WKS

More practice with K_{eq}, K_{sp} and Le Châtelier

Name _____

Period _____ Date _____

1) At 25°C, the value of the K_{eq} is 1.7×10^{-13} for the following reaction,

$$N_2O\ (g) + \tfrac{1}{2}\ O_2\ (g) \rightleftharpoons 2\ NO\ (g)$$

The following concentrations are determined at equilibrium: $[N_2O] = 0.0035$ M and $[O_2] = 0.0027$ M
What is the concentration of NO at this equilibrium position?

2) A solution is found to have a Ba^{2+} concentration equal to 5.0×10^{-4} M. A solution of Na_3PO_4 is added until $Ba_3(PO_4)_2$ (s) forms. What is the PO_4^{3-} ion concentration just before the solid precipitates?

$$Ba_3(PO_4)_2\ (s) \rightleftharpoons 3\ Ba^{2+}\ (aq) + 2\ PO_4^{3-}\ (aq) \qquad K_{sp} = 3.4 \times 10^{-23}$$

3) K_{sp} is a measure of solubility. Thus, one should be able to convert from solubility to K_{sp}. The solubility of $Ca(OH)_2$ in water is 0.173g/100 mL *(This is the point at which a saturated solution is formed.)*
Follow these steps to convert from the solubility to the K_{sp} of $Ca(OH)_2$.

a) What is the molarity of a $Ca(OH)_2$ solution when saturated. (M = moles/L)

b) Complete the chemical equation: $Ca(OH)_2\ (s) \rightleftharpoons$

c) Write the K_{sp} expression of $Ca(OH)_2$: $K_{sp} =$

d) Determine the equilibrium concentrations of Ca^{+2} and OH^-

e) Solve for the K_{sp}

4) A famous technique for producing ammonia gas (NH_3) is called the Haber process. It is an equilibrium process described by this reaction: $N_2\ (g) + 3\ H_2\ (g) \rightleftharpoons 2\ NH_3\ (g) + \text{heat}$

a) List five changes that could be made to shift the equilibrium towards products (get more NH_3).

b) Which change listed above would slow down the RATE of the forward and reverse reactions?

Equation A: $CuCO_3\ (s) \rightleftharpoons Cu^{+2}\ (aq) + CO_3^{2-}\ (aq)$
green solid *clear blue* *clear colorless*

Equation B: $Cu^{+2}\ (aq) + 4\ Cl^-\ (aq) \rightleftharpoons [CuCl_4]^{2-}\ (aq)$
clear blue *clear colorless* *clear green*

Answer the following questions, by analyzing the equilibrium system described in the reactions above.

5) A clear blue $Cu(NO_3)_2$ solution is put into a test tube. What ions are in this solution?_____

6) A clear colorless Na_2CO_3 solution is added to the test tube. What ions are in the Na_2CO_3 solution? _____
When the Na_2CO_3 solution is added to the test tube, equation A shifts.
   a) In what direction does Eq. A shift? _____
   b) What should be observed when Eq. A makes this shift?
   (Discuss formation/dissolution of any solids and any changes in the colors of solutions.)

   c) Use Le Châtelier's Principle to explain why Eq A shifts as you have determined.

7) Now, a clear colorless HCl solution is added to the test tube. What ions are in the HCl solution? _____
When the HCl solution is added to the test tube, equation B shifts.
   a) In what direction does Eq. B shift? _____
   b) What should be observed when Eq. B makes this shift?
   (Discuss formation/dissolution of any solids and any changes in the colors of solutions.)

   c) Use Le Châtelier's Principle to explain why Eq B shifts as you have determined.

When the HCl solution is added to the test tube, equation A also shifts.
   d) In what direction does Eq. A shift? _____
   e) What should be observed when Eq. A makes this shift?
   (Discuss formation/dissolution of any solids and any changes in the colors of solutions.)

   f) Use Le Châtelier's Principle to explain why Eq A shifts as you have determined.

Answers: 1) 5.6×10^{-9} M; 2) 5.2×10^{-7} M; 3a) 0.0233 M; 3e) 5.08×10^{-5}