SECTION 18: MANIPULATING ΔH VALUES

We can represent a reaction with a variety of chemical equations. Each representation has a corresponding ΔH value. As long as you keep in mind that the ΔH value is a function of the number of moles, you will not have a problem with this. Here is an example of the ways in which we can manipulate a balanced equation:

Sample Problem 29: “For the reaction below, ΔH = 4 kJ.

\[ \text{NH}_3(\text{aq}) + \text{H}_2\text{O}(l) \rightarrow \text{NH}_4^+(\text{aq}) + \text{OH}^-(\text{aq}) \]

Calculate ΔH for each of the following alternative ways of representing this reaction.”

1) \[ \text{NH}_4^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{NH}_3(\text{aq}) + \text{H}_2\text{O}(l) \]

2) \[ 3 \text{NH}_3(\text{aq}) + 3 \text{H}_2\text{O}(l) \rightarrow 3 \text{NH}_4^+(\text{aq}) + 3 \text{OH}^-(\text{aq}) \]

Answer: Reaction 1 is the reverse of the original equation. When a reaction is reversed, the sign of ΔH changes, so ΔH = -4 kJ. Reaction 2 is the original equation multiplied by 3 (i.e. we are using 3 moles of ammonia rather than 1). When a reaction is multiplied by a number, so is ΔH, so ΔH = 12 kJ.

It is worth noting that all of this applies to ΔE as well: if you reverse a reaction, ΔE changes sign; and if you multiply a reaction by a number, you must do the same to ΔE.