

**CHEMISTRY 102****EXAM 3 FORM C****SECTION 502****FALL 2010****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 36 questions (20 actual questions).
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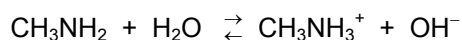
**PART 1**

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**1&2.** Which one of the following combinations cannot produce a buffer solution?

- (a)  $\text{NH}_3$  and  $\text{NH}_4\text{Br}$                       (b)  $\text{NH}_3$  and  $(\text{NH}_4)_2\text{SO}_4$                       (c)  $\text{HCN}$  and  $\text{NaCN}$
- (d)  $\text{HNO}_2$  and  $\text{NaNO}_2$                       (e)  $\text{HClO}_4$  and  $\text{NaClO}_4$

**3&4.** Which one of the following statements is TRUE about the following reaction?



- (a)  $\text{OH}^-$  is the conjugate acid of  $\text{H}_2\text{O}$ .
- (b)  $\text{H}_2\text{O}$  is the conjugate base of  $\text{OH}^-$ .
- (c)  $\text{CH}_3\text{NH}_2$  is the conjugate base of  $\text{H}_2\text{O}$ .
- (d)  $\text{CH}_3\text{NH}_3^+$  is the conjugate acid of  $\text{CH}_3\text{NH}_2$ .
- (e) There are no conjugate acid-base pairs.

**5&6.** For which equilibrium(s) is  $K_p = K_{\text{thermo}}$ ?

- (1)  $\text{Y(aq)} \rightleftharpoons 3\text{X(g)}$                       (2)  $3\text{Y(s)} \rightleftharpoons \text{X(g)}$                       (3)  $3\text{Y(g)} \rightleftharpoons 3\text{Z(g)} + \text{X(g)}$
- (a) 1&2                      (b) 2 only                      (c) 2&3                      (d) 1&2&3                      (e) 3 only

**7&8.** When solid  $\text{NH}_4\text{Cl}$  is added to water, the pH \_\_\_\_\_.

- (a) remains at 7
- (b) becomes less than 7 because of hydrolysis of  $\text{NH}_4^+$ .
- (c) becomes less than 7 because of hydrolysis of  $\text{Cl}^-$ .
- (d) becomes greater than 7 because of hydrolysis of  $\text{NH}_4^+$ .
- (e) becomes greater than 7 because of hydrolysis of  $\text{Cl}^-$ .

**9&10.** If we add enough acid to a solution to cause the pH to decrease from 6.5 to 5.5, this means:

- (a)  $[\text{H}_3\text{O}^+]$  increases by a factor of 10.
- (b)  $[\text{H}_3\text{O}^+]$  decreases by a factor of 10.
- (c)  $[\text{H}_3\text{O}^+]$  increases by 1 M.
- (d)  $[\text{H}_3\text{O}^+]$  decreases by a factor of 6.5/5.5.
- (e)  $[\text{H}_3\text{O}^+]$  decreases by 1 M.

**11&12.** Consider a solution which is 0.10 M in  $\text{NH}_3$  and 0.20 M in  $\text{NH}_4\text{Cl}$ . Which of the following statements is TRUE?

- (a) If a small amount of HCl is added, the pH decreases very slightly.
- (b) If HCl is added, the  $\text{H}^+$  ions react with  $\text{NH}_4^+$  ions.
- (c) If a small amount of NaOH is added, the  $\text{OH}^-$  ions react with  $\text{NH}_3$  molecules.
- (d) If more  $\text{NH}_4\text{Cl}$  is added, the pH increases.
- (e) If more  $\text{NH}_3$  is added, the pH decreases.

**13&14.** Consider 0.1 M solutions of the following weak acids:

HX	$K_a = 1 \times 10^{-5}$
HY	$K_a = 1 \times 10^{-7}$

Which of the following statements is **CORRECT**?

- (a) The solution of HX will have a lower percent ionization than HY.
- (b) HY is the stronger acid.
- (c)  $[\text{Y}^-] > [\text{X}^-]$ .
- (d) The pH of the HX solution is higher than that of the HY solution.
- (e)  $[\text{OH}^-]$  is higher in the HY solution.

**15&16.** Which of the following substances is NOT a strong electrolyte?

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

**17&18.** Calculate the concentration of a solution of NaOH if the pH of the solution is 12.55 at  $25^\circ\text{C}$ .

- (a)  $2.6 \times 10^{-13} \text{ M}$       (b) 0.035 M      (c) 0.021 M  
(d) 4.4 M      (e) 0.12 M

**19&20.** Calculate the value of  $\Delta G$  for a reaction at  $25^\circ\text{C}$  if its thermodynamic equilibrium constant is  $4.5 \times 10^{-6}$ ?

- (a) +5.25 kJ      (b) -25.8 kJ      (c) +30.5 kJ      (d) +36.1 kJ      (e) -0.0055 kJ

**21&22.** The pH of a 0.20 M solution of the weak monoprotic acid, HA, is 5.11. Evaluate the  $K_a$  for the acid.

- (a)  $1.7 \times 10^{-4}$     (b)  $4.1 \times 10^{-5}$     (c)  $6.5 \times 10^{-11}$     (d)  $7.9 \times 10^{-9}$     (e)  $3.0 \times 10^{-10}$

**23&24.** What is the approximate pH of a solution formed by mixing  $\text{HNO}_2$  and  $\text{NaNO}_2$  solutions so that the resulting solution is 0.10 M in  $\text{HNO}_2$  and 0.30 M in  $\text{NaNO}_2$ ?

- (a) 3.82    (b) 2.84    (c) 2.39    (d) 3.41    (e) 4.21

**25&26.** Calculate the percent hydrolysis for a 0.45 M solution of sodium nitrite.

(a)  $1.8 \times 10^{-6} \%$

(b) 3.22 %

(c) 0.25 %

(d)  $7.0 \times 10^{-4} \%$

(e)  $1.2 \times 10^{-3} \%$

**27&28.** What ratio of  $[\text{NH}_3]/[\text{NH}_4^+]$  is required to give a solution with a pH of 9.60?

(a) 1.5:1

(b) 0.43:1

(c) 2.2:1

(d) 4.1:1

(e) 0.87:1

**OVER  $\Rightarrow$**

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

**29&30.** A 20.0 mL sample of 0.500 *M* hydrofluoric acid is titrated with 0.300 *M* NaOH. Calculate the initial pH before the titration is begun.

- (a) 1.94            (b) 1.72            (c) 3.47            (d) 2.95            (e) 0.33

**31&32.** A 20.0 mL sample of 0.500 *M* hydrofluoric acid is titrated with 0.300 *M* NaOH. Calculate the pH after 10.0 mL of 0.300 *M* NaOH has been added.

- (a) 3.11            (b) 3.55            (c) 3.60            (d) 2.60            (e) 2.77

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**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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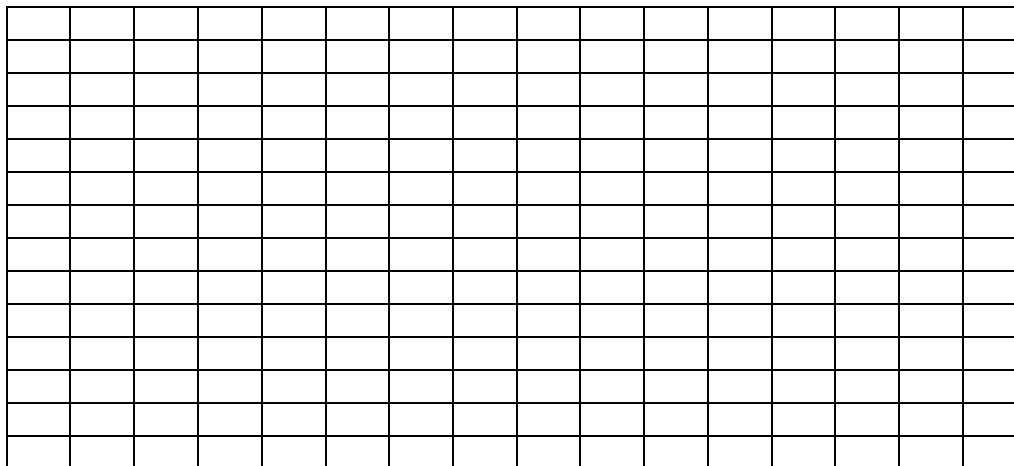
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(5 pts) **33.** A 20.0 mL sample of 0.500 *M* hydrofluoric acid is titrated with 0.300 *M* NaOH. Calculate the pH at the equivalence point.

(5 pts) **34.** A 20.0 mL sample of 0.500 *M* hydrofluoric acid is titrated with 0.300 *M* NaOH. Calculate the pH after 40.0 mL of 0.300 *M* NaOH is added.

**OVER ⇒**

- (5 pts) **35.** A 20.0 mL sample of 0.500 *M* hydrofluoric acid is titrated with 0.300 *M* NaOH. Using the answers to Questions 29-34, 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) **36.** What is the pH of a solution after 50.0 mL of 0.100 *M* KOH is added to a solution made by mixing 215 mL of 0.500 *M* dimethylamine and 475 mL of 0.200 *M* dimethylammonium chloride?



## SCRAP PAPER OR COMMENTS ON EXAM

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**CHEMISTRY 102**

EXAM 3 Form C

**Fall 2010**

Section 502

NAME \_\_\_\_\_

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