# Homework - Worksheet

# Multi-Step Energy Calculations

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

Step 2: *Find n (specific)*
-use mass (molar mass)
-use concentration
-use n = ΔH/H

- use calorimetry
$\Delta H_r = -q$

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

# Sample Problem

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

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

Step1: $H_r$ (general)

$\Delta H_r = nH_r$ $\Sigma nH_{fp} - \Sigma nH_{fr}$

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

Step2: n (specific)

$100\,000\text{ g } NaHCO_3 \times \frac{1\text{ mol } NaHCO_3}{84.01\text{ g } NaHCO_3} = 1190.33\text{ mol}$

Step3: $\Delta H_r$ (specific)

$\Delta H_r = nH_r$

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

$\Delta H_r = 76\,900\text{ kJ}$

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

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

Step 1: Hr (general)

$\Delta Hr = nHr$

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

Step 2: n (specific)

$\Delta Hr = nHr$

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

Step 3: m (specific)

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

**GENERAL (eq'n)**

$\Delta H_r = -802.7\ kJ$

$n = 1\ mol$

**SPECIFIC**

$\Delta H_r = -3700\ kJ$

$n = ?$

$H_r$

Worksheet #1-2