CHM 111 - Acid/Base Quiz 1 **Name:** SOLUTIONS

Due: 3/24/08 at 11:15 AM

Answer the following questions. Report all pH values to the nearest hundredth of a pH unit (Example: pH = 6.54). [20]

1) Write the ionization reactions for the following species when dissolved in water.

Nitric acid, HNO_3

$$HNO_3(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + NO_3^-(aq)$$

Ammonia, NH_3

$$NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

Hypochlorous acid, HClO

$$HClO(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + ClO^-(aq)$$

Methylamine, CH_3NH_2

$$CH_3NH_2(aq) + H_2O(l) \rightleftharpoons CH_3NH_3^+(aq) + OH^-(aq)$$

Ammonium ion, NH_4^+

$$NH_4^+(aq) + H_2O(l) \rightleftharpoons NH_3(aq) + H_3O^+(aq)$$

2) What is the pH of an 0.060 M solution of ammonia, NH_3? The K_b of ammonia is 1.8×10^{-5}.

- pH = 11.01

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

$$K_b = 1.8 \times 10^{-5} = \frac{[NH_4^+][OH^-]}{[NH_3]}$$

	initial	Δ	Equil
NH_4^+	0	+x	x
OH^-	0	+x	x
NH_3	0.060	−x	0.060 − x

$$\frac{x^2}{0.060 - x} = 1.8 \times 10^{-5}$$

solved via quadratic eqn...

$$x = 1.0303 \times 10^{-3} = [OH^-]$$

$$pH = 14 - pOH = 14 - 2.99$$

$$\boxed{pH = 11.01}$$

3) If the *hydroxide* ion concentration of a solution is 3.75×10^{-6} M, what is the pH of the solution? Is the solution acidic or basic?

- pH = 8.57, so the solution is basic (pH > 7).

$pOH = -\log_{10}(3.75 \times 10^{-6}) = 5.43$

$pH = 14 - pOH = 14 - 5.43$

$= \boxed{8.57}$

4) Calculate the pH of a solution made by dissolving 0.0702 grams of the strong base potassium hydroxide, KOH, in enough water to make 250. mL of solution?

strong base.

- pH = 11.70

KOH: FW = 56.1056

$0.0702\,g\ KOH \times \frac{mol\ KOH}{56.1056\,g\ KOH} = 1.251212 \times 10^{-3}\,mol\ KOH$

$\frac{1.251212 \times 10^{-3}\,mol\ KOH}{0.250\,L} = 5.004848 \times 10^{-3}\,M = [OH^-]$

$pOH = -\log_{10}(5.004848 \times 10^{-3}) = 2.30$

$pH = 14 - pOH = \boxed{11.70}$

5) What is the pH of an 0.15 M solution of formic acid, $HCHO_2$? The K_a of formic acid is 1.7×10^{-4}.

- pH = 2.30

$HCHO_2 + H_2O \rightleftharpoons H_3O^+ + CHO_2^-$

$K_a = 1.7 \times 10^{-4} = \frac{[H_3O^+][CHO_2^-]}{[HCHO_2]}$

	Initial	Δ	Equil
H_3O^+	0	+ x	x
CHO_2^-	0	+ x	x
$HCHO_2$	0.15	− x	0.15 − x

$\frac{x^2}{0.15 - x} = 1.7 \times 10^{-4}$

solve via quadratic eqn...

$x = 4.966 \times 10^{-3} = [H_3O^+]$

$pH = \boxed{2.30}$