

## **GENERAL CHEMISTRY:** It's Part of Your World

## **Part 1. The Unfinished Story**



## Mark E. Noble



**Second Edition** 



© 2004, © 2008, © 2011, © 2022 Mark E. Noble

to Patty Until the Twelfth of Never

## **TABLE OF CONTENTS**

PERIODIC TABLE

INSIDE FRONT COVER

CONVERSIONS AND CONSTANTS LIST OF ELEMENTS	LAST PAGE INSIDE BACK COVER
<ol> <li>BACKGROUND AND BASICS         <ul> <li>1.1 The Grand Puzzle</li> <li>1.2 One REALLY BIG item</li> <li>1.3 Survival Guide</li> <li>1.4 Measurement</li> <li>1.5 Can we ever be sure about uncertainty?</li> <li>1.6 Survival Guide</li> </ul> </li> <li>1.7 Problem solving</li> </ol>	1 Sigfigs
2. CHEMICAL UNITS AND THEIR IDENTITIES, Part 1 2.1 Atoms 2.2 Identity 2.3 Mass 2.4 The elements and the Perio 2.5 Group tours 2.6 Monatomic versus polyatomic: one versus many	13 odic Table
3. CHEMICAL UNITS AND THEIR IDENTITIES, Part 2 3.1 Ions and ionic compounds 3.2 Covalent compounds 3.3 What to polyatomic ions 3.4 Wrap up	25 o do about
4. CHEMICAL UNITS AND THEIR IDENTITIES, Part 3 4.1 What's in a name? 4.2 We start with ionics. 4.3 We're ready to compound. 4.4 Binary covalent compounds 4.5 We're done. Almost systems	
5. CHEMICAL UNITS AND MASS  5.1 Still stuck on u. 5.2 We jump to the real world. 5.3 Percent con  5.4 An empirical approach	48 mposition
6. CHEMICAL REACTIONS 6.1 Reactions and equations 6.2 Getting into details 6.3 Kinds of recombustion 6.4 Handling multi-step processes	58 eactions:
7. STOICHIOMETRY, Part 1 7.1 We begin stoichiometry with mass. 7.2 Using dimensional analysis 7.3 General approach	69 S
8. STOICHIOMETRY, Part 2 8.1 What do we do with the leftovers??? 8.2 Excess and limiting 8. versus the ideal world	78 3 The real world
9. STOICHIOMETRY, Part 3 9.1 Liquid reagents 9.2 The solution to solutions 9.3 Now we're reastoichiometry. 9.4 Recapitulate	85 ady for solution
10. AQUEOUS SOLUTIONS AND REACTIONS: Background  10.1 Water basics 10.2 Why is water weird? 10.3 Balance 10.4	93 Technical aside
11. AQUEOUS REACTIONS, Part 1 11.1 Independent ions 11.2 Precipitation: background 11.3 Precipitogether 11.4 Acids and bases	102 tation: putting it
12. AQUEOUS REACTIONS, Part 2  12.1 Names and formulas for acids 12.2 Neutralizations 12.3 It's a to balance 12.5 To diss or not to diss, that is the question.	114 gas! 12.4 Back
13. AQUEOUS REACTIONS, Part 3  13.1 Redox 13.2 Oxnos 13.3 Uses of oxnos	126

14.	AQUEOUS REACTIONS, Part 4  14.1 Some preliminaries 14.2 Oxnos method 14.3 It's your turn.	133
15.	AQUEOUS REACTIONS, Part 5  15.1 Examples 15.2 Titration	142
16.	GASES, Part 1 16.1 The gas phase 16.2 Can you feel the pressure? 16.3 The math of gas 16.4 STP and d 16.5 Mixtures	148
17.	GASES, Part 2 17.1 Stoichiometry with gases 17.2 Molecules in motion 17.3 The need for speed 17.4 Diffusion, effusion, deflation and inflation 17.5 Reality check	161
18.	ENERGY, Part 1 18.1 Economics 18.2 Joule 18.3 Terminology and such 18.4 Thermochemical examples 18.5 Can you take the heat?	174
19.	ENERGY, Part 2 19.1 Four important aspects: one you knew and three are new. 19.2 How good are your standards? 19.3 We are finally getting to where we want to be. 19.4 Stoichiometry 19.5 Calories from the Sun	186
20.	THE ATOM  20.1 Welcome 20.2 Basics and background 20.3 Stand and wave. 20.4 Duality  20.5 Orbits 20.6 Relax, don't get too excited. 20.7 Obit for orbits	200
21.	LIGHT, MATTER AND WAVES 21.1 Here and now 21.2 Light and matter 21.3 Electron duality 21.4 Quantum numbers 21.5 Orbitals 21.6 Shapes of orbitals	213
22.	MANY-ELECTRON ATOMS 22.1 Spin 22.2 Splitting subshells 22.3 Configurations 22.4 The general fill sequence in table format	225
23.	CONFIGURATIONS AND CONSEQUENCES, Part 1 23.1 Reading the Periodic Table 23.2 Ions 23.3 Consequences and trends 23.4 Some important conclusions	237
24.	CONFIGURATIONS AND CONSEQUENCES, Part 2  24.1 Ion charge 24.2 Sizing up an ion 24.3 Taking a spin on magnetism	251
25.	BONDING RELATIONSHIPS  25.1 -•• ••• 25.2 More ionics 25.3 Covalent bonds 25.4 Order! Order!  25.5 Greed 25.6 Extending the gamut 25.7 Applying to compounds	259
26.	THE POLYATOMIC UNIT, Part 1  26.1 Duets, oddities, deficiencies, and excesses 26.2 Lewis 26.3 Examples	273
27.	THE POLYATOMIC UNIT, Part 2  27.1 Delocalization 27.2 More food for thought 27.3 Return to oxnos 27.4 Formal charge 27.5 Formal applications 27.6 Wrap up	284
28.	SHAPE, Part 1 28.1 VSEPR 28.2 How repulsive! 28.3 What shape are we in?	297
29.	SHAPE, Part 2 and POLARITY 29.1 More examples 29.2 Three summaries 29.3 More than one central atom 29.4 Another angle on VSEPR 29.5 Molecular polarity 29.6 Stage 3	306

30. ORBITALS, Part 1 30.1 Basics 30.2 The Valence Bond Approach 30.3 Hybridization sets 30.4 How to use the Valence Bond Approach 30.5 A closing comment	317
31. ORBITALS, Part 2 31.1 Bond orbital type 31.2 Serving up some pi 31.3 Another point for emphasis 31.4 Stage 4	328
32. ORBITALS, Part 3 32.1 The Molecular Orbital Approach 32.2 More orbitals and notation 32.3 The relative energies of molecular orbitals 32.4 Configurations and consequences	335
33. ORBITALS, Part 4 and METALLIC BONDING  33.1 More configurations 33.2 Further aspects 33.3 Bands and conductors	343
Appendix A: THERMOCHEMICAL TABLES	A-1
Appendix D: ANSWERS TO END-OF-CHAPTER PROBLEMS	D-1