Acid Base Properties of Salt Solutions

pH of Salt Solutions

$$NH_4Cl_{(aq)} \rightarrow NH_4^+{}_{(aq)} + Cl^-{}_{(aq)}$$

- Some dissolved anions and cations react with water. This affects the pH of the solution.
- The pH of a salt solution may be neutral, acidic or basic,

Example

$$NH_4Cl_{(aq)} \rightarrow NH_4^+{}_{(aq)} + Cl^-{}_{(aq)}$$

* Do NH_4^+ and Cl^- react with water?

* $Cl^-{}_{(aq)} + H_2O_{(l)} \rightleftharpoons Cl^-{}_{(aq)} + H_2O_{(l)}$ NO REACTION

* $NH_4^+{}_{(aq)} + H_2O_{(l)} \rightleftharpoons NH_{3(aq)} + H_3O^+{}_{(aq)}$

* New products are formed! (NH_3 and H_3O^+)

Hydrolysis

* The reaction of the cation or anion of a salt with water to produce a change in the pH of the solution is called hydrolysis.

Acidic Salt Solutions

* Occurs when a salt consisting of the anion of a strong acid and the cation of a weak base ionizes in water.
* $NH_4Cl \rightarrow NH4^+ + Cl^-$
* $NH_4^+ + H_2O \rightarrow NH_3 + H_3O^+$

Acidic Salt Solutions

* Charged metal ions will also produce hydronium ions in water
  * Al^{3+}, Fe^{3+}, Be^{2+}

Basic Salt Solutions

* When a salt consisting of the anion of a weak acid and the cation of a strong base ionize in water, a base is created.
* $CH_3COONa \rightarrow Na^+ + CH_3COO^-$
* $CH3COO^- + H_2O \rightarrow CH_3COOH + OH^-$

Summary

Salt Solution	pH	Example
Neutral $NaCl$, KBr, $Ba(NO_3)_2$	7	None
Acidic NH_4Cl	<7	$NH_4^+ + H_2O \rightarrow NH_3 + H_3O^+$
Acidic $Al(NO_3)_3$, $FeCl_3$	<7	$Al(H_2O)_6^{3+} + H_2O \rightarrow AlH_2O_5OH_2^+ + H_3O^+$
Acidic/Basic NH_4ClO_2, NH_4CN	<7 Ka(cation)>Kb(anion) >7 Kb(anion)>Ka(cation)	$NH_4^+ + H_2O \rightarrow NH_3 + H_3O^+$ $CN^- + H_2O \rightarrow HCN + OH^-$
Acidic/Basic NaH_2PO_4	<7 Ka(cation)>Kb(anion) >7 Kb(anion)>Ka(cation)	$HSO_3^- + H_2O \rightarrow SO_3^{2-} + H_3O^+$ $HSO_3^- + H_2O \rightarrow H_2SO_3 + OH^-$

Buffer Solutions

Buffer Solutions

* Buffer: Resists the change to pH when limited amounts of an acid or a base are added

Buffer Solution

* Must contain a large amount of acid and base without reacting in a neutralization reaction.

Buffer Solution

* Consist of a mixture of weak acid and its conjugate base (supplied by a salt) or a weak base and it's conjugate acid (supplied by a salt).

Example

- A buffer solution where both CH_3COOH and CH_3COO^- are high
  - When and acid is added
    - $CH_3COO^- + H^+ \rightarrow CH_3COOH$
  - When a base is added
    - $CH_3COOH + OH^- \rightarrow CH3COO^- + H_2O$