Smart Edge!
More Than Knowledge

AQA · GCSE COMBINED SCIENCE: TRILOGY 8464

Chemistry — Higher Tier, Paper 2

June 2025 exam series

QUESTION PAPER

Reproduced for free student revision use by Smart Edge International Ltd. Original paper © AQA. Not affiliated with or endorsed by AQA. For personal study use only — not for resale or redistribution.

AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 2H

Friday 13 June 2025 Morning 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

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.

smartedgestudy.com Free past papers, provided by Smart Edge International Ltd

Do not write outside the box

0 1 Dodecane is an alkane.

0 1 . 1 The general formula for alkanes is C_nH_{2n+2}

A molecule of dodecane has 12 carbon atoms.

Complete the formula of dodecane.

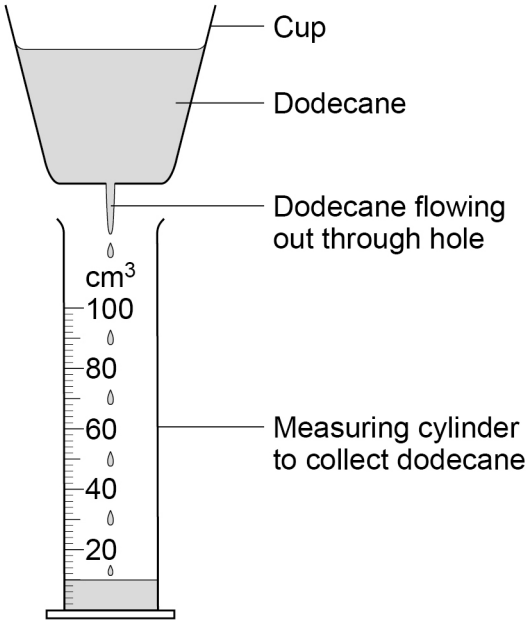
[1 mark]

C ____ H ____

A student investigated the effect of changing the temperature on the viscosity of dodecane.

Figure 1 shows the apparatus.

Figure 1



Do not write outside the box

This is the method used.

1. Add 100 cm^3 of dodecane at 25 °C to the cup.

2. Immediately start a timer.

3. Stop the timer when 40 cm^3 of dodecane has been collected in the measuring cylinder.

4. Record the time taken.

5. Repeat steps 1 to 4 using dodecane at different temperatures.

0 1 . 2 The student used a water bath to heat the dodecane.

Suggest **one** reason why the student used a water bath instead of a Bunsen burner to heat the dodecane.

[1 mark]

0 1 . 3 Give **one** control variable used in the investigation.

[1 mark]

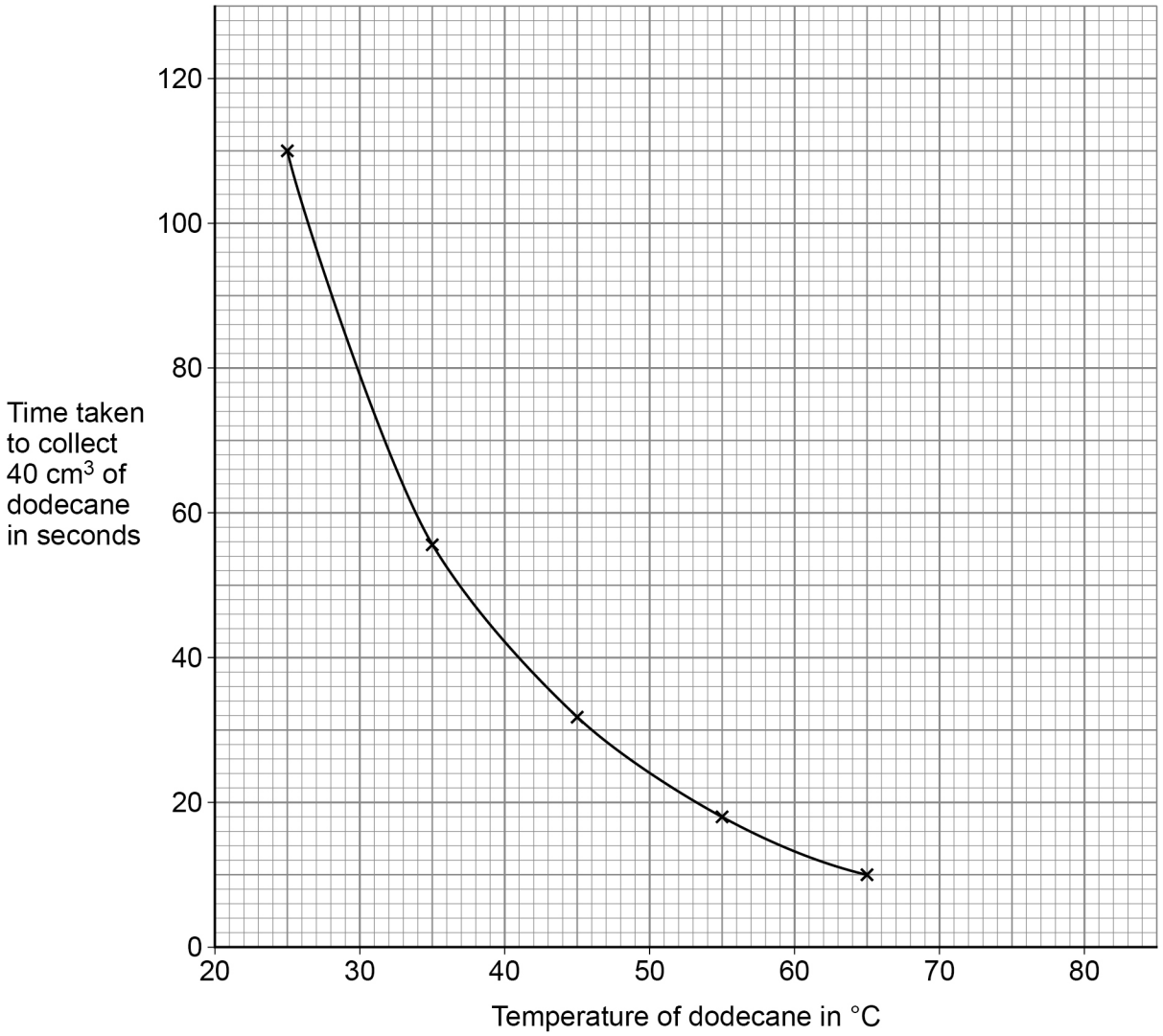
Question 1 continues on the next page

Turn over ►

Do not write outside the box

Figure 2 shows the results.

Figure 2



0 1 . 4 Predict the time taken to collect 40 cm^3 of dodecane at 75 °C.

You should extend the line of best fit on **Figure 2**.

[2 marks]

Time taken = _____ s

Do not write outside the box

0 1 . 5 The higher the viscosity, the slower dodecane flows.

Explain how the trend in **Figure 2** shows the effect of an increase in temperature on the **viscosity** of dodecane.

[2 marks]

7

Turn over for the next question

Do not write outside the box

0 2 The proportions of most gases in the Earth's atmosphere have not changed much for the past 200 million years.

0 2 . 1 About one-fifth of the atmosphere is oxygen.

Describe the test for oxygen gas.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 2 . 2 **Table 1** shows the percentages of some gases in the Earth's early atmosphere and in the Earth's atmosphere today.

Table 1

	Percentage (%) of gas in the atmosphere	
Gas	**Earth's early atmosphere**	**Earth's atmosphere today**
Carbon dioxide	95	0.04
Nitrogen	3	78.0
Oxygen	Less than 1	21.0

smartedgestudy.com Free past papers, provided by Smart Edge International Ltd

Do not write outside the box

Explain how the percentages of gases have changed from Earth's early atmosphere to Earth's atmosphere today.

You should refer to all three gases in **Table 1**.

[6 marks]

Extra space

0 2 . 3 Methane is a greenhouse gas.

Give **two** ways to reduce methane emissions into the atmosphere.

[2 marks]

1

2

Turn over ►

Do not write outside the box

The percentage of sulfur dioxide in the Earth's atmosphere increased between 1850 and 1980.

0 2 . 4 Describe how sulfur dioxide emissions are produced.

[2 marks]

0 2 . 5 Give **one** harmful effect of sulfur dioxide emissions.

[1 mark]

0 2 . 6 Suggest **one** reason why the percentage of sulfur dioxide in the Earth's atmosphere has decreased since 1980.

[1 mark]

14

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Turn over ►

smartedgestudy.com Free past papers, provided by Smart Edge International Ltd

Do not write outside the box

0 3 Crude oil is a finite resource found in rocks.

0 3 . 1 What is meant by a 'finite' resource?

[1 mark]

0 3 . 2 Most of the compounds in crude oil are hydrocarbons.

Define the term 'hydrocarbon'.

[1 mark]

Do not write outside the box

0 3 . 3 Crude oil found in different areas has different compositions.

Table 2 shows the percentage (%) composition of crude oil from one area.

Table 2

Fraction	**Percentage (%) of fraction**
Petrol	31.3
Kerosene	13.4
Diesel oil	14.4
Heavy fuel oil	40.9

The volume of crude oil is measured in a unit called 'barrels'.

1 barrel = 159 dm^3

Calculate the volume of **petrol** in dm^3 in 90 barrels of crude oil.

Give your answer to 3 significant figures.

[4 marks]

Volume of petrol (3 significant figures) = _____ dm^3

Turn over ►

Do not write outside the box

0 3 . 4 Fractions from crude oil can be processed to produce many useful materials by the petrochemical industry.

Which is a useful material produced by the petrochemical industry?

[1 mark]

Tick (✓) **one** box.

Alloys ☐

Ceramics ☐

Fertilisers ☐

Lubricants ☐

0 3 . 5 Catalytic cracking is used to crack hydrocarbons.

Name **one** other method of cracking hydrocarbons.

[1 mark]

_____

0 3 . 6 Alkanes are produced by cracking.

Hydrocarbon **Z** is a different type of hydrocarbon to alkanes.

Hydrocarbon **Z**:

- is also produced by cracking
- can be used to produce polymers.

Describe a test for hydrocarbon **Z**.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

10

Do not write outside the box

0 4 This question is about methanol.

0 4 . 1 Methanol is used in screenwash.

Screenwash is used to keep car windscreens clean.

Screenwash is a formulation.

Define the term 'formulation'.

[1 mark]

Question 4 continues on the next page

Do not write outside the box

Carbon monoxide and hydrogen are used to produce methanol.

The conditions used in the production of methanol are:

- high temperature
- high pressure
- a catalyst.

The equation for the reaction is:

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

91 kJ/mol of energy is transferred during the exothermic forward reaction.

0 4 . 2 How much energy is transferred when methanol is decomposed into carbon monoxide and hydrogen?

[1 mark]

Tick (✓) **one** box.

< 91 kJ/mol ☐

91 kJ/mol ☐

> 91 kJ/mol ☐

0 4 . 3 A scientist developed a principle to predict the effect of changing conditions on a system at equilibrium.

What was the name of the scientist?

[1 mark]

_____

Do not write outside the box

0 4 . 4 What is the effect of increasing the temperature on the proportion of methanol in the equilibrium mixture?

[1 mark]

Tick (✓) **one** box.

The proportion of methanol decreases. ☐

The proportion of methanol stays the same. ☐

The proportion of methanol increases. ☐

0 4 . 5 What is the effect of using a catalyst on the proportion of methanol in the equilibrium mixture?

[1 mark]

Tick (✓) **one** box.

The proportion of methanol decreases. ☐

The proportion of methanol stays the same. ☐

The proportion of methanol increases. ☐

0 4 . 6 Explain the effect of increasing the pressure on the proportion of methanol in the equilibrium mixture.

[3 marks]

Do not write outside the box

0 4 . 7 Explain the effect of using a catalyst on the **rate** of production of methanol.

[3 marks]

0 4 . 8 The catalyst allows the reaction to take place at a lower temperature.

Explain **one** advantage of using a lower temperature in the production of methanol.

Do **not** refer to the position of equilibrium in your answer.

[2 marks]

0 4 . 9 Methanol (CH_3OH) can also be produced by reacting carbon dioxide with hydrogen.

Water is the other product of the reaction.

Write a balanced equation for the reaction.

[2 marks]

_____ + _____ → _____ + _____

15

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Turn over ►

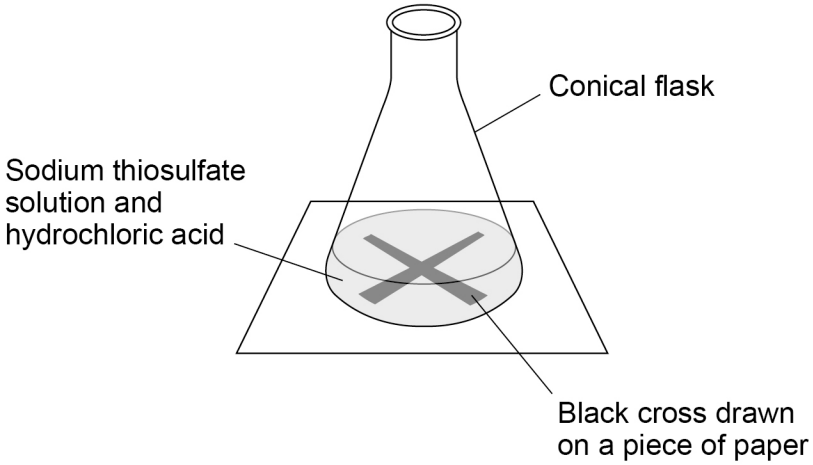
Do not write outside the box

0 5 Students investigated the effect of changing the concentration on the rate of chemical reactions.

A student reacted sodium thiosulfate solution with hydrochloric acid.

Figure 3 shows the apparatus.

Figure 3



This is the method used.

1. Measure 50 cm^3 of sodium thiosulfate solution into a conical flask.

2. Put the conical flask on a black cross drawn on a piece of paper.

3. Add 10 cm^3 of hydrochloric acid to the conical flask.

4. Start a timer.

5. Stop the timer when the cross is no longer visible.

6. Record the time taken.

7. Repeat steps 1 to 6 using different concentrations of sodium thiosulfate solution.

smartedgestudy.com Free past papers, provided by Smart Edge International Ltd

Do not write outside the box

0 5 . 1 What is the dependent variable in this investigation?

[1 mark]

0 5 . 2 The equation for the reaction is:

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

The mixture becomes cloudy as the reaction takes place.

Explain why the mixture becomes cloudy.

[2 marks]

0 5 . 3 Explain the effect of changing the concentration of the sodium thiosulfate solution on the rate of reaction.

[3 marks]

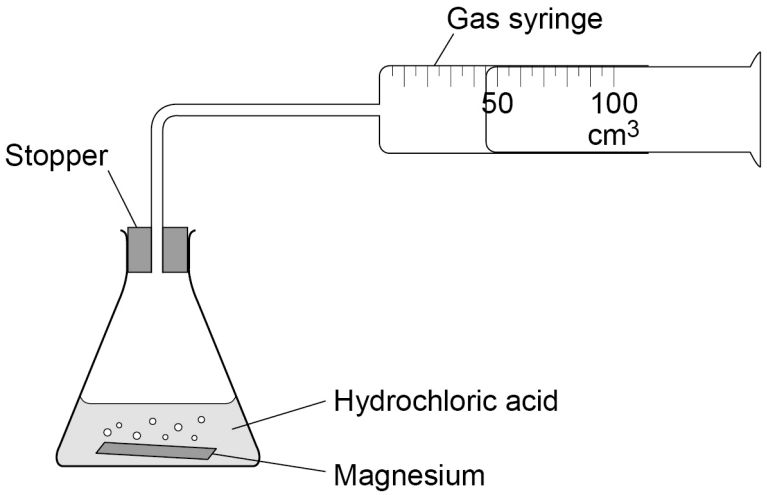
Turn over ►

Do not write outside the box

A different student reacted magnesium with hydrochloric acid.

Figure 4 shows the apparatus.

Figure 4



This is the method used.

1. Measure 50 cm^3 of hydrochloric acid into a conical flask.

2. Add 0.1 g of magnesium ribbon to the conical flask.

3. Insert the stopper into the conical flask as quickly as possible.

4. Start a timer.

5. Record the volume of gas collected every 20 seconds for 5 minutes.

6. Repeat steps 1 to 5 using different concentrations of hydrochloric acid.

0 5 . 4 Why is the stopper inserted into the conical flask as quickly as possible in step 3?

[1 mark]

Do not write outside the box

0 5 . 5 The equation for the reaction of magnesium with hydrochloric acid is:

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

Describe a test for the gas produced in the reaction.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

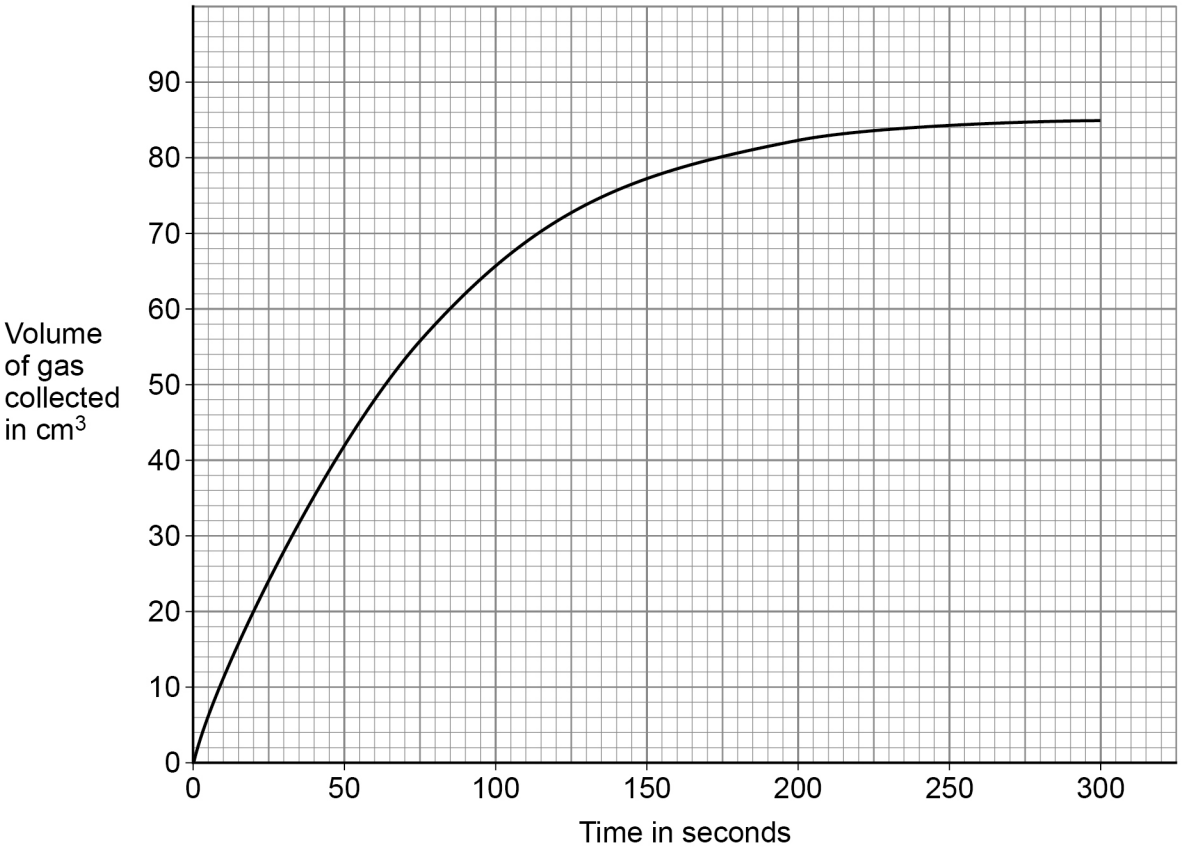
Question 5 continues on the next page

Turn over ►

Do not write outside the box

0 5 . 6 **Figure 5** shows the results for one concentration of hydrochloric acid.

Figure 5



Determine the rate of reaction at 75 seconds.

[4 marks]

Rate = _____ cm^3/s

13

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

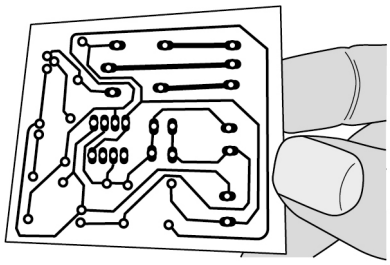
Turn over ►

Do not write outside the box

0 6 Gold is used in the printed circuit boards found in smartphones.

Figure 6 shows a printed circuit board.

Figure 6



A type of smartphone contains 1.73×10^{-4} moles of gold.

0 6 . 1 In one year, a manufacturer sold 2.48 million of this type of smartphone.

Calculate the total mass of gold contained in 2.48 million of these smartphones.

Give your answer in kilograms.

Relative atomic mass (A_r): Au = 197

[5 marks]

Total mass of gold = _____ kg

Do not write outside the box

0 6 . 2 What is the total number of gold atoms in one of this type of smartphone?

The Avogadro constant = 6.02×10^{23} per mole

[1 mark]

Tick (✓) **one** box.

2.87×10^{-28} ☐

1.04×10^{20} ☐

3.48×10^{27} ☐

0 6 . 3 The materials in printed circuit boards can be recycled.

Bioleaching is one method used to extract gold from printed circuit boards.

Describe how bioleaching is used to extract gold.

[3 marks]

Question 6 continues on the next page

Do not write outside the box

0 6 . 4 Copper is also extracted using bioleaching.

Copper can also be extracted from low-grade ores using phytomining.

Phytomining has **not** been widely used to extract copper.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

11

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Copyright information

For confidentiality purposes, all acknowledgements of third-party copyright material are published in a separate booklet. This booklet is published after each live examination series and is available for free download from www.aqa.org.uk

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team.

Copyright © 2025 AQA and its licensors. All rights reserved.