FORMULA SHEET (tear off)

$N_A = 6.022 \times 10^{23}$ $°C = (^5/_9)(°F - 32)$ $°F = (^9/_5)(°C) + 32$

1 amu $= 1.661 \times 10^{-27}$ kg $°C = K - 273.15$ $K = °C + 273.15$

1 atm = 760 torr = 760 mm Hg   1 atm = 1.013 bar $pV = nRT$

$R = 0.08206$ L·atm/mol·K   1 L·atm = 101.3 J

$R = 8.314$ J/mol·K $1 J = 1$ kg·m^2/s^2

$p_A = X_A p_A°$ $[B] = k\, p_B$ $\Delta p_A = X_B p_A°$

$\Delta T_b = K_b m_B$ $\Delta T_f = K_f m_B$ $\Pi = [B]RT$

$H = U + pV$ $G = H - TS$

$\Delta G_{rxn} = \Delta G°_{rxn} + RT \ln Q$ $\ln K = -\Delta G°_{rxn}/RT$ $K_p = K_C (RT)^{\Delta n}$

If $ax^2 + bx + c = 0$, then $x = \left(\dfrac{-b \pm [b^2 - 4ac]^{1/2}}{2a} \right)$

$K_a \cdot K_b = K_w = 1.0 \times 10^{-14}$ (at $T = 25°C$) $pH = pK_a + \log_{10}\{[base]/[acid]\}$

GENERAL CHEMISTRY 2
THIRD HOUR EXAM

Name _____

Panthersoft ID _____

Signature _____

Part 1 _____ **(16 points)**

Part 2 _____ **(24 points)**

Part 3 _____ **(40 points)**

TOTAL _____ **(80 points)**

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Do all of the following problems. <u>Show your work.</u>

Part 1. Multiple choice. Circle the letter corresponding to the correct answer. There is one and only one correct answer per problem. [4 points each]

1) From the substances HI, H_2S, and H_2Se
        a) HI is the strongest acid and H_2Se is the weakest acid
        b) HI is the strongest acid and H_2S is the weakest acid
        c) H_2S is the strongest acid and HI is the weakest acid
        d) H_2S is the strongest acid and H_2Se is the weakest acid
        e) H_2Se is the strongest acid and H_2S is the weakest acid

2) In the reaction

$$Al(H_2O)_6^{3+}(aq) + H_2O(\ell) \leftrightarrows Al(H_2O)_5OH^{2+}(aq) + H_3O^+(aq)$$

the $Al(H_2O)_6^{3+}$ ion functions as
        a) the conjugate base of H_2O
        b) the conjugate acid of H_2O
        c) a Bronsted base
        d) a Bronsted acid
        e) none of the above

3) A small amount of a strong acid is added to a buffer solution. What will happen to the pH of the solution?
        a) The pH will increase by a large amount
        b) The pH will decrease by a large amount
        c) The pH will increase by a small amount
        d) The pH will decrease by a small amount
        e) The pH will not change

4) A titration curve is given in the figure below. The titration is carried out at T = 25. °C.
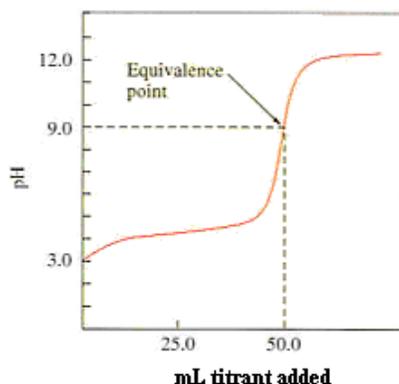
Based on this curve, we may say that
        a) a strong acid is being titrated with a strong base
        b) a weak acid is being titrated with a strong base
        c) a strong base is being titrated with a strong acid
        d) a weak base is being titrated with a strong acid
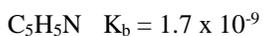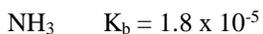   e) cannot tell from the information given

Part 2. Short answer.

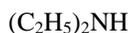1) Define the following terms [4 points each]

       end point

       polyprotic acid

2) Values for K_b for several weak bases are given below, at T = 25. °C.

       NH_3 $K_b = 1.8 \times 10^{-5}$ $(C_2H_5)_2NH$ $K_b = 5.4 \times 10^{-4}$

       C_5H_5N $K_b = 1.7 \times 10^{-9}$ $C_6H_5NH_2$ $K_b = 3.8 \times 10^{-10}$
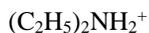
From the lists below circle the correct answer. There is one and only one correct answer per problem.
[4 points each]

       a) The strongest weak base

       NH_3 $(C_2H_5)_2NH$ C_5H_5N $C_6H_5NH_2$

       b) The strongest conjugate acid

       NH_4^+ $(C_2H_5)_2NH_2^+$ $C_5H_5NH^+$ $C_6H_5NH_3^+$

3) A buffer is formed by adding an equal number of moles of hypochlorous acid (HClO, $K_a = 3.5 \times 10^{-8}$) and potassium hypochlorite (KClO) to water, at T = 25. °C.

       a) What is the pH of the buffer? [4 points]

       b) Give the balanced reaction that takes place when a small amount of potassium hydroxide (KOH) is added to the above buffer. [4 points]

Part 3. Problems.

1) Hypochlorous acid (HOCl) is a weak acid, with $K_a = 3.5 \times 10^{-8}$ at T = 25. °C.

    a) Give the conjugate base of HOCl (correct formula and charge) [4 points]

                                                        _____

    b) What is the pH and the percent dissociation for a 0.00900 M aqueous solution of HOCl at T = 25. °C?
[12 points]

2) A 0.687 g sample of a weak monoprotic acid is titrated with a 0.1826 M solution of NaOH, a strong base. After 25.89 mL of the NaOH solution has been added the equivalence point for the titration is reached. What is the molecular mass of the weak monoprotic acid? [12 points]

3) A chemist prepares 1.000 L of a 0.0218 M solution of iodoacetic acid (CH_2ICOOH, MW = 185.9 g/mol), a weak monoprotic acid with K_a = 7.6 x 10^{-4} at T = 25. °C. How many grams of sodium iodoacetate ($NaCH_2ICOO$, MW = 207.9 g/mol) must be added to the solution to convert it into a pH = 3.00 buffer? [12 points]