Diploma Programme
Programme du diplôme
Programa del Diploma

Chemistry
Standard level
Paper 1B

31 October 2025

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

Candidate session number

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.
- 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]**.

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Section B

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

1. The graph shows the variation of the first ionization energy with atomic radius for periods 2, 3 and 4 of the periodic table, with the d-block elements omitted.

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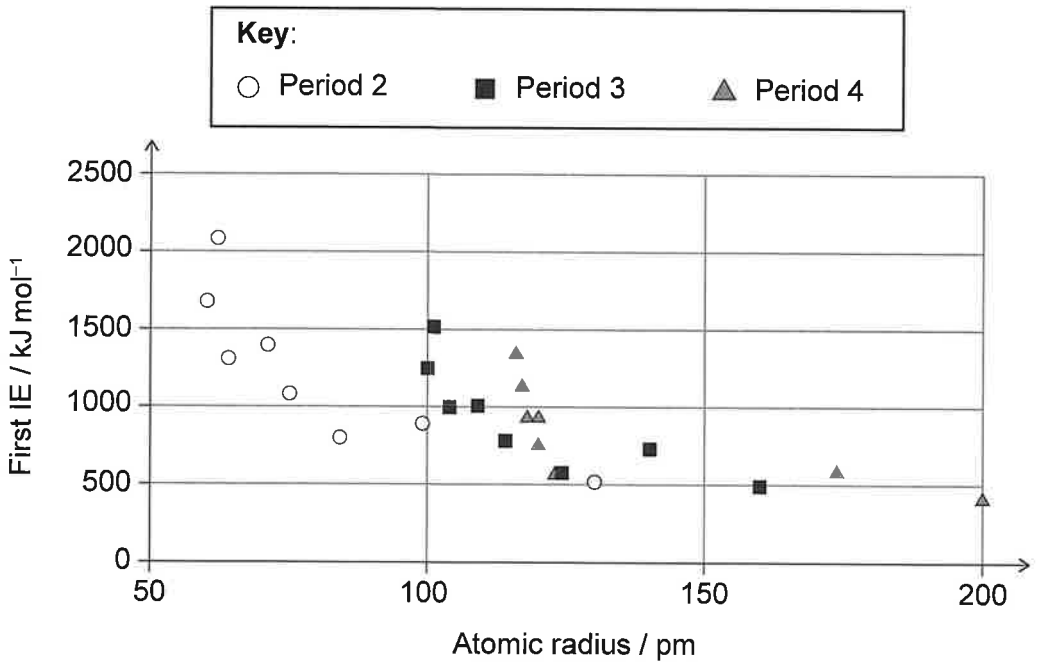

(a) Annotate the graph with an additional data point, marked with a cross (X), for scandium. Use sections 9 and 10 of the data booklet. [1]

(b) Suggest why there might be a link between the two variables in the graph. [1]

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(Question 1 continued)

(c) The graph shows a relationship between first ionization energy and atomic radius.

(i) State the type of relationship between the variables. [1]

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(ii) Compare and contrast the trends shown by the different periods. [2]

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will not be marked.

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2. A teacher gave the class an experimental assignment to determine the concentration of aqueous sodium hydroxide, NaOH, using 2.00 mol dm^{-3} hydrochloric acid, HCl, a thermometer and laboratory glassware.

(a) **Student A** used a 50 cm^3 measuring cylinder to make the following mixtures of the two solutions in a 125 cm^3 conical flask and measured the highest temperature for each mixture.

Volume HCl ± 0.5 / cm^3	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
Volume NaOH ± 0.5 / cm^3	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	0.0
Temperature ± 1 / °C	22	25	28	30	33	33	32	30	27	25	22

(i) Suggest **one** health and safety risk. [1]

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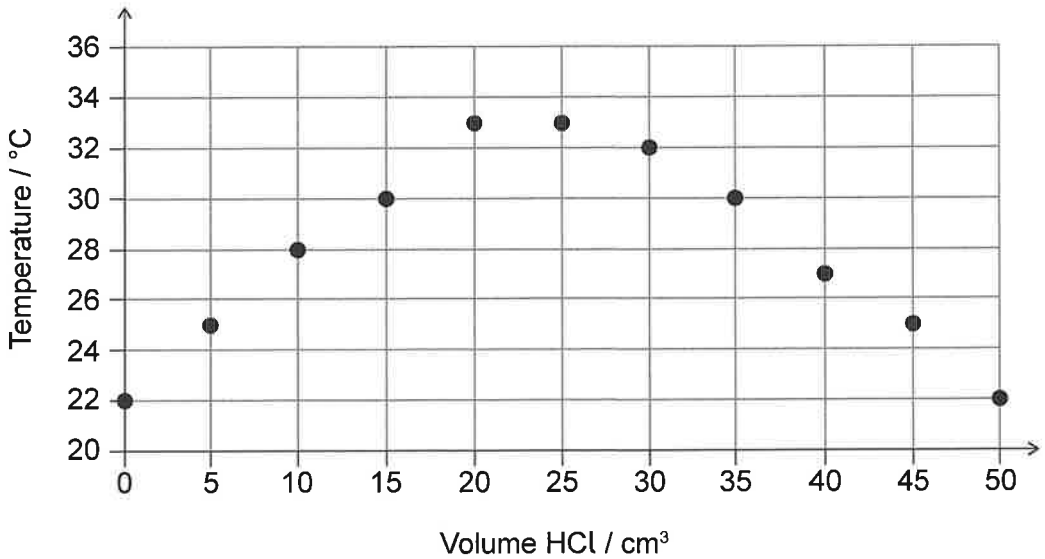
(ii) Use a ruler to draw straight lines of best fit through the increase and the decrease in temperature to show where they intersect. [1]



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(Question 2 continued)

(b) **Student B** used a slightly different technique, transferring 25.00 cm^3 of NaOH to a 125 cm^3 conical flask, using a pipette, and then adding the HCl, 5.00 cm^3 at a time from a burette, measuring the steady temperature at each step.

Volume HCl ± 0.05 / cm^3	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
Temperature ± 1 / °C	22	25	28	30	32	32	31	30	29	29	28

(i) Suggest, giving your reason, which student has the preferable method from a green chemistry perspective. [1]

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(ii) State, giving your reason, which student has the more precise results. [1]

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(iii) Deduce whether this difference in precision would significantly affect the uncertainty of the concentration of NaOH calculated from the point at which the lines intersect. [1]

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(Question 2 continued)

(iv) Comment on how the recorded temperature varies, with volume of HCl, for the two methods. [2]

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(v) Deduce, giving the reason, for which volume reading the temperature would be most affected by heat lost to the surroundings. [2]

Student: ..... Volume reading: .....

Reason: .....

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(vi) Suggest a change to the apparatus that would reduce this heat loss. [1]

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3. Recrystallization is a technique frequently used to purify solids. This process has five steps.

I. The solid is dissolved in the minimum volume of hot solvent.

II. The hot solution is filtered.

III. The solution is allowed to cool slowly.

IV. The crystals of solid formed are filtered from the mixture.

V. The crystals are rinsed with a small quantity of cold, pure solvent.

(a) State the most important factor to be considered when choosing a solvent for recrystallization. [1]

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(b) Deduce which steps of the technique remove impurities with differing solubilities to the desired product. [2]

Step: . . . . . Type of impurity removed: . . . . . .

Step: . . . . . Type of impurity removed: . . . . . .

(c) The initial amount of solvent is critical. Deduce how using too much and too little solvent would affect the yield/purity of the product. [2]

Too much solvent: . . . . . .

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Too little solvent: . . . . . .

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(d) Chlorinated hydrocarbons were once widely used as solvents for recrystallization. State the specific environmental problem, other than global warming, which led to international agreements on limiting their use. [1]

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4. Half-cells such as

$$Fe^{2+}(aq) + 2e^{-} \rightleftharpoons Fe(s)$$

can be connected to other half-cells to form a voltaic cell.

(a) State the chemical formula of a compound that could be dissolved in water to produce the required aqueous solution. [1]

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(b) Describe how you would connect the $Fe^{2+}|Fe$ half-cell to another half-cell to produce electric current through a light bulb. [2]

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(c) State the units in which the current through the light bulb could be measured. [1]

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