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Friday 20 November 2020 ± Morning

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

J250/04 Paper 4 (Foundation Tier)

Time allowed: 1 hour 10 minutes

8191479598

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

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

J250004

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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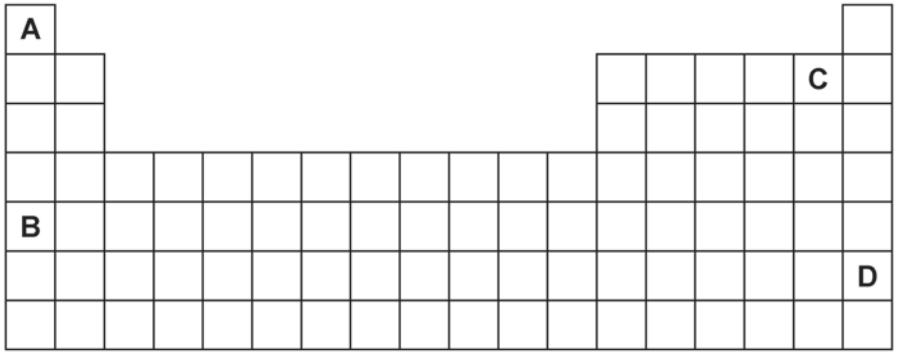
SECTION A

Answer **all** the questions.

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

Write your answer to each question in the box provided.

1 Look at the diagram of the Periodic Table.



Which element **A**, **B**, **C** or **D**, is a reactive metal?

Your answer ☐ **[1]**

2 Crude oil is a **finite** resource.

What does this mean?

A Crude oil is a mixture of hydrocarbons.

B Crude oil is expensive to produce.

C Crude oil is renewable.

D Crude oil will run out.

Your answer ☐ **[1]**

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3 The reaction to make sulfur trioxide, SO_3, is an example of a **dynamic equilibrium**.

The equation is shown below.

$2SO_2(g) + O_2(g) \quad \ldots\ldots\ldots \quad 2SO_3(g)$

Which symbol completes the equation?

A $\rightarrow$

B $\leftarrow$

C =

D $\rightleftharpoons$

Your answer ☐ **[1]**

4 A teacher places a small piece of metal into a test tube of water.

The metal floats and fizzes on the surface of the water.

What is the name of the metal?

A Copper

B Iron

C Lithium

D Silver

Your answer ☐ **[1]**

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5 A mixture contains two liquids, hexane and decane.

The table shows the boiling points of hexane and decane.

	Boiling point (°C)
Hexane	69
Decane	174

Which method is used to separate and collect **hexane** from a mixture of hexane and decane?

A Crystallisation

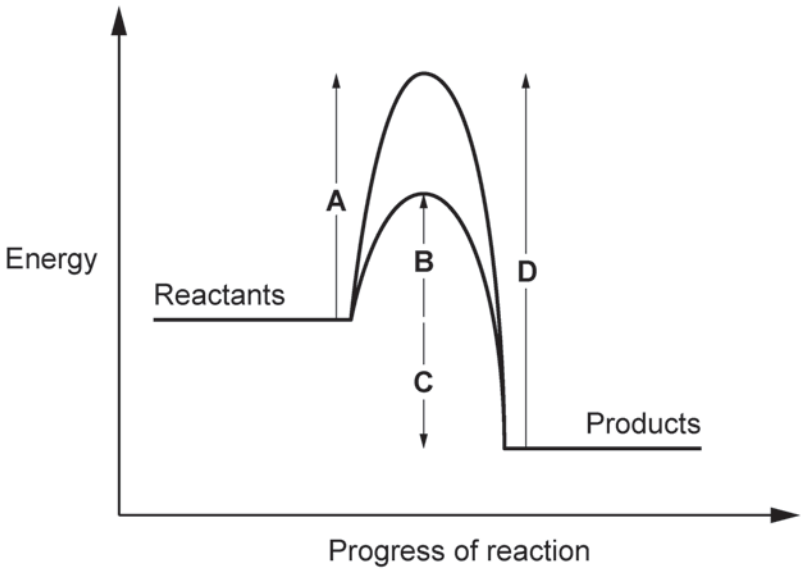
B Evaporation

C Filtration

D Fractional distillation

Your answer ☐ **[1]**

6 Look at the energy profile for a reaction.



Which letter shows the activation energy of the reaction with a catalyst?

Your answer ☐ **[1]**

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7 Copper can be made by heating copper(I) sulfide in air.

Look at the equation.

$Cu_2S + O_2 \longrightarrow 2Cu + \mathbf{X}$

What is the formula of **X**?

A CuS

B S

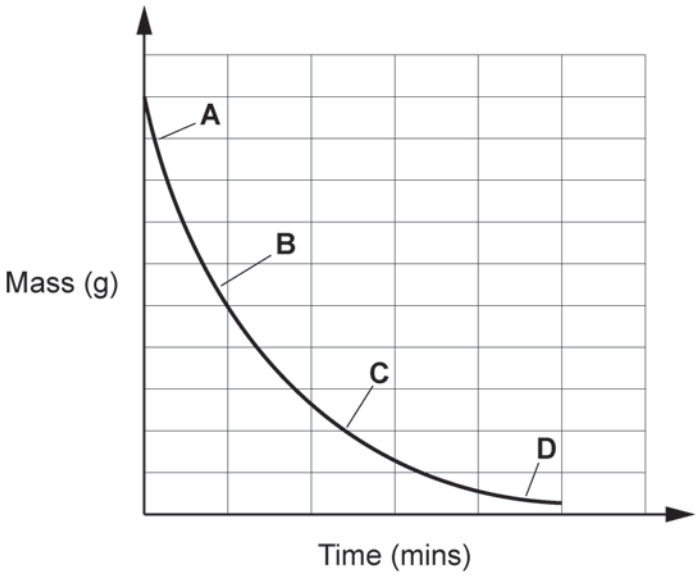
C SO_2

D SO_3

Your answer ☐ **[1]**

8 Marble chips react with dilute hydrochloric acid and release a gas.

The graph shows how the mass of the reactants changes as the reaction progresses.



Which letter shows where the rate of reaction is highest?

Your answer ☐ **[1]**

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9 What is an example of a **biological** catalyst?

A A lipid

B An amino acid

C An enzyme

D A substrate

Your answer ☐ **[1]**

10 The table shows the boiling points of the first five Group 0 elements.

Element	Boiling point (°C)
Helium	–269
Neon	–246
Argon	–186
Krypton	–152
Xenon	–107

Which statement describes the trend in the boiling points?

A The boiling points decrease as the molecules get larger.

B The boiling points decrease as the molecules get smaller.

C The boiling points increase as the atoms get larger.

D The boiling points increase as the atoms get smaller.

Your answer ☐ **[1]**

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SECTION B

Answer **all** the questions.

11 4.5 billion years ago the Earth's atmosphere was different from the atmosphere today.

The table shows the gases found in the Earth's atmosphere as it is today.

Gas	**Nitrogen**	**Oxygen**	**Argon**	**Carbon dioxide**	**Other gases**
Percentage in atmosphere (%)	78	21		0.04	0.06

(a) Calculate the percentage of argon in the atmosphere.

Percentage = ... % **[1]**

(b) Look at the list of gases that may have been present in the Earth's atmosphere 4.5 billion years ago.

ammonia **carbon dioxide** **carbon monoxide**

hydrogen **methane** **water vapour**

Answer the following questions using words from the list.

Each word may be used once, more than once, or not at all.

(i) Which gas condensed to form the oceans?

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

(ii) Which gas was turned into oxygen by plants and algae?

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

(iii) Which gas was turned into nitrogen by bacteria?

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

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12 This question is about different Groups in the Periodic Table.

(a) The elements in Group 7 have different physical properties at room temperature.

Draw a line to connect each **Group 7 element** with its correct **description**.

Group 7 element	Description
Fluorine	Green gas
Chlorine	Grey-black solid
Bromine	Orange-brown liquid
Iodine	Pale-yellow gas

[3]

(b) The Group 7 elements show trends in their chemical properties as you go down the Group.

(i) Use these words to complete the sentences.

You can use each word once, more than once, or not at all.

astatine **bromine** **chlorine** **electrons**

fluorine **ions** **neutrons** **protons**

The most reactive element in Group 7 is ..... .

This is because its atoms gain ..... more easily than atoms of the other elements. **[2]**

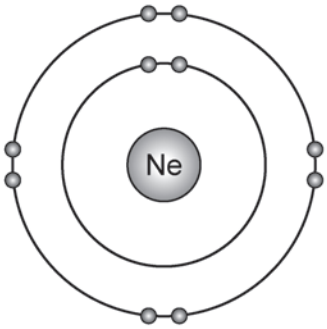
(ii) State why the elements in Group 7 have similar chemical properties.

.....

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

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(c) The diagram shows the arrangement of electrons in an atom of neon.



How reactive is neon? Explain your answer.

Use ideas about electrons in your answer.

.....

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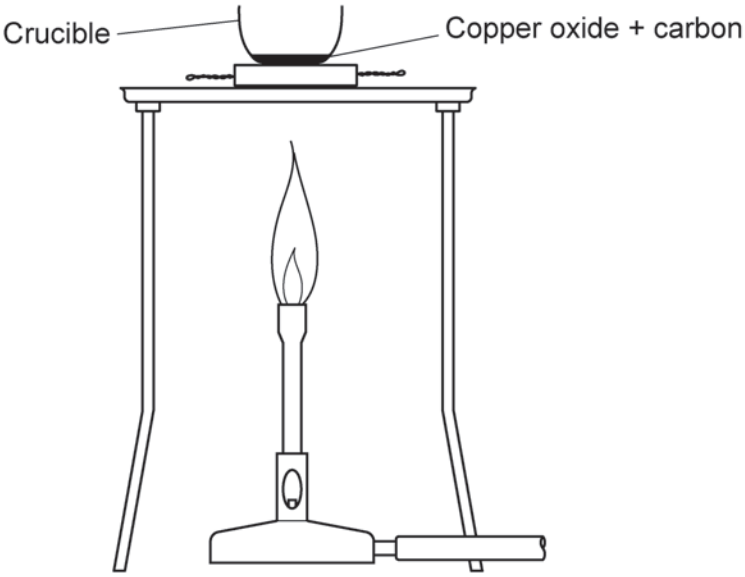
.....

..... **[3]**

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13 In an experiment a student heats copper oxide and carbon to produce copper.

Look at the diagram of the equipment she uses.



(a) Complete the word equation for the reaction.

copper oxide + carbon → copper + ... **[1]**

(b) In the reaction copper ions in the copper oxide are **reduced**.

Explain why.

.....

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

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(c) The student measures the mass of copper made in the experiment.

She repeated the experiment four times.

Look at the table of her results.

Experiment	1	2	3	4
Mass of copper oxide (g)	2.4	2.4	2.4	2.4
Mass of copper (g)	1.7	1.7	0.8	1.6

(i) Look at the mass of copper made in **Experiment 3**.

Suggest why the result of **Experiment 3** is different and why it should **not** be used to calculate the mean.

.....

.....

.....

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

(ii) Calculate the **mean** mass of copper formed. Do **not** include the result of **Experiment 3** in your calculation.

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

Mean mass of copper = ... g **[3]**

(d) Another student repeats the experiment with magnesium oxide and carbon.

There was **no** reaction.

Explain why.

.....

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

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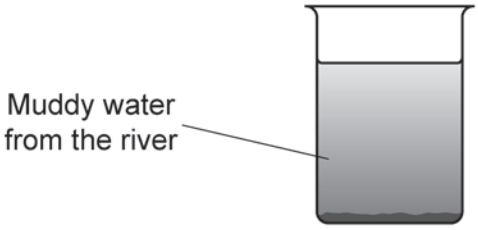
14 Drinking water which comes from rivers needs to be made safe to drink.

(a) What is the name of water that is safe to drink?

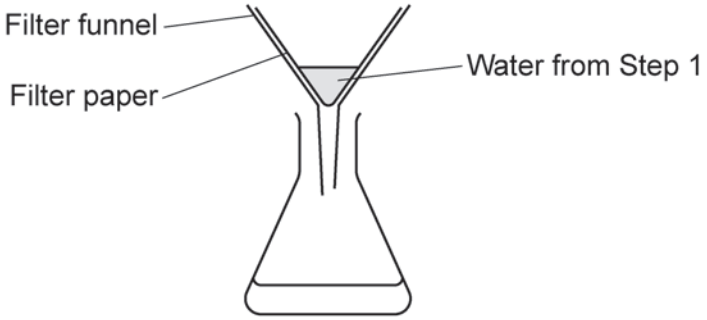
..... **[1]**

(b) A student wants to produce water that is safe to drink from **muddy water** from a river.

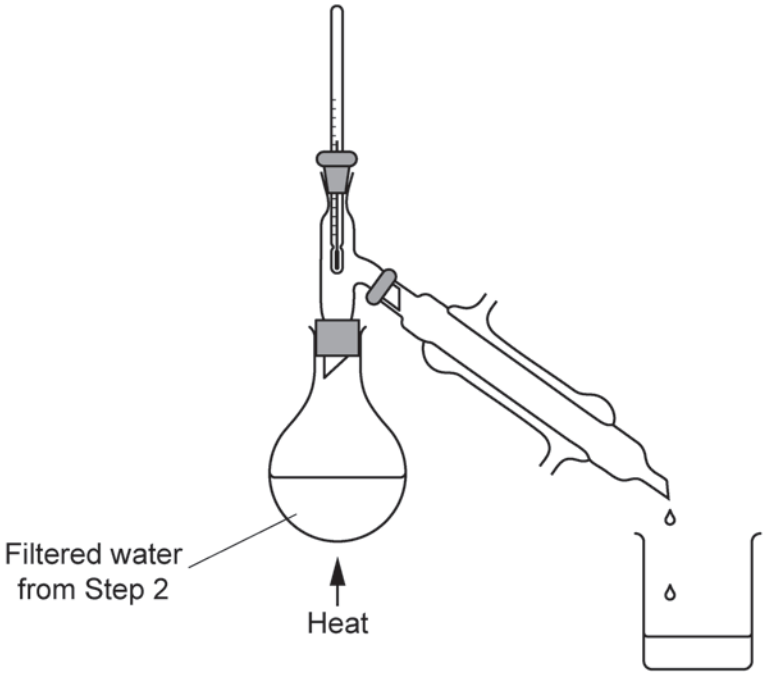
Step 1: He leaves the water from the river in a beaker for 24 hours.



Step 2: He filters the top half of the water in the beaker from Step 1.



Step 3: He distils the filtered water from Step 2.



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Explain how **each** step purifies the water.

Step 1 .....

.....

Step 2 .....

.....

Step 3 .....

.....

[3]

(c) Seawater can be turned into drinking water by desalination. There are two main methods for this, reverse osmosis and simple distillation.

Name of method	**Description of method**	**Approximate cost of drinking water (£ per m^3)**
Reverse osmosis	Seawater is pumped through 'ultrafilters', which trap salt and produce drinking water.	30
Simple distillation	Seawater is heated to separate pure water from salt which is left behind.	80

(i) Suggest why simple distillation is **more** expensive than reverse osmosis.

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

(ii) Suggest **one** environmental problem with both methods.

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

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15 Shopping bags can be made from different types of plastics.

The table shows information about three different plastic bags.

Plastic bag	Weight (g)	Volume (cm^3)	For every 100 bags made:	
			Energy used (kJ)	Waste produced (g)
A	8	19000	2.0×10^3	42
B	35	21000	1.7×10^4	17
C	116	20000	.....	585

(a) Plastic bag **C** uses 31600 J of energy for every **one** bag made.

Calculate the energy used (in kJ) for every **100** bags of **Plastic bag C** made.

Write your answer in standard form in the table.

[3]

(b) One student thinks that **Plastic bag A** is the best bag to use.

Another student thinks **Plastic bag B** is the best bag to use.

Explain why **both** students could be correct.

Use information from the table in your answer.

.....

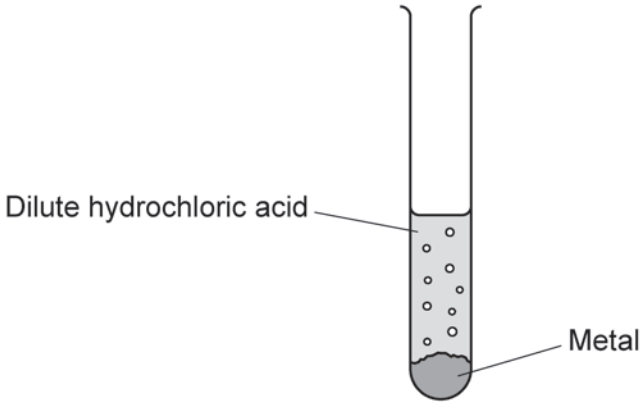
.....

.....

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

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16* The diagram shows the reaction of a metal with dilute hydrochloric acid.



A student thinks she can use this reaction to place four different metals in their order of reactivity.

Describe a method the student could use to get valid results **and** explain how the student would use the results to place the metals in an order of reactivity.

.....

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

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17 Look at the flowchart. It shows how crude oil is changed into useful substances.

Process 1. Fractional distillation	Crude oil is separated into fractions of similar hydrocarbons.
↓	
Process 2.	Some long chain hydrocarbons are turned into short chain hydrocarbons.
↓	
Process 3. Polymerisation	Some of the short chain hydrocarbons are used to make plastics.

(a) Complete the flowchart with the name of **Process 2**. **[1]**

(b) **Table 17.1** shows the supply and demand of two fractions of crude oil.

Fraction	Millions of barrels per day	
	Supply	**Demand**
Petrol	26	39
Fuel oil	19	11

Table 17.1

Explain the importance of **Process 2**.

Use information from **Table 17.1** in your answer.

.....

.....

.....

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

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(c) The hydrocarbon fractions from **Process 1** contain different alkanes.

Table 17.2 shows the boiling point of different alkanes produced in **Process 1**.

Number of carbon atoms in a molecule of the alkane	Boiling point (°C)
1	−162
2	−89
3	.....
4	−1
5	36

Table 17.2

(i) Complete **Table 17.2** with an estimate of the missing boiling point for an alkane molecule with **3 carbon atoms**. **[1]**

(ii) Write the formula for an alkane with **7 carbon atoms**.

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

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18 A student investigates the rate of a reaction at different concentrations.

Fig. 18.1 shows the apparatus he uses.

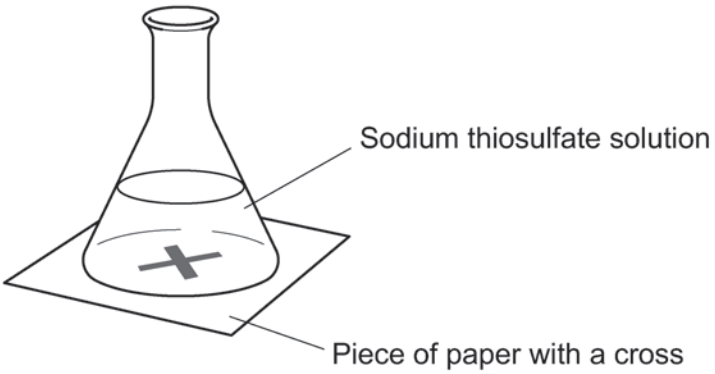


Fig. 18.1

The student adds dilute hydrochloric acid to the sodium thiosulfate solution. He times how long it takes for the cross to disappear. This is the reaction time.

The student repeats the experiment at different concentrations of sodium thiosulfate solution.

The concentration of hydrochloric acid is the same in each experiment.

He plots the results of the experiment on a graph, as shown in **Fig. 18.2**.

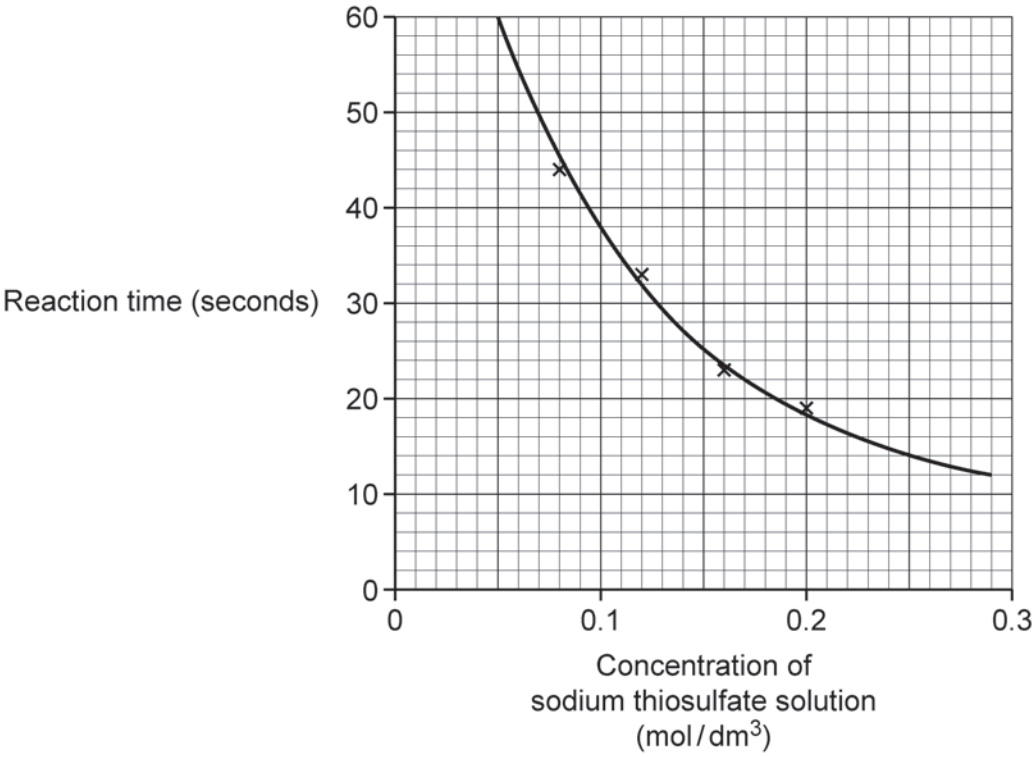


Fig. 18.2

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(a) Look at the equation for the reaction.

$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + S(s) + SO_2(g)$

Which product in the reaction makes the cross disappear?

Tick (✓) **one** box.

$NaCl(aq)$ ☐

$S(s)$ ☐

$SO_2(g)$ ☐

[1]

(b) The rate of reaction can be calculated using the equation:

$$\text{Rate of reaction} = \frac{1}{\text{reaction time}}$$

Use the graph in **Fig. 18.2** to calculate the rate of reaction when the concentration of sodium thiosulfate solution is $0.25\,mol/dm^3$.

Give your answer to **2** decimal places.

Rate of reaction = ... /s **[3]**

(c) **(i)** Describe the trend shown by the graph in **Fig. 18.2**.

.....

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

(ii) State how the rate of reaction changes as the sodium thiosulfate concentration changes.

.....

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

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(d) Another student investigates the effect of temperature on the rate of reaction.

She calculates the rate of reaction at different temperatures, as shown in the table.

Temperature (°C)	Rate of reaction (/s)
30	0.015
40	0.030
50	0.060
60	0.120

Predict the rate of reaction at 70 °C.

Predicted rate of reaction = ... /s **[1]**

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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