# Acids/Base Reactions

There are many ways to define what acids and bases are. The two definitions that we use most often are:

The Arrhenius definition:

Acid- An Acid is a substance that produces hydrogen ions in solution.

Base- A base is a substance that produces hydroxide ions in solution.

The Brønsted-Lowry definition:

Acid- An acid is a proton donor.

Base- A base is a proton acceptor.

Let's look at the reaction between hydrochloric acid and sodium hydroxide:

$$\mathrm{HCl}_{(aq)} + \mathrm{NaOH}_{(aq)} \rightarrow \mathrm{H_2O}_{(l)} + \mathrm{NaCl}_{(aq)}$$

$$\mathrm{H}^+_{(aq)} + \mathrm{Cl}^-_{(aq)} + \mathrm{Na}^+_{(aq)} + \mathrm{OH}^-_{(aq)} \rightarrow \mathrm{H_2O}_{(l)} + \mathrm{Na}^+_{(aq)} + \mathrm{Cl}^-_{(aq)}$$

$$\mathrm{H}^+_{(aq)} + \mathrm{OH}^-_{(aq)} \rightarrow \mathrm{H_2O}_{(l)}$$

# Weak Acids

Both NaOH and HCl are strong electrolytes, things are a little different when we have an acid/base reaction with weak electrolytes:

$$\mathrm{HC_2H_3O_2}_{(aq)} + \mathrm{KOH}_{(aq)} \rightarrow \mathrm{H_2O}_{(l)} + \mathrm{KC_2H_3O_2}_{(aq)}$$

$$\mathrm{HC_2H_3O_2}_{(aq)} + \mathrm{K}^+_{(aq)} + \mathrm{OH}^-_{(aq)} \rightarrow \mathrm{H_2O}_{(l)} + \mathrm{K}^+_{(aq)} + \mathrm{C_2H_3O_2}^+_{(aq)}$$

$$\mathrm{HC_2H_3O_2}_{(aq)} + \mathrm{OH}^-_{(aq)} \rightarrow \mathrm{H_2O}_{(l)} + \mathrm{C_2H_3O_2}^+_{(aq)}$$

The easiest way to determine if an acid is strong or weak is to memorize them.

Hydrochloric acid- HCl, Sulfuric acid- $H_2SO_4$, Nitric acid- $HNO_3$, Hydrobromic acid- HBr

Perchloric acid- $HClO_4$

# Titration

We want to be able to determine the amount of acid or base in a solution. To do this we use a chemical technique called titration. Titration is the stepwise addition of one solution(the titrant) to another solution(the analyte) to determine the amount of analyte in the solution.

In terms of acid-base reactions we are looking to find the equivalence point, that is, the point at which the moles of acid and base are exactly balanced. We typically use an indicator (a chemical that changes color) in mark the end point of our titration.

Ex What volume of 0.100 M HCl solution is needed to neutralize 25.0 mL of 0.350 M NaOH solution?

$$n_{acid} = n_{base} \quad M_a V_a = n_a = n_b = M_b V_b$$

$$M_{HCl} V_{HCl} = M_{NaOH} V_{NaOH}$$

$$0.100M \cdot V_{HCl} = 0.350M \cdot 25.0mL$$

$$V_{HCl} = 87.5mL$$

Ex:

Future Thoughts- How does combustion work?