

Contents

CHAPTER ONE. INTRODUCTION

Part One: What is Environmental Chemistry? 3

Chemistry and Technology
Environment
Environmental Chemistry

Part Two: The Role of Environmental Chemistry in Problem Solving, 5

Environmental Education
Criteria versus Standards

Part Three: Where's the Action? 9

Federal Organization: NEPA and CEQ
The Environmental Protection Agency
Group Action
Environmental Law
Individual Effort

CHAPTER TWO. ATOMS: A CHEMIST'S VIEW OF MATTER

Part One: Elements and Atoms, 19

Regions of the Atom
 The Electron Cloud
 The Nucleus
Isotopes
Atomic Weight of an Element
Gram-Atomic Weight
The Periodic Table of Elements

Part Two: Nuclear Stability, 26

The Discovery of Natural Radioactivity
Stability of Isotopes – Guide for Prediction
Types of Natural Radiation
Natural Decay Series
Half-life
Environmental Exposure to Natural Radiation
Study Questions, 36

CHAPTER THREE. ENERGY FROM ATOMS: NUCLEAR POWER

Part One: Artificial Radioactivity, 41

Artificial Production of Radioisotopes
Nuclear Fission
Chain Reaction
Einstein's Equation: $E = mc^2$
Nuclear Fusion

Part Two: Measurement and Effects of Radioactivity, 46

Radiation Units
Biological Damage Due to Radiation
Biological Concentration of Radioisotopes
Detection of Radiation
The Geiger Counter

Part Three: The Nuclear Power Industry, 54

The Role of the Atomic Energy Commission
The Nuclear Reactor
Nuclear Reactors: Blessing or Bomb?
Atmospheric Discharges
Activation Products
Waterborne Discharges

Waste Heat

Support Aspects of the Nuclear Industry
Benefit versus Risk
Nuclear Alternatives of the Future: The Breeder
Fusion Power
Study Questions, 73

CHAPTER FOUR. MOLECULES: COMPOUNDS AND REACTIONS

*Part One: The Arrangement of Electrons
in the Atom, 79*

The Importance of Models in Science
The Bohr Theory
What is Quantum Mechanics?
A Modern View of Electrons in Atoms
Capacity of Orbitals
Electron Distribution and the Periodic Table

Part Two: Elements into Compounds, 86

Why Do Elements Join?
Ionic Bonding
Lewis Diagrams for Ionic Compounds
Covalent Bonding
Covalent Polar Compounds

Bond Angles for Covalent Molecules
Coexistence: Covalent and Ionic Together
Alternatives and Limitations
Properties and Bonding
Organic Chemistry

Part Three: Chemical Reactions, 100

Chemical Equations
Balancing Equations
Reaction Mechanisms
Reaction Rates
Catalysts
Reactions of Ionic Compounds
Equilibrium Reactions

Study Questions, 104

CHAPTER FIVE. CHEMISTRY OF THE AIR ENVIRONMENT

Part One: What's Up There? 111

Composition of Our Atmosphere
Types of Pollutants

Part Two: Where's It All Coming From? 115

Chemical Oxidation
Oxidation of Organic Compounds
Energy from Oxidation
Energy from Hydrocarbons
Hydrocarbons from Petroleum

Part Three: What's It Like? 123

Oxides of Carbon, 123
Carbon Monoxide
Health Effects of CO
Carbon Dioxide
Environmental Effects of CO₂
Oxides of Sulfur, 129
Oxidation of Sulfur: Two Steps
Other Sulfur Compounds in the Environment
Environmental Effects of Sulfur Oxides
Respiratory Effects

Reducing Emissions from Fuel Combustion
Hydrocarbons, 136
Environmental Effects of Hydrocarbons
Particulates, 138
Reducing Particulate Emissions
Metallic Particulates in the Atmosphere
Toxic and Widespread Metals
Problem Metals in the Future
Asbestos—Mineral Menace
Oxides of Nitrogen, 141
Transport of Nitrogen in the Environment
Environmental Effects of NO_x
Control of NO_x Emissions

Part Four: What's It Doing Up There? 147

The Reactions of Photochemical Smog:
The Trigger

Environmental Effects of Ozone
Reactive Hydrocarbons
Put It All Together: It Smells Smog
The Smog Potential of Stagnant Air

Part Five: The Automobile Is Killing Us, 155

The Automobile as Polluter
Your Automobile—Choosing Gasoline by
Octane Rating
Lead—A Dangerous Additive
What Happens if We “Get the Lead Out”?
Catalytic Control Devices and Lead
Prospects for the Future: Alterations
Alternatives to the ICE
A Zero Pollution Automobile?
Is Technology Enough?
Study Questions, 165

CHAPTER SIX. CHEMISTRY OF THE WATER ENVIRONMENT

Part One: What's Down There? 171

✓ The Hydrological Cycle
Physical Properties of Water
Structure of the Water Molecule
Hydrogen Bonding
Effects of Hydrogen Bonding
Water as a Solvent
Sources of Water Pollution
Classes of Polluted Water

*Part Two: What Problems Do These
Pollutants Cause? 183*

Measuring Dissolved Oxygen: BOD
Measuring Dissolved Oxygen: COD, TOC
Eutrophication
Soaps
Detergents
Phosphates and Eutrophication
Phosphate Substitutes
Ocean Dumping
Oil Spills
Effects of Pollution on the Oceans

Mercury: An Unexpected Peril
Properties and Uses of Mercury
Environmental Exposure to Mercury
Mercury's Surprising Mobility
Thermal Pollution
Beneficial Uses of Waste Heat

Part Three: Obtaining Pure Water, 208

Drinking Water
Desalination
Reclaiming Used Water
Two Success Stories
Treatment of Industrial Wastes

Part Four: What's Being Done, 224

Federal Action
Seattle—Lake Washington's Rebirth
San Diego Bay
Challenge for the Future
Study Questions, 228

CHAPTER SEVEN. PESTICIDES: CHEMICAL CONTROLS AND THEIR ALTERNATIVES

Part One: Scope of the Problem, 233

What is a Pesticide?

Chemical Control of Pests: Promise and Problems

Is Chemical Control the Answer?

Part Two: Organochlorine Compounds, 235

Naming Organic Compounds: DDT

DDT: A Case Study

Insect Resistance to DDT

Biological Magnification

Other Effects of DDT in the Environment

DDT—Judgment by EPA

Newer Chlorinated Hydrocarbon Pesticides

Activity and Structure of Chlorinated

Cyclodienes

Phenoxy Herbicides

Modifying the Basic Structure

Method of Action

Environmental Considerations

Part Three: Organophosphates and Carbamates, 253

Organophosphates

Structure and Activity

Toxicity of Organophosphate Pesticides

Carbamates

Structure and Activity

Toxicity of Carbamates

Part Four: Alternatives, 261

Pathogens, Parasites, and Predators

Sterilization Strategies

Insect Hormones: Pheromones

Juvenile Hormone

Is Juvenile Hormone the Perfect Pesticide?

Gene Infusion

Natural Insecticides

Pyrethrins

Activity and Toxicity

Integrated Control

Part Five: Public Policy, 269

Federal Control

The Role of the States

Public Pressure

Study Questions, 272

CHAPTER EIGHT. CHEMICALS IN THE INTERNAL ENVIRONMENT: FOOD AND DRUGS

Part One: Food Additives—What and Why? 279

Additives: Accidental or Planned?

Reasons for Increased Use

Part Two: Pure and Simple? 281

Essential Foods

Carbohydrates

Fats

Saturated and Unsaturated Fats

Proteins

Minerals and Vitamins

Additives: Natural and Synthetic

Antioxidants

Colors

Acidulants and Alkalies

Flavors

Flavor Enhancers

Other Classes of Additives

Natural Food Toxins

Part Three: Drugs of Use and Abuse, 303

Important Types of Drugs

Amphetamines

Barbiturates

Marijuana

Legislation: Drugs

Standards for Safety

Inspection and Recall

Consumer Reaction

The Future Outlook

Study Questions, 319

Part Four: Who's In Charge? 311

Legislation: Food Additives

Regulation of Carcinogens: The Delaney Clause

CHAPTER NINE. CHEMISTRY CREATES THE AGE OF POLYMERS AND PLASTICS

*Part One: Polymers, Macromolecules,
and Plastics, 327*

Classification of Polymers

Part Two: Addition Polymers, 328

Mechanism of Addition

Engineering the Properties of Polyethylene

Two Pressure Processes for Polyethylene

Vinyl Plastics

The Importance of Plasticizers

Phthalate Plasticizers

Rubber: Natural and Synthetic

Part Three: Condensation Polymers, 339

Formation of Polyesters

Other Condensation Polymers

*Part Four: The Age of Plastics: Problems
and Prospects, 342*

Industrial Uses of Plastics

Plastics for Packaging

Plastics and Solid Waste Disposal

Separation and Recycling of Plastics

Biodegradable Plastics

The Future

Study Questions, 351

EPILOGUE, 356

GLOSSARY, 359

BIBLIOGRAPHY, 366

INDEX, 373