Chem 1105-2015 Summer Problem Set #5

1. Calculate the [H^+(aq)] and the pH in the titration of 22.0 mL of 0.10 M acetic acid, CH_3COOH, with a) 15.0 mL of 0.10 M NaOH, b) 22.0 mL of 0.10 M NaOH, c) 25.0 mL of 0.10 M NaOH

2. If a buffer is made of 12.2 g of benzoic acid(C_6H_5COOH) and 7.20 g of sodium benzoate(C_6H_5COONa) in 500. mL of solution, what is the pH of the buffer? If the buffer is diluted to 1.5 L, what is the pH of the new solution? K_a for benzoic acid = 6.3×10^{-5}

3. How many grams of NH_4Cl would have to be added to 5.0×10^{2} mL of 0.10 M NH_3 to prepare a buffer with a pH of 9.00?

4. A 250. mL buffer consists of 0.20 M HNO_2 and 0.30 M $NaNO_2$. K_a for HNO_2 is 4.5×10^{-4} Calculate the pH of a) the original buffer; b) the buffer on the addition of 10.0 mL of 4.5 M HCl; c) the buffer on the addition of 10.0 mL of 4.0 M NaOH; d) the buffer on the addition of 10.0 mL of 12.0 M HCl.

5. Consider a 250. mL sample of water. Calculate the pH of a) the original water; b) the water on the addition of 10.0 mL of 4.5 M HCl; c) the water on the addition of 10.0 mL of 4.0 M NaOH; d) the water on the addition of 10.0 mL of 12.0 M HCl.

6. Calculate the pH of a solution originally containing 20.0 mL of 0.11 M NH_3. Next calculate the pH after the addition of 5.00, 11.0, 15.0, 20.0, 22.0, and 25.0 mL of 0.10 M HCl. What is the volume of HCl added at the equivalence point? What indicator would be best to use to detect the equivalence point. See textbook.

7. For each of the following salts, a) write a balanced equation showing the equilibrium occuring when the salt is added to water and b) write the K_{sp} expression.
a) ZnS, b) $NiCO_3$, c) SnI_2, d) Ag_2SO_4

8. When solid CoS is added to water the equilibrium concentration of Co^{2+} is 7.7×10^{-11} M. What is the K_{sp} of CoS?

9. Calcium hydroxide has a solubility of 0.93 g/L. What is the K_{sp} of $Ca(OH)_2$?

10. Estimate the solubility of lead bromide in terms of a) moles per liter and b) grams per liter of pure water. $K_{sp}(PbBr_2) = 6.3\times10^{-6}$

11. Will a precipitate of $Mg(OH)_2$ form when 25.0 mL of 0.010 M NaOH(aq) is combined with 75.0 mL of 0.10 M $MgCl_2$(aq). $K_{sp}(Mg(OH)_2) = 1.5\times10^{-11}$

12. What is the molar solubility of BaF_2 in a) pure water, b) water containing 0.15 M KF. $K_{sp}(BaF_2) = 1.7\times10^{-6}$

13. Explain the change in solubility for question #12 in terms of LeChatelier's Principle.

Answer Set for Chem 1105-2015 Summer Problem Set #5

1.	$[H^+(aq)]$	pH
a)	8.5×10^{-6} M	5.07
b)	1.9×10^{-9} M	8.72
c)	1.6×10^{-12} M	12.2

2. pH = 3.90. pH does not change on the dilution of a buffer solution.

3. 4.8 g NH_4Cl

4.a) 3.53, b) 2.85, c) 4.41, d) 0.76

5.a) 7.00, b) 0.76, c) 13.20, d) 0.34

6. 11.15, 9.79, 9.26, 8.92, 8.26, 5.28, 2.18; 22.0 mL of 0.10 M HCl; suitable indicator would be methyl red

7.

a) $ZnS(s) \leftrightharpoons Zn^{2+}(aq) + S^{2-}(aq)$ $$K_{sp} = [Zn^{2+}(aq)][S^{2-}(aq)]$$

b) $NiCO_3(s) \leftrightharpoons Ni^{2+}(aq) + CO_3^{2-}(aq)$ $$K_{sp} = [Ni^{2+}(aq)][CO_3{}^{2-}(aq)]$$

c) $SnI_2(s) \leftrightharpoons Sn^{2+}(aq) + 2I^-(aq)$ $$K_{sp} = [Sn^{2+}(aq)][I^-(aq)]^2$$

d) $Ag_2SO_4(s) \leftrightharpoons 2Ag^+(aq) + SO_4^{2-}(aq)$ $$K_{sp} = [Ag^+(aq)]^2[SO_4{}^{2-}(aq)]$$

8. 5.9×10^{-21}

9. 7.9×10^{-6}

10.a) 0.012 M, b) 4.4 g $PbBr_2$/L

11. Q = 4.7×10^{-7}, Q > K_{sp} thus more precipitate will form.

12.a) 7.5×10^{-3} M, b) 7.6×10^{-5} M

13. Considering the following equilibrium

$$BaF_2(s) \leftrightharpoons Ba^{2+}(aq) + 2F^-(aq) \qquad K_{sp}$$

On the addition of KF or F^- ions to the above system the equilibrium will shift to the left producing more BaF_2 to use up the excess F^- ions. As a result the solubility of BaF_2 will decrease in magnitude.