2.3.1

Acids and Bases

In pure water at 25° C, the concentration of H^+ is always equal to the concentration of OH^-. Both have a concentration of 1.0×10^{-7} Molar. (Placing the symbol for a chemical in brackets $[H^+]$ is chemical shorthand for "concentration of." Therefore, $[H^+]$ is read "the concentration of hydrogen ion.") If we add a substance that results in an increase in $[H^+]$, we say that substance is an **acid**. If we add a substance that results in a decrease in $[H^+]$, we say that substance is a **base**. An acid is any substance that, when added to an aqueous solution, increases the $[H^+]$ of the solution, and a base is any substance that, when added to an aqueous solution, decreases the $[H^+]$ of the solution. A common acid, for example, is hydrochloric acid, HCl. When HCl reacts with water, it dissociates into an H^+ and a chloride ion (Cl^-), thus increasing the $[H^+]$. HCl is considered a strong acid because when placed in water, it completely dissociates into its two ions.

$$\mathbf{HCl \longrightarrow H^+ + Cl^-}$$

A weak acid, such as **acetic acid** (CH_3COOH), dissociates into H^+ and CH_3COO^- (acetate). However, most remains intact as acetic acid, and there is a chemical equilibrium between the CH_3COOH and the $H^+ + CH_3COO^-$. The **conjugate base** is the name given to the now unprotonated compound (acetate). Thus, the disassociation of acetic acid (weak acid) produces acetate (conjugate base) and a hydrogen ion:

$$\mathbf{CH_3COOH \longleftrightarrow H^+ + CH_3COO^-}$$

An example of a base is ammonia (NH_3), which will combine with H^+ to form an ammonium ion (NH_4^+), thus removing H^+ from the solution.

$$\mathbf{NH_3 + H^+ \longrightarrow NH_4^+}$$

Another common base is sodium hydroxide (NaOH). How is this a base? When it dissolves, it dissociates into a sodium ion (Na^+) and OH^-, no change in $[H^+]$, right? However, the OH^- will combine with H^+ to form water, thus removing H^+ from the solution.

$$\mathbf{NaOH \longrightarrow Na^+ + OH^-}$$

$$\mathbf{H^+ + OH^- \longrightarrow H_2O}$$