CONCEPT: HENDERSON-HASSELBALCH EQUATION

We learned that whenever we had a(n) _____ acid or base we were supposed to use our favorite friend the _____ Chart in order to calculate the pH or pOH.

Now, whenever we have a buffer solution we can skip it and use the _____ Equation.

Buffer Equation:

$$\text{pH} = \text{pKa} + \log \frac{(\text{conjugate base})}{(\text{weak acid})}$$

EXAMPLE: What is the pH of a solution consisting of 2.75 M sodium phenolate (C_6H_5ONa) and 3.0 M phenol (C_6H_5OH). The K_a of phenol is 1.0×10^{-10}.

PRACTICE: Calculate the pH of a solution formed by mixing 250 mL of a 0.500 M $C_2H_5NH_2$ solution with 300 mL of a 0.450 M $C_2H_5NH_3^+$ solution. (K_b of $C_2H_5NH_2$ is 5.6×10^{-4}).

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EXAMPLE: What is the buffer component concentration ratio, $\frac{[Pr^-]}{[HPr]}$, of a buffer that has a pH of 5.11. (The K_a of HPr is 1.30×10^{-5}).

EXAMPLE: Over what pH range will an oxalic acid ($H_2C_2O_4$) / sodium oxalate ($NaHC_2O_4$) solution work most effectively? The acid dissociation constant of oxalic acid is 6.0×10^{-2}.

a) 0.22 - 2.22 b) 1.00 – 3.00 c) 0.22 – 1.22 d) 2.0 – 4.0

PRACTICE: Determine how many grams of sodium acetate, $NaCH_3CO_2$ (MW: 82.05 g/mol), you would mix into enough 0.065 M acetic acid CH_3CO_2H (MW: 60.05 g/mol) to prepare 3.2 L of a buffer with a pH of 4.58. The K_a is 1.8×10^{-5}.

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EXAMPLE: Which weak acid-conjugate base combination would be ideal to form a buffer with a pH of 4.74.

a) Cyanic acid and Potassium cyanate ($K_a = 4.9 \times 10^{-10}$)

b) Benzoic acid and Lithium benzoate ($K_a = 6.3 \times 10^{-5}$)

c) Acetic acid and Sodium acetate ($K_a = 1.7 \times 10^{-5}$)

d) Ammonium chloride and Ammonia ($K_a = 5.56 \times 10^{-10}$)

e) Formic acid and Cesium formate ($K_a = 1.7 \times 10^{-4}$)

PRACTICE: A buffer solution is made by combining a weak acid with its conjugate salt. What will happen to the pH if the solution is diluted to one-fourth of its original concentration?

a) The pH will increase

b) The pH will decrease

c) The pH will remain constant

d) The solution will become more neutral