

Exam Four
CHM 205 (Dr. Mattson)
18 March 2005

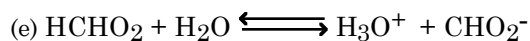
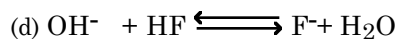
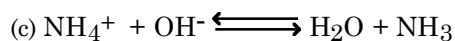
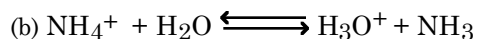
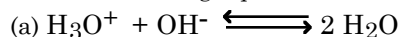
Academic Integrity Pledge:

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. (10 pts) Determine a numerical value for K for each of the following equilibria.



2. (4 pts) Which of the following activities will produce a buffer solution? Indicate "YES" or "NO"

(a) Adding 0.25 mol $\text{HC}_7\text{H}_6\text{O}_2$ (benzoic acid) with 44 g $\text{NaC}_7\text{H}_6\text{O}_2$ in water to make 1.0 L.

(b) Adding 0.08 mol $\text{NaC}_7\text{H}_6\text{O}_2$ to 200 mL 0.5 M HNO_3 .

(c) Adding 0.15 mol NaOH to 500 mL 1.0 M $\text{HC}_7\text{H}_6\text{O}_2$.

(d) Adding 20.0 g $\text{NaC}_7\text{H}_6\text{O}_2$ to 250 mL 0.10 M $\text{HC}_7\text{H}_6\text{O}_2$.

3. (3 pts) (a) What is the pH of a buffer solution prepared by mixing 200 mL 0.54 M nitrous acid with 300 mL 0.37 M sodium nitrite?

b. (2 pts) Would the buffer in above have a larger buffer capacity towards strong acid or strong base?

c. (2 pts) What is the pH that results after diluting the buffer by adding another 250 mL water?

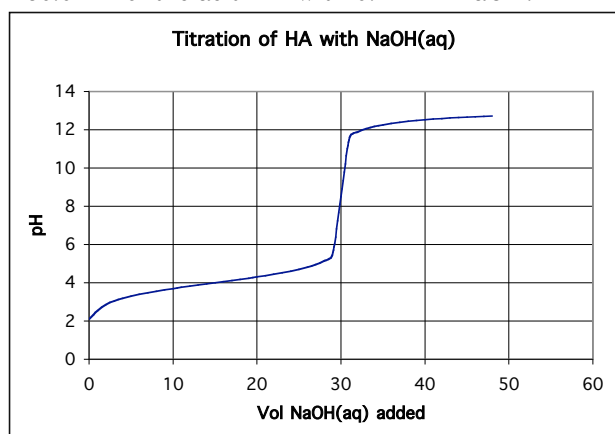
d. (3 pts) Suppose that 0.024 mol NaOH were added to the buffer. What is the resulting pH?

4. (a) (3 pts) What volume of 1.0 M HCl should be added to 50.0 mL 0.942 M sodium acetate in order to make a buffer with a pH of 5.00?

5. (3 pts) What is the molarity of a HIO_3 solution if it takes 45.3 mL of a 0.1434 M NaOH solution to neutralize 20.0 mL of the acid solution?

6. (3 pts) What is the expected pH after 45.0 mL 0.5050 M NaOH have been added to 40.0 mL 0.4227 M HBr?

7. The following titration curve is for the titration of 50.0 mL of the acid HA with 0.211 M NaOH:



(a). (2 pts) What is the molarity of the acid, HA?

(b) (2 pts) What is the K_a value for the acid? (You will use this value in subsequent parts of this question.)

(c) (3 pts) Calculate the pH after 20.0 mL hydroxide has been added.

(d) (3 pt) Calculate the pH after 40.0 mL hydroxide has been added.

(e) (3 pts) Calculate the pH at the equivalence point.

8. (2 pts) Sketch the titration curve expected for the titration of sulfurous acid with sodium hydroxide.

9. (2 pts) Suppose it took 24 mL 0.50 M NaOH to reach the first equivalence point in the titration of phosphoric acid. What is/are the dominant species present in solution after 36 mL NaOH have been added?

Dissociation Constants

Acetic acid, $\text{HC}_2\text{H}_3\text{O}_2$, $K_a = 1.8 \times 10^{-5}$

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

Formic acid, HCHO_2 , $K_a = 1.8 \times 10^{-4}$

Nitrous acid, HNO_2 , $K_a = 4.0 \times 10^{-4}$

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

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

(For DocM's use)

Your exam score (50 possible): _____

Bonus pts: Max: _____ Earned: _____

Total Score (50 maximum) _____

Determine your grade:

A \geq 46.5; B+ \geq 43.5; B \geq 41.0;

C+ \geq 37.5; C \geq 34.00; D \geq 30.00

Answers:

1.

a. $K_n = 1 \times 10^{+14}$

b. $K_a = K_w/K_b = 5.6 \times 10^{-10}$

c. $K_n = 1/K_b = 5.6 \times 10^{+4}$

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

e. $K_a = 1.8 \times 10^{-4}$

2. yes, no, yes, yes

3. 3.41; strong acid; unchanged (3.41); 3.60

4. 0.0168 L = 16.8 mL

5. 0.325 M

6. 12.89

7.

a. 0.127 M

b. $K_a = 1 \times 10^{-4}$

c. 4.30

d. 12.37

e. 8.45

8. diprotic acid will have two equivalence points

9. $H_2PO_4^-$, HPO_4^{2-} , and Na^+