Experiment 8 Post-lab Help Sheet

This post-lab will be graded with <u>no partial credit</u>. Correct answers are worth 2 points, and any wrong answers will get 0 points. Correct answers with the wrong number of significant digits will lose ½ point.

1. The initial temperature of a 3.25 kg bar of aluminum was measured to be 18.7 °C. Calculate the final temperature of the aluminum bar after it absorbs 100.00 kJ of heat. Show your work.

   Look up the specific heat capacity of aluminum in the lab manual (page 65). Calculate the temperature increase using the data given, then add that to the initial temperature to get the final temperature.

2. 2.00 L of water at 88.9 °C was added to a calorimeter containing 3.00 L of water at 22.6 °C. The specific heat capacity of the calorimeter used in this experiment was 90.0 JK^{-1}. Calculate the final temperature of the water in the calorimeter after it reaches thermal equilibrium. Assume the density of water is 1.00 g/cm^3. Show your work.

   Start with the general equation we use for calorimetry.

   Plug in all the known values.

   T_f is unknown, so break up the ΔT terms into T_f and constants.

   Do all the multiplication and gather all your terms together so that you end up with an equation that looks like $xT_f = y$, where x and y are both numbers (big numbers! y will be over a million).

   Divide y by x to get T_f.

   (You can check your answer by plugging it into the original calorimetry equation as T_f. The two sides of the equation should be equal <u>up to the number of significant digits in your answer</u>. If you have three significant digits in your answer and the two sides differ in the fourth digit, that's okay, because the fourth digit is not significant.)

3. After an 83.6055 g chunk of iron was heated in boiling water bath for 30 minutes and then immersed into a calorimeter containing 150.0 g of water at 20.3 °C, the temperature of the water in the calorimeter increased by 4.2 °C. Calculate the amount of heat absorbed by the water in the calorimeter. Calculate the heat capacity of the calorimeter. Show your work.

   Heat absorbed by the water = $m_C \times 4.184 \times \Delta T_C$

   Heat absorbed by the calorimeter = Heated added – Heat absorbed by the water

   You take it from there.

4. Given the following data:

$C_2H_4\ (g) \rightarrow 2\ C\ (graphite) + 2\ H_2\ (g)$ $\Delta H^0 = -52.3$ kJ

$C\ (graphite) + 2\ H_2\ (g) \rightarrow CH_4\ (g)$ $\Delta H^0 = -74.8$ kJ

$C_2H_4Cl_2\ (g) \rightarrow Cl_2\ (g) + C_2H_4\ (g)$ $\Delta H^0 = 217.5$ kJ

Calculate the standard molar enthalpies of formation for $C_2H_4Cl_2$ (g) and CH_4 (g). Show your work.

> *"Standard molar enthalpy of formation" means you can only have* ***elements*** *(not compounds) as reactants, and the only product is* ***one mole*** *of the molecule you're interested in. For example, the standard enthalpy of formation for water would be based on this equation:*
>
> $$H_2\ (g) + \tfrac{1}{2}\ O_2\ (g) \rightarrow H_2O\ (l)$$
>
> *Everything else has to cancel out by adding the chemical equations you are given. To get things to cancel out, you can reverse equations, or can multiply them by some number, or divide them by some number in order to get the unwanted compounds to cancel. But whatever you do to the equation you must also do to the ΔH^0 value. So if you reverse the equation, change the sign on ΔH^0. If you multiply an equation by 2, multiply the ΔH^0 by 2.*
>
> *Remember the rules for significant digits when you are adding and subtracting. If you've forgotten them, look at page 3 of the lab manual.*

5. Given the following data:

$CaCO_3\ (s) \rightarrow CaO\ (s) + CO_2\ (g)$ $\Delta H^0 = 178.4$ kJ

$CO_2\ (g) \rightarrow C\ (graphite) + O_2\ (g)$ $\Delta H^0 = 393.5$ kJ

$2\ Ca\ (s) + O_2\ (g) \rightarrow 2\ CaO\ (s)$ $\Delta H^0 = -1270.2$ kJ

Calculate the standard molar enthalpy of formation for CO_2 (g) and $CaCO_3$ (s). Show your work.

> *These are done just like the ones in problem 4. Get your product on the right side of the equation and your reactants in their elemental form on the left side, then divide the final equation if necessary to make sure you only have one mole of product in your equation.*