

Advanced Chemistry in Creation

Table of Contents

Module 1: Units, Chemical Equations, and Stoichiometry Revisited

Introduction	1
Units Revisited	1
A New Look at Chemical Equations	4
A New Look At Hess's Law	7
Stoichiometry and Limiting Reagents	13
Stoichiometry, Percent Yield, and Multiple Reactions	19

Module 2: The Atom Revisited

Introduction	35
The Atom - What a Bohr!	35
Experiment 21: The Colors of Chemistry	36
A Detailed Look at the Bohr Model	37
The Bohr Model and Atomic Spectra	42
The Size of an Atom	48
Moving From the Bohr Model to the Quantum Mechanical Model	49

Module 3: The Electronic Structure of Molecules

Introduction	67
How Atoms Share Electrons	67
Hybrid Orbitals	68
Molecular Orbitals - Part 1	73
Molecular Orbitals Part 2: The Rule-Breakers	80
Explanation of Experiment 21 Plus Another Experiment	87
Experiment 31: The Effect of a Solvent on the Color of a Substance	88

Module 4: Intermolecular Forces

Introduction	97
Experiment 41: The Kinetic Theory of Matter	97
Applying the Kinetic Theory of Matter to Phase Changes	98
The Different Types of Van Der Waals Forces	102
Cohesive Forces, Adhesive Forces, and Surface Tension	108
Phase Diagrams	110
Crystals and Unit Cells	113
Experiment 42: Identifying Unit Cells	115
Metallic Crystals	116
Ionic Crystals	120

Module 5: Solutions and Colloids

Introduction	127
--------------	-----

A Little Bit of Review	127
Relating Units of Concentration	130
Solubility, van der Waals Forces, and Entropy	132
Temperature and Solubility	137
Experiment 51: Solubility Curves	137
The Effect of a Solute on a Solvent's Phase Diagram	143
Separating Solute From Solvent in a Solution	145
Experiment 52: A Simple Distillation	145
Experiment 53: Paper Chromatography	148
Colloids	150
Experiment 54: Forming Colloidal Particles With Soap	152

Module 6: Solutions and Equilibrium

Introduction	161
A Little Bit of Review	161
The Equilibrium Constant and Gibb's Free Energy	163
Solubility Equilibria	166
The Common Ion Effect	171
Experiment 61: The Common Ion Effect	171
Precipitation From Solution	178
Experiment 62: Precipitation	178

Module 7: Acid/Base Equilibria

Introduction	195
A Little Bit of Review	195
The Real Meaning Behind the pH Scale	198
Calculating the pH of a Solution of an Acid or Base	201
Experiment 71: Calculating Concentration From pH	206
Amphiprotic Substances and Their Behavior	208
Diprotic and Triprotic Acids	211
An Alternative Definition of Acids and Bases	216

Module 8: More on Equilibrium

Introduction	229
Buffer Solutions	229
Experiment 81: The Bicarbonate Buffer	229
The pH of a Buffer	233
The Common Ion Effect and pH	241
The Technique of Successive Approximations	244
Other Equilibrium Situations	245

Module 9: Electrochemistry - Part 1

Introduction	267
A Little Review	267
Analyzing Redox Reactions	271
Experiment 91: A Redox Reaction Between Copper and Zinc	271
Galvanic Cells	274

Experiment 92: Making Your Own Galvanic Cell	280
The Nernst Equation	283
Electrolytic Cells	285
Experiment 93: The Electrolysis of Copper Sulfate	286
Faraday's Law of Electrolysis	290

Module 10: Electrochemistry - Part 2

Introduction	305
Balancing Redox Reactions - The Half-Reaction Method	305
Balancing Redox Reactions - The Change in Oxidation Number Method	313
The Strengths of Oxidizing and Reducing Agents	315
Experiment 101: Predicting the Results of Redox Reactions	321
Relating Redox Potential to ΔG and the Equilibrium Constant	322
Corrosion	325

Module 11: Chemical Kinetics

Introduction	337
A Little Review	337
Experiment 111: The Rate of an Iodine Clock Reaction	339
Another Way to Look at The Kinetics of a Chemical Reaction	344
First-Order Chemical Reactions	346
Second-Order Reactions	349
The Collision Theory of Chemical Kinetics	350
Reaction Mechanisms and Reaction Rates	354

Module 12: An Introduction To Organic Chemistry

Introduction	369
Saturated Hydrocarbons	369
Naming Saturated Hydrocarbons	375
Alkenes and Alkynes	380
Aromatic Compounds	382
Petroleum	385
Polymers	387
Experiment 121: Investigating the Properties of Polyethylene	388
Experiment 122: Making Slime	388
Experiment 123: Crosslinking a Polymer	390

Module 13: Functional Groups in Organic Chemistry

Introduction	397
Alcohols	398
Experiment 131: Yeast and the Fermentation Process	399
Ethers	402
Aldehydes and Ketones	404
Carboxylic Acids	406
Esters	408
Amino Acids and Proteins	410

Carbohydrates	415
Experiment 132: The Hydrolysis of Sucrose	418
Summing Up Organic and Biochemistry	420

Module 14: Nuclear Chemistry

Introduction	425
Binding Energy	425
The Strong Nuclear Force	428
The Stability of a Nucleus	429
Radioactivity	431
Artificial Radioactivity	436
The Rate of Radioactive Decay	437
The Dangers of Radioactivity	438
Radioactive Dating	441
Other uses of Radioactivity and Ionizing Radiation	443
Nuclear Reactions	445
Using Nuclear Reactions to Make Energy	449

Module 15: Review - Part 1

Introduction	457
Review Questions and problems	457

Module 16: Review - Part 2

Review Questions and problems	467
Summing It All Up	475

Glossary 477

Appendix 481

Index 491