General Chemistry II - CHEM 112
SAMPLE EXAM II pg. 1/6

Name (Printed): Section:

Instructions: This test is closed book and closed notes. Calculators are also allowed, although pre-prepared programs, integration and equation solving routines are not. Credit is dependent on showing all steps in the calculation on this test. Clearly state any assumptions or approximations you use to solve the problems. (5 problems, 100 pts)

R = 8.31441 J/K*mol

R = 0.08206 L*atm/K*mol

1 atm = 760 Torr

0 ^{o}C = 273.15 K

N_A = 6.022x10^{23} mol

1 m = 100 cm = 1000 mm = 10^6 mm = 10^9 nm = 10^{10} Å

density of water: ρ = 1.00 g/ml = 1.00 kg/L

$[H_3O^+][OH^-] = 1x10^{-14} = K_w$

$pH + pOH = 14 = pK_w$

$pH = -\log[H_3O^+]$ $[H_3O^+] = 10^{-pH}$

$pOH = -\log[OH^-]$ $[OH^-] = 10^{-pOH}$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

$$K_b = \frac{[B^+][OH^-]}{[BOH]} \text{ or } \frac{[HA][OH^-]}{[A^-]}$$

$$pH = pK_a + \log\frac{[Base]}{[Acid]}$$

$$pH = pK_a + \log\frac{n_b}{n_a}$$

if $ax^2 + bx + c = 0$, then $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

1.) pH of the 0.02M solution of potassium hypoiodate (KOI) is 11.44. Calculate K_a of hypoiodic acid (HOI). (12 pts)

2.) How many mL of a 0.2 M HCl must be added to 50 mL of 0.3M $Ba(OH)_2$ to get a pH of 7.00?) (12 points)

3.) Calculate a change in pH when 10 mL of 0.2 M LiOH is added to the 100 mL of buffer containing 0.1 M hydrobromous acid (HOBr) and 0.2 M of sodium hydrobromide (NaOBr). K_a of HOBr = 2.0×10^{-9}. (15 points)

4.) Titration: This is a multistep problem.

Calculate the pH for the titration of 100 mL of 0.10 M NH_3, $K_b = 1.8 \times 10^{-5}$, with 0.25 M HBr.

a) (10 points) Before any acid is added.

b) (12 points) After 30 mL of acid is added.

c) (15 points) After 40 mL of acid is added

d) (12 points) After 60 mL of acid is added

5.) 5. Multiple choice (4 questions, 12 pts)

A.) In the unusual acid-base reaction $HClO_4 + H_2SO_4 \rightleftharpoons ClO_4^- + H_3SO_4^+$, one of the conjugate acid-base pairs is:

a. $HClO_4$, H_2SO_4
b. H_2SO4, ClO_4^-
c. ClO_4-, $H_3SO_4^+$
d. $H_3SO_4^+$, H_2SO4
e. $HClO_4$, $H_3SO_4^+$

B.) Consider the following Bronsted-Lowry acid-base reaction:

$C_6H_5NH_2 + HCOOH \rightleftharpoons C_6H_5NH_3^+ + HCOO^-$

Which of the following is a conjugate acid-base pair?

a. $C_6H_5NH_2$ and HCO_2H
b. HCOOH and $C_6H_5NH_3^+$
c. $HCOO^-$ and $C_6H_5NH_2$
d. $C_6H_5NH_3^+$ and $C_6H_5NH_2$
e. $C_6H_5NH_3^+$ and $HCOO^-$

C.) Which aqueous solution(s) below is(are) considered *basic*?

I. A solution with a pH = 6
II. A solution with $[OH^-] = 1x10^{-7}$
III. A solution with $[H_3O^+] = 1x10^{-9}$

a. I only
b. II only
c. III only
d. I and II
e. I and III

D.) After completing the following *unfinished* Base Ionization table, what is the order of *increasing base strength*?

Base	K_b	pK_b
Bicarbonate ion, HCO_3^-	2.2×10^{-8}	
Pyridine, C_5H_5N		8.77
Acetate ion, CH_3COO^-	5.7×10^{-10}	

a. (weakest) Bicarbonate ion < Pyridine < Acetate ion (strongest)
b. (weakest) Bicarbonate ion < Acetate ion < Pyridine (strongest)
c. (weakest) Pyridine < Bicarbonate ion < Acetate ion (strongest)
d. (weakest) Acetate ion < Pyridine < Bicarbonate ion (strongest)
e. (weakest) Acetate ion < Bicarbonate ion < Pyridine (strongest