Contents

Pages STRUCTURE OF ATOM-CLASSICAL MECHANICS Discovery of Electron
 Measurement of e/m for Electrons Determination of the Charge on an Electron Positive Rays Protons
 Neutrons
 Subatomic Particles
 Alpha Particles Rutherford's Atomic Model
 Mosley's Determination of Atomic Number - Mass Number - Quantum Theory and Bohr Atom. 43 STRUCTURE OF ATOM-WAVE MECHANICAL APPROACH Wave Mechanical Concept of Atom - de Broglie's Equation Heisenberg's Uncertainty Principle
 Schrödinger's Wave Equation Charge Cloud Concept and Orbitals
 Quantum Numbers Pauli's Exclusion Principle
 Energy Distribution and Orbitals Distribution of Electrons in Orbitals
 Representation of Electron Configuration - Ground-state Electron Configuration of Elements Ionisation Energy Measurement of Ionisation Energies Electron Affinity - Electronegativity. 85 ISOTOPES, ISOBARS AND ISOTONES Isotopes - Representation of Isotopes - Identification of Isotopes Aston's Mass Spectrograph
 Dempster's Mass Spectrograph Separation of Isotopes - Gaseous Diffusion - Thermal Diffusion Distillation - Ultra centrifuge - Electro-magnetic Separation Fractional Electrolysis
 Laser Separation
 Isotopes of Hydrogen Isotopes of Neon - Isotopes of Oxygen - Isotopes of Chlorine Isotopes of Uranium
 Isotopes of Carbon
 Isotopic Effects Isobars = Isotones. 103 **NUCLEAR CHEMISTRY** Radioactivity
 Types of Radiations
 Properties of Radiations Detection and Measurement of Radioactivity
 Types of Radioactive Decay • The Group Displacement Law • Radioactive Disintegration Series - Rate of Radioactive Decay - Half-life Radioactive Dating
 Nuclear Reactions
 Nuclear Fission Reactions - Nuclear Fusion Reactions - Nuclear Equations

Artificial Radioactivity
 Nuclear Isomerism
 Mass Defect
 Nuclear Binding Energy
 Nuclear Fission Process
 Nuclear Chain Reaction
 Nuclear Energy
 Nuclear Reactor
 Nuclear Fusion Process
 Solar Energy
 Fusion as a Source of Energy in

21st Century.

151

5. CHEMICAL BONDING-LEWIS THEORY

Electronic Theory of Valence Ionic Bond Characteristics of Ionic Compounds Covalent Bond Conditions for Formation of Covalent Bond Covalent Bond Covalent Compounds
 Co-ordinate Covalent Bond Differences Between Ionic and Covalent Bonds Polar Covalent Bonds Hydrogen Bonding (H-bonding)
 Examples of Hydrogen-bonded Compounds
 Characteristics of Hydrogen-bond Compounds

193

6. CHEMICAL BONDING-ORBITAL THEORY

• Valence Bond Theory • Nature of Covalent Bond • Sigma (σ) Bond • Pi (π) Bond • Orbital Representation of Molecules • Concept of Hybridization • Types of Hybridization • Hybridization involving d orbitals • Hybridization and Shapes of Molecules • sp³ Hybridization of Carbon • sp² Hybridization of Carbon • sp Hybridization of Carbon • Shape of H_2O molecule • Shape of PCl_5 Molecule • Shape of PCl_5 Molecule • Shape of Atomic Orbitals (LCAO Method) • Bond Order • Homonuclear Diatomic Molecules.



236

7. FIRST LAW OF THERMODYNAMICS

- Thermodynamic Terms: System, Boundary, Surroundings
 Homogeneous and Heterogeneous Systems
 Types of Thermodynamic Systems
 Intensive and Extensive Properties
- State of a System
 Equilibrium and Nonequilibrium States
- Thermodynamic Processes
 Reversible and Irreversible
 Processes
 Nature of Heat and Work
 Internal Energy
- Units of Internal Energy
 First Law of Thermodynamics
- Enthalpy of a System
 Molar Heat Capacities
 Joule-Thomson Effect
 Adiabatic Expansion of an Ideal Gas
 Work Done In Adiabatic Reversible Expansion.



271

8. THERMOCHEMISTRY

Enthalpy of a Reaction
 Exothermic and Endothermic Reactions

Thermochemical Equations • Heat of Reaction or Enthalpy of Reaction • Heat of Combustion • Heat of Solution • Heat of Neutralisation • Energy Changes During Transitions or Phase Changes • Heat of Fusion • Heat of Vaporisation • Heat of Sublimation • Heat of Transition • Hess's Law of Constant Heat Summation • Applications of Hess's Law • Bond Energy

Measurement of the Heat of Reaction



Spontaneous Processes - Entropy - Third Law of Thermodynamics

Numerical Definition of Entropy
 Units of Entropy
 Standard
 Entropy
 Standard Entropy of Formation
 Carnot Cycle



Derivation of Entropy from Carnot Cycle - Physical Significance of Entropy - Entropy Change for an Ideal Gas - Entropy Change Accompanying Change of Phase - Gibb's Helmholtz Equations - Clausius-Clapeyron Equation - Applications of Clapeyron-Clausius Equation - Free Energy and Work Functions - van't Hoff Isotherm - Fugacity and Activity.

10. GASEOUS STATE

Charcteristics of Gases - Parameters of a Gas - Gas Laws
 Boyle's Law - Charles's Law - The Combined Gas Law - Gay
 Lussac's Law - Avogadro's Law - The Ideal-gas Equation
 Kinetic Molecular Theory of Gases - Derivation of Kinetic Gas
 Equation - Distribution of Molecular Velocities - Calculation of
 Molecular Velocities - Collision Properties - van der Waals Equation
 Liquefaction of Gases - Law of Corresponding States - Methods
 of Liquefaction of Gases.

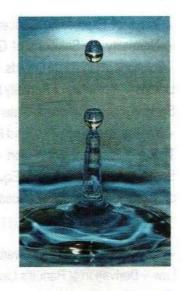
11. LIQUID STATE

Intermolecular Forces in Liquids Dipole-dipole Attractions
 London Forces Hydrogen Bonding Vapour Pressure
 Effect of Temperature on Vapour Pressure Determination of Vapour Pressure The Static Method The Dynamic Method
 Effect of Vapour Pressure on Boiling Points Surface Tension
 Units of Surface Tension Determination of Surface Tension
 Capillary Rise Method Drop Formation Method Ringdetachment Method Bubble Pressure Method Viscosity
 Units of Viscosity Measurement of Viscosity Ostwald
 Method Effect of Temperature on Viscosity of a Liquid Refractive Index
 Optical Activity Specific Rotation Measurement of Optical Activity

12. SOLID STATE



415





13. PHYSICAL PROPERTIES AND CHEMICAL CONSTITUTION

Surface Tension and Chemical Constitution = Use of Parachor in Elucidating Structure = Viscosity and Chemical Constitution
 Dunstan Rule = Molar Viscosity = Rheochor = Dipole Moment
 Determination of Dipole Moment = Dipole Moment and Molecular Structure = Dipole Moment and Ionic Character = Molar Refraction and Chemical Constitution = Optical Activity and Chemical Constitution = Magnetic Properties = Paramagnetic Substances
 Diamagnetic Substances = Molecular Spectra = Electromagnetic Spectrum = Relation Between Frequency, Wavelength and Wave Number = Energy of Electromagnetic Radiation = Molecular Energy Levels = Rotational Energy = Vibrational Energy = Electronic Energy = Absorption Spectrophotometer = Rotational Spectra
 Vibrational Spectra = Vibrational-rotational Spectra = IR Spectroscopy = UV-VIS Spectroscopy = NMR Spectroscopy
 Mass Spectroscopy = Raman Spectra.

14. SOLUTIONS

Ways of Expressing Concentration - Molarity - Molality
 Normality - Solutions of Gases in Gases - Henry's Law
 Solutions of Liquids In Liquids - Solubility of Completely Miscible Liquids - Solubility of Partially Miscible Liquids - Phenol-Water System - Trimethylamine-Water System - Nicotine-Water System
 Vapour Pressures of Liquid-liquid Solutions - Azeotropes - Theory of Fractional Distillation - Steam Distillation - Solutions of Solids in Liquids - Solubility-Equilibrium Concept - Determination of Solubility - Solubility of Solids in Solids.

15. THEORY OF DILUTE SOLUTIONS

Colligative Properties - Lowering of Vapour Pressure - Raoult's Law - Derivation of Raoult's Law - Measurement of Lowering of Vapour Pressure - Barometric Method - Manometric Method - Ostwald and Walker's Dynamic Method - Boiling Point Elevation - Determination of Molecular Mass from Elevation of Boiling Point - Measurement of Boiling Point Elevation - Landsberger-Walker Method - Cottrell's Method - Freezing-point Depression - Determination of Molecular Weight from Depression of Freezing Point - Measurement of Freezing-point Depression - Beckmann's Method - Rast's Camphor Method - Colligative Properties of Electrolytes.

16. OSMOSIS AND OSMOTIC PRESSURE

What is Osmosis = Semipermeable Membranes = Preparation of Cupric Ferrocyanide Membrane = Osmotic Pressure = Pfeffer's Method = Berkeley and Hartley's Method = Osmometer = Isotonic Solutions = Theories of Osmosis = Molecular Sieve Theory = Membrane Solution Theory = Vapour Pressure Theory = Membrane Bombardment Theory = Reverse Osmosis

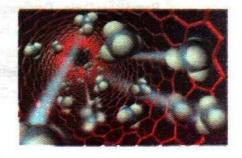




528

559





Desalination of Sea Water Laws of Osmotic Pressure Boyle-van't Hoff Law for Solutions Charles'-van't Hoff Law for Solutions van't Hoff Equation for Solutions Avogadro-van't Hoff Law for Solutions van't Hoff Theory of Dilute Solutions Calculation of Osmotic Pressure Determination of Molecular Weight Relation Between Vapour Pressure and Osmotic Pressure Osmotic Pressure Flectrolytes.

17. CHEMICAL EQUILIBRIUM

- Reversibles Reactions
 Characteristics of Chemical Equilibrium
- Law of Mass Action
 Equilibrium Constant
 Equilibrium Law
- Equilibrium Constant Expression in Terms of Partial Pressures
- Units of Equilibrium Constant
 Heterogeneous Equilibria
- Le Chatelier's Principle
 Conditions for Maximum Yield in Industrial Processes
 Synthesis of Ammonia (Haber Process)
- Manufacture of Sulphuric Acid (Contact Process)
 Manufacture of Nitric Acid (Birkeland-Eyde Process).

18. DISTRIBUTION LAW

Nernst's Distribution Law
 Explanation of Distribution Law
 Limitations of Distribution Law
 Henry's Law
 Determination of Equilibrium Constant from Distribution Coefficient
 Extraction with a Solvent
 Multiple Extraction
 Liquid-Liquid Chromatography
 Applications of Distribution Law
 Solvent Extraction
 Partition Chromatography
 Desilverization of Lead (Parke's Process)
 Determination of Association
 Determination of Dissociation
 Determination of Solubility
 Distribution Indicators

19. PHASE RULE

What is Meant by a 'Phase' - What Is Meant by 'Components'
 Degrees of Freedom - Derivation of the Phase Rule - One-component System - Phase Diagrams - Polymorphism
 Experimental Determination of Transition Point - The Water System - The Sulphur System - Two-component Systems
 The Silver-Lead System - The Zinc-Cadmium System - The Potassium Iodide-Water System - The Magnesium-Zinc System
 The Ferric Chloride-Water System - The Sodium Sulphate-Water System.

20. CHEMICAL KINETICS

Chemical Kinetics = Reaction Rate = Units of Rate = Rate Laws
 Order of a Reaction = Zero Order Reaction = Molecularity of a Reaction = Pseudo-order Reactions = Zero Order Reactions = First Order Reactions = Second Order Reactions = Third Order Reactions
 Units of Rate Constant = Half-life of a Reaction = How to Determine the Order of a Reaction = Collision Theory of Reaction Rates = Effect of Increase of Temperature on Reaction Rate = Limitations of the Collision Theory = Transition State Theory = Activation Energy and Catalysis.



621

672



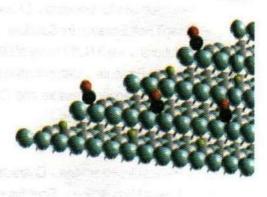
697



21. CATALYSIS

781

Types of Catalysis - Homogeneous Catalysis - Heterogeneous Catalysis - Characteristics of Catalytic Reactions - Promoters
 Catalytic Poisoning - Autocatalysis - Negative Catalysis - Activation Energy and Catalysis - Theories of Catalysis - The Intermediate Compound Formation Theory - The Adsorption Theory
 Hydrogenation of Ethene in Presence of Nickel - Acid-Base Catalysis - Mechanism of Acid Catalysis - Enzyme Catalysis
 Mechanism of Enzyme Catalysis - Characteristics of Enzyme Catalysis.



22. COLLOIDS

807

23. ADSORPTION

Mechanism of Adsorption = Types of Adsorption = Adsorption of Gases by Solids = Adsorption Isotherms = Langmuir Adsorption Isotherm = Derivation of Langmuir Isotherm = Adsorption of Solutes from Solutions = Applications of Adsorption = Ion-exchange Adsorption = Cationic Exchange = Anionic Exchange = Applications of Ion-exchange Adsorption = Water Softening = Deionization of Water = Electrical Demineralization of Water.



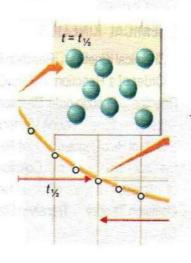
24. ELECTROLYSIS AND ELECTRICAL CONDUCTANCE

Mechanism of Electrolysis = Electrical Units = Faraday's Laws of Electrolysis = Faraday's First Law = Faraday's Second Law
 Importance of The First Law of Electrolysis = Importance of the Second Law of Electrolysis = Conductance of Electrolytes
 Specific Conductance = Equivalent Conductance = Strong Electrolytes = Weak Electrolytes = Measurement of Electrolytic Conductance = Determination of the Cell Constant.



25. THEORY OF ELECTROLYTIC DISSOCIATION

Arrhenius Theory of Ionisation = Migration of Ions = Relative Speed of Ions = What Is Transport Number = Determination of Transport Number = Hittorf's Method = Moving Boundary Method
 Kohlrausch's Law = Applications of Kohlrausch's Law
 Conductometric Titrations = Differences Between Conductometric and Volumetric Titrations.



26. IONIC EQUILIBRIA-SOLUBILITY PRODUCT

Ostwald's Dilution Law = Experimental Verification of Ostwald's Law = Limitation of Ostwald's Law = Theory of Strong Electrolytes
 Ghosh's Formula = Debye-Huckel Theory = Degree of Dissociation = The Common-Ion Effect = Factors Which Influence the Degree of Dissociation = Solubility Equilibria and the Solubility Product = Application of Solubility Product Principle in Qualitative Analysis = Selective Precipitation = Separation of the Basic Ions into Groups.

27. ACIDS AND BASES

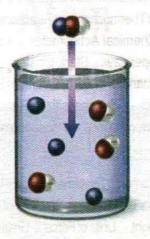
Arrhenius Concept • Bronsted-Lowry Concept • Strength of Bronsted Acids and Bases • Lewis Concept of Acids and Bases
 Relative Strength of Acids • Calculation of K_a • Relative Strength of Bases • Calculation of K_b • The pH of Solutions • Measurement of pH • pH Scale • Numerical Problems Based on pH • What is a Buffer Solution ? Calculation of the pH of Buffer Solutions
 • Numerical Problems Based on Buffers • Acid-base Indicators
 • pH Range of Indicators • Choice of a Suitable Indicator
 • Theories of Acid-base Indicators • The Ostwald's Theory • How an Acid-base Indicator Works • Relation of Indicator Colour to pH
 • Indicator Action of Phenolphthalein • Quinonoid Theory of Indicator Colour Change.

28. SALT HYDROLYSIS

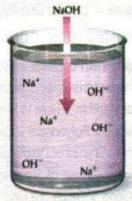
What Is Hydrolysis - Bronsted-Lowry Concept of Hydrolysis
 Why NaCl Solution is Neutral - Salts of Weak Acids and Strong Bases - Salts of Weak Bases and Strong Acids - Salts of Weak Acids and Weak Bases - Quantitative Aspect of Hydrolysis
 Salts of a Weak Acid and Strong Base - Relation Between Hydrolysis Constant and Degree of Hydrolysis - Salts of Weak Bases and Strong Acids - Salts of Weak Acids and Weak Bases
 Determination of Degree of Hydrolysis - Dissociation Constant Method - From Conductance Measurements.

29. ELECTROMOTIVE FORCE

■ What Are Half Reactions ■ Electrochemical Cells ■ Cell Potential or emf ■ Calculating the emf of a Cell ■ Measurement of emf of a Cell ■ Relation Between emf and Free Energy ■ Determination of emf of a Half-cell ■ The Nernst Equation ■ Calculation of Half-cell Potential ■ Calculation of Cell Potential ■ Calculation of Equilibrium Constant for the Cell Reaction ■ Calomel Electrode ■ The Dipping Calomel Electrode ■ The Glass Electrode ■ Quinhydrone Electrode ■ Determination of pH of a Solution ■ Using Hydrogen Electrode ■ Using SCE Instead of SHE ■ Using Glass Electrode ■ Using Quinhydrone Electrode ■ Potentiometric Titrations ■ Acid-base Titrations ■ Oxidation-reduction Titrations ■ Precipitation Titrations ■ Overvoltage or Overpotential ■ emf of Concentration Cell.



932



976



30. PHOTOCHEMISTRY

Photochemical Reactions Difference between Photochemical and Thermochemical Reactions Thermopile Photoelectric Cell
 Chemical Actinometer Laws of Photochemistry Grothus-Draper Law Stark-Einstein Law of Photochemical Equivalence
 Quantum Yield (or Quantum Efficiency) Calculation of Quantum Yield Photosensitized Reactions Photophysical Processes
 Fluorescence Phosphorescence Chemiluminescence



1063

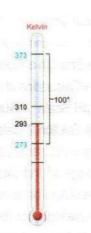
1043

31. SI UNITS

Common Systems of Measurements SI Units of Length SI Units of Volume SI Units of Temperature Units of Mass and Weight Units of Force Units of Work and Heat Energy Units of Pressure Units of Density.

32. MATHEMATICAL CONCEPTS

Logarithmic Functions • Fundamental Properties of Logarithms
 Characteristic and Mantissa • Rule to Find Mantissa
 Antilogarithm • Rule to Find Antilog of a Number • Exponential Functions • Polynomial • Curve Sketching • Displacement-Time Graphs • Types of Displacement-Time Graphs • Velocity-Time Graphs • Types of Velocity-Time Graphs • Graphs of Linear Equations • Slope of a Line • Trigonometric Functions • Inverse Trigonometric Functions • Differentiation • Derivative of a Function • Partial Differentiation • Partial Derivatives • Maxima and Minima • Integration • Constant of Integration • Permutations and Combinations • Factorial of an Integer • Probability.



1069

1099

33. INTRODUCTION TO COMPUTERS

Parts of a Computer Input Devices Output Devices
 Memory Unit Secondary Memory/Storage Devices Hardware
 And Software Operating Systems Programming Languages
 Number System Decimal Number System Binary Number
 System Decimal to Binary Conversion Binary to Decimal
 Conversion Octal Number System Octal to Decimal Conversion
 Decimal to Octal Conversion Octal to Binary Conversion
 Binary to Octal Conversion Hexadecimal Number System
 Hexadecimal to Binary Conversion Binary to Hexadecimal
 Conversion Hexadecimal to Decimal Conversion
 Octal to Hexadecimal Conversion Binary Arithmetic Binary
 Addition Binary Subtraction Binary Multiplication Binary
 Division Binary Arithmetic For Real Numbers



APPENDIX

INDEX