

CHEMISTRY IN ACTION:

**A LABORATORY MANUAL FOR
GENERAL, ORGANIC, AND
BIOLOGICAL CHEMISTRY**

Erwin Boschmann & Norman Wells

FOURTH EDITION



WCB

McGraw-Hill

CHEMISTRY IN ACTION

A Laboratory Manual for General,
Organic, and Biological Chemistry

FOURTH EDITION

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Boston, Massachusetts Burr Ridge, Illinois Dubuque, Iowa
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WCB/McGraw-Hill

A Division of The McGraw-Hill Companies

This book was set in Times Roman by J.M. Post Graphics, Corp.
The editors were Denise T. Schanck and Jack Maisel;
the production supervisor was Janelle S. Travers.
The cover was designed by Hermann Strohbach.
Malloy Lithographing, Inc., was printer and binder.



This book is printed on recycled paper
containing 10% post consumer waste.

CHEMISTRY IN ACTION
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11 12 13 14 MAL MAL 0

ISBN 0-07-006531-4

Library of Congress Catalog Card Number: 89-63610.

This book is printed on acid-free paper.

SAFETY IN THE LABORATORY*

These experiments have been written with the necessary safety precautions in mind. Any hazards that may arise are due to those persons who offend the common rules of safety. Your safety and the safety of those about you is *your* personal responsibility. *Be safety conscious.*

General Rules

1. You must protect your eyes with safety glasses at all times, and the use of a laboratory apron is recommended. Long hair must be confined to the back of the head with some type of fastener.
2. Understand your experiments and follow the procedures carefully. No unassigned experiments will be tolerated.
3. All bottles containing chemicals should be plainly labeled. Materials found in unlabeled bottles should be turned over to the laboratory instructor.
4. Unless a reagent is definitely known to be nontoxic and noncorrosive, handle it as though it were toxic and corrosive.
5. Read carefully the labels on reagent bottles. Be certain you are using the specified quantity of the right reagent in the correct concentration. A wrong choice may result in serious consequences.
6. Never use your mouth in pipetting liquids. Use a pipet bulb.
7. Drinking from beakers is extremely dangerous. Serious, even fatal, poisoning may result from insufficient washing of a beaker used as a drinking glass or from inadvertently drinking from a beaker containing a poisonous solution. All eating or drinking must be done outside the laboratory and should be preceded by a thorough washing of hands.
8. Smoking is not permitted in laboratories or storerooms.
9. Accidents caused by careless handling of glassware can be avoided by observing the following precautions:
 - (a) Fire-polish the ends of all glass rods and tubing.
 - (b) Before inserting glass tubing or thermometers into stoppers (or rubber tubing), be sure that the hole is large enough to accommodate the glass. Moisten both the glass and stopper thoroughly. Hold the tubing between the thumb and forefinger, *not in the palm of the hand*. Grasp the glass close to the end that is being inserted and twist the tube with even pressure. Glycerin is used as a lubricant with cork or if anhydrous conditions are necessary.

*Written in conjunction with P. A. Boaz, Department of Chemistry, Indiana University-Purdue University at Indianapolis.

- (c) Cut rubber or cork away from glass to which they have hardened. Do not push or pull them.
 - (d) When picking up a beaker, place your fingers around the outside of the bottom, not over the top rim. Small beakers of hot solution are best picked up by means of a folded paper strip.
 - (e) Beware of hot glass. Glass cools slowly and may be hot enough to cause painful burns without appearing to be so.
 - (f) Throw away cracked and chipped glassware immediately and obtain replacements from the instructor.
10. Flammable, volatile liquids such as alcohol, ether, and benzene must never be distilled or evaporated over open flames. No flames must be in the immediate neighborhood when these liquids are in use. Carry out operations with flammable volatile substances in the hood. The hood is also used whenever toxic or irritating gases are likely to be evolved.
 11. All solid waste materials are disposed of in the containers provided, *never in the sink*. Glass and metal are disposed of separately in the designated container.
 12. Liquid wastes, unless toxic or corrosive, are poured into sinks while flushing with water. However, volatile liquids should not be disposed of in the sink because of the possibility of the formation of gas pockets which may blow back and ignite. Special containers will be provided for these wastes.
 13. Know the location of the first aid station, fire extinguisher, fire blanket, safety showers, fire alarm, and nearest exit.
 14. Clean up all spills at once. Most laboratory floors are slippery when wet. Take care to dry them after cleaning.
 15. Plenty of running water is the best first aid treatment for all acid or alkali accidents to skin, clothing, or laboratory furniture. *Rapid and immediate treatment is absolutely essential*. Use plenty of running water; a little water or a damp cloth may cause further damage because of heating effects. Eye injuries whether chemical or mechanical must always be considered serious. In case of chemical injury, the eyes must be forced open immediately and flushed thoroughly with water. *No other treatment is to be given except by a doctor*. Clothing soaked with strong acid or alkali should be removed. The following apply to clothing, laboratory furniture, and all parts of the body *except mouth and eyes*:
Acids—after acid has been washed off with plenty of water, solid sodium bicarbonate (baking soda) is applied liberally to the area.
Alkalies—After alkali has been washed off with plenty of water, dilute acetic acid is applied to the area.
 16. The shower is intended for use in case corrosive chemicals are spilled or splashed over a large body area. Do not use the shower to extinguish clothing on fire.
 17. The most painful and serious laboratory accidents are caused by clothing catching fire. Such accidents may produce fatal results in a few seconds since the chances of recovery diminish with the extent of skin surface burned. If a person's clothing catches fire, throw him to the floor and roll him to smother the flames quickly. Do not allow him to remain in a standing position even if you must trip or knock him down. This action will prevent injury to respiratory passages and eyes by flames which naturally rise and envelop the head. *Never turn a fire extinguisher of any type on a person whose clothing is on fire*. Eye injury may result from a soda acid type and frost bite from the carbon dioxide type.
 18. Small laboratory fires are usually best smothered with a small cloth, larger fires with the carbon dioxide fire extinguisher.
 19. *Report all accidents to your instructor*. Give full details concerning the nature of the accident, the chemicals you were using and the immediate first aid you have taken. Only the instructor administers treatment involving materials in the first aid station.
 20. Do not shake down a mercury thermometer.

Laboratory Manners

1. Never take stock bottles to your desk.
2. Insert nothing into bottles of solid reagent bottles. Pour the estimated amount on a piece of weighing paper or into a beaker. Discard any excess. Do not return to the stock bottle.
3. Pipets are not inserted into bottles of liquid reagents. Pour the estimated quantity into a beaker or graduated cylinder. Discard any excess. Do not return to the stock bottle. Wipe away drips from the neck and sides of these bottles.
4. Never weight chemicals directly on the balance pan. Use weighing paper or a watch glass.
5. Distilled water is expensive and must not be wasted. It is used only for making up solutions and an occasional procedure called for by the experiment or the instructor.
6. Before leaving the laboratory, make sure your working surface is clean and dry. Be sure the water, gas, and air cocks are completely shut off.

SAFETY PLEDGE

1. Wear approved eye protection in the laboratory continuously. (If you should get a chemical in your eye, wash with flowing water from sink for 15–20 minutes.)
2. Perform no unauthorized experiments.
3. In case of fire or accident, call the instructor at once. (Note location of fire extinguisher and safety shower now so that you can use it if needed. Wet towels are very efficient for smothering fires.)
4. You must call the instructor for treatment of cuts, burns, or inhalation of fumes.
5. Do not taste anything in the laboratory. (This applies to food as well as chemicals. Do not use the laboratory as an eating place and do not eat or drink from laboratory glassware.)
6. Exercise great care in noting the odor of fumes and avoid breathing fumes of any kind.
7. Do not use mouth suction for filling pipets with chemical reagents. Use a pipet bulb.
8. Don't force glass tubing into rubber stoppers. Use lubricant and protect your hands with a towel when inserting tubing into stoppers.
9. Confine long hair when in the laboratory. (Also, a laboratory apron is essential when you are wearing easily combustible clothing. Such an apron affords desirable protection on all occasions.)
10. Never work in the laboratory alone.
11. No smoking in the laboratory.

I have read the above rules and will observe them in my chemistry course.

signature

date

SAFETY QUIZ

Identify the location of the following safety equipment in your laboratory:

(a) Fire extinguisher

(b) Safety shower

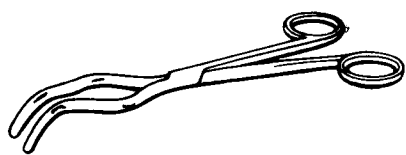
(c) Emergency alarm

(d) Eye wash

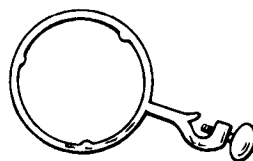
2. Suppose you spill a strong alkali on the countertop, describe the proper procedure for clean-up.

3. How do you dispose of solid waste materials?
4. Describe the proper personal attire for working in the laboratory.
5. Explain the reasoning behind laboratory manners.
 - (a)
 - (b)
 - (c)

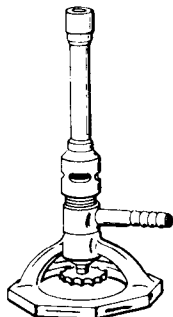
COMMON LABORATORY EQUIPMENT



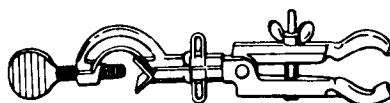
CRUCIBLE TONGS



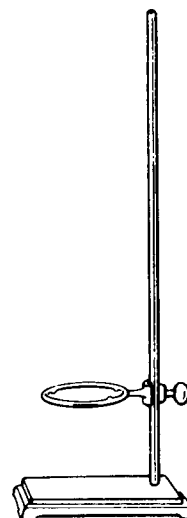
RING SUPPORT



BUNSEN BURNER
(TIRRILL TYPE)



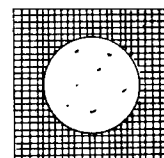
UTILITY CLAMP



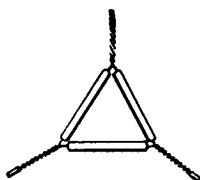
RING STAND



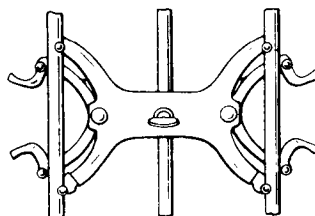
SPATULA



WIRE GAUZE



CLAY TRIANGLE



BURET CLAMP



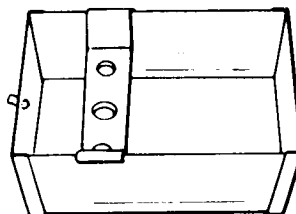
WING TOP, FISHTAIL,
OR FLAME SPREADER



TEST TUBE HOLDER



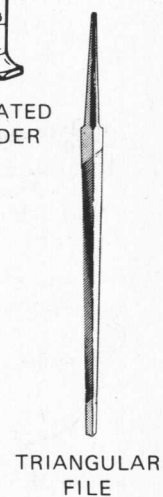
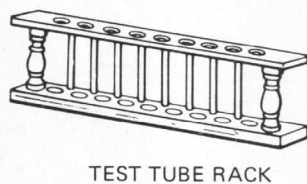
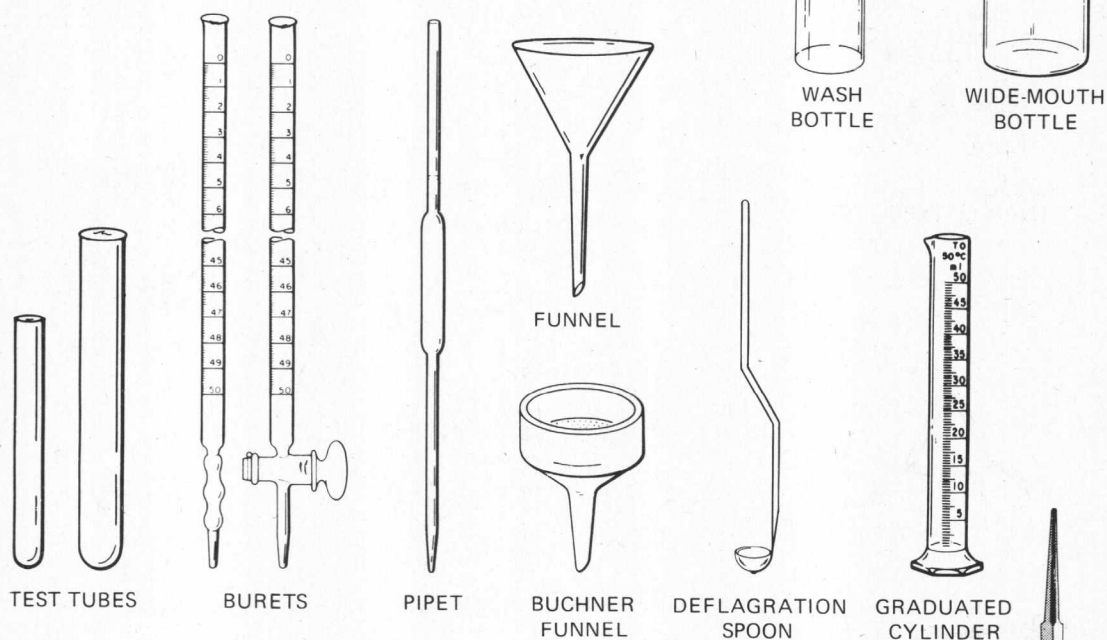
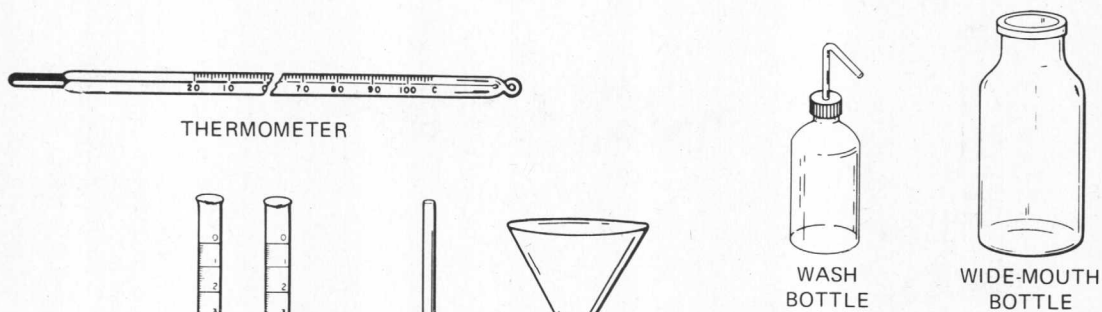
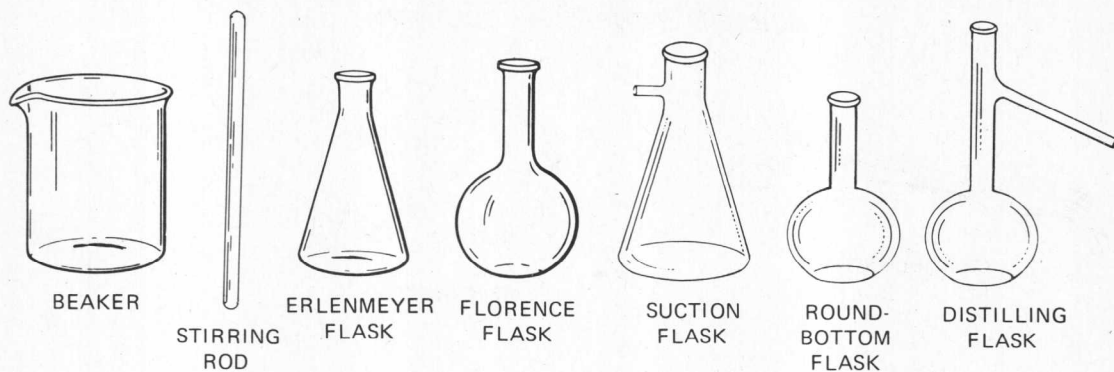
EVAPORATING DISH

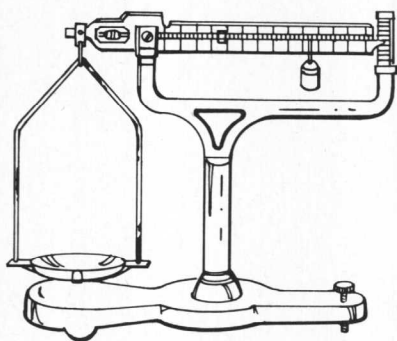


PNEUMATIC TROUGH



WATCH GLASS

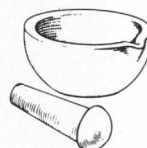




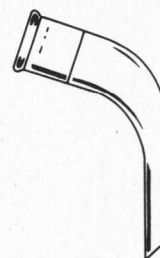
TRIPLE-BEAM BALANCE



FORCEPS



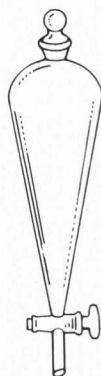
MORTAR
AND PESTLE



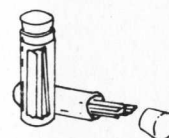
ADAPTER



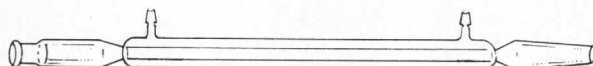
CORK BORERS



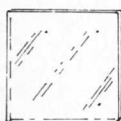
SEPARATORY FUNNEL



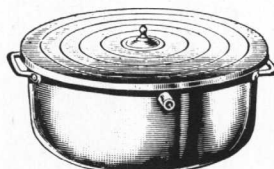
LITMUS PAPER,
RED AND BLUE



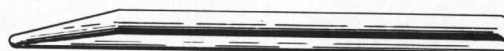
CONDENSER



GLASS PLATE



STEAM BATH



SCOOPULA

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INTRODUCTION TO THE LABORATORY

Materials Needed

Bunsen burner
Glass tubing
File
Wire gauze

Background

The laboratory assigned to you is equipped with tools and safety devices necessary to carry out all experiments in an efficient and safe manner. Most of these will be new to you; as you look around you might at first feel as though you are being asked to bake a cake in a totally strange kitchen where you don't know the location of any ingredient. It is the purpose of this Introduction to familiarize you with some of the physical facilities, equipment, and safety devices associated with the laboratory. While you will not be asked to hand in a report, it is important that all parts be carried out carefully and conscientiously.

Procedure

I. CHECK-IN

As soon as you have been assigned a working area and an equipment drawer, you should familiarize yourself with the contents of the drawer. To do so, transfer all items onto the desk top and identify each by name, using the drawings in the manual if necessary. Examine each item carefully for cleanliness and damage. Then check the items against the list of equipment that will be provided, making a note of any missing or damaged items. Return all usable equipment to the drawer.

II. SURROUNDINGS

1. *Reagent and Equipment Shelves.* Familiarize yourself with all storage places for equipment, reagents, and solutions in the laboratory. These items will normally be found in drawers or on shelves or benches located to the sides or at the ends of the laboratory.
2. *Stockroom.* A supply room is usually located in the vicinity of the laboratory. Become familiar with its location, operation, and staff. If the examination of your equipment showed some damaged or missing items, you may now want to exchange these items and complete your list through the storeroom.
3. *Other.* You should also become knowledgeable with the operation of service outlets on the workbench. These usually include tap water, steam or hot water, gas, forced air, aspirator vacuum line, and a 110-V line. Distilled water may be built in or supplied separately.

Naturally, there are many other features in the laboratory. These will become familiar to you as the term progresses. There is, however, one feature that must be dealt with from the beginning.

III. SAFETY

Because you will often experiment with matter undergoing a change, safety precautions must be strictly observed to keep such changes under control. Read and then sign the Safety Pledge, which will commit you to observe the rules.

Here are the basic DOs and DON'Ts:

- DO** wear safety goggles
- wear protective clothing
- be clean in all work

