2025 Ch H1 Q14

Section: Chemistry in Society
Topic: Controlling the Rate

Question Summary:
This multiple choice question asks which Maxwell-Boltzmann distribution diagram correctly shows how the distribution of kinetic energies changes when the temperature of a reaction is increased from T1 to T2.

Worked Solution

When the temperature of a sample of gas is increased:
- The average kinetic energy of the molecules increases.
- The Maxwell-Boltzmann curve becomes broader and flatter.
- The peak of the curve moves to a higher kinetic energy value (to the right).
- The total area under the curve stays the same (the same number of molecules).

The activation energy, Ea, is shown as a vertical line on the x-axis. At the higher temperature T2:
- A greater fraction of molecules have kinetic energies equal to or greater than Ea.
- This is shown by a larger area under the T2 curve to the right of Ea compared with the T1 curve.

Therefore the correct diagram must show:
- Two curves with the same total area.
- The T2 curve shifted to the right of the T1 curve.
- The T2 curve with a lower maximum height and broader shape than T1.
- More area under the T2 curve than under the T1 curve to the right of Ea.

Final Answer

The correct option is the diagram where the higher temperature curve T2 is broader and lower, shifted to higher kinetic energies than T1, and shows a greater proportion of molecules with energy equal to or greater than Ea.

Revision Tips

- Increasing temperature does not change the number of molecules, only their energy distribution.
- At higher temperature, more molecules have energy greater than or equal to Ea, so the reaction rate increases.

- Remember: higher T -> peak lower and to the right, same area under the curve.