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Data Tables

Part A. pH of Acetic Acid-Sodium Acetate Buffer

mL of 0.2 M HCl added	pH		mL of 0.2 M	рН	
	Actual	Calc.	NaOH added	Actual	Calc.
0			0		
1.0			1.0		
2.0			2.0		
3.0			3.0		
4.0			4.0		
5.0			5.0		
6.0			6.0		
7.0			7.0		
8.0			8.0		
9.0			9.0		
10.0			10.0		

Part B. pH of Ammonia-Ammonium Chloride Buffer

mL of 0.2 M HCl added	рН		mL of 0.2 M	рН	
	Actual	Calc.	NaOH added	Actual	Calc.
0			0		
1.0			1.0		
2.0			2.0		
3.0			3.0		
4.0			4.0		
5.0			5.0		
6.0			6.0		
7.0			7.0		
8.0			8.0		
9.0			9.0		
10.0			10.0		

Part C.

mL of 0.1 M CH ₃ COOH	mL	рН	_ (calc.)
mL of 0.1 M NaCH ₃ COO	mL	pH	_ (actual)

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Calculations

- 1. Using Equation 4 on page 1, calculate the pH of the Part A acetic acid–sodium acetate buffer solution before and after 1.0 mL of 0.2 M HCl solution is added to the buffer. K_a of acetic acid equals 1.8×10^{-5} . Enter these in the Part A Data Table.
- 2. Repeat the pH calculation for each successive 1.0 mL increment of 0.2 M HCl added to the buffer. Enter these values in the Part A Data Table.
- 3. When strong base is added to a buffer of a weak acid–conjugate base, the acid reacts with the base to form water and its conjugate base.

 $\mathrm{HA}(\mathrm{aq}) \,+\, \mathrm{OH}^{-}(\mathrm{aq}) \,\rightarrow\, \mathrm{H}_{2}\mathrm{O}(\mathrm{l}) \,+\, \mathrm{A}^{-}(\mathrm{aq})$

Calculate the pH of the Part A acetic acid–sodium acetate buffer solution after 1.0 mL of the 0.2 M NaOH solution is added to the buffer. Enter this value in the Part A Data Table.

- 4. Repeat the pH calculation for each successive 1.0 mL increment of 0.2 M NaOH added to the buffer. Enter these values in the Part A Data Table.
- 5. The ammonia–ammonium chloride buffer solution is a weak base–conjugate acid buffer solution. $K_{\rm b}$ for NH₃ = 1.8 × 10⁻⁵. Using Equation 4 on page 1 and the relationship, pH = 14.0 pOH, calculate the pH of the ammonia–ammonium chloride buffer solution after 1.0 mL of 0.2 M HCl is added to the buffer solution. The initial moles of both NH₃ and NH₄Cl in 50 mL of the buffer solution are 0.0025 moles. Record the pH value in the Part B Data Table.

$$\mathrm{NH}_3(\mathrm{aq}) + \mathrm{H}_3\mathrm{O}^+(\mathrm{aq}) \rightarrow \mathrm{NH}_4^+(\mathrm{aq}) + \mathrm{H}_2\mathrm{O}(\mathrm{l}).$$

- 6. Repeat the pH calculation for each successive 1.0 mL increment of 0.2 M HCl added to the buffer. Enter these values in the Part B Data Table.
- 7. Repeat the pH calculations for each 1.0 mL increment of 0.2 M NaOH added to the ammonia–ammonium chloride buffer solution. Enter these values in the Part B Data Table.

Post-Laboratory Review Questions

1. Calculate the pH change when 1 mL 0.2 M HCl is added to 50 mL of deionized water. How does this pH value change compare to those obtained when 1 mL of 0.2 M HCl is added to the buffers?

2. At what point did each of the buffers lose their effectiveness? Explain.