



Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

Foundation Tier

Chemistry Paper 2F

F

8464/C/2F

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



01

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:

water + anhydrous copper sulfate \rightleftharpoons hydrated copper sulfate

01.1

How does the equation show that the reaction is reversible? [1 mark]



01.2

Complete the sentences.

Choose answers from the list. [2 marks]

- blue
- green
- orange
- white
- yellow

The colour of anhydrous copper sulfate is _____.

The colour of hydrated copper sulfate is _____.

[Turn over]

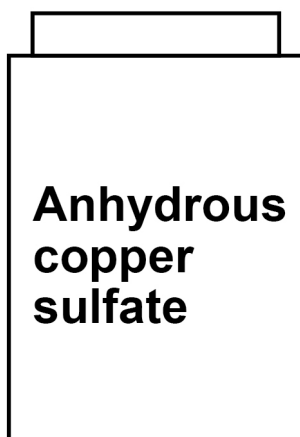


05

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]

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]

Substance

Description of substance

**Sodium chloride
solution**

Compound

Element

Water

Hydrocarbon

Mixture

[Turn over]



0	1	.	5
---	---	---	---

Name the process used to obtain solid sodium chloride from sodium chloride solution. [1 mark]

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 _____

Sterilising _____



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

[Turn over]



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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11



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02

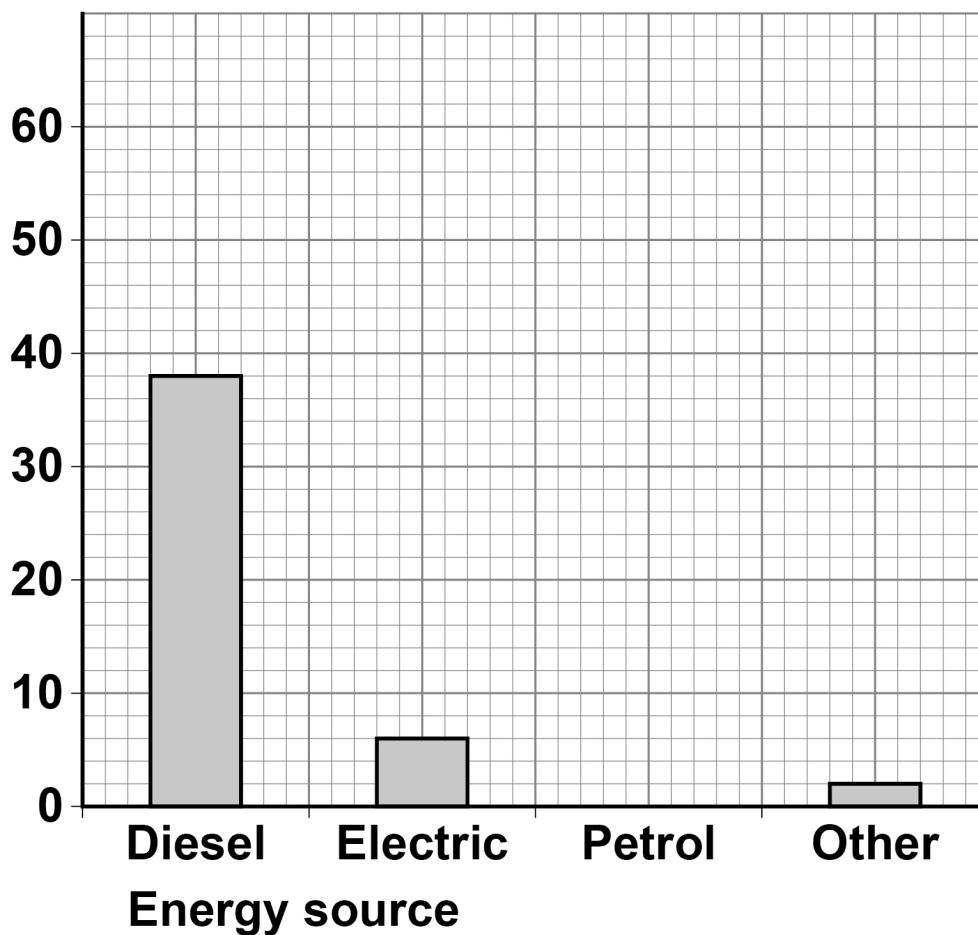
Cars cause atmospheric pollution.

02.1

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

FIGURE 2

Percentage
of cars (%)



The percentage of cars using petrol is 54%.

Draw the bar for petrol on FIGURE 2. [1 mark]

[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



02.2

Which column of data has the greatest range? [1 mark]

Tick (✓) ONE box.

☐

City centre

☐

Countryside

☐

Motorway

02.3

Explain why the concentration of nitrogen dioxide in the air is lower on Sunday. [2 marks]

[Turn over]



REPEAT OF 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



02.4

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]

Mean value for concentration of nitrogen dioxide =

_____ arbitrary units

[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 list. [1 mark]

- finite resource
- formulation
- renewable resource

Platinum is a _____.

[Turn over]



02.7

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



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

2

[Turn over]



Carbon dioxide is a greenhouse gas.

FIGURE 3, on the opposite page, shows the percentage of carbon dioxide in the Earth's atmosphere from 1750.

03.2

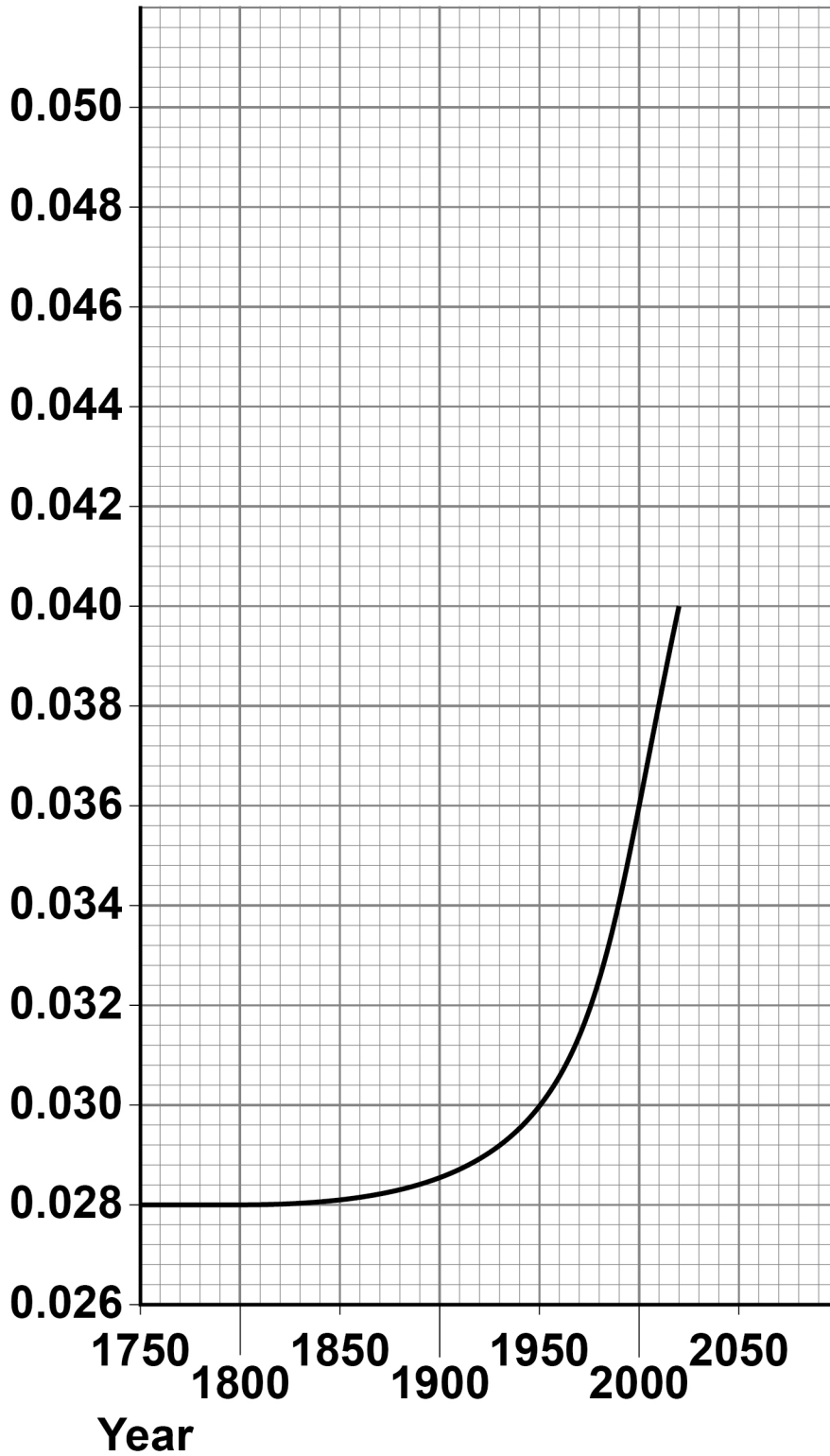
Describe the trend in the percentage of carbon dioxide in the Earth's atmosphere from 1750 to 2000.

Use FIGURE 3. [2 marks]



FIGURE 3

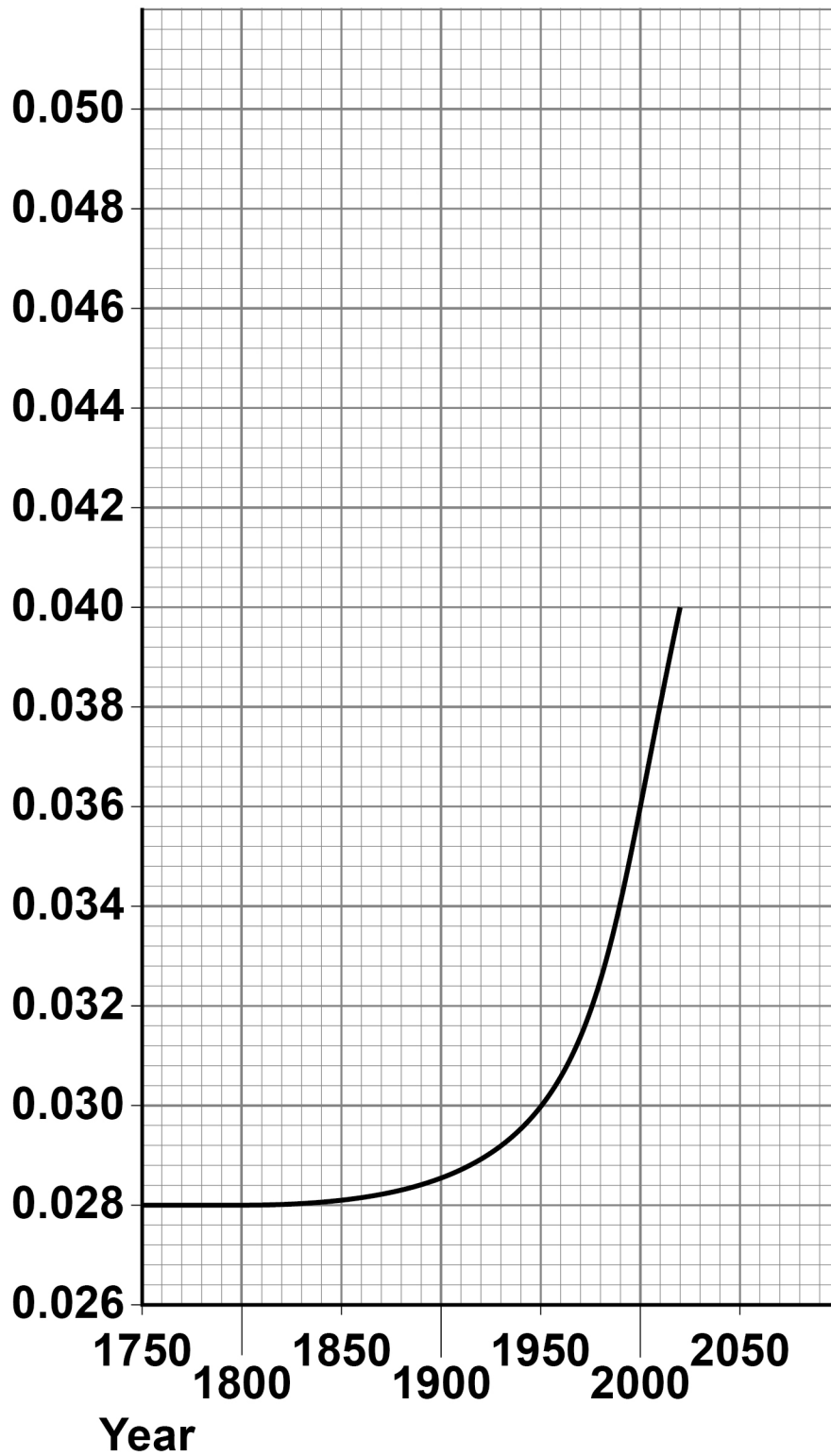
**Percentage of carbon dioxide
in the Earth's
atmosphere (%)**



[Turn over]

REPEAT OF FIGURE 3

**Percentage of carbon dioxide
in the Earth's
atmosphere (%)**



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 _____

Percentage of carbon dioxide in 2000 _____

Change in percentage of carbon dioxide =

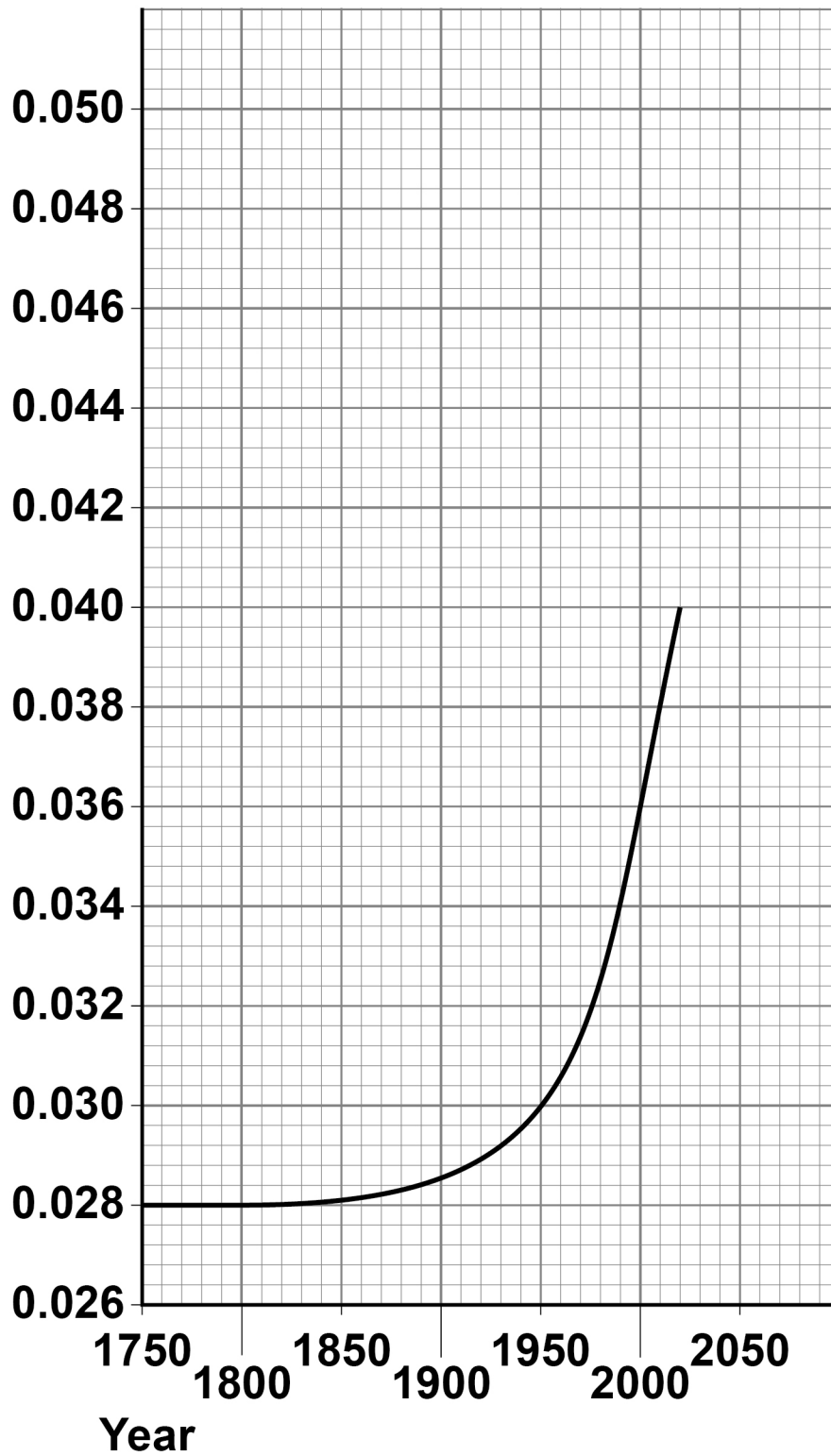
_____ %

[Turn over]



REPEAT OF FIGURE 3

**Percentage of carbon dioxide
in the Earth's
atmosphere (%)**



0	3	.	4
---	---	---	---

Give ONE reason why the percentage of carbon dioxide in the atmosphere is changing. [1 mark]

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 =

_____ %

[Turn over]

9



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]



04.2

What was formed from the water vapour in the Earth's early atmosphere? [1 mark]

Tick (✓) ONE box.

☐

Crude oil

☐

Limestone

☐

Natural gas

☐

Oceans

[Turn over]



04.3

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

Draw ONE line from each gas to what produced the gas.
[2 marks]

Gas

What produced the gas

Algae

Nitrogen

Animals

Fossils

Oxygen

Oceans

Volcanoes



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[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]

[Turn over]



REPEAT OF 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	.	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]

Number of times more nitrogen than oxygen

(2 significant figures) = _____

[Turn over]

9



0	5
---	---

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

0	5	.	1
---	---	---	---

FIGURE 4, on the opposite page, shows the world population and the world production of copper between 1900 and 2020.

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.

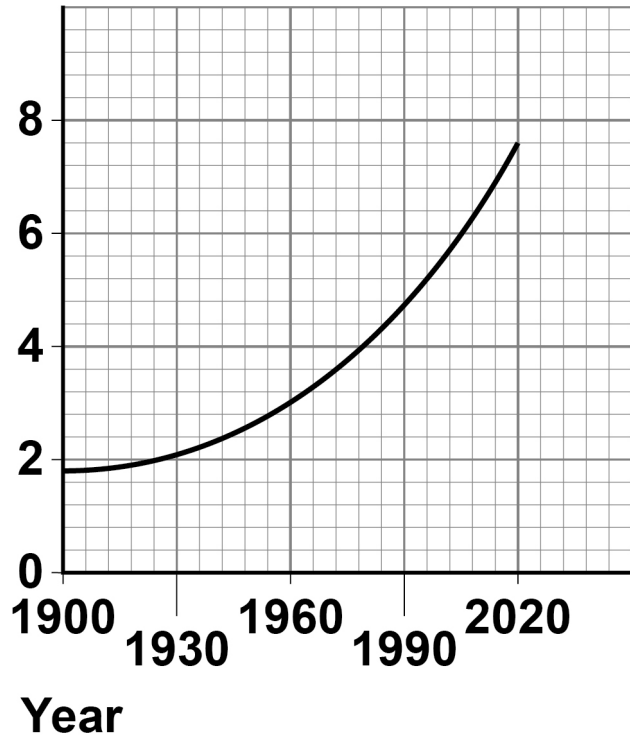
☐

As population increased, copper production increased.

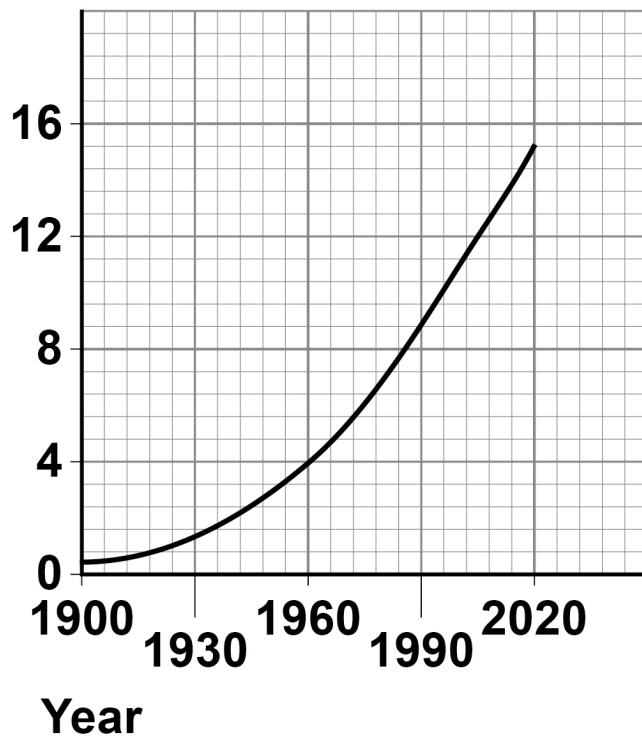


FIGURE 4

**World population
in billions**



**World production of
copper in billions of kg**



[Turn over]

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

05.2

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 saved = _____ 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]

[Turn over]



0	5	.	4
---	---	---	---

Copper is used to make coins.

A coin of mass 8 g contains 75% copper.

Calculate the mass of copper in the coin. [2 marks]

Mass of copper = _____ g

0	5	.	5
---	---	---	---

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

Some processes can reduce the use of limited resources.

On the opposite page, draw ONE line from the description of the process to the name of the process.
[2 marks]



Description of process**Name of process**

**Scrap steel is added
to iron from a blast
furnace**

Extraction

Quarrying

Reacting

**A glass bottle is
refilled**

Recycling

Reusing

[Turn over]



05.6

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

[Turn over]

<hr/>
10

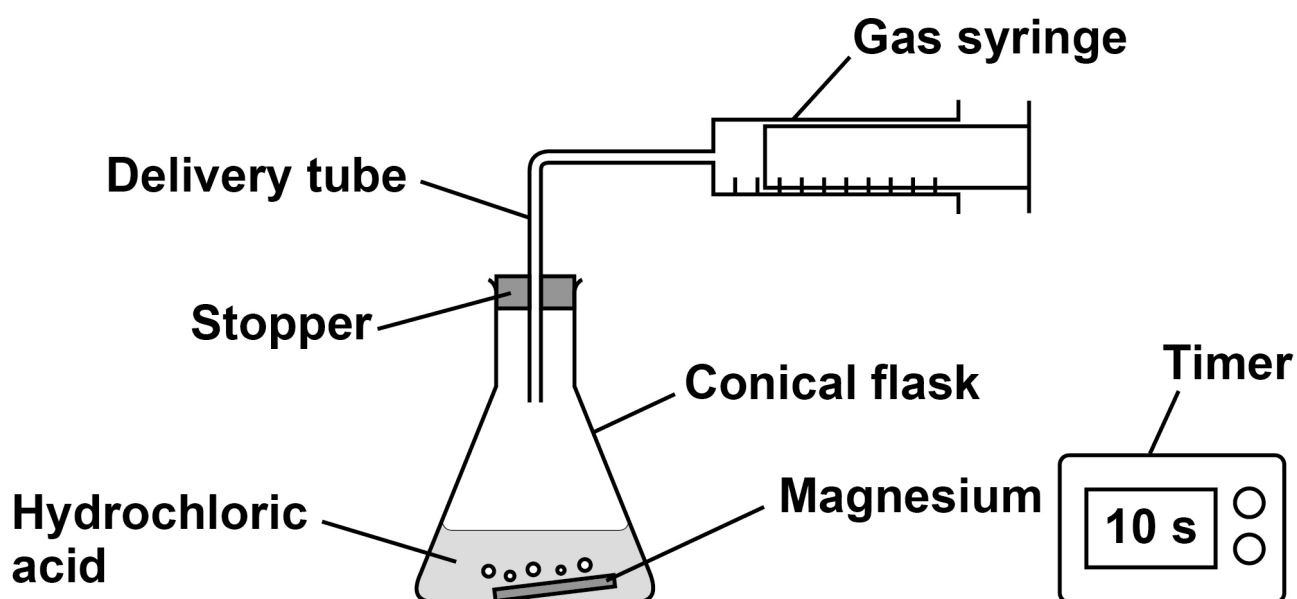


06

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.**

06.1

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

Independent variable _____

Control variable _____

[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 cm³	0	48	72	90	97	98	98

06.2

Complete **FIGURE 6**, on the opposite page.

You should:

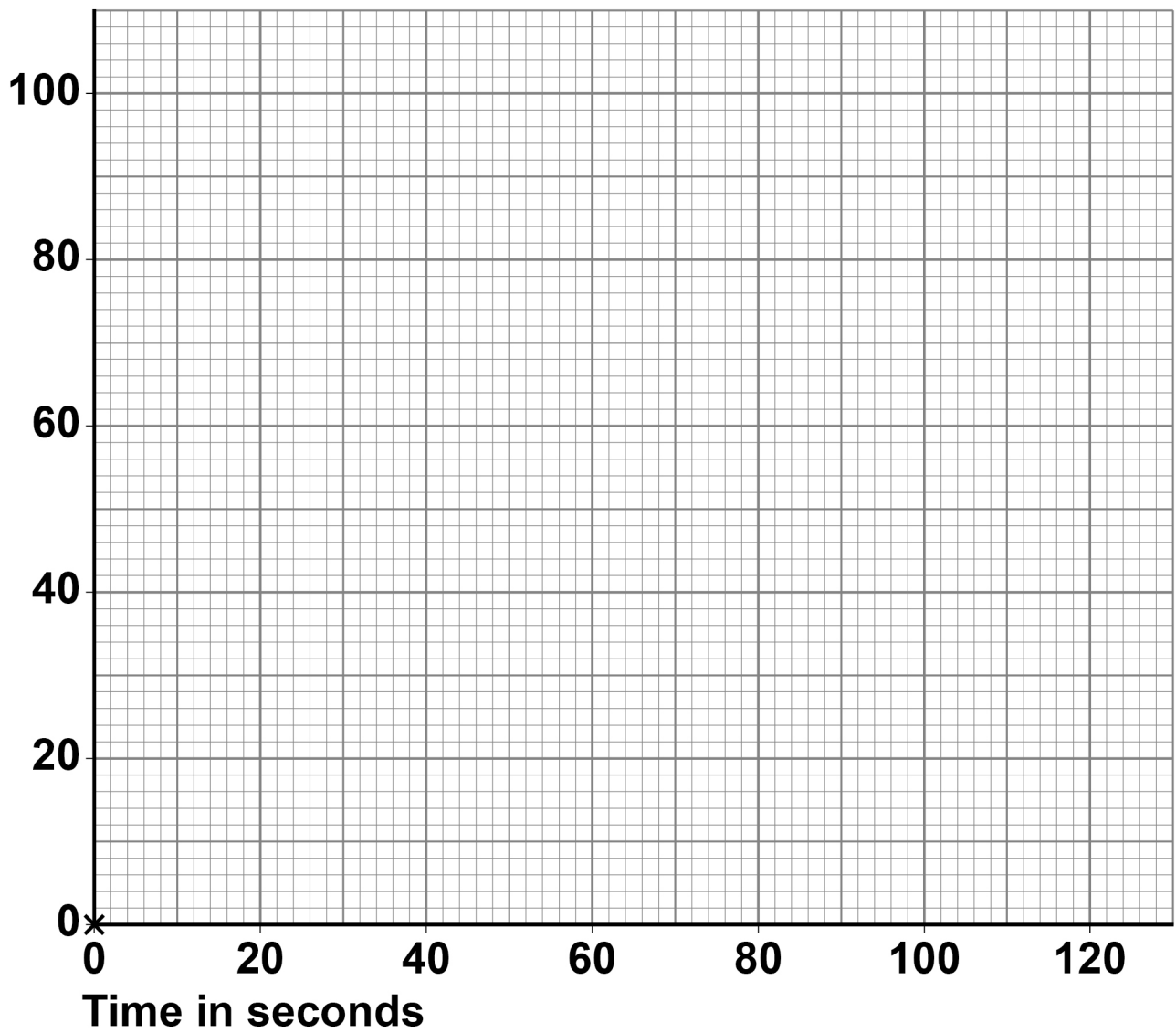
- plot the data from **TABLE 3** (the point 0,0 has been plotted for you)
- draw a line of best fit.

[3 marks]



FIGURE 6

**Volume of
gas in cm³**



[Turn over]



REPEAT OF TABLE 3

Time in seconds	0	20	40	60	80	100	120
Volume of gas in cm³	0	48	72	90	97	98	98

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.

[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]

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

0	7	.	2
---	---	---	---

Alkanes are hydrocarbons.

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

[Turn over]

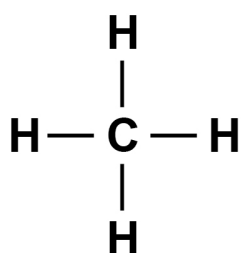


07.3

FIGURE 7 shows two alkane molecules.

FIGURE 7

Methane



Hexane

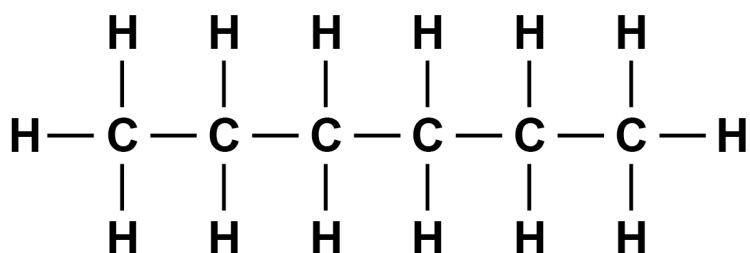


TABLE 4 shows the melting points and boiling points of methane and hexane.

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]

[illegible]

[Turn over]



Hydrocarbons are cracked to produce more useful alkanes and alkenes.

07.4

Decane ($\text{C}_{10}\text{H}_{22}$) 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 _____

Result _____

END OF QUESTIONS

11



Additional page, if required.

Write the question numbers in the left-hand margin.

[illegible]

Additional page, if required.

Write the question numbers in the left-hand margin.

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Question	Mark
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