Diploma Programme
Programme du diplôme
Programa del Diploma

Chemistry
Standard level
Paper 1B

15 May 2026

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

Session number

1 hour 30 minutes [Paper 1A and Paper 1B]

Instructions to students

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the **chemistry data booklet** is required for this paper.
- The maximum mark for paper 1B is **[25 marks]**.
- The maximum mark for paper 1A and paper 1B is **[55 marks]**.

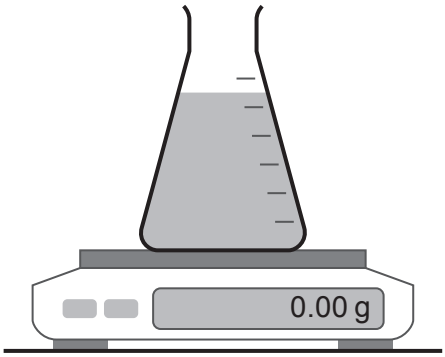
2226 – 4232

9 pages

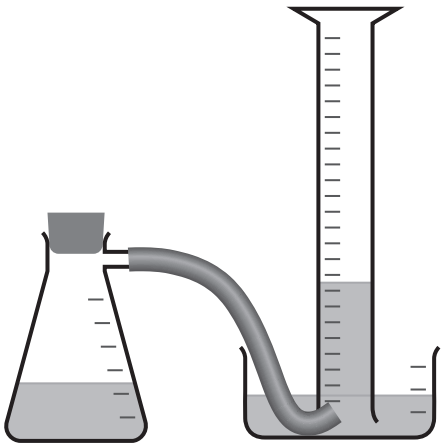
Section B

Answer **all** questions. Answers must be written within the answer boxes provided.

1. A student studied the reaction of hydrochloric acid, HCl, with solid calcium carbonate, $CaCO_3$, using two different methods.



Method 1



Method 2

(a) (i) Write an equation, including state symbols, for the reaction. [2]

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(ii) Deduce the feature of the reaction that allows the rate to be measured with both methods. [1]

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(iii) The experimental design required calcium carbonate, $CaCO_3$, to be in excess.

Calculate the minimum mass of $CaCO_3$, in g, required when 50.0 cm^3 of 0.15 mol dm^{-3} HCl are used. Use section 7 of the data booklet. [2]

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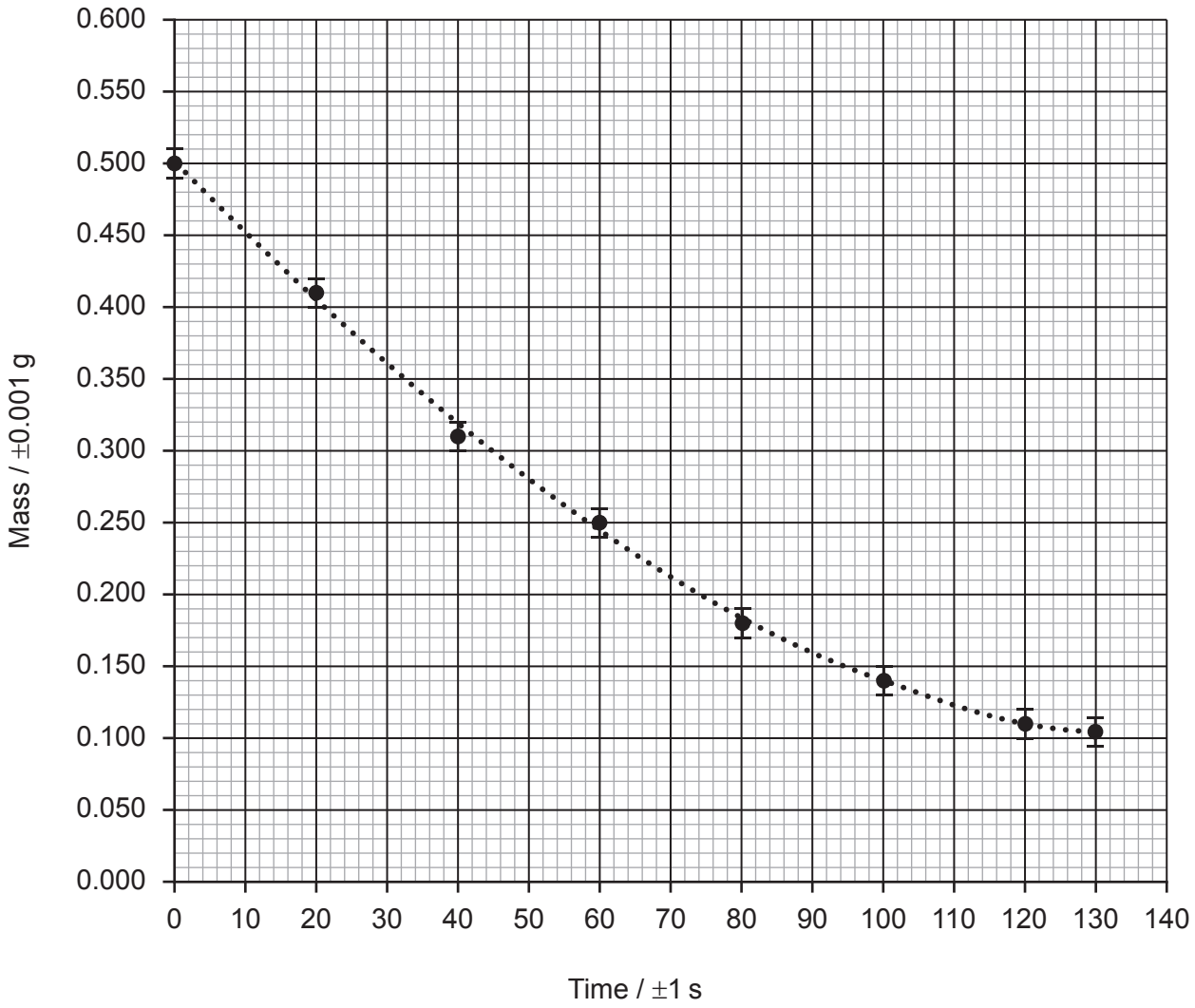
(Question 1 continued)

(b) Using method 1, the student placed the flask with the aqueous HCl on the balance and zeroed the balance before adding 0.500 g of $CaCO_3$. The mass was recorded every 20 seconds until the end of the reaction.

The student plotted the results of the average of three trials with uncertainties obtaining a graph.



Determine the initial rate of reaction, showing your working on the graph. [2]

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(Question 1 continued)

(c) The student repeated the experiment using method 2.

(i) Calculate the volume of gas collected in the measuring cylinder when the reaction goes to completion at $T = 20\,^{\circ}C$ and $P = 1.00 \times 10^5$ Pa. Use section 1 of the data booklet and your answer to part (a)(iii).

If you did not get an answer in part (a)(iii), use 0.250 g, although this is not the correct answer. [2]

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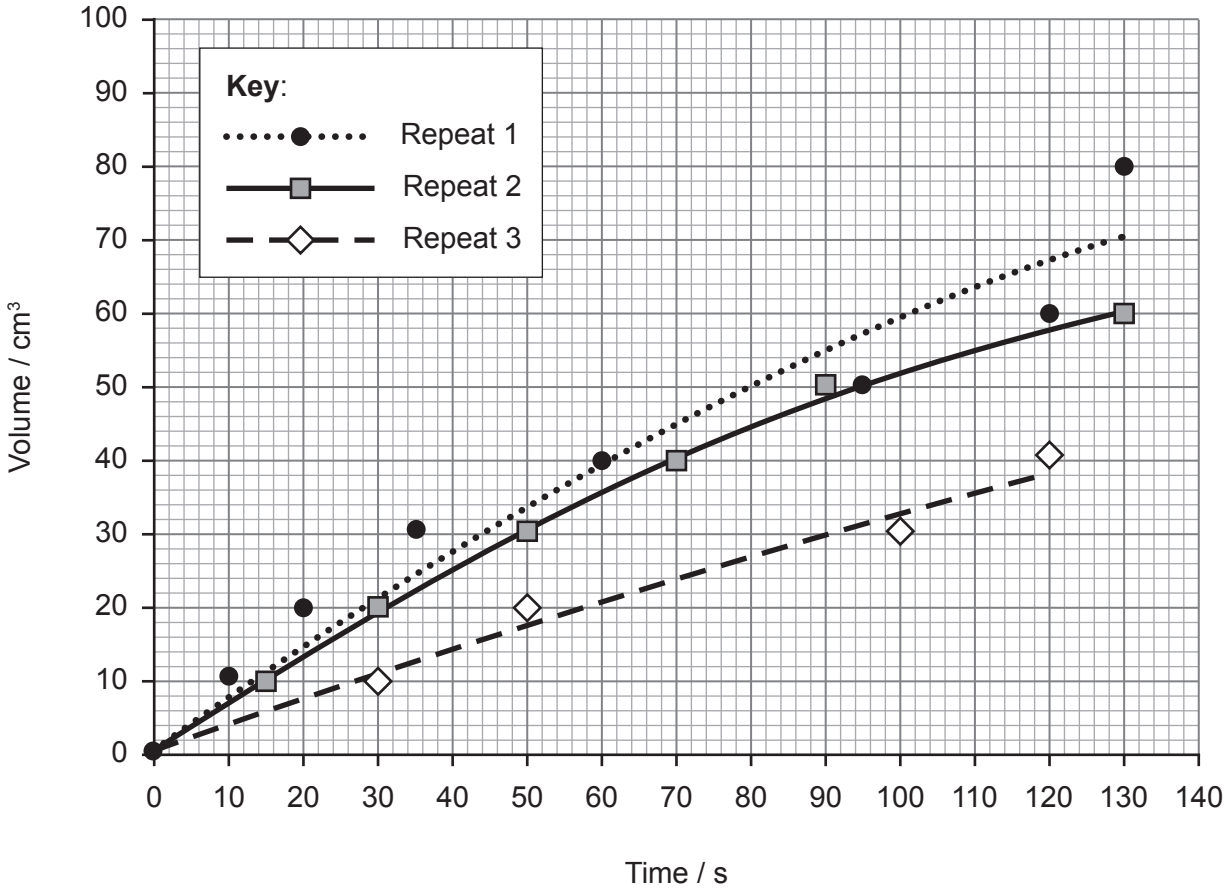
(Question 1 continued)

(ii) Using method 2, the student transferred the aqueous HCl solution to the flask, added the $CaCO_3$ powder, and immediately sealed the flask. The time taken to collect each 10 cm^3 of gas was recorded until no further gas was collected. The experiment was repeated three times and raw data was plotted.



Suggest, with a reason, which method is more precise. Consider the data in part (b) and part (c)(ii). [1]

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(iii) State the type of error responsible for the lower precision in the selected method in part (c)(ii), indicating a possible reason for this error. [1]

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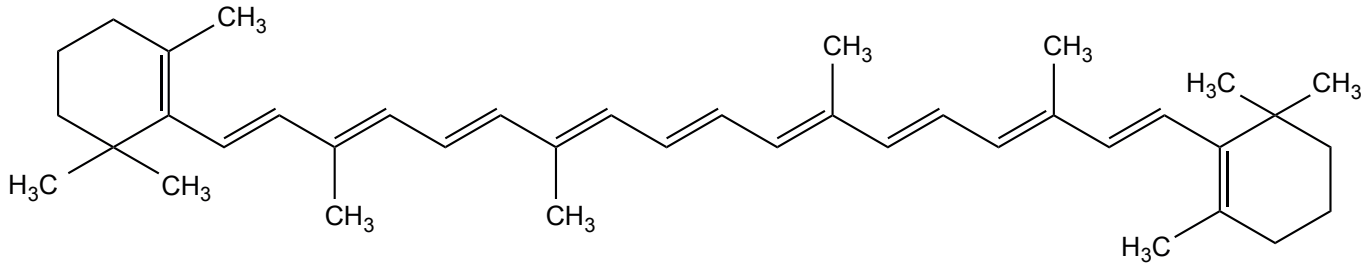
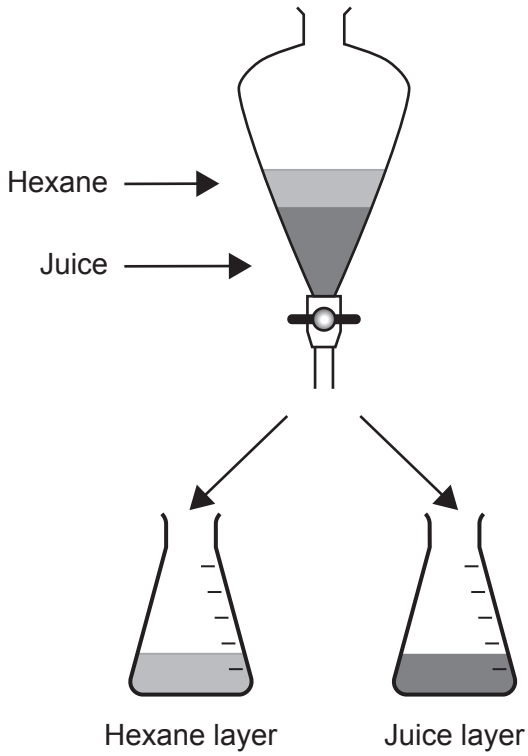
2. The carotenoid content of fresh tomato juice was studied using colorimetry. The structure of one of the carotenoids in a tomato, β-carotene, is shown.



(a) To separate the carotenoids, the filtered tomato juice was placed in a separating funnel with hexane, C_6H_{14}. After swirling the contents, the two immiscible solutions were collected in separate flasks.



Predict, in terms of intermolecular forces, in which solution the carotenoids will be found. [1]

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(Question 2 continued)

(b) An absorption spectrum was used to select the wavelength at which the samples were to be analysed.

(i) Describe the contents of the required solutions. [2]

Reference solution: . . . . . .

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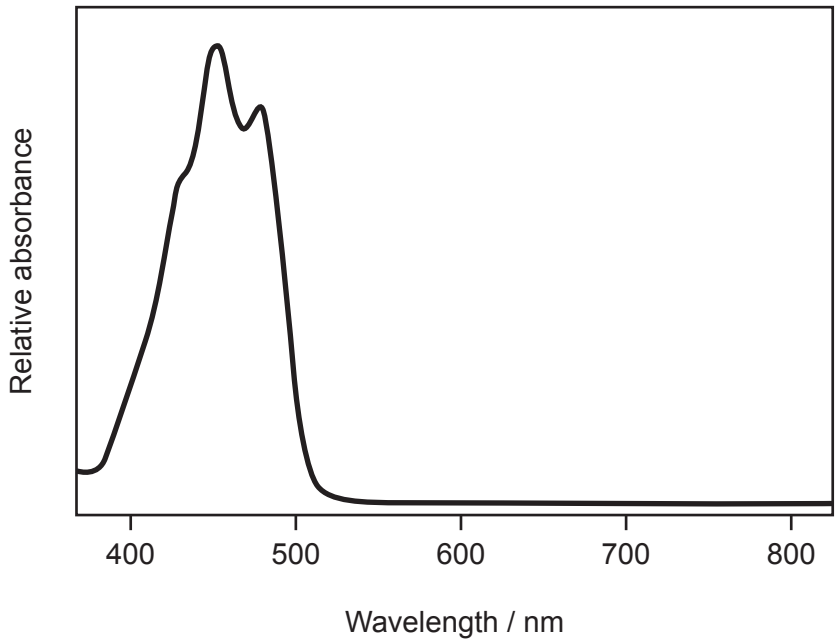
(ii) The obtained absorption spectrum is shown.



Suggest, with a reason, the most suitable wavelength for the determination of β-carotene. [2]

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(Question 2 continued)

(iii) The quantitative determination of the carotenoids required the construction of a calibration curve. Suggest **two** requirements for a reliable calibration curve. [2]

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(c) Tomatoes also contain ascorbic acid, $C_6H_8O_6$.

(i) The student determined the content of ascorbic acid by titration with iodine, I_2. This method is based on the following redox reaction:

$$C_6H_8O_6(aq) + I_2(aq) \rightarrow C_6H_6O_6(aq) + 2I^-(aq) + 2H^+(aq)$$

Deduce which species acts as an oxidizing agent writing a half-equation to justify your conclusion. [1]

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(ii) Starch is added towards the end of the titration.

Explain, with a reason, the use of starch in this titration. [2]

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(Question 2 continued)

(iii) For the titration, 10.000 g (±0.010 %) of tomato juice were placed in a conical flask and diluted with 50 cm^3 of water. The titration was performed using a standardized 0.500 mol dm^{-3} (±0.30 %) solution of iodine, $I_2(aq)$, and a 25.00 cm^3 burette (±0.05 cm^3). The average volume of titrant was 1.20 cm^3.

Calculate the percentage uncertainty of the volume of the titrant showing your working. [1]

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(iv) Suggest **one** change in the method to reduce the major source of uncertainty. [1]

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(d) Experimental results could be compared to those in a database. Suggest **two** factors that must be considered when comparing **these** experimental results to data from a given source. [2]

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References:

2.(b)(ii) With permission from Harvard Forest.

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