Homework - Worksheet

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

$\Delta H_r = ?$

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

$\Delta H_r = [(4\,mol)(90.2\,\frac{kJ}{mol}) + (6\,mol)(-241.8\,\frac{kJ}{mol})] - [(4\,mol)(-45.9\,\frac{kJ}{mol}) + (5\,mol)(0\,\frac{kJ}{mol})]$

$\Delta H_r = -906.4\,kJ$

$\Delta H_r = nH_r$

$H_r = \frac{\Delta H_r}{n} = \frac{-906.4\,kJ}{4\,mol} = \boxed{-226.6\,\frac{kJ}{mol}}$

Multi-Step Energy Calculations

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

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

Step 3: *Find ΔH (specific) / mass / ΔT ...*

Sample Problem

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

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

100 000g

Step1: Hr (general)

$\Delta Hr = \Sigma nHf_p - \Sigma nHf_r$

$\Delta Hr = nHr$

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

Step2: n (specific)

$\left(\frac{100\,000g}{84.01 g/mol}\right)$

$100\,000g \times \frac{1 mol}{84.01 g} = 1190.33 mol$

Step3: ΔHr (specific)

$\Delta Hr = nHr$

$\Delta Hr = (1190.33 mol)(64.6 kJ/mol)$

$\boxed{\Delta Hr = 76\,900 kJ}$

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

ΔH_r

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

Step1: Hr(general)

$\Delta H_r = nH_r$

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

Step2: n(specific)

$\Delta H_r = nH_r$

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

Step3: mass

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

Worksheet #1-5