

Introduction to Chemistry | Table of Contents

Chapter 1: Introduction to Chemistry

1.1 Chemistry in the World

- Chemistry in the World
 - Distinguish between chemistry and other scientific disciplines
 - Identify common examples and applications of chemistry in everyday life

1.2 The Scientific Method

- The Scientific Method
 - Classify steps in the scientific method

Chapter 2: Measurements and Calculations

2.1 The Basic Units of Measurement

- The Basic Units of Measurement
 - Recognize base units and abbreviations in the SI system
 - Define the prefixes used in the SI system

2.2 Units in Measurements

- Units in Measurements
 - Identify the SI units for length, volume, and mass
 - Identify the SI units for time and temperature

2.3 Accuracy and Precision

- Accuracy and Precision
 - Distinguish between accuracy and precision

2.4 Significant Figures

- Significant Figures
 - Express the number of significant figures in a measurement
 - Apply the significant figure rules to solve calculations

2.5 Scientific Notation

- Scientific Notation
 - Convert between standard notation and scientific notation

2.6 Problem Solving, Unit Conversion, and Dimensional Analysis

- Problem Solving, Unit Conversion, and Dimensional Analysis
 - Solve single step conversion problems
 - Solve conversion problems with multiples steps
 - Solve conversion problems with values raised to a power
 - Convert between temperature scales

2.7 Density and Specific Gravity

- Density and Specific Gravity
 - Perform calculations involving densities
 - Compare substances using specific gravity
-

Chapter 3: Matter and Energy

3.1 Matter, Mass, and Weight

- Matter, Mass, and Weight
 - Classify the states of matter
 - Differentiate between mass and matter

3.2 Atoms, Molecules, Compounds, Mixtures

- Atoms, Molecules, Compounds, Mixtures
 - Describe atoms and molecules
 - Distinguish between elements and compounds
 - Compare types of mixtures

3.3 Physical and Chemical Properties

- Physical and Chemical Properties
 - Identify examples of physical properties and physical changes
 - Identify examples of chemical properties and chemical changes

3.4 Energy

- Energy
 - Differentiate between kinetic and potential energy
 - Distinguish between endothermic and exothermic processes
 - Calculate heat capacity

3.5 Conservation of Mass, Matter, and Energy

- Conservation of Mass, Matter, and Energy
 - Demonstrate the law of conservation of matter
 - Define the laws of conservation of matter and energy

Chapter 4: Atomic Structure and the Periodic Table

4.1 The Evolution of the Atomic Theory

- The Evolution of the Atomic Theory
 - Describe Dalton's atomic theory
 - Recognize the scientists involved in defining modern atomic theory

4.2 Atomic Structure

- Atomic Structure
 - Identify subatomic particles

4.3 Elements and Their Symbols

- Elements and Their Symbols
 - Identify chemical symbols
 - Use atomic and mass numbers to determine the number of protons, electrons, and neutrons in an atom

4.4 The Periodic Table

- The Periodic Table
 - Examine the layout of the periodic table
 - Classify elements according to their groups on the periodic table
 - Interpret the elemental data on the periodic table
-

4.5 Ions and Isotopes

- Ions and Isotopes
 - Identify and name common ions
 - Determine the composition of an isotope

4.6 Atomic Mass

- Atomic Mass
 - Use average atomic mass to determine relative abundance of isotopes
 - Calculate average atomic mass

Chapter 5: Ions and Molecules

5.1 Molecular Composition

- Molecular Composition
 - Apply the laws of definite and multiple proportions

5.2 Molecular and Structural Formulas

- Molecular and Structural Formulas
 - Interpret and write empirical and molecular formulas
 - Compare molecular and structural formulas

5.3 Ionic and Molecular Compounds

- Ionic and Molecular Compounds
 - Describe the physical and chemical properties of ionic compounds
 - Define covalent bonds and molecular structures

5.4 Nomenclature of Ionic Compounds

- Nomenclature of Ionic Compounds
 - Name ionic compounds
 - Write the names and formulas of compounds containing polyatomic ions
 - Write the names and formulas of compounds containing metals with variable charges

5.5 Nomenclature of Molecular Compounds

- Nomenclature of Molecular Compounds
 - Convert between the name and formula for a molecular compound
 - Convert between the name and formula for a binary acid
 - Convert between the name and formula for an oxyacid

5.6 Formula Mass

- Formula Mass
 - Calculate formula masses
 - Calculate formula masses for ionic compounds

Chapter 6: Chemical Formulas and Mass Relationships

6.1 The Mole

- The Mole
 - Define the mole as a unit of measure
 - Convert between grams and moles
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6.2 Atoms, Moles, and Mass

- Atoms, Moles, and Mass
 - Convert between grams and number of atoms
 - Calculate the number of formula units, molecules, or atoms in a sample

6.3 Percent Composition

- 6.3 Percent Composition
 - Convert from mass of components to percent composition
 - Convert from molecular formula to percent composition

6.4 Empirical Formulas

- 6.4 Empirical Formulas
 - Calculate an empirical formula from the masses of components
 - Calculate an empirical formula from percent composition

6.5 Molecular Formulas

- 6.5 Molecular Formulas
 - Calculate a molecular formula from an empirical formula and a molecular mass

Chapter 7: Chemical Reactions

7.1 Chemical Change and Chemical Reactions

- Chemical Change and Chemical Reactions
 - Recognize chemical reactions

7.2 Chemical Equations

- Chemical Equations
 - Represent chemical reactions as equations
 - Balance chemical equations

7.3 Precipitation Reactions

- Precipitation Reactions
 - Identify precipitation reactions by applying the solubility rules

7.4 Ionic Reactions

- Ionic Reactions
 - Write balanced equations for ionic reactions

7.5 Acid-Base Reactions

- Acid-Base Reactions
 - Identify the features of acid-base neutralization reactions
 - Write reactions for gas evolution reactions

7.6 Oxidation-Reduction Reactions

- Oxidation-Reduction Reactions
 - Identify the components of oxidation-reduction reactions

7.7 Classification of Chemical Reactions

- Classification of Chemical Reactions
 - Identify combination, decomposition, replacement, and combustion reactions
-

Chapter 8: Calculations in Chemical Reactions

8.1 Molar Ratios

- Molar Ratios
 - Calculate molar ratios

8.2 Moles and Masses in Reactions

- Moles and Masses in Reactions
 - Calculate the number of moles produced in a reaction
 - Calculate the required number of moles of a starting material
 - Calculate the mass of products or reactants

8.3 Reaction Yields

- Reaction Yields
 - Identify limiting reagents
 - Calculate percent yields

8.4 Enthalpy

- Enthalpy
 - Use reaction stoichiometry in the calculation of enthalpy changes

Chapter 9: Atomic Structure and the Periodic Table

9.1 The Electromagnetic Spectrum

- The Electromagnetic Spectrum
 - Describe electromagnetic radiation
 - Describe the features of a wave

9.2 The Bohr Model

- The Bohr Model
 - Explain the Bohr model
 - Use the Bohr model to calculate the energy of electrons

9.3 Orbitals and Electron Configuration

- Orbitals and Electron Configuration
 - Define quantum numbers
 - Determine the electron configurations of atoms
 - Read electron configuration diagrams

9.4 Electron Configurations

- Electron Configurations
 - Distinguish between core electrons and valence electrons
 - Write electron configurations for elements
 - Write electron configurations for ions

9.5 Periodic Trends: Atomic Size and Ionization Energy

- Periodic Trends: Atomic Size and Ionization Energy
 - Use periodic trends to recognize variations in covalent radii
 - Use periodic trends to recognize variations in ionic radii
 - Use periodic trends to recognize variations in ionization energies
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Chapter 10: Molecular Structure

10.1 Lewis Structures

- Lewis Structures
 - Draw Lewis dot structures for atoms
 - Draw Lewis structures for ions and molecules
 - Identify the number of electrons in molecular and ionic structures

10.2 The Octet Rule

- The Octet Rule
 - Use the octet rule to determine the structure of molecules
 - Use the octet rule to identify the presence of double and triple bonds
 - Recognize octet rule exceptions

10.3 Resonance

- Resonance
 - Explain the sharing of electrons in resonance structures

10.4 VSEPR and Molecular Shapes

- VSEPR and Molecular Shapes
 - Use VSEPR theory to predict electron pair geometry
 - Use VSEPR theory to predict molecular structure and electron-pair geometry
 - Use VSEPR theory for molecules with five or more regions of electron density

10.5 Electronegativity and Polarity

- Electronegativity and Polarity
 - Use electronegativity to determine bond polarity
 - Predict bond type based on electronegativities
 - Predict the polarity of molecules

Chapter 11: Gases

11.1 Kinetic Molecular Theory

- Kinetic Molecular Theory
 - Describe the postulates of the kinetic molecular theory of gases

11.2 Gas Pressure

- Gas Pressure
 - Convert between units used in gas law calculations
 - Explain pressure relationships

11.3 Gas Laws

- Gas Laws
 - Perform calculations to demonstrate the relationship between temperature and pressure
 - Perform calculations to demonstrate the relationship between temperature and volume
 - Perform calculations to demonstrate the relationship between pressure and volume

11.4 Avogadro's Law

- Avogadro's Law
 - Perform calculations to demonstrate the relationship between volume and number of moles
-

11.5 The Ideal Gas Law

- The Ideal Gas Law
 - Perform calculations using the ideal gas law
 - Calculate the molar masses of gasses

11.6 Mixtures of Gases

- Mixtures of Gases
 - Perform partial pressure calculations
 - Calculate the pressure of gas collected over water

11.7 Stoichiometry of Reactions of Gases

- Stoichiometry of Reactions of Gases
 - Use gas laws to predict the outcome of reactions

11.8 Gas Law and Mole Fractions

- Gas Law and Mole Fractions
 - Perform gas law calculations involving mole fractions

Chapter 12: Liquids and Solids

12.1 Properties of Liquids and Solids

- Properties of Liquids and Solids
 - Identify the properties of liquids and solids

12.2 Intermolecular Forces

- Intermolecular Forces
 - Describe dipole-dipole interactions
 - Describe dispersion forces
 - Describe hydrogen bonding

12.3 Properties of Liquids

- Properties of Liquids
 - Identify the relationship between phases of matter and intermolecular forces
 - Define viscosity
 - Examine cohesive and adhesive forces
 - Describe surface tension in nature

12.4 Evaporation and Condensation

- Evaporation and Condensation
 - Define condensation and vaporization
 - Describe the impact of pressure on boiling point
 - Calculate the heat involved in vaporization
 - Calculate the heat changes during phase changes

12.5 Melting, Freezing, and Sublimation

- Melting, Freezing, and Sublimation
 - Describe the properties of freezing and melting
 - Describe the properties of deposition and sublimation
 - Predict the effect that intermolecular forces have on physical properties

12.6 Crystalline Solids

- Crystalline Solids
 - Distinguish between ionic, metallic, covalent network, and molecular solids
-

Chapter 13: Chemical Solutions

13.1 Solutions and Solubility

- Solutions and Solubility
 - Define and recognize solutions
 - Distinguish between solute and solvent
 - Identify the properties of solutions
 - Differentiate between saturated, unsaturated, and supersaturated solutions

13.2 Electrolytes

- Electrolytes
 - Classify strong, weak, and nonelectrolytes in aqueous solutions
 - Identify the characteristics of ionic electrolytes
 - Identify covalent electrolytes

13.3 Solutions of Gases in Water

- Solutions of Gases in Water
 - Identify the properties of solutions of gases in liquids

13.4 Mass Percent and Molality

- Mass Percent and Molality
 - Calculate mass percent
 - Calculate volume percent
 - Calculate mass-volume percent
 - Calculate molarity
 - Perform molality and mole fraction calculations

13.5 Dilution

- Dilution
 - Perform dilution calculations

13.6 Solution Stoichiometry

- Solution Stoichiometry
 - Calculate volumes of reagents needed for reaction in solutions

13.7 Freezing Point Depression and Boiling Point Elevation

- Freezing Point Depression and Boiling Point Elevation
 - Define colligative properties
 - Calculate changes in boiling points
 - Calculate freezing points

13.8 Osmosis and Osmotic Pressure

- Osmosis and Osmotic Pressure
 - Calculate osmotic pressure

Chapter 14: Acids and Bases

14.1 Acids and Bases

- Acids and Bases
 - Use physical properties, structure, and definitions to differentiate between acids and bases
 - Predict acidity and basicity based on pH, pOH, and hydronium and hydroxide concentrations
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14.2 Bronsted Lowry Acids and Bases

- Bronsted Lowry Acids and Bases
 - Predict the role of each component of an acid-base reaction

14.3 Acid Base Equilibrium

- Acid Base Equilibrium
 - Predict the formula of a conjugate acid or base
 - Predict the products of acid-base reactions

14.4 Ionization Reactions

- Ionization Reactions
 - Describe ionization reactions
 - Use K_w to calculate concentrations of hydroxide and hydronium ions

14.5 Calculations with pH and pOH

- Calculations with pH and pOH
 - Convert between pH and hydronium ion concentration
 - Define and calculate pOH and use it to predict basicity
 - Use pOH in calculations

14.6 Strong and Weak Acids and Bases

- Strong and Weak Acids and Bases
 - Calculate percent ionization
 - Calculate base ionization constants
 - Use K_a , K_b , pK_a , and pK_b in calculations
 - Describe the ionization of weak acids and bases

14.7 Reactions of Acids and Bases

- Reactions of Acids and Bases
 - Identify acid-base reaction types
 - Predict the product of reactions between acids and carbonates/bicarbonates or metals

14.8 Titrations

- Titrations
 - Read titration curves
 - Calculate the pH of solution after titration
 - Calculate the molar concentrations of unknown solutions using titrations

14.9 Buffers

- Buffers
 - Describe buffers and their purpose

Chapter 15: Chemical Equilibrium

15.1 Rate of Chemical Reactions and the Collision Theory

- Rate of Chemical Reactions and the Collision Theory
 - Define terms associated with reaction rates
 - Recognize the postulates of collision theory

15.2 Factors Affecting Reaction Rates

- Factors Affecting Reaction Rates
 - Determine the intensive properties that impact the rate of reactions
 - Determine the impact that temperature, concentration, and catalysts have on reaction rates
-

15.3 Dynamic Chemical Equilibrium

- Dynamic Chemical Equilibrium
 - Describe chemical equilibrium
 - Write equilibrium expressions

15.4 Equilibrium Constants

- Equilibrium Constants
 - Analyze and calculate equilibrium constants
 - Differentiate between heterogeneous and homogeneous equilibria

15.5 Calculation of Equilibrium Constants and Concentrations

- Calculation of Equilibrium Constants and Concentrations
 - Use concentration data to calculate equilibrium constants
 - Use equilibrium constants to calculate unknown concentrations
 - Use equilibrium constants to calculate changes in concentration

15.6 Le Châtelier's Principle

- Le Châtelier's Principle
 - Predict the impact that changing a concentration will have on equilibrium
 - Predict the impact that changing a pressure will have on equilibrium
 - Predict the impact that changing temperature will have on equilibrium

15.7 The Solubility Product Constant

- The Solubility Product Constant
 - Write solubility product equations
 - Calculate solubility product concentrations
 - Calculate molar solubility by using solubility products
 - Use solubility products to determine solubilities

15.8 Activation Energy and Catalysts

- Activation Energy and Catalysts
 - Identify the impact of catalysts on reaction rates
 - Use the Arrhenius equation to calculate activation energies

Chapter 16: Oxidation and Reduction

16.1 Oxidation and Reduction

- Oxidation and Reduction
 - Define the terms used in electrochemistry
 - Identify oxidation states

16.2 Balancing Redox Equations

- Balancing Redox Equations
 - Balance oxidation-reduction reactions in acidic solutions
 - Balance oxidation-reduction reactions in basic solutions

16.3 Spontaneity in Oxidation-Reduction Reactions

- Spontaneity in Oxidation-Reduction Reactions
 - Evaluate the spontaneity of oxidation-reduction reactions
-

16.4 Batteries and Fuel Cells

- Batteries and Fuel Cells
 - Describe the function of a galvanic cell
 - Define and identify the components and functions of primary batteries
 - Define and identify the components and functions of secondary batteries
 - Define and identify the components and functions of fuel cells

16.5 Electrolysis

- Electrolysis
 - Describe electrolytic cells and electrolysis
 - Evaluate electrolysis of solutions

16.6 Corrosion

- Corrosion
 - Describe the process of corrosion

Chapter 17: Nuclear Chemistry

17.1 Nuclear Structure and Stability

- Nuclear Structure and Stability
 - Define the terms used in nuclear chemistry
 - Describe the energy changes involved in nuclear reactions
 - Predict the stability of nuclei

17.2 Nuclear Equations

- Nuclear Equations
 - Differentiate between alpha, beta, gamma, and positron radiation
 - Identify the particles involved in nuclear reactions
 - Predict the products of alpha, beta, positron, and gamma decay

17.3 Half Life and Age Determination

- Half Life and Age Determination
 - Perform calculations involving the half-life of a radioisotope
 - Discuss the requirements for determination of the age of an object by using radioisotopes

17.4 Transmutation and Nuclear Energy

- Transmutation and Nuclear Energy
 - Explain the process of transmutation
 - Describe the causes, effects, and process of nuclear fission
 - Describe nuclear fusion and contrast with fission
 - Describe the operation of a nuclear power plant

17.5 Radiation Measurements, Exposure, and Safety

- Radiation Measurements, Exposure, and Safety
 - Identify the methods and units used in measuring radiation activity
 - Convert between units of radiation activity
 - Identify the health effects of exposure to radiation
 - Describe the use of nuclear decay in modern medicine
-

Chapter 18: Organic Chemistry

18.1 Organic Molecules

- Organic Molecules
 - Differentiate between organic and inorganic compounds

18.2 Hydrocarbons

- Hydrocarbons
 - Compare and contrast classes of hydrocarbons

18.3 Alkanes

- Alkanes
 - Identify structural representations and physical properties of alkanes
 - Identify isomers of alkanes
 - Convert between alkane names and structures

18.4 Alkenes and Alkynes

- Alkenes and Alkynes
 - Identify structural features, properties, and nomenclature of alkenes
 - Identify structural features, properties, and nomenclature of alkynes

18.5 Reactions of Hydrocarbons

- Reactions of Hydrocarbons
 - Predict the outcome of alkane combustion reactions
 - Predict the products of reactions of alkenes and alkynes

18.6 Aromatic Hydrocarbons

- Aromatic Hydrocarbons
 - Identify structural features and properties of aromatic molecules

18.7 Alcohols

- Alcohols
 - Identify the features of alcohols

18.8 Ethers

- Ethers
 - Name ethers and recognize their physical and chemical properties

18.9 Aldehydes and Ketones

- Aldehydes and Ketones
 - Identify the features of aldehydes and ketones

18.10 Carboxylic Acids and Esters

- Carboxylic Acids and Esters
 - Convert between names and structures of carboxylic acid
 - Identify the structural features of esters

18.11 Amines

- Amines
 - Name amines and recognize their physical and chemical properties

18.12 Polymers

- Polymers
 - Define and recognize polymers
-

Chapter 19: Biochemistry

19.1 The Cell and Their Components

- The Cell and Their Components
 - Identify the components of cells and their functions

19.2 Carbohydrates

- Carbohydrates
 - Differentiate between types of carbohydrates

19.3 Lipids

- Lipids
 - Classify types of lipids
 - Identify the structural features of saturated and unsaturated fatty acids

19.4 Amino Acids

- Amino Acids
 - Identify the structure and function of amino acids
 - Recognize the chemical diversity of amino acids

19.5 Protein Structure

- Protein Structure
 - Distinguish between the four levels of protein structure

19.6 Nucleic Acids

- Nucleic Acids
 - Identify the components of nucleotides

19.7 DNA Structure

- DNA Structure
 - Describe complementary pairs in DNA structure
-