

CHEMISTRY, 3rd Edition

TABLE OF CONTENTS

CHAPTER ONE—INTRODUCTION TO MATTER & ENERGY

TOPIC A: Classification of Matter	
PART 1: Substances (Elements and Compounds)	1
PART 2: Mixtures and Separation of Mixtures	3
◆ Mixtures	3
◆ Separation of Mixtures	4
PART 3: Chemical and Physical Properties	6
PART 4: Chemical and Physical Changes	7
TOPIC B: Introduction to Energy	
PART 1: Endothermic and Exothermic Changes	8
PART 2: Measuring Energy Change	9
◆ Joule Problems	9
◆ Calorie Problems	10
PART 3: General Questions and Definitions	12
TOPIC C: Kinetic Molecular Theory	13
TOPIC D: Temperature	14
TOPIC E: Constructed Response Questions	15

CHAPTER TWO—STATES OF MATTER & CHANGES OF STATE

TOPIC A: Properties of Gases, Liquids, and Solids	17
TOPIC B: Solid-Liquid (Melting and Crystallization)	20
TOPIC C: Solid-Vapor (Sublimation, Deposition, and Condensation)	21
TOPIC D: Liquid-Vapor (Boiling and Condensation)	21
TOPIC E: Vapor Pressure	
PART 1: Vapor Pressure	22
PART 2: “Vapor Pressure of Four Liquids” Chemistry Reference Table	23
TOPIC F: Heating and Cooling Curves	25
TOPIC G: Constructed Response Questions	31

CHAPTER THREE—GASES

TOPIC A: Kinetic Theory of Gases	33
TOPIC B: Real Gases (Deviation from Ideal Behavior)	34
TOPIC C: Boyle’s Law (P vs.V)	34
TOPIC D: Charles’ Law (V vs.T)	37
TOPIC E: Combined Gas Law and STP	38
TOPIC F: Dalton’s Law (Mixed Gases and Partial Pressures)	39
TOPIC G: Avogadro’s Law	40
TOPIC H: General Gas Law ($PV = nRT$)	42
TOPIC I: Graham’s Law	42
TOPIC J: Gas Density	42
TOPIC K: Constructed Response Questions	43

CHAPTER FOUR—NAMING COMPOUNDS, FORMULAS, & EQUATIONS

TOPIC A: Writing Formulas and Naming Compounds	
PART 1: Binary Compounds	45
PART 2: Ternary Compounds	48
TOPIC B: Empirical and Molecular Formulas	
PART 1: Empirical Formulas	49
PART 2: Molecular Formulas	50
PART 3: General Questions	50
TOPIC C: Equations	
PART 1: Types of Equations	51

PART 2: Balancing Equations	54
PART 3: Missing Reactants/Predicting Products	56
TOPIC D: Constructed Response Questions	57

CHAPTER FIVE—ATOMIC CONCEPTS

TOPIC A: Development of the Atomic Theory	59
TOPIC B: Atomic Particles	60
TOPIC C: Atomic Number	61
TOPIC D: Atomic Mass and Mass Number	62
TOPIC E: Isotopes	64
TOPIC F: Valence Electrons	
PART 1: Valence Electrons in Atoms and Ions	66
PART 2: Lewis Dot Diagrams	67
PART 3: Electron Transitions	69
TOPIC G: Electron Configurations by Principal Energy Level	
PART 1: Electron Configurations in the Ground State	70
PART 2: Electron Configurations of Ions	71
PART 3: Electron Configurations in the Excited State	72
TOPIC H: Electron Configurations by Sublevels	
PART 1: Electron Configurations in the Ground State	72
PART 2: Electron Configurations of Ions	73
PART 3: Electron Configurations in the Excited State	73
TOPIC I: Orbital Theory	
PART 1: Sublevels and Orbitals	74
PART 2: Orbital Filling Diagrams	75
TOPIC J: Constructed Response Questions	78

CHAPTER SIX—PERIODIC TABLE & PROPERTIES OF ELEMENTS

TOPIC A: The General Structure of the Periodic Table	83
TOPIC B: Properties of the Elements and Trends in Properties	
PART 1: Atomic and Ionic Radius	85
PART 2: Metals, Nonmetals, and Metalloids	87
◆ Metals	87
◆ Nonmetals	89
◆ Metalloids	90
◆ General Questions	91
PART 3: Reactivity	91
PART 4: Ionization Energy and Electronegativity	92
TOPIC C: Chemistry of a Group (Family)	
PART 1: Alkali Metals	95
PART 2: Alkaline Earth Metals	95
PART 3: Transition Metals	96
PART 4: Halogens	98
PART 5: Noble Gases	99
TOPIC D: Miscellaneous Questions	99
TOPIC E: Constructed Response Questions	100

CHAPTER SEVEN—CHEMICAL BONDING & INTERMOLECULAR FORCES OF ATTRACTION

TOPIC A: Introduction to Bonding and Electronegativity	
PART 1: Chemical Bonding	107
PART 2: Electronegativity and Character of Bonds	108
TOPIC B: Ionic Bonds and Ionic Solids	109
TOPIC C: Covalent Bonds	
PART 1: Covalent Bonds and Molecular Substances	111
PART 2: Polar and Nonpolar Covalent Bonds	113
PART 3: Coordinate Covalent Bonds	115
PART 4: Molecular Shapes and Polarity	117
PART 5: Network Solids	120

TOPIC D: Metallic Bonding	120
TOPIC E: Molecular Attraction (Intermolecular Forces)	
PART 1: Hydrogen Bonding	121
PART 2: Weak Intermolecular Forces (London Dispersion)	122
PART 3: Molecule-Ion Attraction	124
TOPIC F: Constructed Response Questions	125
CHAPTER EIGHT—THE MOLE CONCEPT & STOICHIOMETRY	
TOPIC A: Gram-Atomic and Gram-Molecular Mass	133
TOPIC B: Mole Interpretation (Avogadro’s Number)	134
TOPIC C: The Mole Concept Applied to Gases	136
TOPIC D: Percent Composition by Mass	
PART 1: Percent Composition	137
PART 2: Percent Water in a Hydrate	138
TOPIC E: Empirical and Molecular Formulas	139
TOPIC F: Empirical Formula from Percent Composition	140
TOPIC G: Problems with Equations	
PART 1: Mole-Mole Problems	141
PART 2: Mole-Mass Problems	143
PART 3: Mass-Mass Problems	143
PART 4: Mass-Volume Problems	144
PART 5: Volume-Volume Problems	145
TOPIC H: Constructed Response Questions	146
CHAPTER NINE—SOLUTIONS	
TOPIC A: Theory of Solutions	151
TOPIC B: Concentration	
PART 1: Molarity	152
PART 2: Molality	153
PART 3: Parts Per Million (ppm)	154
PART 4: Percent Mass	154
TOPIC C: Colligative Properties	
PART 1: Boiling Point Elevation	155
PART 2: Freezing Point Depression	155
PART 3: General Questions	156
TOPIC D: Problems Based on the “Solubility” Chemistry Reference Tables	
PART 1: “ <i>Solubility Curves</i> ” Chemistry Reference Table	157
PART 2: “ <i>Solubility Guidelines</i> ” Chemistry Reference Table	159
PART 3: “ <i>Table of Solubilities in Water*</i> ” Chemistry Reference Table	160
TOPIC E: Constructed Response Questions	160
CHAPTER TEN—THERMODYNAMICS & KINETICS	
TOPIC A: Heat of Reaction (Enthalpy)	
PART 1: Definitions and Concepts	163
PART 2: “ <i>Heats of Reaction at 101.3 kPa and 298 K</i> ” Chemistry Reference Table	164
TOPIC B: Activation Energy and Potential Energy Diagrams	165
TOPIC C: Factors Affecting Rate of Reaction	
PART 1: Collision Theory	169
PART 2: Nature of Reactants	169
PART 3: Concentration and Pressure	170
PART 4: Temperature	171
PART 5: Surface Area	172
PART 6: Catalysis	173
TOPIC D: Entropy and Entropy Change	174
TOPIC E: Spontaneous Reactions	176
TOPIC F: “ <i>Standard Energies of Formation at 1 atm and 298 K*</i> ” Chemistry Reference Table	177
TOPIC G: Constructed Response Questions	179

CHAPTER ELEVEN—EQUILIBRIUM

TOPIC A: Definitions and Phase Equilibria	185
TOPIC B: Solubility	186
TOPIC C: Le Chatelier's Principle	
PART 1: Effect of Concentration	187
PART 2: Effect of Pressure	188
PART 3: Effect of Temperature	189
PART 4: Effect of Catalysts	191
TOPIC D: Equilibrium Expression (Quotient)	191
TOPIC E: Solubility Product Constant (K_{sp})	194
TOPIC F: Common Ion Effect	196
TOPIC G: Constructed Response Questions	197

CHAPTER TWELVE—ACIDS, BASES, & SALTS

TOPIC A: Electrolytes	199
TOPIC B: Acid-Base Theories	
PART 1: Arrhenius Acids and Bases	200
◆ Arrhenius Acids	200
◆ Arrhenius Bases	201
PART 2: Bronsted-Lowry Theory	202
◆ Acids: Proton Donors	202
◆ Bases: Proton Acceptors	203
◆ Conjugate Acid/Base Pairs	204
TOPIC C: K_a Expression	
PART 1: pK_a Definition	207
PART 2: “Relative Strengths of Acids in Solution*” Chemistry Reference Table	207
PART 3: Amphoteric (Amphiprotic) Substances	210
TOPIC D: pH	
PART 1: pH Scale	210
PART 2: pH and Hydrogen Ion Concentration	212
TOPIC E: Indicators	214
TOPIC F: Acid-Base Reactions	
PART 1: Neutralization	217
PART 2: Titration	218
PART 3: Hydrolysis Reactions	220
TOPIC G: Constructed Response Questions	221

CHAPTER THIRTEEN—REDOX & ELECTROCHEMISTRY

TOPIC A: Oxidation Number	223
TOPIC B: Redox (Oxidation-Reduction) Reactions	
PART 1: Definitions and Concepts	224
PART 2: Oxidation	226
PART 3: Reduction	229
PART 4: Oxidation Number Changes	230
PART 5: Oxidizing and Reducing Agents	232
TOPIC C: Balancing Redox Equations	
PART 1: Simple Equations	233
PART 2: Complex Equations	234
TOPIC D: Voltaic Cells	
PART 1: Cell Diagrams and Cell Components (Anode, Cathode)	236
PART 2: “Activity Series” Chemistry Reference Table	242
PART 3: “Standard Electrode Potentials*” Chemistry Reference Table	244
TOPIC E: Electrolysis	
PART 1: Definitions and Concepts	249
PART 2: Electrolysis Cell Diagrams and Cell Components (Anode, Cathode)	250
PART 3: Faraday's Law	252
TOPIC F: Constructed Response Questions	253

CHAPTER FOURTEEN—ORGANIC CHEMISTRY

TOPIC A: Definitions and General Properties	257
TOPIC B: Characteristics of Organic Compounds	
PART 1: Geometric and Structural Isomers	258
PART 2: Saturated and Unsaturated Compounds	261
TOPIC C: Homologous Series of Hydrocarbons	
PART 1: Alkanes	264
PART 2: Alkenes	267
PART 3: Alkynes	269
PART 4: Benzene Series	270
TOPIC D: Classes of Organic Compounds	
PART 1: Halides	271
PART 2: Alcohols	273
PART 3: Aldehydes	277
PART 4: Ethers	278
PART 5: Ketones	280
PART 6: Organic Acids	281
PART 7: Esters	282
PART 8: Amines, Amides, and Amino Acids	283
TOPIC E: Organic Reactions	
PART 1: Substitution	284
PART 2: Addition	284
PART 3: Fermentation	287
PART 4: Esterification	288
PART 5: Oxidation	288
PART 6: Combustion	288
PART 7: Polymerization	289
TOPIC F: Polymers	290
TOPIC G: Constructed Response Questions	291

CHAPTER FIFTEEN—NUCLEAR CHEMISTRY

TOPIC A: Spontaneous Decay	307
TOPIC B: Nuclear Equations	
PART 1: Natural Radioactivity	309
PART 2: Artificial Transmutations	311
PART 3: Fission Reactions	314
PART 4: Fusion Reactions	315
TOPIC C: Half-Life	316
TOPIC D: Benefits and Risks Associated with Radioactivity	318
TOPIC E: Accelerators	320
TOPIC F: Nuclear Reactors	321
TOPIC G: Constructed Response Questions	322

CHAPTER SIXTEEN—INDUSTRIAL APPLICATIONS

TOPIC A: Corrosion	323
TOPIC B: Batteries	324
TOPIC C: Petroleum	325
TOPIC D: Metallurgy	326
TOPIC E: Contact Process	328
TOPIC F: Haber Process	328

CHAPTER SEVENTEEN—LABORATORY APPLICATIONS

TOPIC A: Significant Figures	331
TOPIC B: Percent Error	332
TOPIC C: Laboratory Equipment	333
TOPIC D: Laboratory Measurements	337
TOPIC E: Miscellaneous Questions	
PART 1: Density, Volume, and Pressure	339

PART 2: Laboratory Process, Procedure, and Safety	340
PART 3: Reading and Calculating from Charts and Graphs	342
TOPIC F: Constructed Response Questions	347
2001 PHYSICAL SETTING CHEMISTRY Sampler	349
APPENDIX—CHEMISTRY REFERENCE TABLES	
How to Use Chemistry Reference Tables in an Examination	361
Chemistry Reference Tables (2002 Edition)	
TABLE A: Standard Temperature and Pressure	362
TABLE B: Physical Constants for Water	362
TABLE C: Selected Prefixes	362
TABLE D: Selected Units	363
TABLE E: Selected Polyatomic Ions	363
TABLE F: Solubility Guidelines	364
TABLE G: Solubility Curves	364
TABLE H: Vapor Pressure of Four Liquids	365
TABLE I: Heats of Reaction at 101.3 kPa and 298 K	366
TABLE J: Activity Series	367
TABLE K: Common Acids	367
TABLE L: Common Bases	367
TABLE M: Common Acid-Base Indicators	368
TABLE N: Selected Radioisotopes	368
TABLE O: Symbols Used in Nuclear Chemistry	369
TABLE P: Organic Prefixes	369
TABLE Q: Homologous Series of Hydrocarbons	369
TABLE R: Organic Functional Groups	370
TABLE S: Properties of Selected Elements (Sets 1 & 2).....	371
◆ Properties of Selected Elements (Set 1)	371
◆ Properties of Selected Elements (Set 2)	372
TABLE T: Important Formulas and Equations	373
TABLE U: Periodic Table of the Elements (Landscape & Portrait)	373
◆ Periodic Table (Landscape)	373
◆ Periodic Table (Portrait)	374
*Ancillary Chemistry Reference Tables (An asterisk denotes a reference table that is no longer required in certain state chemistry curriculum, but may be used in others.)	
TABLE V: Constants for Various Equilibria at 1 atm and 298 K*	375
TABLE W: Relative Strengths of Acids in Aqueous Solution at 1 atm and 298 K*	376
TABLE X: Standard Energies of Formation of Compounds at 1atm and 298 K*	377
TABLE Y: Standard Electrode Potentials*	378
TABLE Z: Table of Solubilities in Water*	379

NOTE: In a Chemistry course, many concepts that are learned early on remain in use throughout the semester. To find additional material on any topic anywhere in the Chemistry (3rd Edition) Database, use the EXAMgen program's "Find" function located in the *Database* menu at the top of the screen. Type-in any word or part of a word. The program will search the question stem and all answers (correct and incorrect).