

# **101 and 103 Chem**

## **General Chemistry**

Reference: Chemistry 12<sup>th</sup> ED.

By

T. L. Brown, H. E. Le May, B. E. Bursten and C. J. Murphy

**Dr. Fahad Ahmed Alharthi**

### **I. Introduction (Chapter 1)**

**1.4 Units of Measurement:** SI Units, Length and Mass, Temperature, Derived SI Units, Volume, Density

### **II. Stoichiometry (Chapter 3)** (approximately 7 Lectures)

**3.1 Chemical Equations:** Balancing Equations, Indicating the States of Reactants and Products.

**3.2 Some Simple Patterns of Chemical Reactivity:** Combination and Decomposition Reactions, Combustion Reactions.

**3.3 Formula Weights:** Formula and Molecular Weights, Percentage Composition from Chemical Formulas.

**3.4 Avogadro's Number and the Mole:** Molar Mass, Interconverting Masses and Moles, Interconverting Masses and Numbers of particles.

**3.5 Empirical Formulas from Analyses:** Molecular Formulas from Empirical Formulas, Combustion Analysis.

**3.6 Quantitative Information from Balanced Equations**

**3.7 Limiting Reactants and Theoretical Yields:** Percent Yield

**4.5 Concentrations of Solutions (Chapter 4):** Solution, Molarity, Expressing the Concentration of an Electrolyte, Interconverting Molarity, Moles and Volume, Dilution

**13.4 Ways of Expressing Concentrations (Chapter 13):** Mass Percentage, ppm, ppb, Mole Fraction, Molarity and Molality

### **III. Gases (Chapter 10)**

(approximately 6 Lectures)

#### **10.1 Characteristics of Gases**

#### **10.2 Pressure:** Atmospheric Pressure and the Barometer

**10.3 The Gas Laws:** The Pressure-Volume Relationship (Boyle's law), The Temperature-Volume Relationship (Charles's law), The Quantity-Volume Relationship (Avogadro's Law)

**10.4 The Ideal-Gas Equation:** Relating the Ideal-Gas Equation and the Gas Laws

**10.5 Further Applications of the Ideal Gas Equation:** Gas Densities and Molar Mass, Volumes of Gases in Chemical Reactions

**10.6 Gas Mixtures and partial Pressures:** Partial Pressures and Mole Fractions, Collecting of Gases over water

**10.7 Kinetic Molecular Theory:** Distributions of Molecular Speed Application of Kinetic-Molecular Theory to the Gas Laws

**10.8 Molecular Effusion and Diffusion:** Graham's Law of Effusion, Diffusion and Mean Free Path

**10.9 Real Gases Deviations from Ideal Behavior:** The van der Waals Equation

### **First Mid Term Exam**

### **IV. Thermochemistry and Thermodynamics (Chapter 5)**

(approximately 5 Lectures)

**5.1 The Nature of Energy:** Kinetic Energy and Potential Energy, Units of Energy, System and Surroundings, Transferring Energy (Work and Heat),

**5.2 The First Law of Thermodynamics:** Internal Energy, relating  $\Delta E$  to Heat and Work, Endothermic and Exothermic Processes, State Functions

#### **5.3 Enthalpy**

## **5.4 Enthalpies of Reaction**

**5.5 Calorimetry:** Heat Capacity and Specific Heat, Constant-Pressure Calorimetry, Bomb calorimetry (constant-volume calorimetry)

## **5.6 Hess's law**

**5.7 Enthalpies of Formation:** Using Enthalpies of Formation to Calculate Enthalpies of Reaction

## **V. Properties of Solutions (Chapter 13)**

(approximately 5 Lectures)

**13.1 The Solution Process:** The Natural Tendency toward Mixing, The Effect of Intermolecular Forces on Solution Formation, Energetics of Solution Formation, Solution Formation and Chemical reactions

**13.3 Factors Affecting Solubility:** Solute-Solvent Interactions, pressure Effects and Temperature Effects

**13.5 Colligative Properties:** Vapor-Pressure Lowering, Boiling-Point Elevation, Freezing-Point Depression, Osmosis, Determination of Molar Mass

## **VI. Chemical kinetics (Chapter 14)**

(approximately 5 Lectures)

### **14.1 Factors That Affect Reaction rates**

**14.2 Reaction Rates:** Change of Rate with Time, Instantaneous Rate, Reaction Rates and Stoichiometry

**14.3 Concentration and Rate Laws:** Reaction Orders (The Exponents in The rate law), Magnitudes and Units of rate Constants, Using Initial rates to Determine Rate Laws

**14.4 The Change of Concentration with Time:** First-Order Reactions, Second-Order Reactions, Zero-Order Reactions, Half-Life,

**14.5 Temperature and Rate:** The Collision Model, the Orientation Factor, Activation Energy, the Arrhenius Equation, Determining the Activation Energy

## **Second Mid Term Exam**

## VII. Chemical Equilibrium (Chapter 15)

(approximately 5 Lectures)

### 15.1 The Concept of Equilibrium

**15.2 The Equilibrium Constant:** Evaluating  $K_c$ , Equilibrium Constants in Terms of pressure  $K_p$ , Equilibrium Constants and Units

**15.3 Understanding and working with Equilibrium Constant:** The Magnitude of Equilibrium Constants, The Direction of the Chemical Equation and  $K$ , Relating Chemical Equation Stoichiometry and Equilibrium Constants,

### 15.4 Heterogeneous Equilibria

### 15.5 Calculating Equilibrium Constants

**15.6 Applications of Equilibrium Constants:** Predicting the Direction of Reaction, Calculating Equilibrium Concentrations

**15.7 Le Chatelier's Principle:** Change in Reaction or Product Concentration, Effects of Volume and Pressure Changes, Effect of Temperature Changes, The Effect of Catalysts

## VIII. Acid Base Equilibria (Chapter 16)

(approximately 5 Lectures)

### 16.1 Acids and Bases: A Brief Review

**16.2 Bronsted-Lory Acids and Basis:** The  $H^+$  Ion in Water, Proton-Transfer Reactions, Conjugated Acid-Base pairs, Relative Strengths of Acids and Bases

**16.3 The Autoionization of Water:** The Ion Product of Water

**16.4 The pH Scale:** pOH and Other 'p' Scales, Measuring pH

### 16.5 Strong Acids and Bases

**16.6 Weak Acids:** Calculating  $K_a$  from pH, Percent Ionization, Using  $K_a$  to Calculate pH, Polyprotic Acids

**16.7 Weak Bases:** Types of Weak Bases

**16.8 Relationship between  $K_a$  and  $K_b$**

**16.9 Acid-Base Properties of Salt Solutions:** An Anion's Ability to React with water, A Cation's Ability to React with water, Combined effect of cation and Anion in Solution

**17.1 The Common Ion Effect (Chapter 17)**

**17.2 Buffered Solutions:** Composition and Action of Buffered Solutions, Calculating the pH of a Buffer, Buffer Capacity and pH Range, Addition of Strong Acids or Bases to Buffers

**17.4 Solubility Equilibria:** The Solubility-Product Constant  $K_{sp}$