Chem 101B **Problem Set #5** Dr. Su

Will Not be Collected

1. (Review) Use the data given in your Appendix to calculate the heats of reaction, at 25 °C, for the following reactions. For each, is the reaction exothermic or endothermic?
   (a) $2Fe_3O_4$ (s) + 1/2 O_2 (g) --> $3Fe_2O_3$
   (b) KCl (s) + Na (s) --> K (s) + NaCl (s)
   (c) SO_3 (g) + H_2O (l) --> H_2SO_4 (l)

2. (Review) Ammonium nitrate dissolves in water according to the reaction:
   NH_4NO_3 (s) ---> NH_4^+ (aq) + NO_3^- (aq)
   a) Calculate the standard enthalpy change $\Delta H°$ for this reaction, using the following data: Enthalpy of formations for NH_4NO_3 (s) , NH_4^+ (aq) , NO_3^- (aq) are -365.6, -132.5, and -205.0 KJ/mol respectively.
   b) Suppose 15.0 grams of NH_4NO_3 is dissolved in 0.100 L of water at 20.0°C. Calculate the temperature reached by the solution, assuming it to be an ideal solution with a heat capacity close to that of 100 grams of pure water (418 J/K).
   c) What application would this reaction be useful?

3. Use the data given in your Appendix (or CRC handbook) to calculate the entropy change, at 25 °C, for the reactions in problem #1.

4. Calculate $\Delta G°$ at 25 °C for the reaction

   $FeCl_2$ (aq) + 1/2Cl_2 (g) ---> $FeCl_3$ (aq)

   given that $\Delta H° = -127.2$ kJ and $\Delta S° = -233$ J/K. *(Ans. -57.7 kJ)*

5. Determine whether the reaction

   CCl_4 (l) + H_2 (g) ---> HCl (g) + $CHCl_3$ (l)

   is spontaneous at 25 °C under standard state conditions. At 25 °C, $\Delta H° = -91.34$ kJ and $\Delta S° = 41.51$ J/K for this reaction.

6. Calculate the equilibrium constant at 25 °C for the reaction in question #5 given that $\Delta G° = -103.72$ kJ for this reaction. *(Ans. 1.5×10^{18})*

7. How does the value of ΔG change, for the reaction in question #5, if the reaction is carried out at 65 °C? *(Ans. -105 kJ)*

8. For the reaction,

   $BeSO_4$ (s) === BeO (s) + SO_3 (g)

   $K = 3.87 \times 10^{-16}$ at 400. K. Calculate K at 600. K assuming that the enthalpy change, $\Delta H° = 175$ kJ, for the reaction is constant over this temperature range.

   (Ans. 1.6×10^{-8})

Chapter 10 Problems

As always, I recommend looking at the problems at the end of chapter.