NAME

CHEMISTRY 102 EXAM 3 FORM A SECTION 501

FALL 2010 DR. KEENEY-KENNICUTT

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 36 questions (20 actual questions).

PART 1

1&2. The compound, HCIO is a:______.

- (a) strong acid (b) strong base (c) weak acid (d) weak base (e) neutral
- **3&4.** Consider the titrations of the pairs of aqueous acids and bases listed at the left. For which pair is the pH at the equivalence point stated INCORRECTLY?

Acid-Base Pair	pH at Equivalence Point
(a) HF + NaOH	less than 7
(b) $HNO_3 + Ca(OH)_2$	equal to 7
(c) CH ₃ COOH + KOH	more than 7
(d) HCI + NH ₃	less than 7
(e) HClO ₄ + NaOH	equal to 7

5&6. The hydrolysis constant used when finding the pH of a solution of NaCN is:

(a)
$$\frac{K_{a} \text{ for HCN}}{K_{b} \text{ for CN}^{-}}$$
 (b) $\frac{K_{a} \text{ for HCN}}{K_{w}}$ (c) $\frac{K_{w}}{K_{a} \text{ for HCN}}$
(d) $\frac{K_{a} \text{ for Na}^{+}}{K_{w}}$ (e) $\frac{K_{w}}{K_{a} \text{ for Na}^{+}}$

7&8. Which will be a buffer when equal volumes of the following solutions are mixed?

- (a) 0.1 M HClO $_3$ and 0.2 M NaClO $_3$
- (b) 0.1 M NaOH and 0.1 M NaF
- (c) 0.1 M HCl and 0.2 M NaCl
- (d) 0.1 M HCN and 0.2 M NaCN
- (e) 0.1 M NH $_3$ and 0.1 M NaCl
- **9&10.** In a sample of pure water, only one of the following statements is ALWAYS true at all conditions of temperature and pressure. Which one is ALWAYS true?
 - (a) $[H_3O^+] = 1.0 \times 10^{-7} M$
 - (b) $[H_3O^+] = [OH^-]$
 - (c) $[H_3O^+] \times [OH^-] = 1.0 \times 10^{-14}$
 - (d) pH = 7.0
 - (e) pOH + pH = 14.0
- **11&12.** Consider 0.1 M solutions of the following weak acids:

 CH_3COOH $K_a = 1.8 \times 10^{-5}$ HCN $K_a = 4.0 \times 10^{-10}$ Which of the following statements is NOT correct?

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- (a) Acetic acid is a stronger acid than hydrocyanic acid.
- (b) $[CN^{-}]$ in HCN solution > $[CH_{3}COO^{-}]$ in $CH_{3}COOH$ solution.
- (c) The concentration of OH^- ions is greater in the HCN solution.
- (d) The pH of the CH_3COOH solution is lower than the pH of the HCN solution.
- (e) $[H^+]$ in CH₃COOH solution > $[H^+]$ in HCN solution.

13&14. The conjugate acid of HCO_3^- is:

(a) H_2CO_3	(b) H ⁺	(c) H_3O^+	(d) CO_3^{2-}	(e) none of these
()2	()	(-)3 -	() 3	(-)

15&16. Which equilibrium has the thermodynamic equilibrium constant expression: $K_{\text{thermo}} = [X]^3 / (p_Y)$

$(a) \cap (a) \leftarrow (a) \cap (a) \rightarrow (a)$	(a) $Y(g) \stackrel{\rightarrow}{\leftarrow} Z(\ell) + 3X(aq)$	(b) $3X(aq) \stackrel{\rightarrow}{\leftarrow} Y(q) + 3Z(s)$
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- (c) $Y(g) \stackrel{\rightarrow}{\leftarrow} 3Z(g)$ (d) $Y(aq) \stackrel{\rightarrow}{\leftarrow} 3X(g)$
- (e) $3X(g) \stackrel{\rightarrow}{\leftarrow} Y(aq) + 3Z(s)$

17&18. What is the pH of a 7.00×10^{-3} M HI(aq) solution?

	(a) 4.91	(b) 2.15	(c) 3.65	(d) 1.00	(e) 0.97
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19&20. Calculate the thermodynamic equilibrium constant at 25°C for a reaction for which $\Delta G^{\circ} = -12.40$ kJ per mol rxn?

(a) 3.28 x 10 ⁺ (b) 553	(c) 7.32 x 10 ³	(d) 6.20	(e) 149
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21&22. What is the percent ionization of a 0.65 M solution of HNO₂?

(a) 2.6% (b) 1.4% (c) 3.2% (d) 2.1% (e) 3.0%

23&24. What is the pH of a 0.20 M KBrO solution?

	(a) 8.65	(b) 9.40	(C) 4.62	(d) 7.85	(e) 10.95
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25&26. Calculate the pH of the solution resulting from the addition of 20.0 mL of 0.500 M HCl to 80.0 mL of 0.150 M NaOH.

(a)	7.00	(b) 2.73	(c) 11.25	(d) 12.30	(e) 11.85
١	u)	1.00	(0) 2.70	(0) 11.20	(u) 12.00	(0) 11.00

- **27&28.** Calculate the pH that results when 35.0 mL of 1.00 M HCl is added to 500.0 mL of a solution composed of 0.100 M HCOOH and 0.300 M NaCHOO.
 - (a) 4.74 (b) 4.11 (c) 4.51 (d) 3.39 (e) 3.88

The following 5 questions (29 – 35) deal with a single titration:

29&30. A 60.0 mL sample of 0.300 *M* methylamine is titrated with 0.100 *M* HCl. Calculate the initial pH before the titration is begun.

(a) 13.50 (b) 11.59 (c) 11.78 (d) 12.09 (e) 12.28

$OVER \Rightarrow$

- **31&32.** A 60.0 mL sample of 0.300 *M* methylamine is titrated with 0.100 *M* HCl. Calculate the pH after 80.0 mL of 0.100 *M* HCl has been added.
 - (a) 10.12 (b) 9.53 (c) 10.80 (d) 10.50 (e) 10.65

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NAME____

(Please blockprint)

PART 2

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

(5 pts) **33.** A 60.0 mL sample of 0.300 *M* methylamine is titrated with 0.100 *M* HCl. Calculate the pH at the equivalence point.

(5 pts) **34.** A 60.0 mL sample of 0.300 *M* methylamine is titrated with 0.100 *M* HCl. Calculate the pH after 190.0 mL of 0.100 *M* HCl is added.



(5 pts) **35.** A 60.0 mL sample of 0.300 *M* methylamine is titrated with 0.100 *M* HCl. Using the answers to Questions 29-34, sketch the titration curve with pH on the vertical axis and milliliters of acid 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.



36. A weak acid indicator, HIn (K_a = 1.0 x 10⁻⁹) ionizes as follows: HIn $\stackrel{\rightarrow}{\leftarrow}$ H⁺ + In⁻ blue yellow

- (2 pts) (a) The endpoint of an acid-base titration that uses this indicator will be at pH = _____.
- (2 pts) (b) Explain your answer to (a) using the equilibrium expression.

(1 pt) (c) The color at pH = 8 will be _____.

SCRAP PAPER OR COMMENTS ON EXAM

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