AP Chemistry
Ms. Ye

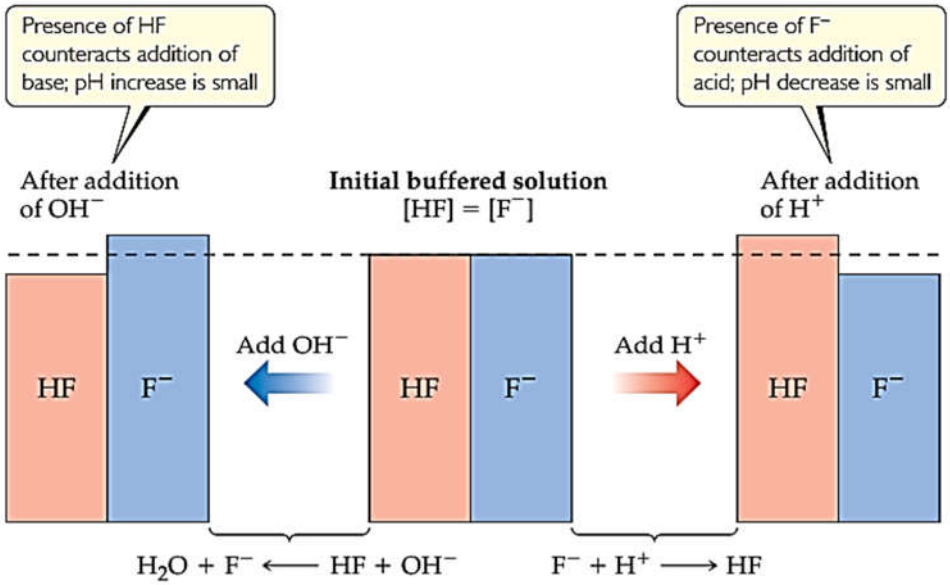
Name _____
Date _____Block _____

BUFFER SOLUTIONS

- Buffers _____ when small amounts of strong acid or strong base are added to them.

How?

- Buffer solutions that contain a _____. This means it contains both an acid to neutralize added OH^- ions and a base to neutralize added H^+ ions.
- Ex: Human blood is a complex buffered solution that maintains the blood pH at about 7.4



▲ **FIGURE 17.2** **Buffer action.** The pH of an HF/F⁻ buffered solution changes by only a small amount in response to addition of an acid or base.

How do you prepare a buffer solution?

- Buffers are often prepared by _____ of that acid or base.
- Buffers **most effectively** resist a change in pH in either direction when the _____ _____. Thus, we usually try to select a buffer whose acid form has a _____.
- In practice, if the concentration of one component of the buffer is more than 10 times the concentration of the other component, the buffering action is poor.

How do you calculate the pH of a buffer solution?

- You can use an ICE Table or the Henderson-Hasselbalch Equation to calculate the pH of a buffer system

Ex: **Calculating the pH of a Buffer: Method 1**
What is the pH of a buffer that is 0.12 *M* in lactic acid [$HC_3H_5O_3$] and 0.10 *M* in sodium lactate [$NaC_3H_5O_3$]? For lactic acid, $K_a = 1.4 \times 10^{-4}$.

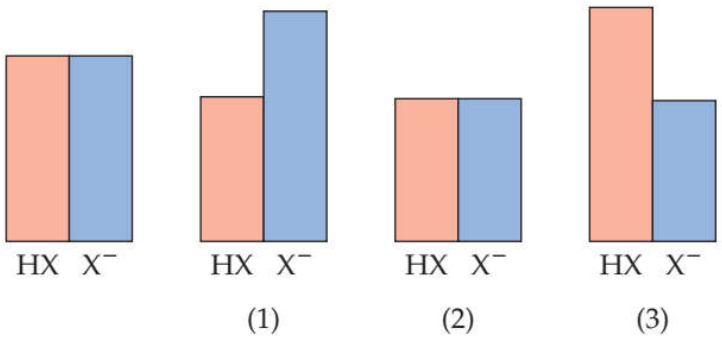
Ex: **Calculating the pH of a Buffer: Method 2**
What is the pH of a buffer that is 0.12 *M* in lactic acid [$HC_3H_5O_3$] and 0.10 *M* in sodium lactate [$NaC_3H_5O_3$]? For lactic acid, $K_a = 1.4 \times 10^{-4}$.

Ex: **Picking components for a specific buffer solution.**
The K_a values for nitrous acid (HNO_2) and hypochlorous (HClO) acid are 4.5×10^{-4} and 3.0×10^{-8}, respectively. Which one would be more suitable for use in a solution buffered at pH 7.0? What other substance would be needed to make the buffer?

Buffers Problem Set

1. A certain buffer is made by dissolving $NaHCO_3$ and Na_2CO_3 in some water. Write equations to show how this buffer neutralizes added H^+ and OH^-.

2. The drawings represents a buffer composed of equal concentrations of a weak acid, HX, and its conjugate base, X^-. The heights of the columns are proportional to the concentrations of the components in the buffer.



   a) Which of the next three drawings represents the buffer after the addition of a strong acid?

   b) Which of the next three drawings represents the buffer after the addition of a strong base?

   c) Which of the three represents a situation that cannot arise from the addition of either an acid or a base? <u>Explain.</u>

3. Explain why a mixture formed by mixing 100 mL of 0.100 M CH_3COOH and 50 mL of 0.100 M NaOH will ultimately become a buffer after reaction.

4. Calculate the pH of a solution that contains 0.10 M $HC_2H_3O_2$ and 0.050 M $NaC_2H_3O_2$. The K_a for acetic acid ($HC_2H_3O_2$)is 1.8×10^{-5}.

5. Calculate the $[H^+]$ in a solution containing 0.75 M HF ($K_a = 7.2 \times 10^{-4}$) and 1.25 M NaF.

6. Calculate the pH of a buffer solution composed of 0.12 M benzoic acid and 0.20 M sodium benzoate. (benzoic acid = $HC_7H_5O_2$ and the Ka = 6.4×10^{-5})

7. Calculate the [sodium benzoate] that must be present in a 0.20 M solution of benzoic acid to produce a pH of 4.00.

8. You are asked to prepare a pH 4.00 buffer starting from 1.50 L of 0.0200 M benzoic acid (C_6H_5COOH) and an excess of sodium benzoate (C_6H_5COONa).
   a. What is the pH of the benzoic acid solution **prior** to adding sodium benzoate?

   b. How many grams of sodium benzoate should be added to prepare the buffer? Neglect the small volume change that occurs when sodium benzoate is added.