A

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

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:

water + anhydrous copper sulfate ⇌ hydrated copper sulfate

4

0 1 . 1

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

0 1 . 2

Complete the sentences.

Choose answers from the list. [2 marks]

- **blue**
- **green**
- **orange**
- **white**
- **yellow**

The colour of anhydrous copper sulfate is _____ .

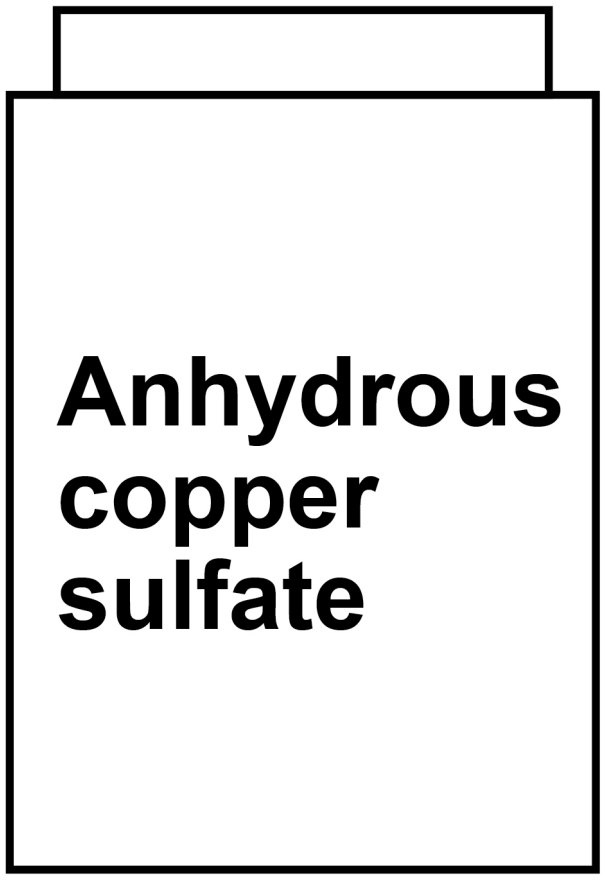
The colour of hydrated copper sulfate is _____ .

[Turn over]

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
Water	Element
	Hydrocarbon
	Mixture

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 _____

_____

[Turn over]

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**

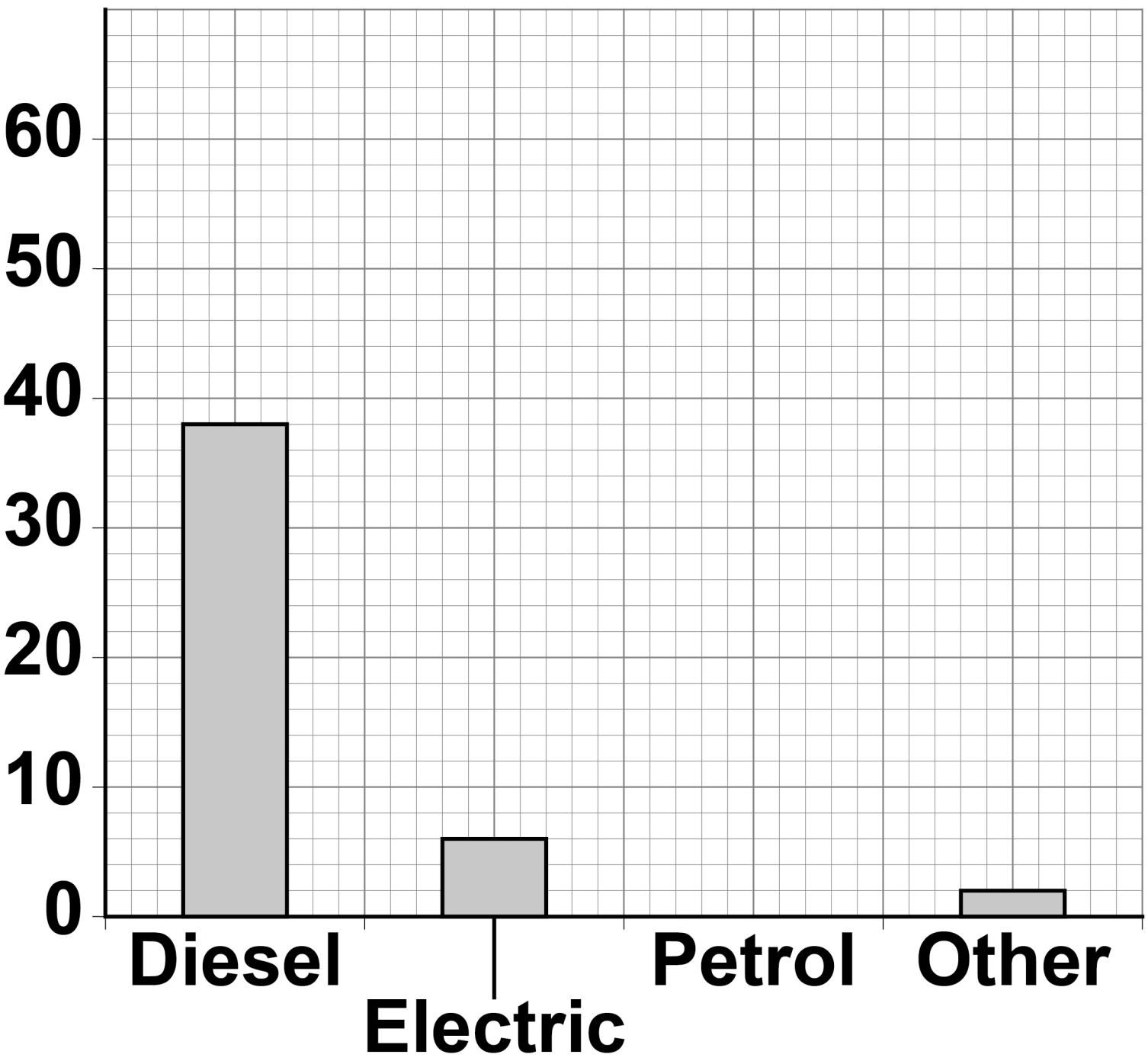
0 2

Cars cause atmospheric pollution.

0 2 . 1

FIGURE 2, on the opposite page, 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]

[Turn over]

Some car emissions contain nitrogen dioxide.

TABLE 1, on the opposite page, shows the concentration of nitrogen dioxide in the air in three different areas for 1 week.

0 2 . 2

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

Tick (✓) ONE box.

- ☐ City centre
- ☐ Countryside
- ☐ Motorway

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**

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0 2 . 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**

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]

Mean value for concentration of nitrogen dioxide =

_____ arbitrary units

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]

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

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.

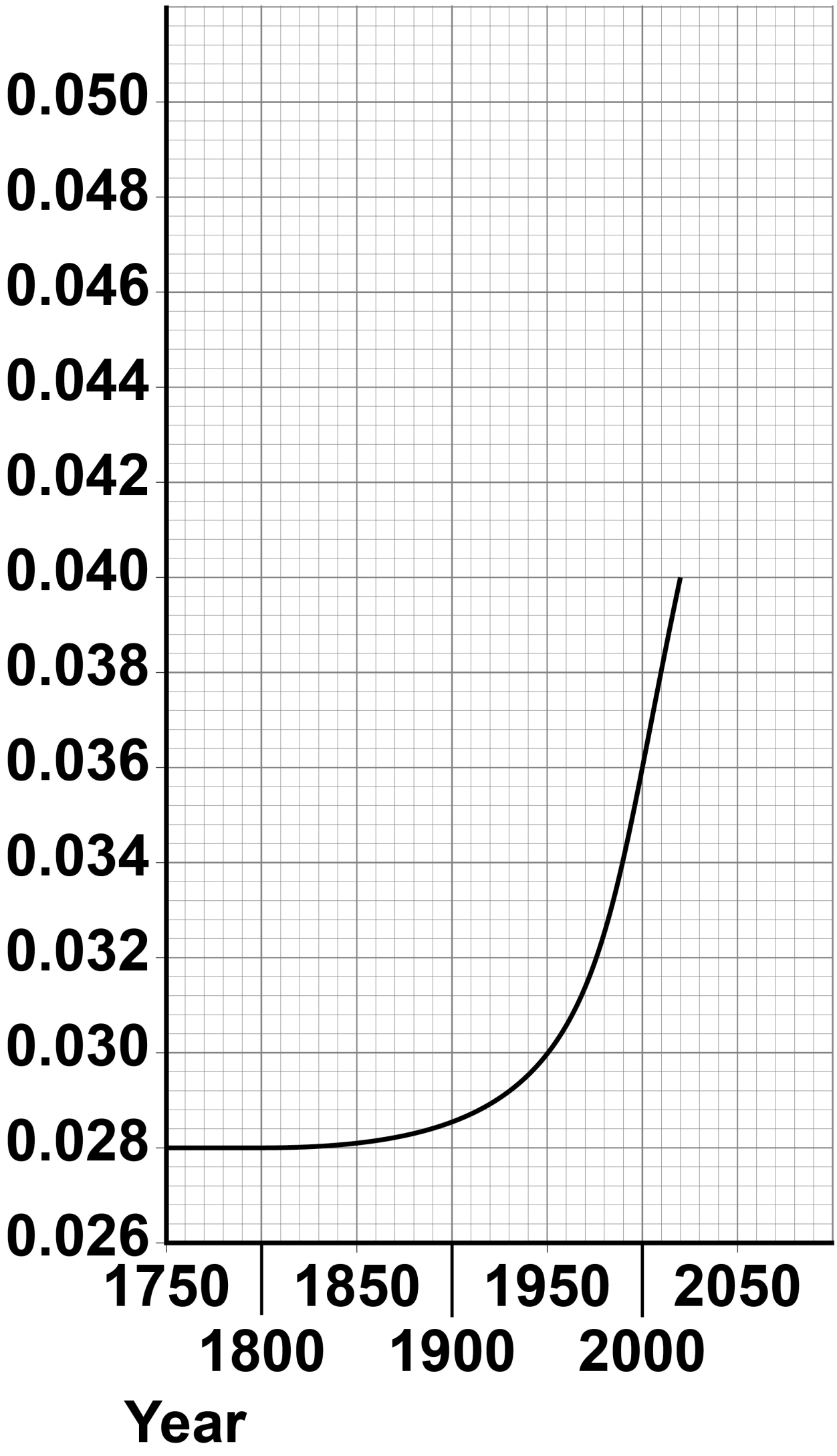
0 3 . 2

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

Use FIGURE 3. [2 marks]

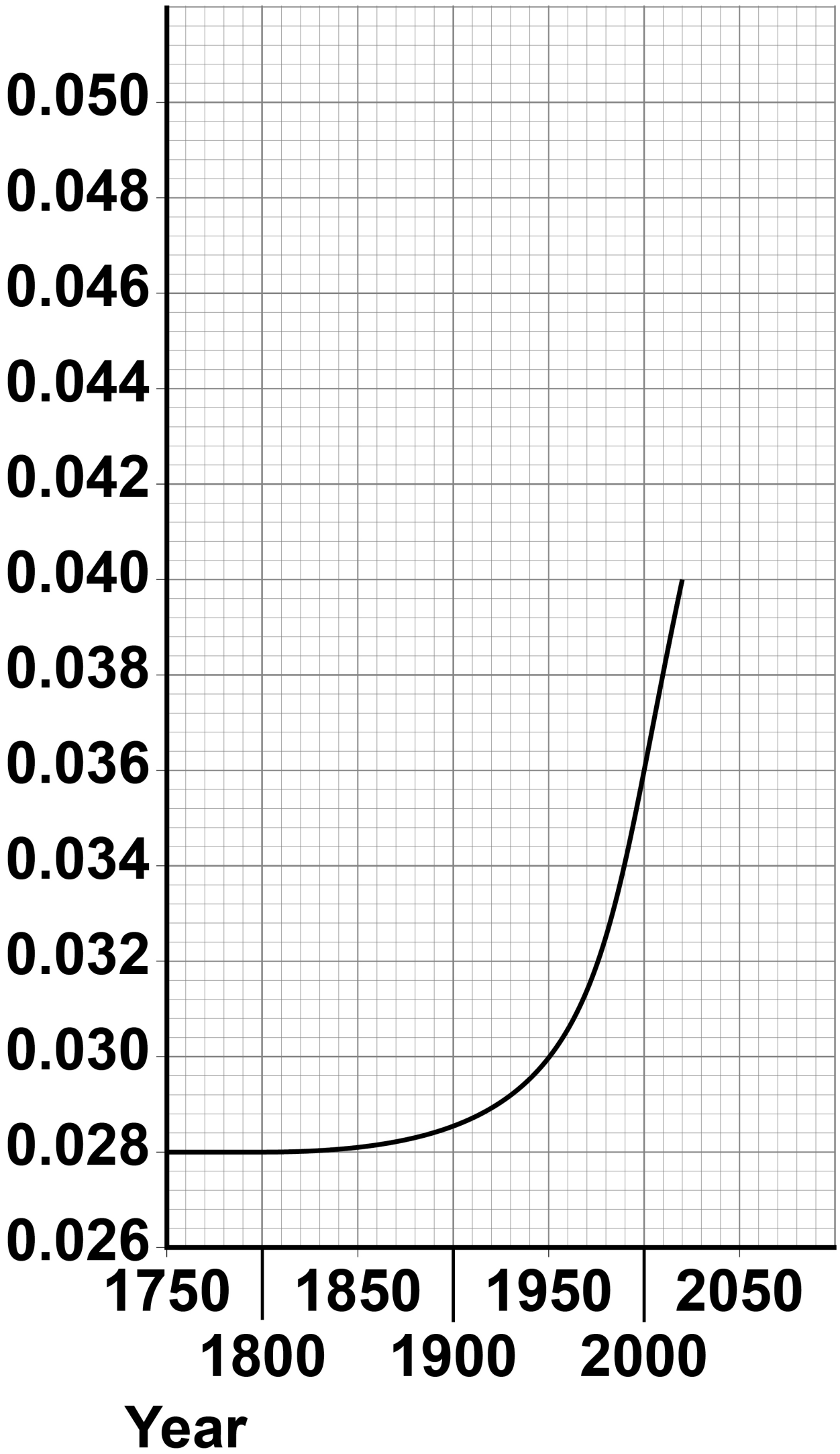
FIGURE 3

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



[Turn over]

REPEAT OF FIGURE 3



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

_____

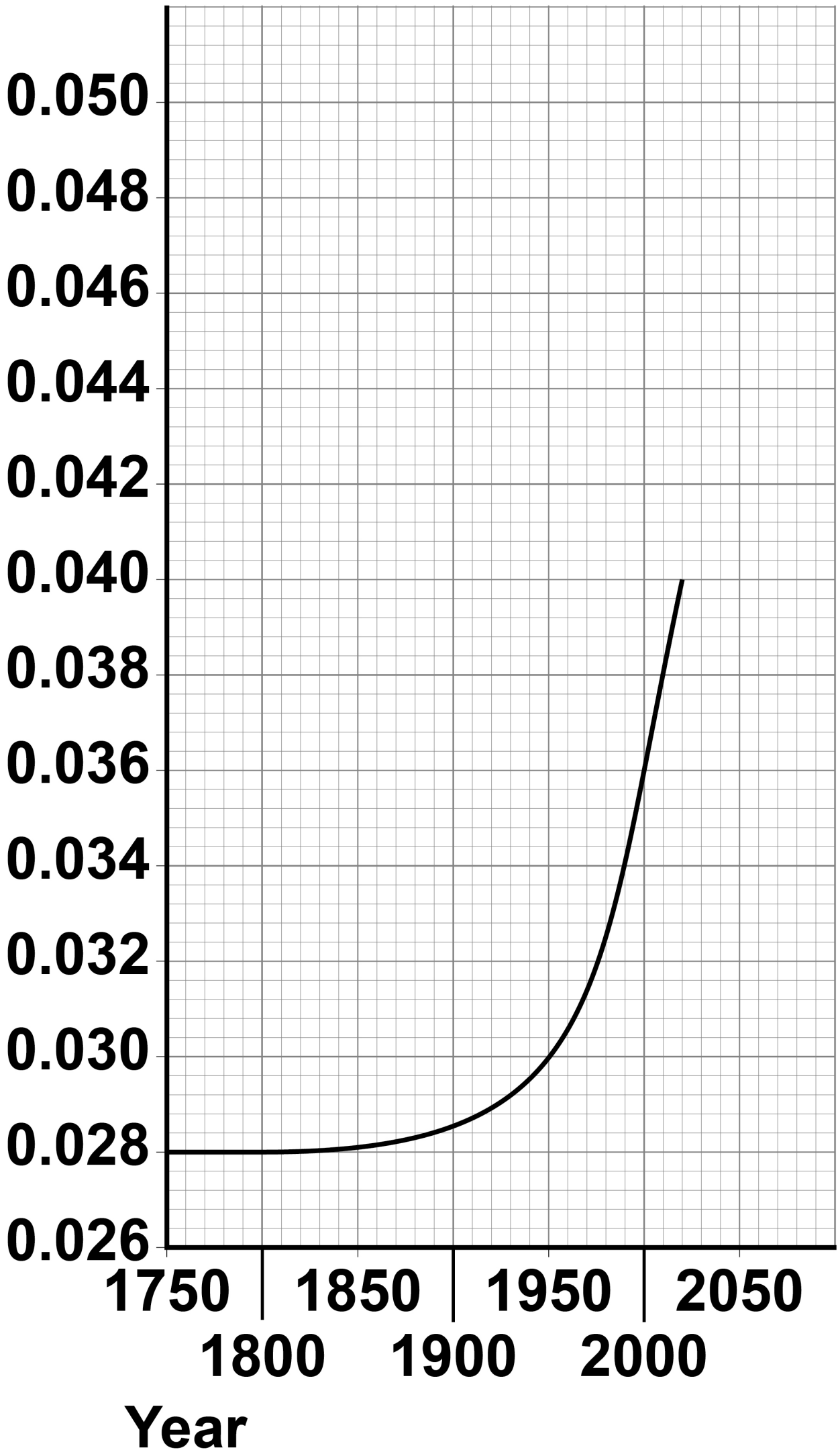
_____

Change in percentage of carbon dioxide =

_____ %

[Turn over]

REPEAT OF FIGURE 3



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, on page 28. [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]

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**

[Turn over]

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]

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.**

[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 . 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]

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) = _____

9

0 5

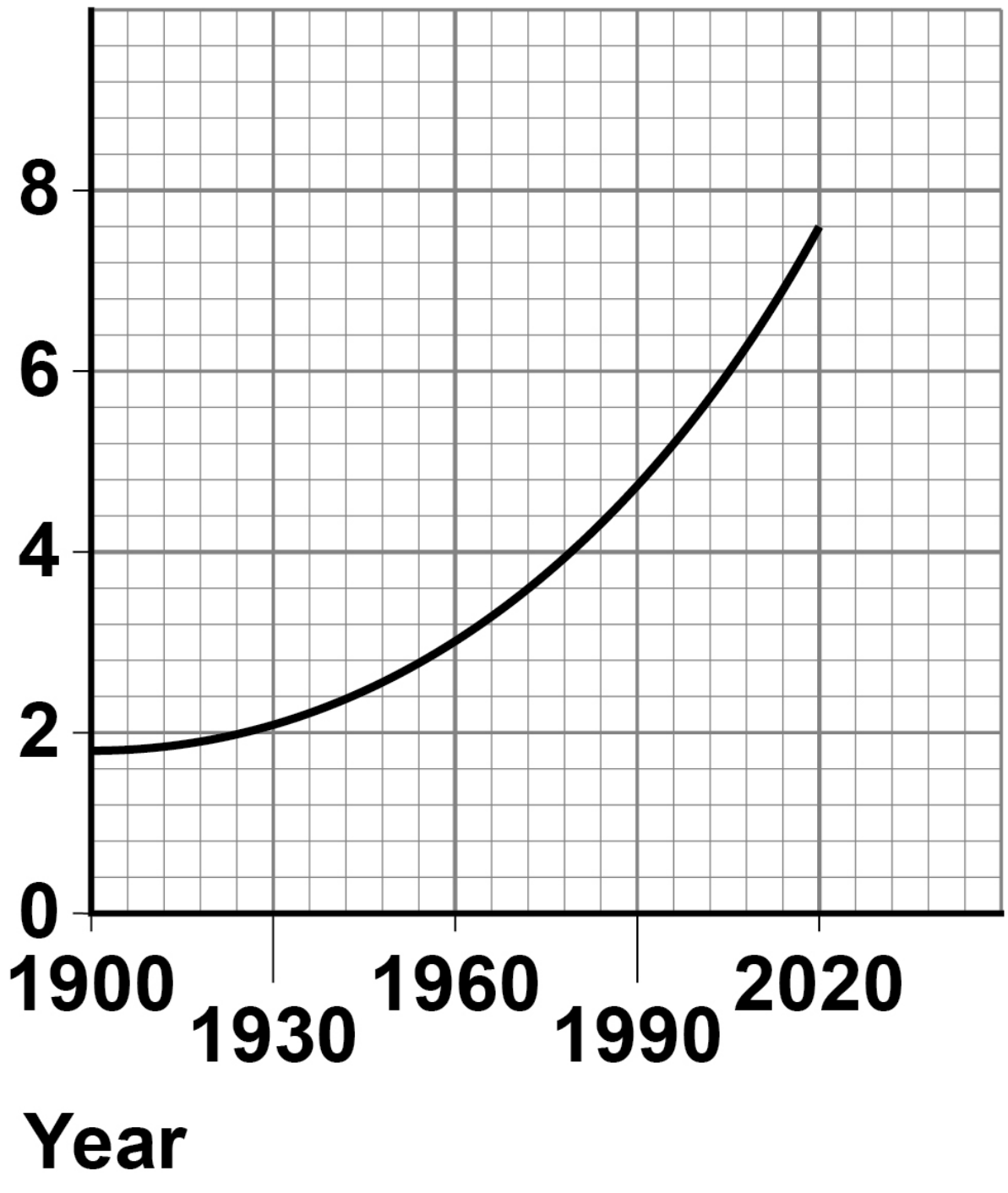
Industries use the Earth's resources to produce useful products.

0 5 . 1

FIGURE 4, on pages 39 and 40, shows the world population and the world production of copper between 1900 and 2020.

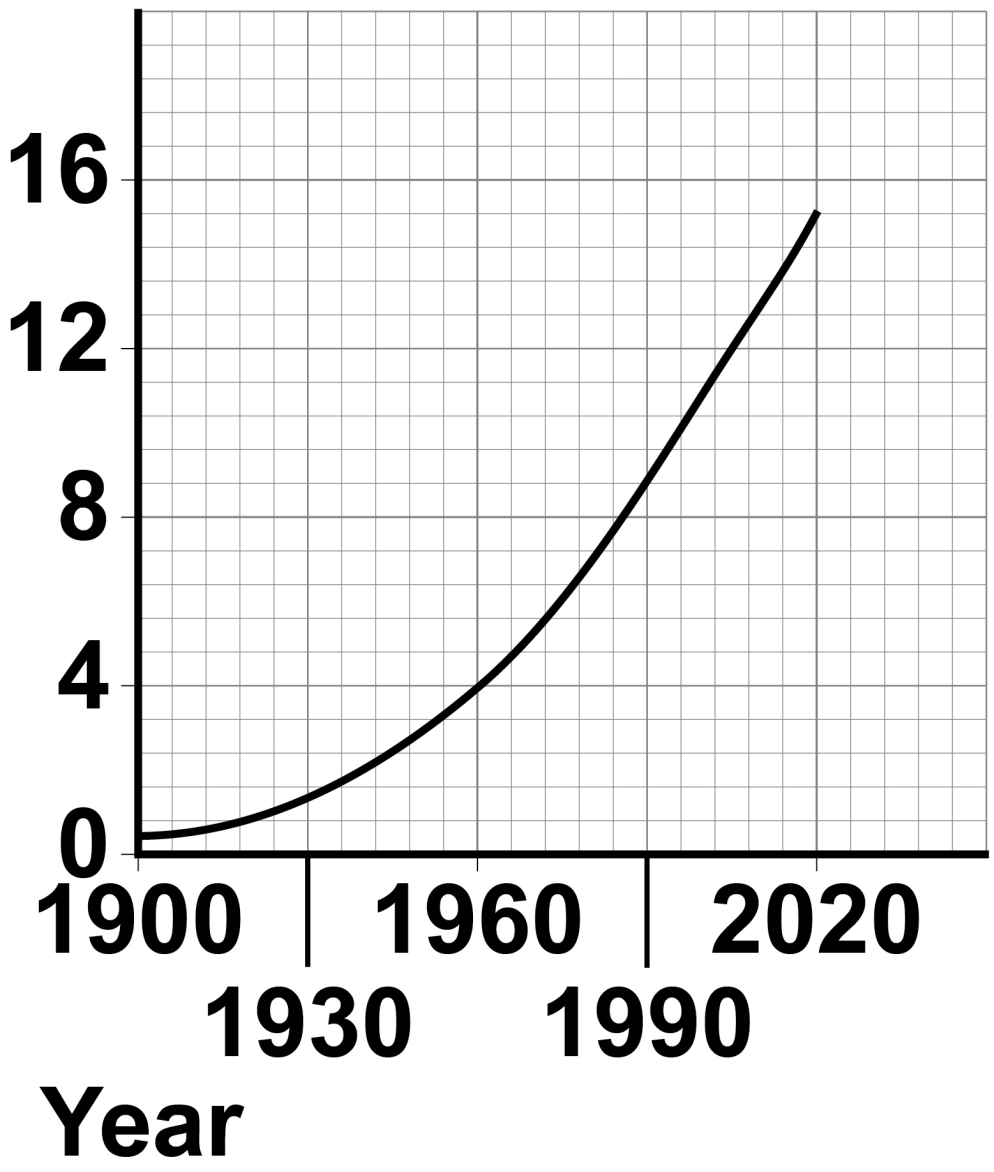
FIGURE 4

World population in billions



[Turn over]

World production of copper in billions of kg



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 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.

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
A glass bottle is refilled	Recycling
	Reusing

[Turn over]

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

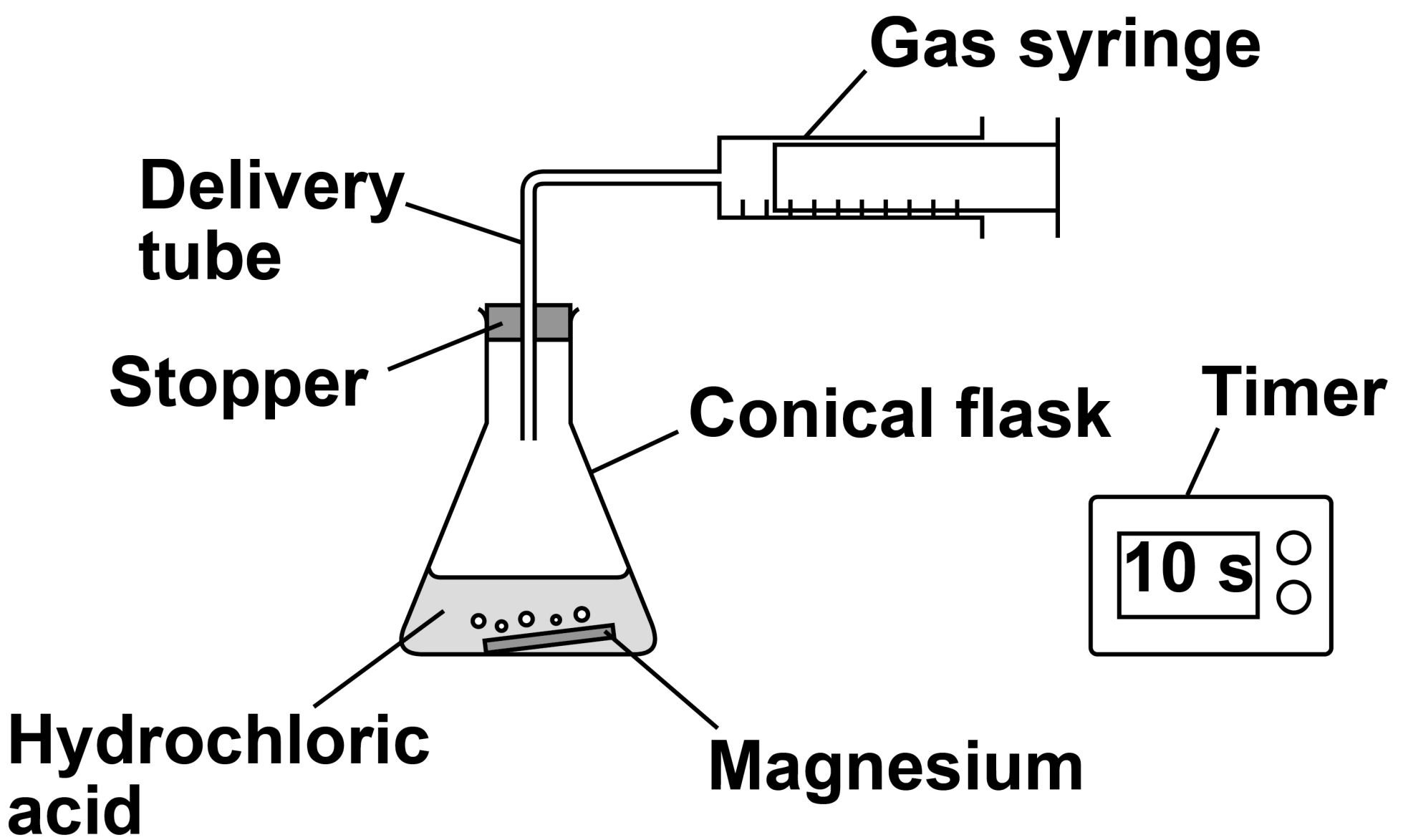
10

0 6

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

FIGURE 5 shows the apparatus.

FIGURE 5



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[Turn over]

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 6 . 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 cm^3	0	48	72	90	97	98	98

0 6 . 2

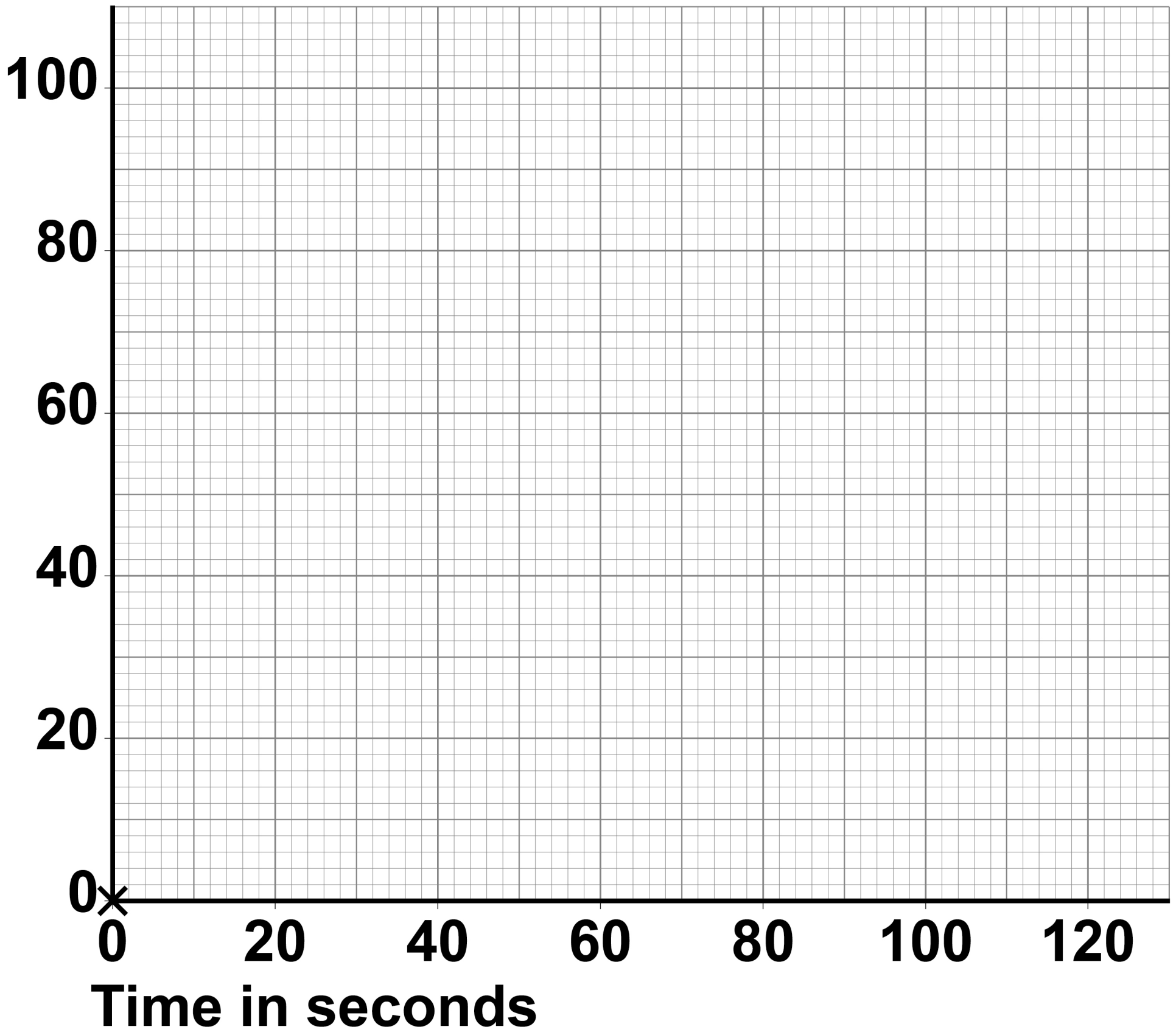
Complete FIGURE 6, on the opposite page.

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



[Turn over]

REPEAT OF 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 . 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]

_____

_____

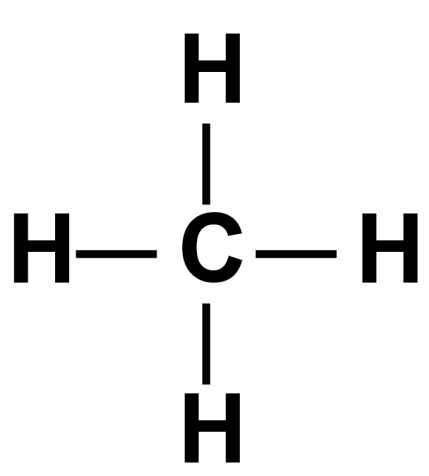
[Turn over]

0 7 . 3

FIGURE 7 shows two alkane molecules.

FIGURE 7

Methane



Hexane

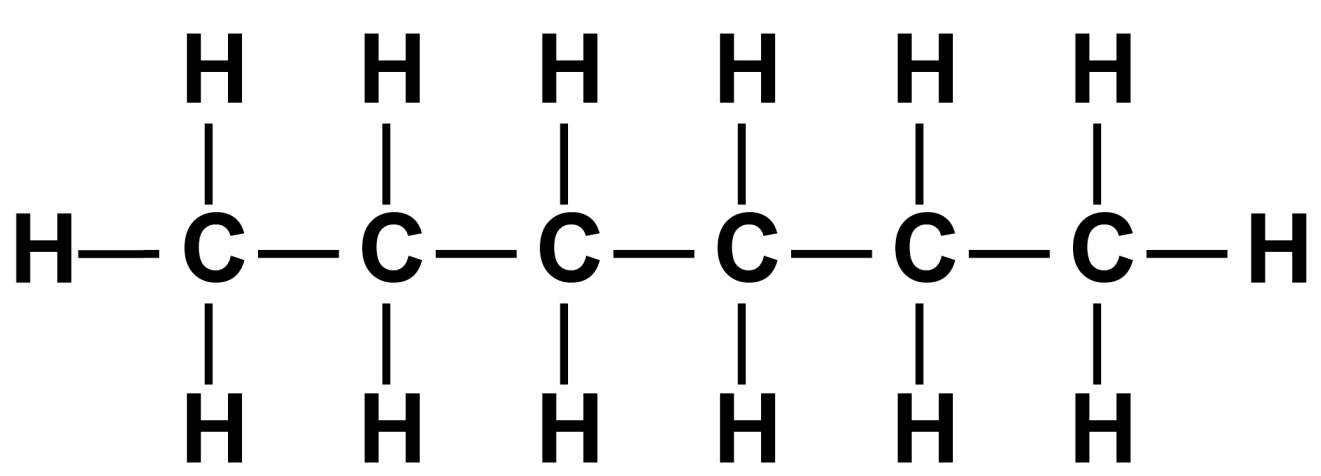


TABLE 4, on the opposite page, shows the melting points and boiling points of methane and hexane.

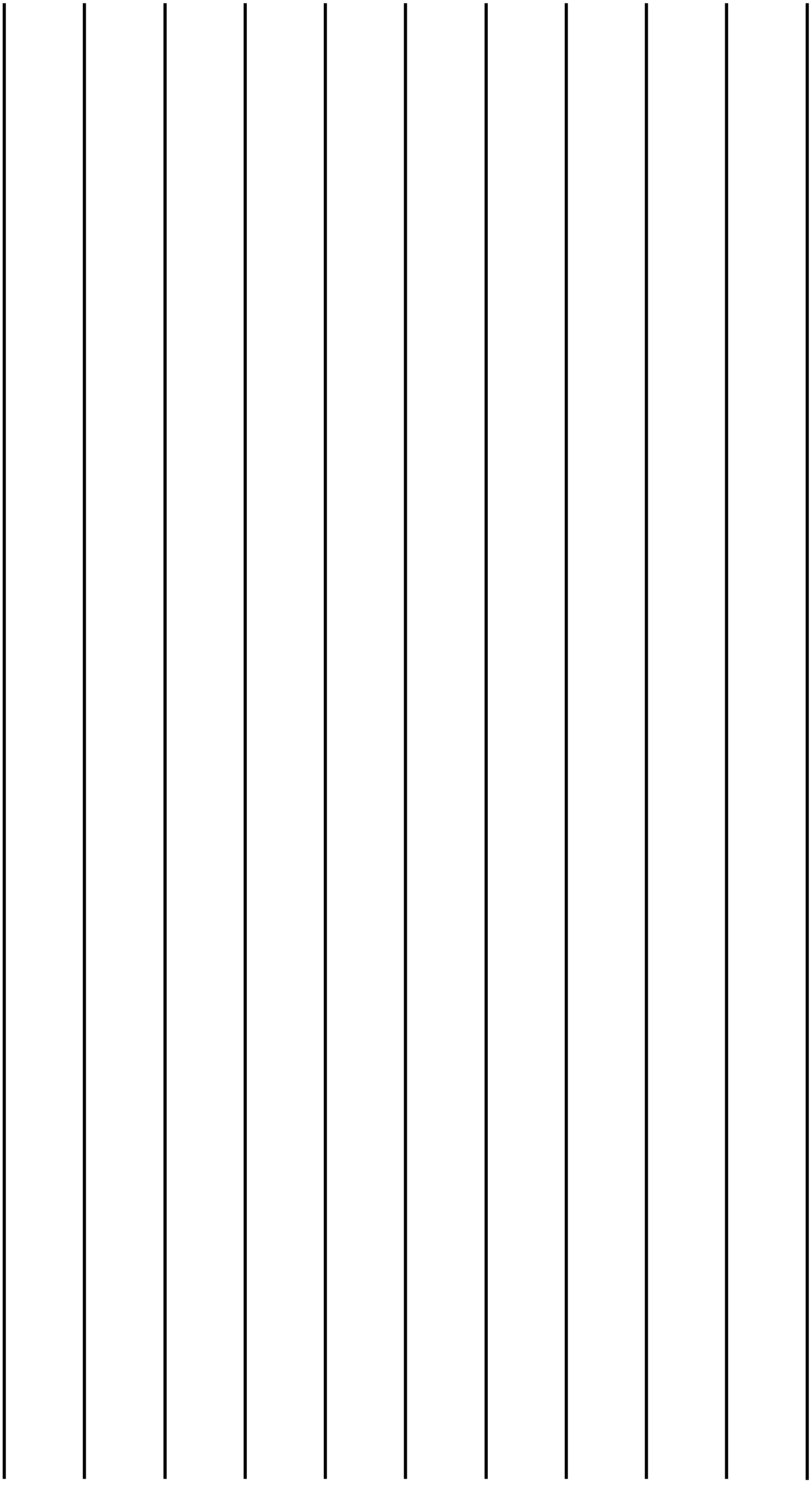
TABLE 4

	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]

[Turn over]

60



[Turn over]

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]

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

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.

Additional page, if required.

Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
1	
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