# **Table of Contents**

INTRODUCTION
About This Book
Foolish Assumptions2
What Not to Read
How This Book Is Organized
Part 1: The Basic Concepts of Chemistry
Part 2: A Cornucopia of Chemical Concepts
Part 3: Blessed Be the Bonds That Tie
Part 4: Environmental Chemistry: Benefits and Problems
Part 5: The Part of Tens
Icons Used in This Book
where to do from here
PART 1: THE BASIC CONCEPTS OF CHEMISTRY
CHAPTER 1: What Is Chemistry, and Why
Do I Need to Know Some?
Understanding What Chemistry Is10
Distinguishing between Science and Technology10
Deciphering the Scientific Method
How the scientific method works
How you can use the scientific method
Looking at the Branches of Chemistry
Macroscopic versus microscopic viewpoints17
Pure versus applied chemistry
Eyeing What You'll Do in Your Chemistry Class18
CHAPTER 2: Contemplating Chemical Calculations
Grasping the SI Measurement System22
Eyeing the basic SI prefixes
Units of length
Units of mass
Units of volume
Units of temperature
Units of pressure
Units of energy25

	Handling Really Big or Really Small Numbers	ŀĘ
	Exploring exponential and scientific notation	
	Adding and subtracting2	26
	Multiplying and dividing	7
	Raising a number to a power2	7
	Relying on a calculator	27
	Deciphering the Difference between Accuracy and Precision 2	8
	Using the Unit Conversion Method to Solve Problems	19
	Knowing How to Handle Significant Figures	13
	Comparing numbers: Exact and counted versus measured3	13
	Determining the number of significant figures	
	in a measured number	
	Reporting the correct number of significant figures	
	Rounding off numbers	15
	Matter and Energy	, 7
CHAPTER 3:	<del></del>	
	Looking at the Facts of Matter	
	Solids	
	Liquids	
	Gases	
	Ice in Alaska, Water in Texas: Changing States of Matter	
	I'm melting away! Oh, what a world!4	
	Boiling point	
	Freezing point	
	Sublimate this!	
	Keeping it simple with pure substances4	
	Throwing mixtures into the mix	
	Nice Properties You've Got There	
	Identifying substances by density4	
	How dense are you? Measuring density	
	Keeping the World in Motion: Energy4	
	Moving right along: Kinetic energy	
	Sitting pretty: Potential energy	
	Measuring Energy	
	Taking a look at temperature	
	Feeling the heat	
CHAPTER 4:	Something Smaller Than an Atom? Atomic	
	Structure5	3
	Taking an Up-Close Look at the Atom: Subatomic Particles	,4
	Taking Center Stage: The Nucleus5	
	Locating the Electrons in an Atom	
	The Bohr model — it's really not boring	
	Quantum mechanical model	

	Configuring Electrons (Bed Check for Electrons)	
	Examining the energy-level diagram	
	Eyeing electron configurations	
	Living on the edge: Valence electrons	
	Examining Isotopes and Ions	
	Isolating the isotope	
	Keeping an eye on ions	/2
CHAPTER 5:	The Periodic Table (But No Chairs)	75
	Repeating Patterns of Periodicity	
	Understanding How Elements Are Arranged in the	,
	Periodic Table	78
	Classifying metals, nonmetals, and metalloids	
	Organizing by periods and families	
	- " - ' - '	
CHAPTER 6:	Balloons, Tires, and Scuba Tanks:	
	The Wonderful World of Gases	87
	Taking a Microscopic View of Gases: The Kinetic	
	Molecular Theory	
	Staying Under Pressure — Atmospheric Pressure, That Is	
	Measuring atmospheric pressure: The barometer	
	Measuring confined gas pressure: The manometer	
	Grasping Different Gas Laws	
	Boyle's law: Nothing to do with boiling	
	Charles's law: Don't call me Chuck	
	The combined gas law	
	Avogadro's law	
	The ideal gas equation	
	The van der Waals equation	
	Applying Gas Laws to Stoichiometry	
	Tackling Dalton's and Graham's Laws	
	Dalton's law	
	Graham's law	
PART 2	2: A CORNUCOPIA OF CHEMICAL CONCEPTS	107
CHAPTER 7:	Chemical Cooking: Chemical Reactions	109
	Knowing What You Have and What You'll Get:	
	Reactants and Products	
	Understanding How Reactions Occur: The Collision Theory	
	Eyeing a one-step collision example	
	Considering an exothermic example	
	LOOKINE ALAN ENGOLIERING EXAMIDIE	113

	Identifying Different Types of Reactions
	Combination reactions
	Decomposition reactions
	Single-displacement reactions116
	Double-displacement reactions
	Combustion reactions119
	Redox reactions119
	Balancing Chemical Reactions120
	Balancing ammonia production
	Flicking the lighter122
CHAPTER O	The Mole: Can You Dig It?125
CHAPTER 8:	
	Counting Particles by Massing
	Using Moles to Count
	Looking up Avogadro's number: Not in the phone book
	Putting moles to work
	Calculating empirical formulas
	Understanding the Role of Moles in Chemical Reactions
	Making the calculations
	Determining what you need and what you'll get: Reaction stoichiometry132
	Figuring out the bang for your buck: Percent yield
	Running out of something and leaving something
	behind: Limiting reactants
CHAPTER 9:	Mixing Matter Up: Solutions
CHAPTER S.	Getting Your Definitions Straight: Solutes, Solvents,
	and Solutions
	Discussing solubility: How much solute will dissolve138
	Exploring saturation
	Focusing on Solution Concentration Units
	Percent composition: Three different ratios
	Molarity: It's number one!
	Molality: Another use for the mole
	Parts per million: The pollution unit146
	Comprehending Colligative Properties of Solutions
	Reducing the pressure: Vapor-pressure lowering
	Using antifreeze in summer: Boiling-point elevation148
	Making ice cream: Freezing-point depression
	Keeping blood cells alive and well: Osmotic pressure
	Clearing the Air on Colloids
	clearing the Air on conolog
cusares :-	
CHAPTER 10	Thermochemistry: Hot Stuff
CHAPTER 10	E Thermochemistry: Hot Stuff
CHAPTER 10	Thermochemistry: Hot Stuff155

Units of energy	57
Heat capacities15	57
Calorimetry	59
Understanding Enthalpy Changes	62
Finding Heats of Reaction16	
Doing it yourself	
Referring to tables10	
Relying on Hess's law	
Using standard heats of formation1	
Uncovering Enthalpies and Phase Transitions	
CHAPTER 11: Sour and Bitter: Acids and Bases	69
Getting to Know the Properties of Acids and	
Bases: Macroscopic View	
Recognizing Acids and Bases: Microscopic View	
The Arrhenius theory: Must have water	
The Bronsted-Lowry acid-base theory: Giving and accepting 17	
Distinguishing between Strong and Weak Acids and Bases	
Ionizing completely: Strong acids	73
Falling to pieces: Strong bases	75
Ionizing partway: Weak acids	75
Finding equilibrium with water: Weak bases	77
Competing for protons: Bronsted-Lowry acid-base reactions 17	77
Playing both parts: Amphoteric water	78
Identifying Acids and Bases with Indicators	79
Taking a quick dip with litmus paper	79
Titrating with phenolphthalein	80
Putting Coffee and Other Substances on the pH Scale	82
Controlling pH with Buffers	85
PART 3: BLESSED BE THE BONDS THAT TIE	87
CHAPTER 12: Where Did I Put That Electron?	
Quantum Theory18	89
Facing the Concepts of Matter and Light	
9 ,	
Understanding the components	
Spectroscopy	
Grasping Bohr's Atomic Model	
De Broglie's contribution	
Heisenberg's contribution	
Understanding the Quantum Mechanical Model	96

CHAPTER 13: Opposites Do Attract: Ionic Bonding	199
Magically Bonding Ions: Sodium + Chlorine = Table Salt	200
Meeting the components	
Understanding the reaction	201
Ending up with a bond	
Identifying Positive and Negative Ions: Cations and Anions	
Grasping Polyatomic Ions	
Putting Ions Together: Ionic Compounds	
Putting magnesium and bromine together	
Applying the crisscross rule	
Naming Ionic Compounds	
Contrasting Electrolytes and Nonelectrolytes	212
CHAPTER 14: Sharing Nicely: Covalent Bonding	215
Eyeing Covalent Bond Basics	215
Considering a hydrogen example	
Comparing covalent bonds with other bonds	
Understanding multiple bonds	
Naming Binary Covalent Compounds	
Learning Many Formulas in a Little Time	
Empirical formula: Just the elements	
Molecular or true formula: Inside the numbers	
Structural formula: Add the bonding pattern	223
Sharing Electron Pairs — Sometimes Equally and Sometimes Not	227
Attracting electrons: Electronegativities	
Polar covalent bonding	
Wondering about water: A really strange molecule	
CHAPTER 15: What Do Molecules Really Look Like? Molecul	ar
Geometry and Hybridization	
Seeing How Shape Matters	
Getting charged with polarity	
Delving Into Electron and Molecular Geometry (VSEPR)	
Comprehending the Valence Bond Theory (Hybridization)	
Breaking Down the Molecular Orbital (MO) Theory	
Breaking Down the Molecular Orbital (MO) Theory	244
CHAPTER 16: Tackling Periodic Trends	247
Checking Out the Importance of Size	247
Comprehending effective nuclear charge	
Explaining changes in atomic radii	
Tracing tendencies of ionic radii	249

E	yeing Trends in Ionization Energies	0
	Noting an increase in sequential energy	0
	Taking stability into consideration	2
	Considering a few exceptions to the rule	2
(	Considering Trends in Electron Affinities25	
CHARTER 17:	Examining the Link between Intermolecular	
	Forces and Condensed States25	5
(	Jnderstanding Types of Intermolecular Forces	
	Bringing ions and dipoles together	
	, , ,	
	Drawing close to hydrogen	
	Bonding temporarily with London (dispersion) forces	
(	Grasping the Properties of Liquids	
`	Resisting an increase: Surface tension	
	Resisting to flow: Viscosity	
	Climbing the walls: Capillary action	
	Warming up: Heat capacity	
٧	Norking with Solids	
	Deciphering Phase Diagrams	
	ENVIRONMENTAL CHEMISTRY:	
BENEFI.	TS AND PROBLEMS26	5
	Saveti Caveti Haddi Haddi Air Ballutian	_
	Cough! Cough! Hack! Hack! Air Pollution	/
	Seeing Where This Mess Began: Civilization's	_
	Effect on the Atmosphere	
	Taking a Closer Look at the Earth's Atmosphere	
	The troposphere: What humans affect the most	
,	Setting the Lowdown on the Ozone Layer	
,	Explaining how the ozone reacts to gases	
	Seeing how CFCs hurt the ozone layer	
(	Comprehending the Greenhouse Effect	
	Breathing Brown Air: Photochemical Smog	
	London smog	
	Photochemical smog27	
	I'm Meltingggggg!" — Acid Rain	
	Don't drink the water: What's in acid rain	5
	Charge them up and drop them out:	
	Electrostatic precipitators27	
	Washing water: Scrubbers	8

	amining the Ins and Outs of	
Wa	ater Pollution	279
Whe	ere Does Water Come from, and Where Is It Going?	280
	Evaporate, condense, repeat	
	Following the water	
	ing a Closer Look at Water: A Most Unusual Substance	
	ntifying Some Common Water Pollutants	
	We really didn't get the lead out: Heavy metal contamination.	
	Raining down acid	
	Getting sick off infectious agents	
	Leaking landfills and LUST	
	Seeping pollution from farms	
	Polluting with heat: Thermal pollution	
	Using up oxygen: BOD	
	ting the Stink out of Wastewater	
	Primary sewage treatment	
	Secondary sewage treatment	
	Tertiary sewage treatmentating Drinking Water	
Trea	aung Drinking water	292
CHAPTER 20: NU	ıclear Chemistry: It'll Blow Your Mind	293
	derstanding Basic Atomic Structure:	
	ll Starts with the Atom	
	ining Radioactivity and Man-Made Radioactive Decay	
	lioactively Decaying the Natural Way	
	Alpha particle emission	
	Beta particle emission	
	Gamma radiation emission	
	Positron emission	
	Electron capture	
_	uring Out When Radioactive Decay Happens: Half-Lives	
	Determining half-lives	
	Safe handling	
	Radioactive datingiating Reactions: Nuclear Fission	
	Calculating chain reactions and critical mass	
	Controlling reactions: Nuclear power plants	
	Producing plutonium with breeder reactors	
	nessing Nuclear Fusion: The Hope for Tomorrow's Energy	
	Overcoming the control issues	
	Imagining what the future holds	
	ntifying the Effects of Radiation	

PART 5:	THE PART OF TENS	313
	en Serendipitous Discoveries in Chemistry	
Tá	aking the Measure of Volume	315
	eeping Rubber Solid	
	ght- and Left-Handed Molecules	
	nding a Shortcut to Color: Artificial Dye	
	reaming Up the Ring Structure	
	iscovering Radioactivity	
	nding Really Slick Stuff: Teflon	
	tick 'Em Up! Sticky Notes	
	rowing Hair	
St	peaking of Sweet Somethings	319
CHAPTER 22: T	en (Or So) Great Chemistry Nerds	321
	medeo Avogadro	
	iels Bohr	
	larie Curie	
	hn Dalton	
	lichael Faraday	
	ntoine Lavoisier	
	mitri Mendeleev	
	nus Pauling	
	nest Rutherford	
	lenn Seaborg	324
Th	hat Third-Grade Girl Experimenting with Vinegar	225
ar	nd Baking Soda	320
CHAPTER 23: T	en Terrific Tips for Passing Chem I	327
	ave a Regular Study Schedule	
	rive For Understanding — Don't Just Memorize	
	ractice by Doing the Homework	
	et Help from Additional Resources	
	ead the Material before Class	
Tá	ake Good Notes	330
Re	ecopy Your Lecture Notes	330
A:	sk Questions	330
G	et a Good Night's Sleep before Exams	331
	ay Particular Attention to Details	
CHAPTER 24: T	he Top Ten Industrial Chemicals	333
Sı	ulfuric Acid (H <sub>2</sub> SO <sub>4</sub> )	333
	itrogen (N <sub>2</sub> )	
	thylene (C,H <sub>d</sub> )	
	xygen (O <sub>2</sub> )	
0.	~JB⊆ (~)/	

	Propylene (C <sub>3</sub> H <sub>6</sub> )
	Chlorine (Cl <sub>2</sub> )
	Ethylene Dichloride (C2H2Cl2)336
	Phosphoric Acid (H <sub>3</sub> PO <sub>4</sub> )337
	Ammonia (NH <sub>3</sub> )
	Sodium Hydroxide (NaOH)
GLOSS	ARY339
INDEX	351