

Contents

Chapter 1. Fundamentals of Inorganic Biochemistry 1

Part A. Fundamentals of Inorganic Solution Chemistry 2

- 1.1 The Elements 2
- 1.2 Formal Oxidation States and Coordination Geometries of Biologically Important Metal Ions 3
- 1.3 Classifications of Metal Ions and Ligands: Hard-Soft Acid-Base (HSAB) Theory 7
- 1.4 Stability Constants 8
- 1.5 Stabilization of Oxidation States 11
- 1.6 Ligand Field Stabilization Energy 12
- 1.7 Kinetics and Mechanisms of Reactions Involving Metal Complexes 16
- 1.8 Electron-Transfer Reactions 20

Part B. Fundamentals of Reaction Kinetics and Thermodynamics 24

- 1.9 Rate Laws and Rate Constants 24
- 1.10 Thermodynamics and Equilibrium 28
- 1.11 Catalysis 32

Part C. Fundamentals of Biochemistry 36

- 1.12 Biological Ligands 36
- 1.13 The Relationship Between Nucleotide and Protein Sequence 48

1.14	Cell Biology	49
1.15	Molecular Biology	53
Notes	57	
Further Reading	58	
Problems	60	

Chapter 2. Experimental Methods 65

Part A. Physicochemical Methods 65

2.1	Introduction to Spectroscopy	65
2.2	Optical Spectroscopy	69
2.3	Magnetic Resonance and Related Properties	76
2.4	Solution Methods Dependent on X-Radiation and γ -Radiation	92
2.5	Electrochemical Methods	98

Part B. Biochemical Methods 108

2.6	Enzyme Kinetics	108
2.7	Measuring the Molecular Mass of a Protein	114
2.8	Measuring the Molecular Mass and Length of Polynucleotides	115
2.9	Measurement of Macromolecule–Ligand Binding Affinities	115
2.10	Protein Isolation and Purification	116
Notes	118	
Further Reading	119	
Problems	122	

Chapter 3. Transport and Storage 133

3.1	Introduction	133
3.2	Metal Ion Uptake and Transmembrane Ion Transport	137
3.3	Transport and Storage of Metal Ions in Vivo	147
Notes	161	
Further Reading	162	
Problems	163	

Chapter 4. Metalloproteins and Metalloenzymes: (I) Oxygen Carriers and Hydrolases 167

4.1	Oxygen Carriers	168
4.2	Hydrolase Enzymes	179
4.3	Hydro-Lyase Enzymes—Aconitase	190
Notes	194	

Further Reading	198
Problems	198

**Chapter 5. Metalloproteins and Metalloenzymes:
(II) Redox Chemistry 203**

5.1	Introduction	203
5.2	Prosthetic Centers, Cofactors, and Coenzymes in Metalloredox Proteins and Enzymes	205
5.3	Electron-Transfer Pathways in Respiratory Metabolism	221
5.4	Electron-Transfer Pathways in Nonrespiratory Metabolism	231
5.5	Protein-Protein Electron Transfer	242
	Notes	247
	Further Reading	248
	Problems	250

Chapter 6. Alkali and Alkaline Earth Metals 257

6.1	Overview of the Biological Chemistry of Group IA and IIA Metals	257
6.2	Membrane Translocation	260
6.3	Alkali Metals and the Regulation of Membrane Potentials	262
6.4	Enzyme Activation	268
6.5	Complexes with Nucleic Acids	273
6.6	Cell Walls and Membranes	278
6.7	Biominerals	279
	Notes	284
	Further Reading	285
	Problems	286

**Chapter 7. Metals in the Regulation of Biochemical
Events 291**

7.1	Calcium as a Secondary Messenger	292
7.2	Regulation of Cellular Concentrations of Metal Ions	303
	Notes	314
	Further Reading	314
	Problems	314

Chapter 8. Cell Toxicity and Chemotherapeutics 319

8.1	Oxygen Toxicity	320
8.2	Metal Toxicity	338

8.3 Coordination Complexes as Therapeutic Agents 342
Notes 349
Further Reading 351
Problems 352

Chapter 9. Metal Complexes as Probes of Structure and Reactivity 357

9.1 Nucleic Acids 357
9.2 Metal Substitution: A Probe of Structure and Reactivity 364
Notes 382
Further Reading 382
Problems 383

Chapter 10. Case Studies 389

10.1 Cytochrome c Oxidase 389
10.2 Mercuric Reductase 400
10.3 Bleomycin 406
10.4 Final Remarks 416
Notes 416
Further Reading 417

Appendices 419

Solutions to Problems Lacking Original Literature
References 427

Index 431