Quiz Four CHM 205 (Dr. Mattson) 16 March 2004	Quiz:_____ / 50 A ≥ 46.5; B+ ≥ 43.5; B ≥ 41.0; C+ ≥ 37.5; C ≥ 34.00; D ≥ 30.00	Name:

Instructions: Show all work whenever a calculation is required! You will receive credit for how you worked each problem as well as for the correct answer. This exam is worth 50 points. Scores greater than 50 will be recorded as 50. BOX ANSWERS!

1. (3 pts) Write the balanced net ionic equation for the neutralization reaction of HF(aq) and NaOH(aq). Determine the numerical value for the equilibrium constant, K_n.

2. (3 pts) Write the balanced net ionic equation for the neutralization reaction of NH_3(aq), and HCl(aq). Determine the numerical value for the equilibrium constant, K_n.

3. (3 pts) Write the balanced net ionic equation for the neutralization reaction of HCl(aq) and NaOH(aq). Determine the numerical value for the equilibrium constant, K_n.

4. (5 pts) Which of the following will produce a buffer when dissolved in water? (Several possible)
   (a) 0.100 mol HCN and 0.080 mol NaCN
   (b) 0.100 mol NH_3 and 0.040 mol HNO_3
   (c) 0.100 mol $NaC_2H_3O_2$ and 0.040 mol NaOH
   (d) 0.100 mol $NaC_2H_3O_2$ and 0.040 mol HCl
   (e) 0.040 mol $NaC_2H_3O_2$ and 0.100 mol HCl

5. (3 pts) What is the molarity of a solution of HCl if it takes 16.98 mL of 0.1144 M NaOH(aq) to neutralize 25.00 mL of the acid to a phenolphthalein endpoint?

6. (3 pts) A buffer is prepared by dissolving 0.140 mol HF in water to make a1.0-L solution. To this solution 1.70-g of solid NaOH (MM = 40) was added. What is the pH?

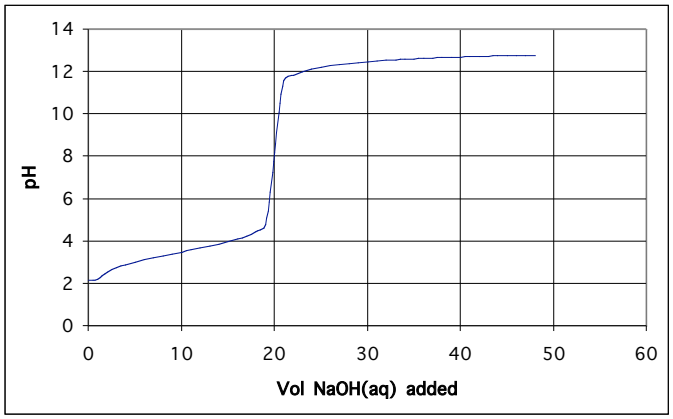
7. Consider a 500 mL buffer that is 0.40 M $HC_2H_3O_2$ and 0.60 M $NaC_2H_3O_2$

(a) (3 pts) What is the pH?

(b) (3 pts) What is the pH after the addition of 0.04 mol NaOH?

(c) (3 pts) Would the original buffer have a larger buffer capacity towards strong acid or base?

8. Consider the titration of 25.00 mL HA(aq) with 0.4500 M NaOH as shown below.



(a) (3 pts) Estimate from the plot K_a for HA.

(b) (4 pts) What sort of calculation would you use after each of the following volumes of base have been added? Write the appropriate letter, A - J as your aqnswer

0.00 mL OH^- added: _____

10.00 mL OH^- added: _____

20.00 mL OH^- added: _____

30.00 mL OH^- added: _____

A. Treat it as pure weak acid; use K_a.
B. Treat it as pure weak base; use K_b.
C. Treat it as excess strong acid; do not use K.
D. Treat it as excess strong base; use K_b and adjust for final volume (add volume of base + acid).
E. Treat it as pure weak acid; use K_a and adjust for final volume (add volume of base + acid).
F. Treat it as buffer problem; use K_a or K_b or Henderson Hasselbalch.
G. Treat it as excess strong acid; use K_a and adjust for final volume (add volume of base + acid).
H. Treat it as excess strong base; do not use K.
I. Treat it as pure weak base; use K_b and adjust for final volume (add volume of base + acid).
J. Treat it as pure weak base; use K_a and adjust for final volume (add volume of base + acid).

(c) (2 pts) How would the plot be different if HA were a stronger weak acid?

(d) (2 pts) How would the plot be different if the HA sample had a higher concentration?

9. The equilibrium constant, K_{sp}, for the $Ca(OH)_2$ is 1.3×10^{-6}

(a) (2 pts) Write the equilibrium expression here

(b) (2 pts) What is the molar solubility of $Ca(OH)_2$?

(c) (2 pts) What is the equilibrium concentration of Ca^{+2}?

(d) (2 pts) What is the equilibrium concentration of OH^-? What is the pH of the solution?

(e) (2 pts) What is the molar solubility of $Ca(OH)_2$ in a solution that is 0.40 M Ca^{+2}?

Dissociation Constants

Acids

Acetic acid, $HC_2H_3O_2$, $K_a = 1.8 \times 10^{-5}$

Hydrofluoric acid, HF, $K_a = 3.5 \times 10^{-4}$

Bases

Ammonia, NH_3, $K_b = 1.8 \times 10^{-5}$

Answers:

1. $HF + OH^- \rightleftharpoons H_2O + F^-$

$K_n = 1/K_b = K_a/K_w = 3.5 \times 10^{+10}$

2. $NH_3 + H_3O^+ \rightleftharpoons H_2O + NH_4^+$

$K_n = 1/K_a = K_b/K_w = 1.8 \times 10^{+9}$

3. $H_3O^+ + OH^- \rightleftharpoons 2\ H_2O$

$K_n = 1/K_w = 1.0 \times 10^{+14}$

4. a, b, and d

5. 7.77×10^{-2} M

6. pH = 3.10

7. (a) pH = 4.92; (b) pH = 5.07; (c) sa

8. $K_a = 3.2 \times 10^{-4}$; (b) A, F, I, H; (c) the pH slope of the buffer region would be lower; (d) it'd take more NaOH to equivalence the end point.

9. (a) $Ca(OH)_2 \rightleftharpoons Ca^{+2} + 2\ OH^-$

(b) 6.9×10^{-3} M

(c) 6.9×10^{-3} M

(d) 1.38×10^{-2}; pH = 12.14

(e) 9.0×10^{-4} M