# Section 14.6
# Buffers

Michael Stogsdill

Mott Community College

# Learning Objectives

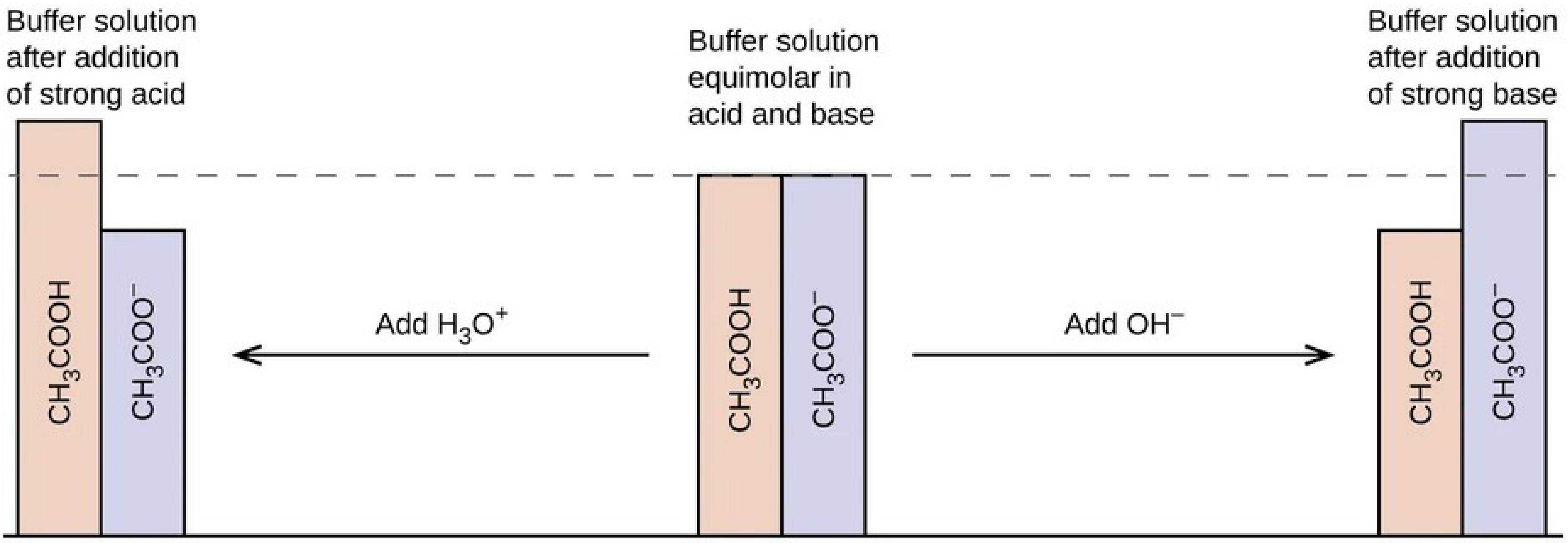
- Describe the composition and function of acid–base buffers
- Calculate the pH of a buffer before and after the addition of added acid or base

# Buffers

- A solution containing a weak conjugate acid-base pair is called a buffer solution, or a buffer.
  - They are usually prepared from a weak acid or base and the salt of its conjugate pair.
- Buffer solutions resist a change in pH when small amounts of a strong acid or a strong base are added


# How Buffers Work

$$CH_3COOH(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + CH_3COO^-(aq)$$



# Buffer Capacity

- Buffer solutions do not have an unlimited capacity to keep the pH relatively constant
  - The ability of a buffer solution to resist changes in pH relies on the presence of significant amounts of its weak acid-base pair.
  - When enough strong acid or base is added to lower the concentration of either member of the buffer pair, the buffering action within the solution is compromised.
- The **buffer capacity** is the amount of acid or base that can be added to a given volume of a buffer solution before the pH changes

# Buffer Capacity

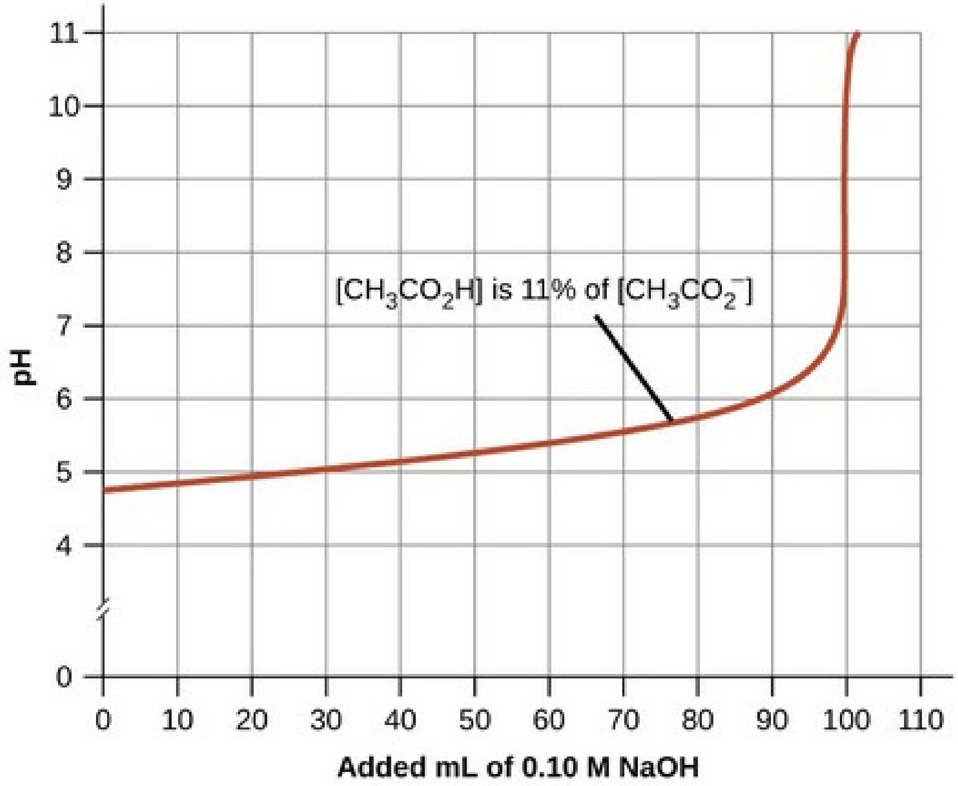
- Buffer capacity depends on the amounts of the weak acid and its conjugate base that are in a buffer mixture.
  - pH is determined by the ratio of conjugate pairs.

# Selection of Suitable Buffer Mixtures

- A good buffer mixture should have about equal concentrations of both of its components.
  - This helps to avoid exhausting one of the components.
- Weak acids and their salts are better as buffers for pHs less than 7
- Weak bases and their salts are better as buffers for pHs greater than 7.

# Selection of Suitable Buffer Mixtures

- A buffer solution has generally lost its usefulness when one component of the buffer pair is less than about 10% of the other.



# The Henderson-Hasselbalch Equation

- The ionization-constant expression for a solution of a weak acid can be written as:

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

- Rearranging to solve for $[H_3O^+]$ yields:

$$[H_3O^+] = K_a \times \frac{[HA]}{[A^-]}$$

# The Henderson-Hasselbalch Equation

- Taking the negative logarithm of both sides of this equation gives

$$-\log[H_3O^+] = -\log K_a - \log\frac{[HA]}{[A^-]}$$

- Which can be written as

$$pH = pK_a + \log\frac{[A^-]}{[HA]}$$

  - It is important to note that the “x is small” assumption must be valid to use this equation.