Characteristics of Buffers

- Composition
  - Significant amounts of a weak acid and its conjugate base
    - Example acetic acid and sodium acetate
  - Significant amounts of a weak base and its conjugate acid
    - Example ammonia and ammonium chloride

- Resist a change in pH when small amounts of acid or base is added

Making a buffer solution

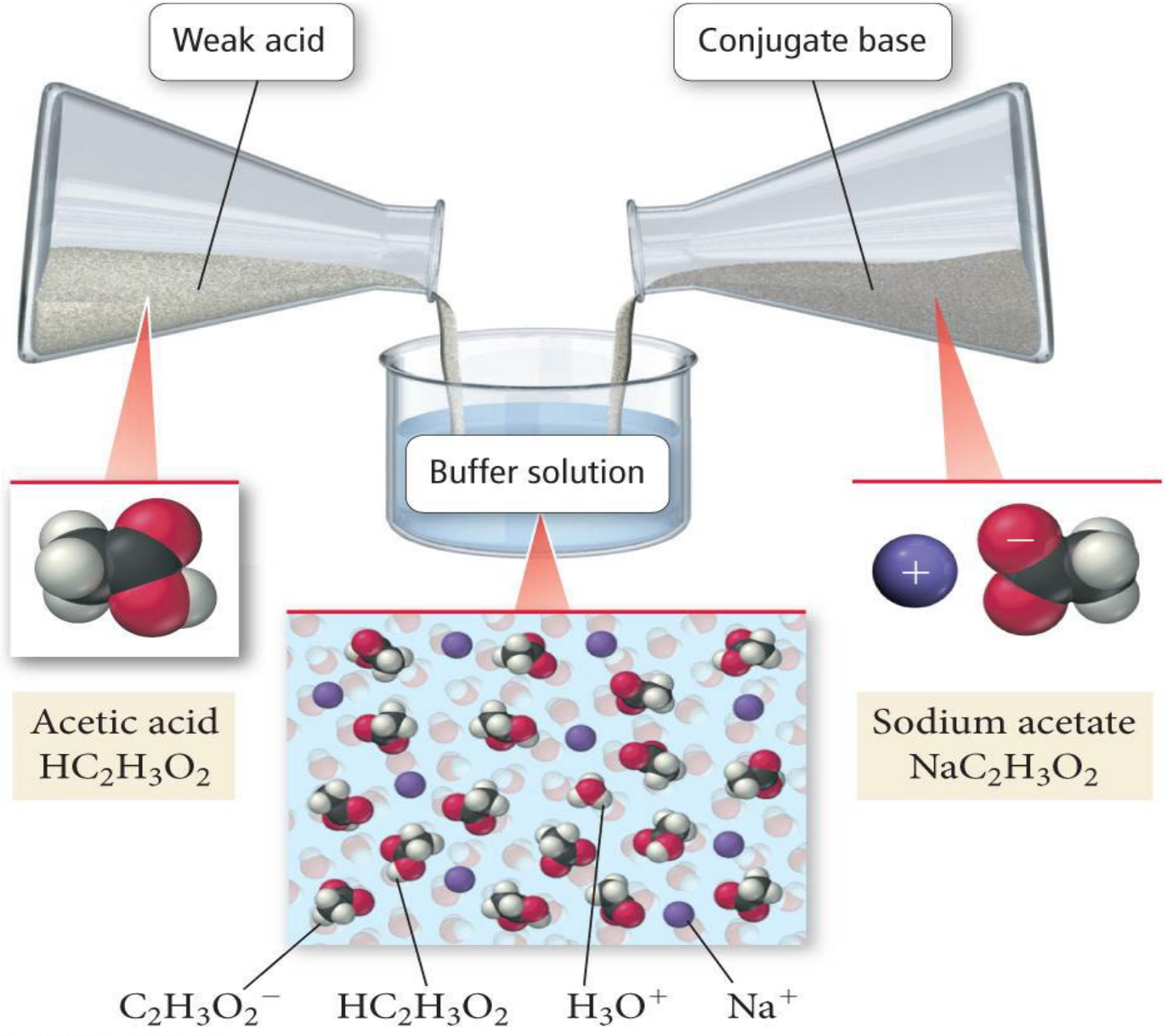

Figure 16.1 : Tro, N. , "Chemistry: A Molecular Approach", 3 r edition, Pearson Prentice Hall, 2013.

Henderson–Hasselbalch Equation

- An equation derived from the K_a expression that allows us to calculate the pH of a buffer solution.

$$\mathrm{pH} = \mathrm{p}K_a + \log\frac{[\text{base}]}{[\text{acid}]}$$

- If given a weak base + conjugate acid buffer solution determine the K_a from using the given K_b and

$$K_w = K_a \times K_b$$

Tro, N. , "Chemistry: A Molecular Approach", 3 r edition, Pearson Prentice Hall, 2013.

Using the Henderson-Hasselbalch equation

- The Henderson–Hasselbalch equation is generally good enough when the "*x* is small" approximation is applicable.

- For most problems, this means that the initial acid and salt concentrations should be over 100 to 1000 times larger than the value of K_a.

Example: Calculating the pH of an acid using the Henderson–Hasselbalch equation

$$\mathrm{pH} = \mathrm{p}K_\mathrm{a} + \log\frac{[\mathrm{base}]}{[\mathrm{acid}]}$$

Calculate the pH of a buffer solution composed of 0.050 M acetic acid ($HC_2H_3O_2$) and 0.100 M sodium acetate ($NaC_2H_3O_2$). Ka = 1.8×10^{-5}

Example: Calculating the pH for a basic buffer using the Henderson–Hasselbalch Equation

Step 2 :

$$\mathrm{pH} = \mathrm{p}K_\mathrm{a} + \log\frac{[\mathrm{base}]}{[\mathrm{acid}]}$$

- base is ammonia, conjugate acid is ammonium
- Use the Ka of ammonium

How do we make a buffer in lab?

1. What is the best choice to make a 0.100 M buffer with a pH of 4.5?

a. Acetic acid/sodium acetate

b. Ammonium chloride/ammonia

Example Problem (making a buffer)

Using your choice in part #1, determine what volume of 1.0 M HA (weak acid) and 1.0 M NaA (sodium salt of conjugate base) we need to use to make 1.0 L of a 0.100 M buffer