

Examples of Standard Enthalpy of Formation - Solutions

Example Problem #1

Some chefs keep baking soda, NaHCO_3 , handy to put out grease fires. When thrown on the fire, baking soda partly smothers the fire, and the heat decomposes it to give CO_2 , which further smothers the flame. The equation for the decomposition of NaHCO_3 is



Calculate the ΔH° for this reaction in kilojoules

Solution

$$\begin{aligned}\Delta H^\circ &= \text{sum of products} - \text{sum of reactants} \\ &= [\text{Na}_2\text{CO}_3(\text{s}) + \text{H}_2\text{O}(\text{g}) + \text{CO}_2(\text{g})] - [(2)\text{NaHCO}_3(\text{s})]\end{aligned}$$

Look up the values in the databook tables for each substance.
Make sure the physical states are identical.

$$\begin{aligned}&= [-1130.7 - 241.8 - 393.5 \text{ kJ/mol}] - [(2)(-950.8 \text{ kJ/mol})] \\ &= -1766 \text{ kJ/mol} - (-1901.6 \text{ kJ/mol}) \\ &= +135.6 \text{ kJ/mol}\end{aligned}$$

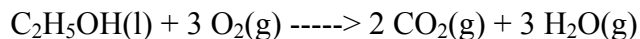
Under standard conditions, the reaction is endothermic by 135.6 kJ/mol.

Example Problem #2

What is the ΔH° in kilojoules for the combustion of 1 mol of ethanol, $\text{C}_2\text{H}_5\text{OH}(\text{l})$, to form gaseous carbon dioxide and gaseous water?

Solution

First write and balance the combustion equation.



Sum of the enthalpies of formation for this equation is:

$$\begin{aligned}\Delta H^\circ &= [(2)\text{CO}_2(\text{g}) + (3)\text{H}_2\text{O}(\text{g})] - [\text{C}_2\text{H}_5\text{OH}(\text{l}) + (3)\text{O}_2(\text{g})] \\ &= [(2)-393.5 + (3)-241.8 \text{ kJ/mol}] - [-277.1 + (3)0 \text{ kJ/mol}] \\ &= [-787 - 725.4 \text{ kJ/mol}] - [-277.1 \text{ kJ/mol}] \\ &= -1512.4 + 277.1 \text{ kJ/mol} \\ &= -1235.3 \text{ kJ/mol}\end{aligned}$$

The reaction for the combustion of ethanol is exothermic by 1235.3 kJ/mol.

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