

Summary of contents

Part 1 Foundations	1
1 Atomic structure	3
2 Molecular structure and bonding	34
3 The structures of simple solids	65
4 Acids and bases	116
5 Oxidation and reduction	154
6 Molecular symmetry	188
7 An introduction to coordination compounds	209
8 Physical techniques in inorganic chemistry	234

Part 2 The elements and their compounds	271
9 Periodic trends	273
10 Hydrogen	296
11 The Group 1 elements	318
12 The Group 2 elements	336
13 The Group 13 elements	354
14 The Group 14 elements	381
15 The Group 15 elements	408
16 The Group 16 elements	433
17 The Group 17 elements	456
18 The Group 18 elements	479
19 The d-block elements	488
20 d-Metal complexes: electronic structure and properties	515
21 Coordination chemistry: reactions of complexes	550
22 d-Metal organometallic chemistry	579
23 The f-block elements	625

Part 3 Frontiers	653
24 Materials chemistry and nanomaterials	655
25 Catalysis	728
26 Biological inorganic chemistry	763
27 Inorganic chemistry in medicine	820
Resource section 1: Selected ionic radii	834
Resource section 2: Electronic properties of the elements	836
Resource section 3: Standard potentials	838
Resource section 4: Character tables	851
Resource section 5: Symmetry-adapted orbitals	856
Resource section 6: Tanabe-Sugano diagrams	860
<i>Index</i>	<i>863</i>

Contents

Glossary of chemical abbreviations	xxi	3 The structures of simple solids	65
		The description of the structures of solids	66
		3.1 Unit cells and the description of crystal structures	66
		3.2 The close packing of spheres	69
		3.3 Holes in close-packed structures	70
Part 1 Foundations	1	The structures of metals and alloys	72
1 Atomic structure	3	3.4 Polytypism	73
The structures of hydrogenic atoms	4	3.5 Nonclose-packed structures	74
1.1 Spectroscopic information	6	3.6 Polymorphism of metals	74
1.2 Some principles of quantum mechanics	8	3.7 Atomic radii of metals	75
1.3 Atomic orbitals	9	3.8 Alloys and interstitials	76
Many-electron atoms	15	Ionic solids	80
1.4 Penetration and shielding	15	3.9 Characteristic structures of ionic solids	80
1.5 The building-up principle	17	3.10 The rationalization of structures	87
1.6 The classification of the elements	20	The energetics of ionic bonding	91
1.7 Atomic properties	22	3.11 Lattice enthalpy and the Born–Haber cycle	91
FURTHER READING	32	3.12 The calculation of lattice enthalpies	93
EXERCISES	32	3.13 Comparison of experimental and theoretical values	95
TUTORIAL PROBLEMS	33	3.14 The Kapustinskii equation	97
		3.15 Consequences of lattice enthalpies	98
2 Molecular structure and bonding	34	Defects and nonstoichiometry	102
Lewis structures	34	3.16 The origins and types of defects	102
2.1 The octet rule	34	3.17 Nonstoichiometric compounds and solid solutions	105
2.2 Resonance	35	The electronic structures of solids	107
2.3 The VSEPR model	36	3.18 The conductivities of inorganic solids	107
Valence bond theory	39	3.19 Bands formed from overlapping atomic orbitals	107
2.4 The hydrogen molecule	39	3.20 Semiconduction	110
2.5 Homonuclear diatomic molecules	40	FURTHER INFORMATION: the Born–Mayer equation	112
2.6 Polyatomic molecules	40	FURTHER READING	113
Molecular orbital theory	42	EXERCISES	113
2.7 An introduction to the theory	43	TUTORIAL PROBLEMS	115
2.8 Homonuclear diatomic molecules	45		
2.9 Heteronuclear diatomic molecules	48	4 Acids and bases	116
2.10 Bond properties	50	Brønsted acidity	117
2.11 Polyatomic molecules	52	4.1 Proton transfer equilibria in water	117
2.12 Computational methods	56	Characteristics of Brønsted acids	125
Structure and bond properties	58	4.2 Periodic trends in aqua acid strength	126
2.13 Bond length	58	4.3 Simple oxoacids	126
2.14 Bond strength	58	4.4 Anhydrous oxides	129
2.15 Electronegativity and bond enthalpy	59	4.5 Polyoxo compound formation	130
2.16 Oxidation states	61	Lewis acidity	132
FURTHER READING	62	4.6 Examples of Lewis acids and bases	132
EXERCISES	62	4.7 Group characteristics of Lewis acids	133
TUTORIAL PROBLEMS	63		

Reactions and properties of Lewis acids and bases	137	Applications of symmetry	196
4.8 The fundamental types of reaction	137	6.3 Polar molecules	196
4.9 Factors governing interactions between Lewis acids and bases	139	6.4 Chiral molecules	196
4.10 Thermodynamic acidity parameters	141	6.5 Molecular vibrations	197
Nonaqueous solvents	142	The symmetries of molecular orbitals	201
4.11 Solvent levelling	142	6.6 Symmetry-adapted linear combinations	201
4.12 The solvent-system definition of acids and bases	144	6.7 The construction of molecular orbitals	203
4.13 Solvents as acids and bases	145	6.8 The vibrational analogy	204
Applications of acid–base chemistry	149	Representations	205
4.14 Superacids and superbases	149	6.9 The reduction of a representation	205
4.15 Heterogeneous acid–base reactions	150	6.10 Projection operators	207
FURTHER READING	151	FURTHER READING	208
EXERCISES	151	EXERCISES	208
TUTORIAL PROBLEMS	153	TUTORIAL PROBLEMS	208
5 Oxidation and reduction	154	7 An introduction to coordination compounds	209
Reduction potentials	155	The language of coordination chemistry	210
5.1 Redox half-reactions	155	7.1 Representative ligands	210
5.2 Standard potentials and spontaneity	156	7.2 Nomenclature	212
5.3 Trends in standard potentials	160	Constitution and geometry	214
5.4 The electrochemical series	161	7.3 Low coordination numbers	214
5.5 The Nernst equation	162	7.4 Intermediate coordination numbers	215
Redox stability	164	7.5 Higher coordination numbers	216
5.6 The influence of pH	164	7.6 Polymetallic complexes	218
5.7 Reactions with water	165	Isomerism and chirality	218
5.8 Oxidation by atmospheric oxygen	166	7.7 Square-planar complexes	219
5.9 Disproportionation and comproportionation	167	7.8 Tetrahedral complexes	220
5.10 The influence of complexation	168	7.9 Trigonal-bipyramidal and square-pyramidal complexes	220
5.11 The relation between solubility and standard potentials	170	7.10 Octahedral complexes	221
Diagrammatic presentation of potential data	170	7.11 Ligand chirality	224
5.12 Latimer diagrams	171	The thermodynamics of complex formation	225
5.13 Frost diagrams	173	7.12 Formation constants	226
5.14 Pourbaix diagrams	177	7.13 Trends in successive formation constants	227
5.15 Applications in environmental chemistry: natural waters	177	7.14 The chelate and macrocyclic effects	229
Chemical extraction of the elements	178	7.15 Steric effects and electron delocalization	229
5.16 Chemical reduction	178	FURTHER READING	231
5.17 Chemical oxidation	182	EXERCISES	231
5.18 Electrochemical extraction	183	TUTORIAL PROBLEMS	232
FURTHER READING	184		
EXERCISES	185		
TUTORIAL PROBLEMS	186		
6 Molecular symmetry	188	8 Physical techniques in inorganic chemistry	234
An introduction to symmetry analysis	188	Diffraction methods	234
6.1 Symmetry operations, elements, and point groups	188	8.1 X-ray diffraction	234
6.2 Character tables	193	8.2 Neutron diffraction	238
		Absorption and emission spectroscopies	239
		8.3 Ultraviolet-visible spectroscopy	240
		8.4 Fluorescence or emission spectroscopy	242
		8.5 Infrared and Raman spectroscopy	244

Resonance techniques	247	10.3 Nuclear properties	302
8.6 Nuclear magnetic resonance	247	10.4 Production of dihydrogen	303
8.7 Electron paramagnetic resonance	252	10.5 Reactions of dihydrogen	305
8.8 Mössbauer spectroscopy	254	10.6 Compounds of hydrogen	306
Ionization-based techniques	255	10.7 General methods for synthesis of binary hydrogen compounds	315
8.9 Photoelectron spectroscopy	255	FURTHER READING	316
8.10 X-ray absorption spectroscopy	256	EXERCISES	316
8.11 Mass spectrometry	257	TUTORIAL PROBLEMS	317
Chemical analysis	259		
8.12 Atomic absorption spectroscopy	260	11 The Group 1 elements	318
8.13 CHN analysis	260	Part A: The essentials	318
8.14 X-ray fluorescence elemental analysis	261	11.1 The elements	318
8.15 Thermal analysis	262	11.2 Simple compounds	320
Magnetometry and magnetic susceptibility	264	11.3 The atypical properties of lithium	321
Electrochemical techniques	264	Part B: The detail	321
Microscopy	266	11.4 Occurrence and extraction	321
8.16 Scanning probe microscopy	266	11.5 Uses of the elements and their compounds	322
8.17 Electron microscopy	267	11.6 Hydrides	324
FURTHER READING	268	11.7 Halides	324
EXERCISES	268	11.8 Oxides and related compounds	326
TUTORIAL PROBLEMS	269	11.9 Sulfides, selenides, and tellurides	327
		11.10 Hydroxides	327
		11.11 Compounds of oxoacids	328
		11.12 Nitrides and carbides	330
		11.13 Solubility and hydration	330
		11.14 Solutions in liquid ammonia	331
		11.15 Zintl phases containing alkali metals	331
		11.16 Coordination compounds	332
		11.17 Organometallic compounds	333
		FURTHER READING	334
		EXERCISES	334
		TUTORIAL PROBLEMS	334
Part 2 The elements and their compounds	271	12 The Group 2 elements	336
		Part A: The essentials	336
9 Periodic trends	273	12.1 The elements	336
Periodic properties of the elements	273	12.2 Simple compounds	337
9.1 Valence electron configurations	273	12.3 The anomalous properties of beryllium	339
9.2 Atomic parameters	274	Part B: The detail	339
9.3 Occurrence	279	12.4 Occurrence and extraction	339
9.4 Metallic character	280	12.5 Uses of the elements and their compounds	340
9.5 Oxidation states	281	12.6 Hydrides	342
Periodic characteristics of compounds	285	12.7 Halides	343
9.6 Coordination numbers	285	12.8 Oxides, sulfides, and hydroxides	344
9.7 Bond enthalpy trends	285	12.9 Nitrides and carbides	346
9.8 Binary compounds	287	12.10 Salts of oxoacids	346
9.9 <i>Wider aspects of periodicity</i>	289		
9.10 Anomalous nature of the first member of each group	293		
FURTHER READING	295		
EXERCISES	295		
TUTORIAL PROBLEMS	295		
10 Hydrogen	296		
Part A: The essentials	296		
10.1 The element	297		
10.2 Simple compounds	298		
Part B: The detail	302		

12.11 Solubility, hydration, and beryllates	349	14.10 Simple compounds of silicon with oxygen	396
12.12 Coordination compounds	349	14.11 Oxides of germanium, tin, and lead	397
12.13 Organometallic compounds	350	14.12 Compounds with nitrogen	398
FURTHER READING	352	14.13 Carbides	398
EXERCISES	352	14.14 Silicides	401
TUTORIAL PROBLEMS	352	14.15 Extended silicon–oxygen compounds	401
 		14.16 Organosilicon and organogermanium compounds	404
13 The Group 13 elements	354	14.17 Organometallic compounds	405
Part A: The essentials	354	FURTHER READING	406
13.1 The elements	354	EXERCISES	406
13.2 Compounds	356	TUTORIAL PROBLEMS	407
13.3 Boron clusters	359	 	
Part B: The detail	359	15 The Group 15 elements	408
13.4 Occurrence and recovery	359	Part A: The essentials	408
13.5 Uses of the elements and their compounds	360	15.1 The elements	409
13.6 Simple hydrides of boron	361	15.2 Simple compounds	410
13.7 Boron trihalides	363	15.3 Oxides and oxanions of nitrogen	411
13.8 Boron–oxygen compounds	364	Part B: The detail	411
13.9 Compounds of boron with nitrogen	365	15.4 Occurrence and recovery	411
13.10 Metal borides	366	15.5 Uses	412
13.11 Higher boranes and borohydrides	367	15.6 Nitrogen activation	414
13.12 Metallaboranes and carboranes	372	15.7 Nitrides and azides	415
13.13 The hydrides of aluminium and gallium	374	15.8 Phosphides	416
13.14 Trihalides of aluminium, gallium, indium, and thallium	374	15.9 Arsenides, antimonides, and bismuthides	417
13.15 Low-oxidation-state halides of aluminium, gallium, indium, and thallium	375	15.10 Hydrides	417
13.16 Oxo compounds of aluminium, gallium, indium, and thallium	376	15.11 Halides	419
13.17 Sulfides of gallium, indium, and thallium	376	15.12 Oxohalides	420
13.18 Compounds with Group 15 elements	376	15.13 Oxides and oxoanions of nitrogen	421
13.19 Zintl phases	377	15.14 Oxides of phosphorus, arsenic, antimony, and bismuth	425
13.20 Organometallic compounds	377	15.15 Oxoanions of phosphorus, arsenic, antimony, and bismuth	425
FURTHER READING	378	15.16 Condensed phosphates	427
EXERCISES	378	15.17 Phosphazenes	428
TUTORIAL PROBLEMS	379	15.18 Organometallic compounds of arsenic, antimony, and bismuth	428
 		FURTHER READING	430
14 The Group 14 elements	381	EXERCISES	430
Part A: The essentials	381	TUTORIAL PROBLEMS	431
14.1 The elements	381	 	
14.2 Simple compounds	383	16 The Group 16 elements	433
14.3 Extended silicon–oxygen compounds	385	Part A: The essentials	433
Part B: The detail	385	16.1 The elements	433
14.4 Occurrence and recovery	385	16.2 Simple compounds	435
14.5 Diamond and graphite	386	16.3 Ring and cluster compounds	437
14.6 Other forms of carbon	387	Part B: The detail	438
14.7 Hydrides	390	16.4 Oxygen	438
14.8 Compounds with halogens	392	16.5 Reactivity of oxygen	439
14.9 Compounds of carbon with oxygen and sulfur	394	16.6 Sulfur	440
		16.7 Selenium, tellurium, and polonium	441

16.8 Hydrides	441	18.9 Organoxenon compounds	484
16.9 Halides	444	18.10 Coordination compounds	485
16.10 Metal oxides	445	18.11 Other compounds of noble gases	486
16.11 Metal sulfides, selenides, tellurides, and polonides	445	FURTHER READING	486
16.12 Oxides	447	EXERCISES	486
16.13 Oxoacids of sulfur	449	TUTORIAL PROBLEMS	487
16.14 Polyanions of sulfur, selenium, and tellurium	452		
16.15 Polycations of sulfur, selenium, and tellurium	452	19 The d-block elements	488
16.16 Sulfur–nitrogen compounds	453	Part A: The essentials	488
FURTHER READING	454	19.1 Occurrence and recovery	488
EXERCISES	454	19.2 Chemical and physical properties	489
TUTORIAL PROBLEMS	455	Part B: The detail	491
		19.3 Group 3: scandium, yttrium, and lanthanum	491
17 The Group 17 elements	456	19.4 Group 4: titanium, zirconium, and hafnium	493
Part A: The essentials	456	19.5 Group 5: vanadium, niobium, and tantalum	494
17.1 The elements	456	19.6 Group 6: chromium, molybdenum, and tungsten	498
17.2 Simple compounds	458	19.7 Group 7: manganese, technetium, and rhenium	502
17.3 The interhalogens	460	19.8 Group 8: iron, ruthenium, and osmium	504
Part B: The detail	461	19.9 Group 9: cobalt, rhodium, and iridium	506
17.4 Occurrence, recovery, and uses	461	19.10 Group 10: nickel, palladium, and platinum	507
17.5 Molecular structure and properties	463	19.11 Group 11: copper, silver, and gold	508
17.6 Reactivity trends	464	19.12 Group 12: zinc, cadmium, and mercury	510
17.7 Pseudohalogens	465	FURTHER READING	513
17.8 Special properties of fluorine compounds	466	EXERCISES	514
17.9 Structural features	466	TUTORIAL PROBLEMS	514
17.10 The interhalogens	467		
17.11 Halogen oxides	470	20 d-Metal complexes: electronic structure and properties	515
17.12 Oxoacids and oxoanions	471	Electronic structure	515
17.13 Thermodynamic aspects of oxoanion redox reactions	472	20.1 Crystal-field theory	515
17.14 Trends in rates of oxoanion redox reactions	473	20.2 Ligand-field theory	525
17.15 Redox properties of individual oxidation states	474	Electronic spectra	530
17.16 Fluorocarbons	475	20.3 Electronic spectra of atoms	530
FURTHER READING	476	20.4 Electronic spectra of complexes	536
EXERCISES	476	20.5 Charge-transfer bands	540
TUTORIAL PROBLEMS	478	20.6 Selection rules and intensities	541
		20.7 Luminescence	543
18 The Group 18 elements	479	Magnetism	544
Part A: The essentials	479	20.8 Cooperative magnetism	544
18.1 The elements	479	20.9 Spin-crossover complexes	546
18.2 Simple compounds	480	FURTHER READING	547
Part B: The detail	481	EXERCISES	547
18.3 Occurrence and recovery	481	TUTORIAL PROBLEMS	548
18.4 Uses	481		
18.5 Synthesis and structure of xenon fluorides	482	21 Coordination chemistry: reactions of complexes	550
18.6 Reactions of xenon fluorides	482	Ligand substitution reactions	550
18.7 Xenon–oxygen compounds	483	21.1 Rates of ligand substitution	550
18.8 Xenon insertion compounds	484	21.2 The classification of mechanisms	552

Ligand substitution in square-planar complexes	555	22.22 Oxidative addition and reductive elimination	617
21.3 The nucleophilicity of the entering group	556	22.23 σ -Bond metathesis	619
21.4 The shape of the transition state	557	22.24 1,1-Migratory insertion reactions	619
Ligand substitution in octahedral complexes	560	22.25 1,2-Insertions and β -hydride elimination	620
21.5 Rate laws and their interpretation	560	22.26 α -, γ -, and δ -Hydride eliminations and cyclometallations	621
21.6 The activation of octahedral complexes	562	FURTHER READING	622
21.7 Base hydrolysis	565	EXERCISES	622
21.8 Stereochemistry	566	TUTORIAL PROBLEMS	623
21.9 Isomerization reactions	567		
Redox reactions	568	23 The f-block elements	625
21.10 The classification of redox reactions	568	The elements	626
21.11 The inner-sphere mechanism	568	23.1 The valence orbitals	626
21.12 The outer-sphere mechanism	570	23.2 Occurrence and recovery	627
Photochemical reactions	574	23.3 Physical properties and applications	627
21.13 Prompt and delayed reactions	574	Lanthanoid chemistry	628
21.14 d-d and charge-transfer reactions	574	23.4 General trends	628
21.15 Transitions in metal-metal bonded systems	576	23.5 Electronic, optical, and magnetic properties	632
FURTHER READING	576	23.6 Binary ionic compounds	636
EXERCISES	576	23.7 Ternary and complex oxides	638
TUTORIAL PROBLEMS	577	23.8 Coordination compounds	639
		23.9 Organometallic compounds	641
22 d-Metal organometallic chemistry	579	Actinoid chemistry	643
Bonding	580	23.10 General trends	643
22.1 Stable electron configurations	580	23.11 Electronic spectra of the actinoids	647
22.2 Electron-count preference	581	23.12 Thorium and uranium	648
22.3 Electron counting and oxidation states	582	23.13 Neptunium, plutonium, and americium	649
22.4 Nomenclature	584	FURTHER READING	650
Ligands	585	EXERCISES	650
22.5 Carbon monoxide	585	TUTORIAL PROBLEMS	651
22.6 Phosphines	587		
22.7 Hydrides and dihydrogen complexes	588	<hr/>	
22.8 η^1 -Alkyl, -alkenyl, -alkynyl, and -aryl ligands	589	Part 3 Frontiers	653
22.9 η^2 -Alkene and -alkyne ligands	590		
22.10 Nonconjugated diene and polyene ligands	591	24 Materials chemistry and nanomaterials	655
22.11 Butadiene, cyclobutadiene, and cyclooctatetraene	591	Synthesis of materials	656
22.12 Benzene and other arenes	593	24.1 The formation of bulk material	656
22.13 The allyl ligand	594	Defects and ion transport	659
22.14 Cyclopentadiene and cycloheptatriene	595	24.2 Extended defects	659
22.15 Carbenes	597	24.3 Atom and ion diffusion	660
22.16 Alkanes, agostic hydrogens, and noble gases	597	24.4 Solid electrolytes	661
22.17 Dinitrogen and nitrogen monoxide	598	Metal oxides, nitrides, and fluorides	665
Compounds	599	24.5 Monoxides of the 3d metals	665
22.18 d-Block carbonyls	599	24.6 Higher oxides and complex oxides	667
22.19 Metallocenes	606	24.7 Oxide glasses	676
22.20 Metal-metal bonding and metal clusters	610	24.8 Nitrides, fluorides, and mixed-anion phases	679
Reactions	614	Sulfides, intercalation compounds, and metal-rich phases	681
22.21 Ligand substitution	614	24.9 Layered MS_2 compounds and intercalation	681
		24.10 Chevrel phases and chalcogenide thermoelectrics	684

Framework structures	685	Heterogeneous catalysis	742
24.11 Structures based on tetrahedral oxoanions	685	25.10 The nature of heterogeneous catalysts	743
24.12 Structures based on linked octahedral and tetrahedral centres	689	25.11 Hydrogenation catalysts	747
Hydrides and hydrogen-storage materials	694	25.12 Ammonia synthesis	748
24.13 Metal hydrides	694	25.13 Sulfur dioxide oxidation	749
24.14 Other inorganic hydrogen-storage materials	696	25.14 Catalytic cracking and the interconversion of aromatics by zeolites	749
Optical properties of inorganic materials	696	25.15 Fischer–Tropsch synthesis	751
24.15 Coloured solids	697	25.16 Electrocatalysis and photocatalysis	752
24.16 White and black pigments	698	25.17 New directions in heterogeneous catalysis	754
24.17 Photocatalysts	699	Heterogenized homogeneous and hybrid catalysis	755
Semiconductor chemistry	700	25.18 Oligomerization and polymerization	755
24.18 Group 14 semiconductors	701	25.19 Tethered catalysts	759
24.19 Semiconductor systems isoelectronic with silicon	702	25.20 Biphasic systems	760
Molecular materials and fullerides	703	FURTHER READING	760
24.20 Fullerides	703	EXERCISES	761
24.21 Molecular materials chemistry	704	TUTORIAL PROBLEMS	762
Nanomaterials	707	26 Biological inorganic chemistry	763
24.22 Terminology and history	707	The organization of cells	763
24.23 Solution-based synthesis of nanoparticles	708	26.1 The physical structure of cells	763
24.24 Vapour-phase synthesis of nanoparticles via solutions or solids	710	26.2 The inorganic composition of living organisms	764
24.25 Templated synthesis of nanomaterials using frameworks, supports, and substrates	711	Transport, transfer, and transcription	773
24.26 Characterization and formation of nanomaterials using microscopy	712	26.3 Sodium and potassium transport	773
Nanostructures and properties	713	26.4 Calcium-signalling proteins	775
24.27 <i>One-dimensional control: carbon nanotubes and inorganic nanowires</i>	713	26.5 Zinc in transcription	776
24.28 <i>Two-dimensional control: graphene, quantum wells, and solid-state superlattices</i>	715	26.6 Selective transport and storage of iron	777
24.29 <i>Three-dimensional control: mesoporous materials and composites</i>	718	26.7 Oxygen transport and storage	780
24.30 <i>Special optical properties of nanomaterials</i>	721	26.8 Electron transfer	783
FURTHER READING	724	Catalytic processes	788
EXERCISES	725	26.9 Acid–base catalysis	788
TUTORIAL PROBLEMS	726	26.10 Enzymes dealing with H ₂ O ₂ and O ₂	793
25 Catalysis	728	26.11 The reactions of cobalt-containing enzymes	802
General principles	729	26.12 Oxygen atom transfer by molybdenum and tungsten enzymes	805
25.1 <i>The language of catalysis</i>	729	Biological cycles	807
25.2 Homogeneous and heterogeneous catalysts	732	26.13 The nitrogen cycle	807
Homogeneous catalysis	732	26.14 The hydrogen cycle	810
25.3 Alkene metathesis	733	Sensors	811
25.4 Hydrogenation of alkenes	734	26.15 Iron proteins as sensors	811
25.5 Hydroformylation	736	26.16 Proteins that sense Cu and Zn levels	813
25.6 Wacker oxidation of alkenes	738	Biominerals	813
25.7 Asymmetric oxidations	739	26.17 Common examples of biominerals	814
25.8 Palladium-catalysed C–C bond-forming reactions	740	Perspectives	815
25.9 Methanol carbonylation: ethanoic acid synthesis	742	26.18 The contributions of individual elements	815
		26.19 Future directions	816
		FURTHER READING	817
		EXERCISES	818
		TUTORIAL PROBLEMS	819

27 Inorganic chemistry in medicine	820	FURTHER READING	832
The chemistry of elements in medicine	820	EXERCISES	833
27.1 Inorganic complexes in cancer treatment	821	TUTORIAL PROBLEMS	833
27.2 Anti-arthritis drugs	824	Resource sections	834
27.3 Bismuth in the treatment of gastric ulcers	825	Resource section 1: Selected ionic radii	834
27.4 Lithium in the treatment of bipolar disorders	826	Resource section 2: Electronic properties of the elements	836
27.5 Organometallic drugs in the treatment of malaria	826	Resource section 3: Standard potentials	838
27.6 Cyclams as anti-HIV agents	827	Resource section 4: Character tables	851
27.7 Inorganic drugs that slowly release CO: an agent against post-operative stress	828	Resource section 5: Symmetry-adapted orbitals	856
27.8 Chelation therapy	828	Resource section 6: Tanabe–Sugano diagrams	860
27.9 Imaging agents	830	Index	863
27.10 Outlook	832		