Buffer

A solution of a weak acid and its salt (i.e. its conjugate base) OR a weak base and its salt (i.e. its conjugate acid)

What a buffer does: resists a change in pH

How a buffer works: since a buffer contains a pair of acid/base conjugates, it has both an acidic and a basic component that can react

- When a small amount of strong acid is added to a buffer, the base in the buffer "attacks" the H^+ (aka H_3O^+) that was added, thus neutralizing the H^+ and **pH does not change** significantly
- When a small amount of strong base is added to a buffer, the acid in the buffer "attacks" the OH^- that was added, thus neutralizing the OH^- and **pH does not change** significantly

How to solve buffer problems:

$$[H^+] = Ka \times \left(\frac{mols\ weak\ acid}{mols\ conjugate\ base}\right)$$

Buffer capacity: once all the moles of weak acid or all the moles of conjugate base are used in neutralization, the buffer is destroyed and the solution is no longer a buffer (because either the weak acid or conjugate base is missing), thus the addition of strong acid or base to the solution will cause pH to change.

- More concentrated buffers are able to neutralize more acid or base, thus having a higher capacity

Perfect Buffer: the most effective buffer, occurs when…

- mols acid = mols base
- $[H^+] = Ka$
- pH = pKa
- When choosing a buffer, pick an acid whose pKa is close to the desired pH
    - Example: if you want a buffered solution with pH of 5.00, pick an acid whose pKa is about 5.00 (meaning a Ka of 1.0×10^{-5})

Example

Calculate the pH of 0.500 L of a buffer solution composed of 0.50 M methanoic acid (HCHOO) and 0.70 M sodium methanoate (NaCHOO) before and after adding 10.0 mL of 1.00 M HCl. Ka of methanoic acid is 1.8×10^{-4}.

Buffer Examples

1. What is the pH of a solution that contains 0.350 mol of HCN and 0.250 mol NaCN if HCN's Ka = 5.8×10^{-10}?

2. What is the pH of a solution when 100.0 mL of a 1.00 M NaF is added to 100.0 mL of a 2.00 M HF if HF's Ka = 6.9×10^{-4}?

3. What is the pH of 1.00 L of a 2.00 M $KC_2H_3O_2$ solution if 3.00 moles of acetic acid are added to it? The Ka of acetic acid is 1.8×10^{-5}.

4. What is the pH when 0.100 L of a 1.00 M NaF solution is added to 0.200 L of a 2.00 M HF solution if the Ka for HF is 6.9×10^{-4}?

5. What is the pH of the solution in Question #4 if 0.100 moles of KOH are added to it?

6. What is the pH of the solution in Question #3 if 0.500 moles of HCl are added to it?

7. What is a perfect buffer and how do you recognize one? What is the $[H^+]$ always equal to?