

Alice Laughlin

# Roe's laboratory guide in chemistry

SEVENTH EDITION



06-31

L3726

E.7

7960155

5

# *Roe's laboratory guide in chemistry*

*Alice Laughlin, B.S., M.S., Ed.D.*

Professor and Former Chairman, Department  
of Chemistry, Jersey City State College,  
Jersey City, New Jersey

SEVENTH EDITION



E7950155

*The C. V. Mosby Company*

Saint Louis 1976

06  
R

SEVENTH EDITION

**Copyright © 1976 by The C. V. Mosby Company**

All rights reserved. No part of this book may be reproduced in any manner without written permission of the publisher.

Previous editions copyrighted 1944, 1950, 1958, 1963, 1967, 1972

Printed in the United States of America

International Standard Book Number 0-8016-1473-2

Distributed in Great Britain by Henry Kimpton, London

CB/CB/B 9 8 7 6 5 4 3 2 1

*Roe's laboratory guide  
in chemistry*

# *Preface*

This laboratory guide in chemistry is designed for use by students enrolled in courses in chemistry for the allied health sciences. It can be utilized, however, in other courses when a maximum of chemistry is explored in a minimum time. To allow a broad choice in laboratory experiences, 65 experiments are offered.

Procedures have been clarified more fully, the list of chemicals for laboratory experiments has been expanded, and a periodic table of the elements appears in the Appendix.

**Alice Laughlin**

# Contents



List of equipment for laboratory experiments, 1

List of chemicals for laboratory experiments, 3

Chemical laboratory apparatus, 5

Preliminary instructions, 11

Laboratory experiments, 14

- 1 A study of the Bunsen burner, 15
- 2 Movement of molecules, 19
- 3 Mixture and compound, 21
- 4 Visualizing the structure of the atom, 25
- 5 Preparation and properties of hydrogen, 29
- 6 Preparation and properties of oxygen, 33
- 7 Oxidation and reduction, 37
- 8 Water, 41
- 9 Distillation, 46
- 10 Hydrogen peroxide, 49
- 11 A study of solution, 51
- 12 Colloids, 55
- 13 Dialysis, 57
- 14 Osmosis, 60

- 15 Acids, bases, and salts, 64
- 16 Displacement reactions, 68
- 17 Indicators and determination of pH, 71
- 18 Ionization, 76
- 19 Standard solutions, 80
- 20 Acidimetry and alkalimetry, 85
- 21 Energy, 90
- 22 Carbon dioxide, 93
- 23 Ammonia, 96
- 24 Air, 98
- 25 Sulfuric acid, 102
- 26 Hydrochloric acid, 104
- 27 Iodine, 106
- 28 Reversibility of a chemical reaction: equilibrium, 108
- 29 Rate of chemical reaction: effect of temperature and concentration, 111
- 30 Metals and nonmetals, 116
- 31 Tests for some metallic ions, 118
- 32 Tests for some nonmetallic ions, 121
- 33 Flame tests, 123
- 34 Chemical analysis, 125
- 35 Practice in balancing equations, 128
- 36 Carbon, 130
- 37 Baking powders, 132
- 38 Tests for elements found in organic compounds, 134
- 39 Formaldehyde, 138
- 40 Ethyl alcohol, 141

- 41 Acetone, 144
- 42 Ethyl ether, 146
- 43 Fatty acids, 149
- 44 Esters, 152
- 45 Benzene, 154
- 46 Benzaldehyde, 156
- 47 Carbohydrates, 158
- 48 Proteins, 163
- 49 Fats, 166
- 50 Cholesterol, 168
- 51 Practice in balancing equations, 170
- 52 Paper chromatography, 172
- 53 Thin-layer chromatography, 176
- 54 Enzyme action—qualitative studies, 180
- 55 Enzyme action—a quantitative study, 183
- 56 Digestion, 186
- 57 Bile, 189
- 58 Milk, 194
- 59 Blood, 198
- 60 Buffers, 201
- 61 Composition of normal urine, 205
- 62 Urine analysis, 211
- 63 Vitamin C or ascorbic acid, 219
- 64 Qualitative analysis of foods, 224
- 65 Analysis of an unknown biochemical mixture, 228



- Appendix A** Table of elements (1970), 230
- B** Balancing equations, 232
- C** Periodic table of the elements, 234

**Color plates**

- 1** Benedict's test for sugar, 213
- 2** Urine color reactions, 214

# *List of equipment for laboratory experiments*

Balance weights  
Balances  
Beakers, 50, 125, and 400 ml.  
Boiling chips  
Bottles, reagent, 125 and 500 ml.  
Bottles, wide-mouthed, 200 to 500 ml.  
Brushes for test tubes  
Bunsen burners with rubber tubing  
Buret clamps  
Burets for class demonstration  
Clamp holders for universal clamp  
Clamps for test tubes  
Clamps, universal, for condensers, etc.  
Clay triangles  
Combustion spoon  
Condensers, glass, Liebig type, about 12 inches  
Cork borers  
Cork stoppers, assorted sizes  
Crucibles, porcelain  
Electrolysis of water apparatus (one for class demonstration)  
Evaporating dishes, 100 to 300 ml.  
Fermentation tubes, not graduated  
Files, small triangular  
Filter paper, about 11 cm.  
Flasks, distilling  
Flasks, Erlenmeyer, 50 and 250 ml.  
Flask, Florence  
Forceps  
Funnels, glass, about 75 mm.  
Glass plates, 4- or 5-inch squares  
Glass rods, 3 mm. diameter  
Glass tubing, 3 to 7 mm. diameter  
Graduated cylinder, 1,000 ml. (one for class use)  
Graduated cylinders, 25 and 100 ml.  
Hydrometers for specific gravity (several for class demonstration)  
Iron nails  
Litmus paper, red and blue  
Magnets  
Matches  
Mortar and pestle  
Nitrazine paper  
Pans or pneumatic troughs, holding 2 to 4 quarts  
Pipets, bulb (medicine droppers)  
Pipets, volumetric, 1, 5, and 10 ml.  
Platinum or nichrome wire for flame tests, sealed in a glass tube (for class demonstration)  
Racks for funnels  
Racks for test tubes  
Ring stands  
Rings to clamp on ring stands, about 4 inches  
Rubber stoppers, assorted sizes  
Safety goggles  
Stirring rods  
Test tubes, preferably lipped, about 150 × 16 mm.  
Test tubes, preferably lipped, about 200 × 25 mm.  
Thermometers

Thistle tubes

Tripods, iron

Urinometers

Volumetric flasks, 100, 250, 500,  
and 1,000 ml.

Watch glasses, 75 mm.

Weighing paper

Wing tops for Bunsen burners

Wire gauze, 5-inch squares for tri-  
pod, preferably with asbestos  
center

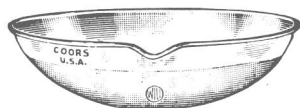
# *List of chemicals for laboratory experiments*

Acetic anhydride  
Acid, glacial acetic  
Acid, hydrochloric  
Acid, nitric  
Acid, oxalic  
Acid, sulfanilic  
Acid, sulfosalicylic  
Acid, sulfuric  
Acid, tannic  
Ascorbic acid (vitamin C)  
Alizarin  
Alum  
Aluminum chloride  
Ammonium chloride  
Ammonium hydroxide  
Ammonium molybdate  
Ammonium nitrate  
Ammonium oxalate  
Amyl alcohol  
Animal charcoal  
Antimony trichloride  
Barium chloride  
Benzidine  
Calcium acetate  
Calcium chloride  
Calcium oxide (fresh, unslaked  
lime)  
Carbon disulfide  
Casein  
Catechol  
Chloroform  
Cobalt chloride

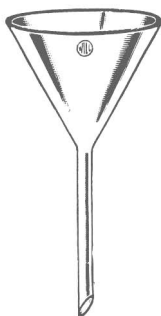
Collodion  
Congo red  
Copper oxide  
Copper, small pieces  
Copper sulfate  
Copper wire  
Cream of tartar  
Dimethylaminoazobenzene  
2,4-Dinitrophenylhydrazine  
Egg albumin, powder  
Ethyl alcohol  
Ethylene glycol  
Ethyl ether, U.S.P.  
Ferric chloride  
Ferrous sulfate  
Fibrin (from blood)  
Formalin  
Gasoline  
Gelatin  
Glucose  
Hydrogen peroxide, U.S.P.  
Iodine  
Iron, powder  
Lard  
Lead acetate  
Lead nitrate  
Lithium carbonate  
Litmus  
Magnesium ribbon  
Manganese dioxide  
Marble  
Mercuric chloride

Mercurous nitrate	Sand
Methyl alcohol	Silver nitrate
Naphthalene	Soda lime
$\alpha$ -Naphthol	Sodium acid phosphate
Olive oil	Sodium bicarbonate
Oxalic acid	Sodium bisulfite
Pancreatin	Sodium carbonate, anhydrous
Pepsin	Sodium citrate
Phenolphthalein	Sodium diethylbarbiturate
Phenolsulfonphthalein	Sodium hydroxide
Phosphorus, white	Sodium, metallic
Potassium bisulfate	Sodium nitrite
Potassium bromide	Sodium nitroprusside
Potassium carbonate	Sodium thiosulfate
Potassium chlorate	Stannous chloride
Potassium dichromate	Starch
Potassium ferrocyanide	Stearic acid
Potassium hydroxide	Steel wool
Potassium iodate	Strontium chloride
Potassium iodide	Sucrose (cane sugar)
Potassium, metallic	Sulfur, flowers
Potassium nitrate	Tributyrin
Potassium oxalate	Urea
Potassium permanganate	Uric acid
Potassium sulfocyanate	Zinc, granular, 20-mesh
Resorcinol	Zinc, mossy

# Chemical laboratory apparatus



Evaporating dish



Funnel



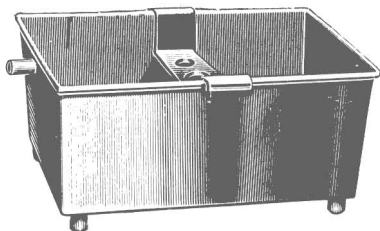
Separatory funnel



Litmus paper



Mortar and pestle



Pneumatic trough



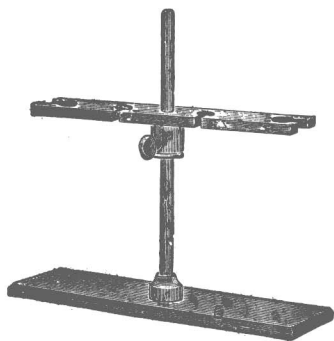
Volumetric  
pipet



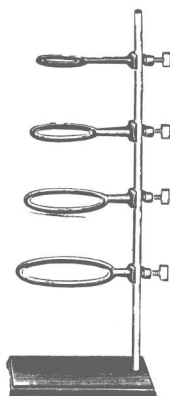
Graduated  
pipet



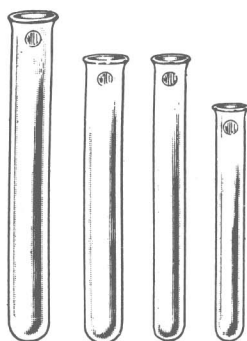
Thistle  
tube



Funnel rack



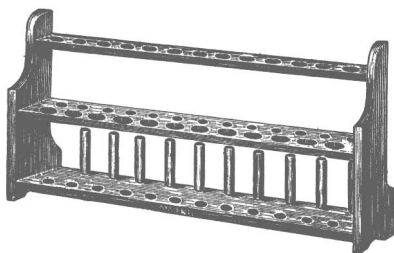
Ring stand



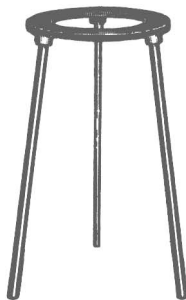
Test tubes



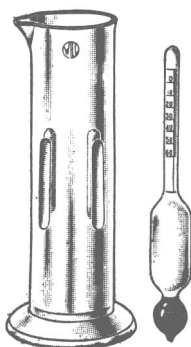
Test tube  
brush



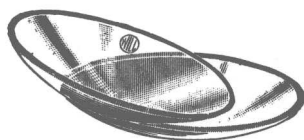
Test tube rack



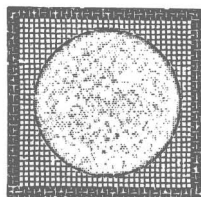
Tripod



Urinometer

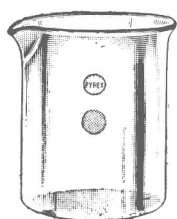


Watch glasses

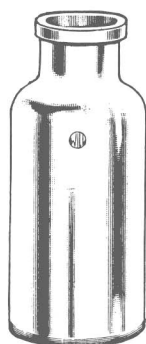


Wire gauze with  
asbestos center





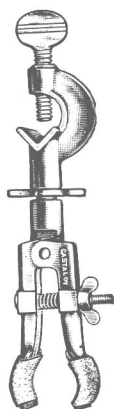
Beaker



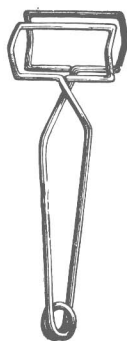
Wide-mouthed  
bottle



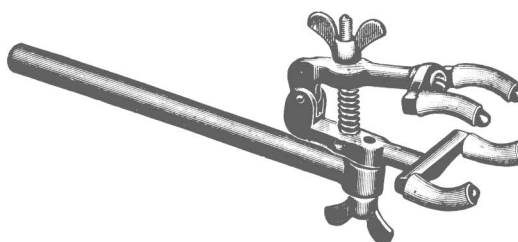
Reagent bottle



Buret clamp



Test tube  
clamp



Universal clamp