

Experiment 10

- Use a graduated cylinder to measure out 10.0 mL of the Buffer B solution and add 15 mL of distilled water. Repeat the necessary steps to test Buffer B in a manner similar to the Part I trials. Determine the volumes of NaOH and HCl that were used to change the pH of Buffer B by 2 units and record the values in your data table. Remember to save the data from the titration with NaOH solution.
- Print the two graphs for the titrations of Buffer A and Buffer B with 0.5 M NaOH. Print the graphs directly from LabQuest, or transfer the data to a computer and Logger Pro software to prepare and print the graphs.

DATA TABLE

	Buffer A	Buffer B
Mass of NaC ₂ H ₃ O ₂ used to prepare buffer (g)	0.149 g	1.49 g
Volume of buffer prepared (mL)	100.0	100.0
Molar concentration of HC ₂ H ₃ O ₂ in buffer (M)	0.1	1.0
Initial pH of buffer	4	4
Volume of 0.5 M NaOH to raise pH by 2 units (mL)	10 mL	17 mL
Volume of 0.5 M HCl to lower pH by 2 units (mL)	10 mL	10 mL
Volume of 0.5 M NaOH at equivalence point (mL)	20 mL	22 mL

DATA ANALYSIS

- Write reaction equations to explain how your acetic acid-acetate buffer reacts with an acid and reacts with a base.

$$\text{CH}_3\text{CO}_2\text{H}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{CH}_3\text{CO}_2^-(\text{aq})$$

$$\text{H}_3\text{O}^+(\text{aq}) + \text{CH}_3\text{CO}_2^-(\text{aq}) \rightleftharpoons \text{CH}_3\text{CO}_2\text{H}(\text{aq}) + \text{H}_2\text{O}(\text{l})$$
- Buffer capacity has a rather loose definition, yet it is an important property of buffers. A commonly seen definition of buffer capacity is: "The amount of H⁺ or OH⁻ that can be neutralized before the pH changes to a significant degree." Use your data to determine the buffer capacity of Buffer A and Buffer B.

2) The buffer capacity for Buffer A was 20 mL of NaOH solution, and 22 mL of NaOH solution for Buffer B.
- Say, for example, that you had prepared a Buffer C, in which you mixed 8.203 g of sodium acetate, NaC₂H₃O₂, with 100.0 mL of 1.0 M acetic acid.

$$M = \frac{\text{mass/molar mass}}{\text{L soln.}} = \frac{(8.203)/(81.944)}{0.1 \text{ L}} = 6.72 \times 10^{-3} \text{ M}$$
 - What would be the initial pH of Buffer C?
 - If you add 5.0 mL of 0.5 M NaOH solution to 20.0 mL each of Buffer B and Buffer C, which buffer's pH would change less? Explain.

3) a)
$$\text{pH} = -\log(1.8 \times 10^{-5}) + \log\left(\frac{[\text{NaC}_2\text{H}_3\text{O}_2]}{0.1}\right)$$

$$= -\log(1.8 \times 10^{-5}) + \log\left(\frac{6.72 \times 10^{-3}}{0.1}\right)$$

$$= 9.57 \rightarrow \approx 10$$

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b) Buffer C, because it has a greater mass of sodium acetate than Buffer B.