1. \[ \text{SO}_3 (g) + \text{H}_2\text{O} (g) \rightleftharpoons \text{H}_2\text{SO}_4 (l) \]

At equilibrium (25 °C): \([\text{SO}_3] = 0.400\ M\quad [\text{H}_2\text{O}] = 0.480\ M\quad [\text{H}_2\text{SO}_4] = 0.600\ M\]

Calculate the value of the equilibrium constant, \(K_{eq}\).

2. \[ \text{PCl}_5 (s) + \text{H}_2\text{O} (g) \rightleftharpoons 2\text{HCl} (g) + \text{POCl}_3 (g) \]

At equilibrium a 2.0L flask contains:
0.45 mol of \(\text{PCl}_5\)      0.26 mol of \(\text{H}_2\text{O}\)     1.35 mol of \(\text{HCl}\)         0.96 mol of \(\text{POCl}_3\)

Calculate the \(K_{eq}\) for the reaction.

3. \(K_{eq} = 798\) at 25 °C for the reaction: \[ 2\text{SO}_2 (g) + \text{O}_2 (g) \rightleftharpoons 2\text{SO}_3 (g). \]

In a particular mixture at equilibrium, \([\text{SO}_2] = 3.80\ M\) and \([\text{SO}_3] = 9.60\ M\). Calculate the equilibrium \([\text{O}_2]\) in this mixture at 25°C.

4. Consider the following equilibrium system, shown below.
\[ 2\text{SO}_2 (g) + \text{O}_2 (g) \rightleftharpoons 2\text{SO}_3 (g) \quad (100°C) \]

0.800 moles of \(\text{SO}_2\) and 0.800 moles of \(\text{O}_2\) are present in a 2.00 L flask at equilibrium.

If the \(K_{eq} = 680.0\), calculate the \([\text{SO}_3]\) at 100°C.
5. Consider the following equilibrium:

\[ 2 \text{NO}_2(g) \rightleftharpoons \text{N}_2\text{O}_4(g) \quad (20^\circ\text{C}) \]

2.00 moles of NO\(_2\) and 1.60 moles of N\(_2\)O\(_4\) are present in a 4.00 L flask at equilibrium. Calculate the value of \(K_{\text{eq}}\) at 20\(^\circ\)C.

6. Consider the following equilibrium system below:

\[ 2 \text{SO}_3(g) \rightleftharpoons 2 \text{SO}_2(g) + \text{O}_2(g) \quad (100^\circ\text{C}) \]

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 \(K_{\text{eq}} = 1.47 \times 10^{-3}\) at 100\(^\circ\)C.

7. If at equilibrium [H\(_2\)] = 0.200M and [I\(_2\)] = 0.200M and \(K_{\text{eq}} = 55.6\) at 250\(^\circ\)C, calculate the equilibrium concentration of HI for the following system:

\[ \text{H}_2(g) + \text{I}_2(g) \rightleftharpoons 2 \text{HI}(g) \]

8. 1.60 moles CO, 1.60 moles H\(_2\)O, 4.00 moles CO\(_2\), 4.00 moles H\(_2\) are found in an 8.00 L container at 690\(^\circ\)C at equilibrium for the following chemical system: \(\text{CO}(g) + \text{H}_2\text{O}(g) \rightleftharpoons \text{CO}_2(g) + \text{H}_2(g)\)

Calculate the value of the equilibrium constant.