The Arrhenius Definition of Acids and Bases

- In 1884 Svante Arrhenius suggested that salts such as NaCl dissociate when they dissolve in water to give particles he called **ions**.
    - $NaCl(s) \rightarrow Na^{+1}(aq) + Cl^{-1}(aq)$
- A few years later, Arrhenius extended this theory by suggesting that acids are neutral compounds that ionize when they dissolve in water to give H^+ ions and a corresponding negative ion
    - Eg) $HCl(g) \rightarrow H^+(aq) + Cl^{-1}(aq)$
- Bases are neutral compounds that either dissociate or ionize in water to give OH-1 ions and a positive ion
    - Eg) $NaOH(s) \rightarrow Na^{+1}(aq) + OH^{-1}(aq)$

An **Arrhenius acid** is therefore any substance that ionizes when it dissolves in water to give the H^+, or hydrogen, ion.

An **Arrhenius base** is any substance that gives the OH^-, or hydroxide, ion when it dissolves in water.

This theory explains why acids have similar properties: The characteristic properties of acids result from the presence of the H^+ ion generated when an acid dissolves in water. It also explains why acids neutralize bases and vice versa. Acids provide the H^+ ion; bases provide the OH^- ion; and these ions combine to form water.

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

The Arrhenius theory has several disadvantages.

- It can be applied only to reactions that occur in water because it defines acids and bases in terms of what happens when compounds dissolve in water.
- It doesn't explain why some compounds in which hydrogen has an oxidation number of +1 (such as HCl) dissolve in water to give acidic solutions, whereas others (such as CH_4) do not.

Only the compounds that contain the OH^- ion can be classified as Arrhenius bases. The Arrhenius theory can't explain why other compounds (such as Na_2CO_3) have the characteristic properties of bases.