**Buffer Problems**

1. Lactic acid is found in milk and human muscle tissue.

Calculate the pH of a solution containing 0.75 M lactic acid, $HC_3H_5O_3$ (Ka of $1.4 \times 10^{-4}$) and 0.25 M sodium lactate. **(pH 3.38)**

HA

A⁻

(1) $HA \rightleftharpoons H^+ + A^-$ (2) $K_A = \frac{[H^+][A^-]}{[HA]}$

(4)

| R | $HA \rightleftharpoons$ | $H^+$ | + | $A^-$ |
|---|---|---|---|---|
| I | 0.75 | ∅ | | 0.25 |
| C | $-x$ | $+x$ | | $+x$ |
| E | $0.75-x$ | $x$ | | $0.25+x$ |

$[H^+] = 4.2 \times 10^{-4}$ M

(6) ∴ pH 3.38

(3) $[H^+] = K_A \frac{[HA]}{[A^-]}$

(5) $= (1.4 \times 10^{-4}) \frac{(0.75)}{(0.25)}$

2. A buffered solution contains 0.25 M $NH_3$ ($K_b = 1.8 \times 10^{-5}$) and 0.40 M $NH_4Cl$.

Calculate the pH of this solution. **(pH 9.05)**

| R | $NH_3 \rightleftharpoons$ | $NH_4^+$ | + | $OH^-$ |
|---|---|---|---|---|
| I | 0.25 | 0.40 | | ∅ |
| C | $-x$ | $+x$ | | $+x$ |
| E | $0.25-x$ | $0.40+x$ | | $x$ |

$K_B = \frac{[NH_4^+][OH^-]}{[NH_3]}$

$[OH^-] = K_B \frac{[NH_3]}{[NH_4^+]}$

$= (1.8 \times 10^{-5}) \frac{(0.25)}{(0.40)}$

$[OH^-] = 1.125 \times 10^{-5}$ M

∴ $[H^+] = 8.89 \times 10^{-10}$ M

pH 9.05

3. Calculate the pH of the solution that results when 0.10 mol gaseous HCl is added to 1.0 L of the buffered solution from problem #2. **(pH 8.73)**

$NH_3 \rightleftharpoons NH_4^+ + OH^- \downarrow$ + $H^+$ → shift right means ↓ $[NH_3]$ + ↑ $[NH_4^+]$

* only subtract moles not mol/L!

$[OH^-] = K_B \frac{[\text{new } NH_3]}{[\text{new } NH_4^+]} = (1.8 \times 10^{-5}) \frac{(0.25\text{mol} - 0.1\text{mol})}{(0.4\text{mol} + 0.1\text{mol})}$

$= 5.4 \times 10^{-6} \frac{\text{mol}}{\text{L}}$ $OH^-$

∴ $H^+ = 1.85$ mol/L

pH 8.73