CHM152   Quiz 5   25 Pts   Spring 2015   Name: __Key__
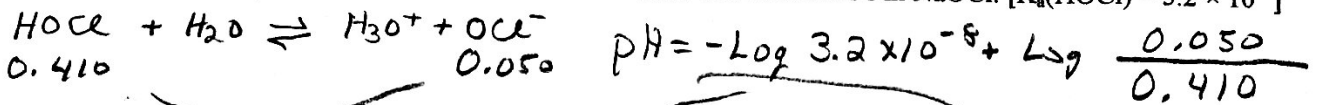
Show all work to receive credit. $pH = pK_a + \log\left(\dfrac{conj.base}{acid}\right)$

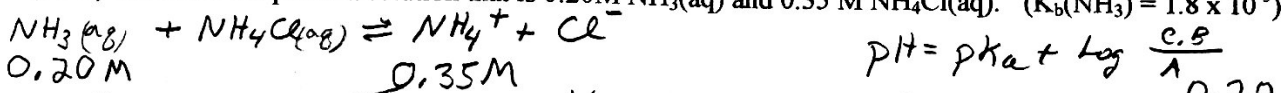1. (3 Pts) Calculate the pH of a solution that is 0.410 M in HOCl and 0.050 M in NaOCl. [K_a(HOCl) = 3.2 × 10⁻⁸]

$HOCl + H_2O \rightleftharpoons H_3O^+ + OCl^-$
0.410   0.050

$pH = -Log\ 3.2 \times 10^{-8} + Log\ \dfrac{0.050}{0.410}$

Buffer solution

$pH = 6.58$

2. (3 Pts) Calculate the pH of a solution that is 0.20 M NH_3(aq) and 0.35 M NH_4Cl(aq). ($K_b(NH_3)$ = 1.8 × 10⁻⁵)

$NH_3(aq) + NH_4Cl(aq) \rightleftharpoons NH_4^+ + Cl^-$
0.20 M   0.35 M

Base Buffer Solution $K_a = \dfrac{K_w}{K_b} = 5.56 \times 10^{-10}$

$pH = pKa + Log\ \dfrac{c.B}{A}$

$pH = 9.26 + Log\ \dfrac{0.20}{0.35}$

$pH = 9.01$

3. (3 Pts) Which one of the following is a buffer solution?
A) 0.40 M HCN and 0.10 KCN
B) 0.20 M CH_3COOH
C) 1.0 M HNO_3 and 1.0 M $NaNO_3$
D) 0.10 M KCN
E) 0.50 M HCl and 0.10 NaCl

4. (4 Pts) A solution is prepared by mixing 500. mL of 0.10 M NaOCl and 500. mL of 0.20 M HOCl. What is the pH of this solution?   [K_a(HOCl) = 3.2 × 10⁻⁸]   7.19   Buffer Solution

$pH = -Log\ 3.2 \times 10^{-8} + Log\ \dfrac{0.5000 \times 0.10}{0.5000 \times 0.20} = 7.19$

5. (3 Pts) Assuming equal concentrations of conjugate base and acid, which one of the following mixtures is suitable for making a buffer solution with an optimum pH of 9.2–9.3?
A) CH_3COONa / CH_3COOH (K_a = 1.8 × 10⁻⁵)
B) NH_3 / NH_4Cl (K_a = 5.6 × 10⁻¹⁰)
C) NaOCl / HOCl (K_a = 3.2 × 10⁻⁸)
D) $NaNO_2 / HNO_2$ (K_a = 4.5 × 10⁻⁴)
E) NaCl / HCl

6. (5 Pts) You have 500.0 mL of a buffer solution containing 0.20 M acetic acid (CH_3COOH) and 0.30 M sodium acetate (CH_3COONa).   What will the pH of this solution be after the addition of 20.0 mL of 1.00 M NaOH solution? [K_a = 1.8 × 10⁻⁵]

initial moles of Acid : $0.5000\ L \left(\dfrac{0.20\ mol}{}\right) = 0.120\ mol\ HOAc$

initial moles of base : $0.5000\ L \left(\dfrac{0.30\ mol}{}\right) = 0.15\ mol\ NaOA$

moles of Added Base : $0.0200\ L \left(\dfrac{1.00\ mol}{}\right) = 0.0200\ mol\ OH^-$

$pH = -Log\ 1.8 \times 10^{-5} + Log\ \dfrac{0.15 + 0.0200}{0.100 - 0.0200} = 5.07$

7. (4 Pts) Will a 0.1 M solution of NH_4NO_3(aq) be acidic, basic, or neutral?   Write hydrolysis equation(s) to support your answers.

$K \rightarrow NH_4^+ + NO_3^- \nleftarrow strong$

$NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$ Acidic