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 (H$_3$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 (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 $H_3O^+$ ion concentration in solution is.

The higher the pH value, the lower the $H_3O^+$ 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.