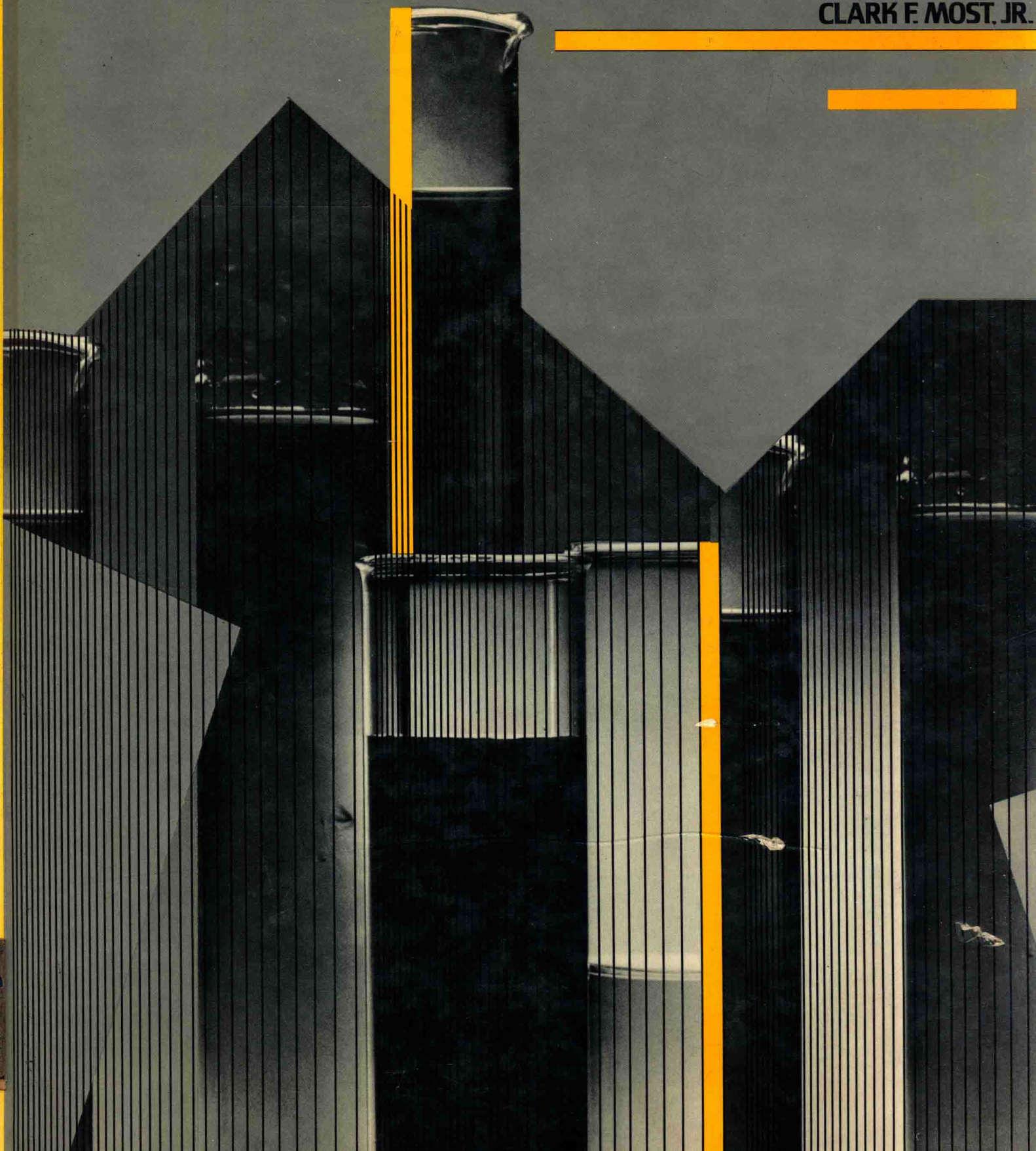


EXPERIMENTAL

ORGANIC CHEMISTRY

CLARK F. MOST, JR.



EXPERIMENTAL ORGANIC CHEMISTRY

Clark F. Most, Jr.

Professor of Chemistry
Delta College
University Center, Michigan



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PREFACE

This book acquaints students with all basic laboratory procedures, presented in four major parts: (I) Techniques, (II) Experiments, (III) Organic Qualitative Analysis, and Appendixes.

TECHNIQUES

The 20-chapter Techniques section acquaints the student with all common organic techniques, and has a relatively simple illustrative experiment with each. Students will occasionally find underlined plays on words which refer to some part of the subject matter at hand. This is not only a matter of interest and perhaps humor, but one of pedagogy as well. It helps train the research-oriented student to look for relationships that are not always immediately apparent.

EXPERIMENTS

The Experiments section introduces more complex experiments than those in the Techniques section. The experiments commonly involve synthetic procedures followed by workup and analysis requiring more than one technique. The experiments are arranged largely by compound class, but there are also sections on famous name reactions, redox, kinetics, acidity and neutralization, and polymers. There are 50 major experiments in addition to those in the Techniques and Organic Qualitative Analysis sections. Basically, each experiment is in the following format: introduction, theory and discussion, techniques, experimental part, writing the discussion, prelaboratory and postlaboratory exercises.

ORGANIC QUALITATIVE ANALYSIS

This part of the book encompasses most of the wet analytical techniques that are required for analysis of major functional groups. It can be used as a mini course on organic wet analysis for characterization and/or identification of a variety of tabulated unknowns, or it can be used as a tool to help identify products obtained in the Techniques and Experiments sections.

The section on qualitative organic analysis has been keyed to each experiment so that the instructor can easily assign wet analytical methods as an adjunct to the experiment.

APPENDIXES

There are three appendixes. Appendix A includes the less-referred-to techniques: sublimation, density determination, and molecular weight determinations. Appendix B is a pronunciation guide, and Appendix C presents a compilation of chemical hazards.

GENERAL APPROACH

Presentations of theory and technique have been presented *separately* so that students do not have to search through theoretical discussions in order to find details of techniques. Each experiment presents enough theory and technique so that students are able to *fully comprehend* reaction and procedure. Attempt has been made to write procedures with such care that the instructions are complete and easy to follow—easy enough so that a good share of prelaboratory lectures are obviated, thereby saving precious laboratory time and curtailing the many procedural questions students often have. A set of prelaboratory exercises accompanying each experiment help the students to carefully consider what they are going to do in the laboratory before beginning work. The writer has been using prelaboratory exercises for about 10 years and has found this approach extremely helpful in promoting understanding and recall. It also saves laboratory time by requiring the students' prior organization of thought process.

Whenever topics are presented which are generally found in detail in lecture textbooks, students are referred to these sources. However, the theory and discussion sections in this book emphasize electron transfer pathways and present fuller discussions of each experiment or technique than are found in many lecture textbooks and in most other laboratory textbooks. The writer believes that it is better to make possible a full understanding of seventy experiments than a half-understanding of one hundred.

Because for most students one of the most difficult areas of laboratory work involves writing a good discussion of results, each experiment includes suggestions for the same.

Students are led into more independent development of procedures by Experiment 37 (which requires that the students write their own procedures by analogy), Part XIX (which discusses synthetic sequences), and the techniques on searching the chemical literature and report writing.

NOMENCLATURE

The common practice of organic laboratory books of indiscriminately mixing common and systematic nomenclature is confusing for students and is not a sound educational technique. *This book uses that nomenclature that seems to be most commonly employed*, but with parenthetical references to the other method. Whenever possible, the IUPAC system has been given preference.

PRONUNCIATION GUIDE

Pronunciation is one of the most neglected areas of chemical study. Many students hesitate in or feel foolish about using words that they do not know how to pronounce. Because proper pronunciation is an important part of chemical communication, Appendix B contains an alphabetized pronunciation guide to many of the chemical and chemically related words used in this book.

SPECTROSCOPY

The IR and NMR techniques do not repeat much of the theoretical detail generally found in lecture textbooks, but enlarge on aspects of a topic which are necessary for student understanding of laboratory processes. Procedural details have been made as complete as practicable.

COMPUTERS

Computer usage is increasingly important in the chemical industry, in medicine, in colleges, and in other areas. To start acquainting students with the chemistry-computer interface, several experiments have been included which utilize computer analysis of experimental results.

MASS SPECTROMETRY

Mass spectrometry is not normally included in organic laboratory books because the equipment is too expensive. However, this book presents an introduction to mass spectrometric analysis via microcomputer simulations.

The mass spectrometry simulation permits for the first time the teaching of mass spectrometry to all students in the undergraduate laboratory. The mass spectrometry program contains 17 different unknown alcohols, aldehydes, and ketones arranged as 36 unknown samples. Some of these unknowns are programmed as GLC samples and require instrument control settings which differ from those used under standard conditions. The students must learn what control setting to use in order to obtain meaningful spectra. They can adjust the controls to maximize or minimize the size of the molecular ion (M) peaks or the ($M + 1$) peaks. The writer has tried to make the results of the simulation as realistic as possible: The sizes of the peaks actually change relative to the control panel settings, and at high ionizing currents, one observes small peaks due to pump oil. Very complete information about unknowns is provided in the Instructor's Manual, including mechanisms of fragmentations.

LABORATORY NOTE-KEEPING

The Laboratory Notebook Technique is the most comprehensive to be found in any organic laboratory book. If the instructor chooses to follow through with the most rigorous procedures discussed, students learn record-keeping techniques that will be acceptable to both university and chemical industry, and will stand up in controversial patent disputes. Also in this section is a review of the various calculations an organic laboratory student must make.

LABORATORY SAFETY

This book treats every experiment as an adjunct in safety, makes available in Appendix C the chemical hazards of the chemicals used in this book, and calls attention to every likely operational hazard. Particularly hazardous chemicals, like benzene, have been avoided. Safety considerations are so much more complete than those found in other organic laboratory books that this text might indeed set a new standard for the same.

CONSERVATION OF CHEMICALS

The cost of organics is an increasingly important consideration. In most cases, the laboratory instructions in this book call for one-quarter to one-half of the amounts of chemicals characteristically required by similar macroscale laboratory textbooks. This book has a built-in program and specific instructions to students for conserving materials. Solvents are recycled, and the products of many processes can be used in later experiments. The technique on process economics emphasizes the necessity of conservation and cost effectiveness.

PROCESS ECONOMICS

A cost analysis of chemical process is the subject of Technique 20. This analysis provides the student with a basis for understanding economics of the chemical industry and is accompanied by a computer program which drastically reduces the time required for analysis.

USABLE PRODUCTS

To further add interest to laboratory work, a number of experiments have been devised that lead to usable products. None of these experiments was chosen solely for its product value. Each relates to a theory and/or technique in the study of organic chemistry laboratory.

Orientation and Organization
Laboratory Safety
Basic Laboratory Equipment and Techniques

CONTENTS

INTRODUCTION

I

ORIENTATION AND ORGANIZATION 3

Organization of the Book	3
Using the Book Effectively	4
Laboratory Efficiency	4
Organization of Thoughts	5
Organization of Work Area	5
Courteous Performance	6

LABORATORY SAFETY 7

Laboratory Attire	7
Personal Habits and Housekeeping	8
Fires, Explosions, and Implosions	8
Fires	8
Extinguishing Fires	9
Explosions	9
Implosions	9
Chemicals and Equipment	9
Chemical Toxicity	10
Equipment and Machinery	10
First Aid	10
Chemicals in Eyes	10
Spills on Clothing and Body	11
Cuts and Thermal Burns	11

BASIC LABORATORY EQUIPMENT AND TECHNIQUES 12

0.1. Community Property	12
0.2. Glassware and Personal Items	12
0.3. Assembly and Care of Glassware	14
Tube and Stopper Assemblies	15
Cleaning Glassware	15
0.4. Stirring	16
0.5. Heating and Cooling	17
Heating with Flames	17
Steam Cones or Baths	18
Hot Water Bath	18
Heating Mantles	18
Hot Plates	19
Oil Baths	19
Sand Baths	20
Reflux	21
Boiling Chips	22
Methods of Cooling	23
0.6. Evaporating and Concentrating Liquids	23
Concentration or Evaporation by Distillation	24
Open Dish Evaporation	24
Evaporation from a Flask	24
0.7. Controlling and Trapping Gases	25
0.8. Adding Chemicals to Reaction Vessels	26
Adding Solids	26
Adding Liquids	26
Adding Gases	27

0.9.	Inert Atmosphere	27
0.10.	Mortar and Pestle	27
0.11.	Testing pH with Indicator Paper	28
0.12.	Storing Products and Intermediates	28
0.13.	Labeling	28
0.14.	Experimental Part	29
	Construction of Flat-bottom Stirrer	29
	Construction of Vacuum Filtration Trap	29

PART I THE TECHNIQUES

30

1. THE LABORATORY NOTEBOOK 33

1.1.	General Instructions	33
	The Notekeeping Hardware	33
	The Record-Keeping Process	34
1.2.	Format	37
	Front Matter	37
	Experimental Section Format	39
1.3.	Flow Diagrams	43
1.4.	Calculations	43
	Significant Figures	43
	Using Density to Calculate Volume from Mass	44
	Reagents and Yields	45
	Percent by Mass Solutions	46
	Dilution to Obtain a Required Molarity	46
1.5.	Experimental Part	46
1.6.	Exercises	47

2. DRYING SOLIDS, LIQUIDS, AND GASES 47

2.1.	Drying Solids	47
	Discussion of Drying Solids	47
	Techniques of Drying Solids	48
2.2.	Drying Liquids	49
	Discussion of Drying Agents	49
	Drying Agent Techniques	50
	Drying by Azeotropic Distillation	51
2.3.	Drying Gases	51
2.4.	Experimental Part	51
2.5.	Exercises	52

3. THERMOMETERS, MELTING POINTS, AND BOILING POINTS 53

3.1.	Thermometers	54
3.2.	Melting Points Discussion	55
	Melting Points of Pure Substances	55
	Melting Points of Impure Substances	57
	Mixture Melting Points	58
3.3.	Melting Point Techniques	59
	Using a Thiele Tube	59
	Using an Electrical Apparatus	60
	Observing and Recording the Melting Point	61
	Mixture Melting Points	61
	Evacuated Tube Melting Points	61
3.4.	Boiling Points Discussion	62
	Vapor Pressure and Boiling	62
	Molecular Considerations	63
3.5.	Boiling Point Techniques	63
	The Distillation Method	63
	The Siwoloboff Microtechnique	64

3.6.	Boiling Point Corrections	65
3.7.	Experimental Part	66
	A. Melting Point Thermometer Calibration	66
	B. Boiling Point Thermometer Calibration	67
	C. Identification of an Unknown Solid	68
3.8.	Exercises	69
4.	FILTRATION	70
4.1.	Filter Paper	70
4.2.	Gravity Filtration	72
4.3.	Vacuum Filtration	73
	The Water Aspirator	73
	Filtration	73
4.4.	Removal of Residues from Filters	74
4.5.	Diatomaceous Earth Filters	74
4.6.	Experimental Part	75
	Precipitation and Filtration of Benzoic Acid	75
4.7.	Exercises	76
5.	RECRYSTALLIZATION	77
5.1.	Discussion of Crystallization	77
	Crystallization Theory	77
	Solvent System	78
	Oiling Out	80
	Fractional Crystallization	80
5.2.	Discussion of Decolorizing	81
5.3.	The Techniques	81
	Selection of Solvent	81
	Dissolving the Impure Product	82
	Decolorizing	83
	Hot Filtration	83
	Crystallization	84
	Cold Filtration	85
	Washing Crystals	85
	Drying Crystals	86
	Recrystallizing Small Samples	86
5.4.	Experimental Part	87
	Purification of Benzoic Acid or Salicylic Acid	87
5.5.	Exercises	88
6.	EXTRACTION	89
6.1.	Discussion of Extraction	89
	Extraction from Solids	89
	Extraction from Liquids	89
6.2.	Extraction Techniques	93
	Solid-Liquid Extractions	93
	Liquid-Liquid Extractions	93
6.3.	Experimental Part	96
	Separation of Benzoic Acid and Naphthalene	96
6.4.	Exercises	97
7.	DISTILLATION	98
7A.	SIMPLE DISTILLATION	99
7.1.	Discussion of Simple Distillation	99
7.2.	Simple Distillation Techniques	100
7.3.	Experimental Part	102
	Sample Distillation of an Unknown Liquid	102
7.4.	Exercises	103

7B.	FRACTIONAL DISTILLATION	103
7.5.	Discussion of Fractional Distillation	103
	Raoult's Law	104
	Vapor-Liquid Composition Diagrams	106
	The Process of Fractionation	106
	Efficiency	108
7.6.	Azeotropes	109
	Maximum-Boiling Azeotropes	109
	Minimum-Boiling Azeotropes	110
7.7.	Fractional Distillation Techniques	111
	Apparatus	111
	The Column	112
	Insulation	113
	Column Holdup	113
	Reflux Ratio	114
	Flask Size	114
	Flooding	114
	Collection of Fractions	114
	Conducting the Distillation	114
	Distillation Chasers	115
7.8.	Experimental Part	115
	Fractionation and Identification of a Binary Mixture	115
7.9.	Exercises	116
7C.	VACUUM DISTILLATION	117
7.10.	Discussion of Vacuum Distillation	117
7.11.	Techniques of Vacuum Distillation	118
	The Apparatus	118
	Promoting Smooth Boiling	121
	Procedure	122
7.12.	Experimental Part	123
	Separation of Methyl Salicylate, Salicylic Acid, and Methylene Chloride	123
7.13.	Exercises	124
7D.	STEAM DISTILLATION	124
7.14.	Discussion of Steam Distillation	124
7.15.	Techniques of Steam Distillation	126
	The Direct Process	126
	The Live Steam Process	126
	Determining the Point of Completion	128
7.16.	Experimental Part	129
	Purification of Aniline	129
7.17.	Exercises	130
7E.	SMALL-SCALE DISTILLATION	130
7.18.	Techniques of Small-Scale Distillation	131
	Small Distilling Flask	131
	Special heads and/or Flasks	132
	Microdistilling Tube	133
7.19.	Experimental Part	133
	Construction and Use of a Microdistilling Tube	133
7.20.	Exercises	134
	CHROMATOGRAPHY	136
8.	THIN-LAYER CHROMATOGRAPHY	136
8.1.	Discussion of TLC	137
	The Adsorbent	137
	The Developer	138
	Interactions Among Absorbent, Developer, and Spotted Compounds	138

8.2.	Techniques of TLC	140
	Preparation of the Adsorbent Slurry	140
	Preparation of the Plates	140
	Making a Micropipet	141
	Spotting the Plates	141
	Selecting a Developer	142
	The Development Chamber	142
	Developing the Chromatogram	142
	Spot Visualization	142
	Calculation of R_f	143
8.3.	Experimental Part	143
	Detecting the Presence of Vanillin and Ethyvanillin	143
8.4.	Exercises	144

9. PAPER CHROMATOGRAPHY 145

9.1.	Discussion of PC	146
9.2.	PC Techniques	146
	The Paper Support	146
	Sample Preparation	147
	Spotting the Paper	147
	The Developer	147
	Development	147
	Visualization	148
9.3.	Discussion of Separating and Identifying Amino Acids	148
9.4.	Experimental Part	149
	Separating and Identifying Amino Acids	149
9.5.	Exercises	150

10. COLUMN CHROMATOGRAPHY 150

10.1.	Discussion of Column Chromatography	151
	The Adsorbent	151
	The Column	152
	Elution	153
10.2.	The Techniques	155
	Preparation of the Column	155
	Adding the Sample	157
	Elution	157
	Monitoring and Collecting Elutants	158
	Emptying the Buret	159
10.3.	Experimental Part	159
	Separation of Methylene Blue and Methyl Orange	159
10.4.	Exercises	160

11. GAS-LIQUID CHROMATOGRAPHY 160

11.1.	Instrumentation	161
	The Injection Block	161
	The Column	162
	The Detector	162
11.2.	Discussion of GLC	162
11.3.	GLC Techniques	165
	The Sample	165
	Preparing the Gas Chromatograph	165
	Injecting the Sample	166
	Marking and Labelling the Chart Paper	167
	Cleaning the Syringe	167
	Obtaining and Storing the Chromatogram	167
11.4.	Qualitative GLC Analysis	167
	Method 1. Measurement of t_R 's	168
	Method 2. Addition of Standard to the Mixture	168

11.5.	Quantitative GLC Analysis	169
	Integration	169
	Peak Area or Height	169
	Peak Width at Half-Height	169
	Weight of Peaks	169
11.6.	Experimental Part	171
	GLC Analysis of Unknown Binary Mixture	171
11.7.	Exercises	172
12.	POLARIMETRY	173
12.1.	Discussion of Optical Rotation	173
	Plane-Polarized Light	173
	Rotation of Plane-Polarized Light	174
12.2.	The Techniques	175
	Sample Preparation	175
	Using the Polarimeter	176
12.3.	Experimental Part	177
	Identification of a Sugar	177
12.4.	Exercises	177
13.	REFRACTOMETRY	178
13.1.	Discussion of Refractive Index	178
13.2.	The Refractometer	179
13.3.	The Techniques	180
	Using the Refractometer	180
	Temperature Corrections	181
13.4.	Experimental Part	181
	Identification of an Unknown	181
13.5.	Exercises	182
14.	ULTRAVIOLET-VISIBLE SPECTROSCOPY	183
14.1.	Spectra and Light	183
	The Nature of UV and VIS Radiation	183
	Photon Absorption	184
14.2.	Quantitative UV-VIS Spectroscopy	185
14.3.	Instrumentation	186
14.4.	The Techniques	187
	The Solvent	187
	Sample Preparation	187
	Sample Cells	187
	Obtaining the Spectrum	188
	Cleaning Up	188
14.5.	Experimental Part	189
	Identification of an Unknown	189
14.6.	Exercises	189
15.	INFRARED SPECTROSCOPY	190
15.1.	The IR Vibrational Phenomenon	190
15.2.	Instrumentation	191
15.3.	IR Spectra	192
	IR Bands	193
	Regions of the IR Spectrum	194
	Analysis of Spectra	194
15.4.	The Techniques	202
	Sampling	202
	Recording the Spectrum	206
	Spectrum Analysis	207
15.5.	Experimental Part	207
	Identification of an Unknown Liquid	207
15.6.	Exercises	208

16. NUCLEAR MAGNETIC RESONANCE 209

- 16.1. The NMR Phenomenon 209
 - Resonance 209
 - Relaxation 210
 - Saturation 210
 - Relaxation and Peak Width 211
- 16.2. Instrumentation 211
 - Homogeneity 212
- 16.3. NMR Spectra 212
 - rf Sweep Versus Field Sweep 212
- 16.4. Analysis of Spectra 213
 - Procedure 213
 - Functional Groups 214
 - Anomalous Peaks 225
- 16.5. The Techniques 227
 - Preparation of the Sample 227
 - Producing the Spectrum 228
 - Cleaning up 231
 - Procedural Summary 232
- 16.6. Experimental Part 232
 - Identification of an Unknown Compound 232
- 16.7. Exercises 233

17. MASS SPECTROMETRY 234

- 17.1. Instrumentation 234
 - Operation of the Instrument 235
- 17.2. Formation and Separation of Ions 238
 - Formation of Ions 238
 - Separation of Ions 239
- 17.3. Isotope Effects 240
 - Isotopic Clusters 241
- 17.4. The Molecular Ion 241
 - Formation of the Molecular Ion Peak 241
 - Locating the Molecular Ion Peak 241
- 17.5. Spectrum Analysis 243
 - General Procedure 243
 - Ion Formulas 244
 - Hydrogen Deficiency 244
 - Odd-Electron Rule 245
- 17.6. Analysis of Compound Classes 245
 - Alcohols 245
 - Aldehydes and Ketones 248
- 17.7. Experimental Part 252
 - Analysis of an Unknown 252
- 17.8. Exercises 253

18. THE CHEMICAL LITERATURE 255

- 18.1. Sources of Information 255
 - Primary Research Journals 256
 - Review Journals and Monographs 256
 - Laboratory Books 256
 - Encyclopedias and Dictionaries 256
 - Volumes of Spectral Data 257
 - References on Synthesis, Methods, and Techniques 257
 - Abstracts and Alerting Services 257
- 18.2. Making a Literature Search 258
 - Search for a Specific Compound 258
 - Search for a Topic, Reactions or Class of Compounds 259
- 18.3. Chemical Abstracts 259
 - The Indexes 259

	Use of a Formula Index	260
	Use of the Subject Index	260
18.4.	Beilstein's Handbook	261
	Organization of Beilstein	261
	Indexes	262
	Using the Formelregister	262
	Using the Sachregister	262
	Using Functional Group Classes	262
	Using the Systemnummer	263
	Using Aldrich or Lange	263
18.5.	Experimental Part	263
18.6.	Exercises	263

19. REPORT WRITING 265

19.1.	The Format	265
	The Title	265
	The Abstract	265
	The Introduction	266
	The Experimental Part	266
	The Results and Discussion	266
	Acknowledgments	266
	Referencing	266
19.2.	Preparing Your Manuscript	268
19.3.	Experimental Part	269
19.4.	Exercises	269

20. PROCESS ECONOMICS 274

20.1.	Cost Analysis	274
20.2.	Process Costs	274
	Raw Materials	274
	Utilities	276
	Labor	276
20.3.	Plant Costs	276
	Location Overhead	276
	Quality Assurance	276
	Maintenance	276
	Waste Disposal	276
	Taxes and Insurance	276
	Depreciation	277
20.4.	Cost, Sales, and Profit	277
20.5.	Cost Analysis Lab Techniques	279
20.6.	Experimental Part	280
	Analysis of Aspirin Synthesis	280
20.7.	Exercises	283

PART II EXPERIMENTS

285

I. LABORATORY SAFETY 287

E1.	LABORATORY SAFETY FEATURES	287
E1.1.	Experimental Part	287
E1.2.	Exercises	288
E2.	DETERMINATION OF FLASH POINT	288
E2.1.	Discussion of Flash Point	288
E2.2.	The Techniques	288
E2.3.	Experimental Part	290
E2.4.	Exercises	290

II. ISOLATIONS 291

E3.	ISOLATION OF CAFFEINE FROM COFFEE	291
	Introduction	292
E3.1.	Discussion of the Isolation	292
E3.2.	Experimental Part	293
E3.3.	Exercises	296
E4.	ISOLATION OF CASEIN AND PREPARATION OF CASEIN GLUE	297
	Introduction	297
E4.1.	Introduction to Adhesion Theory	298
E4.2.	Casein and its Isolation	300
E4.3.	Casein Glue	301
E4.4.	Experimental Part	301
E4.5.	Exercises	303
E5.	ISOLATION OF PIGMENTS FROM SPINACH	304
	Introduction	304
E5.1.	Discussion of the Isolation	305
E5.2.	Experimental Part	305
E5.3.	Exercises	306
E6.	ISOLATION OF LIMONENE FROM ORANGES	307
	Introduction	307
E6.1.	Experimental Part	308
E6.2.	Exercises	309

III. NONBONDED INTERACTIONS 310

E7.	ANTICHAP LIPSTICK	312
E7.1.	Discussion of the Preparation	312
E7.2.	Experimental Part	312
E7.3.	Exercises	314
E8.	PHARMACEUTICAL EMULSIONS	314
	Introduction	314
E8.1.	Emulsions	315
E8.2.	Liquid Emollient Cream Preparation	316
E8.3.	Experimental Part	316
E8.4.	Exercises	317

IV. HALOALKANES 318

E9.	SYNTHESIS OF 7,7-DICHLOROBICYCLO[4.1.0]HEPTANE	319
E9.1.	Discussion of the Synthesis	320
E9.2.	Phase-Transfer Catalysis	321
E9.3.	Experimental Part	322
	A. The Classical Synthesis	322
	B. Phase-transfer Catalyzed Synthesis	324
E9.4.	Exercises	324
E10.	PREPARATION OF 2-CHLORO-2-METHYLPROPANE	326
	Introduction	326
E10.1.	Discussion of the Preparation	326
E10.2.	Discussion of 3° Haloalkane Workup	327
E10.3.	Experimental Part	328
E10.4.	Exercises	330

V. ALKENES 331

E11.	DEHYDROHALOGENATION	331
------	---------------------	-----