

Problem Set Chapter 8

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1. Calculate the final temperature of a 25[g] piece of Al $\left(c = .89 \left[\frac{\text{J}}{\text{gC}}\right]\right)$ that is initially at 25[° C] when 2.3[kJ] of heat is applied

$$\begin{aligned} 2300 &= .89 \cdot 25 \cdot (T_f - 25) \\ T_f &= \frac{2300}{.89 \cdot 25} + 25 \\ &= 128.37[^\circ \text{C}] \end{aligned} \tag{1}$$

2. A 25[g] sample of Fe $\left(c = .89 \left[\frac{\text{J}}{\text{gC}}\right]\right)$ at 22[° C] is placed in 75[g] of water $\left(c = 4.184 \left[\frac{\text{J}}{\text{gC}}\right]\right)$. The final temperature of the mixture is 34[° C]. What was the initial temperature of the water?

$$\begin{aligned} q &= .89 \cdot 25 \cdot (34 - 22) \\ &= 267[\text{J}] \\ 267 &= 4.184 \cdot 75 \cdot (T_o - 34) \\ T_o &= 34.85[^\circ \text{C}] \end{aligned} \tag{2}$$

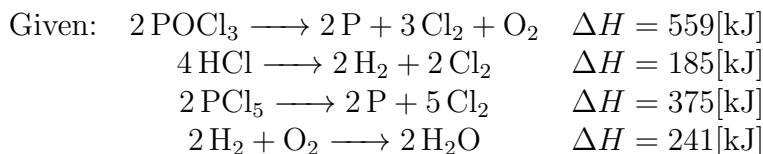
3. The enthalpy change for the combustion of CH₄ is −891[kJ]. Calculate the amount of energy given off if you start with 52[g] of oxygen. Calculate the change of energy for the formation of 125[g] of water.

$$\begin{aligned} \text{CH}_4 + 2 \text{O}_2 &\longrightarrow 2 \text{H}_2\text{O} + \text{CO}_2 \\ E_{\text{O}_2} &= 52 \cdot \frac{1}{32} \cdot \frac{-891}{2} \\ &= -723.94[\text{J}] \\ E_{\text{H}_2\text{O}} &= 125 \cdot \frac{1}{18} \cdot \frac{-891}{2} \\ &= -3093.8[\text{J}] \end{aligned} \tag{3}$$

4. Upon heating, 1[g] of KClO_3 decomposes to KCl and KClO_4 , evolving 350[J] of heat. Calculate ΔH if you start with 55[g] of KClO_3 . Calculate ΔH for the formation of 35[g] of KClO_4 .

$$\begin{aligned}
 4 \text{KClO}_3 &\longrightarrow \text{KCl} + 3 \text{KClO}_4 \\
 \Delta H_{\text{KClO}_3} &= 55 \cdot -350 \\
 &= -19.25[\text{kJ}] \\
 \frac{35}{139} &= .2518[\text{mol}_{\text{KClO}_4}] \\
 \frac{4}{3} \cdot .2518 &= .3357[\text{mol}_{\text{KClO}_3}] \\
 .3357 \cdot 123 &= 41.29[\text{g}_{\text{KClO}_3}] \\
 \Delta H_{\text{KClO}_4} &= 41.29 \cdot -350 \\
 &= -14.45[\text{kJ}]
 \end{aligned} \tag{4}$$

5. Calculate ΔH for the reaction of $2 \text{PCl}_5 + 2 \text{H}_2\text{O} \longrightarrow 2 \text{POCl}_3 + 4 \text{HCl}$



$$\begin{aligned}
 2 \text{P} + 3 \text{Cl}_2 + \text{O}_2 &\longrightarrow 2 \text{POCl}_3 \\
 \Delta H &= -559[\text{kJ}] \\
 2 \text{H}_2 + 2 \text{Cl}_2 &\longrightarrow 4 \text{HCl} \\
 \Delta H &= -185[\text{kJ}] \\
 \hline
 2 \text{P} + 5 \text{Cl}_2 + 2 \text{H}_2 + \text{O}_2 &\longrightarrow 2 \text{POCl}_3 + 4 \text{HCl} \\
 \Delta H &= -744[\text{kJ}] \\
 2 \text{PCl}_5 &\longrightarrow 2 \text{P} + 5 \text{Cl}_2 \\
 \Delta H &= 375[\text{kJ}] \\
 \hline
 2 \text{PCl}_5 + 2 \text{H}_2 + \text{O}_2 &\longrightarrow 2 \text{POCl}_3 + 4 \text{HCl} \\
 \Delta H &= -369[\text{kJ}] \\
 2 \text{H}_2\text{O} &\longrightarrow 2 \text{H}_2 + \text{O}_2 \\
 \Delta H &= -241[\text{kJ}] \\
 \hline
 2 \text{PCl}_5 + 2 \text{H}_2\text{O} &\longrightarrow 2 \text{POCl}_3 + 4 \text{HCl} \\
 \Delta H &= -610[\text{kJ}]
 \end{aligned} \tag{5}$$