AP LAB 09AB: Entropy and Endothermic Reactions

Aim To investigate the relationship between entropy and enthalpy

Apparatus Coffee-cup calorimeter, thermometer, weighing boat, spatula, goggles, electronic balance

Chemicals 1.0 M Citric acid solution, sodium hydrogen carbonate solid

Method

1. Measure 25.0 mL of the citric acid solution into a coffee-cup calorimeter, and record the temperature of the solution. (Allow a few minutes for the temperature to become constant before recording.)

2. Record the exact mass of approx. 6.40-6.60 g of sodium hydrogen carbonate.

3. With the thermometer already in the calorimeter, ***carefully*** add the sodium hydrogen carbonate to the acid.

(NOTE: The solid must be added VERY SLOWLY, a little at a time, to avoid the contents of the cup effervescing and the contents being lost)

4. Gently stir the contents of the calorimeter monitoring the temperature constantly. **Record the lowest temperature reached**.

5. Repeat the experiment to obtain data in a second trial.

Results

	Trial 1	Trial 2
Initial temperature of solution in °C		
Final temperature of solution in °C		
Mass of sodium hydrogen carbonate added in g		

Calculations/Conclusions

Make the assumption that the specific heat capacity of the solution is 4.18 J g^{-1} °C^{-1}, and that the density of the solution is 1.00 g mL^{-1}. You may ignore the heat capacity of the calorimeter.

$$C_6H_8O_{7(aq)} + 3NaHCO_{3(s)} \rightarrow C_6H_5O_7Na_{3(aq)} + 3H_2O_{(l)} + 3CO_{2(g)}$$

1. Determine the limiting reactant in the reaction.

2. Calculate the change in energy of the surroundings, $q_{surroundings}$, in units of Joules for each trial, and then average the two values.

3. Use your answer in Q2 to calculate a value for the q_{system} in kJ mol_{rxn}^{-1}, i.e., calculate $\Delta H°$ for the reaction. **(Use the average number of moles of the limiting reactant in your calculation).**

4. *Based only upon your calculation of* $\Delta H°$, predict the sign of $\Delta S°$ for the reaction. Justify you choice.

5. *Based only on the balanced equation*, predict the sign of $\Delta S°$ for the reaction. Justify you choice.