

## Chem 103 Second Midterm Exam Guide

The test will mainly focus on material in Chapters 16 and 17. However, concepts learned in Chapt 15 will be specially

useful in this test. Study your lecture notes, Group quizzes and homework assignments. Expect to solve problems. Test

yourself by doing problems similar to the homework under time constraints. If you understand the concepts fully, you should be able to do any one of these problems within 10-15 minutes. If not, you need to study and practice further to improve your speed and test taking skills.

The following topics are mentioned to help focus (but not limit) your review:

### Chapter 16-17 Acid base equilibria:

Know the following: Arrhenius and Bronsted definitions of acids and bases, strength of acids, Buffers. Acid base titrations.

Determination of pH at various points in a titration. Indicators, solubility and complex formation equilibria. Chelation.

The following questions are designed to drill you in problem solving for your review. Please don't limit yourself to this review.

Read the chapter well and know the core concepts well. Look at problems from different angles.

(1) What is the pH of a 0.00010 M HNO<sub>3</sub> solution?

(2) What is the pH of a 0.00010 M NaOH solution?

(3) What is the pH of a solution made up by adding 100. mL of .00010 M HCl to 50.0 mL of 1.0 x10<sup>-4</sup> M NaOH?

(4) What is the pH of a solution made up by adding 100. mL of 1.0 x10<sup>-4</sup> M NaOH to 50. mL of .00010 M HCl?

(5) What is [H<sup>+</sup>] in a solution made up by mixing 1.0 mL 1.0 M HCl and 99.0 mL water?

(6) What is the [H<sup>+</sup>] in a solution of 0.10 M HOAc (acetic acid, K<sub>a</sub> = 1.8 x 10<sup>-5</sup>)?

(7) What is the pH of a solution of 0.10 M NaOAc (K<sub>a</sub> = 1.8 x 10<sup>-5</sup>M for HOAc)?

(8) What is the pOH of a solution of 0.10 M NH<sub>3</sub> (ammonia, K<sub>b</sub> = 1.8x 10<sup>-5</sup> M)?

(9) What is the pH of a solution containing 1.0x10<sup>-3</sup> M NH<sub>3</sub> and .020M NH<sub>4</sub>Cl?

(10) what is the [H<sup>+</sup>] of a solution containing acetic acid and a pH of 3.56?

(11) What is the [OH<sup>-</sup>] of a solution containing a pH of 3.0?

(12) A weak acid has a K<sub>a</sub> = 1.0x10<sup>-4</sup>. What is its pK<sub>a</sub>?

(13) A weak acid has a K<sub>a</sub> = 1.0x10<sup>-4</sup>. What is the K<sub>b</sub> for its conjugate base?

(14) A weak acid has a K<sub>a</sub> = 1.0x10<sup>-4</sup>. What is the pK<sub>b</sub> for its conjugate base?

(15) A diprotic acid, H<sub>2</sub>A, has pK's 8.4 and 3.5. What is the K<sub>a</sub> of H<sub>2</sub>A?

(16) A diprotic acid, H<sub>2</sub>A, has pK's 8.4 and 3.5. What is the pK<sub>b1</sub>?

(17) A diprotic acid, H<sub>2</sub>A, has pK's 8.4 and 3.5. Write the chemical equilibrium and value for K<sub>b1</sub>.

(18) A 22.5 mL HCl solution requires 18.5 mL of 0.15 M KOH to reach equivalence. What is [HCl]<sub>o</sub>?

(19) A 22.5 mL of H<sub>2</sub>SO<sub>4</sub> solution requires 18.5 mL of 0.15 M KOH for complete neutralization. What is [H<sub>2</sub>SO<sub>4</sub>]<sub>o</sub>?

(20) Draw the qualitative pH titration curve for problems (18) and (19). (pK<sub>a</sub> for HSO<sub>4</sub> is 2.0).

(21) Titration of 0.394g of sulfamic acid takes 20.mL of 0.10 M HCl to reach equivalence. What is the MW of sulfamic

a.?

- (22) A diprotic acid, H<sub>2</sub>A, has pK's 8.4 and 3.5. 50.0 mL of 0.10M of the diprotic acid, H<sub>2</sub>A, is titrated with 0.20 M NaOH. What is the V<sub>e</sub> (i.e. the first equivalence point)?
- (23) A diprotic acid, H<sub>2</sub>A, has pK's 8.4 and 3.5. 50.0 mL of 0.10M of the diprotic acid, H<sub>2</sub>A, is titrated with 0.20 M NaOH. What is the pH at the following volumes of NaOH added: 0 , 2.0 mL, 12.5 mL, 25.0 mL, 30.0 mL, 37.5 mL. 50.0 mL. 56.0 mL
- (24) A diprotic acid, H<sub>2</sub>A, has pK's 8.4 and 3.5. 50.0 mL of 0.10M of the diprotic acid, H<sub>2</sub>A, is titrated with 0.20 M NaOH. Draw the pH titration curve. Below it, show the fractions, α, of the acid present.
- (25) Suppose that the concentration of bromide ions is 7.3x10<sup>-7</sup>M in a solution saturated with AgBr. What is the K<sub>SP</sub> of AgBr?
- (26) What is the solubility of Ag<sub>2</sub>CO<sub>3</sub> (pK<sub>sp</sub> = 11.07) in pure water?
- (27) What is the solubility of Ag<sub>2</sub>CO<sub>3</sub> (pK<sub>sp</sub> = 11.07) in 0.10 M K<sub>2</sub>CO<sub>3</sub>?
- (28) What is the solubility of Ca(OH)<sub>2</sub> (pK<sub>sp</sub>=5.30) in pH 13 buffer?
- (29) Go over Example 17-16 to practice K<sub>f</sub> equilibria.
- (30) What is the fraction of acetate, α<sub>OAc<sup>-</sup></sub>, in a 1.0M HOAc –NaOAc buffer whose pH is 4.4? (pK<sub>a</sub>=4.75 for HOAc)
- (31) If [HOAc] = 0.500 M in a pH 5.00 acetic acid-sodium acetate buffer, what is [OAc<sup>-</sup>]?
- (32) A solution containing a weak monoprotic acid, HX, of unknown K<sub>a</sub> is prepared as follows: 50.0 mL of 0.10 M NaOH is added to 20. mL of 0.40M HX resulting in a solution of pH 3.50. What is the K<sub>a</sub> of HX?
- (33) 1.70 g of a weak base, B (pK<sub>b</sub> = 11.00) is dissolved in 35.0 mL of 0.20 M HCl, resulting in a pH 2.73 solution. What is the molecular weight of B?
- (34) Determine the solubility of PbCl<sub>2</sub> (pK<sub>sp</sub>= 4.77) in pure water.
- (35) Determine the solubility of CuCl (pK<sub>sp</sub>= 6.76) in 1.00 x 10<sup>-3</sup>M NaCl. Use quadratic formula if appropriate. (compare your 2 answers : one with short cut and the other using the quadratic equation).