

pH and Buffers

Objective:

To measure pH and the effects of buffers and to explain in a short essay the importance of maintaining pH and buffering at critical values in the body, at the level of 85% proficiency for each student.

In order to achieve this objective, you will need to be able to:

1. Define *pH*, *buffer*
2. Measure pH using pH paper and pH meters
3. Observe buffer action and to compare three buffers.

pH and Buffers

Materials:

Group Supplies

pH meter
pH paper (optional)
forceps
ring stand with titration burette and clamp
3 - 100 mL beakers
250 mL beaker for titration
250 mL beaker for rinse waste
0.0015 N HCl to fill the burette
20 mL of each
 Phosphate Buffer (Sorensen's buffer)
 Milk
 Vinegar
50 mL of each
 0.9% NaCl
 Phosphate Buffer (Sorensen's buffer)
 Blood plasma
Safety glasses (as available)

Methods:

1. Using the pH paper and the pH meter, measure and record the pH of the solutions listed in Table 1.
2. Using a 50 mL burette with 0.0015 N HCl, titrate acid into each of the following solutions: (1) 50 mL of 0.9% NaCl, (2) 50 mL of Sorensen's buffer, (3) 50 mL of Blood Plasma. For each solution listed in Table 2 take a pH reading before titration and after each addition of HCl in 10 mL increments. Be careful to not cross contaminate each subsequent measurement.

Results:

Table 1 – Measurement of pH		
Solution	pH paper	pH meter (optional)
20 mL of Phosphate Buffer		
20 mL milk		
20 mL vinegar		

Table 2 – Buffering action of NaCl, Phosphate Buffer, and Blood					
0.9% NaCl (50 mL)		Phosphate Buffer (50 mL)		Blood Plasma (50 mL)	
0.0015 N HCl Titrated	pH	0.0015 N HCl Titrated	pH	0.0015 N HCl Titrated	pH
0 mL		0 mL		0 mL	
10 mL		10 mL		10 mL	
20 mL		20 mL		20 mL	
30 mL		30 mL		30 mL	
40 mL		40 mL		40 mL	
50 mL		50 mL		50 mL	

Discussion:

1. If you know pH, can you determine the actual hydrogen ion concentration? Explain.
2. The pH scale allows us to use simpler numbers to express hydrogen ion concentration. Can you think of any disadvantages in using pH instead of molarity?
3. Describe some activities or situations that might decrease body fluid pH, increase pH.
4. What is a buffer? Do buffers actually get rid of hydrogen ions? Explain.
5. Using the titration data, plot the 3 curves on one graph, with the pH on the Y axis and the mL of 0.0015 N HCl on the X axis. Compare the graphs from each titration. What do these graphs reveal about the buffering capacity of each solution?
6. Name an actual body buffer system. Using chemical formulas illustrate how this buffer system works if excess hydrogen ions are present and if too few hydrogen ions are present.
7. Describe the significance of buffer systems in pH regulation. That is, what would life be like without body fluid buffers?