

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

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	



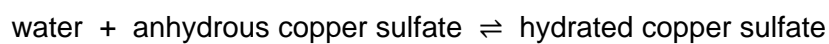
J U N 2 1 8 4 6 4 C 2 F 0 1

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 symbol)



0	1	.	2
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Complete the sentences.

Choose answers from the box.

[2 marks]

blue

green

orange

white

yellow

The colour of anhydrous copper sulfate is white.

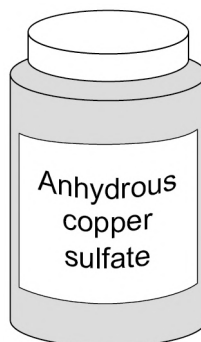
The colour of hydrated copper sulfate is blue.



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 reaction with water vapour (in the air)

Question 1 continues on the next page

Turn over ►

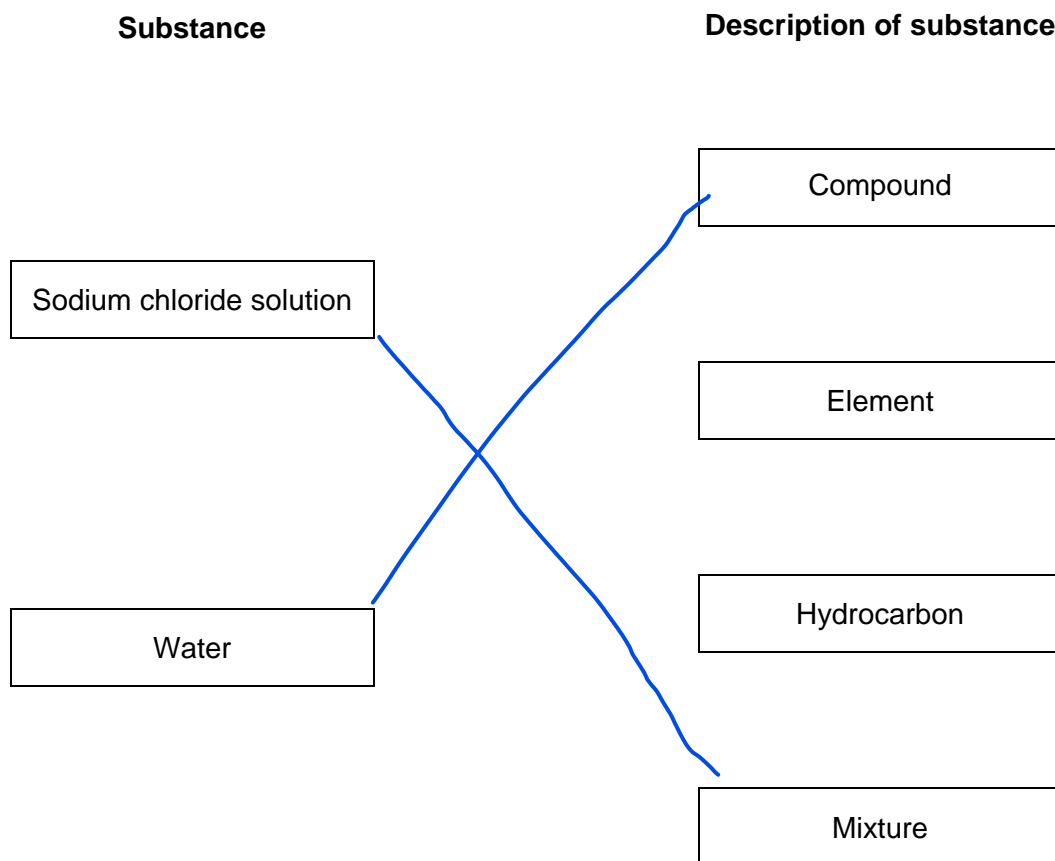


Sodium chloride dissolves in water to form sodium chloride solution.

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 or crystallisation



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 solidsSterilising to kill bacteria

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

☒

11

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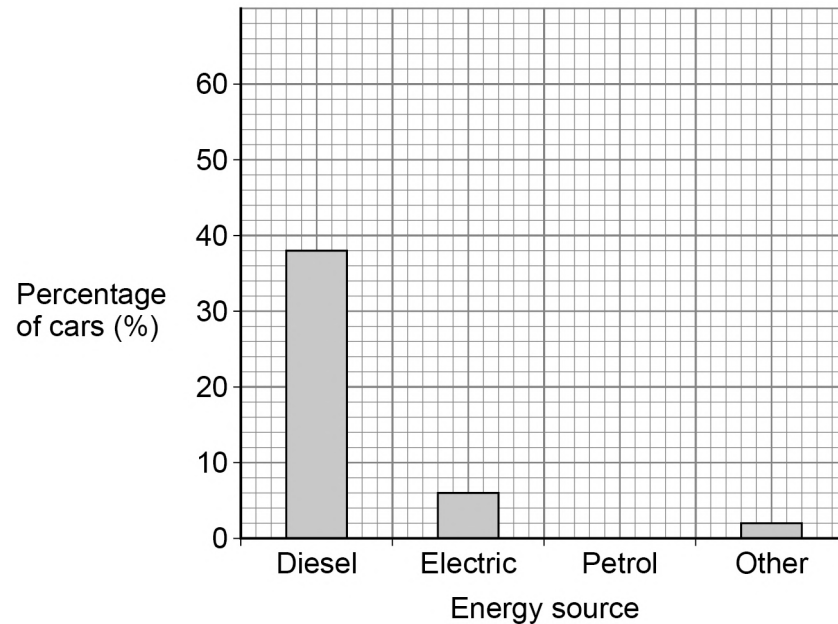


0 2

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**.

bar drawn to 54 (%)

[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]

less traffic

(because) fewer people working

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]

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

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 global warming

2 • melting polar ice caps

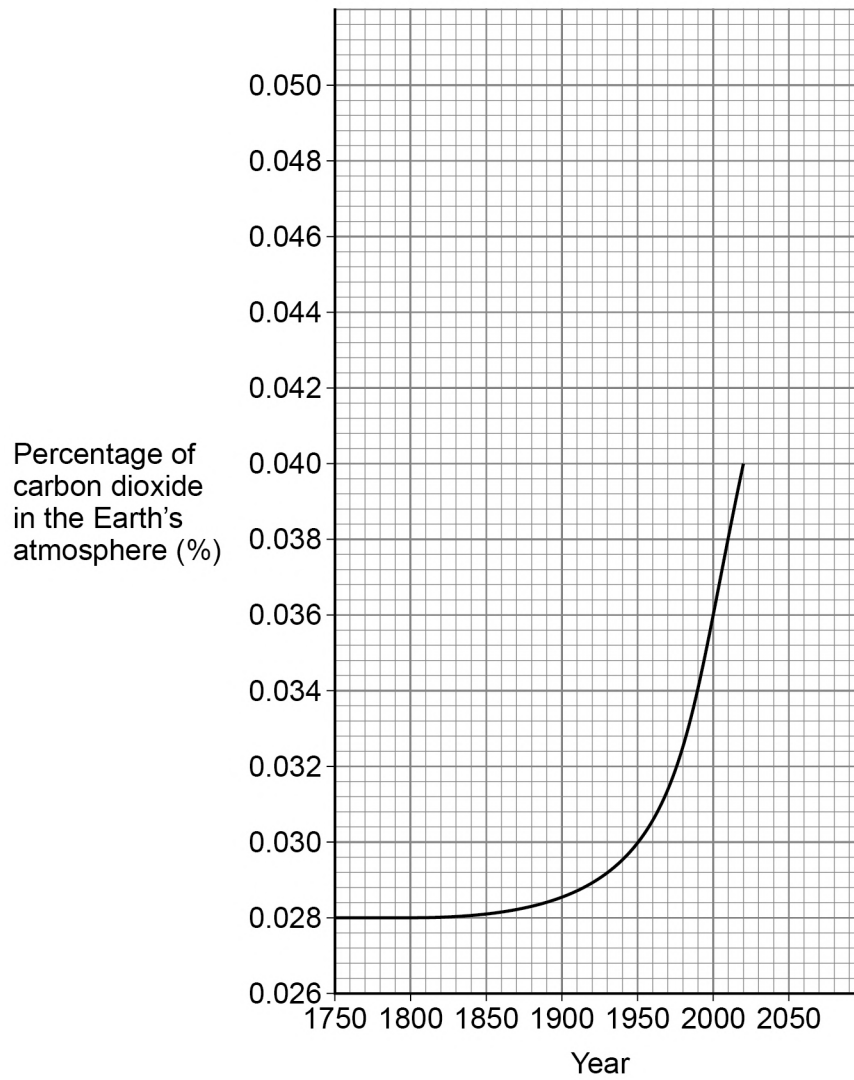
Question 3 continues on the next page

Turn over ►

Carbon dioxide is a greenhouse gas.

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

Figure 3



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]

constant

(then) increases

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)

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]

combustion of fuel

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]

extrapolation on graph

Percentage of carbon dioxide in 2050 = %

determine value from extrapolation at 2050



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]**

occurred (4.6) billion years ago

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

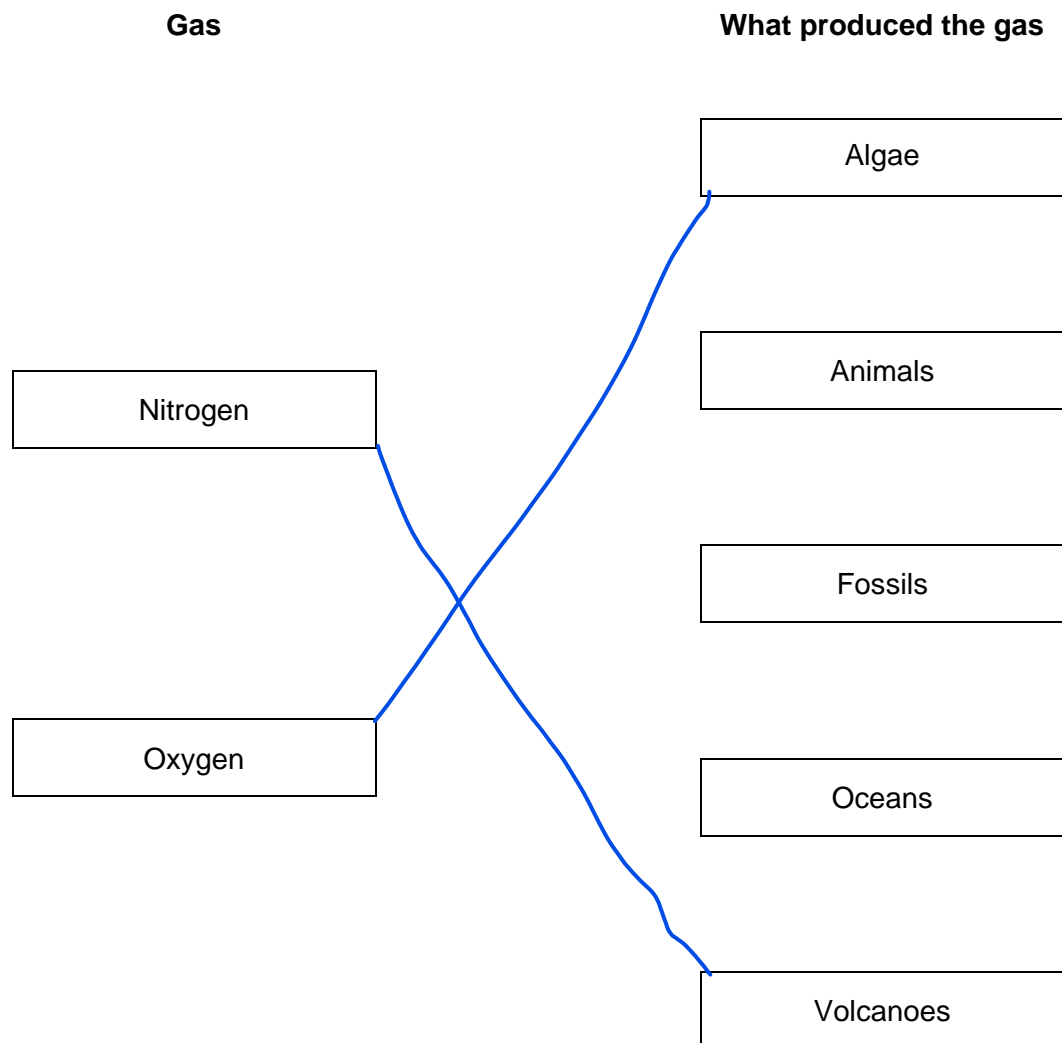
☒

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]

$$\frac{78}{21}$$

$$= 3.714$$

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

9

Turn over for the next question

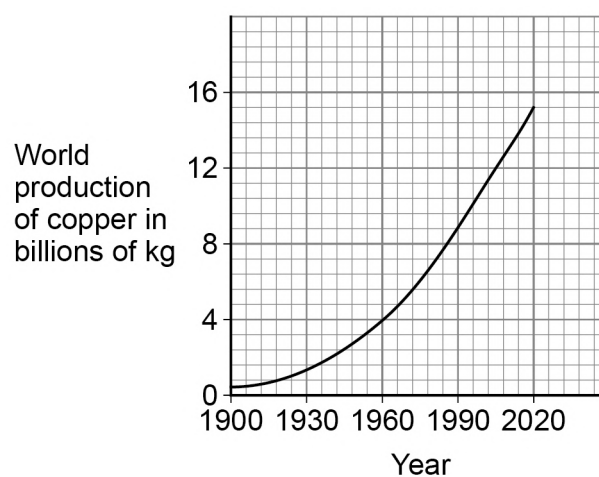
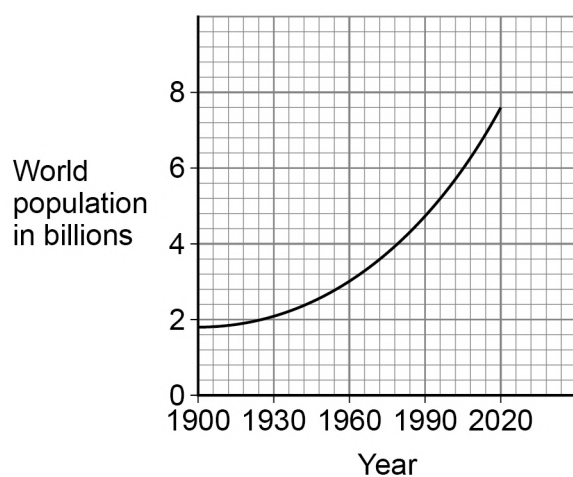
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0 5

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]

$$(\text{copper ore}) = 70 \times 100 = 7000$$

$$(\text{recycled copper}) = 27 \times 100 = 2700$$

$$(7000 - 2700)$$

$$\text{Energy saved} = 4300 \text{ MJ}$$

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

Why is reducing emissions of sulfur dioxide important?

[1 mark]

reduces respiratory problems
(in humans)

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]

$$\frac{75}{100} \times 8$$

$$\text{Mass of copper} = 6 \text{ g}$$

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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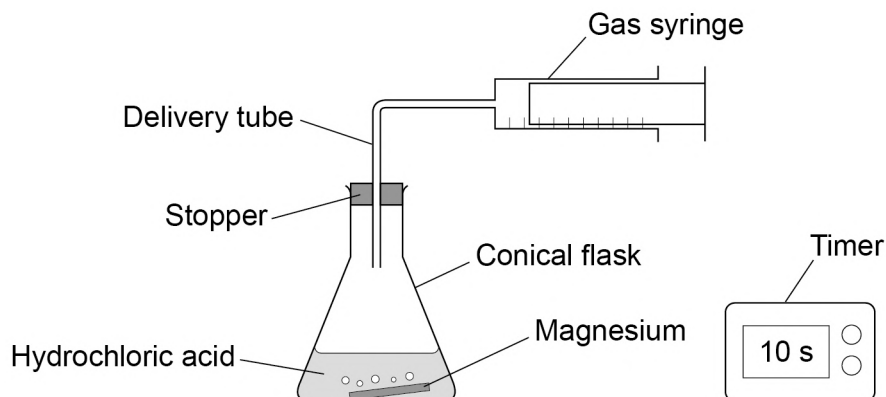


0 6

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 hydrochloric 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

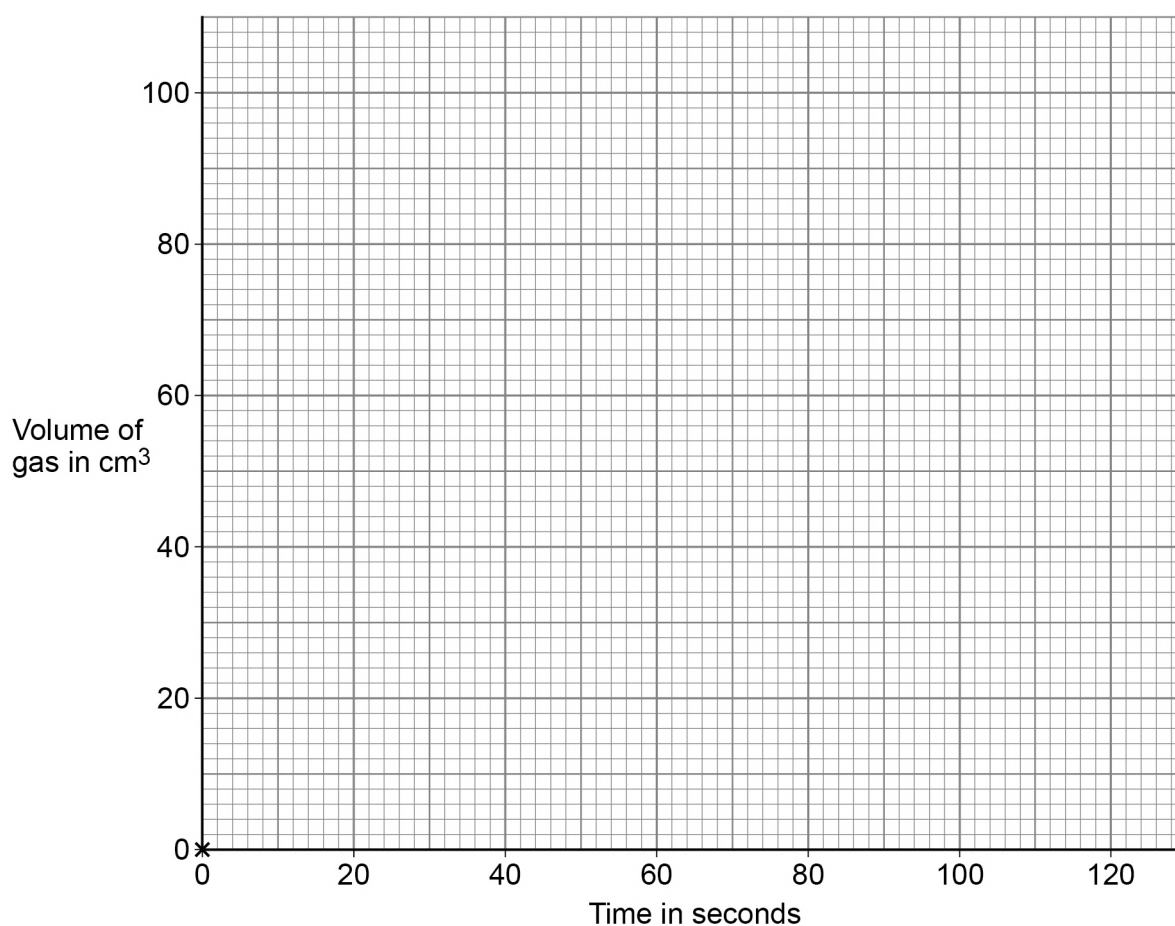
0 6 . 2 Complete **Figure 6**.

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



all points correctly plotted

line of best fit



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]

rate increases

(because) particles have more energy

(so) more frequent collisions

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 plankton or (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

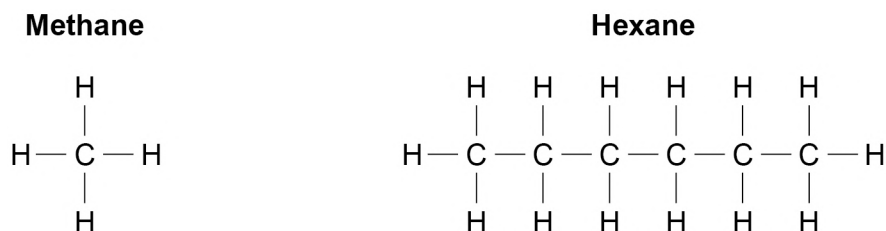


Table 4 shows the melting points and boiling points of methane and hexane.

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]

Indicative content

- methane has 1 carbon atom, hexane has 6
 - methane has 4 hydrogen atoms, hexane has 14
 - both contain C – H bonds
 - only hexane contains C – C bonds
 - both are hydrocarbons
-
- hexane has a higher melting point than methane (or converse)
 - hexane has a higher boiling point than methane (or converse)
 - methane is a gas at room temperature
 - hexane is a liquid at room temperature
-
- both are small molecules
 - hexane has larger molecules than methane
 - weak forces between molecules
 - forces between hexane molecules stronger than between methane molecules
-
- hexane is more viscous than methane
 - both are flammable
-
- methane is more flammable than hexane (or converse)
-
- possible products of combustion from both are: carbon, carbon monoxide, carbon dioxide, water
 - neither conduct electricity



Hydrocarbons are cracked to produce more useful alkanes and alkenes.

0 7 . 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 bromine (water)

Result turns (from orange / brown) to
colourless

11

END OF QUESTIONS



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