NAME ____

CHEMISTRY 102 FALL 2010

EXAM 3 FORM C 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 one of the following combinations **cannot** produce a buffer solution?

(a) NH_3 and NH_4Br (b) NH_3 and $(NH_4)_2SO_4$ (c) HCN and NaCN

(d) HNO_2 and $NaNO_2$ (e) $HClO_4$ and $NaClO_4$

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

$$CH_3NH_2 + H_2O \rightleftarrows CH_3NH_3^+ + OH^-$$

(a) OH^- is the conjugate acid of H_2O.
(b) H_2O is the conjugate base of OH^-.
(c) CH_3NH_2 is the conjugate base of H_2O.
(d) $CH_3NH_3^+$ is the conjugate acid of CH_3NH_2.
(e) There are no conjugate acid-base pairs.

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

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

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

7&8. When solid NH_4Cl is added to water, the pH _____________.

(a) remains at 7

(b) becomes less than 7 because of hydrolysis of NH_4^+.

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

(d) becomes greater than 7 because of hydrolysis of NH_4^+.

(e) becomes greater than 7 because of hydrolysis of 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) $[H_3O^+]$ increases by a factor of 10.

(b) $[H_3O^+]$ decreases by a factor of 10.

(c) $[H_3O^+]$ increases by 1 M.

(d) $[H_3O^+]$ decreases by a factor of 6.5/5.5.

(e) $[H_3O^+]$ decreases by 1 M.

11&12. Consider a solution which is 0.10 M in NH_3 and 0.20 M in NH_4Cl. 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 H^+ ions react with NH_4^+ ions.

(c) If a small amount of NaOH is added, the OH^- ions react with NH_3 molecules.

(d) If more NH_4Cl is added, the pH increases.

(e) If more 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) $[Y^-] > [X^-]$.

(d) The pH of the HX solution is higher than that of the HY solution.

(e) $[OH^-]$ is higher in the HY solution.

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

(a) NH_4Cl (b) $HClO_4$ (c) $HClO_3$ (d) HNO_2 (e) $(CH_3)_2NH_2NO_3$

17&18. Calculate the concentration of a solution of NaOH if the pH of the solution is 12.55 at 25°C.

(a) 2.6×10^{-13} M (b) 0.035 M (c) 0.021 M
(d) 4.4 M (e) 0.12 M

19&20. Calculate the value of ΔG for a reaction at 25°C if its thermodynamic equilibrium constant is 4.5×10^{-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) 1.7×10^{-4} (b) 4.1×10^{-5} (c) 6.5×10^{-11} (d) 7.9×10^{-9} (e) 3.0×10^{-10}

23&24. What is the approximate pH of a solution formed by mixing HNO_2 and $NaNO_2$ solutions so that the resulting solution is 0.10 M in HNO_2 and 0.30 M in $NaNO_2$?

(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) 1.8×10^{-6} % (b) 3.22 % (c) 0.25 %
(d) 7.0×10^{-4} % (e) 1.2×10^{-3} %

27&28. What ratio of $[NH_3]/[NH_4^+]$ 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 ⇒

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." ______________________________

(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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NAME_________________________