

Chemistry 1410 Spring 2005

Quiz 3, Section 1, 20 pts

Name _____ (please print)

$$K_w = [H^+][OH^-] \quad pH = -\log[H^+] \quad pOH = -\log[OH^-] \quad pH + pOH = 14$$

$$K_a K_b = K_w$$

1. Calculate the pH of the following solutions.

a)(3) A 0.82 M HCl solution. $HCl \rightarrow H^+ + Cl^-$

$$pH = -\log[H^+] = -\log(0.82) = 0.09$$

b)(3) If 3.8 grams of NaOH is dissolved in enough water to create a total solution volume of 400 mL.

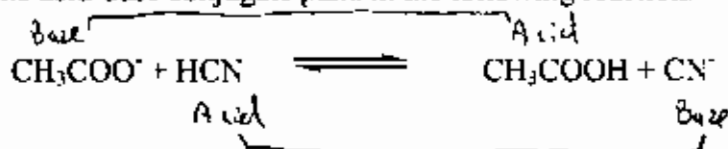
$$3.8 \text{ g NaOH} \times \frac{1 \text{ mole NaOH}}{40.0 \text{ g}} = 0.095 \text{ moles NaOH}$$

$$M_{NaOH} = \frac{0.095 \text{ moles}}{0.400 \text{ L}} = 0.2375 \text{ M NaOH} \quad NaOH \rightarrow Na^+ + OH^-$$

$$pOH = -\log[OH^-] = -\log(0.2375) = 0.62$$

$$pH = pK_w - pOH = 14 - 0.62 = 13.38$$

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

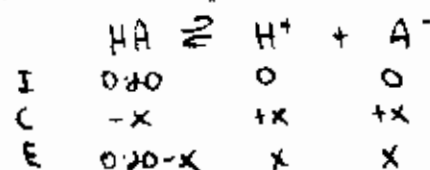


3. The K_a value for ascorbic acid (Vitamin C) is 8.0×10^{-5} .

(2) a) The pH of a 0.20 M solution of ascorbic 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 0.20 M solution of ascorbic acid.



$$K_a = 8.0 \times 10^{-5} = \frac{[\text{H}^+][\text{A}^-]}{[\text{HA}]} = \frac{(x)(x)}{0.20-x}$$

if $x \ll 0.2$

$$8.0 \times 10^{-5} = \frac{x^2}{0.20}$$

$$x = \left((0.20)(8.0 \times 10^{-5}) \right)^{1/2} = 4 \times 10^{-3}$$

$$\frac{4 \times 10^{-3}}{0.2} \times 100 = 2\% \quad \text{so } x \ll 0.2$$

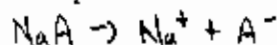
$$x = [\text{H}^+] = 4 \times 10^{-3}$$

$$\text{pH} = -\log(4 \times 10^{-3}) = 2.4$$

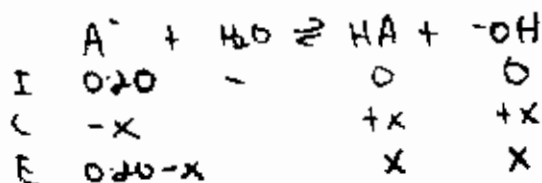
- 4.(2) The pH of a 0.20 M solution of sodium ascorbate (NaA) is

- ☒ A. Greater than 7
☐ B. Less than 7
☐ C. Equal to 7
☐ D. Insufficient information to predict.

- (4) b) Calculate the pH of a 0.20 M solution of sodium ascorbate. $\leftarrow$ conjugate base of ascorbic acid



$$K_b = \frac{K_w}{K_a} = \frac{1 \times 10^{-14}}{8.0 \times 10^{-5}} = 1.25 \times 10^{-10} = \frac{[\text{HA}][\text{OH}^-]}{[\text{A}^-]}$$



$$1.25 \times 10^{-10} = \frac{(x)(x)}{0.20-x}$$

if $x \ll 0.2$

$$1.25 \times 10^{-10} = \frac{x^2}{0.2}$$

$$\frac{5 \times 10^{-6}}{0.2} \times 100 = 2.5 \times 10^{-4}\% \quad \sqrt{(1.25 \times 10^{-10})(0.2)} = x$$

so $x \ll 0.2$

$$5 \times 10^{-6} = x$$

$$x = [\text{OH}^-] = 5 \times 10^{-6}$$

$$\text{pOH} = -\log(5 \times 10^{-6}) = 5.3$$

$$\text{pH} = 14 - \text{pOH} = 14 - 5.3 = 8.7$$