Arrhenius Concept on Acids and Bases

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Acid-Base Concepts

- In 1777, **Antoine Lavoisier** proposed that oxygen was an essential element in acids
- There is one definition involving oxygen (**Lux Flood**) but many other ways more useful and we will discuss those
- The actual cause of acidity and basicity was ultimately explained in terms of the **effect these compounds have on water** by Arrhenius in 1884

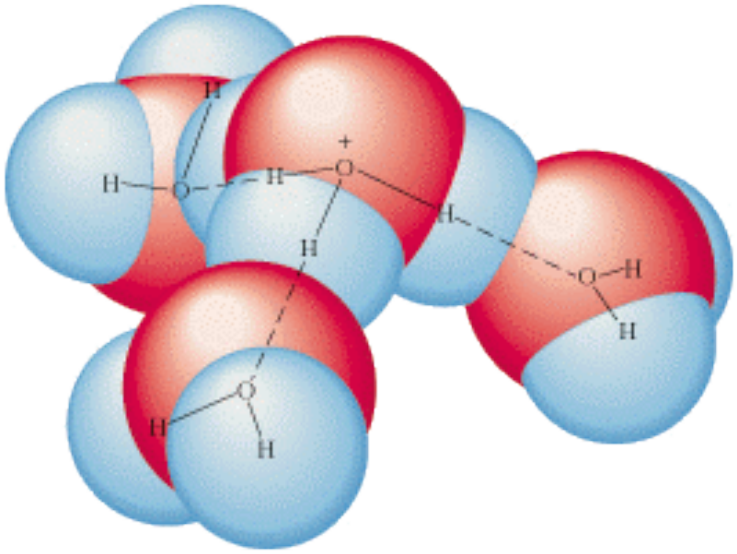
Acids and Bases Concepts

- The Arrhenius concept
- The Bronsted Lowry concept
- Lux Flood concept
- Solvent system concept
- The Lewis concept

Arrhenius Concept

- **Acid – substance when dissolved in water, increases the concentration of hydronium ion (H_3O^+) (produces H^+)**

Arrhenius Concept of Acids and Bases



The H_3O^+ is shown here hydrogen bonded to three water molecules

- **Base - substance when dissolved in water, increases the concentration of hydroxide ion, $OH^-(aq)$ (produces OH^-)**

Arrhenius Concept of Acids and Bases

- In the Arrhenius concept, a **strong (100%) acid** is a substance that **ionizes completely** in aqueous solution to give $H_3O^+(aq)$ and an anion

Example,

$$HClO_4(aq) + H_2O(l) \rightarrow H_3O^+(aq) + ClO_4^-(aq)$$

$$HClO_4(aq) \rightarrow H^+(aq) + ClO_4^-(aq)$$

Six strong acids - **HCl, HBr, HI, HNO_3 , $HClO_4$, and H_2SO_4**

Arrhenius Concept of Acids and Bases

- In the Arrhenius concept, a **strong (100%) base** is a substance that **dissociates completely** in aqueous solution to give OH^- (aq) and a cation

Example,

$$NaOH(s) \xrightarrow{H_2O} Na^+(aq) + OH^-(aq)$$

Six strong bases –

NaOH, LiOH, KOH, $Ca(OH)_2$, $Sr(OH)_2$, and $Ba(OH)_2$

Arrhenius Concept of Acids and Bases

- Example,

Acetic acid, CH_3COOH is weak acid

$$HC_2H_3O_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + C_2H_3O_2^-(aq)$$

Ammonium hydroxide, NH_4OH, is a weak base

$$NH_4OH(aq) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

Arrhenius Concept of Acids and Bases

- The Arrhenius concept is limited in that it looks at acids and bases in aqueous solutions only involving H^+ and OH^-
- There are many substances with acid/base properties that do not involve these and cannot be classified by this theory
- In addition, it singles out the OH^- ion as the source of base character, when other species can play a similar role