aqueous solutions – solutions in which water is the dissolving medium

4.1: General Properties of Aqueous Solutions

• electrolyte – substance whose aqueous solution contains ions
• nonelectrolyte – substance that does not form ions in solution

4.2.1 Ionic Compounds in Water

• dissociate – when ions separate from a solid being dissolved

4.2.2 Molecular Compounds in Water

• the molecular structure is maintained

4.2.3 Strong and Weak Electrolytes

• strong electrolytes – ionic compounds that exist entirely of ions in solution
• weak electrolytes – molecular compounds that produce a small amount of ions
• chemical equilibrium – equilibrium of forming ions and recrystalizing ions

4.2: Precipitation Reactions

\[ AX + BY \rightarrow AY + BX \]

• for methathesis to occur:
  1. the formation of an insoluble product
  2. the formation of either a weak electrolyte or a nonelectrolyte
  3. the formation of a gas that escapes from solution

4.5.1 Precipitation Reactions

• precipitate – insoluble solid formed by a reaction in solution
• solubility – amount of substance that can be dissolved in a given quantity

4.5.2 Solubility Guidelines for Ionic Compounds

• all common ionic compounds of the alkali metal ions and of the ammonium ion are soluble in water

4.5.3 Reactions in Which a Weak Electrolyte or Nonelectrolyte Forms

• hydrogen and hydroxide react to form water
• insoluble metal oxides react with acids

4.3: Acid-Base Reactions

4.3.1 Acids
4.3.2 Bases
- substances that ionize to form hydroxide ions

4.3.3 Strong and Weak Acids and Bases
- strong acid, strong base – strong electrolyte
- weak acid, weak base – weak electrolyte

4.3.4 Neutralization Reactions and Salts
- neutralization reaction – when an acid and base are mixed
  - produces water and a salt

4.4 Ionic Equations
- molecular formula – and equation written to show the complete chemical formulas of reactants and products
- spectator ions – ions that do not play a role in a reaction
- net ionic equation – equation where the spectator ions are removed
- only soluble strong electrolytes are written in ionic form

4.4: Oxidation-Reduction Reactions

4.6.1 Reactions in Which a Gas Forms
- carbonates and bicarbonates

4.6.2 Oxidation and Reduction
- oxidation – loss of electrons
- reduction – gain of electrons

4.6.3 Oxidation of Metals by Acids and Salts
- whenever one substance is oxidized, some other substance must be reduced
- metals react with acids to form salts and hydrogen gas

4.6.4 The Activity Series
- activity series – list of metals arranged in order of decreasing ease of oxidation
- active metals – alkali metals and alkaline earth metals
- any metal on the list can be oxidized by ions of elements below it

4.5: Concentration of Solutions
- solution – homogeneous mixture of two or more substances
• **solvent** – component that is present in greatest quantity
• **solute** – substances dissolved in the solvent

4.1.1 Molarity

• **concentration** – the amount of solute dissolved in a given quantity of solvent or solution
• **molarity** – number of moles of solute in a liter of solution

\[
Molarity = \frac{\text{moles solute}}{\text{volume of solution in liters}}
\]

4.1.2 Dilution

• **dilution** - obtaining a lower concentration of a solution by adding water
• moles solute before dilution = moles solute after dilution

\[
M_{\text{initial}}V_{\text{initial}} = M_{\text{final}}V_{\text{final}}
\]

4.6: Solution Stoichiometry and Chemical Analysis

4.7.1 Titrations

• **standard solution** – solution of known concentration
• **titration** – a known solution that undergoes a specific chemical reaction of known stoichiometry with the solution of unknown concentration
• **equivalence point** – stoichiometrically equivalent quantities of reactants are brought together
• **indicator** – used to show the endpoint of the titration