

# CONTENTS

## CHAPTER I

### KINETIC THEORY OF GASES

	Page
1. Atomic Theory in Chemistry - - - - -	1
2. Fundamental Assumptions of the Kinetic Theory of Gases - - - - -	3
3. Calculation of the Pressure of a Gas - - - - -	5
4. Temperature of a Gas - - - - -	6
5. Specific Heat - - - - -	8
6. Law of Distribution of Energy and Velocity - - - - -	9
7. Free Path - - - - -	17
8. Determination of Avogadro's Number - - - - -	19

## CHAPTER II

### ELEMENTARY PARTICLES

1. Conduction of Electricity in Rarefied Gases - - - - -	24
2. Canal Rays and Anode Rays (Positive Rays) - - - - -	28
3. X-rays - - - - -	29
4. Radiations from Radioactive Substances - - - - -	30
5. Prout's Hypothesis, Isotopy, the Proton - - - - -	34
6. The Neutron - - - - -	40
7. Cosmic Rays. Positrons - - - - -	41
8. Mesons and Nuclear Forces - - - - -	45

## CHAPTER III

### THE NUCLEAR ATOM

1. Lorentz's Electron Theory - - - - -	50
2. The Theorem of the Inertia of Energy. Unitary Field Theory - - - - -	52
3. Investigation of Atomic Structure by Scattering Experiments - - - - -	57
4. Mass Defect and Nuclear Binding Energy - - - - -	61
5. Heavy Hydrogen and Heavy Water - - - - -	65
6. Artificial Disintegration of the Nucleus and Artificial Radioactivity - - - - -	67

# CONTENTS

## CHAPTER IV

### WAVE-CORPUSCLES

	Page
1. Wave Theory of Light. Interference and Diffraction - - - -	73
2. Light Quanta - - - - -	76
3. Quantum Theory of the Atom - - - - -	79
4. Compton Effect - - - - -	82
5. Wave Nature of Matter. De Broglie's Theory - - - - -	84
6. Experimental Demonstration of Matter Waves - - - - -	87
7. The Contradiction between the Wave Theory and the Corpuscular Theory, and its Removal - - - - -	89

## CHAPTER V

### ATOMIC STRUCTURE AND SPECTRAL LINES

1. The Bohr Atom; Stationary Orbits for Simply Periodic Motions - -	98
2. Quantum Conditions for Simply and Multiply Periodic Motions - -	108
3. Matrix Mechanics - - - - -	123
4. Wave Mechanics - - - - -	126
5. Angular Momentum (Moment of Momentum) in Wave Mechanics -	136
6. The Statistical Interpretation of Wave Mechanics - - - - -	139

## CHAPTER VI

### SPIN OF THE ELECTRON AND PAULI'S PRINCIPLE

1. Alkali Doublets and the Spinning Electron - - - - -	145
2. The Anomalous Zeeman Effect - - - - -	149
3. The Hydrogen Atom and X-ray Terms - - - - -	157
4. The Helium Atom - - - - -	161
5. Pauli's Exclusion Principle - - - - -	168
6. The Periodic System. Closed Shells - - - - -	169
7. Magnetism - - - - -	175
8. Wave Theory of the Spin Electron - - - - -	178
9. Application of Wave Mechanics to the Nucleus - - - - -	185

## CHAPTER VII

### QUANTUM STATISTICS

1. Heat Radiation and Planck's Law - - - - -	197
2. Specific Heat of Solids and of Polyatomic Gases - - - - -	206

# CONTENTS

xi

	Page
3. Quantisation of Cavity Radiation - - - - -	213
4. Bose-Einstein Statistics of Light Quanta - - - - -	215
5. Einstein's Theory of Gas Degeneration - - - - -	224
6. Fermi-Dirac Statistics - - - - -	226
7. Electron Theory of Metals. Energy Distribution - - - - -	229
8. Thermionic and Photoelectric Effect in Metals - - - - -	232
9. Magnetism of the Electron Gas - - - - -	235
10. Electrical and Thermal Conductivity. Thermoelectricity - - - - -	236

## CHAPTER VIII

### MOLECULAR STRUCTURE

1. Molecular Properties as an Expression of the Distribution of Charge in the Electronic Cloud - - - - -	240
2. Experimental Determination of the Molecular Constants - - - - -	242
3. Band Spectra and the Raman Effect - - - - -	250
4. Chemical Binding. Classification of Types of Binding - - - - -	260
5. Theory of Heteropolar Ionic Binding - - - - -	262
6. Theory of Co-valency Binding - - - - -	265
7. Theory of van der Waals Forces and other Kinds of Binding - - - - -	267
8. Conclusion - - - - -	269

## APPENDIX

I. Evaluation of Some Integrals Connected with the Kinetic Theory of Gases - - - - -	272
II. Heat Conduction, Viscosity, and Diffusion - - - - -	274
III. Van der Waals' Equation of State - - - - -	278
IV. The Mean Square Deviation - - - - -	280
V. Theory of Relativity - - - - -	283
VI. Electron Theory - - - - -	286
VII. The Theorem of the Inertia of Energy - - - - -	288
VIII. Calculation of the Coefficient of Scattering for Radiation of Short Wave-length - - - - -	289
IX. Rutherford's Scattering Formula for $\alpha$ -rays - - - - -	290
X. The Compton Effect - - - - -	293
XI. Phase Velocity and Group Velocity - - - - -	295
XII. Elementary Derivation of Heisenberg's Uncertainty Relation - - - - -	296
XIII. Hamiltonian Theory and Action Variables - - - - -	297

	Page
XIV. Quantisation of the Elliptic Orbits in Bohr's Theory - - -	300
XV. The Oscillator according to Matrix Mechanics - - -	305
XVI. The Oscillator according to Wave Mechanics - - -	309
XVII. The Vibrations of a Circular Membrane - - -	311
XVIII. Solution of Schrödinger's Equation for the Kepler Problem -	312
XIX. The Resultant Angular Momentum - - -	316
XX. Deduction of Rutherford's Scattering Formula by Wave Me- chanics - - - - -	318
XXI. Deduction of the Selection Rules for the Kepler Problem - -	322
XXII. The Formalism of Quantum Mechanics, and the Uncertainty Relation - - - - -	326
XXIII. Anomalous Zeeman Effect in the D Lines of Sodium - - -	332
XXIV. Enumeration of the Terms in the case of two <i>p</i> -Electrons - -	333
XXV. Temperature Variation of Paramagnetism - - -	336
XXVI. Theory of Nuclear Disintegration - - - - -	340
XXVII. The Stefan-Boltzmann Law and Wien's Displacement Law -	343
XXVIII. Absorption by an Oscillator - - - - -	347
XXIX. Temperature and Entropy in Quantum Statistics - - -	350
XXX. Thermionic Emission of Electrons - - - - -	352
XXXI. Theory of Valency Binding - - - - -	354
XXXII. Theory of the van der Waals Forces - - - - -	357
Bibliography - - - - -	361
Index - . . . . .	363