

Exam Three
CHM 205 (Dr. Mattson)
20 March 2006

Academic Integrity Pledge:

In keeping with Creighton University's ideals and with the Academic Integrity Code adopted by the College of Arts and Sciences, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.

Signature:

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. **BOX YOUR ANSWERS!**

1. (5 pts) Which of the following would form a buffer solution? Circle all that apply.
- A. 30 mL 0.40 M NH_3 + 25 mL 0.25 M NH_4Cl
 - B. 30 mL 0.40 M NH_3 + 25 mL 0.25 M HCl
 - C. 30 mL 0.40 M HCl + 25 mL 0.25 M NH_3
 - D. 30 mL 0.40 M HCl + 25 mL 0.25 M NaOH
 - E. 30 mL 0.40 M NH_4Cl + 25 mL 0.25 M NaOH

2. (3 pts) What is the pH of the solution formed by pouring together 100 mL 0.25 M $\text{HC}_2\text{H}_3\text{O}_2$ and 100 mL 0.20 M $\text{NaC}_2\text{H}_3\text{O}_2$? [Given: $\text{pK}_a = 4.76$]

3. (3 pts) What is the pH of the solution formed by pouring together 100 mL 0.25 M $\text{HC}_2\text{H}_3\text{O}_2$ and 50 mL 0.20 M NaOH ? [Given: $\text{pK}_a = 4.76$]

4. (1 pts) Which buffer has the larger buffer capacity towards strong acid?
- A. The buffer in Question 2.
 - B. The buffer in Question 3.
 - C. They both have the same buffer capacity.

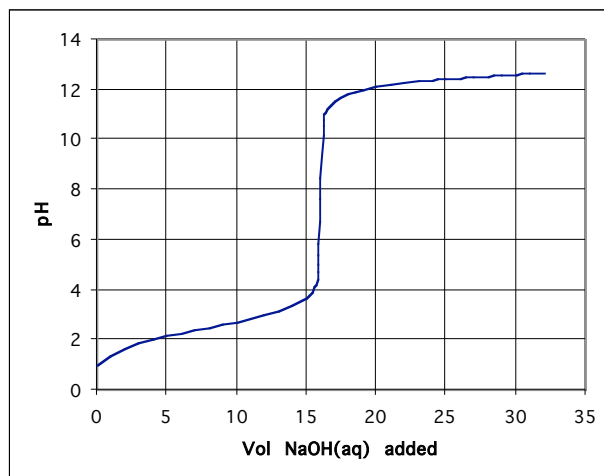
5. (3 pts) What pH would result if 0.005 mol NaOH were added to the solution in Question 2?

6. (1 pts) How would the pH change if the solution in Question 3 were diluted by the addition of 500 mL water? The pH would

A. increase B. remain the same C. decrease

7. (1 pts) How would the pH change if 0.15 mol $\text{NaC}_2\text{H}_3\text{O}_2$ were added to the solution in Question 3? The pH would

A. increase B. remain the same C. decrease



8. The titration curve above resulted when 20.00 mL of an unknown weak acid with a mass of 0.1147 g was titrated with 0.1000 M NaOH .

- 8a. (2 pts) What is the molarity of the original acid?

- 8b (2 pts) What is the molar mass of the acid?

- 8c (2 pts) What is the pK_a of the acid?

8d. (2 pt) *This is a continuation of Question 8.* What indicator would you suggest for this titration? In each case the color change is indicated.

- A. Indicator A, $pK_a = 4.2$ blue to colorless
- B. Indicator B, $pK_a = 6.6$ red to yellow
- C. Indicator C, $pK_a = 8.1$ blue to yellow
- D. Indicator D, $pK_a = 9.0$ colorless to red
- E. Indicator E, $pK_a = 11.4$ orange to colorless

9. Write the net ionic reaction that takes place in each case as an equilibrium expression and give its K_c in terms of K_a , K_b , and K_w .

9a. (2 pts) Strong acid with strong base.

9b. (2 pts) Weak acid HA with strong base.

9c. (2 pts) Weak base A- with strong acid.

10. A 25.00 mL sample of 0.200 M monoprotic weak acid was titrated with 0.140 M sodium hydroxide. From the titration curve, it was estimated that the pK_a of the acid was 4.30.

10a. (2 pts) What volume of base is required to reach the equivalence point?

10b. (2 pts) What is the predicted initial pH of the solution?

10c. (3 pts) What is the calculated pH after 25.00 mL base has been added?

10c. (3 pts) What is the calculated pH at the equivalence point?

11. (3 pts) What is the molar solubility of lead(II) chloride, $PbCl_2$ in water and what is the concentration of each ion? Given: $K_{sp} = 1.2 \times 10^{-5}$

12. (3 pts) Which of the following calcium salts is most soluble in water?

- A. $CaCO_3$ $K_{sp} = 5.0 \times 10^{-9}$
- B. CaF_2 $K_{sp} = 1.5 \times 10^{-10}$
- C. $Ca(OH)_2$ $K_{sp} = 4.7 \times 10^{-6}$
- D. $Ca_3(PO_4)_2$ $K_{sp} = 2.1 \times 10^{-33}$
- E. $CaSO_4$ $K_{sp} = 7.1 \times 10^{-5}$

13. (3 pts) What is the molar solubility of tin(II) hydroxide, $Sn(OH)_2$ in a solution with a pH = 9.00?

Given: $K_{sp} = 5.4 \times 10^{-27}$

14. (BONUS 1 point) Print your name here:

Your exam score (50 possible): _____

PrenHall (0 — 5 max.): _____

Adjusted exam score (50 max.): _____

Determine your grade:

A ≥ 46.5; B+ ≥ 43.5; B ≥ 41.0; C+ ≥ 37.5; C ≥ 34.00; D ≥ 30.00

Answers:

1. A, B and E

2. 4.66

3. 4.58

4. A

5. 4.86

6. B

7. A

8. (a) 0.08 M; (b) 72 g/mol; (c) 2.5; (d) D

9. (a) $\text{H}_3\text{O}^+ + \text{OH}^- \rightleftharpoons 2 \text{H}_2\text{O}$ $K_c = 1/K_w$

(b) $\text{HA} + \text{OH}^- \rightleftharpoons \text{H}_2\text{O} + \text{A}^-$ $K_c = 1/K_b = K_a/K_w$

(c) $\text{H}_3\text{O}^+ + \text{A}^- \rightleftharpoons \text{H}_2\text{O} + \text{HA}$ $K_c = 1/K_a = K_b/K_w$

10. (a) 35.7 mL; (b) 2.50; (c) 4.67; (d) 8.61

11. $x = 0.014 \text{ M}$; $[\text{Pb}^{+2}] = 0.014 \text{ M}$; $[\text{Cl}^-] = 0.028 \text{ M}$

12. C

13. $5.4 \times 10^{-17} \text{ M}$