CHEM 188 – Spring, 2013

Hour Exam 3 (Early)

April 3, 2013

Instructions:

Your scantron answer sheet must show your **NAME**, **7-DIGIT KU ID NUMBER**, and **LAB SECTION**. (Begin these entries at the LEFT end of the space provided.) In answering the questions, be careful to fill in the corresponding circles on the answer sheet according to the number of the question on the exam. **USE A SOFT (No. 2) PENCIL**.

Note that a **periodic table** of the elements is attached at the end of the exam.

Useful information:

Henderson-Hasselbalch eqn. $\mathbf{pH = pK_a + \log \frac{[conj.\,base]}{[acid]}}$

Quadratic formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Gas constant **R = 8.314 J□K□1□mol□1 = 0.0821 L□atm□K□1□mol□1**

Boltzmann constant **k = 1.38 × 10□23 J□K□1**

Conversion factor: **1 L□atm = 101.3 J**

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1. Assuming equal concentrations of conjugate base and acid, which one of the following mixtures is suitable for making a **buffer solution** with an initial pH of 7.4□7.5?

   A. CH_3COONa / CH_3COOH ($K_a = 1.8 \square 10^{\square 5}$)
   B. NH_3 / NH_4Cl ($K_a = 5.6 \square 10^{\square 10}$)
   C. NaOCl / HOCl ($K_a = 3.2 \square 10^{\square 8}$)
   D. $NaNO_2$ / HNO_2 ($K_a = 4.5 \square 10^{\square 4}$)
   E. NaCl / HCl

2. A solution is prepared by mixing 500. mL of 0.050 M NaOCl and 500. mL of 0.20 M HOCl. What is the **pH** of this solution? K_a(HOCl) = 3.2 x 10^{-8}.

   A. 6.89 B. 7.19 C. 7.49 D. 7.80 E. 8.10

3. You are asked to prepare an acetic acid - sodium acetate buffer solution with a pH of 5.00. What **molar ratio of CH_3COONa to CH_3COOH** should be used? [K_a = 1.8 x $10^{\square 5}$ for CH_3COOH]

   A. 3.2 B. 1.8 C. 0.57 D. 0.32 E. 0.18

4. You have 500.0 mL of a buffer solution containing 0.30 M benzoic acid (C_6H_5COOH) and 0.30 M sodium benzoate (C_6H_5COONa). What will the **pH** of this solution be after the addition of 75.0 mL of 1.00 M NaOH solution? [$K_a(C_6H_5COOH) = 6.5 \times 10^{-5}$]

A. 4.33 B. 4.49 C. 4.67 D. 4.89 E. 5.23

5. For which **type of titration** will the pH be <u>greater than 7.0</u> at the equivalence point?

A. strong acid vs. strong base
B. strong acid vs. weak base
C. weak acid vs. strong base
D. all of the above
E. none of the above

6. For hypochlorous acid, HOCl, $K_a = 3.2 \times 10^{-8}$, what is the **equilibrium constant** value for the reaction?

$$OCl^-(aq) + HCl(aq) \rightarrow HOCl(aq) + Cl^-$$

A. 3.2×10^{-22} B. 3.1×10^{-7} C. 3.2×10^{6} D. 3.1×10^{7} E. 3.1×10^{21}

7. Calculate the **pH at the equivalence point** for the titration of 100. mL of 1.00 M NH_3 with 0.10 M HCl. [$(K_b(NH_3) = 1.8 \times 10^{-5})$]

A. 5.15 B. 5.20 C. 5.28 D. 5.37 E. none of these

8. Calculate the **pH of the solution** resulting from the addition of 40.0 mL of 0.10 M KOH to 50.0 mL of 0.10 M HNO_2 (nitrous acid, $K_a = 4.5 \times 10^{-4}$).

A. 2.74 B. 3.17 C. 3.35 D. 3.52 E. 3.95

9. A saturated solution of $PbBr_2$ is found to have a Br^- concentration of 0.023 M. What is the value of $\mathbf{K_{sp}}$ for this compound?

A. 6.1×10^{-6} B. 1.2×10^{-5} C. 4.9×10^{-5}
D. 2.6×10^{-4} E. 2.3×10^{-2}

10. The pH of a saturated solution of $Fe(OH)_2$ is 9.50. What is the value of $\mathbf{K_{sp}}$ for this compound?

A. 1.7×10^{-18} B. 4.0×10^{-15} C. 1.6×10^{-14}
D. 2.5×10^{-10} E. 1.6×10^{-5}

11. The solubility product for bismuth sulfide, Bi_2S_3, is $K_{sp} = 1.6 \times 10^{-72}$. What is the **molar solubility**, **s**, of bismuth sulfide?

A. 1.6×10^{-72} M B. 1.3×10^{-36} M C. 7.4×10^{-25} M

D. 4.9×10^{-19} M E. 1.7×10^{-15} M

12. What is the **pH** of a saturated calcium hydroxide solution? [$K_{sp} = 8.0 \times 10^{-6}$ for $Ca(OH)_2$]

A. 7.55 B. 9.50 C. 10.46 D. 11.23 E. 12.40

13. The solubility product for MgF_2 is $K_{sp} = 8.0 \times 10^{-8}$. Calculate the **molar solubility, s**, of MgF_2 in a solution that is 5.0×10^{-3} M in $Mg(NO_3)_2$.

A. 1.0×10^{-4} M B. 2.0×10^{-4} M C. 1.4×10^{-3} M

D. 2.0×10^{-3} M E. 4.5×10^{-3} M

14. Given that $K_{sp} = 1.3 \times 10^{-33}$ for aluminum (III) hydroxide, $Al(OH)_3$, calculate the **molar solubility** of this compound in a solution buffered at a pH of 4.50.

A. 4.1×10^{-5} M B. 7.3×10^{-6} M C. 1.3×10^{-6} M

D. 2.3×10^{-7} M E. 4.1×10^{-8} M

15. Given the following data,

$K_{sp}[CuS] = 6.0 \times 10^{-37}$

$K_f[Cd(CN)_4^{2-}] = 1.0 \times 10^{25}$

Calculate the **molar solubility, s,** of copper(II) sulfide, CuS, in 0.50 M NaCN.

A. 7.7×10^{-19} M B. 6.1×10^{-7} M C. 2.4×10^{-6} M

D. 9.8×10^{-6} M E. 3.9×10^{-5} M

16. Calculate **w**, the work done on the system, when 18.0 g of $H_2O(l)$ evaporates at 1.00 atm and 25°C. (Assume that the initial volume of $H_2O(l)$ is negligible, and that $H_2O(g)$ behaves as an ideal gas.)

A. –2480 J B. –24.4 J C. 0 J D. +24.4 J E. +2480 J