CHEMISTRY 102   FALL 2010
EXAM 3   FORM D   SECTION 502   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. Which of the following substances is NOT a strong electrolyte?

    (a) HNO_3 (b) $HClO$ (c) $HClO_3$ (d) NH_4Cl (e) $(CH_3)_2NH_2NO_3$

3&4. For which equilibrium(s) is $K_c = K_{thermo}$?

    (1) $3Y(aq) \rightleftarrows 3Z(aq) + X(aq)$ (2) $3Y(s) \rightleftarrows X(aq)$ (3) $Y(aq) \rightleftarrows 3X(g)$

   (a) 1&2   (b) 2 only   (c) 2&3   (d) 1&2&3   (e) 3 only

5&6. Which one of the following combinations **cannot** produce a buffer solution?

    (a) HNO_2 and $NaNO_2$ (b) NH_3 and $(NH_4)_2SO_4$ (c) $HClO_4$ and $NaClO_4$

    (d) NH_3 and NH_4Br (e) HCN and $NaCN$

7&8. If we add enough base to a solution to cause the pH to increase from 4.5 to 5.5, this means:

    (a) $[OH^-]$ increases by 1 M.
    (b) $[OH^-]$ decreases by a factor of 4.5/5.5.
    (c) $[OH^-]$ decreases by 1 M.
    (d) $[OH^-]$ increases by a factor of 10.
    (e) $[OH^-]$ decreases by a factor of 10.

      D1

9&10. Which one of the following statements is TRUE about the following reaction?

$$HNO_2 + H_2O \rightleftarrows H_3O^+ + NO_2^-$$
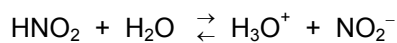
(a) There are no conjugate acid-base pairs.

(b) OH^- is the conjugate acid of H_2O.

(c) H_2O is the conjugate base of OH^-.

(d) HNO_2 is the conjugate acid of H_2O.

(e) NO_2^- is the conjugate base of HNO_2.

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

HA $K_a = 1 \times 10^{-8}$

HB $K_a = 1 \times 10^{-5}$

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

(a) The solution of HA will have a higher percent ionization than HB.

(b) $[OH^-]$ is lower in the HB solution.

(c) HB is the weaker acid.

(d) The pH of the HB solution is higher than that of the HA solution.

(e) $[B^-] < [A^-]$.

13&14. When solid NaClO is added to water, the pH _____.

(a) remains at 7

(b) becomes less than 7 because of hydrolysis of Na^+.

(c) becomes less than 7 because of hydrolysis of ClO^-.

(d) becomes greater than 7 because of hydrolysis of Na^+.

(e) becomes greater than 7 because of hydrolysis of ClO^-.

15&16. Consider a solution which is 0.10 M in NaF and 0.20 M in HF. Which of the following statements is TRUE?

(a) If more NaF is added, the pH decreases.

(b) If a small amount of NaOH is added, the OH^- ions react with F^- ions.

(c) If more HF is added, the pH increases.

(d) If a small amount of HCl is added, the pH decreases very slightly.

(e) If HCl is added, the H^+ ions react with Na^+ ions.

17&18. Calculate the value of ΔG for a reaction at $25^\circ C$ if its thermodynamic equilibrium constant is 2.9×10^5?

   (a) +1.30 kJ   (b) –2.74 kJ   (c) –31.2 kJ   (d) –5.6 kJ   (e) +13.5 kJ

19&20. Calculate the concentration of a solution of HCl if the pH of the solution is 2.79.

   (a) 2.8 M   (b) 0.065 M   (c) 1.1 M

   (d) 1.6×10^{-3} M   (e) 0.12 M

21&22. What is the approximate pH of a solution formed by mixing NH_3 and NH_4Cl solutions so that the resulting solution is 0.20 M in NH_3 and 0.10 M in NH_4Cl?

(a) 9.56   (b) 8.91   (c) 9.84   (d) 8.51   (e) 4.60

23&24. The pH of a 0.40 M solution of the weak acid, HA, is 2.75. Evaluate the K_a for the acid.

(a) 2.5×10^{-4} (b) 8.3×10^{-5} (c) 4.1×10^{-3} (d) 1.8×10^{-5} (e) 7.9×10^{-6}

D4

25&26. What ratio of $[HNO_2]/[NO_2^-]$ is required to give a solution with a pH of 4.00?

(a) 4.6:1   (b) 0.22:1   (c) 1:1   (d) 2.7:1   (e) 0.15:1

27&28. Calculate the percent hydrolysis for a 0.45 M solution of sodium hypochlorite, NaClO.

(a) 0.080 %   (b) 0.17 %   (c) 0.028 %

(d) 0.49 %   (e) 1.2×10^{-3} %

OVER $\Rightarrow$

D5

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

29&30. A 20.0 mL sample of 0.400 M CH_3NH_2 acid is titrated with 0.100 M HCl. Calculate the initial pH before the titration is begun.

(a) 10.31   (b) 10.46   (c) 12.15   (d) 11.85   (e) 12.37

31&32. A 20.0 mL sample of 0.400 M CH_3NH_2 acid is titrated with 0.100 M HCl. Calculate the pH after 50.0 mL of 0.100 M HCl has been added.

(a) 11.80   (b) 10.11   (c) 10.89   (d) 10.30   (e) 10.48

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 20.0 mL sample of 0.400 M methylamine is titrated with 0.100 M HCl. Calculate the pH at the equivalence point.

(5 pts) **34.** A 20.0 mL sample of 0.400 M methylamine is titrated with 0.100 M HCl. Calculate the pH after 90.0 mL of 0.100 M HCl is added.

OVER $\Rightarrow$

(5 pts) **35.** A 20.0 mL sample of 0.400 *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.
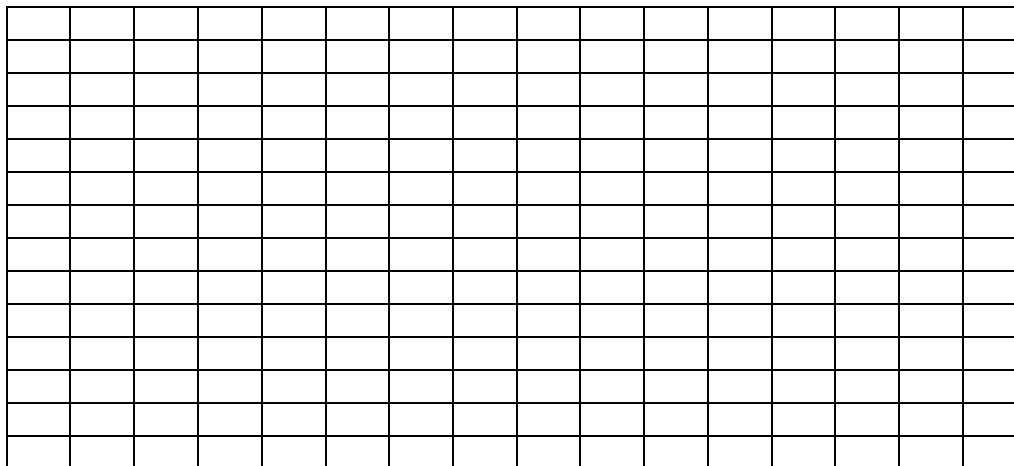
(5 pts) **36.** What is the pH of a solution after 4.00 mL of 1.00 M HCl is added to a solution made by mixing 115 mL of 0.300 M formic acid and 275 mL of 0.100 M sodium formate?

SCRAP PAPER OR COMMENTS ON EXAM

CHEMISTRY 102   **Fall 2010**   NAME

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