



pH Properties of Buffer Solutions AP Chemistry Laboratory #19

Introduction

One of the most important applications of acids and bases in chemistry and biology is that of buffers. A buffer solution resists rapid changes in pH when acids and bases are added to it. Every living cell contains natural buffer systems to maintain the constant pH needed for proper cell function. Many consumer products are also buffered to safeguard their activity. What are buffers made of? How do buffers maintain the delicate pH balance needed for life and health?

Concepts

- Buffer
- Weak acid–weak base
- Conjugate acid–base pair
- Dissociation constant
- Ideal buffer

Background

The ability of buffers to resist changes in pH when acid or base is added is a result of their chemical composition. All buffers contain a mixture of a conjugate acid–base pair; either a weak acid (HA) and its conjugate base (A^-), or a weak base (B), and its conjugate acid (BH^+). Weak acids and weak bases both dissociate slightly in water (Reactions 1 and 2).



These reactions are reversible and both the weak acid and its conjugate base or the weak base and its conjugate acid are present in solution.

The equilibrium constant expressions for these dissociation reactions are:

$$K_a = \frac{[H_3O^+][A^-]}{[HA]} \quad \text{Equation 1}$$

$$K_b = \frac{[OH^-][BH^+]}{[B]} \quad \text{Equation 2}$$

Buffers control pH because the two buffering components, either HA and A^- or B and BH^+ , are able to neutralize both acids and bases added to the solution.



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