

Contents

Preface ix

Introducing Chemistry

1. The First Demonstration: Proof That Air Is a Substance 3
2. Ira Remsen's Investigation of Nitric Acid 4
3. Burning Water 6
4. The Copper Cycle 8
5. Chromium Reduction: Cold Orange to Hot Green 10

Physical Changes

6. Nonadditivity of Volumes 15
7. The Mysterious Sunken Ice Cube 16
8. Colorful Mixture Separations 17
9. Surface Tension of Water: The Floating Needle 19
10. Liquid Nitrogen 20
11. The Cartesian Diver: An Application of Boyle's Law 22
12. Charles' Law: The Relationship between Volume and Temperature of a Gas 23
13. Boiling at Reduced Pressure 24
14. The Collapsing Plastic Soft Drink Bottle and Soft Drink Can 26
15. The Automatic Water Fountain: Hydrogen Effusion 28
16. Eutectic Solidification 30

Reactions Involving Gases

17. Making Hydrogen Gas from an Acid and a Base 33
18. Dancing Mothballs and Dancing Spaghetti 35
19. Producing Methane Gas 37
20. A Hand-Held Reaction: Production of Ammonia Gas 38
21. Producing Two Gases from Ammonium Chloride 39
22. Fluidity of Gases 40
23. The "Aladdin's Lamp" Reaction 42
24. Sparkler in Pure Oxygen 44
25. A Simple Reaction To Produce Foam 46
26. A Gas Evolution Oscillator 47

Reactions of Some Elements

27. Producing Hydrogen Gas from Calcium Metal 51
28. Plastic Sulfur 53
29. Recycling Aluminum 54
30. Making Sodium Chloride from Sodium and Chlorine 56
31. Burning Magnesium in Carbon Dioxide 58
32. The Glowing Test Tube 59
33. Halogens Compete for Electrons 60

- 34. Separating Metallic Iron from Cereal 62
- 35. Floating Pennies 63
- 36. Slow Copper Diffusion 64
- 37. Liquid Iodine 66

Transition Metals and Complex Ions

- 38. Copper Sulfate: Blue to White 69
- 39. Green and Blue Copper Complexes 71
- 40. Changing Coordination Numbers: Nickel Complexes 73
- 41. Colorful Complex Ions in Ammonia 75
- 42. The Magic Handkerchief 77
- 43. Chromate Dyes 78
- 44. Appearing and Disappearing Silver 80
- 45. The Colors of Some Chromium and Manganese Ions 82

Chemical Bonding

- 46. Microcrystal Formation 87
- 47. Solubility and Immiscibility 88
- 48. Bending a Stream of Water 89
- 49. Waves in a Bottle 90
- 50. The Nonpolar Disk Game 91
- 51. Alkanes versus Alkenes: Reaction of the Double Bond 92
- 52. The Disappearing Coffee Cup 94
- 53. Hydrogen Bonding in Slime 95

Energy Changes

- 54. A Chemical Hand Warmer 99
- 55. The Acid in Water Puzzle 101
- 56. Flaming Cotton 102
- 57. Nitrocellulose 103
- 58. The Self-Lighting Candle 105
- 59. Electrochemical Energy in a Flash 107
- 60. Chalk That Glows in the Dark 109
- 61. Chemiluminescence: Glowing School Colors 110

Solutions and Solubility

- 62. Chemical "Miracles" from 1808 115
- 63. Ions in Slow Motion 117
- 64. Supersaturation 119
- 65. Name That Precipitate 121
- 66. Silver Ion Solubilities: Red and White Precipitates 124
- 67. Patriotic Precipitates 126
- 68. A Glittering Shower of Lead Iodide Crystals 128
- 69. Red and White Precipitates in Sodium Silicate 129
- 70. Electrolytic Titration 130

71. Do Frozen Solutions Conduct Electricity? 132
 72. Osmosis and the Egg Membrane 134
 73. Growing Ammonium Oxalate Crystals 136

Kinetics and Equilibrium

74. Temperature and Reduction of Permanganate 139
 75. Balloon Kinetics 141
 76. Appearing Red 143
 77. Disappearing Red 145
 78. A Variation of the Starch-Iodine Clock Reaction 147
 79. Catalytic Copper 149
 80. Enzyme Kinetics: Effects of Temperature and an Inhibitor on Catalase
 Extracted from Potato 150
 81. Enzyme Specificity: Polyphenoloxidase from Potato 152
 82. Autocatalytic Effect 154
 83. Oxidation of Manganese(II) Sulfate by a Catalyst 156
 84. An Organic Clock Reaction 157
 85. Equilibrium: The Dissociation of Acetic Acid 159
 86. Variations of the Formaldehyde Clock Reaction 160

Acids and Bases

87. Acid Rain 165
 88. White Wine or Grape Juice? 167
 89. Amphoteric Properties of Metal Hydroxides 169
 90. Milk of Magnesia versus Acid 171
 91. Simple Buffer Action 172
 92. Disappearing Ink 174
 93. Colorful Effects of Hydrochloric Acid Dilution 175
 94. The Boiler-Scale Reaction 177
 95. Reversible Oxidation-Reduction Color Changes 179

Oxidation and Reduction Reactions

96. Changing Colors: Orange to Green 183
 97. The Copper Mirror 184
 98. Reduction of Copper Oxide 186
 99. Corrosion of an Iron Nail 188
 100. The Mercury Amoeba 190
 101. A Red and Blue Electron Trail 191
 102. Reduction of Sand with Magnesium 193
 103. Electroplating Copper 194
 104. Electrolysis of Potassium Iodide 196
 105. The Aluminum-Copper Trade-Off 197
 106. Water Electrolysis in Yellow, Green, and Blue 198
 107. Visible Oxidation-Reduction in Electrochemical Cells 200
 108. Metal Displacement: Copper and Mercury 202
 109. Hydrogen Peroxide as an Oxidizing and a Reducing Agent 204

- 110. Manganese(III) as an Oxidizing Agent **206**
- 111. Indigo: The Oldest Dye **208**
- 112. Colorful Oxidation of Alcohols **210**

Appendixes

- 1. Cross-Reference of Demonstrations and Chemical Topics **215**
- 2. Properties and Preparation of Laboratory Acids and Bases **216**
- 3. Equipment and Reagent List **217**
- 4. Safety and Disposal **220**
- 5. Periodic Chart of the Elements **222**
- 6. Atomic Weights of the Elements **223**

Index **227**