#2. a) $4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$

$\Delta H_r = \Sigma n H_{fp} - \Sigma n H_{fr}$

$\Delta H_r = -906.4 \text{ kJ}$

$\Delta H_r = n H_r$

$H_r = \frac{\Delta H_r}{n} = \frac{-906.4 \text{ kJ}}{4 \text{ mol}} = -226.6 \text{ kJ/mol}$

Multi-Step Energy Calculations

Step 1: *Find H^o general*
-use Hess's law
-from equation
-use calorimetry

Step 2: *Find n (specific)*
-use mass (molar mass)
-use concentration
-use $n = \Delta H/H^o$

Step 3: *Find ΔH (specific)*
-use $\Delta H = nH^o$

Sample Problem

Ex. $2NaHCO_{3(s)}$ + 129.2kJ ⟶ $Na_2CO_{3(s)}$ + $CO_{2(g)}$ + $H_2O_{(g)}$

What quantity of energy, ΔH_r, is required to decompose 100. kg of $NaHCO_{3(s)}$?

Step 1: Hr (general)

$\Delta Hr = nHr$

$Hr = \frac{\Delta Hr}{n} = \frac{129.2 kJ}{2 mol} = 64.6 kJ/mol$

Step 2: n (specific)

$100000 g\ NaHCO_3 \times \frac{1 mol\ NaHCO_3}{84.01 g\ NaHCO_3} = 1190.33 mol$

Step 3: ΔHr (specific)

$\Delta Hr = nHr$

$\Delta Hr = (1190.33 mol)(64.6 \frac{kJ}{mol})$

$\Delta Hr = 76900 kJ$

ΔH_r

Calculate the mass of methane combusted when 3700. kJ of energy is released according to the following reaction.

$$CH_{4(g)} + 2O_{2(g)} \Rightarrow CO_{2(g)} + 2H_2O_{(g)} + 802.7kJ$$

Step1: Hr (general)

$\Delta Hr = nHr$

$Hr = \frac{\Delta Hr}{n} = \frac{-802.7\,kJ}{1\,mol} = -802.7\,kJ/mol$

Step2: n (specific)

$\Delta Hr = nHr$

$n = \frac{\Delta Hr}{Hr} = \frac{-3700\,kJ}{-802.7\,kJ/mol} = 4.609\,mol$

Step3: m (specific)

$4.609\,mol\,CH_4 \times \frac{16.05\,g\,CH_4}{1\,mol\,CH_4} = 73.98\,g\,CH_4$

Worksheet #1-5