Thermochemistry 3

1. Calculate ΔH for the following reaction based on the thermochemical information given:

$$N_2H_{4(l)} + 2\ H_2O_{2(l)} \rightarrow N_{2(g)} + 4\ H_2O_{(l)}$$

The following information is available:

$N_2H_{4(l)} + O_{2(g)} \rightarrow N_{2(g)} + 2\ H_2O_{(l)}$	$\Delta H_{rxn} = -148.7$ kcal
$2\ H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$	$\Delta H_{rxn} = -136.6$ kcal

both as-is

$(H_{2(g)} + O_{2(g)} \rightarrow H_2O_{2(l)}) \times -2$ $\quad (\Delta H_{rxn} = -44.8\text{ kcal}) \times -2$

$2\ H_2O_2 \rightarrow 2H_2 + 2O_2$ $\quad \Delta H_{rxn} = +89.6$

$\Delta H = (-148.7) + (-136.6) + (89.6)$ kcal $= -195.7$ kcal

Convert the ΔH values to kJ:

$$\frac{-195.7\text{ kcal}}{1\text{ cal}} \left| \frac{4.184\text{ J}}{} \right. = -818.8\text{ kJ}$$

2. Write the reaction for which the reaction enthalpy is equal to the standard heat of formation for $C_5H_8O_{3(l)}$.

$$5\ C_{(gr)} + 4\ H_{2(g)} + \frac{3}{2}\ O_{2(g)} \rightarrow C_5H_8O_{3(l)}$$

3. A) What **quantity of heat is released when 1.00 g of sodium metal reacts with excess water?**

1.00 g

$2\ Na_{(s)} + 2\ H_2O_{(l)} \rightarrow 2\ NaOH_{(aq)} + H_{2(g)}$

ΔH_f° = ∅ −285.83 −469.15 ∅

$\Delta H_{rxn} = 2(-469.15) - 2(-285.83)$

$= -366.64\ kJ$

$$\frac{1.00\ g\ Na \mid 1\ mol\ Na \mid -366.64\ kJ}{22.99\ g\ Na \mid 2\ mol\ Na} = \boxed{-7.97\ kJ}$$

B) What further quantity of heat is released when the hydrogen gas produced burns with O_2 in the air to form water?

$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(g)} \quad \Delta H = -241.83\ kJ$

$$\frac{1.00\ g\ Na \mid 1\ mol\ Na \mid 1\ mol\ H_2 \mid -241.83\ kJ}{22.99\ g\ Na \mid 2\ mol\ Na \mid 1\ mol\ H_2} = \boxed{-5.26\ kJ}$$

4. Consider the reaction: $2PH_{3(g)} + 3\ Cl_{2(g)} \rightarrow 2\ PCl_{3(g)} + 3\ H_{2(g)}$

ΔH = 22.89 ∅ −287 ∅ kJ/mol

A) Calculate ΔH for this reaction.

$\Delta H = 2(-287\ kJ) - 2(22.89\ kJ) = \boxed{-620.\ kJ}$

B) Calculate the heat absorbed or released when 22.0 g of PH_3 reacts.

$$\frac{22.0\ g\ PH_3 \mid 1\ mol\ PH_3 \mid -620.\ kJ}{34.0\ g \mid 2\ mol\ PH_3} = -201\ kJ$$