

Please write clearly in block capitals.

Centre number

1	2	3	4	5
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Candidate number

1	2	3	4
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Surname

Example

Forename(s)

John

Candidate signature

John

I declare this is my own work.

GCSE COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Chemistry Paper 2F

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	
7	
TOTAL	



JUN218464C2F01

0 1

Fresh water contains low levels of dissolved salts.

Water reacts with anhydrous copper sulfate in a reversible reaction.

The word equation for the reaction is:



0 1

1

How does the equation show that the reaction is reversible?

[1 mark]

The two arrows of the equation are
parallel and pointing in opposite directions.



0 1

2

Complete the sentences.

Choose answers from the box.

[2 marks]

~~blue~~

green

orange

~~white~~

yellow

The colour of anhydrous copper sulfate is

white

The colour of hydrated copper sulfate is

blue



0 1 3 Figure 1 shows anhydrous copper sulfate in a sealed container.

Figure 1



Suggest one reason why anhydrous copper sulfate is kept in a sealed container.

[1 mark]

To prevent the copper sulfate reacting with water vapour in the air

Question 1 continues on the next page

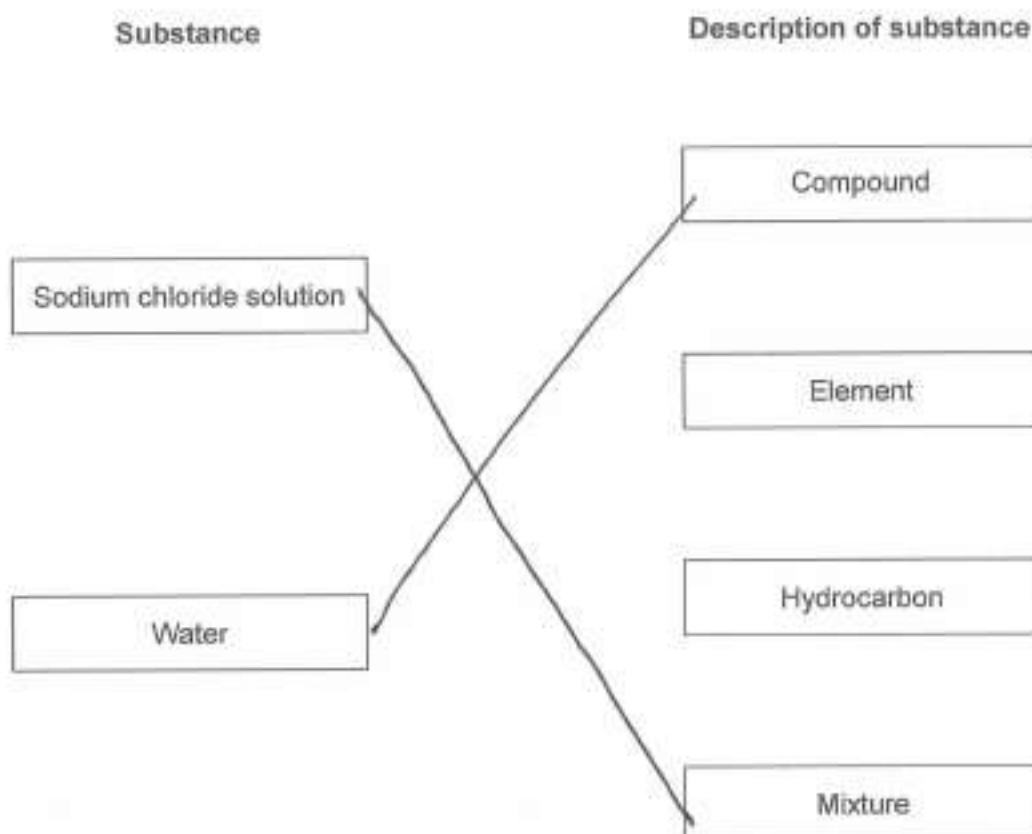
Turn over ►



Sodium chloride dissolves in water to form sodium chloride solution.

0 1 . 4 Draw one line from each substance to the description of the substance.

[2 marks]



0 1 . 5 Name the process used to obtain solid sodium chloride from sodium chloride solution.

[1 mark]

evaporation.



0 1 . 6 Two processes used to obtain potable water from fresh water are:

- filtering
- sterilising.

Give one reason why each process is used.

[2 marks]

Filtering To remove solid contaminants
from the water

Sterilising To kill any bacteria or
micro-organisms in the water

0 1 . 7 Which type of water is the easiest to obtain potable water from?

[1 mark]

Tick (✓) one box.

Ground water

☒

Salt water

☐

Waste water

☐

0 1 . 8 Which of the following is the first stage of waste water treatment?

[1 mark]

Tick (✓) one box.

Aerobic biological treatment of effluent

☐

Anaerobic digestion of sewage sludge

☐

Screening and removal of grit

☒


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ANSWER IN THE SPACES PROVIDED



0 2

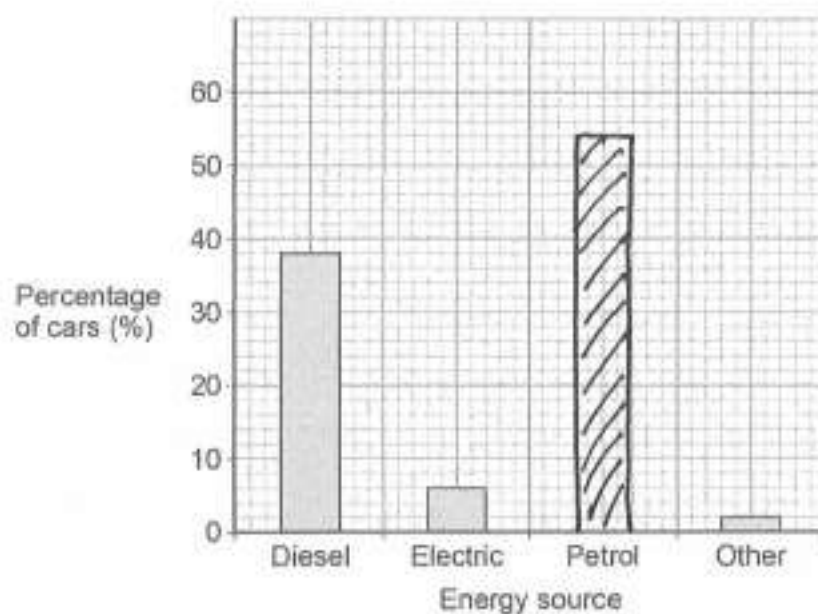
Cars cause atmospheric pollution.

0 2

1

Figure 2 shows the percentage of cars in the UK using different energy sources.

Figure 2



The percentage of cars using petrol is 54%.

Draw the bar for petrol on Figure 2.

[1 mark]

Question 2 continues on the next page

Turn over ►



Some car emissions contain nitrogen dioxide.

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

Table 1

Concentration of nitrogen dioxide in the air in arbitrary units			
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	22	6	17

0 2 . 2 Which column of data has the greatest range?

[1 mark]

Tick (✓) **one** box.

City centre

☒

Countryside

☐

Motorway

☐


- 0 2 3 Explain why the concentration of nitrogen dioxide in the air is lower on Sunday.

[2 marks]

Fewer people drive to work on a Sunday. This means there is less traffic and as such, less pollution.

- 0 2 4 Calculate the mean value for the concentration of nitrogen dioxide in the air in the city centre for the days from Monday to Friday.

Use Table 1.

[2 marks]

$$\text{mean} = \frac{35 + 37 + 37 + 34 + 37}{5}$$

$$= 36 \text{ arbitrary units}$$

Mean value for concentration of nitrogen dioxide = 36 arbitrary units

Question 2 continues on the next page

Turn over ►



Nitrogen dioxide is removed from car emissions by catalytic converters.

0 2 . 5 Which two of the following are correct statements about catalysts?

[2 marks]

Tick (✓) **two** boxes.

Catalysts are included in the chemical equation for a reaction.

☐

Catalysts are **not** used up in a reaction.

☒

Catalysts decrease the surface area of the reactants.

☐

Catalysts increase the concentration of the reactants.

☐

Catalysts lower the activation energy of a reaction.

☒

0 2 . 6 The catalyst in catalytic converters contains platinum.

Platinum is an unreactive metal obtained from the Earth's crust.

Complete the sentence.

Choose the answer from the box.

[1 mark]

finite resource

formulation

renewable resource

Platinum is a finite resource.



0 2 . 7 Emissions from cars that burn fossil fuels contain carbon dioxide.

What is used to test for carbon dioxide?

[1 mark]

Tick (✓) **one** box.

Burning splint

☐

Glowing splint

☐

Limewater

☒

10

Turn over for the next question

Turn over ►



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0 3

An increase in greenhouse gases in the Earth's atmosphere causes an increase in global temperature.

0 3 . 1

An increase in global temperature is a major cause of climate change.

Give **two** effects of global climate change.

[2 marks]

1 Rising sea levels as a result of melting
ice caps

2 More extreme weather

Question 3 continues on the next page

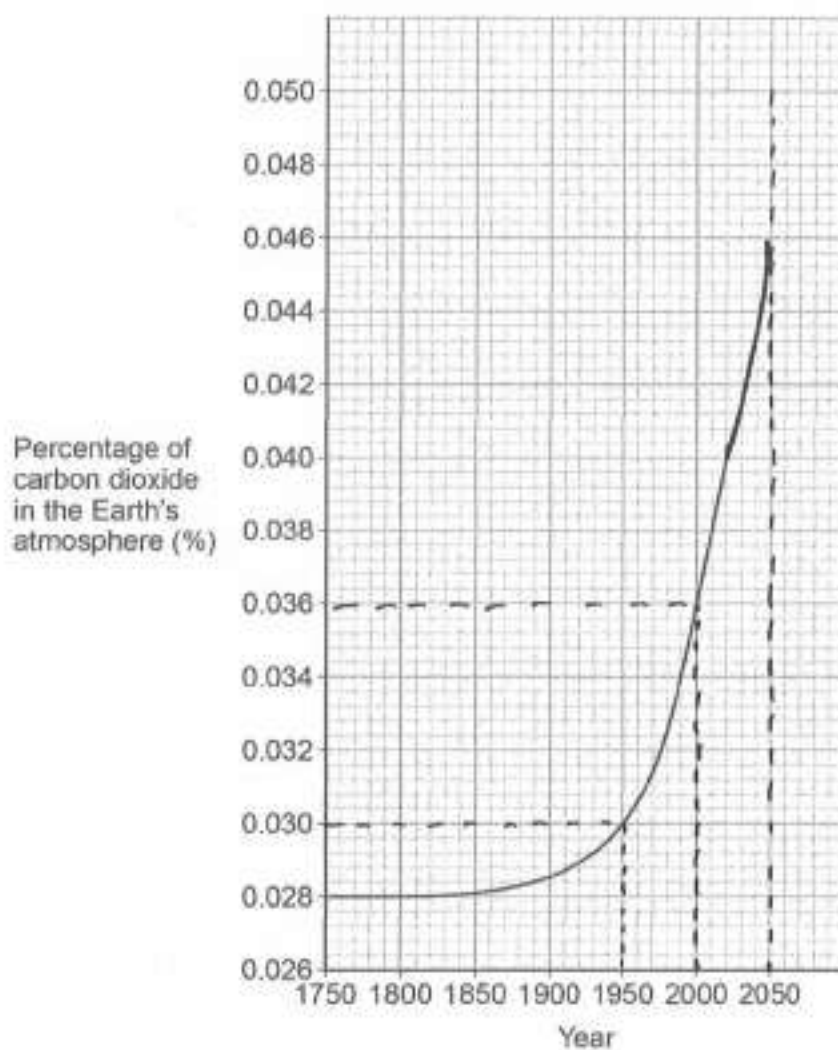
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Carbon dioxide is a greenhouse gas.

Figure 3 shows the percentage of carbon dioxide in the Earth's atmosphere from 1750.

Figure 3



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- 0 3 . 2 Describe the trend in the percentage of carbon dioxide in the Earth's atmosphere from 1750 to 2000.

Use Figure 3.

[2 marks]

Between 1750 and 1840 the Carbon dioxide percentage stayed constant at 0.028%. It then began to rapidly increase after the 1840s up to 0.040% in 2020

- 0 3 . 3 Determine the change in the percentage of carbon dioxide in the Earth's atmosphere from 1950 to 2000.

Use Figure 3.

[2 marks]

Percentage of carbon dioxide in 1950 0.030%

Percentage of carbon dioxide in 2000 0.036%

$$0.036 - 0.030 = 0.006$$

Change in percentage of carbon dioxide = 0.006 %

- 0 3 . 4 Give one reason why the percentage of carbon dioxide in the atmosphere is changing.

[1 mark]

Population increase. This drives up energy demand, meaning there are more CO₂ emissions

- 0 3 . 5 Predict the percentage of carbon dioxide in the Earth's atmosphere in 2050.

You should extend the graph line on Figure 3.

[2 marks]

Percentage of carbon dioxide in 2050 = 0.046 %

Turn over ►



0 4

This question is about the atmospheres of Earth and Mars.

0 4 . 1

Earth's early atmosphere may have been like the atmosphere of Mars today.

Why are scientists **not** certain about the percentage of gases in the Earth's early atmosphere?

[1 mark]

There is limited evidence to prove
exactly how much CO₂ there was

0 4 . 2

What was formed from the water vapour in the Earth's early atmosphere?

[1 mark]

Tick (✓) **one** box.

Crude oil

☐

Limestone

☐

Natural gas

☐

Oceans

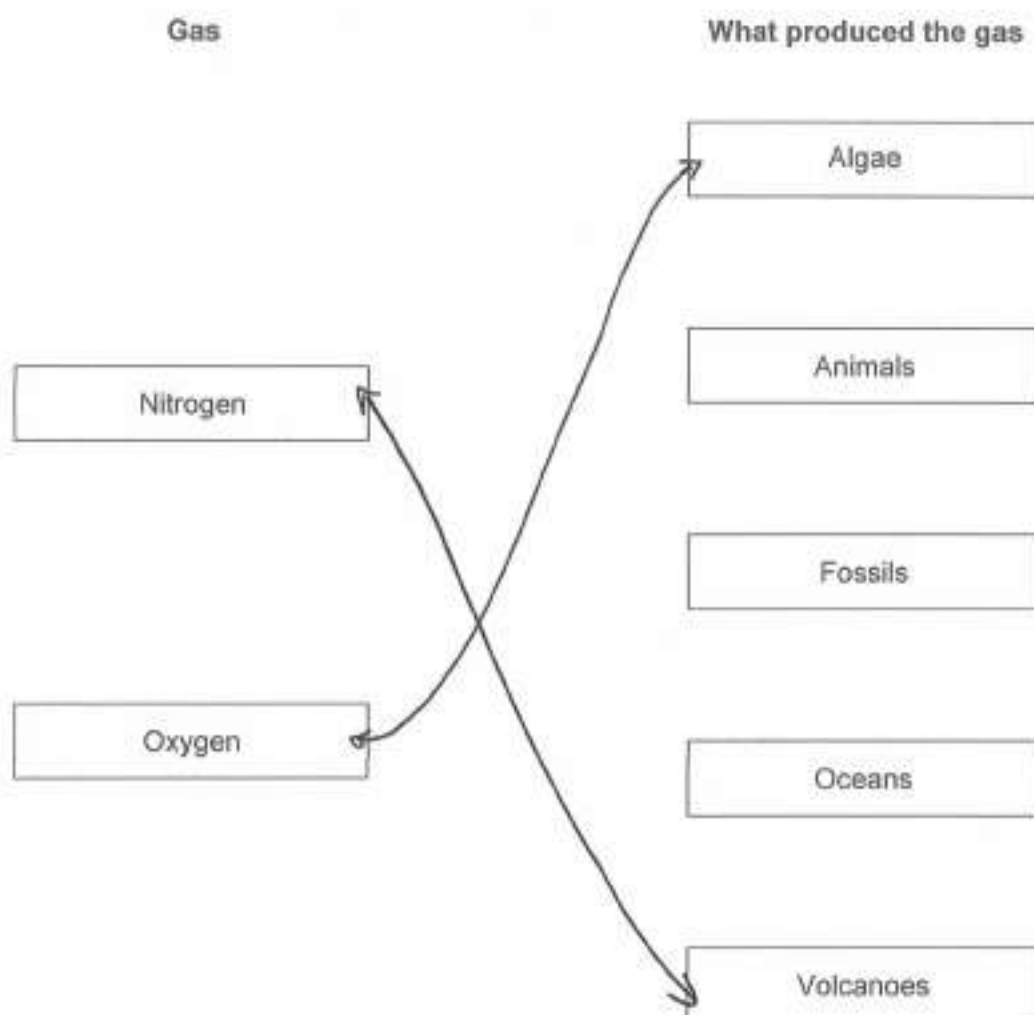
☒

0 4 3

The Earth's atmosphere today consists mainly of nitrogen and oxygen.

Draw one line from each gas to what produced the gas.

[2 marks]



Question 4 continues on the next page

Turn over ►



Table 2 shows the percentage of some gases in the atmospheres of Earth and Mars.

Table 2

Gas	Percentage of gas in atmosphere (%)	
	Earth	Mars
Argon	0.9	1.9
Carbon dioxide	0.04	95
Nitrogen	78	2.6
Oxygen	21	0.2

0 4 . 4 Why are animals not able to live on Mars?

[1 mark]

Tick (✓) one box.

The atmosphere of Mars does not contain enough argon.

☐

The atmosphere of Mars does not contain enough nitrogen.

☐

The atmosphere of Mars does not contain enough oxygen.

☒

0 4 . 5 There is more carbon dioxide on Mars than on Earth.

Which other gas is found in larger quantities on Mars than on Earth?

[1 mark]

Argon



0 4 6

Calculate how many times more nitrogen than oxygen there is in the atmosphere of Earth.

Use Table 2.

Give your answer to 2 significant figures.

[3 marks]

$$\frac{78}{21} = 3.714$$

$$= 3.7 \text{ to 2 s.f.}$$

Number of times more nitrogen than oxygen (2 significant figures) = 3.7

9

Turn over for the next question

Turn over ►



0 5

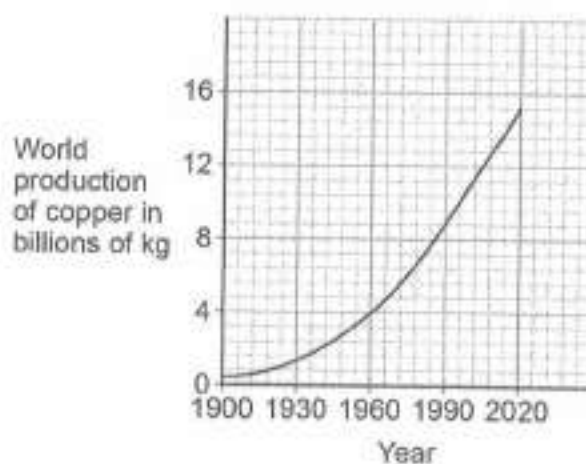
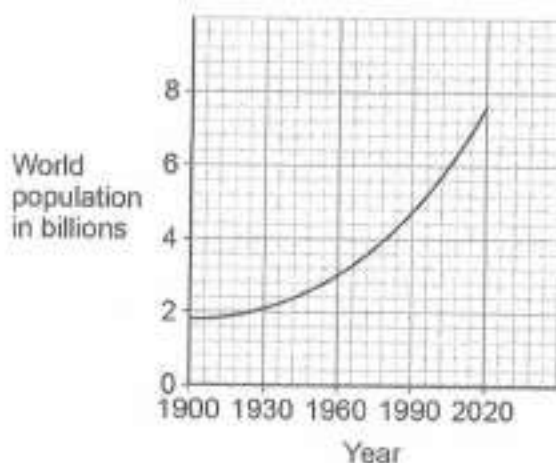
Industries use the Earth's resources to produce useful products.

0 5

1

Figure 4 shows the world population and the world production of copper between 1900 and 2020.

Figure 4



How does the change in the world population compare with the world production of copper?

[1 mark]

Tick (✓) one box.

As population decreased, copper production increased.

☐

As population increased, copper production decreased.

☐

As population increased, copper production increased.

☒


Copper is produced from copper ore and from recycling waste copper.

0 5 . 2 The energy needed to produce 1 kg of copper from copper ore is 70 MJ.

The energy needed to produce 1 kg of recycled copper is 27 MJ.

Calculate the energy saved if 100 kg of copper is produced from recycled copper and not from copper ore.

[3 marks]

Energy for 100kg from ore = $100 \times 70 = 7000 \text{ MJ}$
 Energy for 100 kg from recycling = $100 \times 27 = 2700 \text{ MJ}$

Energy saved = $7000 - 2700 = 4300 \text{ MJ}$

Energy saved = 4300 MJ

0 5 . 3 Producing copper from recycling waste copper reduces emissions of sulfur dioxide.

Why is reducing emissions of sulfur dioxide important?

[1 mark]

Sulfur dioxide is responsible for Acid
rain

0 5 . 4 Copper is used to make coins.

A coin of mass 8 g contains 75% copper.

$\rightarrow 75\% = 0.75$

Calculate the mass of copper in the coin.

[2 marks]

$8 \times 0.75 = 6 \text{ g}$

Mass of copper = 6 g

Turn over ►



0 5 . 5 Iron and glass are both produced from the Earth's resources.

Some processes can reduce the use of limited resources.

Draw one line from the description of the process to the name of the process.

[2 marks]

Description of process

Name of process

Extraction

Scrap steel is added to
iron from a blast furnace

Quarrying

Reacting

A glass bottle is refilled

Recycling

Reusing



0 5 . 6 Life cycle assessments are used to assess the environmental impact of producing iron nails and glass bottles.

There are four stages, A, B, C and D, in a life cycle assessment.

The stages are **not** in the correct order.

Stage A Disposal

Stage B Extracting and processing raw materials

Stage C Manufacturing and packaging

Stage D Use and operation

What is the correct order of stages A, B, C, and D?

[1 mark]

Tick (✓) one box.

C, D, B, A

☐

D, B, C, A

☐

B, C, D, A

☒

10

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Turn over ►

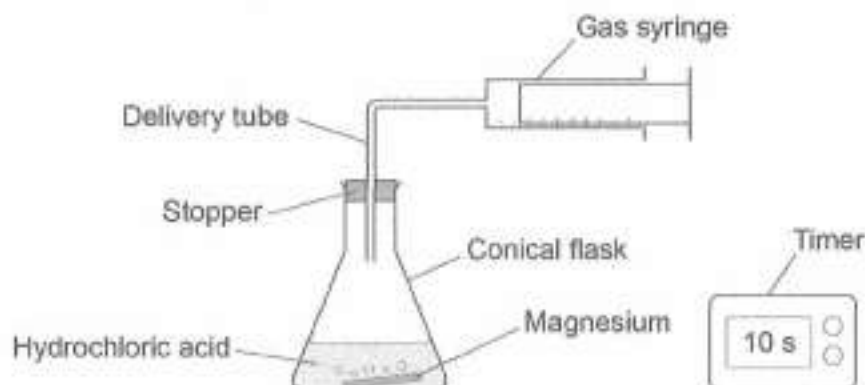


0 6

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

Figure 5 shows the apparatus.

Figure 5



This is the method used.

1. Pour 50 cm³ 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 6 . 1

Give the independent variable and **one** control variable in this investigation.

[2 marks]

Independent variable

Concentration of Hydrochloric Acid

Control variable

Temperature of Acid.

Question 6 continues on the next page

Turn over ►



Table 3 shows the results from the first experiment using hydrochloric acid with a low concentration.

Table 3

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

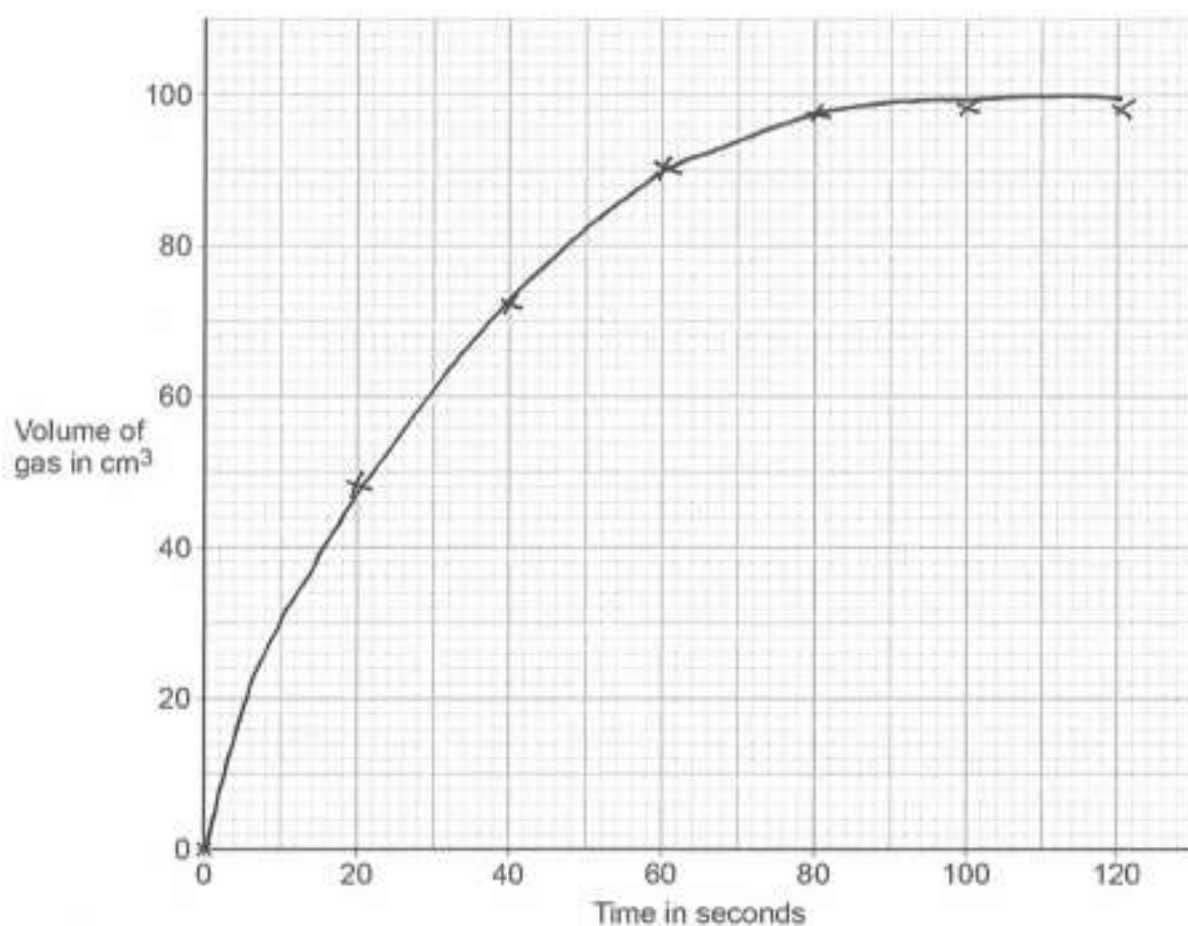
0 6 . 2 Complete **Figure 6**.

You should:

- plot the data from **Table 3** (the point 0,0 has been plotted for you)
- draw a line of best fit.

[3 marks]

Figure 6



0 6 . 3 How does the **rate** of this reaction change with time?

Use Table 3.

[1 mark]

Tick (✓) one box.

The rate decreases.

☒

The rate stays the same.

☐

The rate increases.

☐

0 6 . 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 6 continues on the next page

Turn over ►



0 6 . 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]

Increasing the temperature would give more energy to the particles reacting. This means that they will move around more quickly, leading to a greater number of collisions and hence a faster rate of reaction.

10



0 7

Crude oil is a resource found in rocks.

Most of the compounds in crude oil are hydrocarbons.

0 7 . 1

Complete the sentence.

[1 mark]

Crude oil is formed by the decomposition of ancient Biomass.

0 7 . 2

Alkanes are hydrocarbons.

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

[1 mark]

Propane

Question 7 continues on the next page

Turn over ►



0 7 . 3 Figure 7 shows two alkane molecules.

Figure 7

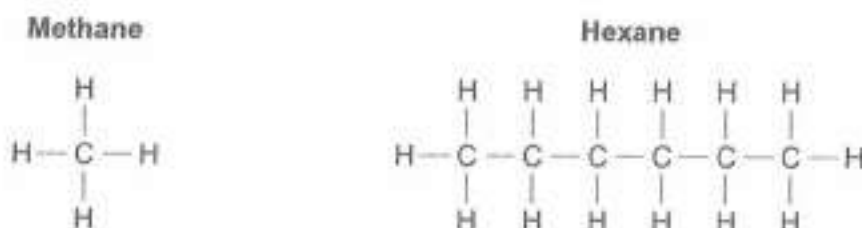


Table 4 shows the melting points and boiling points of methane and hexane.

Table 4

	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 only 1 Carbon atom and 4 Hydrogen atoms. It has a very low melting point and boiling point and as such would be a gas at room temperature. Hexane is a bigger molecule made up of 6 Carbon atoms and 14 hydrogen atoms. It has much higher Melting and boiling points than Methane and is a liquid at room temperature. Because Hexane is larger than methane, the forces between Hexane molecules are stronger than those between methane molecules. This is why Hexane has higher melting and boiling points.



Hydrocarbons are cracked to produce more useful alkanes and alkenes.

0 7 . 4 Decane ($C_{10}H_{22}$) is cracked to produce two products.

Complete the equation for the reaction.

[1 mark]



0 7 . 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 Goes from Orange to Colourless if alkenes are present.

11

END OF QUESTIONS

