Name ___________________________ Test 4

PHYS 0111 (Gen Chem 2) Spring 2005

1. _______

2. _______

3. _______

4. _______

5. _______

6. _______

7. _______

8. _______

A few equations:

$K = \frac{[\text{products}]}{[\text{reactants}]}$

$Q = \frac{[\text{products}]_o}{[\text{reactants}]_o}$

$pH = -\log[H_3O^+]$

$pOH = -\log[OH^-]$

$pK_w = -\log(K_w)$

$pK_a = -\log(K_a)$

$K_w = [H_3O^+][OH^-]$

$pK_w = pH + pOH$

$pH = pK_a + \log[A^-]/[HA]$

A few constants:

$K_w = 10^{-14}$

$pK_w = 14$

K_a values for a few acids

Acid	K_a	pK_a
HSO_4^-	1.2×10^{-2}	1.92
$HClO_2$	1.2×10^{-2}	1.92
H_3PO_4	7.5×10^{-3}	2.12
$CClH_2CO_2H$	1.35×10^{-3}	2.780
HF	7.2×10^{-4}	3.14
HNO_2	4.0×10^{-4}	3.40
CH_3CO_2H	1.8×10^{-5}	4.74
$[Al(H_2O)_6]^{3+}$	1.4×10^{-5}	4.85
$H_2PO_4^-$	6.2×10^{-8}	7.21
HOCl	3.5×10^{-8}	7.46
HCN	6.2×10^{-10}	9.21
NH_4^+	5.6×10^{-10}	9.25
HPO_4^{2-}	4.8×10^{-13}	12.32

1. (10 pts.) Determine the solubility of $BaCO_3$. For $BaCO_3$, $K_{sp} = 5.1 \times 10^{-9}$.

2. a. (6 pts.) Using the information provided below, determine the K for the following reaction.

$$Cu(OH)_2(aq) + 2\,H_3O^+(aq) \rightleftharpoons Cu^{2+}(aq) + 4\,H_2O(l)$$

$$2\,H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq) \qquad K_w = 10^{-14}$$

$$Cu(OH)_2(s) \rightleftharpoons Cu^{2+}(aq) + 2\,OH^-(aq) \qquad K_{sp} = 2.2 \times 10^{-22}$$

b. (6 pts.) Is $Cu(OH)_2$ considered soluble in water?

c. (4 pts.) Will $Cu(OH)_2$ dissolve in aqueous nitric acid? Explain.

3. a. (10 pts.) Determine the concentration of OH^- required to precipitate $Mg(OH)_2$ from a 0.105 M $Mg(NO_3)_2$ solution. For $Mg(OH)_2$ $K_{sp} = 8.9 \times 10^{-2}$.

4. A solution was made by combining 20.0 mL of a 0.0340 M KOH solution with 100.0 mL of a solution that has an initial NH_4Cl concentration of 0.100 M and an initial NH_3 concentration of 0.110 M.

(10 pts.) Determine the pH of the resulting solution, and make certain to write any balanced chemical equations that are needed to determine the pH.

5. (10 pts.) A solution was prepared by dissolving 0.10 mol of HCl and 0.10 mol of NaCl in 250 mL of water. Is this solution a buffer? Explain.

6. (10 pts.) Suggest two acid-base conjugate pairs that could be used to make a buffer that has a pH of approximately 7.3. Refer to the table on the cover page for a list of acids and K_a (pK_a) values.

7. The pH of a buffer (solution 1) that is 0.40 M in H_3PO_4 and 0.40 M in $H_2PO_4^-$ is the same as the pH of a buffer (solution 2) that is 0.10 M in H_3PO_4 and 0.10 M in $H_2PO_4^-$.

a. (6 pts.) Which of these solutions has a higher capacity for absorbing protons? Explain.

b. When 0.0010 mol of OH^- is added to 100 mL of each of the solutions described above, the pH of the solutions will change.

i. (4 pts.) Will the pH of the solutions decrease or increase? Explain.

ii. (4 pts.) The pH of which solution will change more?

8. (2 pts each) At the end of a titration, the following chemicals remained in solution. Will the solutions be acidic, basic, or neutral?

a. $KClO_3$

b. CH_3CO_2Na

c. NH_4NO_3

d. Na_2SO_4