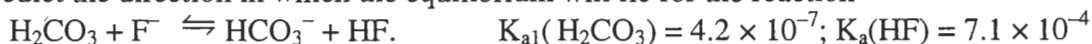**CHM152 Quiz 5 Fall 2014 Name: Key**

Show all work to receive credit.

1. (3 Pts) Consider the weak acid CH_3COOH (acetic acid). If a 0.048 M CH_3COOH solution is 5.2% ionized, determine the $[H_3O^+]$ concentration at equilibrium.

$$0.048 \times 0.052 = 2.5 \times 10^{-3} \text{ M } H_3O^+$$

$$CH_3COOH + H_2O \rightleftharpoons H_3O^+ + CH_3COO^-$$

2. (2 Pts) Predict the direction in which the equilibrium will lie for the reaction
$$H_2CO_3 + F^- \rightleftharpoons HCO_3^- + HF. \qquad K_{a1}(H_2CO_3) = 4.2 \times 10^{-7}; K_a(HF) = 7.1 \times 10^{-4}$$
   A) to the right
   B) to the left   Favors weaker acid
   C) in the middle

3. (3 Pts) Which one of these salts will form a *neutral* solution on dissolving in water?
   A) NaCl ← each ion comes from strong.
   B) KNO_2
   C) NaCN
   D) NH_4NO_3
   E) $FeCl_3$

4. (3 Pts) Which one of these salts will form a *basic* solution on dissolving in water?
   A) NaCl
   B) KCN $CN^- + H_2O \rightleftharpoons HCN + OH^-$
   C) $NaNO_3$
   D) NH_4NO_3
   E) $FeCl_3$

5. (4 Pts) Calculate the pH of a 0.021 M NaCN solution. $[K_a(HCN) = 4.9 \times 10^{-10}]$

$$NaCN \rightarrow Na^+ + CN^-$$
$$CN^- + H_2O \rightleftharpoons HCN + OH^-$$

$K_b = \frac{K_w}{K_a} = 2.04 \times 10^{-5}$
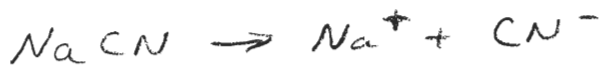
	CN^-		HCN	OH^-
I	0.021		0	0
C	$-x$		x	x
E	$0.021-x$		x	x

$2.04 \times 10^{-5} = \frac{x^2}{0.021-x}$ ← drop 5%?

$x = 6.5 \times 10^{-4} = [OH^-]$

$pOH = 3.18 \qquad pH = 10.82$

More questions on back of page.

6. (2 Pts) Which one of the following is a buffer solution?
   A) 0.40 M HCN and 0.10 KCN   weak acid and its conj base
   B) 0.20 M CH₃COOH
   C) 1.0 M HNO₃ and 1.0 M NaNO₃
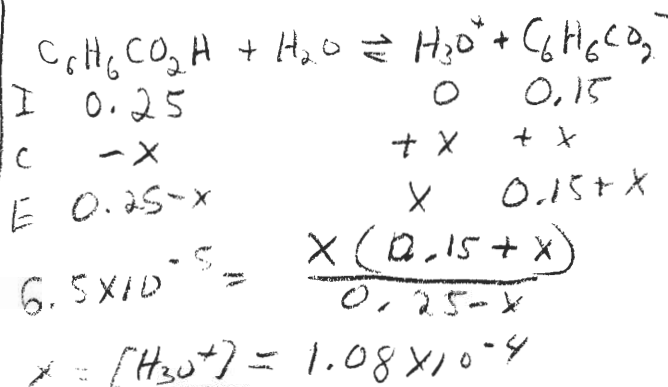   D) 0.10 M KCN
   E) 0.50 M HCl and 0.10 NaCl

7. (4 Pts) Calculate the pH of a buffer solution that contains 0.25 M benzoic acid ($C_6H_5CO_2H$) and 0.15M sodium benzoate (C_6H_5COONa).   [$K_a = 6.5 \times 10^{-5}$ for benzoic acid]

$$pH = pKa + Log \frac{CB}{A}$$

$$pH = -Log\ 6.5 \times 10^{-5} + Log \frac{0.15}{0.25}$$

$$= 4.19 + Log \frac{0.15}{0.25}$$

$$\widehat{pH = 3.97}$$

$$C_6H_6CO_2H + H_2O \rightleftharpoons H_3O^+ + C_6H_6CO_2^-$$

I	0.25	0 0.15
C	-X	+X +X
E	0.25-x	X 0.15+X

$$6.5 \times 10^{-5} = \frac{X(0.15+X)}{0.25-X}$$

$$x = [H_3O^+] = 1.08 \times 10^{-4}$$

$$\widehat{pH = 3.97}$$

8. (4 Pts) Calculate the pH of a solution that is 0.20M NH₃(aq) and 0.35 M NH₄Cl(aq).
   ($K_b(NH_3) = 1.8 \times 10^{-5}$)

$$pK_b + pKa = 14$$

$$4.74 + pKa = 14$$

$$pKa = 9.26$$

$$pH = 9.26 + Log \frac{0.20}{0.35}$$

$$\widehat{pH = 9.01}$$

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

I	0.20	0.35 0
C.	-X	+X +X
E	0.20-x	0.35+X X
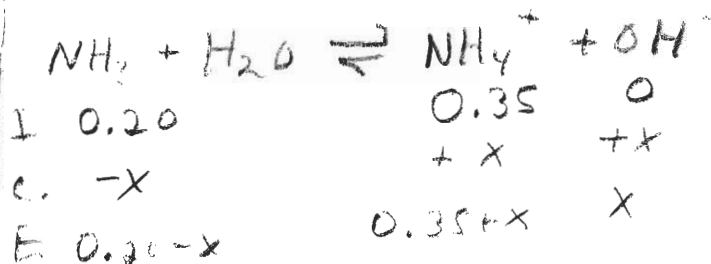
$$K_b = \frac{(0.35+X)(X)}{0.20-X} \quad drop\ x$$
$$5\%\ rule$$

$$x = [OH^-] = 1.029 \times 10^{-5}$$

$$pOH = 4.97$$

$$\widehat{pH = 9.01}$$