Acid-Base Reactions & Salt

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Salts

What is the pH of the products of a neutralization reaction?

Sometimes, the cation or anion of a salt has acidic or basic properties (Brønsted theory).

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Re-examining conjugate acids-bases…

Example #1

$HCl + H_2O \rightarrow H_3O^+ + Cl^-$

HCl is a strong acid. What can be said about the properties of its conjugate base, Cl^-?

Cl^- is a very weak base, because HCl is a strong acid (a weak base does not want to acquire a hydrogen ion, so the reaction will not reverse)

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Example #2

$NH_3 + H_2O <===> NH_4^+ + OH^-$

NH_3 is a weak base. What can be said about the properties of its conjugate acid, NH_4^+?

NH_4^+ is a weak acid because NH_3 is a weak base. It can donate a proton to reverse the reaction.

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If a reaction produces an ionic salt with acidic or basic properties, the pH of the final solution will be affected.

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Effects of ions:

1. Conjugate acids of *weak* bases tend to be acidic.

2. Conjugate bases of *weak* acids tend to be basic.

3. Metal ions of Group 1A and IIA do not affect the pH (except for Be^{2+})

4. Metal ions with +3 charges or greater tend to form acidic solutions.

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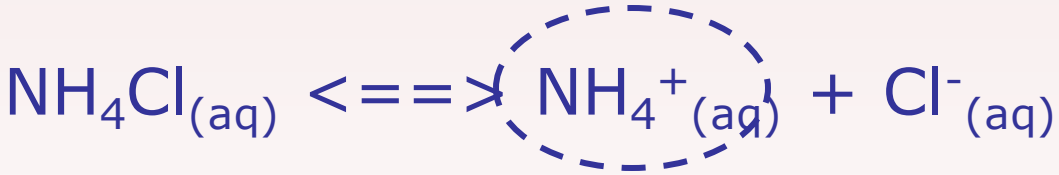
1. Conjugate Acids

What are the ions of NH_4Cl?



How will this affect pH?

pH will be acidic

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2. Conjugate Bases

What are the ions of LiCl?

$LiCl_{(aq)} <==> Li^+_{(aq)} + Cl^-_{(aq)}$

What are the ions of $KC_2H_3O_2$?

$KC_2H_3O_{2(aq)} <==> K^+_{(aq)} + C_2H_3O_2^-{}_{(aq)}$

Which salt(s) will cause a change in pH? Why?

$C_2H_3O_2^-{}_{(aq)}$ (basic)

NOTE: Cl^- is NOT basic. It has basic properties, but it is such a weak base that it doesn't affect the pH

3. Group IA & IIA Metals

These metals will not hydrolyze with water.

do not cause H_2O to become H_3O^+ or OH^-

One exception, Be^{2+}, will cause a solution to become acidic.

4. Other Metals

Some metals often are complexed with water molecules.

$Al(H_2O)_6^{3+}$

These hydrated complexes will react with water to form acids.

$Al(H_2O)_6^{3+} + H_2O \text{ <===> } H_3O^+ + Al(H_2O)_5(OH)^{2+}$

Salts

Some salts will release both a cation and anion that can affect pH.

Need to look at the K_a and K_b values of the ions.

If $K_a > K_b$, the solution will be

If $K_a < K_b$, the solution will be

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Example #1

Salt: NH_4CN

NH_4^+ $K_a = 5.7 \times 10^{-10}$

CN^- $K_b = 1.6 \times 10^{-5}$

$K_a < K_b$, .: the salt forms a basic solution