

# Chapter 8 Solutions, Acids, and Bases

## Summary

### 8.1 Formation of Solutions

- A **solute** is a substance whose particles are dissolved in a solution.
  - The substance in which the solute dissolves is called the **solvent**.
- **Substances can dissolve in water in three ways—by dissociation, dispersion, and ionization.**
- The process in which an ionic compound separates into ions as it dissolves is called **dissociation**.
  - Molecular compounds dissolve in water by **dispersion**, or breaking into small pieces that spread throughout the water.
  - The process in which neutral molecules gain or lose electrons is known as **ionization**.
- **Three physical properties of a solution that can differ from those of its solute and solvent are conductivity, freezing point, and boiling point.**
- **During the formation of a solution, energy is either released or absorbed.**
- Before a solution can form, the attractions among the particles of solvent and of solute must be broken. It takes energy to break the attractions among solute particles and among solvent particles.
  - As the solute dissolves, new attractions form between solute and solvent particles. The formation of these attractions releases energy.
  - Rates of dissolving depend on the frequency and energy of collisions that occur between very small particles. During the formation of a solution, collisions occur between particles of the solute and solvent.
- **Factors that affect the rate of dissolving include surface area, stirring, and temperature.**

### 8.2 Solubility and Concentration

- **Solutions are described as saturated, unsaturated, or supersaturated, depending on the amount of solute in solution.**
- The maximum amount of a solute that dissolves in a given amount of solvent at a constant temperature is called **solubility**.
  - A **saturated solution** is one that contains as much solute as the solvent can hold at a given temperature.
  - A solution that has less than the maximum amount of solute that can be dissolved is called an **unsaturated solution**.
  - A **supersaturated solution** is one that contains *more* solute than it can normally hold at a given temperature.

☛ **Three factors that affect solubility of a solute are the polarity of the solvent, temperature, and pressure.**

- Solution formation is more likely to happen when the solute and the solvent are both polar or both nonpolar.
- Usually, increasing the solvent temperature increases the solubility of solids.
- Increasing the pressure on a gas increases its solubility in a liquid.

☛ **Concentration can be expressed as percent by volume, percent by mass, and molarity.**

- The **concentration** of a solution is the amount of solute dissolved in a specified amount of solution.
- **Molarity** is the number of moles of a solute dissolved per liter of solution.

### 8.3 Properties of Acids and Bases

☛ **Some general properties of acids include sour taste, reactivity with metals, and ability to produce color changes in indicators.**

- An **acid** is a compound that produces hydronium ions ( $\text{H}_3\text{O}^+$ ) when dissolved in water.
- An **indicator** is any substance that changes color in the presence of an acid or base.

☛ **Some general properties of bases include bitter taste, slippery feel, and ability to produce color changes in indicators.**

- A **base** is a compound that produces hydroxide ions ( $\text{OH}^-$ ) when dissolved in water.

☛ **The neutralization reaction between an acid and a base produces a salt and water.**

- The reaction between an acid and a base is called **neutralization**.
- During neutralization, the negative ions in an acid combine with the positive ions in a base to produce an ionic compound called a **salt**.

☛ **Acids can be defined as proton donors, and bases can be defined as proton acceptors.**

### 8.4 Strength of Acids and Bases

- The **pH** of a solution is a measure of its hydronium ion concentration. The pH can be any number from 0 to 14.
- A pH of 7 indicates a neutral solution. Pure water has a pH of 7.
- Acids have a pH less than 7. Bases have a pH greater than 7.

- The lower the pH value, the greater the  $\text{H}_3\text{O}^+$  ion concentration in solution is.
- The higher the pH value, the lower the  $\text{H}_3\text{O}^+$  ion concentration is.
- When strong acids dissolve in water, they ionize almost completely.
- Strong bases dissociate almost completely in water.
- Weak acids and bases ionize or dissociate only slightly in water.
  - A **buffer** is a solution that is resistant to large changes in pH.
  - Buffers can be prepared by mixing a weak acid and its salt or a weak base and its salt.
- Strong acids and bases are strong electrolytes because they dissociate or ionize almost completely in water.
  - An **electrolyte** is a substance that ionizes or dissociates into ions when it dissolves in water.
  - Solutions with electrolytes can conduct electricity.