CHM152   Quiz 4B   Fall 2019   25 Pts   Name: **Key**

SHOW ALL WORK TO RECEIVE CREDIT.

$$pH = pK_a + \log\left(\frac{conj.\,base}{acid}\right)$$

1. (3 Pts) Calculate the pH of a solution that is 0.20M NH_3(aq) and 0.35 M NH_4Cl(aq). ($K_b(NH_3) = 1.8 \times 10^{-5}$)

Basic buffer solution : $K_a = \frac{10^{-14}}{1.8\times10^{-5}} = 5.56 \times 10^{-10}$

$pH = -\log 5.56 \times 10^{-10} + \log \frac{0.20}{0.35}$

$pH = 9.01$

2. (3 Pts) What is the pH of a 0.014 M $Ca(OH)_2$ solution?

strong base

$Ca(OH)_2 (s) \longrightarrow Ca^{2+} + 2OH^-$
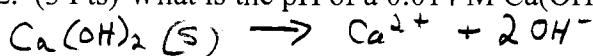
$pOH = -\log (2 \times 0.014) = 1.55$

$pH = 14 - pOH = 12.45$

3. (3 Pts) A 1.5 L sample of a 0.44 M HBr solution is mixed with 2.2 L of a 0.080 M $HClO_4$ solution. What is the pH of the mixture?

Both are strong acids, so find total moles of acid and total volume,

$\frac{1.5 L | 0.44\,mol}{L} + \frac{2.2 L | 0.080\,mol}{L} = 0.836$ moles H_3O^+

$pH = -\log \left(\frac{0.836}{3.7}\right) = 0.65$

4. (3 Pts) What is the pH of a 0.15 M solution of the weak base aniline ($C_6H_5NH_2$; $K_b = 3.8 \times 10^{-10}$)

$C_6H_5NH_2 + H_2O \rightleftharpoons C_6H_5NH_3^+ + OH^-$
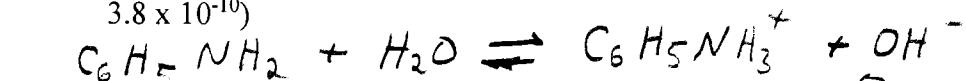
	$C_6H_5NH_2$	$C_6H_5NH_3^+$	OH^-
I	0.15	0	0
C	$-x$	$+x$	$+x$
E	$0.15-x$	x	x

$K_b = \frac{[x][x]}{0.15-x}$

$3.8 \times 10^{-10} = \frac{x^2}{0.15-x} \leftarrow$ drop?

$x = [OH^-] = 7.549 \times 10^{-6}$

$pOH = 5.12$

$pH = 8.88$

5. (2 Pts) What is the pH of 10.0 mL of 0.0020 M HCl?

$pH = -\log [0.0020] = 2.70$

More Questions on Back

6. (2 Pts) Predict the direction in which the equilibrium will lie for the reaction
$C_6H_5COO^- + HF \rightleftharpoons C_6H_5COOH + F^-$.
$K_a(C_6H_5COOH) = 6.5 \times 10^{-5}$; $K_a(HF) = 7.1 \times 10^{-4}$
A) to the right — Favors the weaker acid.
B) to the left
C) in the middle
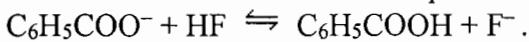
7. (3 Pts) What is the pH of a 0.11 M solution of C_6H_5OH ($K_a = 1.3 \times 10^{-10}$)

weak acid

$C_6H_5OH + H_2O \rightleftharpoons C_6H_5O^- + H_3O^+$

I   0.11   0   0
                                  +x   +x
C   -x
E   0.11-x   x   x
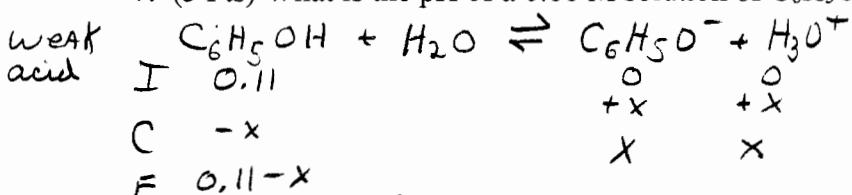
$K_a = \dfrac{x^2}{0.11-x}$ ← drop?

$x = [H_3O^+] = 3.78 \times 10^{-6}$

$pH = -Log [H_3O^+] = 5.42$

8. (3 Pts) Calculate the pH of a buffer solution that contains 0.25 M benzoic acid ($C_6H_5CO_2H$) and 0.15M sodium benzoate (C_6H_5COONa). [$K_a = 6.5 \times 10^{-5}$ for benzoic acid]

$pH = -Log\, 6.5 \times 10^{-5} + Log\, \dfrac{0.15}{0.25}$

$pH = 3.97$

9. (3 Pts) Calculate the pH of a 0.055 M solution of CH_3COONa ($K_a(CH_3COOH) = 1.8 \times 10^{-5}$)

dissociate the salt

$CH_3COONa \xrightarrow{H_2O} CH_3COO^- + Na^+$

hydrolysis of CH_3COO^-

$CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$ ← K_b

I   0.055   0   0
                                   +x   +x
C   -x
E   0.055-x   x   x

$K_b = \dfrac{10^{-14}}{1.8 \times 10^{-5}}$
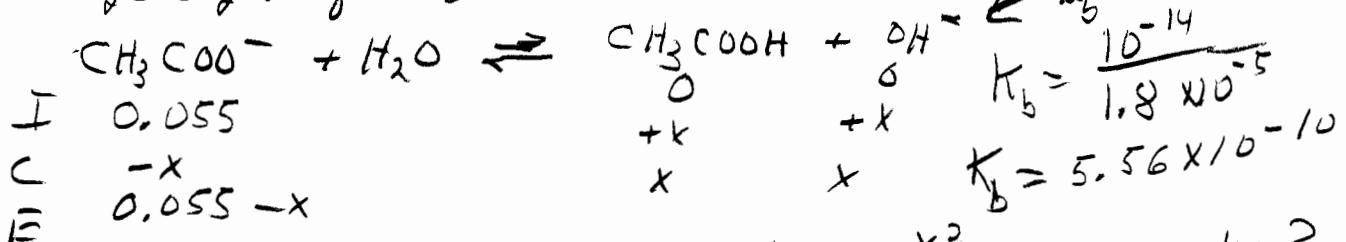
$K_b = 5.56 \times 10^{-10}$

$5.56 \times 10^{-10} = \dfrac{x^2}{0.055-x}$ ← drop?

$x = 5.53 \times 10^{-6} = [OH^-]$

$pOH = 5.26$ $pH = 8.74$