Unit 12 – Chapter 16: Thermodynamics **Name _____**

Assignment #5: Equilibrium Temperature & ΔG, Spontaneity Predictions **Period _____**

1) Organ pipes in unheated churches develop "tin disease", in which white tin is converted to gray tin. Given the below information, calculate the equilibrium temperature for the transition:

White Sn: ΔH^0_f = 0.00 kJ/mol; S^0 = 51.55 J/mol · K

Gray Sn: ΔH^0_f = -2.09 kJ/mol; S^0 = 44.14 J/mol · K

2) Show by calculation whether the reaction is spontaneous at 25^{0}C

$HC_2H_3O_{2(aq)} \longleftrightarrow H^+_{(aq)} + C_2H_3O_2^-{}_{(aq)}$ ΔG^0 = +27.2 kJ

a. When $[H^+] = [C_2H_3O_2^-]$ = 0.85 *M*; $[HC_2H_3O_2]$ = 0.15 *M*

b. When $[H^+] = [C_2H_3O_2^-]$ = 2.0 X 10^{-3} *M*; $[HC_2H_3O_2]$ = 1.0 *M*

3) For the reaction:

$O_{2(g)} + 4\ H^+_{(aq)} + 4\ Fe^{2+}_{(aq)} \rightarrow 2\ H_2O_{(l)} + 4\ Fe^{3+}_{(aq)}$

a) Calculate ΔG^0 at 25^{0}C. (G^0 for Fe^{3+} = -4.1 kJ/mol; Fe^{2+} = -78.9)

b) Calculate ΔG^0 at 25^{0}C when $[Fe^{2+}] = [Fe^{3+}]$ = 0.250 *M*, P_{O2} = 0.755 atm, and the pH of the solution is 3.12.

4) Consider the reaction:

$AgCl_{(s)} \rightarrow Ag^+_{(aq)} + Cl^-_{(aq)}$

a. Calculate ΔG^0 at 25^{0}C.

b. What should the concentrations of Ag^+ and Cl^- be so that ΔG^0 = -1.0 kJ (just spontaneous)?

Take $[Ag^+] = [Cl^-]$.

c. The K_{sp} for AgCl is 1.8 X 10^{-10}. Is the answer to b) above reasonable? Explain.