Thermochemistry Practice #1

1. A 2.05 g solid is heated to 74.21°C and immersed in 26.05 g H_2O in a constant-pressure calorimeter. The initial temperature of the water is 27.20°C and $c_{solid} = 0.519$ J/g K.

   a. What is the change in temperature for the water and the solid?
   b. Does this answer make sense?

2. A 0.1964 g sample of quinine ($C_6H_4O_2$) is burned in a bomb calorimeter that has a heat capacity of 1.56 kJ/K. The temperature of the calorimeter increases by 3.2 K. Calculate the heat of combustion of quinine per gram and per mole.

3. The specific heat capacities of hafnium and ethanol are 0.146 J g^{-1} K^{-1} and 2.45 J g^{-1} K^{-1}, respectively. A piece of hot hafnium weighing 15.6 g at a temperature of 160.0°C is dropped into 125 g of ethanol that has an initial temperature of 20.0°C. What is the final temperature that is reached, assuming no heat loss to surroundings?

4. The generation of 1430 J of heat inside a calorimeter causes the temperature to increase by 1.93°C. What is the heat capacity of the calorimeter?

5. The dissolution of a small amount of salt in the water in the calorimeter described in question 4 causes a temperature rise of 3.46°C. What amount of heat was evolved in the dissolution of the salt?

6. Hydrazine (N_2H_4) reacts with chlorine gas according to the following equation.

   $$N_2H_4\,(l) + 2\,Cl_2\,(g) \longrightarrow 4\,HCl\,(g) + N_2\,(g) \qquad \Delta H = -420.0\text{ kJ}$$

   Calculate the change in enthalpy for this reaction under each of the following conditions.

   a. 25.4 g hydrazine reacts with excess chlorine
   b. 1.45 mol HCl (*g*) is generated

7. Given the following two reactions and corresponding enthalpy changes,

   $$CO_2\,(g) + SiO\,(g) \longrightarrow SiO_2\,(s) + CO\,(g) \qquad \Delta H = -520.9\text{ kJ}$$
   $$8\,CO_2\,(g) + Si_3N_4\,(s) \longrightarrow 3\,SiO_2\,(s) + 2\,N_2O\,(g) + 8\,CO\,(g) \qquad \Delta H = +461.05\text{ kJ}$$

   Compute the change in enthalpy for the following reaction.

   $$5CO_2\,(g) + Si_3N_4\,(s) \longrightarrow 3\,SiO\,(g) + 2\,N_2O\,(g) + 5\,CO\,(g)$$

8. Using the table of ΔH°_f values, determine the standard heats of reaction for the following processes at 25°C and 1 atm.

   a. The combustion of propane (C_3H_8) gas.
   b. The vaporization of water.