Chemistry 20

Unit C: Solutions and acid-base chemistry

Modified Arrhenius theory and neutralization

Hydrogen chloride meets water

- $HCl(g) + H_2O(l) \longrightarrow H_3O{+}(aq) + Cl^{-}(aq)$ produces the hydronium ion in water.
- A modified Arrhenius acid is defined by that aqueous hydronium, so the definition is limited to water.

Acids and bases in water

- You will write the hydronium equation for hydrogen chloride and state the aqueous limit of the acid definition.
- You will write hydroxide equations for sodium hydroxide and ammonia, then tally neutralization to 2 $H_2O(l)$.

Key terms

modified Arrhenius acid

A substance that produces $H_3O+(aq)$, the hydronium ion, in aqueous solution. ($HCl(g) + H_2O(l)$)

modified Arrhenius base

A substance that produces $OH^-(aq)$, the hydroxide ion, in aqueous solution. ($NH_3(aq)$)

neutralization

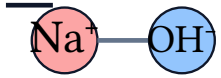
The reaction of hydronium with hydroxide to form water. ($H_3O+(aq) + OH^-(aq) \longrightarrow 2\ H_2O(l)$)

Sources of hydroxide

- $NaOH(s) \longrightarrow Na^+(aq) + OH^-(aq)$ shows full dissociation of the ionic solid in water.
- $NH_3(aq) + H_2O(l)$ in water makes some $NH_4+(aq)$ and $OH^-(aq)$. The formula NH_3 has no OH group, and only part of the ammonia reacts.

Sources of OH^-

$NaOH(s) \longrightarrow Na^+(aq) + OH^-(aq)$



full dissociation

$NH_3(aq) + H_2O \rightleftharpoons NH_4^+ + OH^-$



NH_3 has no OH group; only part reacts

Hydronium plus hydroxide makes two waters

- Neutralization is $H_3O^+(aq) + OH^-(aq) \longrightarrow 2\ H_2O(l)$.
- The tally is 4 H, 2 O, and charge zero on both sides.

Completing the ammonia equation

- Ammonia in water produces $NH_4^+(aq)$ and $OH^-(aq)$.
- The formula NH_3 contains no hydroxide group, and the modified definition still counts the aqueous hydroxide.

Retrieval of three equations

- Write the modified Arrhenius acid equation for HCl(g) with water.
- Write neutralization as hydronium plus hydroxide, with the coefficient on water.