CONTENTS

PART I. INORGANIC CHEMISTRY

| _ | | | n - | | | • |
|----|---|---|------------|----|---|---|
| L. | н | А | ۲, | TE | ĸ | 1 |

| Fundamental | Facts | Regarding | Chemistry, | Matter, | and | Energy | 1 |
|--------------------|-------|-----------|------------|---------|-----|--------|---|
|--------------------|-------|-----------|------------|---------|-----|--------|---|

Importance of Chemistry to Medicine, Health, and Life in Present Era, 1. Matter and Energy, 3. Laws of Conservation of Mass and Energy, 6. Matter Exists in Three Physical States, 7. How We Recognize Different Kinds of Matter, 9. Physical and Chemical Changes, 10. Elements, Compounds, and Mixtures, 11. Summary, 13.

CHAPTER 2

Metals and Noumetals, 15. Occurrence and Physical States, 16. Names of Elements and Their Chemical Symbols, 17. Atoms and Atomic Weights, 18. Atomic Structure: Atoms as Miniature Solar Systems, 20. Atomic Numbers vs. Atomic Weights, 23. Isotopes: Different Species of the Same Element, 24. Periodic Law and Families of Elements, 26. Radioactive Elements, 28. Elements with Atomic Numbers Greater than 92, 29. Are Atoms Indivisible? 29.

CHAPTER 3

How Chemical Compounds Are Formed, 32. Molecules and Molecular Weights, 33. Invariable Composition of Compounds, 34. Elements Which Form Molecules, 34. Valence: Combining Capacity of an Element, 36. Explanation of Valence in Terms of Electron Theory, 37. Covalence: Combination by Sharing Electrons, 40. Formulas: Shorthand Descriptions of Molecules, 41. Quantitative Relations in Formulas, 44.

× CONTENTS

| CHAPTER 4 | |
|--------------|--|
| Chemical Cha | anges and Equations |
| | Types of Chemical Change, 46. Rules for Writing Equations, 47. How to Write and Balance Equations, 48. Equations May Include Transfers or Sharing of Electrons Effected in Chemical Changes, 50. Interpreting Chemical Equations, 51. What Equations Do Not Tell, 52. |
| • | |
| CHAPTER 5 | |
| Two Importa | nt Elements: Oxygen and Hydrogen54 |
| Oxyg | ел: Key to Life and Heat 54 |
| | Almost Everything in Nature Contains Oxygen, 54. Problems of Obtaining Pure Oxygen, 55. Physical Properties. 56. Chemical Properties, 57. Oxides, 58. Oxidation, 59. Importance of Oxygen to Life, 59. Oxygen in Air Kept Constant, 60. Oxygen in Breathing, 60. Use of Pure Oxygen to Prevent Oxygen Lack in Body in Crises, 62. Uses of Oxygen, 64. Ozone, 67. |
| Hydro | gen: The Lightest Element |
| | Occurrence, 68. Obtaining Free Hydrogen, 69. Physical Properties, 70. Chemical Properties, 71. Reduction, 71 Oxidation-Reduction, 72. Uses of Hydrogen, 73. |
| CHAPTER 6 | |
| The Most Imp | portant of all Compounds: Water |
| | Water in Nature, 76. Water in the Body, 76. Its Physica Properties Are Important, 77. Chemical Properties, 79 Hydrates and Water of Hydration, 80. Water Has Very Many Important Uses, 82. Impurities in Natural Waters. 84. Means of Removing Impurities from Water, 86. Hard Waters: Nature and Purification, 90. Other Ways of Coping with Hard Waters, 92. |

| | CONTENTS | X |
|-----------|--|-----------------------|
| CHAPTER | 7 | |
| Classes a | nd Naming of Inorganic Compounds: Some Facts About | |
| | | 96 |
| | How Do Inorganic and Organic Compounds Differ? 9 Main Classes of Inorganic Compounds Defined, 96. N menclature of Inorganic Compounds, 97. |)6. 0- |
| Со | ommon Properties of Different Classes | 99 |
| • | Oxides | 99 |
| | Acids | 95 |
| | Bases | 02 |
| | Applications of Properties of Acids and Bases 10 | 04 |
| | Salts]1 | 07 |
| | Acid Radicals, 107. Different Classes of Salts, 108. Formation of Salts, 108. Neutralization, 110. | r- |
| CHAPTER | 8 | |
| | out Chemical and Energy Changes | 13 |
| | Review of Some Important Facts about Chemical Change 113. Chemical Affinity, the Chief Cause of Chemic Changes, 114. Agencies Which Start or Speed Up Chemical Changes, 114. Reversible Reactions and Chemic Equilibrium, 116. Reactions Which Continue Forward Run to Completion, 117. Explanation in Terms of the Kinetic-Molecular Theory, 118. Energy Absorbed or Speed in Chemical Changes, 110. Importance of Chemical Changes, 110. Importance of Chemical Changes, 110. Importance of Chemical Changes, 110. | n- cal or he |

Free in Chemical Changes, 119. Importance of Chemical and Fnergy Changes in the Human Body, 121.

| Combustion and Oxidation-Reduction | 123 |
|--|------|
| | |
| Combustion or Burning | 123 |
| Conditions Necessary for Combustion to Occur, 123. | Fire |
| Prevention, 126. Starting a Fire, 126. Fires Nob | ody |

xii CONTENTS

Starts: Spontaneous Combustion, 127. Stopping a Fire, 128. Noncombustible Substances, 129. Products of Combustion of Organic Material, 130. Oxidation-Reduction . . . 130 Explanation in Terms of Electron Theory, 131. Oxidizing Agents and Their Uses, 132. Reducing Agents and Their Uses, 134. Oxidation-Reduction in Living Organisms, 135. CHAPTER 10 Nitrogen and the Atmosphere...... 138 138 Nitrogen Nitrogen Cycle in Nature, 139. Ways of Coaxing Atmospheric Nitrogen into Combination, 140. Air, a Gaseous Mixture, 145. Constant Components and Their Uses, 145. Components Which Are Variable in Amount, 146. Air Conditioning, 149. CHAPTER 11 151 Solutions . . What Is a Solution? 151. Uses and Importance of Solutions, 152. Solutions of Gases, Liquids, or Solids in Liquids, 154. Solubility: Dilute and Concentrated Solutions, 155. What Determines How Much of a Substance Will Go into Solution, 155. Ways to Speed Up Rate of Solution, 157. Unsaturated, Saturated, and Supersaturated Solutions, 158. Crystallization, 159. Heat of Solution, 159. Ways of Expressing Concentration of Solutions, 160. Some Striking Physical Properties of True Solutions, 164. True Solutions, Colloidal Dispersions, and Suspensions, 167. Colloidal Systems, 169. Important Properties and Behavior of Colloidal Dispersions, 169. Emulsions, 173. Colloids and Noncolloids in Living Organisms, 174. CHAPTER 12

Electrolytes and Nonelectrolytes, 178. Special Properties of Solutions of Acids, Bases, and Salts, 179. Theory of

Ionization, 181. Ionization of Salts, 182. Ionization of Bases, 184. Ionization of Acids, 185. Hydronium Ions and a Different Concept of Acids and Bases, 186. Degree of Ionization, 188. Application of Ionic Theory to Explanation of Peculiar Properties of Aqueous Solutions of Acids, Bases, and Salts, 188. Physiological Importance of Ionization, 198.

| | | | - | |
|--------------------------|----|-----|---|-----|
| \sim $^{\prime\prime}$ | AD | TFR | 7 | 3 |
| v. 17 | мг | 164 | | - 3 |

| The Halogens and Other Nonmetals | 201 |
|--|-----|
| The Halogens | 202 |
| Fluorine, F ₂ , 202. Chlorine, Cl ₂ , 203. Bromine, Br ₂ , Iodine, I, 204. Bleaching and Disinfecting Action Chlorine, 205. | |
| Sulfur: Properties and Uses | 206 |
| Phosphorus: Another Element Essential to Plant and Animal Life | 207 |
| Boron | 209 |
| Carbon and Some of its Important Inorganic Compounds Important Compounds, 211. | 209 |
| | |
| CHAPTER 14 | |
| Uses of Inorganic Salts in the Body | 216 |

To Build and Repair Tissues, 217. To Assist in Maintaining Normal Osmotic Pressure Conditions, 220. To Maintain Normal Contractility of Muscles and Irritability of Nerves, 222. To Assist in Holding Substances in Solution in Body Fluids, 222. To Furnish Material for the Acidity and Alkalinity of the Digestive Juices, 223. To Assist in Maintaining the Neutrality of the Body, 223. Special Uses for Certain Elements, 224.

xiv CONTENTS

| CHAPTER 15 |
|--|
| Radioactivity, Nuclear Reactions, and Atomic Energy |
| Dawn of the Atomic Era, 228. X-rays: An Invaluable Too of Medicine, 229. Radioactivity: Its Explanation and Use 230. Atom-Smashing Machines and Nuclear Reaction 235. Artificial Radioactivity: Use of Radioactive Isotope 238. Nuclear Fission, Atomic Energy, and the Atomi Bomb, 243. |
| PART II. ORGANIC CHEMISTRY |
| CHAPTER 16 |
| Introduction to Organic Chemistry |
| What Are "Organic" Compounds? 249. How Do The Differ from Inorganic Compounds? 251. Scope and Use of Organic Chemistry, 254. Characteristic Structure of Organic Compounds, 255. Classes of Organic Compound 262. |
| CHAPTER 17 Hydrocarbons and Halogen Derivatives |
| Methane or Paraffin Series |
| Occurrence and Uses, 265. Physical and Chemical Properties, 269. |
| Halogen Derivatives of Methane Series |
| Properties and Uses, 272. |
| Ethylene and Acetylene Series |
| Properties, 275. Uses, 276. Polymerization Yields Plastic and Synthetic Rubber, 277. |
| Cyclic or Ring Hydrocarbons |

| CHAPTER 18 | |
|-----------------------------|---|
| Ethers, Alcoho | ls, Aldehydes, and Ketones |
| Éthers . | |
| | Properties and Uses, 282. Preparation, 284. |
| Alcohol | s 284 |
| : | Kinds of Alcohols, 285. Physiological Effects, 286. Chemical Reactions, 287. Uses, 290. Sources, 291. |
| Aldehy | des and Ketones |
| | Intermediate Products of Oxidation-Reduction in Plants and Animals, 294. Properties of Aldehydes and Ketones, 295. Uses of Some Important Aldehydes, Ketones, and Their Derivatives, 299. |
| CHAPTER 19 Organic Acids | and Salts, Esters, Amines, and Amino Acids 301 |
| Organi | c Acids |
| | Different Types of Organic Acids, 302. Nomenclature, 303. Some Organic Acids Are Found in Common Foods, 304. Physical Properties, 306. Chemical Properties, 306. Organic Acids Are Weak Acids, 308. Unsaturated Fatty Acids, 309. Uses of Organic Acids, 310. |
| Organi | c Salts and Esters |
| | Organic Salts, 311. Esters, 313. |
| Amines | |
| Amino | Acids |
| CHAPTER 20 | |
| Cyclic Compou | ınds |
| | Differences between Open Chain and Ring Compounds, 320. Occurrence in Plants and Animals, 320. |

xvi CONTENTS

| Carbocyclic Hydrocarbons and Their Derivatives | 322 |
|---|----------------------|
| Benzene, 322. Different Positions in Benzene Ring Order of Substitution, 326. Toluene and Xylenes, 327. | and |
| Derivatives with OH Group in Ring or Side Chain | 329 |
| Alcohols, 329. Phenols and Derivatives, 329. | |
| Acids, Salts, and Esters | 332 |
| Nitro Compounds | 336 |
| Amino Compounds | 337 |
| Condensed Cyclics and Heterocyclics | 338 |
| Condensed Carbocyclic Compounds, 338. Heterocyc with Five or Six Atoms in Ring, 339. Condensed Comb tions of Benzene Ring with Pyrrole and Pyridine, Purines and Pyrimidines, 340. Alkaloids and Their Me inal Uses, 341. | ina- |
| CHAPTER 21 | |
| Chemotherapy and Modern Drugs | 345 |
| Chemotherapy with Arsenic and Mercury Compour 346. Sulfa Drugs. 347. Antibiotics, 348. Antihistam and Anticmetic Drugs, 351. Hypnotics (Sleep-produc | inic |
| Drugs), 353. Tranquilizers and Drugs Used in Mc Disorders, 355. Central Nervous System Stimulants (A leptic Drugs), 357. Vasodilators or Antihyperten Drugs, 359. Chemotherapy in Cancer, 361. | ntal ma- |
| Disorders, 355. Central Nervous System Stimulants (A leptic Drugs), 357. Vasodilators or Antihyperten | ntal ma- |
| Disorders, 355. Central Nervous System Stimulants (A leptic Drugs), 357. Vasodilators or Antihyperten Drugs, 359. Chemotherapy in Cancer, 361. PART III. BIOCHEMISTRY CHAPTER 22 | ntal ma- |
| Disorders, 355. Central Nervous System Stimulants (A leptic Drugs), 357. Vasodilators or Antihyperten Drugs, 359. Chemotherapy in Cancer, 361. PART III. BIOCHEMISTRY CHAPTER 22 | ntal una- sive |

| | CONTENTS xvii |
|--------------|---|
| Mond | osaccharides, or Simple Sugars |
| | Structure, 369. Physical Properties, 371. Chemical Properties, 371. |
| Disac | charides |
| | Physical Properties, 375. Chemical Properties, 375. |
| Polys | accharides |
| | Physical Properties, 382. Chemical Properties, 383. Summary, 384. |
| CHAPTER 2 | ?3 |
| Fats and Re | lated Substances |
| Fats | |
| | Occurrence and Chief Function, 386. Composition and Nomenclature, 386. Physical Properties, 389. Physical State of Fats Is Dependent on Their Fatty Acid Content, 390. Chemical Properties, 391. Composition and Properties of Animal Fats, 396. Uses of Fats in the Body, 396. Waxes, 397. |
| Othe | r Lipids 397 |
| | Definition and Classification of Lipids, 397. Compound Lipids, 398. |
| CHAPTER 2 | 24 |
| Proteins and | d Amino Acids 401 |
| | Definition and Occurrence, 401. Formation by Plants, 401. |

Definition and Occurrence, 401. Formation by Plants, 401. Proteins in the Animal Body: Uses and Requirements, 402. Composition, 404. Amino Acids—Units for Building Proteins, 404. Linkage of Amino Acids to Form Proteins, 407. Size and Structure of Protein Molecules, 409. Essential Amino Acids, Adequate and Inadequate Proteins, 412. Physical Properties of Proteins; Isoelectric Points, 416. Chemical Properties of Proteins, 418. Precipitation, 419. Color Reactions, 420. Classification, 421. Summary of Functions of Protein in Body, 424.

xviii CONTENTS

| CHAPTER 25 |
|---|
| The Vitamins |
| Definition and Discovery, 426. Sources, 426. Number and Names, 427. Chemistry, 429. What Vitamins Do. 430. Vitamins as Catalysts in Animal Tissues, 431. Measuring Vitamins and Body Requirements, 433. Vitamin A. 434. Vitamin B ₁ , or Thiamine, 438. Vitamin B ₂ , or Riboflavin, 441. Niacin, 443. Other Vitamins of the B-Complex, 444. Vitamin C, or Ascorbic Acid, 447. Vitamin D, 451. Vitamins E and K, 455. How to Get Optimum Amount of Vitamins, 457. |
| CHAPTER 26 |
| Digestion and Enzymes |
| Digestion |
| Necessity for Digestion of Food, 459. General Description of Digestion, 460. Chemical Changes That Occur in Digestion, 460. Digestive Fluids, 462. |
| Enzymes |
| Enzymes in General |
| Nature and Properties, 468. Different Types of Enzymes, 469. Coenzymes, 470. Factors Which Affect Enzyme Activity, 472. |
| Digestive Enzymes |
| Action of Bacteria in Digestion, 476. Conditions That Affect Digestion, 477. |
| CHAPTER 27 |
| Transportation: Blood and Lymph |
| Absorption of Digested Food Material Into Blood, 480. Functions of the Blood, 482. The Lymph, 483. Composition of the Blood, 484. Formed Elements, 486. Tissue |

Material of the Blood Plasma, 493. Nutritive Material Carried in the Blood, 495. Waste Materials Carried in the Blood, 497. Other Substances Carried in the Blood, 499. Constancy of Blood Composition, 500. Regulation of the Reaction of the Blood, 500. Variation in Blood Composition as an Index to Disease, 502.

| CHAPTER | 28 |
|-------------|---|
| Metabolisn | n: Chemical Changes in the Tissues |
| | Nature of Metabolism, 507. Basal Metabolism, 508. Carbohydrate Metabolism, 510. Metabolism of Fats, 518. Metabolism of Proteins, 521. Summary, 525. |
| Abr | normal Metabolism in Disease 526 |
| | In Diabetes, 526. In Liver Diseases, 530. In Acidosis and Asphyxia, 531. Disorders That Involve Deviations in Basal Metabolism, 531. |
| CHAPTER | 20 |
| | Glands and Their Hormones |
| Endocime | Olunus und Their Hormones |
| | Endocrine System and Nature of Hormones, 534. Internal Secretion of the Pancreas: Insulin, 536. Thyroid Gland and Thyroxine, 539. Parathyroids, 542. Adrenal Gland Hormones, 544. Thymus and Pineal Glands, 548. Sex Gland Hormones, 548. Pituitary Gland, 551. Summary, 554. |
| CHAPTER | 30 |
| Elimination | u: Urine and Feces |
| | Function of the Excretory Organs, 557. How the Kidneys Secrete Urine, 557. |
| Urir | ne 558 |
| | Special Interest Attached to Urine Analysis, 558. Collection of Urine Specimens, 559. Summary of General Prop- |

xx CONTENTS

| | erties of Urine with Their Significance, 559. No Constituents of Urine and Their Significance, 563. N genous Constituents, 564. Inorganic Salts, 566. Abno Constituents of Urine and Their Significance, 567. To Kidney Efficiency, 569. | itro- rmal |
|----------|--|-------------------|
| Feces | *************************************** | 570 |
| | Composition of the Feces, 570. Abnormalities of the F 570. Collection and Marking of Feces, 571. Elimina of Metabolic Products by Intestinal Route, 572. | |
| Milk . | | 573 |
| Appendix | •••••• | 577 |
| | Table of Metric Measures with English Equivalents Common English Measures with Metric Equivalents Apothecaries' Weights and Measures with Metric | 578 578 |
| | Equivalents Conversion Factors for Weights and Measures Centigrade and Fahrenheit Thermometer Scales | 578 579 579 |
| | Temperature Conversion Tables. Solubilities of Common Inorganic Compounds in Water. | 580 581 |
| | Color Reactions of Indicators in Solutions of Different Hydrogen-ion Concentrations. | 582 |
| | Common Poisons and Their Antidotes | 583 584 |
| Index | | 585 |