OCR
Oxford Cambridge and RSA

Friday 13 June 2025 – Morning

GCSE (9–1) Combined Science A (Gateway Science)

J250/04 Chemistry (Foundation Tier)

Time allowed: 1 hour 10 minutes

F

You must have:
- a ruler (cm/mm)
- the Data Sheet for GCSE (9–1) Combined Science A (Chemistry) (inside this document)

You can use:
- a scientific or graphical calculator
- an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

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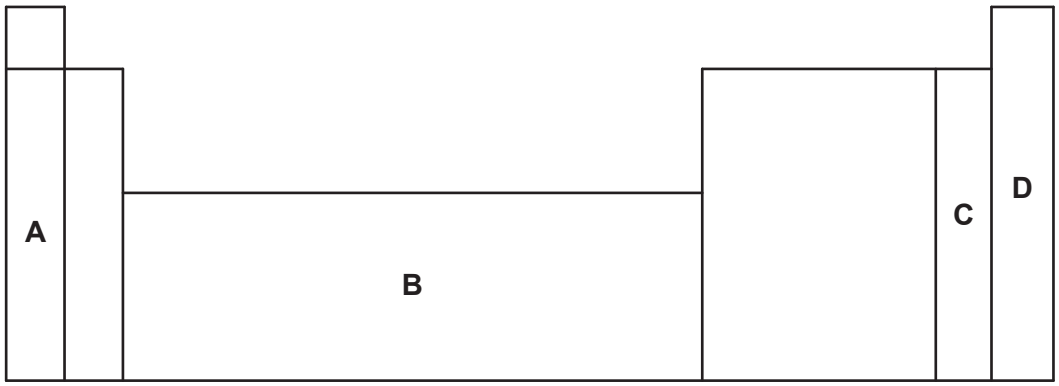
Section A

You should spend a **maximum** of **20 minutes** on this section.

Write your answer to each question in the box provided.

1 Which part of the Periodic Table contains the **least reactive** non-metals?



Your answer ☐ **[1]**

2 Which gas in the atmosphere causes acid rain?

A Carbon monoxide

B Hydrogen

C Oxygen

D Sulfur dioxide

Your answer ☐ **[1]**

3 When is electrolysis used to extract a metal from its ore?

A The metal dissolves in water.

B The metal has a high melting point.

C The metal is in high demand.

D The metal is very reactive.

Your answer ☐ **[1]**

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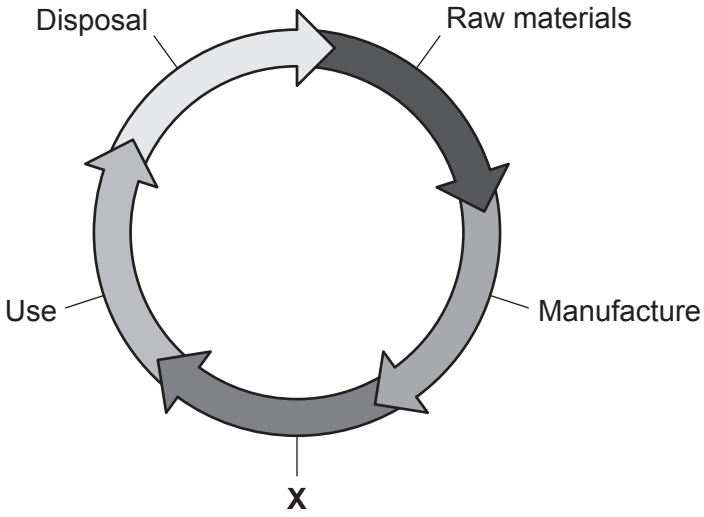
4 The diagram shows the stages in a life-cycle assessment.



What is stage **X**?

A Consumer research

B Design of the product

C Processing of the raw materials

D Transportation of the product

Your answer ☐ **[1]**

5 Part of the reactivity series is shown below.

Aluminium	most reactive
Carbon	↕
Tin	↕
Lead	least reactive

Which metal(s) are produced when their metal oxides are heated with carbon?

A Aluminium only

B Aluminium and lead

C Tin and lead

D Tin only

Your answer ☐ **[1]**

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6 When marble chips react with an acid, they produce a colourless solution and a gas.

Which method is used to determine the rate of reaction?

A A disappearing cross experiment

B Gas chromatography

C Measuring the mass loss using a balance

D Measuring the volume of solution produced

Your answer ☐ **[1]**

7 Which Group 7 element is a red-brown liquid at room temperature?

A Fluorine

B Chlorine

C Bromine

D Iodine

Your answer ☐ **[1]**

8 Desalination is the removal of salt from seawater to produce drinking water.

The seawater is heated and the water vapour condensed and collected.

Which **separation technique** is used to produce drinking water in desalination?

A Chromatography

B Crystallisation

C Distillation

D Filtration

Your answer ☐ **[1]**

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9 The equation shows a reaction that has reached **dynamic equilibrium**.

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

Which statement explains why this reaction is a dynamic equilibrium?

A N_2 and H_2 are gases.

B The rates of the forward and reverse reactions are equal.

C The reaction has stopped.

D The reaction produces a 100% yield of NH_3.

Your answer ☐ **[1]**

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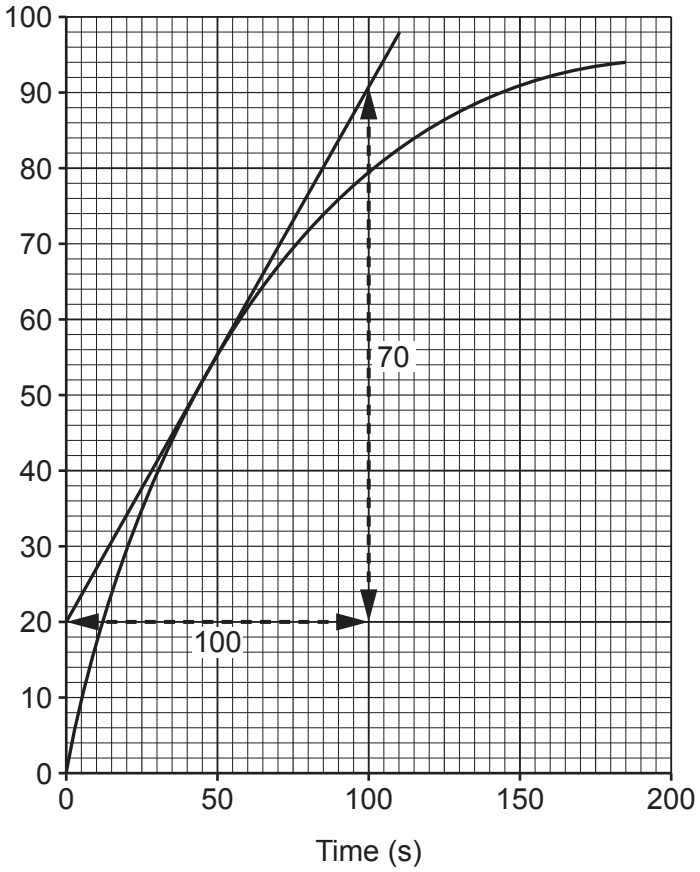
10 The graph shows the volume of gas produced during a reaction.

A tangent has been drawn at 50 seconds. The gradient of the tangent gives the rate of reaction.



What is the rate of reaction, in cm^3/s, at 50 seconds?

A 0.56

B 0.70

C 1.1

D 1.4

Your answer ☐ **[1]**

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Section B

11 Crude oil is a source of hydrocarbons.

(a) Which chemical is a hydrocarbon?

Tick (✓) **one** box.

Calcium carbonate – $CaCO_3$ ☐

Hydrogen chloride – HCl ☐

Methane – CH_4 ☐

[1]

(b) Complete the sentences about crude oil.

Use words from the list.

cracking	**filtration**	**fractional distillation**	**neutralisation**	**reduction**

The hydrocarbons in crude oil are separated by .....

Some of these hydrocarbons are made more useful by .....

[2]

(c) The table shows the description of three resources **A**, **B** and **C**.

Resource	Type	Composition
A	finite	an element
B	finite	a mixture of compounds
C	renewable	a mixture of compounds

Which resource is crude oil?

Explain your choice using information from the table.

Crude oil is resource .....

Reason .....

.....

[2]

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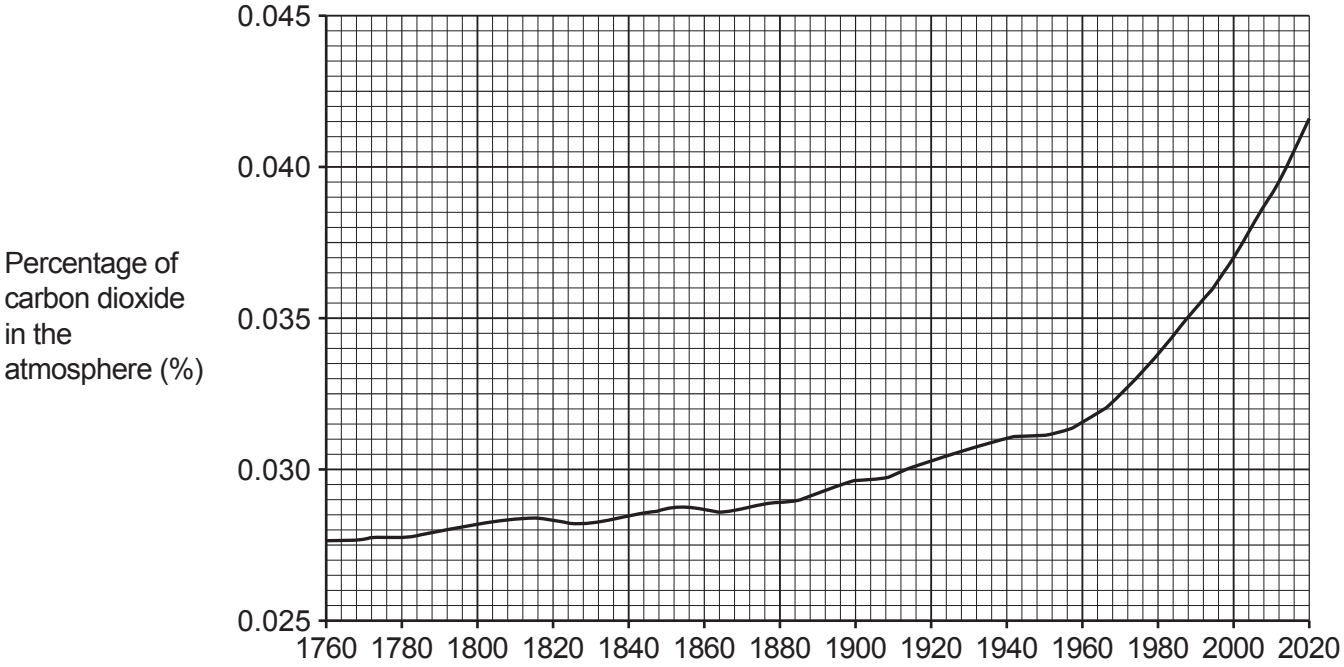
(d) When hydrocarbons burn they produce carbon dioxide.

The graph shows how the percentage of carbon dioxide in the atmosphere has increased since 1760.



Complete the sentences about the graph.

Put a ring around each correct option.

The percentage of carbon dioxide has increased fastest

from **1760–1860 / 1860–1960 / 1960–2020**.

This percentage increase is mainly caused by the use of **fossil fuels / metals / plastics**.

[2]

(e) Scientists think that increased levels of carbon dioxide are causing global warming.

Which statements about the potential effects of global warming are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	**False**
All animals will adapt to survive.		
Droughts and floods will become more likely.		
Extreme weather conditions will increase.		
It will impact crop growth.		

[2]

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12 This question is about elements in Group 1 and Group 7 of the Periodic Table.

(a) Sodium is below lithium in Group 1.

Table 12.1 describes the observations when small pieces of lithium and sodium are placed in water.

Table 12.1

Element	Observation
Lithium	fizzes steadily and disappears slowly
Sodium	melts into a silver ball, fizzes rapidly and disappears quickly

(i) Describe how these observations show how the reactivity of the elements **increases** going down Group 1.

.....

..... **[1]**

(ii) Potassium is below sodium in Group 1.

Describe **one** observation when a small piece of potassium is placed in water.

Use information from **Table 12.1**.

.....

..... **[1]**

(b) When sodium reacts with water, it forms sodium hydroxide and hydrogen.

Complete the **word equation** for the reaction of **potassium** with water.

potassium + water ⟶ ..... + ...

[2]

(c) The equation for sodium, Na, reacting with a Group 7 element, **X**, is:

$$Na(.....) + \mathbf{X}_2(g) \rightarrow 2NaF(s)$$

(i) Sodium is a **solid** at room temperature.

Complete the equation by writing in the missing state symbol for sodium. **[1]**

(ii) State the **name** of element **X**.

..... **[1]**

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(d) A more reactive Group 7 element displaces a less reactive Group 7 element from a solution of one of its salts.

Chlorine **reacts** with potassium bromide as chlorine is **more reactive** than bromine. Bromine **reacts** with potassium iodide as bromine is **more reactive** than iodine. Iodine **does not react** with potassium chloride as iodine is **less reactive** than chlorine.

Table 12.2 shows the results of mixing three Group 7 elements and solutions of their salts.

Table 12.2

Key	✓ = reaction	✗ = no reaction

	Potassium chloride solution	**Potassium bromide solution**	**Potassium iodide solution**
Chlorine		✓	.....
Bromine	.....		✓
Iodine	✗	.....	

Complete **Table 12.2** by putting a tick (✓) or cross (✗) in the three answer spaces. **[2]**

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13 The Earth's early atmosphere may have been mainly carbon dioxide, nitrogen and water vapour.

(a) The sentences describe how the Earth's atmosphere developed over time.

A The Earth cooled down.

B Plants absorbed carbon dioxide and produced oxygen.

C The water vapour condensed to form the oceans.

D The gases were released by volcanoes.

E Plants evolved.

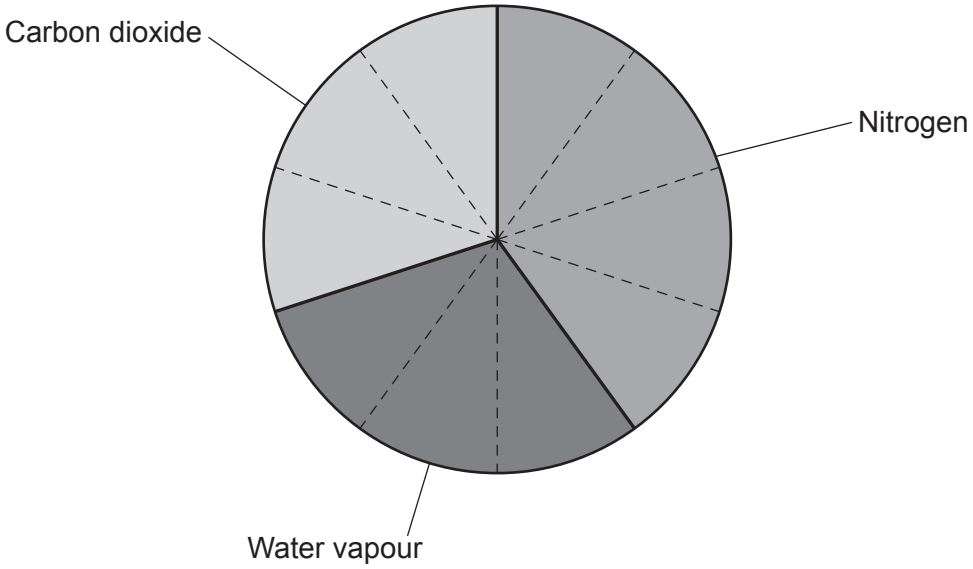
Write the letters in the boxes to show the correct order of the sentences.

The first one has been done for you.

D				

[2]

(b) The pie chart shows the relative amounts of each gas in the Earth's early atmosphere.



Calculate the percentage of nitrogen in the Earth's early atmosphere.

Percentage of nitrogen = ... % **[3]**

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(c) Some of the gases in the Earth's atmosphere today are called greenhouse gases.

(i) What effect do greenhouse gases have in the Earth's atmosphere?

Tick (✓) **one** box.

They dissolve in rain water making it acidic. ☐

They make a hole in the ozone layer. ☐

They trap heat from the Sun. ☐

[1]

(ii) Which of these gases is a greenhouse gas?

Tick (✓) **one** box.

Argon ☐

Methane ☐

Nitrogen ☐

[1]

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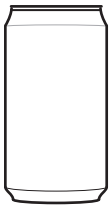
14* Containers for drinks are made from aluminium or glass.



Aluminium can

Glass bottle

The table shows some information about the containers.

	Aluminium can	**Glass bottle**
Energy used in production from raw materials (kJ / kg)	300 000	2 500
Contribution of production to global warming	medium	high
Amount of energy saved during recycling (%)	95	25
Amount of containers collected for recycling (%)	75	75
Time to decompose when put in landfill (years)	80	1 000 000

State which container you would choose to produce as a container for drinks.

Explain your choice using information from the table.
Include an advantage and a disadvantage of your chosen container in your answer.

.....

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.....

.....

..... **[6]**

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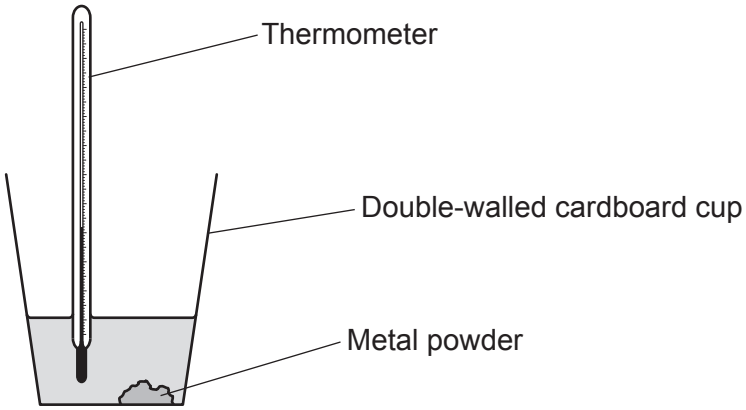
15 A student investigates the reactivity of four different metals.

Fig. 15.1 shows their experiment.

Fig. 15.1



This is their method:

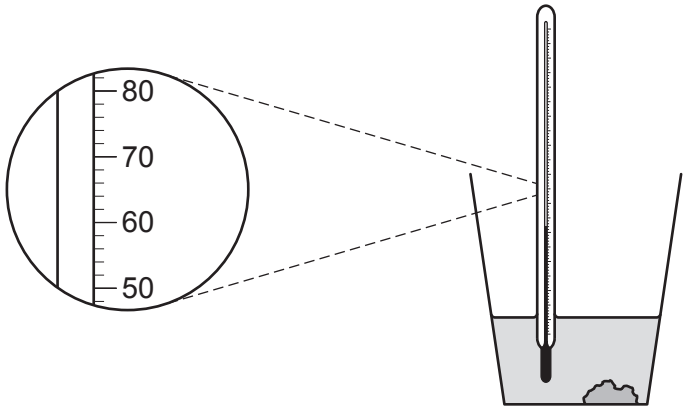
- Put 25 cm^3 of dilute hydrochloric acid into the double-walled cardboard cup.
- Add one spatula of metal powder.
- Measure the highest temperature.

The table shows the student's results.

Metal	Highest temperature (°C)
Copper	20
Iron	23
Magnesium	65
Zinc	32

(a) **Fig. 15.2** shows the thermometer when the metal powder is magnesium.

Fig. 15.2



Draw a line on the thermometer in the circle to show the highest temperature for magnesium. **[1]**

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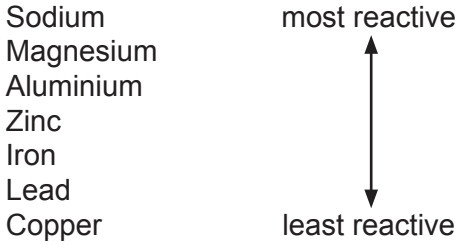
(b) Part of the reactivity series is shown below.



(i) Describe how the highest temperature changes as the reactivity of the metals increases.

.....

..... **[1]**

(ii) The student repeats the experiment with another metal from the reactivity series shown above.

The highest temperature measured is 49 °C.

Suggest the name of this metal.

..... **[1]**

(c) The student repeats the experiment with magnesium.

This table shows all their results.

Experiment	Highest temperature (°C)
1	65
2	63
3	66

(i) Calculate the mean highest temperature.

Give your answer to **2** significant figures.

Mean highest temperature = ... °C **[3]**

(ii) Describe **one** variable the student must control when they repeat this experiment.

.....

..... **[1]**

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(d) The student thinks that the highest temperatures are lower than they should be.

Suggest one **improvement** the student could make so the highest temperatures are more accurate.

.....

..... **[1]**

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16 Hydrogen peroxide solution, $H_2O_2(aq)$, decomposes to make water and oxygen gas.

(a) Complete the **balanced symbol** equation for the reaction.

$$2H_2O_2(aq) \rightarrow .....H_2O(l) + ...(g)$$

[2]

(b) Describe a test and its result which shows that the gas produced in the reaction is oxygen.

Test .....

.....

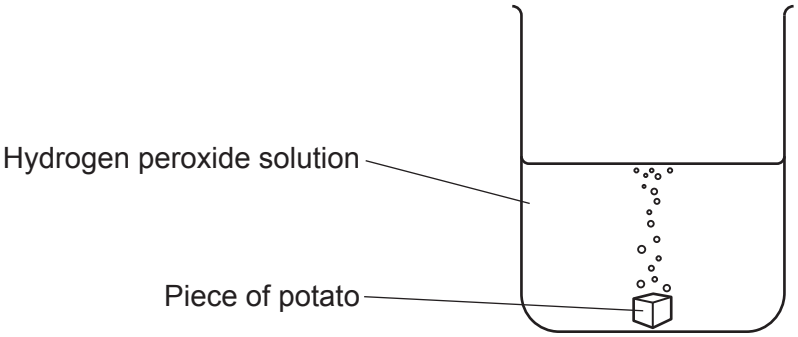
Result .....

.....

[2]

(c) A hydrogen peroxide solution produces oxygen gas slowly.

A student adds a piece of potato to the hydrogen peroxide solution.
The potato contains a biological catalyst.



(i) What name is given to biological catalysts?

..... **[1]**

(ii) Describe and explain the effect of adding the piece of potato to the hydrogen peroxide solution.

Include ideas about rate of reaction and activation energy.

.....

.....

.....

..... **[2]**

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(iii) The student measures the total volume of oxygen produced in the reaction with and without the piece of potato.

With the potato, the total volume is: increased, decreased, stays the same.

Tick (✓) **one** box.

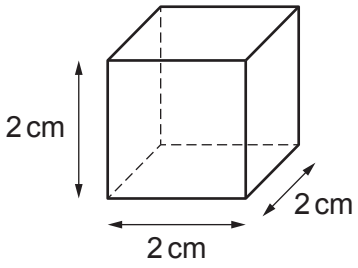
It is decreased. ☐

It is increased. ☐

It stays the same. ☐

[1]

(d) The piece of potato added to the hydrogen peroxide solution is a six-sided cube.



(i) Calculate the surface area of the piece of potato in cm^2.

Surface area of the piece of potato = ... cm^2 **[2]**

(ii) A student thinks that cutting the potato into smaller pieces will make the catalyst more effective.

Explain why the student is **correct**.

Tick (✓) **one** box.

The smaller pieces have a larger mass. ☐

The smaller pieces have a larger surface area. ☐

The smaller pieces have a larger volume. ☐

[1]

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(e) The student measures the rate of reaction when the piece of potato is added to the hydrogen peroxide.

The rate of reaction is 1.5 cm^3/s.

They then measure the rate of reaction again with an increased concentration of hydrogen peroxide.

What would the rate of reaction be now?

Tick (✓) **one** box.

Rate of reaction = 1.5 cm^3/s ☐

Rate of reaction > 1.5 cm^3/s ☐

Rate of reaction < 1.5 cm^3/s ☐

[1]

END OF QUESTION PAPER

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EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.

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