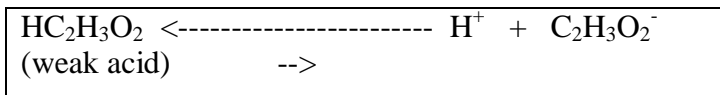


# Buffers – Ch 19.4

# Std 5

Buffers are created by mixing a weak acid and the salt of its conjugate base.



<p><b>Notice the equilibrium favors the acid (left) very strongly. That is why it is a weak acid. Not many ions get formed because it doesn't ionize much.</b></p> $\text{NaC}_2\text{H}_3\text{O}_2 \text{ -----> Na}^+ + \text{C}_2\text{H}_3\text{O}_2^-$ <p>(salt of conj. base)</p>
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Notice the salt (  $\text{NaC}_2\text{H}_3\text{O}_2$  ) ionization is 100% , which means that all of the salt is ionized and none of the original  $\text{NaC}_2\text{H}_3\text{O}_2$  is left. **This puts a lot of the  $\text{Na}^+$  and  $\text{C}_2\text{H}_3\text{O}_2^-$  ions into the water.**

After we put  $\text{HC}_2\text{H}_3\text{O}_2$  and  $\text{NaC}_2\text{H}_3\text{O}_2$  into the water, the ions and substances that can affect the pH are:



We now call this solution a buffer. This buffer will have a  $\text{pH} = 4 (\pm 2)$  depending on the concentrations of the ions.

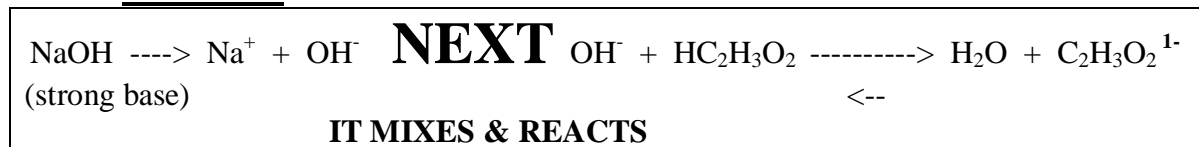
**Let's see what happens when we add acids or bases to the buffer:**

a. **ADD ACID**



At first  $\text{H}^+$  ions from the  $\text{HNO}_3$  make the solution more acidic (lower pH), but they are quickly “grabbed” by the  $\text{C}_2\text{H}_3\text{O}_2^-$  ions which act as “assassin” ions and hold on to the  $\text{H}^+$  ions. This will form  $\text{HC}_2\text{H}_3\text{O}_2$ , which returns the pH close to 4. The pH is again close to the original  $\text{pH} = 4$  because the  $\text{H}^+$  ions taken by the  $\text{C}_2\text{H}_3\text{O}_2^-$  ions are no longer in the water.

b. **ADD BASE**

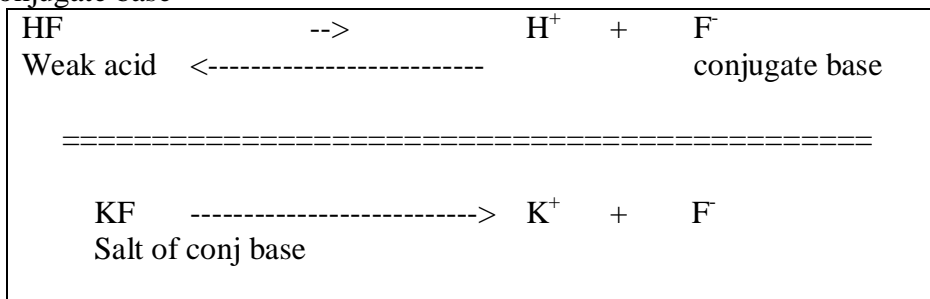


The  $\text{OH}^-$  ions act like “assassins” and “grab” the  $\text{H}^+$  ions away from the  $\text{HC}_2\text{H}_3\text{O}_2$  to form water and  $\text{C}_2\text{H}_3\text{O}_2^{1-}$  ions. That removes  $\text{OH}^-$  ions from the solution and makes more  $\text{C}_2\text{H}_3\text{O}_2^{1-}$  ions. Adding the  $\text{OH}^-$  ions only makes the solution more basic for a short time. When this second reaction takes place the pH come back close to  $\text{pH} = 4$  because the  $\text{OH}^-$  ions are used up forming water.

## Here are additional explanations of Buffers given in class

### Buffer example questions

1. Hydrofluoric acid (HF) a weak acid, and potassium fluoride (KF) the salt of its conjugate base

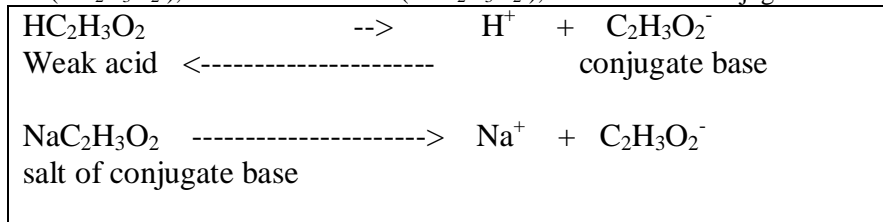


If we add OH<sup>-</sup> (NaOH) - What combines with the OH<sup>-</sup> ions so the pH doesn't change much?

If we add H<sup>+</sup> (HCl) – What combines with the H<sup>+</sup> ions so the pH doesn't change much?

[Answers](#)

2. Acetic acid (HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>), and sodium acetate (NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>), the salt of the conjugate base.



If we add OH<sup>-</sup> (NaOH) - What combines with the OH<sup>-</sup> ions so the pH doesn't change much?

If we add H<sup>+</sup> (HCl) – What combines with the H<sup>+</sup> ions so the pH doesn't change much?

[Answers](#)

3. Can salts of strong acids act as buffers by themselves?

Examples: NaCl, KCl, CaCl<sub>2</sub>, MgCl<sub>2</sub>

[Answers](#)

Here is an important **summary of buffer information**:

The a and b below explain how a buffer works to keep the pH relatively constant when acids or bases are added to their solutions.

- Buffers **resist change** in pH even if H<sup>+</sup> or OH<sup>-</sup> ions are added from strong acids or bases.
- H<sup>+</sup> ions react with conjugate bases of weak acids. OH<sup>-</sup> ions combine with the H<sup>+</sup> ions from weak acids, taking the hydrogen away from them.