1. Which statement(s) explain(s) why reaction rates increase as temperature increases?

   1   The activation energy is less.

   2   Collisions between molecules are more frequent.

   3   A greater proportion of molecules have energy greater than the activation energy.

   A   1, 2 and 3

   B   Only 1 and 2

   C   Only 2 and 3

   D   Only 1

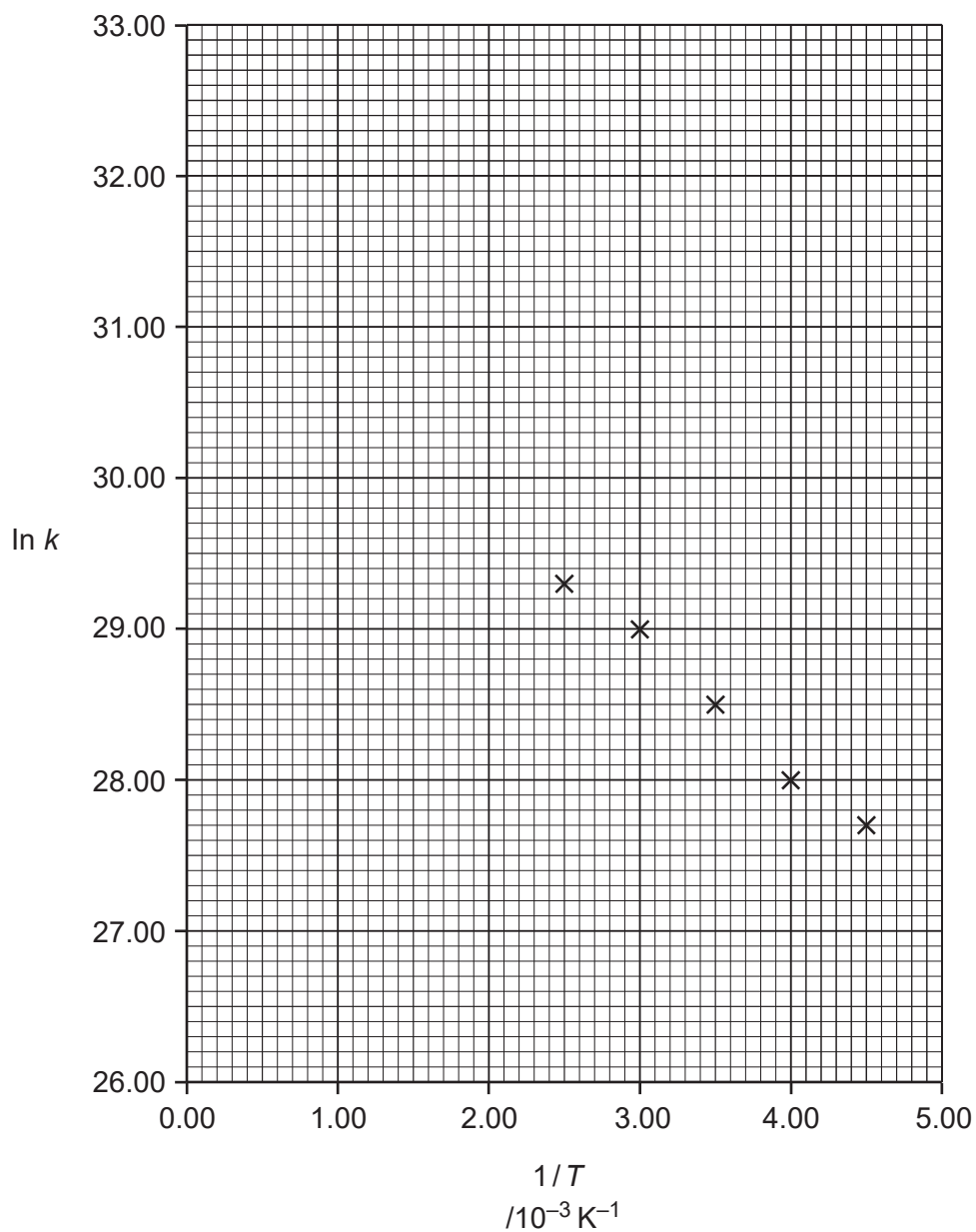   Your answer ⬚   **[1]**

2. This question is about reaction rates.

    Aqueous iron(III) ions, $Fe^{3+}(aq)$, react with aqueous iodide ions, $I^-(aq)$, as shown below.

    $$2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(aq)$$

    A student carries out three experiments to investigate how different concentrations of $Fe^{3+}(aq)$ and $I^-(aq)$ affect the initial rate of this reaction. The results are shown below.

Experiment	$[Fe^{3+}(aq)]$ / mol dm^{-3}	$[I^-(aq)]$ / mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
1	4.00×10^{-2}	3.00×10^{-2}	8.10×10^{-4}
2	8.00×10^{-2}	3.00×10^{-2}	1.62×10^{-3}
3	4.00×10^{-2}	6.00×10^{-2}	3.24×10^{-3}

(a)* Determine the rate constant and a possible two-step mechanism for this reaction that are consistent with these results. **[6]**

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Additional answer space if required

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(b) A student carries out an investigation to find the activation energy, E_a, and the pre-exponential factor, A, of a reaction.

The student determines the rate constant, k, at different temperatures, T.
The student then plots a graph of $\ln k$ against $1/T$ as shown below.

(i) Draw a best-fit straight line and calculate the activation energy, in $J\,mol^{-1}$.
Give your answer to **three** significant figures.

Show your working.

activation energy, E_a = + ... $J\,mol^{-1}$ **[3]**

(ii) Use the graph to calculate the value of the pre-exponential factor, A.

Show your working.

pre-exponential factor, A = ... **[2]**

3. The diagram represents a Boltzmann distribution curve of molecules at a given temperature.
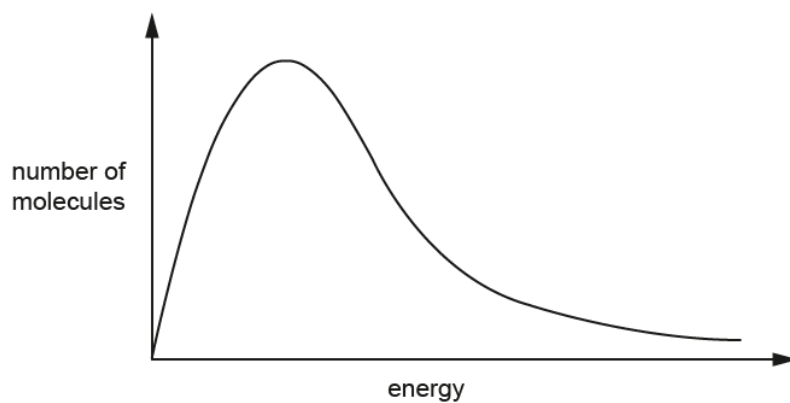
Which statement for this Boltzmann distribution curve is correct at a higher temperature?

A The peak increases in height and moves to the left.

B The peak increases in height and moves to the right.

C The peak decreases in height and moves to the left.

D The peak decreases in height and moves to the right.

Your answer [1]