Equilibrium 3 • CHEM 220

1. Consider the reaction: $2\ N_2O_{5(g)} \Leftrightarrow 2\ N_{2(g)} + 5\ O_{2(g)}$. If the initial partial pressure of N_2O_5 was 3.20 atm and, the total pressure of the system was 7.80 atm at equilibrium, what is K_P for the reaction?

2. At 298 K, the equilibrium expression for the reaction below is $K_P = 1.7 \times 10^{-4}$.

   $$2\ CO_{2(g)} \Leftrightarrow 2\ CO_{(g)} + O_{2(g)}$$

   A) Calculate K_C.

   B) If 2.0 mol of carbon dioxide is placed into a 5.0 L flask, what will be the concentration of all species at equilibrium?

3. Consider the reaction: $H_{2(g)} + I_{2(g)} \Leftrightarrow 2\ HI_{(g)}$. If $K_c = 150$ at 25°C, and a mixture at that temperature contains $[H_2] = 0.75\ M$, $[I_2] = 0.75\ M$, and $[HI] = 2.5\ M$,

   A) Is the system at equilibrium?

   B) If not, to which direction will it shift?

   C) What will be the equilibrium concentrations of reactants and products?

4. At 298 K, $K_p = 3.5 \times 10^6$ for the reaction of $2\ NO_{(g)} \Leftrightarrow N_{2(g)} + O_{2(g)}$. If a mixture initially contains $P_{NO} = 1.50$ atm, $P_{O2} = 0.20$ atm, and $P_{N2} = 0$ atm, what are the equilibrium pressures of all species?

5. Consider the reaction: $CO_{2(g)} + H_{2(g)} \Leftrightarrow CO_{(g)} + H_2O_{(g)}$, for which $K_C = 6.00$ at 400 K. If a mixture initially contains 1.00 M CO_2 and 4.00 M H_2 and is allowed to come to equilibrium, what are the equilibrium concentrations of all species?

6. A gas mixture initially containing 4.00 mol of N_2O_4 and 6.00 mol O_2 in a 3.00 L container are allowed to come to equilibrium by the reaction: $2\ N_2O_{4(g)} + O_{2(g)} \Leftrightarrow 2\ N_2O_{5(g)}$.
   What are the equilibrium concentrations of all species if $K_C = 1.25 \times 10^{-5}$.

7. Consider the gas phase decomposition reaction of hydrogen sulfite at high temperature:

   $$H_2SO_{3(g)} \Leftrightarrow SO_{2(g)} + H_2O_{(g)}$$

   A mixture of the gases initially contains 5.00 atm of hydrogen sulfite and 1.00 atm water vapor, with no sulfur dioxide present. If the equilibrium mixture has a total pressure of 8.62 atm, what is the value of K_P?