CHM 1046 - JOENS WORKSHEET #7 Due date: Monday, October 30th
(Note: Exam 2 is Friday, November 3rd. It will cover material from Chapters 15 and 16).
WORKSHEETS ARE DUE AT THE BEGINNING OF CLASS ON THE DATE GIVEN ON THE WORKSHEET. LATE WORKSHEETS WILL NOT BE ACCEPTED.

NAME ______________________________ Panther ID ____________________________

For problems involving calculations you must show your work for credit.

1) What are the pH and the percent dissociation for a 0.0800 M aqueous solution of hypochlorous acid (HOCl), a weak acid, at T =25. °C. At this temperature $K_a = 3.5 \times 10^{-8}$.

$$HOCl(aq) + H_2O(\ell) \leftrightarrows H_3O^+(aq) + OCl^-(aq) \qquad K_a = \frac{[H_3O^+][OCl^-]}{[HOCl]} = 3.5 \times 10^{-8}$$

	Initial	Change	Equilibrium
H_3O^+	0	x	x
OCl^-	0	x	x
HOCl	0.0800	- x	0.0800 - x

So $\frac{(x)(x)}{(0.0800 - x)} = 3.5 \times 10^{-8}$ Assume x << 0.0800, then

$$\frac{x^2}{(0.0800)} = 3.5 \times 10^{-8}$$

$$x^2 = (0.0800)(3.5 \times 10^{-8}) = 2.8 \times 10^{-9}$$

$x = (2.8 \times 10^{-9})^{1/2} = 5.3 \times 10^{-5}$ $pH = -\log_{10}(5.3 \times 10^{-5}) = 4.28$

The percent dissociation is

$$\% \text{ dissociation} = \frac{[OCl^-]_{eq}}{[HOCl]_{initial}} \times 100\ \% = \frac{5.3 \times 10^{-5}}{0.0800} \times 100\ \% = 0.07\ \%$$

2) Which of the following salt solutions will have a pH much larger than 7.0 at T = 25. °C?

a) A 0.100 M solution of potassium bromide (KBr, a salt of a strong acid + a strong base)
b) A 0.100 M solution of potassium hypobromide (KBrO, a salt of a weak acid and a strong base)
B c) A 0.100 M solution of ammonium chloride (NH_4Cl, a salt of a strong acid and a weak base)
d) Both a and b
e) None of the above

Solution b contains the conjugate base of a weak acid (BrO^-), and so will be a weak base solution. It will have pH > 7.0. Solution a does not contain any ions with acid or base properties, and solution c only contains the conjugate acid of a weak base (NH_4^+), and so will have pH < 7.0. So b is the only correct answer.

3) A 0.0100 M solution of a weak base has pH = 9.78 at T = 25. °C. What is the numerical value for K_b for the weak base?

A general reaction for a weak base (B) is

$B(aq) + H_2O(\ell) \leftrightarrows BH^+(aq) + OH^-(aq)$ $K_b = \frac{[BH^+]\,[OH^-]}{[B]}$

	Initial	Change	Equilibrium
BH^+	0	x	x
OH^-	0	x	x
B	0.0100	- x	0.0100 - x

We know the value for pH, and so pOH = 14.00 - pH = 14.00 - 9.78 = 4.22

So $[OH^-] = 10^{-pOH} = 6.0 \times 10^{-5}$ M = x

Therefore $[BH^+] = x = 6.0 \times 10^{-5}$ M $[B] = 0.0100 - 6.0 \times 10^{-5} = 0.00994$ M

$$K_b = \frac{(6.0 \times 10^{-5})\,(6.0 \times 10^{-5})}{(0.00994)} = 3.6 \times 10^{-7}$$

4) Values for K_a for three weak acids are given below, at T = 25. °C, along with their conjugate bases

formic acid (HCOOH)	$K_a = 1.7 \times 10^{-4}$	conjugate base = $HCOO^-$
hypoiodic acid (HIO)	$K_a = 2.3 \times 10^{-11}$	conjugate base = IO^-
phenol (C_6H_5OH)	$K_a = 1.3 \times 10^{-10}$	conjugate base = $C_6H_5O^-$

Based on this information, we can say

a) $HCOO^-$ is a stronger base than IO^-
b) $HCOO^-$ is a stronger base that $C_6H_5O^-$
C c) IO^- is a stronger base than $C_6H_5O^-$
d) Both a and b
e) All three conjugate bases are the same strength

The stronger the weak acid the weaker the conjugate base. So we can say the conjugate base strengths are in the order $IO^- > C_6H_5O^- > HCOO^-$. So c is the only correct statement.