CHEM 188 – Spring, 2013

Hour Exam 2 (Red)

March 7, 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**

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

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

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1. Identify an acid-base **conjugate pair** in the following reaction:

$$H_2PO_4^- + NH_3 \rightleftharpoons HPO_4^{2-} + NH_4^+$$

A. $H_2PO_4^-$ (acid) and NH_4^+ (base)

B. $H_2PO_4^-$ (acid) and HPO_4^{2-} (base)

C. NH_4^+ (acid) and HPO_4^{2-} (base)

D. HPO_4^{2-} (acid) and NH_3 (base)

E. $H_2PO_4^-$ (acid) and NH_3 (base)

2. Calculate the **pH** of a solution in which the hydroxide ion concentration is $4.8 \times 10^{\square 5}$ M.

A. 2.68 B. 4.32 C. 5.97 D. 9.68 E. 11.32

5. What is the **hydroxide ion concentration** (to the correct number of significant figures) in a solution whose pOH is 2.909?

A. 1×10^{-3} M B. 1.2×10^{-3} M C. 1.23×10^{-3} M

D. 1.233×10^{-3} M E. 1.2331×10^{-3} M

4. Which of the following statements is(are) **false** for a 0.10 M solution of a weak acid, HA?

1. The pH = 1.00
2. The pH > 1.00
3. $[H^-] > [HA]$
4. $[H^-] = [A^-]$

A. 2 only B. 3 only C. 1 & 3 D. 2 & 4 E. none of the above

5. Which answer correctly lists all of the **strong acids** from the following list?

1. HNO_2 (nitrous acid)
2. HCl (hydrochloric acid)
3. H_2SO_4 (sulfuric acid)
4. HBr (hydrobromic acid)
5. HCOOH (formic acid)

A. 1, 2 & 4 B. 2 & 3 C. 2, 3 & 4 D. 1 & 5 E. 1, 2, 3 & 4

6. Calculate the **pH** of 0.020 M $Ba(OH)_2$.

A. 1.40 B. 2.30 C. 12.30 D. 12.60 E. 12.90

7. The K_a for hydrocyanic acid (HCN) is 4.9×10^{-10}. Calculate the **pH** of a 0.0010 M HCN solution.

A. 5.15 B. 5.31 C. 5.65 D. 5.81 E. 6.15

8. The K_a for nitrous acid, HNO_2, is 4.5×10^{-4}. Calculate the **pH** of a 2.5×10^{-4} M HNO_2 solution.

A. 3.47 B. 3.52 C. 3.67 D. 3.75 E. 4.07

9. Calculate the **pH** of a 100. mL aqueous solution prepared by dissolving 1.0 g of hydrocyanic acid (HCN) in water. [$K_a = 4.9 \times 10^{-10}$ for HCN]

A. 4.57 B. 4.87 C. 5.17 D. 5.47 E. 5.77

10. The pH of a 0.25 M weak monoprotic acid (HA) solution is 3.90. What is the $\mathbf{K_a}$ value for this acid?

A. 6.3×10^{-8} B. 4.0×10^{-7} C. 1.3×10^{-6}

D. 4.0×10^{-6} E. 1.3×10^{-5}

11. Calculate the **percent ionization** of formic acid (HCOOH) in 250 mL of an aqueous solution containing 1.25 g of HCOOH. [$K_a = 1.7 \times 10^{-4}$ for formic acid.]

A. 2.0% B. 3.9% C. 7.2% D. 15% E. none of the above

12. Estimate the **original molarity** of a solution of acetic acid ($K_a = 1.8 \times 10^{-5}$) whose pH is 2.42?

A. 0.060 *M* B. 0.24 *M* C. 0.40 *M* D. 0.80 *M* E. 1.2 *M*

13. How many **grams** of nitrous acid, HNO_2, are required to make 750 mL of an aqueous solution with a pH of 2.35? ($K_a = 4.5 \times 10^{-4}$ for nitrous acid.)

A. 1.1 g B. 1.7 g C. 2.7 g D. 4.2 g E. 6.5 g

14. Ammonia has a base ionization constant, $K_b = 1.8 \times 10^{-5}$. Calculate the **pH** of a 9.0×10^{-2} M solution of NH_3.

A. 3.02 B. 4.37 C. 9.63 D. 12.70 E. 11.10

15. Methylamine (CH_3NH_2) is a weak base, with $K_b = 4.4 \times 10^{-4}$. Calculate the **pH** of a 0.0050 M solution of CH_3NH_2.

A. 10.68 B. 10.82 C. 11.11 D. 11.17 E. 11.28

16. The pH of a 0.10 M solution of a weak base is 10.00. What is the $\mathbf{K_b}$ of this base?

A. 1.0×10^{-10} B. 1.0×10^{-9} C. 1.0×10^{-8}
D. 1.0×10^{-7} E. 1.0×10^{-6}

17. What is the **original concentration** of a solution of ammonia ($K_b = 1.8 \times 10^{-5}$) whose pH is 10.98?

A. 0.010 M B. 0.050 M C. 0.10 M D. 0.25M E. 0.50 M

18. Acid strength <u>increases</u> in the series: (weakest) C_6H_5OH, CH_3COOH, HNO_2, to HF (strongest). Which of the following is the **weakest base**?

A. $C_6H_5O^-$ B. CH_3COO^- C. NO_2^- D. F^- E. none are bases

19. For nitrous acid, HNO_2, $K_a = 4.5 \times 10^{-4}$. What is the **equilibrium constant** value for the reaction?

$$NO_2^-(aq) + H_2O(aq) \rightarrow HNO_2(aq) + OH^-$$

A. 4.5×10^{-18} B. 2.2×10^{-11} C. 4.5×10^{10} D. 2.2×10^{17} E. none of the above

20. Oxalic acid ($C_2H_2O_4$) is a **diprotic acid**. Its two stages of ionization are: