Chemistry 12 – Dynamic Equilibrium
Learning Goal B5
Equilibrium Calculations: Problem Set D

1. $SO_{3\,(g)} + H_2O_{\,(g)} \rightleftharpoons H_2SO_{4\,(l)}$

   At equilibrium (25 ^oC): $[SO_3] = 0.400$ M $[H_2O] = 0.480$ M $[H_2SO_4] = 0.600$ M
   Calculate the value of the equilibrium constant, K_{eq}.

2. $PCl_{5\,(s)} + H_2O_{\,(g)} \rightleftharpoons 2\ HCl_{\,(g)} + POCl_{3\,(g)}$

   At equilibrium a 2.0L flask contains:
   0.45 mol of PCl_5 0.26 mol of H_2O 1.35 mol of HCl 0.96 mol of $POCl_3$

   Calculate the K_{eq} for the reaction.

3. $K_{eq} = 798$ at 25 ^oC for the reaction: $2\ SO_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2\ SO_{3\,(g)}$.

   In a particular mixture at equilibrium, $[SO_2] = 3.80$ M and $[SO_3] = 9.60$ M. Calculate the equilibrium $[O_2]$ in this mixture at 25^oC.

4. Consider the following equilibrium system, shown below.

   $2\ SO_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2\ SO_{3\,(g)}$ (100^oC)

   0.800 moles of SO_2 and 0.800 moles of O_2 are present in a 2.00 L flask at equilibrium.

   If the $K_{eq} = 680.0$, calculate the $[SO_3]$ at 100^oC.

5. Consider the following equilibrium:

$2\ NO_{2\ (g)} \rightleftharpoons N_2O_{4\ (g)}$ (20^oC)

2.00 moles of NO_2 and 1.60 moles of N_2O_4 are present in a 4.00 L flask at equilibrium. Calculate the value of K_{eq} at 20^oC.

6. Consider the following equilibrium system below:

$2\ SO_{3\ (g)} \rightleftharpoons 2\ SO_{2\ (g)} + O_{2\ (g)}$ (100^oC)

4.00 moles of SO_2 and 5.00 moles of O_2 are present in a 2.00 L container at equilibrium. Calculate the equilibrium concentration of SO_3 and the number of moles SO_3 present if the value $K_{eq} = 1.47 \times 10^{-3}$ at 100^oC.

7. If at equilibrium $[H_2] = 0.200M$ and $[I_2] = 0.200M$ and $K_{eq} = 55.6$ at 250^oC, calculate the equilibrium concentration of HI for the following system:

$H_{2\ (g)} + I_{2\ (g)} \rightleftharpoons 2\ HI_{(g)}$

8. 1.60 moles CO, 1.60 moles H_2O, 4.00 moles CO_2, 4.00 moles H_2 are found in an 8.00 L container at 690^oC at equilibrium for the following chemical system: $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2\ (g)} + H_{2\ (g)}$

Calculate the value of the equilibrium constant.