1. A gaseous chemical equilibrium has an equilibrium constant with the following form.

$$K_{\mathrm{p}} = \frac{P_{\mathrm{HI}}^2}{P_{\mathrm{H_2}} P_{\mathrm{I_2}}}$$

A) Write a balanced chemical equation for this system/reaction.

B) Write an expression for K_{c} and determine the relationship between K_{p} and K_{c}.

C) A container holds $[H_2] = 2.95 \times 10^{-3}$ M, $[I_2] = 5.22 \times 10^{-4}$ M, and $[HI] = 1.95 \times 10^{-3}$ M at 25 °C. If $K_{\mathrm{c}} = 48.8$ at 25 °C, in which direction will the reaction proceed in the container?

2. In the laboratory you synthesize emerald-colored crystals of trihydrate potassium ferrioxalate ($K_3[Fe(C_2O_4)_3]\cdot 3H_2O$) from aqueous solutions of $FeCl_3$ and $K_2C_2O_4$.

$$FeCl_3\,(aq) + 3K_2C_2O_4\,(aq) + 3H_2O\,(l) \rightarrow K_3[Fe(C_2O_4)_3]\cdot 3H_2O\,(s) + KCl\,(aq)$$

Recrystallization from a saturated aqueous solution of your products, contaminated with by-products and starting materials, served to purify your desired product.

A) Write a (solubility) equilibrium constant for dissolution of the crystals:

$$K_3[Fe(C_2O_4)_3]\cdot 3H_2O\,(s) \rightleftharpoons 3K^+\,(aq) + [Fe(C_2O_4)_3]^{3-}\,(aq) + 3H_2O\,(l)$$

B) If cooling the saturated solution results in crystal formation, is the dissolution of the $K_3[Fe(C_2O_4)_3]\cdot 3H_2O$ and endothermic or exothermic process?

3. Consider the reaction between phosphorus(III) chloride and chlorine gas to produce phosphorus(V) chloride.

$$PCl_3\,(g) + Cl_2\,(g) \rightarrow PCl_5\,(g) \qquad K_p = 24.2$$

A) A 1.00 L container at constant temperature contains $P_{PCl_3} = 1.5$ atm, $P_{Cl_2} = 0.72$ atm, and $P_{PCl_5} = 0$ atm initially. Calculate the partial pressures at equilibrium.

B) Describe some ways in which we can increase the concentration of PCl_5 (g).

C) The energy diagram for the reaction is shown below. Determine how the equilibrium number of moles of PCl_5 would change if system were heated.