Acid-Base Reactions

SECTION 3

OBJECTIVES

- Describe a conjugate acid, a conjugate base, and an amphoteric compound.
- Explain the process of neutralization.
- Define *acid rain,* give examples of compounds that can cause acid rain, and describe effects of acid rain.

In the previous sections, you learned about three acid-base theories: Arrhenius, Brønsted-Lowry, and Lewis. The Brønsted-Lowry theory is especially useful for describing acid-base reactions that take place in aqueous solutions. This section will use the Brønsted-Lowry description to explore reactions between acids and bases.

Conjugate Acids and Bases

The Brønsted-Lowry definitions of acids and bases provide a basis for studying proton-transfer reactions. Suppose that a Brønsted-Lowry acid gives up a proton; the remaining ion or molecule can re-accept that proton and can act as a base. Such a base is known as a conjugate base. Thus, *the species that remains after a Brønsted-Lowry acid has given up a proton is the* **conjugate base** *of that acid.* For example, the fluoride ion is the conjugate base of hydrofluoric acid.

$$\underset{\text{acid}}{HF(aq)} + H_2O(l) \rightleftharpoons \underset{\text{conjugate base}}{F^-(aq)} + H_3O^+(aq)$$

In this reaction, the water molecule is a Brønsted-Lowry base. It accepts a proton from HF to form H_3O^+, which is an acid. The hydronium ion is the conjugate acid of water. *The species that is formed when a Brønsted-Lowry base gains a proton is the* **conjugate acid** *of that base.*

$$HF(aq) + \underset{\text{base}}{H_2O(l)} \rightleftharpoons F^-(aq) + \underset{\text{conjugate acid}}{H_3O^+(aq)}$$

In general, Brønsted-Lowry acid-base reactions are equilibrium systems meaning that both the forward and reverse reactions occur. They involve two acid-base pairs, known as conjugate acid-base pairs.

$$\underset{\text{acid}_1}{HF(aq)} + \underset{\text{base}_2}{H_2O(l)} \rightleftharpoons \underset{\text{base}_1}{F^-(aq)} + \underset{\text{acid}_2}{H_3O^+(aq)}$$

The subscripts designate the two conjugate acid-base pairs: (1) HF and F^- and (2) H_3O^+ and H_2O. In every conjugate acid-base pair, the acid has one more proton than its conjugate base.