Chemistry 1410 Spring 2005
Quiz 3, Section 2, 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 0.67 M HNO_3 solution. $HNO_3 \rightarrow H^+ + NO_3^-$

$pH = -\log[H^+] = -\log(0.67) = 0.17$

b)(3) If 5.2 grams of KOH is dissolved in enough water to create a total solution volume of 600 mL.

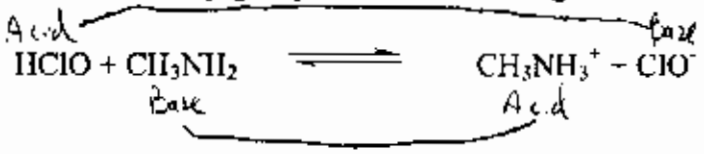
$5.2\text{ g KOH} \times \frac{1\text{ mole KOH}}{56.1\text{ g}} = 0.093\text{ moles KOH}$

$M_{KOH} = \frac{0.093\text{ moles}}{0.600\text{ L}} = 0.15\text{ M}$ $KOH \rightarrow K^+ + OH^-$

$pOH = -\log[OH^-] = -\log(0.15) = 0.81$

$pH = pK_w - pOH = 14 - 0.81 = 13.19$

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



3. The K_a value for aceteylsalicylic acid (aspirin) is 3.0×10^{-4}.

(2) a) The pH of a 0.50 M solution of acetylsalicylic 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 0.50 M solution of acetylsalicylic acid.

	HA	$\rightleftharpoons$	H^+	+	A^-
I	0.50		0		0
C	$-x$		$+x$		$+x$
E	$0.50-x$		x		x

$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{(x)(x)}{0.50-x} = 3.0 \times 10^{-4}$

if $x \ll 0.5$

$3.0 \times 10^{-4} = \frac{x^2}{0.50}$

$x = \sqrt{(0.50)(3.0 \times 10^{-4})} = 0.012$

$\frac{0.012}{0.50} \times 100 = 2.4\%$

so $x \ll 0.50$

$x = [H^+] = 0.012$

$pH = -\log(0.012) = 1.92$

4.(2) The pH of a 0.50 M solution of sodium acetylsalicylate (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 0.50 M solution of sodium acetylsalicylate. ← conjugate base of acetylsalicylic acid

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

$K_b = K_w/K_a = \frac{1 \times 10^{-14}}{3.0 \times 10^{-4}} = 3.33 \times 10^{-11}$

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

	A^-		H_2O	$\rightleftharpoons$	HA	+	^-OH
I	0.50		-		0		0
C	$-x$				$+x$		$+x$
E	$0.50-x$				x		x

$K_b = 3.33 \times 10^{-11} = \frac{[HA][^-OH]}{[A^-]} = \frac{(x)(x)}{0.50-x}$

if $x \ll 0.50$

$3.33 \times 10^{-11} = \frac{x^2}{0.50}$

$\sqrt{(3.33 \times 10^{-11})(0.50)} = x$

$4.08 \times 10^{-6} = x$

$\frac{4.08 \times 10^{-6}}{0.5} \times 100 = 8 \times 10^{-4}\%$

so $x \ll 0.5$

$x = 4.08 \times 10^{-6} = [^-OH]$

$pOH = -\log(4.08 \times 10^{-6}) = 5.39$

$pH = 14 - pOH = 14 - 5.39$

$pH = 8.61$