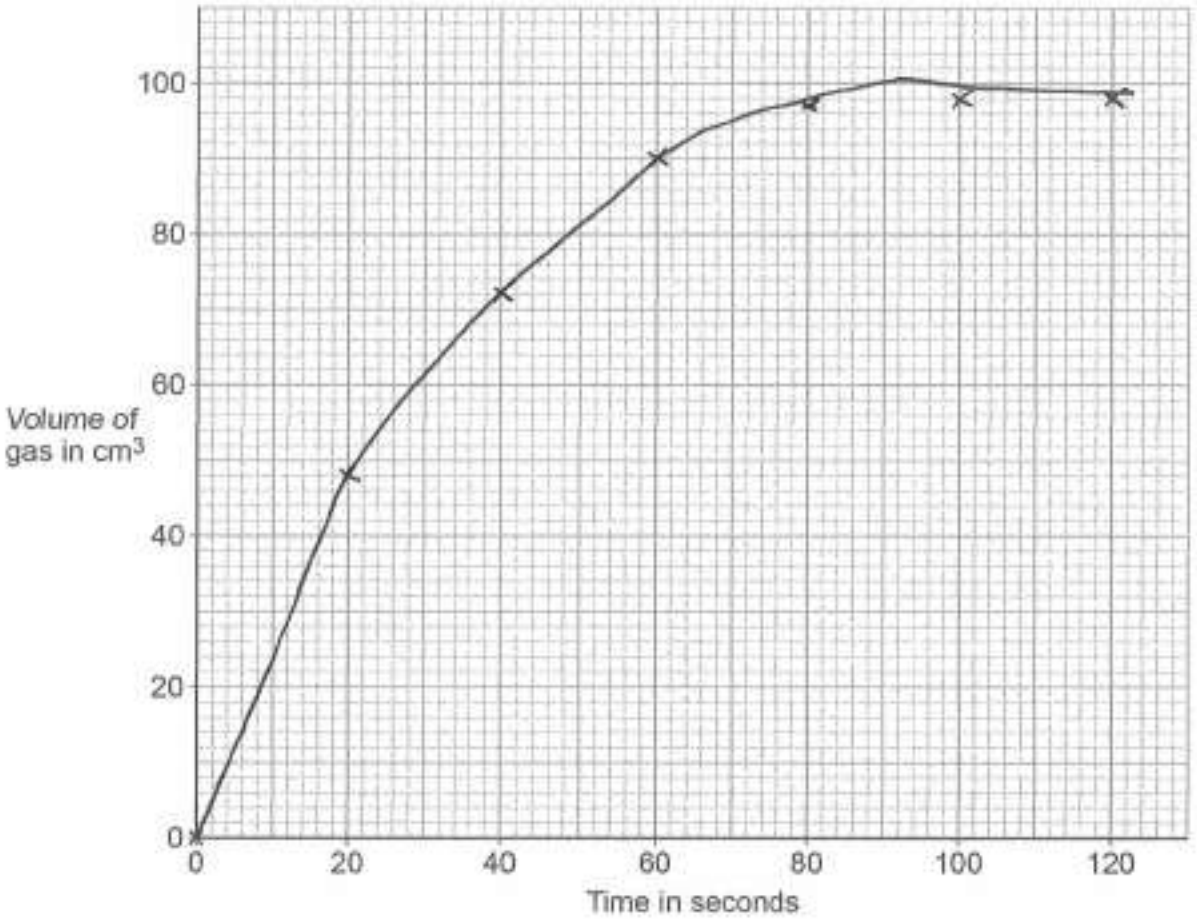
0 1 . 2 Complete **Figure 2.**

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



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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

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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]

Temperature increases the rate of reaction by increasing the kinetic energy of the particles. This means that collisions between particles are more frequent and happen with enough energy to react more often.

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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 Ancient Biomass.

0 2 . 2 Alkanes are hydrocarbons.

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

[1 mark]

Propane

Question 2 continues on the next page

0 2 . 3 **Figure 3** shows two alkane molecules.

Figure 3

Methane

Hexane

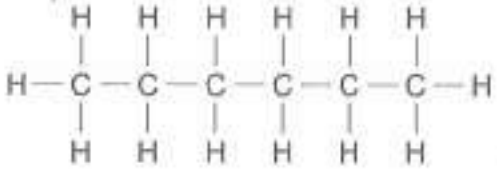

Table 2 shows the melting points and boiling points of methane and hexane.

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]

Methane is made up of 1 Carbon atom bonded to 4 Hydrogen atoms. It is a small molecule with weak intermolecular forces. This means it has a low melting point and boiling point and is as such a Gasat room temperature. Hexane is a much larger molecule, with 6 Carbons bonded to each other in a chain, with 14 hydrogens bonded. As it is a Larger molecule its inter-molecular forces are stronger than methane's. This means it's boiling point and melting point is higher than methane. It is a liquid at room temperature.

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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]

$C_{10}H_{22} \rightarrow$ C8 H18 + 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 Bromine water

Result It will turn from orange to colourless in the presence of an alkene.

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Turn over for the next question

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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]

A Solution Suspected of Containing water Can be added to anhydrous copper Sulfate. If water is present then the white Copper Sulfate will turn blue

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]

A Substance Containg only a Single element or Compound.

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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]

% impurity = $\frac{0.6}{0.12}$ = 5%

mass of impurity = 250g × 5% as 5% = 0.05

= 250g × 0.05

= 12.5g

Mass of the impurity = 12.5 g

0 3 . 4 Explain how distillation is used to obtain potable water from salty water.

[4 marks]

Distillation can purity salty water using evaporation. Salty water is boiled and the resulting steam collected. When the salty water boils off it leaves behind the salt. The steam can then be condensed back to water. This gives a pure and potable sample.

Question 3 continues on the next page

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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]

Distillation requires energy to heat enough to boil the water. Ground water only needs to be filtered and sterilised.

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Turn over for the next question

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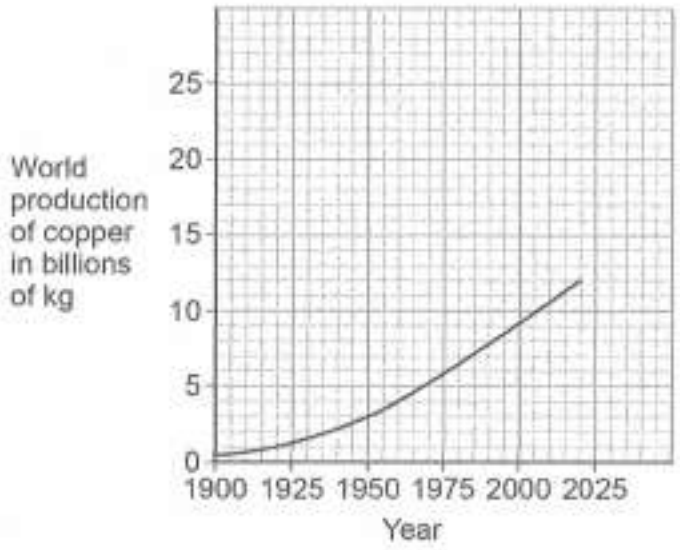
0 4 Industries use the Earth's natural copper resources to produce useful products.

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]

The amount of copper produced has been increasing at an accelerating rate between 1900 and 2020

0 4 . 2 Suggest **one** reason for the trend in **Figure 4**.

[1 mark]

population growth

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

[1 mark]

Alternative metals may be used in the future.

Question 4 continues on the next page

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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 ☐

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0 4 . 5 Give **two** disadvantages of phytomining compared with traditional mining methods.

Do **not** refer to cost in your answer.

[2 marks]

1 Phytomining produces copper more slowly

2 Requires a large area of land.

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]

Energy for recycling = $27.2 \times 8.89 \times 10^9 \times 0.41$

$= 9.914 \times 10^{10}$ MJ

Energy for extraction = $70.4 \times 8.89 \times 10^9 \times 0.59$

$= 3.693 \times 10^{11}$ MJ

Total Consumption = $9.914 \times 10^{10} + 3.693 \times 10^{11} = 4.6844 \times 10^{11}$ MJ

only recycling = 2.418×10^{11} MJ

Saving = $4.6844 \times 10^{11} - 2.418 \times 10^{11} = 2.27 \times 10^{11}$ MJ

Difference in energy used (3 significant figures) = 2.27×10^{11} MJ

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Turn over ▶

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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.

$\mu g\ m^{-3}$

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

[2 marks]

mean = 33 $\mu g\ m^{-3}$

$33 = \frac{35 + 37 + 37 + 34 + 37 + 29 + x}{7}$

$x = (7 \times 33) - [(3 \times 37) + 34 + 29]$ X = 22 micrograms per m^3

$= 22\ \mu g\ m^{-3}$

0 5 . 3 Each value in **Table 3** has an uncertainty of ± 2 micrograms per m^3.

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

[2 marks]

These results have the lowest value. $\pm 2\ \mu g\ m^{-3}$ will not affect 35 or 23 $\mu g\ m^{-3}$ readings to much as they are only a small percentage. For a reading of 6 $\mu g\ m^{-3}$, $\pm 2 \mu g\ m^{-3}$ means an error of 33%

Question 5 continues on the next page

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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]

$2\ NO_2 \rightarrow N_2 + 2O_2$

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]

One that can't be renewed or replaced and as such will run out

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]

Carbon dioxide will be produced during the manufacturing stage of the car. Extraction and processing of materials will contribute to the cars carbon foot print, so will any disposal and recycling processes at the end of the cars life cycle.

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

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

0 6 . 3 The reaction reaches equilibrium.

Explain how an equilibrium is reached.

[2 marks]

The reaction must take place in a closed system so that no products or reactants escape. Equilibrium is reached when the rates of forward and backwards reaction are equal

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

Give **one** reason for your answer.

[2 marks]

The equilibrium position is unaffected because both forward and backward reactions would be increased by the same amount

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. ☑

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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]

The yeild of amonia will decrease as the reaction will shift left to the endo thermic side to reduce the increased heat

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END OF QUESTIONS