Ionic Equilibria **Name_____**

1. Equal volumes of the following pairs of solutions are mixed. Which pair will produce a buffer solution?
A. 0.10 mol L^{-1} HCl and 0.05 mol L^{-1} NaOH
B. 0.10 mol L^{-1} HCl and 0.15 mol L^{-1} NH_3
C. 0.10 mol L^{-1} HCl and 0.05 mol L^{-1} NH_3
D. 0.10 mol L^{-1} HCl and 0.20 mol L^{-1} CH_3COOH
E. 0.10 mol L^{-1} HCl and 0.20 mol L^{-1} NaCl

2. Which of the following has the highest buffer capacity?
A. 0.10 *M* $H_2PO_4^-$/0.10 *M* HPO_4^{2-}
B. 0.50 *M* $H_2PO_4^-$/0.10 *M* HPO_4^{2-}
C. 0.10 *M* $H_2PO_4^-$/0.50 *M* HPO_4^{2-}
D. 0.50 *M* $H_2PO_4^-$/0.50 *M* HPO_4^{2-}
E. They all have the same buffer capacity.

3. A phosphate buffer ($H_2PO_4^-$/HPO_4^{2-}) has a pH of 8.3. Which of the following changes will cause the pH to increase?
A. dissolving a small amount of Na_2HPO_4
B. dissolving a small amount of NaH_2PO_4
C. adding a small amount of dilute hydrochloric acid
D. adding a small amount of dilute phosphoric acid
E. making the buffer more concentrated by removing some water

4. What is the pH of a solution that consists of 0.50 *M* $H_2C_6H_6O_6$ (ascorbic acid) and 0.75 *M* $NaHC_6H_6O_6$ (sodium ascorbate)? For ascorbic acid, $K_a = 6.8 \times 10^{-5}$
A. 3.76 B. 3.99 C. 4.34 D. 4.57 E. 5.66

5. A 20.0-mL sample of 0.30 *M* HBr is titrated with 0.15 *M* NaOH. What is the pH of the solution after 40.3 mL of NaOH have been added to the acid?
A. 2.95 B. 3.13 C. 10.87 D. 11.05 E. 13.14

6. A sample of a monoprotic acid (HA) weighing 0.384 g is dissolved in water and the solution is titrated with aqueous NaOH. If 30.0 mL of 0.100 *M* NaOH is required to reach the equivalence point, what is the molar mass of HA?
A. 37.0 g/mol B. 81.0 g/mol C. 128 g/mol D. 20.3 g/mol E. 211 g/mol

7. The solubility of magnesium phosphate is 2.27×10^{-3} g/1.0 L of solution. What is the K_{sp} for $Mg_3(PO_4)_2$?
A. 6.5×10^{-12} B. 6.0×10^{-14} C. 5.2×10^{-24} D. 4.8×10^{-26} E. 1.0×10^{-26}

8. Use the following information to calculate the solubility product constant, K_{sp}, for CuCl. A saturated solution of CuCl in water was prepared and filtered. From the filtrate, 1.0 L was measured out into a beaker and evaporated to dryness. The solid CuCl residue recovered in the beaker was found to weigh 0.041g.
A. $K_{sp} = 1.7 \times 10^{-9}$
B. $K_{sp} = 1.7 \times 10^{-7}$
C. $K_{sp} = 1.7 \times 10^{-5}$
D. $K_{sp} = 4.3 \times 10^{-4}$
E. $K_{sp} = 2.1 \times 10^{-2}$

9. A solution is prepared by mixing 50.0 mL of 0.50 *M* $Cu(NO_3)_2$ with 50.0 mL of 0.50 *M* $Co(NO_3)_2$. Sodium hydroxide is added to the mixture. Which hydroxide precipitates first and what concentration of hydroxide ions present in solution will accomplish the separation?
$K_{sp} = 2.2 \times 10^{-20}$ for $Cu(OH)_2$, $K_{sp} = 1.3 \times 10^{-15}$ for $Co(OH)_2$
A. $Co(OH)_2$; $[OH^-] = 6.9 \times 10^{-6}$ *M*
B. $Co(OH)_2$; $[OH^-] = 2.6 \times 10^{-7}$ *M*
C. $Cu(OH)_2$; $[OH^-] = 1.8 \times 10^{-7}$ *M*
D. $Cu(OH)_2$; $[OH^-] = 1.1 \times 10^{-9}$ *M*
E. $Cu(OH)_2$; $[OH^-] = 1.0 \times 10^{-17}$ *M*

10. What is the maximum amount of sodium sulfate that can be added to 1.00 L of 0.0020 *M* $Ca(NO_3)_2$ before precipitation of calcium sulfate begins? $K_{sp} = 2.4 \times 10^{-5}$ for calcium sulfate
A. 1.2×10^{-2} mol
B. 4.9×10^{-3} mol
C. 3.5×10^{-3} mol
D. 1.2×10^{-5} mol
E. 4.8×10^{-8} mol