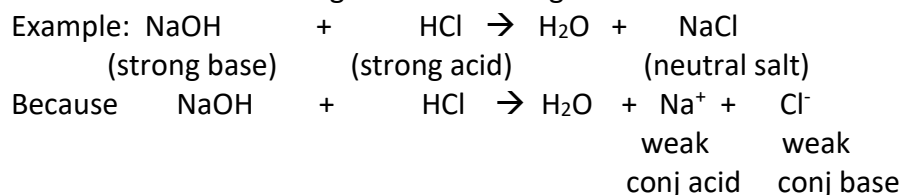


## Section 3 Notes AP Chemistry—Acid-Base Properties of Salts

Read Ch.14 (p.686-690)

Normally, we think of salts dissolved in water as producing neutral solutions. This is only true of salts made from strong acids and strong bases.



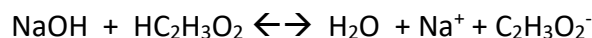
Both conjugates that form the salt are weak. They do nothing in the solution (spectator ions).

**But**, a salt made from a weak acid and a strong base or a strong acid and a weak base, do not form neutral solutions.

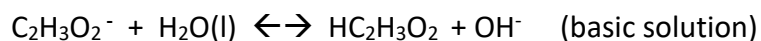
A salt from a **weak acid** and a **strong base** forms a solution that is **slightly basic** not because of the strong base but because of the strong conjugate base of the weak acid.

A salt from a **strong acid** and a **weak base** forms a solution that is **slightly acidic** not because of the strong acid but because of the strong conjugate acid of the weak base.

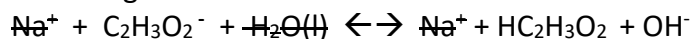
Example: **NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>** is a salt made from NaOH (strong base) and HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> (weak acid)



Na<sup>+</sup> is a spectator ion and does nothing, but the C<sub>2</sub>H<sub>3</sub>O<sub>2</sub><sup>-</sup> being a strong conjugate base reverses back combining with the H<sub>2</sub>O to produce hydroxide ions and the weak acid.



So simply dissolving this **salt** in H<sub>2</sub>O would produce sodium and acetate ions and hydroxide ions rendering the **solution basic**.



I can now find the pH of this solution by using the same equation we used for finding the pH of any weak acid or a weak base solution.

Since it is a basic solution forming, I use the following equation:

$$K_b = \frac{[\text{OH}^-][\text{HC}_2\text{H}_3\text{O}_2]}{[\text{C}_2\text{H}_3\text{O}_2^-]} \quad \text{[salt]}$$

But I don't have a K<sub>b</sub> for acetic acid, only a K<sub>a</sub> (1.8x 10<sup>-5</sup>). I need a K<sub>b</sub> since I am finding [OH<sup>-</sup>].

**Remember:** K<sub>a</sub> = K<sub>w</sub>/K<sub>b</sub> and K<sub>b</sub> = K<sub>w</sub>/K<sub>a</sub>

So to find K<sub>b</sub> = 1.0 x 10<sup>-14</sup>/1.8 x 10<sup>-5</sup>. Therefore, K<sub>b</sub> = 5.56 x 10<sup>-10</sup>

Now if I ask, what is the pH of a solution of 0.15M NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> I can find it by plugging the values into the equation:

$$K_b = \frac{X^2}{[\text{salt}]}$$

$$5.56 \times 10^{-10} = \frac{X^2}{(0.15)} \quad X = [\text{OH}^-] \text{ and } [\text{HC}_2\text{H}_3\text{O}_2]$$

$$X^2 = 8.33 \times 10^{-11}$$

$$X = 9.13 \times 10^{-6} \text{ M}$$

$$[\text{OH}^-] = 9.13 \times 10^{-6}$$

$$\text{pOH} = -\log(9.13 \times 10^{-6}) = 5.04$$

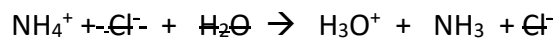
$$\text{pH} = 14 - 5.04 = \mathbf{8.96} \text{ (slightly basic)}$$

Likewise, if we had a solution of a weak base and a strong acid, we would have a slightly acidic solution because of the strong conjugate acid of the weak base.



The NH<sub>4</sub><sup>+</sup> ion of the salt would reverse itself with H<sub>2</sub>O to produce H<sub>3</sub>O<sup>+</sup> and NH<sub>3</sub>'

The salt itself in a aqueous solution would produce a slightly acidic solution.



Now I need a K<sub>a</sub> since I'm finding the H<sub>3</sub>O<sup>+</sup> ion. I only have a K<sub>b</sub> for NH<sub>3</sub> so I follow the same method to find the K<sub>a</sub>.

$$K_a = K_w/K_b$$

$$K_a = 1.0 \times 10^{-14}/1.8 \times 10^{-5} = 5.56 \times 10^{-10}$$

What is the pH of a 0.20M solution of NH<sub>4</sub>Cl ?

$$5.56 \times 10^{-10} = \frac{X^2}{(0.20)} \quad X = [\text{H}_3\text{O}^+] \{[\text{NH}_3]\}$$

$$X = 1.05 \times 10^{-5}$$

**pH** = -log [H<sub>3</sub>O<sup>+</sup>] = -log (1.05 x 10<sup>-5</sup>)= **4.98** (slightly acidic)

Since we now know that salts can make acidic or basic solutions, we can use them with their acids or bases with the same (common ion) conjugate to make solutions that resist pH changes. These solutions are called BUFFERS.

Buffers appear in your video and will be discussed in the next set of notes.

**HW:** Do problems **114, 116, 120, 126, and 130**. Watch Video **“Acid Base Reactions and Buffers”**