

CONTENTS

1. Atomic Structure and the Periodic Table	1
The Atom as a Nucleus with Orbital Electrons	1
Atomic Spectra of Hydrogen and the Bohr Theory	2
The Dual Nature of Electrons-Particles or Waves	8
The Heisenberg Uncertainty Principle	9
The Schrodinger Wave Equation	10
Build-up of the Elements-Hund's Rule	17
Sequence of Energy Levels	19
Arrangement of the Elements in Groups in the Periodic Table	20
Problems	22
Further Reading	23
2. Bonding and Structure	24
Attainment of a Stable Configuration	24
Types of Bonds	24
Transitions between the Main Types of Bonding	26
General Properties of Ionically and Covalently Bonded Compounds	31
Structures of Ionic Solids	32
Ionic Compounds of the Type AX (ZnS, NaCl, CsCl)	34
Lattice Energy	36
Ionic Compounds of the Type AX_2 (CaF ₂ , TiO ₂)	38
Layer Structures	40
Stoichiometric Defects	41
Nonstoichiometric Defects	43
Semiconductors and Transistors	45
Structures of Simple Covalent Molecules	46
Sidgwick-Powell Theory	47
Hybridization	49
The Extent of d Orbital Participation in Molecular Bonding	58
Sigma and Pi Bonds	59
Molecular Orbital Method	61
LCAO Method	61
Rules for Linear Combination of Atomic Orbitals	68
Examples of Molecular Orbital Treatment	69
Examples of Molecular Orbital Treatment for Heteronuclear Diatomic Molecules	73
United Atom Method	75

General Properties of Metals	75
Theories of Bonding in Metals	80
Alloys	85
Problems	89
Further Reading	90
3. General Properties of the Elements	92
Size of Atoms and Ions	92
Ionization Energies	94
Electron Affinity	97
Born-Haber Cycle	97
Electronegativity	99
Polarizing Power and Polarizability-Fajan's Rules	102
Metallic Character	102
Standard Electrode Potentials and Electrochemical Series	104
The Occurrence and Isolation of the Elements	109
Thermodynamics of Reduction Processes	113
Horizontal, Vertical and Diagonal Relationships in the Periodic Table	116
Hydrogen	117
Hydrides	121
Acids and Bases	123
Problems	125
Further Reading	126
4. <i>s</i> -Block Elements	128
Group I-Alkali Metals (Table 4.1)	128
Group II-Alkaline Earth Metals (Table 4.4)	139
Problems	151
Further Reading	153
5. <i>p</i> -Block Elements	154
Group III (Table 5.1)	154
Group IV (Table 5.3)	171
Group V	200
Group VI (Table 5.11)	229
Group VII-The Halogens (Table 5.15)	254
Group O-The Noble Gases (Table 5.20)	278
Problems	288
Further Reading	291

6.	<i>d</i> -Block Elements (Table 6.1)	294
	General Properties	294
	Scandium Group	305
	Titanium Group (Table 6.7)	308
	Vanadium Group (Table 6.9)	315
	Chromium Group (Table 6.11)	323
	Manganese Group (Table 6.13)	334
	Iron, Cobalt and Nickel Groups	346
	Iron Group (Table 6.15)	346
	Cobalt Group (Table 6.18)	357
	Nickel Group (Table 6.20)	365
	Horizontal Comparisons in the Iron, Cobalt and Nickel Groups	373
	Copper Group (Currency Metals) (Table 6.22)	374
	Zinc Group (Table 6.24)	382
	Problems	391
	Further Reading	392
7.	<i>f</i> -Block Elements	394
	The Lanthanide Series (Table 7.1)	394
	The Heavier Elements	406
	Problems	418
	Further Reading	419
8.	Coordination Compounds	420
	Double Salts and Coordination Compounds	420
	Effective Atomic Numbers	425
	Shapes of <i>d</i> Orbitals	426
	Bonding in Transition Metal Complexes	426
	Crystal Field Theory	427
	Chelates	442
	Nomenclature of Coordination Compounds	445
	Isomerism	446
	Problems	449
	Further Reading	450
9.	The Atomic Nucleus	451
	Structure of the Nucleus	451
	Forces in the Nucleus	452
	Stability and the Ratio of Neutrons and Protons	453
	Modes of Decay	453

γ -Radiation	455
Half-Life Period	455
Binding Energy and Nuclear Stability	456
α -Decay	457
Radioactive Displacement Laws	457
Radioactive Decay Series	458
Induced Nuclear Reactions	459
Some Units and Definitions	461
Problems	461
Further Reading	462
10. Spectra	463
Energy Levels in an Atom	463
Determining the Ground State Terms-Hund's Rules	470
Hole Formulation	471
Electronic Spectra of Transition Metal Complexes	475
Further Reading	483
Appendix I: Abundance of the Elements	484
Appendix II: Melting Points of the Elements	485
Appendix III: Densities of the Solid and Liquid Elements	486
Appendix IV: Some Average Single Bond Energies in kJ mol^{-1} Some Double and Triple Bond Energies	487
Appendix V: Solubilities of Main Group Compounds in Water	488
Appendix VI: Atomic Weights (Based on $^{12}\text{C}=12.000$)	489
Appendix VII: Standard Textbooks	490
Index	491