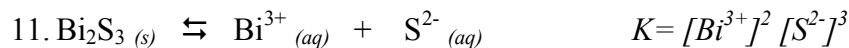
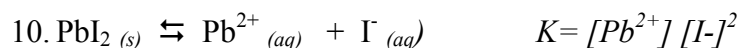
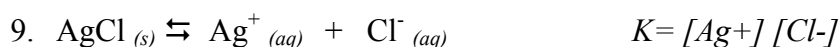
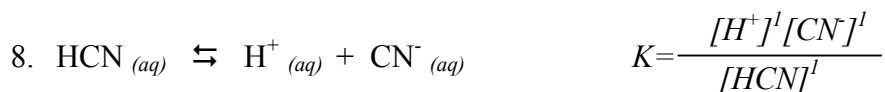
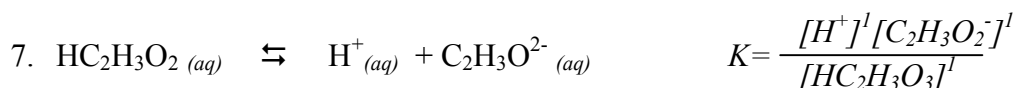
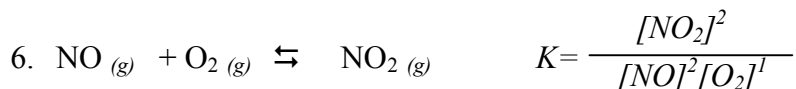
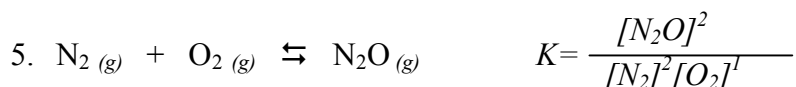
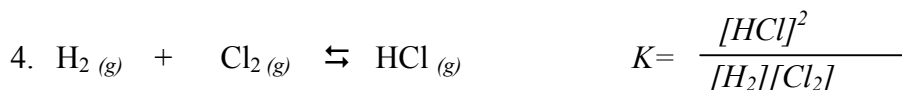
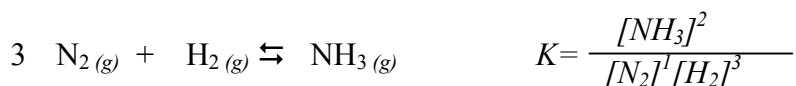
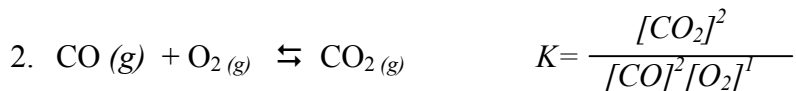
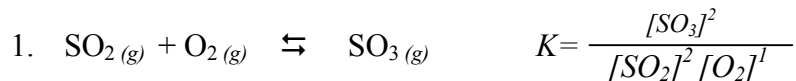


Equilibria

I. Balance each equation and write an equilibrium expression for each of the following reactions.



II. In each of the following, determine the unknown quantity from the information given. The number in parentheses refers to the corresponding reaction in Part I to which you should refer.

1. Find K_{eq} if $[\text{SO}_2] = 1.0 \text{ M}$; $[\text{O}_2] = 1.0 \text{ M}$; $[\text{SO}_3] = 2.0 \text{ M}$ (1) $4.0/\text{M}$

2. Find K_{eq} if $[\text{CO}] = 0.5 \text{ M}$; $[\text{O}_2] = 0.5 \text{ M}$; $[\text{CO}_2] = 2.5 \text{ M}$ (2) $50/\text{M}$

3. Find K_{eq} if $[\text{N}_2] = 0.25 \text{ M}$; $[\text{H}_2] = 0.10 \text{ M}$; $[\text{NH}_3] = 0.010 \text{ M}$ (3) $.40 \text{ M}^2$

4. Find K_{eq} if $[\text{H}_2] = 2.0 \times 10^{-3} \text{ M}$; $[\text{Cl}_2] = 2.5 \times 10^{-2} \text{ M}$; $[\text{HCl}] = 1.5 \times 10^{-3} \text{ M}$ (4) 0.045

5. Find $[\text{O}_2]$ if $K_p = 45.0 \text{ atm}^{-1}$; $[\text{N}_2] = 1.0 \text{ atm}$; $[\text{N}_2\text{O}] = 1.0 \text{ atm}$ (5) 0.022 atm

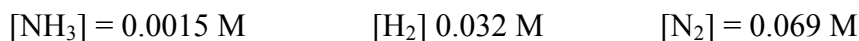
6. Find $[\text{NO}]$ if $[\text{O}_2] = 0.10 \text{ M}$; $[\text{NO}_2] = 0.20 \text{ M}$; $K_{\text{eq}} = 10.0$ (6) 0.20 M

7. Find $[N_2]$ if $[H_2] = 1.0 \times 10^{-2} \text{ M}$; $[NH_3] = 2.0 \times 10^{-3} \text{ M}$; $K_{eq} = 1.5 \times 10^{-4}$ (3) $2.67 \times 10^{-4} \text{ M}$
8. Find $[CO]$ if $[O_2] = 1.3 \times 10^{-3} \text{ M}$; $[CO_2] = 2.5 \times 10^{-4} \text{ M}$; $K_{eq} = 3.6 \times 10^{-3}$ (2) 0.116 M
9. Find K_a if $[HC_2H_3O_2] = 0.10 \text{ M}$; $[H^+] = [C_2H_3O_2^-] = 0.0010 \text{ M}$ (7) 1.0×10^{-5}
10. Find K_a if $[HCN] = 0.0010 \text{ M}$; $[H^+] = 0.010 \text{ M}$; $[CN^-] = 2.0 \times 10^{-8}$ (8) 2.0×10^{-7}
11. Find $[C_2H_3O_2^-]$ if $[HC_2H_3O_2] = 1.5 \times 10^{-2} \text{ M}$; $[H^+] = 2.0 \times 10^{-3} \text{ M}$; $K_a = 1.8 \times 10^{-5}$ (7) $1.35 \times 10^{-4} \text{ M}$
12. Find $[H^+]$ if $[HCN] = 3.6 \times 10^{-3} \text{ M}$ and $[CN^-] = [H^+]$; $K_a = 5.8 \times 10^{-8}$ (8) 1.44×10^{-5}
13. Find K_{sp} if the solubility of silver chloride is $4.3 \times 10^{-6} \text{ g/100 mL}$ (9) $9.0 \times 10^{-14} \text{ M}$
14. Find K_{sp} if the solubility of bismuth (III) sulfide is $2.9 \times 10^{-5} \text{ g/100 mL}$ (11) 6.16×10^{-30}
15. Find $[Pb^{2+}]$ if K_{sp} for PbI_2 is 7.5×10^{-9} (10) $1.23 \times 10^{-3} \text{ M}$

III. Solve each of the following problems involving equilibria.

1. Calculate the equilibrium constant for the following reaction; $2A + B \rightleftharpoons 3C + D$, where the concentrations are $A = 3.0 \text{ M}$; $B = 2.0 \text{ M}$; $C = 2.0 \text{ M}$; and $D = 4.0 \text{ M}$ 1.78
2. The equilibrium constant for the reaction $A + B \rightleftharpoons 2C$ is 50. After mixing equimolar quantities of A and B, the equilibrium concentration of C is found to be 0.50 M. What are the concentrations of A and B at equilibrium? 0.071 M
3. Consider the reaction $PCl_5 (g) \rightleftharpoons PCl_3 (g) + Cl_2 (g)$. the equilibrium mixture in a 9.0 L container was found to include 0.25 moles of PCl_5 , 0.36 moles of PCl_3 , and 0.36 moles of Cl_2 . From this data calculate the equilibrium constant for the reaction at the reaction temperature of 225° C . 0.058 M
4. Nitrogen is caused to react with hydrogen to form ammonia at 450° C in a 4.0 L vessel. At equilibrium, the partial pressures observed for each of the species in the reaction was as follows: ammonia 900 mm Hg, nitrogen 180 mm Hg and hydrogen 305 mm Hg. From this information calculate the equilibrium constant for the reaction at this temperature. $K_{eq} = 3.5 \times 10^5$ $K_p = 2.5 \times 10^{-3}$
5. Consider the reaction $H_2 (g) + I_2 (g) \rightleftharpoons 2 HI (g)$. The equilibrium constant for this reaction is 32. If at equilibrium the concentration of HI is 0.40 M and that of I_2 is 0.05 M, what is the concentration of hydrogen? 0.10 M
6. The equilibrium constant of the following reaction is 8. What is the concentration of oxygen at equilibrium?

$$4 Al (s) + 3 O_2 (g) \rightleftharpoons 2 Al_2O_3 (s) \quad 0.5 \text{ M}$$
7. For the reaction $H_2 (g) + I_2 (g) \rightleftharpoons 2 HI (g)$ what is the equilibrium constant if the following concentrations are observed at equilibrium? $[H_2] = 5.62 \text{ M}$ $[I_2] = 0.130 \text{ M}$ $[HI] = 7.89 \text{ M}$ 85.2
8. Given the equilibrium concentrations shown below, what is the dissociation constant for ammonia?



$$K=1$$