**CONCEPT:** HENDERSON-HASSELBALCH EQUATION

**Henderson-Hasselbalch Equation**

- Allows us to calculate the _____ of a buffer without having to use an _______ Chart.
  - □ Only applies to buffers composed of _______________ acid-base pairs.

| Henderson-Hasselbalch Equation | | |
|---|---|---|
| $pH = pK_{\_} + \log\frac{[CB]}{[\_\_]}$ | $pH = pK_{\_} + \log\frac{[CA]}{[\_\_]}$ | [ ] = __ or _____ |

**EXAMPLE**: Calculate the pH of a solution containing 2.0 M nitrous acid ($HNO_2$) and 1.48 M lithium nitrite ($LiNO_2$).

$K_a = 4.6 \times 10^{-4}$.

**PRACTICE:** The $K_b$ of $C_6H_5NH_2$ (aniline) is $3.9 \times 10^{-10}$. Determine pH of a buffer solution made up of 500 mL of 1.4 M $C_6H_5NH_2$ and 230 mL of 2.3 M $C_6H_5NH_3^+$.

**CONCEPT:** HENDERSON-HASSELBALCH EQUATION

**PRACTICE:** Determine the buffer component concentration ratio (CB/WA) for a buffer with a pH of 4.7. $K_a$ of boric acid ($H_3BO_3$) is $5.4 \times 10^{-10}$.

**PRACTICE:** Calculate mass of $NaN_3$ that needs be added to 1.8 L of 0.35 M $HN_3$ in order to make a buffer with a pH of 6.5. Ka of hydrazoic acid is $1.9 \times 10^{-5}$.

**CONCEPT:** HENDERSON-HASSELBALCH EQUATION

$$pH = pKa + \log\frac{[CB]}{[WA]}$$

$$pH = pKb + \log\frac{[CA]}{[WB]}$$

**Calculating Buffer Range**

- Buffers are ____________ at a specific pH range: $pH = pKa \pm$ __
- Recall that a buffer is __________ when [WA] = [CB] or [WB] = [CA].
  - □ This is because _____ of the buffer will equal to ______ of the WA, and will resist pH change the best.

$$pH = pKa + \log\frac{[0.40]}{[0.40]} \longrightarrow pH = pKa + \_\_\_\_\_ \longrightarrow pH = \_\_\_\_$$

**EXAMPLE**: Determine the buffering range of a solution containing lactic acid ($K_a = 1.4 \times 10^{-4}$) and sodium lactate.

**PRACTICE:** Which of the following weak acid-conjugate base combinations would result in an ideal buffer solution with a pH of 9.4?

a) formic acid ($HCHO_2$) and sodium formate ($K_a = 1.8 \times 10^{-4}$)

b) benzoic acid ($HC_7H_5O_2$) and potassium benzoate ($K_a = 6.5 \times 10^{-5}$)

c) hydrocyanic acid (HCN) and lithium cyanide ($K_a = 4.9 \times 10^{-10}$)

d) iodic acid ($HIO_3$) and sodium iodate ($K_a = 1.7 \times 10^{-1}$)