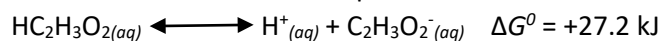1) Organ pipes in unheated churches develop "tin disease", in which white tin is converted to gray tin. Given the below information, calculate the equilibrium temperature for the transition:

   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 25^0C

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

   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:

   $$O_{2(g)} + 4 H^+_{(aq)} + 4 Fe^{2+}_{(aq)} \rightarrow 2 H_2O_{(l)} + 4 Fe^{3+}_{(aq)}$$
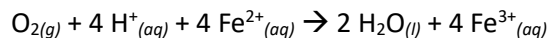
   a) Calculate ΔG^0 at 25^0C.

   b) Calculate ΔG^0 at 25^0C 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:

   $$AgCl_{(s)} \rightarrow Ag^+_{(aq)} + Cl^-_{(aq)}$$
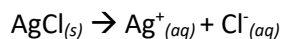
   a. Calculate ΔG^0 at 25^0C.

   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.