CHM 1046 - JOENS WORKSHEET #7 Due date: M,W,F Monday, October 17
T,R Tuesday, October 18

* While I prefer you turn in a hard copy of the worksheet, I will accept scanned copies sent to my email address, joensj@fiu.edu

Section: (circle one) M,W,F Tu,Tr

For problems involving calculations you must show your work for credit. Unless otherwise stated, you may assume T = 25.0 °C.

1) Give the conjugate acid and the conjugate base for NH_3 (ammonia).

conjugate acid ______**NH_4^+**________ conjugate base ______**NH_2^-**________

To form the conjugate acid of a substance add an H^+; to form the conjugate base of a substance remove an H^+.

2) An aqueous solution has $[OH^-] = 2.7 \times 10^{-4}$ M. What are the pH and concentration of hydronium ion, $[H_3O^+]$, for the solution?

pH = ______10.43_________ $[H_3O^+]$ ___3.7×10^{-11}____

$pOH = -\log_{10}[OH^-] = -\log_{10}(2.7 \times 10^{-4}) = 3.57$

pH + pOH = 14.00 , and so pH = 14.00 – pOH = 14.00 – 3.57 = 10.43

$[H_3O^+] = 10^{-pH} = 10^{-10.43} = 3.7 \times 10^{-11}$ M

3) What is the pH for a 0.0375 M aqueous solution of potassium hydroxide (KOH, MW = 56.11 g/mol)?

KOH is a strong soluble base, and so in water the reaction that occurs is

$KOH(s) \rightarrow K^+(aq) + OH^-(aq)$

So $[OH^-] = \dfrac{0.0375 \text{ mol KOH}}{\text{L soln}} \cdot \dfrac{1 \text{ mol } OH^-}{1 \text{ mol KOH}} = 0.0375 \text{ M } OH^-$

And so $pOH = -\log_{10}[OH^-] = -\log_{10}(0.0375) = 1.43$

pH + pOH = 14.00 , and so pH = 14.00 – pOH = 14.00 – 1.43 = 12.57

4) Hypochlorous acid (HOCl, MW = 52.46 g/mol) is a weak monoprotic acid, with $K_a = 3.5 \times 10^{-8}$.

a) Give the reaction that occurs when hypochlorous acid is added to water. Identify the Bronsted acid, the conjugate base of the Bronsted acid, the Bronsted base, and the conjugate acid of the Bronsted base.

reaction $HOCl(aq) + H_2O(\ell) \leftrightarrows H_3O^+(aq) + OCl^-(aq)$

Bronsted acid ____HOCl__________ Bronsted base _____H_2O______

conjugate base ____OCl^-__________ conjugate acid _____H_3O^+______

b) What is the pH of a 0.062 M aqueous solution of hypochlorous acid?

$$K_a = \frac{[H_3O^+][OCl^-]}{[HOCl]} = 3.5 \times 10^{-8}$$

	Initial	Change	Equilibrium
H_3O^+	0	x	x
OCl^-	0	x	x
HOCl	0.062	–x	0.062 – x

So $$\frac{(x)(x)}{(0.062 - x)} = 3.5 \times 10^{-8}$$

Assume x << 0.062. Then

$$\frac{x^2}{0.062} = 3.5 \times 10^{-8} \qquad x^2 = (3.5 \times 10^{-8})(0.062) = 2.17 \times 10^{-9}$$

$$x = (2.17 \times 10^{-9})^{1/2} = 4.66 \times 10^{-5}$$

4.66×10^{-5} is more than 10 times smaller than 0.062, and so our assumption was good.

So $[H_3O^+] = 4.66 \times 10^{-5}$ M $\qquad$ $pH = -\log_{10}(4.66 \times 10^{-5}) = 4.33$

Note that if you do this problem exactly using the quadratic, you get the same value for pH (to two figures to the right of the decimal point).

5) A particular weak base has $pK_b = 4.47$ What is the numerical value for K_b for the weak base?

$K_a = 10^{-pKa} = 10^{-4.47} = 3.4 \times 10^{-5}$