

**CHEMISTRY 102****EXAM 3 FORM D****SECTION 502****FALL 2008****DR. KEENEY-KENNICUTT**

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- Directions: (1) Put your name on PART 1 and your name and signature on PART 2 of the exam where indicated.
- (2) Sign the Aggie Code on PART 2 of this exam.
- (3) Each multiple choice question is actually 2 questions on your scanning sheet. If you are sure of an answer, **put the same answer down for both questions** for 5 pts. If you cannot decide between two answers, put your best answer down for the first (odd) question and the other answer down for the second (even) question. If you get the first one correct you'll get 3 pts; if you get the second one correct you'll get 2 pts. If there is an ambiguous multiple choice question, use the last page to explain your answer.
- (4) Do NOT write on the envelope.
- (5) When finished, put everything in the envelope and wait to be excused. At the table, take everything out of the envelope. You can pick up the multiple choice part with the answers outside my office after 3pm.
- (6) There are a total of 33 questions (19 actual questions).
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**PART 1**

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**1&2.** A 0.10 M solution of which one of the following salts has a pH greater than 7?

- (a) KBr            (b)  $\text{CH}_3\text{NH}_3\text{Cl}$             (c)  $\text{Ba}(\text{NO}_3)_2$             (d)  $\text{KClO}$             (e)  $\text{NH}_4\text{Cl}$

**3&4.** Which one of the following acids is NOT a strong acid?

- (a)  $\text{HNO}_3$             (b)  $\text{HClO}_3$             (c)  $\text{HClO}_4$             (d)  $\text{HCl}$             (e)  $\text{HF}$

**5&6.** The conjugate acid of  $\text{HF}$  is:

- (a)  $\text{H}_2\text{F}^+$             (b)  $\text{OH}^-$             (c)  $\text{F}^-$             (d)  $\text{H}_3\text{O}^+$             (e) none of these

**7&8.** The acid-base indicator,  $\text{HIn}$ , has a  $K_a$  value of  $1.0 \times 10^{-8}$ . The endpoint for any titration using this indicator will occur at  $\text{pH} = \underline{\hspace{2cm}}$ :

- (a) 7            (b) 10            (c) 6            (d) 8            (e) 13

**9&10.** Which of the following combinations are buffer solutions? All components are present in 0.50 M concentrations.

(1)  $\text{HNO}_3$  and  $\text{NH}_4\text{NO}_3$     (2)  $\text{HClO}_3$  and  $\text{NaClO}_3$     (3)  $\text{HCN}$  and  $\text{NaCN}$     (4)  $\text{NH}_3$  and  $\text{NH}_4\text{Cl}$

(a) 1, 3, 4      (b) 1, 2      (c) 2, 3, 4      (d) 3, 4      (e) 1, 3

**11&12.** Consider 0.1 M solutions of the following weak acids:

$\text{CH}_3\text{COOH}$        $K_a = 1.8 \times 10^{-5}$

$\text{HBrO}$        $K_a = 2.5 \times 10^{-9}$

Which of the following statements is **NOT** correct?

- (a) Acetic acid is a stronger acid than hypobromous acid.
- (b) The concentration of  $\text{OH}^-$  ions is greater in the  $\text{HBrO}$  solution.
- (c)  $[\text{BrO}^-]$  in  $\text{HBrO}$  solution  $>$   $[\text{CH}_3\text{COO}^-]$  in  $\text{CH}_3\text{COOH}$  solution.
- (d)  $[\text{H}^+]$  in  $\text{CH}_3\text{COOH}$  solution  $>$   $[\text{H}^+]$  in  $\text{HBrO}$  solution.
- (e) The pH of the  $\text{CH}_3\text{COOH}$  solution is lower than the pH of the  $\text{HBrO}$  solution.

**13&14.** A 0.20 M solution of a monoprotic acid is 3.7% ionized. What is the  $K_a$  for this weak acid?

(a)  $1.3 \times 10^{-3}$     (b)  $3.7 \times 10^{-4}$     (c)  $3.2 \times 10^{-6}$     (d)  $2.9 \times 10^{-5}$     (e)  $2.7 \times 10^{-4}$

**15&16.** What is the pH of a  $8.2 \times 10^{-4}$  M HCl?

- (a) 2.35      (b) 4.51      (c) 4.72      (d) 3.09      (e) 3.17

**17&18.** It is desired to buffer a solution at pH = 10.3.

What molar ratio of  $\text{CH}_3\text{NH}_2$  to  $\text{CH}_3\text{NH}_3\text{Cl}$  should be used?.

- (a) 0.88/1      (b) 0.70/1      (c) 0.12/1      (d) 2.8/1      (e) 0.40/1

**19&20.** Calculate the  $\Delta G^\circ$  for the reaction at  $25^\circ\text{C}$  if the value of the thermodynamic equilibrium constant,  $K_{\text{thermo}}$ , is  $1.00 \times 10^{-2}$ ? ( $R = 8.314 \text{ J/mol}\cdot\text{K}$ )

- (a)  $-5.4 \text{ kJ/mol}$       (b)  $+11.4 \text{ kJ/mol}$       (c)  $+5.4 \text{ kJ/mol}$   
(d)  $+95.7 \text{ kJ/mol}$       (e)  $-11.4 \text{ kJ/mol}$

**21&22.** If  $K_w$  is  $2.9 \times 10^{-15}$  at  $10^\circ\text{C}$ , what is the pH of pure water at  $10^\circ\text{C}$ ?

- (a) 6.51      (b) 7.00      (c) 7.27      (d) 7.45      (e) none of these

**23&24.** What is the pH of a solution that is 0.25 M  $\text{NH}_4\text{NO}_3$ ?

- (a) 4.93      (b) 5.50      (c) 9.16      (d) 4.32      (e) 7.00

**The following 5 questions (25 – 31) deal with a single titration:**

**25&26.** A 50.0 mL sample of 0.100 *M* nitrous acid is titrated with 0.200 *M* NaOH. Calculate the initial pH before the titration is begun. The  $K_a$  for nitrous acid is on the back of the envelope.

- (a) 2.17      (b) 1.58      (c) 1.00      (d) 2.39      (e) 2.04

**27&28.** A 50.0 mL sample of 0.100 *M* nitrous acid is titrated with 0.200 *M* NaOH. Calculate the pH after 10.0 mL of 0.200 *M* NaOH has been added.

- (a) 2.92      (b) 3.17      (c) 3.00      (d) 3.52      (e) 3.66



## PART 2

Please read and sign: "On my honor, as an Aggie, I have neither given nor received unauthorized aid on this exam." \_\_\_\_\_

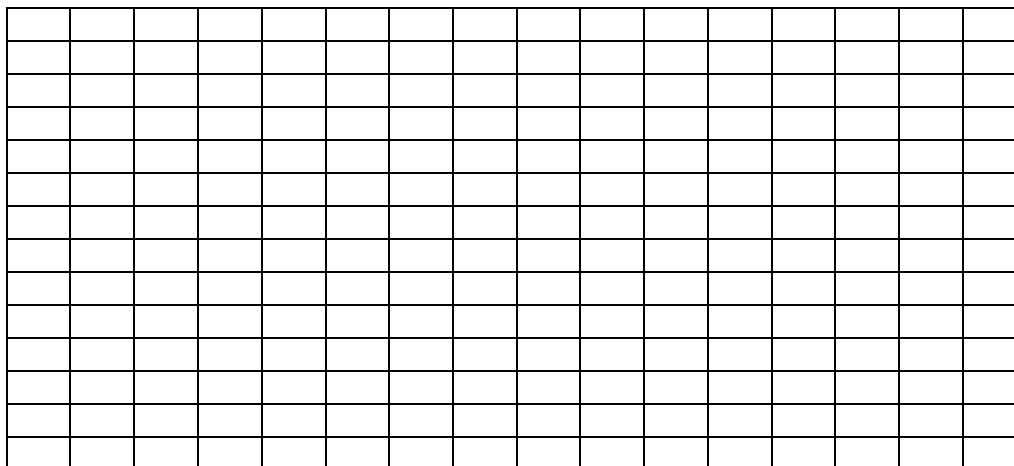
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(5 pts) **29.** A 50.0 mL sample of 0.100 *M* nitrous acid is titrated with 0.200 *M* NaOH. Calculate the pH at the equivalence point.

(5 pts) **30.** A 50.0 mL sample of 0.100 *M* nitrous acid is titrated with 0.200 *M* NaOH. Calculate the pH after 30.0 mL of 0.200 *M* NaOH is added.

- (5 pts) **31.** A 50.0 mL sample of 0.100 M nitrous acid is titrated with 0.200 M NaOH. Using the answers to Questions 21-26, sketch the titration curve with pH on the vertical axis and milliliters of base added on the horizontal axis. Label the axes and plot your 4 points. Point out the buffer region and the equivalence point. If you cannot complete the calculations, sketch what the curve should look like for partial credit.



- (5 pts) **32.** (a) All solutions of soluble salts and bases will become saturated if the concentrations are high enough. Write the appropriate equilibrium and the  $K_{sp}$  expression for  $\text{CuF}_2(\text{s})$ .
- (5 pts) (b) If 47.0 grams of  $\text{CuF}_2$  will dissolve in 1.00 L of solution at  $25^\circ\text{C}$ , what is the  $K_{sp}$  for  $\text{CuF}_2$  at  $25^\circ\text{C}$ ?

(5 pts) **33.** A solution is prepared by mixing 1.00 mol of  $\text{NH}_4\text{Cl}$  and 2.00 mol of  $\text{NH}_3$  in a 1.00 liter container.  
To 100. mL of this solution is added 40.0 mL of 1.00 M HCl. What is the pH of this new solution?



# SCRAP PAPER OR COMMENTS ON EXAM

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**CHEMISTRY 102**  
EXAM 3 Form D

**Fall 2008**  
Section 502

NAME \_\_\_\_\_

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