Calculations Using the Equilibrium Constant   Name:_____
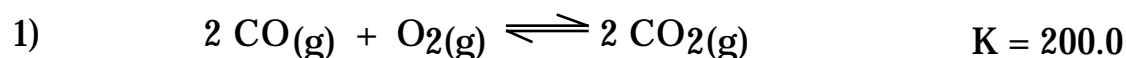
1) $$2\ CO_{(g)}\ +\ O_{2(g)} \rightleftharpoons 2\ CO_{2(g)} \qquad\qquad K = 200.0$$
If the above reaction is at equilibrium and the partial pressure of CO is 10.0 kPa and the partial pressure of O_2 is 5.00 kPa, what is the partial pressure of the CO_2?

2) For the equation above pure CO_2 was put into a container. when the system reached equilibrium, the partial pressure of the CO_2 is measured as 40 Torr and the partial pressure of CO is 4.0 Torr. What is the partial pressure of the O_2?
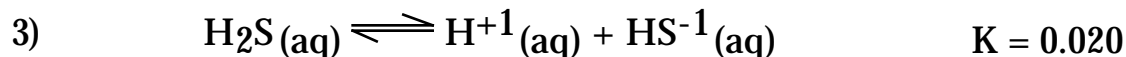
3) $$H_2S_{(aq)} \rightleftharpoons H^{+1}_{(aq)} + HS^{-1}_{(aq)} \qquad\qquad K = 0.020$$
A measured amount of H_2S was added to water and allowed to come to equilibrium. At equilibrium the hydrogen ion concentration was 0.0010. What is the equilibrium concentration of H_2S?

4) For the equation above, pure H_2S was added to water and the resulting solution was allowed to reach equilibrium. At equilibrium the concentration of H_2S was measured to be 2.0 M. What are the concentrations of the H^{+1} and HS^{-1} ions?
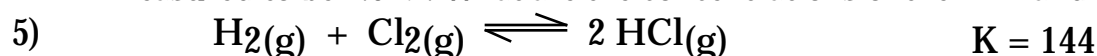
5) $$H_{2(g)}\ +\ Cl_{2(g)} \rightleftharpoons 2\ HCl_{(g)} \qquad\qquad K = 144$$
If 1.00 mol of HCl is put into a 1.00 L flask, what will be the equilibrium concentration of each gas at equilibrium?
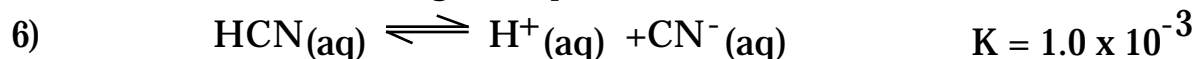
6) $$HCN_{(aq)} \rightleftharpoons H^{+}_{(aq)} + CN^{-}_{(aq)} \qquad\qquad K = 1.0 \times 10^{-3}$$
If 5.00 mol of pure HCN are dissolved in 1.00 L of solution, what will be the equilibrium concentration of H^+ and CN^-?
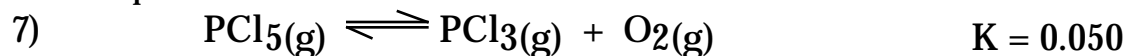
7) $$PCl_{5(g)} \rightleftharpoons PCl_{3(g)}\ +\ O_{2(g)} \qquad\qquad K = 0.050$$
If the partial pressure of O_2 is 10.0 mmHg, PCl_3 is 60.0 mmHg and the partial pressure of PCl_5 is 1000.0 mmHg, will the mixture react to produce more products (shift right), more reactants (shift left) or is it already at equilibrium?
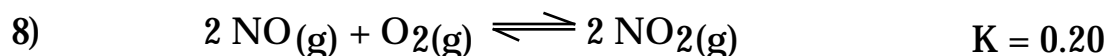
8) $$2\ NO_{(g)} + O_{2(g)} \rightleftharpoons 2\ NO_{2(g)} \qquad\qquad K = 0.20$$
If the partial pressure of NO_2 is 400.0 mmHg, and the partial pressure of the reactants is 300.0 mmHg each, will the mixture react to produce more products (shift right), more reactants (shift left) or is it already at equilibrium?
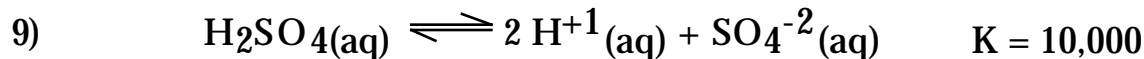
9) $$H_2SO_{4(aq)} \rightleftharpoons 2\ H^{+1}_{(aq)} + SO_4^{-2}_{(aq)} \qquad\qquad K = 10,000$$
If the hydrogen ion concentration is 2.0 M, the sulfate ion concentration is 1.0 M and the acid concentration is 0.010M, will the mixture react to produce more products (shift right), more reactants (shift left) or is it already at equilibrium?

Answers: 1) 316 kPa   2) 0.50 Torr   3) 5.0×10^{-5} M   4) both are 0.20 M
5) $[H_2]=[Cl_2]=0.0714$ M and HCl = 0.857 M   6) $[H^+]=[CN^-]=0.0702$ M and [HCN] = 4.93 M
7) shift left   8) shift right   9) shift right