

# AQA

GCSE

# Chemistry

## SET B – Paper 2 Higher Tier

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# H

### Materials

Time allowed: 1 hour 45 minutes

#### For this paper you must have:

- a ruler
- a calculator
- the Periodic Table (found at the end of the paper).

### Instructions

- Answer all questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

### Information

- There are 100 marks available on this paper.
- 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.
- When answering questions 01.2, 04.2 and 06.5 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

### Advice

- In all calculations, show clearly how you work out your answer.

Name: .....

**01.1** Which of the following would be considered in the **life-cycle assessment** of a product?

Tick **three** boxes.

Sales projections

☐

Profit per product

☐

Manufacturing process

☐

Transport requirements

☐

Useful lifetime of product

☐

Available colour schemes

☐

**[3 marks]**

**01.2** Two people manage a café that sells take-away drinks.

One person believes that paper cups are the most sustainable.

The other person believes that polystyrene cups are better for the environment.

They do some research into cup production and find data summarised in **Table 1.1**

**Table 1.1**

	Paper	Polystyrene
Raw material	wood	oil
Petrol per cup used in transportation of raw materials (g)	4.1	none (oil is transported through pipelines)
Chemicals used per cup (g)	1.8	0.05
Relative amount of electricity used in production of one cup	36	1
Relative amount of waste water created in the production of one cup	580	1

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### 01.3 Polymers can be *thermosoftening* or *thermosetting*.

Explain your answer.

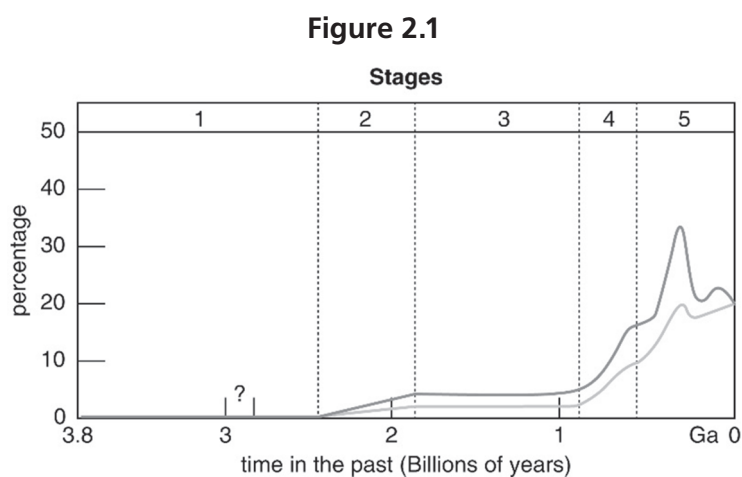
**Turn over >**

**02.1** Draw a line from each gas to the percentage present in the atmosphere.

Gas	Percentage present in the atmosphere
argon	0.04%
carbon dioxide	0.9%
nitrogen	21%
oxygen	78%

[2 marks]

**02.2** Figure 2.1 shows estimates of how oxygen levels have varied over the last 3.8 billion years. The highest are shown in black, and the lowest are shown in grey.



In stage two of the graph, oxygen is produced on Earth for the first time.

What was responsible for this and what was the name of the process?

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[2 marks]

**02.3** Give the balanced symbol equation for the process in question 02.2

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[1 mark]

**02.4** As atmospheric oxygen levels rose, carbon dioxide levels fell.

Name one process that captured carbon dioxide.

Explain how the carbon was transformed so that it was removed from the atmosphere for the long term.

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**[2 marks]**

**02.5** Table 2.1 shows the **yearly increase** in carbon dioxide ppm (parts per million) in the atmosphere at ten-year intervals.

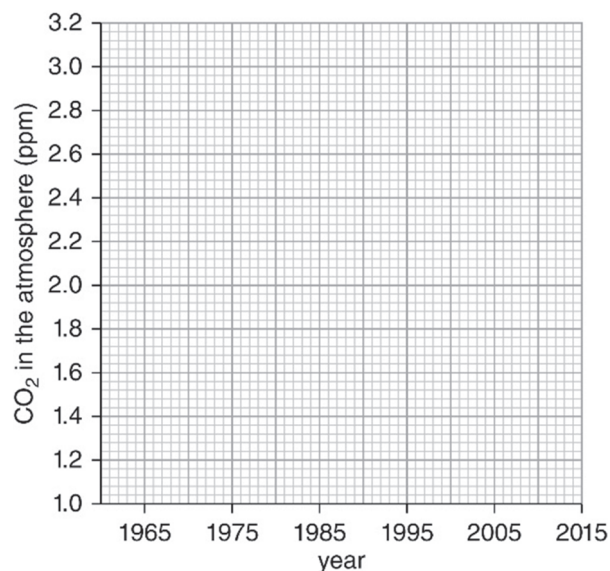
**Table 2.1**

Year	1965	1975	1985	1995	2005	2015
CO <sub>2</sub> growth rate (ppm/year)	1.02	1.08	1.27	2.00	2.54	3.03

source: [www.noaa.gov](http://www.noaa.gov)

Plot the data on the axes below.

Draw a line of best fit.



**[2 marks]**

**Question 2 continues on the next page**

**02.6** Using your graph, calculate the rate of increase in the CO<sub>2</sub> growth rate **between 1990 and 2010**

Use a suitable number of decimal places for your answer.

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**[2 marks]**

**02.7** What can be concluded from these data?

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**[1 mark]**

**03** A student was given some ink and asked to identify the dyes in it.

She marked a start line on the bottom of a sheet of paper and put a spot of ink on it.

She stood the paper in some solvent and waited for the dyes to rise up the paper.

When the solvent stopped rising, she dried the paper out.

She measured the distance from the start line to the separate dye spots and from the start line to the solvent front.

**Table 3.1** shows her results.

**Table 3.1**

	Red spot	Blue spot	Solvent front
Distance from start line (cm)	3.6	8.5	12.2

The student was told that her ink contains two dyes from this list:

Dye 1;  $R_f$  value = 0.30

Dye 2;  $R_f$  value = 0.42

Dye 3;  $R_f$  value = 0.70

Dye 4;  $R_f$  value = 0.85

**03.1** Identify which dyes are in the ink.

Show your working.

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**[3 marks]**

**03.2** Suggest a way to improve the reliability of her results.

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**[1 mark]**

**Question 3 continues on the next page**

**03.3** The student was then given four ionic compounds to identify.

She carried out these tests:

1. Dip a cleaned wire into a sample of each compound and hold it in a blue Bunsen burner flame. Observe and record flame colours.
2. Add sodium hydroxide solution to a solution of each compound. Observe and record any precipitates.
3. Add dilute nitric acid to each compound and bubble any gas produced through limewater. Observe and record if the limewater turns milky.
4. Add silver nitrate solution and dilute nitric acid to each compound. Observe and record any precipitates.
5. Add barium chloride solution and dilute hydrochloric acid to a solution of each compound. Observe and record any precipitates.

**Table 3.2** shows the results of these tests.

**Table 3.2**

Compound	Test				
	1	2	3	4	5
A	green	blue precipitate	yes	–	–
B	orange-red	white precipitate	–	yellow precipitate	–
C	orange	–	–	–	white precipitate
D	crimson	–	–	white precipitate	–

Using these results, identify each of the compounds.

A .....

B .....

C .....

D ..... **[8 marks]**

**Turn over >**



**04.1** Which of the following statements about crude oil are **correct**?

Tick **three** boxes.

Finite resource

☐

Made from rocks

☐

A mixture of many compounds

☐

Made of different carbohydrates

☐

Can be manufactured from plankton

☐

Formed from ancient tiny sea creatures

☐

**[3 marks]**

**04.2** Explain how **fractional distillation** is used to separate crude oil into its separate fractions.

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**[6 marks]**

**Question 4 continues on the next page**

**04.3** Three fuels, A, B and C, have been collected from the fractional distillation of crude oil.

The fuels are tested and the results are shown in **Table 4.1**

**Table 4.1**

Fuel	Boiling point (°C)	Relative viscosity	Relative flammability
A	28	low	high
B	300	high	low
C	260	fairly high	fairly low

Molecules are made from atoms. The molecules in one of the fuels was made from **3 carbon atoms**, one from **16 carbon atoms** and one from **22 carbon atoms**.

State how many carbon atoms there are in molecules of fuel A, molecules of fuel B and molecules of fuel C.

A has ..... carbon atoms.

B has ..... carbon atoms.

C has ..... carbon atoms.

**[2 marks]**

**04.4** Give reasons for any trends you can see in the results.

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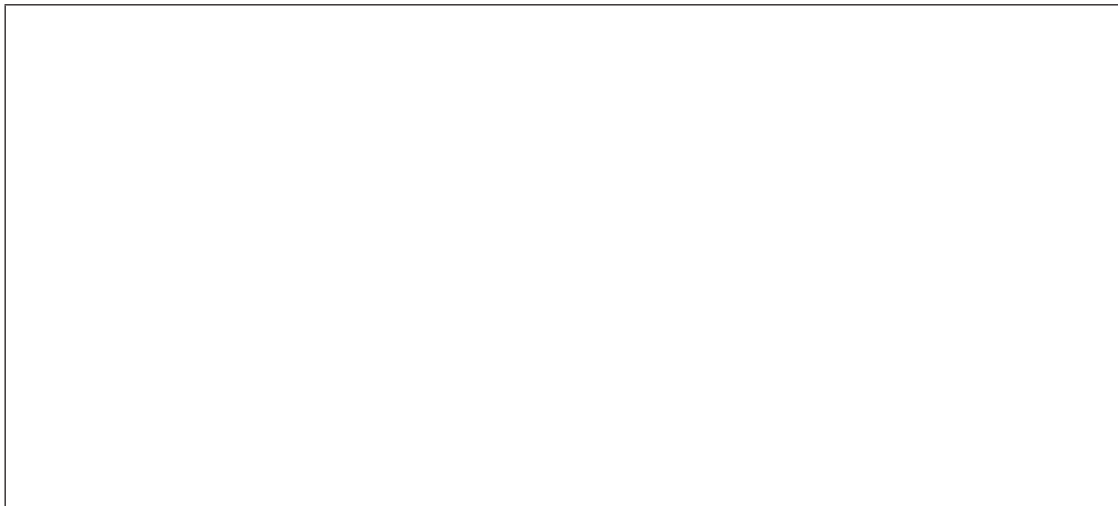
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**[2 marks]**

**05** Some students want to study the rate of reaction as marble chips (solid calcium carbonate) react with dilute hydrochloric acid. They plan to use a gas collection method.

**05.1** Draw a diagram of the experimental set up that will allow the students to take the measurements they will need.

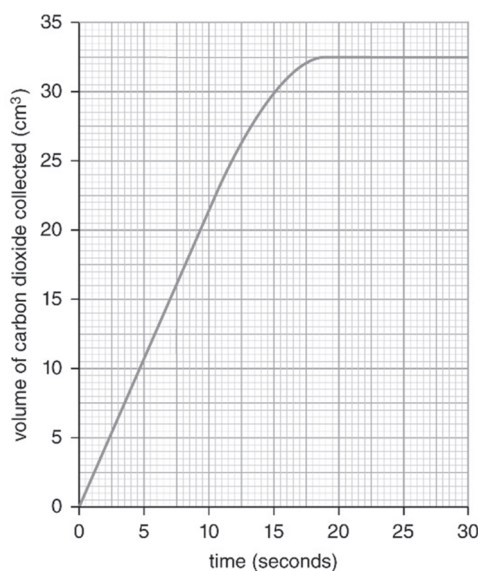
Label the diagram.



[2 marks]

The students take their measurements and plot the graph shown in **Figure 5.1**

**Figure 5.1**



Question 5 continues on the next page

**05.2** Interpret the graph above to deduce whether the reaction is faster in the first 5-second interval (0–5 seconds) or in the third (10–15 seconds).

..... [1 mark]

**05.3** Calculate the rate of reaction for this faster interval.

.....  
.....  
..... [2 marks]

**05.4** Give **two** ways the students could **increase** the reaction rate.

1. ....
2. .... [2 marks]

**05.5** Choose **one** of the methods you have suggested in question 05.4

Use collision theory to explain why the method increases the rate of reaction.

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..... [2 marks]

**06** This question is about the Haber process.

**06.1** The Haber process requires nitrogen.

Where is the nitrogen obtained for the Haber process?

Tick **one** box.

- |                       |                          |
|-----------------------|--------------------------|
| From the ground       | <input type="checkbox"/> |
| From fertilisers      | <input type="checkbox"/> |
| From the air          | <input type="checkbox"/> |
| From composted manure | <input type="checkbox"/> |

[1 mark]

**06.2** Which part of the Haber process requires use of an iron catalyst?

Tick **one** box.

- |   |                          |
|---|--------------------------|
| Extraction of liquid nitrogen           | <input type="checkbox"/> |
| Extraction of nitrogen from the air     | <input type="checkbox"/> |
| Reaction of nitrogen and hydrogen       | <input type="checkbox"/> |
| Extraction of hydrogen from natural gas | <input type="checkbox"/> |

[1 mark]

Question 6 continues on the next page

**06.3** Describe the factors that need to be considered when choosing the temperature for the Haber process.

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[2 marks]

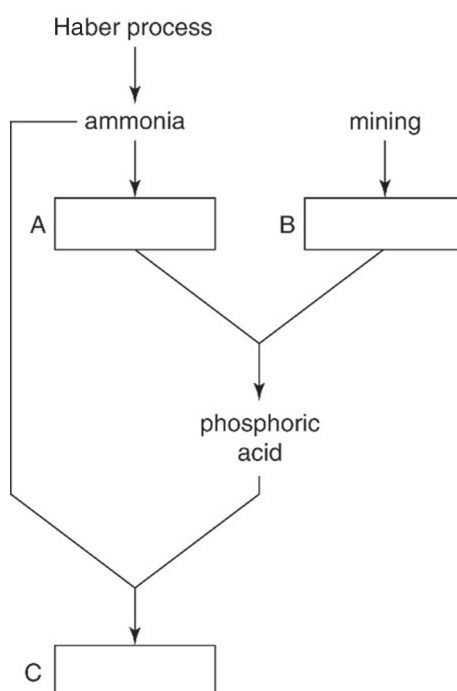
**06.4** A producer of industrial fertilisers uses the products of the Haber process and of mining to make its products.

Label **Figure 6.1** by writing the correct substance in the three boxes.

Choose from:

nitric acid	ammonium salts	phosphate rock	potassium chloride	ammonium phosphate	ammonium nitrate
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**Figure 6.1**



[3 marks]

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- the reactants
- the equipment to be used
- the techniques involved.

**Turn over >**

**07.1** Write a balanced symbol equation for the complete combustion of ethanol in air.

State symbols are **not** required.

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[2 marks]

**07.2** What is the product when ethanol reacts with an oxidising agent, such as potassium dichromate(VI)?

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[1 mark]

**07.3** Why is the product named in question 07.2 a **weak** acid?

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[2 marks]

**07.4** Draw the monomer of butene with the double bond between the second and third carbon atoms.

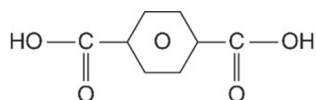
Draw the repeating unit when this butene molecule is polymerised.

[2 marks]

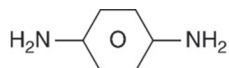


**07.5** *Kevlar* is made by the condensation polymerisation of benzene-1,4-dicarboxylic acid and 1,4-diaminobenzene.

The structure of benzene-1,4-dicarboxylic acid is:



The structure of 1,4-diaminobenzene is:



Draw the structure of **one** repeat unit of the polymer product of this reaction and name the other product.

Other product: ..... [2 marks]

**07.6** What does the production of *Kevlar* have in common with the production of proteins from amino acids in living organisms?

[1 mark]

Turn over >

- 08** A farmer has permission to divert water from a river running past his land in order to irrigate his fields.

He needs to find the diversion point with the optimal pH for his crops.

The river runs 5.5 km past his fields.

The other side of the river is split into several areas:

- 2 km runs past an organic arable farm
- 2.5 km runs past a livestock farm
- 1 km runs past a detergent manufacturing plant

He only has time to take 40 samples and decides to take samples equally spread out from all three sections of the river.

- 08.1** How many samples will be taken in each section?

arable farm: .....

livestock farm: .....

detergent plant: ..... **[2 marks]**

- 08.2** Suggest how the farmer could concentrate his sampling to focus on the area likely to provide the cleanest water.

Explain your answer.

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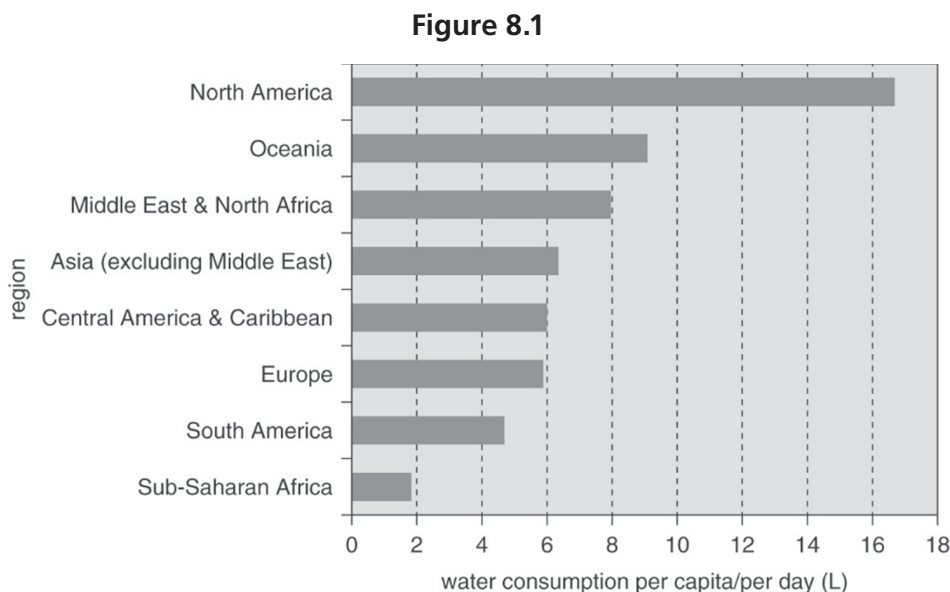
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**[2 marks]**

08.3 Figure 8.1 below shows global drinking water consumption per capita per day.



What percentage of water is consumed per capita in Sub-Saharan Africa as a percentage of consumption per capita in North America?

You will need to take **approximate** readings for both regions.

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[2 marks]

08.4 When metal is extracted from its ore by traditional leaching, cyanide is used.

What alternative is used in bioleaching to produce the leachate solution?

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[1 mark]

Question 8 continues on the next page

**08.5 Table 8.1** gives the annual operating costs of the largest copper extraction projects in 2000

**Table 8.1**

Project	Extraction method	Cost (US cent / lb Cu)
A	conventional	29.5
B	bioleaching	30.1
C	conventional	30.2
D	conventional	39.9
E	conventional	40.2
F	bioleaching	50.0
G	bioleaching	60.8

Suggest why bioleaching still only accounts for 20% of global copper production, despite its environmental advantages.

Analyse the data in **Table 8.1**, and use your knowledge of bioleaching.

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**[3 marks]**

- 09** One of the steps in the manufacture of sulfuric acid is reacting sulfur dioxide and oxygen to produce sulfur trioxide.

This is a reversible reaction.

The data in **Table 9.1** shows the percentage yield of sulfur trioxide at different temperatures.

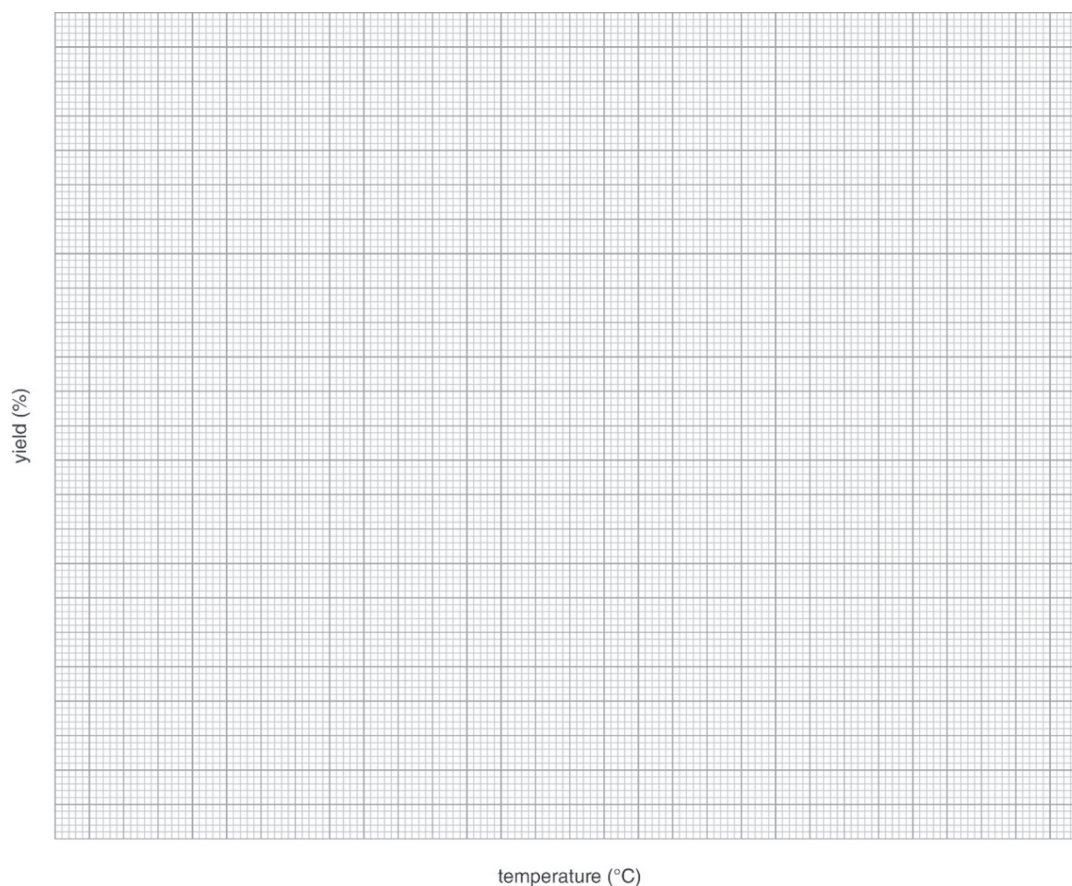
All other conditions are held constant.

**Table 9.1**

Temperature (°C)	300	400	500	600	700	800
Yield (%)	97	91	74	44	23	10

- 09.1** Plot the data on the graph.

Draw a line of best fit.



**[2 marks]**

**Question 9 continues on the next page**

**09.2** Use your graph to estimate the percentage yield at 450°C under these conditions.

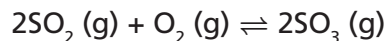
[1 mark]

**09.3** Is the reaction exothermic or endothermic?

Explain your answer using the graph **and** Le Chatelier's principle.

[3 marks]

**09.4** The equation for the oxidation of sulfur dioxide is:



Predict whether increasing the pressure would move the equilibrium to the left or to the right.

Explain your answer using Le Chatelier's principle.

[2 marks]

**09.5** In the industrial production of sulfur trioxide, a catalyst (vanadium(V) oxide) is used.

Does this affect the position of equilibrium?

Explain your answer.

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**[2 marks]**

**END OF QUESTIONS**

## The Periodic Table

## Key



Relative atomic mass —  
 Atomic symbol —  
 Name —  
 Atomic/proton number —

1  
**H**  
 hydrogen  
 1

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