2024 Higher Chemistry Paper 1 – Q19

Section: Chemistry in Society
Topic: Chemical Energy (Bond Enthalpies)

Question summary (Q19):
The mean bond enthalpy of the N–H bond is equal to one third of ΔH for which change?

Worked Solution:
• Mean bond enthalpy is defined as the enthalpy change when one mole of bonds is broken in the gaseous state.
• For an N–H bond, consider the reaction:
$NH_3(g) \rightarrow N(g) + 3H(g)$.
• Here, 3 N–H bonds are broken. The total ΔH for this process is 3 × (bond enthalpy of N–H).
• Therefore, the bond enthalpy of N–H = (1/3) × ΔH of $NH_3(g) \rightarrow N(g) + 3H(g)$.
• Reversing: $N(g) + 3H(g) \rightarrow NH_3(g)$ has ΔH = −(3 × bond enthalpy).
• The question asks for ΔH where mean bond enthalpy = (1/3) ΔH. That corresponds to option A.

Final Answer: A — $N(g) + 3H(g) \rightarrow NH_3(g)$

Revision Tips:
• Bond enthalpy values always refer to bonds in the gaseous state.
• For polyatomic molecules, total bond enthalpy = number of bonds × mean bond enthalpy.
• Watch carefully for whether ΔH refers to bond breaking (endothermic, +) or bond making (exothermic, −).