Properties of Acids and Bases

Objectives

1. To learn about two models of acids and bases
2. To understand the relationship of conjugate acid-base pairs
3. To understand the concept of acid strength
4. To understand the relationship between acid strength and the strength of the conjugate base
5. To learn about the ionization of water

Properties of Acids and Bases

A. Acids and Bases

The Arrhenius Model

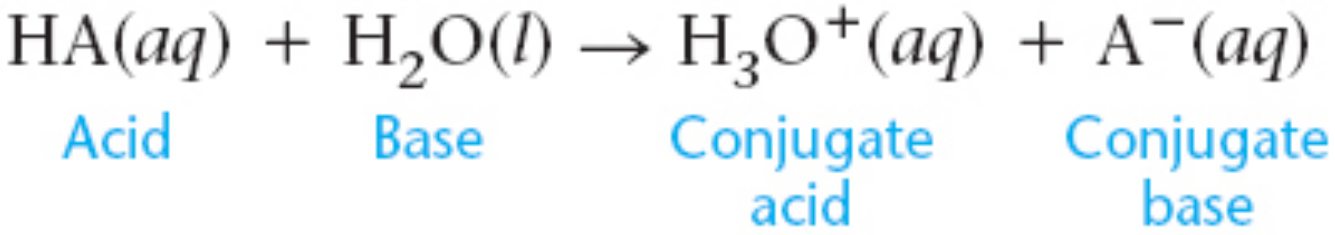
- Acid – produces hydrogen ions in aqueous solution
- Base – produces hydroxide ions in aqueous solution

Properties of Acids and Bases

A. Acids and Bases

The Bronsted-Lowry Model

- Acid – proton donor
- Base – proton acceptor
- The general reaction for an acid dissolving in water is

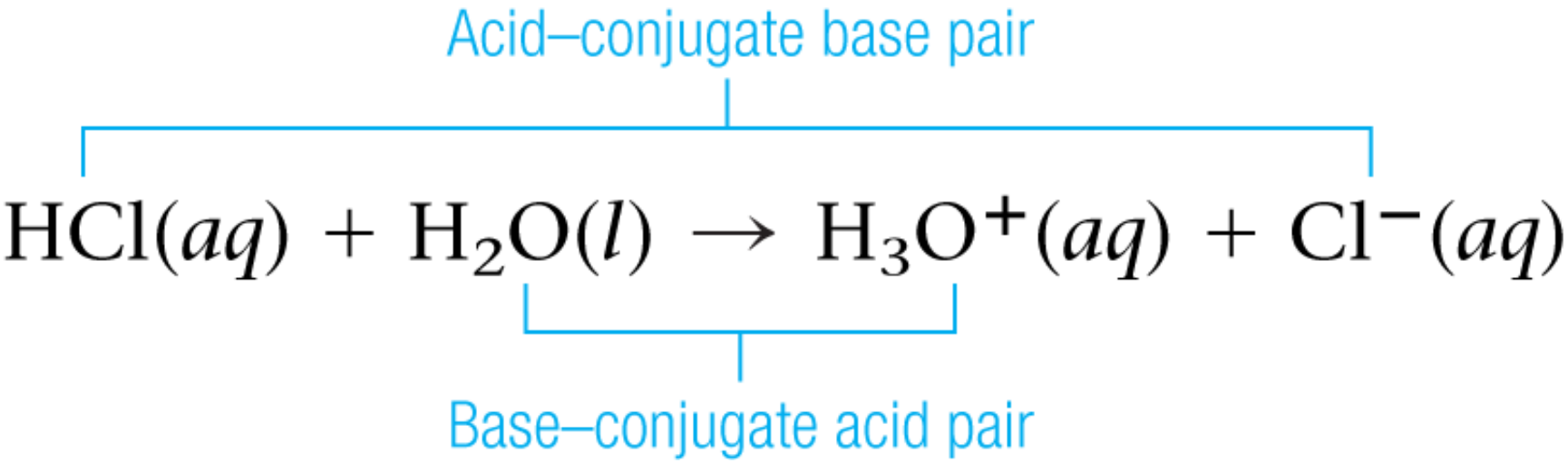


Properties of Acids and Bases

A. Acids and Bases

The Bronsted-Lowry Model

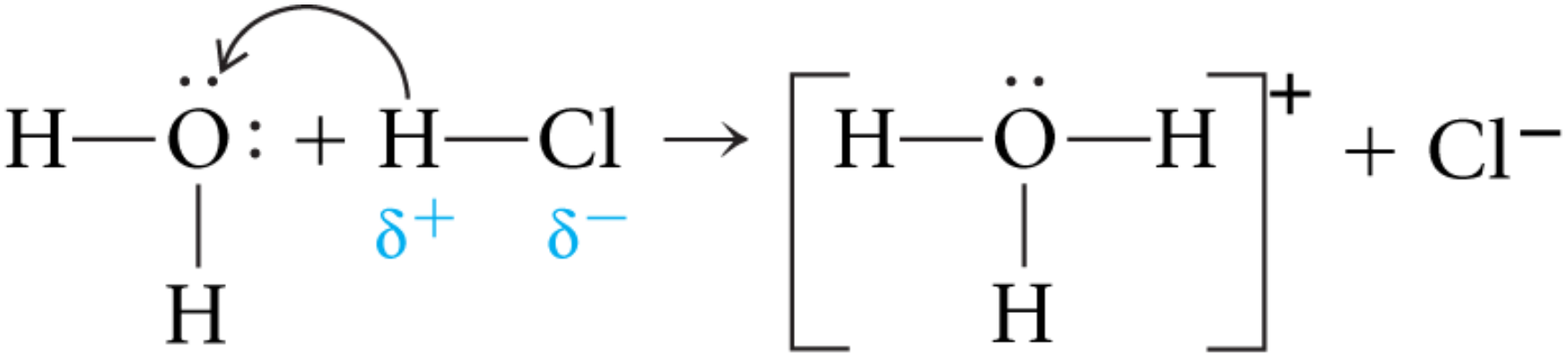
- Conjugate acid-base pair



Properties of Acids and Bases

A. Acids and Bases

The Bronsted-Lowry Model



- Water acts as a base accepting a proton from the acid.
- Forms hydronium ion (H_3O^+)

Properties of Acids and Bases

B. Acid Strength

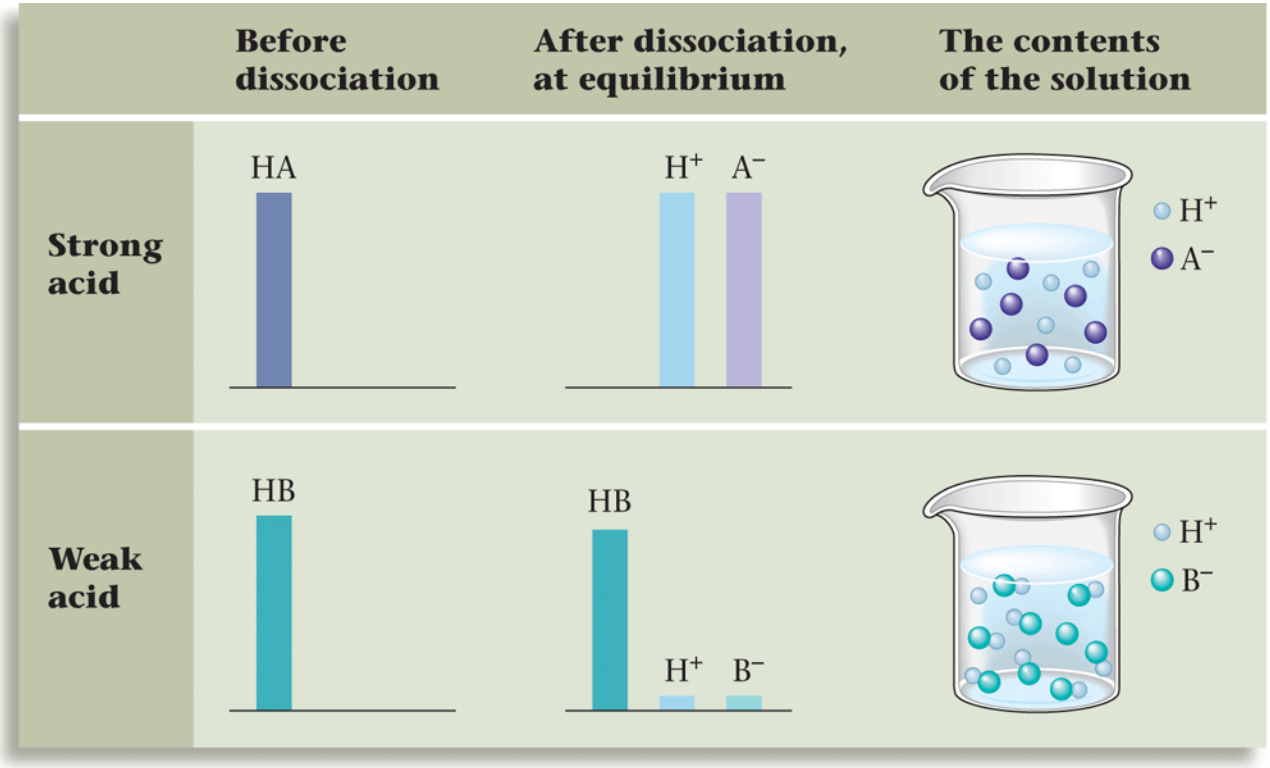
- Strong acid – completely ionized or completely dissociated

Properties of Acids and Bases

B. Acid Strength

- Weak acid – most of the acid molecules remain intact

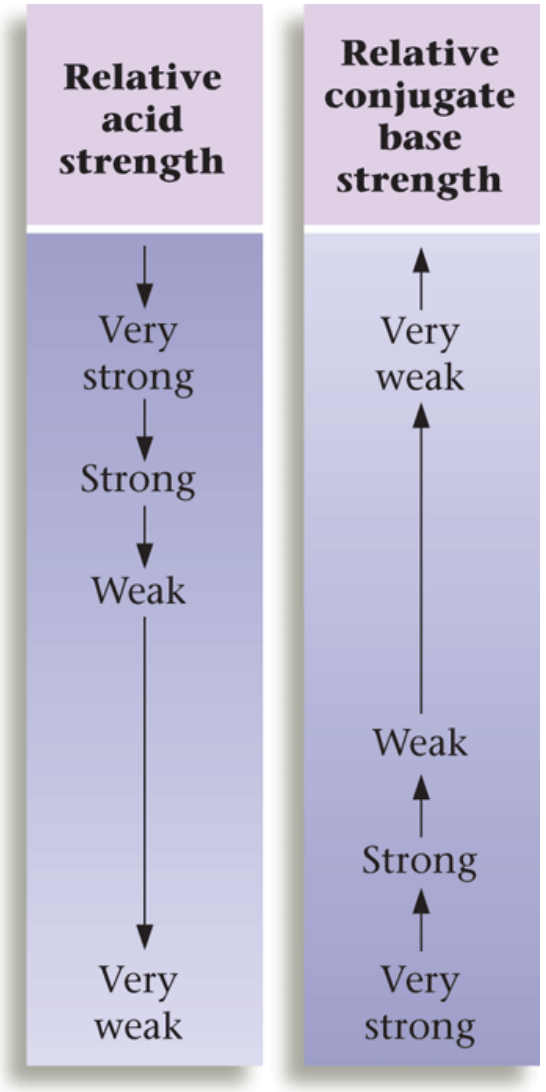
$$HA(aq) + H_2O(l) \Leftarrow H_3O^+(aq) + A^-(aq)$$



Properties of Acids and Bases

B. Acid Strength

- A strong acid contains a relatively weak conjugate base.



Properties of Acids and Bases

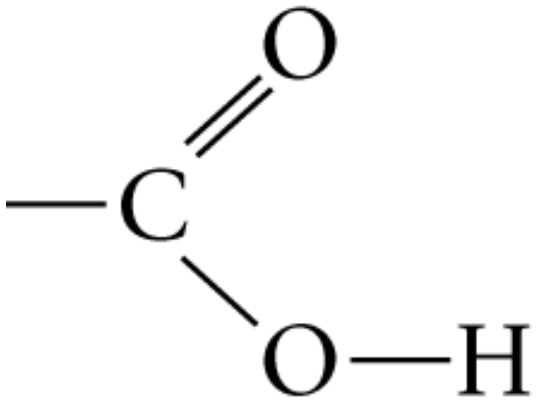
B. Acid Strength

- Common strong acids are
  - Sulfuric acid, H_2SO_4
  - Hydrochloric acid, HCl
  - Nitric acid, HNO_3
  - Perchloric acid, $HClO_4$

Properties of Acids and Bases

B. Acid Strength

- Oxyacid – acidic proton is attached to an oxygen atom
- Organic acid – have a carbon atom backbone and commonly contain the carboxyl group



  - Typically a weak acid

Properties of Acids and Bases

B. Acid Strength

Table 16.1

Ways to Describe Acid Strength

Property	Strong Acid	Weak Acid
the acid ionization (dissociation) reaction	forward reaction predominates	reverse reaction predominates
strength of the conjugate base compared with that of water	A^- is a much weaker base than H_2O	A^- is a much stronger base than H_2O

Properties of Acids and Bases

C. Water as an Acid and a Base

- Water is amphoteric – it can behave as either an acid or as a base
- Ionization of water

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

  - Concentration of hydronium and hydroxide are equal

$$[H_3O^+] = [OH^-] = 1.0 \times 10^{-7}\ M$$

Properties of Acids and Bases

C. Water as an Acid and a Base

– Product of $[H_3O^+]$ and $[OH^-]$ is always constant.

$$[H^+][OH^-] = 1.0 \times 10^{-14} = K_w \text{ at } 25\ ^\circ C$$

Properties of Acids and Bases

C. Water as an Acid and a Base

Let's Review

1. An *acidic solution*, where $[H^+] > [OH^-]$
2. A *basic solution*, where $[OH^-] > [H^+]$
3. A *neutral solution*, where $[H^+] = [OH^-]$

In each case, however, $K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$.