

Contents

PREFACE	vii	
1 CHEMISTRY, ENVIRONMENT, AND POLLUTION		3
Nature of Environmental Threats	3	
The Role of Chemistry	4	
Matter and Atoms	5	
Mixtures, Mixing, and the Spread of Pollution	8	
Thermodynamics, Energy, and Natural Change	10	
Separation and Pollution Control	18	
Zero Pollution?	22	
Man's Chemicals versus Nature's Chemicals	23	
Measurement and Environmental Pollution	24	
Metric System	24	
Exponential Numbers	29	
Conversion of Units and Environmental Problem Solving	34	
Significant Figures	38	
Exercises	40	
Glossary	42	
2 ATOMS		45
Building Blocks	45	
The Nuclear Atom	45	
Nature of the Atom	48	
The Periodic System of Elements	49	
Waves and Electromagnetic Radiation	53	
The Hydrogen Atom	57	
The Simplified Shell Model	60	
Shell-Filling Rules	61	
Shells and Elements	65	
Basis of the Periodic Table	67	
Classification of Elements	69	
Electronic Structure of Elements	71	
Electron Dot Formulas	71	
Ions, Metals, and the Periodic Table	72	
Atomic and Ionic Size	75	
Abundance of Elements	75	
Pollution and the Periodic Table	77	
Exercises	79	
Glossary	80	
3 CHEMICAL BONDS AND INTERMOLECULAR FORCES		83
The Architects of Matter	83	
Inert-Gas Electronic Structures	84	

Ionic Bonds	85
Covalent Bonds	90
Coordinate Covalent Bonds	94
Resonance Bonding	97
The Three-Electron Bond	97
Bond Polarity	99
Intermolecular Forces	101
Exercises	103
Glossary	106

4 THE STRUCTURE OF ENVIRONMENTAL MATTER

Matter, Molecules, and Bonds	109
Size, Shape, and Stability of Molecules	110
Arrangement of Atoms and Bonds in Molecules	113
Molecules Prominent in the Atmosphere	116
Polyatomic Ions in Water	121
Role of Organic Matter	126
Organic Molecules	127
The Molecules of Life	134
Exercises	145
Glossary	147

5 MOLECULAR MOTION AND CHEMICAL CHANGE

151

The Motion of Molecules and Atoms	151
Vaporization and Physical Change	153
Chemical Reactions	155
Reaction Types	158
Chemical Reactions and Equilibrium	160
Chemical Equations	163
Atomic and Molecular Weights	167
Chemical Equations—A Quantitative Link Between Pollution and Resources	170
The Mole	176
And Now, the Total Environment	177
Exercises	178
Glossary	182

6 ATMOSPHERE, OXYGEN, AND GLOBAL AIR POLLUTION

Our Priceless Atmosphere	185
Origin of Atmospheric Oxygen	188
World Oxygen Supply	190
A Perspective on Atmospheric Gases Endangered by Man	197
The Greenhouse Effect	199
Carbon Dioxide, Greenhouse, and Climate	202
Particulate Matter and Climate	206
Ozone and the SST	208
Atmospheric Layers and Inversions	210
Exercises	215
Glossary	218
Additional Reading	219

7	AIR POLLUTION IN THE ENVIRONMENT OF MAN	
	Air Pollution in the Habitat of Man	221
	The Impact of Air Pollution	226
	Carbon Monoxide	230
	Sulfur Compounds	234
	Particles	242
	Oxides of Nitrogen	248
	Hydrocarbons and Photochemical Oxidants	252
	Major Air-Pollution Sources—Coal-Burning Electric Plants	257
	Major Air-Pollution Sources—The Automobile's Gasoline Engine	264
	Exercises	271
	Glossary	274
	Additional Reading	275
8	OUR WATER ENVIRONMENT	
	Environmental Role of Water	277
	The Earth's Water Resources	279
	The Uses of Water	282
	Water—Properties and Natural Impurities	284
	A Perspective on Water Pollution	288
	Dissolved Oxygen—A Key to Clean Water	290
	Organic Contaminants and BOD	293
	Detergents and Phosphorus	298
	Algae, Nutrients, and Eutrophication	303
	Wastewater Treatment	307
	Thermal Pollution	311
	Inorganic Minerals in Water	314
	Acidic and Basic Water: The pH Scale	317
	Water to Drink	321
	The Oceans	323
	Exercises	324
	Glossary	327
	Additional Reading	329
9	ENVIRONMENTAL CONTAMINATION BY HEAVY METALS	
	Our Metal-Rich Environment	331
	Chemical Bonding of Metal Atoms	332
	Heavy Metals and Sulfur	335
	Heavy-Metal Pollution—Nature and Biological Effect	338
	Heavy Metals in Air, Earth, and Water	341
	Mercury	343
	Lead	349
	Other Heavy Metals	353
	Exercises	354
	Glossary	356
	Additional Reading	357
10	CHEMICAL WARFARE AGAINST PESTS	
	Pest Control and Environmental Reality	359
	Pesticide Pollution	360
	History of Chemical Pest Control	360

The Structure of Insecticide Molecules	361
Insecticide Uses	364
Chemical Breakdown	367
Insecticide Migration and Contamination	370
The -cide of Insecticides	373
Insecticides in Man and Ecosystem	377
Options to Chemical Insect Control	382
Exercises	384
Glossary	386
Additional Reading	387

NUCLEAR ENERGY, RADIOACTIVITY, AND ENVIRONMENT

389

Introduction	389
The Nonenvironmental Nucleus	390
Isotopes	391
Nuclear Instability	394
Radioactivity	398
Half-Lives	401
Nuclear Transformations	402
Radiation Dosage	407
Dosage and Biological Damage	409
Molecular Origin of Biological Damage	413
Chemical Factors in Human Exposure to Radioisotopes	415
Exposure to Natural Radioactivity	419
Nuclear Fission	422
Beta Decay to Environmental Radioisotopes Following Fission	426
Plutonium	429
Fission Bombs	430
Environmental Threat of Nuclear Weapons	433
Electric-Power Generation by Fission	436
Environmental Impact of Nuclear Power	441
Breeder Reactors	446
Nuclear Fusion	448
Fusion Bombs	450
Electric-Power Generation by Fusion	453
Plowshare	457
Overview of Radiation Sources	458
Exercises	461
Glossary	464
Additional Reading	466

INDEX 467