

1. Find the pH for each of the following: (12 points)

a. 0.25 M HCO<sub>2</sub>H

$$\frac{x^2}{0.25-x} = 1.8 \times 10^{-4}$$

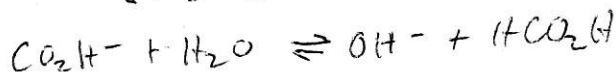
using approx  $\frac{x^2}{0.25} = 1.8 \times 10^{-4}$

2  $x = 6.71 \times 10^{-3} \text{ M} = [\text{H}^+]$

(Approx is valid since x is 2.68% of 0.25)

b. 0.520 M NaCO<sub>2</sub>H

$[\text{CO}_2\text{H}^-] = 0.520 \text{ M}$



3  $K_b = \frac{K_w}{1.8 \times 10^{-4}} = 5.56 \times 10^{-11} = \frac{[\text{OH}^-][\text{HCO}_2\text{H}]}{[\text{CO}_2\text{H}^-]} = \frac{x^2}{0.520-x}$

using approx,  $x = 5.37 \times 10^{-6} = [\text{OH}^-]$   
(Valid → x is 0.001% of 0.520)

pOH = 5.27

**pH = 8.73**

2. You want to prepare a buffer with pH = 8.75 from 0.15 M NH<sub>4</sub>Cl and 0.10 M NH<sub>3</sub>. Starting with 100.0 mL of 0.15 M NH<sub>4</sub>Cl, how many milliliters of 0.10 M NH<sub>3</sub> must you add? (8 points)

1  $\text{pH} = \text{pK}_a + \log \frac{[\text{A}^-]}{[\text{HA}]}$  For NH<sub>4</sub><sup>+</sup>, pK<sub>a</sub> = 9.25

1  $8.75 = 9.25 + \log \frac{[\text{NH}_3]}{[\text{NH}_4^+]}$

1  $-0.50 = \log \frac{[\text{NH}_3]}{[\text{NH}_4^+]} = \log \frac{n_{\text{NH}_3}}{n_{\text{NH}_4^+}}$

1  $0.316 = \frac{n_{\text{NH}_3}}{n_{\text{NH}_4^+}}$

$0.316 = \frac{n_{\text{NH}_3}}{15. \text{mmol}}$

$n_{\text{NH}_3} = 4.74 \text{ mmol}$

(conv to mL)  $\times \frac{1 \text{ mL}}{0.10 \text{ mmol}}$

**= 47 mL of 0.10 M NH<sub>3</sub>**

In 100.0 mL 0.15 M NH<sub>4</sub>Cl

$n_{\text{NH}_4^+} = 15. \text{mmol}$