



Diploma Programme
Programme du diplôme
Programa del Diploma

Chemistry Standard level Paper 1B

16 May 2025

Zone A afternoon | Zone B afternoon | Zone C afternoon

Candidate session number

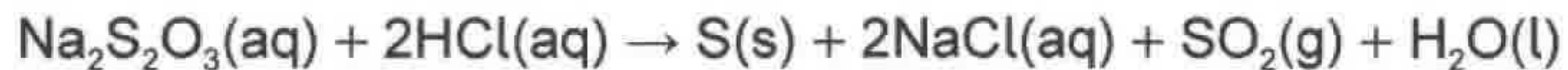
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1 hour 30 minutes [Paper 1A and Paper 1B]

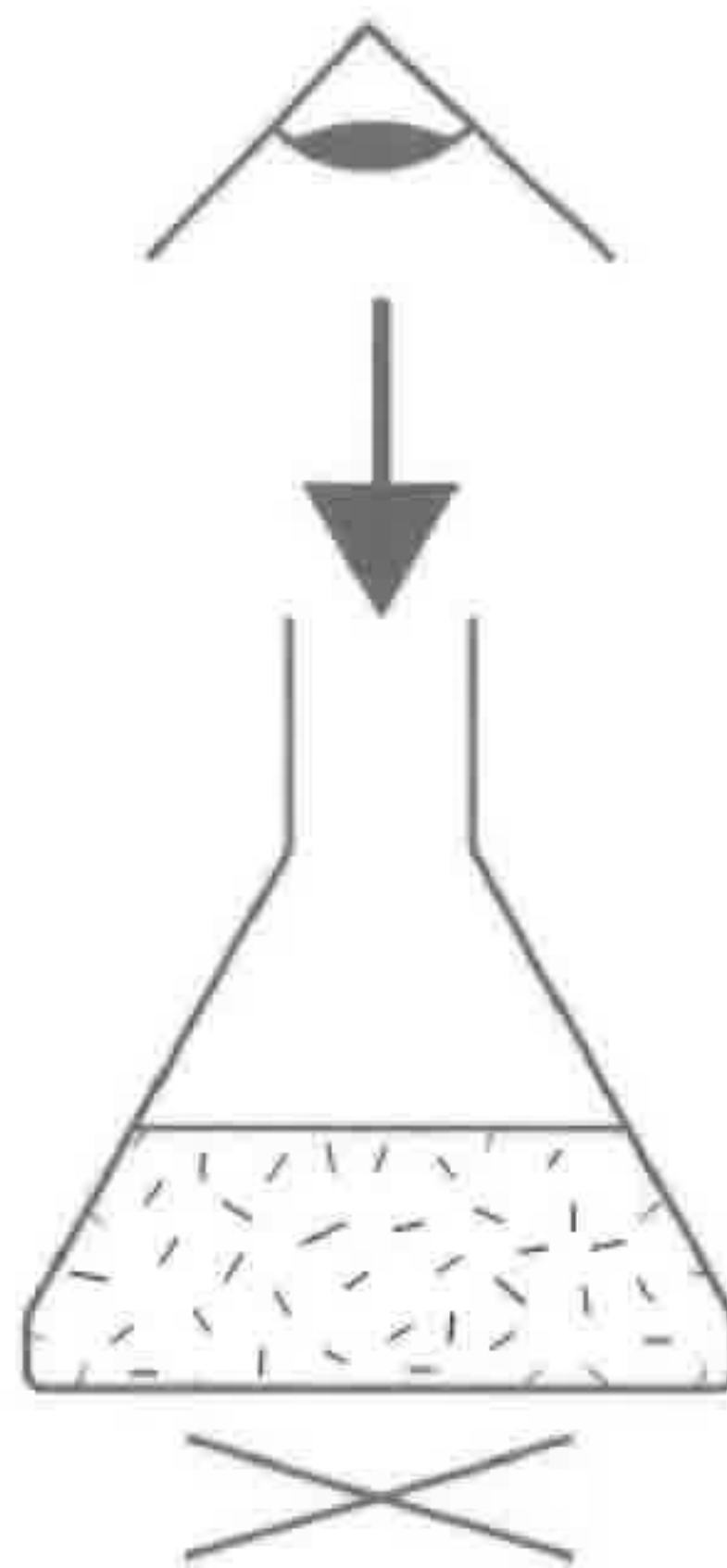
Instructions to candidates

- 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.

1. A student investigated the effect of concentration on the rate of reaction between sodium thiosulfate, $\text{Na}_2\text{S}_2\text{O}_3$, and hydrochloric acid, HCl .



Since the solid sulfur product is insoluble, the rate can be determined by measuring the time it takes for the clear solution to turn off-white or pale yellow until the X mark on a white tile below the flask can no longer be seen.



~~mark~~

- (a) Determine the mass of sodium thiosulfate needed to make 500.0 cm^3 of a $0.1500\text{ mol dm}^{-3}$ solution. [2]

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- (b) Explain how to make the $0.1500\text{ mol dm}^{-3}$ solution in a volumetric flask. [3]

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(Question 1 continued)

- (c) Suggest how to make a 100.0 cm^3 solution of $0.03000\text{ mol dm}^{-3}$ sodium thiosulfate from the original $0.1500\text{ mol dm}^{-3}$ solution. [3]

- (d) The student recorded the following data.

$\text{Na}_2\text{S}_2\text{O}_3$ concentration (mol dm^{-3})	Reaction Time $\text{s} \pm 0.1 \text{ s}$					
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
0.020						
0.010						
0.005						

(d) The student recorded the following data.

Na₂S₂O₃ concentration (mol dm⁻³)	Reaction Time s ± 0.1 s					
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
0.1500 ± 0.08 %	21.1	19.7	18.1	17.3	19.4	19.1 ± 1.5
0.120 ± 0.1 %	26.4	24.8	26.9	26.2	25.1	25.9 ± 0.9
0.0900 ± 0.1 %	33.8	32.4	31.5	30.8	32.6	32.2 ± 1.2
0.0600 ± 0.2 %	48.3	49.3	45.9	46.4	44.6	46.9 ± 1.9
0.0300 ± 0.4 %	96.2	95.8	97.9	95.9	93.7	95.9 ± 1.0

The solutions of sodium thiosulfate were made as accurately as possible from solid sodium thiosulfate by weighing the appropriate mass with a balance that can measure to one hundredth of a gram (±0.01 g), rather than by dilution of a stock solution.

Explain why the percentage uncertainties of concentrations increase as the concentrations decrease.

[1]

(Question 1 continued)

(e) State **one** safety concern for a product of this experiment and **one** precaution that should be taken.

[2]

Safety Concern:
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Precaution:
.....



2. A student was given a mixture to separate and collect the individual components. The mixture contained sand, $\text{SiO}_2(\text{s})$, sodium chloride, $\text{NaCl}(\text{s})$, and iron filings, $\text{Fe}(\text{s})$. The student observed the original mixture and made the following hypothesis.

“The iron would have the lowest percent by mass because it appeared to be present in the smallest quantity.”

- (a) Suggest a set of experimental steps required to obtain pure samples of each component of the mixture.

[4]

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- (b) The following data were collected.

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(b) The following data were collected.

Substance	Mass in g $\pm$ 0.01 g	Percentage composition %
Mixture before separation	5.62	N/A
Iron after separation	2.17	
Sand after separation	1.98	
Salt after separation	1.80	32.0%

Calculate the percent composition of the iron and sand in the mixture

[1]

(This question continues on the following page)

(Question 2 continued)

- (c) The percentages in (b) add up to more than 100. Suggest a reason that would explain these results and how to reduce or eliminate this issue. [2]

Reason:

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Reduce or Eliminate:

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- (d) The results did not support the original hypothesis. Suggest why the hypothesis was incorrect. [1]

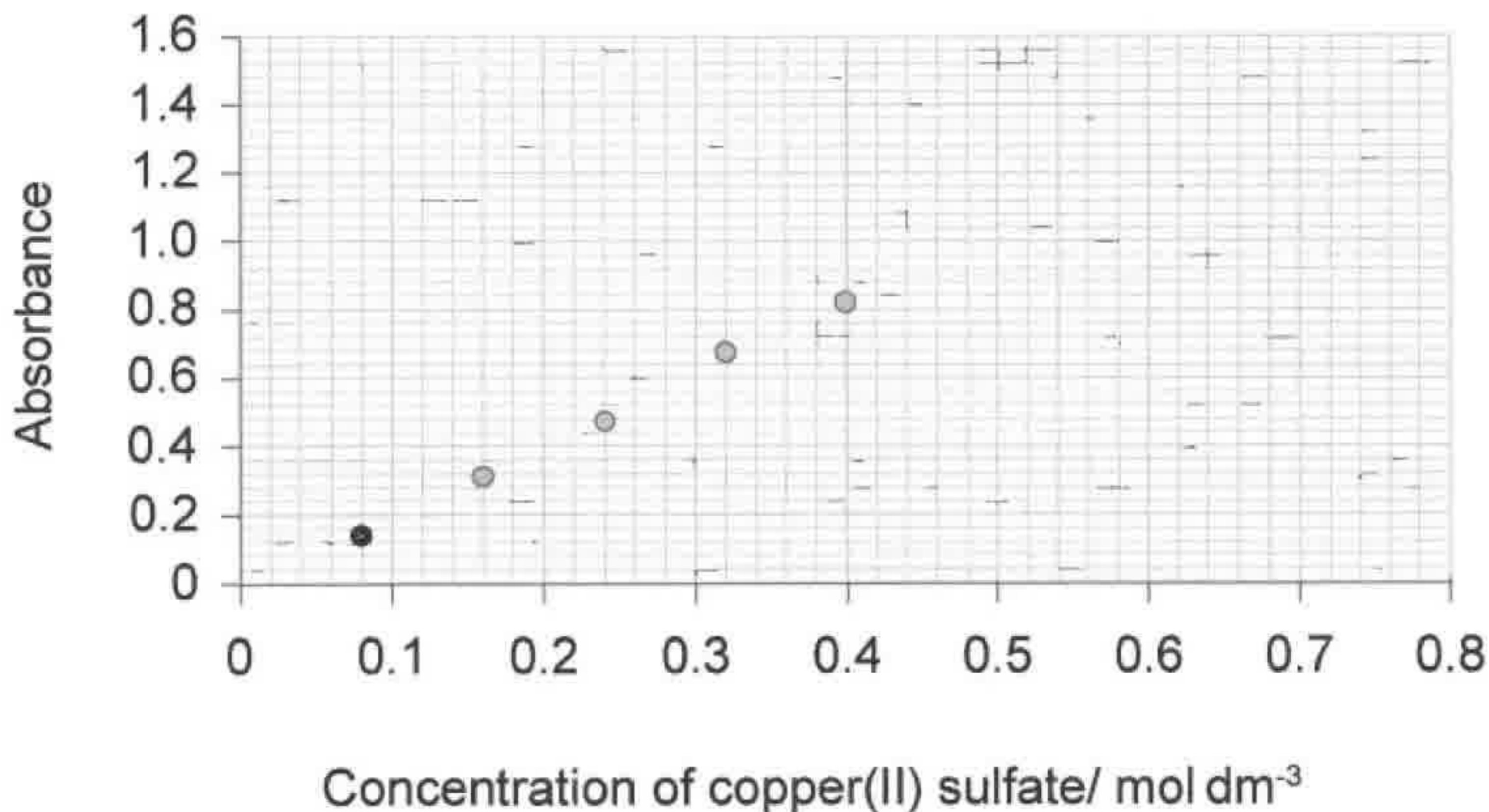
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3. A colorimetry experiment was conducted on a series of solutions of copper(II) sulfate, CuSO_4 . The absorbance versus concentration data were graphed.

(a) Draw a line of best fit in the graph, extrapolating beyond the data given.

[2]



0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8

Concentration of copper(II) sulfate/ mol dm⁻³

- (b) State the mathematical relationship between absorbance and concentration. [1]

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- (c) Deduce the equation that relates the absorbance to concentration, including the value of the constant. [2]

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- (c) Deduce the equation that relates the absorbance to concentration, including the value of the constant.

[2]

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- (d) Estimate the absorbance value of a $0.600 \text{ mol dm}^{-3} \text{ CuSO}_4$ solution.

[1]

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