
MODERN INORGANIC CHEMISTRY

William L. Jolly

*Professor of Chemistry
University of California, Berkeley*

TU Darmstadt
Teilbibliothek Chemie/
Materialwissenschaft

McGraw-Hill Book Company

New York St. Louis San Francisco Auckland Bogotá Hamburg
Johannesburg London Madrid Mexico Montreal New Delhi
Panama Paris São Paulo Singapore Sydney Tokyo Toronto

CONTENTS

Preface	xiii
Chapter 1 Electron Configurations of Atoms and the Periodic Table	1
Quantum Numbers	1
Orbital Shapes and Energies for the Hydrogen Atom	3
Electron Configurations of Atoms and Ions	10
The Periodic Table	13
Ionization-Potential Trends	15
Atomic-Size Trends	21
Problems	22
Chapter 2 Symmetry and the Elements of Group Theory	24
Symmetry Operations and Symmetry Elements	25
Point Groups	27
Character Tables and Irreducible Representations	30
Reducible Representations	36
Problems	38
Chapter 3 Covalent Bonding	40
The Lewis Octet Theory	40
The Isoelectronic Principle	46
Bond Distances	50
Bond Strength	55
Dissociation Energies / Bond Energies / Force Constants	
Bond Polarity	64
Dipole Moments / Nuclear Magnetic Resonance /	
Nuclear Quadrupole Resonance / Mössbauer	
Spectroscopy / X-ray Photoelectron Spectroscopy /	
Electronegativities	
Prediction of Molecular Topology	76

Valence-Shell Electron Repulsion	77
Total Coordination Number 2 / Total Coordination	
Number 3 / Total Coordination Number 4 / Total	
Coordination Number 5 / Total Coordination	
Number 6 / Total Coordination Number 7 / A Caveat	
Conformational Isomerism Based on Bond Rotations	91
Problems	93
Chapter 4 Molecular Orbital Theory	96
Simple LCAO Theory	96
Criteria for Stable Molecular Orbitals	103
Sigma, Pi, and Delta Molecular Orbitals	104
Diatomc Molecules	105
Electron Density Contour Maps	108
Symmetry and Polyatomic Molecules	114
Hybridization	121
Walsh Diagrams	124
Pi Bonding Beyond the First Row of the Periodic Table	127
Simple Hückel Theory	129
Hyperconjugation	133
Calculations	135
Extended Hückel Theory-/ SCF Methods	
Problems	145
Chapter 5 The Kinetics and Mechanisms of Gas Phase Reactions	147
Reactions of Hydrogen with Halogens	147
Orbital Symmetry Effects	152
Explosions	155
Problems	158
Chapter 6 Compounds of Hydrogen	160
Classification of the Hydrides	160
Saline Hydrides / Metallic Hydrides / Hydrogen Storage	
with Metallic Hydrides / Transition-Metal Hydride	
Complexes / Nonmetal Hydrides	
Hydridic and Protonic Character	168
Problems	170
Chapter 7 Acid-Base Reactions	171
Gas-Phase Proton Affinities	171
Proton Affinities of Anions	
Aqueous Acidities of Protonic Acids	177
Binary Hydrides / Hydroxy Acids / Transition-Metal	
Carbonyl Hydrides	

Hydrogen Bonding	184
Kinetics of Proton-Transfer Reactions	193
The Entropy of Ionization of Aqueous Acids	195
Some Special Aqueous Acids	196
Acids and Bases in Protic Solvents	199
Acids and Bases in Aprotic Solvents	204
Lewis Acid-Base Theory	205
Problems	211
Chapter 8 Some Thermodynamic and Kinetic Aspects of Aqueous Redox Chemistry	214
The Use of Thermodynamic Data	214
Reduction Potentials / The Use of Tabulated Potentials / Dependence of Potentials on pH / Reduction-Potential Diagrams	
Mechanisms of Oxyanion Reactions	230
The Landolt Clock Reaction	
Problems	234
Chapter 9 Solvated Electrons	236
The Hydrated Electron	236
Metal-Ammonia Solutions	241
Physical Characteristics / Reactions / Kinetics	
Alkali-Metal Anions	246
Problems	248
Chapter 10 Boron Hydrides and Their Derivatives	249
Syntheses	249
The Synthesis of Boron Hydrides / The Synthesis of Borane Anions / The Synthesis of Carboranes	
Structure and Bonding	253
Three-Center Bonding / MO Theory of Clusters	
Metallocarboranes and Metalloboranes	259
Other Main-Group Cluster Compounds	260
Problems	262
Chapter 11 The Solid State	264
Classification of Bonds and Crystals	264
Crystals Containing Finite Complexes / Crystals Containing Infinite One-Dimensional Complexes / Crystals Containing Infinite Two-Dimensional Complexes / Crystals Containing Infinite Three-Dimensional Complexes	
The Effect of Radius Ratio and Charge on Structure	280
Lattice Energy	285
Application of the Isoelectronic Principle	288

Oxidation-Reduction Reactions	458
Outer-Sphere Electron Transfer / Inner-Sphere Redox Reactions / Electron Transfer through Extended Bridges / Mixed-Valence Compounds / Unstable Intermediate Oxidation States	
Problems	469
Chapter 20 Homogeneous Catalysis	470
Olefin Hydrogenation	473
Olefin Dimerization and Metathesis	474
Olefin Isomerization	477
Hydroformylation	478
Water Gas Shift Reaction	479
Acetic Acid from Ethylene	479
Template Syntheses	481
Problems	482
Chapter 21 Heterogeneous Catalysis	484
Effects of Surface Site on Adsorption	484
Effects of Surface Coverage on Adsorption of Carbon Monoxide	490
The Fischer-Tropsch Process	493
Ziegler-Natta Olefin Polymerization	496
Ammonia Synthesis	497
Electrode Surface Modification	498
Catalysis by Metal Clusters	501
Problems	504
Chapter 22 Some Biological Systems	505
Metalloporphyrins and Related Systems	505
Hemoglobin and Myoglobin / Vitamin B ₁₂	
Iron-Sulfur Proteins and Nitrogen Fixation	517
<i>cis</i> -Dichlorodiammineplatinum(II) Anticancer Activity	524
Carbonic Anhydrase	524
Superoxide Dismutases	526
Problems	528
Appendices	529
A Units and Conversion Factors	529
B Term Symbols for Free Atoms and Ions	532
C Electron Affinities	535
Electron Affinities of Atoms / Electron Affinities of Molecules and Radicals	

D Ionization Potentials	538
E Selected Values of Thermodynamic Data	539
F Ionic Radii	550
G Inorganic Nomenclature	556
Formulas and Names of Compounds in General	556
Names for Ions and Radicals	557
Acids	559
Salts Containing Acid Hydrogen	560
Coordination Compounds	560
Alternative Modes of Linkage of Some Ligands / Use of Abbreviations / Complexes with Unsaturated Molecules or Groups / Compounds with Bridging Atoms or Groups / Homoatomic Aggregates	
Prefixes or Affixes Used in Inorganic Nomenclature	564
Multiplying Affixes / Structural Affixes / Substitutional Affixes	
Answers to Selected Problems	566
Indexes	579
Formula Index	
Subject Index	