Chemistry 1410 Spring 2005
Quiz 3, Section 1, 20 pts

Name _____(please print)

$K_w = [H^+][OH^-]$ $pH = -\log[H^+]$ $pOH = -\log[OH^-]$ $pH + pOH = 14$

$K_aK_b = K_w$

1. Calculate the pH of the following solutions.

a)(3) A 0.82 M HCl solution. $HCl \rightarrow H^+ + Cl^-$

$pH = -\log[H^+] = -\log(0.82) = 0.09$

b)(3) If 3.8 grams of NaOH is dissolved in enough water to create a total solution volume of 400 mL.

$3.8\ g\ NaOH \times \frac{1\ mole\ NaOH}{40.0\ g} = 0.095\ moles\ NaOH$

$M_{NaOH} = \frac{0.095\ moles}{0.400\ L} = 0.2375\ M\ NaOH$ $NaOH \rightarrow Na^+ + {}^-OH$

$pOH = -\log[OH^-] = -\log(0.2375) = 0.62$

$pH = pK_w - pOH = 14 - 0.62 = 13.38$

2.(2) Identify the acid-base conjugate pairs in the following reaction.

Base Acid

$CH_3COO^- + HCN \rightleftharpoons CH_3COOH + CN^-$

Acid Base

3. The K_a value for ascorbic acid (Vitamin C) is 8.0×10^{-5}.

(2) a) The pH of a 0.20 M solution of ascorbic acid (HA) is

A. Greater than 7
(B.) Less than 7
C. Equal to 7
D. Insufficient information to predict.

(4) b) Calculate the pH of a 0.20 M solution of ascorbic acid.

	$HA \rightleftharpoons$	H^+	+ A^-
I	0.20	0	0
C	$-x$	$+x$	$+x$
E	$0.20-x$	x	x

$K_a = 8.0 \times 10^{-5} = \frac{(H^+)(A^-)}{(HA)} = \frac{(x)(x)}{0.20-x}$

if $x \ll 0.2$

$8.0 \times 10^{-5} = x^2/0.20$

$x = \left((0.20)(8.0\times10^{-5})\right)^{\frac{1}{2}} = 4\times10^{-3}$

$\frac{4\times10^{-3}}{0.2} \times 100 = 2\% \quad$ so $x \ll 0.2$

$x = [H^+] = 4\times10^{-3}$

$pH = -\log(4\times10^{-3}) = 2.4$

4.(2) The pH of a 0.20 M solution of sodium ascorbate (NaA) is

(A) Greater than 7
B. Less than 7
C. Equal to 7
D. Insufficient information to predict.

(4) b) Calculate the pH of a 0.20 M solution of sodium ascorbate. ← conjugate base of ascorbic acid

$NaA \rightarrow Na^+ + A^-$

$A^- + H_2O \rightleftharpoons HA + {}^-OH$

$K_b = \frac{K_w}{K_a} = \frac{1\times10^{-14}}{8.0\times10^{-5}} = 1.25\times10^{-10} = \frac{(HA)(^-OH)}{(A^-)}$

	A^- +	$H_2O \rightleftharpoons$	HA +	^-OH
I	0.20	–	0	0
C	$-x$		$+x$	$+x$
E	$0.20-x$		x	x

$1.25\times10^{-10} = \frac{(x)(x)}{0.20-x}$

if $x \ll 0.2$

$1.25\times10^{-10} = \frac{x^2}{0.2}$

$\sqrt{(1.25\times10^{-10})(0.2)} = x$

$5\times10^{-6} = x$

$\frac{5\times10^{-6}}{0.2} \times 100 = 2.5\times10^{-4}\% \quad$ so $x \ll 0.2$

$x = [^-OH] = 5\times10^{-6}$

$pOH = -\log(5\times10^{-6}) = 5.3$

$pH = 14 - pOH = 14 - 5.3 = 8.7$