1. At a certain temperature, $K_p = 0.25$ for the reaction: $\text{N}_2\text{O}_4 (g) \rightarrow 2\text{NO}_2(g)$. For the following, state whether the reaction is at equilibrium. If not, state in which direction the system will shift.
   a. A flask containing $\text{N}_2\text{O}_4$ at a pressure of 1.00 atm and $\text{NO}_2$ at a pressure of 0.50 atm.
   b. A flask containing $\text{N}_2\text{O}_4$ at pressure 0.60 atm and $\text{NO}_2$ at a pressure of 3.20 atm.

2. For the following reaction, $K = 51$. Determine the concentrations of all species at equilibrium for each of the following cases.
   \[ \text{H}_2 (g) + \text{I}_2 (g) \rightarrow 2\text{HI}(g) \]
   a. 1.0 mol of HI is placed in a 2.5 L flask.
   b. 1.0 mol each of $\text{H}_2$, $\text{I}_2$ and HI are placed in a 1.00 L flask.
3. At 25 °C, $K_p = 1.89 \times 10^{-6}$ for the following reaction: $2 \text{NH}_3 \rightleftharpoons \text{N}_2 + 3 \text{H}_2$ 
If ammonia is placed into an evacuated flask at an initial pressure of 0.88 atm, calculate the total pressure at equilibrium.

4. Consider the following reaction, which is endothermic: $2\text{SO}_3 \rightleftharpoons 2\text{SO}_2 + \text{O}_2$
How will the position of the equilibrium be shifted for each of the following changes?
   a. $\text{O}_2$ is added
   b. $\text{SO}_2$ is removed
   c. $\text{SO}_3$ is added
   d. The volume of the container is decreased
   e. $\text{Ne}$ is added, increasing the total pressure
   f. The temperature is raised

5. For the reaction below, in which direction will the equilibrium be shifted for each of the following?
   $\text{Ni}^{2+} (aq) + 4 \text{Cl}^- (aq) \rightleftharpoons \text{NiCl}_4^{2-} (aq)$
   a. Water is added, increasing the volume
   b. $\text{NaCl}$ is added
   c. $\text{AgNO}_3$ is added ($\text{AgCl}$ is insoluble)