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Chemistry

Standard level

Paper 1B

31 October 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

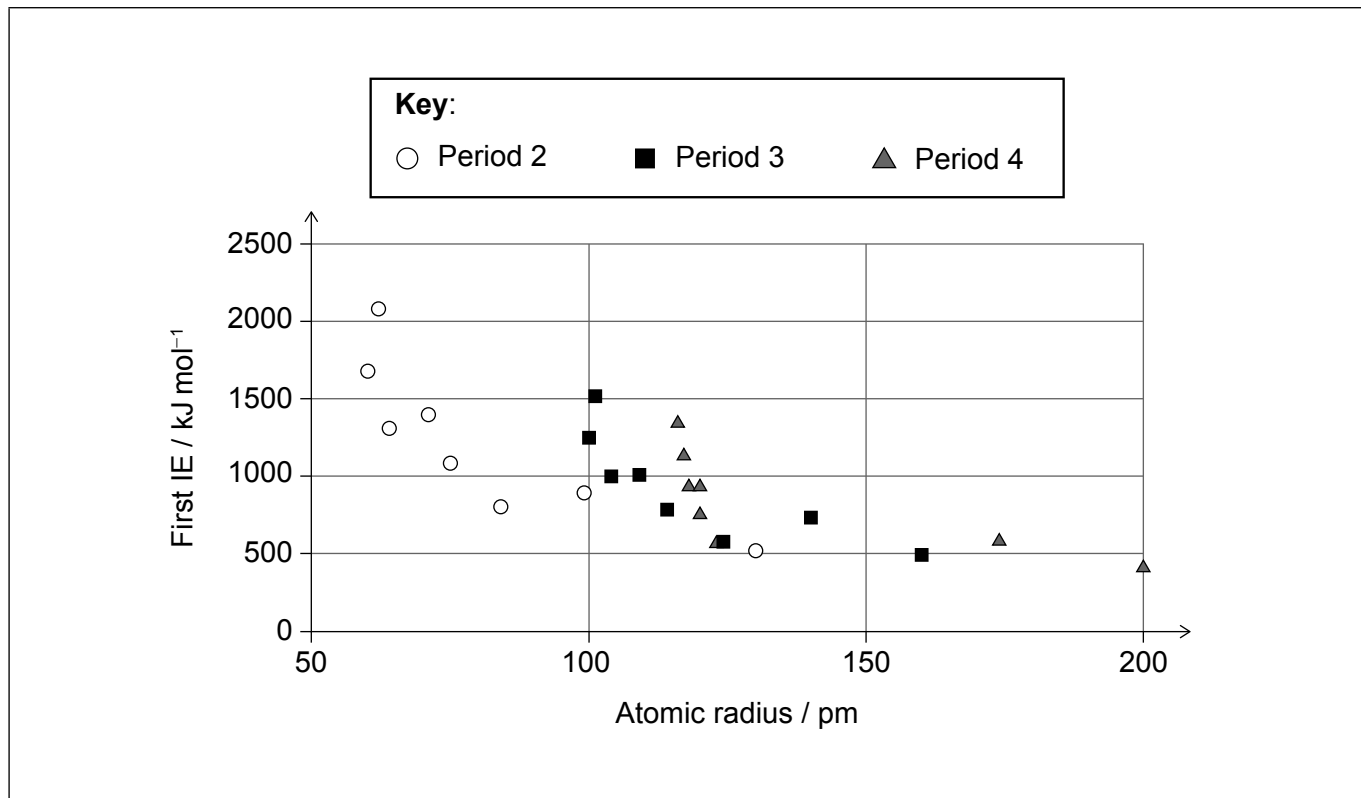
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the **chemistry data booklet** is required for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



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.



- (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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(This question continues on the following page)



(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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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 cm³ measuring cylinder to make the following mixtures of the two solutions in a 125 cm³ conical flask and measured the highest temperature for each mixture.

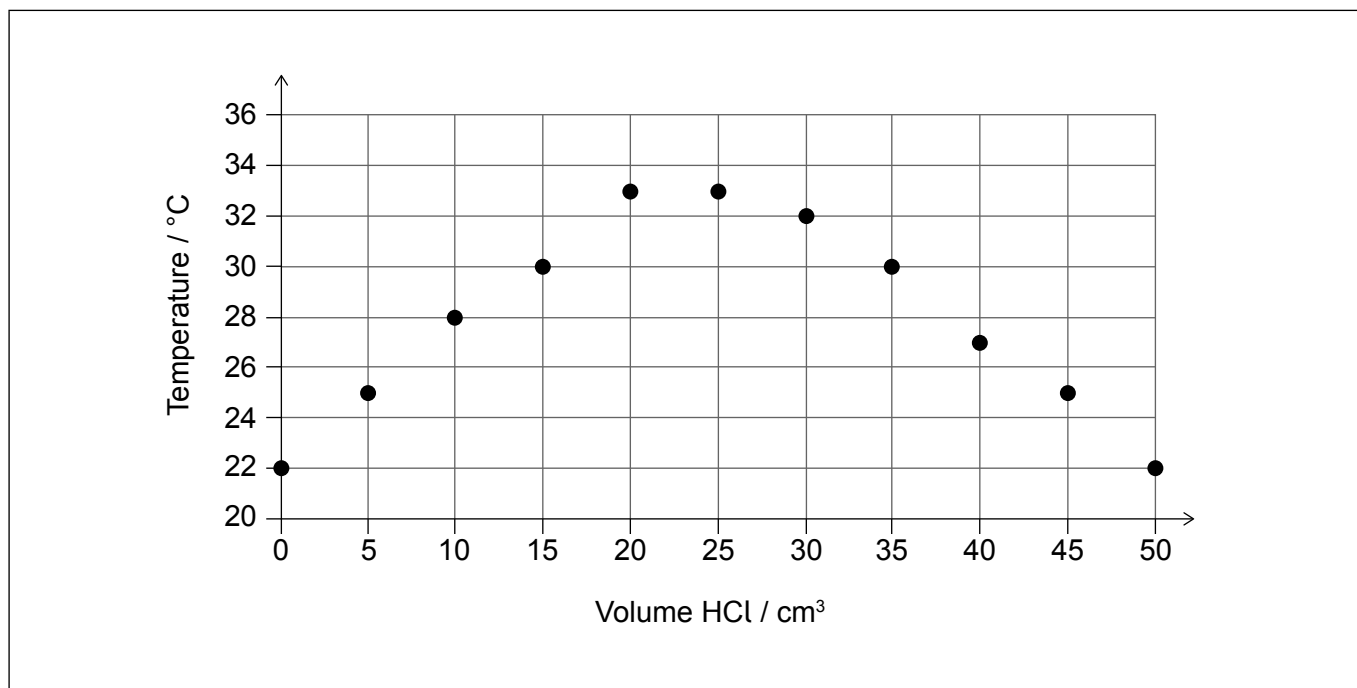
Volume HCl ± 0.5 / cm ³	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
Volume NaOH ± 0.5 / cm ³	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	0.0
Temperature ± 1 / °C	22	25	28	30	33	33	32	30	27	25	22

(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]



(This question continues on the following page)



(Question 2 continued)

- (b) **Student B** used a slightly different technique, transferring 25.00 cm³ of NaOH to a 125 cm³ conical flask, using a pipette, and then adding the HCl, 5.00 cm³ at a time from a burette, measuring the steady temperature at each step.

Volume HCl ± 0.05 / cm³	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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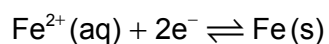
(d) Chlorinated hydrocarbons were once widely used as solvents for recrystallization. State the specific environmental problem, other than global warming, which led to international agreements on limiting their use.

[1]

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4. Half-cells such as



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 $\text{Fe}^{2+}|\text{Fe}$ 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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12EP10

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