

INTERNATIONAL EDITION



Second Edition

Chemistry

A World of Choices

PAUL B. KELTER
JAMES D. CARR
ANDREW SCOTT



McGraw-Hill

Prelude

On the Need to Know	1
P.1 Why Do We Need to Understand Chemistry?	2
P.2 How We Find Out about Chemistry	6
P.3 Chemical Technology Risks and Benefits	11
P.4 Chemical Information: Where Can You Get It and How Accurate Will It Be?	14
Main Points	17
Important Terms	17
Exercises	18
Food for Thought	19
Readings	20
Resources	20
Websites	20

Chapter 1

Origins	21
1.1 The Origin of Matter	21
1.2 The Origin of Atoms	29
1.3 The Origin of the Earth and Solar System	36
1.4 The Formation of Molecules and Ions	38
1.5 Origin of Life on Earth	43
1.6 Origins of Chemistry as a Science	47
Main Points	47
Important Terms	48
Exercises	49
Food for Thought	51
Readings	51
Resources	51
Websites	51
Appendix to Chapter 1 Significant Figures	53

Chapter 2

Connections	55
2.1 Alchemy and Its Connection to Modern Chemistry	57
2.2 The Advent of Modern Chemistry	59
2.3 The Meaning of Periodic: Putting the Elements on the Table	68
2.4 The Electronic Logic of the Periodic Table	75
2.5 A Tour of the Periodic Table	83
Main Points	94
Important Terms	95
Exercises	96
Food for Thought	99
Readings	100
Websites	100

Chapter 3

Bonding	101
3.1 The Principles of Bonding	102
3.2 Classifications of Bonding	104
3.3 Representations of Chemical Compounds	108
3.4 The Forces of Bonding	112
3.5 What's in a Name? Chemical Nomenclature	118
Main Points	123
Important Terms	124
Exercises	124
Food for Thought	126
Readings	126
Websites	126

Chapter 4

Recycling and Chemical Mathematics	127
Nature's Recycling: The Earth as a Materially Closed but Energetically Open System	128

4.2	Introducing Chemical Equations	130
4.3	Using and Recycling Aluminum	138
4.4	The Recycling Process	151
4.5	The Current Status of Recycling	158
4.6	Green Chemistry—A Philosophy to Protect the Global Commons	160

Main Points	163
Important Terms	163
Exercises	165
Food for Thought	167
Readings	168
Resources	168
Websites	168

Appendix to Chapter 4 Working with Exponents, SI Units, and Dimensional Analysis	169
---	-----

Chapter 5

The Role of Energy in Chemical Reactions	177
--	-----

5.1	What is Energy?	178
5.2	Energy Appears in Many Forms	182
5.3	Energy Coming Out and Energy Going In	186
5.4	Breaking and Making the Bonds	188
5.5	Why Do Chemical Reactions Happen?	192
5.6	An Introduction to Chemical Kinetics	196
5.7	Why Bother Knowing All This?	200

Main Points	201
Important Terms	201
Exercises	202
Food for Thought	204
Readings	204
Websites	204

Chapter 6

Creating with Carbon—The Importance of Molecular Structure	205
--	-----

6.1	Introducing Organic Chemistry	206
6.2	The Nature of Carbon and the 3-D Structures of Compounds	207
6.3	The Impact of Structure	217
6.4	Synthetic Polymers—Structures That Have Changed Our Lives	231
6.5	Stereoisomers	236

Main Points	238
Important Terms	238

Exercises	240
Food for Thought	241
Readings	242
Websites	242

Chapter 7

Properties of Water	243
---------------------	-----

7.1	Water—Exceptional in Many Ways	245
7.2	The Universal Solvent	255
7.3	Water Hardness	258
7.4	Colligative Properties	263
7.5	Summing Up	269

Main Points	269
Important Terms	269
Exercises	270
Food for Thought	273
Readings	273
Websites	273

Chapter 8

Acids and Bases	275
-----------------	-----

8.1	What Is an Acid?	277
8.2	Molarity and the Acid Concentration	279
8.3	Bases—The Other Half of the Story	283
8.4	Oxides as Acids and Bases	284
8.5	The pH Scale	286
8.6	Water and pH	289
8.7	Seeing Acid/Base Concentration	291
8.8	Neutralization	296

Main Points	300
Important Terms	300
Exercises	301
Food for Thought	303
Readings	303
Websites	303

Chapter 9

Acid Rain	305
-----------	-----

9.1	The Nature of Acid Rain	306
9.2	Historical Perspective	310
9.3	Chemical, Ecological, and Social Consequences of Acid Rain	314
9.4	Where Do We Go from Here?	319

Main Points	323
Important Terms	323

Exercises	323
Food for Thought	324
Readings	325
Websites	325

Chapter 10

Water Quality: Chemical Concerns, Chemical Solutions 327

10.1 What Is Water Pollution?	330
10.2 Agricultural Sources of Water Pollution	334
10.3 Industrial Sources of Water Pollution	345
10.4 Oil Spills	350
10.5 Wastewater Treatment	354
10.6 In Conclusion	356

Main Points	356
Important Terms	356
Exercises	357
Food for Thought	358
Readings	358
Websites	359

Chapter 11

Behavior of Gases 361

11.1 Balloons and the Properties of Gases	362
11.2 A Closer Look at Pressure	364
11.3 Dalton's Law of Partial Pressures Takes Flight	367
11.4 The Pump: The Behavior of Gases as a Fashion Statement	369
11.5 Applications of the Ideal Gas Equation	375
11.6 Solubility of Gases in Water	381

Main Points	383
Important Terms	383
Exercises	383
Food for Thought	385
Readings	386
Websites	386

Chapter 12

Air Quality 387

12.1 The Atmosphere	390
12.2 Ozone Depletion	396
12.3 The Greenhouse Effect	402
12.4 Smog	408

12.5 Particulate Matter	411
12.6 In Conclusion: Chemistry, A World of Choices	413

Main Points	414
Important Terms	415
Exercises	415
Food for Thought	417
Readings	418
Websites	418

Chapter 13

The Earth as a Resource 419

13.1 Introduction	420
13.2 Gold (Au)	423
13.3 Copper (Cu)	427
13.4 Iron (Fe)	429
13.5 Aluminum (Al)	432
13.6 The Structure of Metals	435
13.7 Corrosion	436
13.8 Petroleum and Other Fossil Fuels	436
13.9 Soil and Clay	439
13.10 Spaceship Earth	440

Main Points	441
Important Terms	441
Exercises	441
Food for Thoughts	443
Readings	443
Websites	443

Chapter 14

The Power of the Nucleus 445

14.1 The Radioactive Decay of Atomic Nuclei	446
14.2 The Kinetics of Nuclear Decay	453
14.3 Applications of Natural Radioactivity	455
14.4 The Making of a Nuclear Bomb	460
14.5 Using Nuclear Fission to Produce Electricity	465
14.6 The Exploitation of Fusion	468
14.7 Disposal of Radioactive Waste	472
14.8 Where Do We Go From Here?	473

Main Points	473
Important Terms	473
Exercises	474
Food for Thought	475
Readings	476
Websites	476

Chapter 15

Solar Power: The Chemical Energy Alternative	477
15.1 The Energy We Receive from the Sun	480
15.2 Photosynthesis—The Solar Energy Model	486
15.3 Spectroscopy	488
15.4 Energy Exchange Works Both Ways	489
15.5 Photovoltaics—Converting Light Energy	498
15.6 Will It Happen?—The Future of Solar Power	500
Main Points	501
Important Terms	502
Exercises	502
Food for Thought	504
Readings	504
Websites	504

Chapter 16

The Chemistry of Life	505
16.1 Proteins	506
16.2 The Nature of DNA	512
16.3 The 3-D Structure of DNA	515
16.4 Genes—Where the Action Starts	516
16.5 DNA Replication—How Genes Pass Down through the Generations	520
16.6 Carbohydrates	521
16.7 Lipids, Including Fats and Oils	524
16.8 From Chemicals to People	526
16.9 The Genetic Frontier—New Choices We Can Make about Life	529
Main Points	533
Important Terms	534
Exercises	535
Food for Thought	536
Readings	536
Websites	536

Chapter 17

The Chemistry of Food	537
17.1 Water as a Nutrient	538
17.2 Carbohydrate	540
17.3 Fat	544
17.4 Protein	550
17.5 Vitamins	552
17.6 Minerals	555
17.7 Food Additives	558
17.8 Choosing a Balanced Diet	562
17.9 Energy Needs	563
17.10 Genetically Modified Food	568
17.11 Eating—A Crucial Choice	569
Main Points	569
Important Terms	569
Exercises	570
Readings	571
Websites	571

Chapter 18

Chemistry at Home	573
18.1 Building the House	573
18.2 Keeping the House Clean	577
18.3 Chemicals in the Kitchen	583
18.4 Personal Care	585
18.5 Pharmaceuticals	591
18.6 Summary	595
Main Points	596
Important Terms	596
Exercises	597
Readings	599
Websites	599
Answers to Odd-Numbered Exercises	601
Glossary	615
Credits	627
Index	629