Chemistry 12 – Dynamic Equilibrium
Learning Goal B6
Equilibrium Calculations: Problem Set E

Solve each problem and show all of your work.

1. At equilibrium, a 5.0L flask contains:
   0.75 mol of PCl_5 0.50 mol of H_2O 7.50 mol of HCl 5.00 mol of $POCl_3$
   Calculate the K_{eq} for the reaction:

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

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

   In a particular mixture at equilibrium, $[SO_2]$ = 4.20 M and $[SO_3]$ = 11.0 M. Calculate the equilibrium $[O_2]$ in this mixture.

3. Consider the following equilibrium:

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

When 0.600 moles of SO_2 and 0.600 moles of O_2 are placed into a 1.00 L container and allowed to reach equilibrium, the equilibrium $[SO_3]$ is to be 0.250 M. Calculate K_{eq}.

4. Consider the following equilibrium:

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

2.00 moles of NO_2 are placed in a 1.00 L flask and allowed to react. After equilibrium is established, 1.80 moles of NO_2 are present. Calculate K_{eq}.

5. Consider the chemical system below:

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

4.00 moles of SO_2 and 5.00 moles O_2 are placed in a 2.00 L container at 200°C and allowed to reach equilibrium. If the equilibrium $[O_2]$ is 2.00 M, calculate the value of $K_{eq.}$

6. If the initial $[H_2]$ = 0.200 M, $[I_2]$ = 0.200 M and K_{eq} = 55.6 (at 250°C) calculate the equilibrium concentrations of all molecules in the following chemical system.

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

7. 1.60 moles CO and 1.60 moles H_2O are placed in a 2.00 L container at 690 °C

$$CO_{\,(g)} + H_2O_{\,(g)} \rightleftharpoons CO_{2\,(g)} + H_{2\,(g)} \qquad K_{eq} = 10.0$$

Calculate all equilibrium concentrations.

8. $SO_{3\,(g)} + NO_{(g)} \rightleftharpoons NO_{2\,(g)} + SO_{2\,(g)}$; $K_{eq} = 0.800$ at 100^oC.

If 4.00 moles of each reactant are placed in a 2.00L container, calculate all equilibrium concentrations at 100^oC for the chemical system shown above.

*9. Consider the following equilibrium system:

$$2\ NO_{2\,(g)} \rightleftharpoons N_2O_{4\,(g)}$$

Two sets of equilibrium data are listed for the same temperature.

Container 1	2.00 L	0.12 moles NO_2	0.16 moles N_2O_4
Container 2	5.00 L	0.26 moles NO_2	? moles N_2O_4

Determine the number of moles N_2O_4 in the second container.