



State of Florida  
Department of Education  
Ralph D. Turlington, Commissioner of Education  
Tallahassee, Florida  
Affirmative action/equal opportunity employer

*Division of Vocational Education*



©State of Florida, Department of State, 1982

Authorization for reproduction is hereby granted to the State System of Public Education as defined in 228.041(1), Florida Statutes. No authorization is granted for distribution or reproduction outside the State System of Public Education without prior approval in writing.

The materials reproduced in this safety guide were selected by a committee that included Florida vocational instructors and supervisors as being the best available in terms of content and cost of acquisition. Each instructor should preview the materials prior to classroom use for content accuracy and for acceptable safety measures. Since safety procedures may vary in different locations, the Division of Vocational Education and the selection committee members do not certify that all safety measures are included in the materials.

The use of trademarks in this document is strictly for the purpose of clarity and in no way should be considered an endorsement by the Department of Education, Florida State University, or The Center for Studies in Vocational Education.

# **FLORIDA INDUSTRIAL ARTS SAFETY GUIDE**

# ACKNOWLEDGMENTS

The Division of Vocational Education wishes to express appreciation to the many individuals who contributed to this safety guide.

Appreciation is extended to the Project Committee, which consisted of the Local Project Coordinator, Richard Hair, Department Chairman of Industrial Arts and Industrial Education, Hillsborough High School, and the following members:

Conrad Frassa, teacher, LaVoy School, Tampa

Jerry Hamm, teacher, Conway Junior High, Orlando

John K. Horn, Program Coordinator, Industrial Arts Education,  
Orange County

Lowell (Tom) Hudson, Supervisor, Industrial Arts, Duval County

Jim Morris, Supervisor, Industrial Arts, Dade County

Robert Pryor, Assistant Professor, Industrial Education, Florida  
International University, Miami

John Thomas, teacher, Jenkins Middle School, Palatka

James L. Whittamore, Industrial Arts Consultant, Lee County

Thanks also to B. H. Blankenbecler, Supervisor of Industrial Arts and Industrial Education, Hillsborough County Schools, who administered the project for the county.

Special acknowledgment is given to Robert Pryor, who wrote and revised the safety color code poster and various items in this guide.

Gratitude is expressed to Ralph Steeb, State Consultant for Industrial Arts Education, for attending all committee meetings and for providing overall guidance and direction.

Appreciation is extended to Marvin Patterson, Project Manager, and to Thomas W. Sommer and James R. Vandervest of The Center for Studies in Vocational Education, Florida State University, for their assistance in committee activities and in the production of this safety guide.

Finally, thanks are due Margaret Van Every and P. V. LeForge, editors; Dan Haskin, visual designer; and Debra G. Green and Gary Carroll, illustrators, all of The Center for Studies in Vocational Education, Florida State University, for their contributions to this safety guide.

# TABLE OF CONTENTS

Acknowledgments . . . . .	iv
Preface . . . . .	vii
Introduction . . . . .	3
Safety Responsibilities . . . . .	5
Liability . . . . .	8
Shop Safety Standards . . . . .	8
Practices That May Lead to Liability . . . . .	9
State Regulations . . . . .	10
Emergency Action . . . . .	11
Suggested Procedure in the Event of a Serious Injury . . . . .	11
The First Aid Kit . . . . .	13
Eye Safety . . . . .	14
Hazards of Solvents . . . . .	16
Shock Hazards . . . . .	20
Facets of a Safety Program . . . . .	23
Qualifying on Machines . . . . .	24
Daily Safety Operations Checklist for Students . . . . .	26
Safety Zone Lines . . . . .	27
Metals Safety . . . . .	35
Plastics Safety . . . . .	149
Woods Safety . . . . .	193
Hand and Portable Power Tools Safety . . . . .	269
Graphic Arts Safety . . . . .	347
Electricity/Electronics Safety . . . . .	465
Welding Safety . . . . .	523
Automotive and Power Mechanics Safety . . . . .	631
Annotated Bibliography . . . . .	739
Additional Resources . . . . .	749
Organizations . . . . .	775
Index . . . . .	783

(1)

( )

( )

# PREFACE

Accidents can happen in a second. They're sometimes tragic and always unexpected. But they're also preventable. The key is safety, but knowing safe practices is not enough. In this age of increasingly complex machines and machine technology, one must *use* these practices and use them continuously.

Public schools should emphasize safety in vocational subjects, science, and sports. Industrial arts educators must be ever alert to the potential dangers that exist in their laboratories. It is up to teachers and administrators to develop in each student a knowledge of safety practices and an awareness of when to use these practices. This knowledge can be used not only during the school program, but in life and on the job as well.

Because of the importance of safety education in industrial arts laboratories, the Florida Division of Vocational Education has prepared this set of instructional materials. In addition to the *Florida Industrial Arts Safety Guide*, the set includes:

1. A group of posters reflecting general safety attitudes and habits.
2. Three self-contained safety books: *Developing Shop Safety Skills*; *Shop Safety Skills*, Teacher Guide; and *Shop Safety Skills*, Student Workbook (American Association for Vocational Instructional Materials).
3. An eye protection packet, *An Option to See: Educators Resource Guide* (National Society for the Prevention of Blindness).
4. A hand tool booklet, *Proper Use and Care of Handtools, Pliers, Screwdrivers, Wrenches, Striking and Struck Tools* (Klein Tool, Inc.).
5. A booklet, *Safety and Health for Industrial/Vocational Education* (U.S. Government Printing Office).

This manual is intended primarily for secondary school shop teachers, but industrial arts supervisors, principals, superintendents, and school board members will also find it a source of useful information.

(

(

(

# GENERAL SAFETY RULES AND HABITS

GENERAL SAFETY RULES AND HABITS

Pages 16–18 are adapted from *Health and Safety Identification Program*, produced by Industrial Department, United Brotherhood of Carpenters and Joiners of America, Washington, D.C., n.d.

Page 19 is adapted from *Health and Safety Newsletter*: "Common Solvents and Their Hazards," produced by United Auto Workers, Detroit, Michigan, 1977.

Pages 20–22 are adapted from *Electricity Concepts: Unit 1: Lab Manual*, produced by Energy Concepts, Inc., Chicago, n.d.

# INTRODUCTION

Industrial arts teachers shoulder a great responsibility for the education and welfare of students in their classes. Although each teacher is dependent upon a hierarchy of administrators and supervisors, s(he) is nevertheless the principal organizer and director of educational experiences and activities. The content, outcome, and indeed the success or failure of that part of the educational program resides with the teacher and the teacher alone.

But the industrial arts teacher has a responsibility that most classroom teachers do not. Because a shop teacher's basic teaching aids include machines, power tools, and electrical equipment, safety is an integral part of any industrial arts program. Isolated or unrelated lectures on safety practices are not enough. Integrating safety awareness and procedures into the total classroom instruction is a vital task.

The human instinct for self-preservation is, unfortunately, not always very strong when everyday safety is concerned. Many people fall victim to it-can't-happen-to-me attitudes. The students must be educated in the basics and specifics of safety—just as they must learn general objectives and specific tasks in training for a career.

The two main purposes of safety education are (1) to protect the student from being injured in the school shop or laboratory and (2) to develop habits, attitudes, and perceptions that will help ensure safety awareness throughout a lifetime. This manual and its accompanying materials are intended to serve as guides to help the teacher accomplish these important tasks. And because accidents will happen despite all precautions, this guide includes important information about how teachers can protect themselves from liability.

These materials do not make up a complete safety program, nor do they pretend to tell the teacher much about *how* to teach safety. Rather, general and specific rules, regulations, and practices are presented in an effort to achieve a certain minimum coverage. The teacher is encouraged to use the materials as aids in developing a comprehensive and integrated safety program. A truly effective safety program is practiced regularly and naturally as part of the daily work.

One way to increase the effectiveness of a safety program is to encourage student participation. Students can and should be actively involved in planning and presenting programs, demonstrations, and other activities. The appointment of a student "shop steward," "safety engineer," or "committee on shop safety" can be of great help in getting students interested in promoting safety rules and procedures.

The teacher should study these materials before planning any laboratory safety program. There may be sections of this guide that are not applicable to all industrial arts classes. Teachers are advised to adapt this material to suit their individual needs. Instruction should be given when it is most timely and meaningful to the student, rather than by the "shotgun" method—trying to explain everything there is to know about shop safety all at once. Applicable parts of this safety guide can also be reproduced for use as handouts. In this way, students will have a ready reference for reinforcing their knowledge when they need it most.

Generally, this manual consists of the following:

1. An introductory section on general safety rules and habits. This includes several pages on liability.
2. An introduction to safety procedures relating to the following tools and machines:
  - a. Machines for working with metals, plastics, and woods
  - b. Hand and portable power tools
  - c. Equipment used in electricity and electronics
  - d. Graphic arts equipment
  - e. Welding equipment
  - f. Automotive and power mechanics tools and equipment

In addition, each section contains a safety quiz and a transparency master for each piece of equipment.

3. An appendix of professional organizations and manufacturers of equipment and supplies
4. A list of audiovisuals
5. A bibliography of industrial arts safety-related materials.

# **SAFETY RESPONSIBILITIES**

## **The Philosophy of Safety Education**

The fundamental purpose of a safety program is to prevent students from being injured. Because students lack the experience and maturity to behave with concern for their own safety, the teacher has a moral and professional responsibility to safeguard those who have been enrolled in the course. To achieve this, a safe working environment must be created and safety instruction and evaluation must be an integral part of the course work.

A good safety program also serves an economic purpose—both for the teacher and the pupil. Injuries to students may impair their future earning power by restricting their avenues for employment. This would create a hardship not only for the victim but also for his or her family. The teacher, therefore, must protect against the possibility of being sued. “Hold harmless” legislation frees him or her from liability in a shop accident unless negligence can be proved. Still, legal services may be required in a suit to establish negligence.

## **The Scope of Responsibility**

The responsibility for safety in industrial arts programs rests with many people: the school board, the administration, the parents, and the teacher. The teacher’s role should not, however, be construed as a passive one, accepting whatever conditions are given. Quite the reverse. It is the teacher’s duty not only to provide a safety education program, but also to keep supervisors and administrators advised of the needs of the shop and the program. Any unsafe conditions should be reported immediately in writing. The portion of the instructional program having unsafe conditions or equipment should be suspended until corrective action is taken. A prompt and detailed report serves as evidence of the teacher’s concern and good intentions.

## **The Responsibility of Parents**

Parents should begin safety education at home, but they should also concern themselves with the enactment of good school safety laws. An important part of this concern should be for the hiring of qualified personnel and the quality of equipment and facilities. Parents’ cooperation and interest are of the utmost importance. The teacher should capitalize on the influence of parents on the development of their children and involve them in the safety programs of the school. Teachers should make sure that parents are represented on the industrial arts advisory committee.

## **The Responsibility of the School Board**

Legally, the school board is a government agency. Under a state law that became effective on January 1, 1975, all such branches of the state can be sued to recover damages for injury or loss of property, personal injury, or death caused by the negligence or wrongful act or omission of any employee while acting within the scope of employment. Because safety in industrial arts programs begins with an efficient facility, safe equipment, proper materials, and competent instructional personnel, the school board has the responsibility to provide these elements. Safety should never be subordinate to economy.

Because school boards may be liable for damages caused by negligence, they are authorized to purchase insurance protection. Individual teachers may buy self-insurance. These types of insurance will defray the costs of legal services or a judgment against the school or the individual.

### **The Responsibility of the Administration**

The teacher, as the certified subject specialist and as the individual closest to the student, is the one most responsible for safety and for other aspects of the student's education. To carry out these large responsibilities, the teacher needs the unqualified support of the school administration. Such support, in fact, amounts to the main responsibility of administrators concerning shop safety: they must provide the teacher with the information, facilities, tools, and equipment needed to conduct an ongoing safety program and to create a safe working environment.

The Florida Department of Education has the responsibility of providing school districts with leadership and direction in the development of practical safety programs. This leadership is expressed in guides and consultive services. The state and regional consultants for industrial arts provide technical assistance to districts and teachers.

District superintendents and their administrative personnel must give their wholehearted cooperation to establishing an ongoing and viable safety program. County policies and procedures should be furnished to develop, maintain, and evaluate school safety programs. The county should also be concerned with providing special individual equipment, adequately maintained power equipment, safe facilities, and the leadership required to motivate teachers to maintain a successful safety program.

The county director or supervisor of industrial arts has the specific task of directing safety programs through teachers in shops and laboratories. Supervisors should provide guides, accident report forms, in-service education and information, equipment, maintenance procedures, and most important, direct supervision of the safety program.

### **The Responsibility of the Teacher**

Despite the role of parents, administrators, supervisors, and the school board, the main burden of responsibility for school shop safety rests on the industrial arts teacher.

A teacher's duties and powers are defined in law. In addition, the law requires that teachers exercise the care that any reasonably prudent person would exercise in a similar situation. The teacher also has a moral responsibility to protect the welfare of the students by creating a safe environment and instilling in them a safety consciousness.

Because the teacher stands *in loco parentis* (in the place of the parent), s(he) must take on some of the rights and duties of parents. Thus, the teacher has the added requirement to act as a reasonable and prudent parent would.

To escape any charge of negligence, it is necessary for all teachers to have a planned safety program and adequate pupil supervision. Teachers should never exceed their authority, use poor judgment, or fail to take necessary safety precautions.

For their own safety, however, industrial arts teachers should find out if their school provides liability coverage. If not, they are encouraged to investigate self-insurance, which is available through a variety of private agencies and professional organizations.

### **The Responsibility of the Student**

The primary recipient of all safety procedures and plans is the student. But no safety program can succeed without the student bearing a great deal of responsibility for his or her own well-being. The program of safety education should cause each student to quickly realize his or her responsibility to develop sound safety habits.

The philosophy of any safety education program should be such that students will come to realize that they are responsible for their own safety, in school and out. Yet students' immaturity and lack of experience must be taken into account. A student may realize that a particular act is dangerous but may not realize the *amount* of danger or realize the consequences of the act. A good professional educator, then, must be a bit of a psychologist—able to size up students as individuals and anticipate behavior that might cause accidents. Some students might be given to horseplay, for instance, while others might be absentminded or untidy. But if a student commits an unsafe act despite being told not to, the teacher is not excused from liability. Such contributory negligence on the part of the pupil is seldom a factor in releasing a teacher from liability.

# LIABILITY

Under the Florida Constitution, the state cannot be sued unless the legislature authorizes it. Such a law is generally referred to as *sovereign immunity*. In 1975, however, the legislature authorized individuals to bring suits against the state or its agencies in the same manner that they might sue a private individual. This waiver of immunity or acceptance of responsibility for its *tort*, or wrongful act, is limited to \$100,000 for each person or a total of \$200,000 for each occurrence.

The legislation specifically prohibits tort suits from being brought against state employees for any injuries or damages suffered as a result of any action, event, or omission of that employee while acting in the scope of his or her employment. This immunity from suit does not apply if the employee acted in bad faith, with malicious purpose, or in a manner exhibiting wanton and willful disregard of human rights, safety, or property.

If an accident happens in an industrial arts class, a tort liability suit may be brought against the teacher, the school, or the state. In a tort liability suit, however, the plaintiff must prove that s(he) is worse off than s(he) was before the accident, and that the accident was caused by negligence on the part of the defendant.

Legal negligence may be defined as the failure to observe that standard of care that a normal and prudent person would observe under the same or like circumstances.

Generally speaking, then, a teacher would not be subject to liability in tort actions without wrongdoing or fault on his or her part.

## Shop Safety Standards

A practical, ongoing safety program will not only result in a low accident rate but will also serve to protect the teacher from judgment in the event of an injury. By adhering at all times to the following shop safety standards, a teacher should be able to demonstrate that no negligence exists.

1. Provide adequate supervision at all times. **Never** leave a class unattended. If it is absolutely necessary to be out of the room, shut off power to all machines and have a qualified person watch the class for you. It is a good idea to plan for this eventuality by checking with your principal or director before the need arises.
2. Behave as a reasonable and prudent person would under the same or similar circumstances.
3. Develop a sound safety education program as an integral part of the course of instruction. Formulate clear, basic rules and regulations and enforce them *rigidly*.
4. Give adequate instruction in the proper, safe use of all machines, tools, and equipment. Closely supervise student use of all such items to make certain your instruction has been effective. Administer periodic safety tests.
5. Insist that guards be installed on all equipment to protect students from moving parts such as blades, pulleys, and gears. These guards should meet state standards.
6. Insist that eye-protection devices be worn as part of a comprehensive eye-safety program.

7. Provide protective clothing for special hazards and insist that this clothing be used. Regular personal clothing should be proper for the particular job or situation (ties or rings should not be worn around machinery, for instance).
8. Make sure that the facility is properly maintained. Housekeeping chores should be done daily and carefully supervised. Any defective equipment should be repaired at once by the teacher or, if beyond the scope of repair by the teacher, reported in writing to the proper authority. Copies of all such reports should be kept and filed. Danger signs or "out of order" signs should be posted on defective equipment until repairs are made.
9. Keep accurate written records relative to safety instruction and to accidents. Secure written statements from witnesses to accidents.
10. Make sure that all toxic and flammable materials are clearly labeled and properly stored.
11. Develop a professional understanding of your students with regard to levels of maturity, health, background, personality, coordination, attitude, and other traits that might affect a student's behavior in class. Check the cumulative records of each student as early as possible in the school year. Any physical or behavioral problems should be taken up with the proper school personnel and with parents. The teacher should be informed before any students with handicaps (epileptics, students who are hard of hearing, partially sighted students, or students with behavioral problems) are assigned to the program. Extraordinary standards of precaution should be established to protect these students.

### **Practices That May Lead to Liability**

The above standards of safety should be carried out continuously. At the same time, there are practices that an instructor must take great care to avoid. The instructor should pay close attention to the following rules. Failure to do so may lead to liability.

1. Do not leave the laboratory while students are working.
2. Do not leave a person who is not qualified to teach industrial arts in charge of the laboratory.
3. Do not permit students who are not enrolled in the class to use laboratory equipment and tools.
4. Do not permit students to use machines or tools for which proper instruction has not been given.
5. Do not allow pupils to use equipment that has not been approved by the administration and the school board.
6. Do not permit students to work in the laboratory during free periods when the facility is unsupervised.
7. Do not allow the use of equipment by students who are prone to accidents or who possess physical handicaps that may be the cause of accidents.
8. Do not send pupils outside the laboratory to perform activities or errands for the school, or for other departments within the school.

## State Regulations

The Florida State Board of Education establishes rules for the operation of public schools. Part III, Section B, Chapter 6A-2 of the State Board of Education Rules contains the standards for existing educational facilities. Subsections deal with the entire school facility in regard to such topics as electrical equipment, flammable materials, ventilation, fire safety, storage, and illumination.

Specifically, subsection 6A-2.97 contains regulations unique to industrial arts classes.

### **6A-2.97: Safety Devices in Shops, Laboratories, and Other Process Areas**

(1) Use of personal protection devices and other protective equipment is required when students and staff are exposed to the following:

- (a) Arc welding, heavy gas cutting, scarfing.
- (b) Spot welding, brazing, or cutting.
- (c) Machining of any materials causing flying chips.
- (d) Injurious radiations, dusts, fumes, gases, vapor mists.
- (e) Sledging, hammering, chipping, scaling, drilling, grinding,

chiseling, wire brushing, and caulking operations where flying objects or particles may strike the body.

- (f) Chemicals, acids, caustics, and molten metals.

(2) Personal protection devices which come in contact with the skin shall be sanitized after each use.

(3) Clothing, jewelry and personal grooming of personnel in shops and labs shall not constitute a hazard.

(4) Individual equipment power shut-off, within reach of the operator, shall be provided for all working machinery. Each individual machine shall be equipped with an approved electromagnetic starter switch.

(5) No safeguard, safety appliance, or safety device guarding a machine or machine part shall be removed or made ineffective except when the machine is stopped and for the purpose of immediate cleaning, repairing, or adjusting. Upon completion of repairing, cleaning or adjusting, such guard, appliance, or device shall immediately be replaced. Any shop or laboratory tool or equipment found to be unsafe shall be red-tagged and removed from service until the condition is corrected.

(6) The floors in areas where machines are used shall be kept free from waste, grease, and obstructions.

(7) Welding operations shall be located in a shielded area, and the area shall be free of combustible material and persons not wearing protective devices.

(8) Areas where toxic fumes are produced shall be properly vented to the outside.

(9) Flammable fumes or dust produced in a student occupied facility shall be mechanically exhausted to the outside with approved explosion-proof motor driven equipment with filters in place.

(10) Each space equipped with unprotected gas valves accessible to students shall have an approved master cut-off readily accessible to the instructor.

(11) Each shop or lab equipped with electrically powered machinery accessible to students shall have one or more conspicuously color-coded disconnect switches at convenient locations throughout the space.

(12) Kilns shall be properly shielded from combustibles, combustible surfaces and personnel, and shall not be located in the path of or adjacent to any means of egress, or exposed to unauthorized persons.

(13) Automotive, body and frame repair areas requiring welding and cutting shall be separated from engine overhaul and related fuel handling activities.

(14) A tire cage shall be provided when pressurizing tires on split rims.

(15) Vehicle lifts shall be provided with a mechanical safety lock.

(16) Piping and working machinery with component parts shall be safety color-coded in accordance with ANSI Z53.1-1971.

(17) The safety color-coded chart shall be posted in a conspicuous place available to employees and students.

(18) Hazardous work and storage areas shall be identified by appropriate caution signs.

(19) All equipment designed to be permanently mounted shall be securely fastened to its supporting surface.

(20) Safety zone lines shall be used on the floor area surrounding working machinery.

(21) Fume hoods shall be provided and kept in proper operating condition. Operations where flammable gas, toxic vapors or noxious odors are given off shall be performed in the fume hoods.

(22) Safety equipment such as showers and floor drains, eye wash, fire blankets and proper extinguishing equipment shall be provided, properly installed and maintained correctly. Specific Authority 229.053(1), 235.012 FS. Law Implemented 230.23(9), 230.756, 235.014(2), 235.06, 235.26 FS. History—New 6-10-75, Amended 9-6-78.

### **Emergency Action**

Although serious accidents are rare, an industrial arts instructor should always be prepared for one. The question "What will I do if an emergency occurs?" is one to which all teachers should give serious thought. School district policies and procedures regarding accidents and sickness should be discussed with the department head or principal and memorized. Plans should be made concerning communications, first aid, and transportation. These plans should be written down and discussed with each group of students.

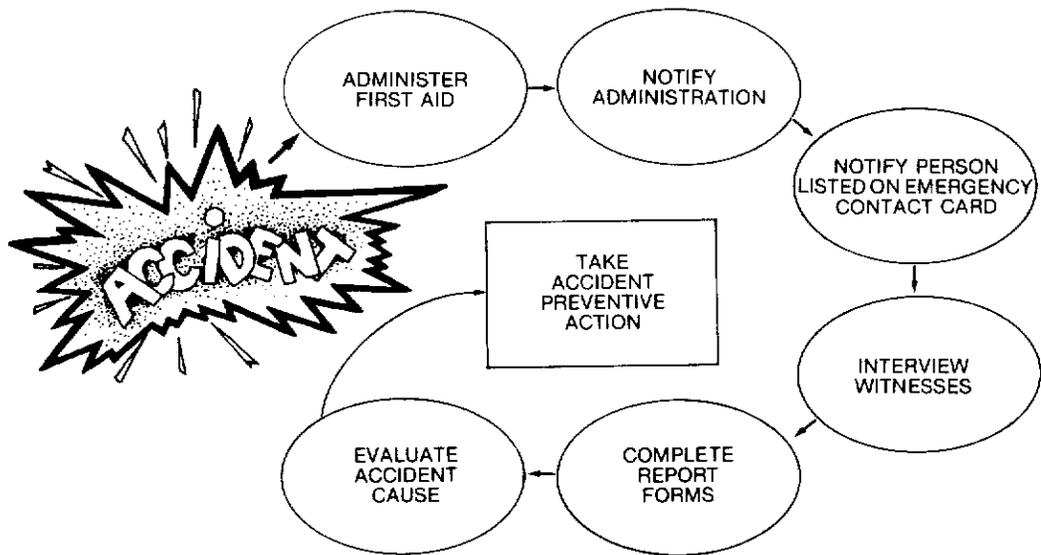
### **Suggested Procedure in the Event of a Serious Injury**

The first thing to do in an emergency is to send for help. An ambulance or an emergency rescue unit should be called immediately. If the injury is not serious, first aid can be given, but in no case should the victim be given medication. The instructor should then initiate the notification of the principal or department head. An injured student should never be left alone, however, and the teacher should never leave the class without providing supervision.

The family should be notified as soon as possible after aid has been sent for. They should contact the family doctor. If the family cannot be reached, the instructor should contact the family doctor. If neither the family nor the family doctor is available, the instructor should call a local doctor or a doctor at the hospital.

The Superintendent of Schools and the Risk Management Department must be notified of any serious injury as soon as possible after the injury occurs. Applicable accident reports should be filled out and submitted.

After the above procedures have been carried out, the teacher should take a hard and close look into the primary cause of the accident and into any contributing factors. A series of accident prevention measures can then be initiated to prevent such an accident from ever happening again.



# THE FIRST AID KIT

The American Red Cross recommends that the following supplies be available in a school first-aid cabinet:

- 1-inch adhesive compress (2 units)
- 2-inch bandage compress (2 units)
- 3-inch bandage compress (2 units)
- 4-inch bandage compress (2 units)
- 3-inch × 3-inch plain gauze pad (1 unit)
- gauze roller bandage (2 units)
- eye-dressing packet (1 unit)
- 1/2 square yard plain absorbent gauze (4 units)
- 24-inch × 72-inch plain absorbent gauze (3 units)
- triangular bandages (4 units)
- tourniquet (1 unit)
- scissors (1 unit)
- tweezers (1 unit)

Instructors should be aware that there may be legal restrictions to administering first aid. They are advised to study their school or district policy regarding the use of first aid before an accident occurs.

# EYE SAFETY

## Protecting Eyesight

One of our most valuable possessions is our eyesight. But we take sight so much for granted and treat it so carelessly that many states have seen fit to pass special legislation to protect eyesight in schools. Florida's eye-safety law is reproduced below. Note that it is still the responsibility of the teacher to make certain that protective devices are worn where hazards exist. Any teacher who does not rigidly enforce the law in his or her shop will be liable for negligence if and when an eye injury occurs.

Sometimes (for example, when a student is pouring metals) it is advisable to wear two types of protection—spectacle-type safety glasses *and* a plastic face shield. Neither device alone can be relied upon to stop flying drops of molten metal.

All eye-protection devices should be periodically disinfected. First, wash all parts with soap and water, then rinse. Prepare a deodorant solution that kills germs as well as fungi and either swab the device thoroughly or immerse it in the solution for ten minutes. If the device is allowed to dry in the air, the germicidal residue will retain its effectiveness for some time.

Ideally, each student should have a pair of safety glasses that s(he) can use throughout his or her school career in shop and chemistry courses. Each shop, however, must have available a sufficient type and quantity of these devices to protect the largest number of students (and visitors) who may be engaged in performing or observing the activities.

Elsewhere in this safety kit is an eye-safety packet entitled *An Option to See*, produced by the National Society for the Prevention of Blindness. The packet should be used by all industrial arts teachers as part of an eye-safety instruction program.

## Eye Protection Device Law

CHAPTER 67-181  
House Bill No. 754

AN ACT relating to public schools; revising and amending sections 228.002, 230.302(3), 231.361, 231.40(1), 232.45, 233.09(5)(b), 236.071(1) and 237.17, Florida Statutes.

Section 5. Section 232.45, Florida Statutes, is amended to read:

232.45 Eye protection devices required in certain vocational and chemical laboratory courses—

(1) Eye protective devices shall be worn by students, teachers, and visitors in courses including, but not limited to, vocational or industrial arts shops or laboratories and chemistry, physics or chemical-physical laboratories, at any time at which the individual is engaged in or observing an activity or the use of hazardous substances likely to cause injury to the eyes.

(a) Activity or the use of hazardous substances likely to cause injury to the eye includes:

1. Working with hot molten metals;
2. Milling, sawing, turning, shaping, cutting, grinding or stamping on any solid material using power equipment;
3. Heat treatment; tempering or kiln firing of any metal or other materials;
4. Gas or electric arc welding;
5. Caustic or explosive materials;
6. Working with hot liquids or solids including chemicals which are flammable, caustic, toxic or irritating.

(2) The boards of public instruction of the several counties may furnish plano safety glasses or devices for students and teachers and shall furnish such equipment for all visitors to such classrooms or laboratories, or may purchase such plano safety glasses or devices in large quantities and sell them at cost to students and teachers, but shall not purchase, furnish or dispense prescription glasses or lenses.

(3) To implement and carry out the purpose of this act the boards of public instruction of the several counties are hereby given authority to promulgate rules and regulations to accomplish the purpose of the law.

(4) "Industrial quality eye protective devices" as used in this act means devices meeting the requirements of the American standard safety code for head, eye, and respiratory protection Z2, 1-1959, promulgated by the American Standards Association, Incorporated.

# THE HAZARDS OF SOLVENTS

All solvents are poisonous. There is really no such thing as a "safety" solvent. Some solvents are worse than others, but every solvent should be treated with great suspicion.

Generally speaking, solvents can damage the body in four ways:

1. Skin Disease
2. Irritation of Eyes, Nose, and Throat
3. Narcotic Effect on the Nervous System
4. Damage to Internal Organs

## **Skin Disease**

All solvents can cause skin disease (dermatitis) by dissolving the natural protective barrier of oil on the skin. If the skin has enough direct contact with a solvent, it can turn dry and white and can develop cracks and flakes.

Some solvents can also penetrate the skin and enter the bloodstream. Some solvents are noticeably irritating on contact but others cause no particular pain even while they are penetrating the skin or defatting the skin.

## **Irritation of Eyes, Nose, and Throat**

All solvents can irritate the sensitive membranes of the eyes, nose, and throat. The airborne concentration at which this occurs varies from solvent to solvent. It appears that mixtures of solvents can cause this irritating effect at very low levels. At high enough an exposure level it becomes nearly impossible to remain in the work area where the solvent is used.

## **Narcotic Effect on the Nervous System**

All solvents can affect the nervous system through what is known in technical terms as "narcosis" or "depression of the Central Nervous System (CNS)." It is actually the brain itself which is affected by the solvent and causes a variety of symptoms. The symptoms caused by this are varied:

irritability	drunkenness
fatigue	nausea
headaches	staggering gait
dizziness	unconsciousness
sleepiness	death

## **Damage to Internal Organs**

Many solvents have been known for years to cause damage to internal organs, primarily the kidney and liver. Recent medical research is showing that more organs are affected than previously thought. At present, however, there appears to be considerable variation in the organs damaged by different solvents.

## **Liver and Kidney**

The liver and kidneys are often damaged in their attempt to detoxify and eliminate the solvent. For example, the use of carbon tetrachloride in industry has been mostly stopped because of its well-known effect on the

liver. However, a closely-related solvent, trichloroethane, appears to not damage the kidney and only slightly damages the liver (if at all).

### **Cancer**

Some solvents have been found to cause cancer. Benzene causes leukemia (although the very closely related solvent toluene apparently does not).

Some chlorinated solvents have been found to cause cancer in test animals and are thus presumed to cause cancer in people. These solvents are carbon tetrachloride, chloroform, trichloroethylene, and perchloroethylene. Some scientists now suspect that all chlorinated solvents might cause cancer, although methyl chloroform has been found not to cause cancer in the animals tested so far.

### **Peripheral Nerve Damage**

New studies have indicated that solvents may also damage the "peripheral nervous system" which is the system of nerves leading from the spinal cord to the arms and legs. The symptoms caused by this nerve damage are numbness, tingling sensations, weakness, and paralysis in the arms and legs, which is a condition known as "peripheral neuropathy."

Sensitive tests can measure the speed of the impulse along these nerves. The speed of the nerve impulse has been found to be slowed in workers exposed to some solvents, which is considered to be an indication of peripheral nervous system damage.

An epidemic of peripheral neuropathy in a fabric coating plant in 1973 was believed to be caused by methyl butyl ketone (MBK).

Both hexane and jet fuel have also been linked with this sort of nerve damage.

A study in Finland of car spray painters exposed to a mixture of toluene, xylene, butylacetate, and naphtha found this mixture to cause numbness in the hands and feet, slowed nerve impulse speed, and slowed dexterity (plus an impairment of intelligence and memory functions).

Trichloroethylene has also been found to slow the nerve impulse, although speed returned to normal several months after the exposure stopped.

### **Heart Attack**

Several solvents have so far been found to contribute to a form of heart attack known as "arrhythmia." It appears that these solvents make the heart muscle more sensitive to adrenaline in the body. In this sensitive state, the adrenaline causes the heart to beat rapidly and irregularly, which in some cases has caused death.

Methyl chloroform, trichloroethylene, toluene, and gasoline have all been found to cause this problem.

### **Psychological Problems**

Since one of the actions of solvents is on the brain, it can be expected that more problems result than just headaches and dizziness. Investigations have shown that many solvents can cause a variety of problems in psychological behavior which are hard to distinguish from problems caused by everyday living. Problems like fatigue, apathy, irritability, depression, nervousness, insomnia, giddiness, and mental confusion have all been noted. Intelligence and memory can also be impaired.

**Other Health Problems**

Some solvents have been found to cause other problems such as damage to the bone marrow and the blood-forming mechanism, and damage to the lungs. Concern has also been raised that solvents might damage the reproductive system of both men and women.

**Explosion and Fire Hazard**

Another hazard of solvents is the explosion and fire hazard present when the vapors are present in the air. Some solvents evaporate more quickly than others (they have a higher "vapor pressure") and are thus more dangerous. Similarly, some solvents are more flammable than others (they have a lower "flash point") and are more dangerous.

Regulations require that ventilation be provided in many solvent operations to control the fire and explosion hazard.

# COMMON SOLVENTS AND THEIR HAZARDS

	OSHA TLV	Proposed† TLV	Health Hazards	Fire/Explosion Hazard
<b>ALCOHOLS</b>				
methanol (wood alcohol)	200 ppm		skin, brain, liver, irritation, causes blindness when ingested	high
ethanol	1000		skin, brain, irritation	high
n-propyl alcohol	200		skin, brain, irritation	high
isopropyl alcohol	400		skin, brain, irritation	high
isobutyl alcohol	100	50	skin, brain, irritation	high
isoamyl alcohol	100		skin, brain, irritation	moderate
<b>ALIPHATIC HYDROCARBONS</b>				
pentane(s)	1000	600	skin, brain	extreme
hexane(s)	500	100	skin, brain, peripheral nervous system	high
heptane(s)	500	400	skin, brain	high
petroleum naphtha	500		skin, brain, this mixture of aliphatic hydrocarbons may contain benzene.	high
Stoddard solvent	500	100	skin, brain, this mixture of aliphatic hydrocarbons may contain benzene.	high
gasoline			skin, brain, this mixture may contain benzene, lead, and ethylene dibromide, a carcinogen. Since mixtures vary, no TLV is set. Heart attack.	high
kerosene			skin, brain	high
jet fuel			skin, brain, peripheral nervous system	high
<b>AROMATIC HYDROCARBONS</b>				
benzene	10*	1	skin, brain, liver, kidneys, blood, causes cancer. May cause genetic damage	high
toluene	200*	100 a	skin, brain, irritation, heart attack	high
xylene	100		skin, brain, blood, irritation, causes menstrual problems, may increase the risk of heart attack.	high
coal tar naphtha	100		skin, brain, liver, kidneys, blood, this mixture of aromatic hydrocarbons usually contains benzene.	moderate
nitrobenzene	1 s		skin, brain, liver, kidneys, blood	moderate
<b>CHLORINATED HYDROCARBONS</b>				
carbon tetrachloride	10*		skin, brain, liver, kidneys, causes cancer	none**
chloroform	50*	10	skin, brain, liver, kidneys, causes cancer	none**
methylene chloride	500*	200	skin, brain, blood, irritation, lungs	none**
tetrachloroethane	5 s	1	skin, brain, liver, kidneys, blood	none**
methyl chloroform (1, 1, 1 trichloroethane)	350		skin, brain, liver, heart attack	none**
ethylene dichloride	50*		skin, brain, liver, kidneys, irritation	high**
trichloroethylene	100		skin, brain, peripheral nervous system, liver, kidneys, causes cancer, heart attack	low**
perchloroethylene	100*		skin, brain, liver, kidneys, causes cancer	none**
<b>KETONES</b>				
acetone	1000		skin, brain, irritation	high
methyl ethyl ketone	200		skin, brain, irritation	high
methyl butyl ketone	100	25	skin, brain, peripheral nervous system, irritation	high
methyl isobutyl ketone	100		skin, brain, irritation	high
<b>ETHERS</b>				
ethyl ether	400		skin, brain, kidneys, irritation	extreme
isopropyl ether	500	250	skin, brain, irritation	extreme
<b>ESTERS</b>				
ethyl formate	100		skin, brain, irritation	high
methyl acetate	200		skin, brain, irritation	high
ethyl acetate	400		skin, brain, irritation	high
isopropyl acetate	250	150	skin, brain, irritation	high
amyl acetate	100		skin, brain, liver, blood	high
<b>GLYCOLS</b>				
ethylene glycol			skin, brain, kidneys, blood, irritation	low
cellulosolve	200 s	100 s	skin, brain, kidneys, blood, irritation, lungs	moderate
methyl cellosolve	25 s		skin, brain, liver, kidneys, blood, irritation, lungs	moderate
<b>OTHER</b>				
turpentine	100		skin, brain, kidneys, irritation	high
carbon disulfide	20*		skin, brain, peripheral nervous system causes insanity and suicide, increases the risk of heart attack.	extreme
pyridine	5		skin, brain, liver, kidneys, blood, irritation	high
tetrahydrofuran	200		skin, brain, liver, kidneys	high
dioxane	100 s	1	skin, brain, liver, kidneys, irritation, lungs, causes cancer	high
nitromethane	100		skin, brain, irritation	high

† Proposals for new TLV's have been made by OSHA, NIOSH, or the ACGIH NOTE: Italics indicate that the effect is weak, or only suspected

\* OSHA has additional regulations for these chemicals. See "air contaminants" in the General Industry standards

s Known to be easily absorbed through the skin

\*\*Decomposes into phosgene by heat or ultraviolet light.

# SHOCK HAZARDS

Most electrical sources have a set of terminals (usually two) which are connected to a load. The source may be a battery, a power supply, or a generator which supplies electrical energy to the load. The load converts the electrical energy to some other form of energy. A light bulb converts electrical energy to light energy, a motor converts it to mechanical energy, and a soldering iron to heat energy.

There is a balance between the energy supplied by the source and that used or dissipated by the load. But this balance can be upset if the source terminals make direct contact with each other. In this way the terminals are short circuited, and the source tries to deliver unlimited amounts of energy. This energy appears as intense heat at the point of contact, also along the connecting wires.

Figure 1 shows an example of a simple short circuit in which the wires have touched each other. With a battery as a source, the hazard of a short is not great. But a short across electric power company lines can be extremely dangerous, and can cause intense heat, sparks, and possibly a fire.

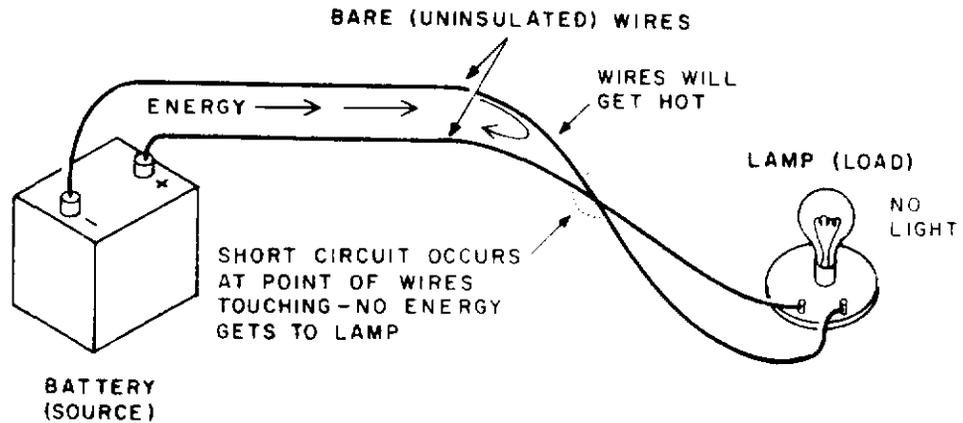


Figure 1, Example of a Simple Short Circuit

The human body is a good conductor of electricity. When a person touches an electrically "live" point, electricity tries to "flow" from his or her fingers to the ground. When this happens, the person experiences an "electric shock." Figure 2 illustrates this.

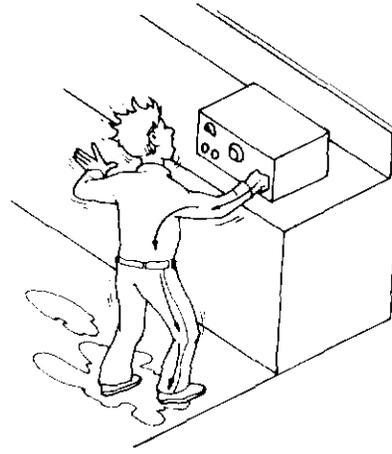


Figure 2, The Uninsulated Human Body is a Good Conductor of Electricity

The possibilities of shock are reduced considerably if the person stands on a material that prevents the flow of current through it. Such materials are called insulators. Wood and rubber are good insulators.

Exposed metal or wet surfaces are good conductors, so it is good practice to avoid work surfaces combining water or metal and electricity. Figure 3 illustrates a safe laboratory arrangement. The insulated floor mat prevents current from flowing through the person's body to ground. The insulated mat on top of the bench also reduces the shock hazard, especially if the bench is made of metal. Rubber-soled shoes provide some protection against shock.

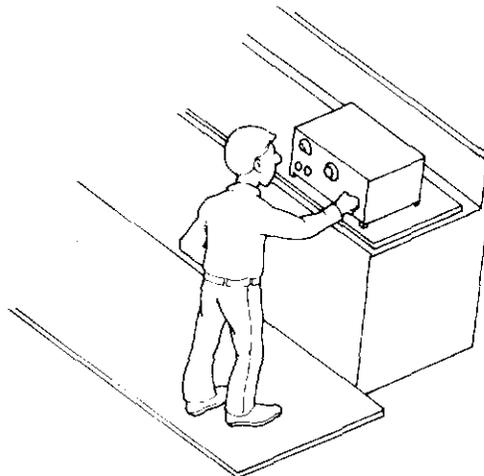


Figure 3, An Insulated Human Body is Not a Good Conductor of Electricity

A cluttered work bench is also a shock hazard. Spilled liquids, extra test equipment, loose electrical components, and test leads are potential hazards. So are bare wires, worn or wet insulation, and metal terminals.

Improper grounding can make equipment unsafe. Use only equipment that has an adequate earth-ground connection. This means that a three-wire line is used, and one of the wires connects the metal cabinet or chassis of the equipment to the earth ground. This connection provides an electrical path for current should the "live" connections within the unit touch the metal cabinet or chassis. If there were no ground connection, the metal surface would be "live" and would be a shock hazard.

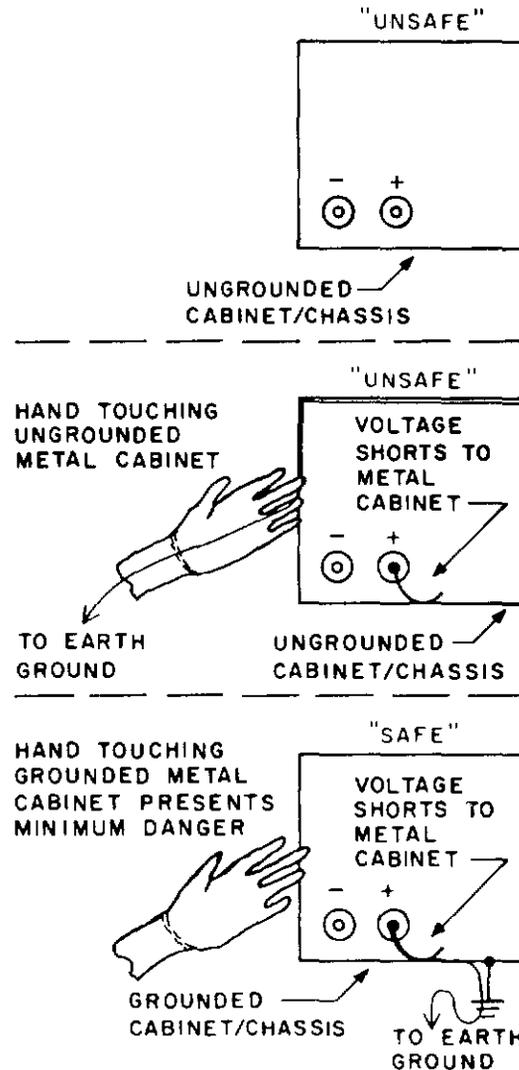


Figure 4, Grounded and Ungrounded Metal Cabinets

Figure 4 shows the advantages of a grounded cabinet or chassis compared to an ungrounded one. A grounded metal case presents a better path for current than a person's body.

Further protection from shock and other hazards includes turning on the equipment only after the circuits have been connected, and turning it off if circuit changes are to be made. Also, follow the instructions given in this manual, and those given by your instructor.

## **FACETS OF A SAFETY PROGRAM**

A written, comprehensive, and organized safety program is a must for all industrial arts classes. Here's a synopsis of the facets of this program that have been discussed so far.

In a safe, well-run industrial arts laboratory:

1. Safety instruction is an integral part of all learning experiences.
2. Written and performance tests are administered and the results filed.
3. Accidents and unsafe conditions are reported in writing.
4. Laboratories, equipment, and tools meet state laws and regulations.
5. Compliance regarding safe practices is insisted upon.

## QUALIFYING ON MACHINES

Safety, of course, begins at home. Informed parents can make a vocational instructor's job easier by instilling a safety consciousness in their children. Vocational instructors should stress home safety in any guest lectures or recruiting activities.

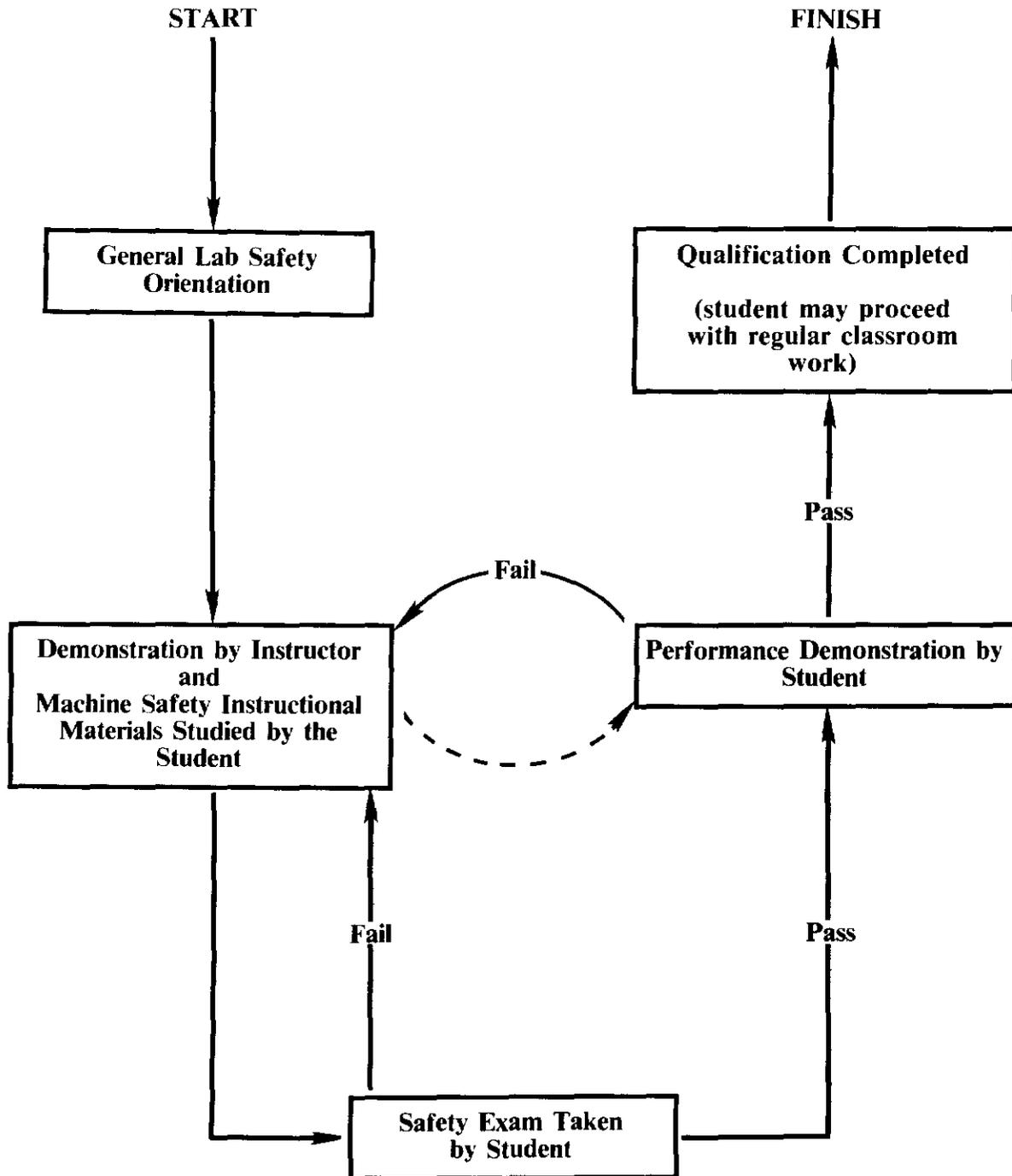
An instructor's responsibility, however, begins in the shop, and a basic premise that all instructors must work from is that no student will be allowed to use the machines until s(he) demonstrates that s(he) can do so safely.

Safety instruction begins the first day of class. At that time, all students should be told that safety will be part of the curriculum, given a short explanation of the color coding, and shown various protective devices such as face shields, gloves, and guard rails. The instructor should then begin demonstrating the safe use of machines and tools. Students should be given handouts illustrating safe operations and procedures. After the instructor's demonstration, students should be allowed to ask questions about any part of the demonstration that they are unsure of.

The next step toward qualifying on the machines is a safety exam. Students should take a written test and an oral test, and should demonstrate that they know how to use each machine safely. This demonstration should consist of hands-on activity by the student—first with the power off (changing blades or bits, emergency stop procedures, movements of machine guards, etc.), then with the power on (making basic cuts and other procedures). The instructor should monitor each student's demonstration on an individual basis.

If a student fails any part of this exam, s(he) must go through the instructor's demonstration step again. If the student passes, s(he) will be allowed to proceed with regular classroom work.

## CYCLE FOR QUALIFYING ON MACHINES



# DAILY SAFETY OPERATIONS CHECKLIST FOR STUDENTS

## Preparation

1. Always obtain permission from the teacher.
2. Clear the area for work.
3. Wear proper clothing, remove jewelry, and secure long hair.
4. Inspect the machine (wiring, switches, guards, etc.).
5. Use proper protective clothing and equipment.

## Operation

1. Disconnect the power.
2. Make checks and adjustments.
3. Remove adjusting wrenches or keys.
4. Place guards in proper position.
5. Secure work and maintain proper footing.
6. Turn power on (use caution).
7. Do not rush or force the machine.
8. Observe all safety zone lines.

## Shutdown

1. Turn the power off.
2. Wait until all parts of the machine have stopped.
3. Remove your material from the machine.
4. Clean up (make sure that the power is disconnected when you are cleaning hazardous parts of the machine).

## SAFETY ZONE LINES

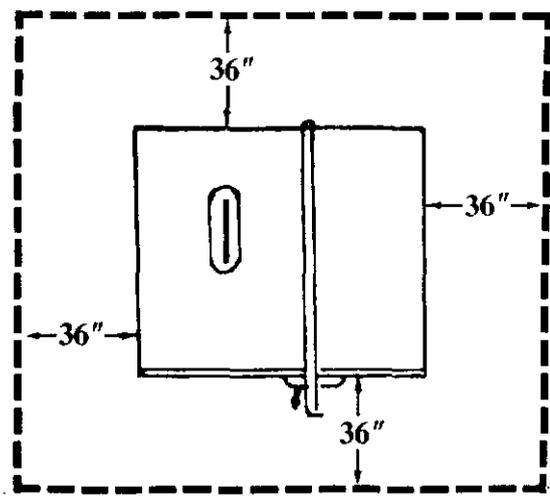
Students should keep a safe distance away from any machine in operation. The creation of safety zones around each machine helps to ensure the safety of onlookers. Lines demarking these zones *must* be painted on the floor surrounding each piece of equipment. Color options for these lines are:

- yellow
- yellow and black striped
- yellow and black checkered

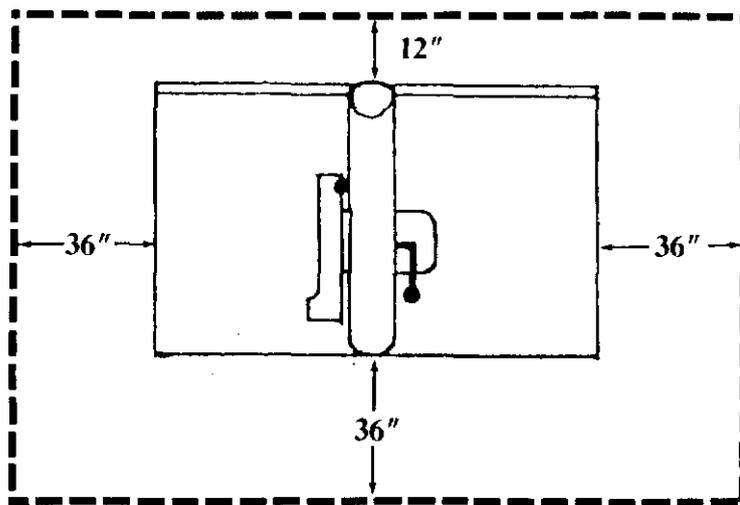
Only the machine operator should be within the safety zone lines.

Each line should be two inches wide. As a general rule of thumb, lines should be painted 36 inches from the machine on the operator's side and 24 inches on the other three sides. Allowances may be made when machines are located back-to-back, along a wall, or in other special positions.

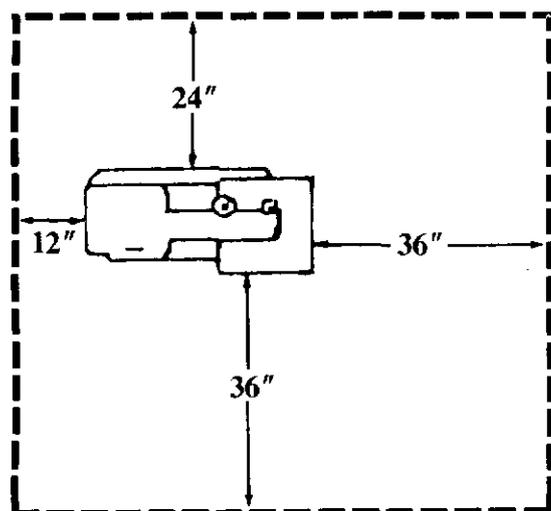
The next 7 pages give suggested safety zone dimensions for common machines found in industrial arts classes.



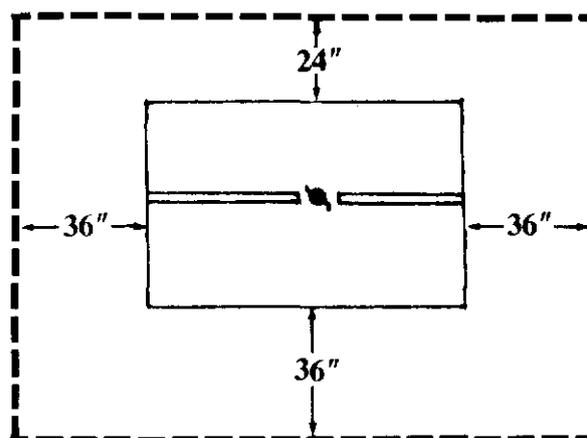
**CIRCULAR SAW**



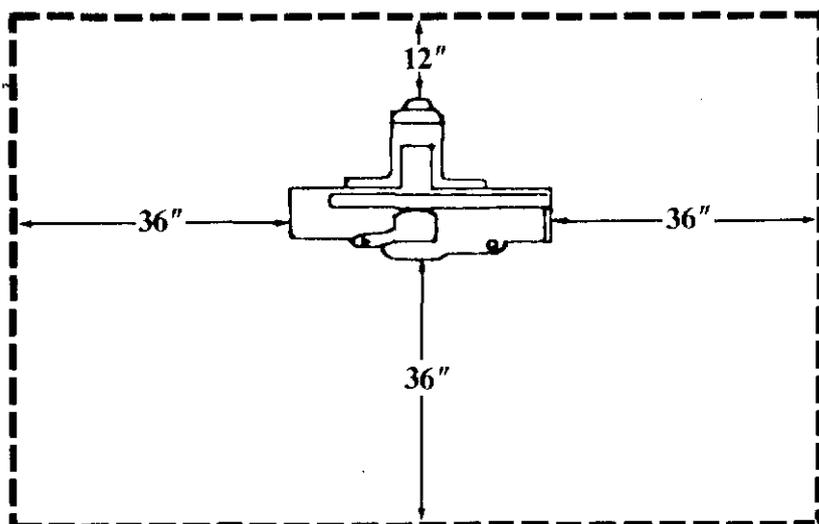
**RADIAL ARM SAW**



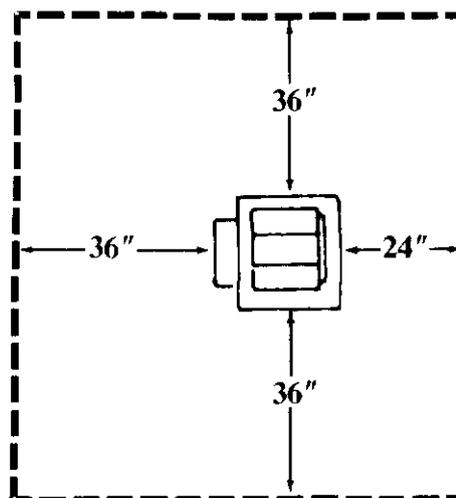
**BAND SAW**



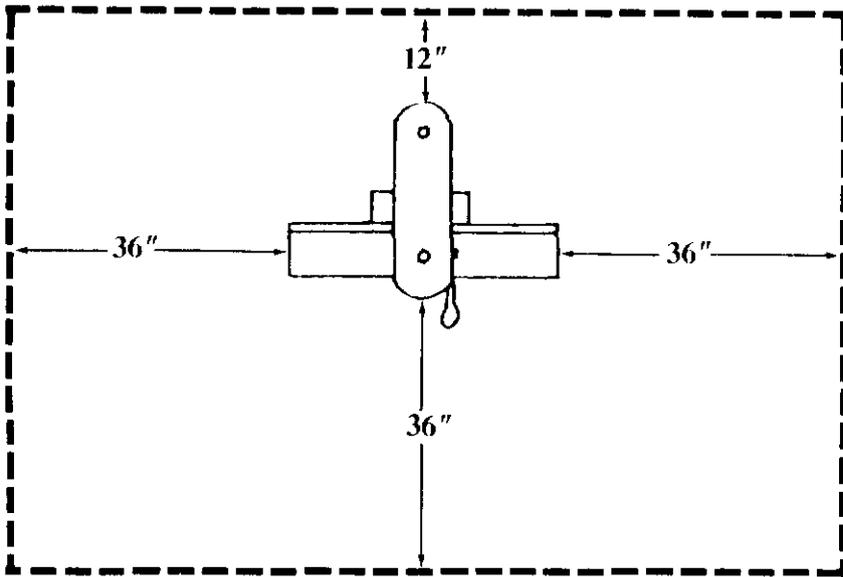
**SHAPER (WOOD)**



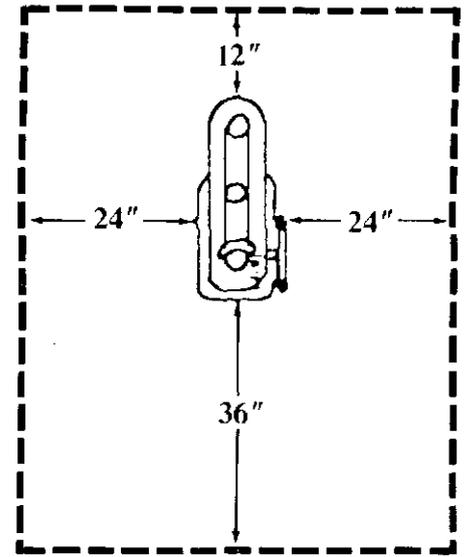
**JOINTER**



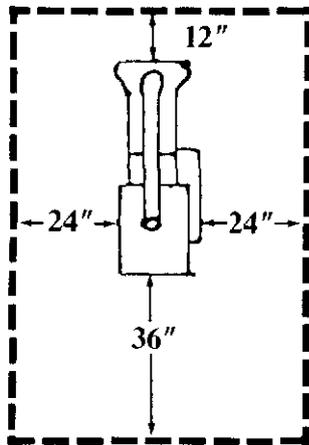
**WOOD PLANER**



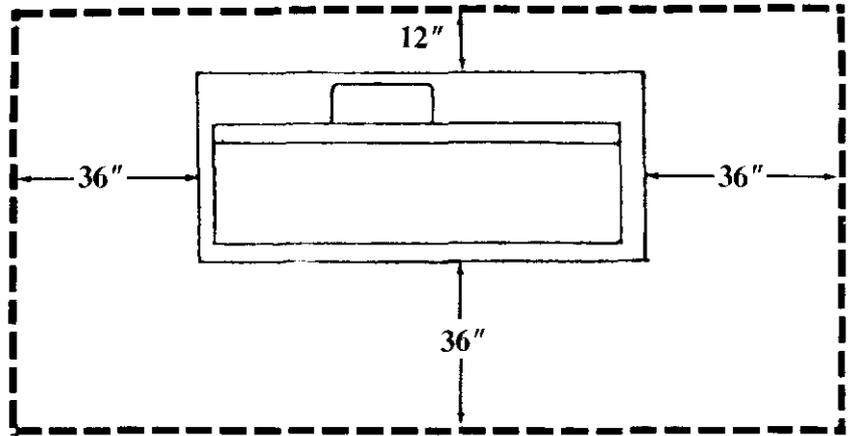
MORTISER



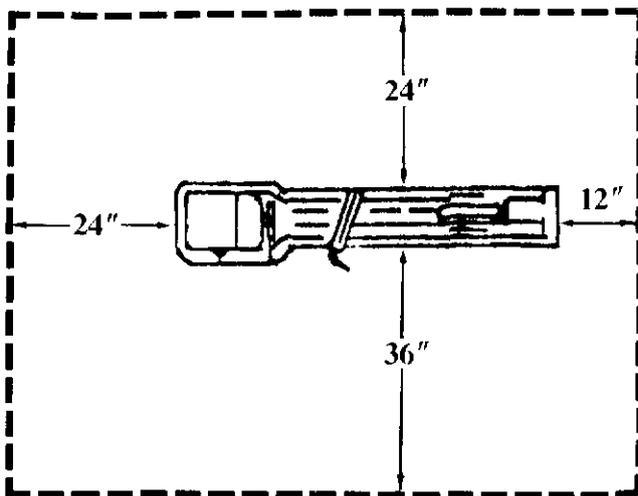
DRILL PRESS



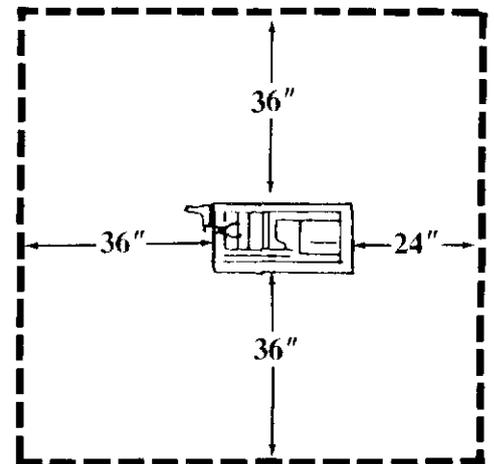
JIG SAW



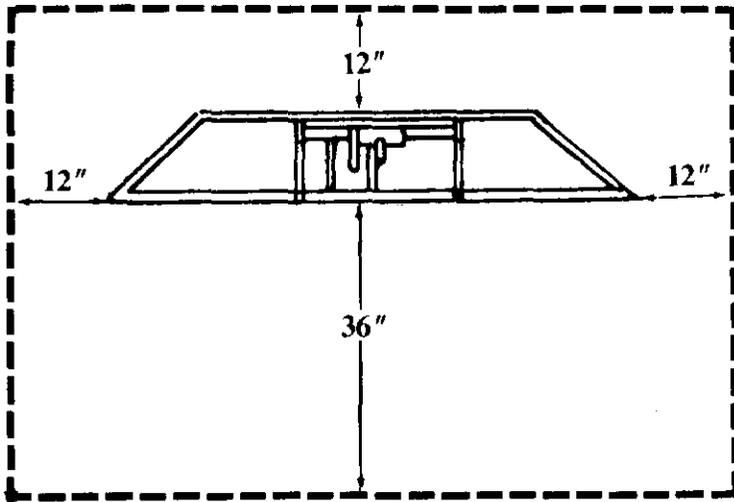
UNIPLANE



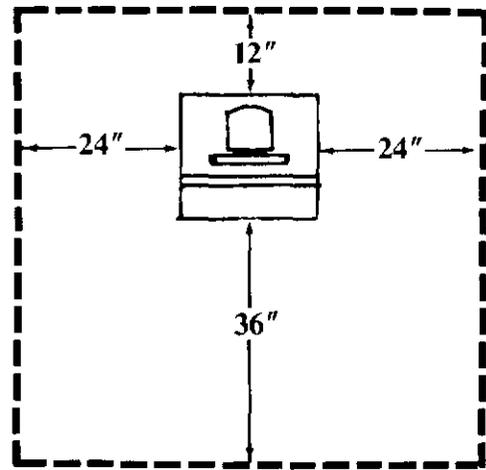
WOOD LATHE



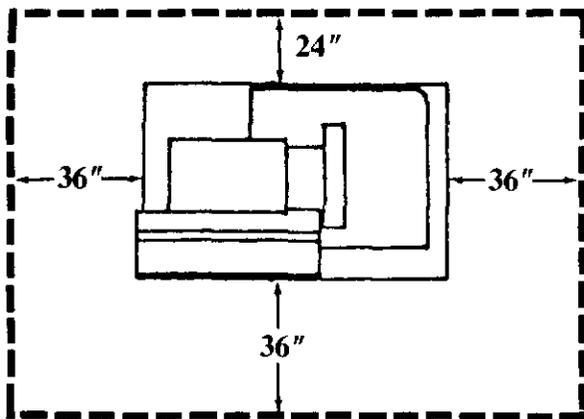
HACK SAW



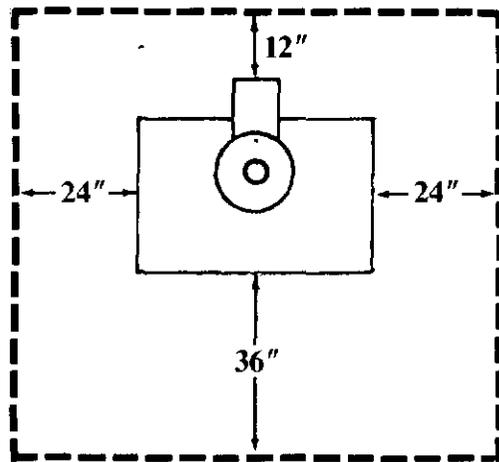
PANEL SAW



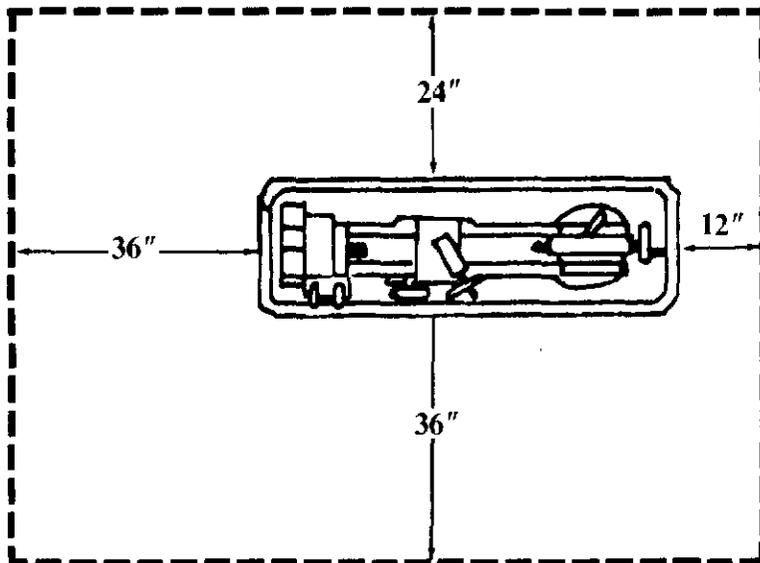
DISC SANDER



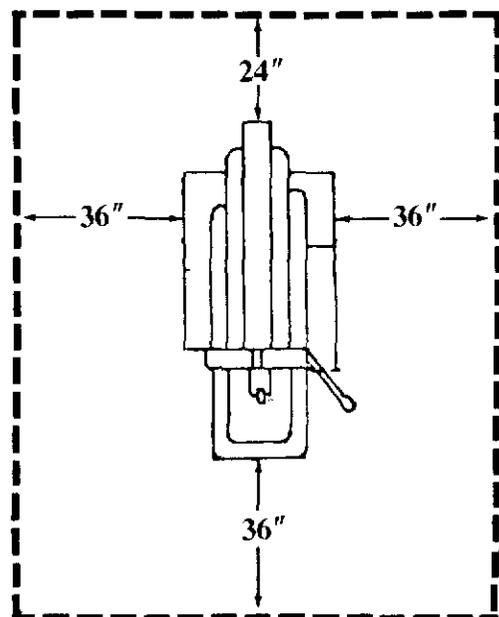
SANDER



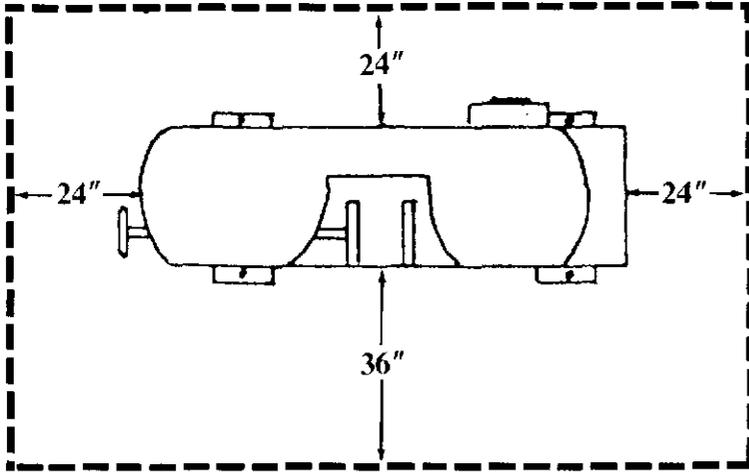
PAPER DRILL



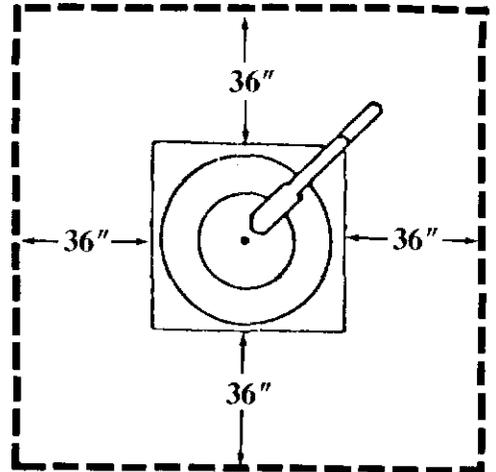
METAL LATHE



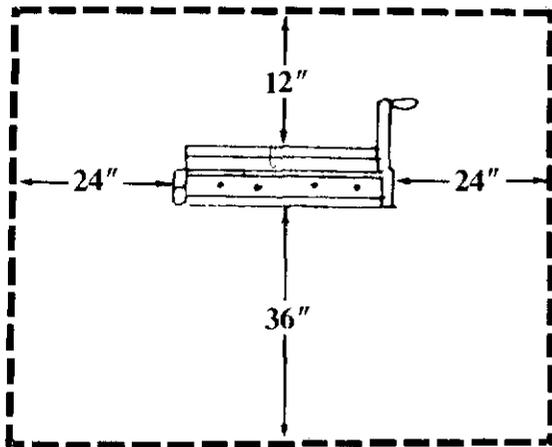
METAL SHAPER



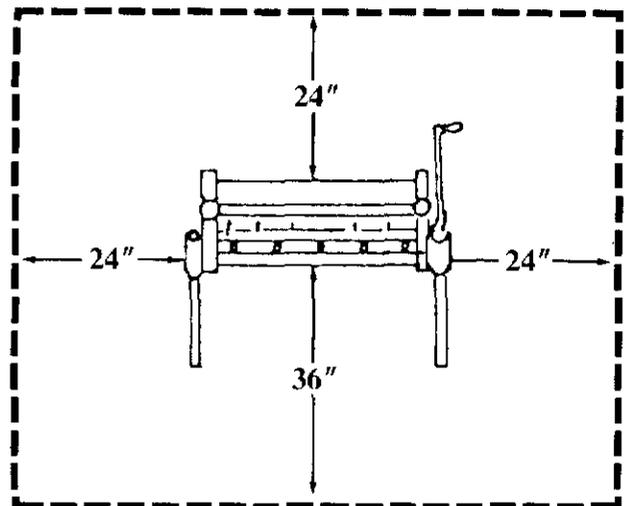
**BAND SAW (HORIZONTAL METAL)**



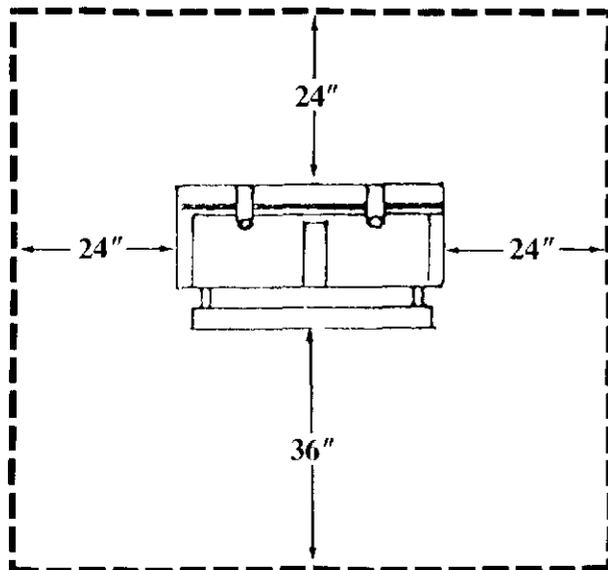
**BENDER**



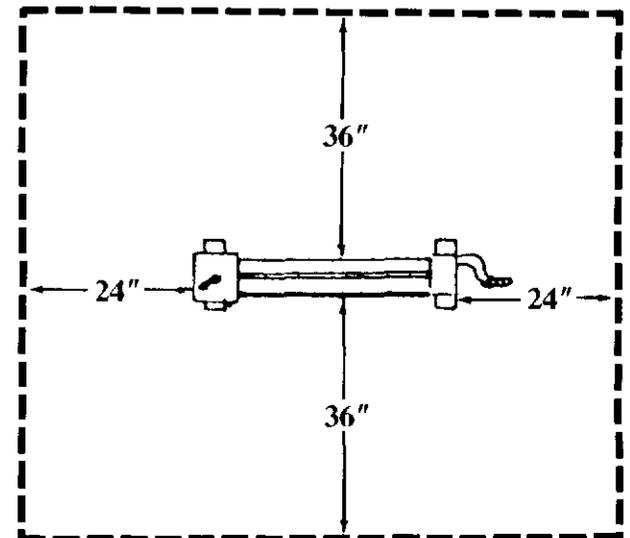
**BAR FOLDER**



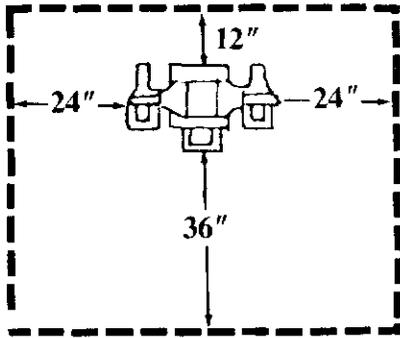
**SHEET METAL BRAKE**



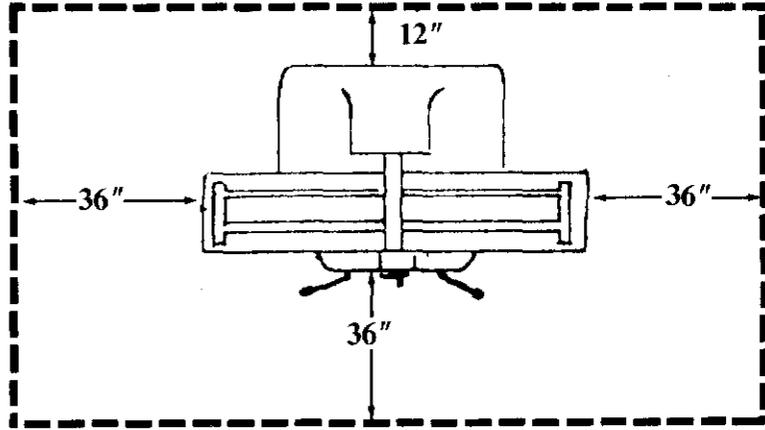
**SQUARING SHEARS**



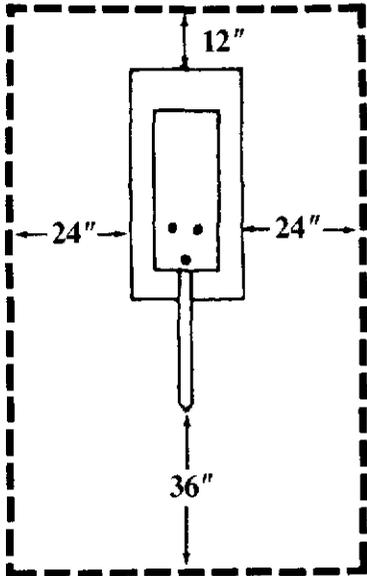
**SLIP ROLLS**



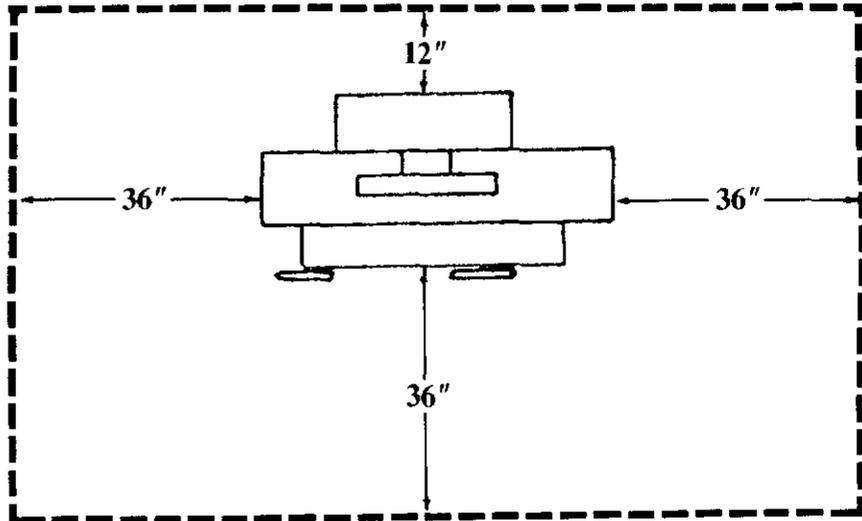
FLOOR GRINDER



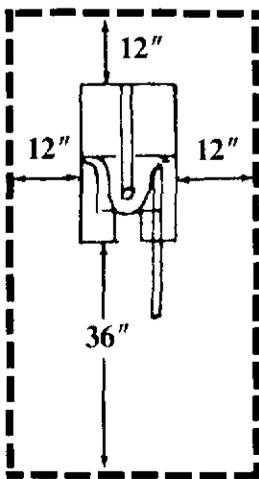
HORIZONTAL MILL



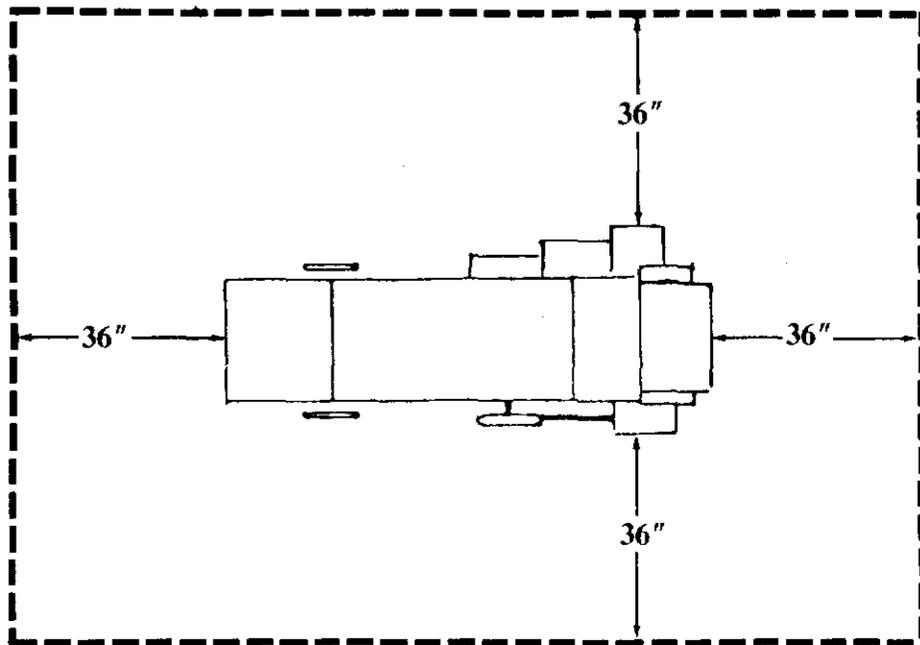
SPOT WELDER



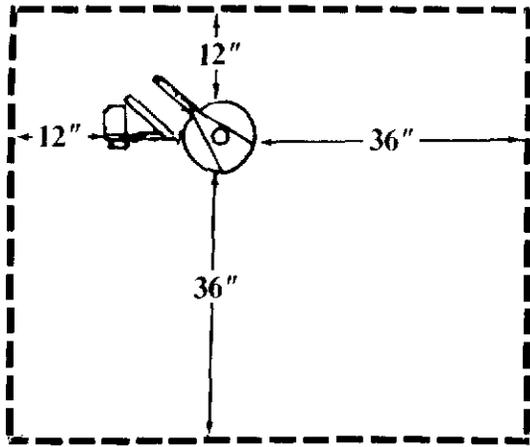
SURFACE GRINDER



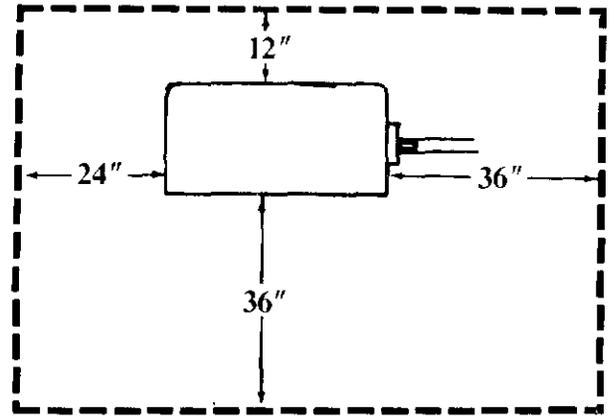
ARBOR PRESS



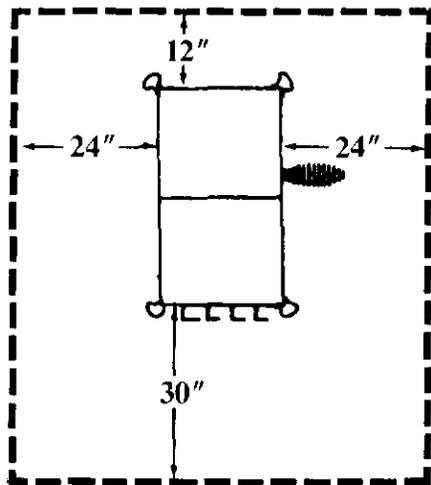
PRESS



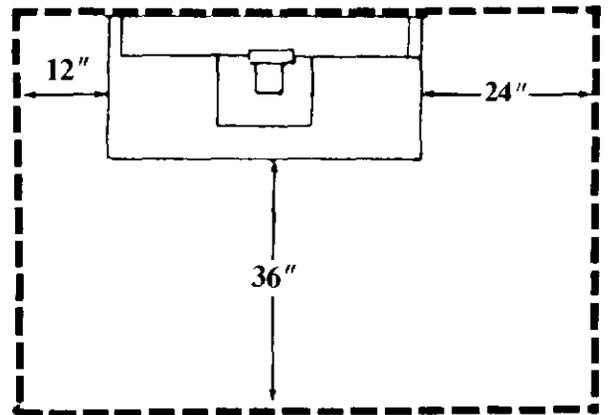
**FURNACE**



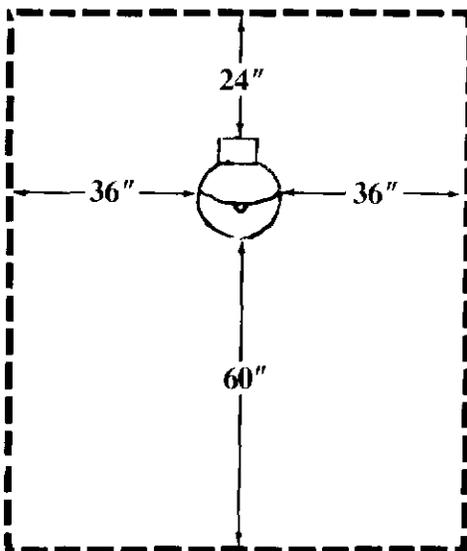
**HEAT TREATING FURNACE**



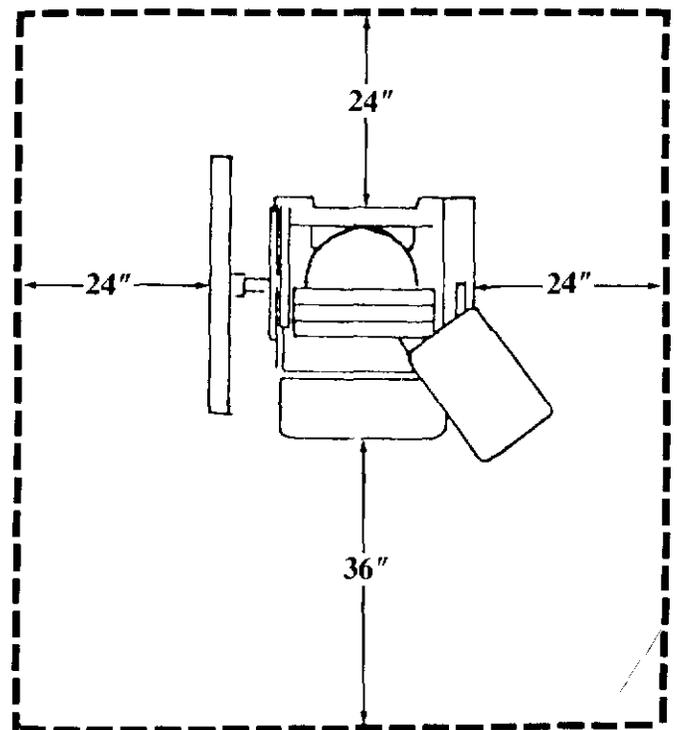
**BENCH FURNACE**



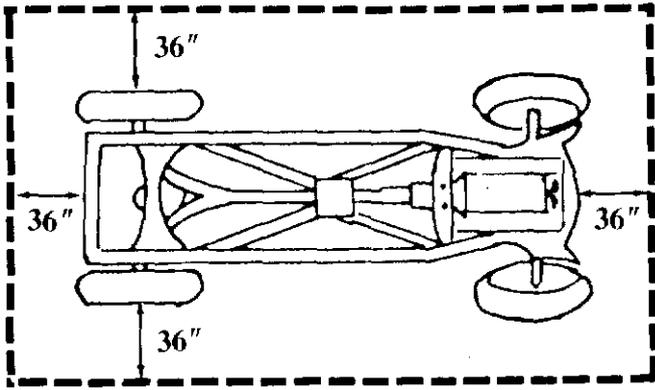
**ELECTRICAL TEST BENCH**



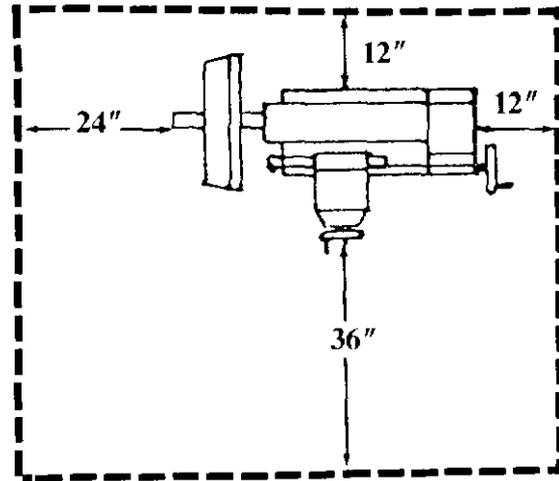
**FORGE**



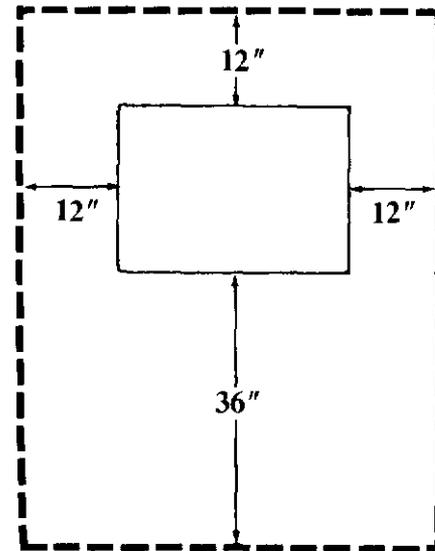
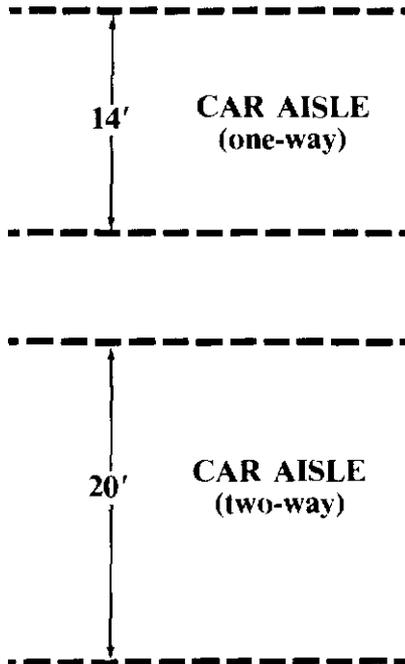
**PLATEN PRESS**



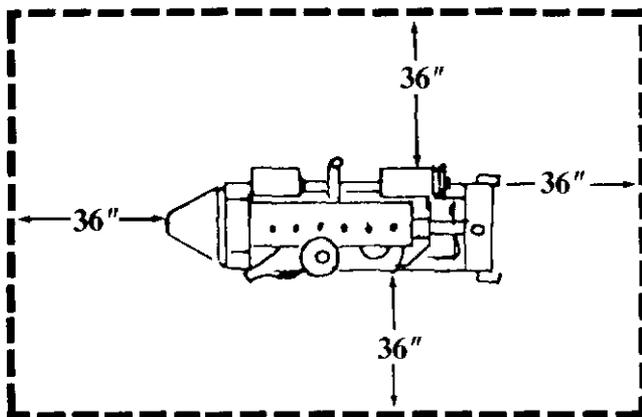
**CHASSIS STALL**



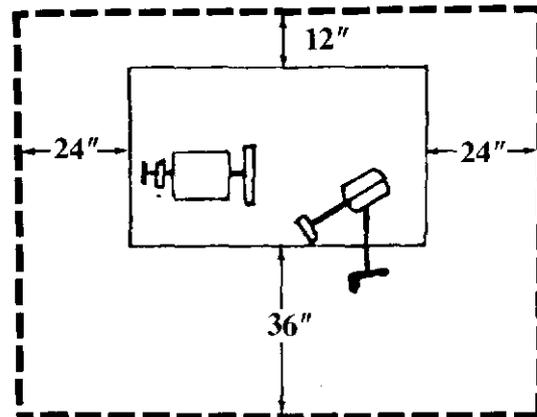
**BRAKE DRUM LATHE**



**SPARK PLUG CLEANER**



**ENGINE STAND**



**VALVE REFAKER**

**PART 1:**  
**EQUIPMENT FOR WORKING WITH METALS**

Band Saw

Crucible Furnace

Gas Forge

Soldering Furnace

Grinder

Surface Grinder

Lathe

Milling Machine

Power Hacksaw

Shaper

Squaring Shear

Bar Folder

Box and Pan Brake

Buffer

Slip Roll Forming Machine

Combination Rotary Machine

Pages 37-38 and 131-142 were adapted from Pennsylvania Industrial Arts Safety Guide, produced by Pennsylvania Department of Education and Industrial Arts Association of Pennsylvania, Harrisburg, Pennsylvania, 1981.

Pages 39-130 and 148 were adapted from Safety Education Handbook, produced by Kansas State Department of Education, Wichita, Kansas, 1981.

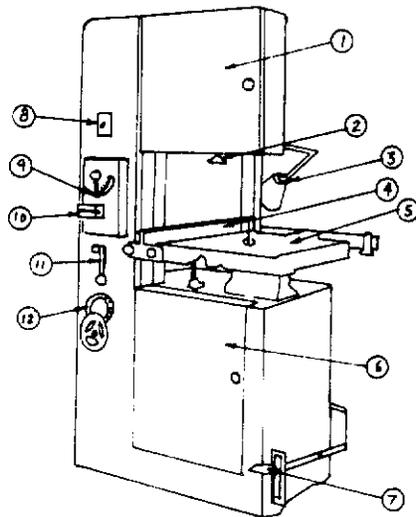
Pages 143-147 were adapted from Health and Safety Hazard Identification Program, produced by Industrial Department, United Brotherhood of Carpenters and Joiners of America, Washington, D. C., n.d.

## SAFETY RULES FOR WORKING WITH METALS

1. Keep your work area free from scraps of metal stock.
2. Keep metal-cutting tools sharp.
3. Make sure that hammer heads and screwdriver blades are fastened tightly to their handles.
4. Always put a handle on a file before you use it.
5. Grind mushroom heads and all burrs off cold chisels, center punches, and other small hand tools.
6. Never carry tools in your pockets.
7. Never try to hold a piece of metal in your hand while it is being machined. Use a fixture or a clamp to hold the work-piece.
8. Keep tools and machines clean and in good working order during use and after use.
9. Sheetmetal is sharp. If you are scratched or cut, get first aid immediately. Don't laugh off a small injury. Infection may start many days after you scratch your hand.
10. A clean shop is a safe shop. Don't "wait for George to do it."
11. Wear appropriate gloves when handling hot metals.
12. Always wear eye protection. A sliver of metal in the eye can cause blindness. Don't think that it can't happen to you. Each year, there are over 64,000 eye injuries in school and industrial shops. Don't add to this number.
13. Get rid of waste materials properly.
14. Put away tools and accessories. Clutter causes accidents.
15. Exercise caution when using portable hand tools, spot welders, electric shears, and the like. These tools operate on at least 110 volts of electricity. This charge can kill or cause a serious shock or burns under certain conditions. Make sure that the power cords are in good working condition and that plugs are not broken. Keep cords away from oil and hot surfaces.
16. Never use electrical tools around flammable vapors or gases. This could cause an explosion.

17. Be sure that your hands are dry before using an electrical power tool.
18. Never use measuring tools on metal while it is being machined.
19. Always keep machine guards in place. They were put there for your protection.
20. Operate a machine only after you have had instruction on it. Remember that you must know what you are doing before you start a machine.
21. Stop a machine before oiling it.
22. Never "feel" the surface of a metal while it is being machined.
23. Clean chips off with a brush--never with a rag or your hand.
24. Never allow anyone to stand near a machine that you are operating.
25. You can pinch your fingers with pliers or snips. Be careful when using these tools.
26. Files are brittle. Handle them carefully. They can shatter in your hands. Always use a file with a handle.
27. Choose the right tool for the job.
28. Wear protective clothing when working with hot metals.
29. Wear a face mask when there is danger of flying chips.
30. Wear goggles when grinding metals.

## BAND SAW

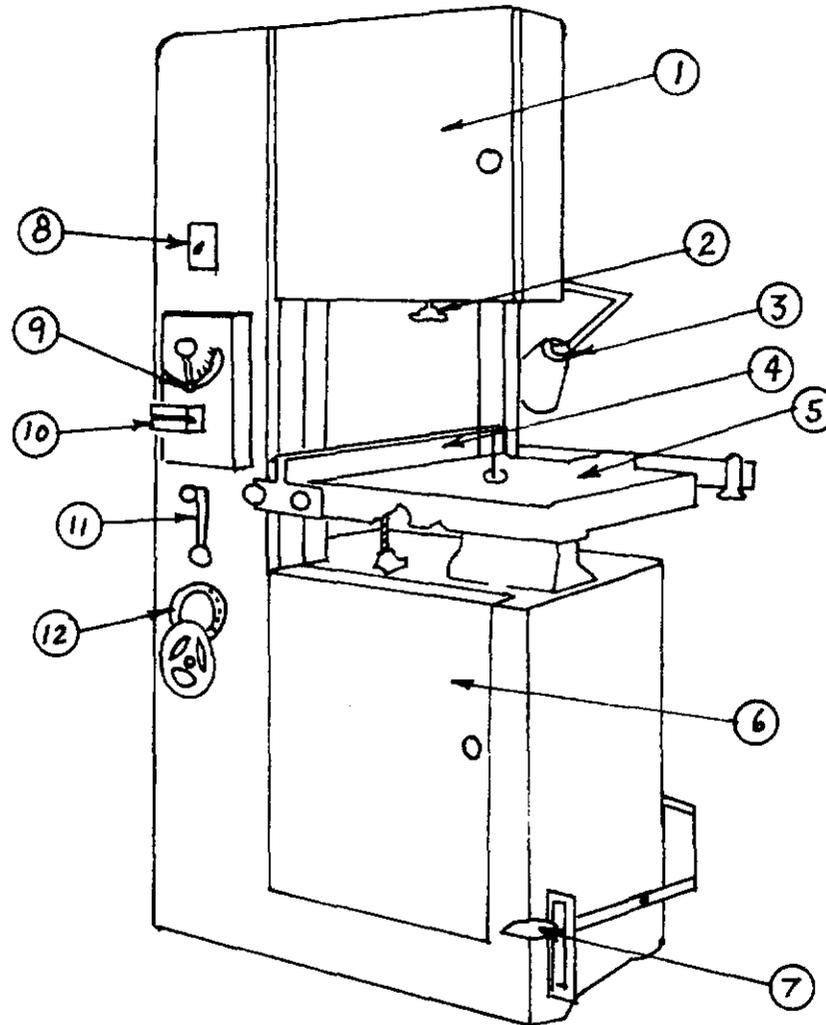


1. UPPER WHEEL COVER
2. TENSION KNOB
3. LAMP
4. FENCE
5. TABLE
6. LOWER WHEEL COVER
7. FOOT BRAKE
8. WELDER SWITCH
9. WELDER SELECTOR
10. WELDING VISE
11. SWITCH
12. SPEED CONTROL

1. A band saw shall be so guarded that the saw blade shall be enclosed (except for the working portion of the blade which is between the bottom of the guide rolls and the table). (OSHA)
2. A guard for the blade on the band saw shall protect the saw blade at the front and outer sides, and this portion of the guard shall be self-adjusting to raise and lower with the guide. (OSHA)
3. All band saws shall be provided with a tension control device to indicate proper tension. (OSHA)
4. Appropriate eye protection shall be worn.
5. A pupil should secure permission from the teacher before cutting large or irregular shaped pieces.
6. Hands and fingers should be kept in such a position that there is no danger of them slipping into the blade. Hold the work piece on either side of the kerf line. Use a push stick where necessary.
7. The machine must not be left until it has completely stopped.
8. Scrap should be removed only when the machine is stopped.

9. The guide and guard should be adjusted to within 1/4 inch of the work.
10. Properly secured and adjusted guards should be used at all times.
11. Jewelry should be removed, loose clothing eliminated, and long hair confined.
12. The work should be guided slowly, letting the machine do the work. Do not force the work into the blade.
13. Avoid backing out of a cut (kerf).
14. Cut only stock which has a flat surface to bear against the table.
15. The material should be held firmly.
16. Waste must not accumulate on the saw table.
17. If the blade breaks or comes off, step away immediately. Shut off the power, if possible. Notify the teacher.
18. The floor should always be kept clean of cuttings, oil, and scrap.
19. Sawed material must be handled with care until all burrs are removed.
20. Chips should be cleaned off the machine with a brush, not with hands or a rag.
21. Adjustments must never be made until the machine is stopped.
22. The saw must always be operated at speeds in accordance with the type and thickness of the metal being cut.
23. Give undivided attention to the job. The operator should be the only one inside the safety zone area.

# BAND SAW



- |                     |                     |                   |
|---------------------|---------------------|-------------------|
| 1 UPPER WHEEL COVER | 5 TABLE             | 9 WELDER SELECTOR |
| 2 TENSION KNOB      | 6 LOWER WHEEL COVER | 10 WELDING VISE   |
| 3 LAMP              | 7 FOOT BRAKE        | 11 SWITCH         |
| 4 FENCE             | 8 WELDER SWITCH     | 12 SPEED CONTROL  |



## BAND SAW SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

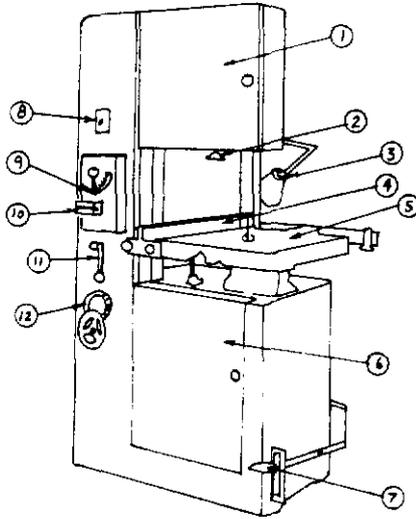
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

(Circle true or false)

- |  |   |   |
|--|---|---|
| 1. The blade guard should be adjusted to about 1/4 inch from the work.   | T | F |
| 2. The blade guides should be tightly adjusted against the blade.  | T | F |
| 3. The teacher's permission is required before one can operate a band saw.   | T | F |
| 4. Adjustments should be made with the power off.  | T | F |
| 5. Eye protection is not required when operating a band saw.   | T | F |
| 6. One should use a brush to remove chips from the table.  | T | F |
| 7. A person should not try to increase the speed of cutting by applying pressure with the hands.   | T | F |
| 8. It is all right to leave the machine as soon as the cut has been finished.  | T | F |
| 9. Scrap should be removed only after the blade has stopped.   | T | F |
| 10. Material should always be held firmly.   | T | F |
| 11. A band saw should be so guarded that the saw blade is enclosed (except for the working portion of the blade which is between the bottom of the guide rolls and the table). | T | F |
| 12. All band saws will have a tension control device to indicate the proper tension.   | T | F |
| 13. A push stick should never be used on a metal band saw.   | T | F |

(Circle true or false)

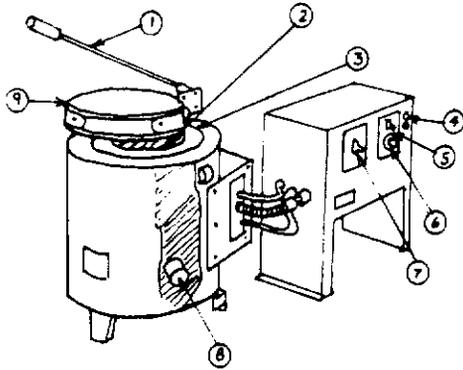
- 14. The operator should be the only person inside the safety zone area.     T     F
- 15. A rag can be used to clean the table of scraps.     T     F
- 16. In the spaces provided, identify the parts of the band saw illustrated below:



- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_
- 4 \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7 \_\_\_\_\_
- 8 \_\_\_\_\_

- 9 \_\_\_\_\_
- 10 \_\_\_\_\_
- 11 \_\_\_\_\_

## CRUCIBLE FURNACE

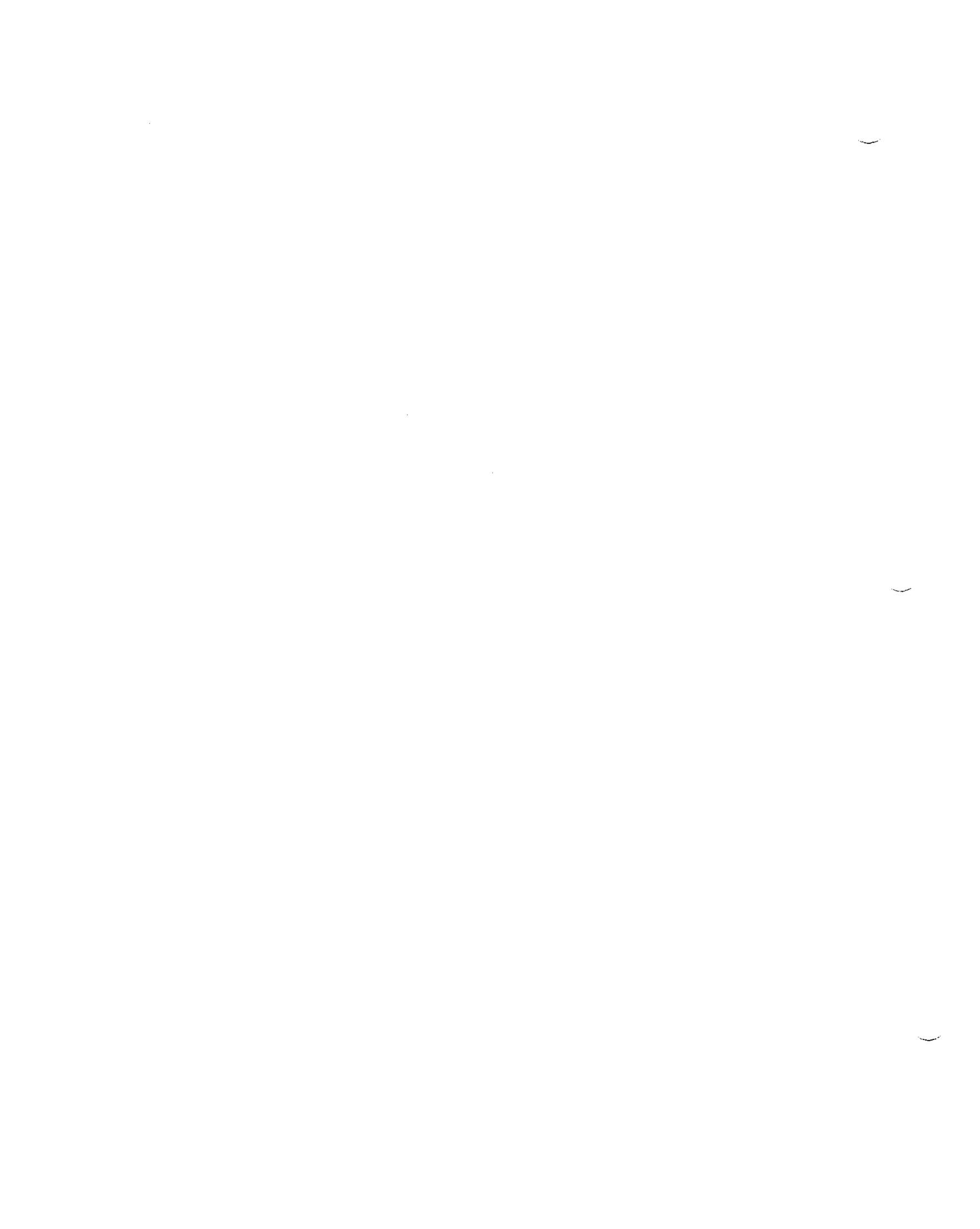


1. LID HANDLE
2. FIRE BOX WITH CRUCIBLE
3. FIRE BRICK
4. SWITCH
5. IGNITER SWITCH
6. AIR CONTROL
7. GAS CONTROL
8. CLAY DRAIN PLUG
9. LID

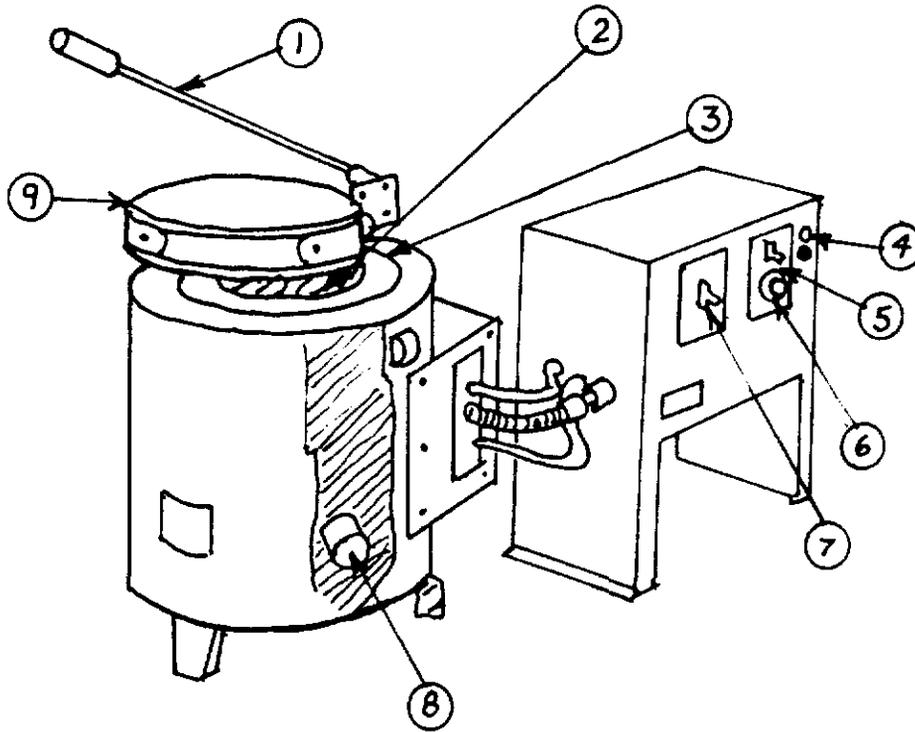
1. Whenever protective equipment is provided, it shall be the duty of each pupil to use this equipment. (OSHA)
2. Inhaling fumes from brass, zinc, galvanized iron, or lead paint must be avoided.
3. The furnace shall be operated only with the teacher's permission and after instruction has been received.
4. Jewelry should be removed, loose clothing eliminated, and long hair confined.
5. All guards must be in place and operating correctly.
6. Proper eye protection is required.
7. Protective clothing must be worn (coat, gloves, face shield, shoes, and leg protectors).
8. Metal must not be thrown or dropped into the crucible. Tongs should be used.
9. Metal shall never be melted or poured in an unventilated place. The fumes may be injurious.
10. Moisture must be kept out of the furnace and metal when one is working with hot metals.
11. Caution should be exercised in the foundry area. Crucibles, equipment, flasks, and castings may be hot.

12. Flammable materials (paints, solvents, etc.) must be kept away from the foundry area.
13. The mold is to be checked by the teacher before it is closed to make sure that it is not too damp or too dry.
14. Molds must remain covered until they are ready for pouring.
15. The pupil should practice lifting and pouring with a cold, empty crucible. He/she should run through the entire procedure several times.
16. The furnace should be lighted only when directed by the teacher. Instructions should be carefully followed.
17. Before any molding sand that has been tempered is used for making a mold, the teacher should be asked to check the moisture content.
18. One should never pour a mold unless one is sure that the moisture content of the sand is correct. Too much moisture in the sand will cause an explosion.
19. Weights should be put on a flask before hot metal is poured to prevent the metal from running out on the floor.
20. A crucible of melted metal is never to be lifted or handled unless the tongs that are used will grip it firmly and evenly.
21. Metal should be poured slowly and kept close to the floor.
22. If the floor is concrete, someone should be standing by to shovel foundry sand on all spills. Concrete explodes violently when heated.
23. It is important to remember that prior to removing the crucible the worker should shut off the gas first, then the air. A crucible lifter should be used to remove the crucible from the furnace.
24. Water and wet items must be kept away from the foundry area, except for tempering the sand.
25. In consumable pattern casting (styrofoam), the sprue basin should be kept filled to prevent firing. The foundry room area vent fan should be turned on. It is also important that persons working in the area not breathe the fumes.

26. Castings should be allowed to cool before breaking them out of the molds.
27. The crucible should be completely emptied. Solidified metal will crack the crucible when it is reheated.
28. Each worker should know where the fire extinguisher is located before attempting to pour hot metals.
29. No crucible furnace shall be operated unless approved safety devices (i.e., ultraviolet or thermo controls) are attached to control the flow of gas.
30. The furnace must be equipped with spark lighters--do not light by throwing in lighted papers.



# CRUCIBLE FURNACE



- |                          |                   |
|--------------------------|-------------------|
| 1 LID HANDLE             | 6 AIR CONTROL     |
| 2 FIRE BOX WITH CRUCIBLE | 7 GAS CONTROL     |
| 3 FIRE BRICK             | 8 CLAY DRAIN PLUG |
| 4 SWITCH                 | 9 LID             |
| 5 IGNITER SWITCH         |                   |

( )

( )

( )

## CRUCIBLE FURNACE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

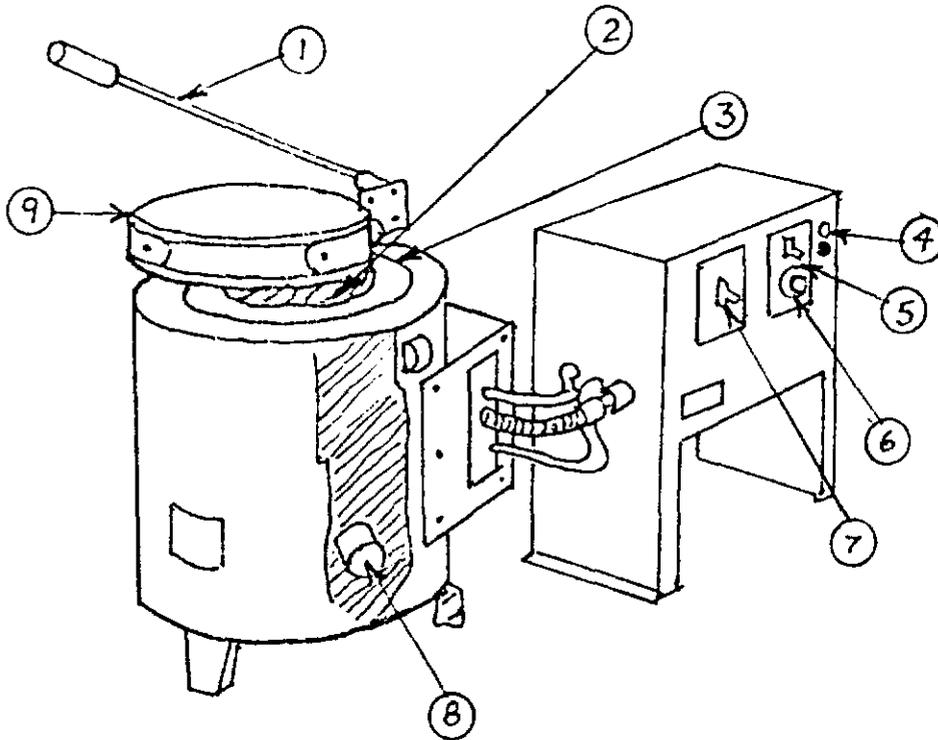
(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. Metal accidentally spilled on the floor should be kicked aside.                        | T | F |
| 2. Hot metal should be poured as quickly as possible.                                     | T | F |
| 3. Protective clothing is necessary only when charging the crucible.                      | T | F |
| 4. Metal should not be thrown or dropped into the crucible. Tongs should always be used.  | T | F |
| 5. If goggles are used, a face shield is not necessary.                                   | T | F |
| 6. If water comes in contact with the molten metal, it will cause an offensive odor.      | T | F |
| 7. The pupil must always get the teacher's permission before lighting the furnace.        | T | F |
| 8. When one has finished using the furnace, one should shut off the air first.            | T | F |
| 9. Fumes from brass are not harmful.  | T | F |
| 10. Long hair is not as dangerous in the foundry area as in other areas of the metal lab. | T | F |
| 11. Moisture may cause explosions in the foundry area.                                    | T | F |
| 12. Some molten metal should be left in the crucible after pouring.                       | T | F |
| 13. The tongs should fit loosely around the crucible.                                     | T | F |

(Circle true or false)

- |   |   |   |
|---|---|---|
| 14. One should practice lifting the cold crucible from the furnace before the actual melting is done.                 | T | F |
| 15. Leg protectors are an important safety precaution.  | T | F |
| 16. The fumes from styrofoam are not harmful.   | T | F |
| 17. Styrofoam patterns may cause flames to shoot from the sprue hole if the basin is not kept filled.                 | T | F |
| 18. Molds should be broken out of the sand immediately after pouring.   | T | F |
| 19. It is not always necessary for a teacher to check every mold before pouring.                                      | T | F |
| 20. The crucible should be held approximately 24 inches above the floor when pouring is done.                         | T | F |
| 21. Weights are placed on the mold before pouring to ensure a good seal between the flask halves.                     | T | F |
| 22. The moisture content of the sand should be checked by the teacher.  | T | F |
| 23. Water can be used for tempering sand.   | T | F |
| 24. It is the pupil's duty, as well as his/her responsibility, to wear and use all safety equipment that is provided. | T | F |
| 25. Solvent should be kept near the foundry area so it can be used to clean the floor in case of a spill.             | T | F |

26. In the space provided, identify the parts of the crucible furnace:

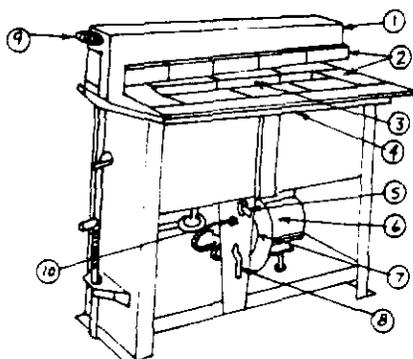


1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_  
5 \_\_\_\_\_

6 \_\_\_\_\_  
7 \_\_\_\_\_  
8 \_\_\_\_\_  
9 \_\_\_\_\_



## GAS FORGE

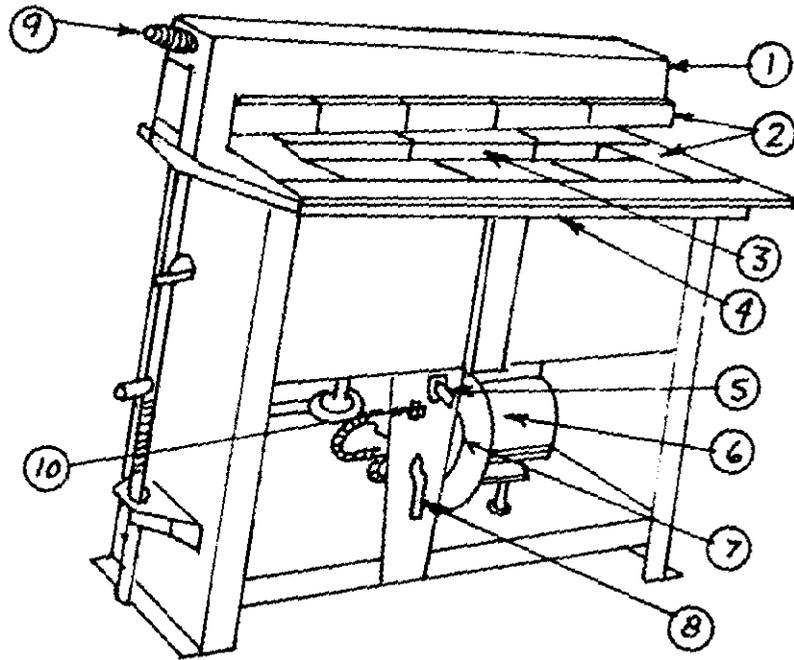


1. LID
2. FIRE BRICK
3. FIRE BOX
4. WORK RACK
5. AIR CONTROL
6. BLOWER MOTOR
7. BLOWER
8. GAS CONTROL
9. LID HANDLE
10. IGNITER SWITCH

1. Obtain permission from the teacher before lighting the gas forge.
2. Clear the area of all flammable material.
3. Keep the area well ventilated.
4. Wear a face shield, safety glasses, or goggles.
5. Make sure no one but the operator is in the operator's zone.
6. Keep the lid of the forge open when lighting it.
7. Follow the manufacturer's sequence of directions for igniting air and gas.
8. Always put hot articles where they will not be accidentally touched, causing burns.
9. Always keep the floor clean to avoid stumbling and falling.
10. Wear asbestos gloves when tongs are not used.
11. Use chalk to label hot metal that is left unattended. It must be marked "HOT."
12. Follow safety instructions when moving hot metal. Warn all persons who may be in the way. Consider all the metal around the furnace as being hot.
13. Keep the anvil face clear of scraps and flakes of metal.

14. Hammer only the metal being forged. Strike the hammer on the face of the anvil.
15. Stand so that the face is protected when quenching metal.
16. Never attempt to forge flammable metals.
17. Use the proper tongs to handle hot metal.
18. Use only tools with safe handles and properly dressed heads.
19. Shut off the gas first and then the air when work with the forge is finished.
20. Quench the hot tongs before putting them away.
21. Know where the fire extinguishers are located in the lab prior to starting the forge.
22. Always keep a pail of water near the forge.
23. No forge furnace shall be operated unless approved safety devices (i.e., ultraviolet or thermo controls) are attached to the flow of gas.
24. The furnace must be equipped with a spark lighter--do not light by throwing in lighted paper.

# GAS FORGE



- 1 LID
- 2 FIRE BRICK
- 3 FIRE BOX
- 4 WORK RACK
- 5 AIR CONTROL

- 6 BLOWER MOTOR
- 7 BLOWER
- 8 GAS CONTROL
- 9 LID HANDLE
- 10 IGNITER SWITCH



## GAS FORGE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

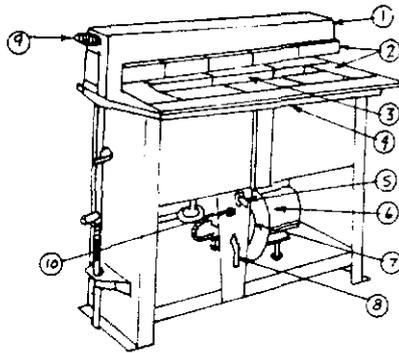
---

(Circle true or false)

- |  |   |   |
|--|---|---|
| 1. Tongs should be used to handle hot metal.   | T | F |
| 2. The lid should be closed when lighting the forge.                                   | T | F |
| 3. Hot metal should be marked "HOT" with crayon.                                       | T | F |
| 4. The air should be turned off first when shutting the forge down.                    | T | F |
| 5. Safety glasses are not really necessary after the forge has been started.           | T | F |
| 6. The handles of the tongs should be cooled before replacing them in the tool rack.   | T | F |
| 7. The exhaust fan should be turned on before starting the forge.                      | T | F |
| 8. Hot metal should be left lying on the floor.  | T | F |
| 9. Strike the anvil with a hammer before striking the metal being forged.              | T | F |
| 10. A pail of cool drinking water should be kept near the forging area.                | T | F |
| 11. It is considered a safe practice to light the forge with a match held in the hand. | T | F |
| 12. It is important to obtain the teacher's permission before using the forge.         | T | F |
| 13. One should locate the fire extinguishers after starting the forge.                 | T | F |

(Circle true or false)

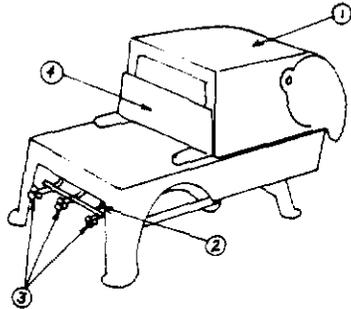
14. A person should stand so that his/her head is not directly over the workpiece when quenching hot metal. T F
15. There should always be a can of alcohol near the forge to be used in case of an accident (such as fire). T F
16. In the spaces provided, identify the parts of the gas forge.



1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_  
5 \_\_\_\_\_

6 \_\_\_\_\_  
7 \_\_\_\_\_  
8 \_\_\_\_\_  
9 \_\_\_\_\_  
10 \_\_\_\_\_

## SOLDERING FURNACE

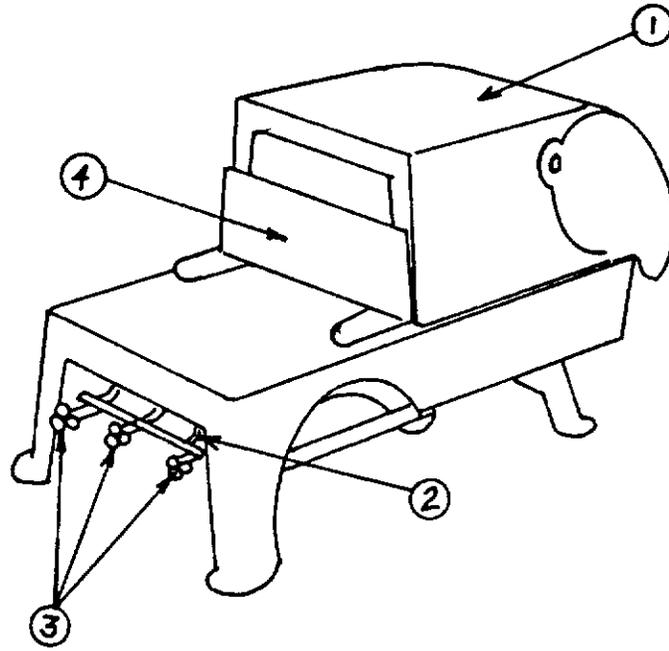


1. HOOD
2. GAS LINE PILOTS
3. GAS VALVE
4. HEAT SHIELD

1. Obtain permission from the teacher before lighting the furnace for soldering.
2. See that the area is properly ventilated.
3. Wear eye protective devices.
4. Light the furnace by following this procedure:
  - A. Stand to one side of the furnace.
  - B. Place a lighted piece of paper in the furnace if it does not have a pilot light.
  - C. Turn on the gas slowly.
  - D. Adjust the flame so that all the fire is confined within the furnace.
5. Select the correct flux for the soldering job that is to be done.
6. When using gas furnaces, keep flammables away from the area.
7. Do not carry hot soldering coppers around in the shop.
8. Keep the hands away from the eyes and mouth.
9. Avoid overheating the soldering copper. "Red" hot is too hot!
10. Never leave hot soldering coppers unattended in the furnace.
11. Put the hot soldering copper and other hot objects where people cannot be burned.

12. Keep the soldering flux in an area where it is safe from spilling.
13. Exercise special care when filing a hot soldering copper. Use a vise to hold it when filing.
14. Use care when storing the copper after use. Improper storage can result in serious burns or a fire.
15. Wash the hands thoroughly after using the soft solder and flux.
16. Tin the soldering copper in a well-ventilated area.
17. Do not touch joints that have just been soldered.
18. Store the soldering fluxes in proper containers and in a safe place.
19. Test any material around a soldering area before picking it up. It may be hot.
20. Avoid breathing the fumes from the fluxes.
21. Coppers should be put down only on insulated, nonflammable surfaces.
22. Do not allow molten solder to come in contact with wet or moist surfaces.
23. When using sal ammoniac, avoid inhaling the fumes.
24. Report any indication of gas escaping from the soldering furnace.
25. Never immerse the hot soldering copper in water to cool it.
26. Shut off the gas when the soldering furnace is no longer in use.

# SOLDERING FURNACE



1 HOOD

2 GAS LINE PILOTS

3 GAS VALVE

4 HEAT SHIELD



## SOLDERING FURNACE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

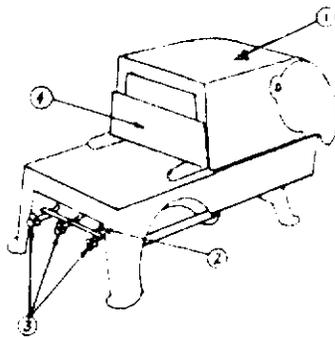
---

(Circle True or False)

- |   |   |   |
|---|---|---|
| 1. It is dangerous to use solder where parts or materials are wet or moist.   | T | F |
| 2. It is not harmful to breathe the gases which are produced from the soldering process.  | T | F |
| 3. Fumes from sal ammoniac may be inhaled safely.   | T | F |
| 4. It is not necessary or wise to heat the copper to bright red.  | T | F |
| 5. Good ventilation in the soldering area is a must.  | T | F |
| 6. A person should look directly into the furnace when lighting it.   | T | F |
| 7. Eye protection is necessary only when lighting the furnace.  | T | F |
| 8. A soldering copper should always be picked up by its handle, whether it's hot or cold.                                       | T | F |
| 9. Hot soldering irons should not be laid down near combustible materials.  | T | F |
| 10. A hot soldering copper that has to be carried should be held downward, with the carrier watching and warning others nearby. | T | F |
| 11. The soldering iron should be cooled after use by immersing it in water.   | T | F |
| 12. It is not harmful to touch the mouth or eyes with the hands while soldering because fluxes are nontoxic.                    | T | F |

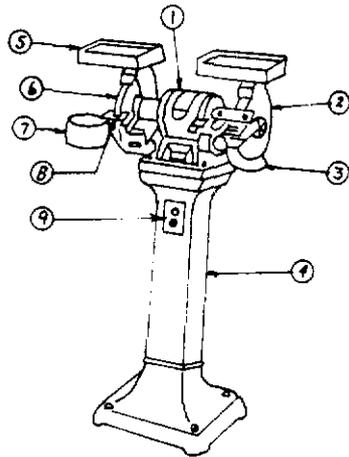
(Circle true or false)

13. There is not need for alarm if a slight gas leak is indicated. T F
14. A firm grip must be kept on the handle when filling on hot soldering copper. T F
15. All fluxes are the same. T F
16. In the spaces provided, identify the parts of the soldering furnace:



1 \_\_\_\_\_ 2 \_\_\_\_\_  
3 \_\_\_\_\_ 4 \_\_\_\_\_

## GRINDER

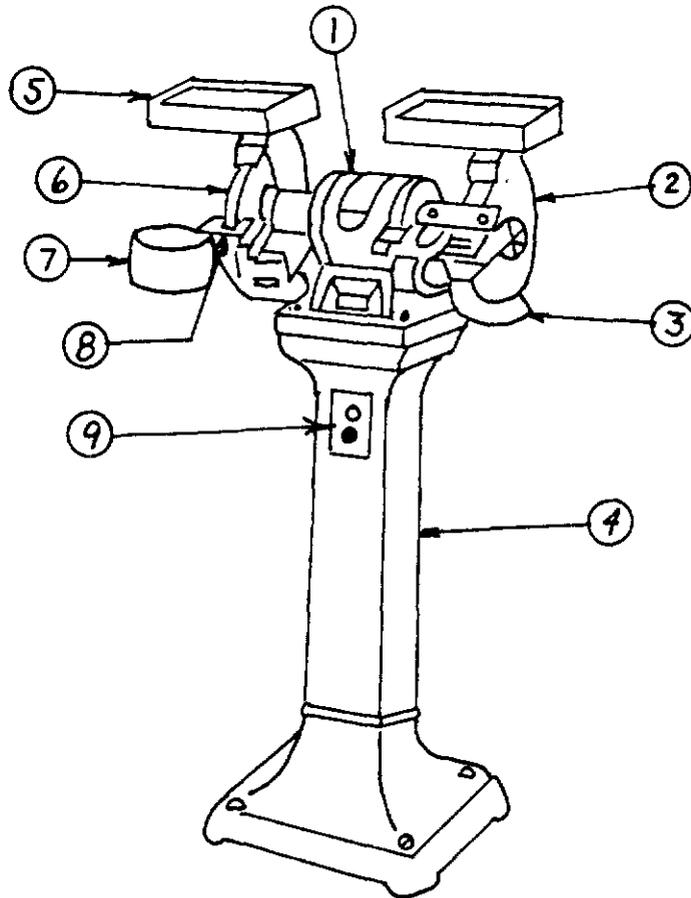


1. MOTOR
2. WHEEL GUARD
3. DUST DEFLECTOR
4. PEDESTAL
5. SAFETY SHIELD
6. ABRASIVE WHEEL
7. WATER POT
8. TOOL REST
9. SWITCH

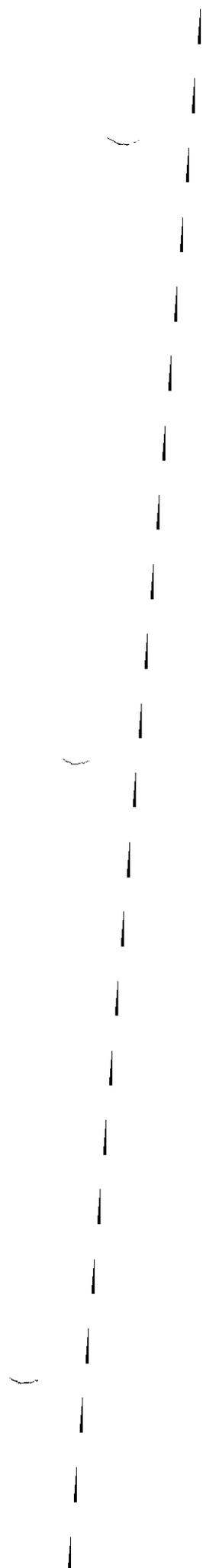
1. Floor and bench-mounted grinders shall be provided with rests which are rigidly supported and readily adjustable. Such work rests shall be kept at a distance not to exceed 1/8 inch from the surface of the wheel. (OSHA)
2. The abrasive wheel guard shall cover the spindle end nut and flange projections. (OSHA)
3. On bench and pedestal grinders, the safety guards shall be such that the exposure of the wheel will not exceed 90 degrees or one-fourth of the periphery. (OSHA)
4. On all grinders, the driving flange shall be securely fastened to the spindle. (OSHA)
5. Abrasive wheels shall be mounted between flanges which shall not be less than one-third the diameter of the wheel. (OSHA)
6. Any abrasive wheel shall be closely inspected before mounting and shall also be sounded by the user (with the ring test) to make sure it has not been damaged. (OSHA)
7. When bushings are used in the wheel hole on abrasive wheels, they shall not exceed the width of the wheel and shall not contact the flange. (OSHA)
8. Permission must be obtained from the teacher before using the grinder.

9. No one but the operator should be inside the operator's zone.
10. A face shield and safety glasses (goggles, spectacles) must be worn, and the glass safety guard on the grinder must be used.
11. Hands must be kept away from the wheel while it is in motion.
12. Work should be held with the hands. The teacher should be asked for special instruction and permission to grind small pieces.
13. Only the face of the wheel should be used.
14. Material should be pressed against the wheel with the correct amount of pressure.
15. The wheel must be dressed, when necessary.
16. Work should be kept in motion across the face of the wheel.
17. Power must be turned off after each use of the grinder.
18. Small pieces should be held securely in a proper holder. It is unsafe to hold small pieces in the hand, as they might get away and follow the wheel into the guard.
19. Adjustments must not be made with the grinder running.
20. Avoid grinding on the side of a light wheel. Side grinding must be done only on a wheel that is designed and built for this operation.
21. A wheel that will stand the maximum speed of the grinder must be used.
22. Stones should not be overheated. Cool the project in water. This protects tools, stone, and fingers.
23. Never grind any material except iron or steel on a grinder. Other materials stick to the wheel.
24. The operator should not stand directly in front of a grinding wheel when the grinder is started.
25. Work must not be jammed into the wheel.

# GRINDER



- |   |                |   |                |
|---|----------------|---|----------------|
| 1 | MOTOR          | 6 | ABRASIVE WHEEL |
| 2 | WHEEL GUARD    | 7 | WATER POT      |
| 3 | DUST DEFLECTOR | 8 | TOOL REST      |
| 4 | PEDESTAL       | 9 | SWITCH         |
| 5 | SAFETY SHIELD  |   |                |



GRINDER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

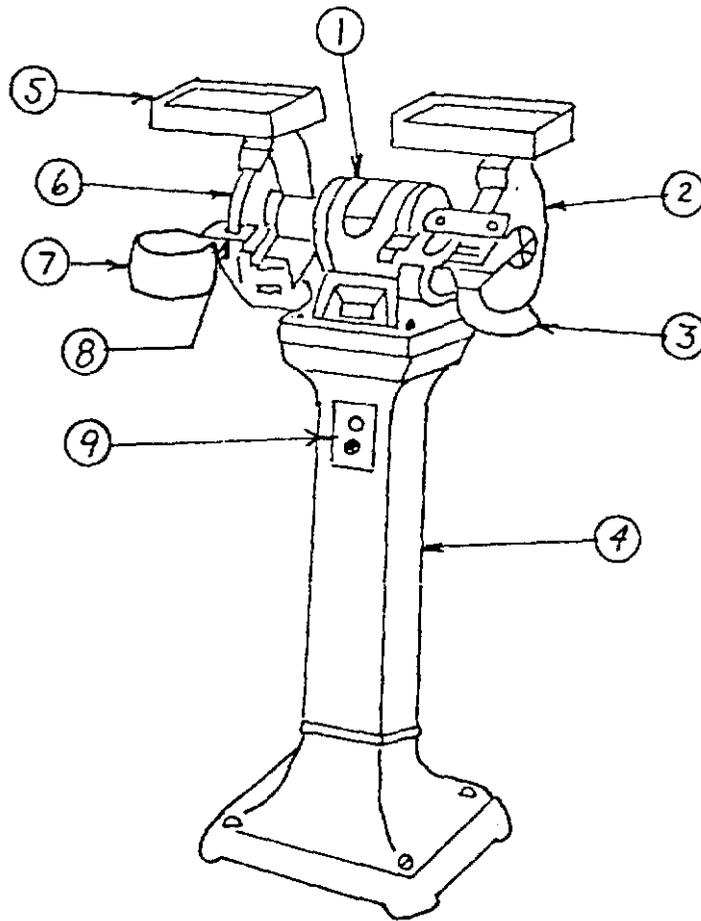
(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. The grinder should be stopped before adjusting the tool rest.                                | T | F |
| 2. Eye protection is not always necessary.  | T | F |
| 3. A grinding wheel that is suspected of being cracked should never be used.                    | T | F |
| 4. It is unsafe to operate the grinder with the housing removed from around the grinding wheel. | T | F |
| 5. A face guard is not necessary when the grinder has a glass shield.                           | T | F |
| 6. The side of the wheel is used for rough grinding.  | T | F |
| 7. One should force material into the grinding wheel to remove the metal faster.                | T | F |
| 8. A wheel that vibrates excessively should not be used.  | T | F |
| 9. The paper should always be removed from the sides of the grinding wheel.                     | T | F |
| 10. It is safe to operate the grinder when another person is standing nearby.                   | T | F |
| 11. A grinding wheel may be used until it is worn to less than half its original diameter.      | T | F |
| 12. Pupils should leave the tool grinder without turning it off.                                | T | F |
| 13. The grinder should not be used if it is poorly lighted.                                     | T | F |

(Circle true or false)

- |  |   |   |
|--|---|---|
| 14. It is possible to determine if the stone is properly dressed by touching the face of the rotating wheel with the forefinger. | T | F |
| 15. A piece of scrap metal can be forced into the wheel to stop it.  | T | F |
| 16. One should grind only iron and steel on the grinder.   | T | F |
| 17. Small pieces of material that are to be ground can be held in the hand during grinding.                                      | T | F |
| 18. One should stand directly in front of the grinding wheel when the grinder is turned on.                                      | T | F |
| 19. The metal being ground should be cooled in oil.  | T | F |
| 20. Grinding should be concentrated on one particular portion of the wheel face.   | T | F |

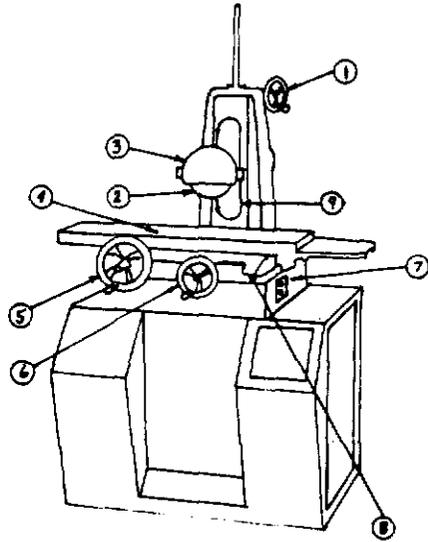
21. In the spaces provided, identify the parts of the grinder:



1	_____	6	_____
2	_____	7	_____
3	_____	8	_____
4	_____	9	_____
5	_____		



## SURFACE GRINDER

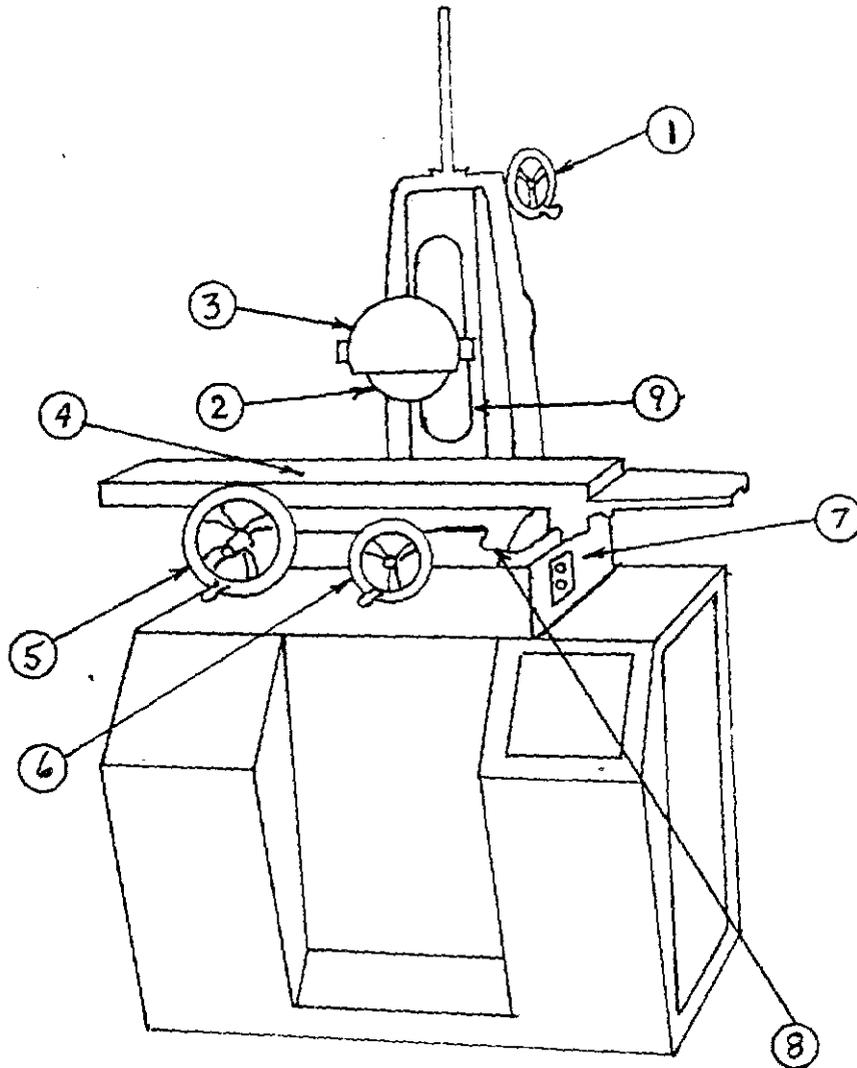


1. VERTICAL FEED HANDWHEEL
2. GRINDING WHEEL
3. WHEEL GUARD
4. MAGNETIC CHUCK
5. HORIZONTAL FEED HANDWHEEL
6. CROSS FEED HANDWHEEL
7. OFF-ON SWITCH
8. SADDLE
9. DUST GUARD

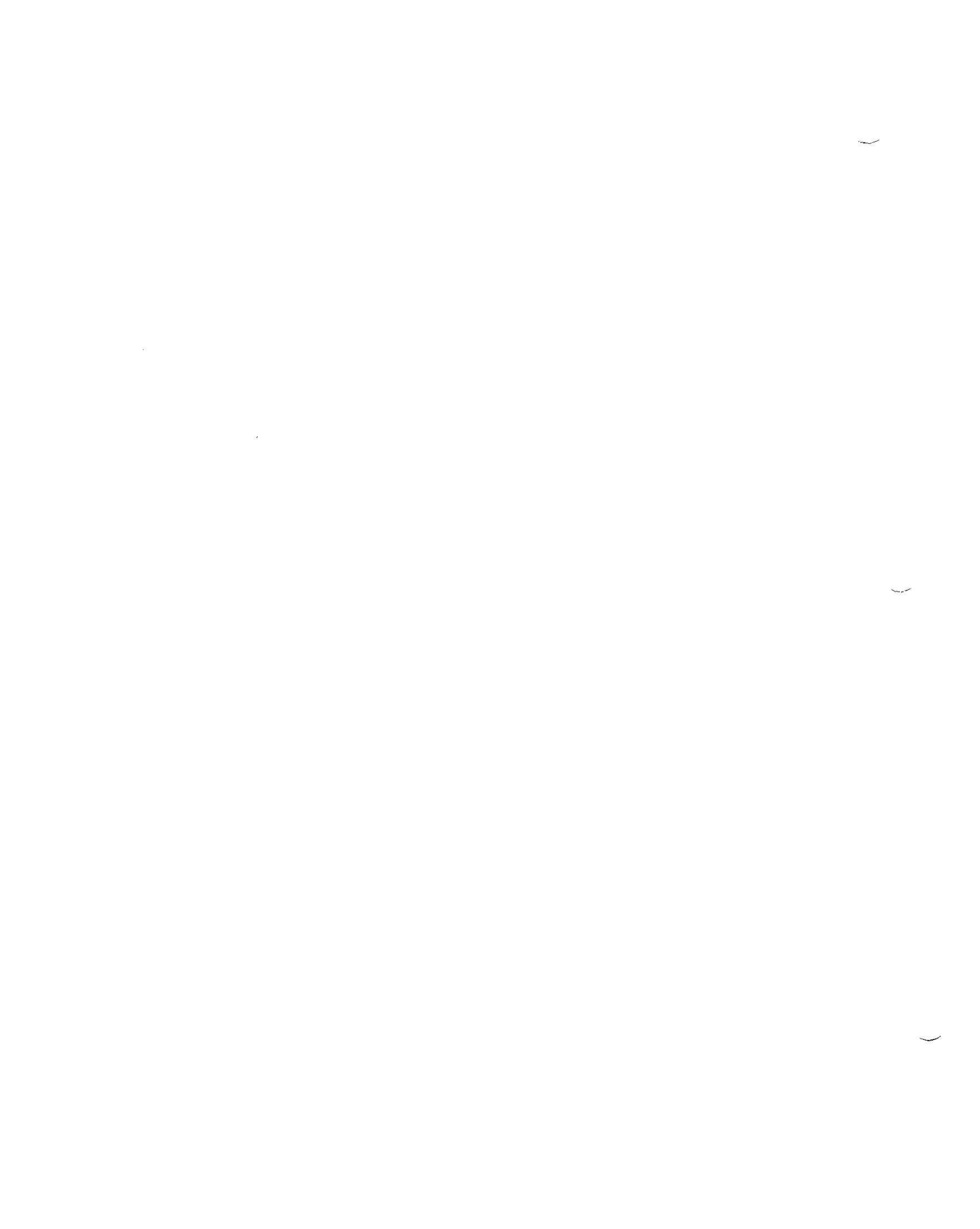
1. On surface grinders, the exposed portion of the wheel shall not exceed 150 degrees.
2. Safety guards are required to cover the spindle end nut and flange projections.
3. Labs performing dry grinding shall provide a suitable hood or enclosures that are connected to an exhaust system.
4. Eye protective devices shall be worn when grinding.
5. A person must be thoroughly familiar with all the electrical and mechanical controls before operating this machine.
6. The grinder shall not be used unless the wheel guard is in place and well secured.
7. If a magnetic chuck is used, one should make sure it is holding the work securely before starting.
8. The machine must be completely stopped before any adjustments are made or projects removed.
9. If the grinding wheel chatters, the grinder should be stopped. The wheel may be loose on the spindle.

10. One should make sure the work clears the wheel before starting the machine. (Use a handwheel for the table movement.)
11. A grinding wheel should never be operated at speeds exceeding those recommended by the manufacturer.
12. Hands must be kept away from the moving parts while the automatic feed is engaged.
13. The work table shall be kept clear of tools, rags, etc.
14. A vise or clamp should always be used when grinding small or short pieces on a magnetic chuck.

# SURFACE GRINDER



- |                             |                        |
|-----------------------------|------------------------|
| 1 VERTICAL FEED HANDWHEEL   | 6 CROSS FEED HANDWHEEL |
| 2 GRINDING WHEEL            | 7 OFF-ON SWITCH        |
| 3 WHEEL GUARD               | 8 SADDLE               |
| 4 MAGNETIC CHUCK            | 9 DUST GUARD           |
| 5 HORIZONTAL FEED HANDWHEEL |                        |



## SURFACE GRINDER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

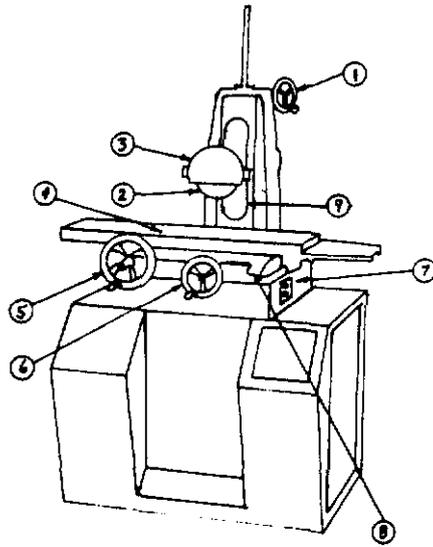
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. Eye protection is not needed while the surface grinder is being set up for operation.                                  | T | F |
| 2. The power must always be turned off if a noise or vibration occurs.  | T | F |
| 3. It is not necessary to check the grinding wheel for cracks at the beginning of every new job.                          | T | F |
| 4. Hands should be kept clear of the wheel while the grinder is running.  | T | F |
| 5. No more than two people should operate the surface grinder at any one time.  | T | F |
| 6. According to OSHA standards, the wheel of the surface grinder should not be exposed more than 180 degrees.             | T | F |
| 7. The surface grinder should not be operated unless the guard is positioned to cover the nut in the center of the wheel. | T | F |
| 8. The workpiece may be moved on a magnetic chuck while the machine is operating.   | T | F |
| 9. A rag or shop towel should always be kept on the table of the surface grinder.   | T | F |
| 10. Small or short pieces of metal may have to be held in a vise when using a magnetic chuck.                             | T | F |

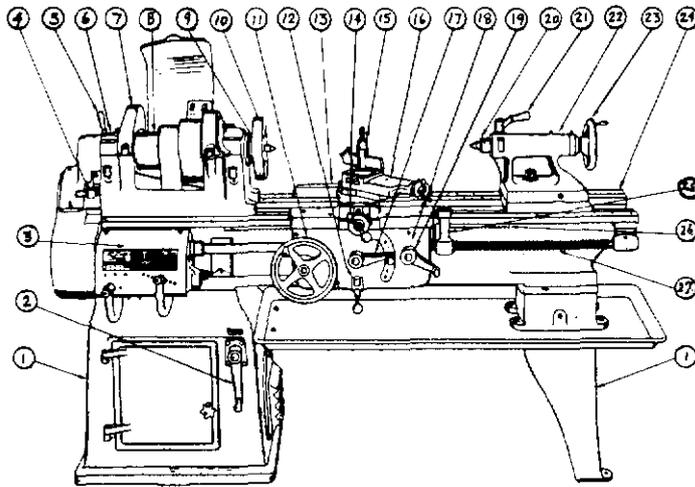
11. In the spaces provided, identify the parts of the surface grinder:



1. \_\_\_\_\_  
2. \_\_\_\_\_  
3. \_\_\_\_\_  
4. \_\_\_\_\_  
5. \_\_\_\_\_

6. \_\_\_\_\_  
7. \_\_\_\_\_  
8. \_\_\_\_\_  
9. \_\_\_\_\_

# LATHE

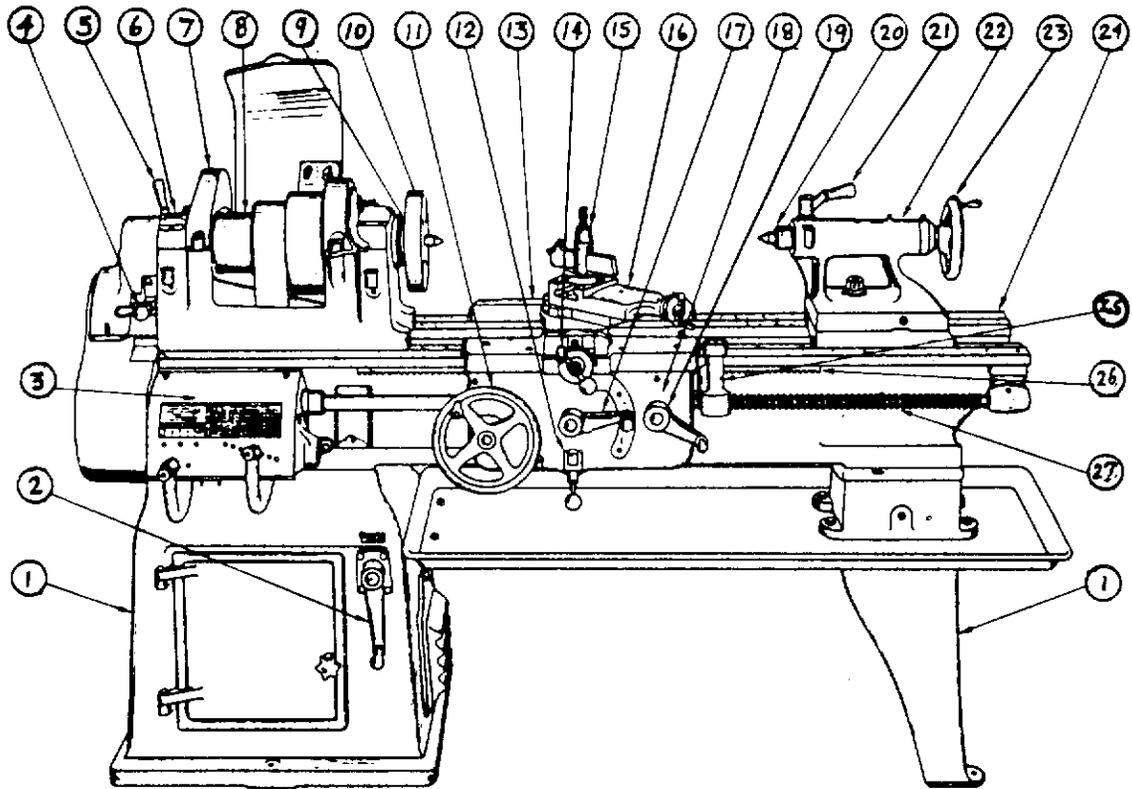


1 LEG	15 TOOL POST
2 BELT LEVER	16 COMPOUND REST
3 GEAR BOX	17 FEED CHANGE
4 FEED REVERSE LEVER	18 APRON
5 BACK GEAR LEVER	19 HALF-NUT LEVER
6 HEADSTOCK	20 TAILSTOCK SPINDLE
7 BACK GEARS	21 TAILSTOCK LEVER
8 CONE PULLEY	22 TAILSTOCK
9 HEADSTOCK SPINDLE	23 TAILSTOCK HAND WHEEL
10 FACE PLATE	24 BEDWAYS
11 APRON HAND WHEEL	25 THREAD DIAL
12 APRON FEED	26 RACK
13 SADDLE	27 LEAD SCREW
14 CROSS FEED BALL CRANK	

1. Wear appropriate eye protection.
2. Roll the sleeves above the elbows and remove or fasten any loose clothing. Especially remove necktie and jewelry.
3. Check to see that all guards are in place.
4. Be sure that all parts of the carriage will clear any rotating part during the full length of the cut.
5. Do not start the lathe if there are any operating knobs or levers that are not understood. Investigate engagement and the direction of rotation by slowly turning the lathe by hand.
6. Make all adjustments only when the machine is at a dead stop.
7. Remove the chuck key or wrench immediately after using.
8. Work alone at the machine. It should be started and stopped by only one person.
9. Be sure that the cutting tool is set on the exact center of the work. A tool set above center may grab the work, breaking the tool and/or throwing the work out of the lathe.
10. Be sure of the setup--ask if uncertain.

11. Place the hands on the controls or at one's sides except when filing or polishing.
12. Keep the hands away from chips.
13. Never try to shift the belts on the lathe while it is running. Always turn the pulleys by hand when shifting the belt.
14. Bring the lathe to a complete stop before reversing it.
15. Remove the tool holder and tool post before filing or polishing.
16. Stop the machine before attempting to measure the job.
17. Finish by hand feed any cuts that are close to a chuck or against a shoulder.
18. Have the cutter as close to the tool post as possible when the tool holder is clamped tight.
19. Do not hand stop a lathe chuck. Allow it to coast to a stop. Keep the hands away from all moving parts.
20. Never try to operate a machine and engage in conversation at the same time.
21. Don't walk away and leave the machine running.
22. Do not use air for cleaning the machine.
23. Never lay tools on the machine where they might interfere with the operation of the machine, or where they might become entangled in the work, chuck, or chips.

# LATHE



- |                      |                          |                         |
|----------------------|--------------------------|-------------------------|
| 1 LEG                | 11 APRON HAND WHEEL      | 20 TAILSTOCK SPINDLE    |
| 2 BELT LEVER         | 12 APRON FEED            | 21 TAILSTOCK LEVER      |
| 3 GEAR BOX           | 13 SADDLE                | 22 TAILSTOCK            |
| 4 FEED REVERSE LEVER | 14 CROSS FEED BALL CRANK | 23 TAILSTOCK HAND WHEEL |
| 5 BACK GEAR LEVER    | 15 TOOL POST             | 24 BEDWAYS              |
| 6 HEADSTOCK          | 16 COMPOUND REST         | 25 THREAD DIAL          |
| 7 BACK GEARS         | 17 FEED CHANGE           | 26 RACK                 |
| 8 CONE PULLEY        | 18 APRON                 | 27 LEAD SCREW           |
| 9 HEADSTOCK SPINDLE  | 19 HALF-NUT LEVER        |                         |
| 10 FACE PLATE        |                          |                         |



## LATHE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

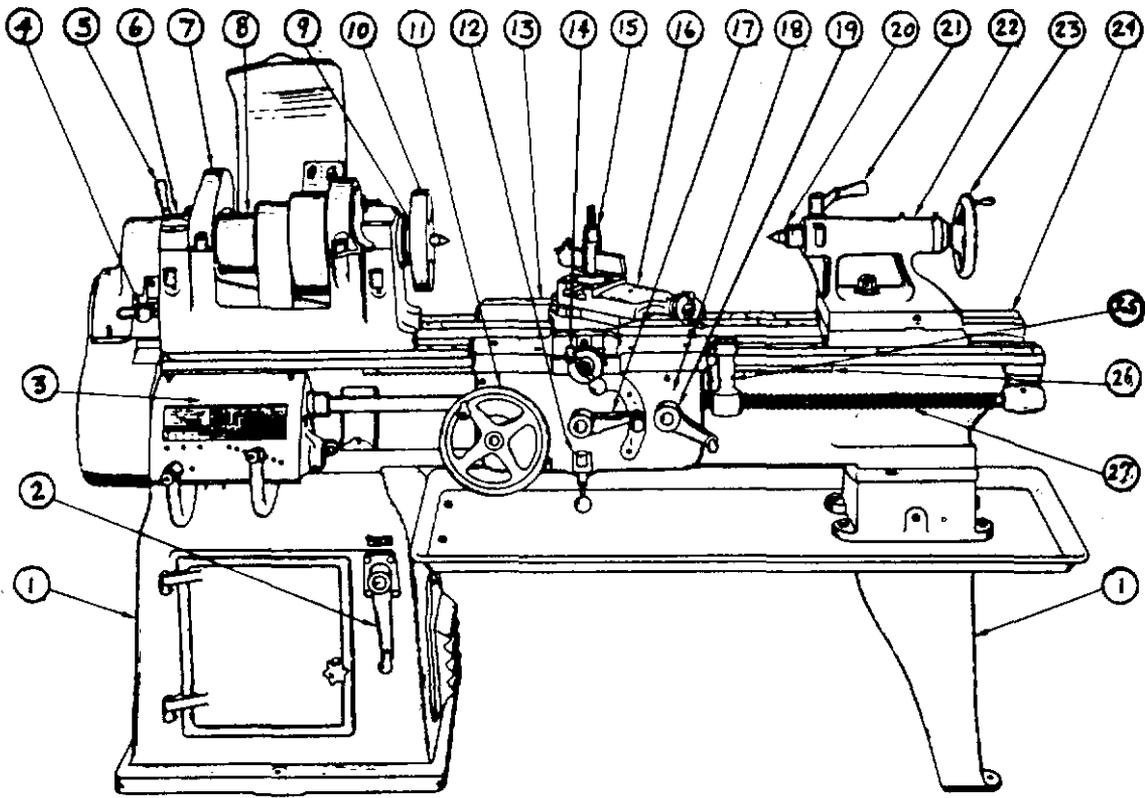
---

(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. The chuck wrench remains in the chuck when the machine is stopped.                       | T | F |
| 2. Measurements should be made while the machine is stopped.                                | T | F |
| 3. The lathe must be rotating in reverse before work is cleaned with a rag.                 | T | F |
| 4. A person should always start and stop his/her own machine.                               | T | F |
| 5. Adjustments should be made while the machine is running.                                 | T | F |
| 6. It is safe to operate the lathe while wearing long sleeves.                              | T | F |
| 7. All guards should be in place before the lathe is turned on.                             | T | F |
| 8. Only tools such as a chuck key or crescent wrench should be left on the machine.         | T | F |
| 9. It is all right to carry on short conversations while running the lathe.                 | T | F |
| 10. Chips may be removed with the hands only after the machine has come to a complete stop. | T | F |
| 11. After the switch has been turned off, the chuck may be slowed down by hand.             | T | F |
| 12. The lathe should be at a complete stop before the direction of rotation is changed.     | T | F |

(Circle true or false)

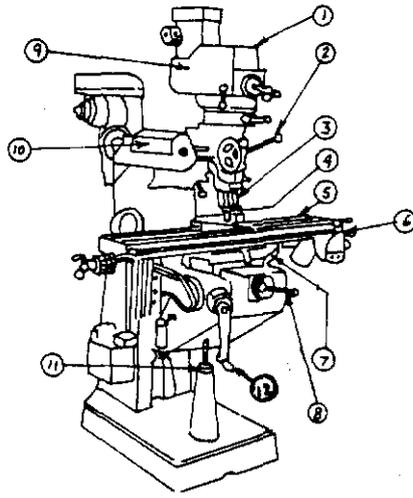
13. A lathe should never be left unattended while it is running. T F
14. After setting up the lathe, the chuck should be rotated by hand before turning on the power. T F
15. The cutting tool should be positioned just below the center of the work. T F
16. The tool post should be moved to the far right end of the lathe before filing or polishing. T F
17. In the spaces provided, identify the parts of the lathe.



1 _____	10 _____	19 _____
2 _____	11 _____	20 _____
3 _____	12 _____	21 _____
4 _____	13 _____	22 _____
5 _____	14 _____	23 _____
6 _____	15 _____	24 _____
7 _____	16 _____	25 _____
8 _____	17 _____	26 _____
9 _____	18 _____	27 _____



## MILLING MACHINE

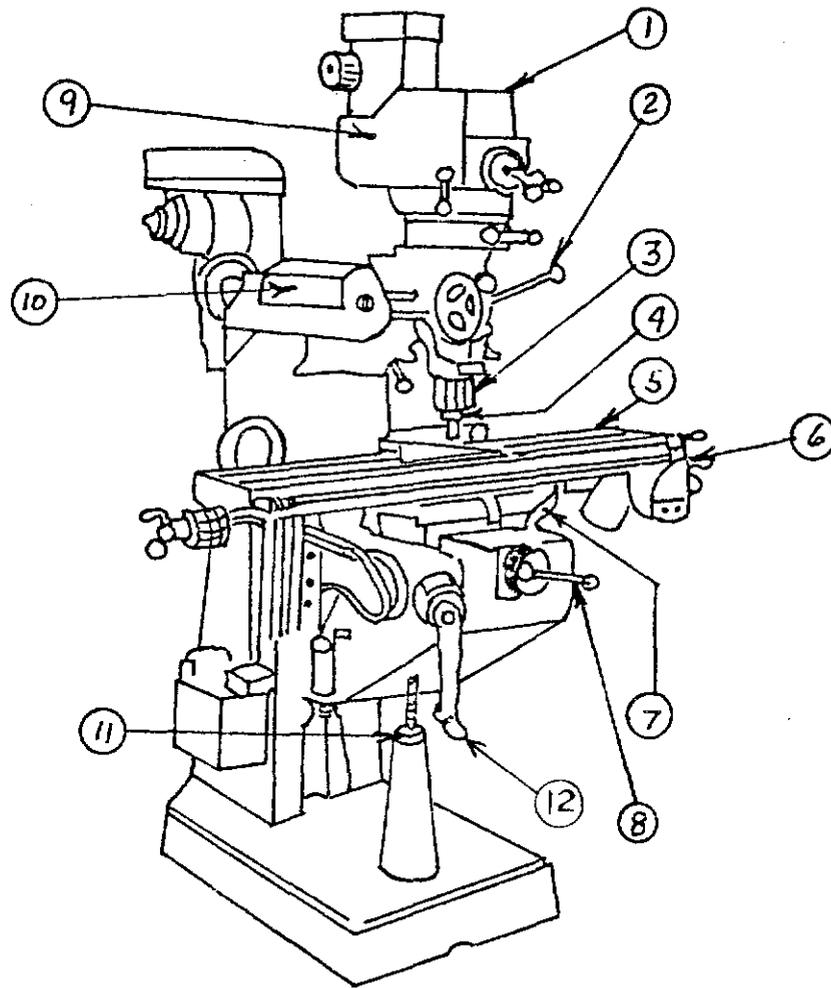


1. HEAD
2. HAND FEED LEVER
3. QUILL
4. SPINDLE
5. TABLE
6. LONGITUDINAL FEED
7. CROSS SLIDE
8. CROSS FEED HAND WHEEL
9. GUARD
10. RAM
11. KNEE LIFT SCREW
12. VERTICAL LIFT CRANK

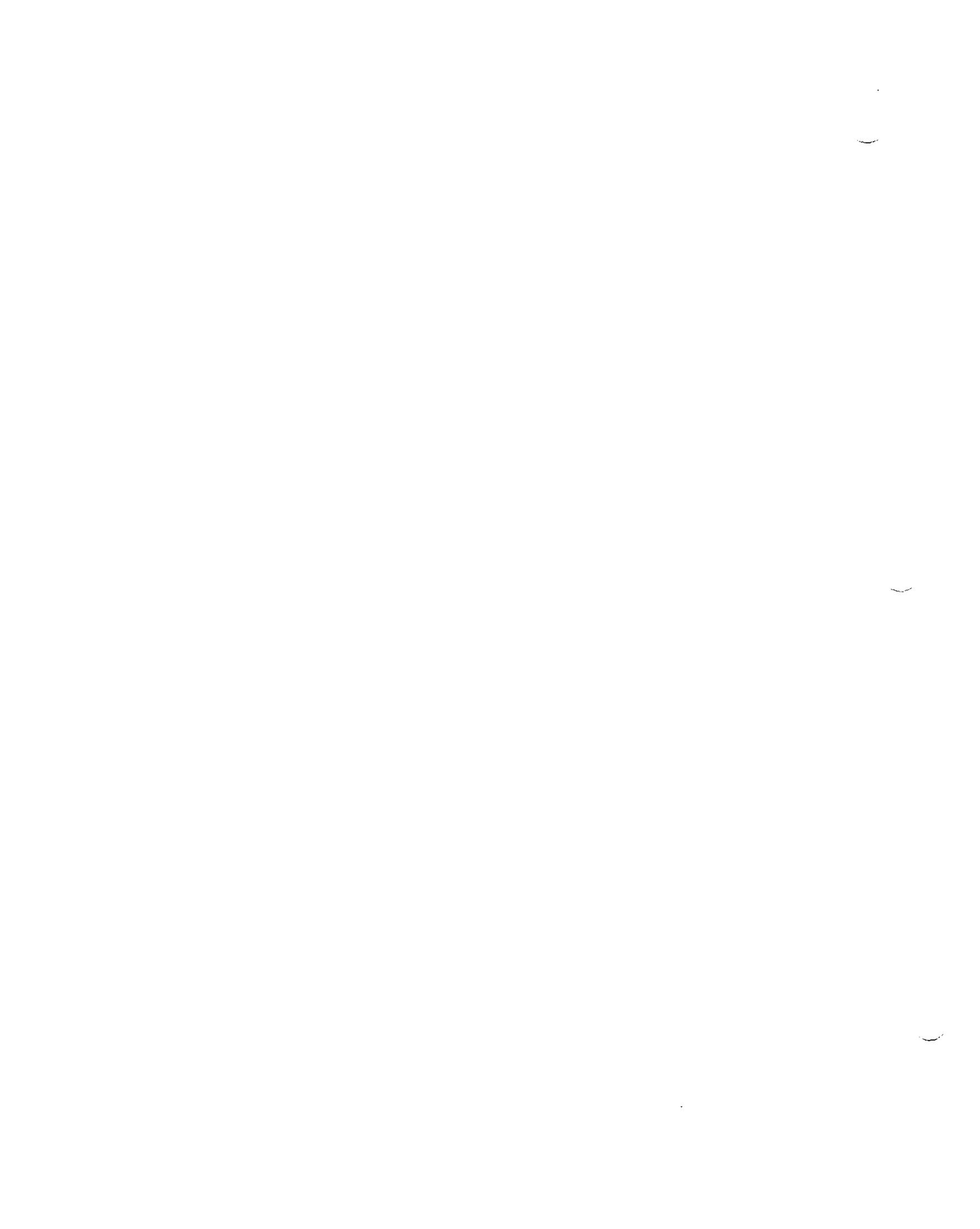
1. A guard shall be used on the milling machine at the point of operation that exposes an operator to injury. (OSHA)
2. One or more methods of machine guarding shall be provided to protect the operator and other persons in the machine area from hazards. (OSHA)
3. Special tools shall be provided to assist the operator in order to avoid placing the hands in the danger zones. (OSHA)
4. Permission from the teacher must be obtained before using the milling machine.
5. Eye protection must always be worn during setup as well as operation.
6. Adjustments or setups shall be made only when the machine is at a dead stop.
7. Tie, rings, watch, and other jewelry must be removed before operating the machine.
8. Never wear loose clothing when operating the milling machine. Roll sleeves up above the elbow. Long hair shall be confined.
9. Many of the attachments used on the milling machine are very heavy. Protective-type footwear should be worn to protect the feet from falling objects.

10. Hearing protectors should be used where noise exceeds the level of exposure allowed in Section 1910.95 of the OSHA regulations.
11. Gloves should not be worn.
12. Correctly fitting wrenches should be used on machine parts.
13. A proper cutter must be selected. It should also be sharp.
14. All cutters should be handled carefully.
15. Only a soft hammer or mallet should be used to seat work against the parallels or bottom of the vise.
16. The job should be securely fastened.
17. The machine must be set for an appropriate depth of cut.
18. A person should select a feed to match the depth of cut.
19. The handles must be disengaged when the automatic feed is to be used or the table is to be locked.
20. A person should stand to one side of the machine when starting it.
21. It is important that the cutter is turning in the proper direction.
22. Work should be fed against the rotation of the cutter.
23. When the machine is at rest, use a brush to remove chips from the work.
24. All automatic feeds should be released.
25. One should never reach over or near the rotating cutter.
26. The milling machine must not be left unattended while it is in operation.
27. When a chuck key is used, it should be removed from the chuck before the spindle is started. (This is upon the completion of locking or unlocking.)
28. Only the person operating the machine should be in the safety zone.
29. The floor around the machine should be kept clear of chips, and spilled cutting fluid should be wiped up immediately.
30. A person should not talk to anyone while operating the machine.
31. Only the person using the machine should turn it on and off.

# MILLING MACHINE



- |                     |                         |
|---------------------|-------------------------|
| 1 HEAD              | 7 CROSS SLIDE           |
| 2 HAND FEED LEVER   | 8 CROSS FEED HAND WHEEL |
| 3 QUILL             | 9 GUARD                 |
| 4 SPINDLE           | 10 RAM                  |
| 5 TABLE             | 11 KNEE LIFT SCREW      |
| 6 LONGITUDINAL FEED | 12 VERTICAL LIFT CRANK  |



## MILLING MACHINE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

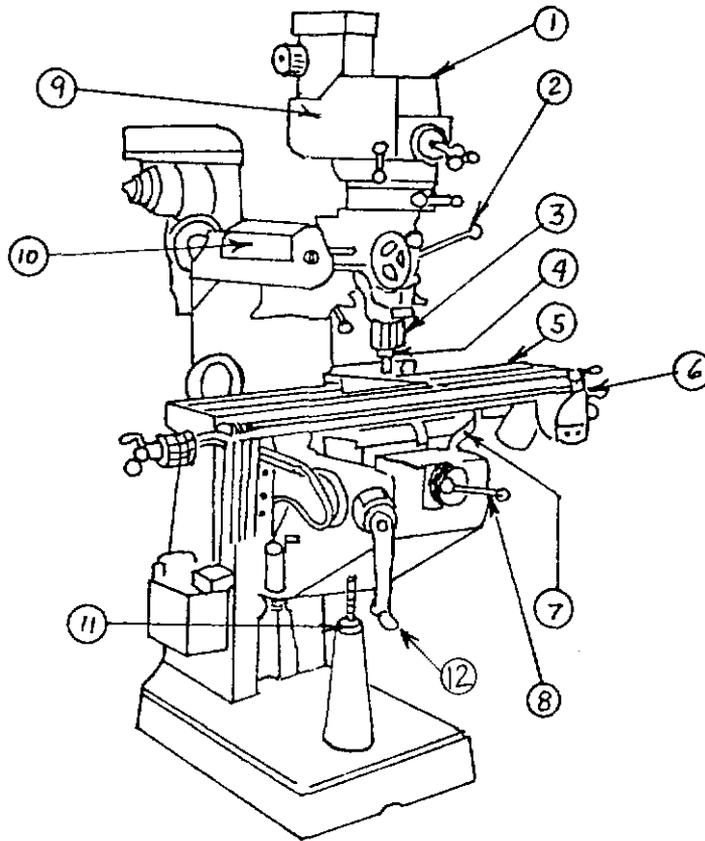
---

(Circle true or false)

1. All attachments and clamps on the milling machine should be checked for tightness before turning on the power. T F
2. When the milling machine cutter is revolving, the table should be cleaned. T F
3. The striking of a mill cutter with a steel hammer may damage the hammer. T F
4. A person who has finished using the milling machine should release all of the automatic feeds. T F
5. On long cuts, it is permissible to leave the machine while it is on automatic feed. T F
6. Eye protection should be worn at all times. T F
7. The milling machine is one of the least dangerous machines to operate. Therefore, it is not necessary to ask for permission every time one uses it. T F
8. If the milling machine is equipped with a guard which interferes with a particular job or operation, it is permissible to remove it. T F
9. Gloves may need to be worn while operating the milling machine (depending on the job being done). T F
10. Long sleeves should be rolled up. T F
11. A person should ask a friend to turn the machine on for him/her in order to prevent reaching over a rotating cutter. T F

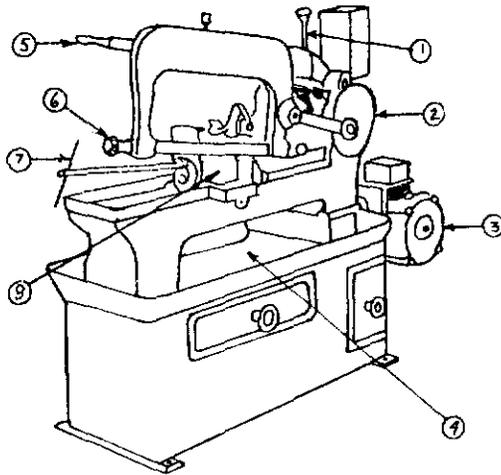
(Circle true or false)

- 12. No more than three people should be in the safety zone at any one time. T F
- 13. Handles should be disengaged when the machine is on automatic feed. T F
- 14. No adjustments should be made while the machine is running. T F
- 15. For most work in the school lab, the milling machine should be set on the highest speed. T F
- 16. In the spaces provided, identify the parts of the milling machine:



1	_____	5	_____	9	_____
2	_____	6	_____	10	_____
3	_____	7	_____	11	_____
4	_____	8	_____	12	_____

## POWER HACKSAW

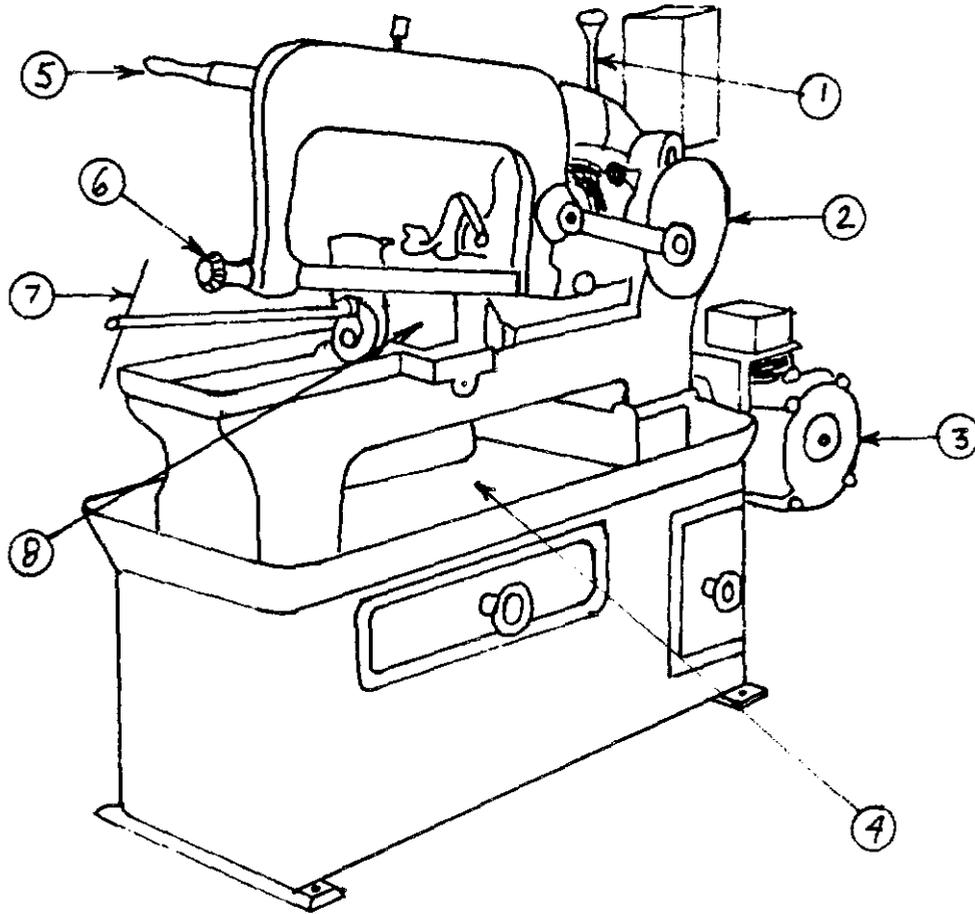


1. FEED LEVER
2. FLYWHEEL
3. MOTOR
4. COOLANT RESERVOIR
5. FRAME HANDLE
6. BLADE TENSION KNOB
7. VISE HANDLE
8. VISE

1. Machines designed for a fixed location shall be securely anchored to prevent walking or moving. (OSHA)
2. Eye protection shall be worn.
3. Work shall be mounted only when the saw is stopped.
4. Protruding ends of long pieces shall be supported so they will not fall and cause an injury.
5. It is important to guard against people walking into protruding stock.
6. Saw blades must be in good condition.
7. The speed of the blade shall be adjusted to suit the job and blade.
8. The project shall be secured in the vise.
9. The blade tension should comply with the manufacturer's recommendations.
10. The machine should be stopped for speed adjustment unless it is a variable speed machine.
11. The saw must not be operated without all the guards.
12. The saw should be stopped when the blade breaks. Then the blade should be removed.
13. The blade should be fed slowly and gradually into the work.

14. A person should never attempt to saw short pieces of stock unless he/she has another piece of the same diameter in the opposite side of the jaws. Pieces smaller than 1/4 inch should be cut manually.
15. Stand to one side of the saw frame when the power is to be turned on.
16. It is not advisable to bend over the saw while it is in operation.
17. Hands should be kept away from the blade and the line of travel of moving parts.
18. One should turn off the power after using the power hacksaw and stand by the machine until it has completely stopped.
19. The machine and area should be cleaned with a brush.
20. Loose clothing should not be worn when a person is running the power hacksaw.

# POWER HACKSAW



1 FEED LEVER

2 FLYWHEEL

3 MOTOR

4 COOLANT RESERVOIR

5 FRAME HANDLE

6 BLADE TENSION KNOB

7 VISE HANDLE

8 VISE



## POWER HACKSAW SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

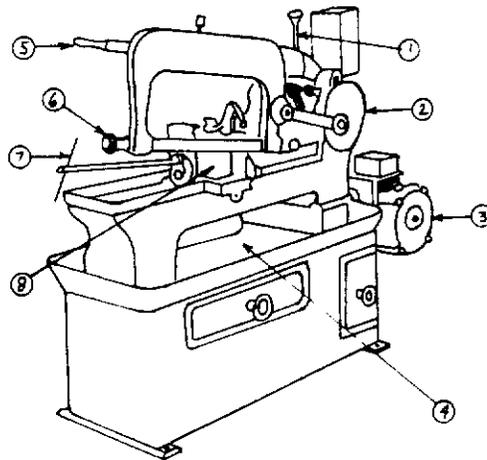
---

(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. Hacksaw blades are made to cut in both directions.   | T | F |
| 2. If the blade is dull and cuts slowly, apply hand pressure to make it cut faster.                             | T | F |
| 3. The blade pressure should be reduced when sawing thin metal.   | T | F |
| 4. Work should be mounted when the power is turned on.  | T | F |
| 5. If the power hacksaw begins to move or jump when in use, the operator should turn the power off immediately. | T | F |
| 6. If the base of the power hacksaw begins to move or jump, the operator should turn the power off immediately. | T | F |
| 7. Most hacksaw blades can be operated at the same speed.   | T | F |
| 8. A person who is sawing long pieces of stock should have another pupil hold one end.                          | T | F |
| 9. The operator should stand at the end of the saw frame when the power is turned on.                           | T | F |
| 10. The power hacksaw must always be cleaned with a brush.  | T | F |
| 11. The blade should be fed slowly into the work.   | T | F |

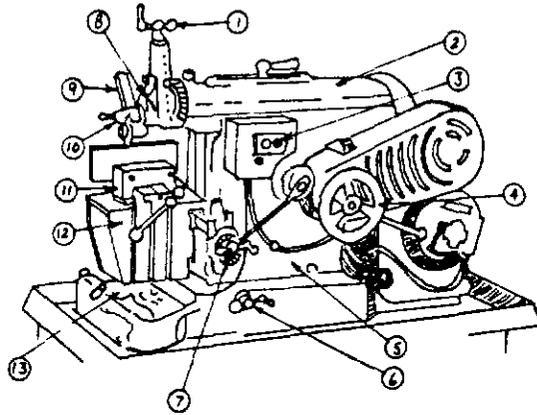
(Circle true or false)

12. On some occasions, it may be necessary to hold the material with the hand while cutting with the power hacksaw. T F
13. The saw may be left unattended while it is running only if the material is greater than one-inch thick. T F
14. In the spaces provided, identify the parts of the power hacksaw:



- |         |         |
|---------|---------|
| 1 _____ | 5 _____ |
| 2 _____ | 6 _____ |
| 3 _____ | 7 _____ |
| 4 _____ | 8 _____ |

## SHAPER

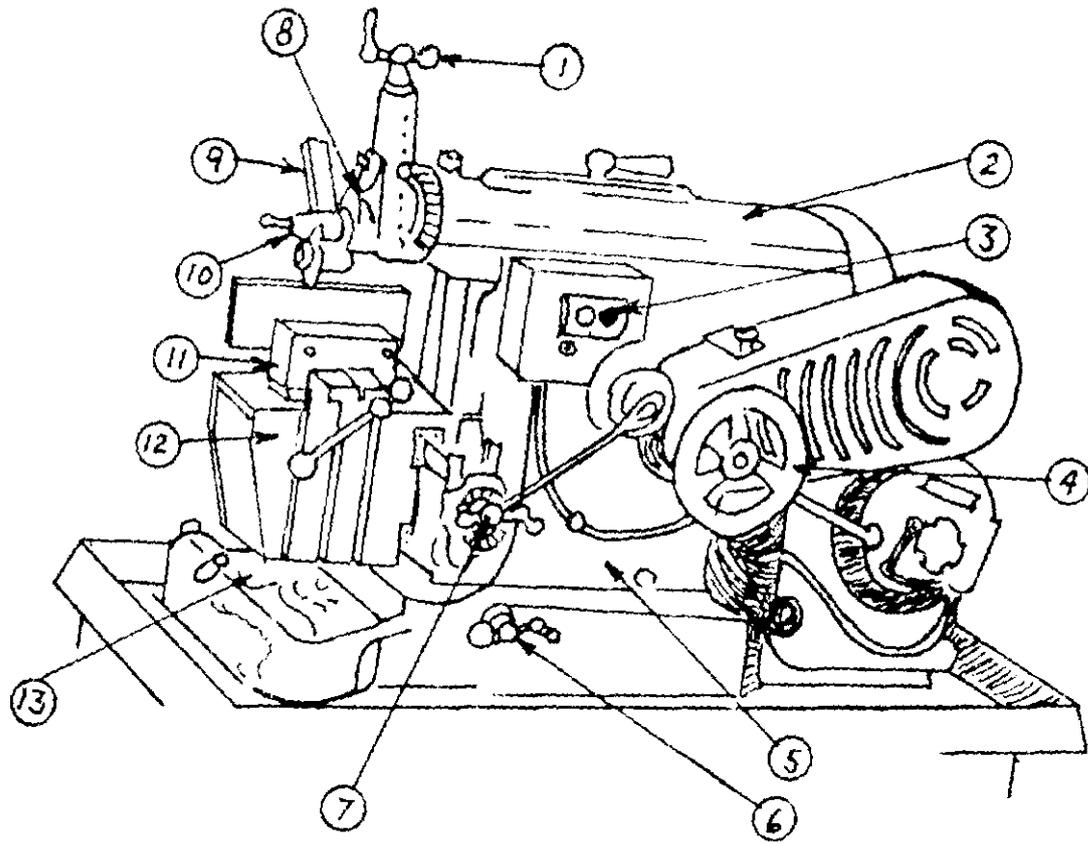


1. VERTICAL FEED
2. RAM
3. SWITCH
4. HAND WHEEL
5. COLUMN
6. TABLE HEIGHT ADJUSTMENT
7. AUTOMATIC FEED
8. CLAPPER BOX
9. TOOL AND HOLDER
10. TOOL POST
11. VISE
12. TABLE
13. TABLE SUPPORT

1. Wear adequate eye protection.
2. Make adjustments and measurements only when the machine is at a complete stop.
3. Keep the hands and fingers a minimum of six inches from the cutting tool and all other moving parts.
4. Avoid standing directly in front of or behind the ram.
5. Make sure the machine comes to a complete stop before leaving it.
6. Be sure the fences and guards are correctly fastened in place.
7. Remove jewelry, eliminate loose clothing, and confine long hair.
8. Do not put tools or tooling on any part of the machine.
9. Never remove chips while the machine is in motion.
10. Be sure to thoroughly understand the operation of the machine before attempting to operate it.
11. Use a soft hammer or mallet to set work on the parallels.
12. Secure the work firmly in the machine.
13. Select the proper tool for the job.

14. Set the machine for the proper depth of the cut.
15. Be sure that the ram and head will clear the work and also any holding device.
16. Check to see that the lever is in a neutral position before starting the motor.
17. Handle the cutter bit with care.
18. Making too deep a cut, or not securely clamping the work in the vise, may result in injury.
19. Make sure to use the correct stroke, speed, and depth of cut before using the shaper.
20. Make sure no one but the operator is inside the operator's zone.
21. Clean the machine and area with a brush.
22. Do not leave the shaper unattended while it is running.
23. Operate the machine only with the teacher's permission, and after instruction has been received.

# SHAPER



1 VERTICAL FEED

2 RAM

3 SWITCH

4 HAND WHEEL

5 COLUMN

6 TABLE HEIGHT ADJUSTMENT

7 AUTOMATIC FEED

8 CLAPPER BOX

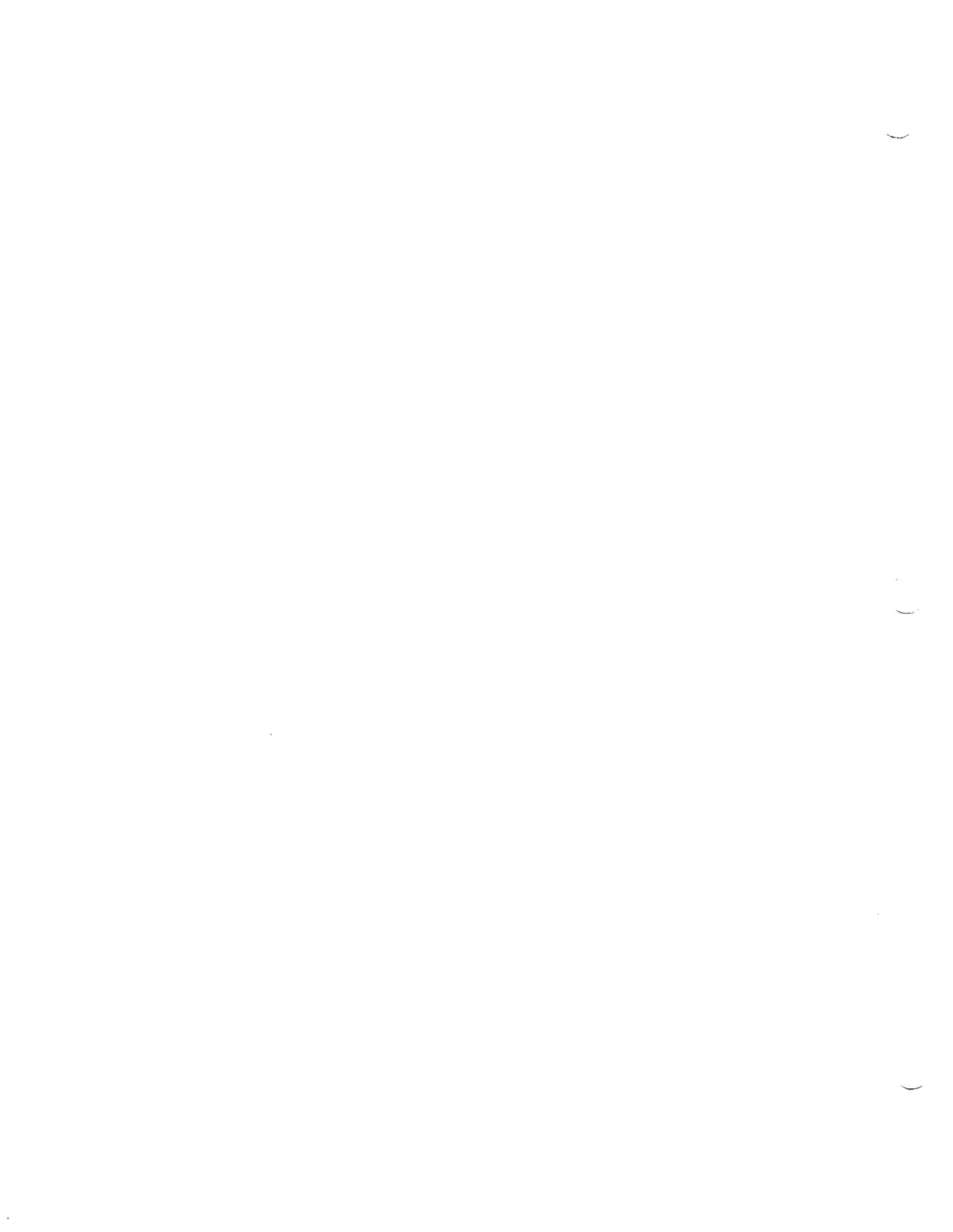
9 TOOL AND HOLDER

10 TOOL POST

11 VISE

12 TABLE

13 TABLE SUPPORT



## SHAPER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

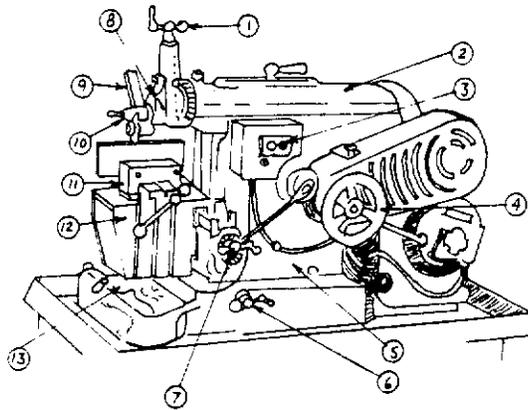
(Circle true or false)

- |  |   |   |
|--|---|---|
| 1. A heavy cut may get the job done more quickly but also could be unsafe. | T | F |
| 2. Chips may be removed while the machine is running.                      | T | F |
| 3. Eye protection must be worn.  | T | F |
| 4. All clearances should be checked before the ram is set in motion.       | T | F |
| 5. It is permissible to stand in front of the machine while it is running. | T | F |
| 6. All setups should be approved by the teacher.                           | T | F |
| 7. The shaper must never be left running and unattended.                   | T | F |
| 8. The operator can visit with others while running the shaper.            | T | F |
| 9. The machine and area should always be cleaned with a brush.             | T | F |
| 10. The lever should be in a forward position before starting the motor.   | T | F |
| 11. Long hair that isn't confined might get caught in the shaper.          | T | F |
| 12. It's all right to lay tools on the machine.                            | T | F |
| 13. The part should be securely held in a vise.                            | T | F |
| 14. One can adjust the shaper while it is running.                         | T | F |

(Circle true or false)

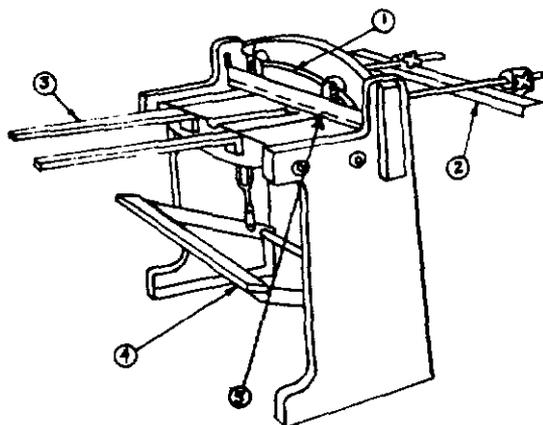
15. Fences and guards should be fastened tightly in place.            T        F
16. It's all right to stand in front of the ram.            T        F
17. It's all right to stand behind the ram.            T        F

18. In the spaces provided, identify the parts of the shaper:



- |         |          |
|---------|----------|
| 1 _____ | 8 _____  |
| 2 _____ | 9 _____  |
| 3 _____ | 10 _____ |
| 4 _____ | 11 _____ |
| 5 _____ | 12 _____ |
| 6 _____ | 13 _____ |
| 7 _____ |          |

## SQUARING SHEAR

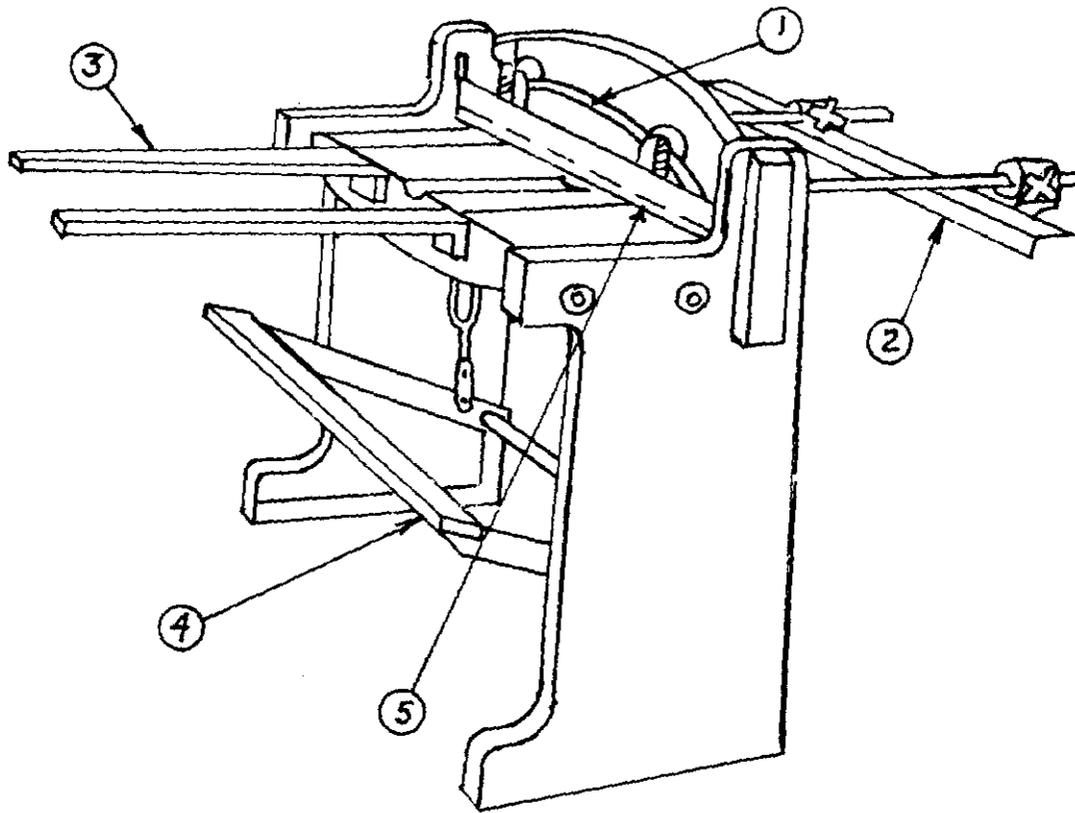


1. HOLD-DOWN GUARD
2. BACK GAUGE
3. EXTENSION ARMS
4. FOOT PEDAL
5. SEE-THROUGH SAFETY GUARD

1. Never cut excessively small pieces on a shear.
2. Wear eye protection.
3. Never reach behind the shear to support the metal. This places the operator in an awkward position, subject to a fall, and also puts the operator's fingers in a blind area.
4. Use care in handling the sheared, razor-sharp metal.
5. Keep the foot that is not being used out from under the treadle.
6. Feed and operate the machine from the front or the operator's position.
7. Always keep the fingers at least four inches from the hold-down guard and blade.
8. Operate the machine only with the teacher's permission and after instruction has been received.
9. When squaring, always hold the metal against the squaring bar on the left.
10. Pick up all metal scrap and place it in proper containers.

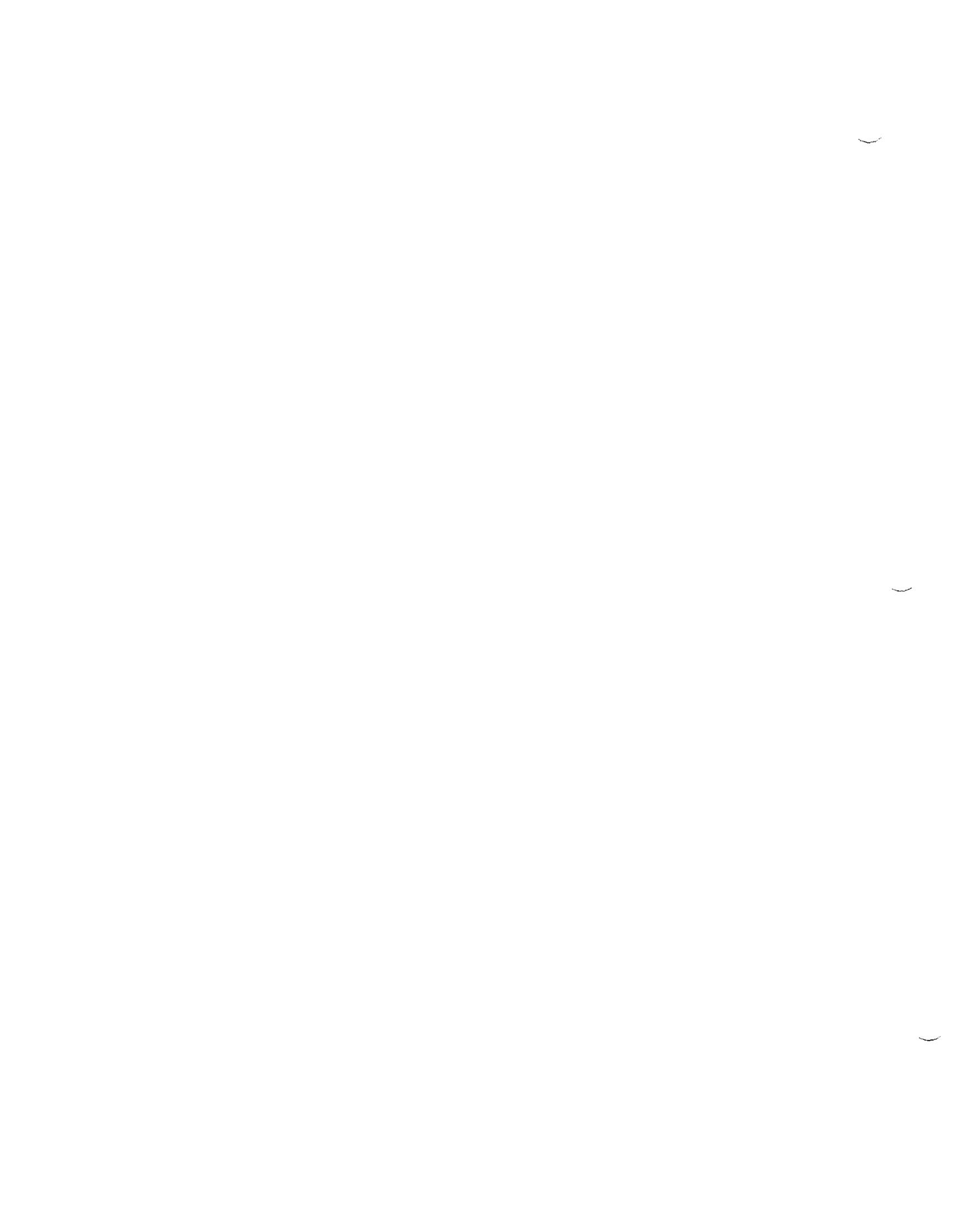
11. Get help when cutting large pieces of sheet metal.
12. Keep the floor in front of the shear clean and clear in order to avoid slipping.
13. Guards must be in place at all times, including the hold-down guard and a transparent guard in front of the hold-down guard to prevent fingers from entering under the guard.
14. Do not attempt to cut narrow strips of metal lengthwise.
15. Check the setup and machine before operating it.
16. Never surpass the capacity of the machine.
17. Regulate the pressure on the treadle according to the gauge and type of stock. Keep the foot on the treadle to ease its return to a normal position.

# SQUARING SHEAR



1 HOLD-DOWN GUARD  
2 BACK GAUGE

3 EXTENSION ARMS  
4 FOOT PEDAL  
5 SEE-THROUGH SAFETY GUARD



## SQUARING SHEAR SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

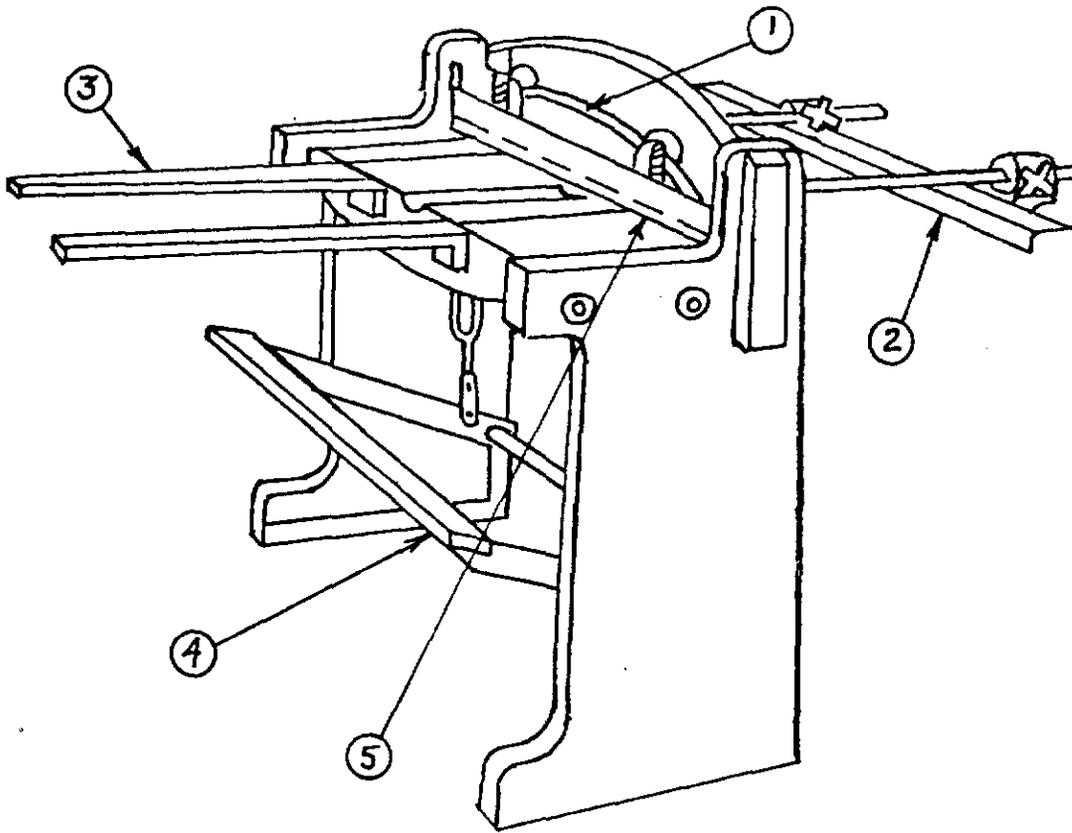
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

(Circle True or False)

- |   |   |   |
|---|---|---|
| 1. For some projects, the guard can be removed.   | T | F |
| 2. One should feed and operate only from the treadle side of the machine.                         | T | F |
| 3. Eye protection is not required.  | T | F |
| 4. Care in handling of sheared metal should always be observed because the edges are razor sharp. | T | F |
| 5. One should never reach forward enough to permit the fingers to get under the hold-down bar.    | T | F |
| 6. It is poor practice to jump on the treadle.  | T | F |
| 7. One should not bother the teacher for permission to use the shear.                             | T | F |
| 8. The metal should be held against the squaring bar on the left side when squaring it.           | T | F |
| 9. Guards must not be removed from the shear.   | T | F |
| 10. The shear can cut any thickness of metal.   | T | F |
| 11. The shear does not require any adjustment before operating.                                   | T | F |
| 12. One should not attempt to cut long, narrow strips lengthwise.                                 | T | F |
| 13. Both feet are needed to operate the treadle.  | T | F |

14. In the spaces provided, identify the parts of the squaring shear:



1 \_\_\_\_\_

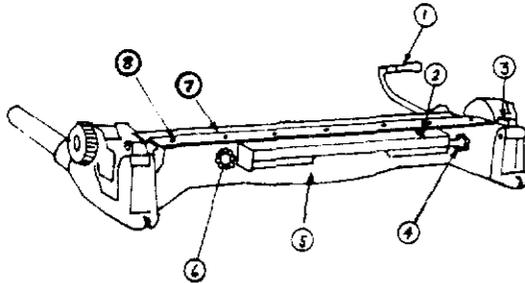
2 \_\_\_\_\_

3 \_\_\_\_\_

4 \_\_\_\_\_

5 \_\_\_\_\_

## BAR FOLDER

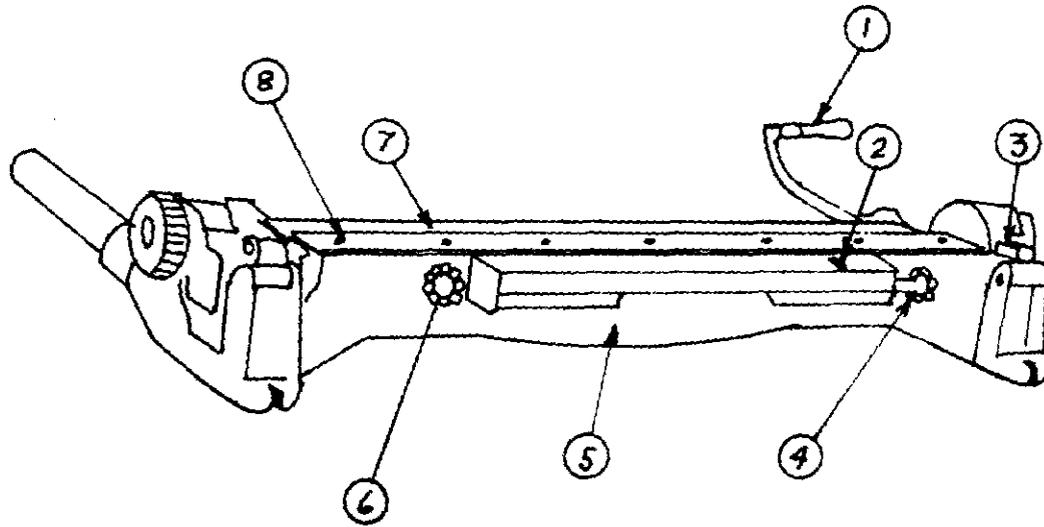


1. OPERATING HANDLE
2. DEPTH GAUGE
3. 450-900 STOPS
4. DEPTH GAUGE WHEEL
5. BASE
6. LOCK WHEEL
7. WING
8. BLADE

1. Remove jewelry, eliminate loose clothing, and confine long hair.
2. Use proper eye protection at all times.
3. Operate only with the teacher's permission, and after instruction has been received.
4. Make sure all guards are in place and operating correctly.
5. Make bends smoothly and steadily.
6. Restore the machine lever to its proper position after each operation.
7. Remove the sharp burrs and edges on sheet metal before folding it.
8. Hold the handle firmly.
9. Keep hands clear of movable parts.
10. Make sure that no one but the operator is inside the operator zone.
11. Let the handle down slowly after completing a bend.
12. Work with only one piece of metal at a time. Never double the thickness or fold two pieces side by side.
13. Do not force, hit, or drop levers or handles.



# BAR FOLDER



- 1 OPERATING HANDLE
- 2 DEPTH GAUGE
- 3 45°-90° STOPS
- 4 DEPTH GAUGE WHEEL
- 5 BASE
- 6 LOCK WHEEL
- 7 WING
- 8 BLADE



## BAR FOLDER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

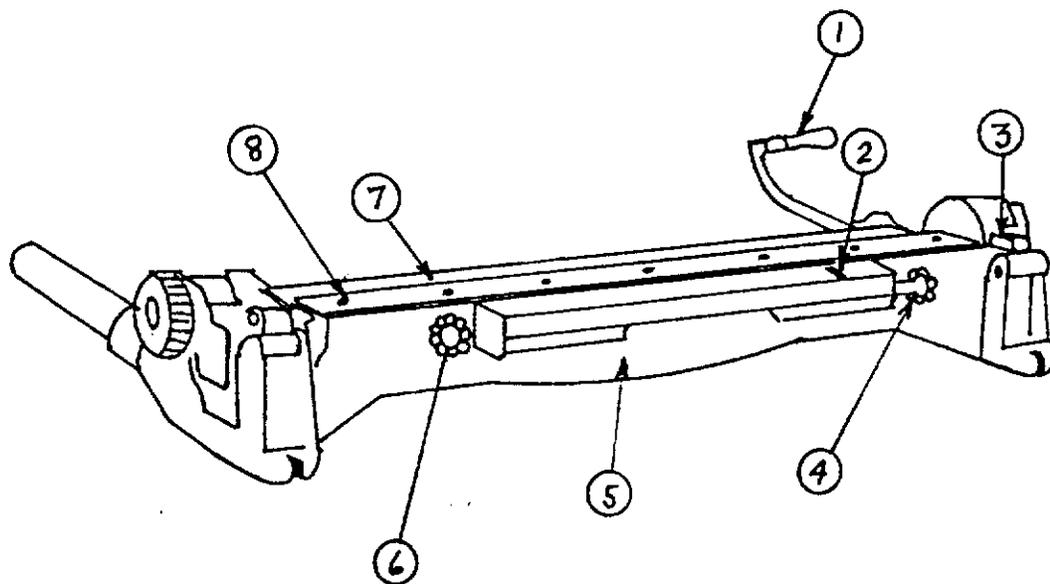
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

(Circle true or false)

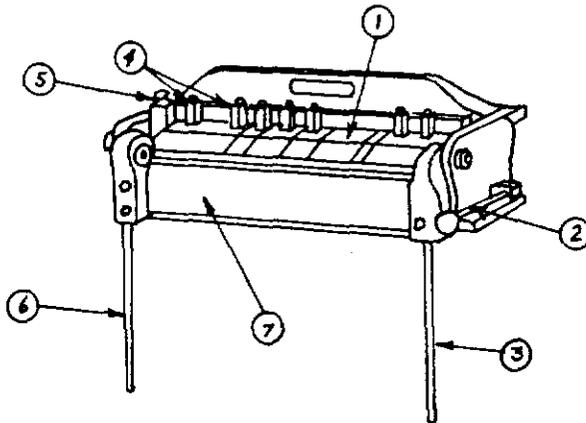
- |   |   |   |
|---|---|---|
| 1. Sharp burrs and edges should be removed before attempting to place metal in the machine.                                 | T | F |
| 2. Fingers must be kept clear of moving parts.  | T | F |
| 3. Two pieces of metal can be bent at the same time.  | T | F |
| 4. If a handle becomes stuck in position, tap it lightly with a hammer.   | T | F |
| 5. Safety glasses are not needed on this machine.   | T | F |
| 6. No one but the operator should be in the operator zone.  | T | F |
| 7. The handle should be held loosely.   | T | F |
| 8. Hands must be kept clear of the moving parts of the folder.  | T | F |
| 9. A pupil must secure the teacher's permission before using the folder.  | T | F |
| 10. A person should make bends as fast as he/she can, so the next person can use the folder.                                | T | F |
| 11. If a pupil needs to bend a large piece of metal, he/she may remove any safety guards that are in the way of the folder. | T | F |

12. In the spaces provided, identify the parts of the bar folder:



1	_____	6	_____
2	_____	7	_____
3	_____	8	_____
4	_____		
5	_____		

## BOX AND PAN BRAKE

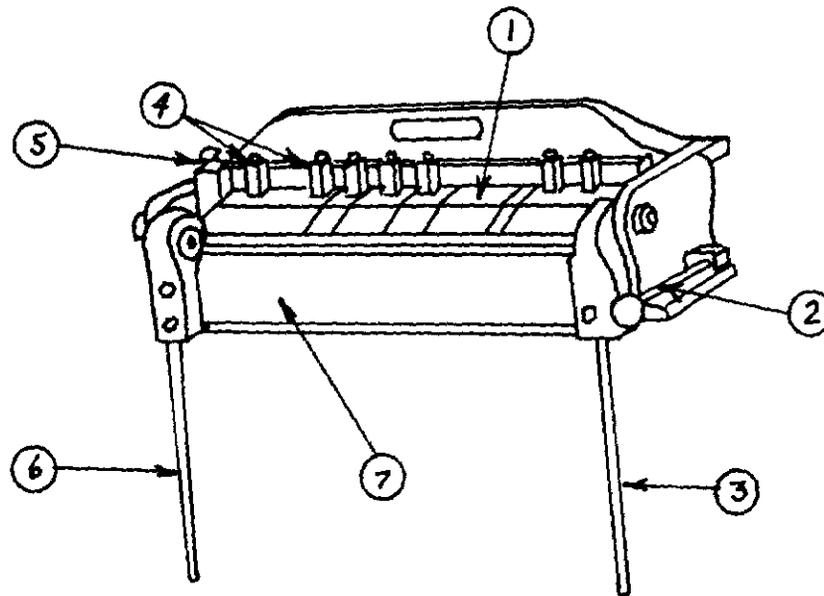


1. BLADE SEGMENTS
2. BLADE POSITION HANDLE
3. WING HANDLE
4. BLADE HOLDING BOLTS
5. HEIGHT ADJUSTMENT
6. WING HANDLE
7. WING

1. Never attempt to operate the brake until instruction has been given.
2. Obtain permission from the teacher before using the brake.
3. Wear safety glasses or goggles.
4. Keep the fingers clear of the clamping bar and blade.
5. Make sure no one but the operator is inside the safety zone.
6. Fold only a single thickness of sheet metal within the capacity of the brake.
7. Get assistance when bending large, thick material in order to avoid back strain.
8. Hold the handle firmly.
9. Make sure the area in front of the brake is clear before swinging the wing up.
10. Let the bar down slowly after completing a bend.
11. In order to avoid cuts, carefully handle the sheet metal that is being formed.
12. Keep the floor area in front of the brake clear and clean to avoid slipping.

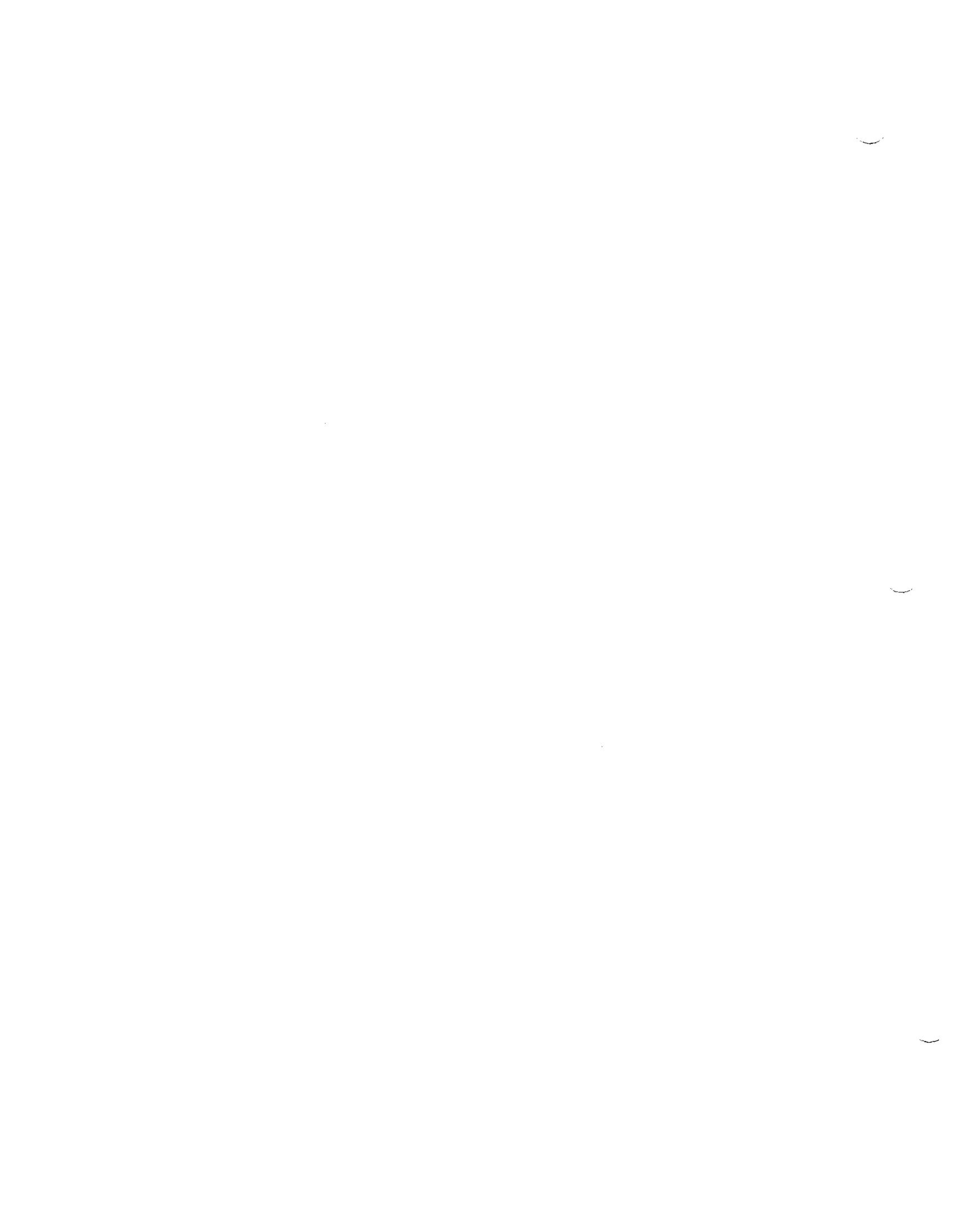


# BOX AND PAN BRAKE



- 1 BLADE SEGMENTS
- 2 BLADE POSITION HANDLE
- 3 WING HANDLE
- 4 BLADE HOLDING BOLTS

- 5 HEIGHT ADJUSTMENT
- 6 WING HANDLE
- 7 WING



## BOX AND PAN BRAKE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

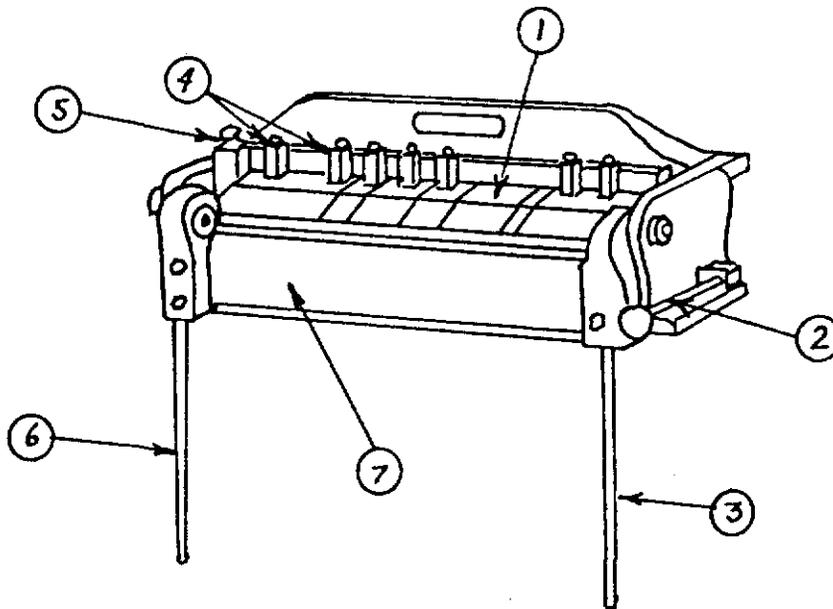
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. One should always release the bar quickly after completing a bend.                                     | T | F |
| 2. Safety glasses must always be worn when using the brake.   | T | F |
| 3. The handle should be held firmly.  | T | F |
| 4. If necessary, more than one piece of metal can be folded at a time.                                    | T | F |
| 5. A person should get assistance when bending large pieces of sheet metal.                               | T | F |
| 6. Sheet metal can cause severe cuts.   | T | F |
| 7. When one has finished with the brake, he/she should throw the scrap metal in a neat pile on the floor. | T | F |
| 8. One does not have to ask the teacher's permission in order to use this simple machine.                 | T | F |
| 9. No one but the operator should be inside the safety zone.  | T | F |
| 10. The clamping bar can pinch the fingers.   | T | F |

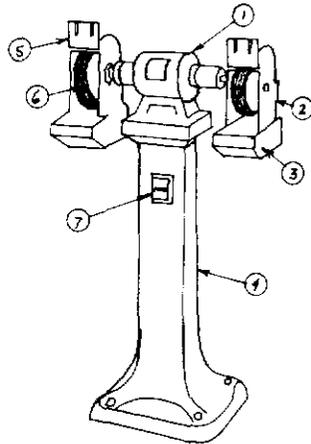
11. In the spaces provided, identify the parts of the box and pan brake:



1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_

5 \_\_\_\_\_  
6 \_\_\_\_\_  
7 \_\_\_\_\_

## BUFFER

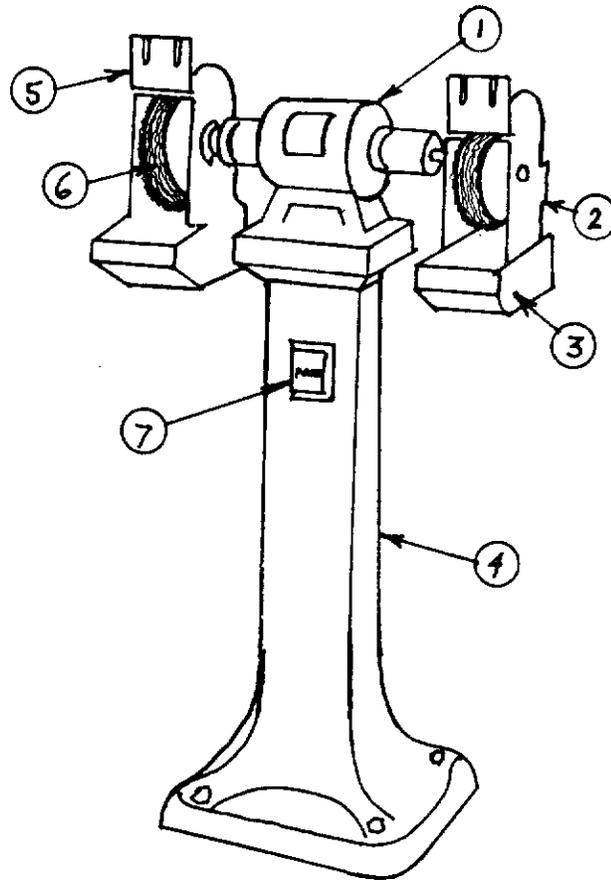


1. MOTOR
2. WHEEL GUARD
3. DUST CHUTE
4. PEDESTAL
5. SAFETY DEFLECTOR
6. BUFFING WHEEL
7. SWITCH

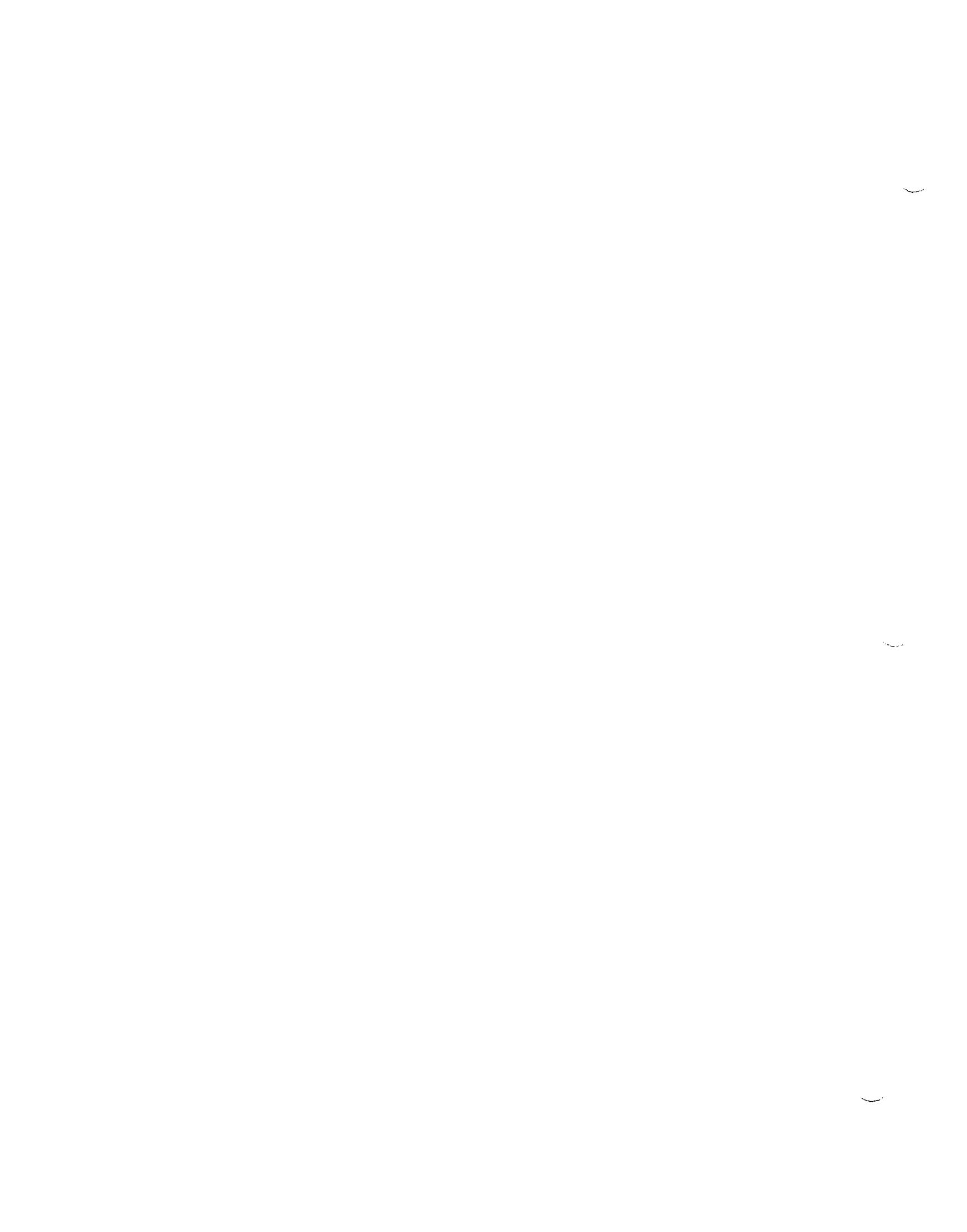
1. Buffers shall be provided with suitable hoods or enclosures that are connected to an exhaust system. (OSHA)
2. A pupil must obtain permission from the teacher before using the buffer.
3. Use both hands to hold the work securely.
4. The teacher should be asked for special instruction and permission to buff small pieces.
5. A face shield and safety glasses shall be worn.
6. Compound should be applied sparingly.
7. Hands must be kept away from the wheel while it is in motion.
8. Work should be held below the center (horizontal axis) of the wheel as it revolves toward the operator.
9. Flat surfaces must be buffed from the center toward the outer edges. Sharp edges should point downward.
10. Material should be pressed against the wheel with just enough pressure to cause the wheel to polish the material.
11. The power must be turned off after using the buffer.

12. The buffer and its area should be cleaned with a brush or an air gun.
13. One should always stand to one side of the wheel when applying compound.
14. Gloves, rags, or part of a shop coat must never be used to hold the workpiece.
15. Caution should be exercised to avoid burning the hands by overheating the workpiece.
16. Jewelry should be removed, loose clothing eliminated, and long hair confined.
17. The operator should make sure all guards are in place and operating correctly.
18. It is important to use care when buffing around corners or openings where the wheel could grab or throw the workpiece.
19. The area behind the buffer should always be open, and no one but the operator should be in the safety zone.
20. One should never take one's eyes off the work even for an instant while using the buffer.

# BUFFER



- |   |             |   |                  |
|---|-------------|---|------------------|
| 1 | MOTOR       | 5 | SAFETY DEFLECTOR |
| 2 | WHEEL GUARD | 6 | BUFFING WHEEL    |
| 3 | DUST CHUTE  | 7 | SWITCH           |
| 4 | PEDESTAL    |   |                  |



## BUFFER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

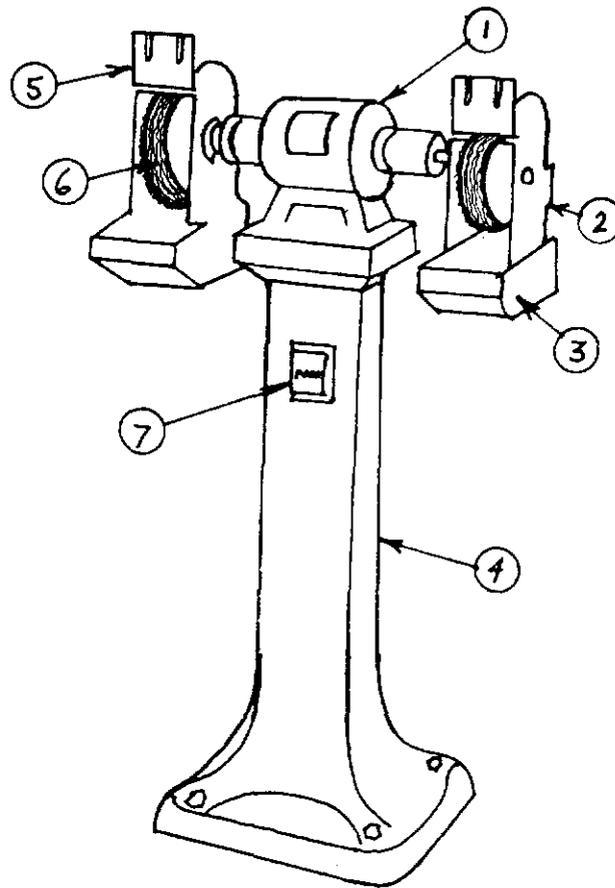
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

(Circle true or false)

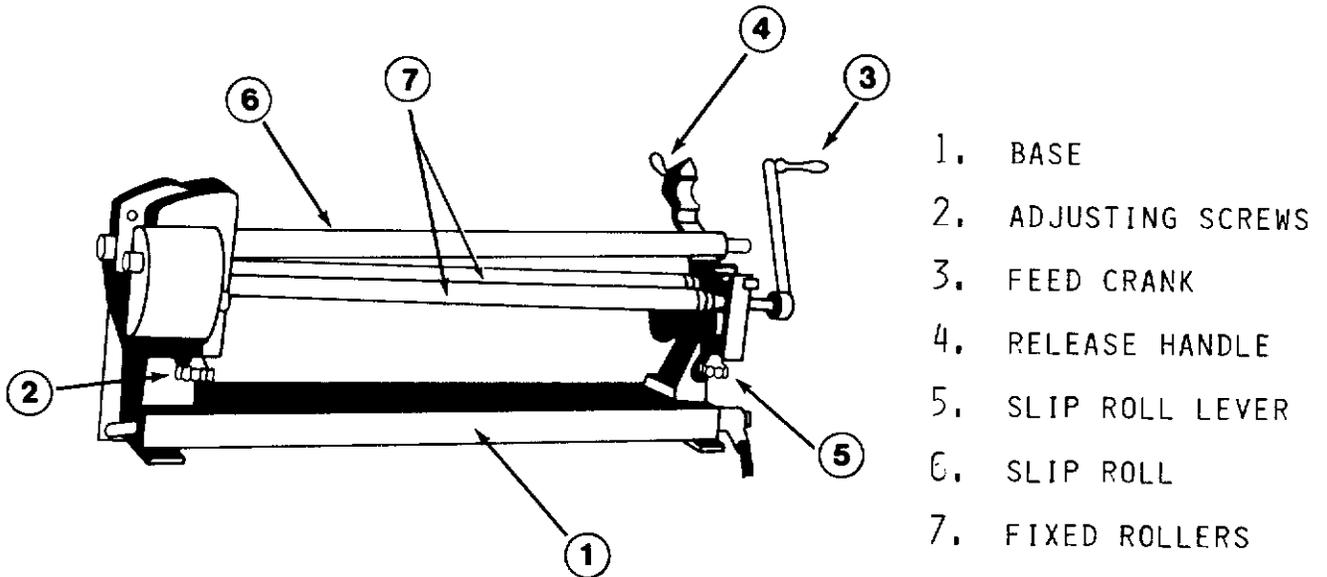
- |   |   |   |
|---|---|---|
| 1. A rag should be used to hold hot objects while buffing.  | T | F |
| 2. One should always buff on the lower half of the wheel.   | T | F |
| 3. It is not necessary to wear eye protection if buffing compound is used.  | T | F |
| 4. Special permission to buff small pieces must be obtained from the teacher.   | T | F |
| 5. A person who is using the buffer should point the sharp edges of his/her work upwards.                             | T | F |
| 6. A heavy coat of compound should be applied to the wheel.   | T | F |
| 7. A person should stand to one side when applying compound to the wheel.   | T | F |
| 8. One should keep one's eyes on the work at all times.   | T | F |
| 9. The operator should lightly touch the wheel with his/her hand to check for the proper amount of compound.          | T | F |
| 10. A person who is applying too much pressure when buffing around corners can cause the wheel to grab the workpiece. | T | F |
| 11. No more than two people should work on the buffer at a time.  | T | F |

12. In the spaces provided below, identify the parts of the buffer:



1	_____	5	_____
2	_____	6	_____
3	_____	7	_____
4	_____		

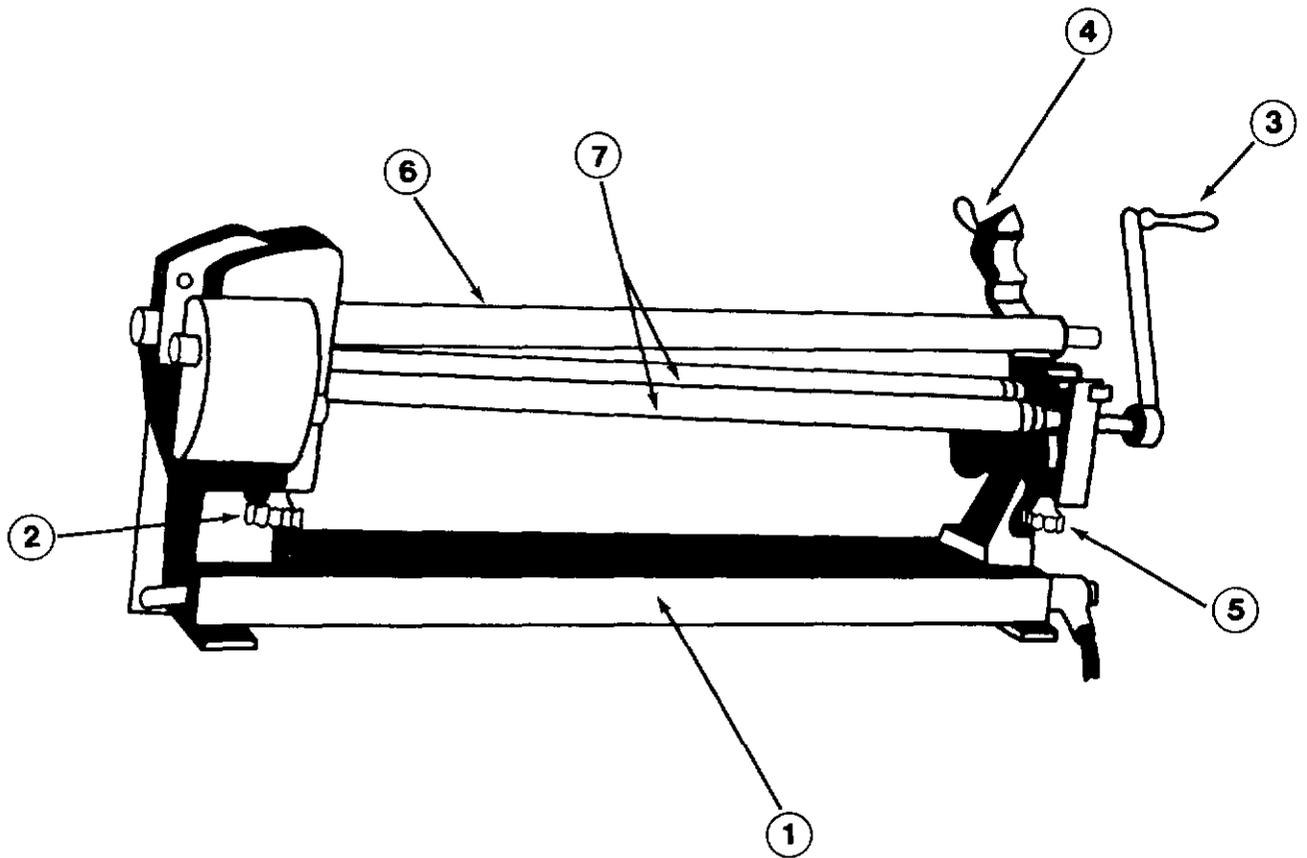
## SLIP ROLL FORMING MACHINE



1. Remove jewelry, eliminate loose clothing, and confine long hair.
2. Proper eye protection should be worn.
3. The machine should be operated only with the teacher's permission and after instruction has been received.
4. Sharp burrs and edges should be removed from sheet metal before it is rolled.
5. Hands should be kept clear of the rollers.
6. If the workpiece is large and unwieldy, an assistant should be used to help hold the workpiece during rolling.
7. Only a single piece should be rolled at a time.
8. The crank should be turned slowly.
9. Make several passes; do not try to make the roll on a single pass.
10. The gauge rating of the slip roll forming machine should not be exceeded.
11. Show caution when removing a rolled piece from the slip roll.



# SLIP ROLL FORMING MACHINE



- |                     |                    |
|---------------------|--------------------|
| 1. BASE             | 5. SLIP ROLL LEVER |
| 2. ADJUSTING SCREWS | 6. SLIP ROLL       |
| 3. FEED CRANK       | 7. FIXED ROLLERS   |
| 4. RELEASE HANDLE   |                    |



## SLIP ROLL FORMING MACHINE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

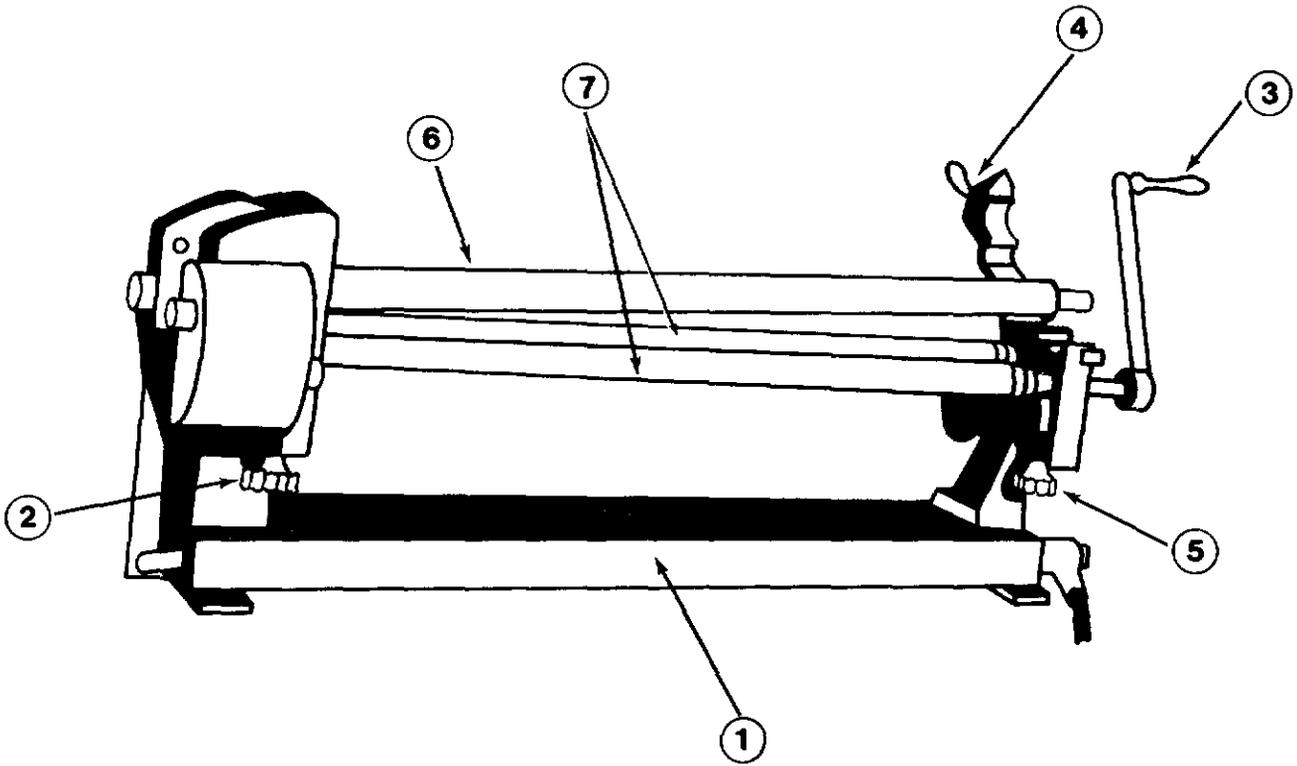
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. Safety glasses are not needed when using this machine.                           | T | F |
| 2. A pupil must secure teacher's permission before operating this machine.          | T | F |
| 3. The operator should try to completely roll the piece on a single pass.           | T | F |
| 4. Sharp burrs and edges should be removed before the metal is rolled.              | T | F |
| 5. Under no circumstances should a second person help place stock into the machine. | T | F |
| 6. Several pieces can be rolled at the same time.                                   | T | F |
| 7. Hands must be kept clear of the rollers.   | T | F |

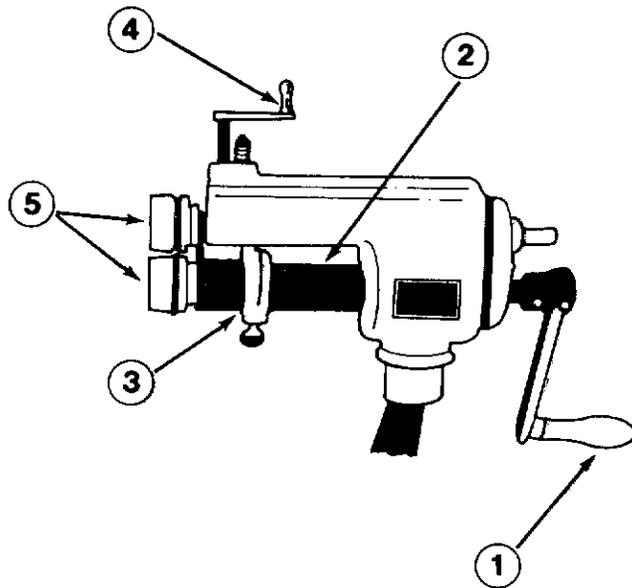
8. In the spaces provided, identify the parts of the slip roll forming machine:



1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_

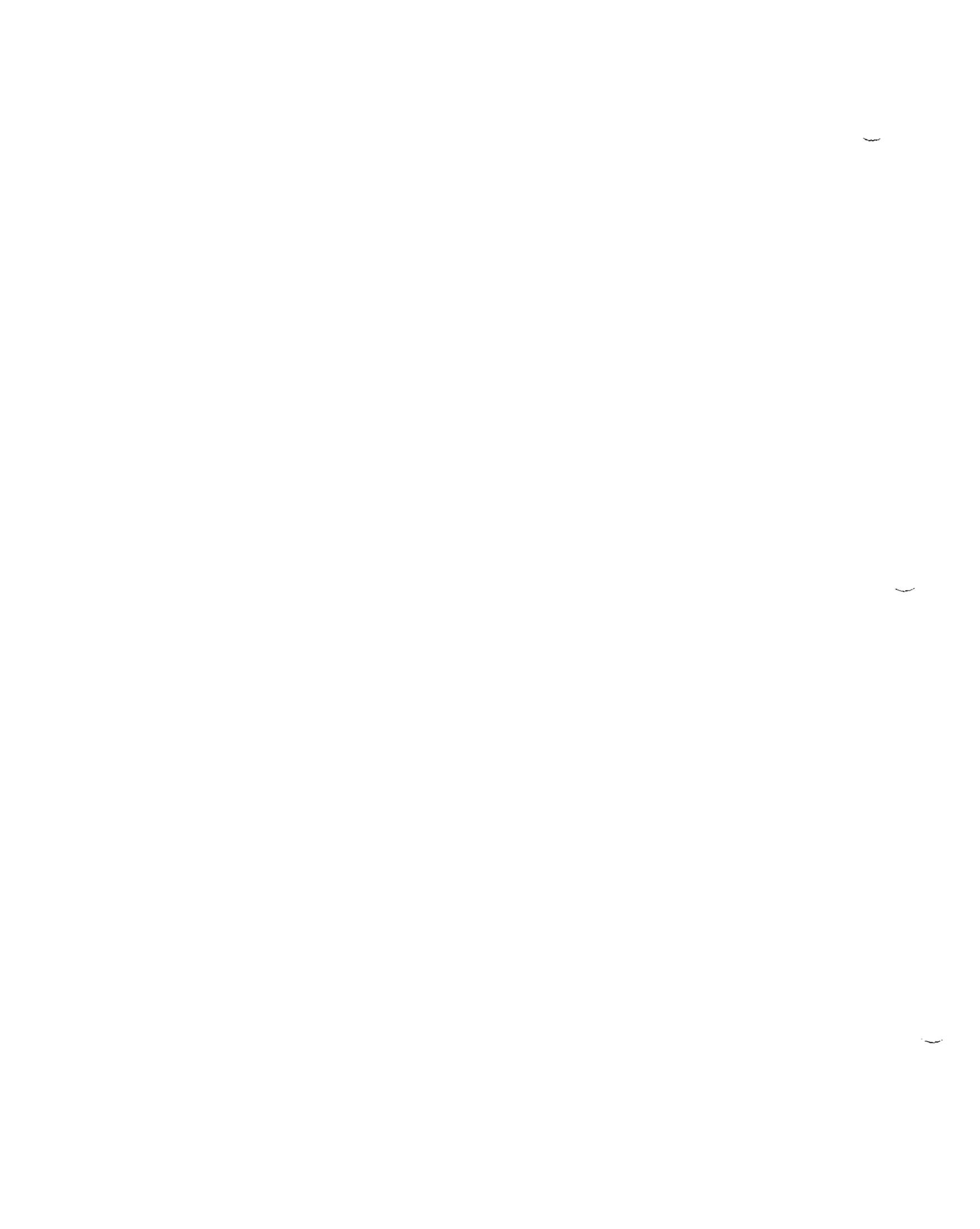
5 \_\_\_\_\_  
6 \_\_\_\_\_  
7 \_\_\_\_\_

## COMBINATION ROTARY MACHINE

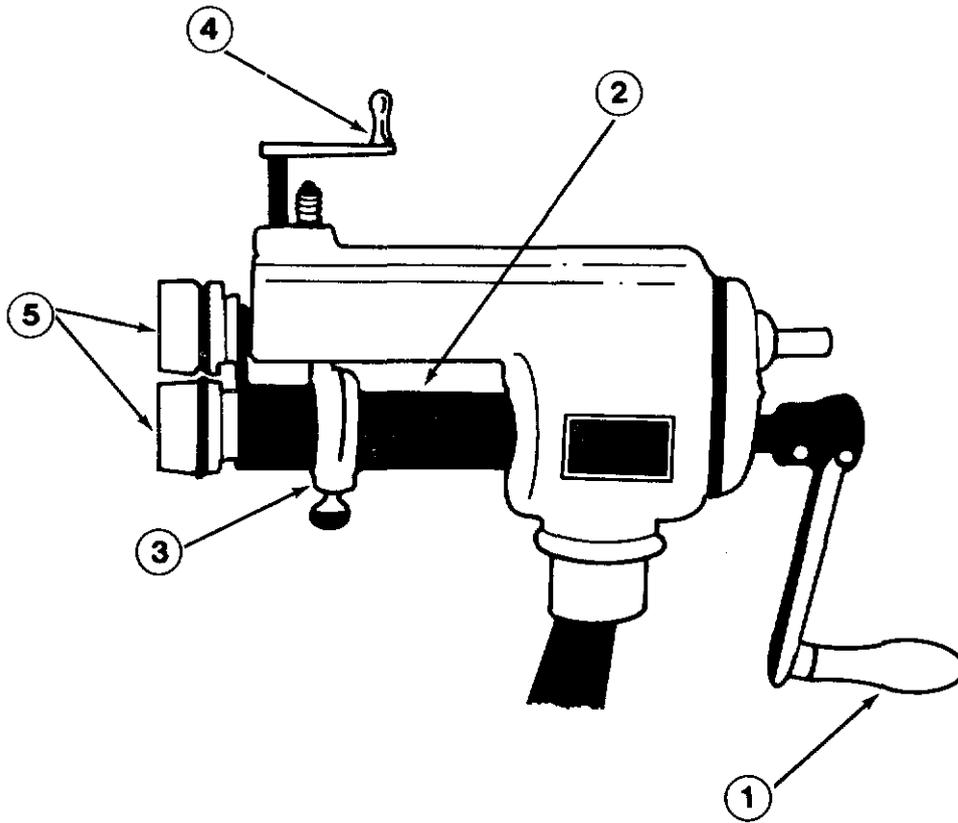


1. FEED CRANK
2. THROAT
3. DEPTH GAUGE
4. TENSION ADJUST
5. ROLL FORMERS

1. Remove jewelry, eliminate loose clothing, and confine long hair.
2. Use proper eye protection.
3. Operate only with teacher's permission and after instruction has been received.
4. Sharp edges and burrs should be removed from sheet metal before it is rolled.
5. Keep hands clear of roll formers.
6. Turn the feed crank smoothly.
7. Get assistance when forming long, awkward workpieces.
8. Do not exceed the gauge rating of the combination rotary machine.
9. Check to be sure that roll formers have been installed properly in pairs.
10. Only a single piece should be rolled at a time.
11. Handle sheet metal carefully to avoid cutting yourself.



# COMBINATION ROTARY MACHINE



- 1. FEED CRANK
- 2. THROAT
- 3. DEPTH GAUGE

- 4. TENSION ADJUST
- 5. ROLL FORMERS



## COMBINATION ROTARY MACHINE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

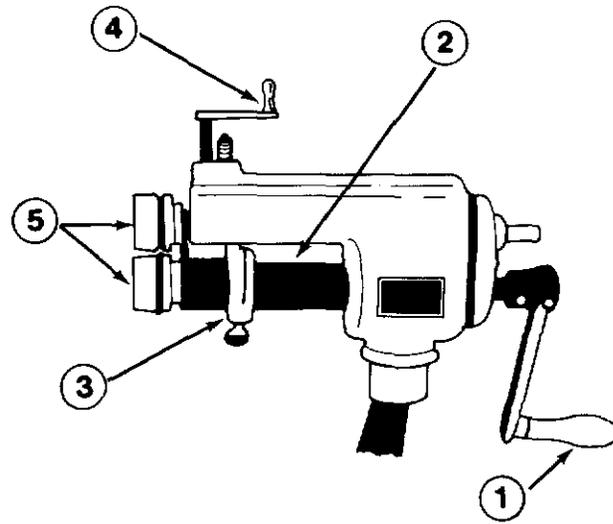
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. A pupil must secure teacher's permission before using this machine.                      | T | F |
| 2. Because this is a hand-operated machine, it poses no threat to the operator.             | T | F |
| 3. Safety glasses are not needed when using this machine.                                   | T | F |
| 4. You should remove sharp burrs and edges before attempting to form stock on this machine. | T | F |
| 5. Hands should be kept clear of the roll formers.  | T | F |
| 6. Several thicknesses of stock can be formed at the same time.                             | T | F |

7. In the spaces provided, identify the parts of the combination rotary machine:



1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_

4 \_\_\_\_\_  
5 \_\_\_\_\_

TOXIC EFFECTS OF METALS

<u>Metal</u>	<u>Uses</u>	<u>Effects</u>	<u>Exposure Limits</u>
Aluminum	Building, packaging, cars, air planes, cans	Thought to be nontoxic. Suspected of causing lung disease, brain disease. Currently being investigated. May cause delayed asthma reactions.	fumes--5 mg/m <sup>3</sup>
Beryllium	Alloy with copper	Beryllium disease -- lumps in lung, usually leads to heart failure. Can start long after exposure, poor survival rate. Also causes allergic skin reactions. May cause cancer.	.00001 mg/m <sup>3</sup> OSHA
Cadmium	Additive in brass and bronze, batteries, electroplating, solders	Short term--fire hazard; nausea; headache; cough; eye, nose, throat irritation. Long term---emphysema-like lung disease, skeletal bone problems, kidney problems. High exposure--pneumonia-like lung disease.	0.05 mg/m <sup>3</sup> ceil. 0.04 mg/m <sup>3</sup> NIOSH
Chromium	Cleaning metal, electroplating, alloy with iron to make stainless steel, some cements, chromium salts used in preserving wood	Thought to be nontoxic as a dust. Chromic acid causes skin lesions, "chrome holes" that do not heal on hands and arms and in the nose. Mist may cause lung problems. Some chromates can cause lung cancer, skin rashes from contact.	0.05 mg/m <sup>3</sup> 0.001 mg/m <sup>3</sup> for cancer-causing types
Cobalt	Aluminum and iron alloys, carbide steel, magnets	Short term--skin rashes and allergies. Relatively low toxicity. Allergic lung reaction--asthma. Long term---lung disease, may reverse after exposure stops.	0.1 mg/m <sup>3</sup>

Toxic Effects of Metals, continued

Metal	Uses	Effects	Exposure Limits
Copper	Main component in bronze and brass. Used to conduct electricity	Generally considered harmless. Main effects-- metal fume fever, skin and eye irritation.	0.1 mg/m <sup>3</sup> for fumes, OSHA
Iron	Iron and steel alloys	Short term--metal fume fever. Long term---siderosis--a nonserious lung disease where iron fumes deposit in the lung but cause no impairment. Occurs in electric arc welders after many years exposure (10-20 years). They can, however, block X-Rays and make them more difficult to read.	5 mg/m <sup>3</sup>
Lead	Many uses such as lead solder, lead paint, batteries, gasoline additives	Serious toxic effects on nervous system, reproductive system, kidney, liver, spleen, anemia, lead palsy or "wrist drop"--loss of strength in wrist and middle two fingers--first sign of nerve damage. May eventually lead to brain damage, paralysis, and convulsions. Reproductive system--can harm fetus, also can cause infertility in both males and females. Diagnosis--measure blood lead level.	varies from .05 to .2 mg/m <sup>3</sup> depending on the industry. Also being contested in courts.
Magnesium	In carbon steel, ductile iron alloys, jet air planes, autos, boat, tools, machinery.	Not a serious health hazard. A fire hazard. Short term--metal fume fever. May cause inflammation of wounds.	OSHA 15 mg/m <sup>3</sup> ACGIH 10 mg/m <sup>3</sup>

Toxic Effects of Metals, continued

Metal	Uses	Effects	Exposure Limits
Manganese	In high alloy wrought steel, batteries, and welding sticks	Short term--metal fume fever and, rarely, a pneumonia lung disease. Long term---managanese poisoning--a crippling but not fatal disease affecting the nervous system. Apathy and sleeplessness lead to muscle and walking problems, speech disturbance, and "uncontrollable laughter". Cripples for life. Onset is usually delayed.	1 mg/m <sup>3</sup>
Mercury	In aluminum alloys, mercury solder, electrical use	Neurological damage--tremors, shakes, psychological irritability, restlessness. Can also cause gum disease, speech abnormalities. Easily penetrates skin and clothing. Long term---kidney damage also.	0.05 mg/m <sup>3</sup>
Nickel	Bronze, nickel, steel alloys, plating operations	Not very toxic. "Nickel itch"--eczema-type skin reaction. Nickel carbonyl, though, is formed when nickel is burned and is very toxic. It starts with headache, nausea, leads to chest pain, shortness of breath, and eventually to lung disease, brain disease, and cancer of the nose and lung. Also causes fetal deformaties.	1 mg/m <sup>3</sup> nickel fume. OSHA .007 mg/m <sup>3</sup> ACGIH .350 mg/m <sup>3</sup> for nickel carbonyl
Phosphorus	Bronze additive, matches, fireworks	Some forms are not toxic. White or yellow phosphorus, though, can cause bone damage ("phossy jaw"); liver damage; pneumonia, eye, nose, and throat irritation; and skin burns. It is also very flammable and must be kept under water to prevent fires.	yellow 0.1 mg/m <sup>3</sup>

Toxic Effects of Metals, continued

Metal	Uses	Effects	Exposure Limits
Selenium	Smelting by-product, hardening additive	Creates strong garlic odor in sweat and urine. Also causes skin burns, liver damage, stomach problems, throat irritation, tooth cavities. Causes cancer in animals. Selenium oxychloride--used as a solvent and resin plasticizer is very damaging to the skin.	0.2 mg/m <sup>3</sup>
Tellurium	Copper refining, alloyed with tin, copper, steel, lead, and iron	Garlic odor in sweat, breath, and urine. Dry metallic taste in mouth, stomach pains, itchy scaly skin, nausea.	0.1 mg/m <sup>3</sup>
Thallium	Contaminant in lead and zinc, iron additive	Very toxic (a main component of rat poison). Hair loss, joint and stomach pain, allergic sensitivity, and death. Absorbed easily from skin or if swallowed. Used in many suicides.	0.1 mg/m <sup>3</sup>
Tin	In aluminum, lead, nickel, copper, and zinc alloys. Tin coating. Solder, babbitt	Not considered harmful. Causes stannosis--a lung disease which causes no impairment but will show up on X-Rays and may confuse diagnoses.	2 mg/m <sup>3</sup>
	Organic tin--in paints and plastics, catalysts for urethane, polyvinyl chloride stabilizers, wood preservatives, silicone curing agents, insecticides	Very irritating to skin and eyes, delayed reaction. Serious health hazards.	0.1 mg/m <sup>3</sup>

Toxic Effects of Metals, continued

Metal	Uses	Effects	Exposure Limits
Titanium	Aircraft, missiles, tubing	Not toxic except for titanium chloride, which is very damaging to the skin, eyes, and lungs.	10 mg/m <sup>3</sup> ACGIH 15 mg/m <sup>3</sup> OSHA
Vanadium	Steel alloy	Lung damage--pneumonia or emphysema. Skin, eye, throat irritation. Nervous disorders, anemia.	0.1 mg/m <sup>3</sup> fumes--OSHA 0.05 mg/m <sup>3</sup> fumes--ACGIH
Zinc	Soldering flux, iron alloy, galvanizing	Very irritating to skin, eyes, throat, lungs. "Zinc chills"--metal fume fever is very common. May cause lung damage.	5 mg/m <sup>3</sup> --fumes

## REFERENCES

Materials were selected and reviewed from the following sources and in some instances were incorporated in the production of the preceding unit.

1. Baldor Electric Company
2. Bridgeport Textron Machine Division
3. Dake Corporation
4. DiAcro Houdville - Houdville Industries
5. Grinding Wheel Institute
6. K. O. Lee Company
7. McEnglevan Heat Treating Mfg.
8. NIOSH - U.S. Department of Health, Education, and Welfare
9. Ohio Industrial Arts and Vocational Education Department
10. OSHA - U.S. Department of Labor
11. Pennsylvania Industrial Arts Association and Department of Education
12. Pittsburg State University - L. Duane Griffin
13. Powermatic Tool Company
14. Rockwell Delta - Rockwell International
15. Roper Whitney, Incorporated
16. Shawnee Mission Public Schools - Bill Studwin
17. South Bend Lathe, Incorporated
18. Utah State Safety Guide
19. Washington State Industrial Arts Safety Guide
20. Wyoming State Department of Education

**PART 2:**  
**EQUIPMENT FOR WORKING WITH PLASTICS**

Heating Units

    Heating Oven

    Strip Heater

Injection Molder

Plastics Granulator

Vacuumformer

Pages 151-155 were adapted from Health and Safety Hazard Identification Program, produced by Industrial Department, United Brotherhood of Carpenters and Joiners of America, Washington, D. C., n.d.

Page 157 was adapted from Pennsylvania Industrial Arts Safety Guide, produced by Pennsylvania Department of Education and Industrial Arts Association of Pennsylvania, Harrisburg, Pennsylvania, 1981.

Pages 159-192 were adapted from Safety Education Handbook, produced by Kansas Department of Education, Wichita, Kansas, 1981.

## PLASTICS, GLUES, RESINS, AND FOAMS

By definition, a plastic is a material which is soft while being manufactured and hardens into a solid state as a finished product. Plastics have this capacity because they consist of large molecules which link together in a chain to form a huge stable molecule. Thus polyurethane is a chain of many urethane molecules linked together. Resin is just another name for the soft state of the plastic. Foams are one form of end product. Glues are often made with a plastic base dissolved in some type of solvent. When the solvent evaporates, the glue hardens to form a "plastic"-type material.

Plastics are generally divided into thermosetting and thermoplastic resins. Thermoplastics can be heated up and recast in some other form again and again. Thermosetting resins can only be cast once and cannot be remelted without destroying them. Also all plastics contain additives, such as plasticizers, stabilizers, hardeners, filling agents, colors, flame retardants, and catalysts. Each additive has a specific purpose. Plasticizers make the final product more flexible. Fillers will result in a harder, rougher plastic. Stabilizers keep it from being easily destroyed by temperature or over time. Catalysts cause the plastic to harden faster. Through the use of additives, an unlimited variety of plastics can be produced.

Since there are thousands of different plastics and glues, it is impossible to discuss here all the plastics or glues you may use or be exposed to. Instead we will discuss several of the more common ones, and if the one you use is missed, you can contact us and we will find information on it.

### Polyurethane

Polyurethane has been called a "super plastic" because of its many uses. It is used in glues, adhesives, coating materials, lacquers, foam for cushions, soles of shoes, etc. It consists of five separate components: an isocyanate, a polyol, a catalyst, a blowing agent (for making foam mostly), and a catalyst accelerator. When mixed together the foam is "cured" and hardens. It can also contain surfactants (chemicals to ensure uniform foaming) and fire retardants.

The most hazardous exposures occur when it is being mixed. This is partly because some components, like the isocyanate, become vapors quickly when mixing occurs. The reaction creating the plastic is "exothermic," meaning it gives off heat, increasing the production of vapor. Also, when the foam is cut with heat, this also allows additional vapor to be released.

Isocyanate. The most common isocyanate used, and also the most toxic, is toluene di-isocyanate or TDI (also known by the trade name Desmodur T80). Another common and less toxic one is methylene bis (4-phenyl) isocyanate or MDI (trade name of Caradate 30). Others include hexamethylene di-isocyanate (HMDI), naphthalene di-isocyanate (NDI), and di-isocyanate dicyclohexyl urethane. These are much less toxic than TDI and MDI.

All the isocyanates are very irritating to the eyes, nose, throat, lungs, and skin. They can cause coughing, breathlessness, chest pain, and in very high exposures, pneumonia and death. In addition, TDI is famous for being a "sensitizer" of the lungs. This means that when a worker comes into contact with it, (s)he may become allergic to it, as if s(he) were allergic to ragweed pollen but much worse. It can cause asthma attacks when even a very small, undetectable amount is present.

That sensitized worker must be removed from all exposure and, preferably, placed in a different building since even sharing the same ventilation system with a room where TDI is being used may cause an attack. Presumably only a small percentage of workers will become sensitized but it has been shown that the larger the exposure, the more likely it is that you will be sensitized. High exposures can sensitize an individual on the first exposure. Some cases exist where, for unknown reasons, a person eventually loses his or her allergy to TDI, but this is rare.

More recently, isocyanates have been shown to cause decreased lung capacity from long-term exposures. They also are suspected of causing cancer and genetic mutations in humans based on recent experiments with bacteria.

Exposures will be particularly high if TDI is sprayed. OSHA has set a very low exposure limit for TDI (0.02 parts TDI per million parts of air). NIOSH would like to see that limit cut by three-fourths. Precautions to take include changing clothes to make sure TDI is not brought home; air monitoring by the company to check for contamination levels; and cleaning up spills immediately with a combination of water, ammonia, and isopropyl alcohol.

Using premixed polymers can effectively reduce exposures.

Catalysts. Either amine compounds or metal salts are used as catalysts to speed up curing of isocyanate resins. Both can be absorbed through the skin. The amines (such as morpholine, methyl morpholine, tetraethyl diamine) burn the eyes, nose, throat, skin, and lungs. Over long periods of exposure they may cause bladder and nerve problems. One peculiar effect is that they temporarily damage the cornea of the eye, causing hazy blue vision and halos to be seen around bright lights. This problem can be particularly serious since it impairs night driving.

Polyols. Are not toxic, but may cause slight skin irritation.

Blowing agents. Usually either freon or carbon dioxide are used. Freon may cause dizziness or light-headedness. Carbon dioxide is not hazardous except at very high levels.

Accelerators. Are usually organic tin compounds (such as dibutyl tin). These are severe skin and eye irritants and can cause damage to the nervous system.

Other additives. Include silicon (a surfactant) which is an eye irritant; phosphate esters (fire retardants) which are absorbed through the skin and can cause blurred vision, headaches, nausea, cramps, and breathing problems; and solvents such as methylene chloride which cause dizziness, nausea, skin rashes, irritation, and affect the nervous system.

### Polyvinyl Chloride (PVC)

Polyvinyl chloride is one of the most commonly used plastics today. Its component (vinyl chloride) monomer has long been known to have immediate toxic effects on the nervous system, causing light-headedness and depression. It also causes dulled vision and hearing, severe skin and eye irritation, and nausea. Frostbite can occur after evaporation from the skin. Recently, vinyl chloride has been definitely linked with a rare type of liver cancer called angiosarcoma, brain cancer, and lung cancer. Workers cleaning vats of vinyl chloride have developed "acroosteolysis," or destruction of the bones in the fingers. Vinyl chloride can be absorbed through the skin as well as inhaled.

Citric acid compounds, added to give it flexibility (as a plasticizer), can act as an anesthetic and also affect the blood pressure. Phthalic acid compounds (such as di-2-ethylhexyl phthalate), another plasticizer, has been known to cause fetal deformities when exposed to pregnant rats. They are considered relatively nontoxic, though.

Stabilizers, including calcium, magnesium, and oils, like soybean oil, are also added but are considered nontoxic. Organic tin compounds which are very toxic, causing eye and liver damage, are also used as stabilizers. Barium salts, another stabilizer, are very poisonous if swallowed and also can cause a nondisabling lung disease called baritosis.

### Epoxy Resins

Epoxy resins are used in paints, adhesives, sealing compounds, coatings for floors and roads, printed circuits, rocket nozzles, sports equipment (like skis), and machine parts. They are very versatile because they are lightweight and do not contain any solvents. They are, for that reason, used in aircrafts a lot to replace welding and riveting. They often contain diluents to make them more fluid; fillers, pigments; flexibilizers; fire retardants

(bromine or chlorine); accelerators; and modifiers, such as phenol, urea, melamine, polyester, polyurethane, silicone, vinyl, or nylon. Amine catalysts are used to decrease curing time. They can cause allergic reactions. Three, diethylene triamine (DEA), triethylene tetramine (TEA), and ethylene diamine, are known to cause sensitization and extreme allergic asthma attacks. They are also highly alkaline and cause extensive skin corrosion.

One main component of epoxy resins is epichlorohydrin. Immediate results of high exposures may be nausea, vomiting, stomach or liver pain, and difficulty in breathing. It is extremely irritating to eyes, nose, throat, lungs, and skin. Severe skin burns can occur several hours after contact. Long-term exposures may cause kidney, liver, and lung damage. It has also been declared a lung carcinogen (cancer-causing) substance in animals and possibly in humans.

Epoxy resins are generally a combination of epichlorohydrin with bisphenol A (4, 4'-isopropylidene-diphenol). Bisphenol A is known to cause skin rashes and may cause allergic skin reactions. It has been shown to penetrate both plastic and rubber gloves.

Because the reaction of the components is exothermic (gives off heat), fumes produced can cause respiratory problems. Later grinding, sanding, or polishing of epoxy resins may produce dust or fumes that can have the same effects on the skin and lungs.

### Acrylics

Acrylics produce glass-clear rigid plastics, such as lucite. They are commonly used in paints. They are skin, eye, nose, and throat irritants. They have a very unpleasant odor. They are made by combining a liquid and a powder. The liquid may contain an acrylic (such as methyl methacrylate) and an initiator (such as dimethyl p-toluidine). The powder will have more of the acrylic plus an activator (such as benzoyl peroxide).

Acrylates, like methyl methacrylate, have been shown in animal experiments to cause decreased blood pressure and heart rate, and increased breathing. They may cause cardiac arrest. They can cause allergic reactions in those workers who become sensitized to them. They also may affect the development of the fetus in pregnant workers. Benzoyl peroxide is an irritant, but may also be an explosion hazard in the powder form.

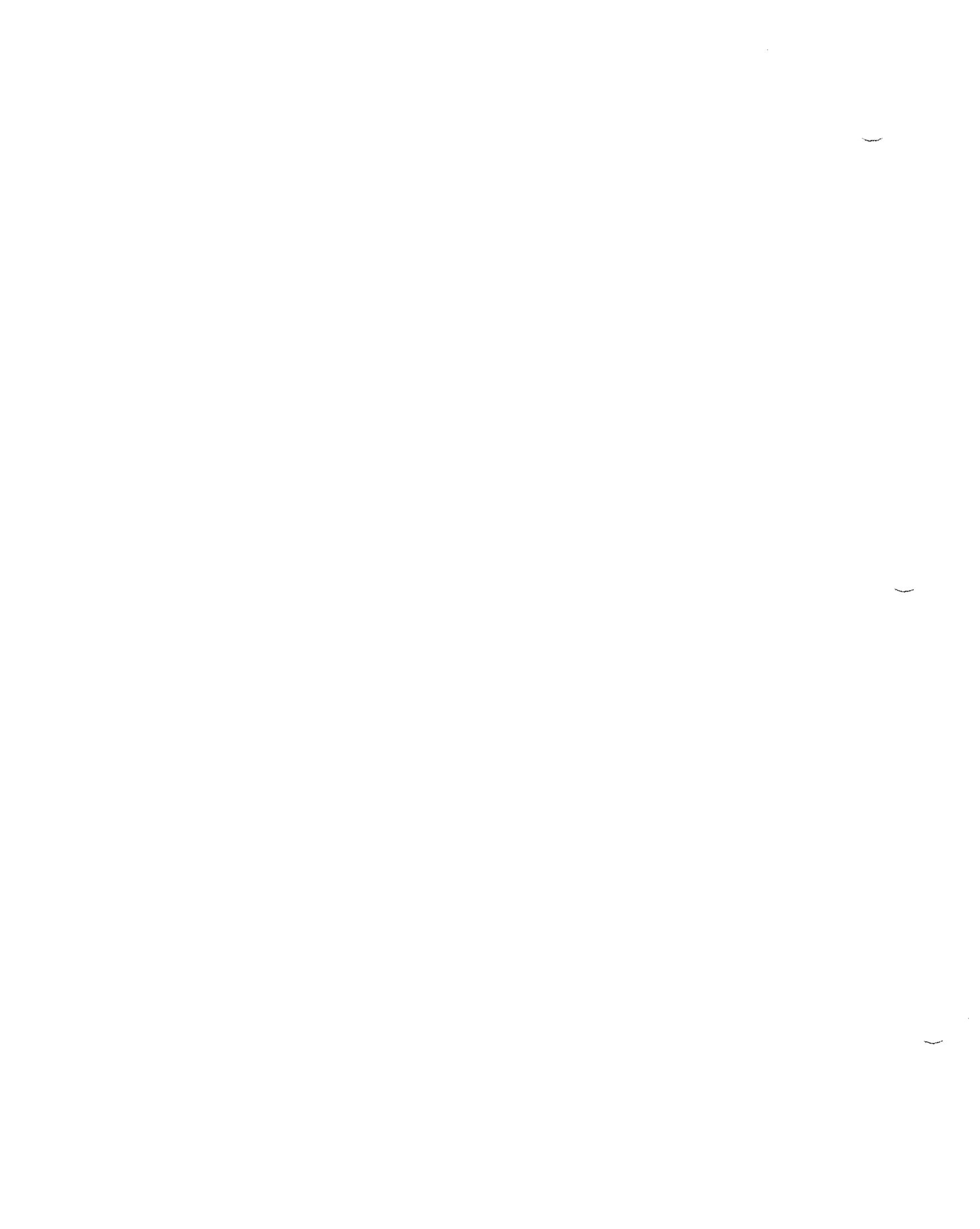
### Formaldehyde

Formaldehyde is used in glues for plywood, furniture, doors, sports equipment, and general assembly work. It is generally combined with either urea, phenol, or melamine. Urea-formaldehyde foam is a popular insulation material. When furfuryl alcohol is added, it may be used to make particle board. Bakelite is a

combination of phenol and formaldehyde used in furniture making. It is the mainstay of 17 industries and a raw material of 68 others.

Formaldehyde is a well-known irritant causing severe eye, nose, and throat irritation at very low levels (down to 1/30th the OSHA, PEL, permissible exposure limit of 3 ppm). Higher exposures (2-4 times the OSHA limit) can cause coughing, tightening of the chest, headache, and heart problems. Exposures 10 to 20 times the OSHA limit can cause death from pneumonia-like lung disease. It also causes severe skin rashes and may sensitize an individual, creating allergic reactions. Most recently it has been determined that it causes nasal cancer in rats. If present with hydrogen chloride, the two chemicals can combine to form bis-chloro-methyl-ether, a powerful human carcinogen, causing lung cancer. As a result, the Consumer Product Safety Commission has, in 1981, recommended that urea-formaldehyde foam be barred from use in home insulation.

Urea is an irritant but not supposed to be very toxic, being a normal part of human metabolism. Melamine is also supposed to be less toxic than formaldehyde. Phenol is a serious hazard for skin exposures. It penetrates the skin rapidly and has caused gangrene and coma even from repeated exposures to dilute solutions. It can also damage the eye severely if not rinsed out with water immediately. Small amounts swallowed will cause burning in the throat, stomach pain, headache, and ultimately coma and death. Inhalation of phenol vapors can cause damage to the lungs, liver, and kidneys. It can be smelled at very low levels, way below the OSHA limit of five parts per million.



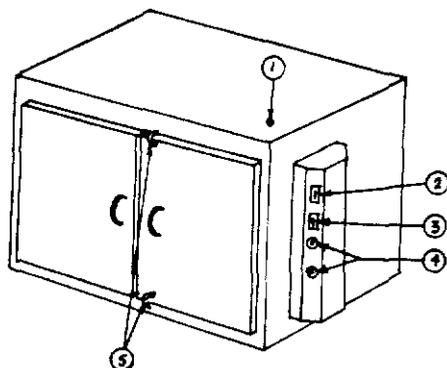
## SAFETY RULES FOR WORKING WITH PLASTICS

1. Wear proper eye protection.
2. Never mix any two substances together unless you understand the reactions of the mixture.
3. Use proper ventilation to dispel toxic vapors that may be given off.
4. Never work around open flames.
5. Wear plastic gloves and other protective clothing that will help to guard against skin irritation.
6. Wear protective gloves for handling hot plastics.
7. Use a face mask and an appropriate respirator when sanding fiberglass or other plastic materials that produce hazardous dust.
8. Keep materials with low flash points under refrigeration.
9. Keep all guards in place when operating any plastics machine.
10. Warning signs and protective devices should be provided at each plastics heating unit.
11. Use only recommended materials and procedures for injection mold forming processes.
12. Properly dispose of all flammable waste material.
13. Certain catalytic reactions produce a great deal of heat. They should be mixed in metal containers only.
14. Always add catalyst to resin--never resin to catalyst.



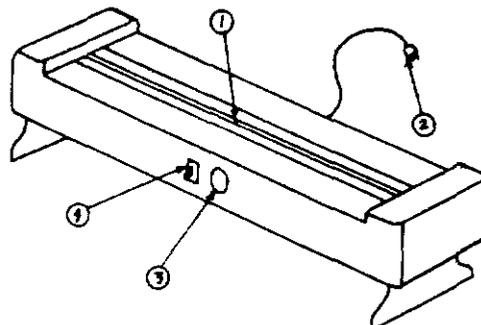
## HEATING UNITS

### HEATING OVEN



1. VENT HOLE
2. FAN SWITCH
3. HEATER SWITCH
4. TEMPERATURE CONTROLS
5. SPRING DOOR

### STRIP HEATER

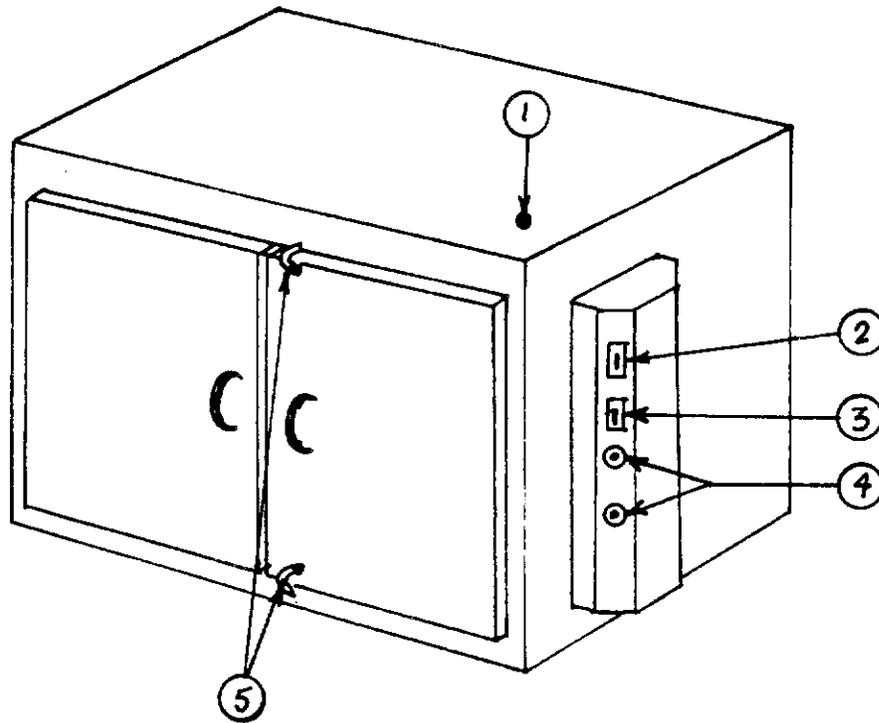


1. HEATING ELEMENT
2. PLUG
3. CONTROL LIGHT
4. SWITCH

1. Wear proper heat resistive gloves and clothing when working around the heating devices used to form plastics.
2. Maintain proper heating ranges when using plastics heating units because uncontrolled heat can cause the plastics to burn and become a fire hazard.
3. Wear safety glasses in the laboratory.
4. Use caution with the electrical parts of appliances. Don't operate the units in a damp area.
5. Take precautions with the appliance when operation is completed because the unit will remain hot and hazardous to other persons in the laboratory.
6. Check for clearance from the teacher before using a heating unit.
7. Exercise extreme care when operating a strip heater because the heating element is exposed.



# HEATING OVEN



1 VENT HOLE

2 FAN SWITCH

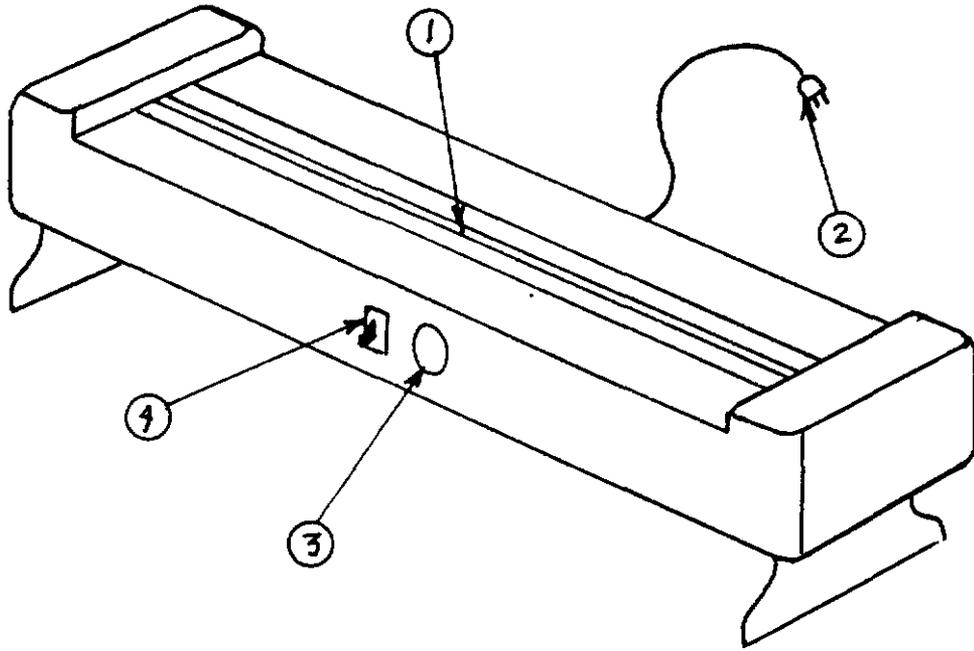
3 HEATER SWITCH

4 TEMPERATURE CONTROLS

5. SPRING DOOR CATCH



# STRIP HEATER



1 HEATING ELEMENT

2 PLUG

3 CONTROL LIGHT

4 SWITCH



# HEATING UNITS SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

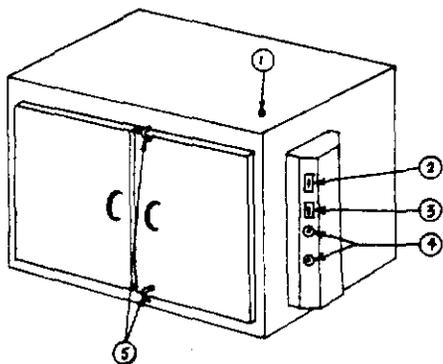
(Circle true or false)

- |  |   |   |
|--|---|---|
| 1. Unattended heating devices in the laboratory are dangerous because unsuspecting persons may touch them. | T | F |
| 2. Some units will heat plastics up to the flash point.  | T | F |
| 3. Safety glasses do not need to be worn.  | T | F |
| 4. The heating element of the strip heater is easily touched.  | T | F |

Complete the following statement:

5. \_\_\_\_\_ with the plastics material during the heating operation can burn the operator.
6. In the spaces provided, identify the parts of the heating oven:

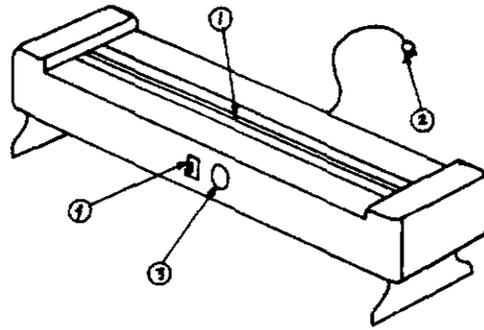
A. HEATING OVEN



- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_
- 4 \_\_\_\_\_
- 5 \_\_\_\_\_

6. In the spaces provided, identify the parts of the strip heater:

B. STRIP HEATER



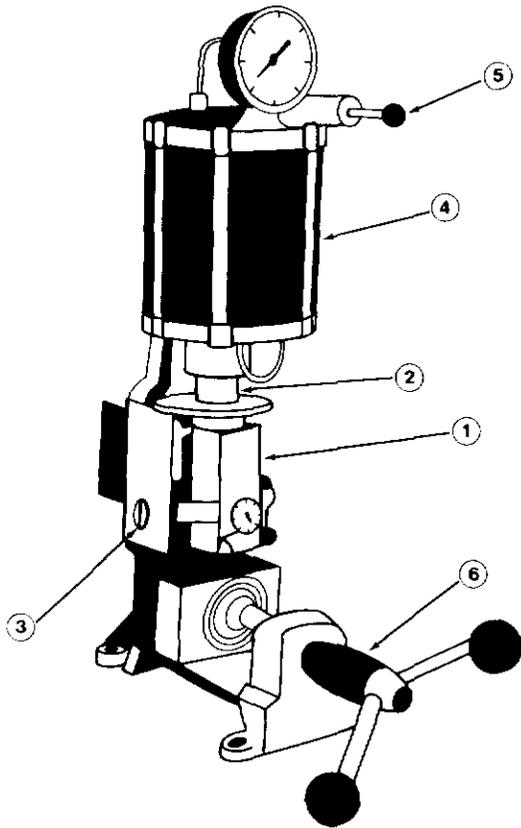
1 \_\_\_\_\_

3 \_\_\_\_\_

2 \_\_\_\_\_

4 \_\_\_\_\_

## INJECTION MOLDER



1. HEATING CHAMBER
2. RAM
3. OIL CHAMBER
4. AIR CHAMBER
5. RAM OPERATING HANDLE
6. MOLD VISE

Injection molding machines vary greatly according to size of the "shot" injected into the mold cavity and the actual physical size of the machine. While their functions are basically the same, their safety rules differ, even though many rules are common.

The safety rules below are in reference to a small machine used in schools and industries where a small "shot" size is needed and a high rate of production is not necessary.

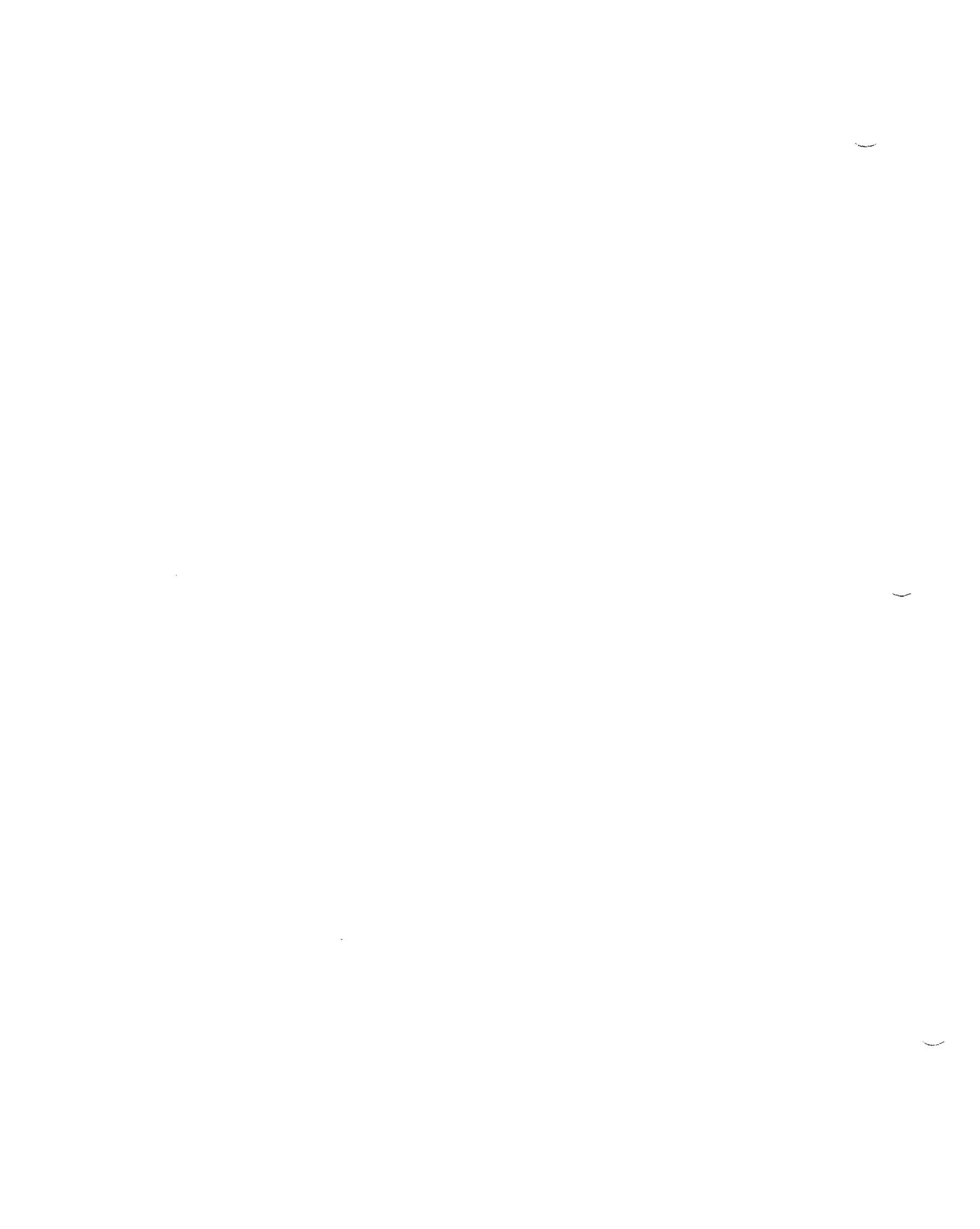
1. Wear proper eye protective devices.
2. Control the heat because overheated plastics will be forced out of the molds.
3. Obtain permission from the teacher to operate the injection molder.
4. Control the ram pressure and mold clamping pressure in a range for safe operation of the molder.
5. Remember that the molded plastics will stay very hot for a period of time when out in the air.
6. Do not operate the machine if the floor around the machine is damp or wet.
7. Wear proper hand protection when moving the hot molds or the parts.
8. Caution bystanders when purging injection molding equipment.

9. Keep all guards in place while operating the molder.
10. Remember that air-operated machines are much quicker in movement than the hydraulic machines and may cause a safety hazard.
11. Be sure the machine is up to the proper heat for the plastics material before operating the ram into the barrel.
12. Keep your fingers out of the feed hopper.
13. Be careful where you touch the machine; parts of the machine are extremely hot.
14. Work in a ventilated area because heated plastics expel fumes.

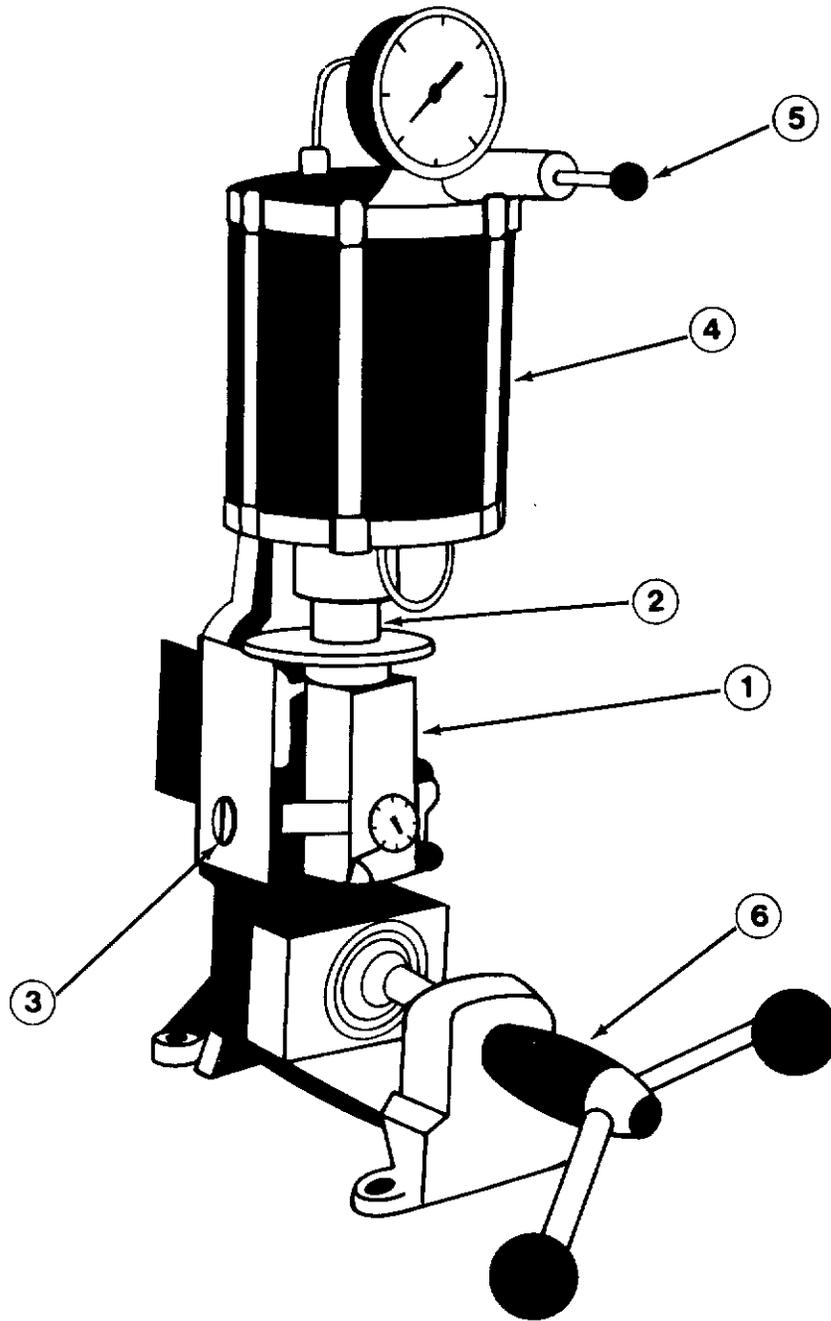
In addition to the rules listed previously, the following rules must also be observed when using the large, commercial injection molders.

1. Do not remove any safety shield or device from the machine except for maintenance or mold change; replace all devices before commencing operation.
2. Do not attempt to defeat safety devices by any means.
3. Do not allow more than one operator to operate machine at the same time.
4. Treat all molding machines with respect as even machines with very small clamp capacities can cause painful injury when carelessly operated.
5. Shut off pump motor and turn machine mode selector switch to "manual" when working in clamp area for other than ordinary part removal or loading of inserts in the mold.
6. Check all safety devices periodically; such checks must be made at the beginning of each shift of operation or whenever changes in operation have been made.
7. When operating, do not stand on machine base for any reason.
8. When purging machine, always stand back and away from the nozzle. **WARNING:** The existence of the second nozzle requires that extra caution be observed.
9. Always shut off pump when working in die area to mount molds, connect water lines, etc.

10. Wear asbestos gloves when handling heated barrel, nozzles, or when working with heated mold.
11. Do not attempt to clear frozen material from nozzle by pressure alone. Allow nozzle heater to melt the plug or heat nozzle tip with torch. Nozzle slug will ooze out when properly heated. If the nozzle does not pass the material using the above methods, remove the nozzle and check the orifice for blockage by foreign material.
12. Do not adjust limit switches, etc., when machine is operating.
13. Be sure that all mold mounting bolts are tight. Retighten these and all machine bolts and nuts periodically.
14. Heavy molds should only be handled with a properly sized hoist and eye-bolts.
15. Do not reach up into parts chute.
16. With the two-color rotating die, observe these precautions:  
For mechanical rotation, do not use excessive clamp speeds that may cause damage to the indexing system. For hydraulic and mechanical rotation, be sure all hydraulic lines and electrical wires are clear of mold.



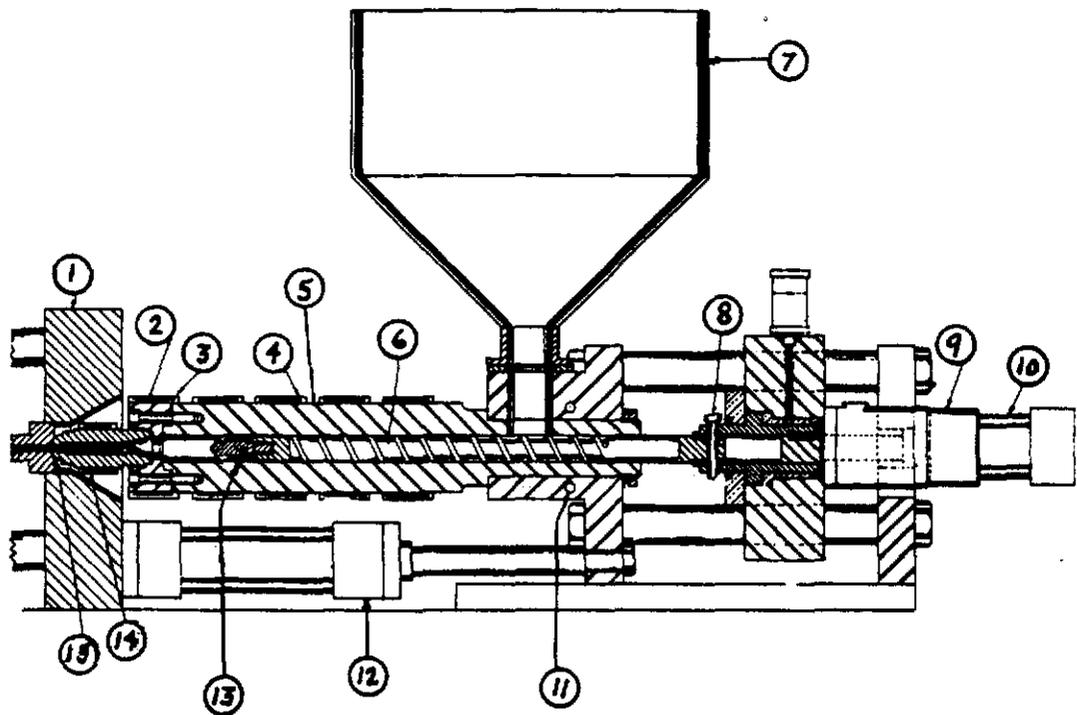
# INJECTION MOLDER



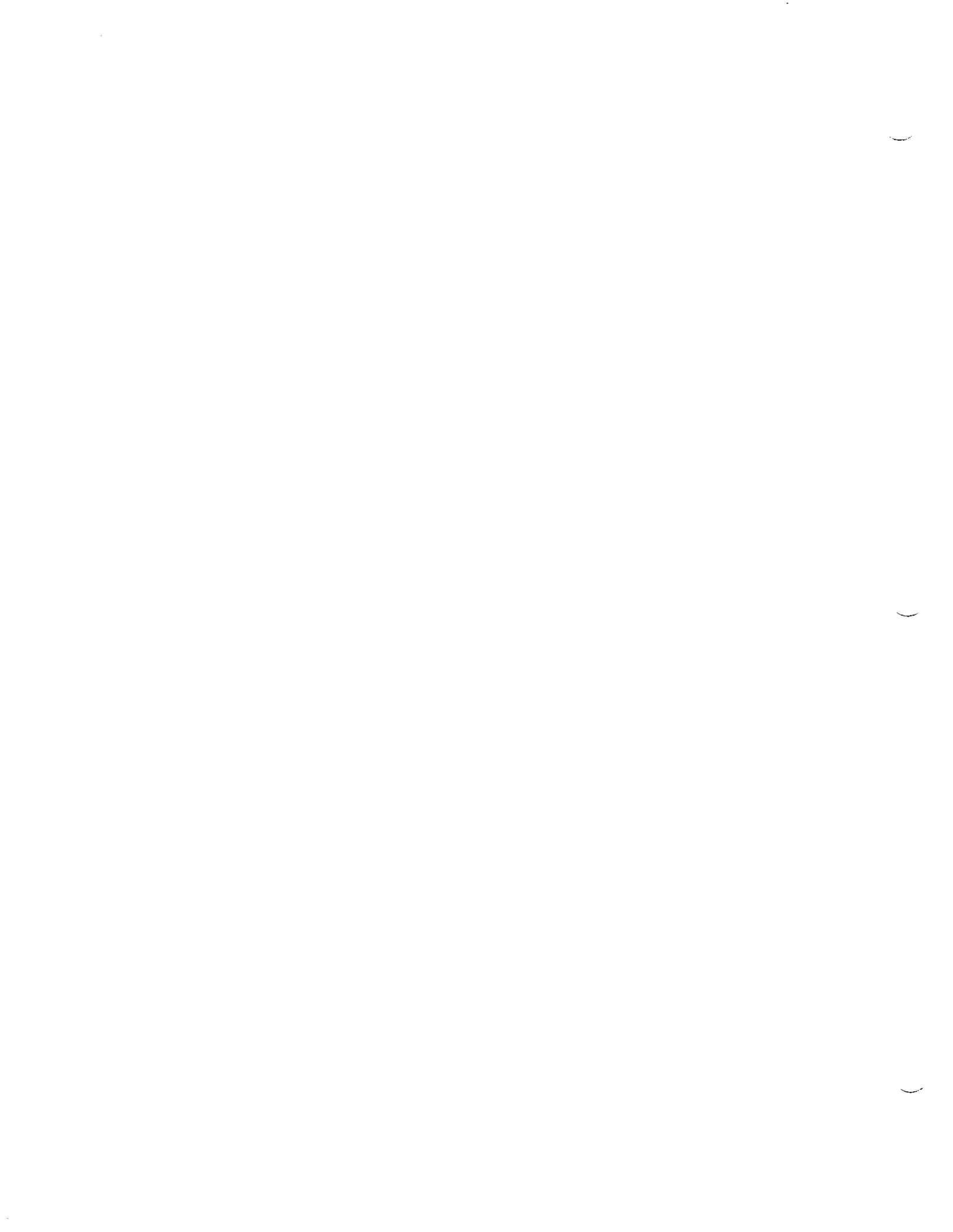
- |   |                 |   |                     |   |                      |
|---|-----------------|---|---------------------|---|----------------------|
| 1 | HEATING CHAMBER | 3 | TEMPERATURE CONTROL | 5 | RAM OPERATING HANDLE |
| 2 | RAM             | 4 | AIR CHAMBER         | 6 | MOLD VISE            |



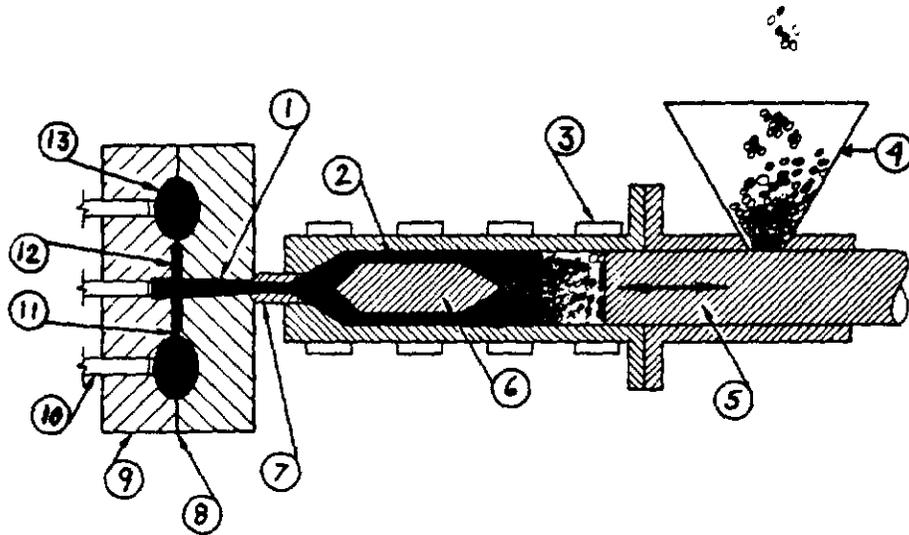
## INJECTION MOLDER



- |   |                   |    |                   |
|---|-------------------|----|-------------------|
| 1 | STATIONARY PLATEN | 9  | HYDRAULIC MOTOR   |
| 2 | NOZZLE ADAPTOR    | 10 | INJECT CYLINDER   |
| 3 | HEATER            | 11 | COOLING CHANNEL   |
| 4 | HEATER            | 12 | CARRIAGE CYLINDER |
| 5 | BARREL            | 13 | NON-RETURN VALVE  |
| 6 | FEED SCREW        | 14 | NOZZLE HEATER     |
| 7 | MATERIAL HOPPER   | 15 | NOZZLE            |
| 8 | SHEAR PIN         |    |                   |



# INJECTION MOLDER



1 SPRUE

2 SUPPORT FINS

3 HEATERS

4 FEED HOPPER

5 INJECTION PISTON

6 TORPEDO

7 NOZZLE

8 VENT ALONG PARTING LINE

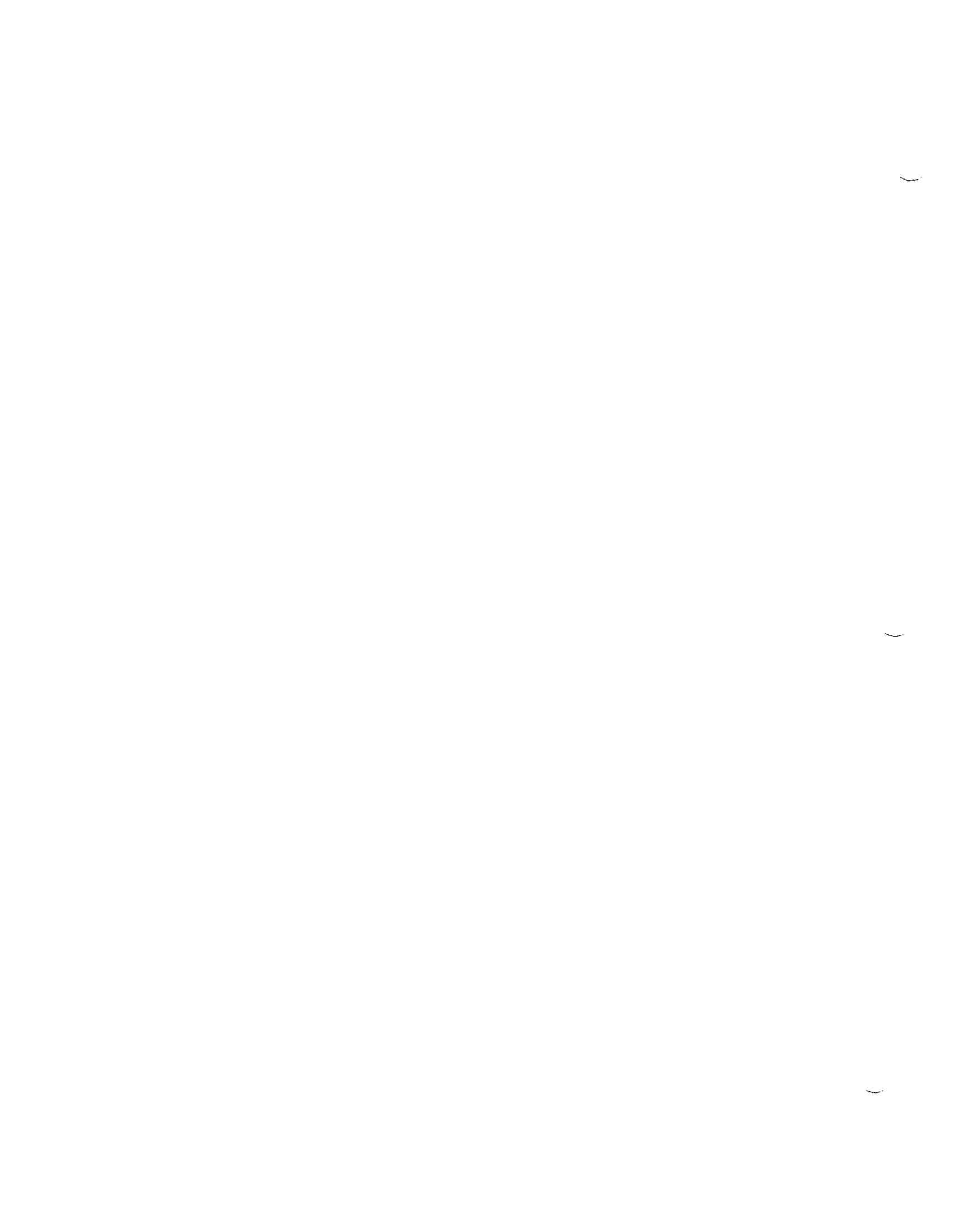
9 MOLD

10 EJECTION PINS

11 GATES

12 RUNNERS

13 CAVITY OR PART



## INJECTION MOLDER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

(Circle true or false)

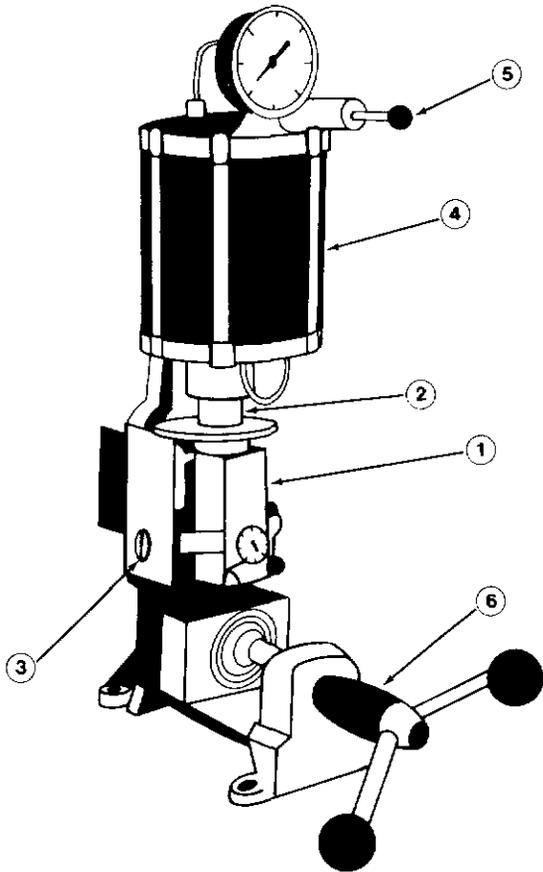
- |   |   |   |
|---|---|---|
| 1. Wear proper eye protection.  | T | F |
| 2. Proper hand protection need not be worn.   | T | F |
| 3. You must get permission from the teacher to use the machine.                     | T | F |
| 4. Damp floors around the machine are not a safety hazard.                          | T | F |
| 5. All guards must be in place when using the machine.                              | T | F |
| 6. Parts of the machine are extremely hot.  | T | F |
| 7. There is no danger to the fingers from pinching when using the injection molder. | T | F |

Complete the following statements:

8. The heated plastic material is forced into the mold with \_\_\_\_\_ pressure.
9. Control of the \_\_\_\_\_ and heat is necessary in order for plastics not to be forced from the molds.
10. Molded plastics remain very \_\_\_\_\_ for a period of time after they are removed from the mold.
11. Caution bystanders when \_\_\_\_\_ the machine.
12. \_\_\_\_\_ operated machines are quicker in movement than hydraulic machines.

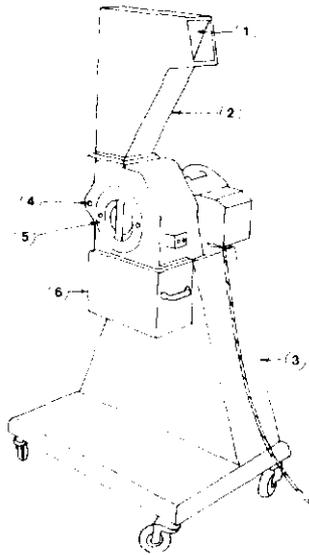
13. In the spaces provided, identify the parts of the injection molder.

INJECTION MOLDER



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_

## PLASTICS GRANULATOR

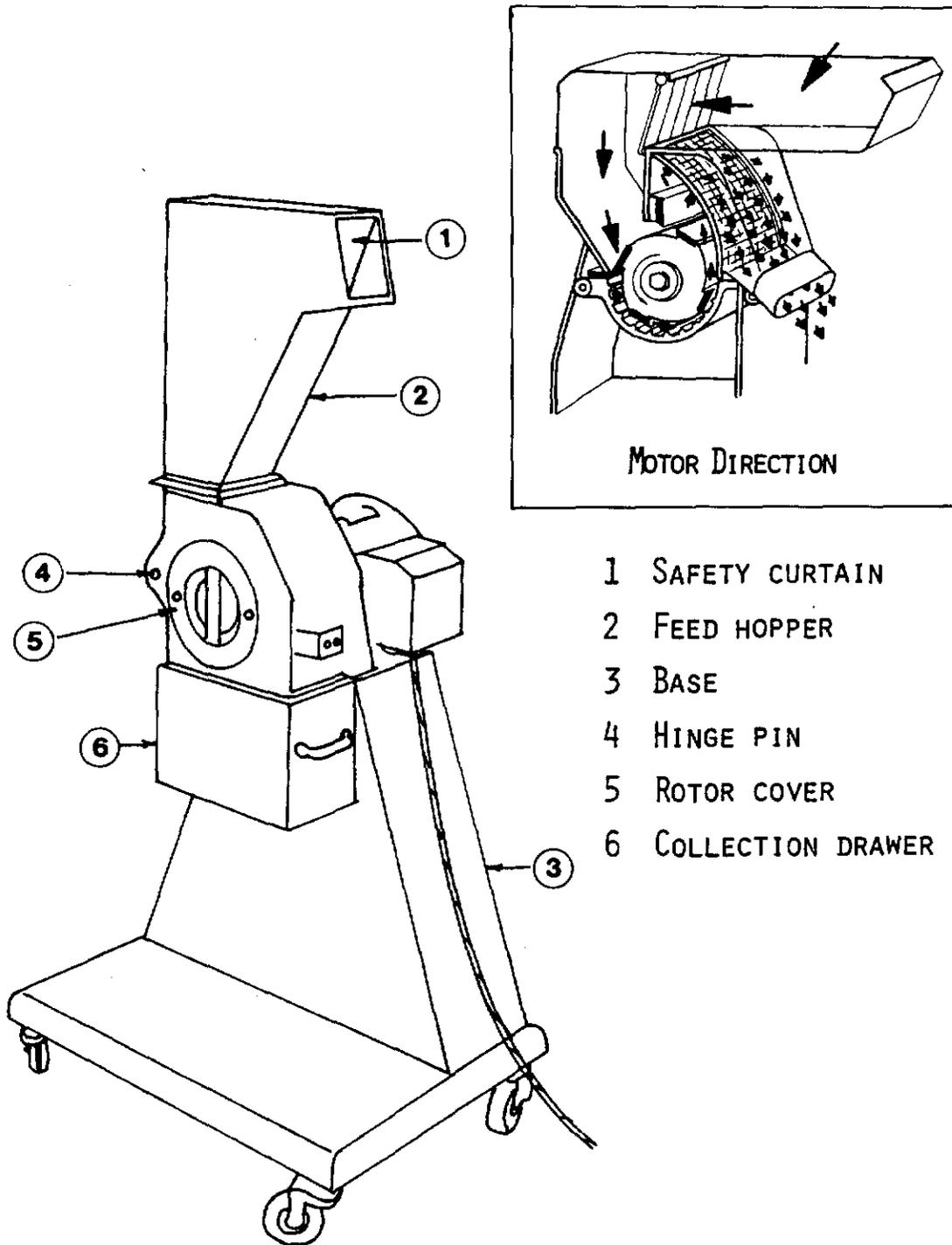


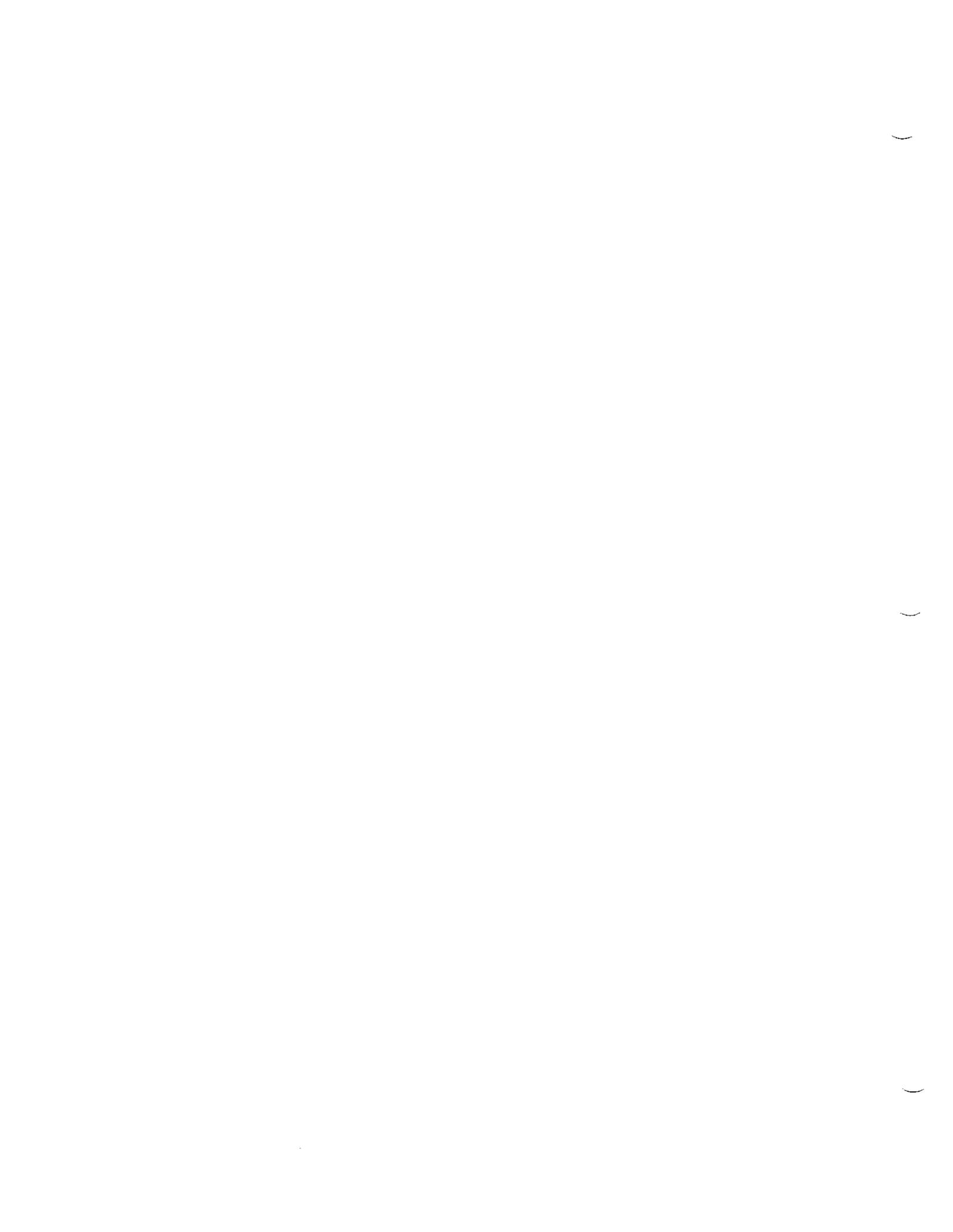
1. SAFETY CURTAIN
2. FEED HOPPER
3. BASE
4. HINGE PIN
5. ROTOR COVER
6. COLLECTION DRAWER

1. Wear eye protection when using the machine.
2. Check plastic material for waste fragments of metal or wood before placing the material in the granulator.
3. Turn off the main switch of the machine before placing plastic scrap through the safety curtain into the feed hopper.
4. Keep hands clear of the feed hopper when the machine is on. Never place hands into the feed hopper even if the machine is turned off.
5. Never stand in front of or open the safety curtain when the machine is turned on.
6. Use ear plugs; noise may be excessive if machine is used for long periods.



# PLASTICS GRANULATOR





PLASTICS GRANULATOR SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

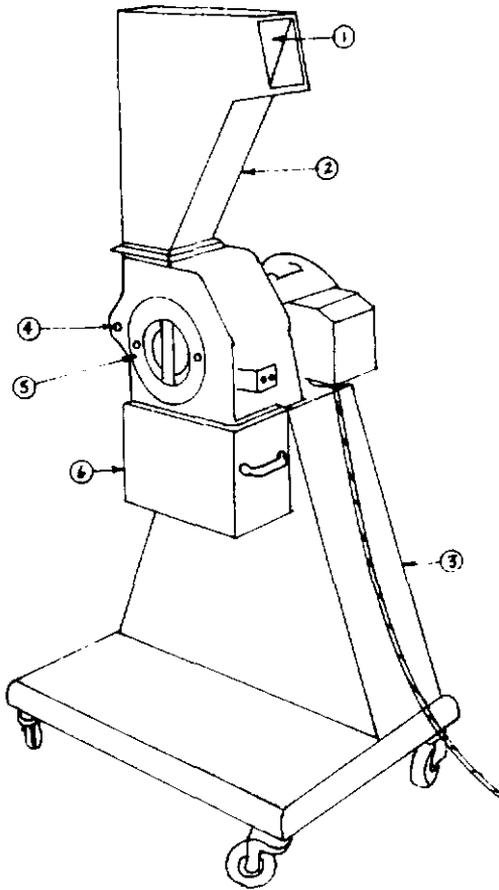
---

(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. There is no need to wear safety glasses or goggles while using this machine.                           | T | F |
| 2. Scrap material may be ground without checking for impurities.  | T | F |
| 3. When loading the feed hopper, you must be sure the main switch to the machine is turned off.           | T | F |
| 4. You may use your hands to clear the feed hopper.   | T | F |
| 5. Always stand to one side of the machine and not in front of the safety curtain when the machine is on. | T | F |
| 6. Noise is not a health factor when using this machine.  | T | F |

Scrap Grinder Safety Quiz(continued)

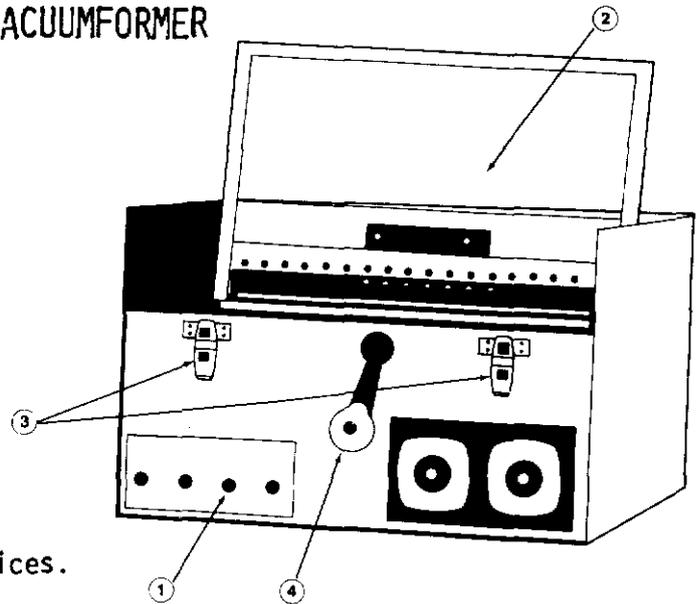
7. Name the parts of the plastics granulator.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_

## VACUUMFORMER

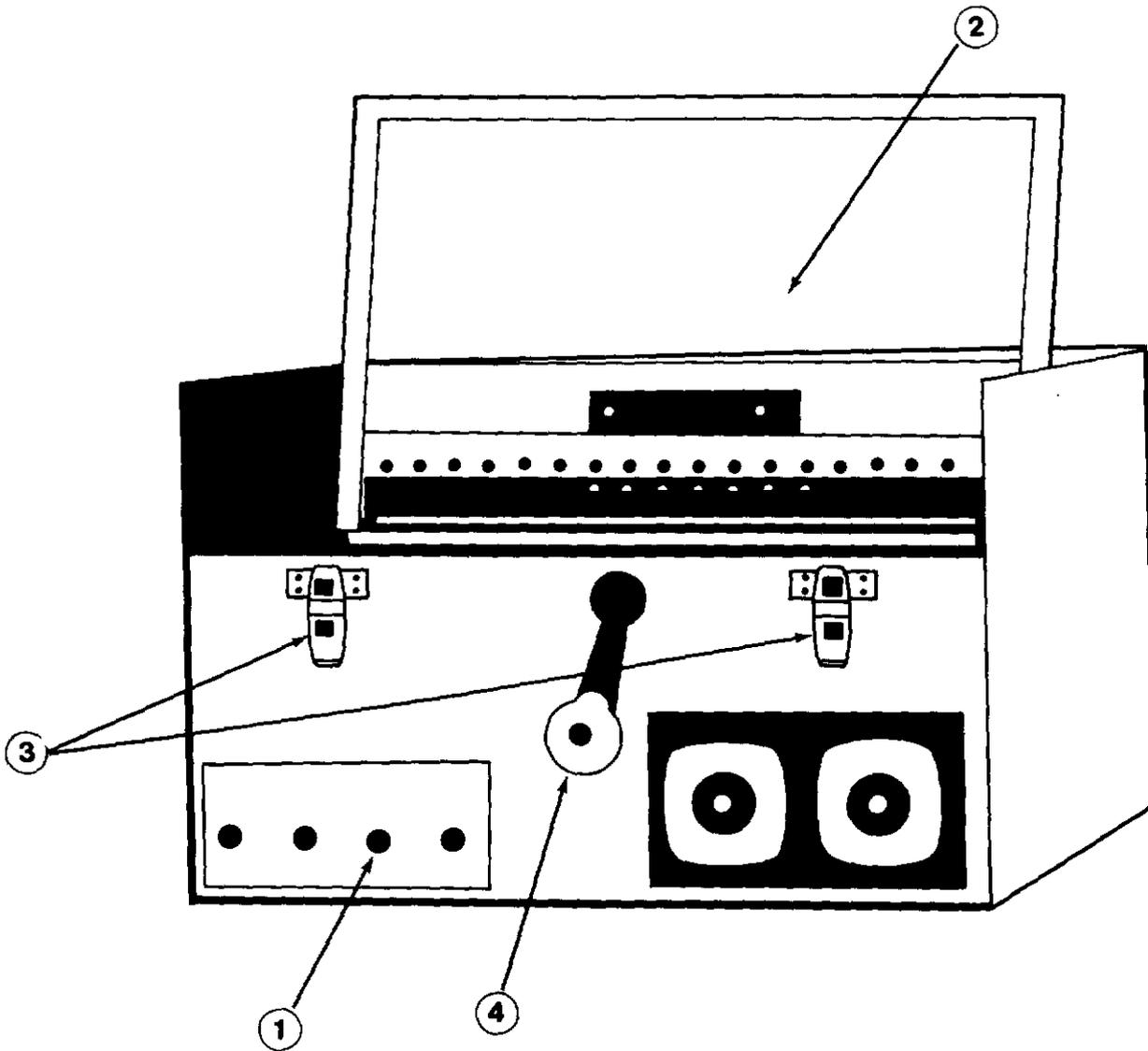
1. HEATER SWITCH
2. HEATER
3. CLAMPING DEVICE
4. MOLD SUPPORT
5. CONTROLS TO FORM PLASTIC



1. Wear eye protective devices.
2. Be sure that the clamp frame is adjusted to the thickness of the plastics.
3. Keep the hands away from the heating units to prevent serious burns.
4. Control the air pressure and vacuum in a manner that will not cause any hazards.
5. Do not touch the heated plastics until they have cooled properly. Use heat resistive gloves to unload parts.
6. Use a safety air nozzle gun to cool plastics, taking care to direct the air only on the plastics. Nozzle must be reduced to less than 30 PSI.
7. Remember that the clamp frames will be very hot after forming.
8. Don't leave the machine unattended in the heating cycle because the sheet stock could become overheated and start a fire.
9. Do not allow the sheet stock to come into contact with the heating element.
10. All safety guards must be in place and functioning.
11. Temperature and air pressure must be correctly adjusted.
12. Do not operate the machine if the floor is damp.
13. Always work with plastic material in a well-ventilated area.



# VACUUMFORMER



1 HEATER SWITCH  
2 HEATER

3 CLAMPING DEVICE  
4 CONTROLS TO FORM  
PLASTIC



VACUUMFORMER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

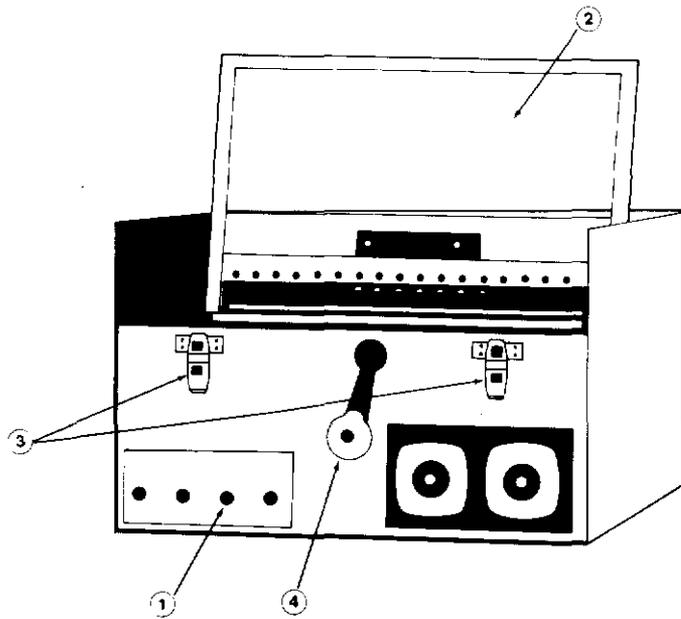
(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. The plastics materials used in sheet form could catch fire during the forming process. | T | F |
| 2. The frames become very hot during forming operations.                                  | T | F |
| 3. Plastics materials are hot when they are lifted from the mold.                         | T | F |
| 4. Wear eye protective devices.   | T | F |
| 5. Ventilation is not a prime concern when working with plastic materials.                | T | F |

Complete the following statements.

6. Temperature and \_\_\_\_\_ pressure must be correctly set.
7. The machine must not be operated when the floors are \_\_\_\_\_.
8. If the machine is in a heating cycle, do not \_\_\_\_\_.

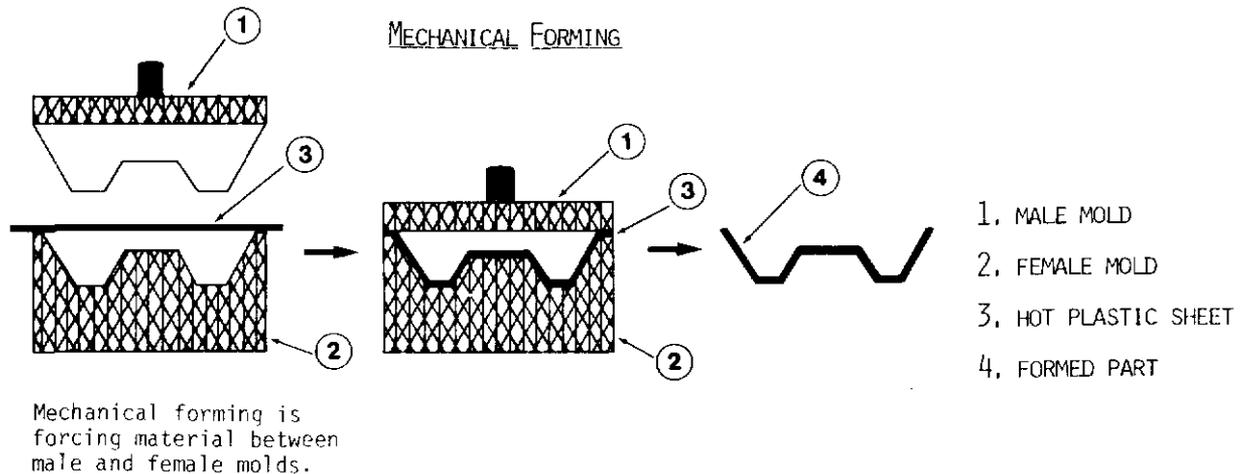
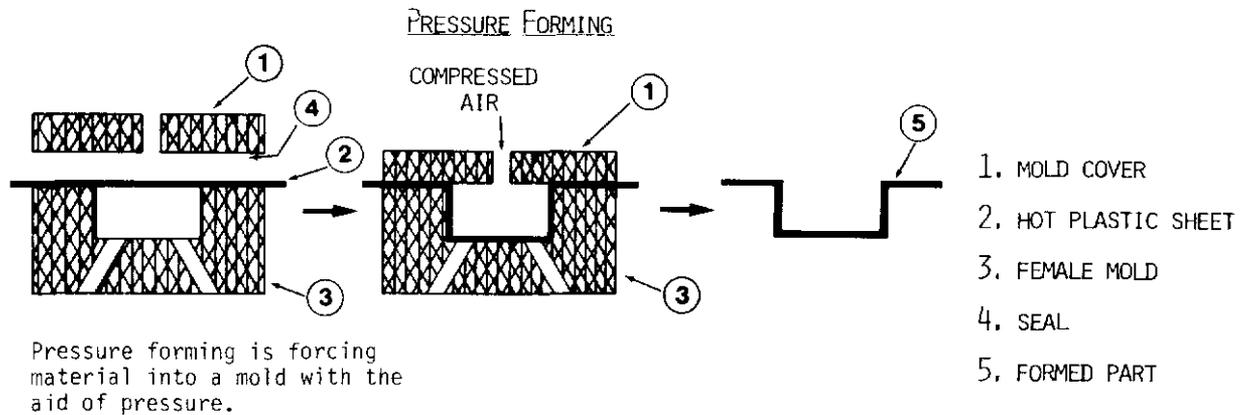
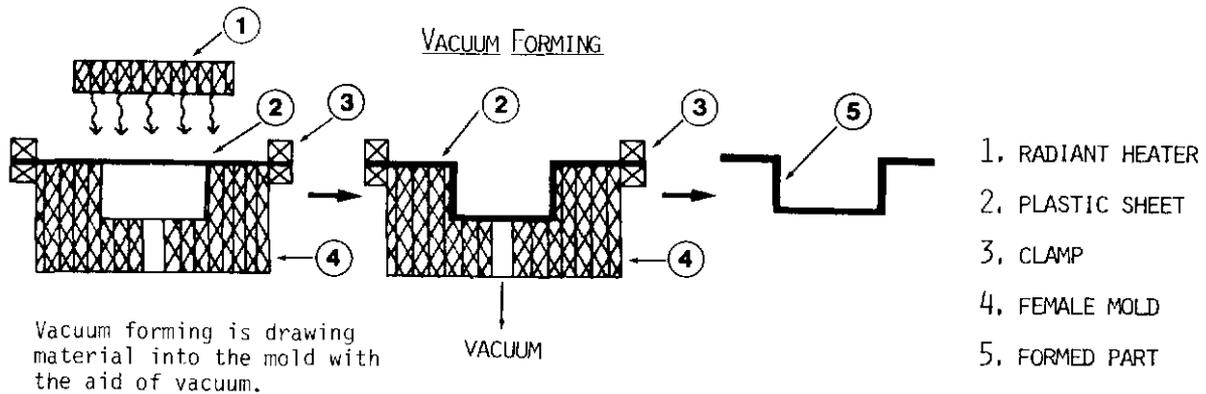
9. Name the parts of the vacuum-former.



1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

## THERMOFORMING PROCESSES

There are basically three methods of thermoforming: vacuum forming, pressure forming, and mechanical forming. Machines used with these processes have similar safety rules.



## REFERENCES

Materials were selected and reviewed from the following sources, and in some instances were incorporated in the production of the preceding unit.

C. W. Brabender, Instruments, Inc.

Dake Corporation

Di-Acro Houdaille, Houdaille Industries Inc.

Educational Machinery Corp.

Kansas State Department of Education - Plastics for Industrial Arts

McNeil Akron, Inc.

Newbury Industries, Inc.

Sterling Extruder Corp.

Society of Plastics Engineers, Inc.

Society of Plastics Industry, Inc.

**PART 3:**  
**EQUIPMENT FOR WORKING WITH WOODS**

Circular Table Saw

Radial Saw

Band Saw

Scroll (Jig) Saw

Miter Box Saw (Motorized)

Planer (Surfacer)

Jointer

Wood Lathe

Drill Press

Finishing Machines

    Belt and Disc Sander

    Disc Sander

Pages 195-196 were adapted from Pennsylvania Industrial Arts Safety Guide, produced by Pennsylvania Department of Education and Industrial Arts Association of Pennsylvania, Harrisburg, Pennsylvania, 1981-

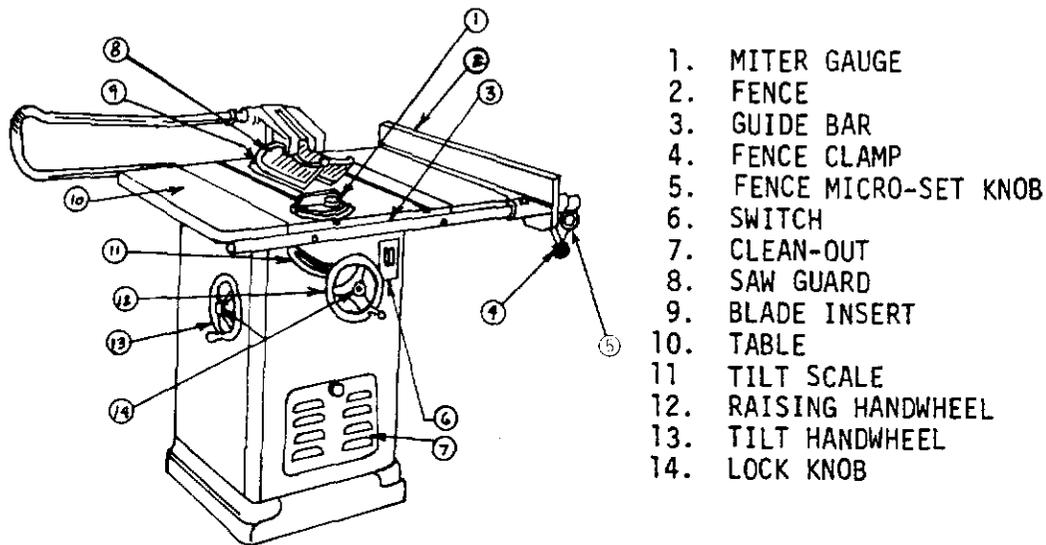
Pages 197-268 were adapted from Safety Education Handbook, produced by Kansas Department of Education, Wichita, Kansas, 1981.

## SAFETY RULES FOR WORKING WITH WOOD

1. Always keep tools and equipment in top condition.
2. Wear eye protection when working in the shop.
3. Follow the safety procedures recommended for each power tool.
4. Wear tight-fitting clothing.
5. Roll up your sleeves.
6. Remove loose clothing and jewelry.
7. When working with heavy pieces of wood, such as sheets of plywood and two-by-four studs, wear a sturdy pair of shoes.
8. Keep materials neatly stacked.
9. Keep your work area clean and free from small scraps, excessive sawdust, and oil.
10. Always remove nails from used lumber.
11. Keep tables of machines and other work surfaces free from tools, scraps, and materials.
12. Never try to move materials past a person who is using a power tool or machine.
13. Never attempt to speak to or otherwise startle a person using a power tool or machine.
14. Never start or stop a machine for someone else. Always follow the machine operator's instructions when helping.
15. Make sure that all hand tools are sharp and in good working order.
16. Always carry sharp or pointed tools away from your body. Never put them in your pockets.
17. Never hold a small piece of wood in your fingers as you cut it.
18. Always use the guards on machines when provided. If a standard guard cannot be used, make use of holding and clamping devices and push sticks.

19. Plan your work before you begin. If large stock is to be cut, get help before you begin, not after you are in difficulty.
20. Never use machines or power tools when you are tired or hurried. Accidents often happen when someone tries to do things too fast.
21. Make sure that a machine has come to a full stop before adjusting or oiling it or changing a blade.
22. Always wear goggles or a face mask if there is a danger of flying chips.
23. Get first-aid treatment for even the slightest scratch.
24. Wear a dust respirator when sanding.
25. Wear ear protection such as ear plugs or earmuffs when excessive noise is a problem.
26. Know the location of the appropriate fire extinguisher to be used with wood, flammable liquids, and electrical equipment.
  - Class A fire--woods and paper products
  - Class B fire--flammable liquids
  - Class C fire--electrical equipment
27. Return all finishing materials to metal containers and cabinets.
28. Place all oily rags in an approved metal container.
29. Use the dust collection system for stationary tools if possible.
30. Keep your fingers and hands out of the path of sharp-edged cutting tools.

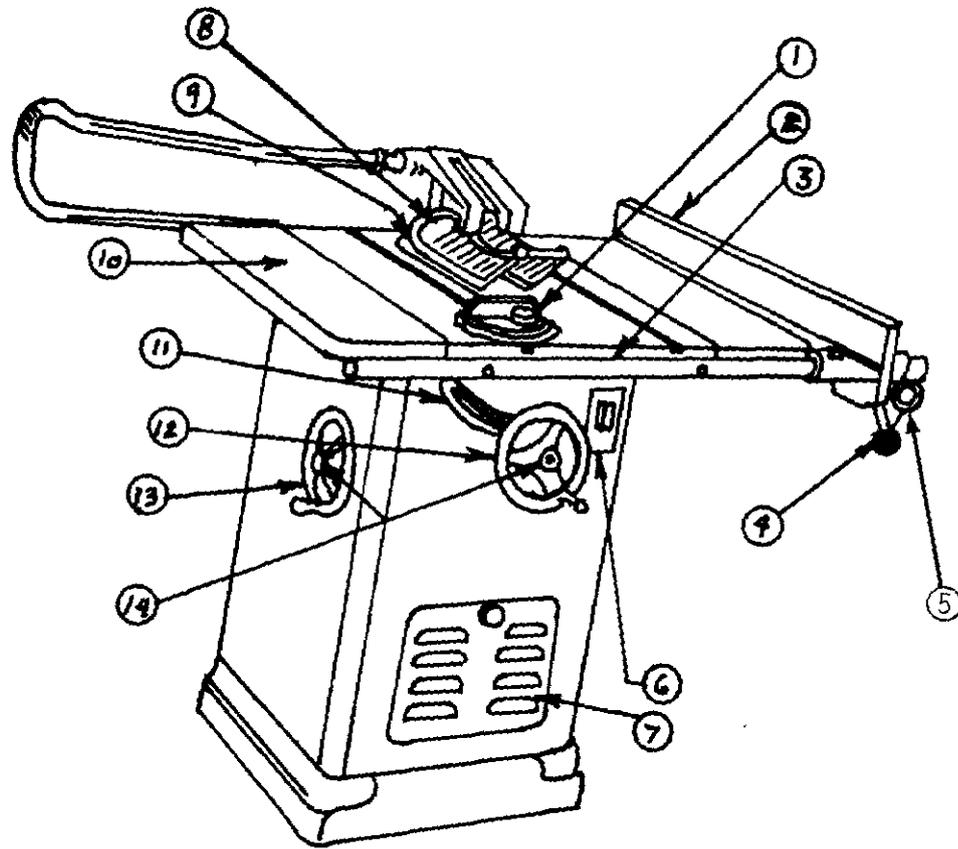
## CIRCULAR TABLE SAW



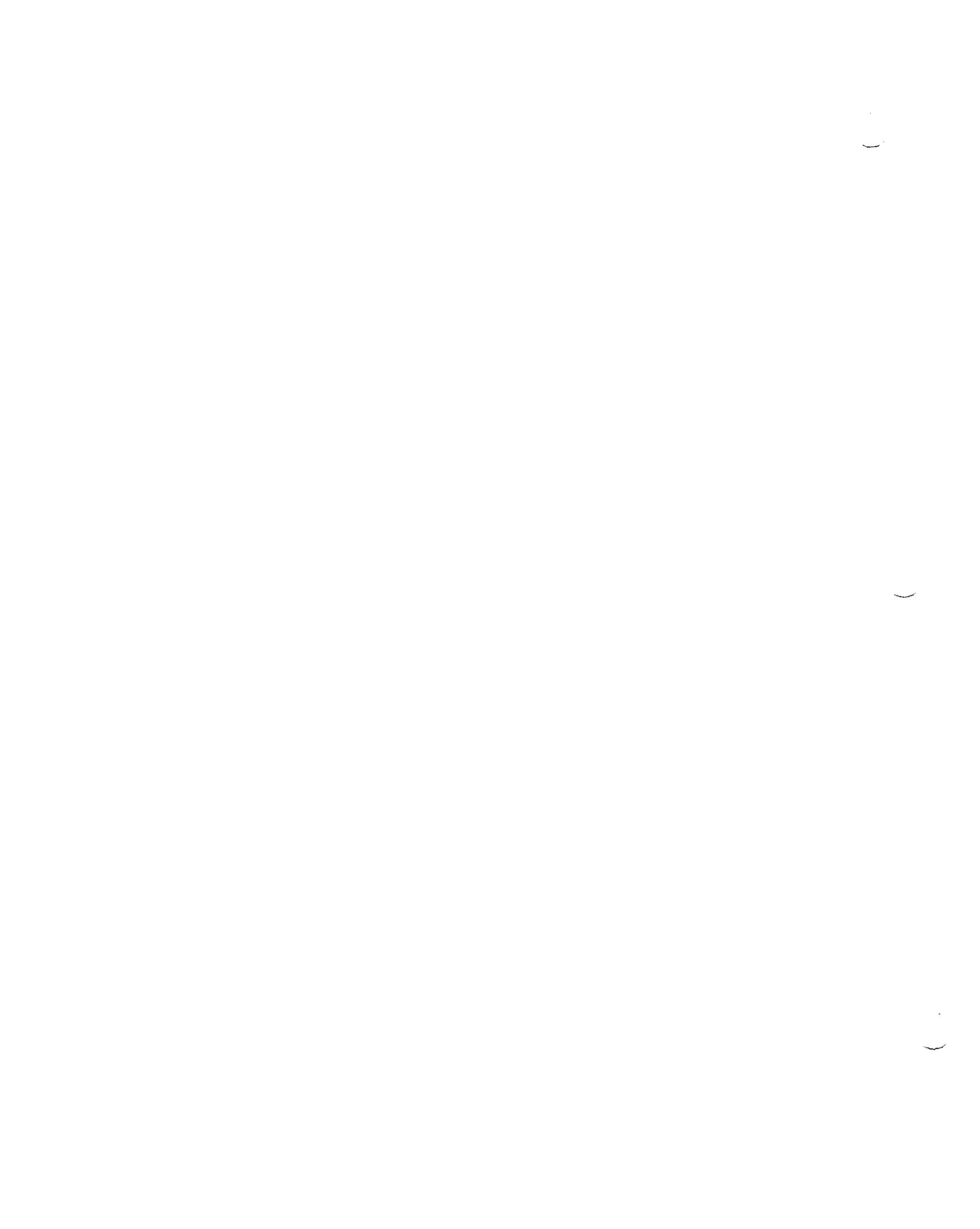
1. Circular table saws are required to be equipped with the following protective devices:
  - A. A hood to completely enclose that portion of the saw above the table and material being cut.
  - B. A spreader to prevent the material from squeezing the blade.
  - C. Non-kickback fingers or dogs to prevent the material from being thrown back at the operator. (OSHA)
2. Teacher's permission should be obtained before using the table saw.
3. All lumber must be free from loose knots, nails, paint, or pebbles.
4. The proper saw blade should be selected and installed for the work to be done.
5. The blade must be sharp and free of cracks or other defects.
6. Adjustments should be made only when the machine is at a "dead" stop.
7. The saw blade extension should be limited to 1/8 inch or less above the stock being cut. Opinions may differ, so check with the teacher.
8. All guards and other safety devices must be in their proper positions.

9. A ripping fence or cutoff gauge should be used when cutting material.
10. The teacher should be asked to approve all special setups.
11. A clearance block must be used when a ripping fence is used as a gauge.
12. An adequate number of proper push sticks must be available.
13. No one but the operator should be inside the safety zone.
14. A face shield or safety glasses shall be worn.
15. The operator should stand to one side of the line of the saw blade.
16. Fingers and all parts of the hands must be kept clear of path to the saw blade.
17. The operator must stop the saw and move out of the operating zone before responding to anyone trying to attract his/her attention.
18. The stock should be fed only as fast as the saw will freely cut.
19. The stock should be pushed only by the operator. A push stick should be used when ripping narrow pieces of stock.

# CIRCULAR TABLE SAW



- |                        |                      |
|------------------------|----------------------|
| 1 MITER GAUGE          | 8 SAW GUARD          |
| 2 FENCE                | 9 BLADE INSERT       |
| 3 GUIDE BAR            | 10 TABLE             |
| 4 FENCE CLAMP          | 11 TILT SCALE        |
| 5 FENCE MICRO-SET KNOB | 12 RAISING HANDWHEEL |
| 6 SWITCH               | 13 TILT HANDWHEEL    |
| 7 CLEAN-OUT            | 14 LOCK KNOB         |



## CIRCULAR TABLE SAW SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

### True-False:

- T F 1. The blade should not be raised more than 1/8 inch above the stock.
- T F 2. The fence and miter gauge can be used at the same time to crosscut.
- T F 3. Freehand sawing is not permitted.
- T F 4. All special setups must be checked by the teacher.
- T F 5. A person may rip a seven-foot long board by himself/herself, using the circular table saw.
- T F 6. It is best to stand directly behind the blade when ripping.
- T F 7. When ripping, a spreader is used to keep the material from pinching the blade.
- T F 8. One may reach over the saw blade to help guide the stock being cut.
- T F 9. Guards shall be left on the machine at all times.
- T F 10. A person using a dado head should check to make sure all the chisel blades are pointed toward the operator.
- T F 11. A push stick should be used when one is ripping stock under three-inches wide.
- T F 12. Dull blades may be used on the circular table saw because of the speed and power of the saw.

Multiple Choice:

\_\_\_13. A person who is operating the circular table saw should stand:

- A. to the right side of the blade
- B. to the left side of the blade
- C. directly behind the blade
- D. anywhere--it makes no difference

\_\_\_14. Crosscutting stock requires the use of a:

- A. fence
- B. miter gauge
- C. stop block
- D. push stick

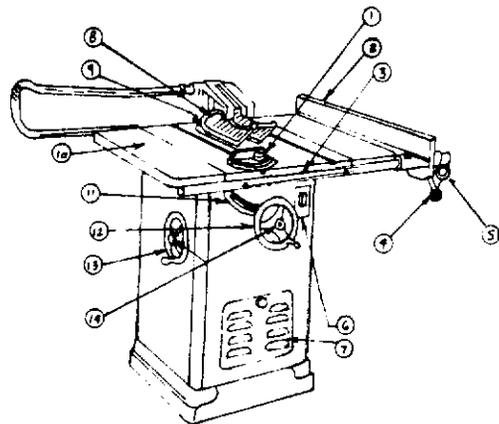
\_\_\_15. All circular table saw adjustments should be made:

- A. after the fence has been removed from the table top
- B. while the saw is in motion
- C. according to the blade being used
- D. when the saw blade is completely stopped

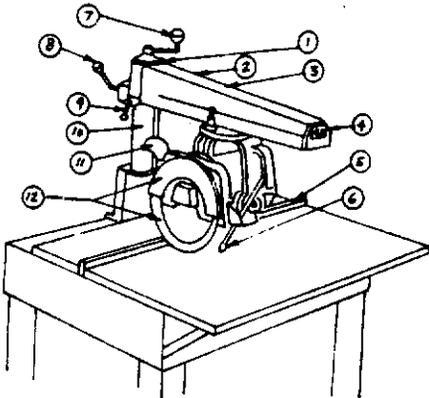
16. Identify the circular table saw parts indicated in the drawing:

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_
- 10. \_\_\_\_\_
- 11. \_\_\_\_\_
- 12. \_\_\_\_\_
- 13. \_\_\_\_\_

14. \_\_\_\_\_



## RADIAL SAW

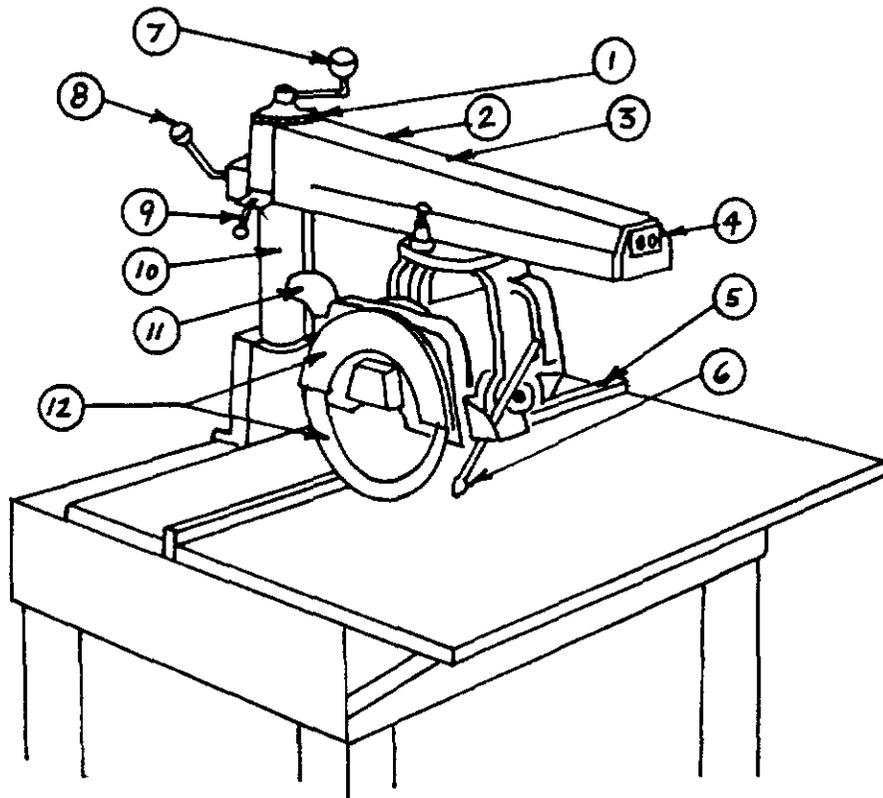


1. MITER SCALE
2. RETURN SPRING
3. ARM
4. SWITCH
5. FENCE
6. KICKBACK GUARD
7. ELEVATING HANDLE
8. ARM CLAMP HANDLE
9. MITER LATCH
10. COLUMN
11. SAW DUST SPOUT
12. SELF-ADJUSTING BLADE GUARDS

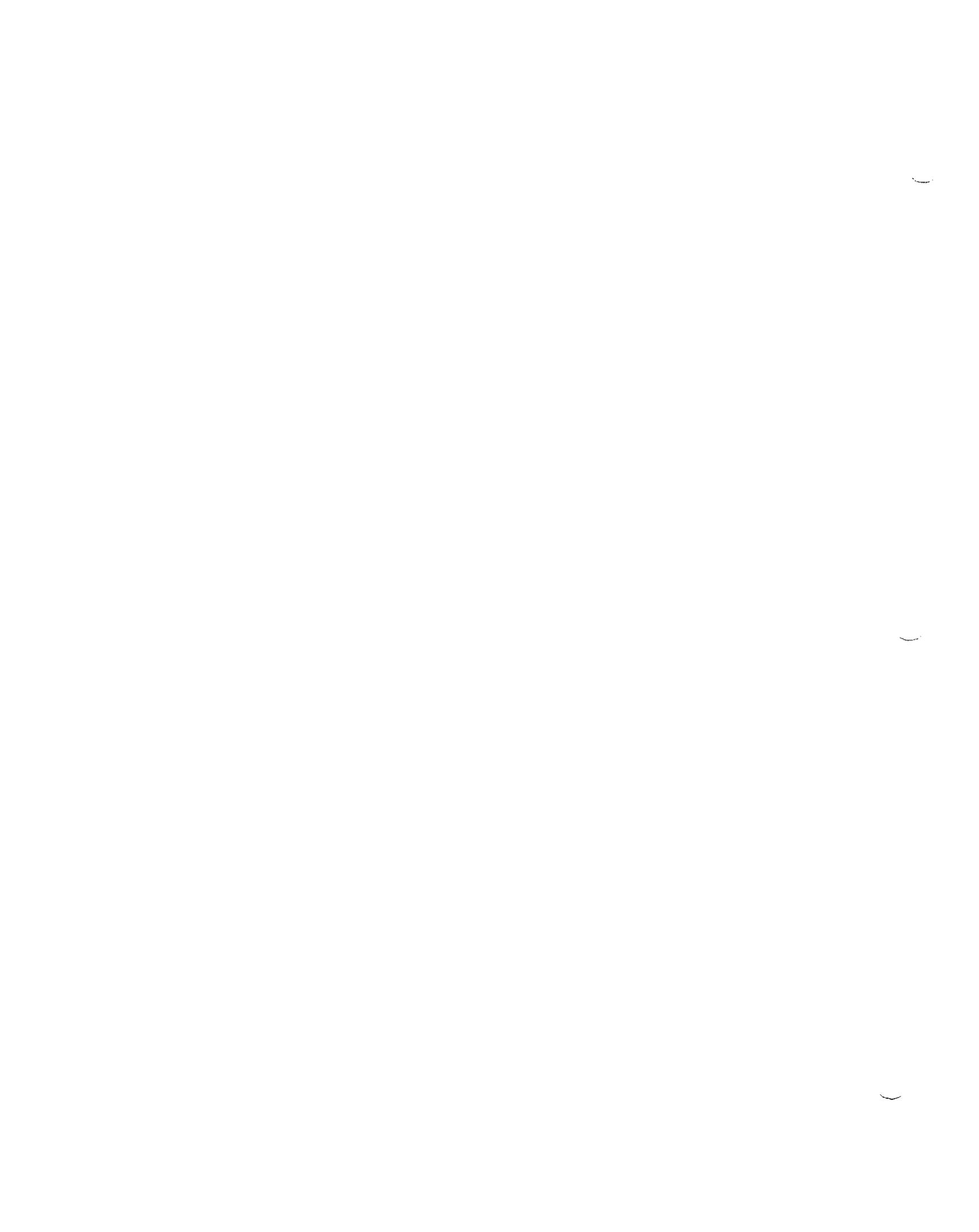
1. The upper hood shall completely enclose the upper portion of the blade down to a point that will include the end of the saw arbor. (OSHA)
2. Each radial saw shall be provided with non-kickback fingers or dogs. (OSHA)
3. An adjustable stop shall be provided to prevent the forward travel of the blade beyond the position necessary to complete the cut in repetitive operations. (OSHA)
4. Radial saws are required to be installed in such a manner that the front end of the unit will be slightly higher than the rear so the cutting load will return gently to the starting position when released by the operator. A return spring should be attached to the post and the motor, which will aid in the return. (OSHA)
5. The blade should be set at a depth to cut not more than 1/8-inch below the surface of the table.
6. The operator should check to make sure the saw is back against the stop before turning on the power. The blade must not be touching any wood when the power is turned on.
7. The material to be cut must be held firmly against the table and fence.
8. The direction of rotation of this saw blade causes it to climb into the stock and then to stall. To avoid this, feed the saw slowly and smoothly.

9. Hands and fingers should be kept at least six-inches clear of the path of the saw blade at all times.
10. The motor should reach full speed before a cut is begun.
11. The table should always be cleaned of scraps and dust before, during, and after use of the saw.
12. All special setups (except for straight cutoff work) must be checked by the teacher.
13. The operator should make sure the saw blade has stopped rotating before making any adjustments on the machine.
14. The teacher's permission must be obtained before one attempts to use the machine.

## RADIAL SAW



- |                  |                                |
|------------------|--------------------------------|
| 1 MITER SCALE    | 7 ELEVATING HANDLE             |
| 2 RETURN SPRING  | 8 ARM CLAMP HANDLE             |
| 3 ARM            | 9 MITER LATCH                  |
| 4 SWITCH         | 10 COLUMN                      |
| 5 FENCE          | 11 SAW DUST SPOUT              |
| 6 KICKBACK GUARD | 12 SELF-ADJUSTING BLADE GUARDS |



## RADIAL SAW SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

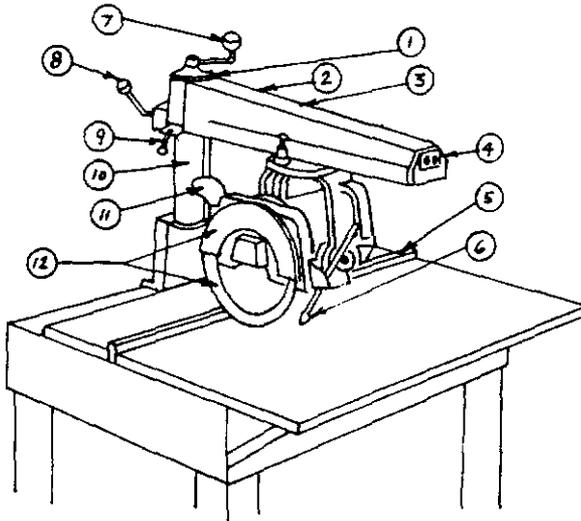
### True-False:

- T F 1. The saw blade should be set one-half inch below the table surface.
- T F 2. This saw must be set so it will automatically return to the rear of the machine.
- T F 3. All adjustments and stops should be set before starting the saw.
- T F 4. On thick material it is permissible to remove the guards on the bottom of the blade so one can see.
- T F 5. After turning off the machine, the operator should stand by until the blade stops rotating.
- T F 6. Before moving the arm to make miter cuts, one must first raise the blade.
- T F 7. This saw can be the most dangerous machine in the shop because of its many uses.
- T F 8. Since the blade cuts into the material, it is not necessary to hold the material against the fence.
- T F 9. Curved or warped wood is not too difficult to cut on this saw.
- T F 10. The most dangerous operation on this saw is ripping wood.
- T F 11. The teacher's permission to operate this machine is needed only after the pupil makes a special setup.
- T F 12. When crosscutting, feed the saw through the stock only as fast as it will cut.

Multiple Choice:

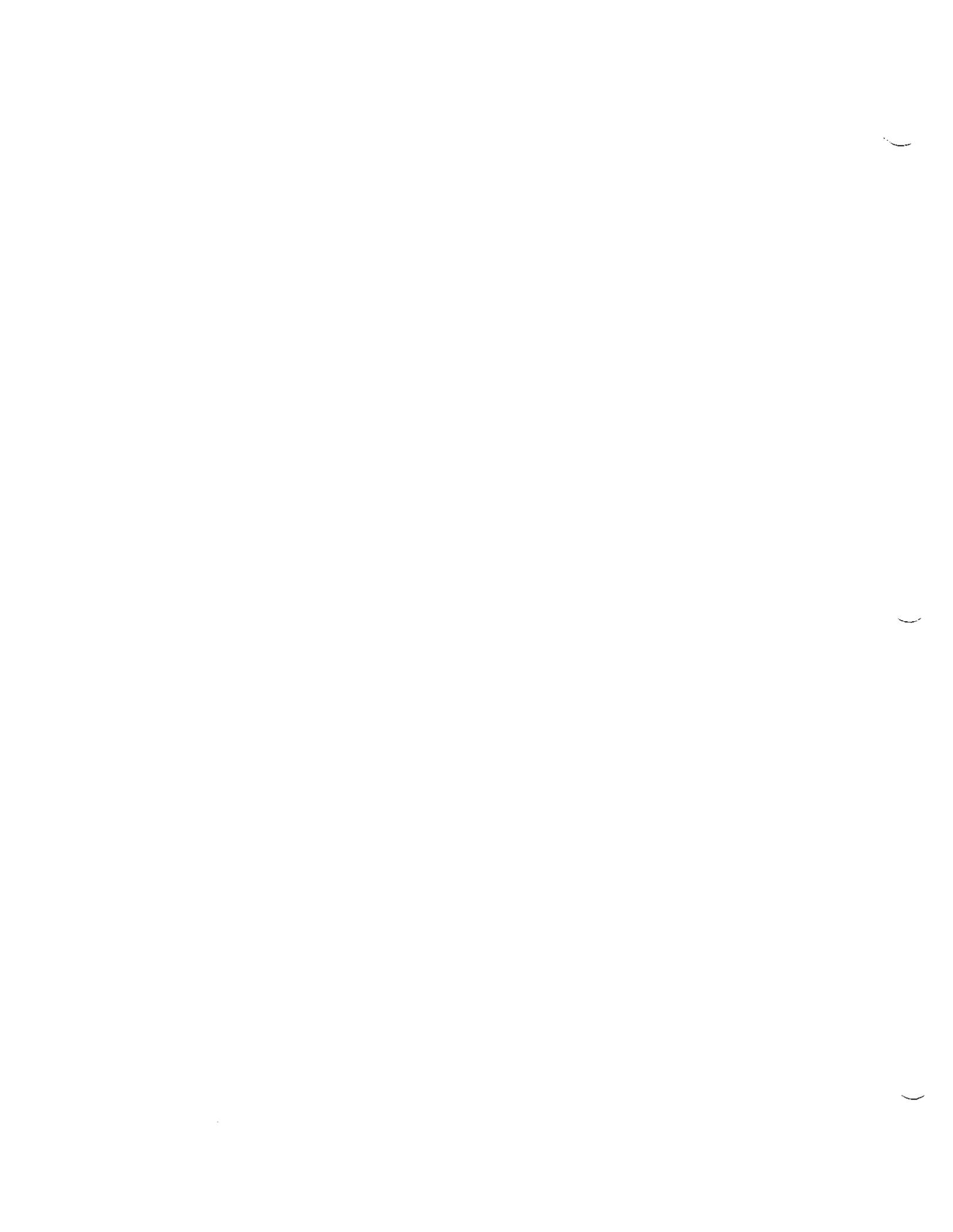
- \_\_\_\_\_ 13. The radial saw can be most safely used for:
- A. crosscutting
  - B. ripping
  - C. cutting dados
  - D. curved cuts
- \_\_\_\_\_ 14. Pushing a piece of wood into a coasting blade may:
- A. damage the machine
  - B. ruin the blade
  - C. result in a serious accident
  - D. do all of the above
- \_\_\_\_\_ 15. One should remember that the radial arm saw pulls itself into the work, therefore:
- A. hardwood should never be cut
  - B. assistance from a helper is necessary
  - C. it is necessary to hold back on the handle to prevent the saw from choking
  - D. none of the above are true

16. Identify the parts of the radial saw indicated in the drawing:

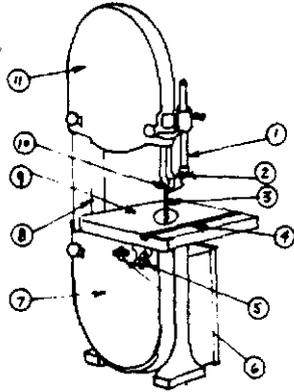


1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_  
5 \_\_\_\_\_  
6 \_\_\_\_\_

7 \_\_\_\_\_  
8 \_\_\_\_\_  
9 \_\_\_\_\_  
10 \_\_\_\_\_  
11 \_\_\_\_\_  
12 \_\_\_\_\_



## BAND SAW

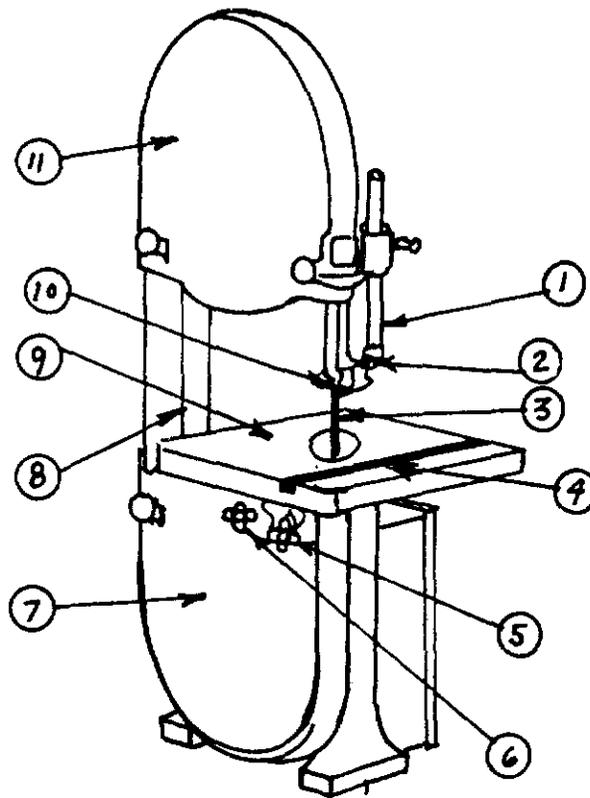


1. GUIDE POST
2. BLADE SUPPORT LOCK SCREW
3. BLADE
4. MITER GAGE GROOVE
5. TABLE CLAMP
6. ADJUSTING SCREW FOR  
BLADE GUIDES
7. LOWER WHEEL GUARD
8. REAR BLADE GUARD
9. TABLE
10. UPPER BLADE GUIDE
11. UPPER WHEEL GUARD

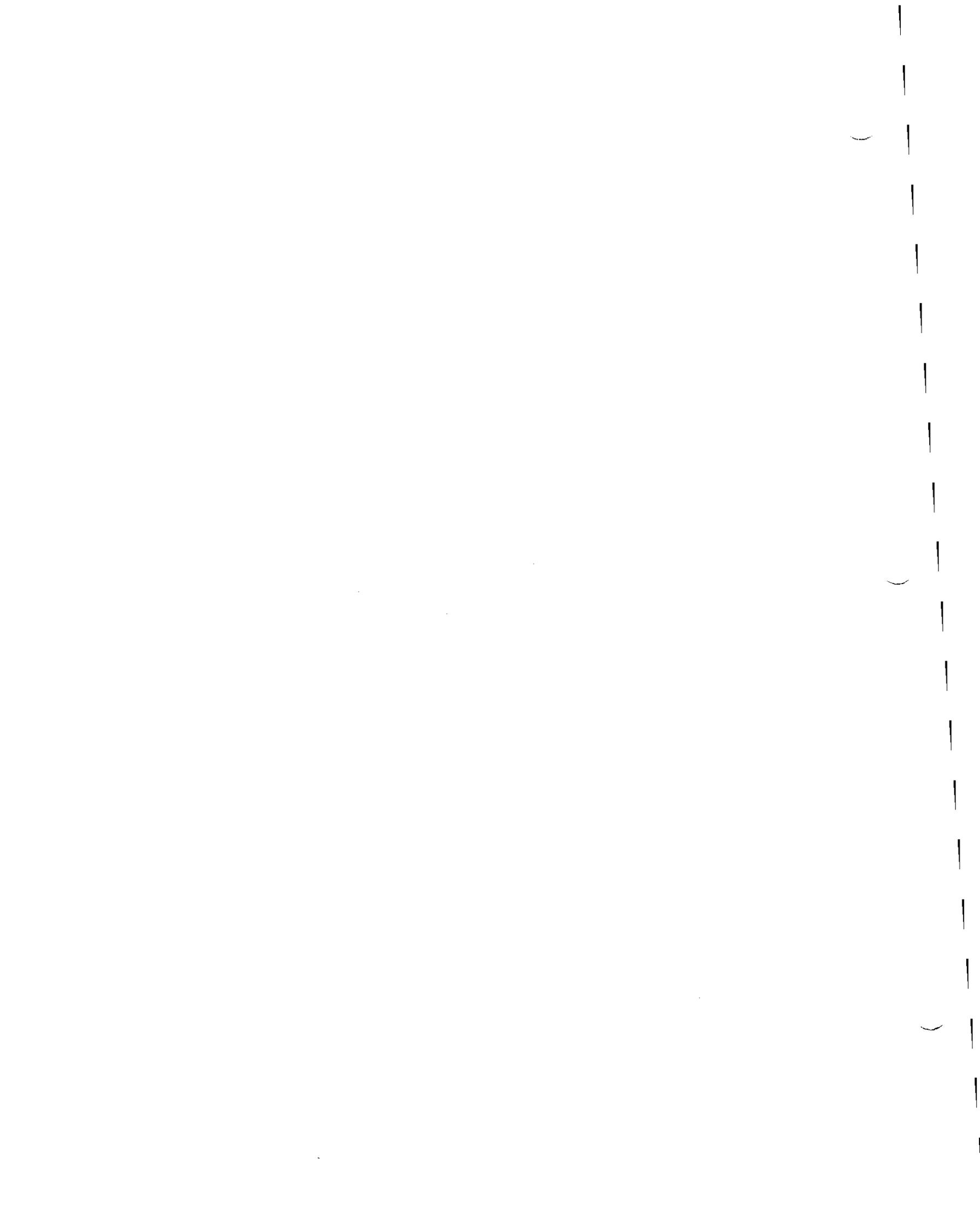
1. All portions of the saw blade are required to be covered, except at the point of operation. (OSHA)
2. The wheels of the band saw shall be completely enclosed by metal. (OSHA)
3. The band saw shall be equipped with a tension control device. (OSHA)
4. A suitable guard of the in-running feed roll must be in place. (OSHA)
5. One must obtain permission from the teacher before using the band saw for the first time.
6. Only stock that is in good shape should be cut.
7. All guards must be in the right place.
8. Adjustments should be made only when the machine is at a dead stop.
9. The upper blade guide should be set one-quarter inch or less above the work.
10. All special setups should be checked with the teacher.
11. Only the operator should be inside the operator's safety zone.
12. The material must be held firmly and the fingers kept a safe distance away from the saw blade.
13. The saw blade should be kept from twisting or binding when cutting curves.

14. The machine must be allowed to come to a dead stop before the blade is backed out of a long cut.
15. One should step away immediately if the saw blade breaks or comes off. The power should be shut off, if possible, and the teacher notified after all movement has stopped.
16. The power should be turned off after using and one should stand by until the machine has stopped.
17. Scraps of wood on the table should be cleared away only after the blade stops running.
18. If help is needed to support heavy or long work, the helper must never pull or guide the work. The helper supports the weight; the operator runs the machine.
19. Cylindrical stock must not be cut on the band saw. It is likely to roll in the hands.
20. Relief cuts must be made before cutting the outline of sharp curves.

## BAND SAW



- |   |                                     |    |                   |
|---|-------------------------------------|----|-------------------|
| 1 | GUIDE POST                          | 7  | LOWER WHEEL GUARD |
| 2 | BLADE SUPPORT LOCK SCREW            | 8  | REAR BLADE GUARD  |
| 3 | BLADE                               | 9  | TABLE             |
| 4 | MITER GAUGE GROOVE                  | 10 | UPPER BLADE GUIDE |
| 5 | TABLE CLAMP                         | 11 | UPPER WHEEL GUARD |
| 6 | ADJUSTING SCREW FOR<br>BLADE GUIDES |    |                   |



## BAND SAW SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

### True-False:

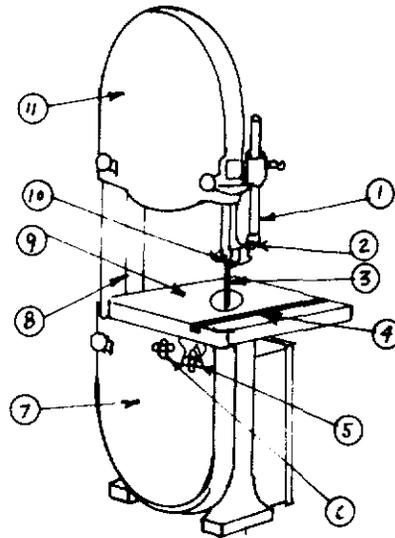
- T F 1. The upper blade guide should be adjusted to 1/4-inch above the stock.
- T F 2. A person who is assisting a fellow pupil should stand to the right of the blade.
- T F 3. The teeth of the band saw blade should be pointed up at the point of operation.
- T F 4. One who is cutting curves should first make relief cuts.
- T F 5. The band saw must be at a dead stop when adjustments are made.
- T F 6. The roller bearing on the guide is to prevent the blade from being pulled from the lot when backing out.
- T F 7. If a blade breaks, one needs to get a fellow pupil to stop the machine.
- T F 8. A bench brush should be used to clean chips and dust from the table.
- T F 9. The saw should be running at full power before cutting material.
- T F 10. The operator's hands should never be in a direct line with the blade.

### Multiple Choice:

- \_\_\_\_\_ 11. When starting the band saw, the operator should stand:
- A. to the right of the saw blade
  - B. to the left of the saw blade
  - C. in front of the saw
  - D. behind the saw

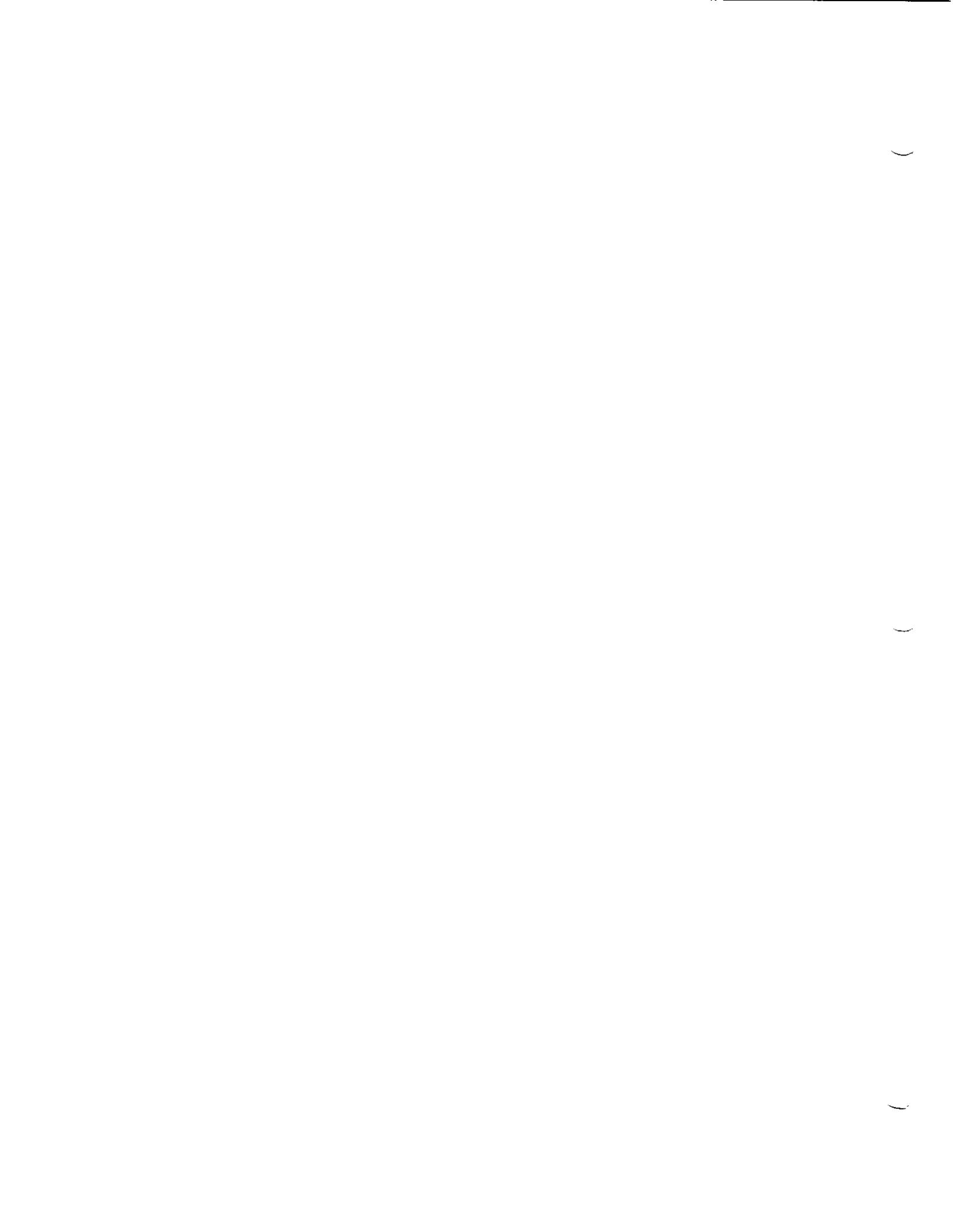
- \_\_\_\_\_ 12. If the band saw blade should break or come off the wheels, one should:
- A. shut off the power and stand clear
  - B. continue cutting
  - C. move the stock away to avoid damage
  - D. call another pupil.
- \_\_\_\_\_ 13. If it becomes necessary to back out on a long cut, one should:
- A. try to make a sharp turn on the blade
  - B. continue to push the stock forward
  - C. stop the machine and back the stock off
  - D. carefully back the stock away from the blade
- \_\_\_\_\_ 14. The upper saw guide of the band saw should be set:
- A. when the saw is coasting.
  - B. tightly against the stock
  - C. 1/2 inch above the stock
  - D. 1/4 inch or less above the stock.

15. Identify the parts of the band saw indicated in the following drawing:

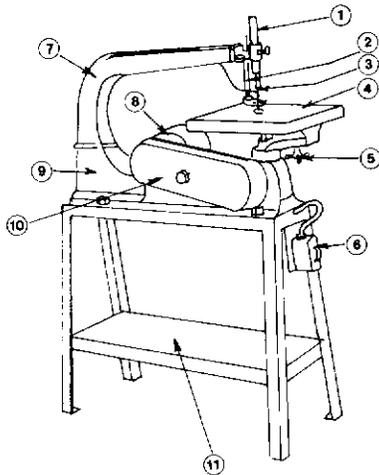


- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_

- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_
- 10. \_\_\_\_\_
- 11. \_\_\_\_\_



## SCROLL (JIG) SAW

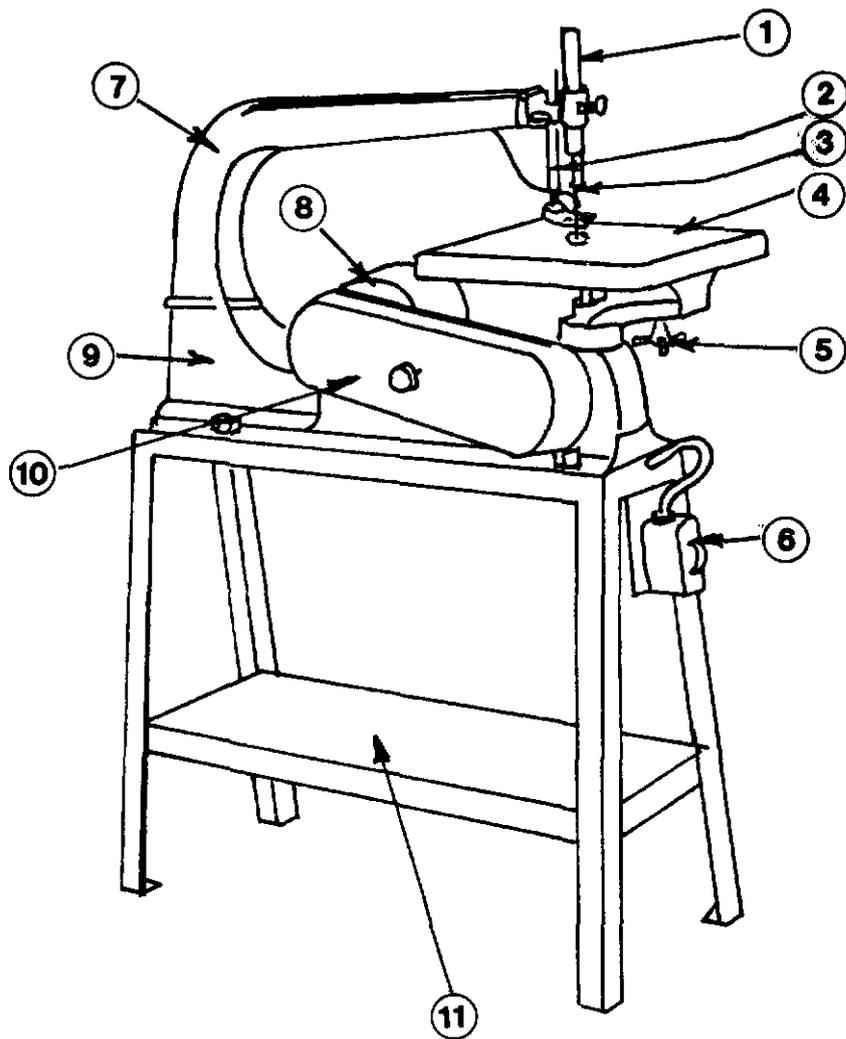


1. TENSION SLEEVE
2. HOLD-DOWN GUARD
3. UPPER CHUCK
4. TABLE
5. TABLE ADJUSTMENT KNOB
6. SWITCH
7. OVER ARM
8. MOTOR
9. BASE
10. BELT AND PULLEY GUARD
11. STAND

1. Hinged saw tables shall be so constructed that the table can be firmly secured in any position and in true alignment with the saw. (OSHA)
2. All belts, pulleys, gears, shafts, and moving parts shall be guarded in accordance with the specific requirements in the OSHA Handbook. (OSHA)
3. The teacher's permission must be obtained before using the machine.
4. The operator should select a blade to suit the thickness of the wood and the size of the curves to be cut.
5. The blade should first be tightened securely in the lower chuck, then in the upper chuck.
6. The blade guide should be adjusted in line with the blade to support it while cutting.
7. The operator should lower the hold-down or pressure foot to press lightly on the surface of the stock being cut.
8. One can check the tension of the blade by turning the motor by hand. If knocking is heard, stop the machine and readjust the tension.
9. The stock should be held firmly while feeding it at a moderate rate of speed.

10. Fingers and hands must be kept away from the path of the blade.
11. Large curves should be cut first, then small details.
12. One should not make sudden turns or sharp turns.
13. Only stock with a flat surface should be cut.
14. One should turn off the machine and wait until it has completely stopped before removing scraps or leaving the machine.

## SCROLL (JIG) SAW



- |                         |                          |
|-------------------------|--------------------------|
| 1 TENSION SLEEVE        | 7 OVER ARM               |
| 2 HOLD-DOWN GUARD       | 8 MOTOR                  |
| 3 UPPER CHUCK           | 9 BASE                   |
| 4 TABLE                 | 10 BELT AND PULLEY GUARD |
| 5 TABLE ADJUSTMENT KNOB | 11 STAND                 |
| 6 SWITCH                |                          |

1

2

3

## SCROLL (JIG) SAW SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

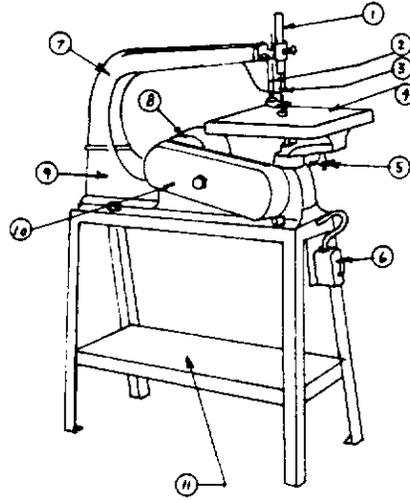
### True-False:

- T F 1. The scroll saw can cut as small as 90° corners.
- T F 2. The pulley should be turned by hand to be sure the blade functions correctly before turning on the machine.
- T F 3. The hold-down guard must be in place to keep the material from being pulled up with the upward stroke.
- T F 4. The blade should be installed with the teeth pointing up.
- T F 5. The tension from the upper head pulls the blade back up after the motor pulls it down.
- T F 6. Since the scroll saw is the easiest saw to operate, it is possible to talk to a friend while operating it.
- T F 7. Safety glasses must be worn when operating the scroll saw.
- T F 8. The pulley belt must be covered at all times when the saw is in use.

### Multiple Choice:

- \_\_\_\_\_ 9. One's fingers should never be permitted to get:
- A. directly in line with the blade
  - B. close to the tension sleeve
  - C. near the over arm
- \_\_\_\_\_ 10. All scraps and cutoff pieces should be removed only:
- A. when the machine is at a dead stop
  - B. at the end of the period
  - C. when installing a new blade

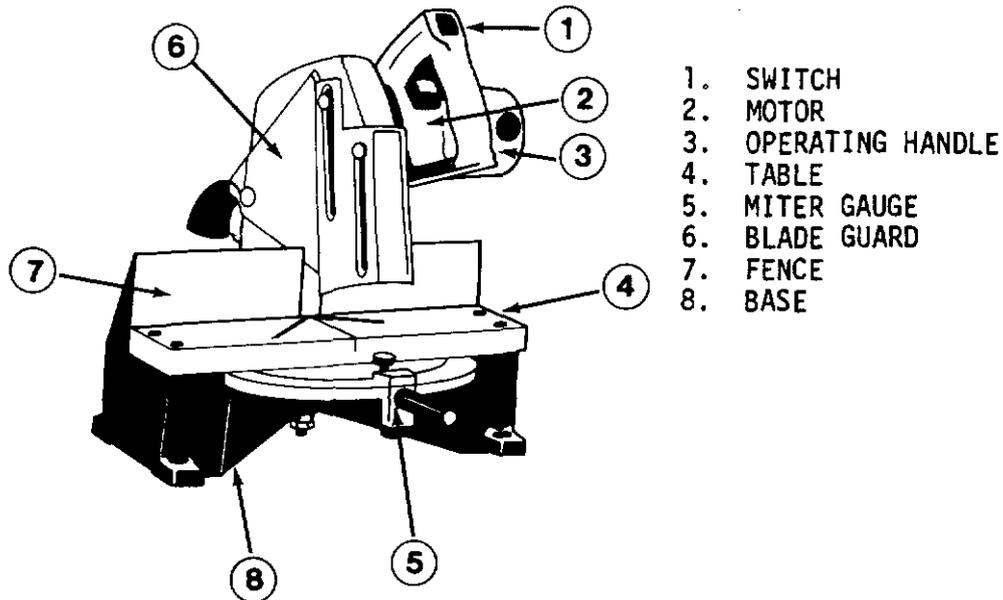
11. Identify the parts of a scroll saw indicated in the drawing:



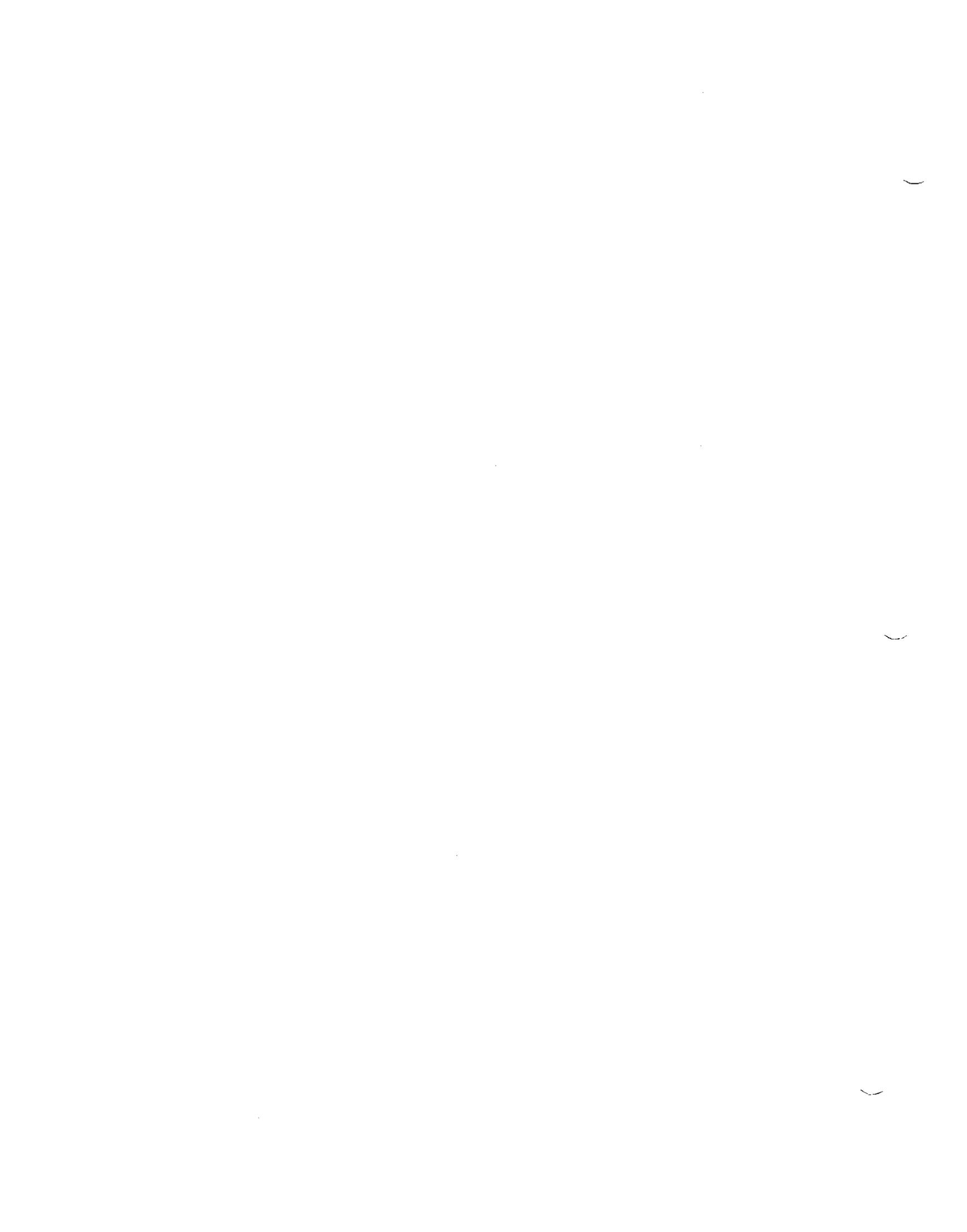
1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_  
5 \_\_\_\_\_  
6 \_\_\_\_\_

7 \_\_\_\_\_  
8 \_\_\_\_\_  
9 \_\_\_\_\_  
10 \_\_\_\_\_  
11 \_\_\_\_\_

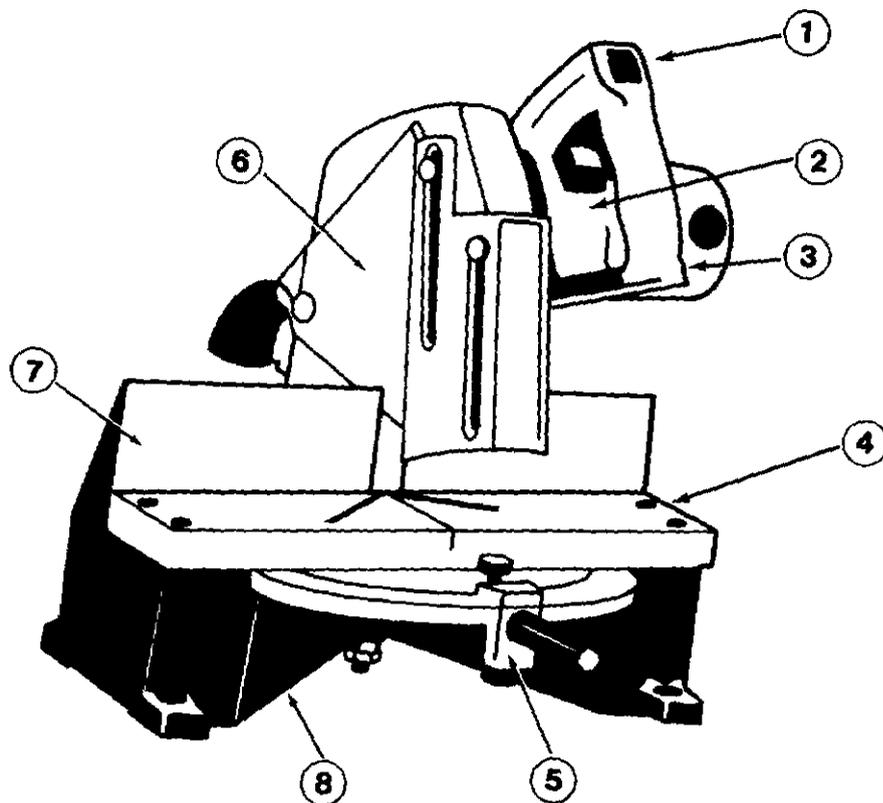
## MITER BOX SAW (MOTORIZED)



1. Each miter box saw shall be provided with a hood that will completely enclose the upper half of the saw, the arbor end, and the point of operation at all positions of the saw. Its hood shall be so designed that it will automatically cover the lower portion of the blade, regardless of the position of the saw. (OSHA)
2. A pupil must get the teacher's permission to use the saw and the teacher must check the setup before it is used.
3. The material to be cut should be held firmly against both the table and the fence.
4. The material must not be held by hand. Some type of clamp should be used.
5. The hands should never come within six inches of the cutting blade.
6. The area should be cleaned up after the saw has been used.

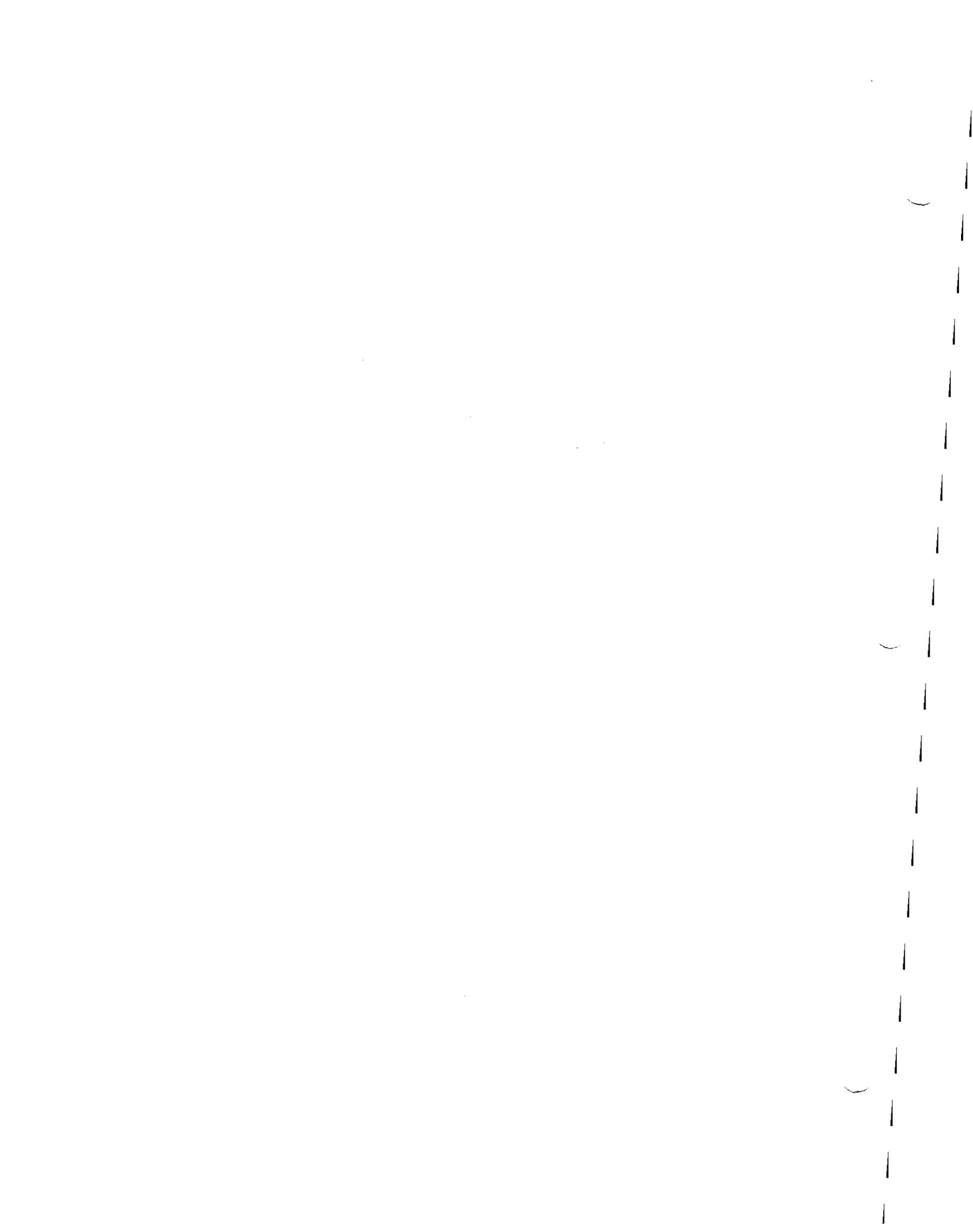


MITER BOX SAW  
(MOTORIZED)



- 1 SWITCH
- 2 MOTOR
- 3 OPERATING HANDLE
- 4 TABLE

- 5 MITER GAUGE
- 6 BLADE GUARD
- 7 FENCE
- 8 BASE



## MITER BOX SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

### True-False:

- T F 1. The teacher should check the setups before a pupil turns on the machine.
- T F 2. It is usually best to work in pairs on this piece of equipment.
- T F 3. It is all right to use stop blocks on a motorized miter box saw.
- T F 4. One does not need to wear safety glasses when using this saw because it takes just a minute to complete an operation with the saw.
- T F 5. It is advisable to remove the guards on the side of the saw blade to see better what you are doing.

### Multiple Choice:

- \_\_\_\_\_ 6. When operating the motorized miter box:
- A. remove tie, rings, watch, and other jewelry, and roll up the sleeves
  - B. always wear safety glasses or face shield
  - C. keep the guards in place and in use at all times
  - D. all of the above
- \_\_\_\_\_ 7. When making any adjustments:
- A. disconnect the power
  - B. unlock the pivot arm
  - C. apply the brake
  - D. lock the motor in an up position

\_\_\_ 8. Work should be held firmly against:

- A. the table
- B. the fence
- C. the fence and table
- D. the pivot arm.

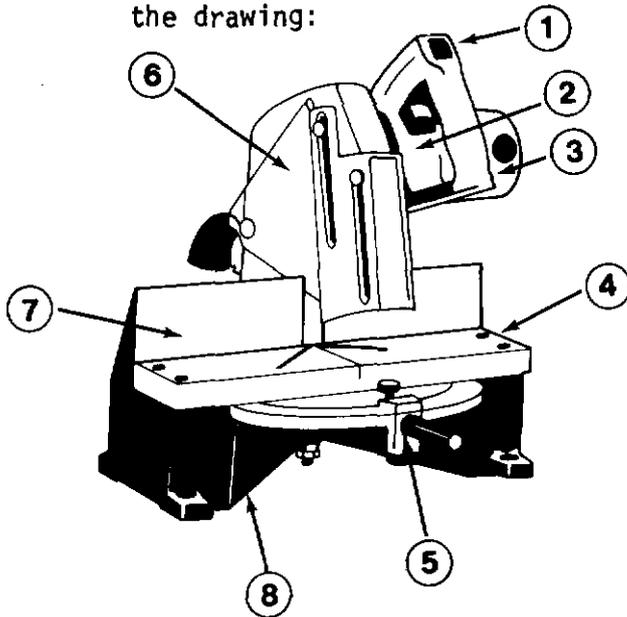
\_\_\_ 9. When a cut has been made:

- A. release the trigger and remove the scrap from the table
- B. release the trigger and lock the motor in up position
- C. release the trigger and apply the brake
- D. release the trigger and move to the next operation

\_\_\_ 10. When ready to cut one should wait for the motor on the miter box:

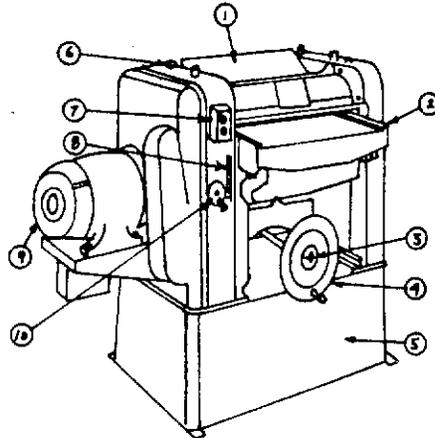
- A. to come up to half speed
- B. to come up to full speed
- C. to reach a speed for the type of job to be done
- D. to reach any speed

11. Give the correct names of the parts of the saw indicated on the drawing:



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_

## PLANER (SURFACER)

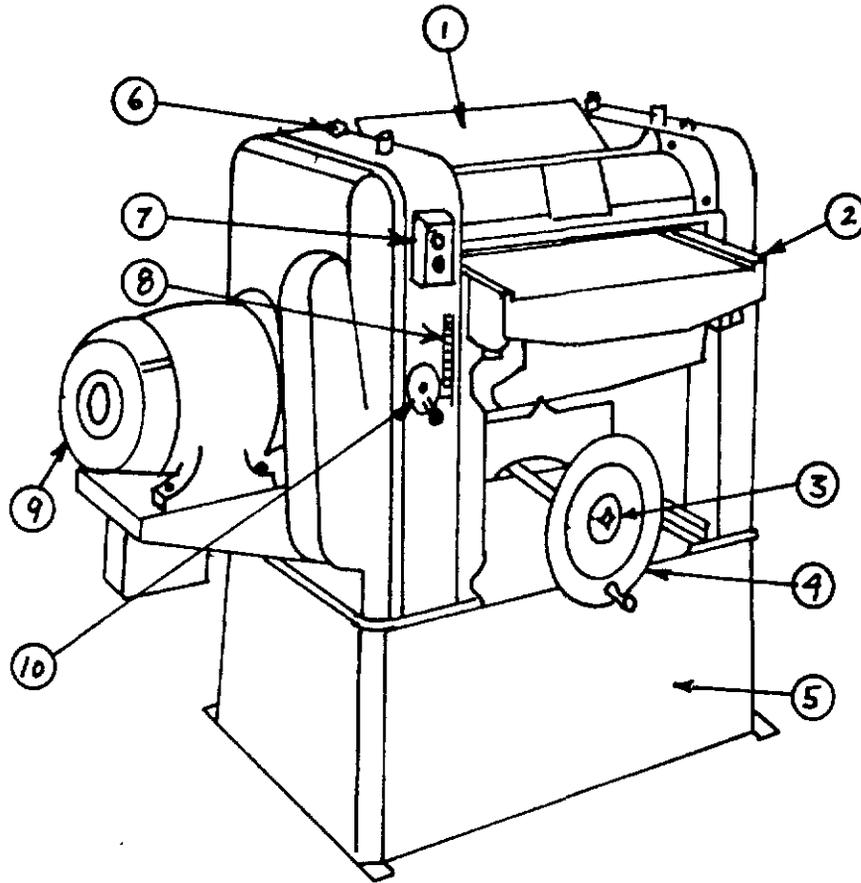


1. CHIP GUARD
2. TABLE
3. HANDWHEEL LOCK
4. ELEVATING HANDWHEEL
5. BASE
6. FEED ROLL ADJUSTMENTS
7. SWITCH
8. DEPTH OF-CUT-GAUGE
9. MOTOR
10. VARIABLE SPEED FEED ROLL

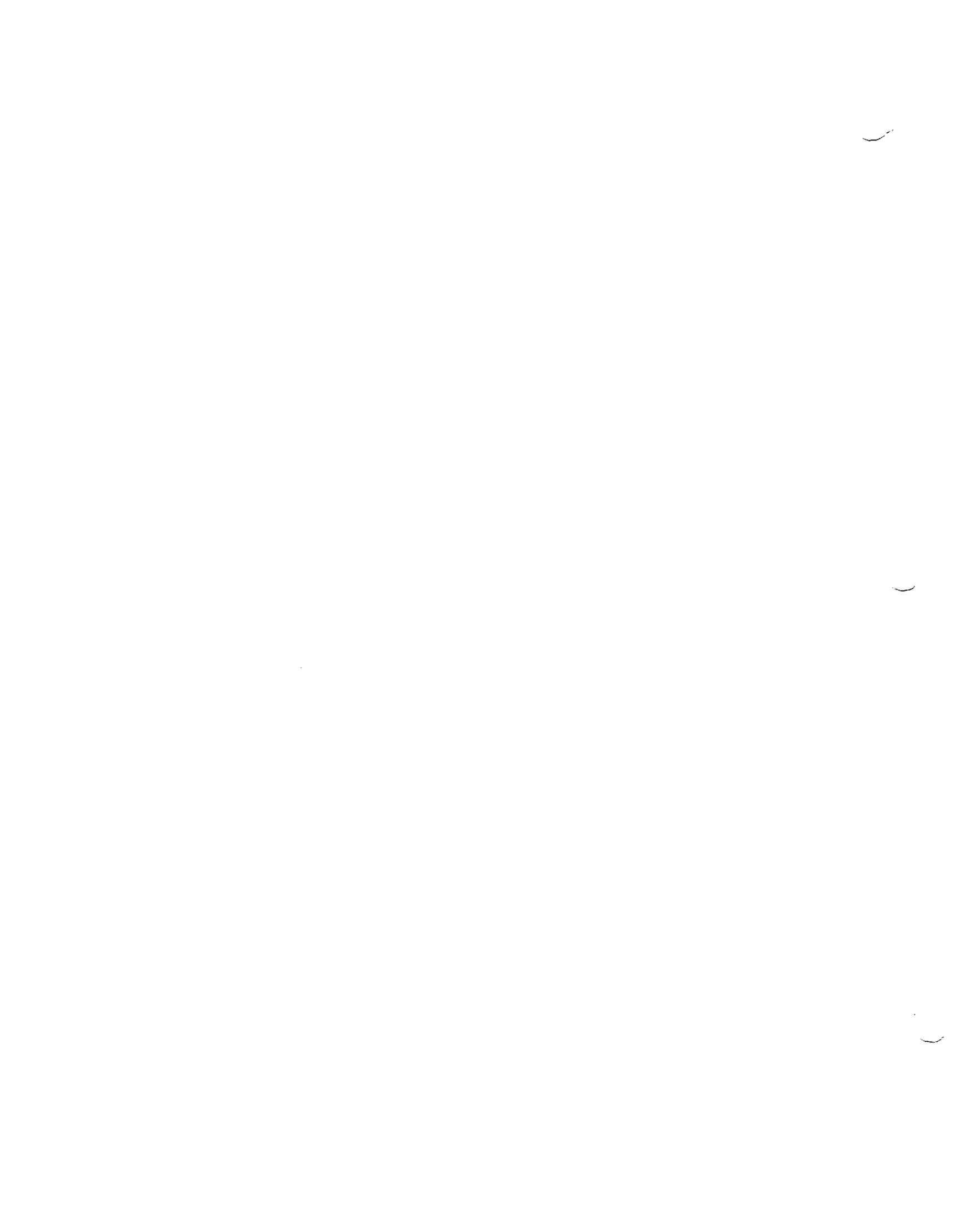
1. The cutting heads must be guarded with a metal guard which has a minimum thickness of 1/16 inch, if made of sheet metal; or a minimum of 3/16 inch, if made of cast iron. (OSHA)
2. Where an exhaust system is used, the guards shall form a part of the hood and shall be constructed of metal. (OSHA)
3. Feed rolls must be guarded by a hood or suitable guard to prevent the operator's hands from coming in contact with the in-running rolls.
4. The stock should be checked to make sure it is clean and free from loose knots and other defects.
5. Never surface stock smaller than 10" or the distance between the rollers plus 2 inches.
6. Loose clothing and dangling jewelry present safety hazards. One should avoid wearing them when operating the planer.
7. One should always stand to one side of the planer when it is in use.
8. Adjustments should be made only when the machine is at a dead stop.

9. The board to be planed must have at least one true surface.
10. The cuts on wide boards should be limited to 1/16 inch or less.
11. Thin stock can be planed by placing it on top of a thick-surfaced board.
12. Only one board should be planed at any one time.
13. The teacher's permission should be obtained before operating the planer.

## PLANER (SURFACER)



- |   |                     |    |                          |
|---|---------------------|----|--------------------------|
| 1 | CHIP GUARD          | 6  | FEED ROLL ADJUSTMENTS    |
| 2 | TABLE               | 7  | SWITCH                   |
| 3 | HANDWHEEL LOCK      | 8  | DEPTH-OF-CUT GAUGE       |
| 4 | ELEVATING HANDWHEEL | 9  | MOTOR                    |
| 5 | BASE                | 10 | VARIABLE SPEED FEED ROLL |



## PLANER (SURFACER) SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

### True-False:

- T F 1. Wood with loose knots is dangerous and should not be run through the planer.
- T F 2. The shortest board that should be run through the machine should be two inches longer than the distance between the rollers.
- T F 3. Grain direction is unimportant when surfacing stock.
- T F 4. One can get one's finger pinched between the board and the table when running short boards.
- T F 5. The operator should stand to one side of the stock being surfaced.
- T F 6. Painted or used wood may be cleaned up on the planer without any problems.
- T F 7. The planer will straighten out a curved or twisted board.
- T F 8. Glued joints must be scraped off before being surfaced.
- T F 9. The operator should look into the machine to check the depth of the cut on the material.
- T F 10. Chips should be removed even if the machine is running.

### Multiple Choice:

- \_\_\_\_\_ 11. If the material jams or the planer fails to work properly, one should:
- A. adjust the pressure of the feed rollers
  - B. readjust the depth of the cut
  - C. push harder on the wood
  - D. turn off the power and call the teacher

\_\_\_\_\_ 12. In planing most stock it is not necessary to remove more than:

- A. three turns on the adjustment wheel
- B. 1/8 inch of stock per cut
- C. 1/16 inch of stock per cut
- D. any amount is all right

\_\_\_\_\_ 13. Wood to be surfaced down to 3/8-inch thickness or less should be:

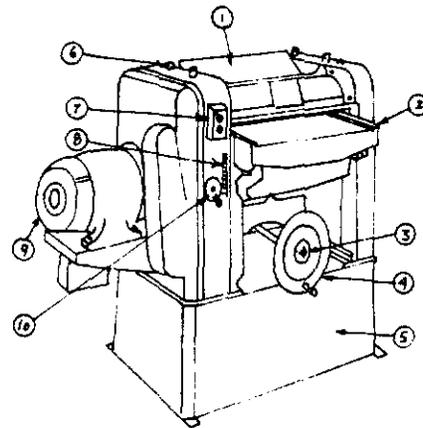
- A. surfaced on the edges first
- B. placed on top of a thicker board and run through the planer
- C. fed into the machine behind a piece of like thickness
- D. placed beside a piece of like thickness and run through the machine

\_\_\_\_\_ 14. Which side of the board does the planer cut?

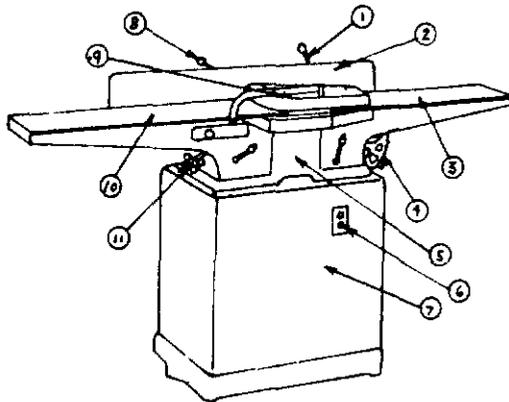
- A. Bottom
- B. Top
- C. Both sides at the same time

15. Name the parts of the planer indicated in the following drawing:

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_
- 10. \_\_\_\_\_



## JOINTER

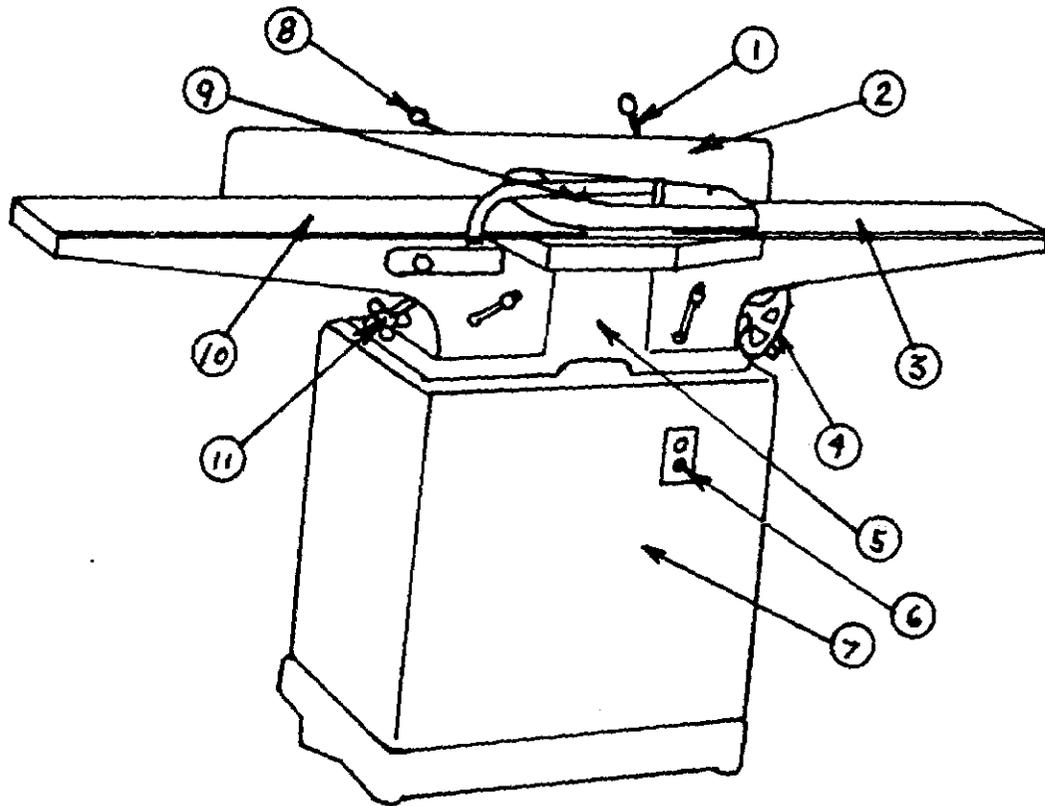


1. FENCE TILTING LEVER
2. FENCE
3. IN-FEED TABLE
4. IN-FEED TABLE ADJUSTING WHEEL
5. BASE
6. SWITCH
7. STAND
8. FENCE ADJUSTMENT LEVER
9. FRONT GUARD
10. OUT-FEED TABLE
11. OUT-FEED TABLE ADJUSTING WHEEL

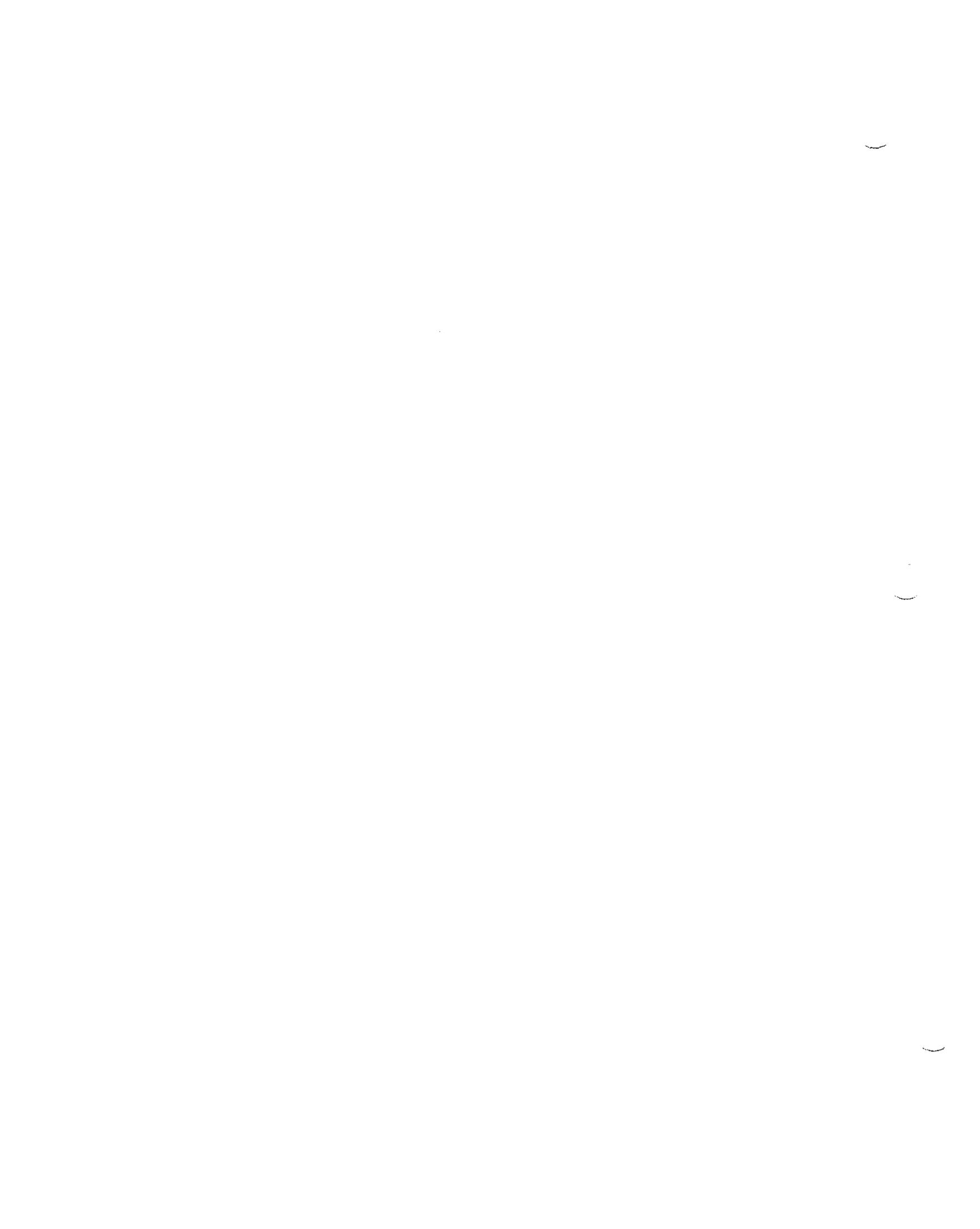
1. **HAND-FED WITH HORIZONTAL HEAD:** shall have a cylindrical cutting head with the knife projecting no more than 1/8-inch beyond the cylinder.
2. **TABLE OPENINGS:** the clearance between the rear table and cutter head shall be 1/8-inch maximum. The table throat opening (when tables are set with each other for zero cut) shall be two and one-half inches maximum.
3. **HORIZONTAL HEAD:** shall have an automatic guard covering the head on the working side of the fence or gauge, and a guard covering the head back of the fence or gauge.
4. **VERTICAL HEAD:** shall have an exhaust hood or other guard completely enclosing the revolving head, except for a slot wide enough to perform work.
5. Operate only with the teacher's permission and after instruction has been received.
6. Remove jewelry, eliminate loose clothing, and confine long hair.
7. Make sure all guards are in place and operating correctly.
8. Always use the proper eye protection.
9. Make all adjustments with the power turned off.

10. Use a push stick or push block when the hands would pass over or within two inches of the cutter head.
11. Make several light cuts ( $1/6''$  to  $1/8''$ ) instead of one heavy cut ( $1/2''$ ).
12. Remember that the absolute minimum length of material that may be joined is twice the size of the knives-- 6" jointer, 12"; 8" jointer, 16".
13. Do not adjust or move the rear or feed table without permission.

# JOINTER



- |                                 |                                   |
|---------------------------------|-----------------------------------|
| 1 FENCE TILTING LEVEL           | 7 STAND                           |
| 2 FENCE                         | 8 FENCE ADJUSTMENT LEVEL          |
| 3 IN-FEED TABLE                 | 9 FRONT GUARD                     |
| 4 IN-FEED TABLE ADJUSTING WHEEL | 10 OUT-FEED TABLE                 |
| 5 BASE                          | 11 OUT-FEED TABLE ADJUSTING WHEEL |
| 6 SWITCH                        |                                   |



## JOINTER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

### True-False:

- T F 1. The size of the jointer is determined by the length of its knives.
- T F 2. A stock less than ten inches in length should not be joined on the power jointer.
- T F 3. The depth of the cut is adjusted by the rear table.
- T F 4. A push block should not be used when jointing the face.
- T F 5. The jointer fence should be checked with a T-level.
- T F 6. Boards that are 1/4-inch thick cannot be jointed on the jointer.
- T F 7. When jointing the edge, the rough face goes against the fence.
- T F 8. The only time that the front guard should be removed is when one is cutting a rabbit.
- T F 9. The out-feed table is level with the cutter knives.

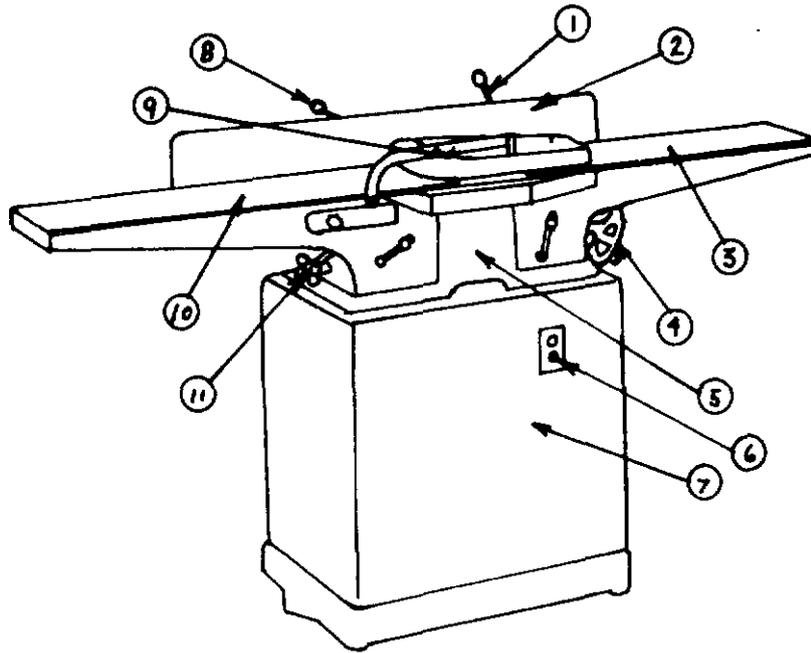
### Multiple Choice:

- \_\_\_\_\_ 10. Which of the following is not a part of the jointer?
- A. base
  - B. in-feed table
  - C. miter gauge
  - D. fence

Multiple Choice:

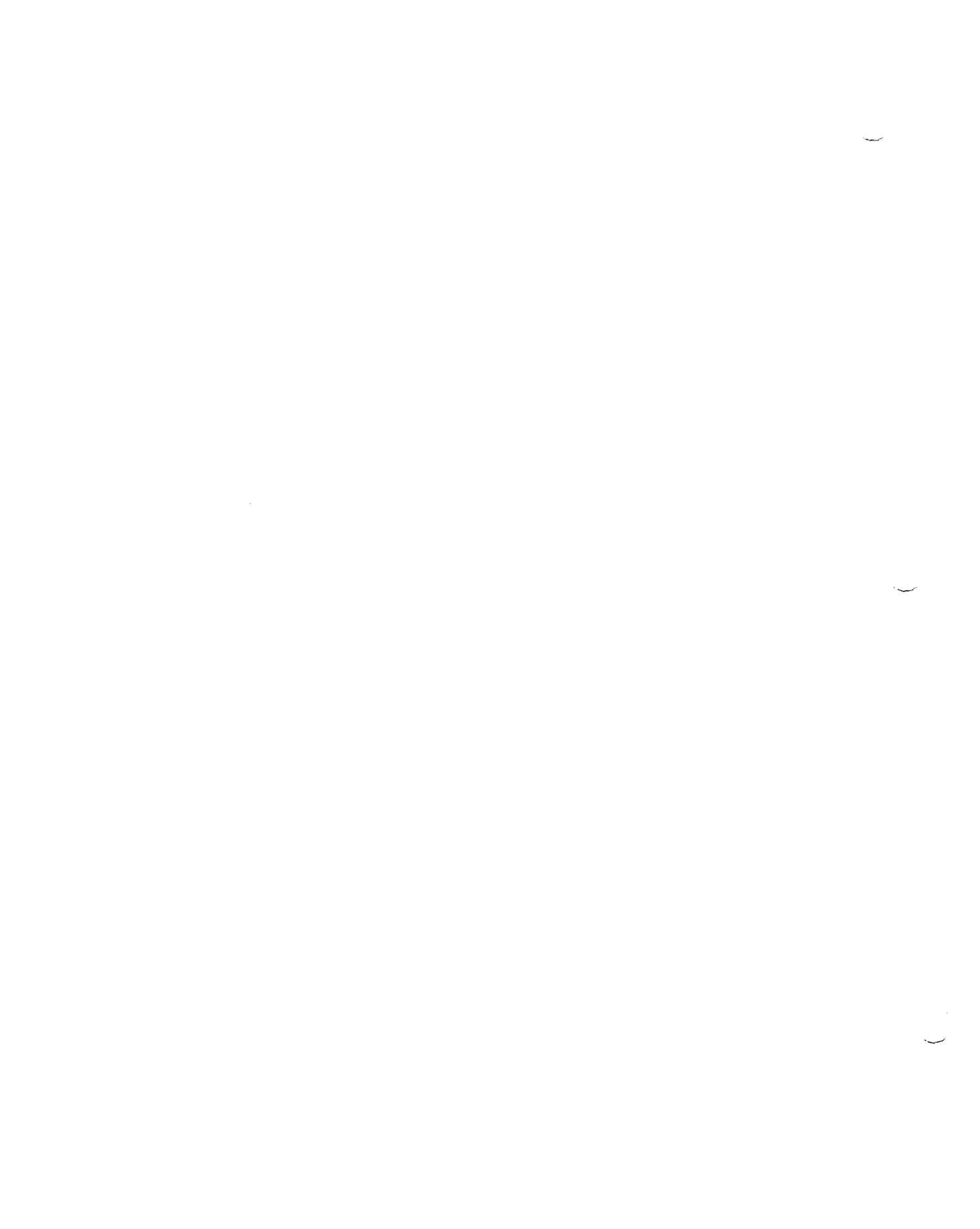
- \_\_\_\_ 11. The size of the jointer is determined by:
- A. the length of the knives.
  - B. the length of the table
  - C. the number of knives
  - D. none of these
- \_\_\_\_ 12. The depth of cut is adjusted by:
- A. the fence
  - B. the rear table
  - C. the guard
  - D. the front table
- \_\_\_\_ 13. Which of these operations cannot be done on the jointer?
- A. cutting a level
  - B. cutting a rabbit
  - C. cutting a dado.
  - D. surfacing a board
- \_\_\_\_ 14. The jointer must have, as a safety device:
- A. a front guard
  - B. a rear guard
  - C. a locking fence
  - D. all of the above
- \_\_\_\_ 15. The jointer takes the place of:
- A. a rip saw
  - B. a file
  - C. a hand plane
  - D. a tri-square

16. Identify the parts of the jointer shown in the following drawing:

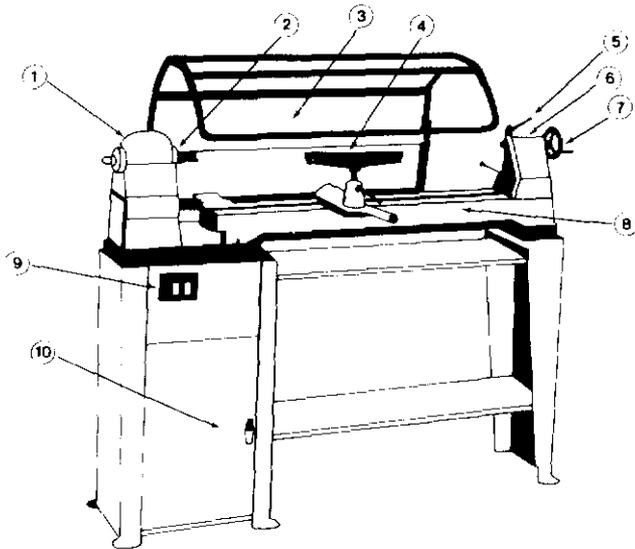


1 \_\_\_\_\_  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_  
 4 \_\_\_\_\_  
 5 \_\_\_\_\_  
 6 \_\_\_\_\_

7 \_\_\_\_\_  
 8 \_\_\_\_\_  
 9 \_\_\_\_\_  
 10 \_\_\_\_\_  
 11 \_\_\_\_\_



## WOOD LATHE



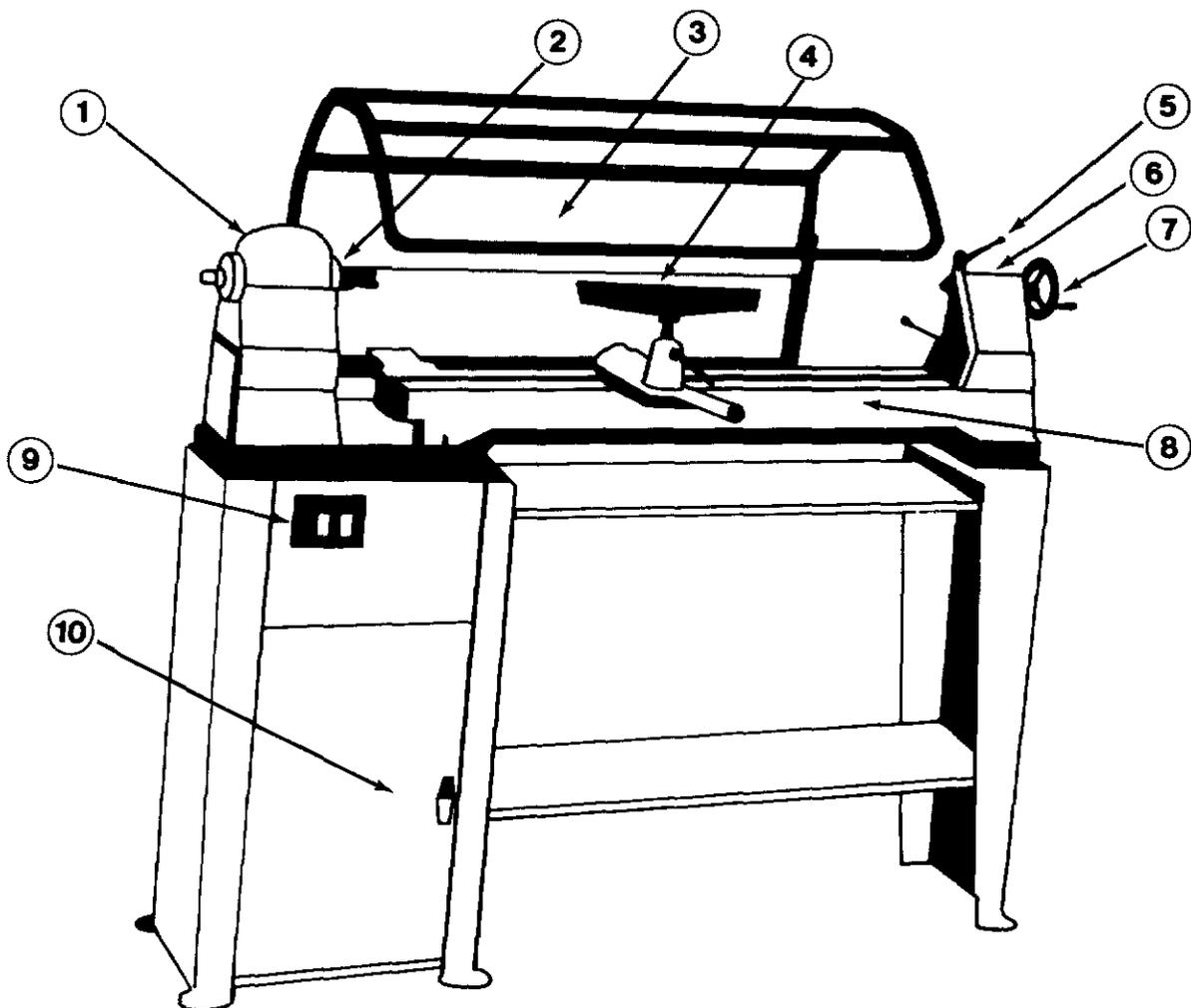
1. HEAD STOCK
2. INDEXING PIN
3. SAFETY SHIELD
4. TOOL REST
5. TAIL STOCK SPINDLE CLAMP
6. TAIL STOCK
7. TAIL STOCK HANDLE
8. LATHE BED
9. SWITCH
10. MOTOR

1. Cutting heads on wood-turning lathes, whether rotating or not, shall be covered as completely as possible by hoods or shields, which shall be hinged to the machine so they can be thrown back for making adjustments. (OSHA)
2. Lathes used for turning long pieces of wood stock, held only between two centers, shall be equipped with long, curved guards extending over the tops of the lathes in order to prevent the workpiece from being thrown out of the machine if the guards should become loose. (OSHA)
3. The teacher's permission must be obtained before using the lathe.
4. One should never use stock that is cracked or has knots, checks, or poor glue joints.
5. All glued material must be properly cured and dry. It must set 24 hours before it is used in the lathe.
6. Before turning on the power, the operator should rotate the stock by hand to check that it is free. He/she should stand to one side when the power is first turned on.

7. Rough stock is to be turned at the slowest speed on the lathe.
8. One should increase and decrease the speed gradually because centrifugal force may break the wood or cause the material to come off the spindle.
9. The tool rest should be adjusted as close to the material as possible when starting and should be frequently readjusted as the turning progresses.
10. The lathe should be started at its lowest speed.
11. The turning tool should be held firmly with both hands while cutting.
12. The lathe must be stopped before using the calipers to determine the diameter of the stock. The tool rest should not be adjusted until the lathe has stopped.
13. All large-diameter stock is turned at the slowest lathe speed.
14. The tool rest and tool rest post should be removed when sanding, finishing, or polishing. Abrasive paper should not be wrapped around the hands or fingers for sanding.
15. The work should be supported with a steady rest when cutting small diameters that are a minimum of 12-inches long.
16. Faceplate work must be securely screwed to the faceplate before it is turned. Great care must be taken when turning to avoid cutting too deeply and striking screws.
17. Faceplate work must be cut to a circular shape on the band saw before turning.
18. The machine and the area around the machine must be cleaned up when work on the lathe is completed.

## WOOD LATHE

- |                             |                      |
|-----------------------------|----------------------|
| 1. HEAD STOCK               | 6. TAIL STOCK        |
| 2. INDEXING PIN             | 7. TAIL STOCK HANDLE |
| 3. SAFETY SHIELD            | 8. LATHE BED         |
| 4. TOOL REST                | 9. SWITCH            |
| 5. TAIL STOCK SPINDLE CLAMP | 10. MOTOR            |





## WOOD LATHE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

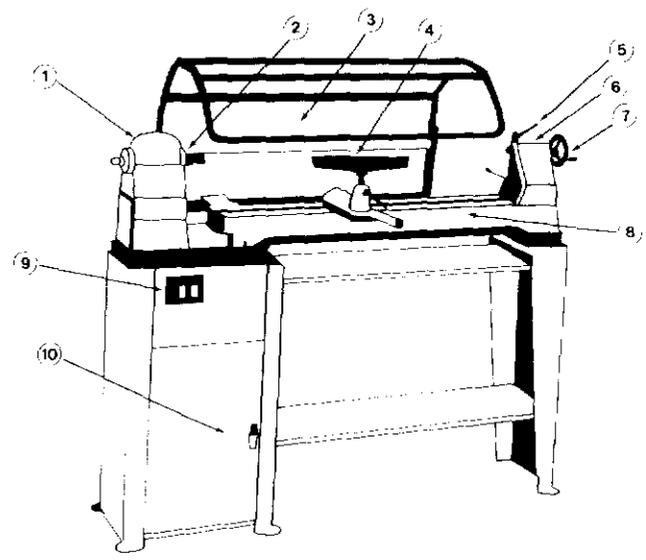
### True-False:

- T F 1. The speed of the machine is determined by the size, shape, and kind of material being used.
- T F 2. The space between the tool rest and the work should be 1/4- to 1/2-inch.
- T F 3. Since the lathe is equipped with a safety shield, it is not necessary to wear safety glasses.
- T F 4. Lathe tools should not be used unless they are very sharp.
- T F 5. When sanding, it is permissible to feel the smoothness while the lathe is running.
- T F 6. The tool rest and tool post should be removed when sanding.
- T F 7. Cutting tools must be held tightly and firmly against the tool rest.
- T F 8. Since the safety shield covers the spinning workpiece, loose clothing and long hair are not any problem.
- T F 9. When starting to turn a large block, it is necessary to start at the slowest speed possible.
- T F 10. It is unsafe to turn work that is lopsided or out of balance.
- T F 11. Prior to starting the lathe, one should turn the work one complete revolution by hand.
- T F 12. Material that has been glued and clamped can be used after one hour of drying.

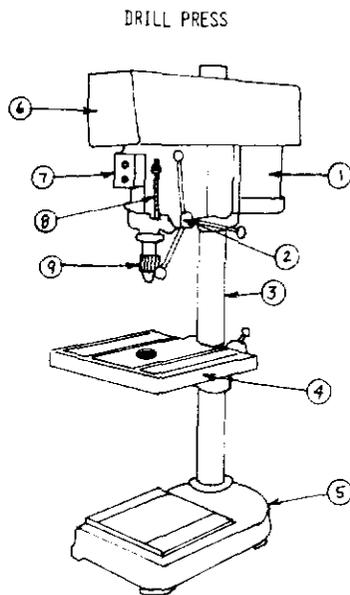
Multiple Choice:

- \_\_\_\_\_ 13. All adjustments on the lathe should be made:
- A. after the initial cuts are made
  - B. with the teacher present
  - C. while the machine is at a dead stop
  - D. while the machine is slowly turning
- \_\_\_\_\_ 14. For a beginning operation, one should start the lathe at:
- A. a speed of 5,000 rpm
  - B. a medium speed
  - C. the highest speed
  - D. the slowest speed
- \_\_\_\_\_ 15. The turning tool should be held:
- A. firmly against the tool rest
  - B. with one hand
  - C. only at the start
  - D. tucked under the arm
16. Give the correct names of the lathe parts indicated in drawing:

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_
- 10. \_\_\_\_\_



## DRILL PRESS

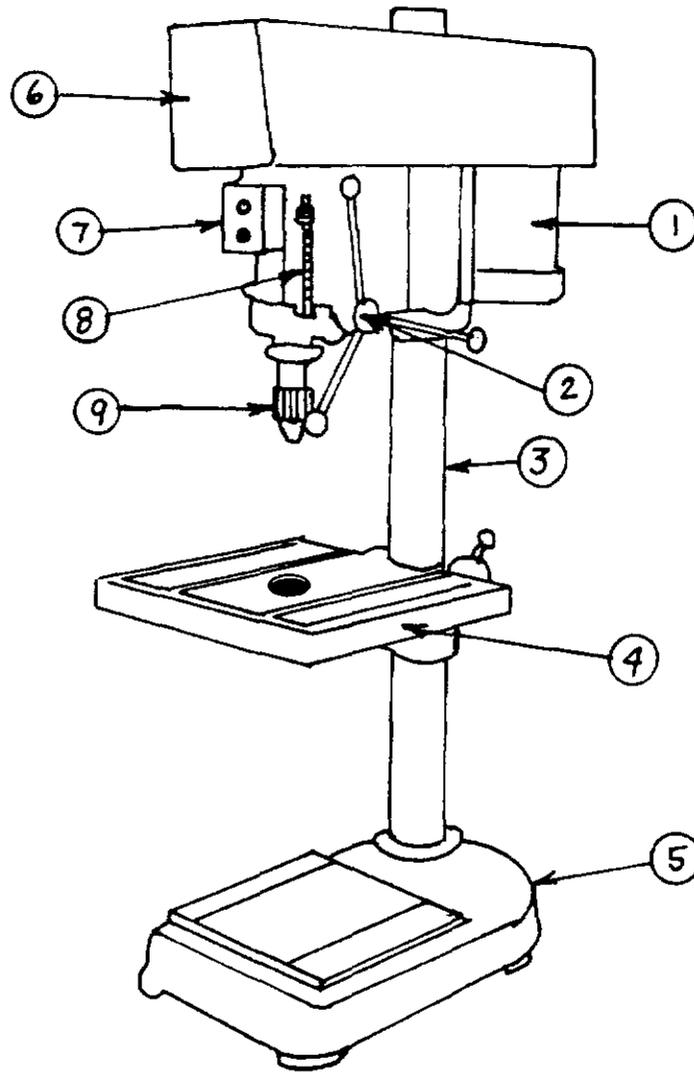


1. MOTOR
2. PILOT WHEEL FEED
3. COLUMN
4. TABLE
5. BASE
6. BELT GUARD
7. SWITCH
8. DEPTH STOP
9. QUILL

1. All belts and pulleys shall be guarded. (OSHA)
2. The teacher's permission must be obtained before using the drill press.
3. The operator should make sure the table is secure and the depth adjustment set before turning on the power.
4. The drive belt must be on the correct pulleys for the desired speed (1200 -3000 rpm for drilling wood).
5. One should never attempt to use a regular auger bit on the drill press or in the hand drill. Auger bits for this machine have the lead screw cut smooth and the square tang cut off.
6. The chuck key must be removed before turning on the power.
7. Small pieces should be clamped in a drill vise or to the table.
8. A shop cap should be worn or the hair tied up when working around whirling machinery. Rings, wristwatches, and gloves should not be worn.

9. The drills must be ground in balance so that they do not tend to whip the work.
10. The operator should turn off the power and wait until the machine has come to a full stop before grabbing a piece of stock which has been caught up in the machine.
11. One should ease up on the feed pressure before breaking through the other side in order to prevent catching and having the work jerked out of the clamps or vise.
12. The drill should be fed slowly and raised periodically to avoid burning a bit.
13. The table and floor should be kept clean before and after using the machine.

# DRILL PRESS



- |   |                  |   |            |
|---|------------------|---|------------|
| 1 | MOTOR            | 6 | BELT GUARD |
| 2 | PILOT WHEEL FEED | 7 | SWITCH     |
| 3 | COLUMN.          | 8 | DEPTH STOP |
| 4 | TABLE            | 9 | QUILL      |
| 5 | BASE             |   |            |



## DRILL PRESS SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

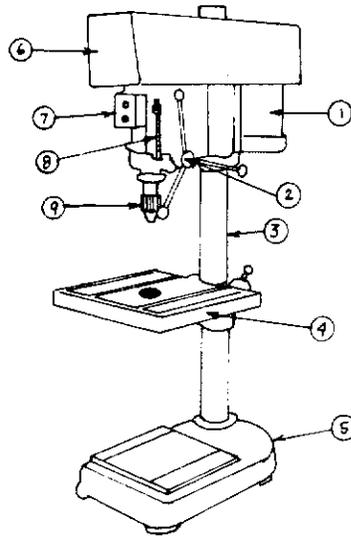
### True-False:

- T F 1. It is necessary to select the proper speed.
- T F 2. The chuck key should be kept in the chuck at all times to prevent losing it.
- T F 3. The material to be drilled should be held in the hands.
- T F 4. Long hair must be confined by a cap or tied back.
- T F 5. Safety glasses need not be worn when using the drill press.
- T F 6. The use of a drill vise or clamps is the proper procedure to follow in drilling materials.
- T F 7. The operator should brush off the table with the hands when leaving the machine.
- T F 8. The drill press should be unplugged when changing speed or belt position.
- T F 9. All jewelry should be removed before using the drill press.
- T F 10. Dull drill bits can burn material or grab it, and therefore should not be used.
- T F 11. It is better to use a high speed when drilling harder material so one can get done faster.

Multiple Choice:

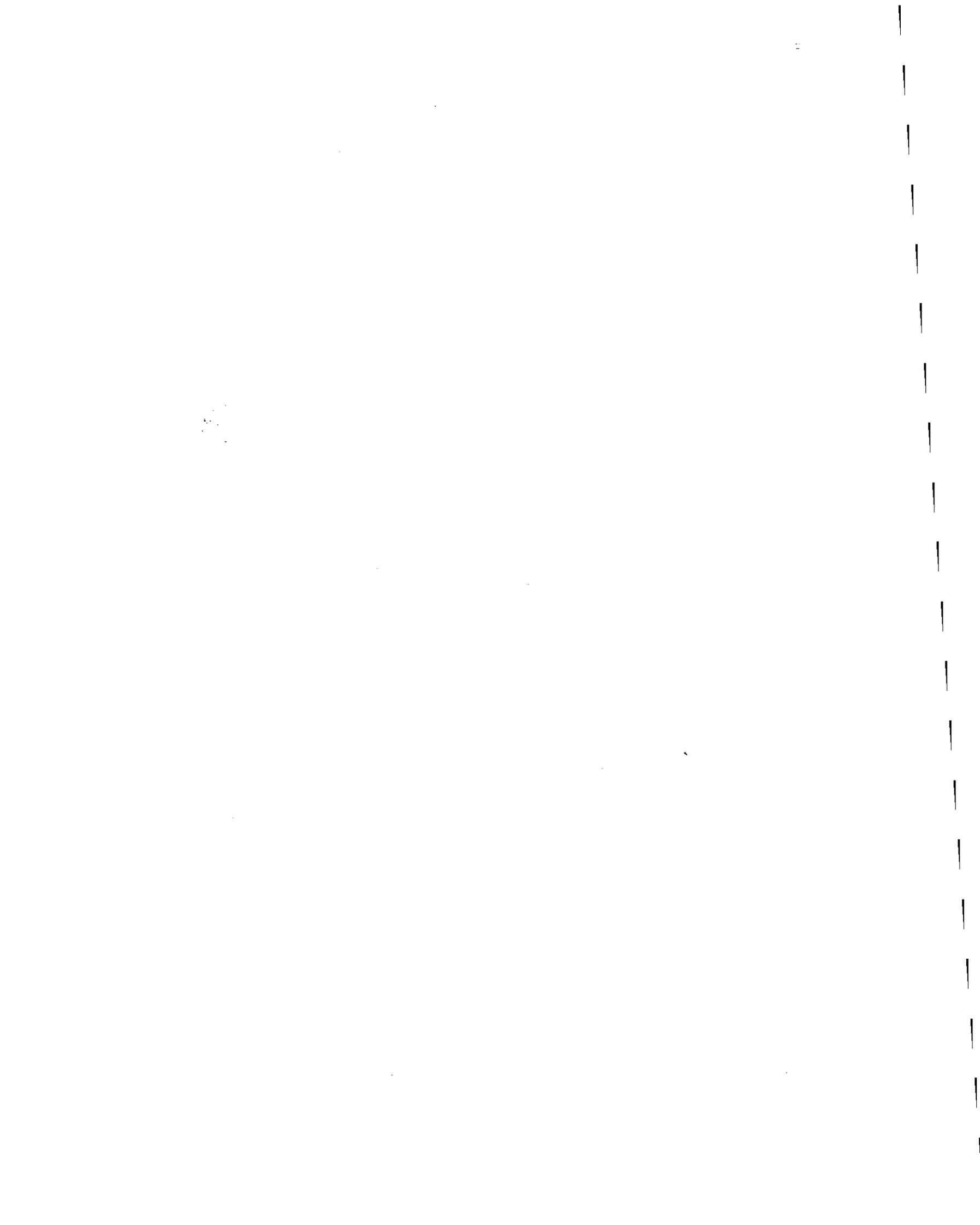
- \_\_\_\_\_ 12. If the work is caught by the drill and starts to revolve, one should:
- A. exert more feed pressure
  - B. stop the machine immediately
  - C. grab it with both hands
  - D. decrease the feed pressure
- \_\_\_\_\_ 13. The safest way to remove chips or cuttings from the drill press is:
- A. brush them away with the hands
  - B. use an air hose
  - C. blow them away
  - D. use a brush
- \_\_\_\_\_ 14. Touching or grabbing the rotating chuck with the hands is:
- A. never permissible and very dangerous
  - B. done to slow down or stop the chuck
  - C. safe if a rag is used to protect the hands
  - D. permissible if the teacher is watching
- \_\_\_\_\_ 15. Using the correct speed usually gets the following results:
- A. it keeps the bit from overheating
  - B. it provides the proper cutting action
  - C. it makes for safer working conditions
  - D. it does all of the above

16. Give the correct names for the parts of the drill press indicated in the following drawing:



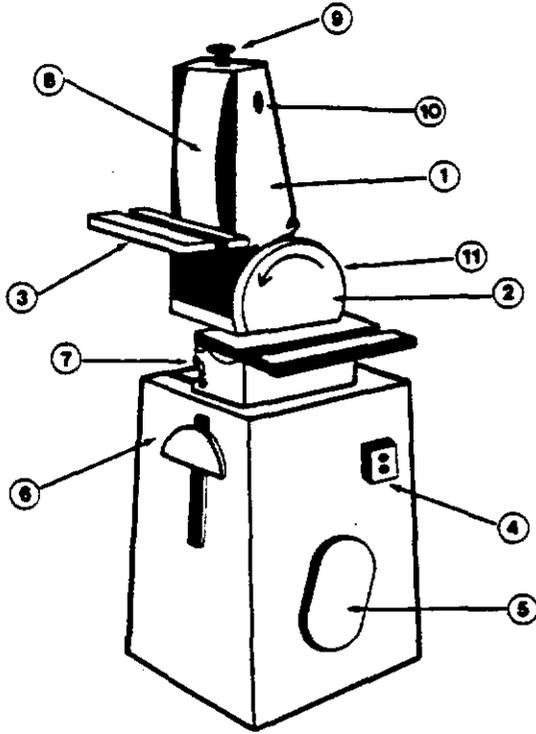
1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_  
4 \_\_\_\_\_  
5 \_\_\_\_\_

6 \_\_\_\_\_  
7 \_\_\_\_\_  
8 \_\_\_\_\_  
9 \_\_\_\_\_



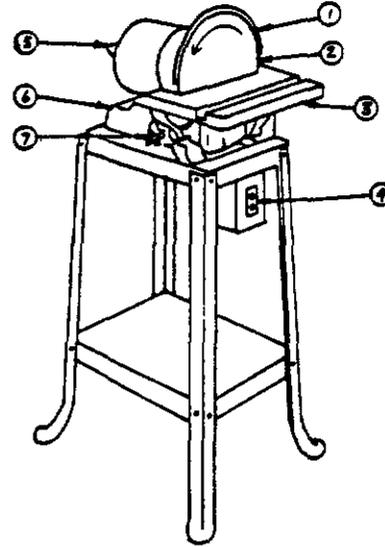
## FINISHING MACHINES

### BELT AND DISC SANDER



- |                  |                    |
|------------------|--------------------|
| 1. GUARD         | 7. TABLE LOCK KNOB |
| 2. ABRASIVE DISC | 8. ABRASIVE BELT   |
| 3. TABLE         | 9. TRACKING KNOB   |
| 4. SWITCH        | 10. TENSION KNOB   |
| 5. MOTOR         | 11. ROTATION       |
| 6. STAND         |                    |

### DISC SANDER



- |                    |
|--------------------|
| 1. GUARD           |
| 2. ABRASIVE DISC   |
| 3. TABLE           |
| 4. SWITCH          |
| 5. MOTOR           |
| 6. BASE            |
| 7. TABLE LOCK KNOB |

1. Belt sanding machines are required to be equipped with guards at each nip point where the sanding belt runs on to a pulley. (OSHA)
2. Each disc sanding machine shall have enclosed the revolving disc, except for that portion of the disc above the table. (OSHA)
3. The machine must never be used without the authorized permission of the teacher.
4. Eye protection must be worn.

5. The clearance between the sanding disc and table or rest should not exceed 1/16 inch.
6. One should sand small workpieces on the downside side of the spinning disc.
7. One must not attempt to hold small pieces in the hands. If a large number of small pieces must be sanded, a holding jig or device should be built.
8. All adjustments should be made while the machine is at dead standstill.
9. The sander should be stopped by shutting off the power. A scrap piece of material can be used to bring the wheel to a stop.
10. The sander should not be operated if the disc is loose. This condition should be reported to the teacher.
11. The material should be moved back and forth to avoid heating and burning of the disc.
12. The operator should always check the tightness of the belt.
13. The stock must be firmly against the stop to prevent the belt from throwing it.
14. A push block should be used when sanding thin pieces of material. Both hands are to be kept on the push block.

## FINISHING MACHINES (BELT/DISC SANDERS) SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

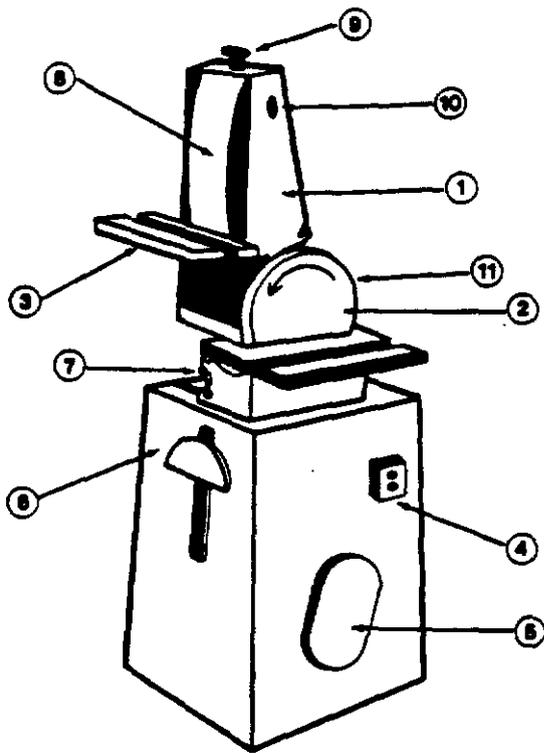
### True-False:

- T F 1. There is very little danger when using these machines.
- T F 2. The clearance between the sanding disc and the table should not exceed 1/16 inch.
- T F 3. One must sand small workpieces on the upside of the spinning disc.
- T F 4. Small pieces should be held in some type of holding device and not in the hands.
- T F 5. After shutting off the power, the operator should use a scrap block and stop the wheel from spinning.
- T F 6. The belt on the belt sander should be loose so it will not grab wood out of the operator's hands.
- T F 7. When sanding thin stock, a push block must be used.
- T F 8. Federal safety rules require that nip points on belt sanders be guarded.
- T F 9. If the sanding disc becomes loose, one needs to press the stock against it harder.
- T F 10. Adjustments can be made to a closer tolerance while the machines are running.
- T F 11. The stock should be moved constantly to keep from burning both the disc and the stock.
- T F 12. When using a belt sander, a stop should be used to keep the belt from throwing the stock.

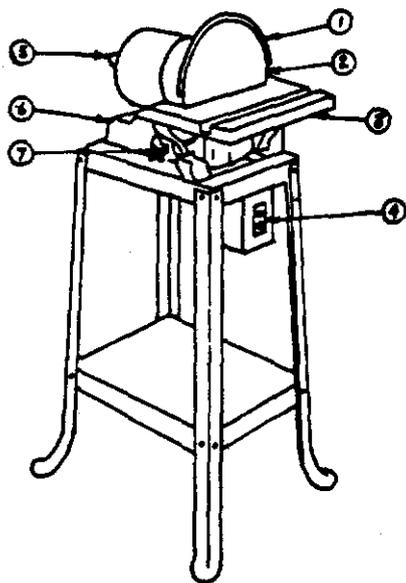
Multiple Choice:

- \_\_\_\_\_ 13. On the disc sander, the operator should sand against the disc
- A. center
  - B. upward-motion side
  - C. rim
  - D. downward-motion side
- \_\_\_\_\_ 14. For best results, the stock should be fed into the sander
- A. with a gentle pressure
  - B. at a fast speed
  - C. with firm pressure
  - D. at a slow speed
- \_\_\_\_\_ 15. When abrasives become full of pitch, they will cause
- A. the disc to tear
  - B. the material to burn
  - C. the disc to come off
  - D. material to be jerked from the hand

16. Identify the parts of the machines in the drawings:



1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_



1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_

## REFERENCES

Materials were selected and reviewed from the following sources, and in some instances were incorporated in the production of the preceding unit.

1. OSHA - U.S. Department of Labor
2. NIOSH - U.S. Department of Health, Education, and Welfare
3. Ohio State Department of Education--Industrial Arts and Vocational Education Safety Guide
4. Pennsylvania Industrial Arts Association and State Department of Education, State Safety Guide
5. Powermatic Tool Company
6. Pittsburg State University - L. Duane Griffin
7. Rockwell Delta - Rockwell International
8. Shawnee Mission Public Schools - Bill Studyvin
9. Utah State Department of Education, State Safety Guide
10. Washington State Department of Education, Industrial Arts Safety Guide
11. Wichita Public Schools Woodwork Teachers
  - (1) Clayton Hall - North High School
  - (2) Don Joachims - Curtis Junior High School
  - (3) Pete Moriconi - Retired
  - (4) Ken Ratcliff - Metro High School
  - (5) Chester Shippy - West High School
12. Wyoming State Department of Education

## **PART 4:**

### **HAND AND PORTABLE POWER TOOLS**

Electric Drill

Bayonet Saw

Circular Saw

Router

Belt Sander

Disc Sander (Grinder)

Finishing Sander

Planer

Air Impact Wrench

Solder Gun

Soldering Irons

Pages 271 and 333-337 were adapted from Washington State Industrial Arts: Safety Guide, produced by M&M Protection Consultants, Seattle, Washington, 1980.

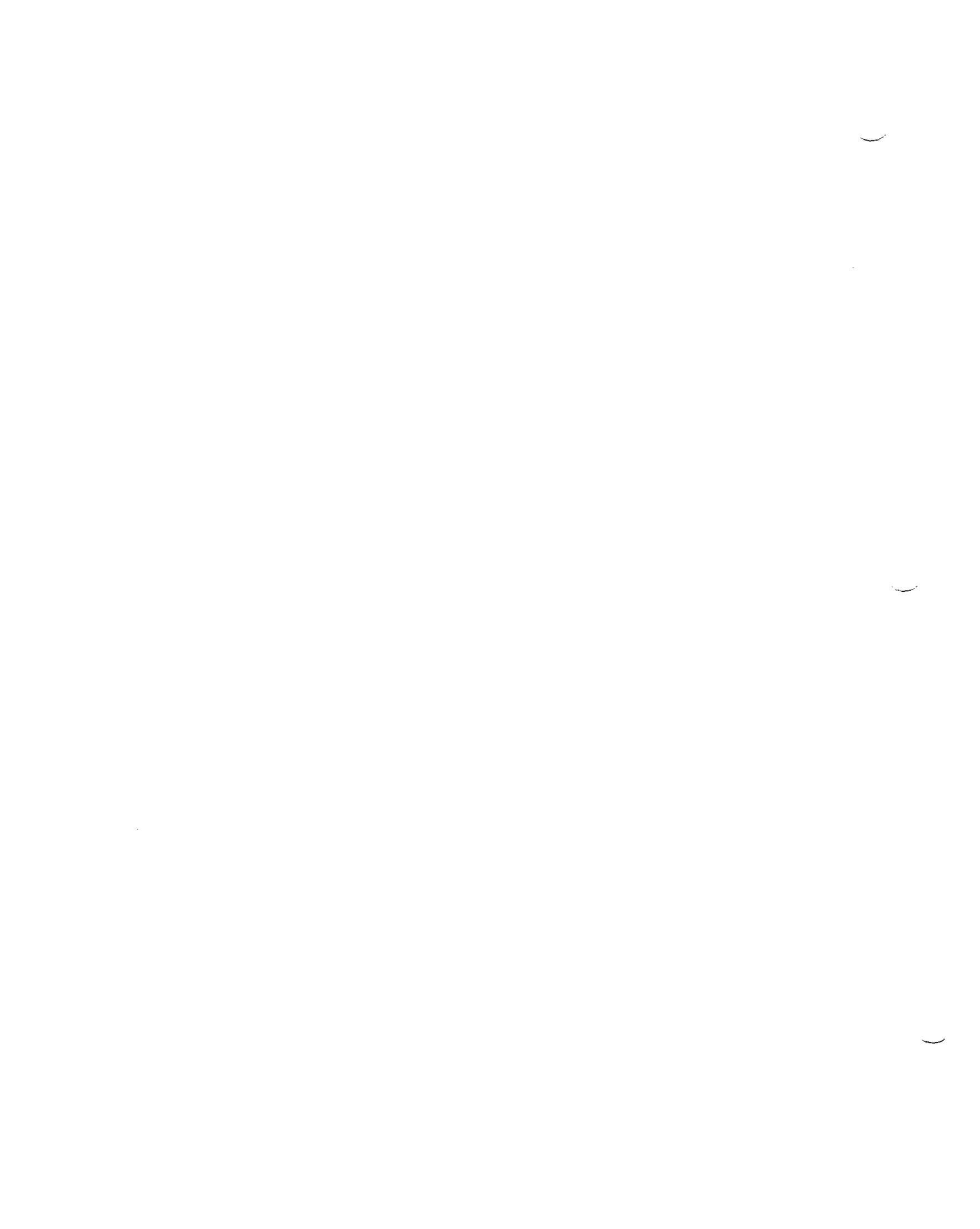
Pages 273-281, 285-287, 291-293, 297-299, 303-305, 309, 311, 315-317, 321-323, 327-329, and 339-346 were adapted from Safety Education Handbook, produced by Kansas State Department of Education, Wichita, Kansas, 1981.

Pages 283, 289, 295-296, 301-302, and 325 were adapted from Safety Compliance Manual, produced by Indiana Curriculum Materials Center, Bloomington, Indiana, 1975.

Page 331 was adapted from Pennsylvania Industrial Arts Safety Guide, produced by Pennsylvania Department of Education and Industrial Arts Association of Pennsylvania, Harrisburg, Pennsylvania, 1981.

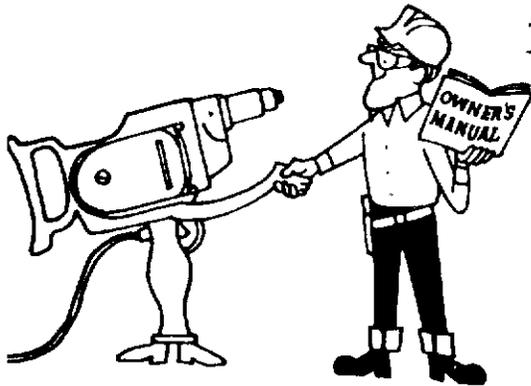
## SAFETY RULES FOR PORTABLE ELECTRIC HAND TOOLS

1. Obtain the instructor's permission before you use portable electric tools.
2. Be sure that the tool's switch is in the Off position before you plug in the electric cord.
3. Wear eye protection when you operate any portable electric tool.
4. The switch on each tool's handle should be the constant pressure type. That is, when pressure is released, power is shut off.
5. Be sure that the tool is properly grounded--do not use it in wet areas.
6. Do not wear loose or baggy clothing that could be caught in revolving parts.
7. Before starting to use a tool, be sure that you have secure footing and that your work area is free of obstacles.
8. Inspect its electric cord for breaks or exposed wires before you use a tool.
9. Avoid exerting excessive pressure while operating portable electric tools or they may become damaged and cause an accident.
10. Secure all work properly before applying the tool.
11. Inspect guards before starting, to see that they function properly.
12. A tool is not to be used with DC current unless the name plate indicates that it is AC/DC.



## RECOMMENDATIONS FOR THE SAFE USE OF PORTABLE HAND TOOLS

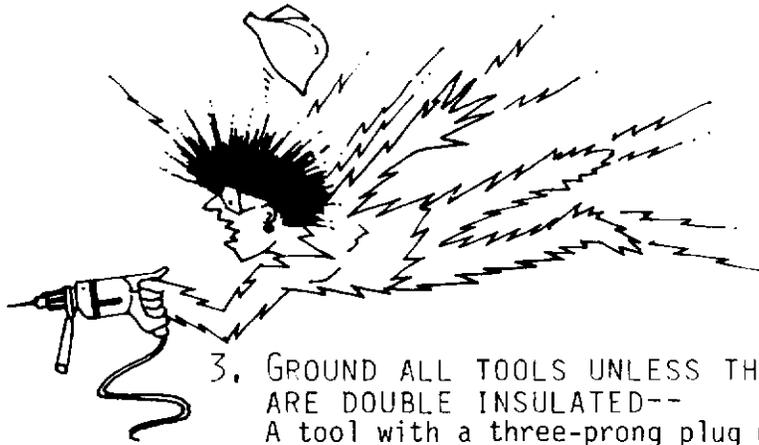
(Provided by: Power Tools Institute, Inc.)



1. KNOW YOUR POWER TOOL--Read and understand the owner's manual and the labels affixed or included in the shipping container. Keep manuals and labels in a safe place for future reference.



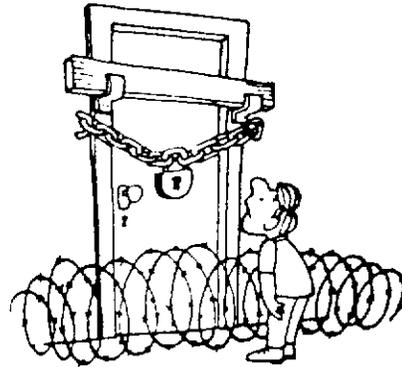
2. KEEP WORK AREA CLEAN AND WELL LIGHTED



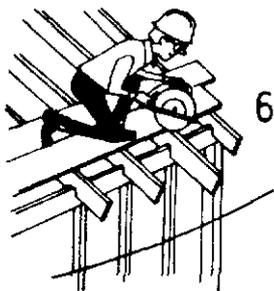
3. GROUND ALL TOOLS UNLESS THEY ARE DOUBLE INSULATED--  
A tool with a three-prong plug must be plugged into a three-hole electric receptacle known to be grounded. If an adapter is used to accommodate a two-hole receptacle, attach the adapter with a screw to a known ground.



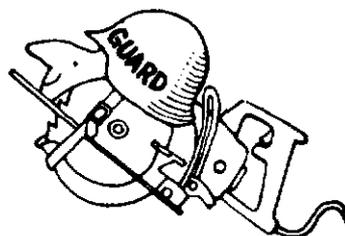
4. AVOID A DANGEROUS ENVIRONMENT--  
Do not use power tools in damp, wet, or explosive atmospheres (fumes, dust, or flammable materials).



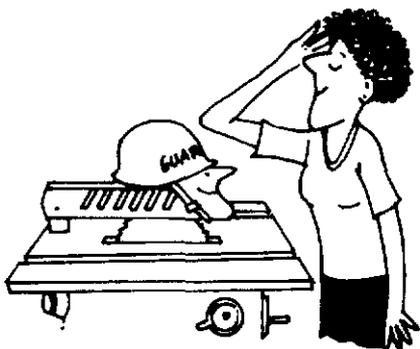
5. KEEP CHILDREN AWAY--All observers should be kept at a safe distance from work areas.



6. BE AWARE OF POWER LINES AND ELECTRICAL CIRCUITS-- particularly the hidden ones.



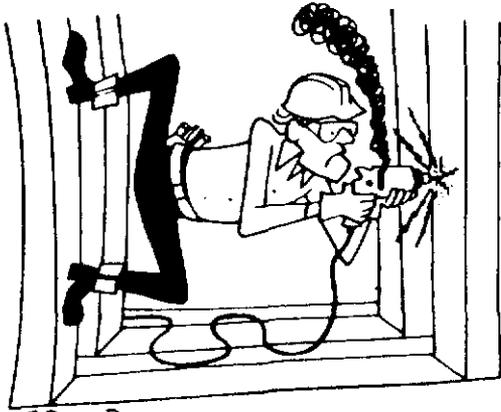
7. BE ALERT--Using power tools in tight work areas may put you dangerously close to cutting tools.



8. KEEP GUARDS IN PLACE-- And in proper working order,



9. SECURE WORK--Use clamps or a vice to hold work pieces. Loose work pieces can cause injury.

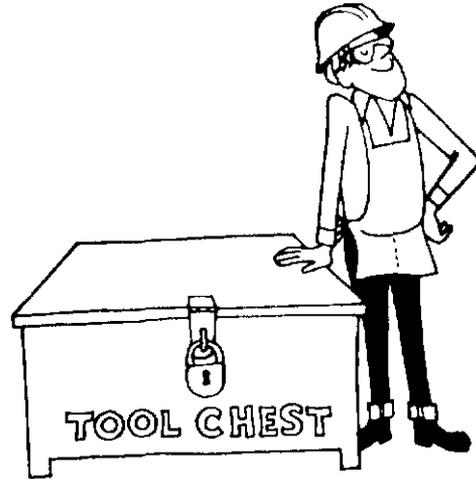


10. **DO NOT FORCE TOOLS--**  
Tools do a better and safer job when used in the manner for which they are designed.



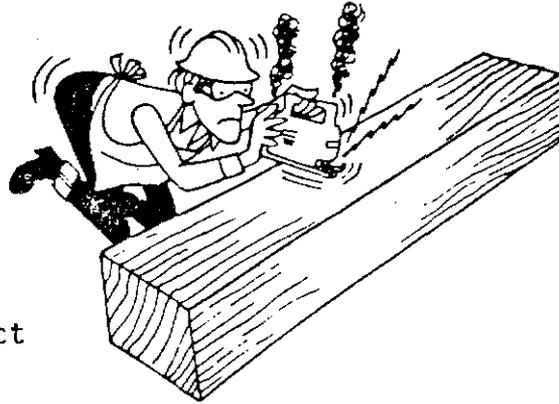
12. **WEAR PROPER APPAREL--**  
Loose clothing, dangling jewelry, and long hair may get caught in moving parts.

11. **STORE IDLE TOOLS--**When tools are not in use, store them in a dry, locked container. Inspect tools for good working order prior to storage and before re-use.



13. **WHEN A TOOL IS USED OUTDOORS--**  
You must use an extension cord marked "For Outdoor Use." Extension cords not in use should be stored in a dry and well-ventilated area.

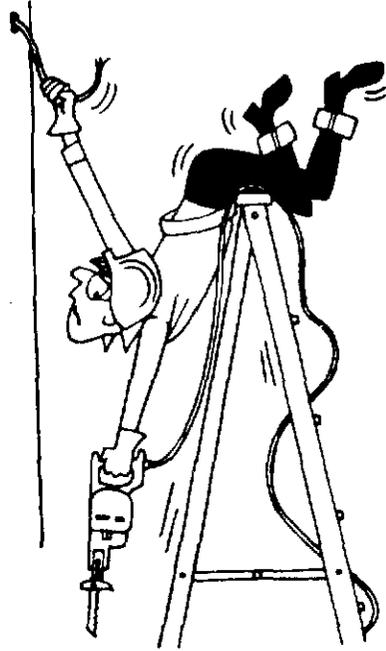
14. USE THE CORRECT TOOL--  
Plan the work to be  
done and use the correct  
tool for the job.



15. USE SAFETY GLASSES with side  
shields when working with  
power tools. Use face or  
dust mask in dusty work areas.  
This applies to all persons  
in the work area. Also,  
safety gloves and shoes should  
be worn when necessary.



16. DISCONNECT TOOLS--When they are  
not in use (before servicing or  
adjusting, before changing  
accessories, or when storing),  
disconnect the power supply cord.
17. SWITCHES--Never use a tool with a  
malfunctioning switch. Have it  
repaired or replaced before using it.



18. **DO NOT OVERREACH**--Keep proper footing and balance at all times.



21. **REMOVE ADJUSTING KEYS AND WRENCHES.** Always check tools before use to see that keys and wrenches are removed before connecting the tool to its power supply.

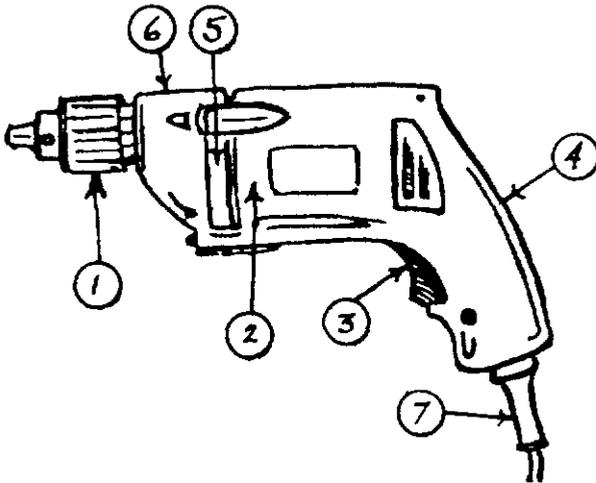
19. **DO NOT ABUSE CORDS**--Never carry a tool by its power cord or yank cord or extension cords from the receptacle. **DANGER**--Keep power and extension cords away from excessive heat and sharp edges.



20. **AVOID ACCIDENTAL STARTING**--Do not carry plugged in tools with your finger on the switch. Always make sure the switch is off when plugging the tool into an electrical power supply.

22. **MAINTAIN YOUR TOOLS**--Follow the manufacturer's recommended maintenance procedures. Keep cutting edges clean and sharp for safe operation of the tool. Have necessary repairs made by proper service people.

## ELECTRIC DRILL

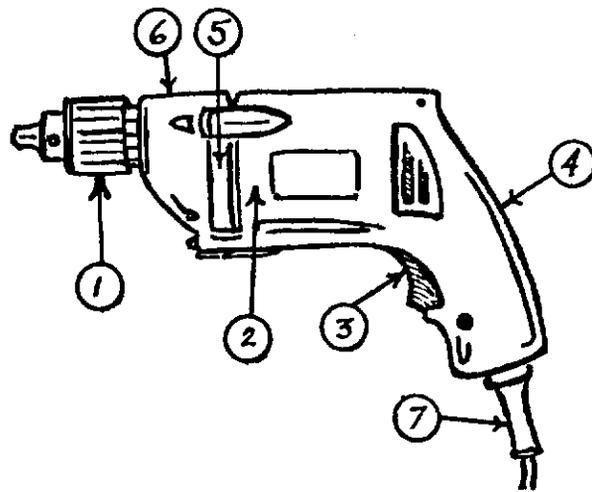


1. Geared Key Chuck
2. Housing
3. Insulated Trigger Switch
4. Pistol Grip Handle
5. Motor Cooling Fan
6. Reduction Gear
7. Cord Strain Reliever

1. Operate the drill only with the teacher's permission and after instruction has been received.
2. Remove jewelry, eliminate loose clothing, and confine long hair before you use the drill.
3. Always use the proper eye protection.
4. Unplug the drill when you change bits.
5. Make sure the switch is off and the key removed before you connect the drill to a power source.
6. Mark the hole location with a center punch (metal) or awl (wood) before you drill.
7. Be sure the work is tightly clamped or secured before you drill.
8. Drill with straight, even, steady pressure.
9. Use sharp, straight bits of the size intended for the machine.
10. Never try to use a square-tang auger bit in a portable drill motor.
11. Lay the coasting drill down, with the bit pointing away from you.
12. Do not drill through cloth.
13. Always use the screwdriver attachment in such a way that it cannot injure the operator if it slips off the work.
14. Select the drilling speed that is suitable for the work being done.

15. To prevent "seizing," relieve the pressure on the drill just before it breaks through a piece of metal.
16. Never lock the switch in the On position when you are holding the portable drill in your hands. The switch lock should be used only when the portable drill is fastened in a stand.
17. Have a firm grip on a portable electric drill when you drill holes in metal.

## ELECTRIC DRILL



1 GEARED KEY CHUCK

2 HOUSING

3 INSULATED TRIGGER  
SWITCH

4 PISTOL GRIP HANDLE

5 MOTOR COOLING FAN

6 REDUCTION GEARS

7 CORD STRAIN RELIEVER

—

—

—

## ELECTRIC DRILL SAFETY QUIZ

NAME \_\_\_\_\_

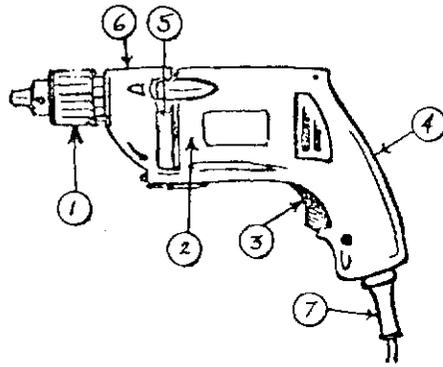
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

True or False:

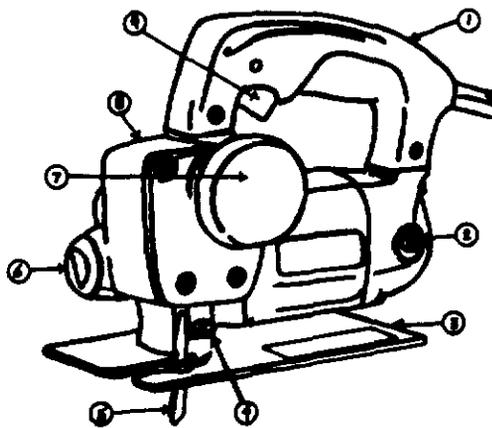
- \_\_\_\_\_ 1. Eye protection is not necessary when you use a drill.
- \_\_\_\_\_ 2. Any accident or trouble should be reported to the teacher.
- \_\_\_\_\_ 3. When using a drill, it is not necessary to know how to operate all switches and controls.
- \_\_\_\_\_ 4. You should obtain the teacher's permission before operating the drill.
- \_\_\_\_\_ 5. Before you insert or change a drill bit, the plug should be connected to the electric outlet.
- \_\_\_\_\_ 6. The proper drill bit should always be selected.
- \_\_\_\_\_ 7. Before using the drill, the cord should be checked for breaks or wear.
- \_\_\_\_\_ 8. Before starting the drill, the key should be removed from the chuck.
- \_\_\_\_\_ 9. The drill should be stopped by gripping the chuck.
- \_\_\_\_\_ 10. The drill should be forced when necessary.
- \_\_\_\_\_ 11. When you lay the drill down, you should make sure the bit is pointing away from you, even when it is coasting to a stop.
- \_\_\_\_\_ 12. It is not necessary to worry about how sharp the drill bits are.
- \_\_\_\_\_ 13. Small pieces to be cut should be held in your hand.
- \_\_\_\_\_ 14. Before you start using the drill, you should clean the air cooling vents.
- \_\_\_\_\_ 15. It is not necessary to make certain the portable drill is properly grounded through the electric cord.



16. Identify the parts of an electric drill.

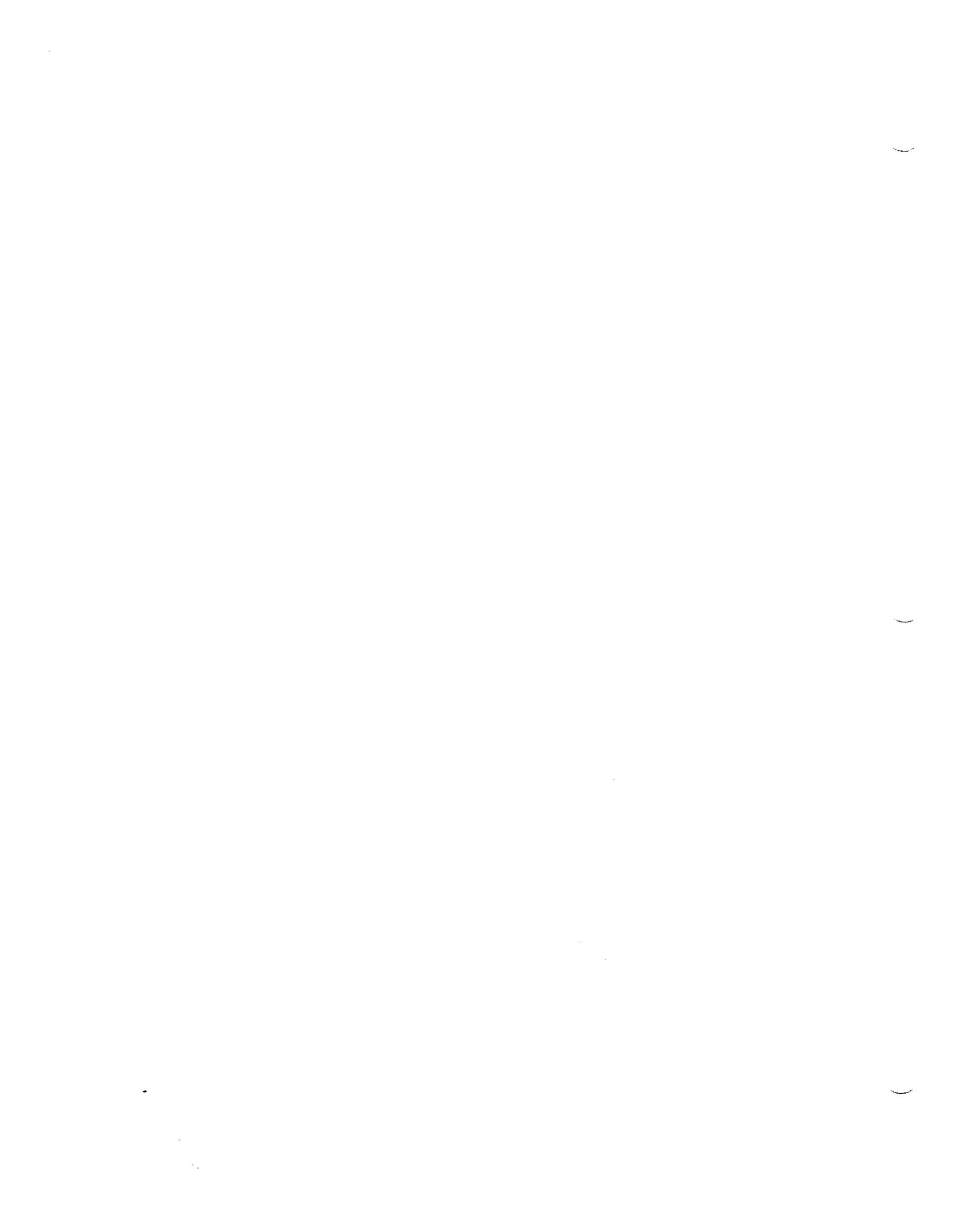
- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_

## BAYONET SAW

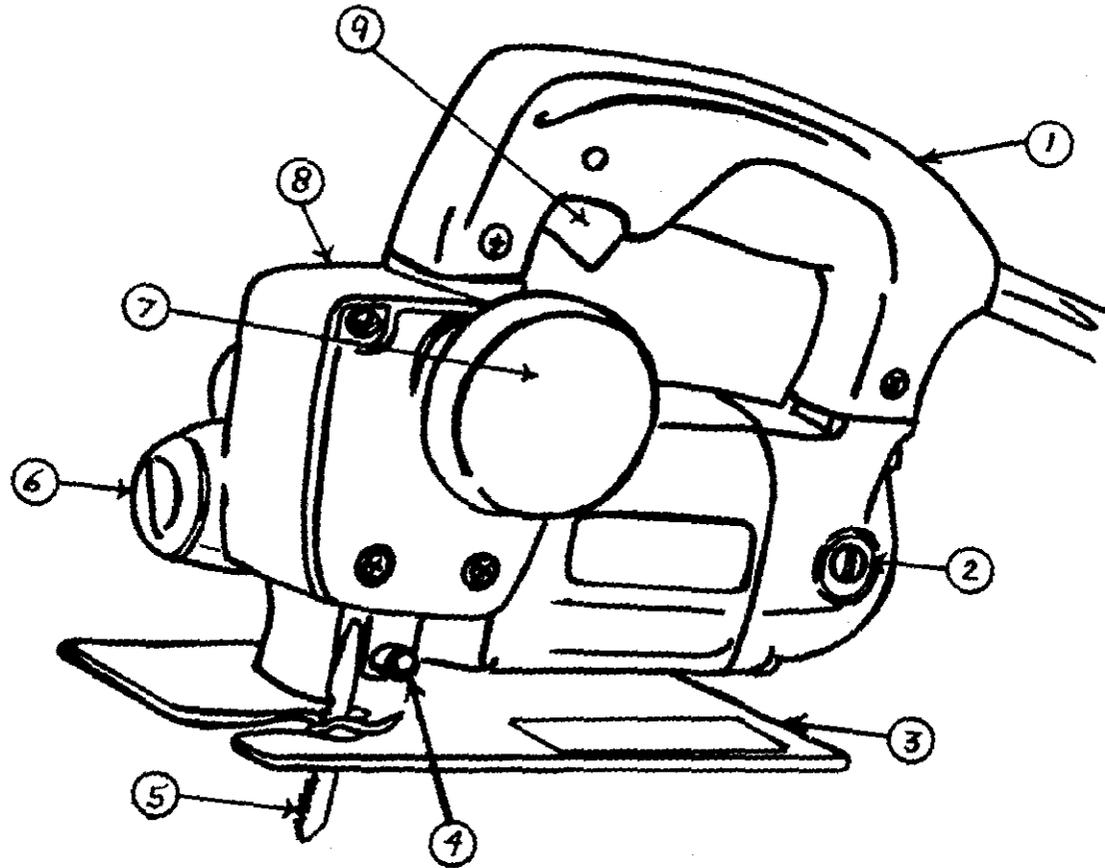


1. Handle
2. Brushes
3. Base
4. Blade Screw
5. Blade
6. Lubricant Port
7. Guide Knob
8. Housing
9. On-Off Switch

1. Operate only with the teacher's permission and after instruction has been received.
2. Remove jewelry, eliminate loose clothing, and confine long hair before using the saw.
3. Make sure all the guards are in place and operating correctly.
4. Always use the proper eye protection.
5. Make sure the blade is the correct type for the material to be sawed, and that it is tightly clamped into the chuck.
6. Be sure the switch is off before connecting the saw to the power source.
7. Use a vise or clamps to securely hold the materials to be cut.
8. Keep the cutting pressure constant. Do not force the blade into the work.
9. Always hold the base firmly against the metal being cut.
10. Do not put the saw down on the bench until it has stopped.
11. Be sure to lay the tool on its side if the blade is in the tool.
12. Always disconnect the cord when repairing or adjusting the saw and when changing blades.
13. Avoid cutting curves so sharply that the blade will twist and break.



# BAYONET SAW



- 1 HANDLE
- 2 BRUSHES
- 3 BASE
- 4 BLADE SCREW
- 5 BLADE

- 6 LUBRICANT PORT
- 7 GUIDE KNOB
- 8 HOUSING
- 9 ON-OFF SWITCH



# BAYONET SAW SAFETY QUIZ

NAME \_\_\_\_\_

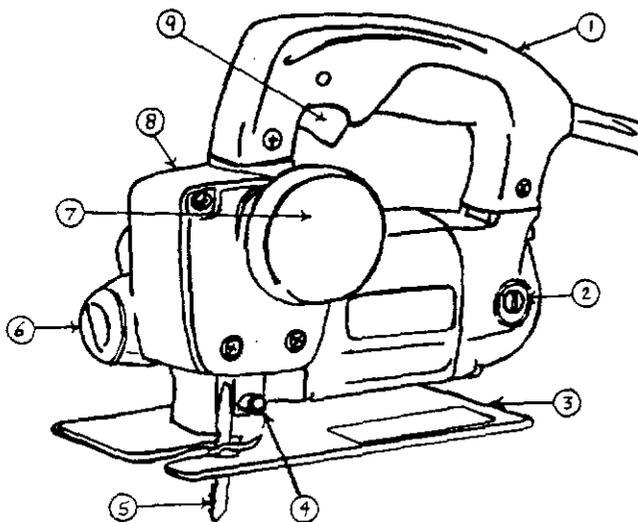
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

True or False:

- \_\_\_\_\_ 1. One should always select the correct blade for the work and properly secure it in the chuck.
- \_\_\_\_\_ 2. Material may be cut with a jigsaw without being clamped down.
- \_\_\_\_\_ 3. Cutting pressure does not need to be constant.
- \_\_\_\_\_ 4. Curves should not be cut so sharply that the blade will twist.
- \_\_\_\_\_ 5. The base of the portable jigsaw or saber saw does not need to be on the work when cutting.
- \_\_\_\_\_ 6. Eye protection is not necessary with this small portable power tool.
- \_\_\_\_\_ 7. One should always obtain permission from the teacher before using the bayonet saw.
- \_\_\_\_\_ 8. Broken bayonet saw blades may be mounted upside down in order to get more use from the broken blade.
- \_\_\_\_\_ 9. Identify the parts of a bayonet saw.



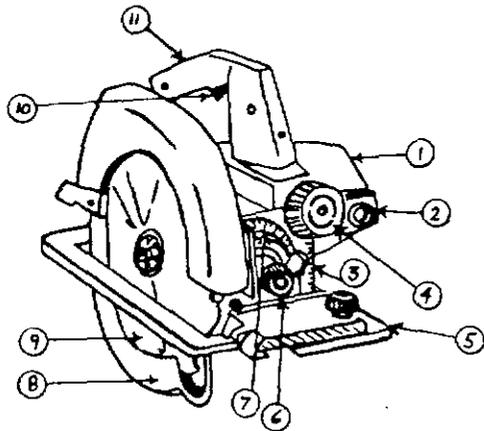
- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_

—

—

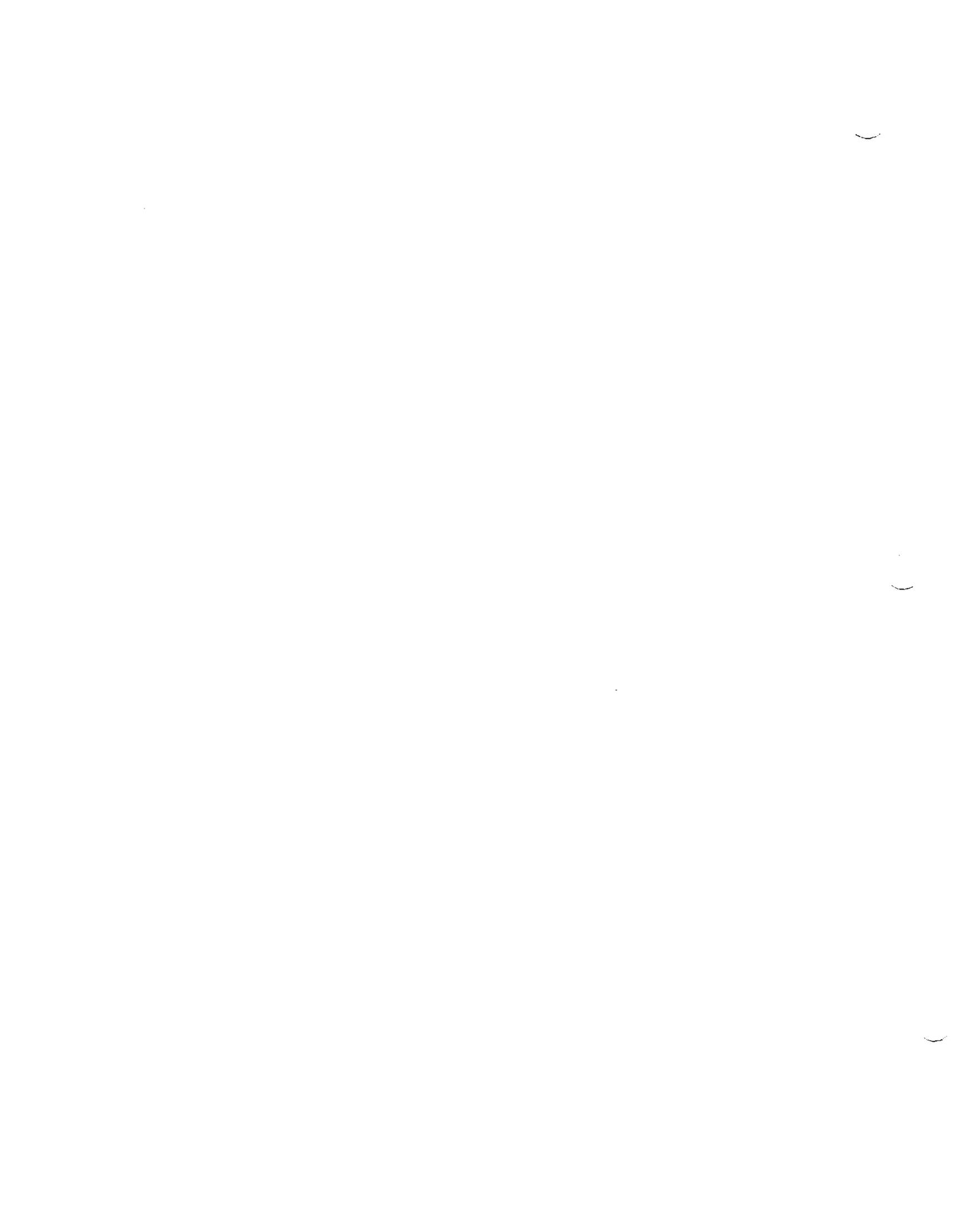
—

## CIRCULAR SAW

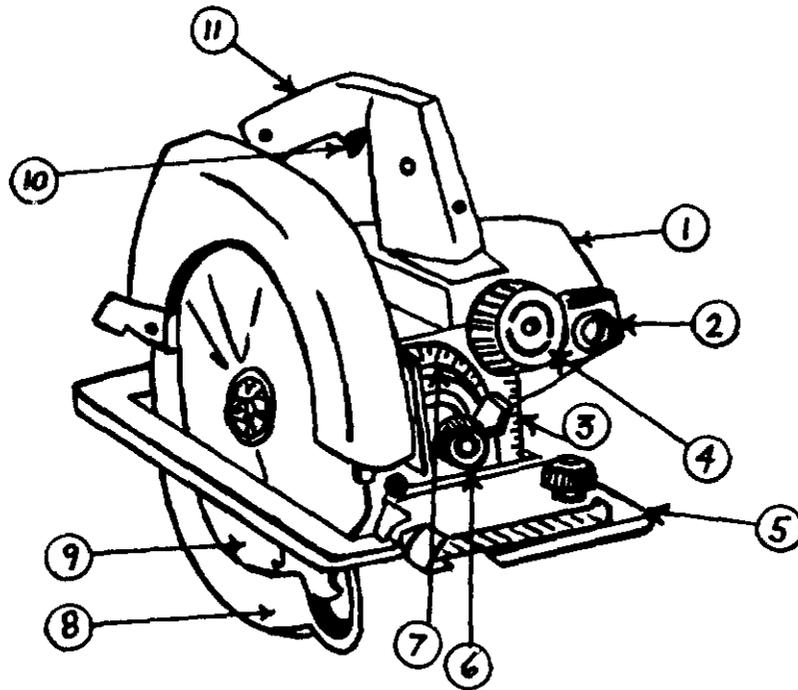


1. Housing
2. Brush Holder
3. Depth Scale
4. Depth Lock Knob
5. Tilting Base
6. Tilt Lock Knob
7. Angle Scale
8. Retractable Guard
9. Saw Blade
10. Insulated Trigger Switch
11. Contoured Handle

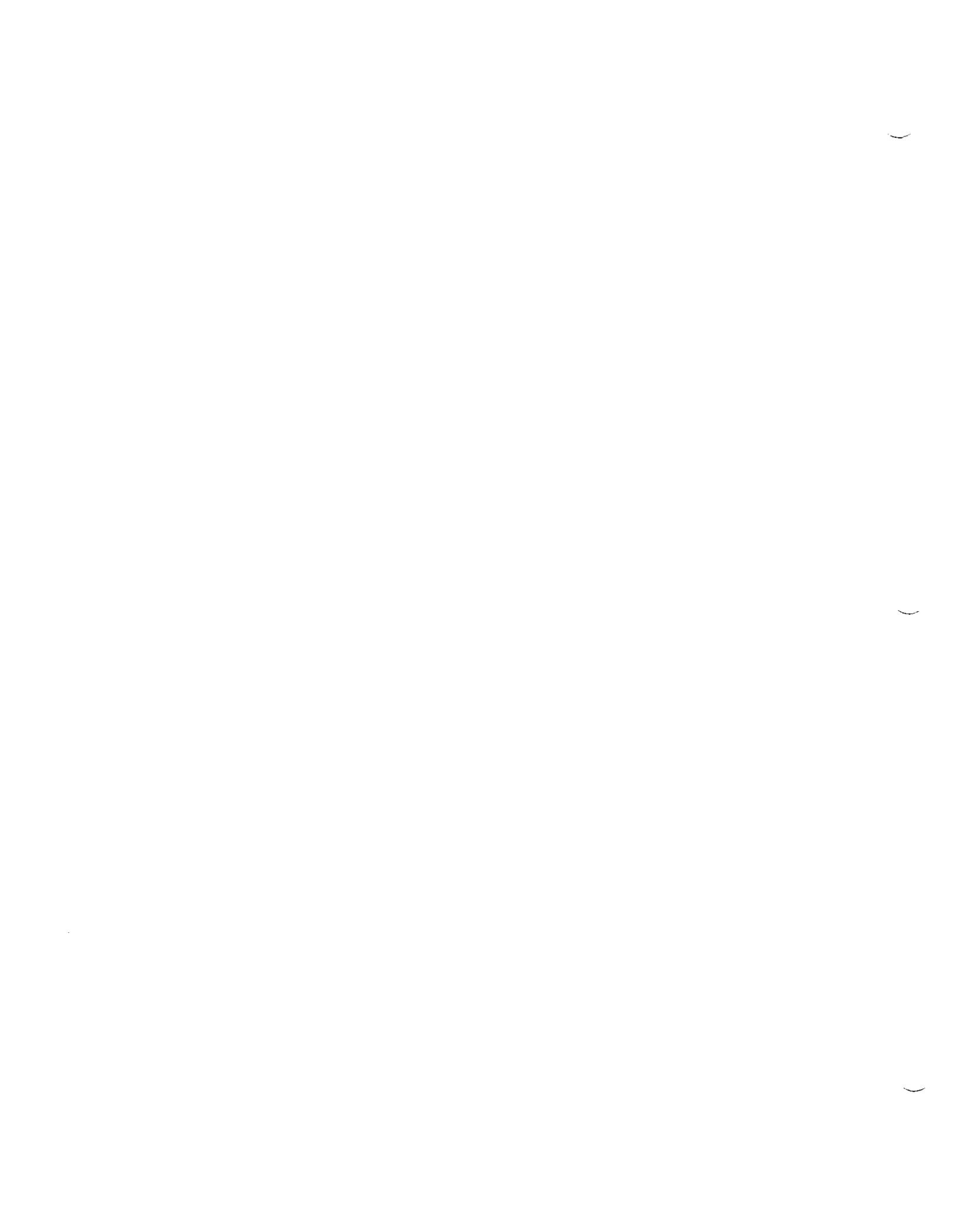
1. Operate only with the teacher's permission and after instruction has been received.
2. Remove jewelry, eliminate loose clothing, and confine long hair before using the saw.
3. Make sure all the guards are in place and operating correctly.
4. Always use the proper eye protection.
5. Make sure that the retractable guard returns automatically to cover the blade after each cut.
6. Check the base setting for the proper depth of each cut.
7. Make sure that the power cord is clear of the blade.
8. Be sure the material to be cut is adequately supported.
9. Do not start the cut until the saw has reached its full speed.
10. Advance the saw slowly and in a straight line. Do not twist or turn the tool.
11. Stop cutting immediately if the blade binds or the machine or material begins to smoke.
14. Do not stretch for items beyond your reach. Keep the proper footing and balance at all times.
15. Support the material to be cut in such a way that the kerf will not close and bend the blade either during a cut or at the end of a cut.
16. Unplug the machine whenever you change blades or make adjustments.



## CIRCULAR SAW



- |                   |                             |
|-------------------|-----------------------------|
| 1 HOUSING         | 6 TILT LOCK KNOB            |
| 2 BRUSH HOLDER    | 7 ANGLE SCALE               |
| 3 DEPTH SCALE     | 8 RETRACTABLE GUARD         |
| 4 DEPTH LOCK KNOB | 9 SAW BLADE                 |
| 5 TILTING BASE    | 10 INSULATED TRIGGER SWITCH |
|                   | 11 CONTOURED HANDLE         |



## CIRCULAR SAW SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

True or False:

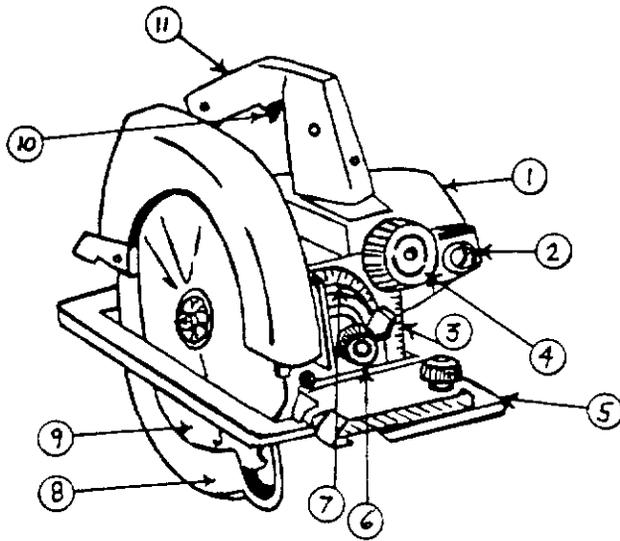
- \_\_\_\_\_ 1. Eye protection is required when working with the portable circular saw.
- \_\_\_\_\_ 2. All trouble and accidents should be reported.
- \_\_\_\_\_ 3. It is not necessary to know how to operate the portable circular saw before using it.
- \_\_\_\_\_ 4. You must always cut off the grounding plug from the power cord, and use a two-hole outlet.
- \_\_\_\_\_ 5. You can use the portable circular saw anytime you want to.
- \_\_\_\_\_ 6. It does not matter how deep the blade is set when cutting.
- \_\_\_\_\_ 7. The saw should be turned on only after making contact with the material being sawed.
- \_\_\_\_\_ 8. If a saw stalls in heavy material, you should always turn off the switch.
- \_\_\_\_\_ 9. A circular blade is for making circular cuts.
- \_\_\_\_\_ 10. Forcing the saw always helps when cutting heavy or thick materials.

Fill in the blank:

- 11. Keep the \_\_\_\_\_ away from the blade.
- 12. Make sure the teeth of the blade are \_\_\_\_\_, and pointed to the front of the saw base.
- 13. \_\_\_\_\_ should be supported.
- 14. Small pieces should be \_\_\_\_\_ in a \_\_\_\_\_ or to a bench top or sawhorse.
- 15. Check the \_\_\_\_\_ and \_\_\_\_\_ adjustments to be sure they are tight.

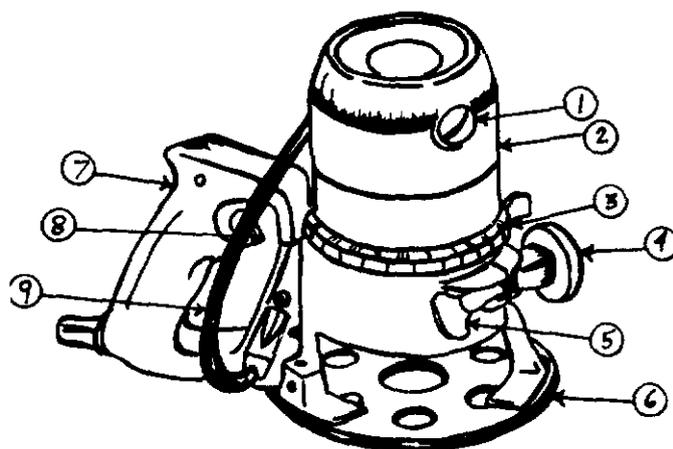
Short Answer:

16. Why is it dangerous to adjust a portable circular saw while the blade is in motion?
17. Why should you always use a guide for ripping?
18. Identify the parts of a circular saw.



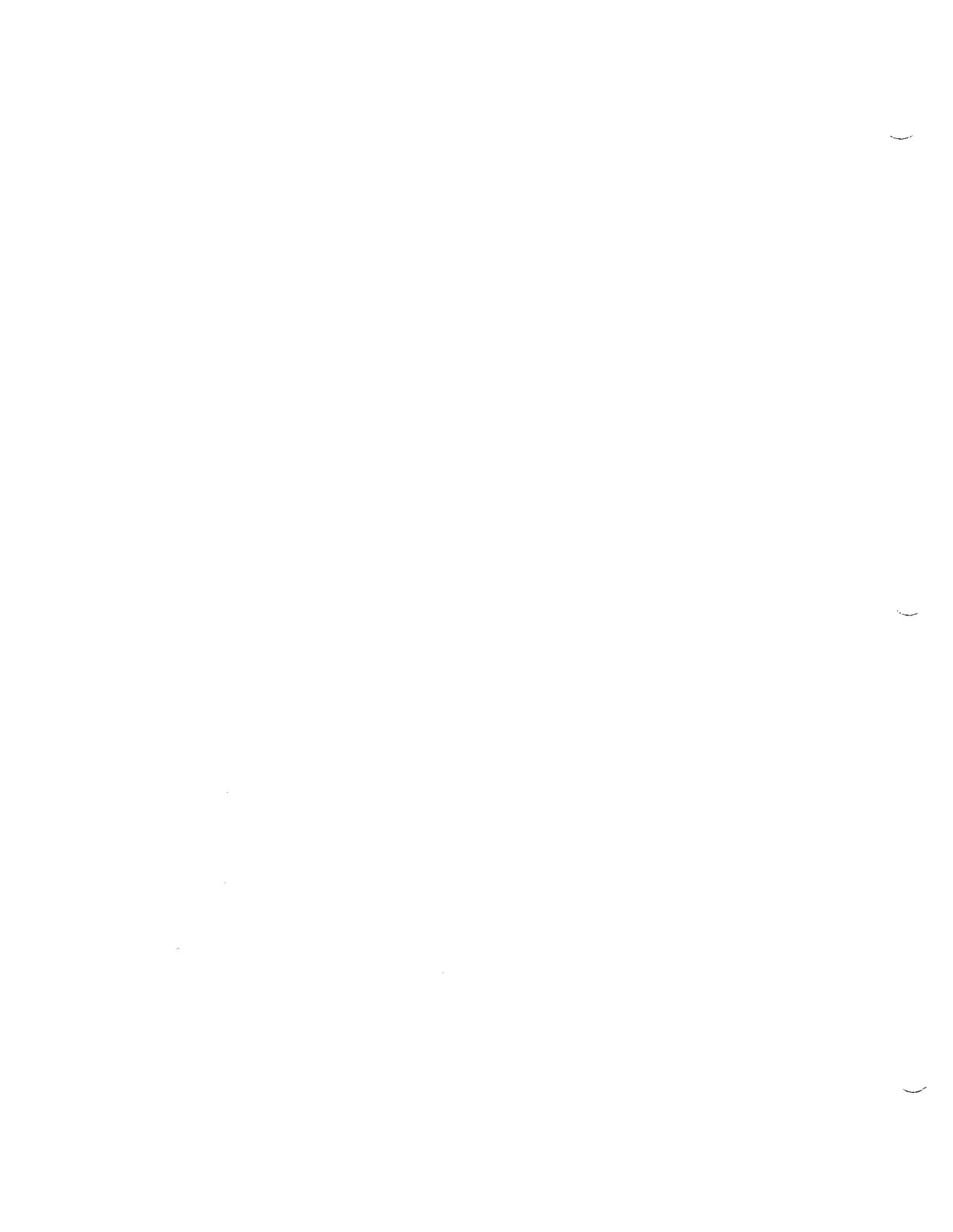
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_

## ROUTER

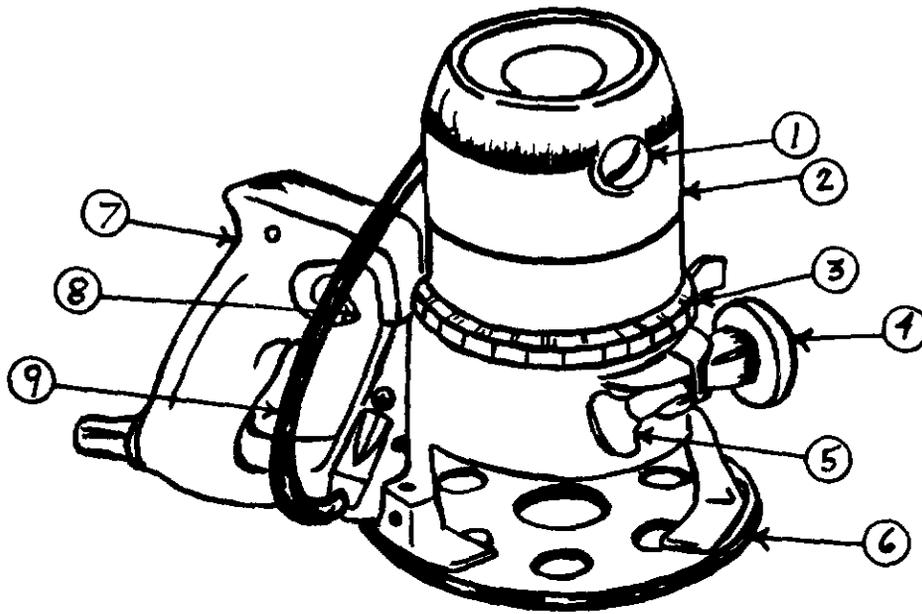


1. Brushes
2. Housing
3. Micrometer Depth Adjustment
4. Guide Knob
5. Locking Handle
6. Sub-Base
7. D-Handle
8. Insulated Trigger Switch
9. Motor Safety Disconnect

1. Operate only with the teacher's permission and after instruction has been received.
2. Remove all jewelry, eliminate loose clothing, and confine long hair before using this tool.
3. Make sure all the guards are in place and operating correctly.
4. Always use the proper eye protection.
5. Be sure the switch is off before inserting the plug into the power source.
6. Be sure the collet chuck is tight, and the bit is secure.
7. Make sure the work piece is clamped or rigidly held, and the area the router must travel is free of obstructions.
8. Hold the router with both hands. The cutting pressure should be constant. Do not force or jam the router into the work.
9. Make a trial cut on a piece of similar scrap material.
10. Disconnect the router from the power source when changing bits, making adjustments, or when it is not in use.
11. Feed the machine so that the leading edge of the knife is "biting in" as the router is pushed along.
12. Lay the machine down with the cutter pointing away. Beware of the coasting machine.



# ROUTER



- |                                  |                               |
|----------------------------------|-------------------------------|
| 1 BRUSHES                        | 6 SUB-BASE                    |
| 2 HOUSING                        | 7 D-HANDLE                    |
| 3 MICROMETER DEPTH<br>ADJUSTMENT | 8 INSULATED TRIGGER<br>SWITCH |
| 4 GUIDE KNOB                     | 9 MOTOR SAFETY DISCONNECT     |
| 5 LOCKING HANDLE                 |                               |



## ROUTER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

True or False:

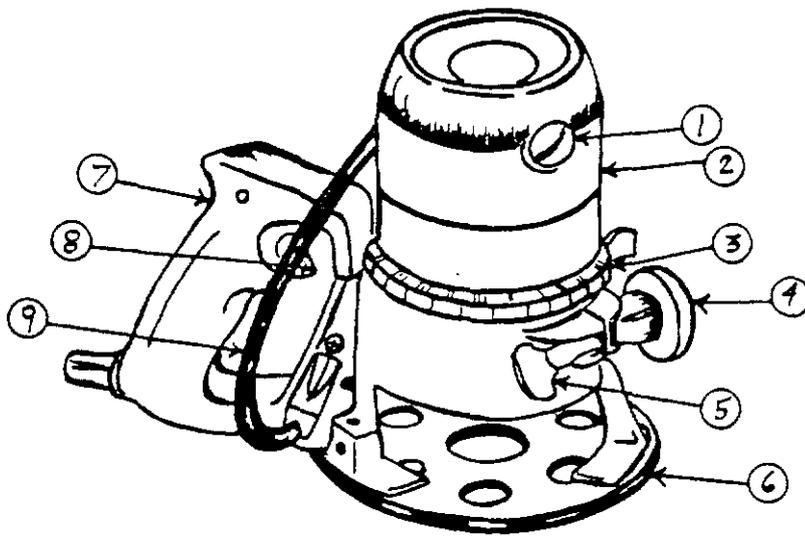
- \_\_\_\_\_ 1. Eye protection is necessary when operating the portable router.
- \_\_\_\_\_ 2. Accidents need not be reported to the teacher.
- \_\_\_\_\_ 3. It is not necessary to locate and learn to operate all switches and controls before using the router.
- \_\_\_\_\_ 4. It is necessary to ask permission from the teacher before using the portable router.
- \_\_\_\_\_ 5. When using the portable router, only one hand is needed.
- \_\_\_\_\_ 6. It is not necessary to hold onto the router when it is turned on.
- \_\_\_\_\_ 7. You should always make sure the switch is in the off position before connecting the router to a power source.
- \_\_\_\_\_ 8. The air vents need not be kept clean.

Fill in the blank:

- 9. Always lay the router down with the \_\_\_\_\_ pointing away from you.
- 10. The cutter should be inserted at least \_\_\_\_\_ inch into the chuck.
- 11. Make adjustments only when the cutter is at a \_\_\_\_\_.
- 12. Make certain the portable router is properly grounded through the \_\_\_\_\_.

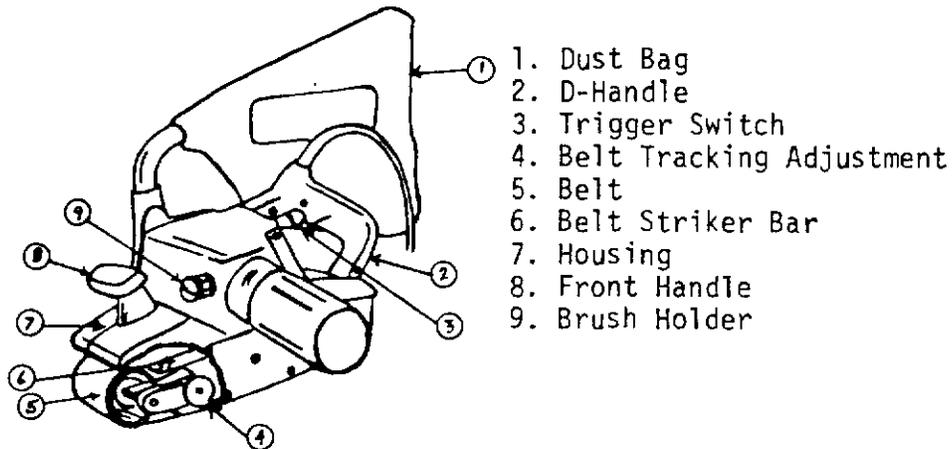
Short Answer:

13. What safety procedure should be followed when changing cutters or making adjustments on the portable router?
14. Why is it necessary for the fence or guide to be securely clamped?
15. Why is it necessary to clamp the piece of work down?
16. To have a good clean cut, how should the cutters be treated?
17. Which way should you move the router when cutting?
18. Identify the parts of a router.

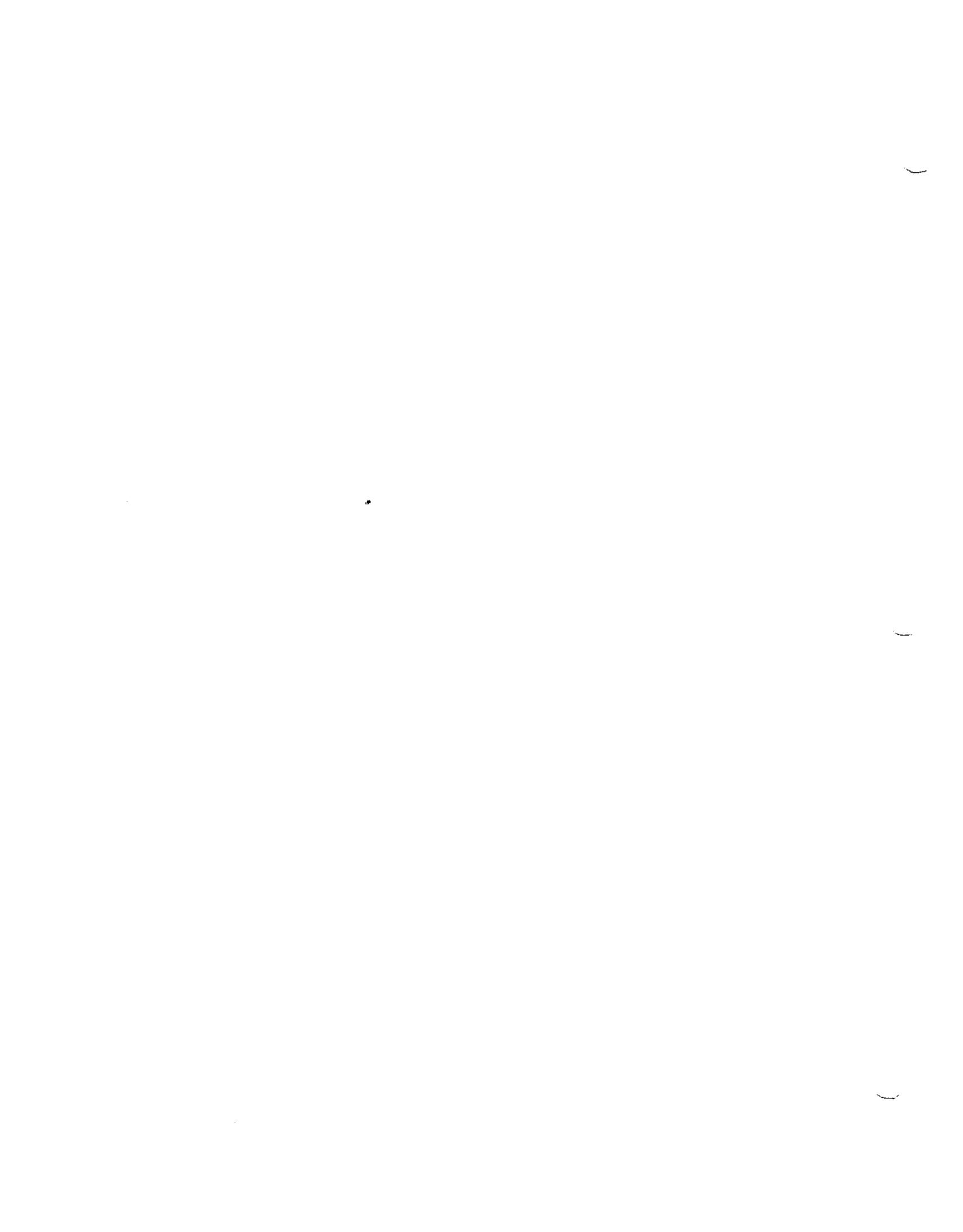


1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_

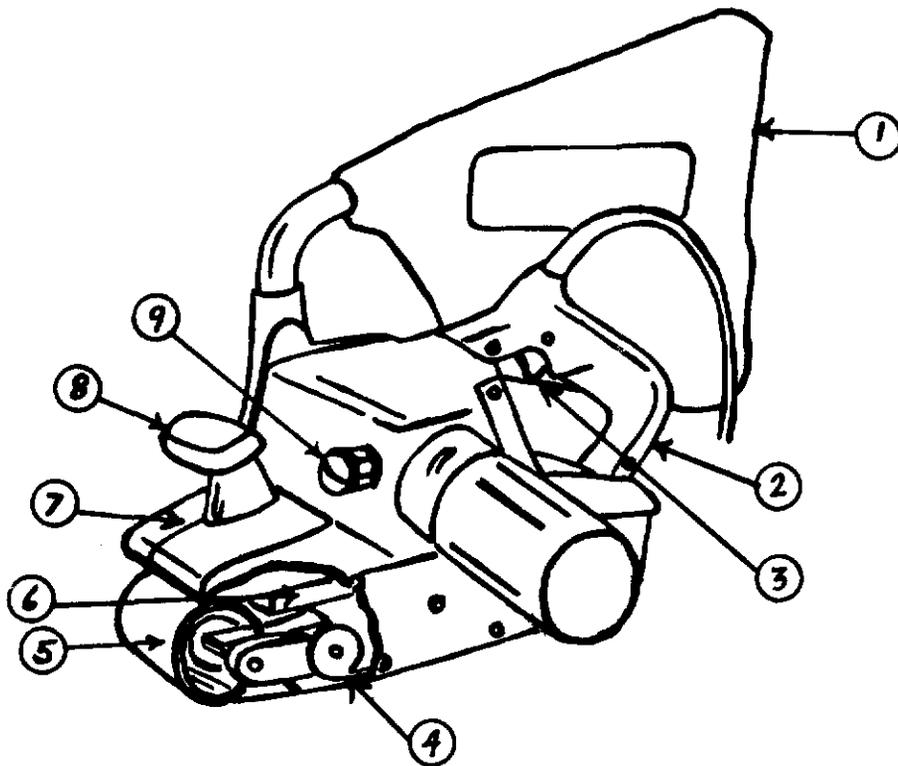
## BELT SANDER



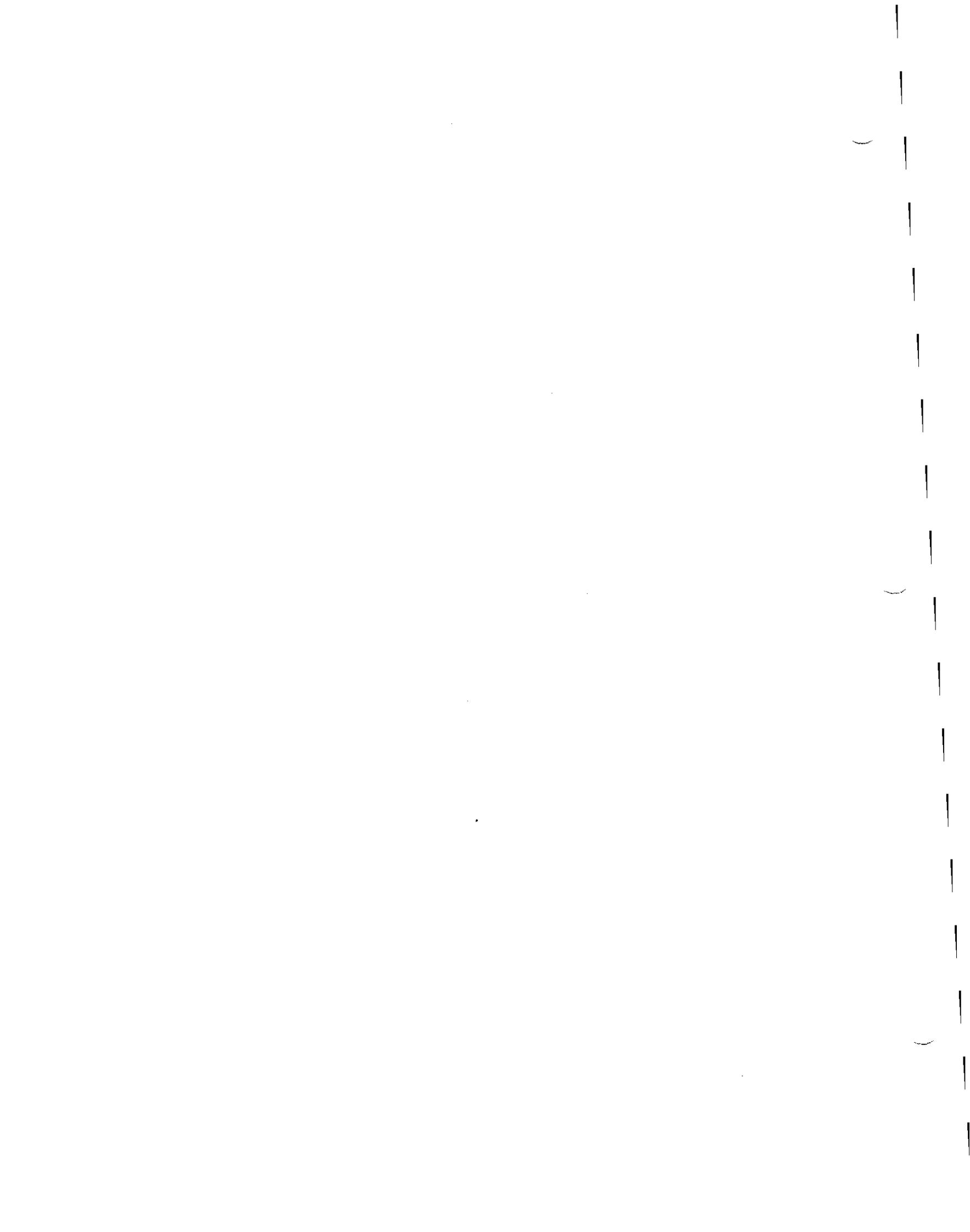
1. Operate only with the teacher's permission and after instruction has been received.
2. Remove jewelry, eliminate loose clothing, and confine long hair before using the sander.
3. Always use the proper eye protection.
4. Check to see if the belt is in good condition, is tracking properly, and is the correct grit size for the job.
5. Be sure the switch is off before connecting the sander to the power source.
6. Start the sander above the work. Let the rear of the belt touch first; then level the sander. Do not tilt it sideways.
7. Sand in the direction of the wood grain, moving the sander back and forth over a large area. Do not pause in one spot.
8. Keep the electrical cord and the dust bag away from the working area.
9. Lift the sander off the work and wait until it has stopped before placing it on the bench.
10. Make sure the opening of the dust bag is clean. In some types of sanding dust, there is a danger of spontaneous combustion if the dust is left in the bag.
11. Firmly fasten down the work to be sanded. The sander exerts a tremendous pulling force.



# BELT SANDER



- |   |                             |   |                  |
|---|-----------------------------|---|------------------|
| 1 | DUST BAG                    | 6 | BELT STRIKER BAR |
| 2 | D-HANDLE                    | 7 | HOUSING          |
| 3 | TRIGGER SWITCH              | 8 | FRONT HANDLE     |
| 4 | BELT TRACKING<br>ADJUSTMENT | 9 | BRUSH HOLDER     |
| 5 | BELT                        |   |                  |



# BELT SANDER SAFETY QUIZ

NAME \_\_\_\_\_

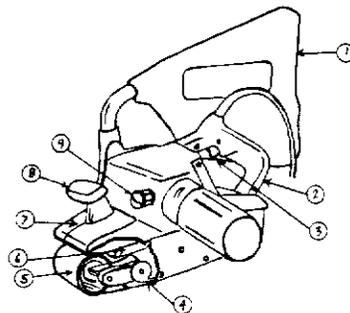
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

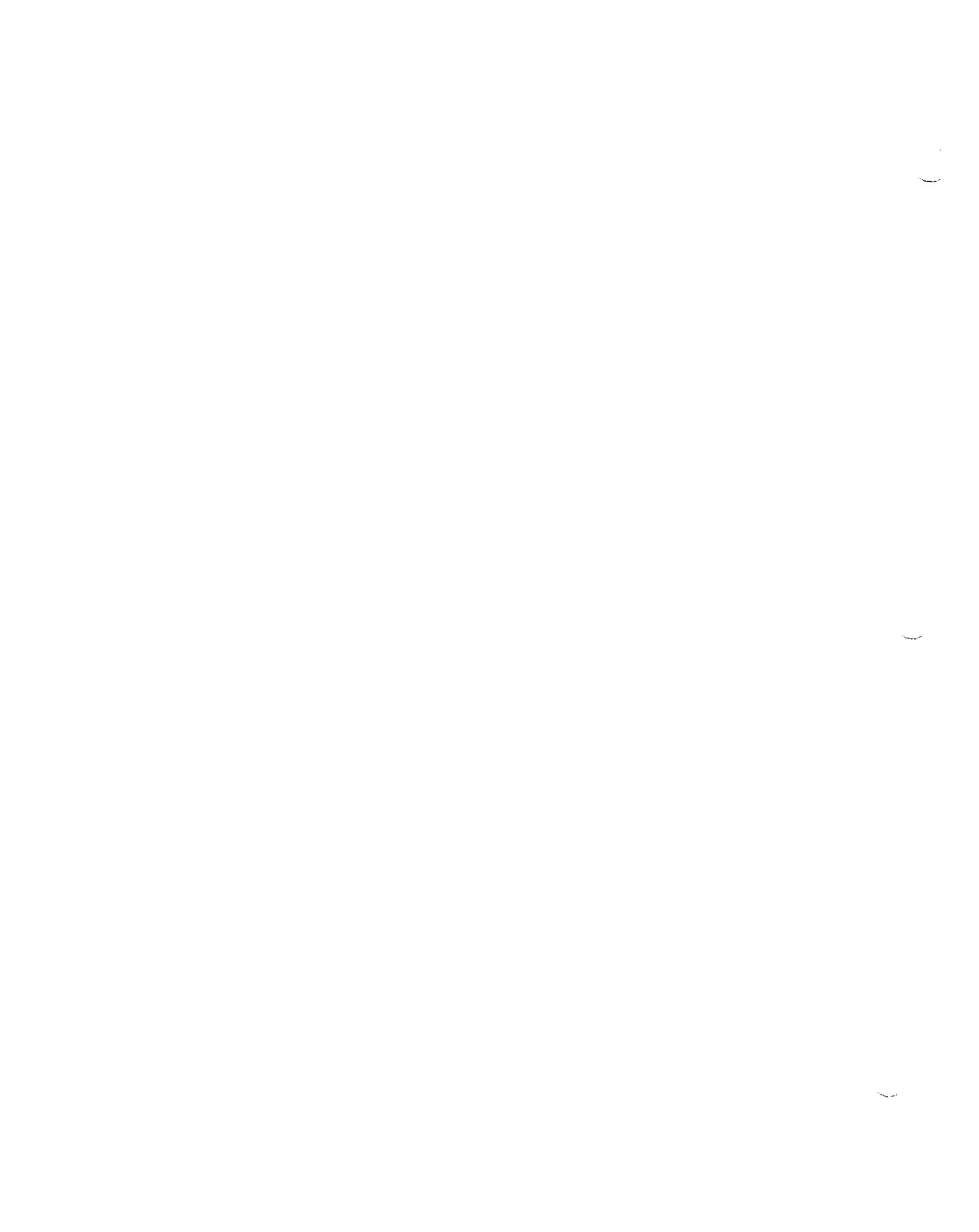
## True or False:

- \_\_\_\_\_ 1. Because of the money and time you'll save, you should always wait until the dust bag is full before emptying it.
- \_\_\_\_\_ 2. You should not wear goggles when using the sander; they may fog up and cause you to make an error in your work.
- \_\_\_\_\_ 3. It is always good to use a bigger grit size than is recommended.
- \_\_\_\_\_ 4. It is sometimes best to hold the sander by the power cord and allow it to walk itself across the work piece.
- \_\_\_\_\_ 5. You should always sand against the grain.
- \_\_\_\_\_ 6. You should let the front of the belt touch the wood first; then level the sander.
- \_\_\_\_\_ 7. To make sure the belt is tracking properly, you should allow the sander to run for a few seconds without making contact with the work.
- \_\_\_\_\_ 8. Identify the parts of the belt sander.

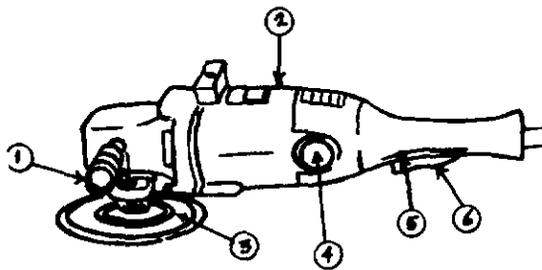


- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_



## DISC SANDER (GRINDER)

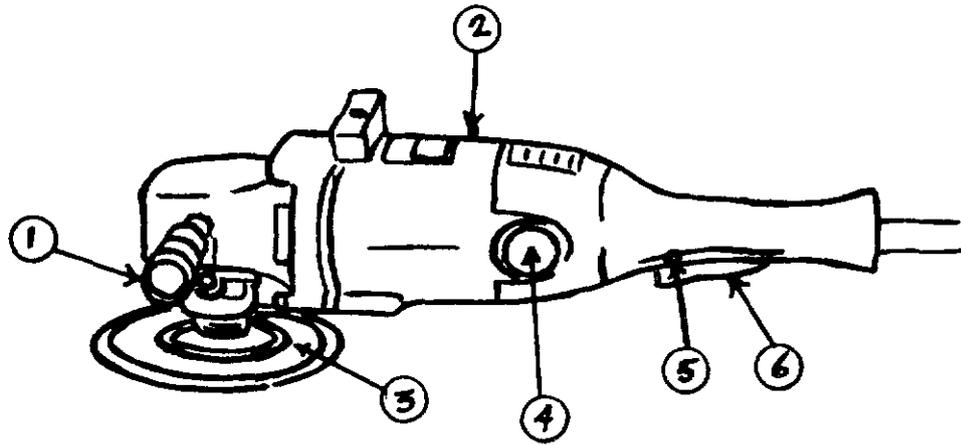


1. Auxiliary Handle
2. Motor
3. Back-up Pad
4. Brush Cap
5. Switch Locking Button
6. Trigger Switch

1. Operate only with the teacher's permission and after instruction has been received.
2. Remove jewelry, eliminate loose clothing, and confine long hair before using the sander.
3. Make sure all the guards are in place and operating correctly.
4. Always use the proper eye protection.
5. Be sure the switch is in the "off" position before connecting the sander to the power source.
6. Make sure the back-up pad and disc are securely fastened to the tool. Unplug the sander when changing discs.
7. Stand clear of the spark line or spark area.
8. Sand or finish with a stroking motion. Do not pause in one spot.
9. Do not allow the edge of the disc to touch the edge of the stock.
10. Place the sander on its back or on a rubber stand when it's not in use. Disconnect it from the power source.
11. Some discs may be defective and fly apart at high RPMs. Hold the sander under a bench or provide other protection when starting up a new disc.
12. Sand only on the downstroke side of the disc.
13. Do not hold small pieces of work in your hand.
14. Wear a dust mask when sanding masonry.

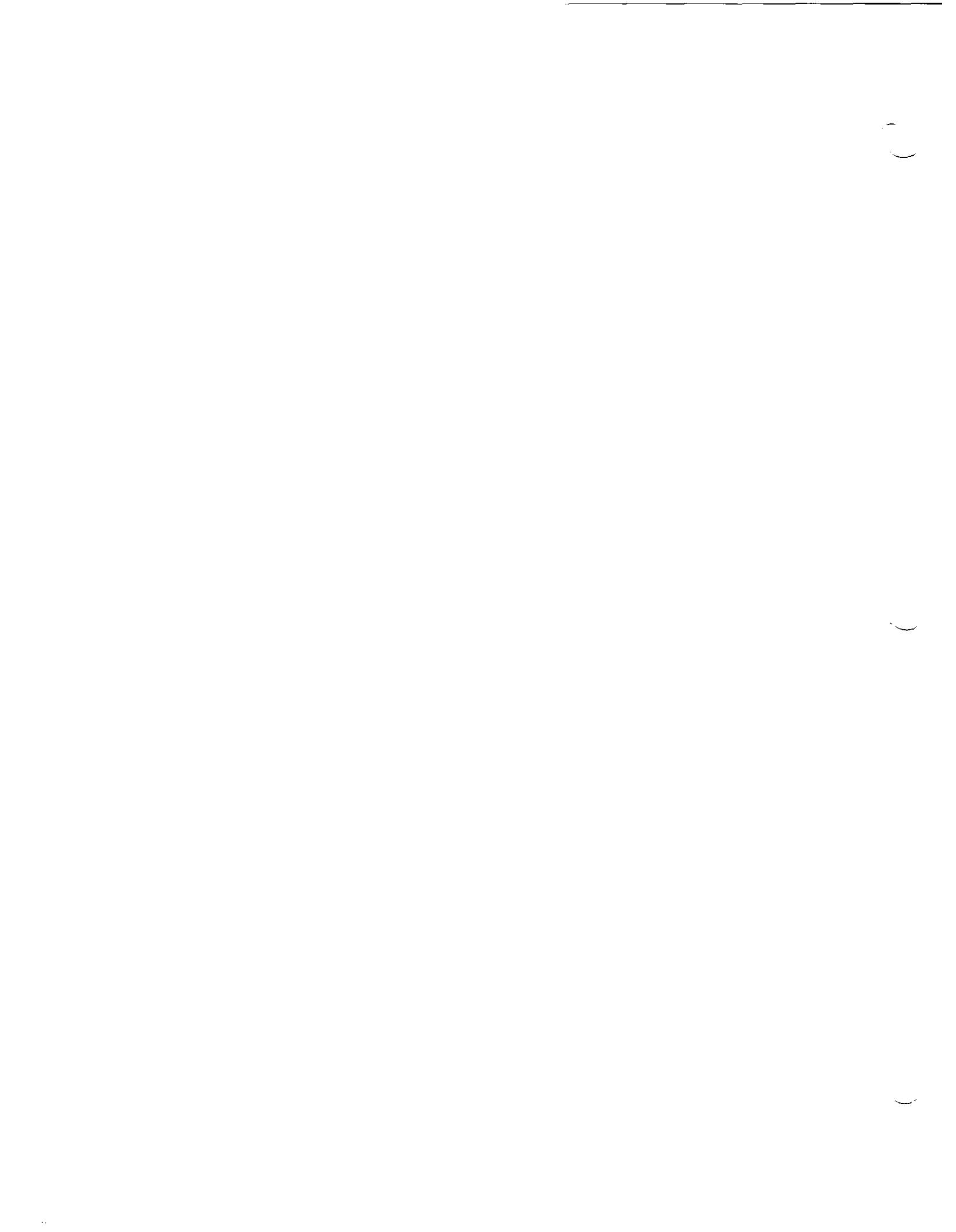
15. Make certain the portable grinder is properly grounded through the electric cord.
16. Keep the cord away from the grinding disc.
17. Make certain the grinding disc is of suitable RPM rating for the grinder being used.
18. Check grinding disc before using for cracks or breaks.
19. The face of the disc must be free from grooves.
20. Use face of disc only unless it is designed for grinding on the edge.
21. If in doubt about the operation, safety, or job you are doing, always check with the teacher.
22. Keep the portable grinder away from your body.
23. Use the portable grinder as nearly as possible in the horizontal position.

# DISC SANDER (GRINDER)



- 1 AUXILIARY HANDLE
- 2 MOTOR
- 3 BACK-UP PAD

- 4 BRUSH CAP
- 5 SWITCH LOCKING BUTTON
- 6 TRIGGER SWITCH



## DISC SANDER OR GRINDER SAFETY QUIZ

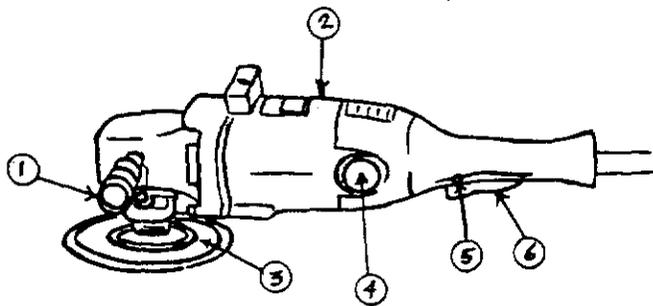
NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

True or False:

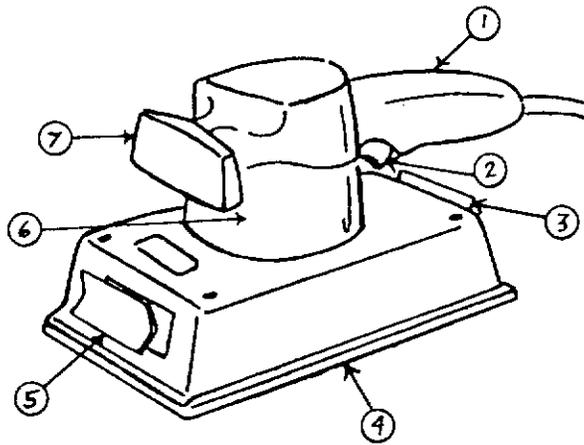
- \_\_\_\_\_ 1. Eye protection must always be used when operating this machine.
- \_\_\_\_\_ 2. The student must get the teacher's permission before using the disc sander or grinder.
- \_\_\_\_\_ 3. Grinding wheels with chips or cracks may still be used as long as the chips or cracks are small.
- \_\_\_\_\_ 4. The RPM rating on the grinding wheel is the slowest speed at which that wheel should be used.
- \_\_\_\_\_ 5. Grinding wheels that are loose on their mountings should not be used.
- \_\_\_\_\_ 6. One should always make certain the grinder or sander is properly grounded through the power cord.
- \_\_\_\_\_ 7. This machine is capable of catching loose clothing or hanging jewelry.
- \_\_\_\_\_ 8. It is permissible to use a vise or other clamping devices to hold small objects for grinding.
- \_\_\_\_\_ 9. The operator should use a stroking motion for grinding or sanding with this machine.
- \_\_\_\_\_ 10. Identify the parts of the disk sander.



1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_

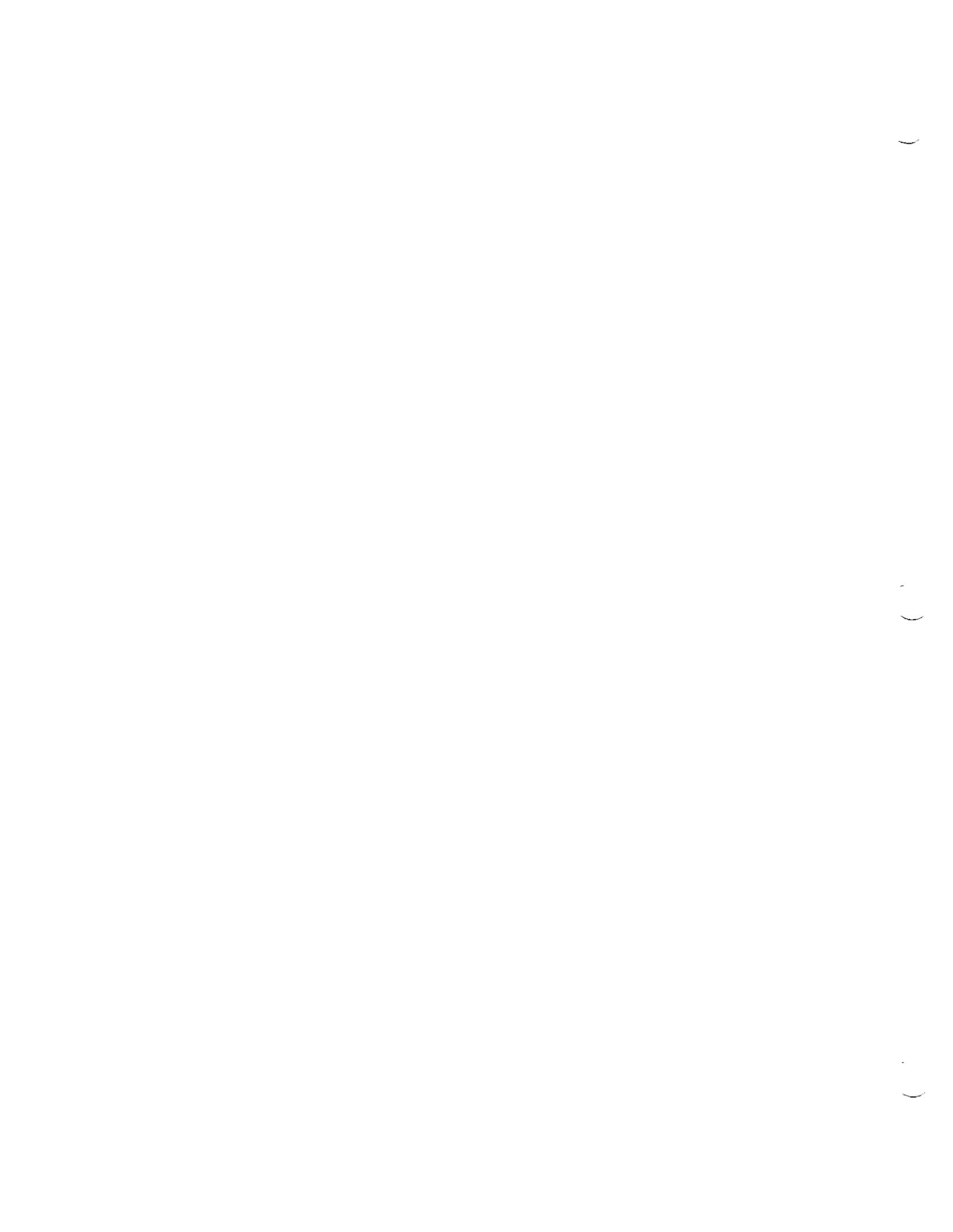


## FINISHING SANDER

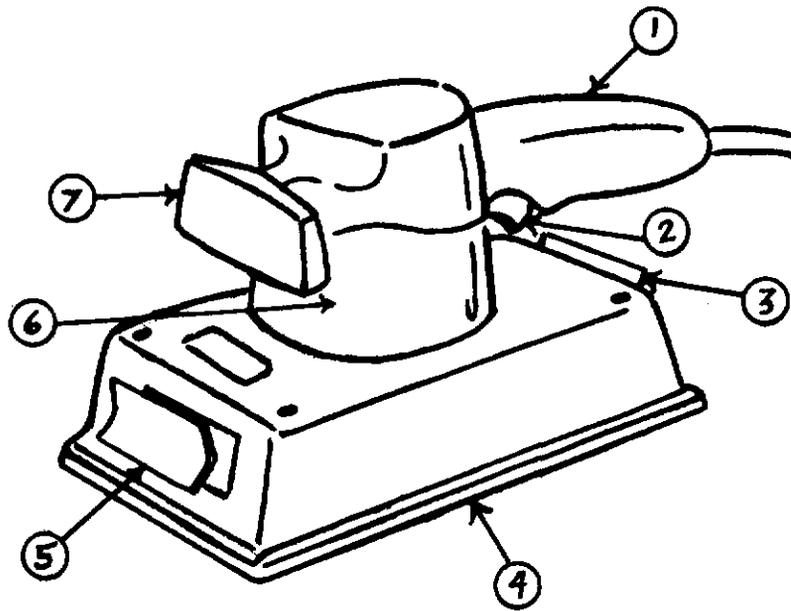


1. Handle
2. Insulated Trigger Switch
3. Paper Clamp
4. Pad
5. Paper Clamp
6. Housing
7. Front Hand Knob

1. Operate only with the teacher's permission and after instruction has been received.
2. Remove jewelry, eliminate loose clothing, and confine long hair before using the sander.
3. Always use the proper eye protection.
4. Be sure the switch is in the "off" position before connecting the sander to the power source.
5. Make sure the abrasive sheet is in good condition and properly installed on the tool.
6. Start the tool above the work, set it down evenly, and move slowly over a wide pattern area.
7. When you are finished sanding, do not put the sander on the workbench until it has stopped running.
8. Never lift or carry the sander by its power cord.
9. Do not overload the sander by pushing down. Allow the weight of the sander to supply the pressure.
10. Always keep the hands clear of the moving abrasive when operating the sander.



# FINISHING SANDER



- |                            |                   |
|----------------------------|-------------------|
| 1 HANDLE                   | 5 PAPER CLAMP     |
| 2 INSULATED TRIGGER SWITCH | 6 HOUSING         |
| 3 PAPER CLAMP              | 7 FRONT HAND KNOB |
| 4 PAD                      |                   |



# FINISHING SANDER SAFETY QUIZ

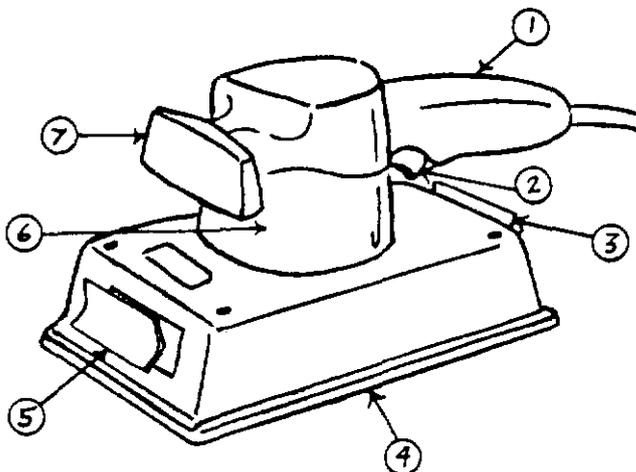
NAME \_\_\_\_\_

CLASS \_\_\_\_\_

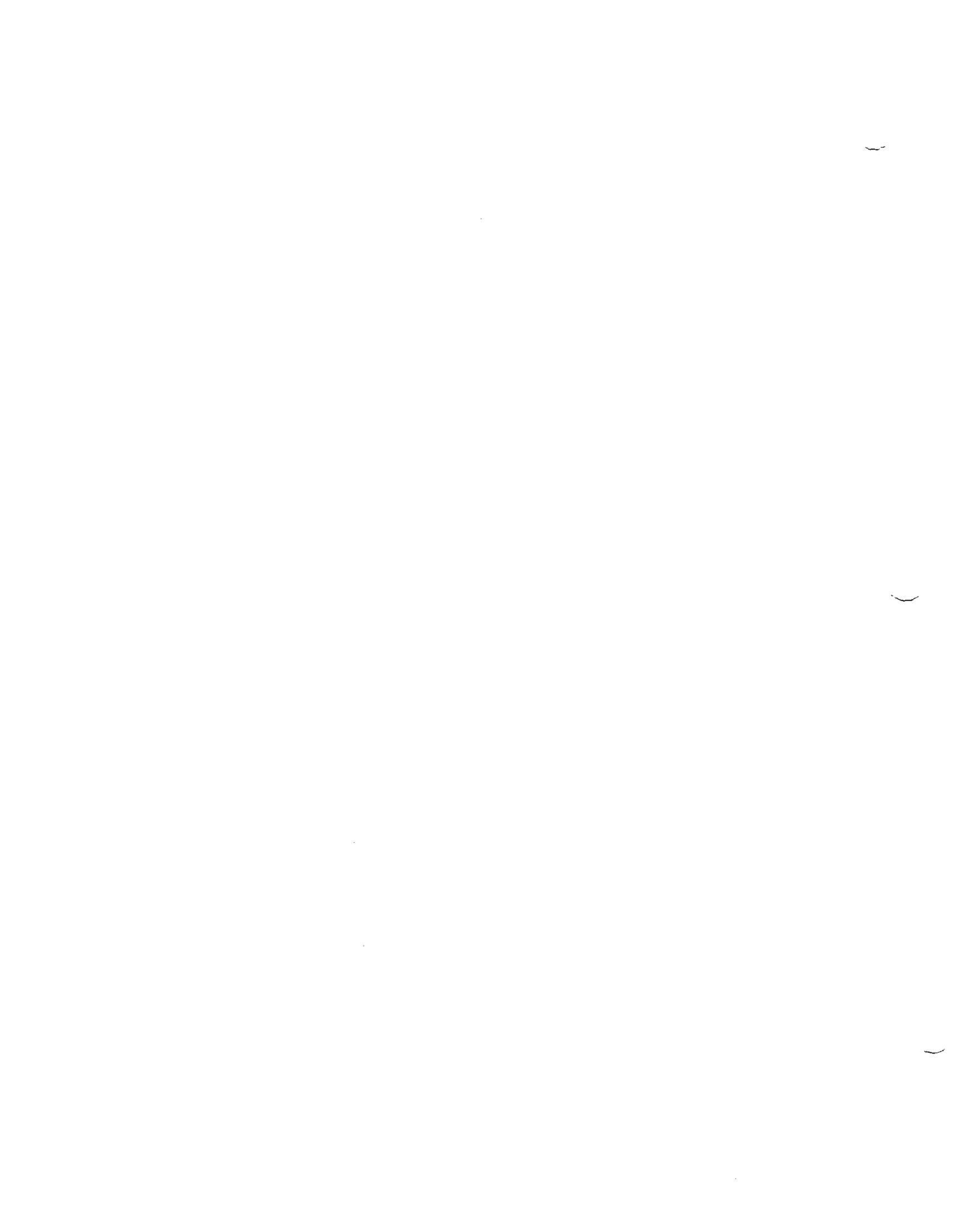
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

True or False:

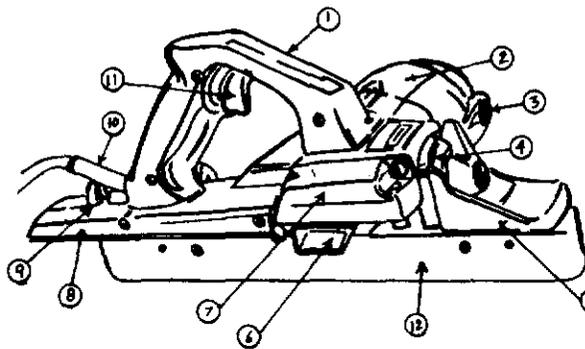
- \_\_\_\_\_ 1. You must wear a hard hat when using a sander.
- \_\_\_\_\_ 2. Because most families have portable sanders in their homes, it is not necessary for the teacher to give instruction in the use of portable sanders.
- \_\_\_\_\_ 3. Before laying down the sander, you should wait until it has completely stopped.
- \_\_\_\_\_ 4. You must wear eye protection when using a sander.
- \_\_\_\_\_ 5. To make sure the machine is functioning properly, you should always plug in the machine while the switch is on.
- \_\_\_\_\_ 6. Because the sandpaper is dangerous to the touch--especially after sanding--you should always carry the sander by its power cord.
- \_\_\_\_\_ 7. Pressing down on the sander can shorten work times and should be done whenever possible.
- \_\_\_\_\_ 8. On simple sanding operations, it is permissible to place your hands next to the sanding action to guide the sander in a straight line.
- \_\_\_\_\_ 9. Identify the parts of the finishing sander.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_

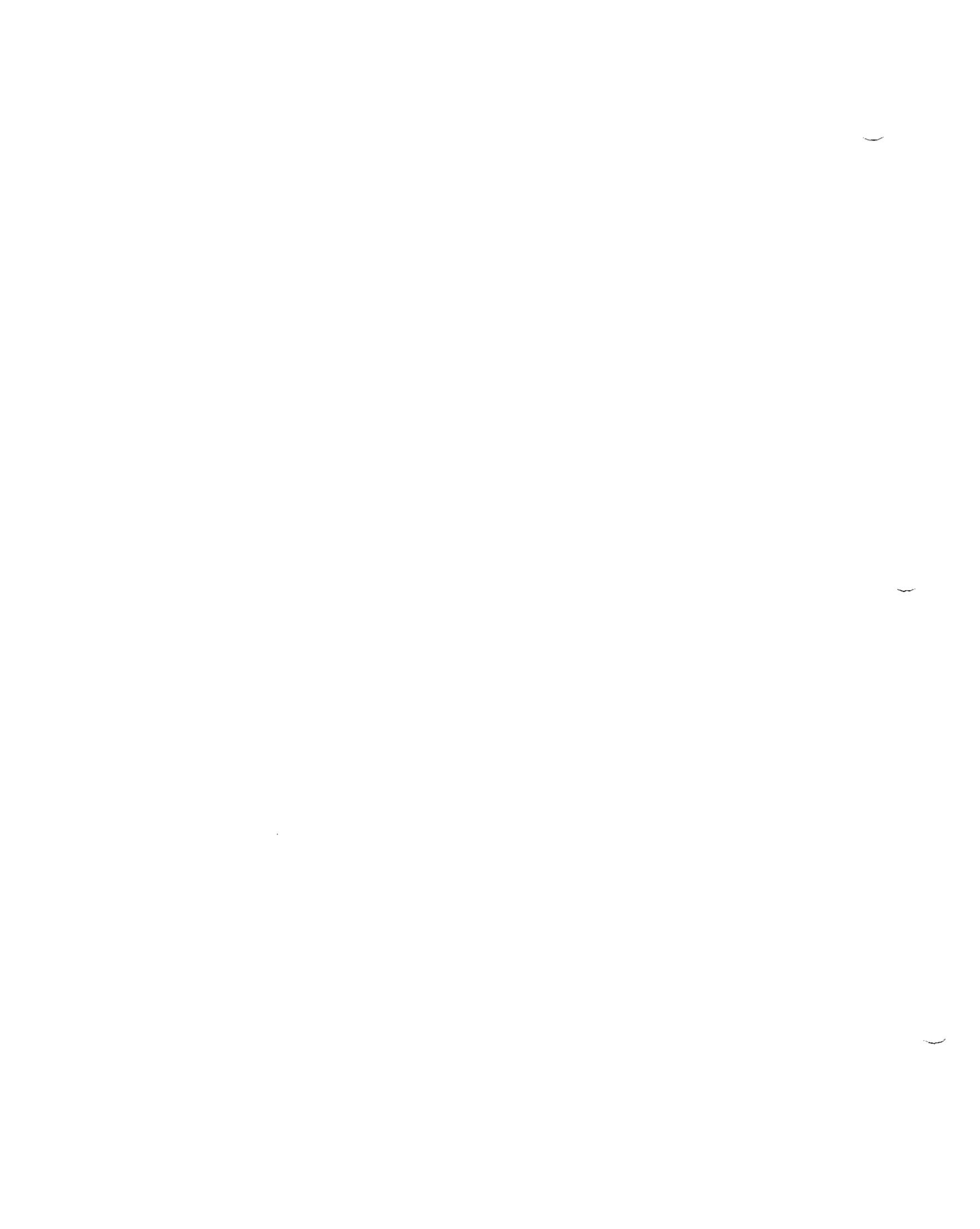


## PLANER

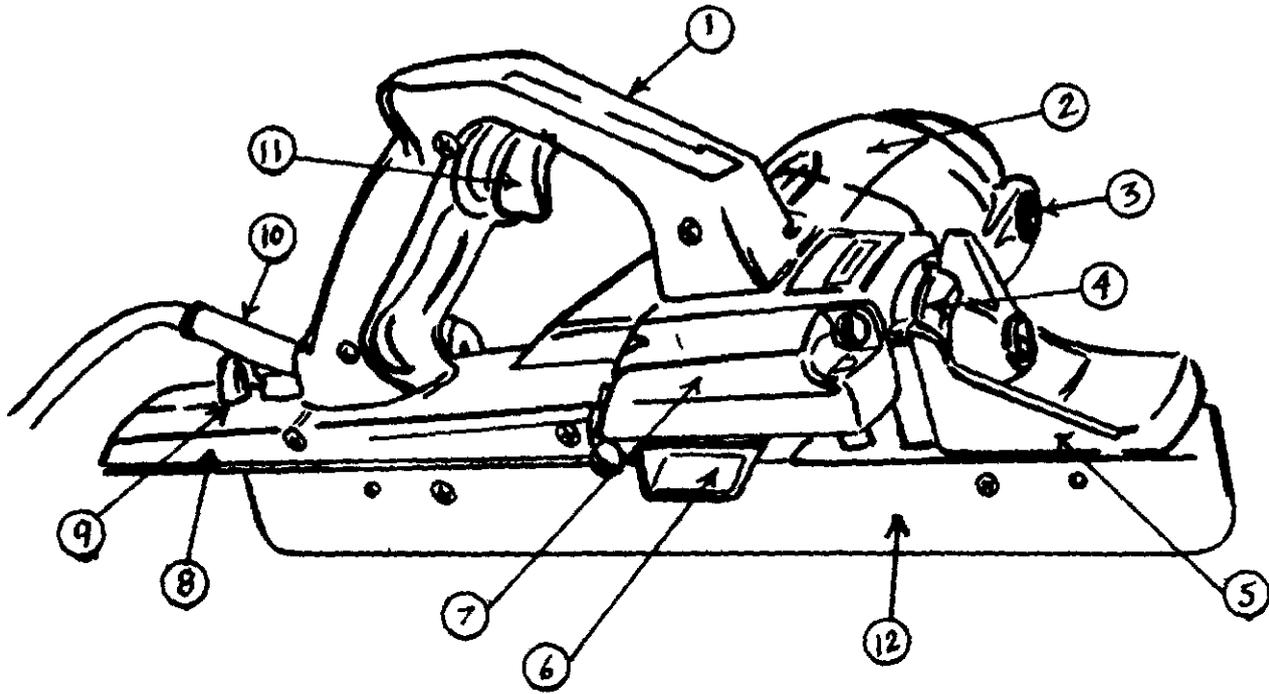


1. D-Handle
2. Housing
3. Brush Holder
4. Depth Adjustment
5. Front Shoe
6. Chip Deflector
7. Guard
8. Rear Shoe
9. Cord Deflector
10. Cord Strain Reliever
11. Insulated Trigger Switch
12. Fence

1. Operate only with the teacher's permission and after instruction has been received.
2. Remove jewelry, eliminate loose clothing, and confine long hair before using the planer.
3. Make sure all the guards are in place and operating correctly.
4. Always use the proper eye protection.
5. Before connecting the planer to the power source, make sure the switch is in the "off" position.
6. Make all adjustments with the planer disconnected from the power source.
7. Place the front shoe on the work piece and start the motor. Then move the plane over the work, keeping a constant speed and pressure.
8. Keep the fence and rear shoe tightly against the work piece until the cutter has cleared the work.
9. Keep your hands on the handle and motor housing and away from the cutter head.
10. Be sure there is clearance for the motor.
11. Do not lay the planer down until the cutter stops rotating.



# PLANER



- |                    |                             |
|--------------------|-----------------------------|
| 1 D-HANDLE         | 6 CHIP DEFLECTOR            |
| 2 HOUSING          | 7 GUARD                     |
| 3 BRUSH HOLDER     | 8 REAR SHOE                 |
| 4 DEPTH ADJUSTMENT | 9 CORD DEFLECTOR            |
| 5 FRONT SHOE       | 10 CORD STRAIN RELIEVER     |
|                    | 11 INSULATED TRIGGER SWITCH |
|                    | 12 FENCE                    |



## PLANER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

True or False:

- \_\_\_\_\_ 1. It is not necessary to secure permission from the teacher before using the portable power plane.
- \_\_\_\_\_ 2. You must use only one hand when using the portable power plane.
- \_\_\_\_\_ 3. After releasing the switch, it is necessary to hold the portable power plane until the motor stops.
- \_\_\_\_\_ 4. Always disconnect the electric cord before making adjustments or changing cutters.

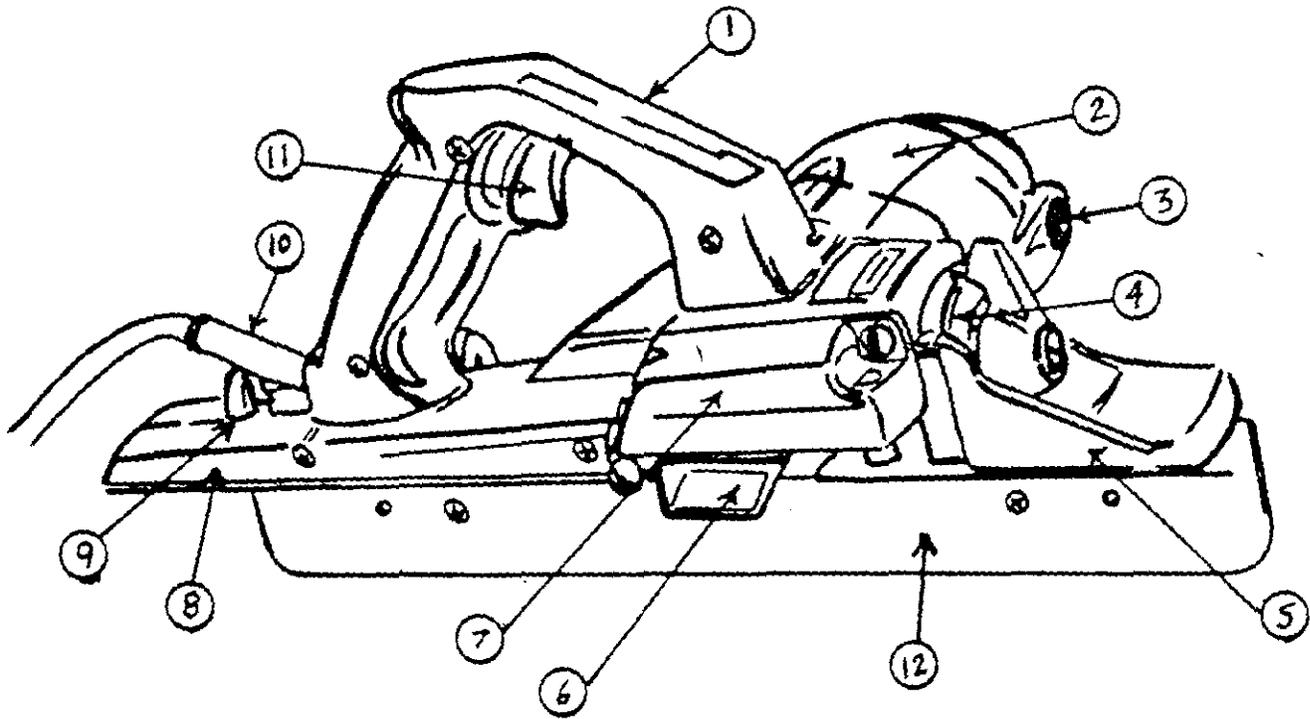
Fill in the blank:

5. \_\_\_\_\_ is necessary when using a power plane.
6. Report any \_\_\_\_\_ or \_\_\_\_\_ to the teacher immediately.
7. \_\_\_\_\_ and \_\_\_\_\_ to operate all switches and controls before using the power plane.
8. Make certain the portable power plane is properly \_\_\_\_\_ through the electric cord.

Explain:

9. Why is it necessary to have the work securely clamped and held in the best position to perform the operation?

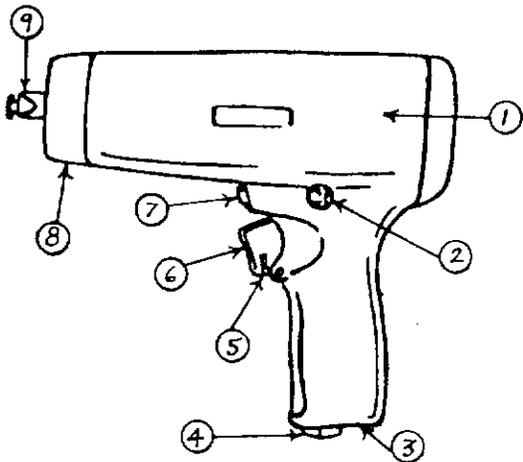
10. Identify the parts of a power plane.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_

- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_
- 10. \_\_\_\_\_
- 11. \_\_\_\_\_
- 12. \_\_\_\_\_

## AIR IMPACT WRENCH



1. Housing
2. Reversing Valve
3. Built-in Oiler
4. Compressed Air Inlet
5. Output Torque Control
6. Trigger Switch
7. Exhaust Air Outlet
8. Rubber Nose Guard
9. Square Drive

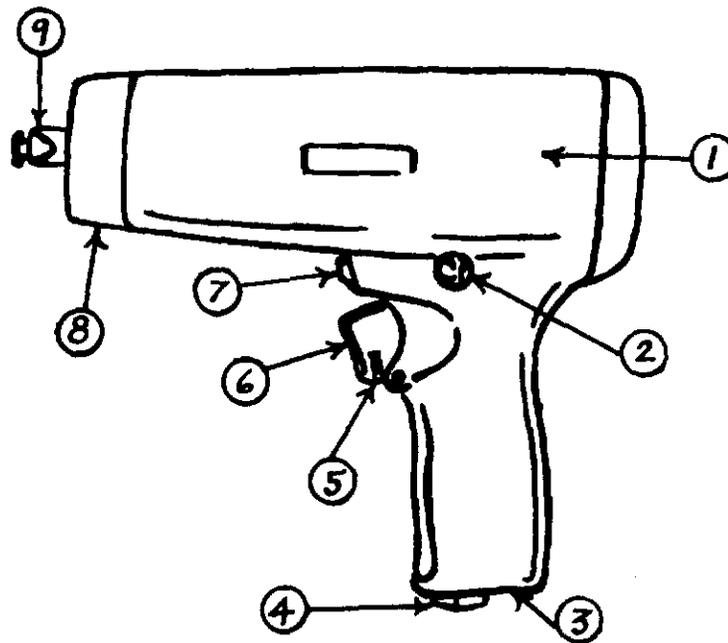
1. Operate only with the teacher's permission and after instruction has been received.
2. Remove jewelry, eliminate loose clothing, and confine long hair before using this tool.
3. Always use the proper eye protection.
4. Make sure all the hoses and fittings are tightened securely before opening the outlet air valve.
5. Be sure that the recommended air line pressure is used (approximately 90 to 100 P.S.I.).
6. Use only an impact socket.
7. For tightening or loosening fasteners, use the tool in short bursts to avoid the possibility of stripping a bolt.
8. To check the rotation, use the tool in short bursts.
9. When work is completed:
  - (a) shut off the air supply to the tool hose,
  - (b) vent the compressed air in the hose by squeezing the trigger, and
  - (c) disconnect the air tool from the air hose.
10. Store the air tool in a dry location.

—

—

—

## AIR IMPACT WRENCH



- |                         |                      |
|-------------------------|----------------------|
| 1 HOUSING               | 6 TRIGGER SWITCH     |
| 2 REVERSING VALVE       | 7 EXHAUST AIR OUTLET |
| 3 BUILT-IN OILER        | 8 RUBBER NOSE GUARD  |
| 4 COMPRESSED AIR INLET  | 9 SQUARE DRIVE       |
| 5 OUTPUT TORQUE CONTROL |                      |



# AIR IMPACT WRENCH SAFETY QUIZ

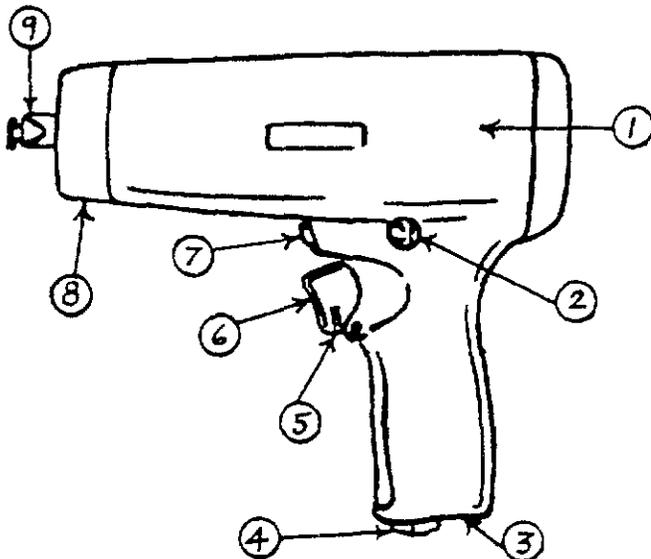
NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

True or False:

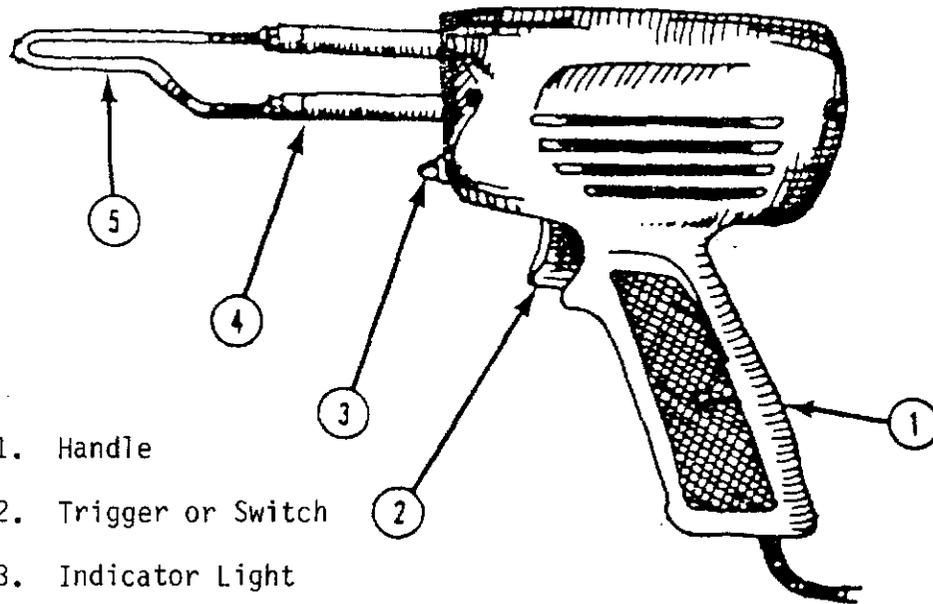
- \_\_\_\_\_ 1. It is safe to operate the impact wrench with one hand if the bolt or nut is not too tight.
- \_\_\_\_\_ 2. Since there are no chips, eye protection is not necessary.
- \_\_\_\_\_ 3. The sockets used must be designed for impact wrenches. Regular sockets are not adequate.
- \_\_\_\_\_ 4. The tool should be disconnected from the air line at the end of the hose whip, not at the tool.
- \_\_\_\_\_ 5. The impact wrench must be disconnected when not in actual use.
- \_\_\_\_\_ 6. Short bursts of power should always be used when operating the tool.
- \_\_\_\_\_ 7. Identify the parts of an air impact wrench.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_



## SOLDER GUN

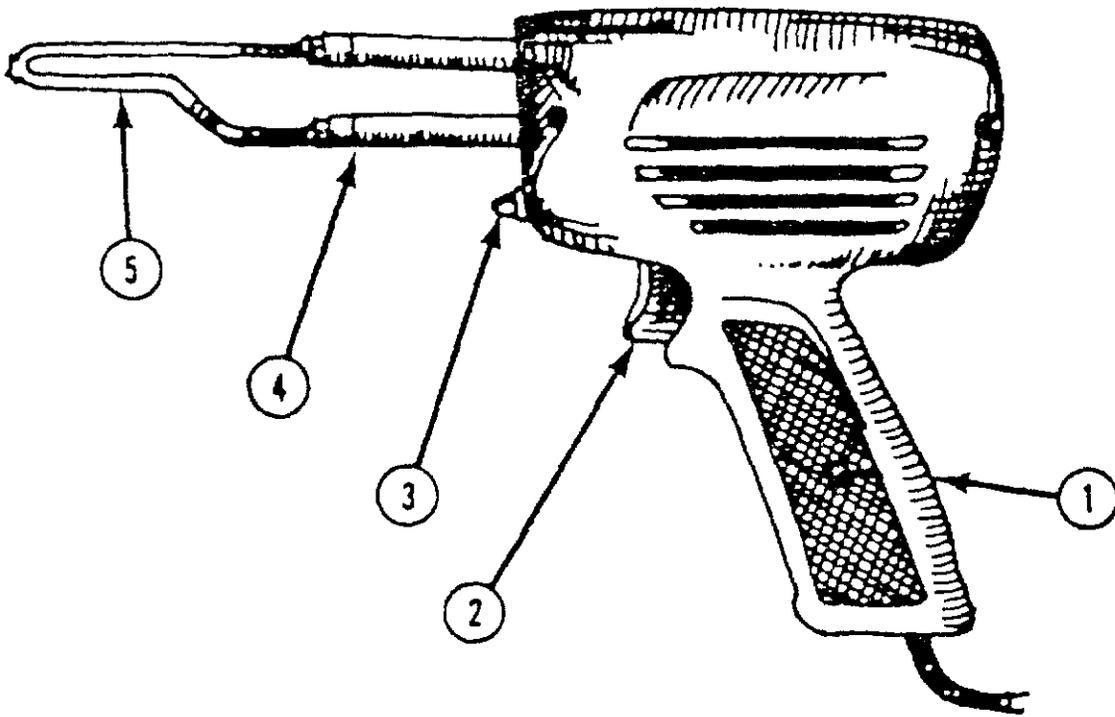


1. Handle
2. Trigger or Switch
3. Indicator Light
4. Tip Holder
5. Soldering Tip

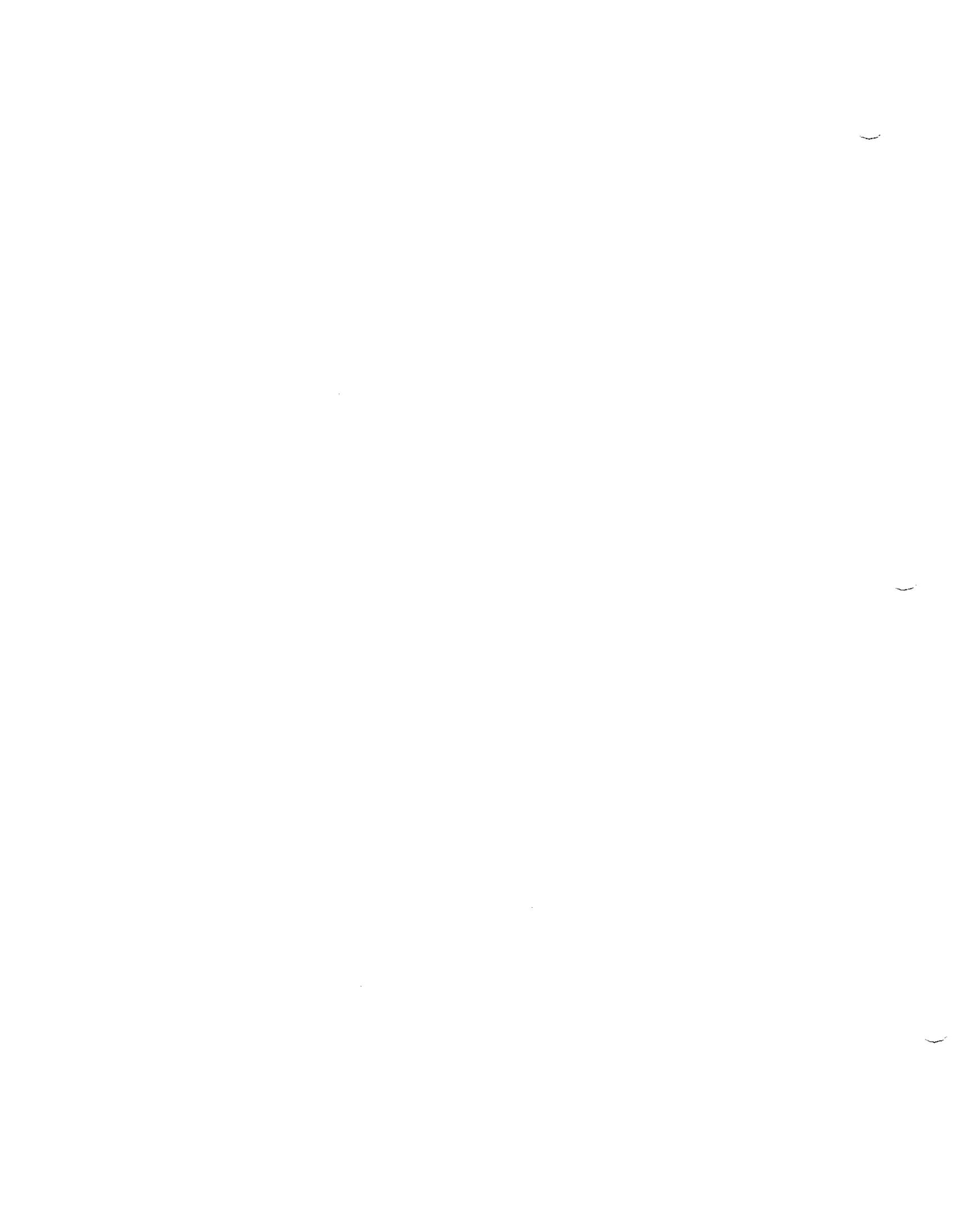
1. Always wear approved eye protection.
2. Work in a well-ventilated area and do not inhale soldering fumes.
3. Observe all rules for handling hot materials.
4. Do not flip excess molten solder off the tip of a solder gun. Wipe it off with a piece of steel wool.
5. Do not stand in wet areas while using the solder gun.
6. Never leave the solder gun unattended with the electrical cord plugged in.
7. Always disconnect the cord when changing soldering tips.
8. Soldering flux can cause burns. Clean up flux immediately.
9. In case of acid burns, flush immediately with water.



# SOLDER GUN



1. HANDLE
2. TRIGGER OR SWITCH
3. INDICATOR LIGHT
4. TIP HOLDER
5. SOLDERING TIP



# SOLDER GUN SAFETY QUIZ

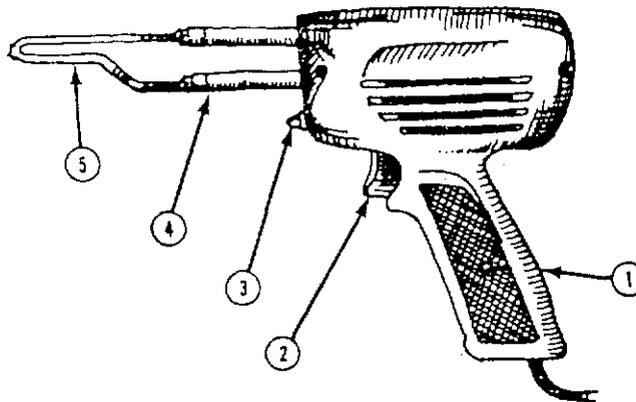
NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

True or False:

- \_\_\_\_\_ 1. You should wear safety goggles only if you think solder might flip in your eyes.
- \_\_\_\_\_ 2. A large, airy room would be a better place to solder than a small closed space.
- \_\_\_\_\_ 3. You should use pliers or a clamp to hold small objects while soldering.
- \_\_\_\_\_ 4. The most important thing to remember when changing soldering tips is to stand in a wet area.
- \_\_\_\_\_ 5. Excess flux should be cleaned up after the work has cooled and after you have taken a break.
- \_\_\_\_\_ 6. Identify the parts of a solder gun.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

—

—

—

## SOLDERING AND BRAZING OPERATION

The health hazard potential of any soldering or brazing operation depends on, among other things, the types of filler metals, fluxes, coatings, cleaning agents, gases, and base metals used. It is important, therefore, that a person should know what materials s(he) is working with, what hazards they present, and what symptoms might be felt if s(he) comes in contact with them. It is also important that if one begins to experience any of these symptoms, s(he) report to the school nurse or seek prompt medical advice. The following discussion talks about some of the materials and exposure symptoms that might be encountered.

### CLEANING AGENTS

**ACIDS**--For the most part, acids used for cleaning should be diluted with water. (IF ONE MUST DO ONE'S OWN DILUTING, THE FOLLOWING "RULE OF THUMB" APPLIES: ALWAYS PUT THE ACID INTO THE WATER; NEVER PUT THE WATER INTO THE ACID. ALSO, A FULL FACE SHIELD AND PROTECTIVE GLOVES SHOULD BE WORN.) However, even diluted acids can cause skin burns and can generate irritating fumes. Therefore, work with any acids should be carried out in well-ventilated areas and face shield and protective gloves should be worn. Some specific acids that might be encountered include:

1. **HYDROCHLORIC OR MURIATIC ACID**--A corrosive acid, yellowish in color. Inhalation of hydrochloric acid fumes will cause choking.
2. **SULFURIC ACID**--This acid is intensely irritating to the respiratory system and the skin. When used to remove rust, scale, and oxide from metals, it can form hydrogen, a flammable gas.
3. **PHOSPHORIC ACIDS**--Although not as hazardous as sulfuric acid, exposure to phosphoric acid can result in an inflammation of the mucous membranes and also skin irritation.
4. **NITRIC ACIDS**--This acid can cause severe skin burns and severe irritation of the respiratory tract.

**ALKALIS**--Alkali mixtures used in cleaning operations usually contain sodium or potassium hydroxide. When sodium or potassium hydroxide is put into water to make a solution, it can cause the water to boil. This causes bubbling and splashing, so that concentrated solutions or bits of the solid alkalis can get on the skin or in the eyes of the person mixing the solution. Inhalation of the fumes can irritate the tissues and membranes of the respiratory tract. Skin contact with these alkalis will cause irritation.

**ORGANIC SOLVENTS**--Organic solvents are used to remove oil and grease from the workpiece. Most organic solvents are flammable and thus are potential fire and explosion hazards. Exposure to the vapors of organic solvents can result in irritation of the eyes, nose, throat, and lungs; dizziness; headaches; and sensations of drunkenness. Organic solvents containing chlorine may break down due to the heat and generate phosgene gas which, at low concentration (less than one part per million), has a sweet odor. At about one ppm it smells like musty or new-mown hay. Phosgene is a severe pulmonary irritant and, in high concentrations, can cause death. Prolonged or continued skin contact with most organic solvents will remove essential skin oils which will lead to dry, cracking skin and possibly irritation and/or infection.

**ULTRASONIC CLEANING**--Passing an ultrasonic soundwave through a solution creates a vibratory force which breaks off particles and contaminants from small metal parts that were placed in the solution for cleaning. If one uses ultrasound cleaning methods, s(he) should follow the manufacturer's instructions and check with the teacher or supervisor for any special protective clothing required.

## SOLDERING FLUXES

Many fluxing agents are used in soldering and brazing operations. The fluxing agent is determined by the metals to be joined. In most cases, these fluxes give off acid or alkali fumes when heated. Because they contain acids and/or alkalis, they can irritate the skin. Again, conducting soldering and brazing operations in well-ventilated areas (see the section on ventilation) and the use of protective clothing and gloves are recommended.

**CORROSIVE FLUXES**--These fluxes leave a chemically active residue after soldering.

1. **ZINC CHLORIDE**--This is the main ingredient in corrosive fluxes used in the soldering of stainless steel, galvanized iron, cast iron, and aluminum. Zinc chloride fumes can irritate the eyes, nose, and lung tissue, and skin contact with this fluxing agent can cause chemical burns.

2. **AMMONIUM CHLORIDE**--The inhalation of these fumes will be irritating to respiratory passages.
3. **STANNOUS CHLORIDE**--It is not considered a serious health hazard. The fumes are irritating to respiratory passages.
4. **ACIDS**--They are frequently used as ingredients with fluxes. (See the discussion under "Cleaning Agents.")

**INTERMEDIATE FLUXES**--Lactic, benzoic, and glutamic acids frequently are used in the mild intermediate fluxes. These organic acids can produce a mild irritation of the skin upon contact. The fumes can be mildly irritating to respiratory passages.

**NONCORROSIVE FLUXES**--Rosin dissolved in an organic solvent is the most common type of noncorrosive flux. Typical solvents are alcohol, turpentine, or petroleum spirits--all of which are flammable. Exposure to these solvents can result in an irritation of the respiratory passages and can cause some central nervous system effects (see "Organic Solvents"). Rosin dissolved in trichloroethylene --which is nonflammable-- is also used. If trichloroethylene is the solvent, special attention must be given to providing adequate ventilation when soldering with this type of flux, due to its potential for generating phosgene. Fumes generated from the decomposition of these fluxes are irritating to respiratory passages.

### BRAZING FLUXES AND ATMOSPHERES

Depending on the type of brazing and base metals used, either a flux or a controlled atmosphere may be used to promote the formation of a brazed joint. The most hazardous brazing fluxes are the fluoborates, fluorides, potassium, and sodium hydroxide.

**FLUOBORATES**--When heated, the fluoborate can release fluorine fumes which are a severe lung irritant. Overexposure to these fumes is usually minimized, however, due to operator reaction to the sharp odor.

**FLUORIDES**--These compounds are used in brazing with silver, magnesium, and aluminum-silicon filler metals. The fluoride fumes generated are severe lung irritants. Skin contact with fluoride compounds will cause irritation.

**SODIUM AND POTASSIUM HYDROXIDE**--This is a fluxing ingredient used on molybdenum alloy steels. (See previous discussion on alkalis)

**CONTROLLED BRAZING ATMOSPHERES**, commonly employed in furnace brazing, are used to prevent the formation of oxides during brazing. Typical brazing atmospheres used are hydrogen, carbon monoxide, carbon dioxide, dissociated ammonia, and nitrogen. To prevent a safety hazard, the work

should be done in a physical enclosure or by using local exhaust ventilation. When this is done properly, they present little or no problem of toxicity. However, some mixtures of gases may be explosive. Therefore, before heating the furnace, the atmosphere must be flooded with the gas to remove all air.

### BASE AND FILLER METALS

A variety of different metals and alloys will be encountered during the soldering and brazing process. The four metals considered the most hazardous are lead, cadmium, beryllium, and zinc.

**LEAD**--Lead is used in the soldering process in the form of lead-tin and lead-silver filler metals. When heated, lead oxide fumes are formed. Excessive exposure to lead oxide fumes can result in lead poisoning. The symptoms include loss of appetite, indigestion, nausea, vomiting, constipation, headache, abdominal cramps, nervousness, and insomnia.

**CADMIUM**--Cadmium is found in some silver and zinc solders and in some base metals. When heated, cadmium oxide fumes can be generated. Excessive exposure to these fumes can result in cadmium poisoning. The symptoms include dry cough, irritation of the throat and nasal passages, tightness of the chest, and restlessness. Cadmium has been suspected of causing cancer of the prostate.

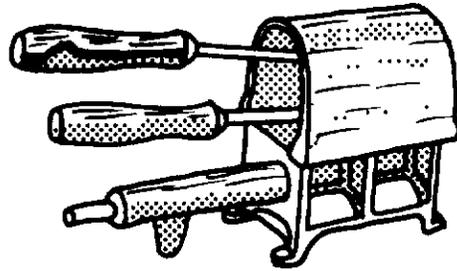
**BERYLLIUM**--Beryllium is used in magnesium filler metals for furnace brazing, and in some aluminum brazing filler metals. While soldering, temperatures are normally too low to generate fumes from beryllium, but the heat involved in brazing can generate beryllium fumes, which are extremely hazardous. Short term exposure to these fumes may result in a chemical pneumonia. Long term effects include shortness of breath and chronic cough, loss of weight, and fatigue. NIOSH has considered beryllium to be a potential human lung carcinogen.

**ZINC**--Zinc is used in large amounts in zinc-cadmium and zinc-aluminum solders, and in some base metals. When heated, zinc oxide fumes are generated. Excessive exposure to freshly formed zinc oxide fumes can give one an illness called metal fume fever or "zinc chills." Symptoms include the presence of a sweetish or metallic taste in the mouth, dryness and irritation of the throat, coughing, a feeling of weakness, fatigue, and a general malaise condition similar to that of influenza. Usually the illness disappears in a day or so with no permanent aftereffects. The presence of zinc oxide dust, which is the end product several minutes after zinc oxide fume formation, presents little or no health problems.

**OTHER METALS**--Other trace metals present in base and filler metals which give off toxic fumes include antimony, arsenic, chromium, bismuth, cobalt, nickel, selenium, thorium, vanadium, or compounds of these metals. NIOSH has stated that arsenic is a suspected lung and lymphatic carcinogen; chromium (hexavalent) is a suspected lung carcinogen. The amount of fumes generated from these trace metals is usually small, and hazardous concentrations are not normally found. But soldering and brazing with filler or base metals containing these trace elements should be conducted in well-ventilated areas to be absolutely sure that hazardous concentrations do not exist.

## SOLDERING IRONS

The traditional soldering tool is the soldering iron with a copper bit. This bit is usually heated electrically or with a gas flame.



FLAME HEATED IRON

One of the most common hazards associated with using soldering irons is burns. One should make sure that the soldering iron is equipped with a properly insulated holder before using it. When not in use, the soldering iron should be placed in a fireproof holder (or back in the stove) and never allowed to lie on the floor, chairs, or tables where it can come in contact with combustible materials or accidentally be touched by anyone. A hot soldering iron should never be left unattended. If it is electric, make sure it is disconnected.

### FLAME-HEATED IRONS

1. Check the hose connections, particularly the stove connection, for gas leaks. Also, check the connections at the cylinder valve if a "bottled" fuel gas is used. (Soap and water may be used.)
2. Remember that gas-fired irons are not thermostatically controlled, so care must be taken to prevent overheating of the metals, which could result in the generation of excess fumes.

### ELECTRICALLY HEATED IRONS

Before using an electrically heated iron, one should make the following safety checks:

1. Check the thermostatic control (if the soldering iron has one) to make sure that it is working properly, and that it is adjusted to the proper temperature.
2. Check the lead cord for proper insulation and make sure that it is free from grease and oil. Also, make sure that the cord is not lying in walkways where it could present a tripping hazard.
3. Check all electric tools and extension cords. They should be fitted with a three-prong plug for proper grounding.
4. Store all electric soldering irons in a dry place. Check the iron before using it to be sure it's dry.

## REFERENCES

Materials were selected and reviewed from the following sources, and in some instances were incorporated in the production of the preceding unit.

1. Sioux Tools, Inc.
2. Rockwell International Corporation
3. Pennsylvania Industrial Arts Safety Guide  
Pennsylvania Department of Education
4. Frank Paxton Lumber Co.
5. Occupational Safety Manual,  
Wyoming State Department of Education
6. NIOSA
7. OSHA
8. Power Tools Institute, Inc.

## **PART 5:**

### **EQUIPMENT FOR WORKING WITH GRAPHIC ARTS**

Platen Press

Offset Composition Equipment

Phototypesetter/Composer

Light Table

Waxer

Offset Press

Proof Presses

Platemaker

Paper Cutter

Folder

Paper Drill

Stapler

Darkroom Equipment

Enlarger

Contact Printer

Process Cameras

Screen Printer

Rubber Stamp and Gold Stamp Press

Finishing Equipment

Hand-Operated Paper Cutter

Dry Mount Press

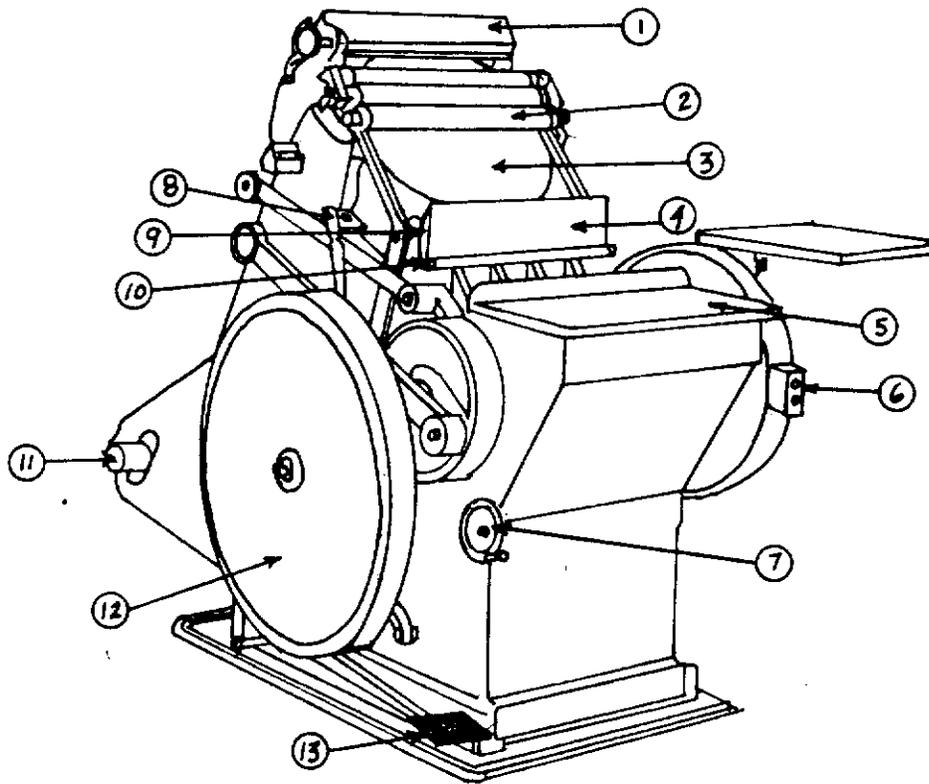
Print Dryer

Spray Adhesives and Film Cleaners

Cutting Tools

Pages 349-464 were adapted from Safety Education Handbook, produced by Kansas State Department of Education, Wichita, Kansas, 1981.

## PLATEN PRESS

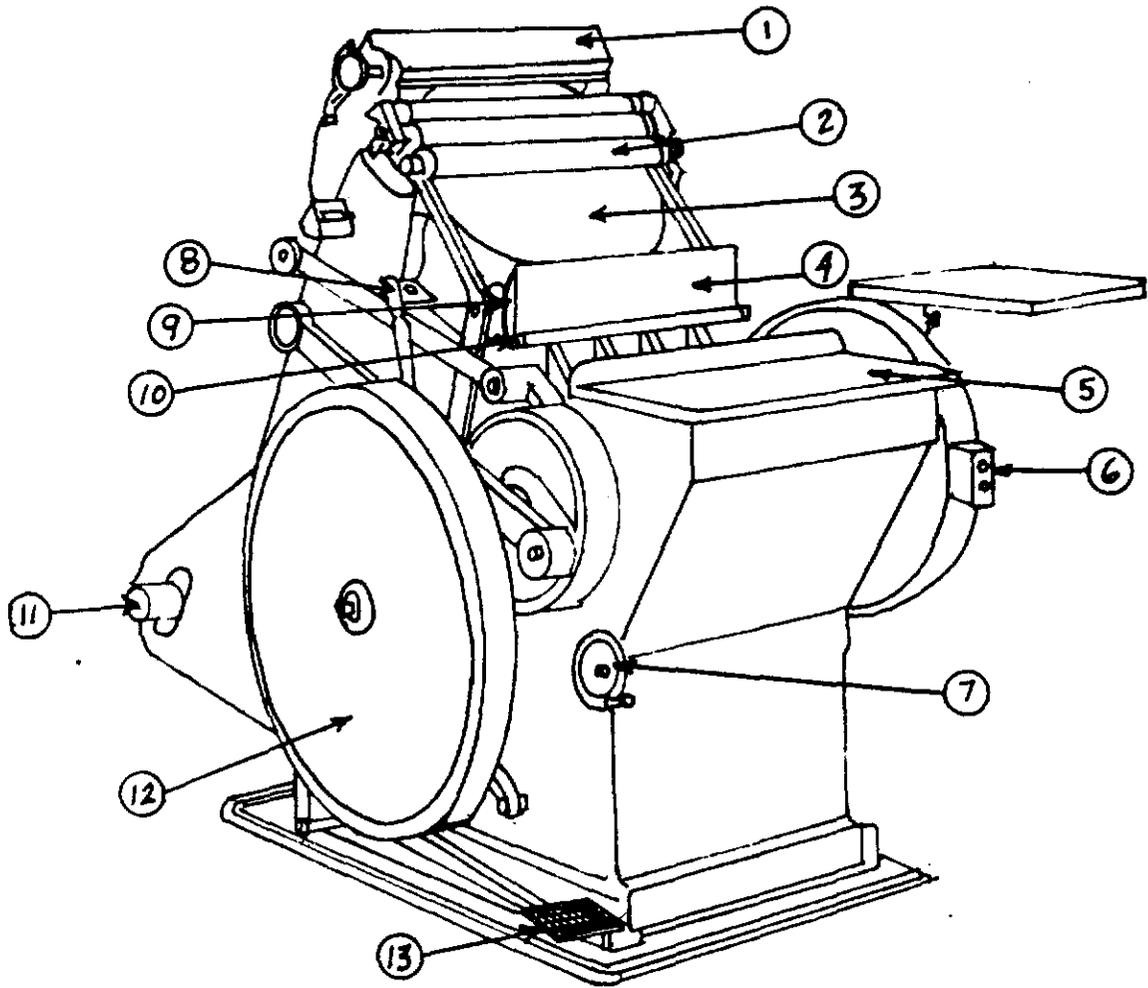


- |                   |                     |
|-------------------|---------------------|
| 1. INK FOUNTAIN   | 8. IMPRESSION LEVER |
| 2. INK ROLLERS    | 9. CHASE BED        |
| 3. INK DISK       | 10. PLATEN          |
| 4. PLATEN GUARD   | 11. MOTOR           |
| 5. DELIVERY BOARD | 12. FLY WHEEL       |
| 6. POWER SWITCH   | 13. BRAKE           |
| 7. SPEED CONTROL  |                     |

1. Operate the platen press only with the teacher's permission and after instructions have been received.
2. Make no adjustments while the machine is running.
3. Oil the press only when the power is turned off and the machine is at a dead stop.
4. Apply ink to the disk only when the press is at a dead stop.

5. Remove your hands at once when the press begins to close--even if the paper is not in straight. Use the throw-off lever to stop the machine before making any adjustments.
6. Never reach into or below the press while it is running.
7. Use the foot brake and turn off the machine if an emergency occurs.
8. Do not talk to the machine operator. This might distract his or her attention from the work and may contribute to an accident.
9. Do not operate the machine while the teacher is out of the room.
10. Never allow sleeves or ties to hang loosely while operating the press. Aprons should also be securely fastened, and extreme care must be taken so that they do not come in contact with moving parts.
11. Be certain the form is locked securely in the bed.
12. Make sure no one else is inside the operator's zone.
13. Set the speed of the press according to your ability to feed it.
14. Keep flammable solvents in fireproof containers, and store oily or dirty rags in proper containers.
15. Open ink cans carefully.
16. Do not lift heavy forms alone. Get help if it is needed.
17. Store heavy forms so they will not fall on someone's feet.
18. Avoid paper cuts by handling paper carefully.
19. Supply all roller-type printing machines with nip guards. (OSHA)

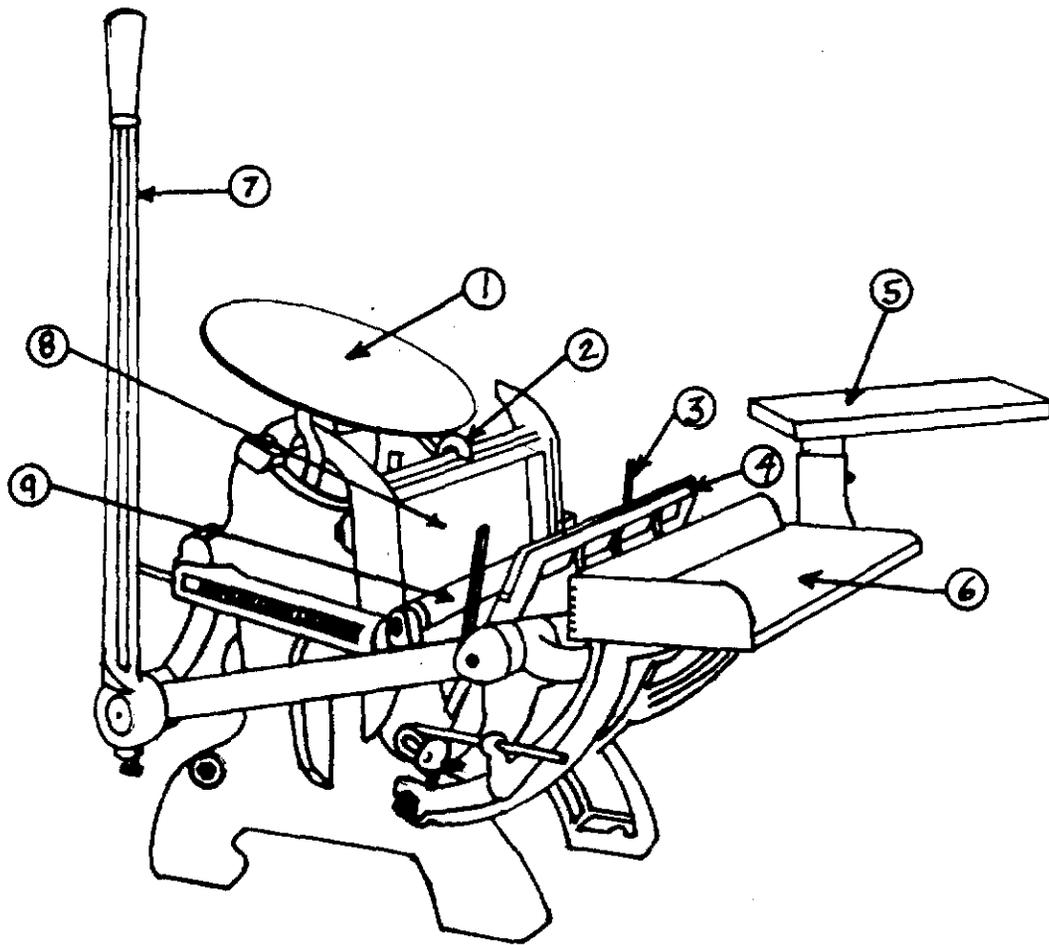
PLATEN PRESS  
(POWER-OPERATED)



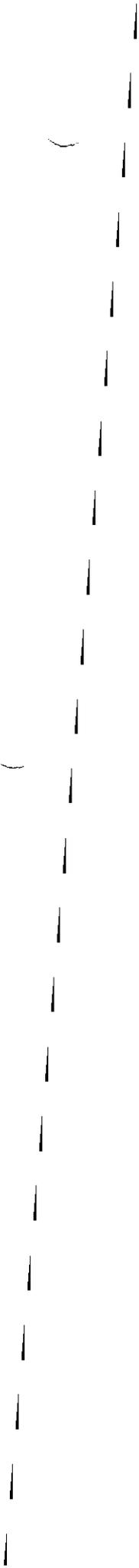
- |   |                |    |                  |
|---|----------------|----|------------------|
| 1 | INK FOUNTAIN   | 8  | IMPRESSION LEVER |
| 2 | INK ROLLERS    | 9  | CHASE BED        |
| 3 | INK DISK       | 10 | PLATEN           |
| 4 | PLATEN GUARD   | 11 | MOTOR            |
| 5 | DELIVERY BOARD | 12 | FLY WHEEL        |
| 6 | POWER SWITCH   | 13 | BRAKE            |
| 7 | SPEED CONTROL  |    |                  |



PLATEN PRESS  
(HAND LEVER-OPERATED)



- |   |                 |   |                      |
|---|-----------------|---|----------------------|
| 1 | INK DISK        | 6 | DELIVERY BOARD       |
| 2 | TOP CHASE CLAMP | 7 | HAND OPERATING LEVER |
| 3 | GRIPPER         | 8 | BED                  |
| 4 | PLATEN          | 9 | INK ROLLER           |
| 5 | FEED BOARD      |   |                      |



## PLATEN PRESS SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

### True-False:

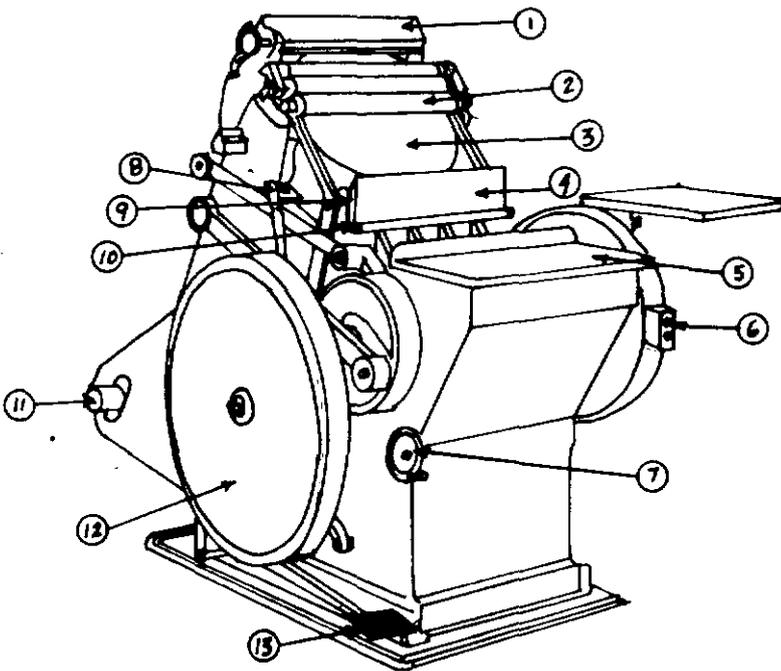
- T F 1. It is important to avoid talking to others when feeding the press.
- T F 2. It is safe to reach into or below the press if it is running slowly.
- T F 3. One should never wear loose or dangling clothing when working near a press.
- T F 4. Oily rags used for cleaning the press should be thrown in the wastebasket.

### Multiple Choice:

- \_\_\_\_\_ 5. The press should be oiled only when: (a) the power is off and the machine is at a dead stop, (b) the machine is running slowly, (c) it is noisy, (d) the ink rollers pass across the delivery board.
- \_\_\_\_\_ 6. It is best to ink the disk when the press is: (a) operating slowly, (b) operating fast, (c) at a dead stop, (d) coasting.
- \_\_\_\_\_ 7. The speed of the press should be decided by: (a) the amount of work to be done, (b) the amount of time needed to do the work, (c) the rate of the previous operator, (d) the present operator's ability to feed the press.
- \_\_\_\_\_ 8. Talking to someone operating the press is all right: (a) only when pertaining to shop problems, (b) when the teacher is in the shop, (c) if the operator is the shop foreman, (d) never.
- \_\_\_\_\_ 9. Use the platen press: (a) anytime the teacher is in the shop, (b) only after receiving the teacher's permission, (c) anytime you need to, (d) after watching others and learning how to operate it.

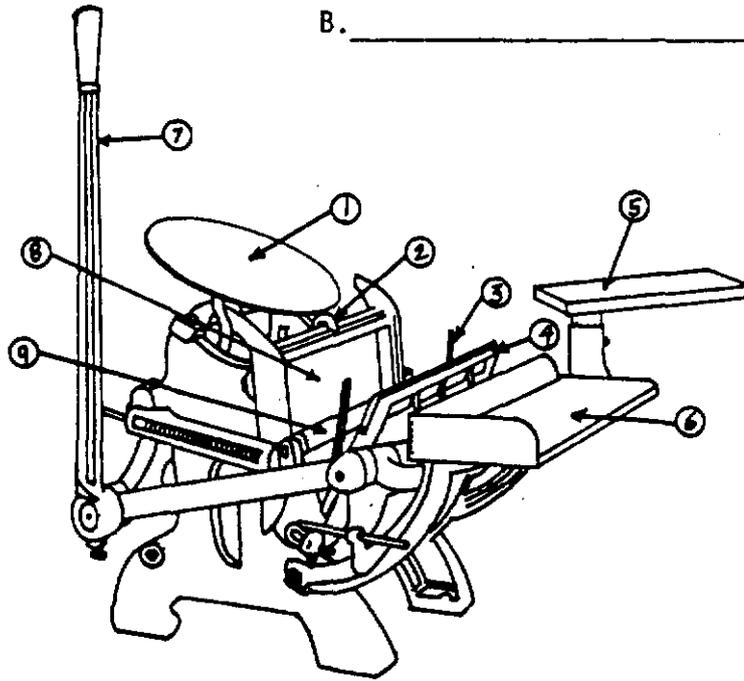
- \_\_\_\_\_ 10. If it is necessary to leave the press for only a moment: (a) it is safe to leave the machine running, (b) ask another pupil to operate it temporarily, (c) turn off the power and wait for the press to come to a complete stop, (d) leave it as soon as the switch has been flipped to the "off" position.
- \_\_\_\_\_ 11. If the type forms are quite heavy: (a) get someone to help, (b) show your independence by lifting it alone, (c) take a chance that it won't be dropped, (d) do none of these.
- \_\_\_\_\_ 12. Before adjusting misfed stock: (a) use the throw-off lever and wait for the platen to stop, (b) slow the machine down, then reach in quickly and adjust it, (c) reach in quickly when the platen opens, (d) do none of these.
- \_\_\_\_\_ 13. Handle paper by the edges whenever possible: (a) to keep it clean, (b) to avoid paper cuts, (c) because it's easier, (d) none of these.
- \_\_\_\_\_ 14. Write the correct name of each machine and its parts in the space provided.

A. \_\_\_\_\_

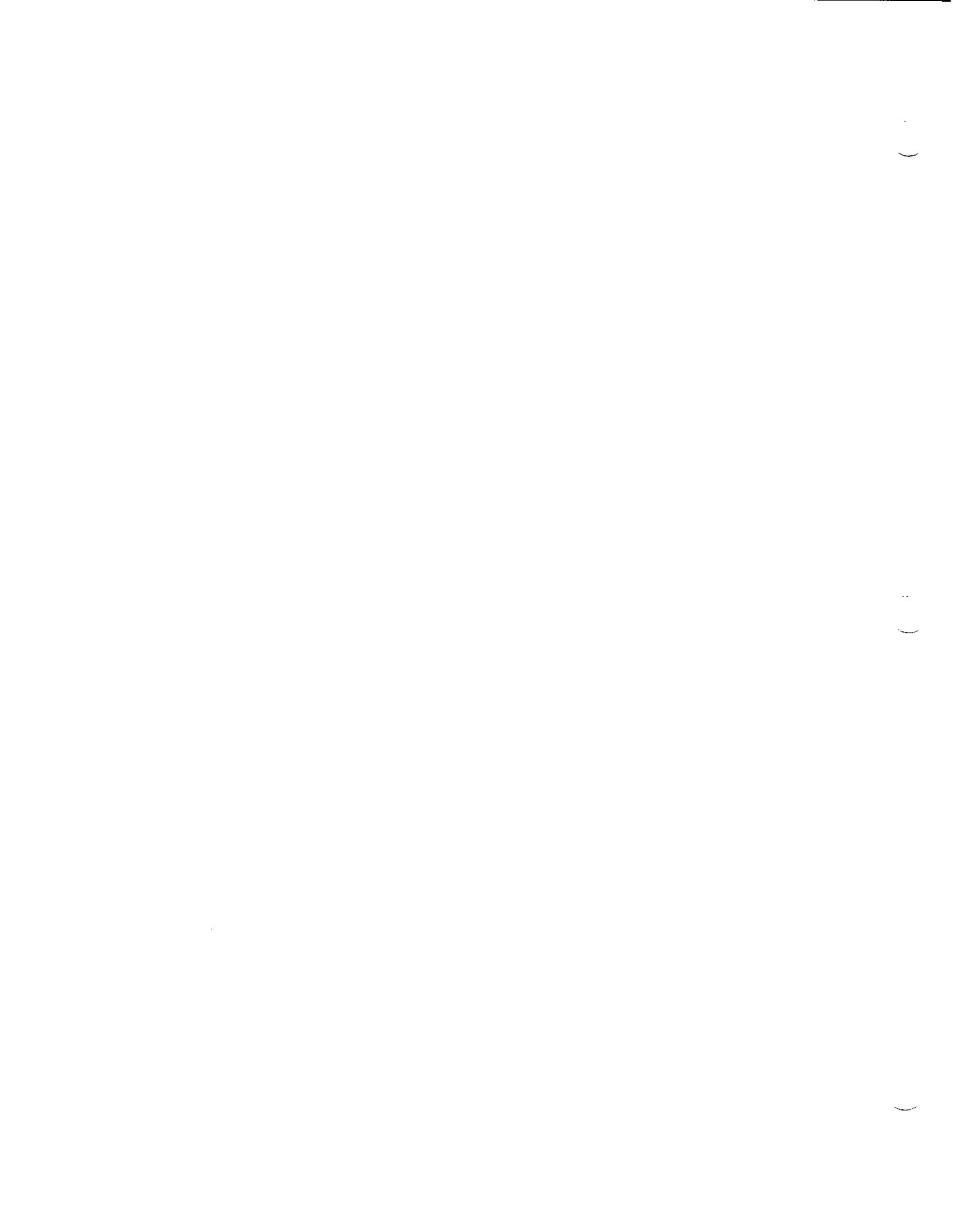


1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_
13. \_\_\_\_\_

B. \_\_\_\_\_

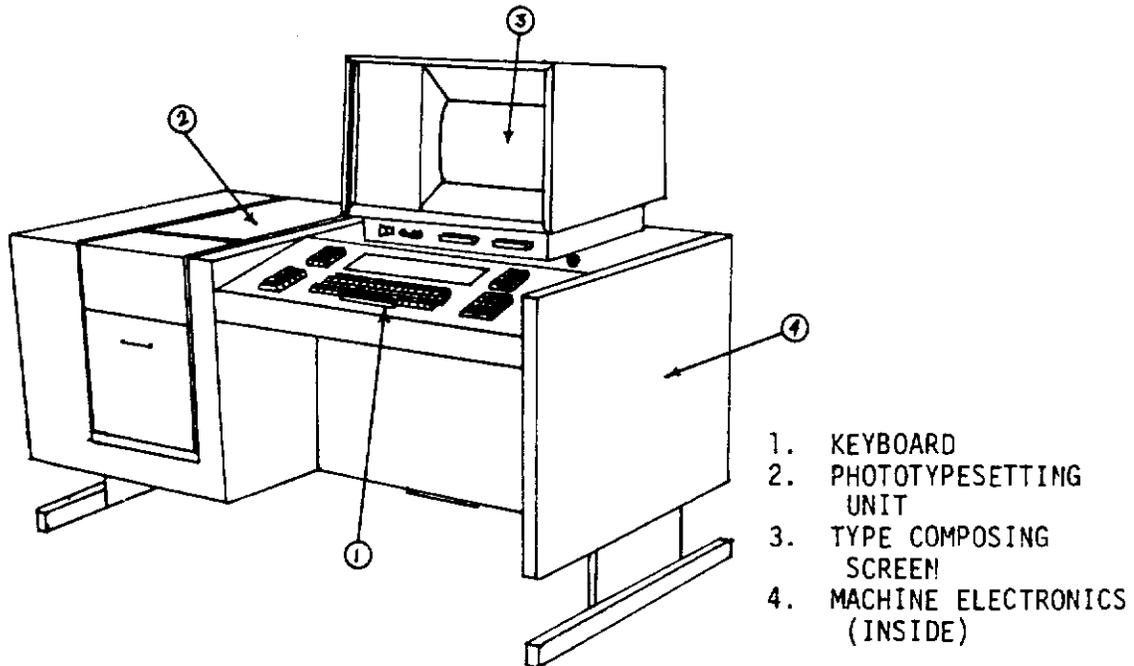


1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_



## OFFSET COMPOSITION

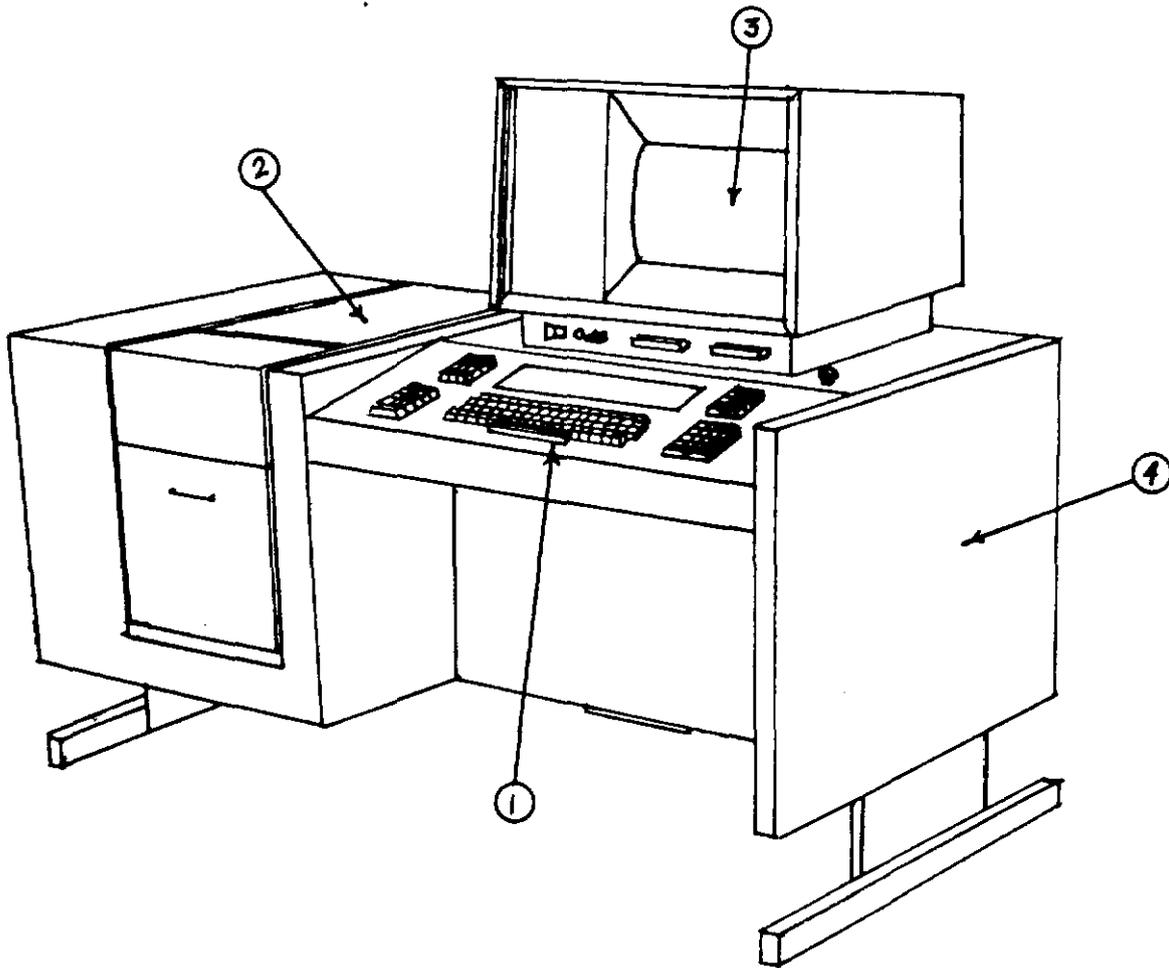
### PHOTOTYPESETTER/COMPOSER



1. Operate the composer only after the proper instruction and after receiving the teacher's permission.
2. Advise the teacher of any machine malfunction; do not attempt repairs.
3. Do not remove the protective cover of a composing machine and reach inside. These machines may have high voltage circuits inside them.
4. Use extreme care when handling type fonts as dropping them will cause breakage or scratching.
5. When mixing chemicals for the machine processor, avoid letting them come into contact with your skin. Wear safety glasses to prevent chemicals splashing in your eyes.
6. Always wash your hands after processing photo paper.
7. Avoid inhaling chemical dust or fumes when working with processing chemicals.
8. Unplug the machine before reaching into it to clear up any paper jams.



# PHOTOTYPESETTER

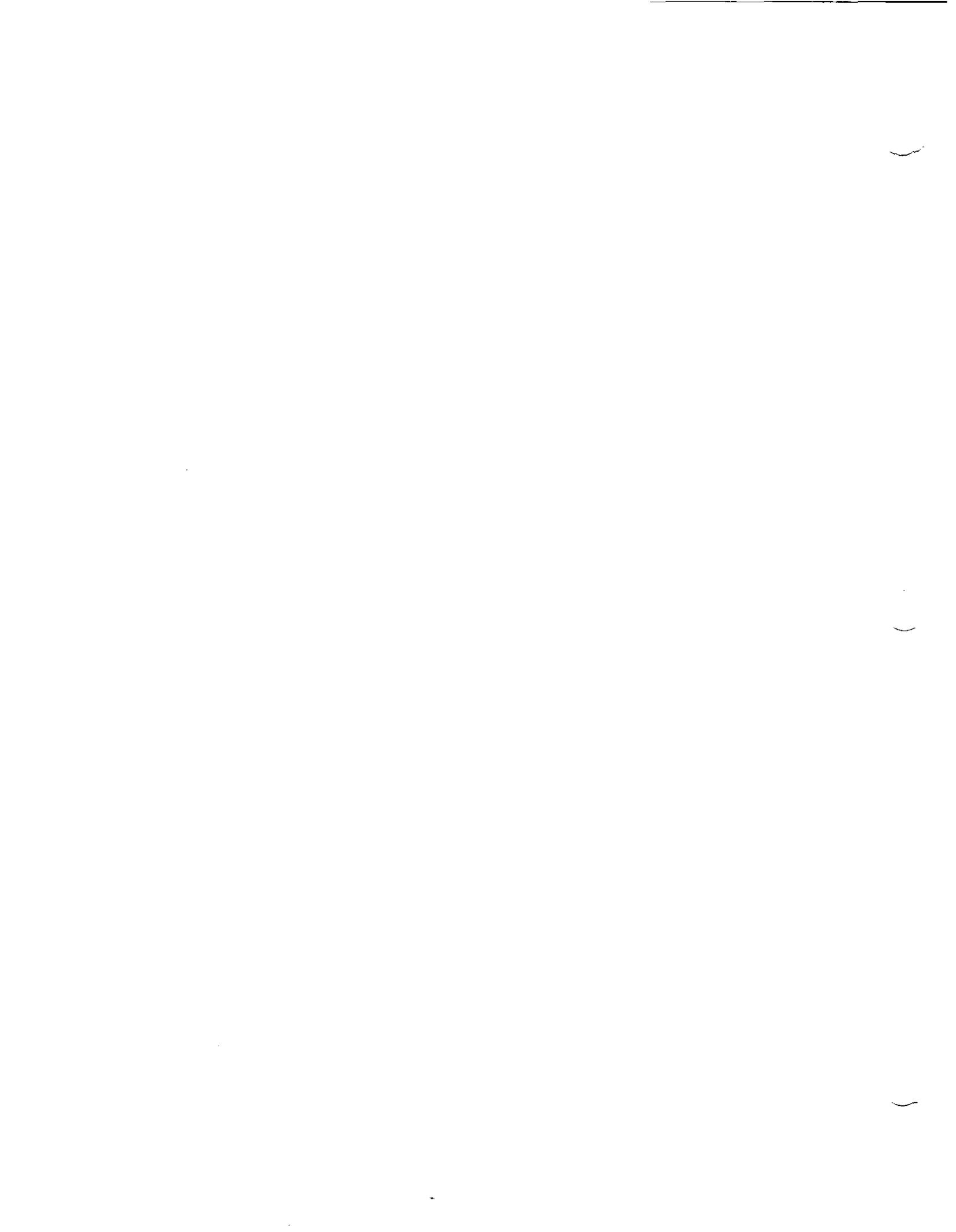


1 KEYBOARD

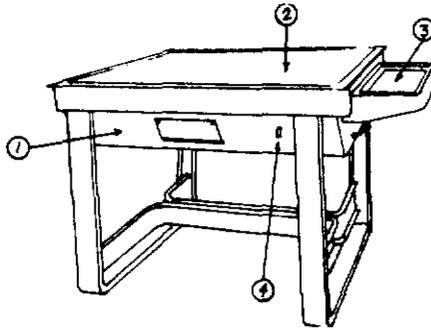
2 PHOTOSSETTING UNIT

3 TYPE COMPOSING SCREEN

4 MACHINE ELECTRONICS  
(INSIDE)



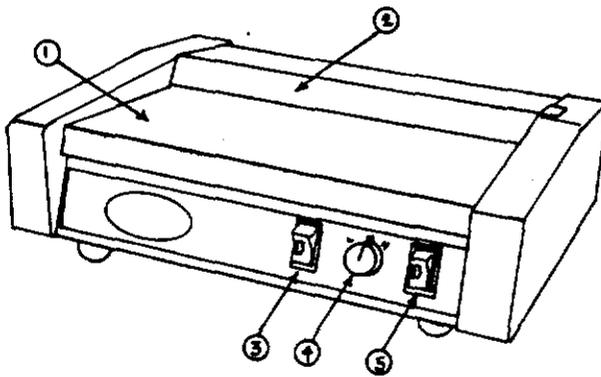
## LIGHT TABLE



1. LIGHT HOUSING
2. GLASS TOP
3. STORAGE SHELF
4. LIGHT SWITCH

1. Keep all foreign material off the glass.
2. Keep fingers out of the cutting area when cutting a flat.
3. Store the cutting tools, X-acto knives, and razor blades properly and keep them sharp.
4. Do not lean, sit, or drop anything on a glass-top light table. Use extreme care when cleaning it.

## WAXER



1. WAX TRAY COVER
2. WAX ROLLER UNDER GUARD
3. POWER SWITCH
4. THERMOSTAT
5. WAX ROLLER SWITCH

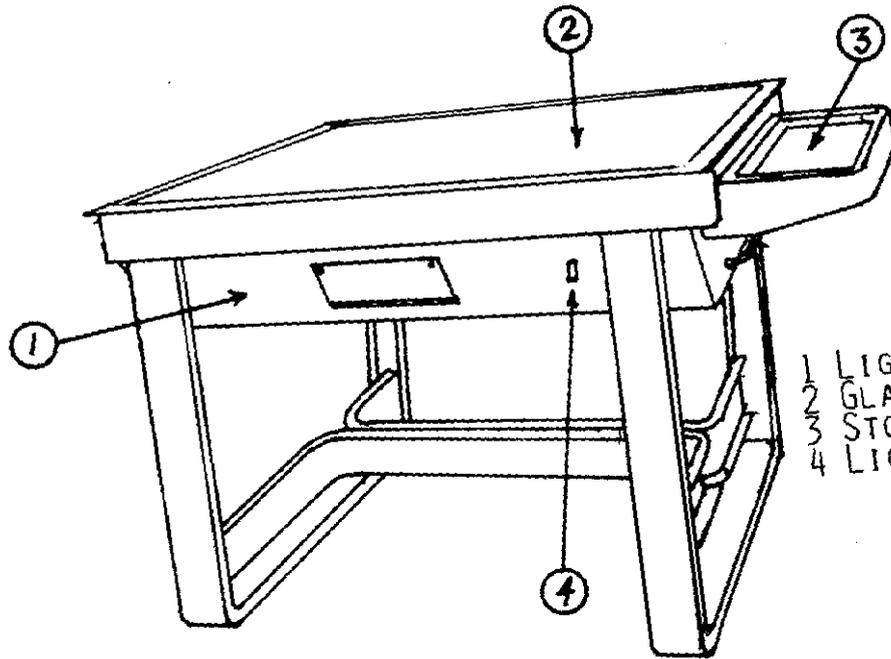
1. To avoid burns, be careful not to touch the hot parts of a waxer. Do not move the waxer as this may spill the hot wax.
2. Always add wax to the waxer before turning it on.

1

2

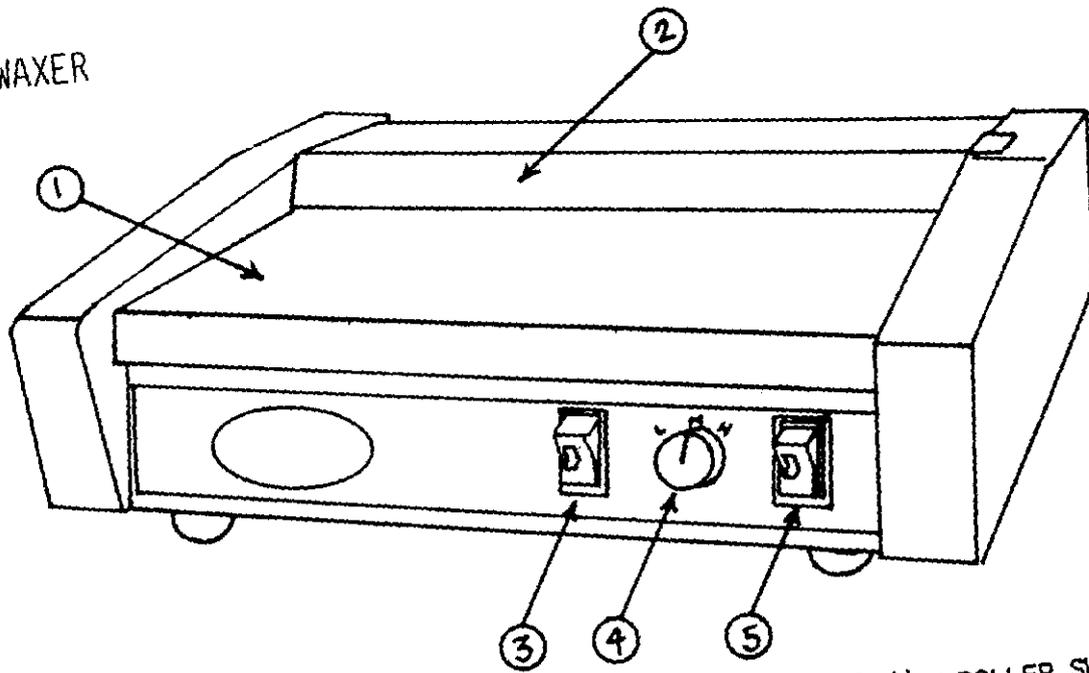
3

# LIGHT TABLE

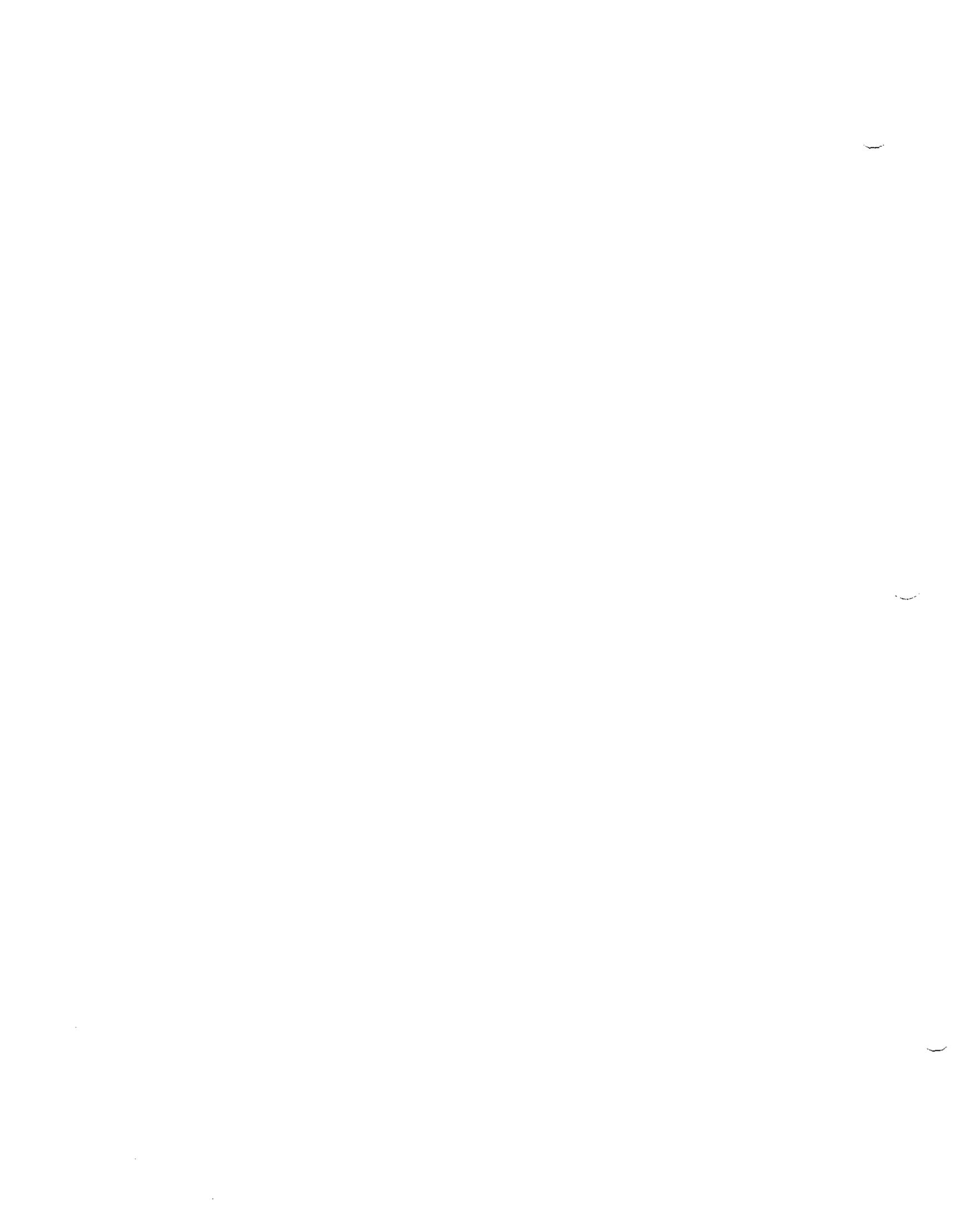


- 1 LIGHT HOUSING
- 2 GLASS TOP
- 3 STORAGE SHELF
- 4 LIGHT SWITCH

# WAXER



- 1 WAX TRAY COVER
- 2 WAX ROLLER UNDER GUARD
- 3 POWER SWITCH
- 4 THERMOSTAT
- 5 WAX ROLLER SWITCH



## OFFSET COMPOSITION SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

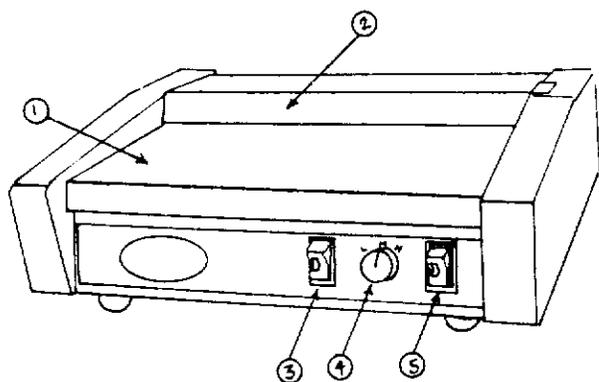
### True-False:

- T F 1. Chemicals for the machine processor are not dangerous, so no special precaution needs to be taken when using them.
- T F 2. The composer should be unplugged before reaching into it to clear up paper jams.
- T F 3. It is safe to lean or sit on light tables and stripping tables because they have unbreakable glass tops.
- T F 4. It is safer to use a dull cutting tool than a sharp one.
- T F 5. Hands should be washed after processing photo paper.
- T F 6. A waxer has no moving parts, so ties and other dangling clothing can be worn safely.

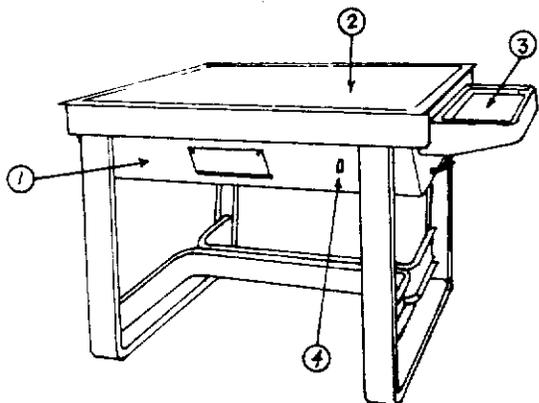
### Multiple Choice:

- \_\_\_\_\_ 7. If the composer malfunctions, do not attempt repairs unless: (a) the teacher gives permission, (b) you know what you are doing, (c) another pupil helps you, (d) a project deadline must be met.
- \_\_\_\_\_ 8. Cutting tools, X-acto knives, and razor blades should never be: (a) dull, (b) carried in the pocket, (c) left on the light table after use, (d) all of these.
- \_\_\_\_\_ 9. When mixing chemicals for the composer processor: (a) avoid skin contact, (b) wear safety glasses, (c) avoid inhaling fumes, (d) do all of these.
- \_\_\_\_\_ 10. Add wax to the waxer: (a) before turning it on, (b) after the machine warms up, (c) anytime it is needed, (d) none of these.
- \_\_\_\_\_ 11. To avoid burns: (a) be very careful when using the waxer, (b) do not move the waxer unless the wax is cool, (c) both of these, (d) neither a nor b--melted wax is not hot enough to burn a person.

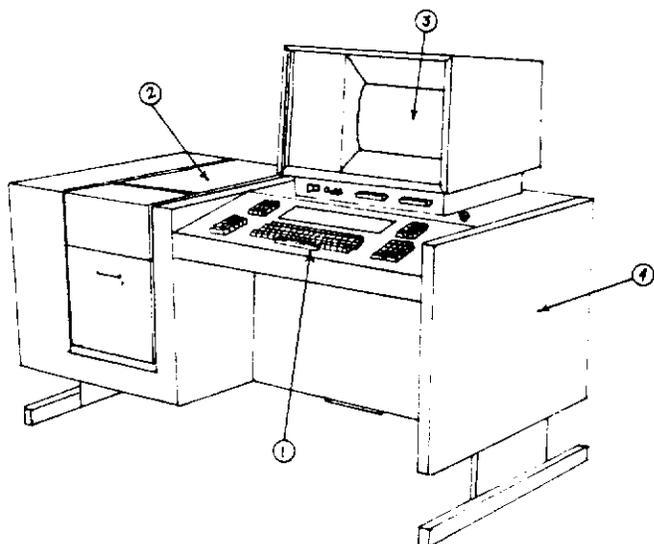
12. Write the correct name of each machine and its parts in the space provided.



- A. \_\_\_\_\_  
 1. \_\_\_\_\_  
 2. \_\_\_\_\_  
 3. \_\_\_\_\_  
 4. \_\_\_\_\_  
 5. \_\_\_\_\_



- B. \_\_\_\_\_  
 1. \_\_\_\_\_  
 2. \_\_\_\_\_  
 3. \_\_\_\_\_  
 4. \_\_\_\_\_

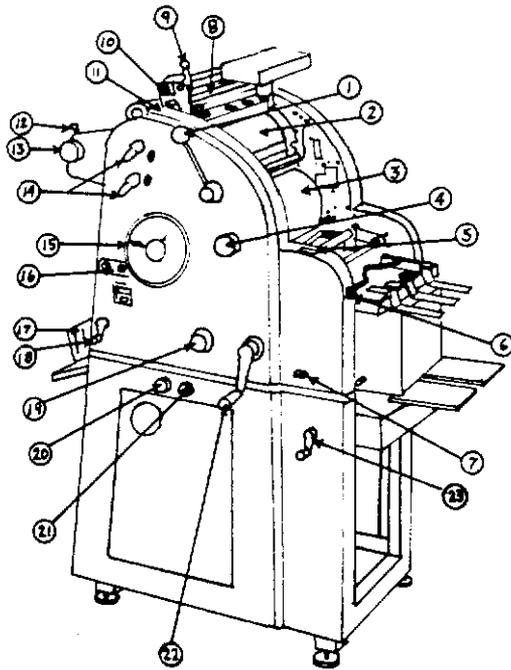


- C. \_\_\_\_\_  
 1. \_\_\_\_\_  
 2. \_\_\_\_\_  
 3. \_\_\_\_\_  
 4. \_\_\_\_\_

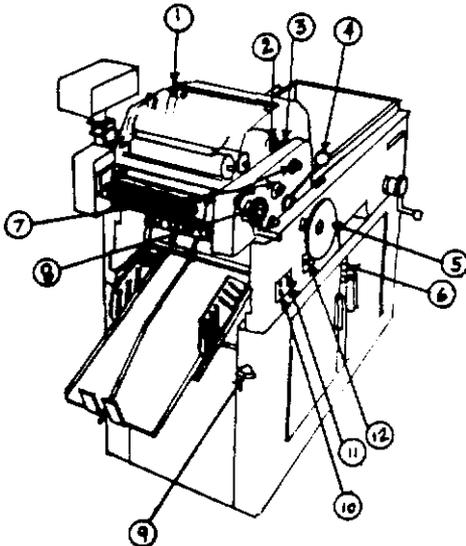
## OFFSET PRESS

1. Operate only with the teacher's permission and after instructions have been received.
2. Stop the press before adjusting, cleaning (except when cleaner attachment is being used), oiling, and clearing of jams.
3. Do not reach over the press during operation. Avoid retrieving misfed sheets while the press is in operation.
4. Watch for malfunctions on the press. If a malfunction is observed, the press should be shut down and the teacher informed before continuing work. Do not attempt any repairs.
5. Operate the press only at the speed designated by the teacher.
6. Use caution when cleaning a moving press. Keep the hands away from grippers and moving rollers.
7. Do not use any tools on the press without the teacher's permission.
8. Be sure clothing is safe for press work. Remove or fasten any loose clothing, neckties, or jewelry. Roll loose sleeves to the elbows.
9. Fasten hair securely or wear a protective hair cover if the hairstyle presents a potential hazard.
10. Keep the floor around the press clear and clean at all times. Wipe up or pick up any spilled oil, ink, water, or paper.
11. Avoid any unnecessary conversation when operating the press.
12. Beware of rollers and gears. Keep the covers and guards in place at all times.
13. Do not leave the press while it is in operation.
14. Keep solvents in fireproof containers and return dirty rags to the proper container after use.
15. Supply all roller-type printing machines with nip guards. (OSHA)

## OFFSET PRESS



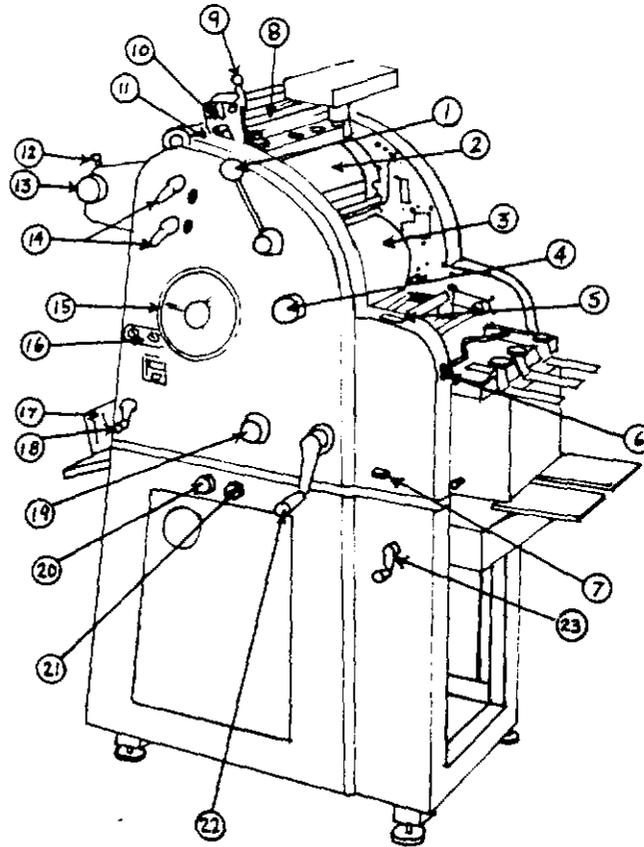
1. OPERATION CONTROL LEVER
2. MASTER CYLINDER
3. BLANKET CYLINDER
4. VERTICAL COPY ADJUSTING LOCK
5. COPY COUNTER
6. PAPER FEED LEVER
7. TABLE RELEASE
8. FOUNTAIN SOLUTION TROUGH
9. AQUAMATIC NIGHT LATCH HANDLE
10. AQUAMATIC CONTROL
11. AQUAMATIC LOCK-OUT LATCH
12. INK FOUNTAIN CONTROL
13. INK FOUNTAIN ROLLER KNOB
14. FORM ROLLER CONTROL LEVERS
15. HAND WHEEL
16. MOTOR DRIVE AND VACUUM PUMP SWITCHES
17. RECEIVING TRAY
18. SPEED CONTROL
19. BUCKLE CONTROL
20. AIR CONTROL
21. VACUUM CONTROL
22. PAPER ELEVATOR CRANK
23. PAPER GUIDE CRANK



1. REPELEX CONTROLS
2. REPELEX FOUNTAIN ROLLER KNOB
3. REPELEX FORM ROLLER CONTROL KNOB
4. SINGLE LEVER CONTROL
5. HANDWHEEL
6. VACUUM AND BLOWER CONTROLS
7. INK FORM ROLLER CONTROL KNOBS
8. INK FOUNTAIN ROLLER KNOB
9. SPEED CONTROL
10. MACHINE SWITCH
11. VACUUM FEEDER SWITCH
12. IMPRESSION ADJUSTMENT

## OFFSET PRESS

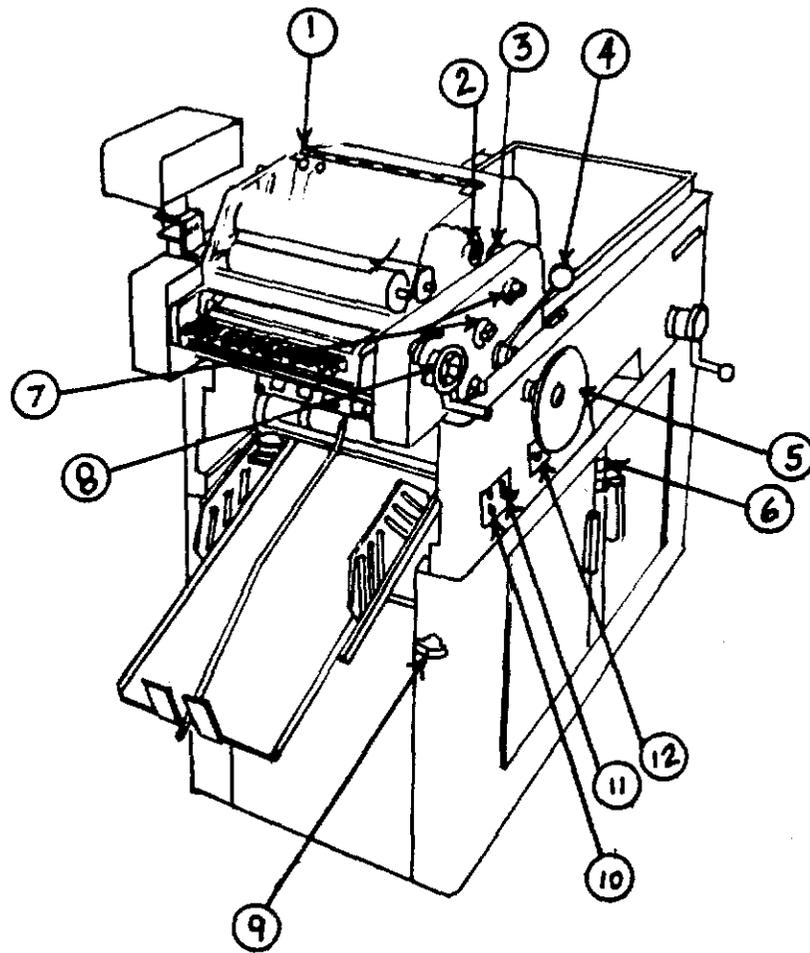
- 1 OPERATION CONTROL LEVER
- 2 MASTER CYLINDER
- 3 BLANKET CYLINDER
- 4 VERTICAL COPY ADJUSTING LOCK
- 5 COPY COUNTER
- 6 PAPER FEED LEVER
- 7 TABLE RELEASE
- 8 FOUNTAIN SOLUTION TROUGH
- 9 AQUAMATIC NIGHT LATCH HANDLE
- 10 AQUAMATIC CONTROL
- 11 AQUAMATIC LOCK-OUT LATCH
- 12 INK FOUNTAIN CONTROL
- 13 INK FOUNTAIN ROLLER KNOB
- 14 FORM ROLLER CONTROL LEVERS
- 15 HAND WHEEL
- 16 MOTOR DRIVE AND VACUUM PUMP SWITCHES
- 17 RECEIVING TRAY
- 18 SPEED CONTROL
- 19 BUCKLE CONTROL
- 20 AIR CONTROL



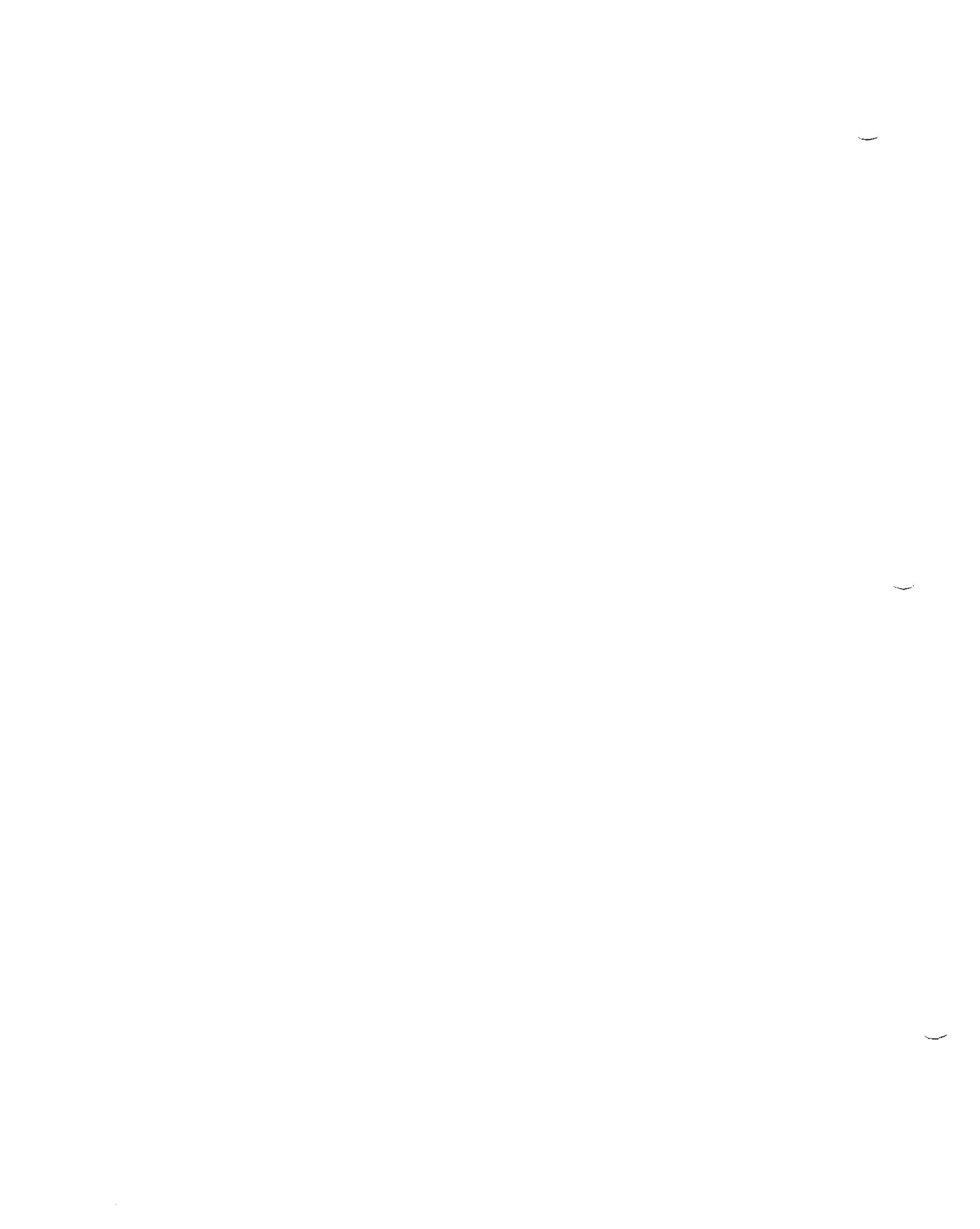
- 21 VACUUM CONTROL
- 22 PAPER ELEVATOR CRANK
- 23 PAPER GUIDE CRANK



## OFFSET PRESS



- |                                    |                                 |
|------------------------------------|---------------------------------|
| 1 REPELEX CONTROLS                 | 6 VACUUM AND BLOWER CONTROLS    |
| 2 REPELEX FOUNTAIN ROLLER KNOB     | 7 INK FORM ROLLER CONTROL KNOBS |
| 3 REPELEX FORM ROLLER CONTROL KNOB | 8 INK FOUNTAIN ROLLER KNOB      |
| 4 SINGLE LEVER CONTROL             | 9 SPEED CONTROL                 |
| 5 HANDWHEEL                        | 10 MACHINE SWITCH               |
|                                    | 11 VACUUM FEEDER SWITCH         |
|                                    | 12 IMPRESSION ADJUSTMENT        |



## OFFSET PRESS SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

### True-False:

- T F 1. It is safe to reach carefully across the press when it is operating.
- T F 2. Pupils are not to use any tools on the press without the teacher's permission.
- T F 3. Final adjustments may be made while the press is running slowly.
- T F 4. Loose or dangling clothing should not be worn when one is working around the press.
- T F 5. Talking with others while running the press is allowed if the operator keeps his/her mind on what he/she is doing.
- T F 6. Gears need not be covered while the press is in operation if the operator is careful.
- T F 7. It is all right to leave the press while it is running if you return to it immediately.

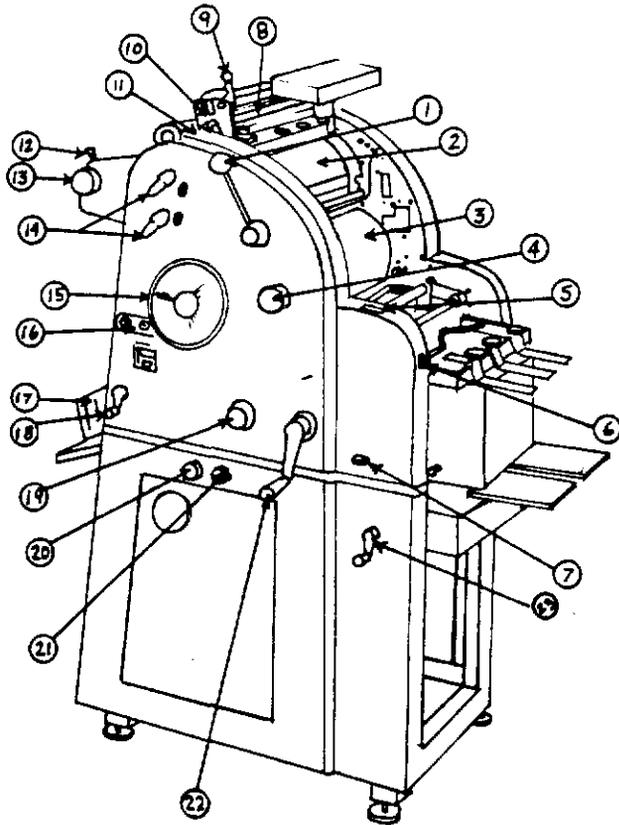
### Multiple Choice:

- \_\_\_\_\_ 8. Before operating the offset press, one should: (a) get the teacher's permission, (b) place all guards in position, (c) have received instruction on how to operate it, (d) have done all of these.
- \_\_\_\_\_ 9. Oily rags should always be placed: (a) in the wastebasket, (b) in the scrap box, (c) in a metal self-closing can, (d) where the next person can find them.
- \_\_\_\_\_ 10. Scraps, paper, and other litter: (a) may be left on the floor to be swept up later, (b) should be disposed of in the wastebasket, (c) can be ignored because they do not cause a safety hazard, (d) none of these.

11. Before operating the offset press, one should: (a) tuck in loose clothing, (b) remove rings, watches, and other jewelry, (c) roll up long sleeves, (d) do all of these.

12. Write the correct name of each machine and its parts in the space provided.

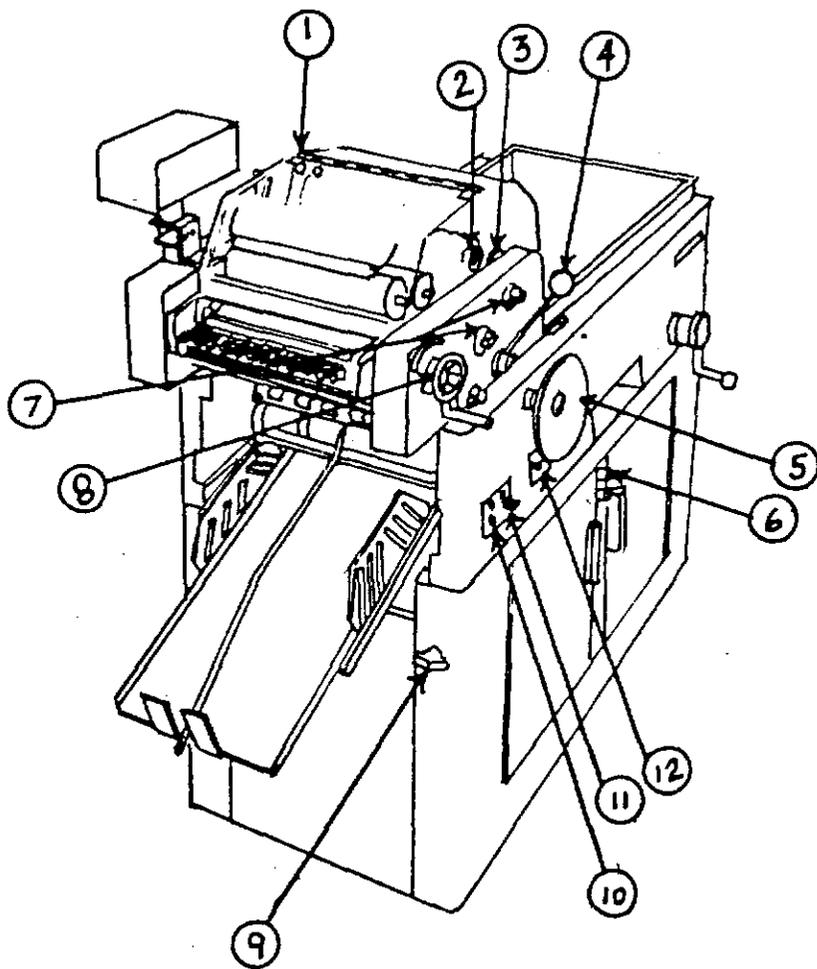
A. \_\_\_\_\_



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_
- 10. \_\_\_\_\_
- 11. \_\_\_\_\_
- 12. \_\_\_\_\_

- 13. \_\_\_\_\_
- 14. \_\_\_\_\_
- 15. \_\_\_\_\_
- 16. \_\_\_\_\_
- 17. \_\_\_\_\_
- 18. \_\_\_\_\_

- 19. \_\_\_\_\_
- 20. \_\_\_\_\_
- 21. \_\_\_\_\_
- 22. \_\_\_\_\_
- 23. \_\_\_\_\_

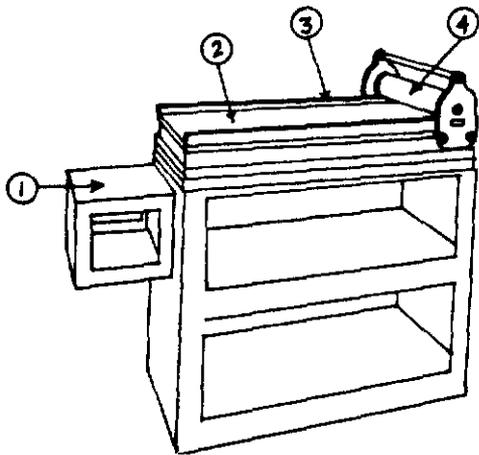


B. \_\_\_\_\_

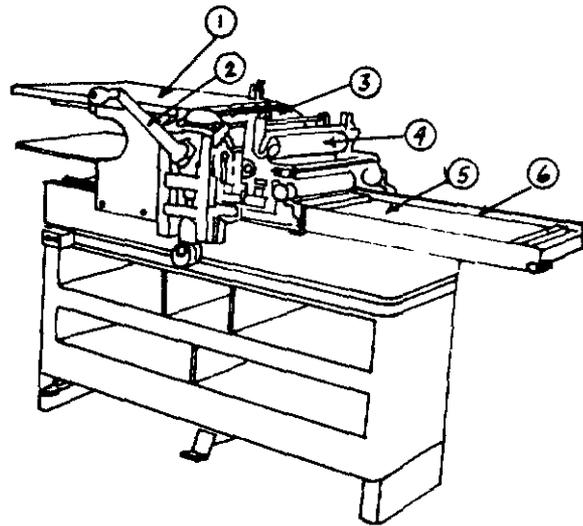
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_



## PROOF PRESSES



1. INK DISK
2. BED
3. TRACK
4. IMPRESSION CYLINDER

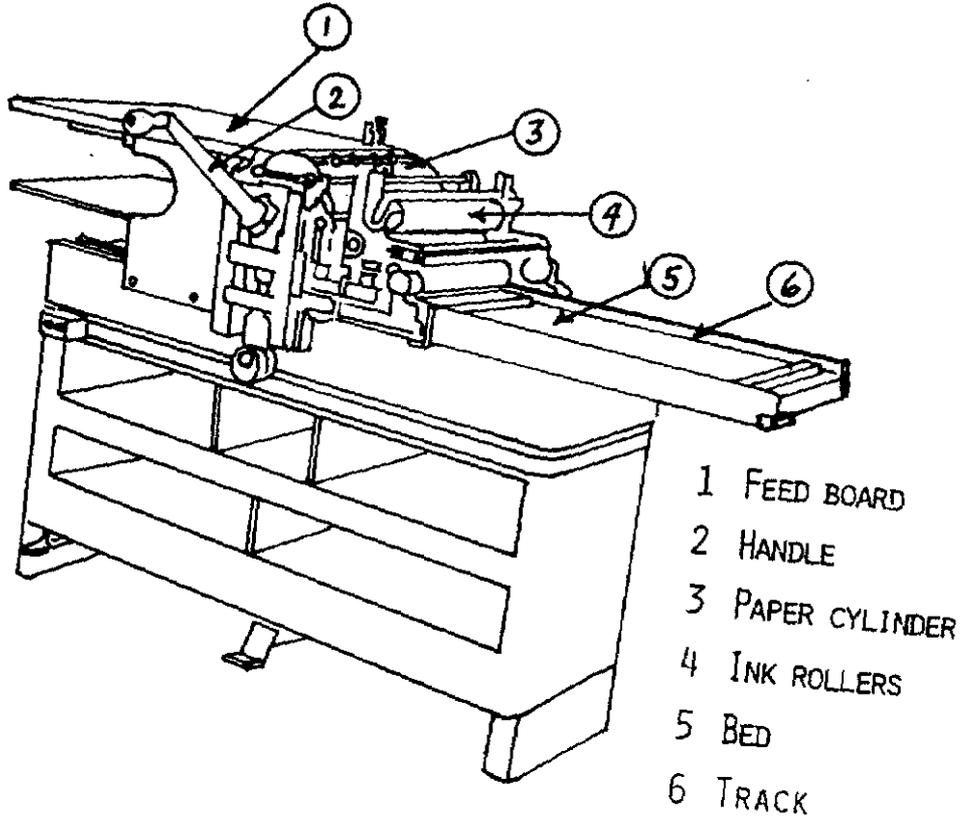
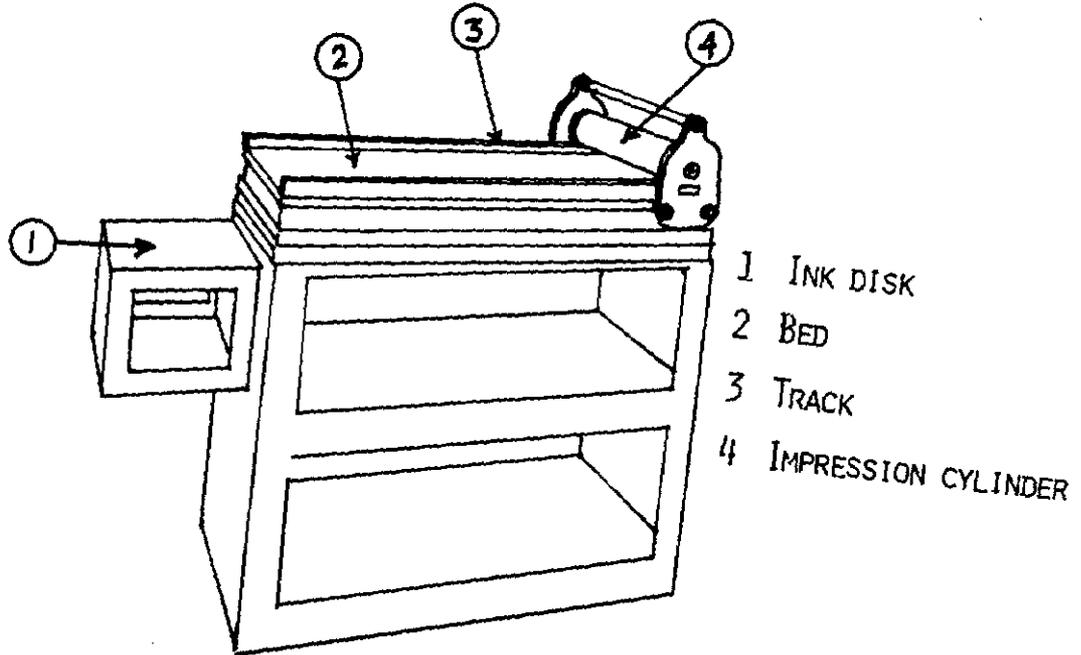


- |                    |                |
|--------------------|----------------|
| 1. FEED BOARD      | 4. INK ROLLERS |
| 2. HANDLE          | 5. BED         |
| 3. PAPER CYLINDERS | 6. TRACK       |

1. Operate only with the teacher's permission and after instructions have been received.
2. Only one student is allowed to operate the proof press at any one time.
3. Keep your hands off the track.
4. Leave the handle in an upright position when it's not in use.
5. Clean type after proofing.
6. After the type is cleaned, return the cleaning rags to the fireproof metal rag container and leave the area clean.
7. Treat type cleaner with care. It is flammable, poisonous, and hard on the skin.
8. Before using the proof press, secure loose clothing and long hair to prevent its being pulled into the press.
9. Do not use tweezers with an attached bodkin. Bodkins are sharp and can cause injury.
10. Pick up type or other objects that fall on the floor. Even small items can cause one to slip and fall.



PROOF PRESSES





## PROOF PRESSES SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

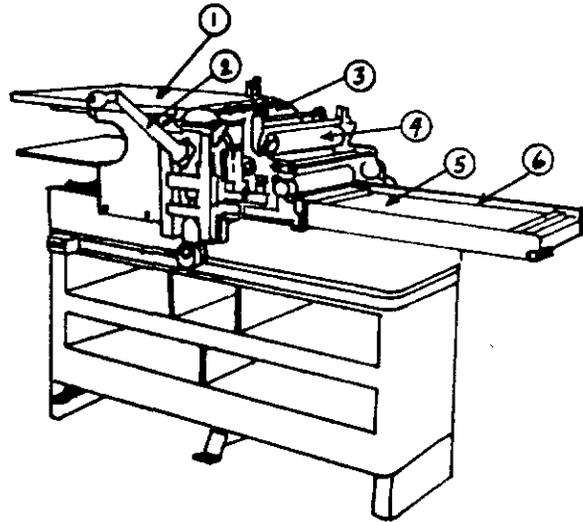
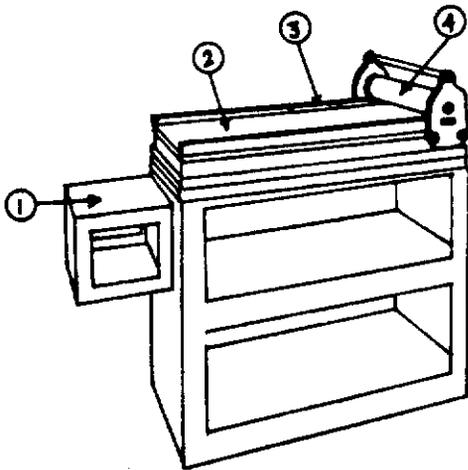
### True-False:

- T F 1. Type cleaner is both flammable and poisonous.
- T F 2. If any type falls on the floor while you are using the proof press, leave it there until the work is finished, then pick it up.
- T F 3. Loose clothing doesn't need to be tucked in before using the proof press because the press will not catch clothing.

### Multiple Choice:

- \_\_\_\_\_ 4. When not in use, the handle of the proof press should be left: (a) upright, (b) down, (c) down and locked, (d) any way at all.
- \_\_\_\_\_ 5. After cleaning type, dirty rags should be: (a) rolled in a tight bundle, (b) thrown in a wastebasket, (c) placed in a covered metal container, (d) left on the press for the next person to use.
- \_\_\_\_\_ 6. During the operation of the proof press, the following persons may be involved: (a) one person only, (b) the operator plus a helper chosen by the operator, (c) the operator, helper, and one other pupil observer, (d) any number of people, as long as they don't distract the operator.
- \_\_\_\_\_ 7. When using the proof press, the pupil should protect his/her hands by: (a) handling the brayer correctly, (b) moving the roller quickly, (c) asking another pupil to operate the roller, (d) keeping them clear of the ends of the press and the track.

8. Write the correct name of the machines and each part in the spaces provided.



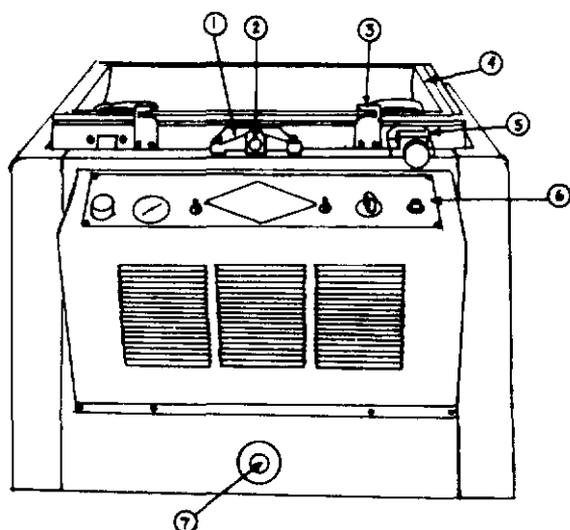
A. \_\_\_\_\_

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_

B. \_\_\_\_\_

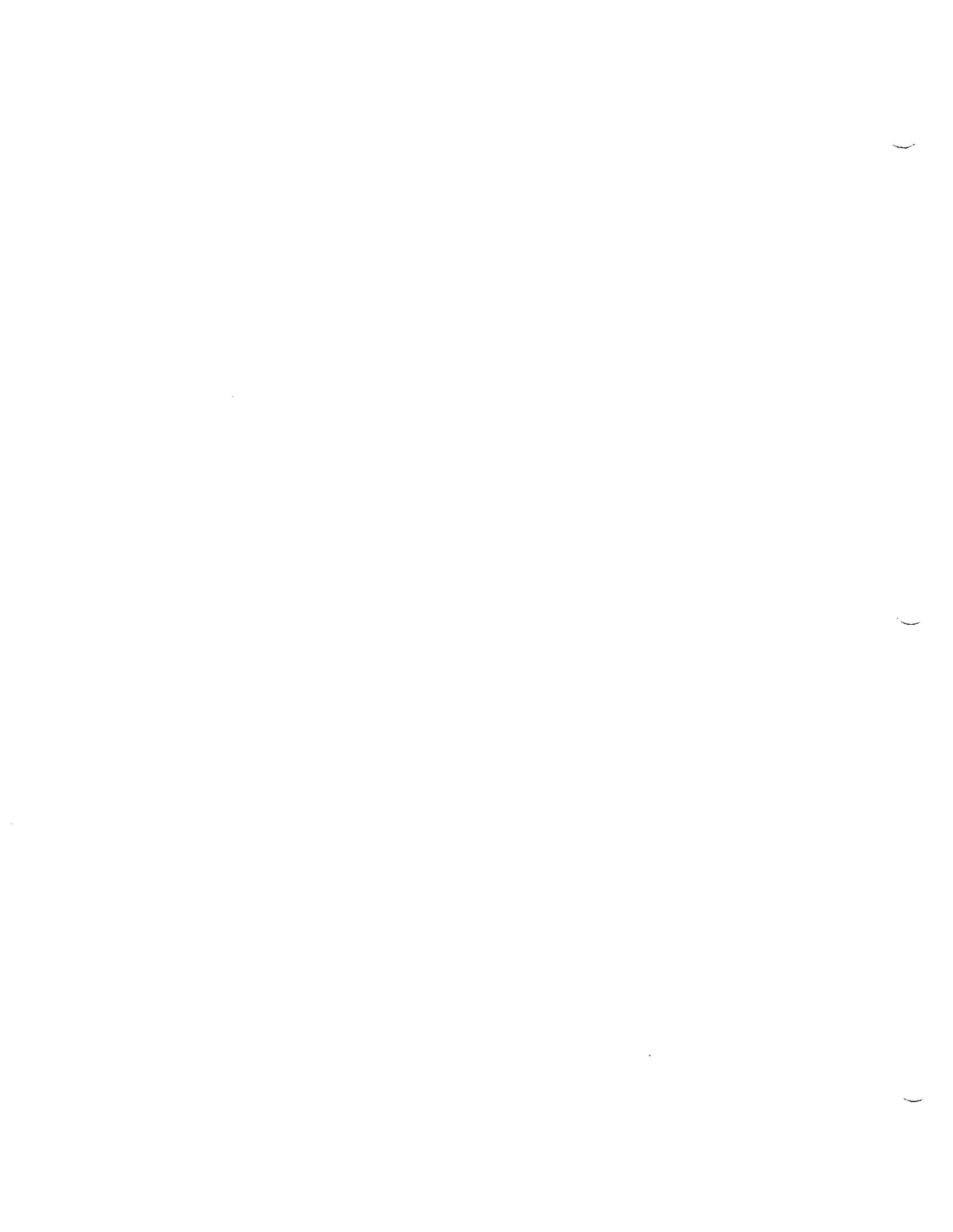
- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_

## PLATEMAKER

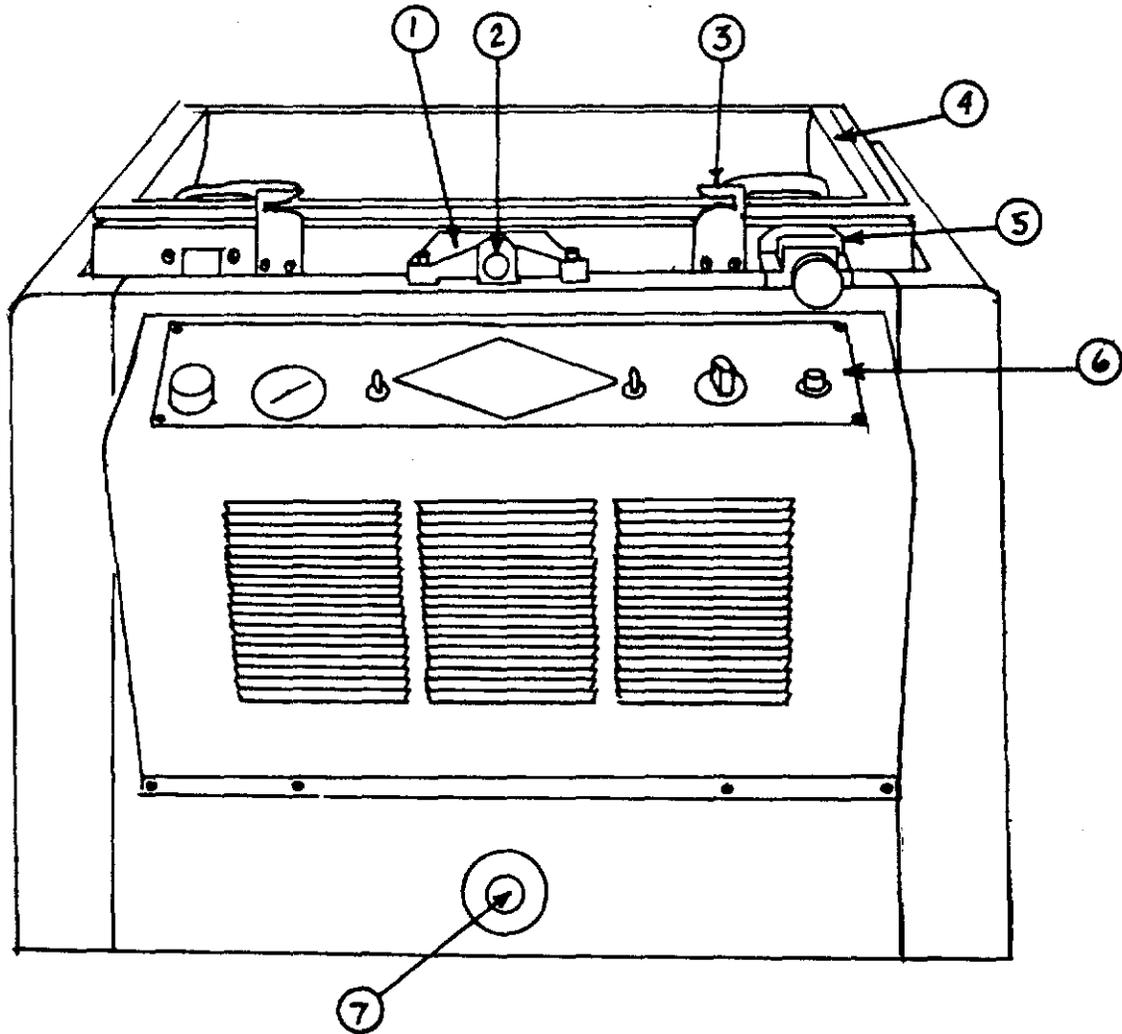


1. AXLE BEARING
2. AXLE
3. GLASS FRAME LATCH
4. VACUUM FRAME ASSEMBLY
5. VACUUM FRAME LATCH
6. CONTROL PANEL
7. ARC CONTROL

1. Operate only with the teacher's permission and after instructions have been received.
2. Do not look into the light which is used for exposing the plates. Ultraviolet light can be harmful to the eyes.
3. Persons wearing contact lenses must be especially careful not to look at the light as this may cause the lens to weld itself to the eye.
4. Do not turn on the light unless the vacuum frame is locked down.
5. Do not touch the photo carbons or light bulbs. They can become very hot.
6. Disconnect the platemaker before changing the carbons or making adjustments. Be careful of hot carbons.
7. Be careful not to break the glass of the vacuum frame. To avoid this, be sure the vacuum is drained before lifting the glass lid.
8. Be sure the exhaust fan is working and the plate area is properly vented.
9. Handle thin metal plates with care. They are sharp.
10. Avoid inhaling fumes from the chemicals used to develop plates. Use all the chemicals in a well-ventilated place.



# PLATEMAKER



1 AXLE BEARING

2 AXLE

3 GLASS FRAME LATCH

4 VACUUM FRAME ASSEMBLY

5 VACUUM FRAME LATCH

6 CONTROL PANEL

7 ARC CONTROL



## PLATEMAKER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

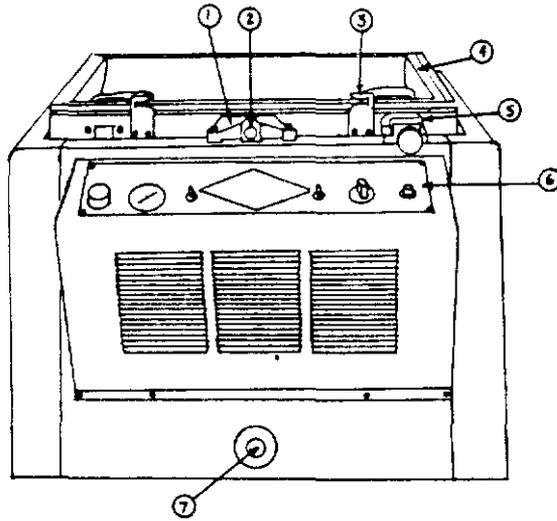
### True-False:

- T F 1. The platemaker should be disconnected before changing the carbons or making adjustments.
- T F 2. Never look into the light used for exposing the plate because it may be harmful to the eyes.
- T F 3. The light may be turned on before locking down the vacuum frame.
- T F 4. Metal plates are thin and sharp and should be handled with care.

### Multiple Choice:

- \_\_\_\_\_ 5. Do not touch photo carbons because: (a) they may break, (b) they may be hot, (c) one may get fingerprints on them, (d) they may be dirty.
- \_\_\_\_\_ 6. Be especially careful not to look at the platemaker light if wearing: (a) contact lenses, (b) sunglasses, (c) eye-glasses, (d) safety goggles.
- \_\_\_\_\_ 7. To avoid breaking the glass of the vacuum frame, don't raise the lid before you: (a) drain the vacuum, (b) turn off the light, (c) disconnect the platemaker, (d) do all of these.

8. Write the correct name of each part of the machine in the space provided.



A. \_\_\_\_\_

1. \_\_\_\_\_

5. \_\_\_\_\_

2. \_\_\_\_\_

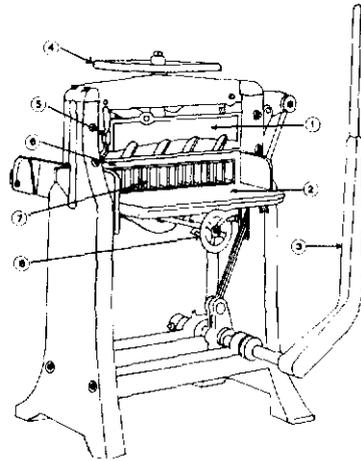
6. \_\_\_\_\_

3. \_\_\_\_\_

7. \_\_\_\_\_

4. \_\_\_\_\_

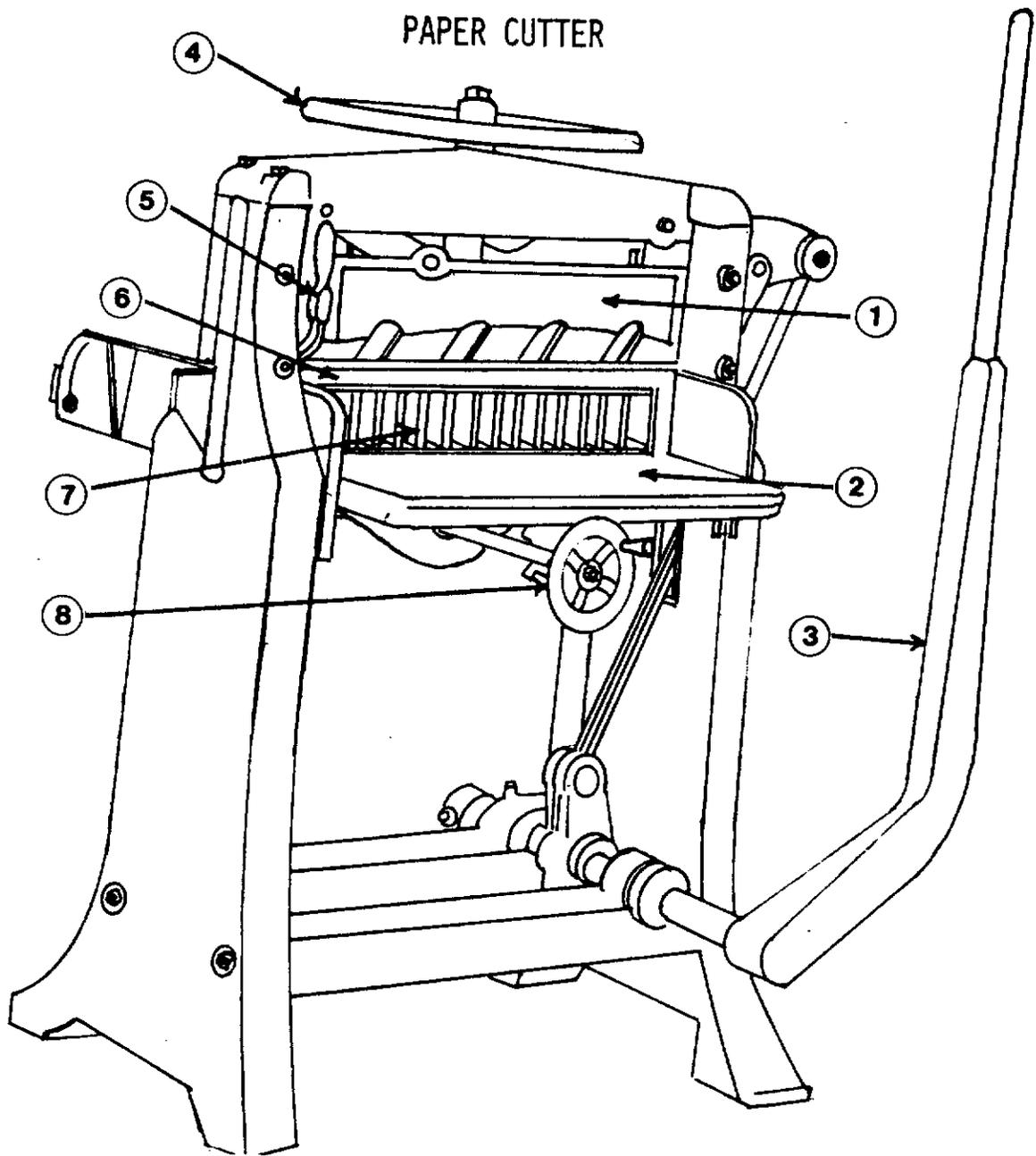
## PAPER CUTTER



1. MEASURING TAPE
2. BED
3. LEVER
4. CLAMP WHEEL
5. SAFETY
6. CUTTER BLADE
7. BACK FENCE
8. BACK FENCE WHEEL

1. Operate only with the teacher's permission and after instructions have been received.
2. Make sure no one else is inside the operator's zone. The paper cutter is a one-person machine.
3. Never work on the paper cutter unless safety devices are present and in working order.
4. Before setting the back gauge, be certain the handle (lever) controlling the blade is in its proper position and the safety lock is engaged.
5. Never raise the clamp higher than the knife blade.
6. Limit the amount of stock to be cut at any one time. Do not overload.
7. Keep hands clear of the blade at all times. Under no circumstances should the blade ever be touched.
8. Keep both hands on the handle (lever or levers) controlling the blade during the cut and then return it to its proper position.
9. Be sure the handle (lever) controlling the blade is returned to its proper position before reaching for the cut stock.
10. Check to see that the safety lock engages after using the cutter.
11. Changing of the cutter knife should be done by the teacher.
12. Allow no foreign objects to come into contact with the paper cutter knife or to lie on the cutter table. Paper cutters must be used only for cutting paper.





1 MEASURING TAPE

2 BED

3 LEVER

4 CLAMP WHEEL

5 SAFETY

6 CUTTER BLADE

7 BACK FENCE

8 BACK FENCE WHEEL



## PAPER CUTTER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

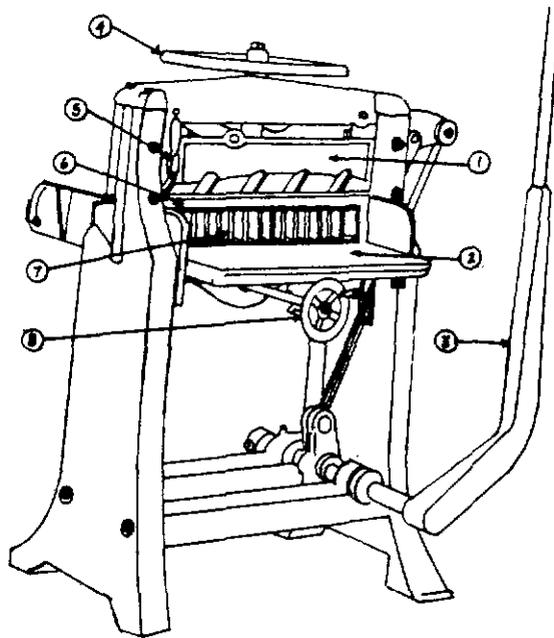
### True-False:

- T F 1. Use the paper cutter to cut plastic items, thin pieces of wood, etc., as well as paper.
- T F 2. Keep both hands on the handle when using the cutter.
- T F 3. Cut beyond the capacity of the paper cutter because most machines have an overload designed into them.
- T F 4. Ask a friend to help operate the paper cutter because it is a two-person job.
- T F 5. Under no circumstances should the paper cutter blade ever be touched by the pupil.
- T F 6. Clean, oil, and adjust the paper cutter while the machine is operating.

### Multiple Choice:

- \_\_\_\_\_ 7. Before adjusting the paper cutter, be sure that the handle controlling the blade: (a) is locked in its proper position, (b) is in a downward position, (c) has the clamp down, (d) has the knife down.
- \_\_\_\_\_ 8. Reach for the cut stock when: (a) the blade is on the upward stroke, (b) the blade is on the downward stroke, (c) the handle controlling the blade has returned to its proper position, (d) the clamp is down.
- \_\_\_\_\_ 9. When operating the paper cutter, be sure to keep: (a) both hands on the handle, (b) only one hand on the handle, (c) one hand on the stock, (d) one hand on the back gauge adjuster.
- \_\_\_\_\_ 10. Use the paper cutter: (a) anytime the teacher is in the room, (b) only after the teacher's permission has been received, (c) anytime it's needed, (d) after watching others operate it.

11. Write the correct name of each part in the space provided.



1. \_\_\_\_\_

5. \_\_\_\_\_

2. \_\_\_\_\_

6. \_\_\_\_\_

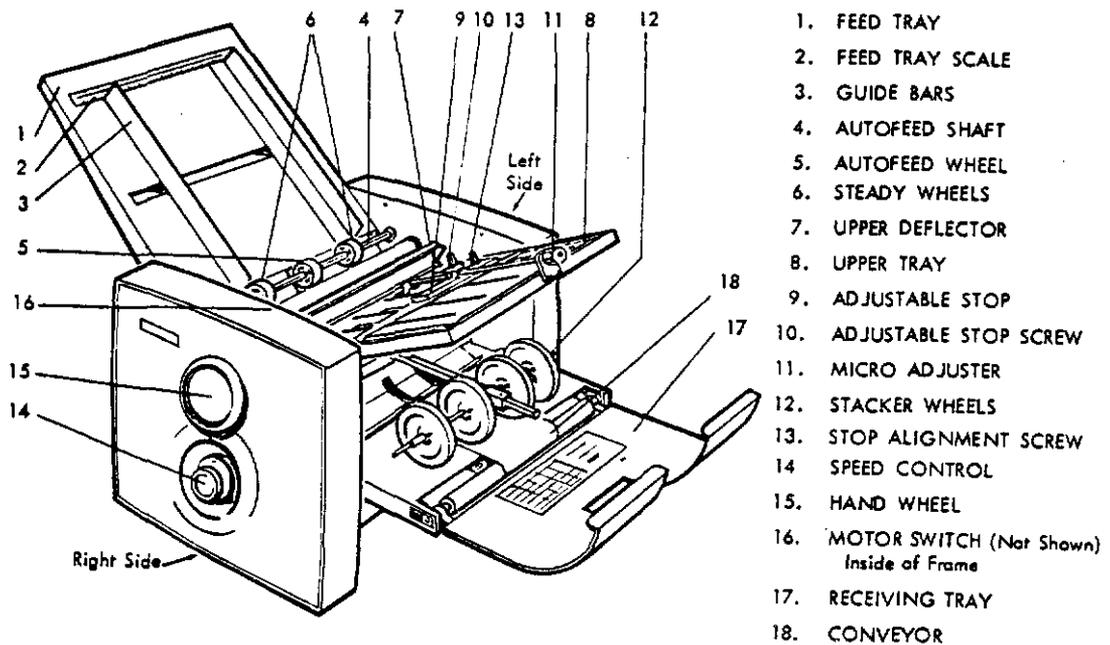
3. \_\_\_\_\_

7. \_\_\_\_\_

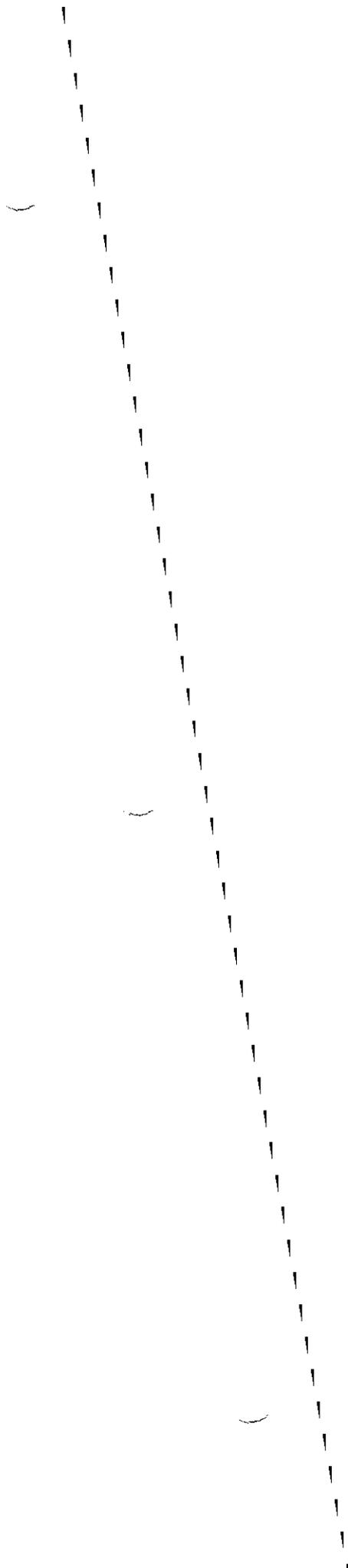
4. \_\_\_\_\_

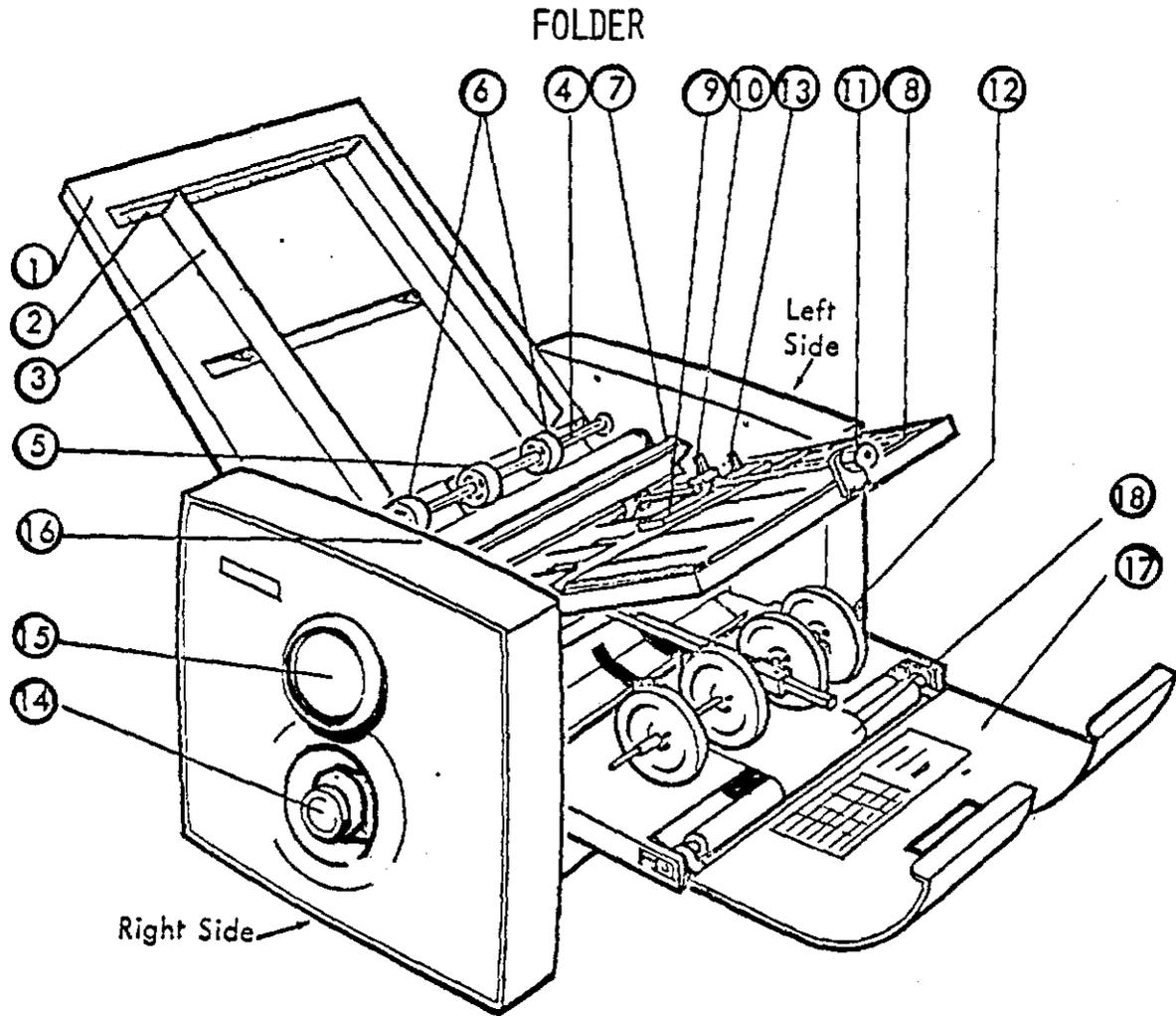
8. \_\_\_\_\_

## FOLDER



1. Operate only with the teacher's permission and after instructions have been received.
2. Secure or eliminate loose clothing, long hair, and jewelry.
3. Keep the hands away from the moving rollers in the folder.
4. Do not attempt to remove a misfed or jammed sheet while the machine is running.
5. Turn off the power when making changes in the folder settings for different-sized sheets of paper.
6. Keep all tools off the tables of the folder.
7. Be sure the electrical cord is out of the way.
8. Report any folder malfunctions to the teacher.





- |   |                 |    |   |
|---|-----------------|----|---|
| 1 | FEED TRAY       | 10 | ADJUSTABLE STOP SCREW                       |
| 2 | FEED TRAY SCALE | 11 | MICRO ADJUSTER                              |
| 3 | GUIDE BARS      | 12 | STACKER WHEELS                              |
| 4 | AUTOFEED SHAFT  | 13 | STOP ALIGNMENT SCREW                        |
| 5 | AUTOFEED WHEEL  | 14 | SPEED CONTROL                               |
| 6 | STEADY WHEELS   | 15 | HAND WHEEL                                  |
| 7 | UPPER DEFLECTOR | 16 | MOTOR SWITCH (Not Shown)<br>Inside of Frame |
| 8 | UPPER TRAY      | 17 | RECEIVING TRAY                              |
| 9 | ADJUSTABLE STOP | 18 | CONVEYOR                                    |



## FOLDER SAFETY QUIZ

NAME \_\_\_\_\_

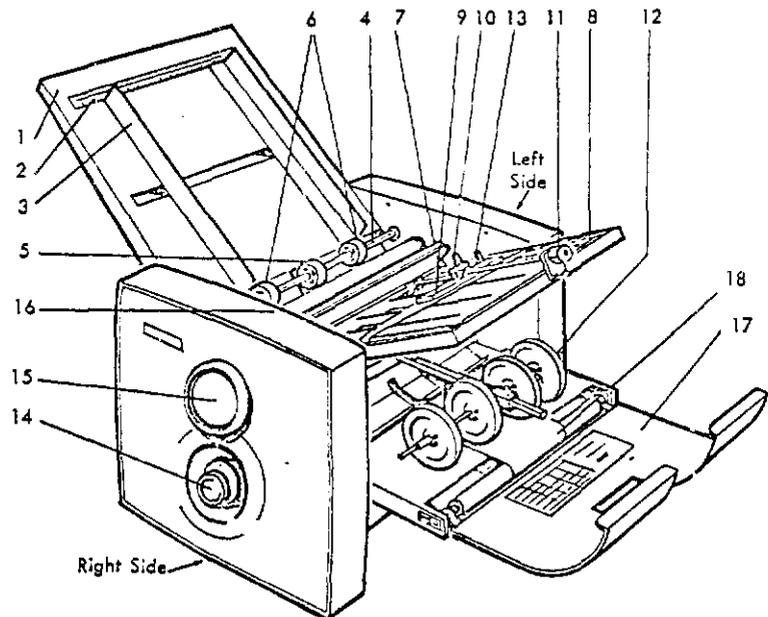
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

### True-False:

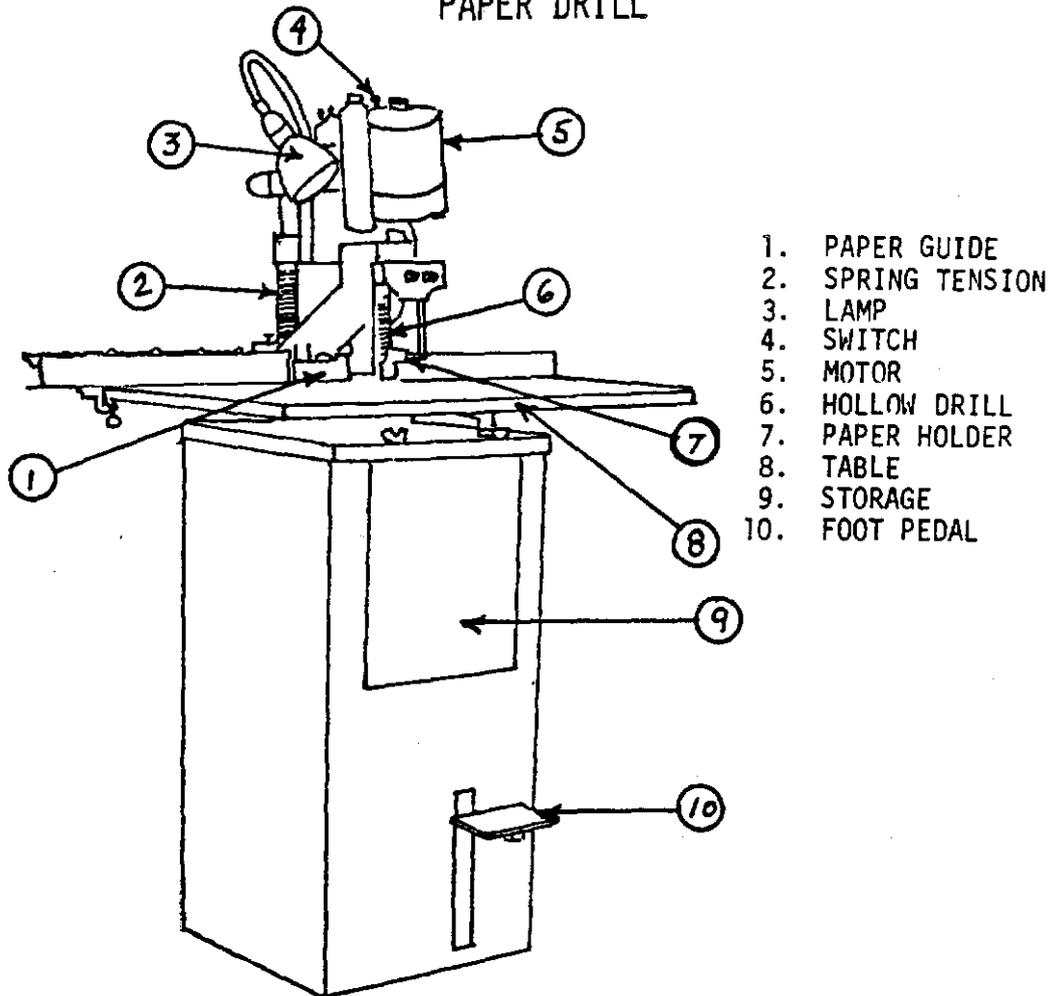
- T F 1. Jammed or misfed sheets may be removed while the machine is running, if it is running slowly.
- T F 2. Power should be turned off when making changes in the folder settings for different-sized sheets of paper.
- T F 3. Loose clothing and long hair should be secured before operating the folder.
- T F 4. A pupil who doesn't know how to operate a folder should ask another pupil to show him/her how to do it.
- T F 5. Tools being used should be laid on the tables of the folder.
- T F 6. Fingers must be kept away from moving rollers.
  
- 7. Write the correct name of each part of the machine in the space provided.  
(see next page)



A. \_\_\_\_\_

- |          |           |
|----------|-----------|
| 1. _____ | 10. _____ |
| 2. _____ | 11. _____ |
| 3. _____ | 12. _____ |
| 4. _____ | 13. _____ |
| 5. _____ | 14. _____ |
| 6. _____ | 15. _____ |
| 7. _____ | 16. _____ |
| 8. _____ | 17. _____ |
| 9. _____ | 18. _____ |

## PAPER DRILL

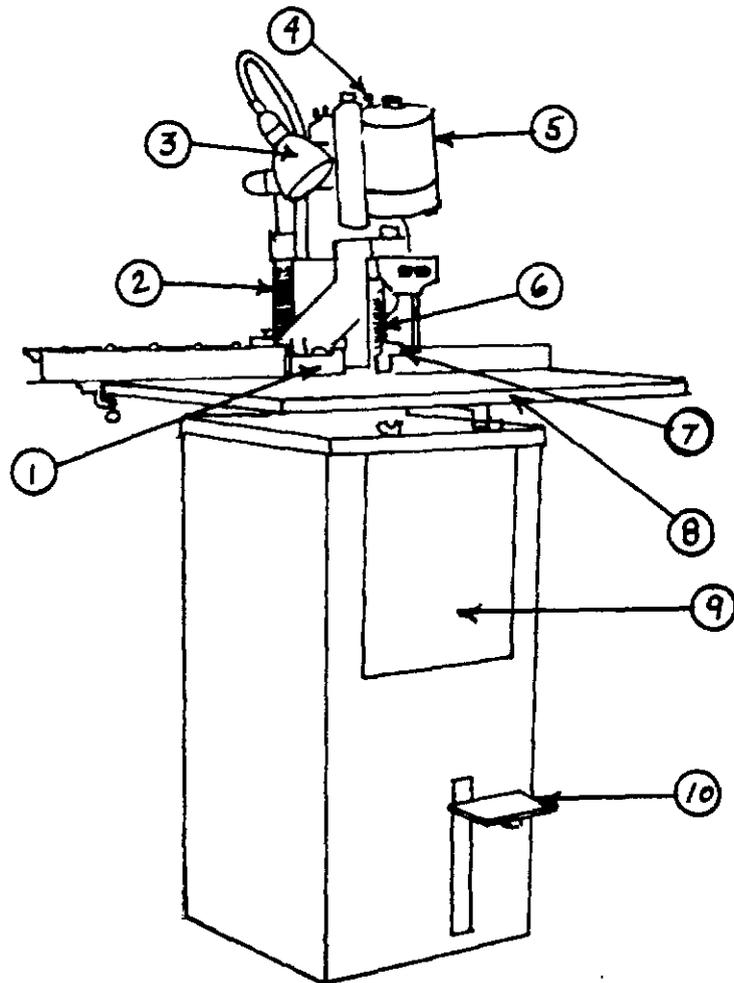


1. PAPER GUIDE
2. SPRING TENSION
3. LAMP
4. SWITCH
5. MOTOR
6. HOLLOW DRILL
7. PAPER HOLDER
8. TABLE
9. STORAGE
10. FOOT PEDAL

1. Operate only with the teacher's permission and after instructions have been received.
2. Be sure the paper guide is securely fastened before turning on the machine.
3. Hold the paper securely against the paper guide.
4. Be sure the fingers are clear before stepping on the foot pedal.
5. Let the foot pedal return slowly.
6. Be aware that the drill bit may be hot.
7. Keep the area around your feet clear at all times.



## PAPER DRILL



- |   |                |    |              |
|---|----------------|----|--------------|
| 1 | PAPER GUIDE    | 6  | HOLLOW DRILL |
| 2 | SPRING TENSION | 7  | PAPER HOLDER |
| 3 | LAMP           | 8  | TABLE        |
| 4 | SWITCH         | 9  | STORAGE      |
| 5 | MOTOR          | 10 | FOOT PEDAL   |



PAPER DRILL SAFETY QUIZ

NAME \_\_\_\_\_

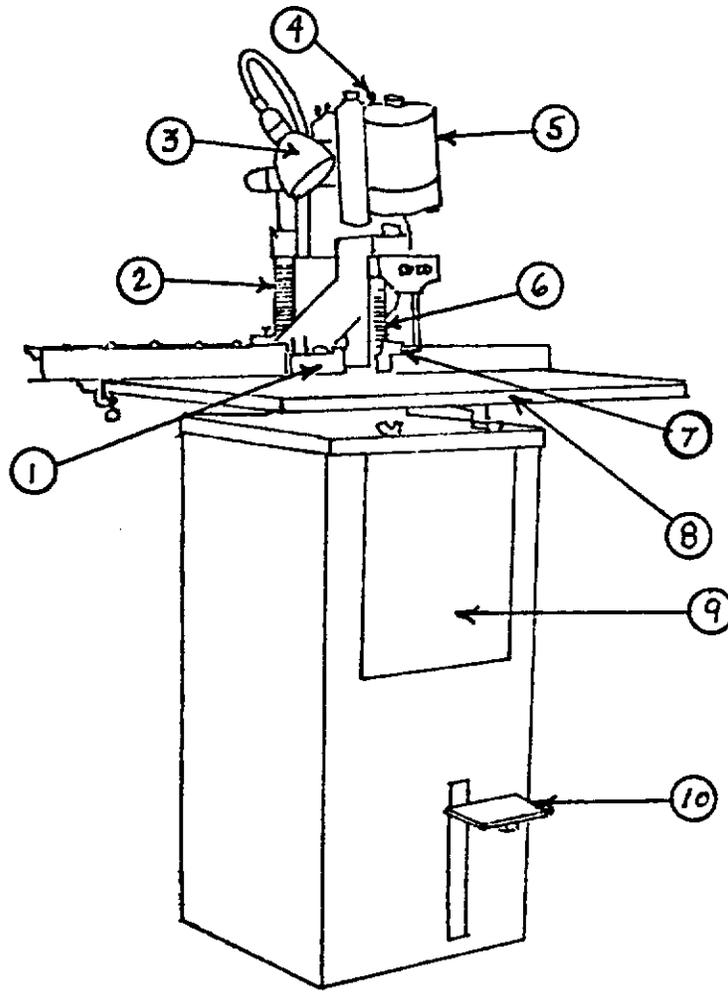
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

True-False:

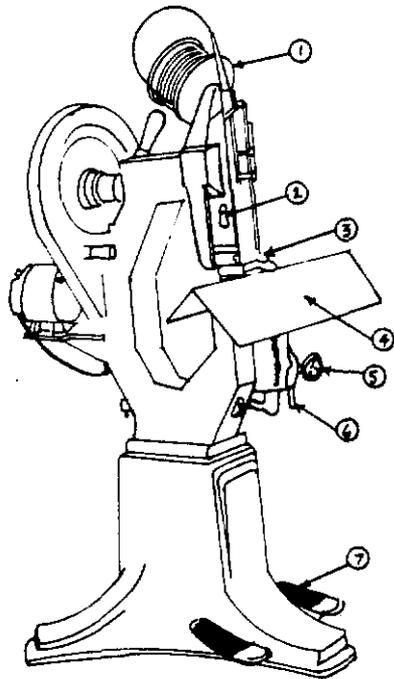
- T F 1. Be sure the paper guide is unfastened before turning on the machine.
- T F 2. Hold the paper loosely against the paper guide.
- T F 3. Allow the foot pedal to return slowly.
- T F 4. Use of the drill bit may cause it to become hot.
  
- 5. Write the correct name of each part of the machine in the space provided.  
(see next page)



A. \_\_\_\_\_

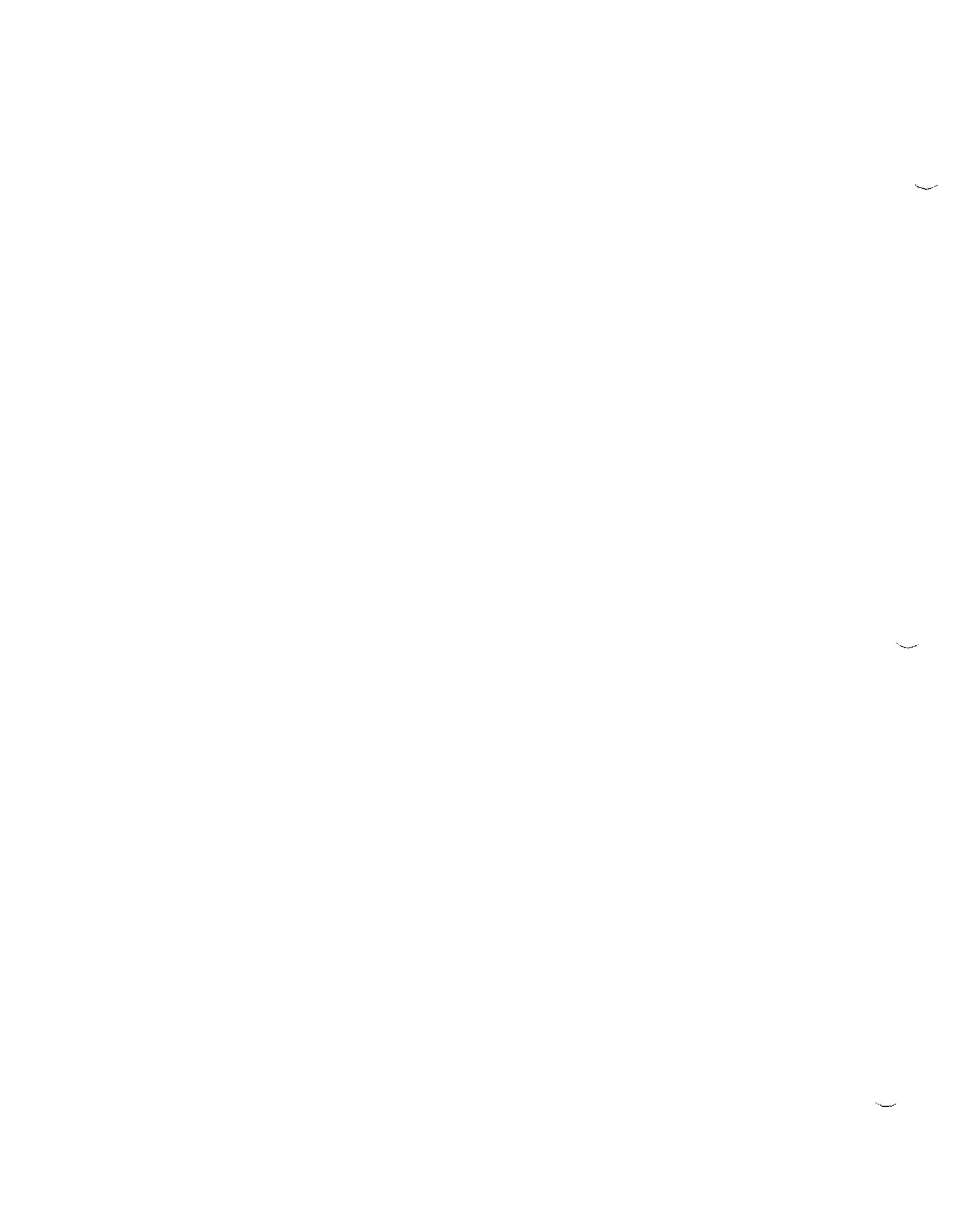
- |          |           |
|----------|-----------|
| 1. _____ | 6. _____  |
| 2. _____ | 7. _____  |
| 3. _____ | 8. _____  |
| 4. _____ | 9. _____  |
| 5. _____ | 10. _____ |

## STAPLER

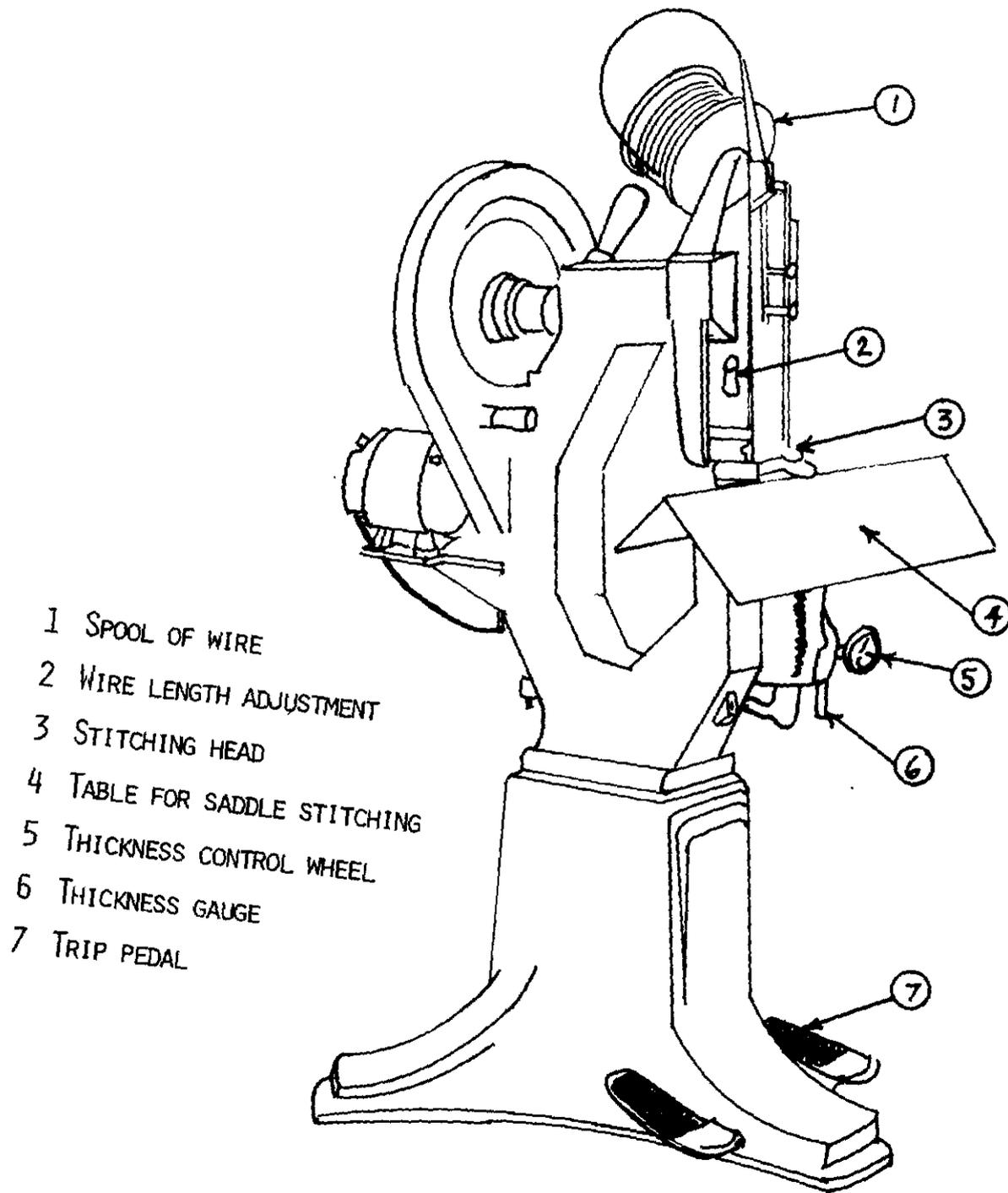


1. SPOOL OF WIRE
2. WIRE LENGTH ADJUSTMENT
3. STITCHING HEAD
4. TABLE FOR SADDLE STITCHING
5. THICKNESS CONTROL WHEEL
6. THICKNESS GAUGE
7. TRIP PEDAL

1. Operate only with the teacher's permission and after instructions have been received.
2. Adjust the machine only when the power is turned off.
3. In case a staple jams in the clinchers, turn the machine off before removing the staple.
4. Make sure that no one else is inside the operator's zone.
5. Keep your hands away from the movable parts of the stapler, especially the head and clincher, in order to prevent driving a staple into your fingers or hands.
6. Place your foot firmly on the lever control.
7. When loading or unloading staples or wire, be very careful that the wire does not spring back or whip into your face or eyes.
8. Turn off the power after using the stapler.
9. Install a guard on all rotary staple cutters to prevent your hands from reaching into the cutting zone. (OSHA)



# STAPLER





## STAPLER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

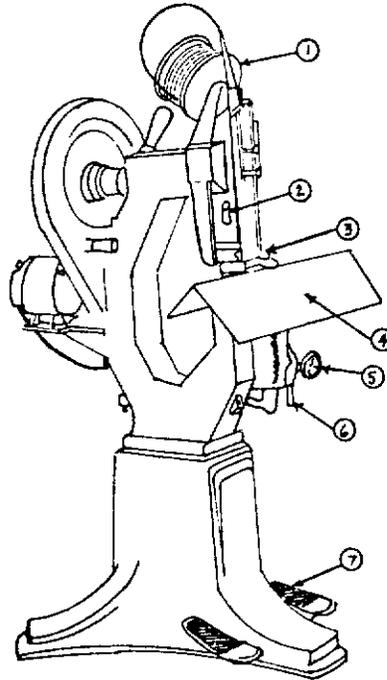
### True-False:

- T F 1. If a staple jams in the clinchers, it is best to reach in quickly and remove it.
- T F 2. The wire may spring back or whip into your face or eyes when you are loading staples.
- T F 3. Saving time is important, so after using the stapler, leave it turned on for the next person.

### Multiple Choice:

- \_\_\_\_\_ 4. During operation of the stapler, the following persons may be involved: (a) the operator only, (b) the operator plus a helper requested by the operator, (c) the operator, a helper, and no more than one observer, (d) any number of people, as long as they don't distract the operator.
- \_\_\_\_\_ 5. Use the stapler: (a) anytime the teacher is in the room, (b) only after receiving the teacher's permission, (c) only after the teacher has given instructions, (d) both b and c.
- \_\_\_\_\_ 6. Adjust the stapling machine: (a) when it is in motion, (b) after each staple, (c) when the power is off, (d) when the power is turned on.

Write the correct name of each part in the space provided.



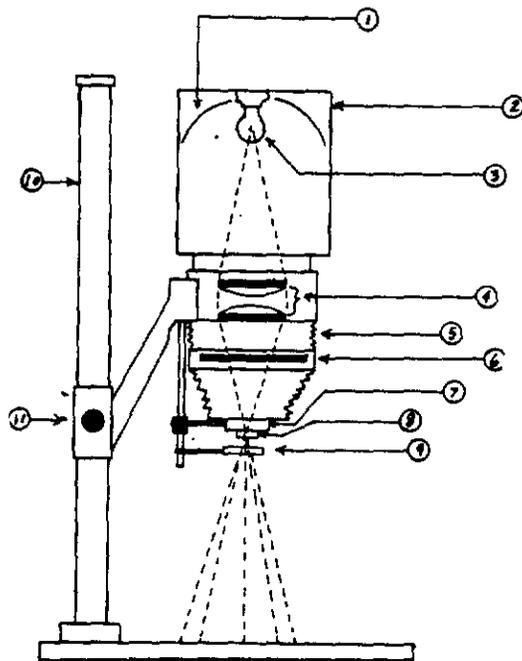
- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_

## DARKROOM EQUIPMENT (GRAPHIC ARTS/PHOTOGRAPHY)

1. There will be no horseplay in the darkroom.
2. The ventilator fan should be turned on whenever someone is using the darkroom.
3. The darkroom must be kept clean and the floor clear of obstructions.
4. All spills should be wiped up immediately.
5. Due to the low light level in the darkroom, extreme care must be taken to avoid running into objects. Do not start working until your eyes adjust to the light.
6. The hands must be kept away from the face while working in the darkroom.
7. Chemical goggles, rubber gloves, and an apron should be worn when preparing chemical solutions.
8. A person working in the darkroom should make sure of the formula and mixing procedure before handling chemicals.
9. Contents of bottles and containers must be identified by labels; never trust your smell. Never taste chemicals!
10. Chemicals are to be mixed only in well-lighted places.
11. Acid must always be added to water; never the opposite.
12. Because of the danger of an explosion, one should never shake a bottle of strong acid or alkali.
13. Chemicals must not be spilled on clothing as it may cause skin irritation.
14. Tongs or rubber gloves should be used in handling film and paper during the developing process.
15. Hands are to be carefully washed with soap and water after developing film or prints.
16. Chemicals should not be stored in glass bottles or on high shelves where they might fall and cause injury.
17. Many photographic chemicals are poisonous and/or caustic and should be kept out of the reach of children.

18. Pupils must realize that contact with photographic chemicals may cause skin rashes, irritation, and other health problems, some of which may not be evident for months or years.
19. Electrical equipment must not be handled with wet hands or while standing on a wet floor.
20. A person should not touch any electrical device when working around a sink unless the device is properly grounded.
21. All water temperature control units in darkrooms will be operated only by the teacher, not the pupils.
22. The instructor should change burned-out safelight bulbs. Some require special handling to be changed safely.
23. All loose clothing and long hair must be secured when operating the color drum processor.

## DARKROOM EQUIPMENT

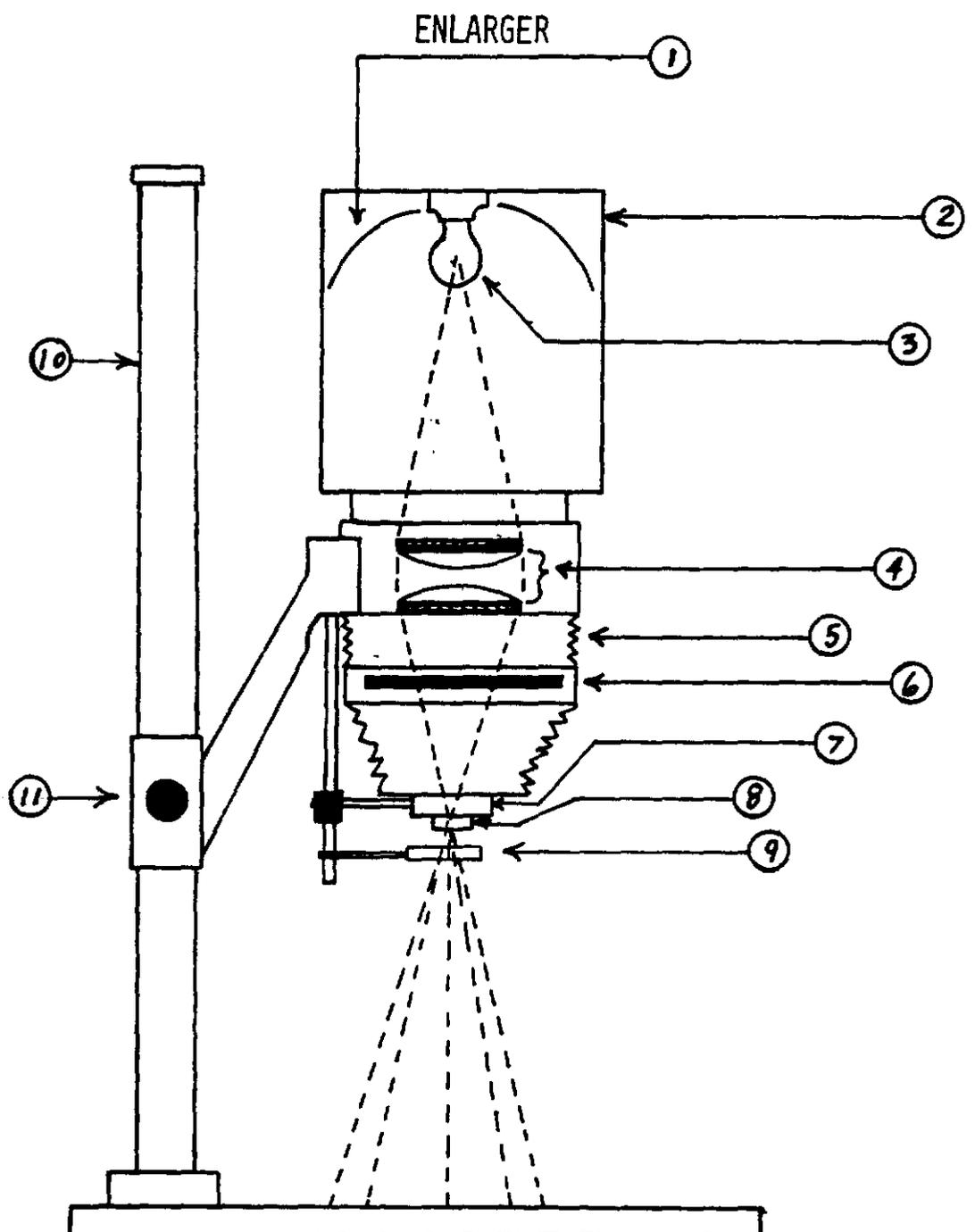


### ENLARGER

1. REFLECTOR
2. LAMP HOUSING
3. LAMP
4. CONDENSER
5. BELLOWS
6. NEGATIVE CARRIER
7. LENS BOARD
8. LENS
9. FILTER
10. POST
11. VERTICAL ADJUSTMENT

1. Operate it only with the teacher's permission and after instructions have been received.
2. Do not touch the enlarger with wet hands or when standing on a wet floor.
3. Be sure all the electrical wiring is in good condition before you operate the enlarger.
4. Change a burned-out enlarger light bulb in a well-lighted area.
5. Be careful not to pinch your fingers in the gears when raising or lowering the enlarger head (while focusing).
6. Be careful when handling the lens and condenser lens.
7. Know how the timer on the enlarger operates. Treat it as carefully as any other electrical tool.
8. When raising the enlarger head, check to see that there is proper clearance overhead for the safelight.
9. Before raising or lowering the enlarger head, release the brake/locking mechanism.
10. Make certain your head is clear of the enlarger head before raising or lowering it.

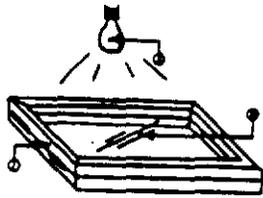




- |                |                    |                        |
|----------------|--------------------|------------------------|
| 1 REFLECTOR    | 5 BELLOWS          | 9 FILTER               |
| 2 LAMP HOUSING | 6 NEGATIVE CARRIER | 10 POST                |
| 3 LAMP         | 7 LENS BOARD       | 11 VERTICAL ADJUSTMENT |
| 4 CONDENSER    | 8 LENS             |                        |



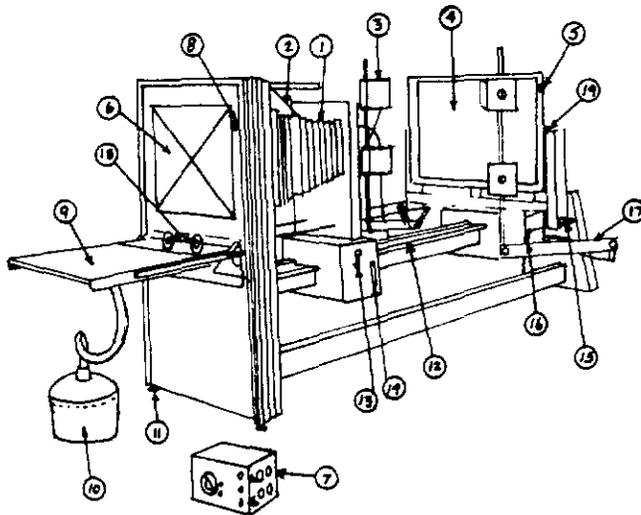
## CONTACT PRINTER



1. FRAME
2. LIGHT SOURCE
3. GLASS

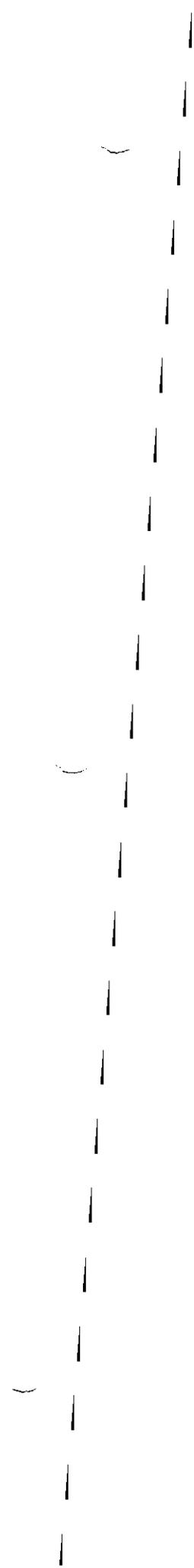
1. Operate only with the teacher's permission and after instructions have been received.
2. When loading the contact printer, be careful not to drop or break the glass.

## PROCESS CAMERA

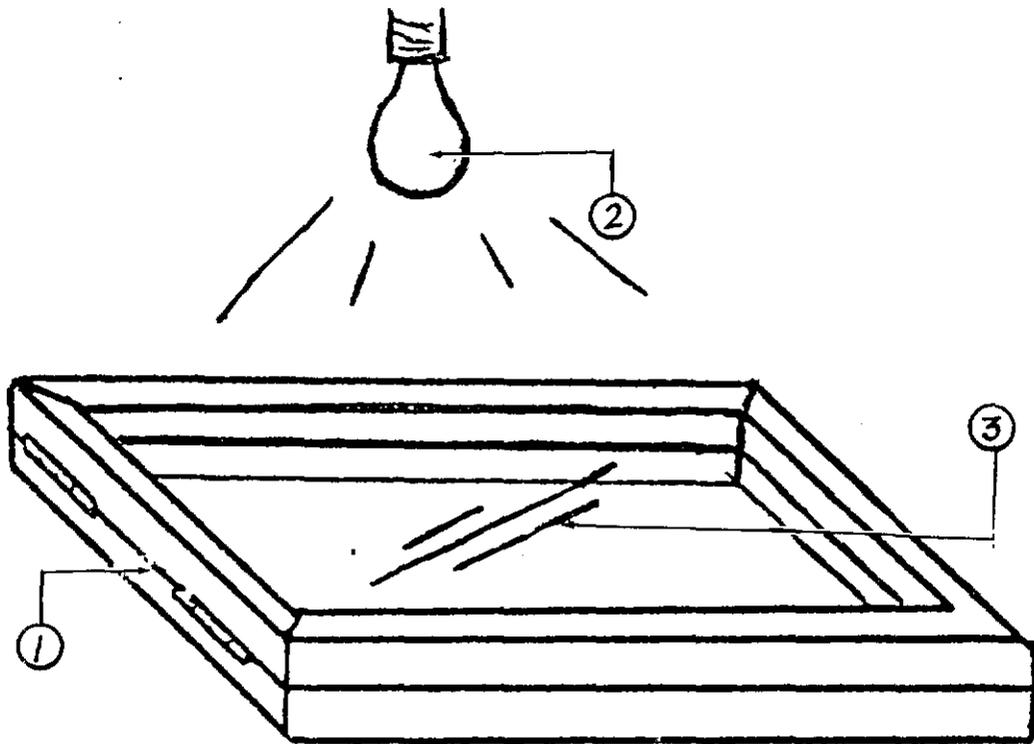


1. BELLOWS
2. BELLOWS SUPPORT
3. QUARTZ LIGHTS
4. COPYBOARD
5. COPYBOARD COVER LATCH
6. GROUND GLASS
7. DUAL RANGE TIMER
8. VACUUM CONTROL SWITCH
9. VACUUM FILM HOLDER
10. VACUUM PUMP
11. LEVELING LEGS
12. PERCENTAGE FOCUSING SCALES
13. CRANK FOR FRONT CASE MOVEMENT
14. FRONT CASE LOCK
15. CRANK FOR COPYBOARD MOVEMENT
16. COPYBOARD LOCK
17. LAMP ARM
18. LENSBOARD MOVEMENT CONTROLS
19. COPYBOARD POSITION LATCH

1. Operate only with the teacher's permission and after instructions have been received.
2. To prevent severe burns, do not touch hot process camera lights.
3. Avoid flashing lights in other pupils' eyes. Do not look into the lights on the camera.
4. Exercise caution when working around the glass copyboard to be sure it is not dropped or broken.



# CONTACT PRINTER



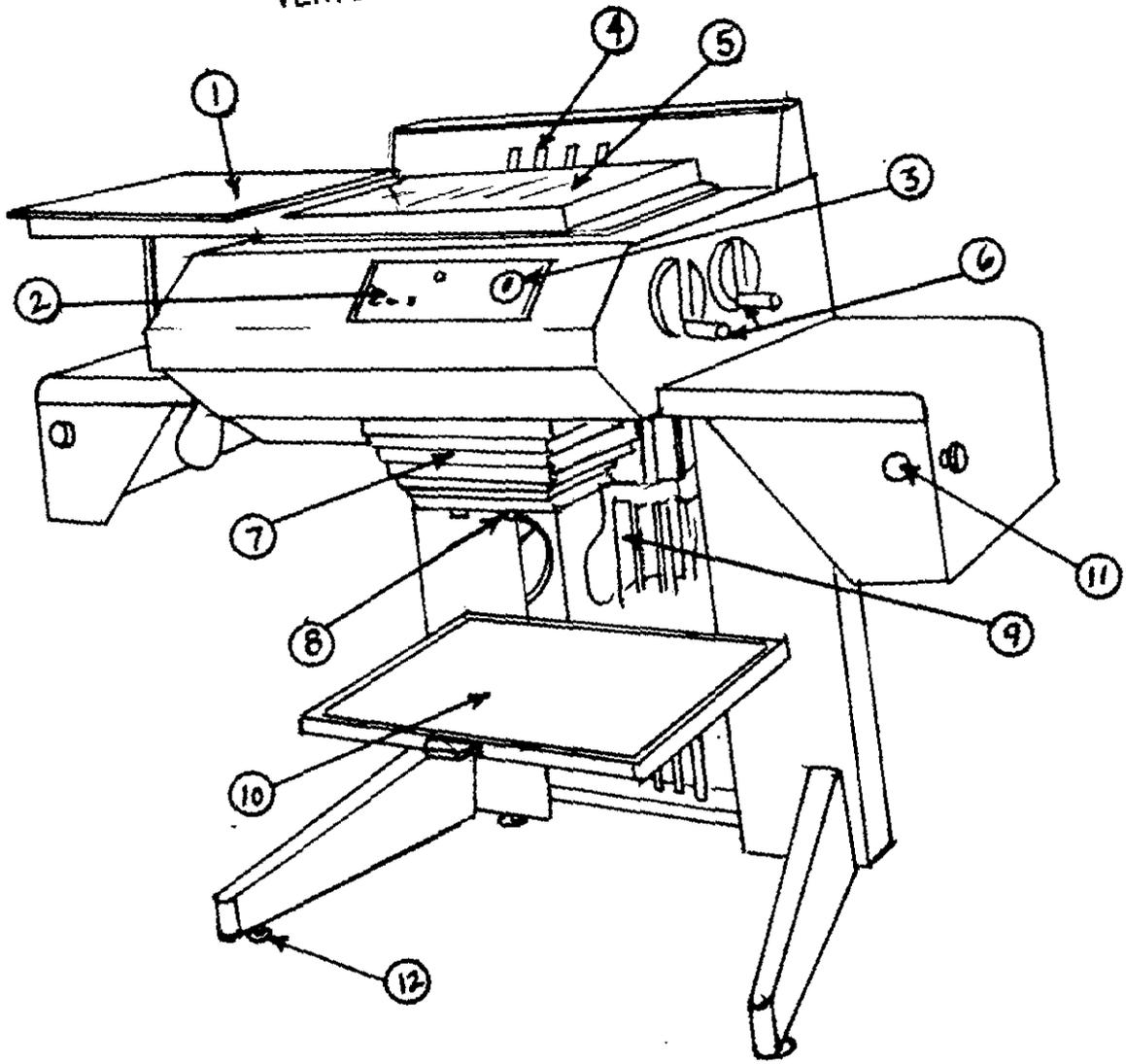
- 1 FRAME
- 2 LIGHT SOURCE
- 3 GLASS

—

—

—

# VERTICAL PROCESS CAMERA



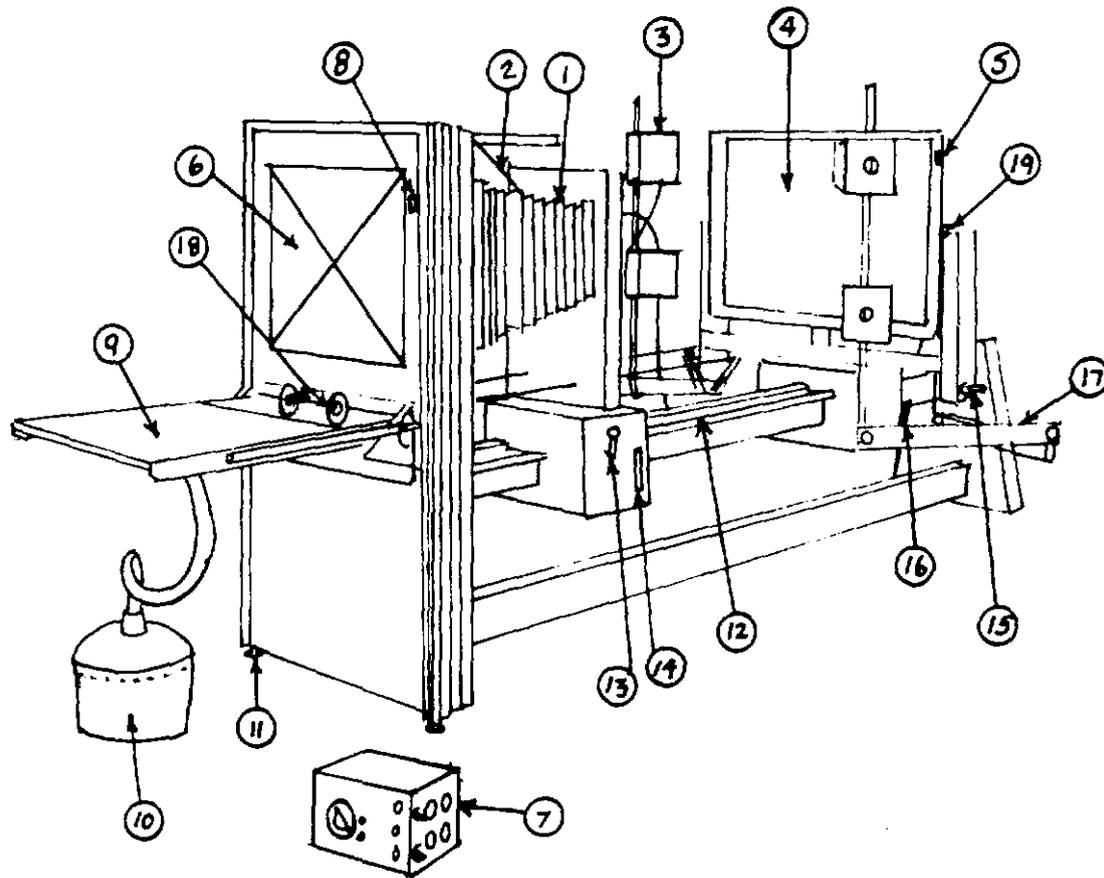
- 1 VACUUM FILM HOLDER
- 2 CONTROL PANEL
- 3 DUAL RANGE TIMER
- 4 PERCENTAGE SCALES
- 5 GROUND GLASS
- 6 HANDLES FOR LENS AND COPYBOARD MOVEMENT
- 7 BELLOWS
- 8 LENS
- 9 SCREW DRIVE
- 10 COPYBOARD
- 11 COPYBOARD LIGHT ANGLE ADJUSTMENT
- 12 LEVELING LEGS

—

—

—

## HORIZONTAL PROCESS CAMERA



- |                         |                                  |
|-------------------------|----------------------------------|
| 1 BELLWS                | 11 LEVELING LEGS                 |
| 2 BELLWS SUPPORT        | 12 PERCENTAGE FOCUSING SCALES    |
| 3 QUARTZ LIGHTS         | 13 CRANK FOR FRONT CASE MOVEMENT |
| 4 COPYBOARD             | 14 FRONT CASE LOCK               |
| 5 COPYBOARD COVER LATCH | 15 CRANK FOR COPYBOARD MOVEMENT  |
| 6 GROUND GLASS          | 16 COPYBOARD LOCK                |
| 7 DUAL RANGE TIMER      | 17 LAMP ARM                      |
| 8 VACUUM CONTROL SWITCH | 18 LENSBOARD MOVEMENT CONTROLS   |
| 9 VACUUM FILM HOLDER    | 19 COPYBOARD POSITION LATCH      |
| 10 VACUUM PUMP          |                                  |



## DARKROOM SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

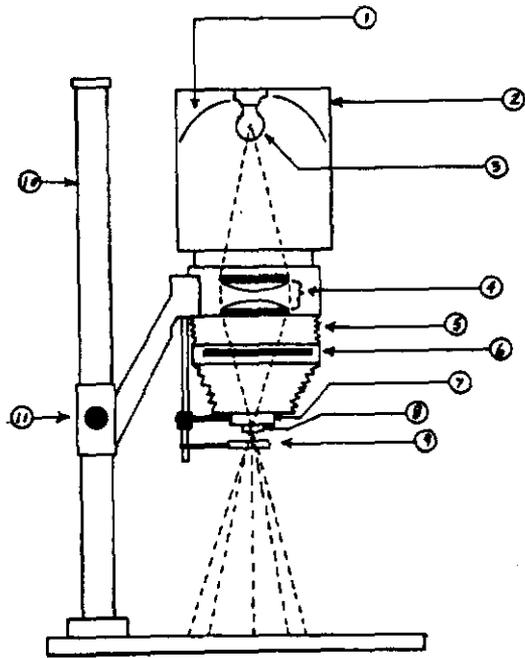
- T F 1. Hands should be carefully washed with soap and water after a person has used chemicals.
- T F 2. Hands are to be kept away from the face when working in the darkroom.
- T F 3. Process camera lights become very hot during use.
- T F 4. Electrical devices in the darkroom should be operated with wet hands.
- T F 5. Many photographic chemicals are poisonous and/or caustic and may cause skin rashes, irritation, or other health problems.
- T F 6. Water temperature control units in the darkroom may be operated by pupils.
- T F 7. The ventilator fan should always be left turned on as long as anyone is working in the darkroom.
- T F 8. Pupils may change burned-out safelight bulbs.
- T F 9. All loose clothing and long hair must be secured when one is operating the color drum processor.
- T F 10. The light on the process camera is not bright enough to be dangerous to the eyes.
- T F 11. Plastic or rubber gloves will usually provide the needed protection to people who may suffer allergic skin reactions to certain photographic chemicals.
- T F 12. A person who is raising the enlarger head should check to see if there is proper clearance for the safelight.
- T F 13. The brake/locking mechanism should not be released before raising or lowering the enlarger head.

T F 14. One should make sure his/her head is out of the way before raising or lowering the head of the enlarger.

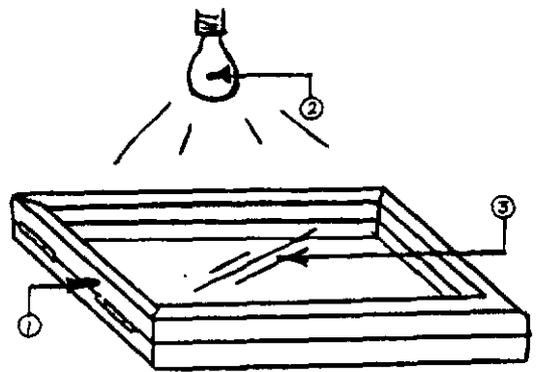
Multiple Choice:

- \_\_\_\_\_ 15. Splashing or spilling chemicals on clothing: (a) may cause skin irritation, (b) may discolor clothing, (c) wastes chemicals, (d) does all of these.
- \_\_\_\_\_ 16. When handling film and paper during developing, use: (a) tongs, (b) rubber gloves, (c) bare hands, (d) either a or b, (e) either b or c.
- \_\_\_\_\_ 17. Any liquids spilled in the darkroom should be: (a) wiped up immediately, (b) reported to the teacher, (c) left for end-of-class cleanup, (d) left for the custodian to clean up.
- \_\_\_\_\_ 18. Electrical equipment or switches must not be used: (a) with wet hands, (b) while standing on a wet floor, (c) unless wearing rubber gloves, (d) both a and b, (e) both b and c.
- \_\_\_\_\_ 19. When mixing acids: (a) always pour water into acid, (b) pour acid into water, (c) pour either acid into water or water into acid, (d) refrain from mixing acid and water.
- \_\_\_\_\_ 20. Identify the contents of bottles by: (a) taste, (b) smell, (c) reading the label, (d) asking another person.
- \_\_\_\_\_ 21. After developing film or prints: (a) wash your hands thoroughly, (b) tell the teacher the work is finished, (c) continue working as usual, (d) leave things out for the next person.
- \_\_\_\_\_ 22. Always replace corks or caps on bottles when finished because this will help: (a) keep the sink area clean, (b) eliminate spilling, (c) keep the contents from evaporating, (d) do all of these.
- \_\_\_\_\_ 23. When preparing chemical solutions, the following protection should be worn: (a) goggles, rubber gloves, and apron, (b) apron and rubber gloves, (c) goggles and rubber gloves, (d) apron and goggles.
- \_\_\_\_\_ 24. Never shake a bottle of strong acid or alkali because: (a) it may spill, (b) it may explode, (c) it may evaporate, (d) it may be dropped.
- \_\_\_\_\_ 25. Chemicals should never be stored: (a) in glass bottles on high shelves, (b) in plastic bottles on low shelves, (c) in glass bottles on low shelves, (d) none of the above.

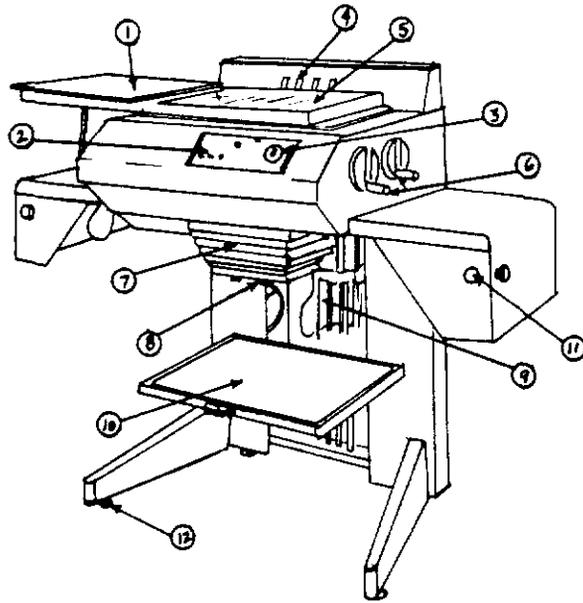
26. The contact printer should be used: (a) anytime the teacher is in the room, (b) anytime you need to, (c) only with the teacher's permission, (d) only after you have watched others do it.
27. When loading the contact printer, be careful not to drop or break the: (a) glass, (b) negative, (c) printing frame, (d) none of these.
28. Write the correct name of each machine and its parts in the space provided.



- A. \_\_\_\_\_
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_



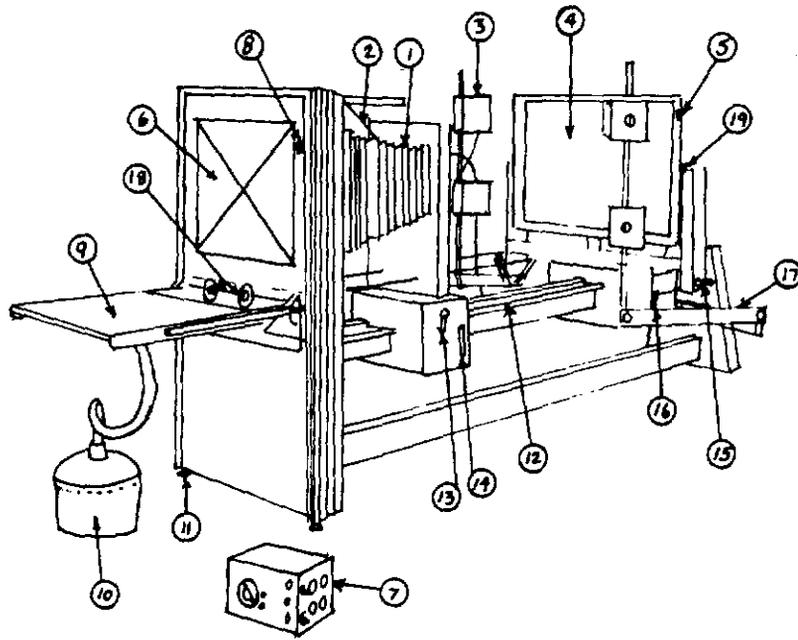
- B. \_\_\_\_\_
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_



C. \_\_\_\_\_

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_

- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_
- 10. \_\_\_\_\_
- 11. \_\_\_\_\_
- 12. \_\_\_\_\_

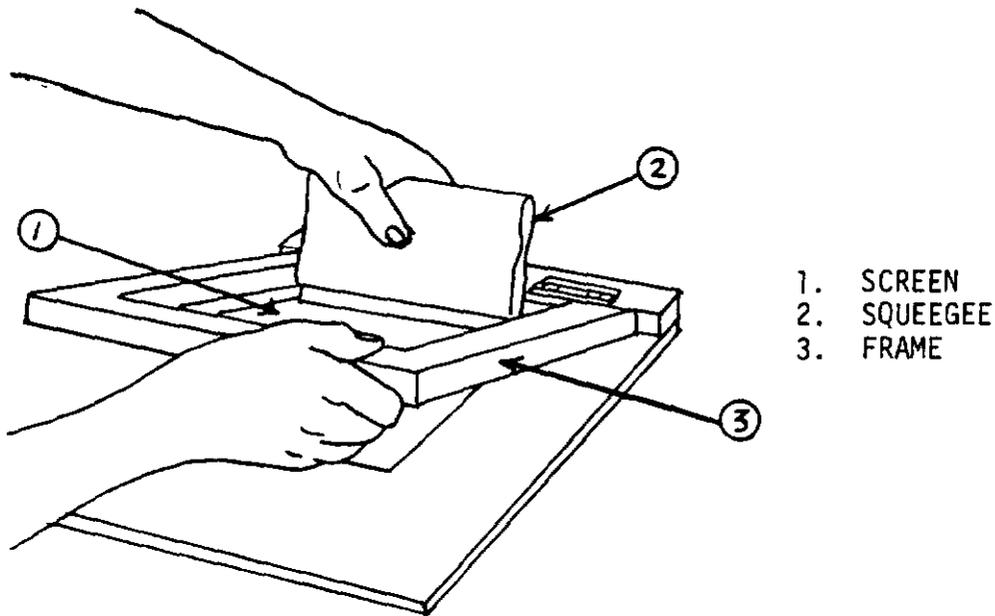


D. \_\_\_\_\_

- |           |           |
|-----------|-----------|
| 1. _____  | 11. _____ |
| 2. _____  | 12. _____ |
| 3. _____  | 13. _____ |
| 4. _____  | 14. _____ |
| 5. _____  | 15. _____ |
| 6. _____  | 16. _____ |
| 7. _____  | 17. _____ |
| 8. _____  | 18. _____ |
| 9. _____  | 19. _____ |
| 10. _____ |           |



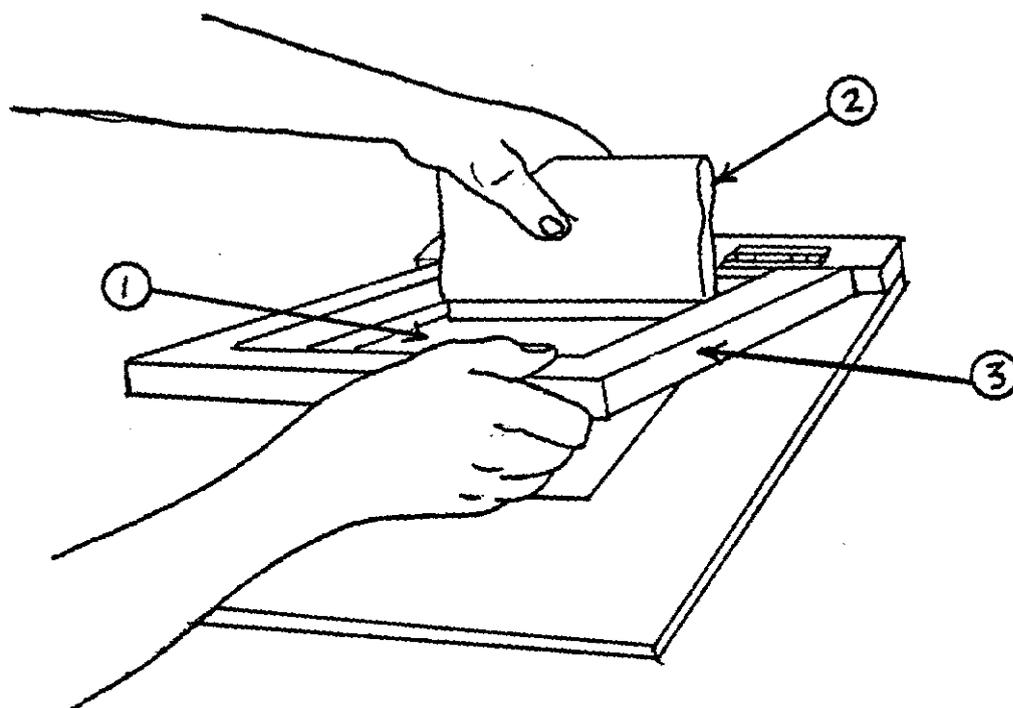
## SCREEN PRINTER



1. Use all tools and materials in the screen printing area only with the teacher's permission and after instructions have been received.
2. When exposing photo stencils, avoid looking directly at the exposure lights.
3. Follow standard darkroom safety procedures when preparing materials for photo stencils.
4. Use stencil cutting tools in approved holders and keep the cutting edges sharp.
5. Use screen inks and cleaners only in well-ventilated areas. Many of them give off toxic fumes.
6. Wear appropriate eye protection when working with screen cleaners and inks.
7. Return cleaning rags to the approved metal fireproof containers.
8. If using a motorized screen press, be careful that your hands do not become caught under the screen or in the moving parts of the press.
9. Clean up oils, paints, or inks that are spilled on the floor.
10. Keep flammable liquids in approved containers and cabinets.



# SCREEN PRINTER



- 1 SCREEN
- 2 SQUEEGEE
- 3 FRAME



## SCREEN PRINTER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

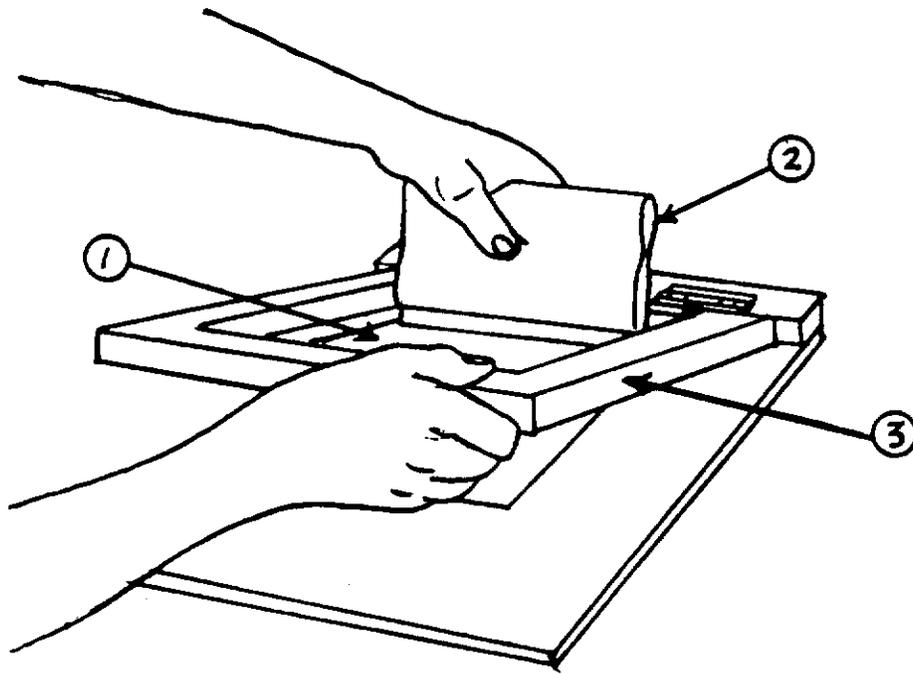
### True-False:

- T F 1. Many screen inks and cleaners give off toxic fumes.
- T F 2. Photo stencil exposure lights are not very bright; therefore, no special precautions need to be taken when working around such lights.
- T F 3. Special darkroom safety procedures need to be followed when preparing materials for photo stencils.
- T F 4. Flammable liquids should be stored in metal fireproof containers.

### Multiple Choice:

- \_\_\_\_\_ 5. Stencil cutting tools should be: (a) sharp, (b) used only in approved holders, (c) stored properly after use, (d) all of these.
- \_\_\_\_\_ 6. If a pupil doesn't understand a silkscreen operation, he/she should: (a) ask the teacher for help, (b) ask another pupil who knows, (c) go ahead as planned and hope it works, (d) do none of these.
- \_\_\_\_\_ 7. When working with screen inks and cleaners: (a) wear appropriate eye protection, (b) work only in a well-ventilated area, (c) wash hands after use, (d) do all of these.
- \_\_\_\_\_ 8. After use, cleaning rags should be: (a) placed in metal fire-proof container, (b) thrown in the wastebasket, (c) left for the next pupil to use, (d) rolled up in a neat bundle.
- \_\_\_\_\_ 9. If oils, paints, or inks spill on the floor: (a) be careful not to slip on it until cleanup time, (b) clean it up at once, (c) inform the teacher, (d) warn others not to step on it.

Write the correct name of each part in the space provided.

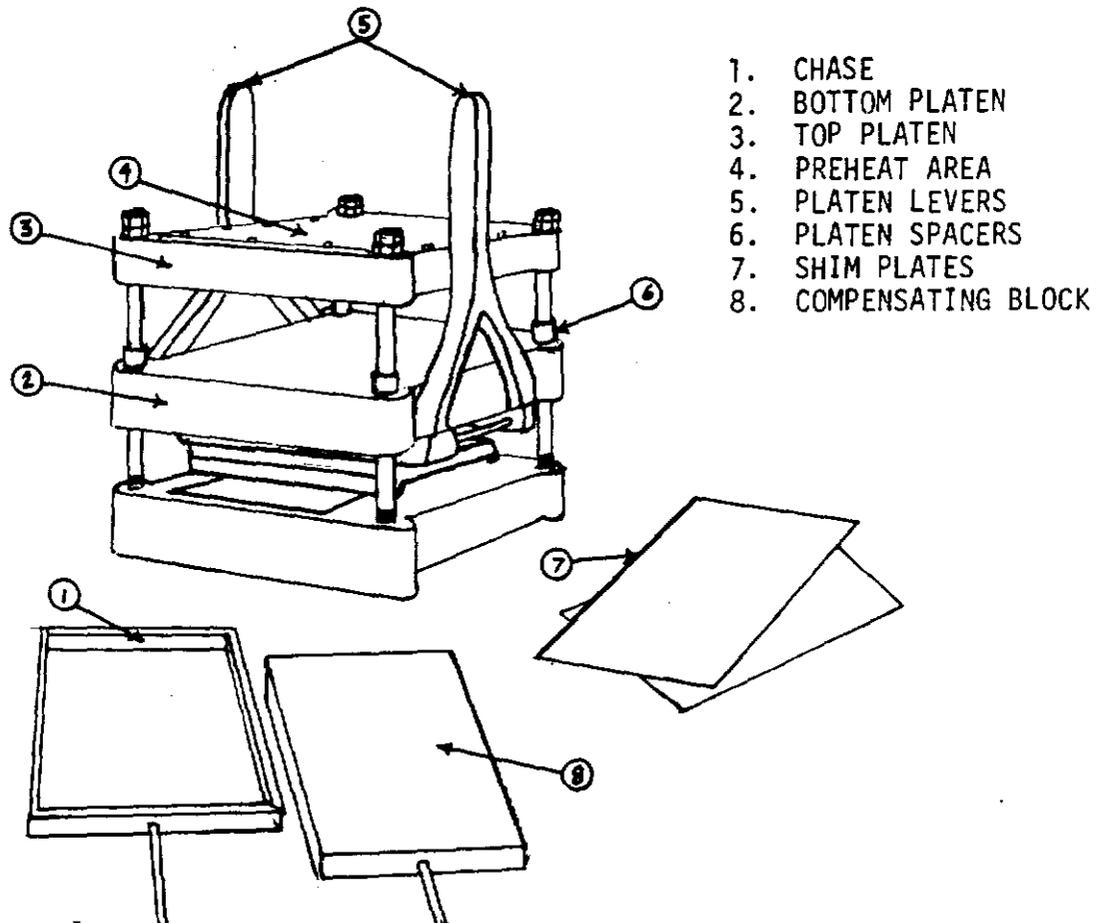


1. \_\_\_\_\_

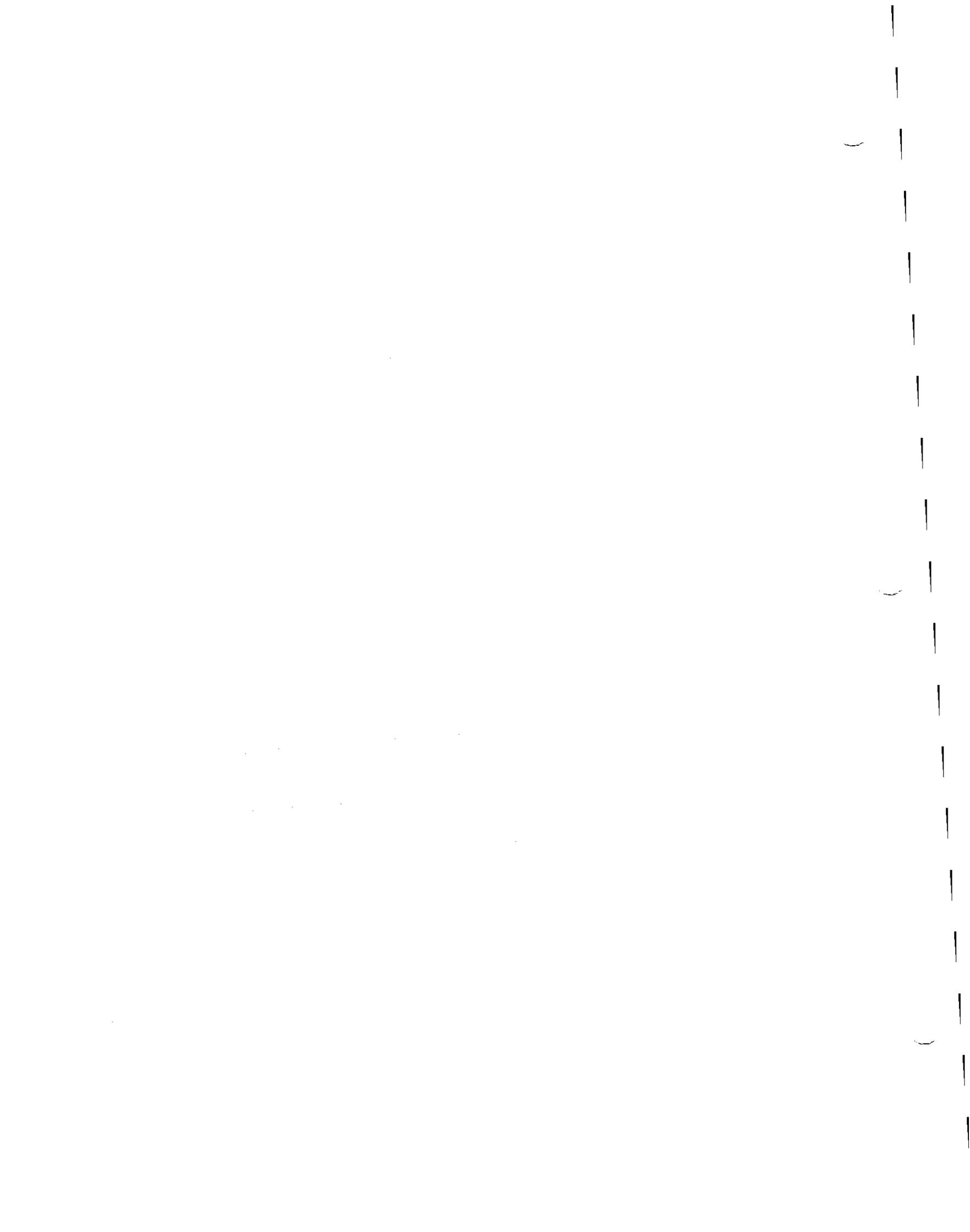
3. \_\_\_\_\_

2. \_\_\_\_\_

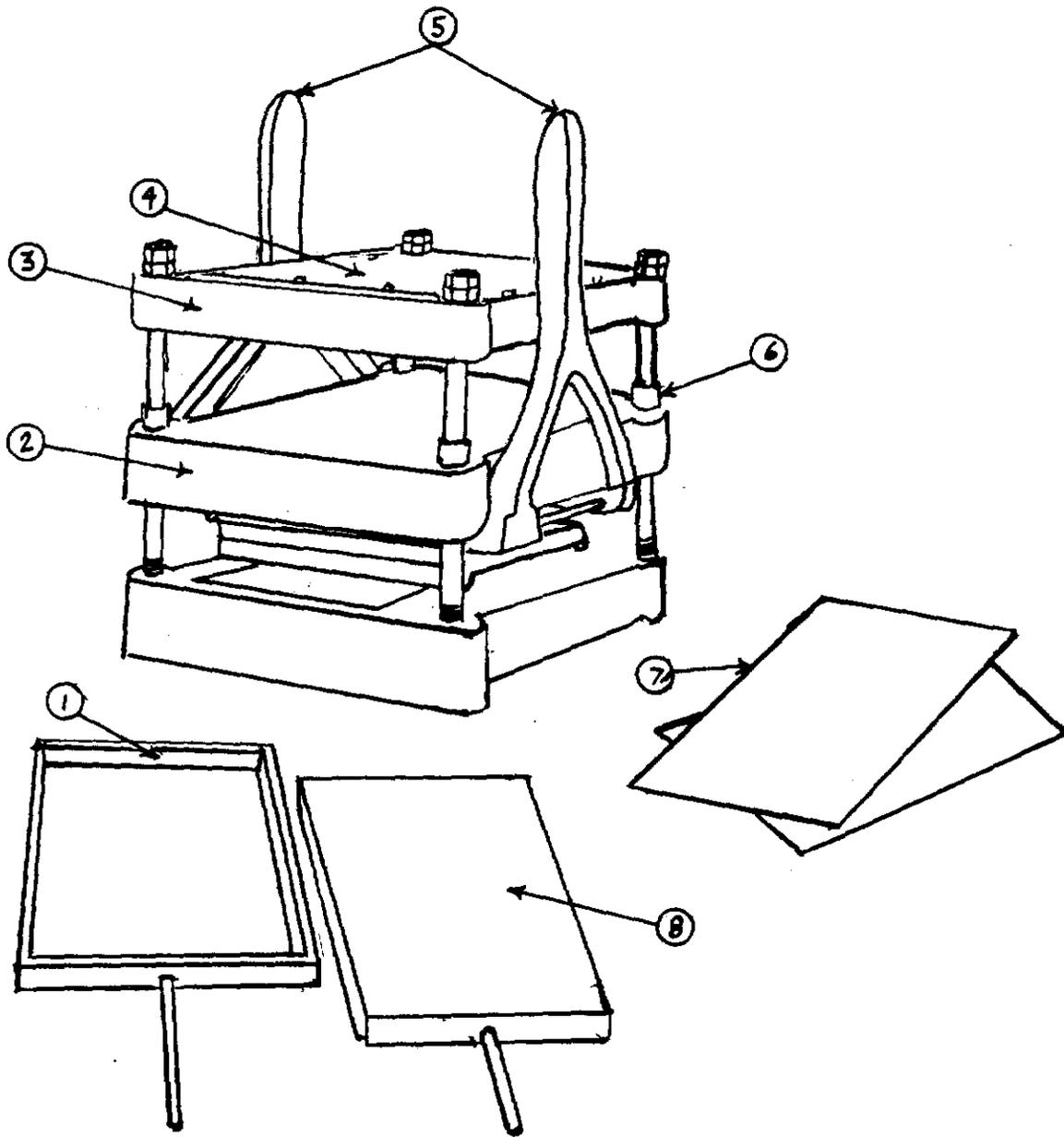
## RUBBER STAMP AND GOLD STAMP PRESS



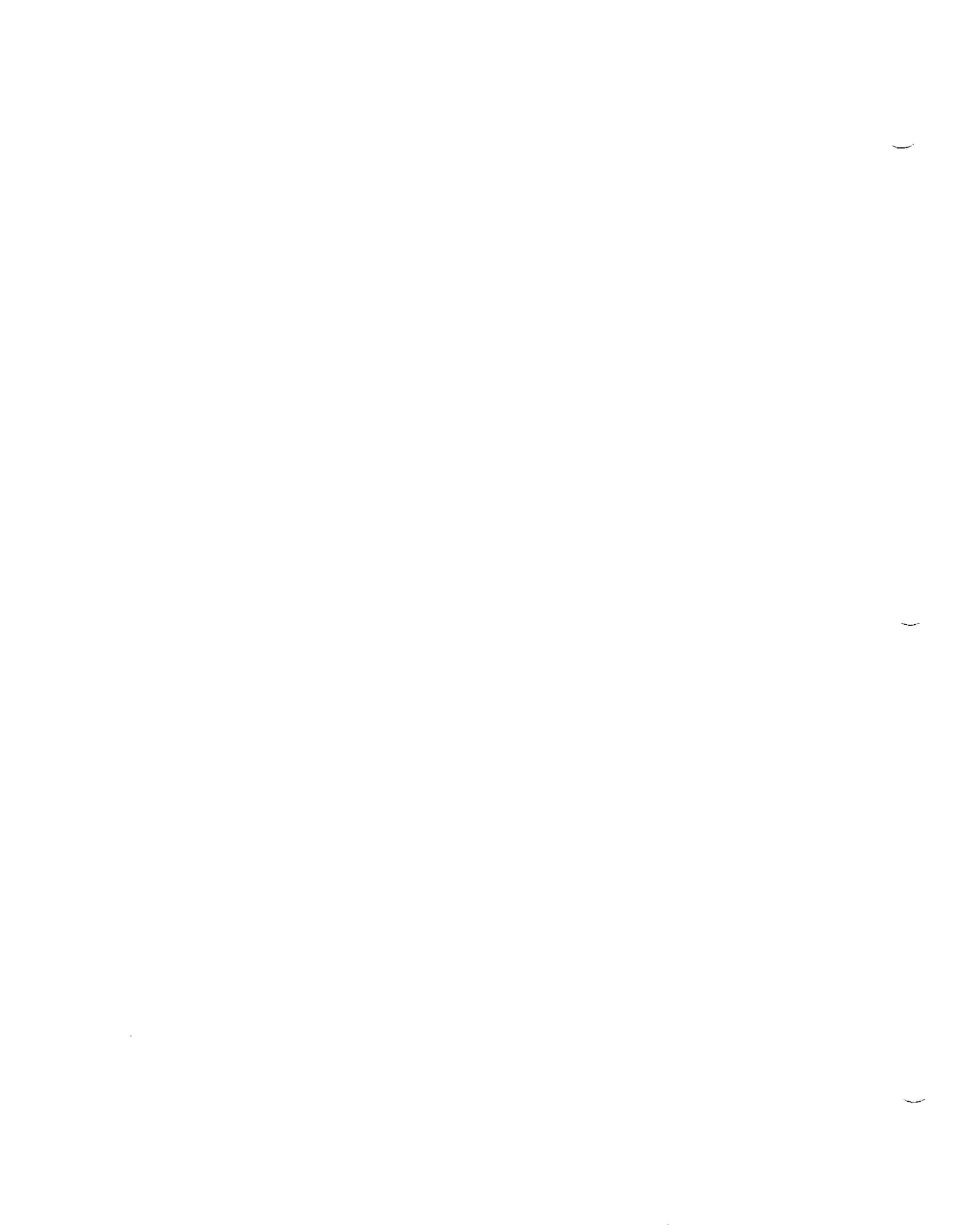
1. Operate only with the teacher's permission and after instructions have been received.
2. Use caution when using the heating element as it can cause severe burns.
3. Keep the work surface clean at all times.
4. Do not throw or drop type.
5. Take extreme care when operating a rubber stamp press, as many parts of it get very hot during use.
6. When making the stamp base, be very careful with the saw and drill.



# RUBBER STAMP AND GOLD STAMP PRESS



- |                 |                      |
|-----------------|----------------------|
| 1 CHASE         | 5 PLATEN LEVERS      |
| 2 BOTTOM PLATEN | 6 PLATEN SPACERS     |
| 3 TOP PLATEN    | 7 SHIM PLATES        |
| 4 PREHEAT AREA  | 8 COMPENSATING BLOCK |



# RUBBER STAMP AND GOLD STAMP PRESS SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

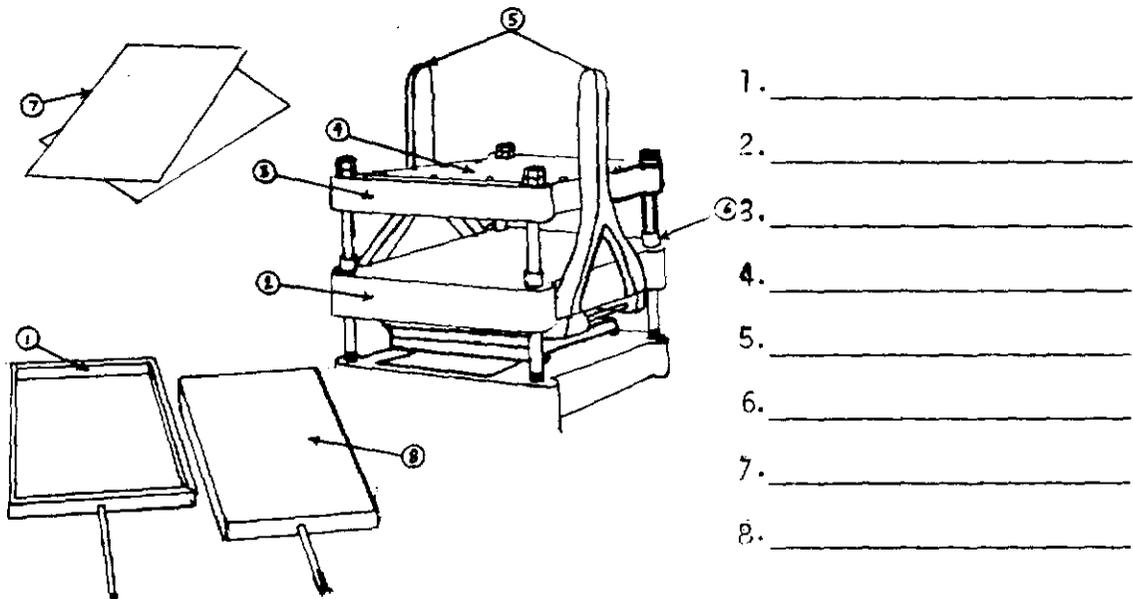
## True-False:

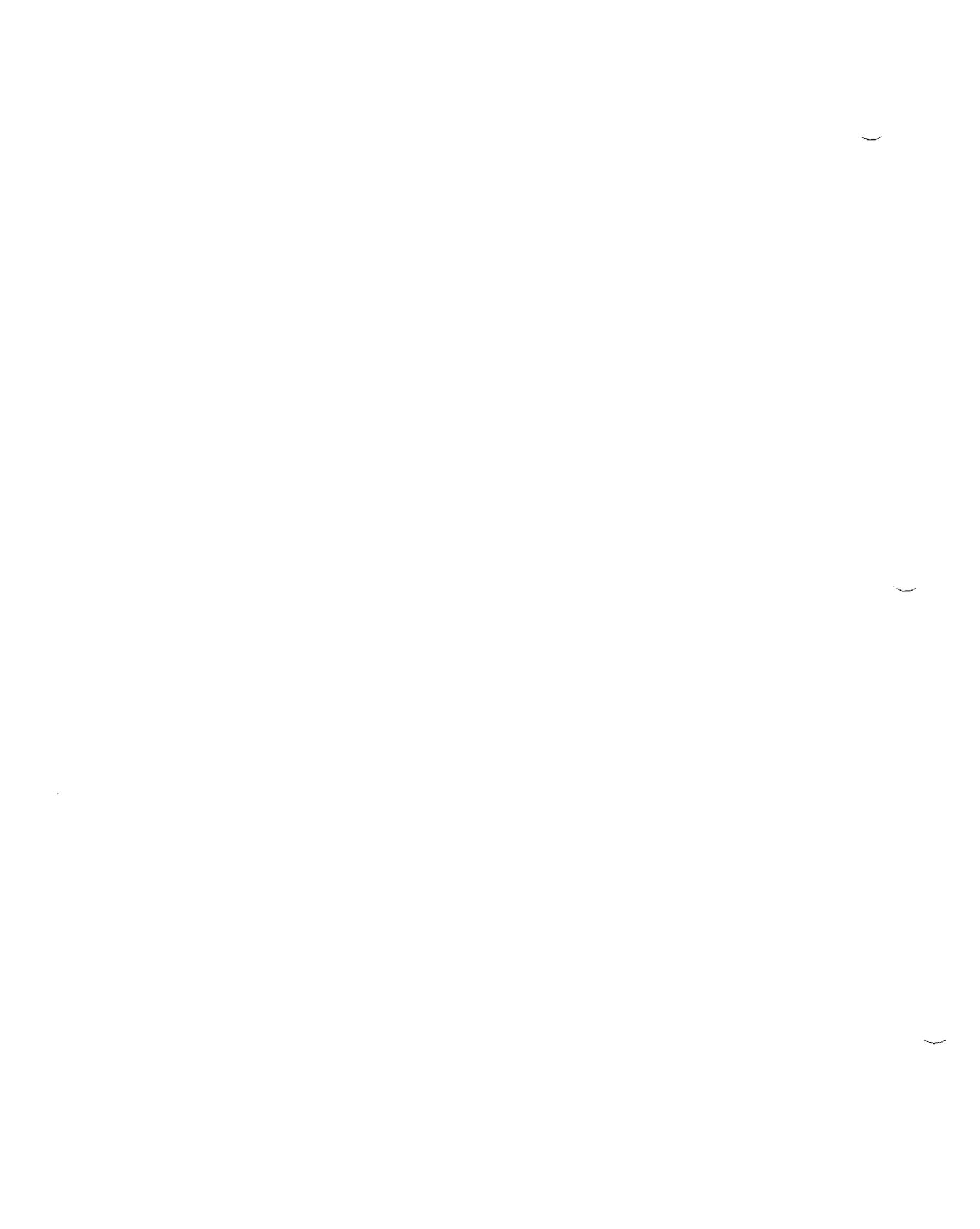
- T F 1. It is not necessary to take extra safety measures when using the rubber stamp press because it only becomes warm, not hot, during use.
- T F 2. You should be especially careful with the saw and drill that are used in making the stamp base.

## Multiple Choice:

- \_\_\_\_\_ 3. Before operating the rubber stamp press or the gold stamp press, one should: (a) get the teacher's permission, (b) ask another pupil for instructions on how to operate them, (c) have received teacher instructions on how to operate them (d) both a and c above.
- \_\_\_\_\_ 4. Keep the work area: (a) cluttered, (b) clean, (c) confined to a small corner of the shop, (d) none of these.

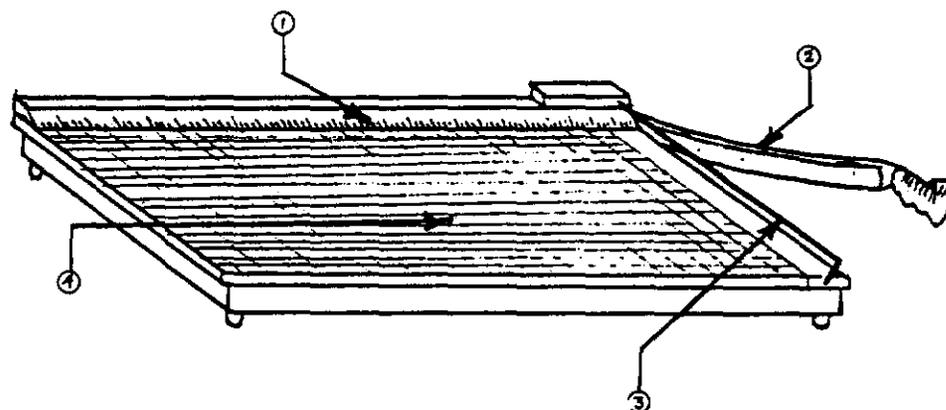
Write the correct name of each part in the space provided.





## FINISHING EQUIPMENT

### HAND-OPERATED PAPER CUTTER



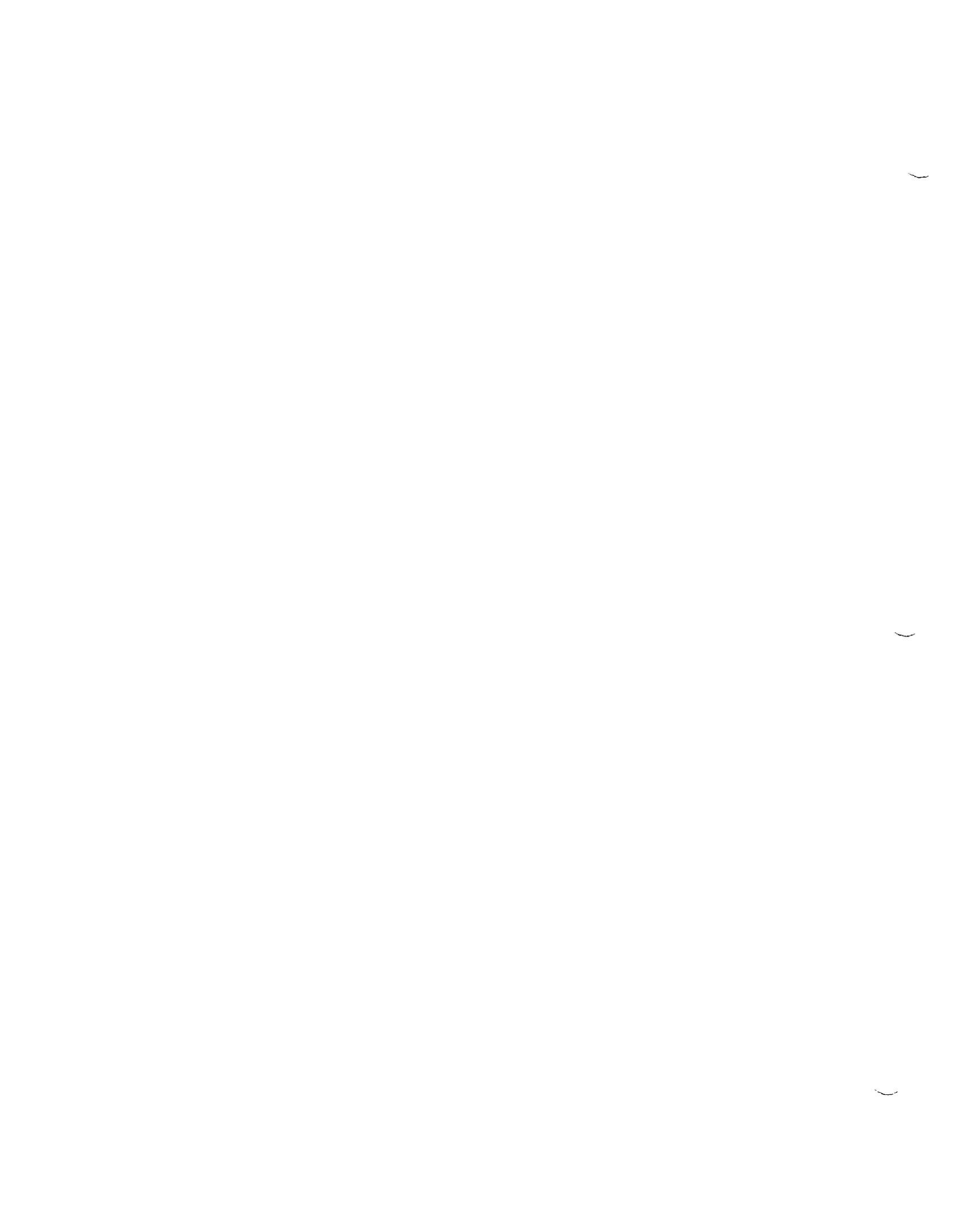
1. SCALE OF INCHES

2. KNIFE

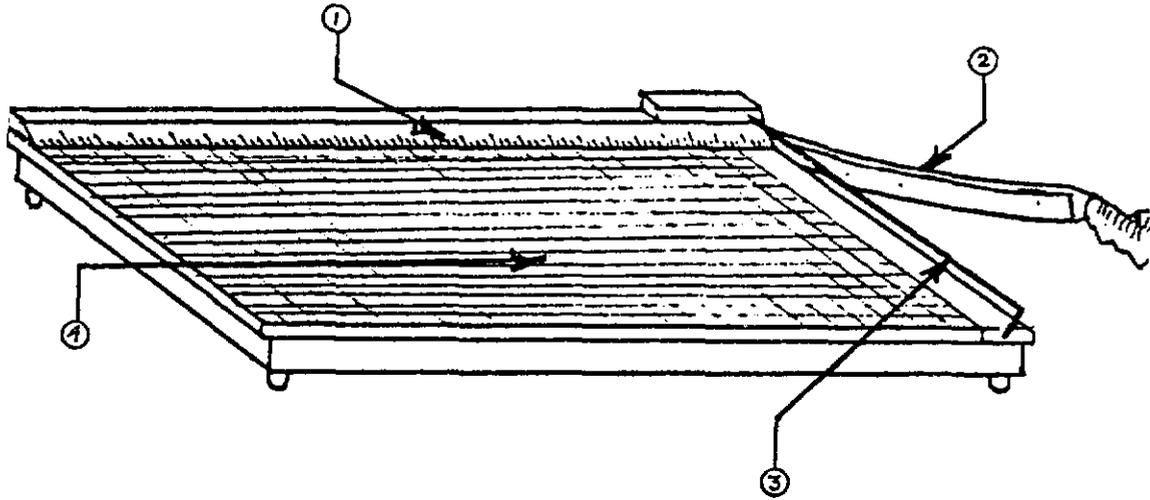
3. GUARD

4. PAPER TABLE

1. Operate only with the teacher's permission and after instructions have been received.
2. Use the paper cutter with great care as it can cause serious cuts and pinches.
3. When operating the paper cutter, keep the fingers behind the safety guard and never remove the guard.
4. To prevent cut fingers, use the safelight when cutting orthochromatic film in the darkroom. For cutting panchromatic film in total darkness, the cutting edge should be coated with fluorescent or luminous paint.
5. Place a ruler, not the fingers, next to the blade to hold the paper flat.
6. When using the paper cutter, cut only one sheet of paper or film at a time. Do not use the paper cutter to cut anything except paper or film.
7. When finished, always close the cutting blade and fasten it with the safety lock.



# HAND-OPERATED PAPER CUTTER



1 SCALE OF INCHES

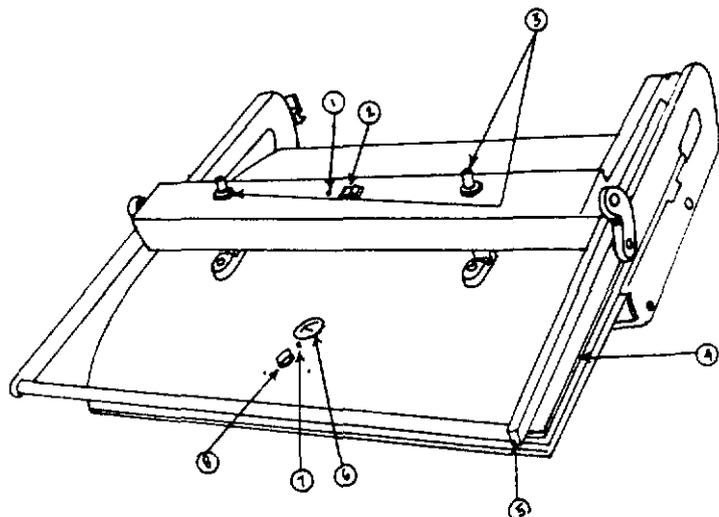
2 KNIFE

3 GUARD

4 PAPER TABLE



## DRY MOUNT PRESS

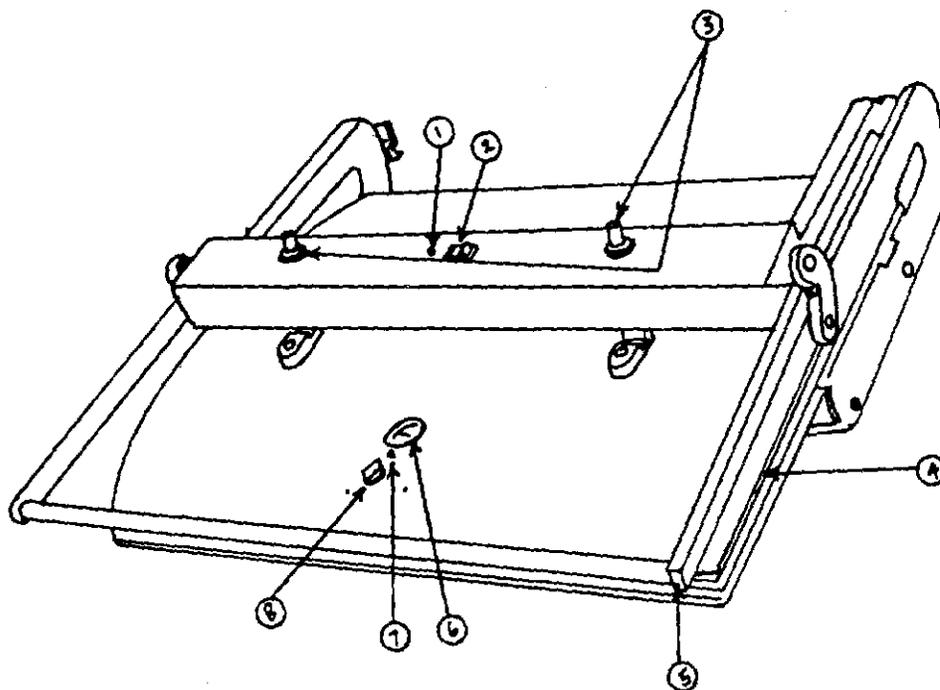


1. POWER LIGHT (RED)
2. ON/OFF SWITCH
3. PRESSURE ADJUSTMENT KNOBS
4. SPONGE PAD
5. HANDLE
6. THERMOMETER
7. PILOT LIGHT (AMBER)
8. THERMOSTAT

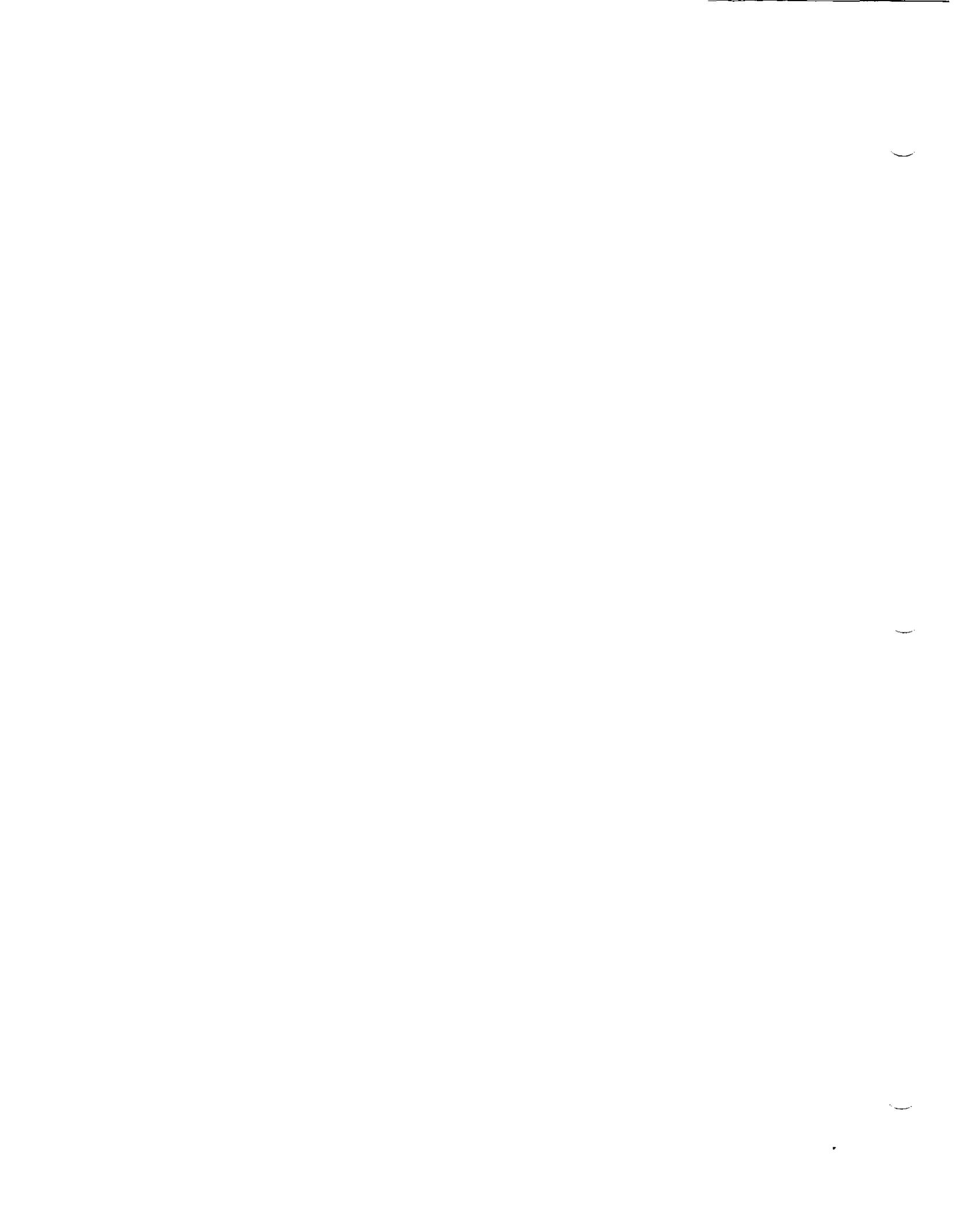
1. Operate only with the teacher's permission and after instructions have been received.
2. When using the dry mount press or tacking iron, be careful not to burn yourself.
3. Never test the heat of the press or tacking iron by touching them.
4. Do not let your hands come into contact with the platen of the dry mount press. Also, do not close the press on your hands.
5. Dry mount with the heat setting prescribed by the teacher.
6. Do not lay the hot tacking iron down on papers or the counter top. Return it to its proper holder after each use.
7. When closing the platen of the dry mount press, be sure that the print and the mount are the only items under the platen.
8. Turn off and unplug the press or tacking iron when the job is finished.



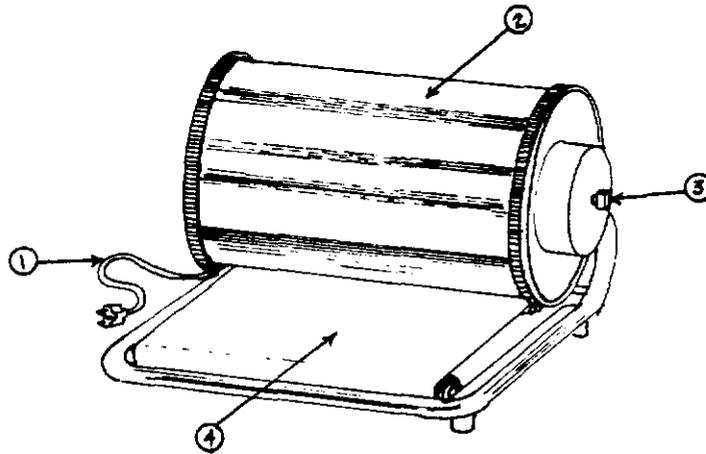
# DRY MOUNT PRESS



- |                             |                       |
|-----------------------------|-----------------------|
| 1 POWER LIGHT (RED)         | 5 HANDLE              |
| 2 ON/OFF SWITCH             | 6 THERMOMETER         |
| 3 PRESSURE ADJUSTMENT KNOBS | 7 PILOT LIGHT (AMBER) |
| 4 SPONGE PAD                | 8 THERMOSTAT          |

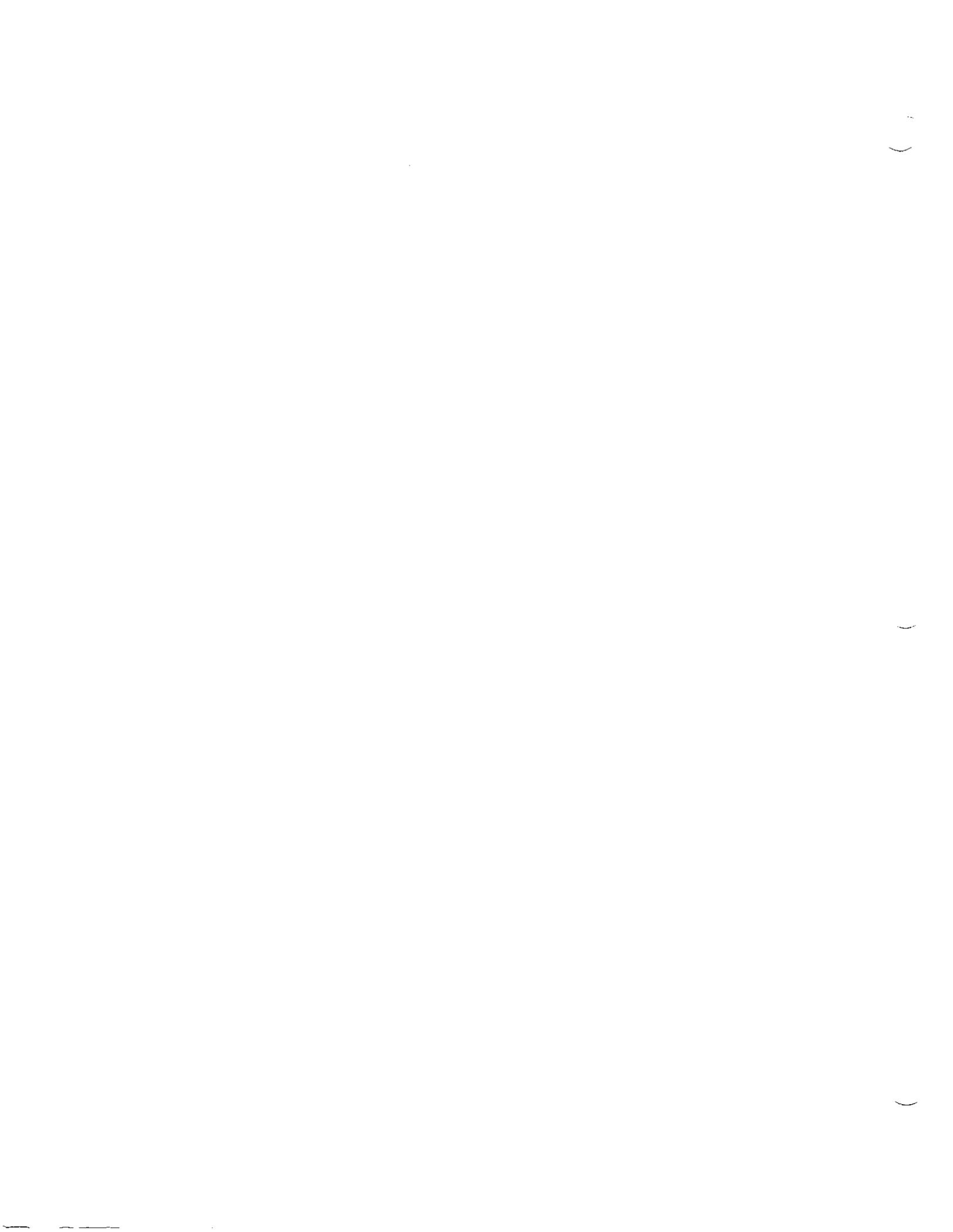


## PRINT DRYER

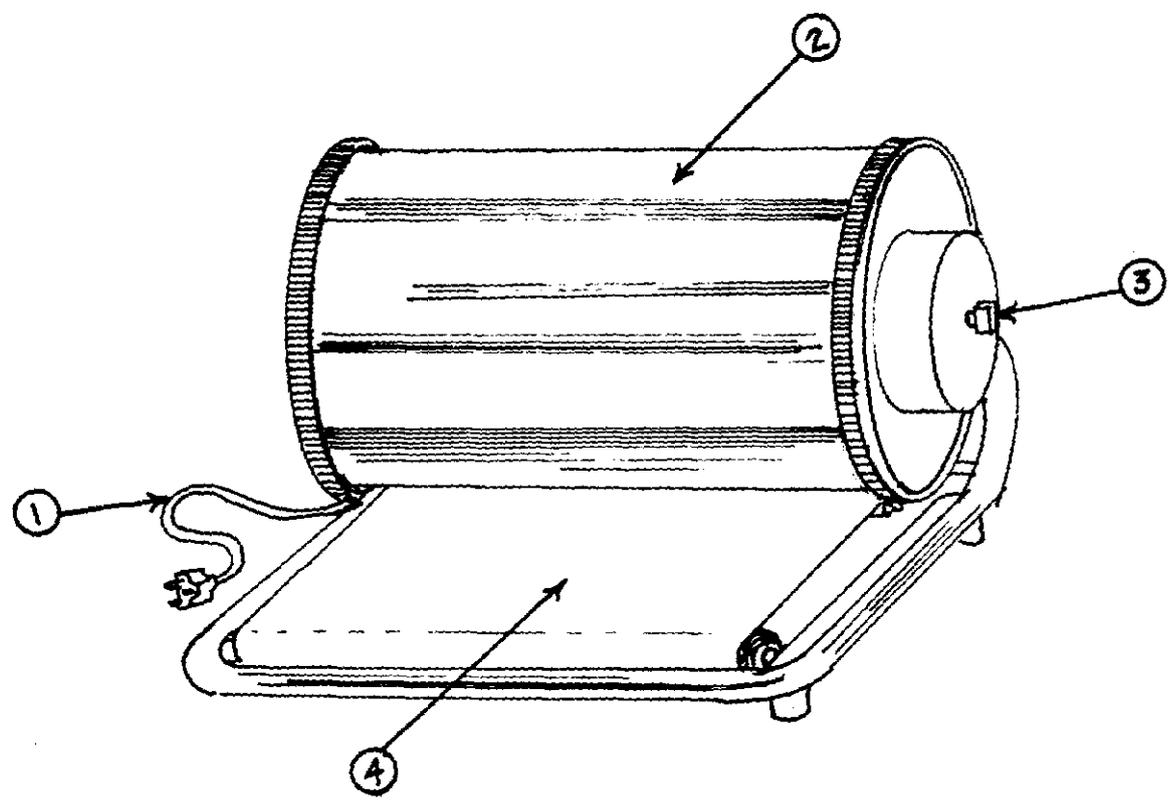


1. POWER CORD
2. FERROTYPE TIN
3. THERMOSTAT
4. CANVAS COVER

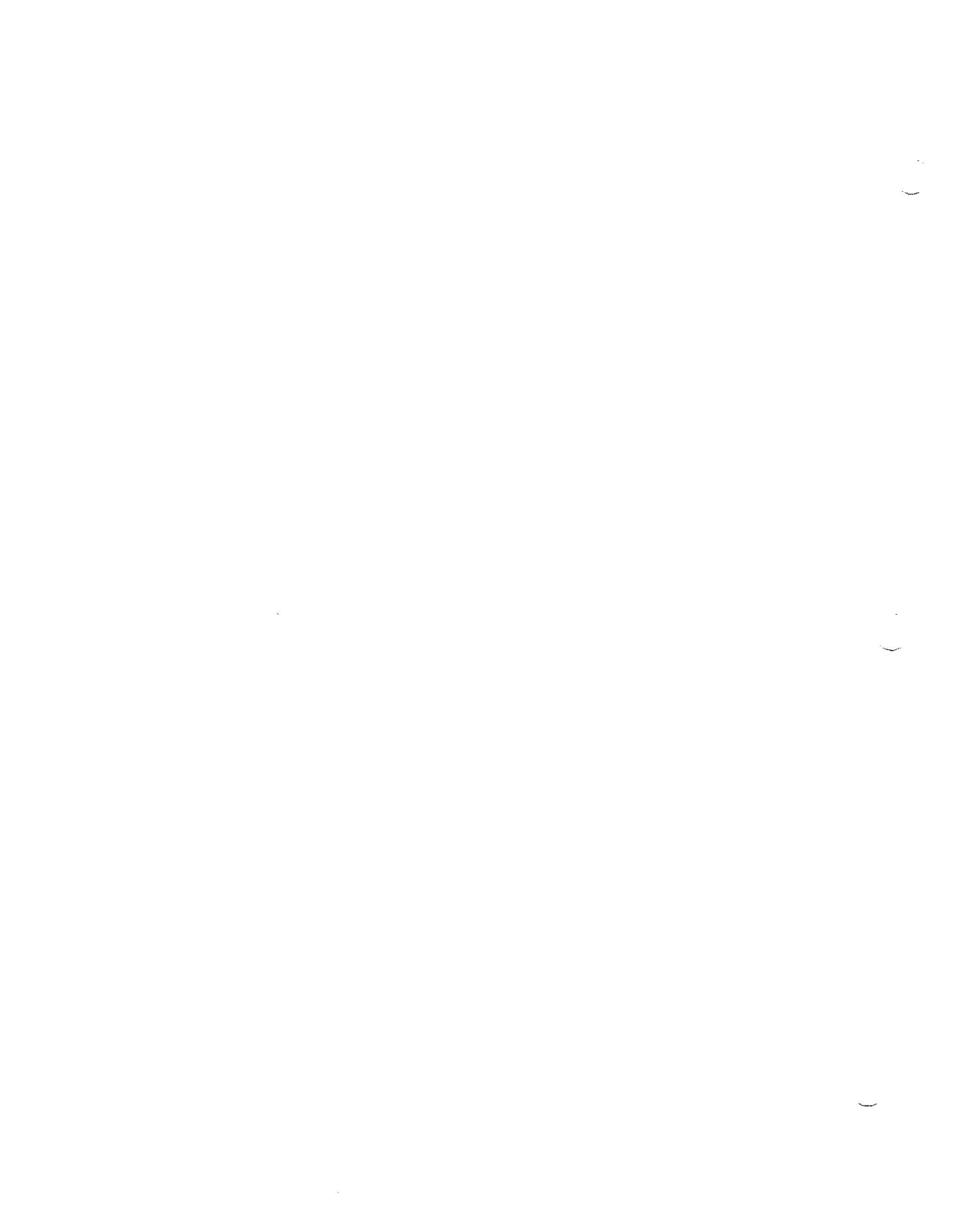
1. Operate only with the teacher's permission and after instructions have been received.
2. Be careful to avoid burns when using the print dryer. Its surfaces are hot.
3. Be sure the electrical cord to this machine is not worn and is properly grounded.
4. Do not use this machine with wet hands or while standing on a wet floor.



# PRINT DRYER



- 1 POWER CORD
- 2 FERROTYPING TIN
- 3 THERMOSTAT
- 4 CANVAS COVER



## SPRAY ADHESIVES AND FILM CLEANERS

1. Get instructions on how to use these materials properly and safely before proceeding.
2. Use spray adhesives and film cleaners in a well-ventilated place. They are flammable.
3. Avoid breathing the fumes. There is evidence that these fumes can seriously damage one's health.
4. Do not use these materials in areas where others will have to breathe the fumes.
5. Treat these substances just like you would treat any other flammable material.

## CUTTING TOOLS

1. Use all cutting tools (scissors, X-acto knives, matte knife, etc.) very carefully.
2. Keep all cutting tools sharp since dull blades can be dangerous.
3. Carry and store all cutting tools in a safe manner.
4. To prevent serious cuts, never try to catch a dropped cutting tool.

## FINISHING EQUIPMENT SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

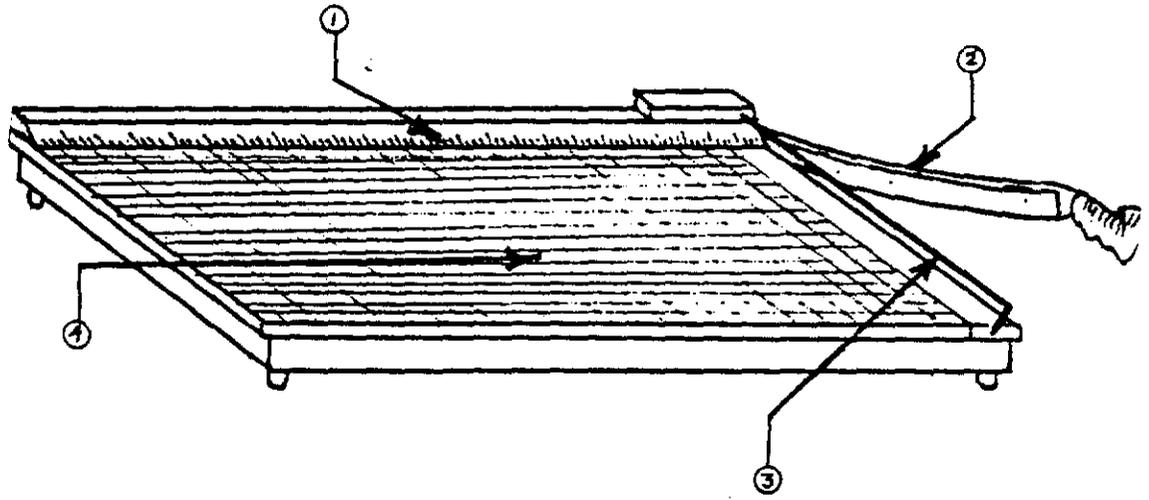
### True-False:

- T F 1. The guard should be removed before using the paper cutter.
- T F 2. The paper cutter may also be used to cut cloth, plastic, and thin pieces of wood.
- T F 3. The tacking iron must be returned to its proper holder after use to avoid fire danger or damage to the counter.
- T F 4. The heat setting for the dry mount press is to be decided by the teacher.
- T F 5. Spray adhesives and film cleaners are flammable and special precautions should be taken when using them.
- T F 6. The print dryer becomes only slightly warm during use.
- T F 7. The paper cutter can cause serious cuts and pinches.
- T F 8. A person using the paper cutter should cut several pieces at one time to save energy and time.
- T F 9. The print dryer should not be used with wet hands or while standing on a wet floor.

### Multiple Choice

- \_\_\_\_\_ 10. For cutting panchromatic film in total darkness, the cutting edge of the paper cutter should be coated with: (a) lumin-  
escent paint, (b) fluorescent paint, (c) latex paint,  
(d) a or b above.
- \_\_\_\_\_ 11. When using spray adhesives or film cleaners, be sure to:  
(a) avoid breathing the fumes, (b) store them in a metal  
cabinet, (c) avoid using them around sparks or flames, (d) do  
all of these.

- \_\_\_\_\_12. When using the tacking iron or dry mount press, extreme care should be taken due to: (a) the weight of the equipment, (b) the style of the equipment, (c) the high temperature of the equipment, (d) none of these.
- \_\_\_\_\_13. Before using the paper cutter, the pupil should: (a) put on safety glasses, (b) have the teacher's permission, (c) tie back long hair, (d) tuck in loose clothing.
- \_\_\_\_\_14. When the paper cutter is not in use, the blade must be: (a) closed and locked, (b) open and locked, (c) closed and unlocked, (d) open and unlocked.
- \_\_\_\_\_15. When using the dry mount press, keep the hands away from: (a) the base, (b) the mat, (c) the platen, (d) the mount.
- \_\_\_\_\_16. To avoid burns, always draw the tacking iron away from: (a) the print edge, (b) the mount board, (c) the hand, (d) the print center.
- \_\_\_\_\_17. In order to hold paper flat when using the paper cutter, use: (a) the left hand, (b) a ruler, (c) the right hand, (d) a piece of cardboard.
- \_\_\_\_\_18. When using the paper cutter, cut the following number of sheets of paper at one time: (a) one, (b) two, (c) three, (d) five.
- \_\_\_\_\_19. When closing the platen of the dry mount press, the only two things under the platen should be: (a) the print and tape, (b) the print and mount, (c) the mount and protective shield, (d) the mount and tape.
- \_\_\_\_\_20. When finished with the dry mount press or tacking iron, always: (a) turn it off and unplug, (b) leave it plugged in for the next pupil, (c) unplug only, (d) turn off only.
21. Write the correct name of each item and its parts in the space provided.  
(See next page)



A. \_\_\_\_\_

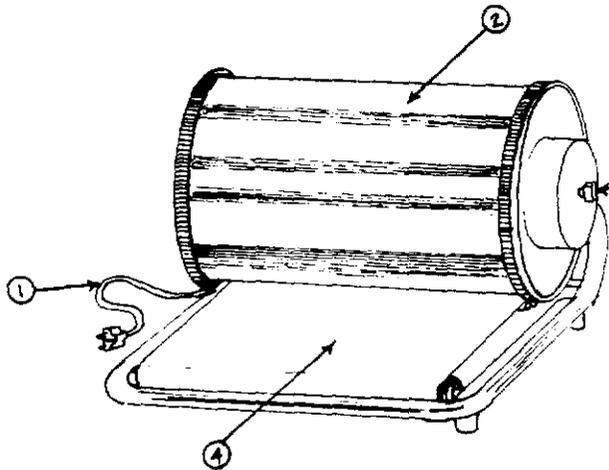
1. \_\_\_\_\_

3. \_\_\_\_\_

2. \_\_\_\_\_

4. \_\_\_\_\_

B. \_\_\_\_\_

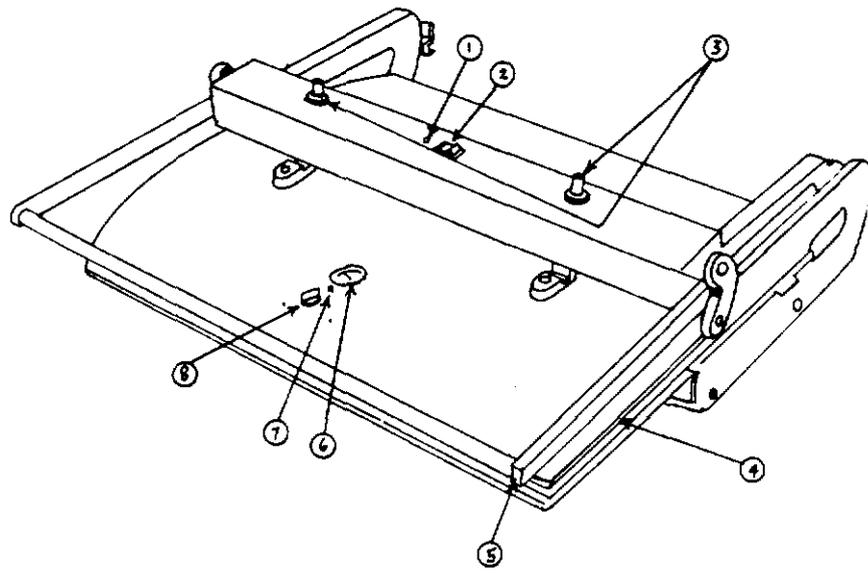


1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_



C. \_\_\_\_\_

1. \_\_\_\_\_

5. \_\_\_\_\_

2. \_\_\_\_\_

6. \_\_\_\_\_

3. \_\_\_\_\_

7. \_\_\_\_\_

4. \_\_\_\_\_

8. \_\_\_\_\_

## REFERENCES

Materials were selected and reviewed from the following sources, and in some instances were incorporated in the production of the preceding unit.

Accident Prevention for Industrial Arts, Vocational and Technical Education Programs. Oklahoma State Board of Vocational and Technical Education.

California Industrial Arts Safety Instruction Manual. California State Department of Education: Sacramento

Ohio Industrial Arts and Vocational Education Safety Manual. State of Ohio Department of Education.

Pennsylvania Industrial Arts Safety Guide. Industrial Arts Association of Pennsylvania, Pennsylvania Department of Education.

Safety Planning in Graphic Communications Education. Graphic Arts Technical Foundation: Pennsylvania, 1979

Utah Industrial Education Safety Recommendations and UOSHA Standards. Utah State Board of Education.

Washington State Industrial Arts Safety Guide. Washington State Board of Education.

Wichita State University Photography Safety Instructions. Wichita State University: Kansas.

Wyoming Occupational Education Safety Manual. Wyoming State Department of Education: Wyoming, 1973

A. B. Dick Company	Michael Business Machines
Addressograph-Multigraph Corp.	Nuarc Company, Inc.
Challenge Machinery Co.	Photo Materials Company
Chandler & Price Co.	Robertson Photo-Mechanix, Inc.
Compugraphic	Screen Printing & Drying Machine Co.
Hammond Machinery Builders, Inc.	Seal, Inc.
Interlake, Inc.	SSP Brown Camera, Inc.
Lowel-Light Manufacturing, Inc.	Vivitar Corporation
MacMillan Arts & Crafts, Inc.	

## **PART 6:**

### **EQUIPMENT FOR WORKING IN ELECTRICITY/ELECTRONICS**

Cathode-ray Tube

Circuit Boards and Kits

Etched-Circuit PC Boards

Multimeter

Oscilloscope

Power Supply

Signal Generator

Signal Tracer

Transformer

Pages 467-468 were adapted from Vocational Safety Guide, produced by Hillsborough County Public Schools, Tampa, Florida, 1980.

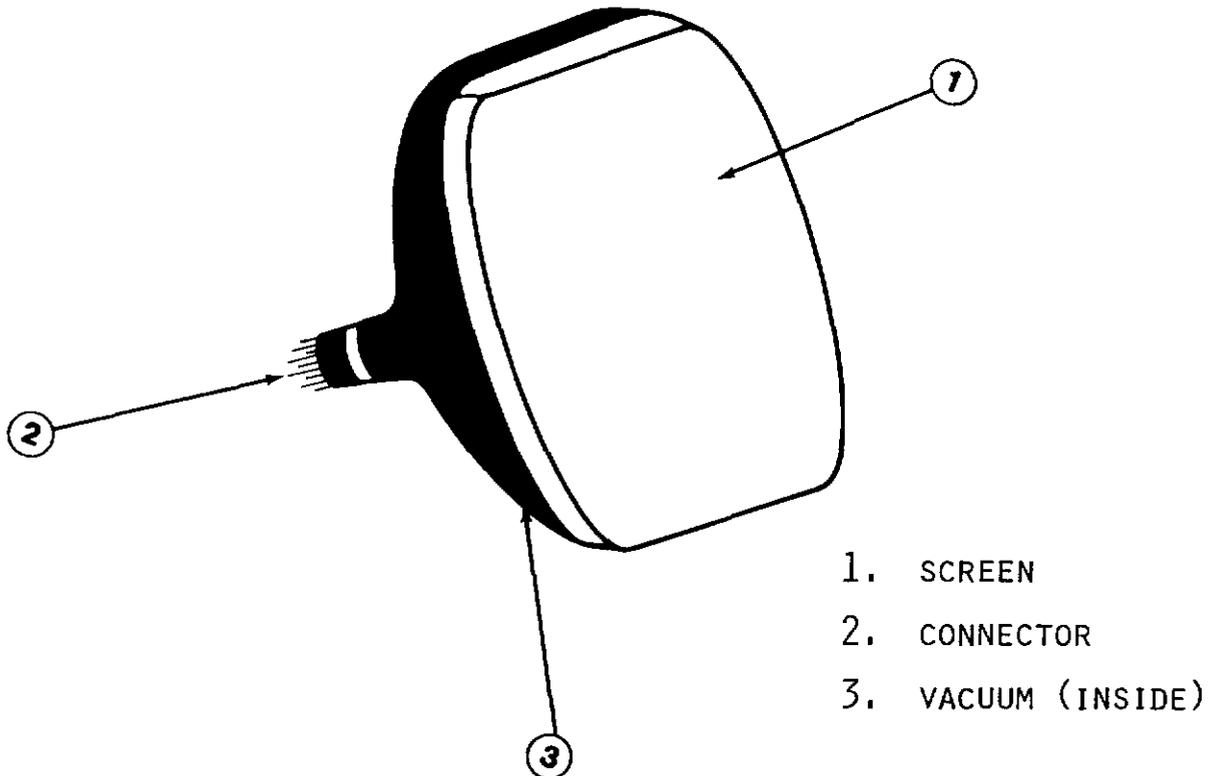
Pages 469-521 were adapted from Safety Education Handbook, produced by Kansas State Department of Education, Wichita, Kansas, 1981.

## ELECTRICITY/ELECTRONICS SAFETY RULES

1. Don't underestimate the potential danger of a 110 VAC circuit.
2. Consider all wires and terminals as live and "hot" until they are proven otherwise by a safe method of testing.
3. Resist the temptation to throw a switch just to see what happens.
4. Make wiring changes only with the power off.
5. Disconnect or unplug appliances and equipment before attempting repairs.
6. Disconnect the power cord before you touch anything behind the front panel of a transmitter.
7. Do not work on live circuits except when absolutely necessary.
8. Never install equipment that will overload a circuit.
9. Do not work on live voltage circuits by yourself.
10. Be careful around electric arcs, because they will cause bad burns to skin and eyes.
11. Stand on dry, nonconductive surfaces when you work on live circuits or use electric tools.
12. Do not wear metal jewelry, watches, rings, chains, etc., when you work on electrical equipment.
13. Remember that an involuntary reaction to electric shock can cause you to injure yourself and possibly others.
14. Always wear safety glasses when you solder.
15. Remove headphones before you work on equipment.
16. Wear gloves and a face shield when you handle cathode-ray tubes. Old CRTs should be smashed in a large steel barrel by dropping a heavy metal rod through a hole in the top of the barrel. Never leave CRTs sitting around as curiosities.
17. Do not touch a metal cabinet or other grounded material to avoid electrical shock.
18. Never bypass electrical protective devices.
19. All electrical lines must be properly fused.
20. Turn off power before replacing fuses.

21. Locate and correct the cause of a blown fuse or tripped circuit breaker before replacing the fuse or resetting the breaker.
22. Experimental circuits and wiring practice boards should be fused properly.
23. All tools should have proper guards.
24. Never attempt to use a piece of electrical equipment known to be faulty.
25. Do not use tools with frayed or damaged cords. Make it a habit to inspect cords, plugs, etc.
26. Do not use meter leads with defective probes.
27. Be sure the power is off when checking a circuit with an ohmmeter.
28. Make it a habit to keep one hand in your pocket or behind your back when using a test probe.
29. Use a test lamp or suitable meter for testing a circuit.
30. Make sure capacitors are discharged before you touch them. Experimental power supplies should incorporate "bleeder" resistors.
31. Have a ground on all power tools.
32. Mechanically ground all electric motors.
33. Chassis of AC-DC radios should be kept clear of any grounded conductors. Use an isolation transformer if one is available; otherwise determine polarity and reverse the plug, if necessary.
34. Protect all electrical wires when routing them over refrigerant tubing.
35. Make sure wire size and insulation are appropriate for the job.
36. Tag and lock all electrical disconnects when working on live circuits.
37. Use the proper-sized electrical cord.
38. Follow instructions when handling and charging storage batteries.
39. Keep sparks and flames away from storage batteries, especially when the batteries are being charged.

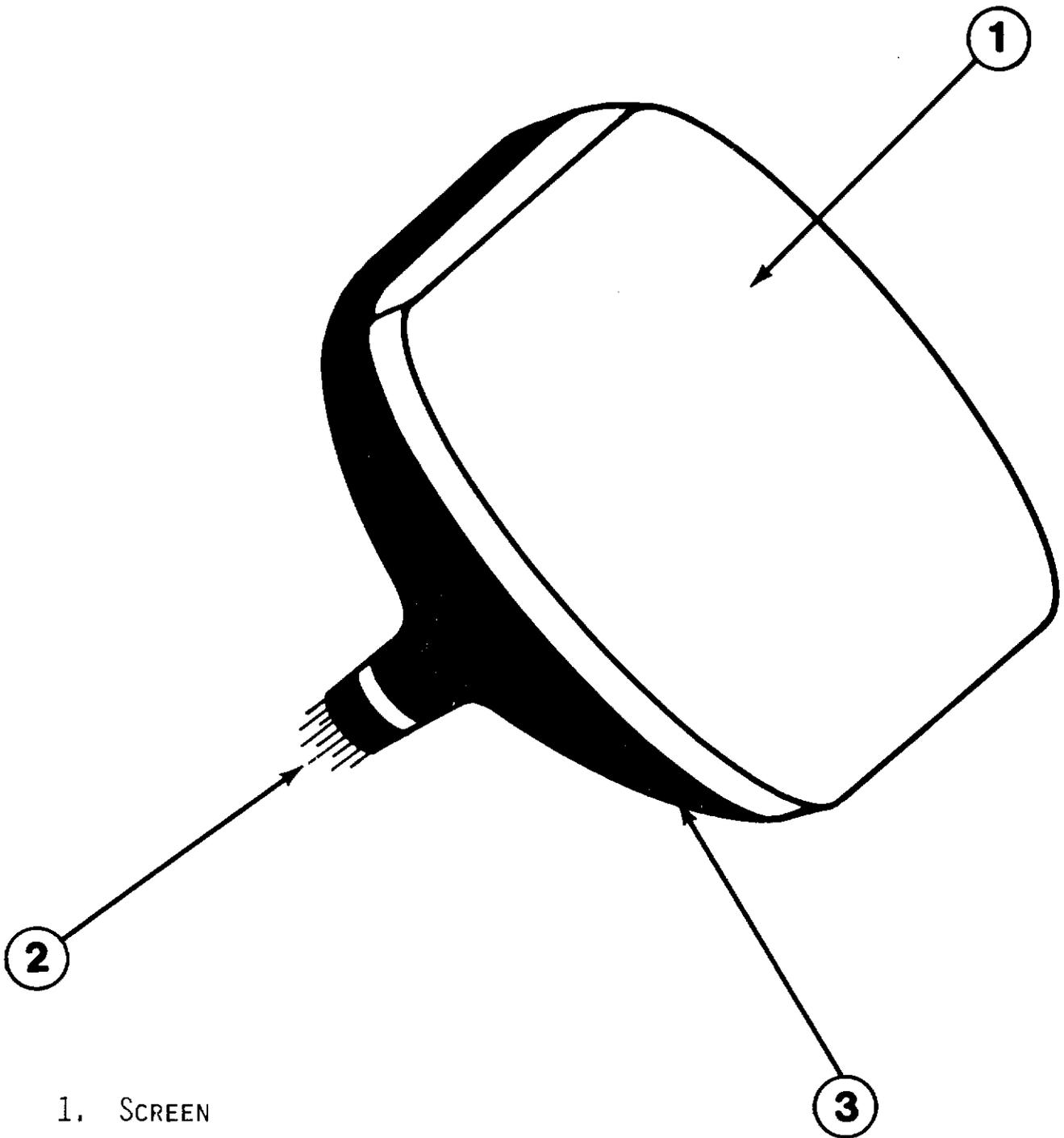
## CATHODE-RAY TUBE



1. Cathode-ray tubes must be handled with great care. They are an extreme implosion hazard if broken.
2. The teacher shall always be present when pupils are handling or deactivating a cathode-ray tube.
3. A face shield and gloves must be worn when handling cathode-ray tubes.
4. Because of the implosion hazard the room should be cleared of people when handling cathode-ray tubes.
5. Cathode-ray tubes store a high electrical potential. A severe shock can occur if the tube is not properly grounded.
6. A cathode-ray tube should be placed in a cardboard carton when it is carried.



# CATHODE-RAY TUBE



- 1. SCREEN
- 2. CONNECTOR
- 3. VACUUM (INSIDE)



## CATHODE-RAY TUBE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

Read each statement carefully and record the best choice.

\_\_\_\_\_ 1. When handling a cathode-ray tube:

- A. clear the room of people.
- B. have the teacher present.
- C. wear a face shield and gloves.
- D. do all of the above.

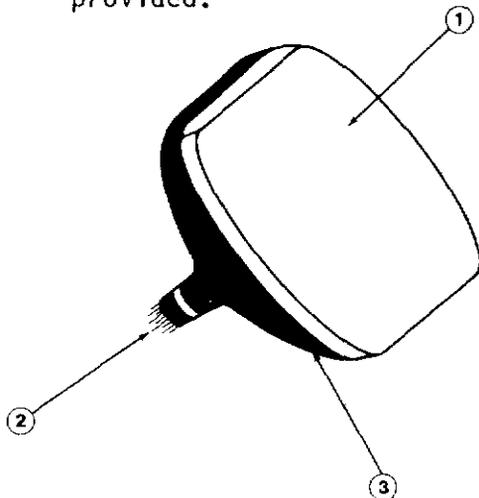
\_\_\_\_\_ 2. Cathode-ray tubes are dangerous because:

- A. they have a small neck.
- B. they are an extreme implosion hazard.
- C. they store a high electrical potential.
- D. they are both B and C.

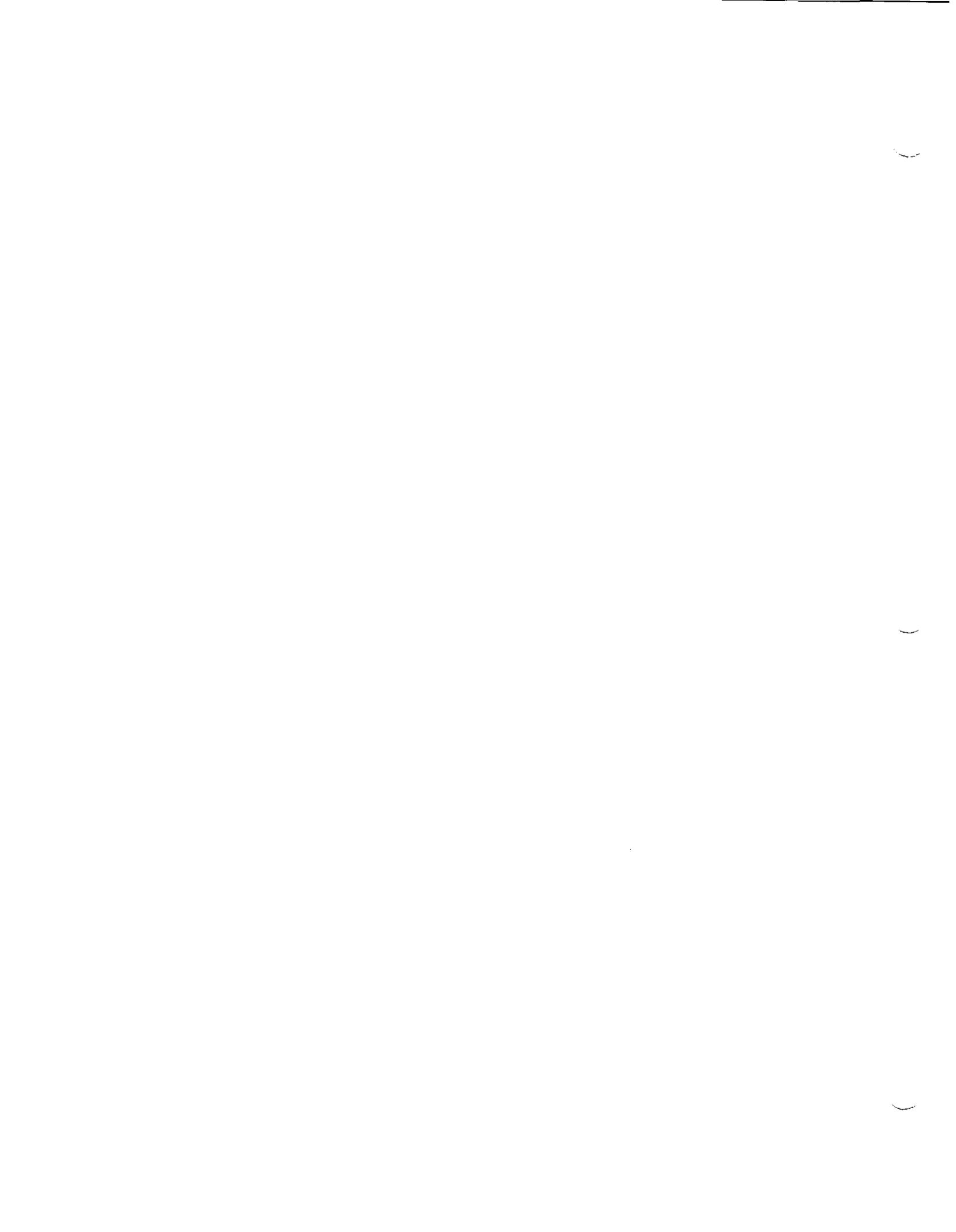
\_\_\_\_\_ 3. When carrying a cathode-ray tube:

- A. the teacher should be present.
- B. the cathode-ray tube should be held by its neck.
- C. the cathode-ray tube should be placed in a cardboard carton.
- D. be sure to have both A and C.

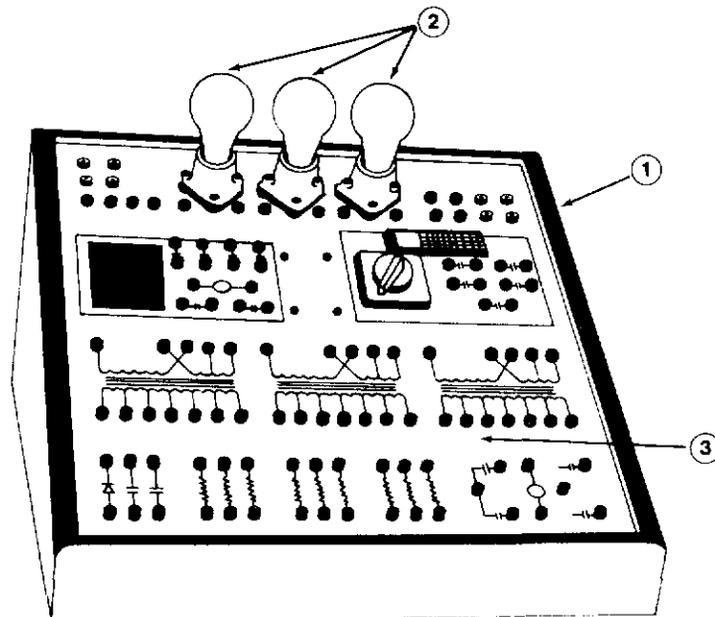
4. Label the parts of the cathode-ray tube in the spaces provided.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_



## CIRCUIT BOARDS AND KITS

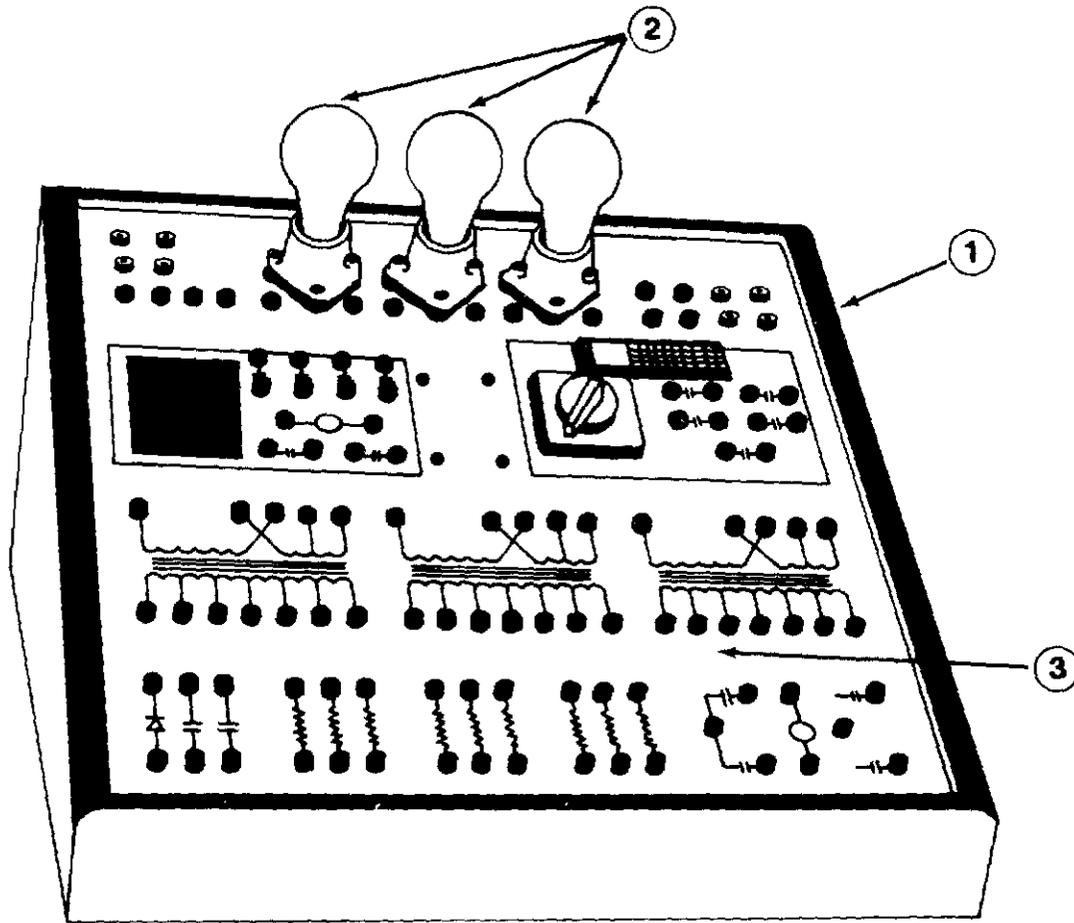


1. CHASSIS
2. INDICATORS
3. CIRCUIT BOARD

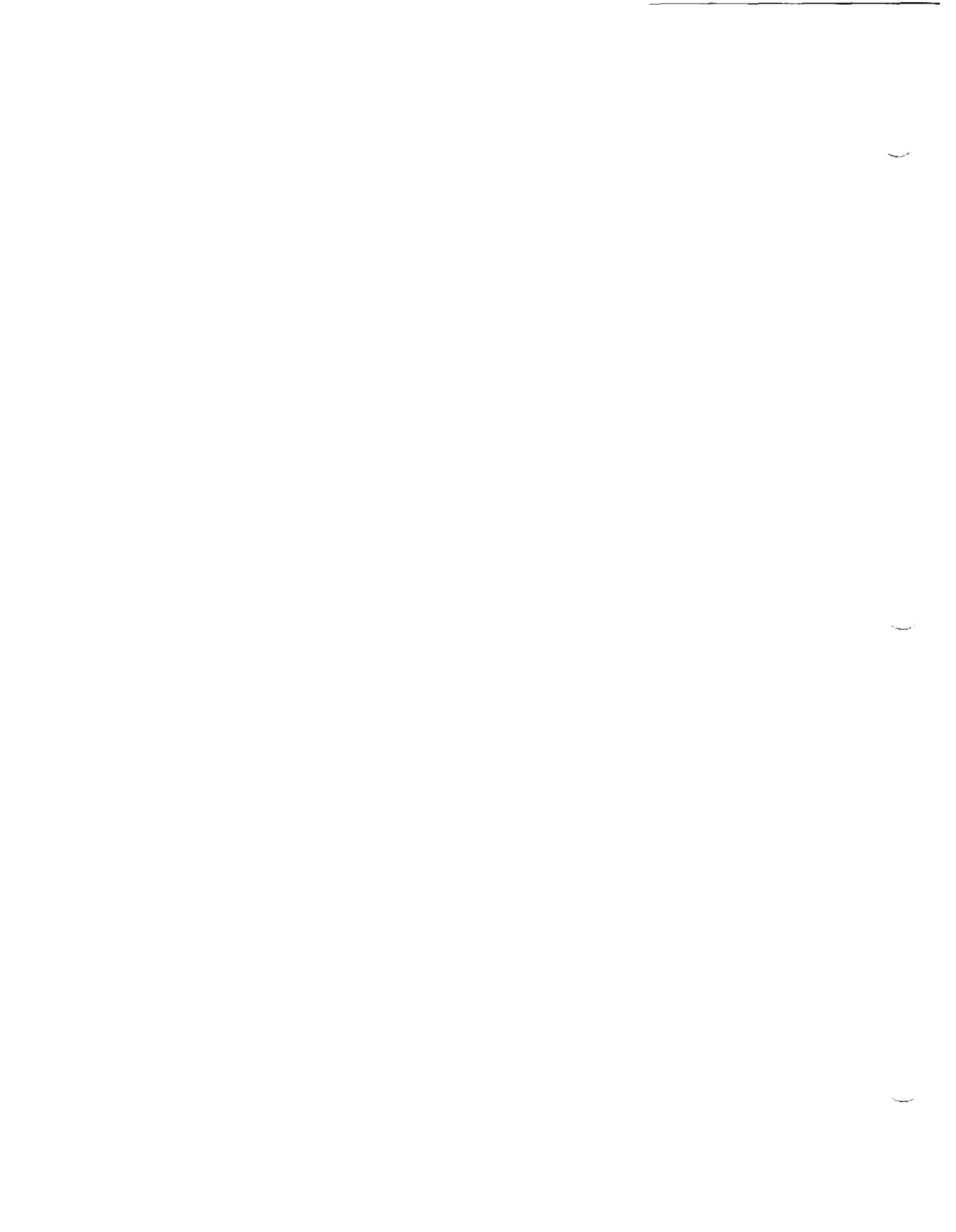
1. Never experiment with circuits unless you have been instructed to do so.
2. Keep the chassis or case clear of grounded objects.
3. Be sure all capacitors are discharged.
4. Disconnect the power source before making adjustments to the circuits.
5. Always check the circuits with a voltmeter or test lamp to determine the values and dangers that might be encountered.
6. Always stand on an ungrounded surface when using a circuit board or working on a kit.
7. Use an isolation transformer when working with 117 volts AC.



# CIRCUIT BOARD TRAINER



1. CHASSIS
2. INDICATORS
3. CIRCUIT BOARD



CIRCUIT BOARDS AND KITS SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

Read each statement carefully and record the best choice.

\_\_\_\_ 1. When using 117 volts AC:

- A. always use an isolation transformer.
- B. always use an indicator lamp.
- C. always keep the chassis or case clear of grounded objects.
- D. do both A and C.

\_\_\_\_ 2. For one's own protection, one should:

- A. be sure all capacitors are charged.
- B. be sure all capacitors are discharged.
- C. stand on a grounded surface.
- D. do both B and C.

\_\_\_\_ 3. When wiring a circuit board or kit:

- A. never experiment with the circuits.
- B. never place the board or kit on an ungrounded surface.
- C. never disconnect the power source.
- D. never do both A and B.

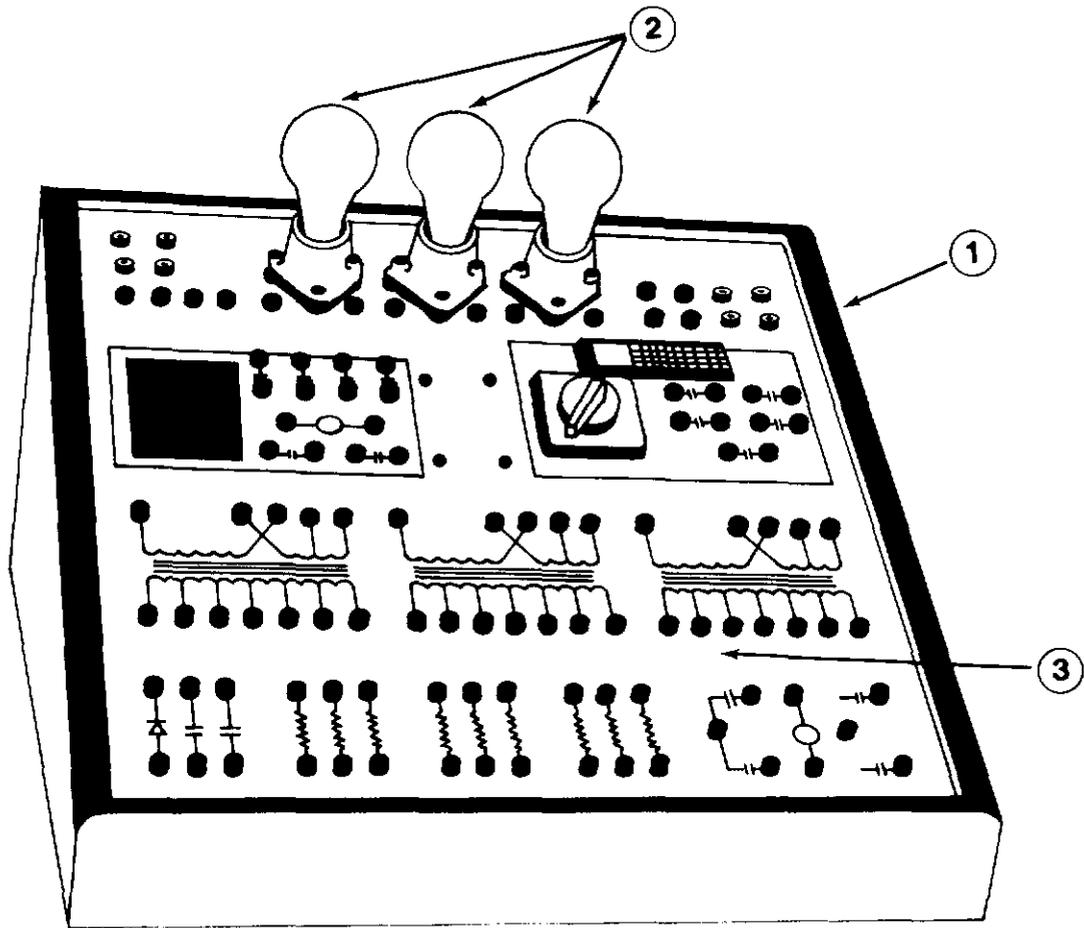
\_\_\_\_ 4. When making adjustments on an active circuit:

- A. stand on an ungrounded surface.
- B. disconnect the power source, when it is possible.
- C. stand on a grounded surface.
- D. do both A and B.

\_\_\_\_ 5. To determine the values and dangers encountered in using a circuit board or assembling a kit:

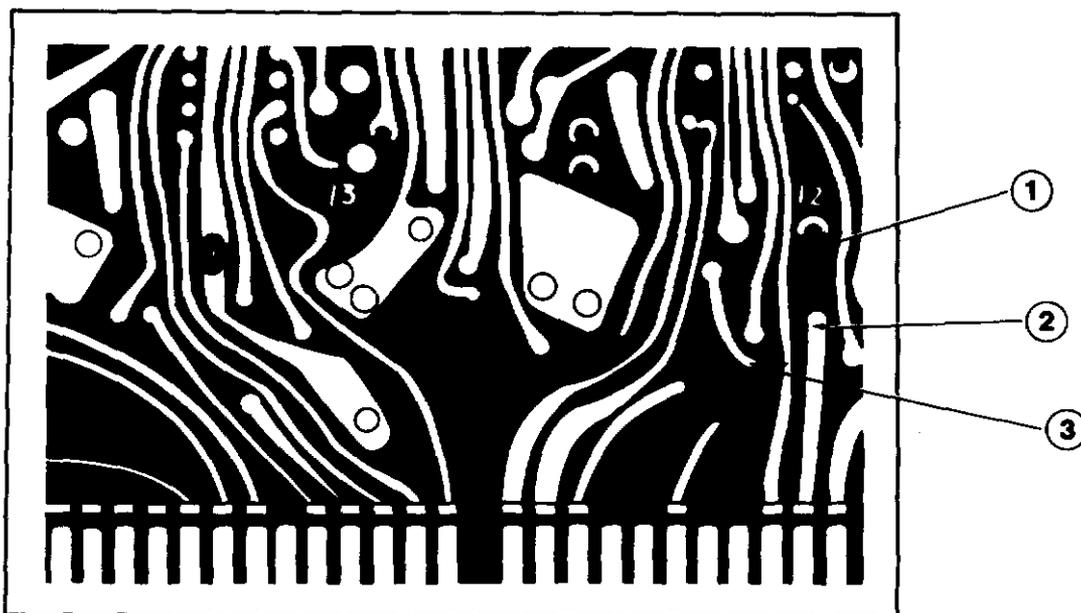
- A. read the lab manual carefully.
- B. use a moistened finger.
- C. check the circuits with a test lamp or voltmeter.
- D. do both A and C.

6. Label the parts of the circuit board.



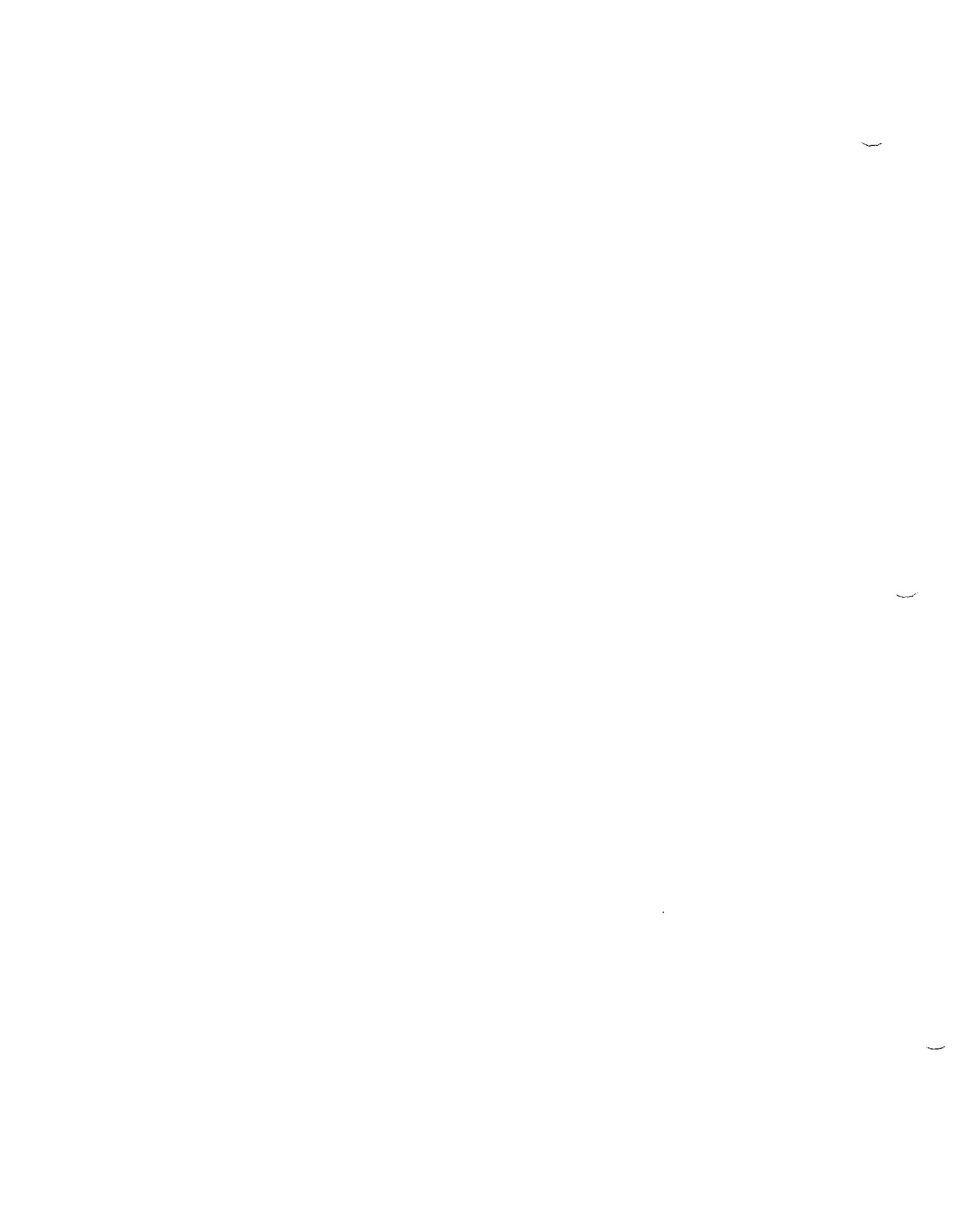
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

## ETCHED-CIRCUIT P C BOARDS

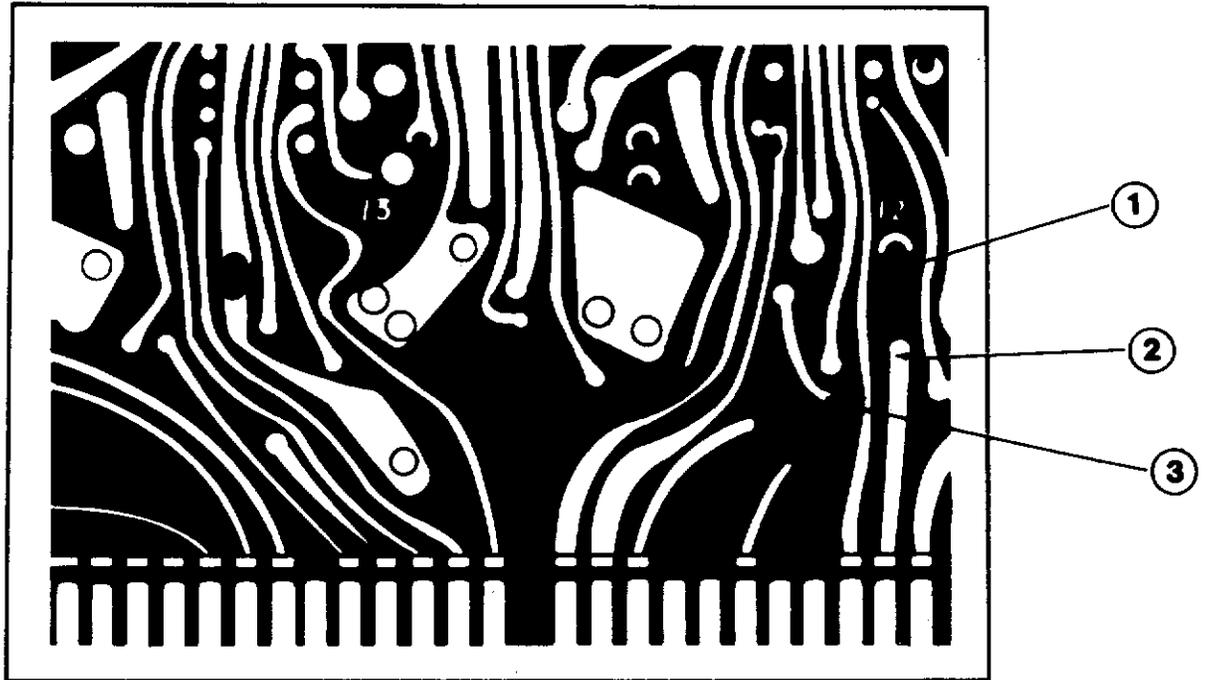


1. FIBER PLASTIC BODY
2. SOLDERING SOCKET
3. COPPER CONDUCTOR

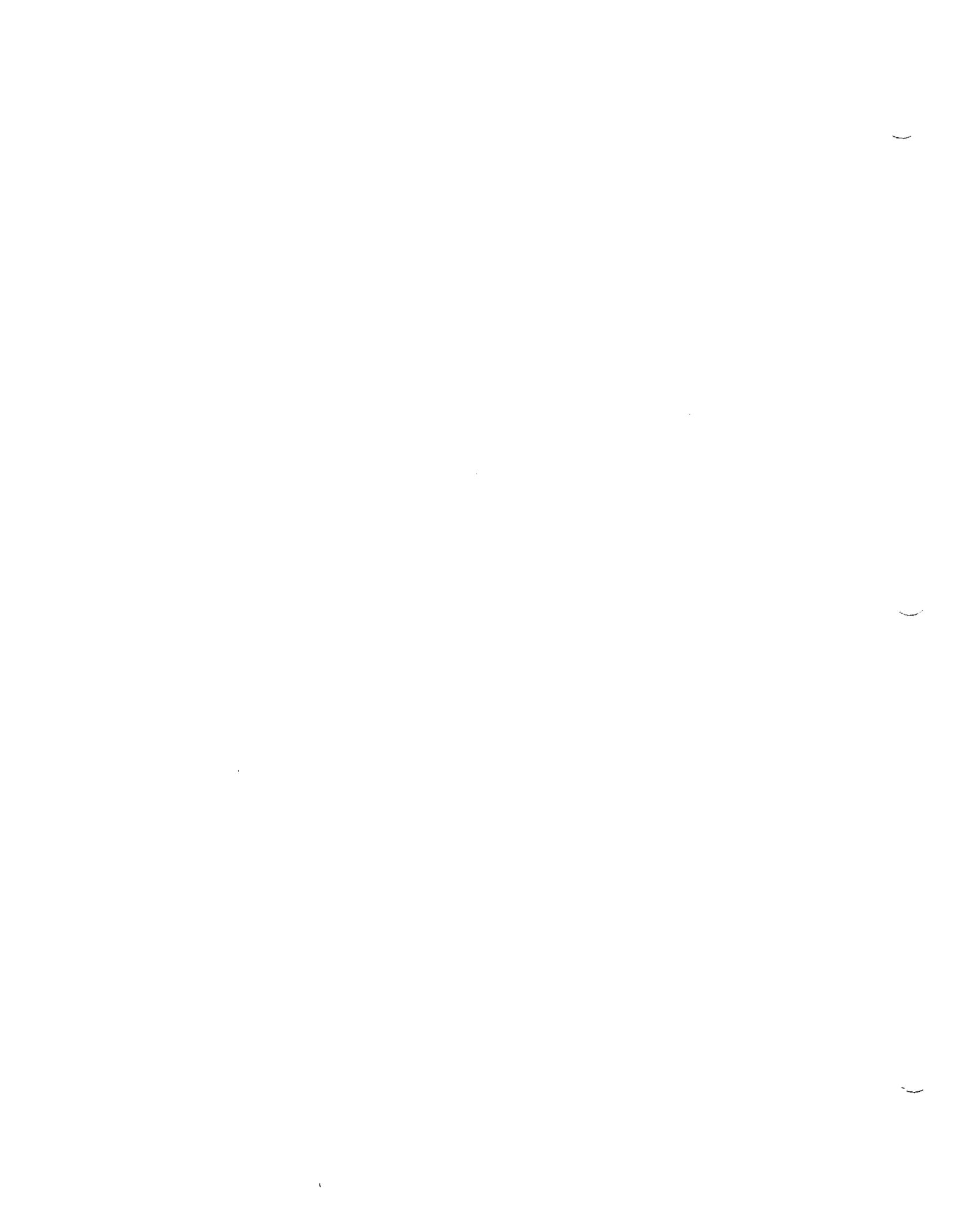
1. Most chemicals used to make etched-circuit P C boards are flammable. Do not use them near heat or flames.
2. Developers such as those used on P C contact film and P C boards should be used only where there is adequate ventilation.
3. Rubber gloves should be worn when working with any of the chemicals used to make etched-circuit P C boards.
4. None of the chemicals used to make etched-circuit P C boards should be allowed to come in contact with the eyes, skin, or mucous membranes (inner nose or mouth).
5. The chemicals used to make etched-circuit P C boards must not be swallowed. They are poisonous.
6. When using chemicals contained in spray cans, it is important not to puncture the cans or spray the chemicals directly on the skin.



# ETCHED-CIRCUIT PC BOARD



1. FIBER PLASTIC BODY
2. SOLDERING SOCKET
3. COPPER CONDUCTOR



## ETCHED-CIRCUIT P C BOARDS SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

Read each statement carefully and record the best choice.

\_\_\_\_\_ 1. Most chemicals used to make an etched-circuit P C board are:

- A. stored in glass bottles.
- B. flammable.
- C. highly caustic.
- D. both B and C.

\_\_\_\_\_ 2. When using chemicals in spray cans:

- A. avoid direct contact with the spray.
- B. do not use them around heat or flames.
- C. do not puncture the can.
- D. observe all of the above.

\_\_\_\_\_ 3. When working with chemicals that are used to make etched-circuit P C boards:

- A. work in a room with no light.
- B. keep all the windows tightly closed.
- C. protect your hands with rubber gloves.
- D. do none of the above.

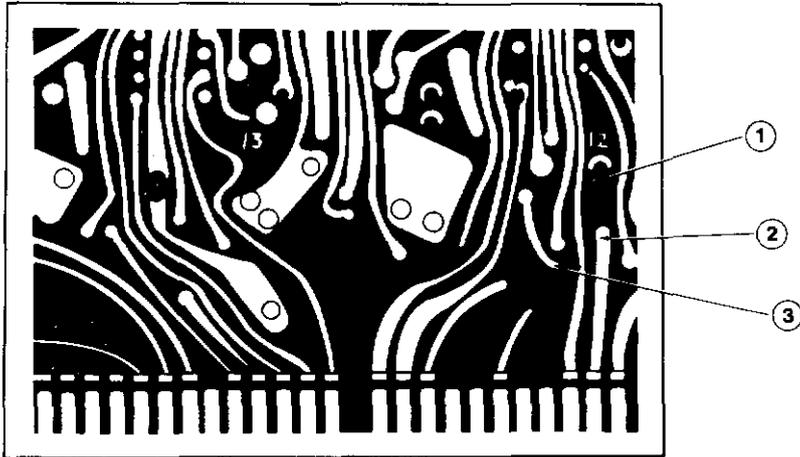
\_\_\_\_\_ 4. If one is using a P C contact film developer or a P C board developer, one should:

- A. be sure to have adequate ventilation.
- B. keep all the windows tightly closed.
- C. work in a room with no light.
- D. do both A and C.

\_\_\_\_\_ 5. When making an etched-circuit P C board:

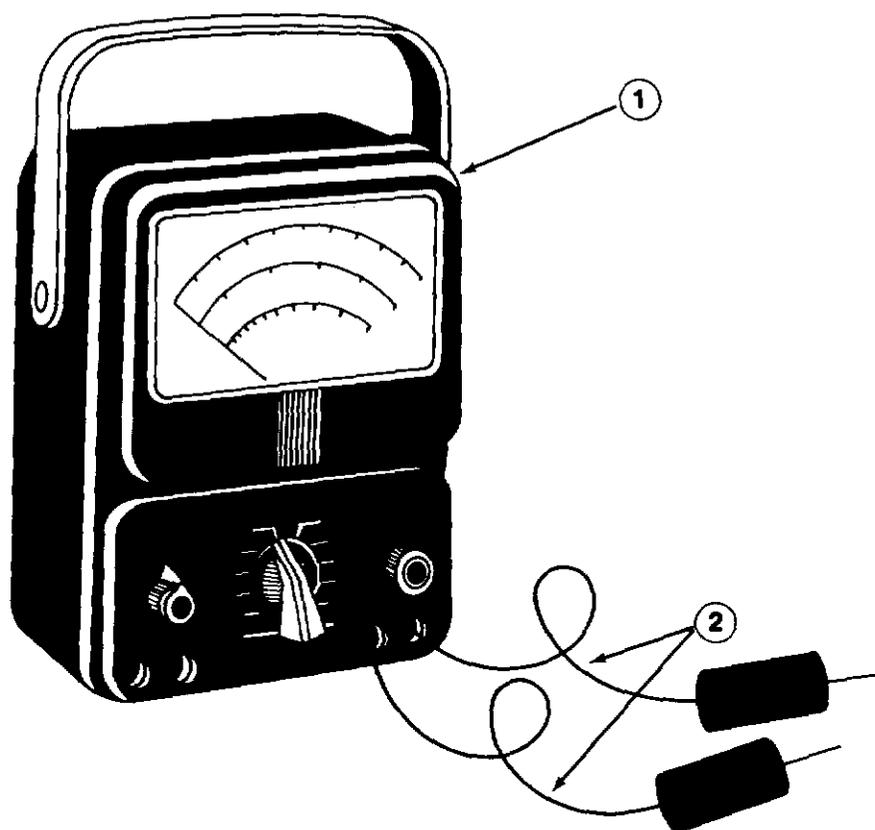
- A. never spill any of the chemicals.
- B. never swallow any of the chemicals.
- C. never inhale the fumes from the chemicals.
- D. remember both B and C.

6. When working with the chemicals used to make etched-circuit P C boards:
- A. never pour them into metal containers.
  - B. never allow them to be used indoors.
  - C. never allow them to come into contact with the eyes, skin, or mucous membranes.
  - D. Observe both B and C.
7. Label the parts of the etched-circuit PC board.



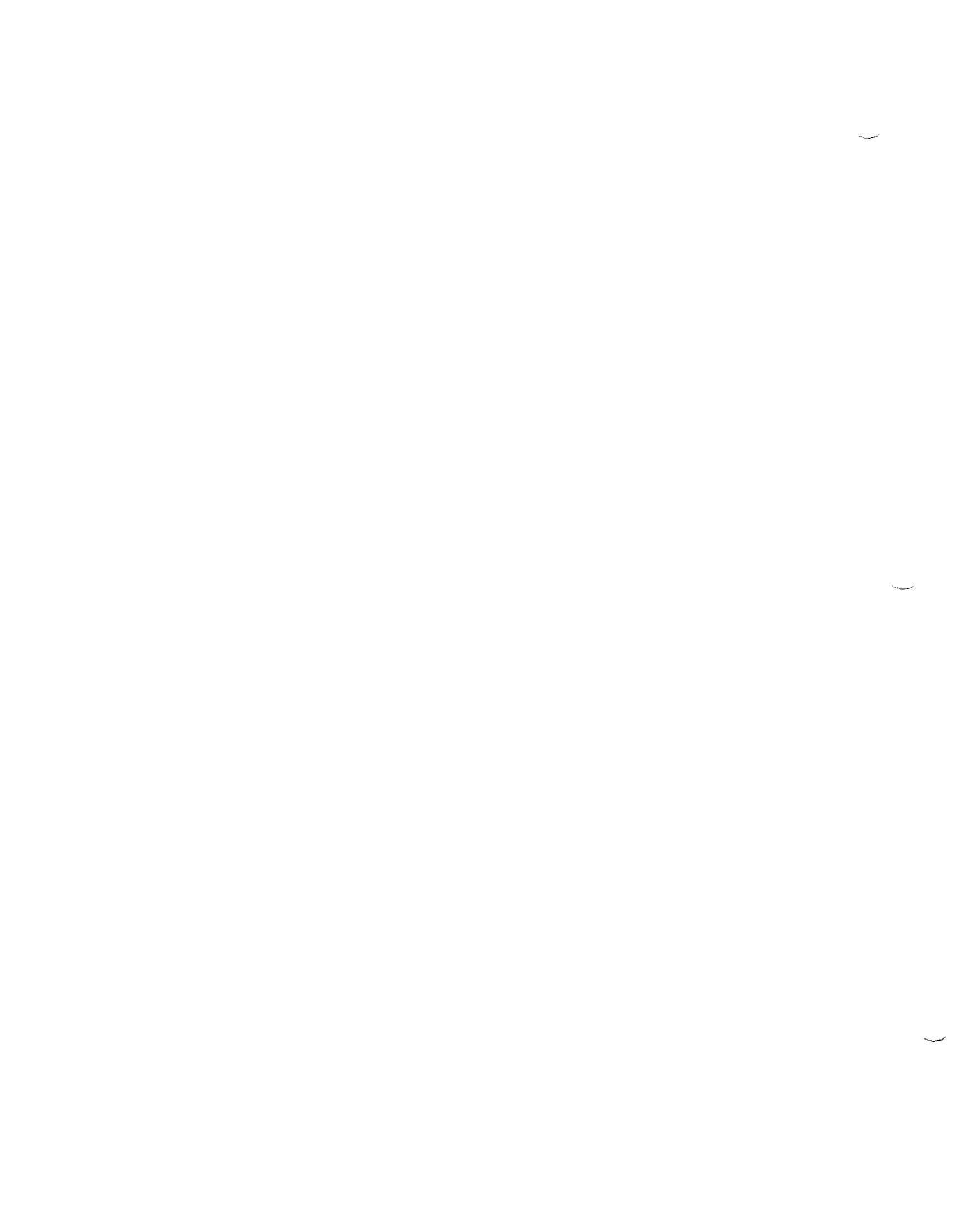
- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_

## MULTIMETER

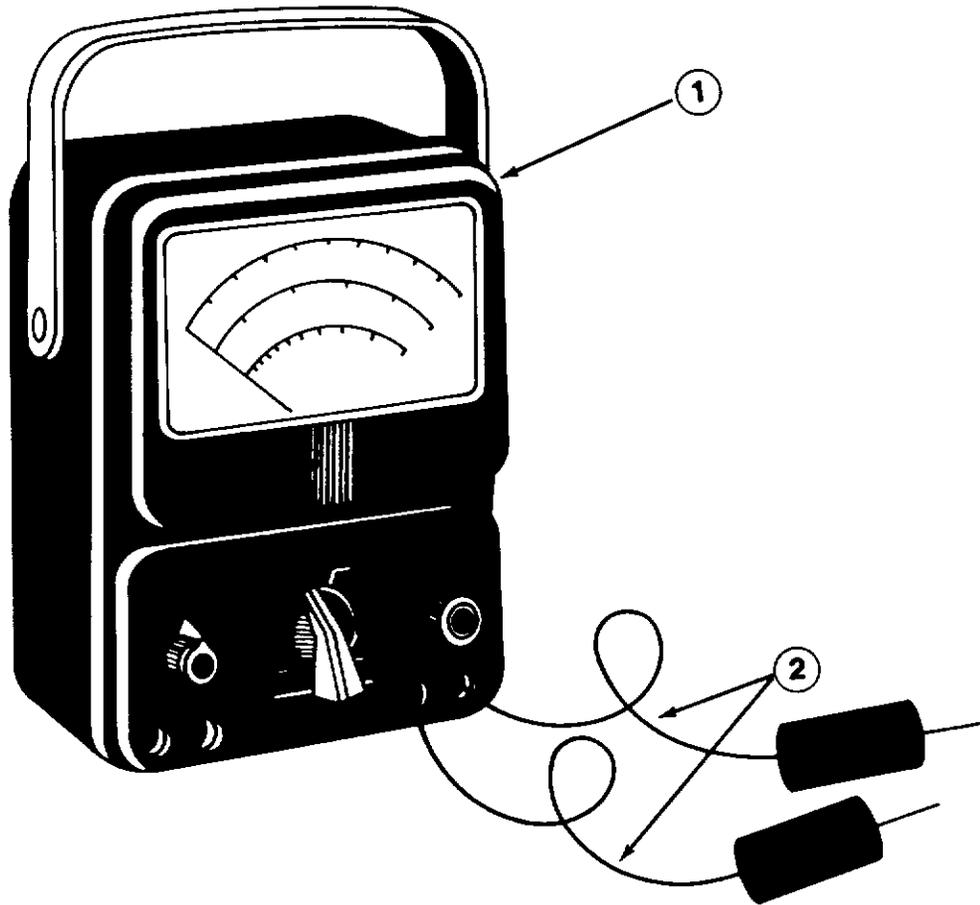


1. CHASSIS
2. TEST LEADS

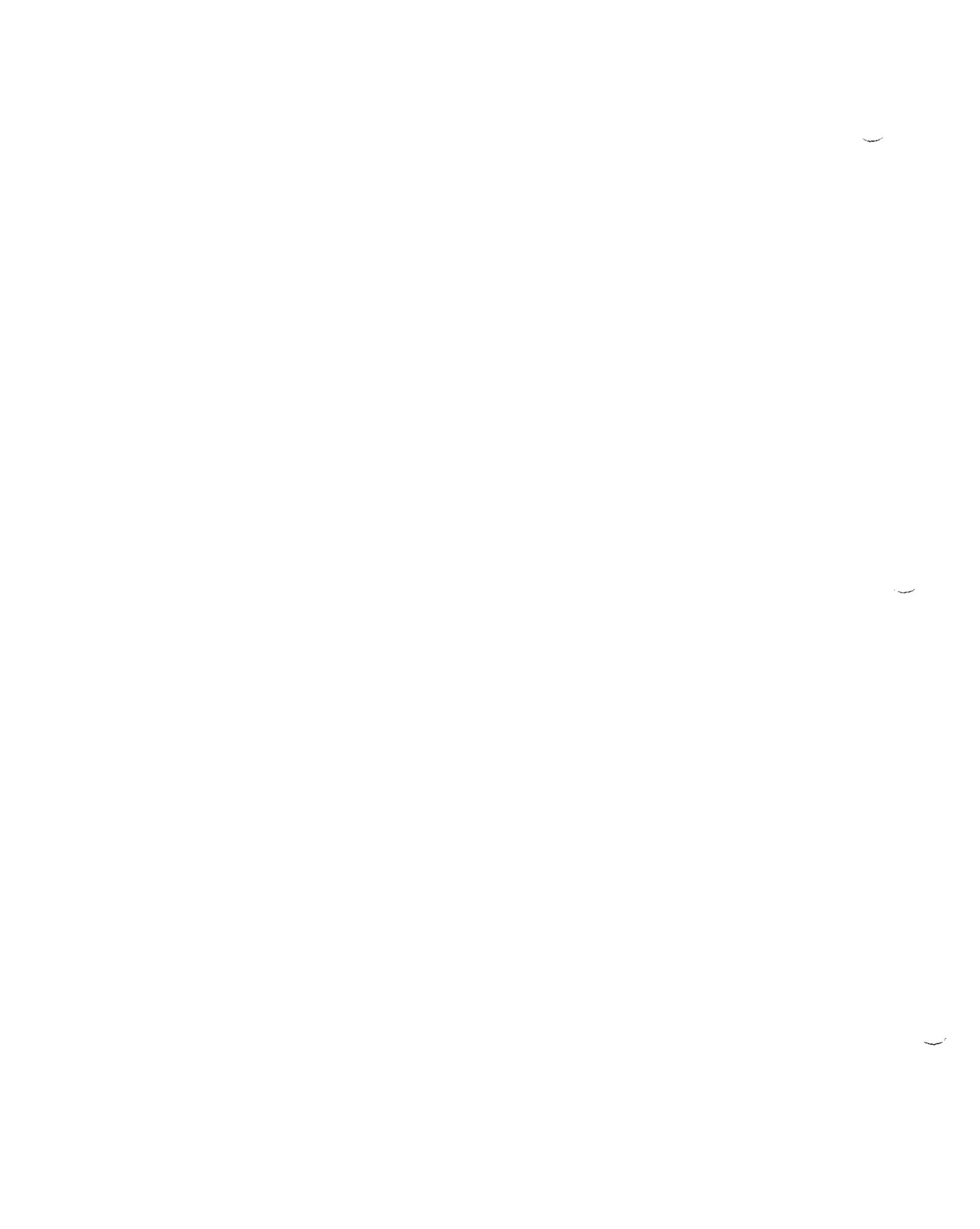
1. Use the multimeter only after the proper instruction and after receiving the teacher's permission.
2. Do not touch the metal parts of the test leads when making circuit tests.
3. Always stand on an ungrounded surface when using a multimeter.
4. Always connect the negative lead first when taking measurements with a multimeter.



# MULTIMETER



1. CHASSIS
2. TEST LEADS



## MULTIMETER SAFETY QUIZ

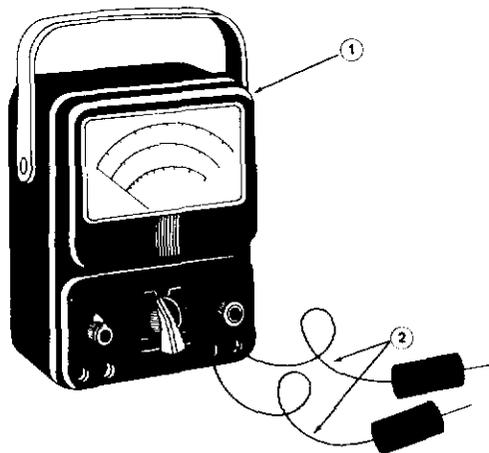
NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

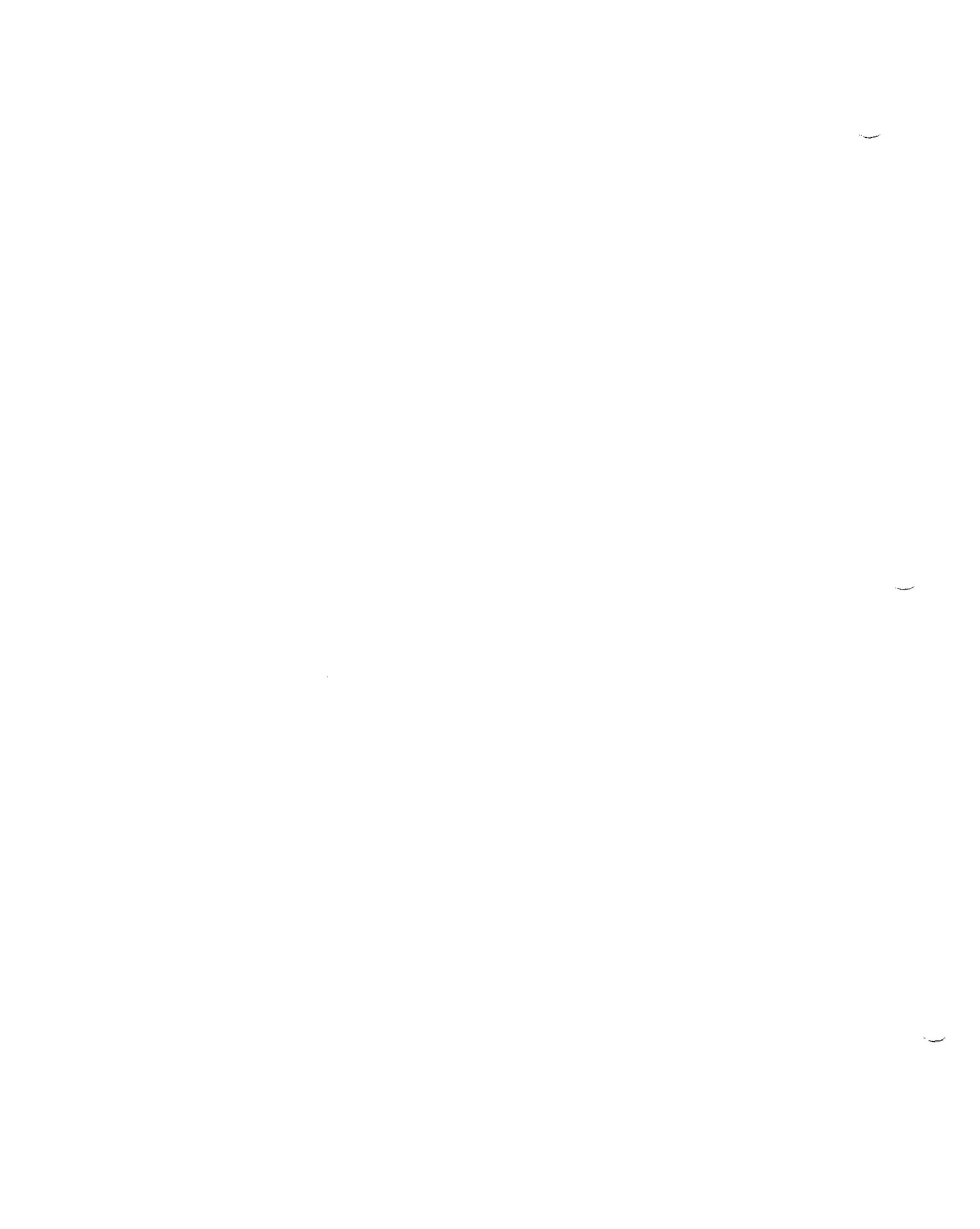
Read each statement carefully and record the best choice.

- \_\_\_\_ 1. When making circuit measurements with a multimeter:
- A. zero the ohms scale first.
  - B. always connect the positive lead first.
  - C. do not touch the metal parts of the test leads.
  - D. do both A and C.
- \_\_\_\_ 2. When using a multimeter:
- A. always connect the positive lead first.
  - B. stand on an ungrounded surface.
  - C. always connect the negative lead first.
  - D. do both B and C.
- \_\_\_\_ 3. Do not use a multimeter until:
- A. the teacher has given proper instruction in its use.
  - B. the ohms scale has been zeroed.
  - C. the battery has been checked.
  - D. both A and B have been done.
- \_\_\_\_ 4. In the space provided, identify the parts of the multimeter.

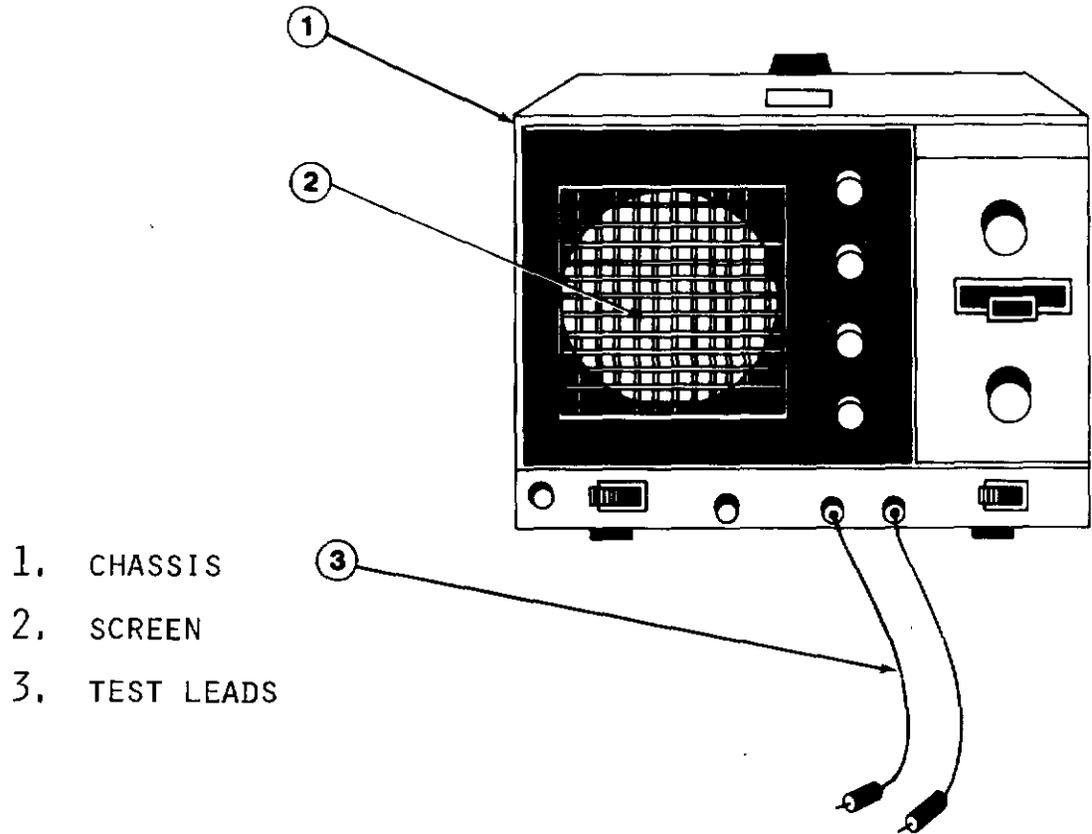


1. \_\_\_\_\_

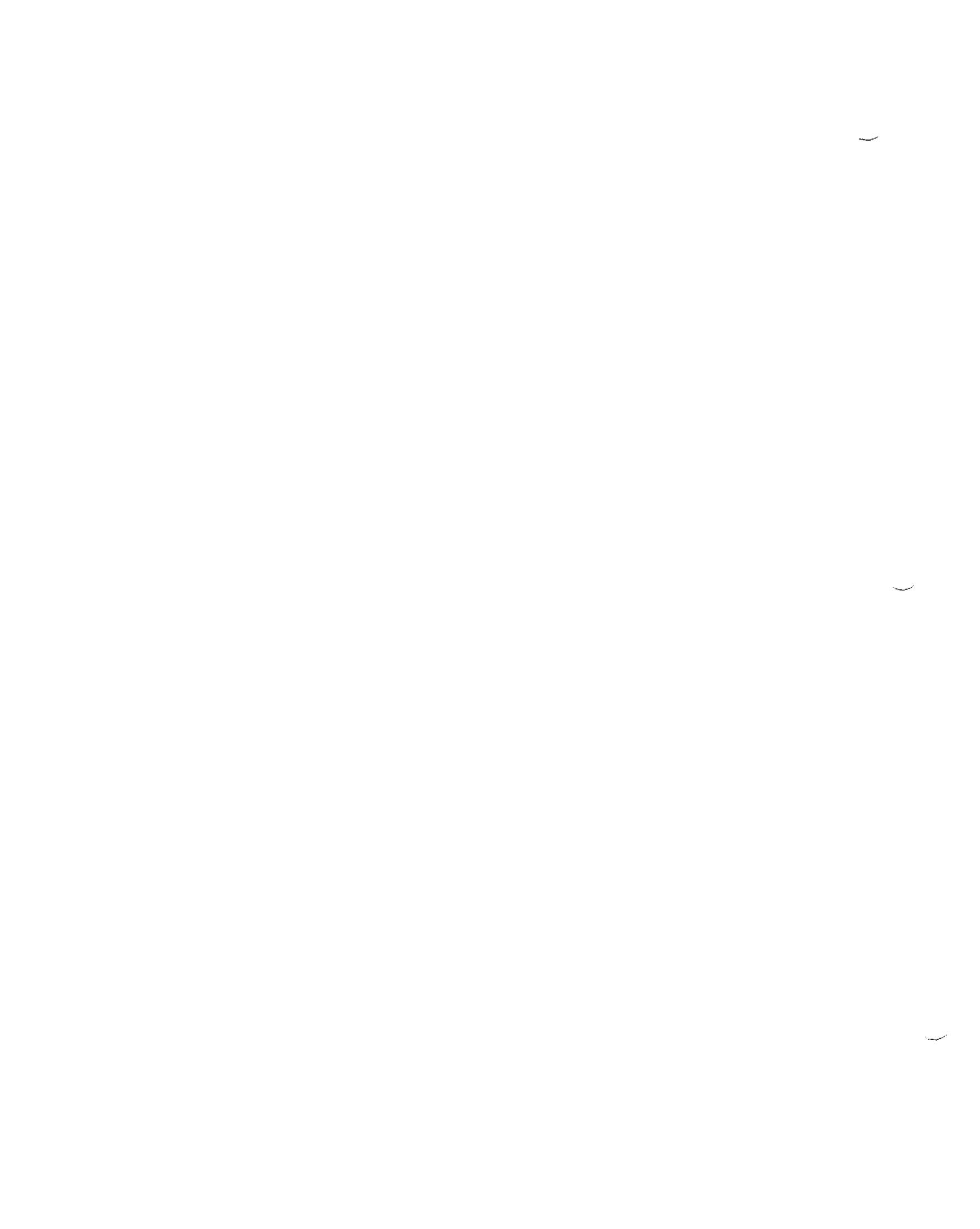
2. \_\_\_\_\_



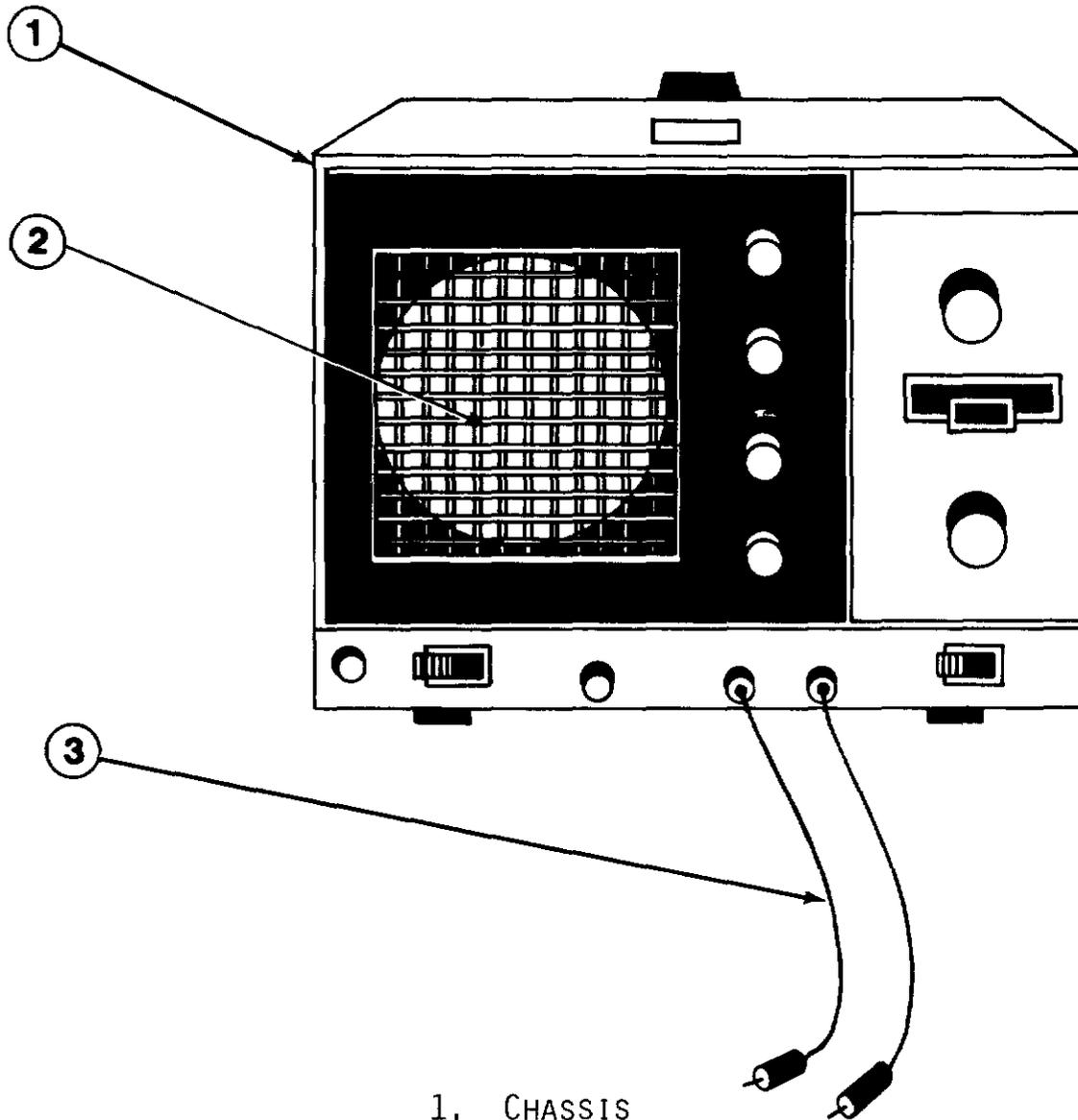
## OSCILLOSCOPE



1. Use the oscilloscope only after proper instruction and after receiving the teacher's permission.
2. Disconnect an oscilloscope from the circuit and power source before servicing or repairing it.
3. Examine the power cord for defects each time the oscilloscope is used.
4. Do not touch the metal parts of the test leads when making circuit tests.
5. Always stand on an ungrounded surface when using an oscilloscope.
6. Always connect the negative lead first when taking measurements with an oscilloscope.



# OSCILLOSCOPE



1. CHASSIS
2. SCREEN
3. TEST LEADS



## OSCILLOSCOPE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

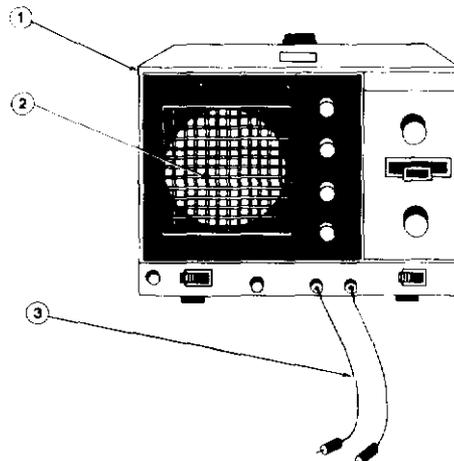
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

Read each statement carefully and record the best choice.

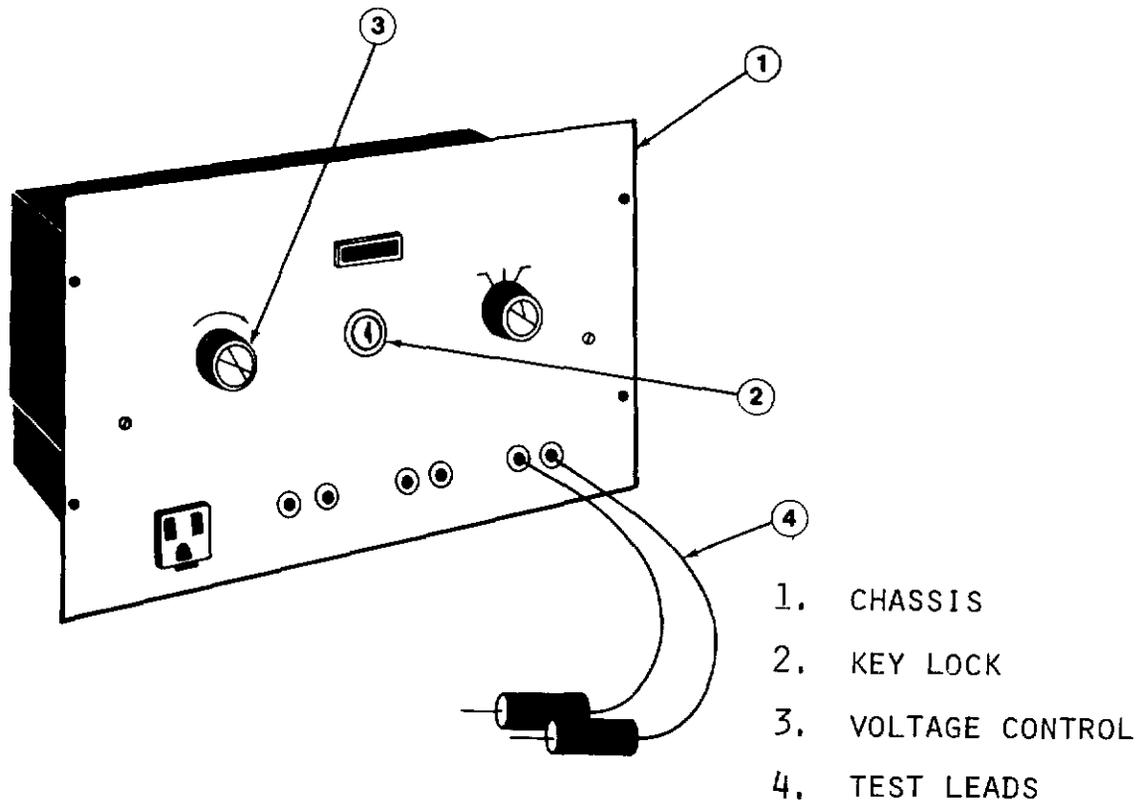
- \_\_\_\_\_ 1. When making circuit measurements with an oscilloscope:
- A. do not touch the metal parts of the test leads.
  - B. always connect the positive lead first.
  - C. always connect the negative lead first.
  - D. do both A and C.
- \_\_\_\_\_ 2. When using an oscilloscope:
- A. always stand on an ungrounded surface.
  - B. always stand on a grounded surface.
  - C. always work alone.
  - D. do both A and C.
- \_\_\_\_\_ 3. Do not use an oscilloscope until:
- A. the cabinet has been checked for defects.
  - B. the power cord has been checked for defects.
  - C. the teacher has given proper instruction in its use.
  - D. both B and C have been done.
- \_\_\_\_\_ 4. Before servicing or repairing an oscilloscope:
- A. see if the tube lights up.
  - B. disconnect the oscilloscope from the power source.
  - C. check the vertical hold.
  - D. do both A and B.
- \_\_\_\_\_ 5. Label the parts of an oscilloscope.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

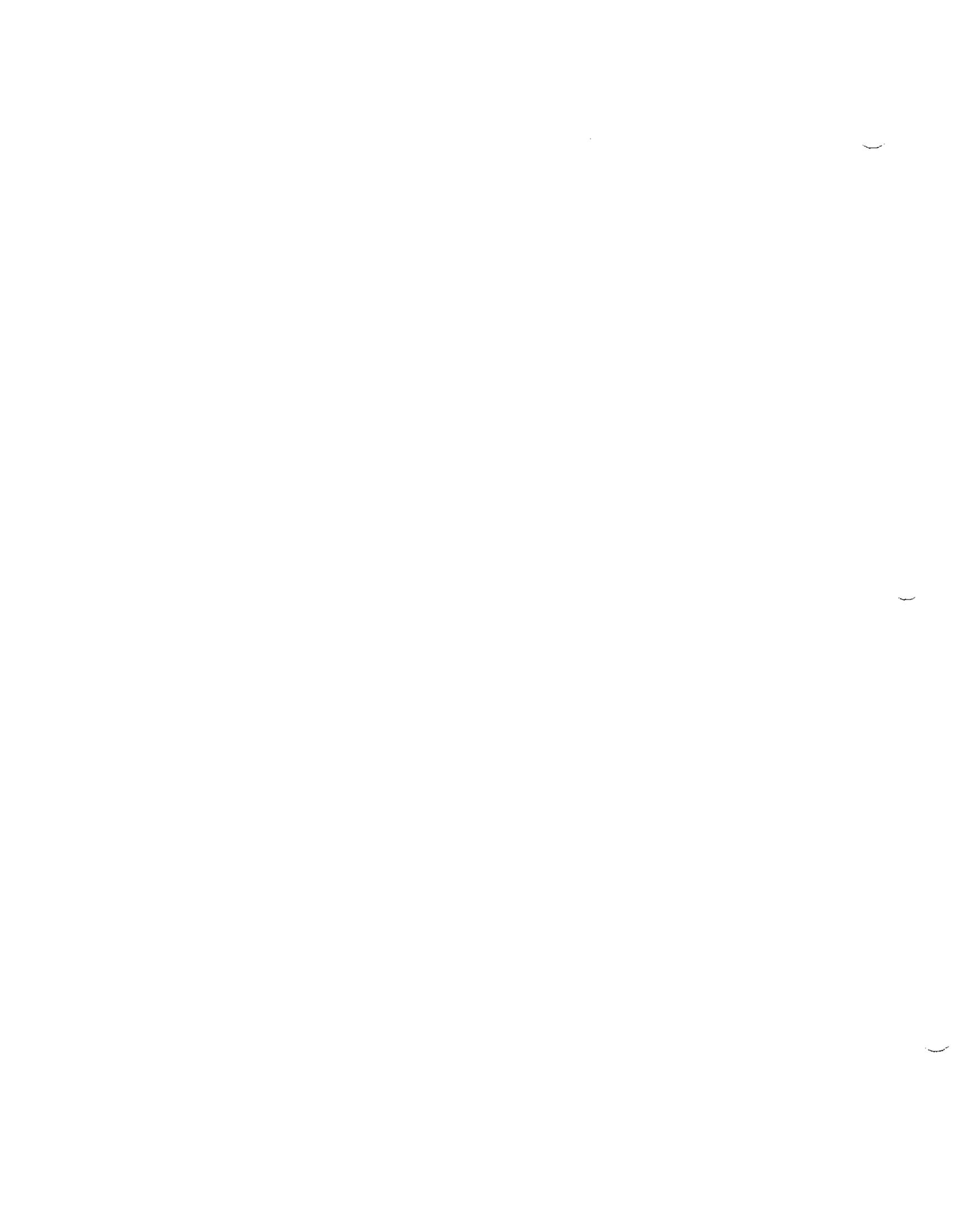




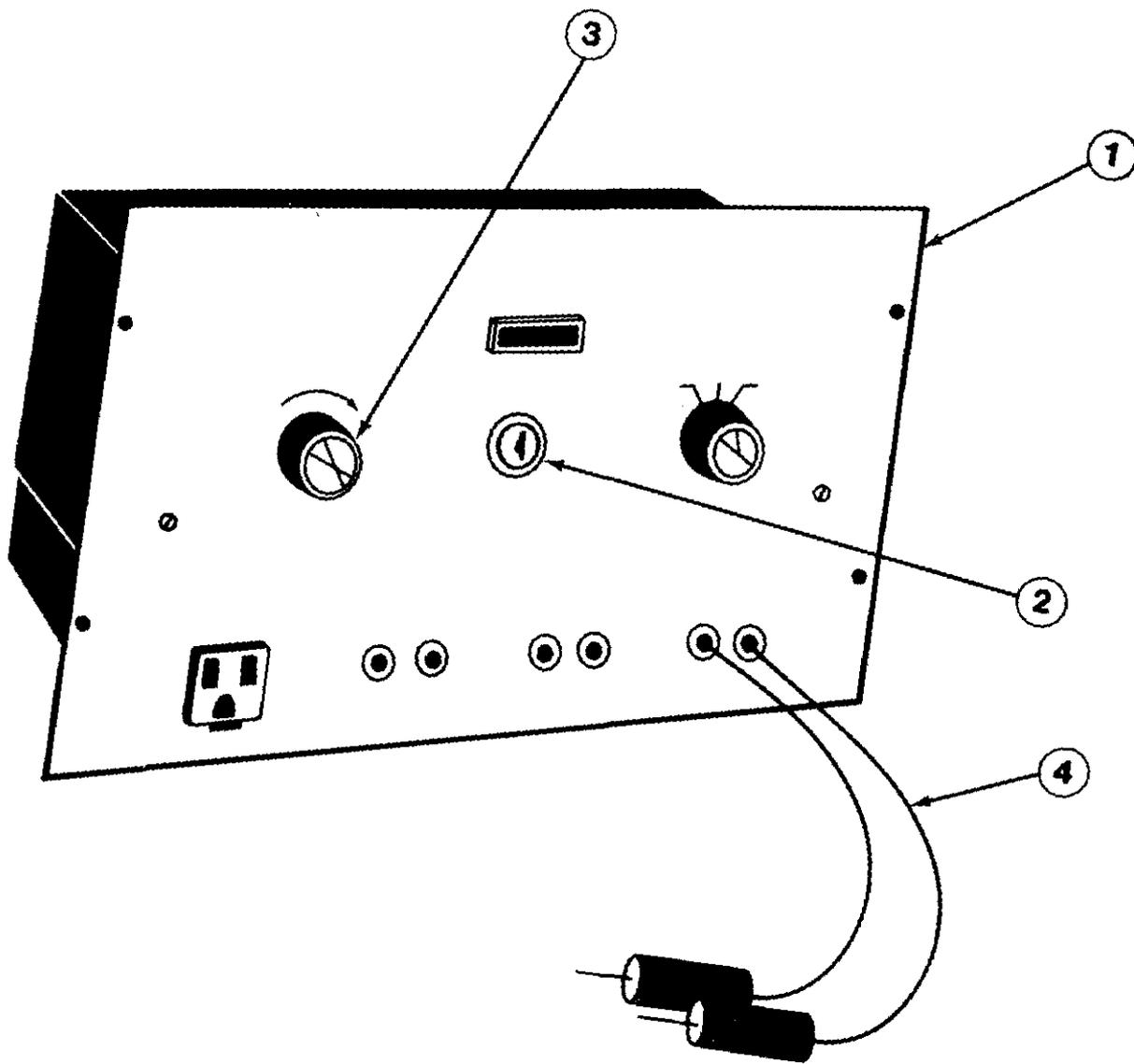
## POWER SUPPLY



1. Use a power supply only after proper instruction and after receiving the teacher's permission.
2. Disconnect the power supply from the circuit and power source before servicing or repairing it.
3. Examine the power cord for defects each time the power supply is used.
4. Set all power supply controls to "zero" or "off" before connecting to the power source.
5. Turn off the power supply before replacing fuses or resetting circuit breakers.
6. Always stand on an ungrounded surface when using a power supply.



POWER SUPPLY



1. CHASSIS
2. KEY LOCK
3. VOLTAGE CONTROL
4. TEST LEADS



# POWER SUPPLY SAFETY QUIZ

NAME \_\_\_\_\_

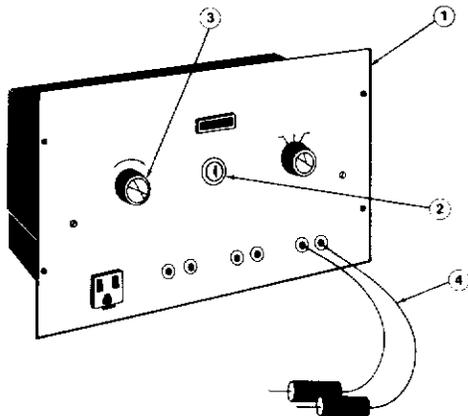
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

Read each statement carefully and record the best choice.

- \_\_\_\_\_ 1. Disconnect the power supply from its power source before:
- A. adjusting the output.
  - B. servicing or repairing it.
  - C. replacing the fuses or resetting the circuit breakers.
  - D. doing both B and C.
- \_\_\_\_\_ 2. Do not use a power supply unless:
- A. the teacher has given proper instruction in its use.
  - B. the output has been adjusted.
  - C. the power cord has been examined for defects.
  - D. both A and C have been done.
- \_\_\_\_\_ 3. When using a power supply:
- A. always stand on an ungrounded surface.
  - B. always stand on a grounded surface.
  - C. always use uninsulated leads.
  - D. do both B and C.
- \_\_\_\_\_ 4. Before connecting the power supply to its power source:
- A. set all the controls to the correct reading.
  - B. place the power source on a grounded surface.
  - C. set all the controls to "zero" or "off."
  - D. do both B and C.

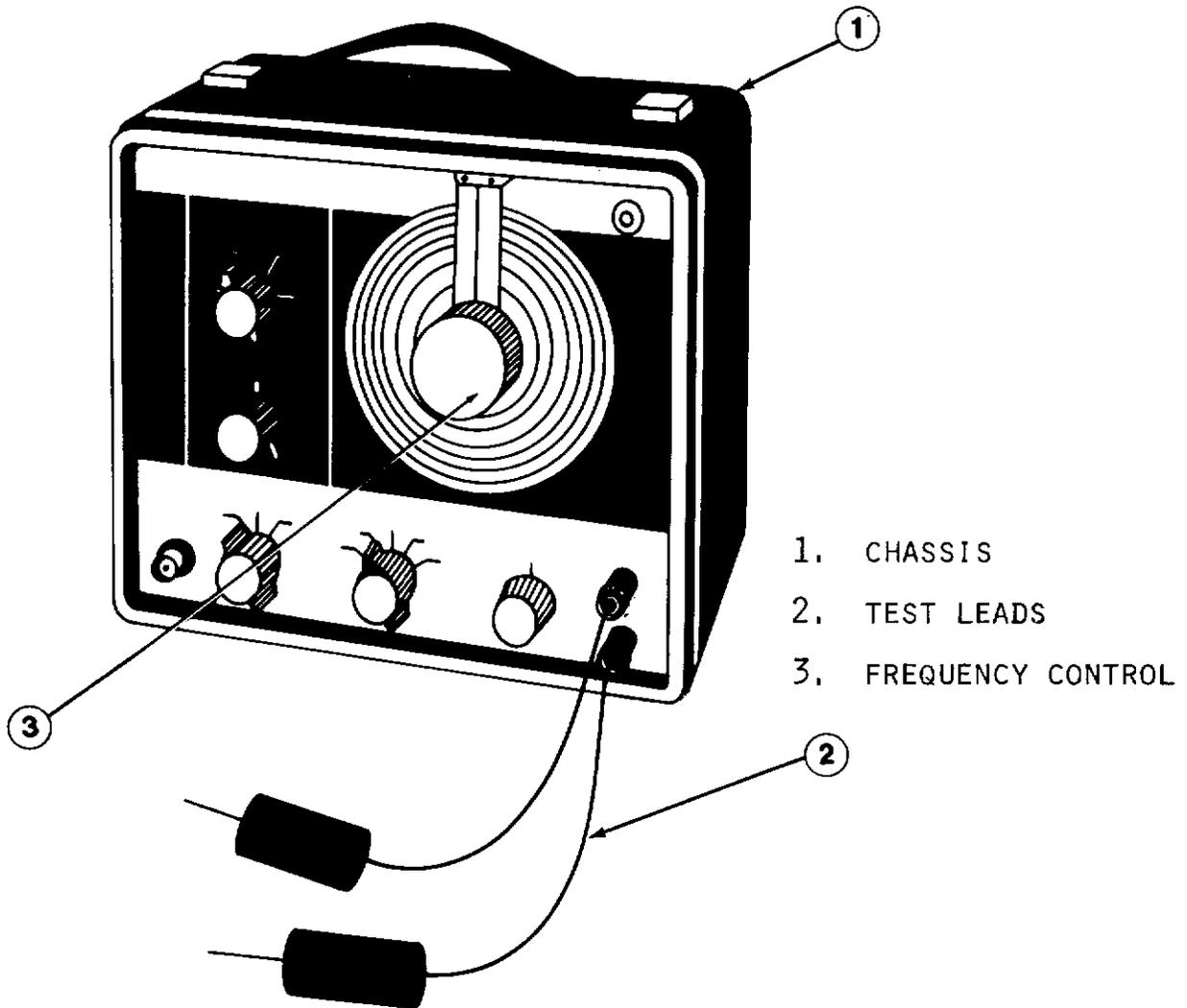
\_\_\_\_\_ 5. Label the parts of a power supply.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_

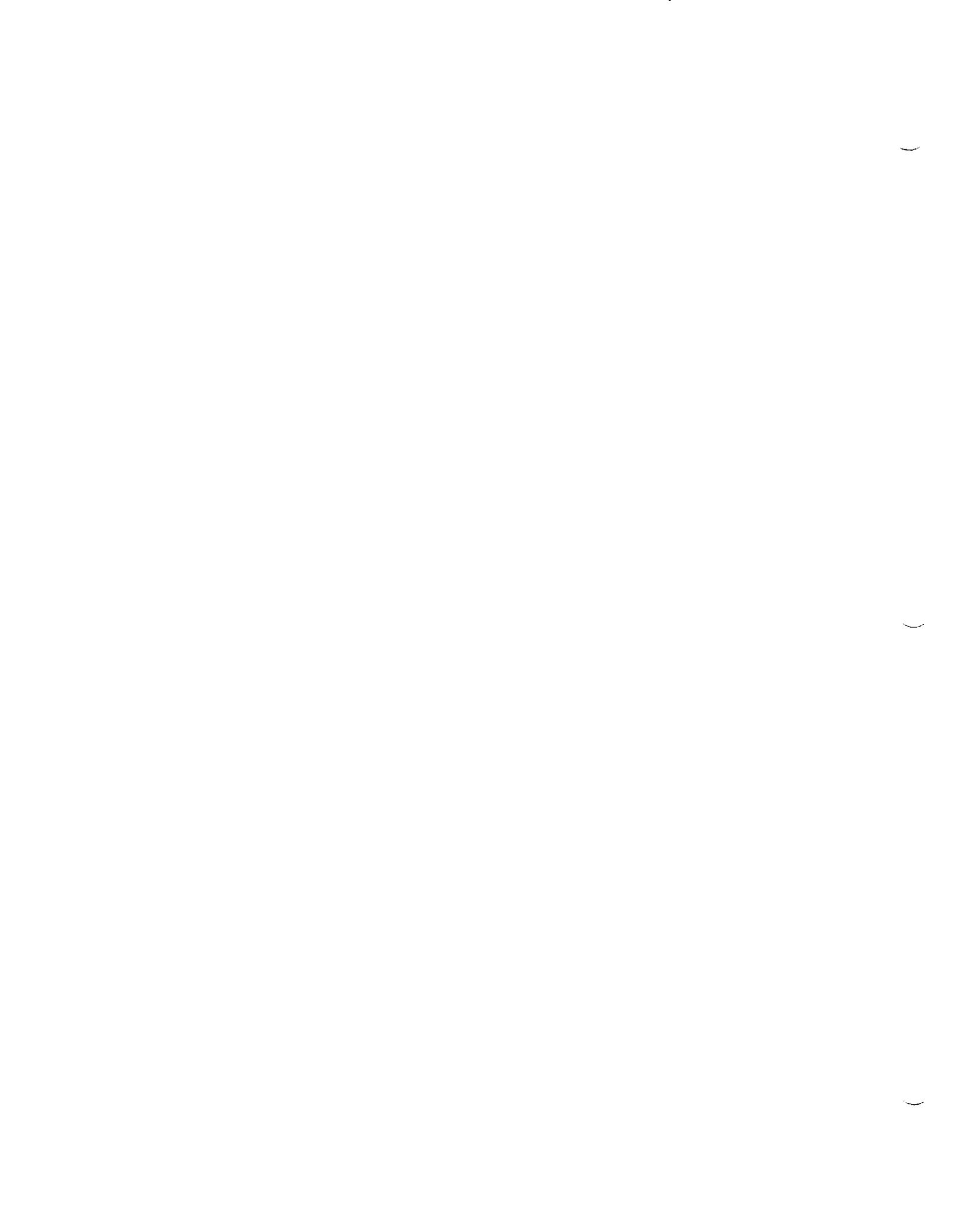


## SIGNAL GENERATOR

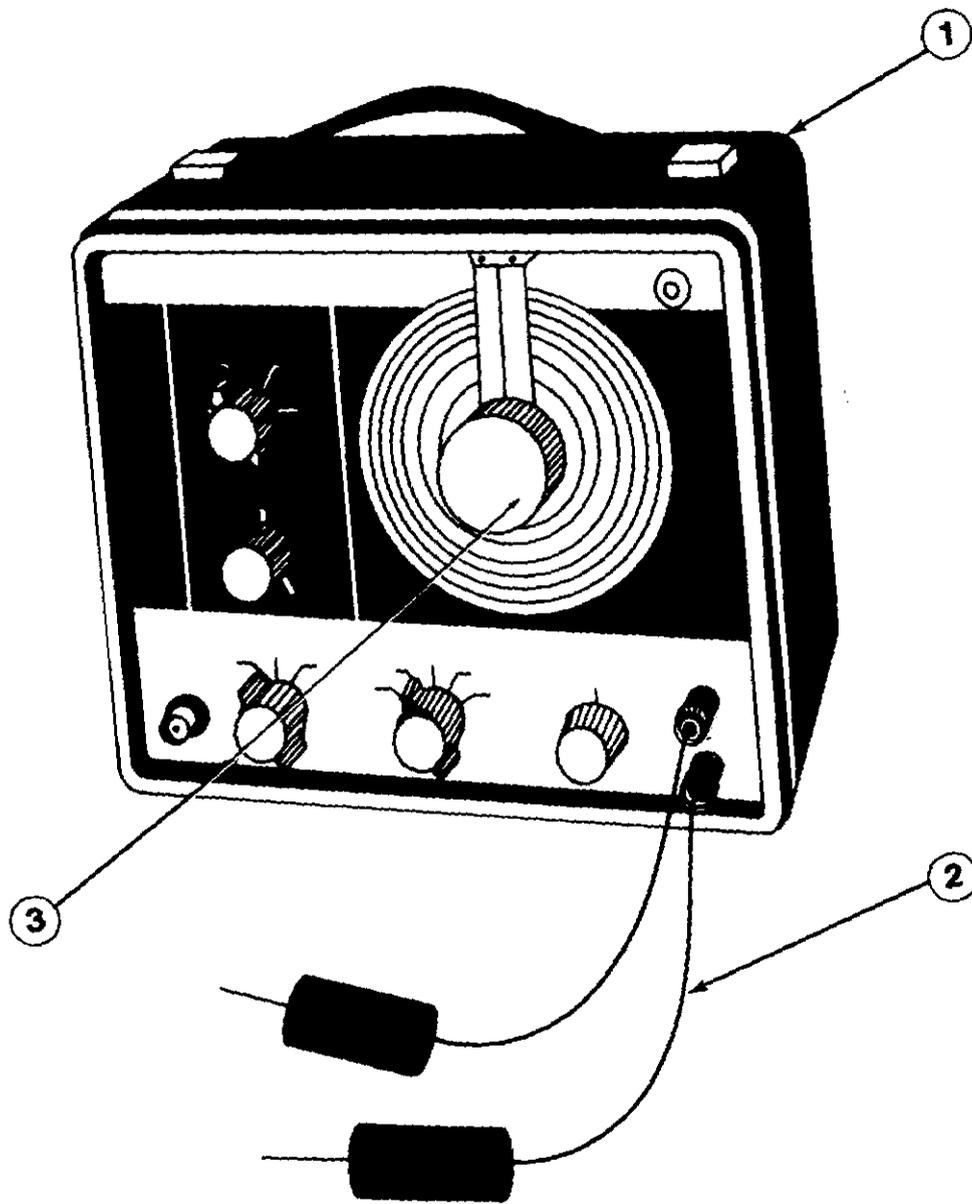


1. CHASSIS
2. TEST LEADS
3. FREQUENCY CONTROL

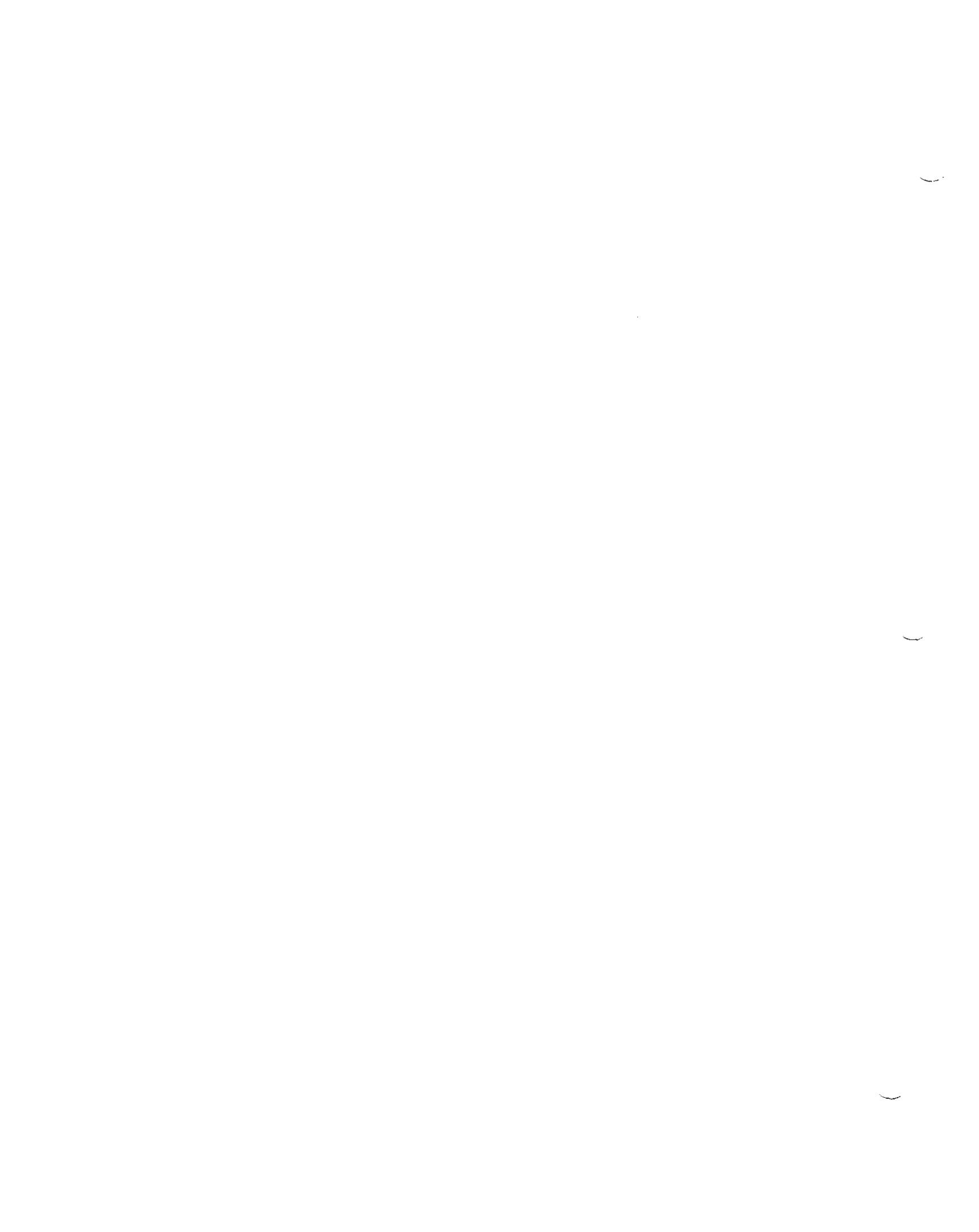
1. Use a signal generator only after proper instruction and after receiving the teacher's permission.
2. Disconnect the signal generator from the circuit and power source before servicing or repairing it.
3. Examine the power cord for defects each time the signal generator is used.
4. Do not touch the metal parts of the test leads when making circuit tests.
5. Always stand on an ungrounded surface when using a signal generator.



# SIGNAL GENERATOR



- 1. CHASSIS
- 2. TEST LEADS
- 3. FREQUENCY CONTROL



# SIGNAL GENERATOR SAFETY QUIZ

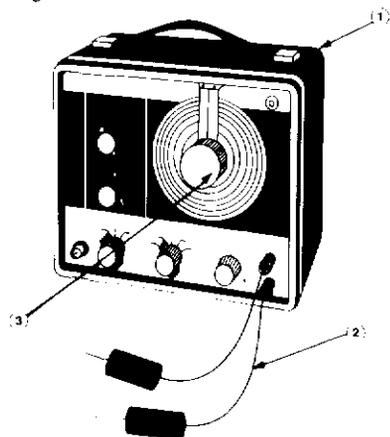
NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

Read each statement carefully and record the best choice.

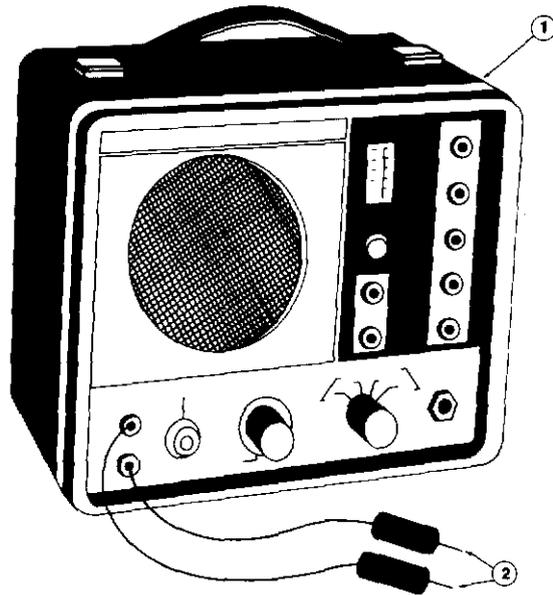
- \_\_\_\_ 1. Do not use a signal generator until:
  - A. the teacher has given proper instruction in its use.
  - B. the power cord has been examined for defects.
  - C. it has been set for the proper frequency.
  - D. both A and B have been done.
  
- \_\_\_\_ 2. Disconnect the signal generator from the power source:
  - A. before setting the frequency.
  - B. before making any connections.
  - C. before servicing or repairing it.
  - D. before doing both A and C.
  
- \_\_\_\_ 3. When connecting a signal generator into an electrical circuit:
  - A. do not touch the metal parts of the leads.
  - B. place it on a grounded surface.
  - C. connect the positive lead first.
  - D. do both A and B.
  
- \_\_\_\_ 4. When using a signal generator:
  - A. always stand on a grounded surface.
  - B. always stand on an ungrounded surface.
  - C. connect the positive lead first.
  - D. do both B and C.
  
- \_\_\_\_ 5. In the spaces provided, label the parts of a signal generator.



1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_



## SIGNAL TRACER

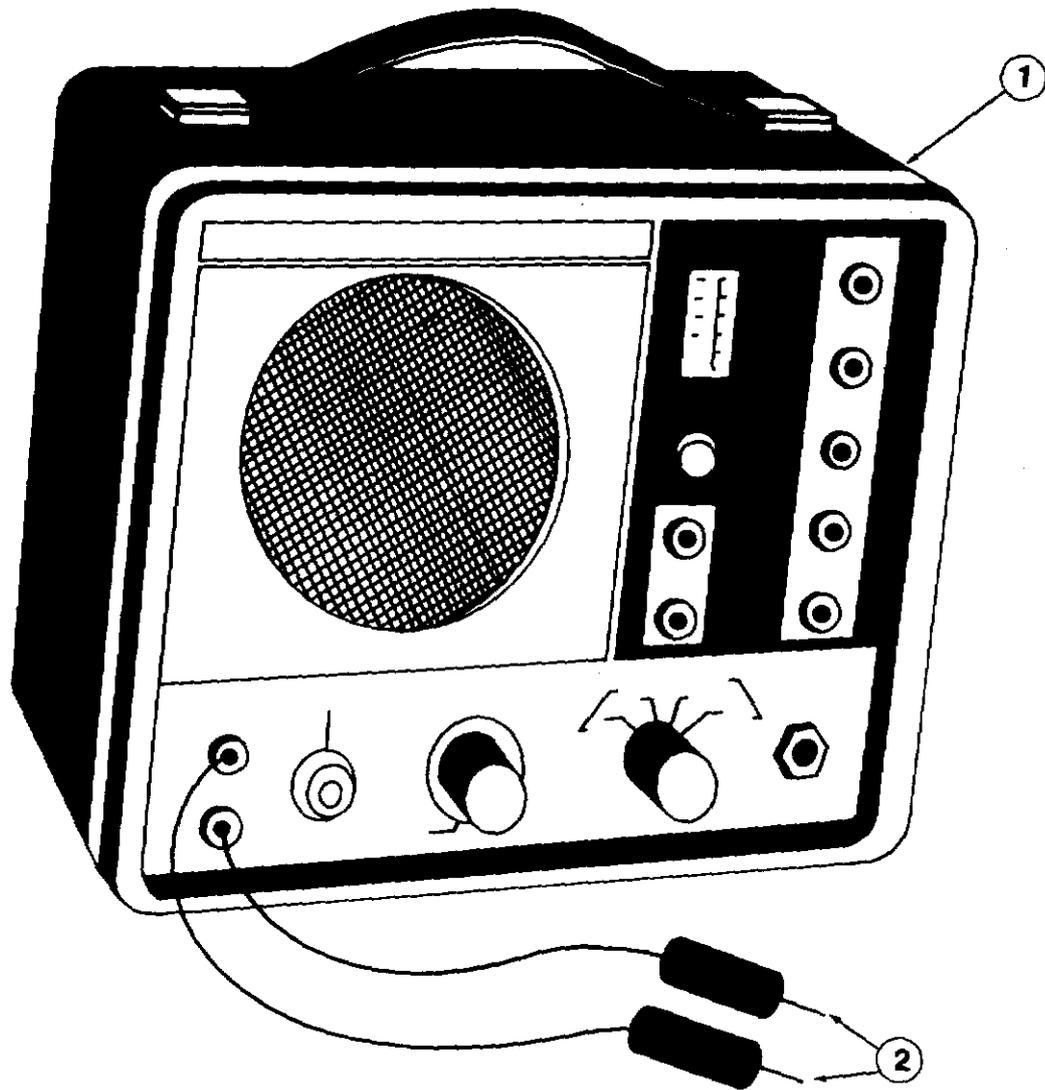


1. CHASSIS
2. TEST LEADS

1. Use a signal tracer only after proper instruction and after receiving the teacher's permission.
2. Disconnect the signal tracer from the circuit and power source before servicing or repairing it.
3. Examine the power cord for defects each time the signal tracer is used.
4. Do not touch the metal parts of the test leads when making circuit tests.
5. Always stand on an ungrounded surface when using a signal tracer.
6. Always connect the negative lead first when taking measurements with a signal tracer.



# SIGNAL TRACER



1. CHASSIS
2. TEST LEADS



## SIGNAL TRACER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

Read each statement carefully and record the best choice.

\_\_\_\_\_ 1. When making tests with a signal tracer:

- A. always turn off the power source.
- B. always connect the negative lead first.
- C. always connect the positive lead first.
- D. do both A and B.

\_\_\_\_\_ 2. When using a signal tracer:

- A. always use uninsulated test leads.
- B. always examine the power cord for defects.
- C. stand on an ungrounded surface.
- D. do both B and C.

\_\_\_\_\_ 3. Before servicing or repairing a signal tracer:

- A. disconnect it from the circuit and power source.
- B. turn the switch off.
- C. place it on a grounded surface.
- D. do both A and C.

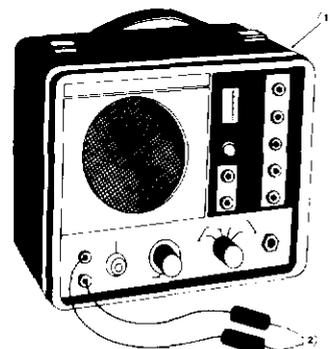
\_\_\_\_\_ 4. For one's own protection, one should not:

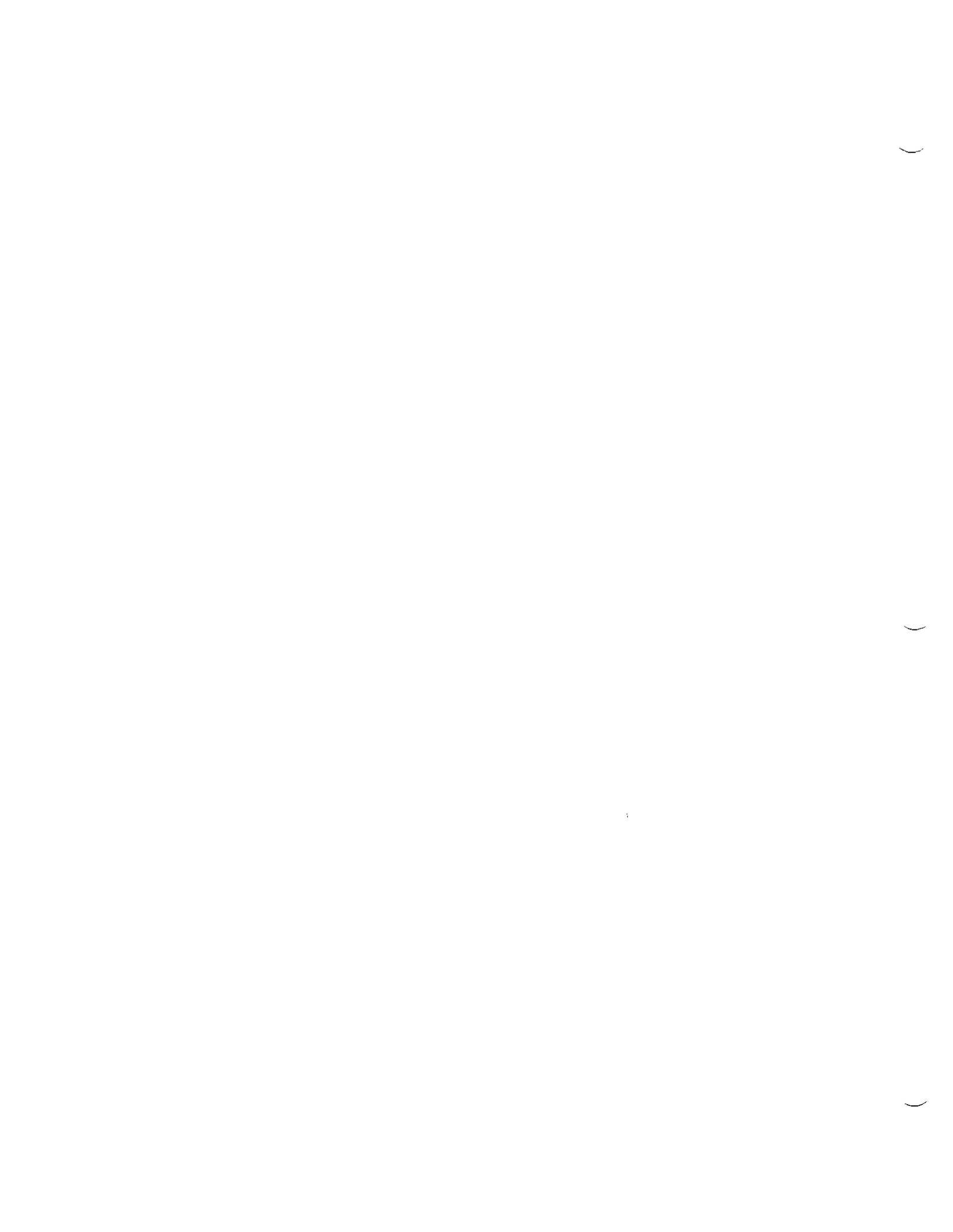
- A. touch the metal parts of the test leads when making circuit tests.
- B. use a signal tracer until the teacher has given proper instruction in its use.
- C. use a signal tracer on an ungrounded surface.
- D. do both A and B.

\_\_\_\_\_ 5. Label the parts of a signal tracer.

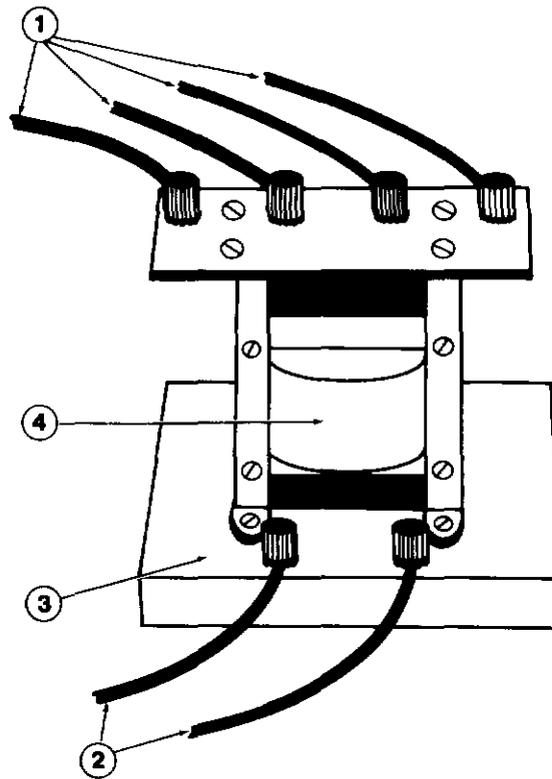
1. \_\_\_\_\_

2. \_\_\_\_\_



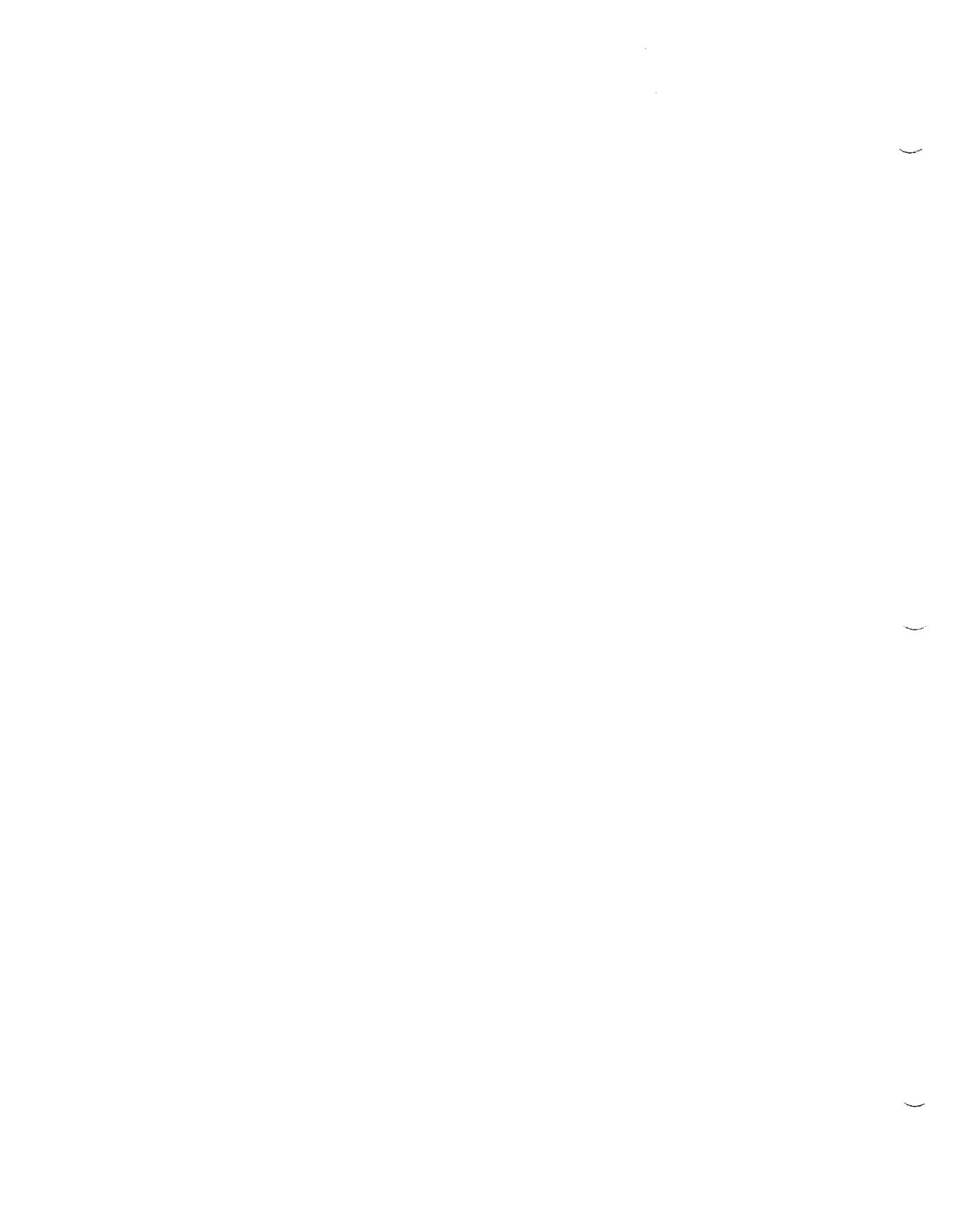


## TRANSFORMER

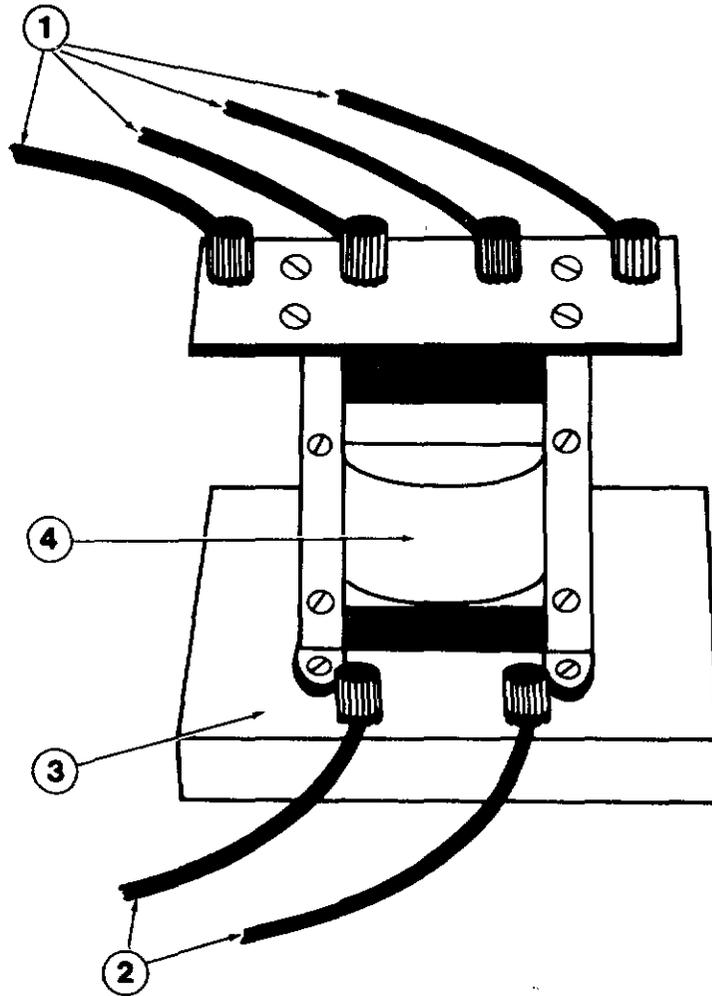


1. OUTPUT (SECONDARY)
2. INPUT (PRIMARY)
3. BASE
4. TRANSFORMER

1. Be sure the AC input line is connected to the primary side of the transformer.
2. Disconnect the transformer from the power source before servicing or repairing it.
3. Always stand on an ungrounded surface when using a transformer.



# TRANSFORMER



- 1 OUTPUT (SECONDARY)
- 2 INPUT (PRIMARY)
- 3 BASE
- 4 TRANSFORMER

1

2

3

# TRANSFORMER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

Read each statement carefully and record the best choice.

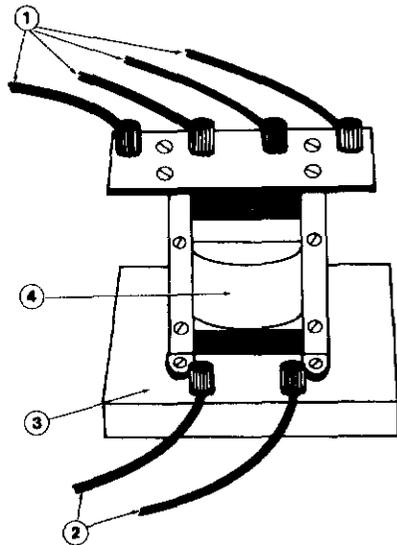
\_\_\_\_ 1. Before servicing or repairing a transformer:

- A. find out which winding is the primary.
- B. see if the transformer leads are color coded.
- C. disconnect the transformer from the circuit.
- D. do both A and B.

\_\_\_\_ 2. Before using a transformer:

- A. be sure the leads are color coded.
- B. be sure the AC input line is connected to the primary side of the transformer.
- C. be sure you are standing on an ungrounded surface.
- D. do both B and C.

\_\_\_\_ 3. Label the parts of the transformer in the spaces provided.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_

10

11

12

**PART 7:  
EQUIPMENT FOR WELDING**

- Oxyacetylene Welder
- Arc Welder
- TIG Welder
- MIG Welder
- Spot Welder

1

3

3

## WELDING EQUIPMENT SAFETY RULES

### GAS WELDING, CUTTING, AND BRAZING

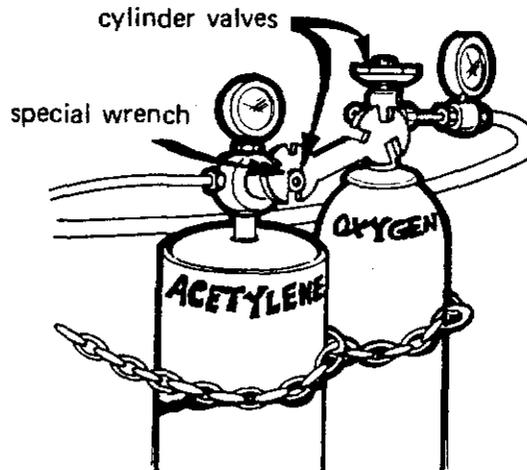
1. Oxygen cylinders in storage are required to be separated from fuel gas cylinders or other combustible materials at a minimum distance of 20 feet or by a noncombustible barrier at least five feet high.



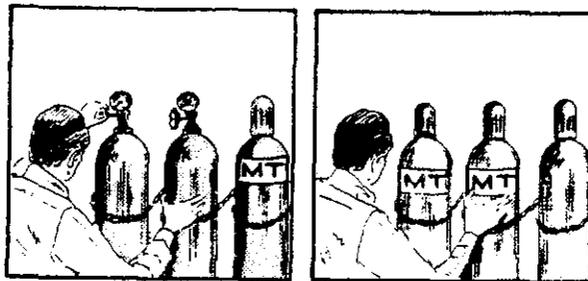
2. All cylinders shall be kept away from radiators and other sources of heat. Keep any burning substance or combustible materials away from oxygen supplies and post "No Smoking" signs in the area.
3. All cylinders stored inside buildings must be located in a well-protected, well-ventilated, dry location at least 20 feet from highly combustible materials and away from elevators, stairs, or gangways. They are not to be kept in unventilated enclosures such as lockers and cupboards.



4. All cylinder valves must be closed when work is finished. Where a special wrench is required it must be left in position on the stem of the valve while the cylinder is in use so that the fuel gas flow can be quickly turned off in case of emergency. In the case of manifolded or coupled cylinders at least one such wrench must always be available for immediate use.



5. All cylinders should be legibly marked to identify contents.
6. No cylinder is permitted to stand alone without being secured with lashing or chain to prevent it from toppling over.
7. Acetylene shall not be used at a pressure in excess of 15 psi on the line supply gauge.
8. Indoor storage of compressed gas shall be limited to total capacity of 2,000 cubic feet or 300 pounds of liquified petroleum gas.
9. Do not leave pressure in the hoses when leaving the area. Shut off the oxygen and acetylene at the cylinder.
10. Mark empty tanks "MT," close the valves, and replace valve caps securely.



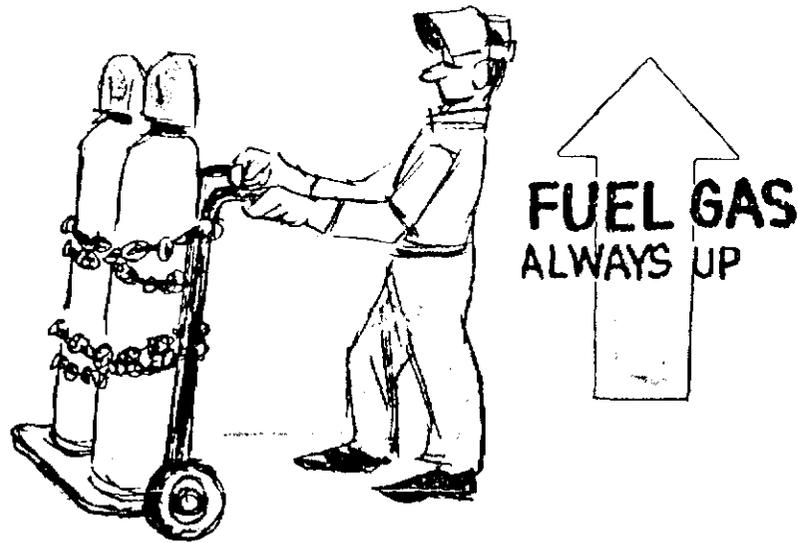
11. Empty cylinders shall have their valves closed and the valve protection caps shall be in place.

12. Oxygen cylinders or apparatus shall be kept free from oily or greasy substances and shall not be handled with oily hands or gloves.
13. An oxygen-fuel gas welding hose showing leaks, burns, worn places, or other defects rendering it unfit for service is to be repaired or replaced.



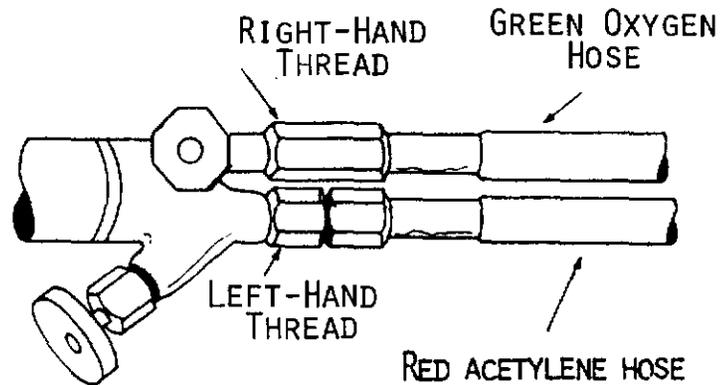
14. Gas cylinders shall be kept far enough away from the actual welding or cutting operation that sparks or hot slag will not reach them.
15. Gas cylinders shall not be placed where they might become part of an electric circuit.
16. Gas cylinders shall never be used as rollers or supports, whether full or empty, and the number and markings stamped into cylinders shall not be tampered with.
17. Only the owner of the cylinder or person authorized by him/her shall refill a cylinder.
18. Unless it is connected to a manifold, an oxygen cylinder shall not be used without first attaching an oxygen regulator to the cylinder valve.
19. Gas cylinder valves shall not be tampered with nor shall any attempt be made to repair them.

20. Fuel-gas cylinders shall be placed with the valve end up. All cylinders (particularly acetylene) in use should be securely retained in an upright position to prevent accidents. An acetylene cylinder in a horizontal position would allow the discharge of acetone through the welding or cutting torch, which would clog the mixer passages, create a fire hazard, reduce the efficiency of the flame, and contaminate the weld area.



21. Before a person connects a regulator to a cylinder valve, he/she must see that the valve is opened slightly and then closed immediately to blow off sediment in the connection.
22. Before a regulator is removed from a cylinder valve, the valve shall be closed and the gas released from the regulator.
23. Nothing which may damage the safety device or interfere with the quick closing of the valve shall be placed on top of an acetylene cylinder when it is in use.
24. Fuel gas shall never be used from cylinders without reducing the pressure through a suitable regulator.

25. An acetylene cylinder valve shall not be open more than one and one-half turns; preferably no more than three-fourths of a turn. The generally recognized colors for welding hoses are: red for acetylene, green for oxygen, and black for inert gas and air.



26. When parallel lengths of oxygen and acetylene hoses are taped together, not more than four inches out of twelve inches shall be covered by tape.
27. Acetylene generators shall be of approved construction and shall be plainly marked with the maximum rate of acetylene in cubic feet per hour for which they are designed, and the weight and size of carbide necessary for a single charge.

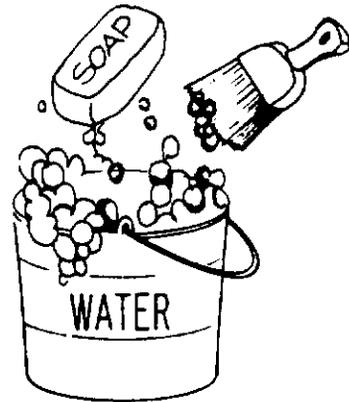


## OXYACETYLENE WELDING

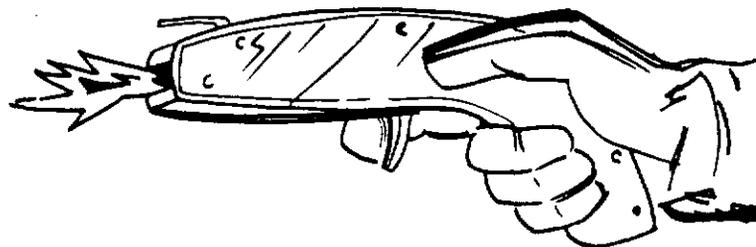
### SETTING-UP PRECAUTIONS

1. Before connecting a regulator to a gas cylinder, open cylinder valve momentarily (called "cracking cylinder valve") to blow out any accumulated particles of dirt, dust, etc. which may have lodged there in transit. Do not stand in front of valve outlet when operating cylinder valve.
2. When connecting regulators to the cylinders, make sure the connecting nuts are secured tightly to prevent leaks.
3. The pressure adjusting screw of the regulators should be turned out until it is loose. This prevents the pressure from rupturing the diaphragms.
4. One should always stand to one side or away from the gauge face of the regulators when opening the cylinder valves.
5. The cylinder valves should never be opened suddenly, as the rush of high pressure may injure the regulator mechanism.
6. When oxygen cylinders are in use, the cylinder valve should be opened all the way to prevent leaks.
7. When acetylene cylinders are in use, the cylinder valve must not be opened over one half turn so it can be secured quickly.
8. If the acetylene cylinder valve is operated by a "T" handle wrench, the "T" wrench should always be left in place while the cylinder is in use. The cylinder can then be secured quickly in an emergency.
9. Oxygen and acetylene hoses must never be interchanged or a fire or explosion may result.
10. All damaged nuts or connections shall be removed from service.

11. Soapy water should be used to test the equipment for leaks (a grease-free soap is recommended).

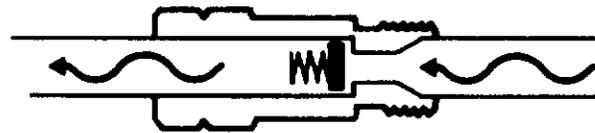


12. Oil or grease must never be allowed to come in contact with oxygen under pressure.
13. Oxygen must never be used as a substitute for compressed air.
14. A person who is starting to weld or cut should make certain there is no material in the area that hot slag or hot metal might ignite.
15. The proper size tip and the proper gas pressures should always be used.
16. Goggles should always be worn when working with a lighted torch.
17. A clear space should be kept between the cylinders and the work.
18. Matches must not be used for lighting torches.

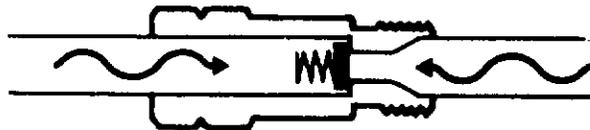


USE A FRICTION LIGHTER TO LIGHT BLOWPIPE. YOU MIGHT GET A BAD BURN IN TRYING TO USE A MATCH.

19. Acetylene must never be released where it might be the cause of a fire or explosion.
20. Fittings must be securely connected before anyone uses the equipment.
21. The torch and hose must not be hung on regulators or cylinder valves.
22. An oxygen regulator must never be connected to a cylinder containing combustible gas.
23. One should not experiment with regulators or torches nor alter them in any way.
24. All oxyacetylene operations should be under the supervision of trained and qualified personnel.
25. Safety reverse flow-check valves must be installed on the outlet nipple of the oxygen and fuel regulators to prevent reverse flow.



NORMAL FLOW



REVERSE FLOW STOPPED

## WELDING AND CUTTING

1. Special care should be exercised when working in a confined space (proper clothing, ventilation, etc.).
2. Free oxygen must never be introduced into a confined space, as it supports and accelerates combustion.
3. Good ventilation is necessary when welding or cutting brass, bronze, galvanized iron, etc.
4. A suitable air line mask should be worn when cutting iron or steel coated with lead, or with paint containing lead.
5. Particular caution should be exhibited when welding or cutting in dusty or gaseous locations.
6. Containers that have held a flammable substance should never be cut or welded until they have been thoroughly cleaned and safeguarded.



7. Jacketed containers or other hollow parts must be sufficiently vented before heating, welding, or cutting.
8. Cylinders, hoses, and the operator must be protected when flame cutting.
9. Stud ends of welding rods must not be dropped on floors or decks.
10. The bushings in the castings should be removed before heating the castings.
11. One should never weld or cut on bulkheads until a careful inspection of the opposite side is made and sufficient fire watches are available.
12. Protective clothing should be worn at all times. Sleeves should be kept buttoned about the wrist. Collars should be kept buttoned.

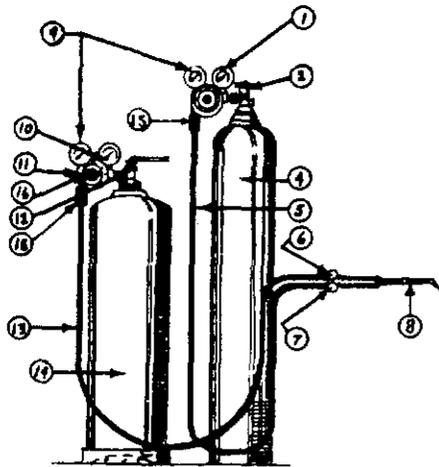
13. Fire-resistant gauntlet gloves should be used at all times.
14. Front pockets and cuffs on overalls should be eliminated.
15. The proper shade lens should be worn during all welding and cutting operations.
16. Helmets and goggles should be checked frequently for light leaks, cracks, and missing cover lens.

### FIRE PREVENTION

1. Cutting or welding torches should never be used where sparks or an open flame of any kind would be a hazard.
2. Cutting or welding work must be taken to a location where there will be no possibility of setting anything on fire.
3. If flammable materials cannot be moved, sheet metal should be used to keep the sparks close to the work being done.
4. A person who is welding or cutting on a wooden deck or floor should sweep it clean and wet it down before starting work.
5. A person who is starting to cut off a piece of steel should make sure it will not drop where there is a possibility of starting a fire.
6. When one is welding close to wooden construction it should be protected from direct heat.
7. A person who is welding near materials that will burn should be ready to promptly put out any fire, using fire extinguishers, water, or sand.
8. Fires can smolder undetected. If there is a possibility that a smoldering fire may have been started, a worker should be kept at the scene of the work for at least half an hour after the job is completed.
9. Heavy cutting sparks sometimes fly 25 to 30 feet and hold their heat for several seconds after landing. This is an important fact to keep in mind!



## OXYACETYLENE WELDER

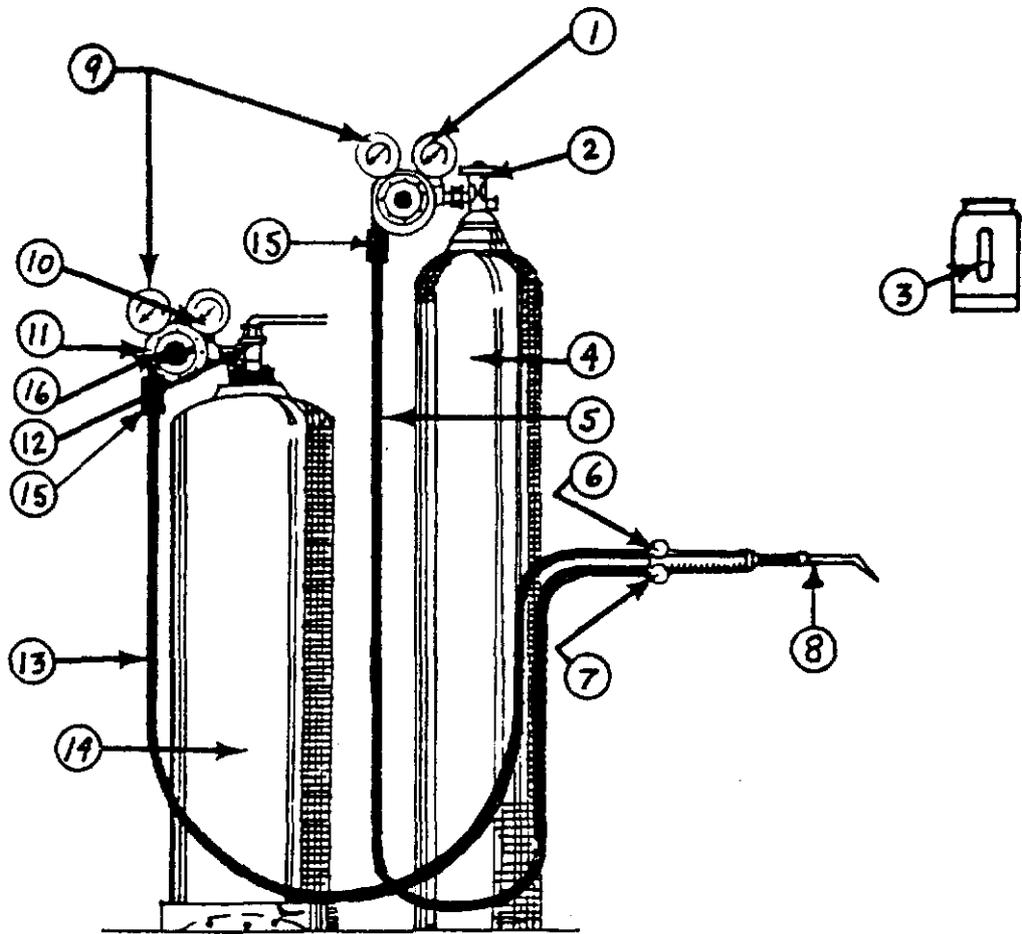


1. CYLINDER PRESSURE GAUGE
2. OXYGEN CYLINDER VALVE
3. CYLINDER CAP
4. OXYGEN CYLINDER
5. OXYGEN HOSE
6. ACETYLENE TORCH VALVE
7. OXYGEN TORCH VALVE
8. WELDING BLOWPIPE
9. OUTLET PRESSURE GAUGE
10. CYLINDER PRESSURE GAUGE
11. ACETYLENE REGULATOR
12. ACETYLENE CYLINDER VALVE
13. ACETYLENE HOSE
14. ACETYLENE CYLINDER
15. SAFETY REVERSE FLOW CHECK VALVE
16. ADJUSTING SCREW

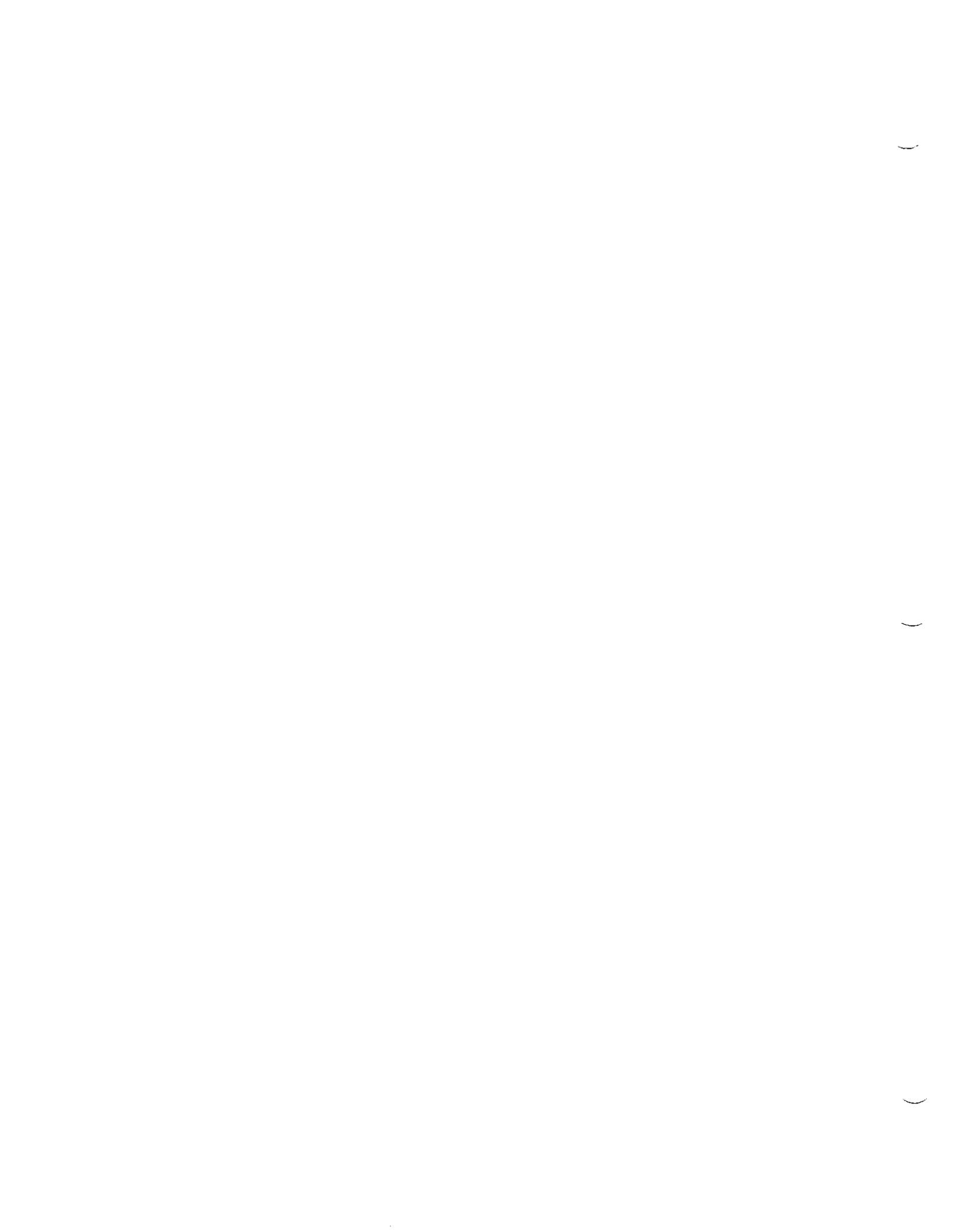
1. Obtain permission from the teacher to use the oxyacetylene welder.
2. Wear safety goggles at all times when gas welding.
3. Adjust the welder for operation in the following sequence:
  - A. Inspect the regulator's adjusting screws to ensure that they are all the way out (counterclockwise).
  - B. Open the oxygen cylinder (green) valve slowly. (When wide open, stand to one side.)
  - C. Open the acetylene cylinder (red) valve (1/4 to 1/2 turn).
  - D. Open the torch oxygen valve one turn.
    - (1) Turn the oxygen regulator valve adjusting screw until the proper reading is obtained. (See the chart on page 601 for the tip being used.
    - (2) Turn off the torch oxygen valve.
  - E. Turn the acetylene regulator adjusting screw in slowly until the correct reading is obtained for the tip being used.
4. Have the teacher check setup before lighting the torch.
5. Use the following procedure for lighting the torch:

- A. Turn the torch acetylene valve 1/16 of a turn, then ignite the acetylene gas coming from the tip with a spark lighter.
  - B. Readjust the acetylene regulator adjusting screw until the correct reading is obtained.
  - C. Turn the acetylene torch valve on slowly until the flame jumps away from the tip. Then slightly reduce the fuel supply to bring the flame back to the tip.
  - D. Adjust the torch oxygen valve to obtain a neutral flame.
6. NEVER lay down a lighted torch.
  7. NEVER use acetylene gas at a pressure greater than 15 psi.
  8. Take care not to burn the hoses.
  9. Replace goggles, hoses, and torch in their proper places and clean the area when welding is finished.

## OXYACETYLENE WELDER



- |   |                         |    |                                 |
|---|-------------------------|----|---------------------------------|
| 1 | CYLINDER PRESSURE GAUGE | 9  | OUTLET PRESSURE GAUGE           |
| 2 | OXYGEN CYLINDER VALVE   | 10 | CYLINDER PRESSURE GAUGE         |
| 3 | CYLINDER CAP            | 11 | ACETYLENE REGULATOR             |
| 4 | OXYGEN CYLINDER         | 12 | ACETYLENE CYLINDER VALVE        |
| 5 | OXYGEN HOSE             | 13 | ACETYLENE HOSE                  |
| 6 | ACETYLENE TORCH VALVE   | 14 | ACETYLENE CYLINDER              |
| 7 | OXYGEN TORCH VALVE      | 15 | SAFETY REVERSE FLOW CHECK VALVE |
| 8 | WELDING BLOWPIPE        | 16 | ADJUSTING SCREW                 |



# OXYACETYLENE WELDER SAFETY QUIZ

NAME \_\_\_\_\_

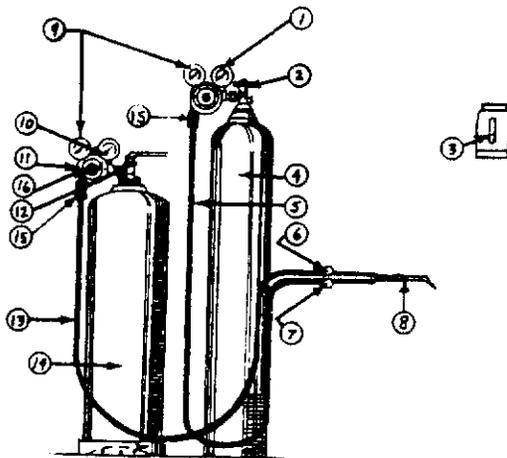
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

True or False: Circle the correct answer.

- T F 1. Gas bottles may be laid on the floor when not in use.
- T F 2. Closed containers are not hazardous to weld or repair.
- T F 3. The cylinder caps should be placed on all bottles when not in use.
- T F 4. Eye protection must be worn for all welding, cutting, and chipping operations.
- T F 5. The equipment should not be wiped down with oily rags.
- T F 6. Acetylene pressure should be set at 20 psi.

In the spaces provided, identify the parts of the oxyacetylene welder:



- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_
- 4 \_\_\_\_\_
- 5 \_\_\_\_\_
- 6 \_\_\_\_\_
- 7 \_\_\_\_\_
- 8 \_\_\_\_\_
- 9 \_\_\_\_\_
- 10 \_\_\_\_\_
- 11 \_\_\_\_\_
- 12 \_\_\_\_\_
- 13 \_\_\_\_\_
- 14 \_\_\_\_\_
- 15 \_\_\_\_\_
- 16 \_\_\_\_\_



## OXYGEN-ACETYLENE WELDING SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

True or False: Circle the correct answer.

- T F 1. Oxygen and acetylene hoses may be interchanged.
- T F 2. A hose may be repaired with tape when damaged.
- T F 3. A regulator should always be attached before using oxygen from a cylinder.

Multiple Choice: Put the correct letter on the line preceding the number.

- \_\_\_\_\_ 4. Oil or grease in the presence of oxygen pressure may cause:
- A. ignition.
  - B. low pressure.
  - C. flameout.
- \_\_\_\_\_ 5. Acetylene regulators and acetylene cylinder valve outlets have \_\_\_\_\_ thread connections.
- A. right-handed
  - B. left-handed
  - C. vertical
- \_\_\_\_\_ 6. The blowpipe oxygen valve should be \_\_\_\_\_ when testing connections for leaks.
- A. open
  - B. closed
  - C. removed
- \_\_\_\_\_ 7. Leaks in a blowpipe hose can be tested by immersing it in \_\_\_\_\_.
- A. oil
  - B. water
  - C. soapy water

- \_\_\_\_\_ 8. The acetylene tank valve should be opened:
- A. all the way.
  - B. one half turn.
  - C. one and one-half turns.
  - D. two and one-half turns.
- \_\_\_\_\_ 9. The acetylene hose is always colored:
- A. blue.
  - B. green.
  - C. red.
  - D. none of these.
- \_\_\_\_\_ 10. The oxygen hose is always colored:
- A. blue.
  - B. green.
  - C. red.
  - D. none of these.
- \_\_\_\_\_ 11. One should make sure welding equipment is:
- A. lubricated with oil.
  - B. tightened by hand.
  - C. kept free of oil and grease.
  - D. lubricated weekly.
- \_\_\_\_\_ 12. Welding goggles are worn because they:
- A. magnify the work.
  - B. protect the eyes from dust.
  - C. help a person concentrate on his/her work.
  - D. protect the eyes against heat, rays, and sparks.
- \_\_\_\_\_ 13. The oxygen valve adjusting screw should be turned:
- A. with a pair of pliers.
  - B. three full turns.
  - C. one and one-fourth turns or less.
  - D. until the proper reading is obtained.
- \_\_\_\_\_ 14. When lighting a welding torch, one should use:
- A. a friction torch lighter.
  - B. a match.
  - C. a fluid lighter.
  - D. a piece of lighted paper.

- \_\_\_\_\_ 15. If a welding torch backfires, one should:
- A. dip the torch in water.
  - B. Inspect the hose.
  - C. put an "Out-of-order" sign on the equipment.
  - D. close the acetylene valve.
- \_\_\_\_\_ 16. One should move cylinders by:
- A. tilting and rolling them on their bottom edge.
  - B. dragging or sliding them.
  - C. lifting them with the valve protection caps.
  - D. bouncing them.
- \_\_\_\_\_ 17. When storing cylinders, they should be:
- A. kept away from heat and extreme weather changes.
  - B. stored in a small, well-ventilated, dry location.
  - C. kept away from highly combustible materials.
  - D. all of the above.
- \_\_\_\_\_ 18. One should close valves:
- A. before moving.
  - B. on empty cylinders.
  - C. when work is finished.
  - D. in all of the above.
- \_\_\_\_\_ 19. Acetylene hose pressure should be limited to below:
- A. 20 lbs. per square inch.
  - B. 18 lbs. per square inch.
  - C. 15 lbs. per square inch.
  - D. 25 lbs. per square inch.
- \_\_\_\_\_ 20. If a hose is damaged, one should:
- A. continue to use it.
  - B. replace it.
  - C. bind it with tape.
  - D. do none of the above.



In response to the arc welding industry's ongoing concern for safety and the health of welders, the American Welding Society has established a new standard for warnings. Over the next several months, welders will start seeing a new warning on Lincoln electrode and flux packages. Following shortly will be a similar warning on power sources and wire feeders. An example of this new warning is reproduced below:

# WARNING

---

**READ AND UNDERSTAND THIS LABEL      PROTECT YOURSELF AND OTHERS**

---

**ELECTRIC SHOCK** can kill.

- Do not permit electrically live parts or electrodes to contact skin ... or your clothing or gloves if they are wet.
- Insulate yourself from work and ground.

**FUMES AND GASES** can be dangerous to your health.

- Keep fumes and gases from your breathing zone and general area.
- Keep your head out of fumes.
- Use enough ventilation or exhaust at the arc or both.

**ARC RAYS** can injure eyes and burn skin.

- Wear correct eye, ear, and body protection.

---

**READ AND UNDERSTAND THE MANUFACTURER'S INSTRUCTIONS  
AND YOUR EMPLOYER'S SAFETY PRACTICES.**

See American National Standard Z49.1, "Safety in Welding and Cutting", published by the American Welding Society, 2501 N.W. 7th St., Miami, Florida 33125; OSHA Safety and Health Standards, 29 CFR 1910 available from U.S. Dept. of Labor, Washington, D.C. 20210.

**DO NOT REMOVE THIS LABEL**

# ARC WELDING SAFETY PRECAUTIONS

**PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. READ AND UNDERSTAND BOTH THE SPECIFIC INFORMATION GIVEN IN THE OPERATING MANUAL FOR THE WELDER AND/OR OTHER EQUIPMENT TO BE USED AS WELL AS THE FOLLOWING GENERAL INFORMATION.**

1. Have all installation, maintenance and repair work performed only by qualified people.
2. Protect yourself from possible dangerous electrical shock.
  - a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Never permit contact between "hot" parts of the circuits and bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.
  - b. Always insulate yourself from the work and ground using dry insulation when welding in damp locations, on metal floors, gratings or scaffolds, and particularly when in positions (such as sitting or lying) where large areas of your body can be in contact with a conductive surface.
  - c. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition.
  - d. Never dip the electrode holder in water for cooling.
  - e. Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.
  - f. If using the welder as a power source for mechanized welding, the above precautions also apply for the automatic electrode, electrode reel, welding head, nozzle or semiautomatic welding gun.
3. Keep all equipment safety guards, covers and devices in position and good repair.
4. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.
5. When working above floor level, protect yourself from a fall should you get a shock. Never wrap the electrode cable around any part of your body.
6. Arcburn may be more severe than sunburn. Therefore:
  - a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Filter lens should conform to ANSI Z87.1 standards.
  - b. Use suitable clothing to protect your skin and that of your helpers from the arc rays.
  - c. Protect other nearby personnel with suitable non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.
7. Droplets of molten slag and metal are thrown or fall from the welding arc. Protect yourself with oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places.
8. Always wear safety glasses when in a welding area. Use glasses with side shields when near slag chipping operations.
9. Remove fire hazards well away from the area. If this is not possible cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
10. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.
11. Be sure the work cable is connected to the work as close to the welding area as practical. Work cables connected to the building framework or other locations some distance from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.
12. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. When welding on galvanized, lead or cadmium plated steel and other metals which produce toxic fumes, even greater care must be taken.
13. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.
14. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned." For information purchase "Safe Practices for Welding and Cutting Containers That Have Held Combustibles", A6.0-65 from the American Welding Society, Miami, Florida 33125.
15. Vent hollow castings or containers before heating, cutting or welding. They may explode.
16. For more detailed safety information it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting — ANSI Standard Z49.1" for \$5.00 from the American Welding Society, Miami, Florida 33125.

## Additional Safety Precautions

### For Electrically Powered Welders

The high voltage and rotating parts associated with this type of equipment require observance of these additional precautions:

1. Disconnect and lock out all power sources before doing any work on the equipment.
2. Make the electrical installation in accordance with the National Electrical Code and all local codes.
3. Properly ground the equipment in accordance with the National Electrical Code and the manufacturer's recommendations. The work or metal to be welded must also be connected to a good electrical ground.

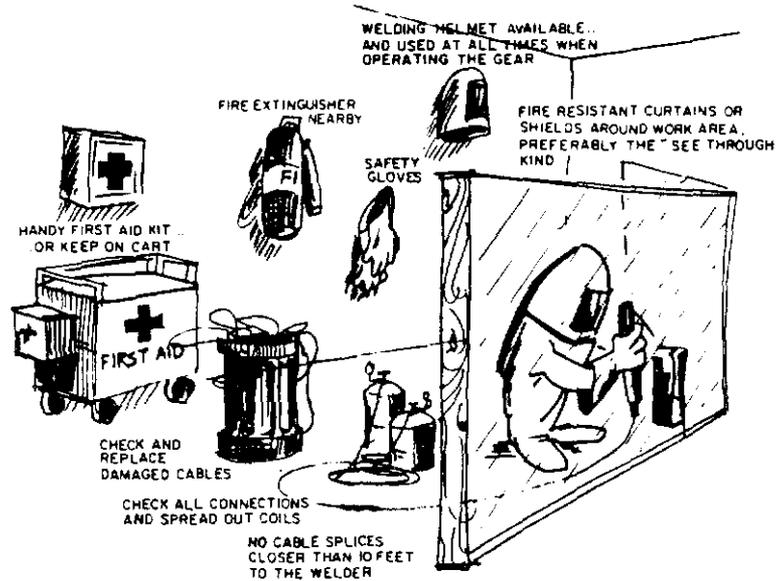
### For Engine Powered Welders

The required fuel and rotating parts associated with this type of equipment require observance of these additional precautions:

1. Whenever possible, turn the engine off before troubleshooting and maintenance work.
2. Operate internal combustion engines in open, well-ventilated areas or vent the engine exhaust fumes to the outside.
3. Do not add the fuel near an open flame or when the engine is running. Stop the engine and, if possible, allow it to cool to prevent spilled fuel from igniting on contact with hot engine parts or electrical sparks. Do not spill fuel when filling tank.
4. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.
5. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.

(AMERICAN WELDING SOCIETY)

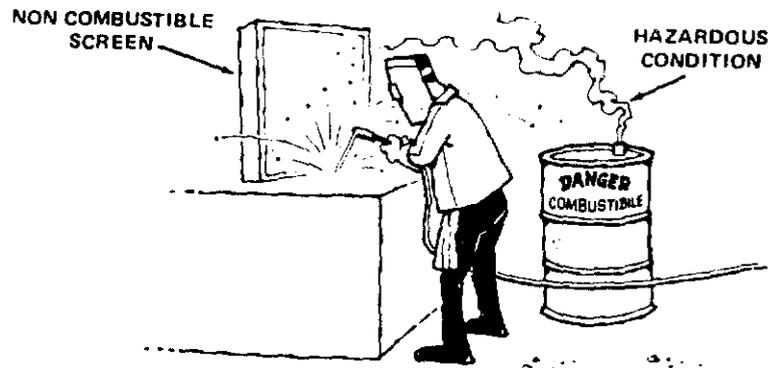
## ELECTRIC WELDING SAFETY (OSHA/NIOSH)



1. Welding machine trouble shall always be checked by competent authorized electricians. NEVER BY A PUPIL.
2. Polarity switches shall not be operated while the machine is working under load. These switches are to be operated only while the machine is idling.
3. The frame or case of the welding machine (excluding engine-driven machines) is required to be grounded.
4. Do not ground to pipelines carrying gases or flammable liquids or conduits carrying electrical conductors.
5. If the floors have been wetted down, special precautions must be taken against electrical shock.
6. Do not ground to a building structure remote from the weld. The ground might lose its effectiveness over a long distance, and would present a tripping hazard.
7. A disconnecting switch or controller is required at or near each arc welding machine.

8. Cables with splices within ten feet of the holder are prohibited.
9. Work and electrode lead cables with damaged insulation or bare conductors require replacement.
10. Check electrode holders for loose or exposed connections.
11. If the metal inert gas welding process is used, check for leaks in gas hoses.
12. Do not coil or loop electrode cable around parts of your body.
13. If workers are not required to wear appropriate goggles, non-combustible booths or screens are required to protect the workers or other persons adjacent to welding areas from welding rays.
14. Portable welding equipment that is suspended from overhead structures is required to be equipped with safety chains or cables capable of supporting the total shock load in the event of support failure.
15. Store electrode holders where they cannot make electrical contact with personnel, conducting objects, fuels, or compressed gas tanks.
16. When no welding is to be done for any substantial period of time (e.g., at lunch or overnight), all electrodes must be removed from their holders and the machine disconnected from the power source.
17. Never strike an arc on a compressed gas cylinder. Keep electrodes, electrode holders, and any other live parts away from gas cylinders.
18. The electrode holder shall be placed on a hook when not in use. Do not leave it on the floor.
19. When working in an open area, a portable flash shield shall be used to protect other personnel from arc flash.
20. Pliers (not gloves) must be used to carry hot projects.
21. Welding cables shall be kept dry and free from grease and oil.
22. All welding operations shall be performed within the rated capacity of the welding cables.

23. All flammable and combustible materials must be removed from the welding area.



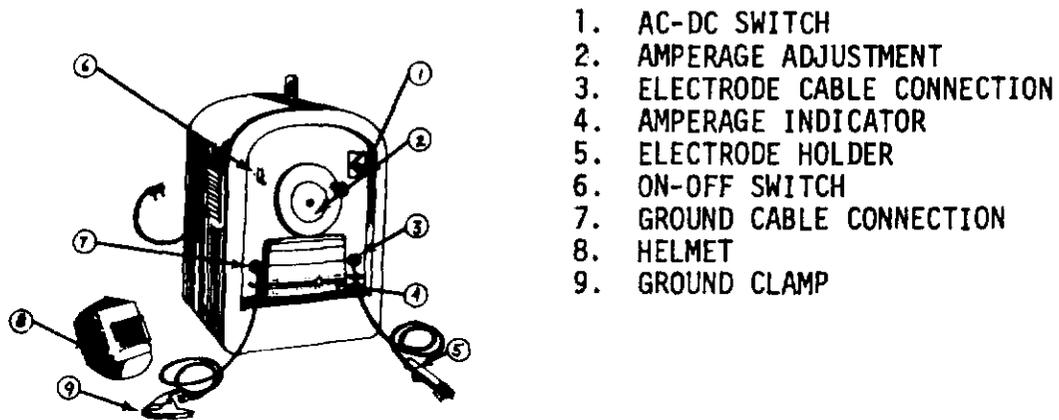
24. One must not work in an area where combustible dust is suspended in the air.
25. No welding or cutting should be performed on used drums, barrels, tanks, or other containers until they have been cleaned thoroughly, eliminating all flammable materials and all substances (such as greases, tars, or acids) which might produce flammable or toxic vapors when heated.
26. All hollow spaces, cavities, or containers should be vented to permit the escape of air or gases before preheating, cutting, or welding.
27. Do not weld on or cut pipes or other metals in contact with combustible walls, partitions, ceilings, or roofs if the work is close enough to start a fire by conducting heat through the metal.
28. If the process being used requires open circuit (no load) voltages higher than the voltages indicated in the following table, adequate insulations must be provided to prevent shock.

Operation

Type	Manual	Automatic (mechanized)
Alternating current	80 volts	100 volts
Direct current	100 volts	100 volts

29. For AC welding under wet conditions or where perspiration is a problem, a reliable automatic control should be used to reduce the no-load voltage. This will prevent shock.
30. Do not change the polarity switch when the machine is under load. The arcing due to the high current can burn the switch contact surface or cause serious burns to the welder.
31. Check to see that the welding machine has a power disconnect switch. This allows immediate shutdown in case of emergency. A machine should not be used unless it has such a switch.

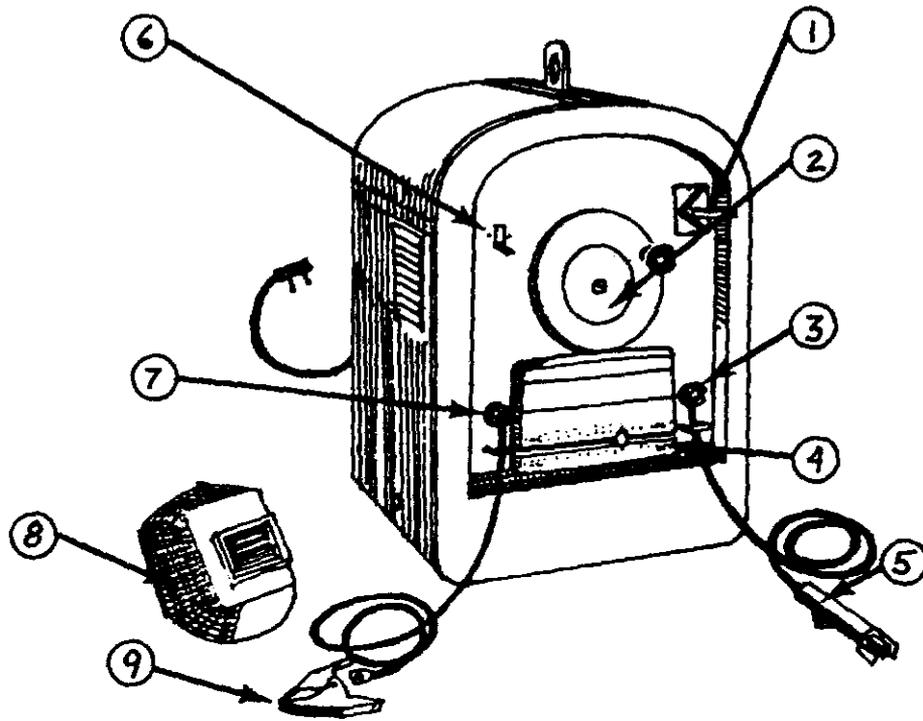
## ARC WELDER



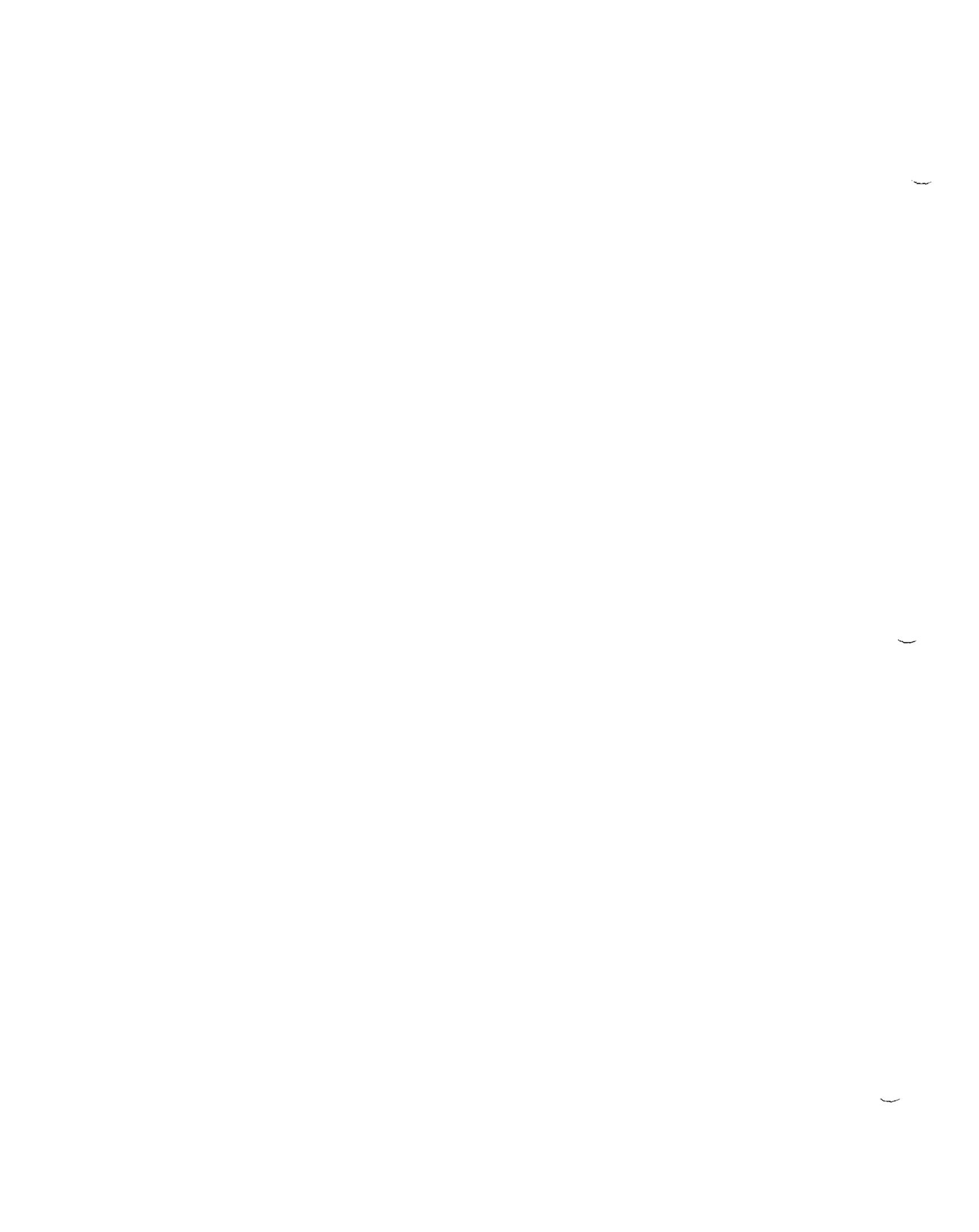
1. The arc welder must be operated only with the teacher's permission and after instruction has been received.
2. Jewelry must be removed, loose clothing eliminated, and long hair confined.
3. All guards are to be in place and operating correctly.
4. The proper eye protection must always be used.
5. A welding helmet must be worn when welding.
6. Proper ventilation must be available.
7. Goggles must be worn when chipping slag.
8. Others in the area must be warned prior to striking an arc.
9. Gloves and proper clothing must be worn when welding.
10. Closed containers should not be welded without the teacher's permission.
11. Cables, clamps, and electrode holder should be checked to make sure they are working properly.
12. Screens to protect others must be in place before welding is started.



# ARC WELDER



- |                              |                           |
|------------------------------|---------------------------|
| 1 AC-DC SWITCH               | 6 ON-OFF SWITCH           |
| 2 AMPERAGE ADJUSTMENT        | 7 GROUND CABLE CONNECTION |
| 3 ELECTRODE CABLE CONNECTION | 8 HELMET                  |
| 4 AMPERAGE INDICATOR         | 9 GROUND CLAMP            |
| 5 ELECTRODE HOLDER           |                           |



## ARC WELDER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

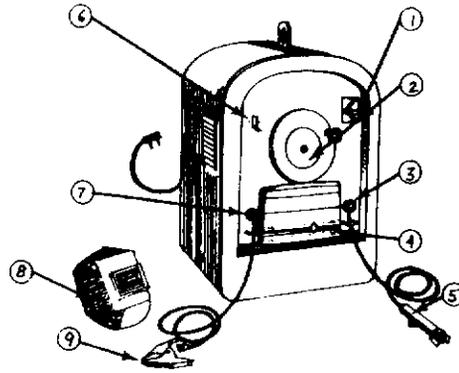
---

True or False:

(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. A person should warn anyone nearby before starting to weld.                                    | T | F |
| 2. Goggles, as well as a welding hood, should be put on before starting to weld.                  | T | F |
| 3. A closed container is dangerous to weld.   | T | F |
| 4. Gloves are not necessary when welding.   | T | F |
| 5. It is dangerous to weld without the proper ventilation.  | T | F |
| 6. An electric shock is possible if you touch both the electrode and the ground at the same time. | T | F |

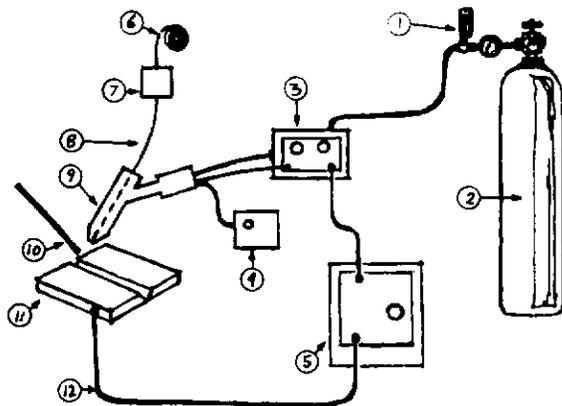
7. In the spaces provided, identify the parts of the arc welder.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_

TIG (TUNGSTEN INERT GAS) WELDER  
MIG (METAL INERT GAS) WELDER



1. FLOW METER & REGULATOR
2. INERT GAS SUPPLY
3. CONTROL SYSTEM
4. COOLANT SYSTEM
5. WELDING MACHINE
6. WIRE REEL
7. WIRE FEEDER(MIG)
8. WIRE
9. TORCH
10. ELECTRODE (TIG)
11. WORK
12. GROUND

1. Operate only with the teacher's permission and after instruction has been received.
2. Remove jewelry, eliminate loose clothing, and confine long hair.
3. Always use the proper eye protection.
4. Wear additional protective welding clothing, including a helmet, long-sleeved jacket, and gloves in order to prevent burns from ultraviolet and infrared rays emitted while arc welding.
5. For TIG or MIG welding use a helmet equipped with a minimum number twelve density shade.
6. Be certain that any welder equipped with a high frequency stabilizing unit is installed, maintained, and used according to the recommendations of both the manufacturer and the Federal Communications Commission.

9. Never touch the tungsten electrode or MIG wire while the welder is turned on. It is electrically "hot" and can cause a serious shock.
10. Never use the high frequency when performing shield metal arc (stick electrode) welding.

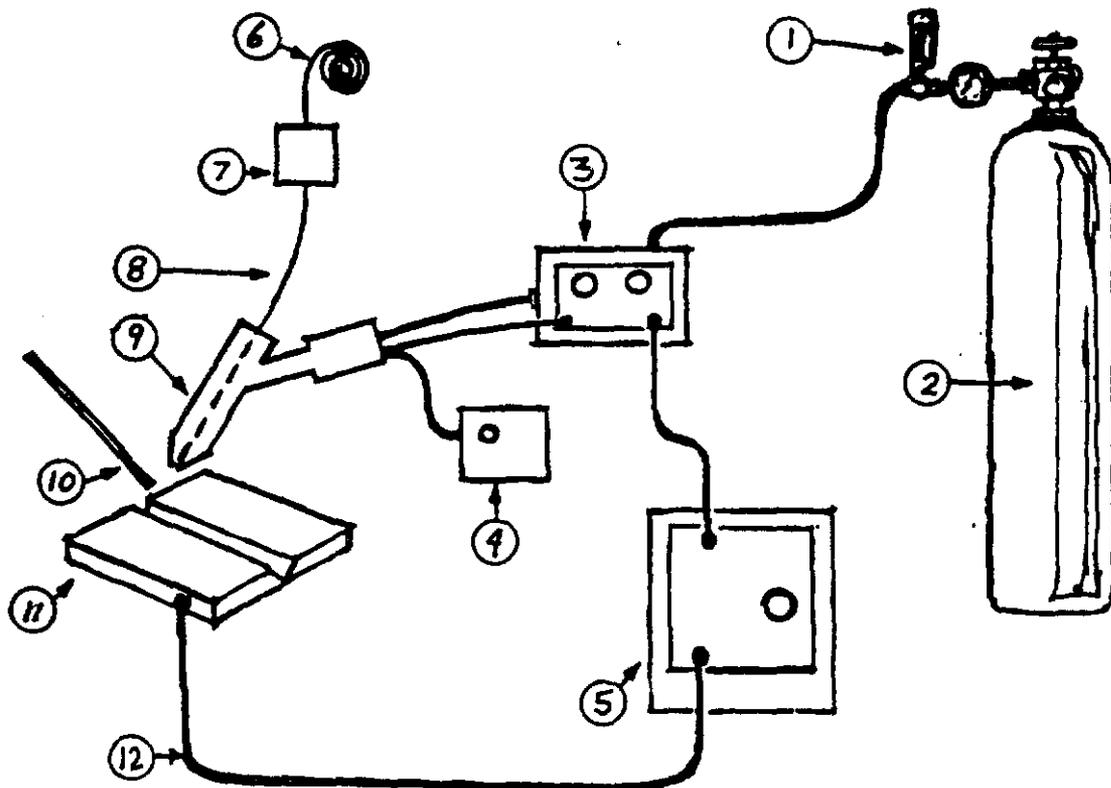
### TIG (TUNGSTEN INERT GAS) WELDING

1. Wear heavy, fire-resistant clothing, including long-sleeved shirts and leather gloves.
2. Use a safety shield to protect the people in surrounding areas from eye damage.
3. Use pliers or a suitable tool for handling the hot metal.
4. Use the proper shade of glass in the welding hood to protect the operator from ultraviolet rays that might damage the eyes.
5. Keep the area clear of inflammable liquids and foreign inflammable material and objects.

### MIG (METAL INERT GAS) WELDING

1. Make sure you use the proper equipment, such as gauges, hoses, and electrical cables, and check to see that they are in proper working order.
2. Use the proper shielding to protect all bystanders.
3. Weld near proper ventilation to exhaust fumes and inert gases.
4. Wear the proper welding helmets and lenses.
5. Wear proper personal clothing, such as gloves, leather jackets, and hair protectors.

TIG (TUNGSTEN INERT GAS) WELDER  
MIG (METAL INERT GAS) WELDER



- 1 FLOW METER & REGULATOR
- 2 INERT GAS SUPPLY
- 3 CONTROL SYSTEM
- 4 COOLANT SYSTEM
- 5 WELDING MACHINE
- 6 WIRE REEL (MIG)

- 7 WIRE FEEDER (MIG)
- 8 WIRE
- 9 TORCH
- 10 ELECTRODE (TIG)
- 11 WORK
- 12 GROUND



# TIG & MIG WELDER SAFETY QUIZ

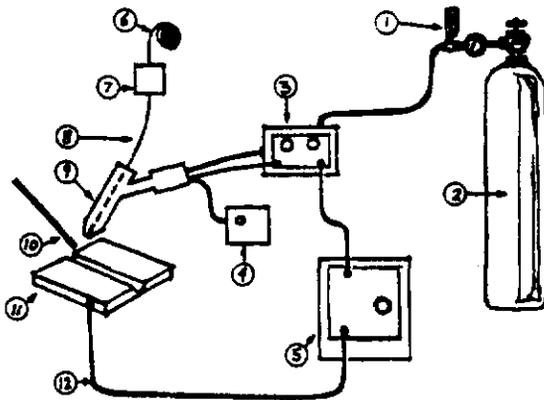
NAME \_\_\_\_\_

CLASS \_\_\_\_\_

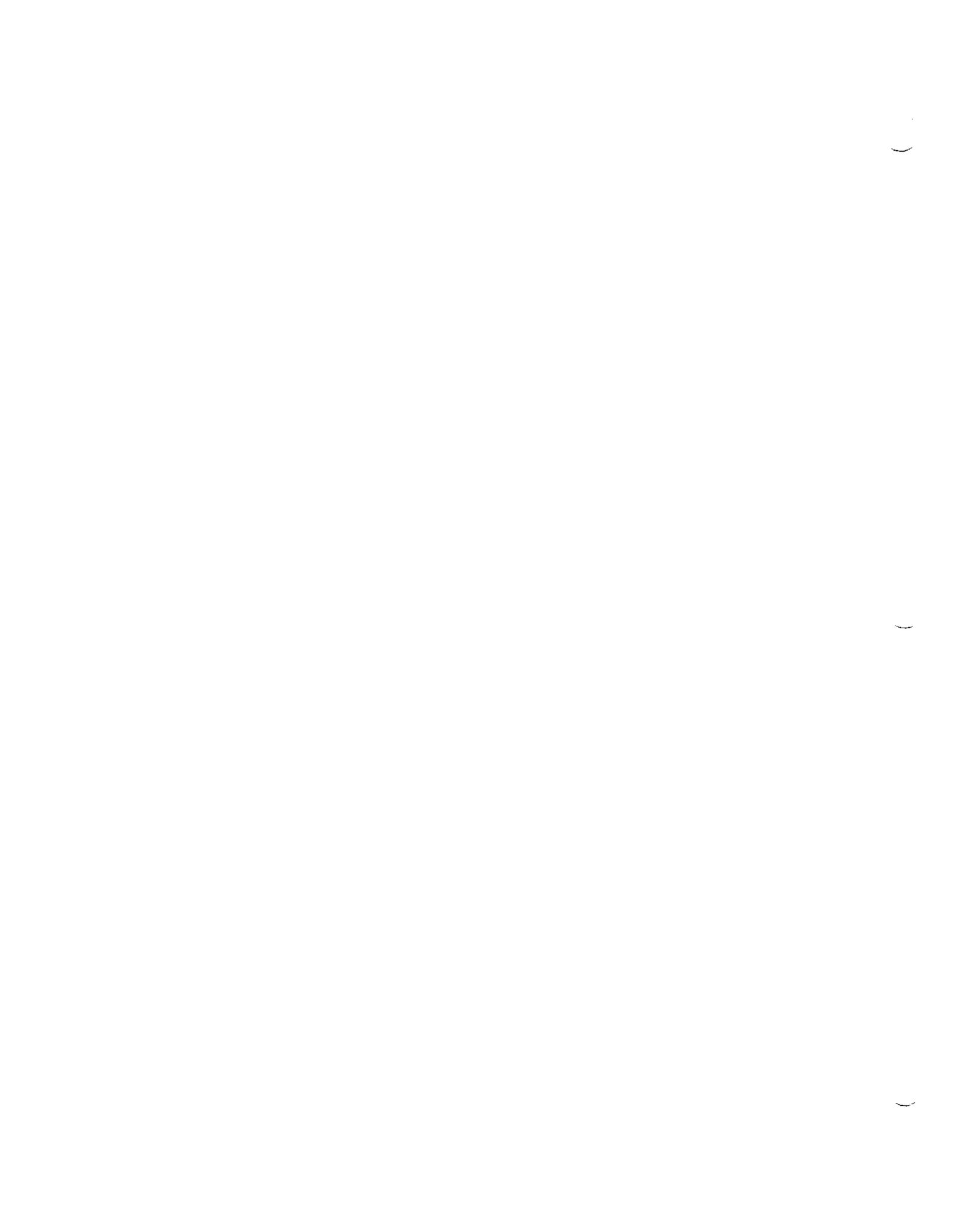
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

True or False:

- |   |   |   |
|---|---|---|
| 1. High frequency welding units are manufactured according to guidelines established by the Federal Communications Commission.          | T | F |
| 2. It is all right to do TIG or MIG welding without a welding helmet.   | T | F |
| 3. A worker can be shocked by touching the tungsten electrode while the TIG welder is turned on.  | T | F |
| 4. The high frequency switch must be turned off while performing regular arc welding.   | T | F |
| 5. Both metal arc welding and gas-shielded arc welding give off ultraviolet and infrared radiation which can burn the unprotected skin. | T | F |
| 6. Name the parts in the following illustration.  |   |   |



1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_

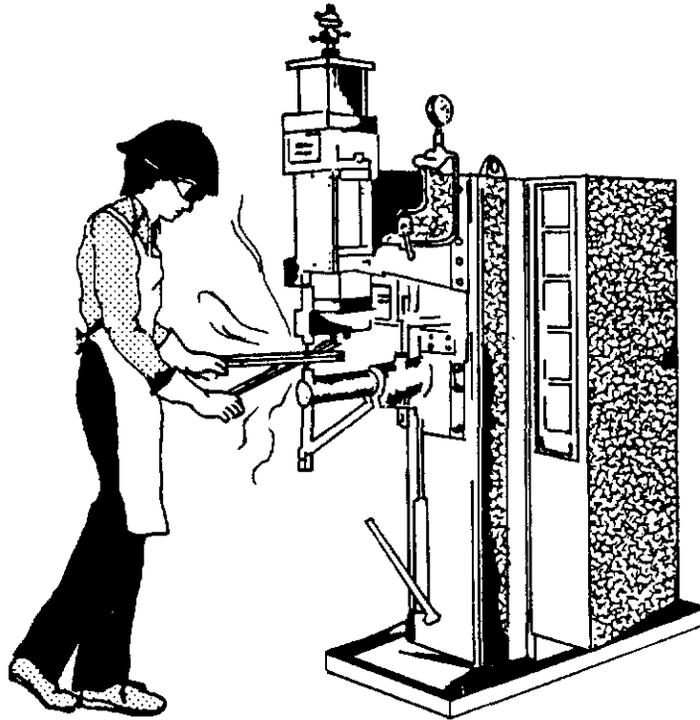


## SPOT WELDERS

Spot welding is a method of joining two pieces of metal together with electric heat and mechanical pressure. The heat is developed by the resistance of the metal to high-amperage, low-voltage current which passes through a limited area. This is where a resistance weld is made. Some safety suggestions for operating the spot welder follow:

1. Before attempting to make power line connections, change tips, or make repairs, be sure the unit is completely disconnected from the power line.
2. Always avoid contact between any part of the human body and any current-carrying part of the spot welder.
3. Be sure the welder is connected to the proper voltage and securely grounded. A grounding wire is provided in the power cord for grounding the welder in case of internal insulation breakdown. Do not cut off the grounding terminal on the cord plug.
4. Operate the spot welder from a separately fused circuit. The capacity of the welder is affected by the line voltage. If the circuit is overloaded, the performance will be reduced. Extension cords should not be used because of the voltage drop they are apt to cause.
5. Wear a face shield when operating a spot welding machine. This protects the eyes and face from hot molten particles.
6. Be sure the tongs are properly aligned and the pressure correctly adjusted before turning on the welder. Check the alignment before the power is turned on. If the tips are misaligned, the work to be welded will move out of place. There is no advantage in having excessive tong pressure. The metal to be welded should be in close contact before applying pressure on the tongs.
7. Never apply current to the tong tips without having metal between them.
8. Keep the tong tips dressed. As the welder is used, the diameter of the tong tips will increase in size. This increased diameter will require more current and a longer time setting. For galvanized and stainless steels, the tips must be clean and properly dressed or the weld will cause excessive splatter.

9. Be sure there is water flowing through water-cooled welders before using them. If water is not flowing to cool the tips, they will be burned.
10. Start the exhaust fan before welding galvanized metal. The fumes given off from welding zinc-coated material may cause zinc fume fever.



SPOT WELDING CAN RELEASE SMALL QUANTITIES OF FUMES.

## ELECTRIC WELDING SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

### True or False:

- |  |   |   |
|--|---|---|
| 1. One should avoid looking at the arc or flash unless equipped with the appropriate dark glasses. | T | F |
| 2. Helmets and welding goggles must be free of cracks or holes.                                    | T | F |
| 3. It is not necessary to wear protective clothing when arc welding.                               | T | F |
| 4. It is safer and better to wear low-cut shoes, rather than boots, in any welding situation.      | T | F |

### Multiple Choice:

- \_\_\_\_\_ 1. Rotary current-setting switches may be changed:
- A. when the machine is under full load.
  - B. when the machine is idling.
  - C. at any time.
- \_\_\_\_\_ 2. Polarity switches may be changed:
- A. at any time.
  - B. when the machine is under full load.
  - C. when the machine is idling.
- \_\_\_\_\_ 3. Welding machine trouble shall be checked by:
- A. the pupil.
  - B. an authorized electrician.
  - C. anyone.

- \_\_\_ 4. Gasoline tanks will be welded in school shops:
- A. always.
  - B. never.
  - C. sometimes.
- \_\_\_ 5. An electric arc flash will burn:
- A. the skin and eyes.
  - B. the feet.
  - C. the clothing.
  - D. all of the above.
- \_\_\_ 6. The ground clamp should be attached firmly to:
- A. the welder.
  - B. the work.
  - C. the table.
  - D. both B and C.
- \_\_\_ 7. Arc ray burns should be treated as:
- A. heat rash.
  - B. a minor sunburn.
  - C. a scald.
  - D. a severe sunburn.
- \_\_\_ 8. The cables need to be:
- A. kept insulated.
  - B. kept dry.
  - C. free from grease and oil.
  - D. all of the above.
- \_\_\_ 9. Report to the teacher at once:
- A. if the electrode holder, ground clamp lugs, or cable gets hot.
  - B. if the handle slips off the electrode holder.
  - C. if there is a bare wire.
  - D. if all of the above occur.
- \_\_\_ 10. When handling hot metal, use:
- A. a helmet.
  - B. a pair of pliers
  - C. a c-clamp.
  - D. a chipping hammer.

- \_\_\_\_11. The observation window in the welding helmet is cracked.  
It will:
- A. allow dust to pass through it.
  - B. obstruct one's view.
  - C. transmit infrared and ultraviolet rays.
  - D. rattle every time the helmet is flipped up.
- \_\_\_\_12. When one has finished using the electrode holder, one should:
- A. place it on a metal workbench.
  - B. clamp it on the metal frame of the workbench.
  - C. rest it on the floor.
  - D. suspend it so that it will not touch any metal.
- \_\_\_\_13. If a cable or the electrode holder overheats, one should:
- A. notify the teacher.
  - B. turn the voltage down.
  - C. stop welding and wait until it cools.
  - D. change the electrode holder.
- \_\_\_\_14. One should always draw the curtains on the welding booth  
before striking an arc in order to:
- A. protect the eyes from the infrared and ultraviolet rays.
  - B. keep the work from getting cool.
  - C. prevent anyone from noticing any mistakes.
  - D. protect anyone nearby from the infrared and ultraviolet rays.
- \_\_\_\_15. Before leaving heated metal unattended, one should use chalk  
or soapstone to label it with the word "hot" because:
- A. someone may be burned if he/she touches it.
  - B. other work may be placed on it.
  - C. One can then tell to whom it belongs.
  - D. chalk will help cool it.

Complete the following statements:

16. For eye protection against infrared and ultraviolet rays, a person must wear a welding\_\_\_\_\_.
17. When chipping slag, one must wear\_\_\_\_\_.
18. Arc welding should be done only behind proper screens or in a\_\_\_\_\_.
19. If one's skin is exposed to electric arc rays, he/she will be\_\_\_\_\_.
20. A\_\_\_\_\_ should be near when electric welding is being done.
21. The welding area should be well\_\_\_\_\_.



**REGO** COMPANY 4201 W. PETERSON AVE. CHICAGO, ILL.

The remainder of this section consists of a set of safety transparencies and a script that explains them. This script can be referred to when showing the transparencies to the class. The drawings and script deal with all phases of welding safety.

"REGO SLANTS ON SAFETY"  
(DIALOGUE FOR TRANSPARENCY PRESENTATION)

POLICE YOUR WORK AREA

1. Never place welding or cutting operations close to combustible materials (gasoline cans, paints, paper, rags, etc.).
2. Cylinders with regulators attached should not be rolled to a new location. Regulators should be removed and protective cylinder valve caps installed before moving the cylinders.

When cylinders are secured in a welding cart, the cylinder valves should be closed before the cart is moved.

3. All cylinders (particularly acetylene) in use should be securely retained in an upright position to prevent accidents. A nonvertical acetylene cylinder in use would allow the discharge of acetone through the welding or cutting torch, clogging the mixer passages, creating a fire hazard, reducing the efficiency of the flame, and contaminating the weld area.

STORAGE OF CYLINDER VALVES

1. Cylinders should not be stored near stair wells, gangways, elevator shafts, etc. where cylinders may be knocked over or damaged by passing or falling objects.
2. Store all gas cylinders not in use away from excessive heat sources such as stoves, furnaces, radiators, the direct rays of the sun, or open flames. Cylinders in storage should always be securely chained to a wall or support in an upright position.
3. Keep any burning substance or combustible materials away from oxygen supplies and post "No Smoking" signs.
4. When necessary to move gas cylinders, always carefully roll them on their bottom edge, being sure that the protective shipping cap is securely in place.

Sliding, dragging, or rolling them causes excessive wall wear, which may create hazardous conditions.

5. Do not hammer on, drop, or use gas cylinders as rollers for machinery moving purposes.

6. Never directly use a hammer blow to loosen the protective transportation cap on oxygen or other types of gas cylinders. Use a short piece of clean wood to absorb the hammer blow and prevent sparks and dangerous spalling of the hammer and metal cap.
7. If a leak develops in a fuel gas cylinder that cannot be stopped by closing the valve, immediately place the cylinder outside the building and away from a possible fire source (in a location free from a wind current which might carry the gas fumes to an ignition source).  
  
Post temporary warning signs near a leaking cylinder, notify the gas dealer immediately, and get special instructions on how to return the cylinder to the dealer.
8. When a gas cylinder is ready for return to the supplier, be sure the cylinder valve is closed to prevent internal contamination and the shipping cap is in place to protect the cylinder valve. Mark the cylinder "MT" in a prominent place.
9. Valve protection cylinder caps should never be used for lifting a cylinder. Use a cradle or platform with the cylinders securely chained in place. Do not use slings or electromagnetic lifts.
10. Keep fuel gas cylinders separated from oxygen cylinders in storage. Keep empty cylinders separated from full ones in storage.

#### FIRE PROTECTION

1. Always have a fire extinguisher in good operating condition and readily available when operating welding and cutting equipment.
2. Upon the completion of a welding, heating, or cutting operation, one should immediately (and carefully) inspect the surrounding area for smoldering embers. At least one half hour should be allowed before leaving the area and then only after conducting another inspection. Also, other personnel in the area should be alerted to the danger of latent fire possibilities.

#### DRESS PROPERLY

Always wear clean, oil-free clothing during welding and cutting operations. Protect the hands with leather welding gloves to avoid burns from radiation and hot molten slag. Low-cut shoes, trousers with cuffs, or open pockets in which sparks or molten slag may lodge should not be worn.

### USE YOUR TOOLS CORRECTLY

Never use oxygen or other gases as a substitute for compressed air in the operation of air-operated tools, the blowing off of parts, or for ventilation purposes. The only exception to this rule is where oxygen is used to blow out torch passages or welding hoses when setting up equipment that has not been used for a while.

### DON'T TAMPER WITH CYLINDER SAFETY DEVICES

Never tamper with the safety devices on gas cylinders (fuse plugs, safety disc caps, etc.) or permit the torch flame to contact the cylinders.

### CRACKING OF CYLINDER VALVES

Before connecting a regulator to a gas cylinder, open the cylinder valve momentarily (this is called "cracking the cylinder valve") to blow out any accumulated particles of dirt, dust, etc. which may have lodged there in transit. Do not stand in front of the valve outlet when operating the cylinder valve.

### SECURE REGULATOR TO CYLINDER WITH PROPER WRENCH

Always use a proper fitting wrench to tighten a regulator to a cylinder or station outlet connection. Never tighten by hand, using the regulator as a substitution for a wrench.

### OPEN CYLINDER VALVE SLOWLY

1. After attaching a regulator to a gas cylinder, one should be sure the regulator adjusting screw is fully released. It should be backed off in a counterclockwise direction so it swivels freely before the cylinder valve is opened. One should never stand directly in front of a regulator when turning on the cylinder valve.
2. The cylinder valve should always be opened slowly so gas pressure will build up slowly in the regulator (this particularly applies to the oxygen cylinder). A quick opening of the cylinder valve causes a buildup of heat due to the recompression of the gas. When combined with combustible materials, ignition and fire may result.
3. Always use a regulator to reduce the gas cylinder pressure to the operating pressures recommended by the equipment manufacturer.

### SAFE USE OF ACETYLENE

1. Never use acetylene in excess of 15 psig pressures. Hazardous conditions can result beyond this point.
2. The maximum safe rate at which acetylene may be drawn from a cylinder should never exceed 1/7 of the cylinder's capacity per hour. For greater acetylene flows, use a manifold.
3. Always leave the fuel gas cylinder valve wrench in place when the cylinder valve is open, so it can be closed quickly in an emergency. Do not open acetylene cylinder valves more than one turn.

### NEVER USE A REGULATOR FOR A GAS OTHER THAN THAT FOR WHICH IT WAS INTENDED

1. Never attempt to adapt and use a fuel gas or inert gas regulator on an oxygen cylinder. A special protective device is furnished in the REGO oxygen regulator to harmlessly dissipate the heat caused by recompression when the cylinder valve is quickly opened. It is not furnished on fuel gas and inert gas regulators.
2. Never use a regulator for gases other than those for which it was recommended by the manufacturer, as the diaphragm and seat materials may not be compatible with other gases.
3. Always refer to the various gases by their proper name. Do not refer to oxygen as "air" or acetylene as "gas."

### PROPER OPERATING PRESSURES

Always follow the manufacturer's recommendations in setting up and operating equipment in the selection of tip size, and in fuel and oxygen operating pressures.

### BLOWING OUT WELDING HOSE

1. Never blow out oxygen, acetylene, or other fuel gas hoses in an unventilated room or around an open flame or other ignition sources.
2. Oxygen supports combustion. It can "puff" a tiny spark into a roaring flame. It can even cause oily or greasy rags to burst into flame from spontaneous combustion or cause a serious fire or explosion.

### PRE-OPERATION SAFETY CHECK

1. CAUTION! - Before operating the equipment, be sure all the connections are leak-tight. Each time equipment connections are loosened and retightened, one should carefully check each connection for leaks, using clean, oil-free, soapy water. Do not use flame for this purpose.
2. CAUTION! - Before lighting up, momentarily (and separately) allow the oxygen and fuel gases to flow through the torch to ensure that "mixed" gases are not present in the welding hoses.
3. Never use defective, worn, or leaky equipment. Have it repaired promptly.
4. If equipment is not to be used for a period of time, the cylinder valves should be closed, the hoses and regulators should be purged of fuel and oxygen, the regulator adjusting screws should be placed in a "backed-off" position, and the torch valves should be closed. Before putting the equipment back into service, it is important to make sure the adjusting screws are released.

### USE PROPER HOSE LENGTH

1. Use as short a length of welding hose as is practical. The longer the hose length, the higher the operating pressures required. This also wastes gas and may be difficult to handle.
2. Using too many hose splicers can cause an excessive loss of pressure to the torch, which may in turn cause a hazardous operating condition.

### LIGHTING TORCH TIP

Never use a match to light a welding or cutting torch. Always use a spark lighter. Fingers are easily burned by the igniting gas if a match is used.

### PROPER EYE PROTECTION

1. Always wear goggles to protect your eyes from injurious light rays, sparks, and hot molten metal during welding, cutting, and heating operations. Eye protection should comply with established federal specifications and those recommended by the welding distributor.
2. Always protect yourself, other persons present, welding hoses, gas cylinders, and flammable materials in the area from the hot slag and sparks that come from the welding and cutting operation.

### PROPER VENTILATION

Never perform welding, cutting, brazing, or heating operations in a poorly ventilated area. Avoid breathing the fumes from these operations at all times, particularly when zinc, cadmium, or lead-coated metals are involved.

### KEEP TIPS CLEAN

1. Dirty, plugged, or partially plugged flame ports can cause overheating, excessive popping, and possible flashback.
2. If one or more preheat ports are restricted on cutting tips, the unbalanced flame condition can cause pre-ignition conditions to exist.
3. Due to the distortion of preheat flames, the restricted ports may cause the tip to overheat.

### HOW TO ELIMINATE EQUIPMENT "SQUEAKS" AND "YOURSELF"

1. Never oil or grease any part of the welding and cutting equipment, nor allow it to come in contact with oil and grease. This includes (but is not limited to) gas cylinders, tools, work bench, regulators, torches, tips, and even the clothes that are worn (such as jackets, gloves, aprons, etc.).

Oxygen, under the right conditions, can react violently with oil or grease, resulting in explosions, fire, and damage or injury to property and personnel.

2. Do not attempt to repair the regulators or torch. Equipment which is incorrectly repaired can cause leaks and other hazardous conditions. Consult the local REGO welding equipment distributor.
3. All heating, welding, and cutting equipment must be maintained at an "oxygen clean" level. This also includes tools, clothes, gloves, benches, etc. Otherwise, oil and grease will be transmitted by contact from a "dirty" to a "clean" piece of equipment. Eventually it will come to the oxygen regulator.

### WORN WELDING HOSE - DO NOT REPAIR! - REPLACE!!!

Never repair a leaking (worn, abraded, etc.) welding hose with tape. Always consult the local REGO supplier for advice. Replace the hose immediately, if safe use is questionable.

### MAINTAIN BACK-FLOW CHECK VALVES

With the check valve removed from the torch and/or regulator, place the check unit in the reverse flow position on the test hose. Use oil-free compressed air and check the unit for leaks across the seat. The unit should not leak at pressures above the manufacturer's back-flow pressure rating.

### CAUTION!-- THE NEXT CUT MADE MAY BE YOUR THROAT!

1. Never use a welding, cutting, or heating torch on a pipe or container that has held a flammable liquid. Explosive vapors can gather and linger in closed containers for a long period of time.
2. The seams and inner side walls of a container may be coated with combustible materials, which can gasify with applied heat and combust (with a cutting torch flame).

### BEWARE OF FLYING CONCRETE CHIPS!

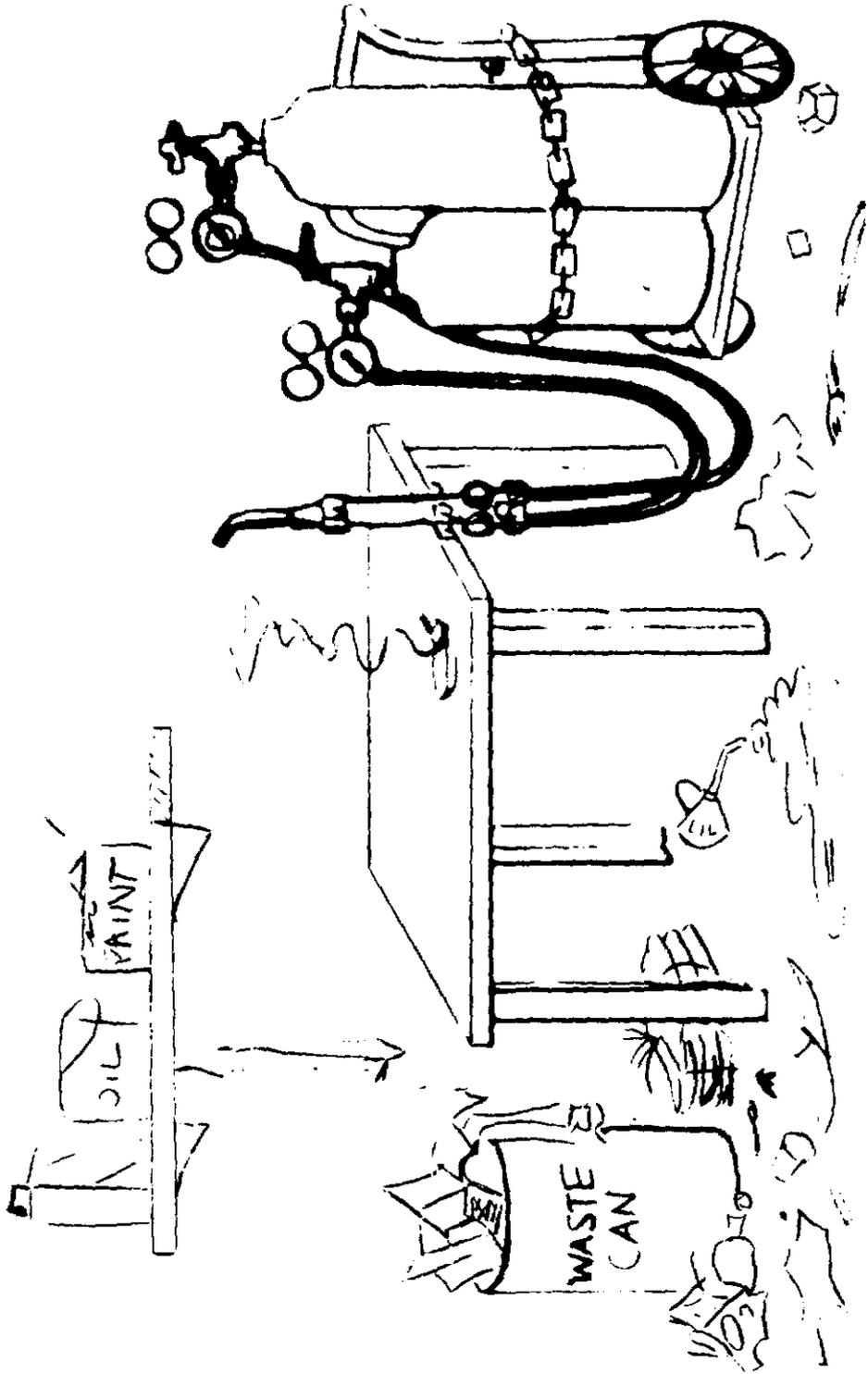
Prevent concrete "explosion" by using a layer of sand and asbestos sheet to catch slag.

### VACATION CAME EARLY THIS YEAR!

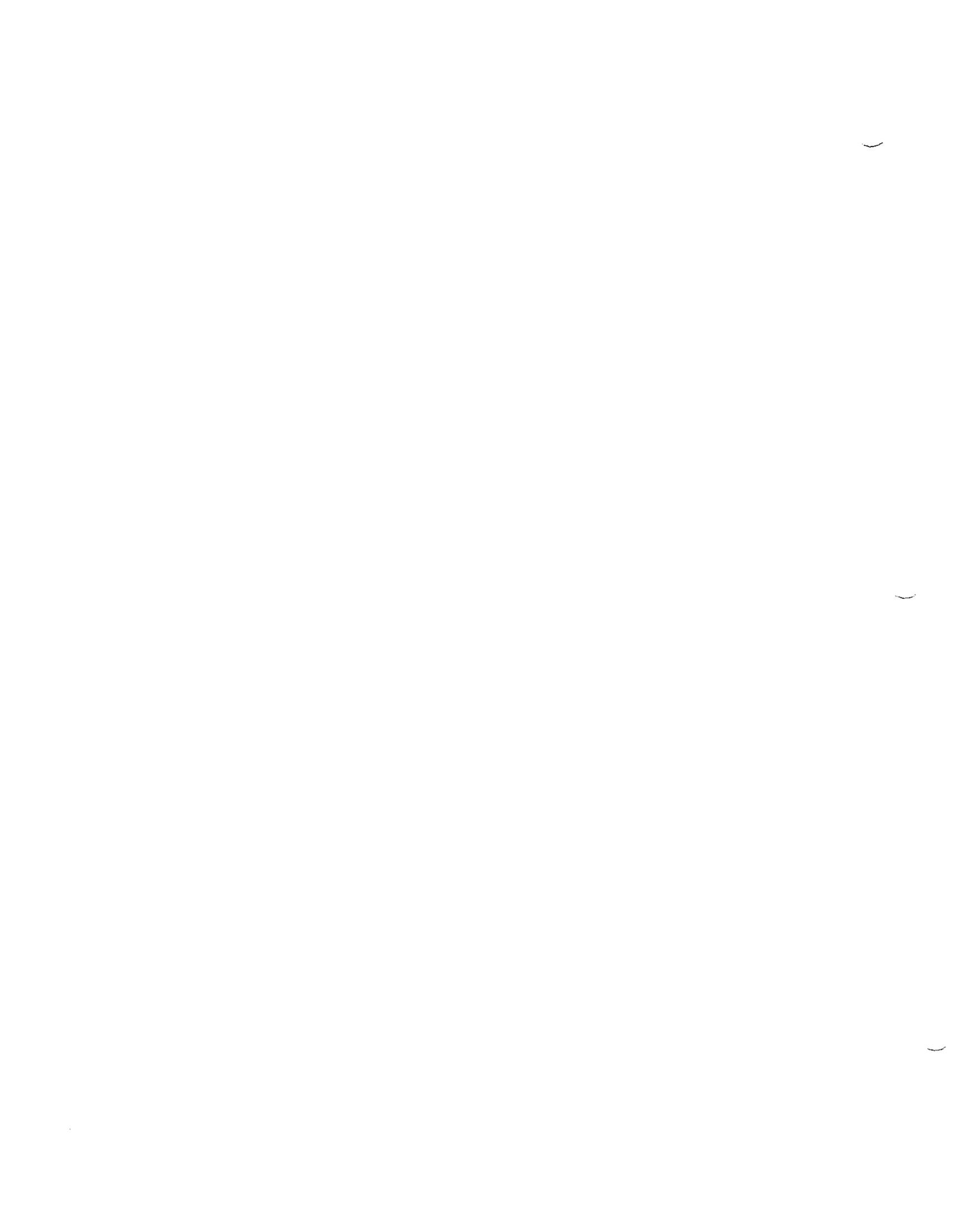
Securely support the material that is being cut or welded so it will not fall and cause damage or personal injuries.

### LEAVE FILLING OF CYLINDER TO THE MANUFACTURER

Never attempt to mix gases in a cylinder or fill one empty gas cylinder from another (particularly an oxygen cylinder). The mixture of incompatible gases and/or heat caused by recompression of the gas or gases may result in ignition and fire.

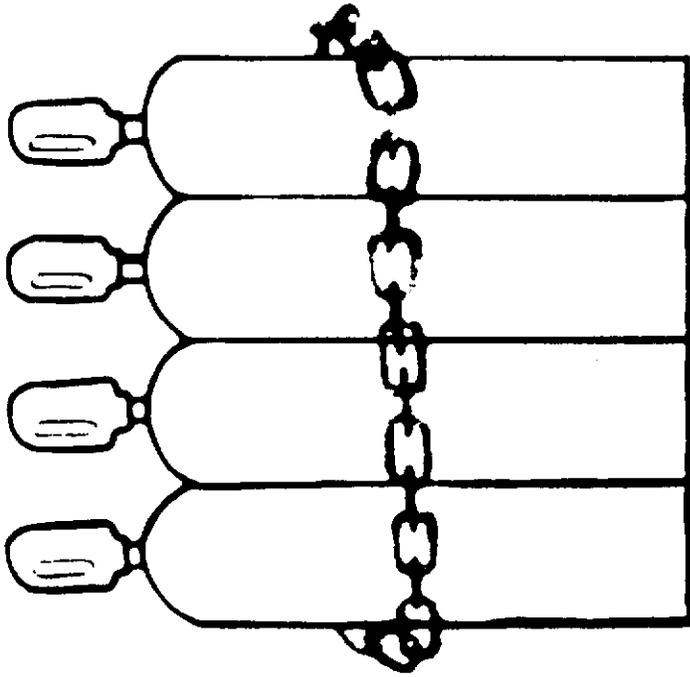


POLICE YOUR WORK AREA



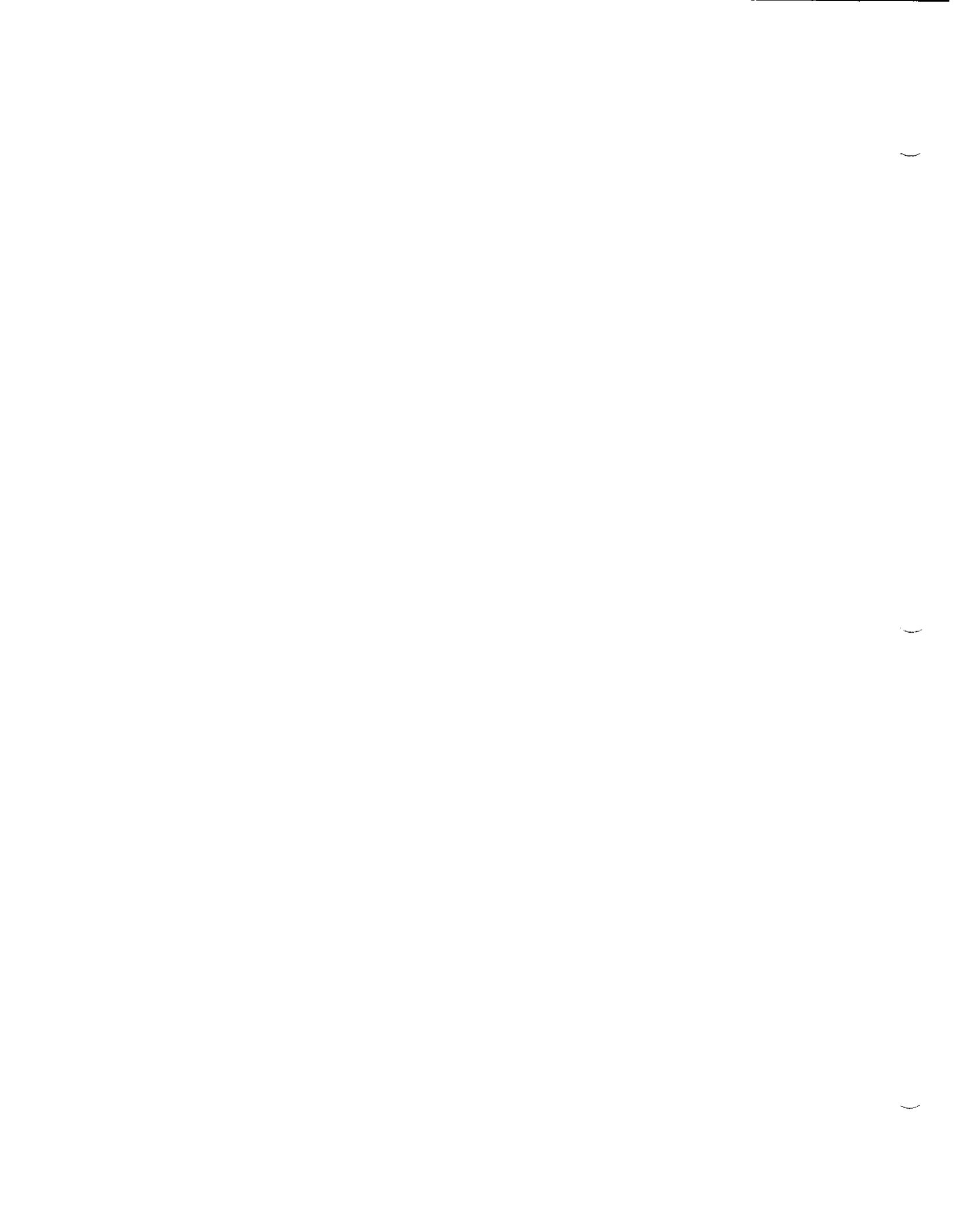
NO SMOKING

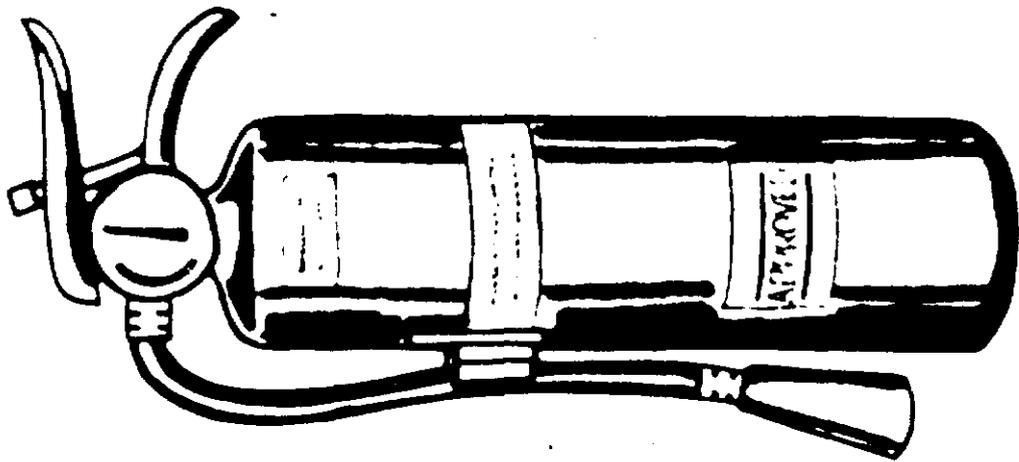
KEEP THIS  
AREA CLEAN



OXYGEN  
STORAGE

# STORAGE OF CYLINDER VALVES



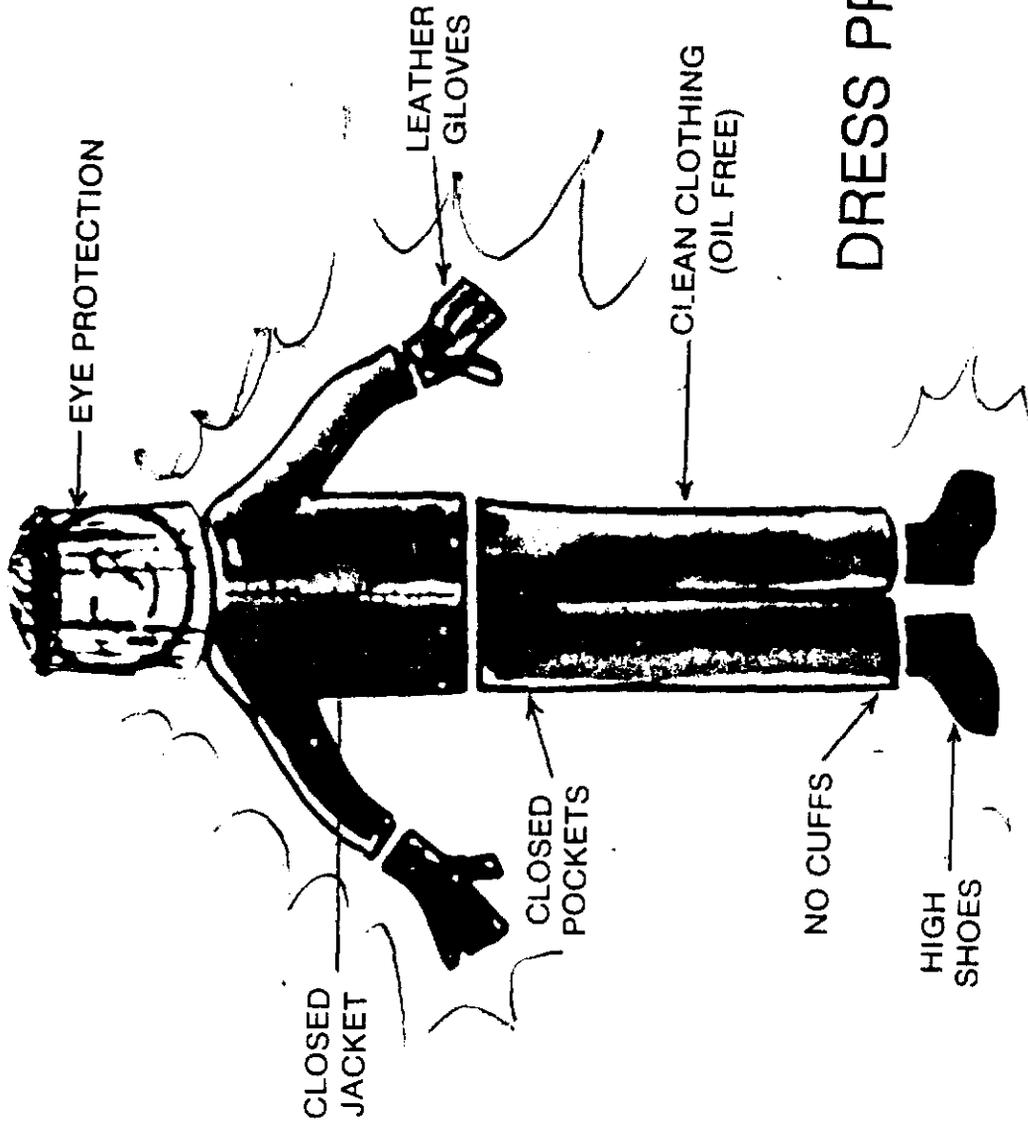


  
FIRE PROTECTION

)

)

)

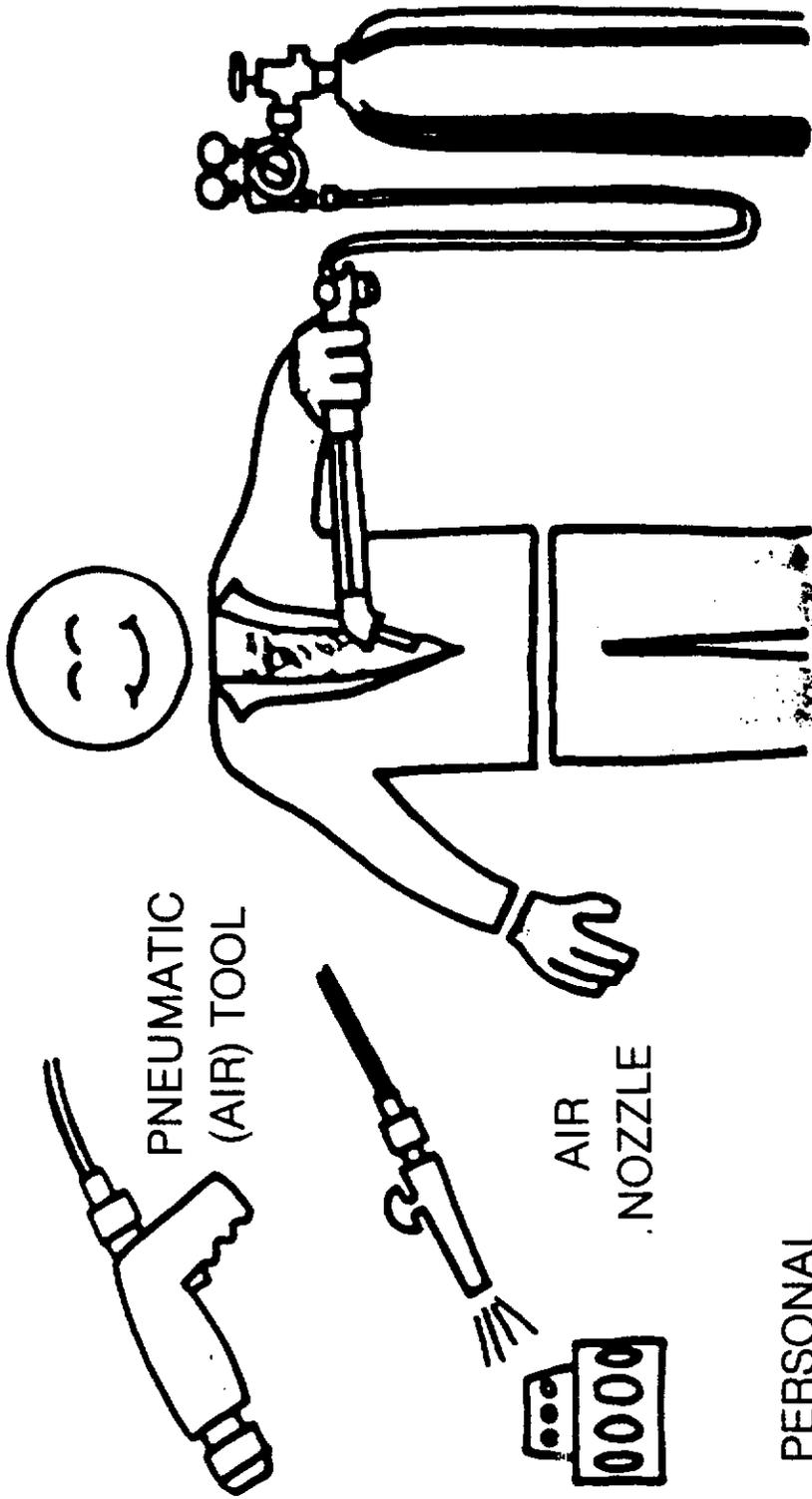


DRESS PROPERLY

—

—

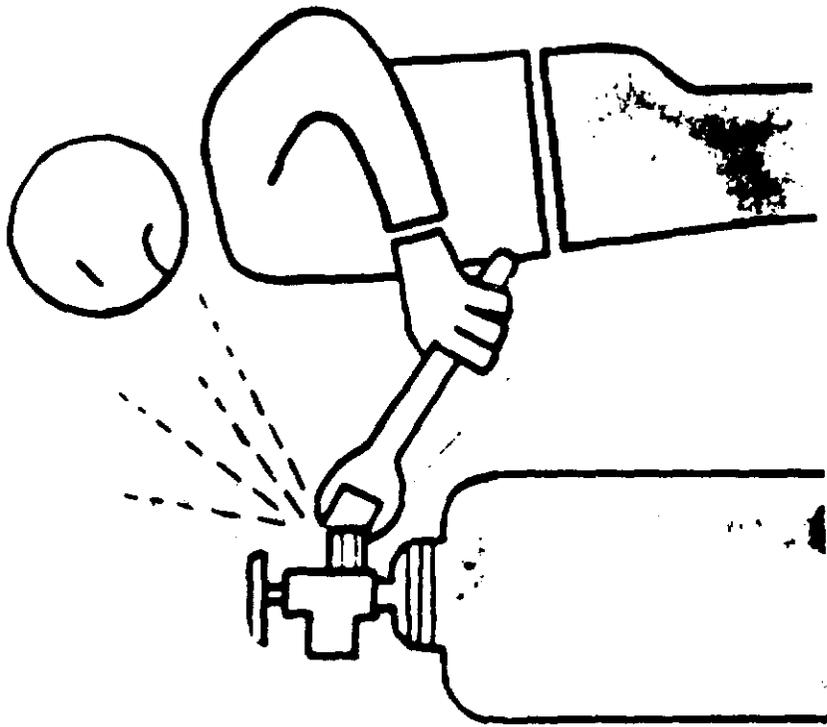
—



PERSONAL  
VENTILATION  
NEVER

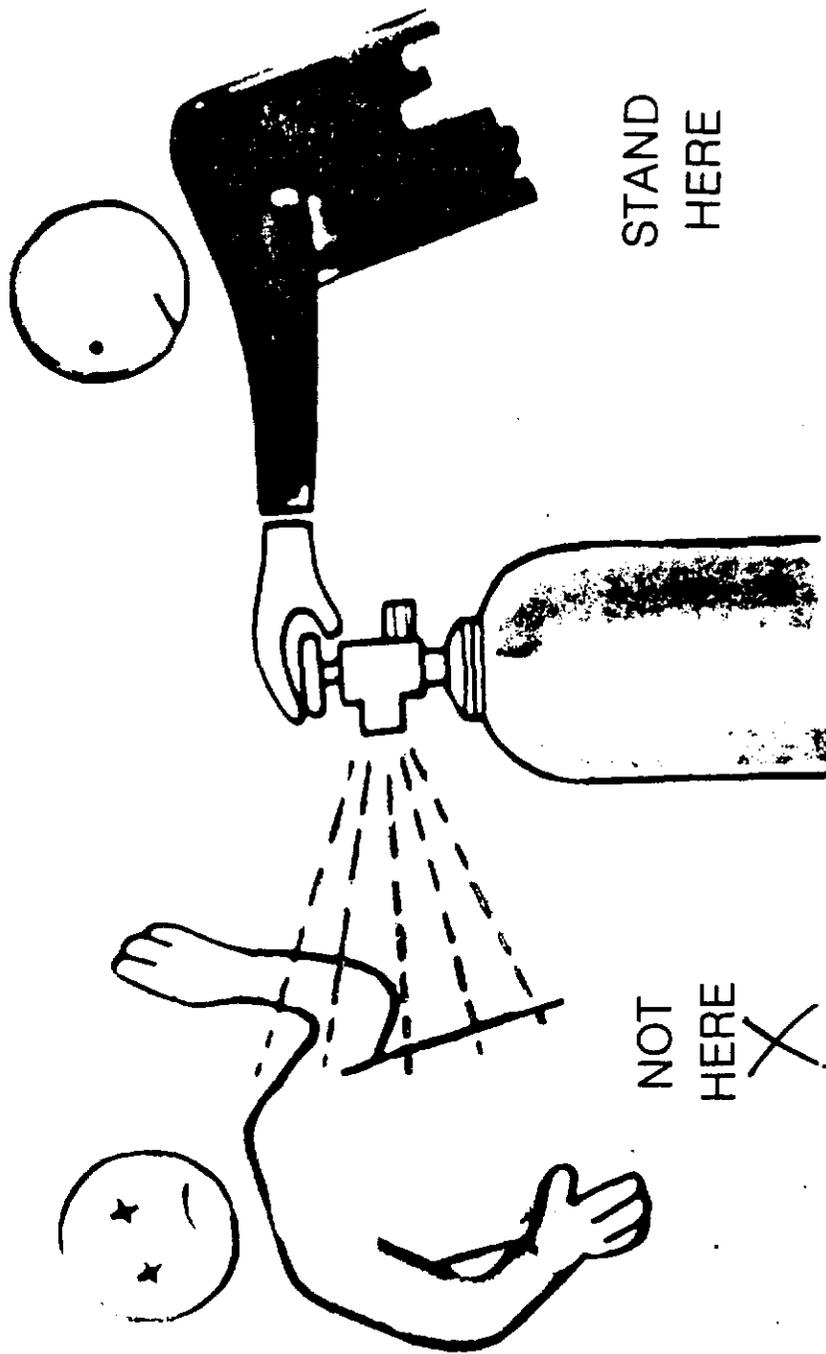
USE YOUR TOOLS CORRECTLY



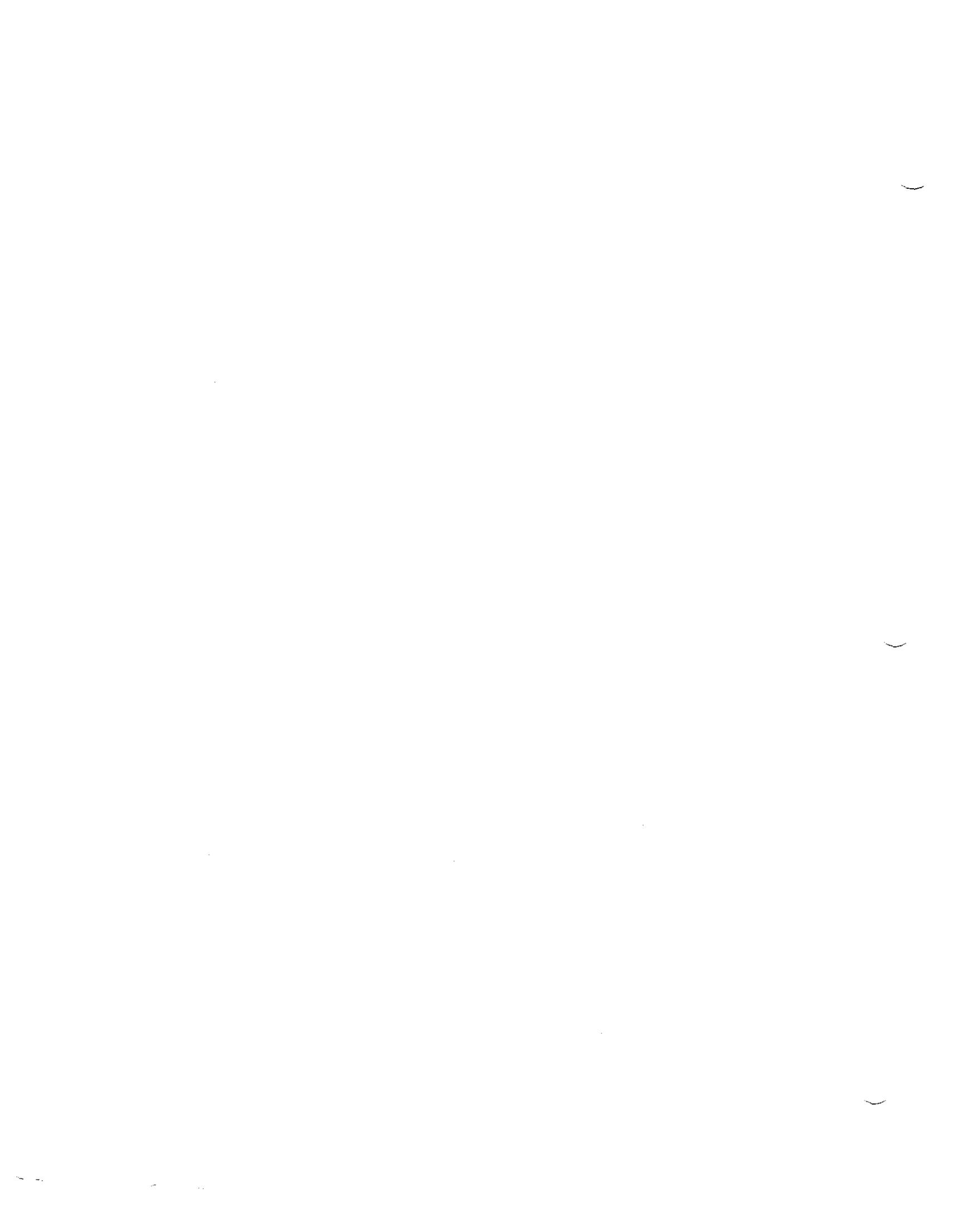


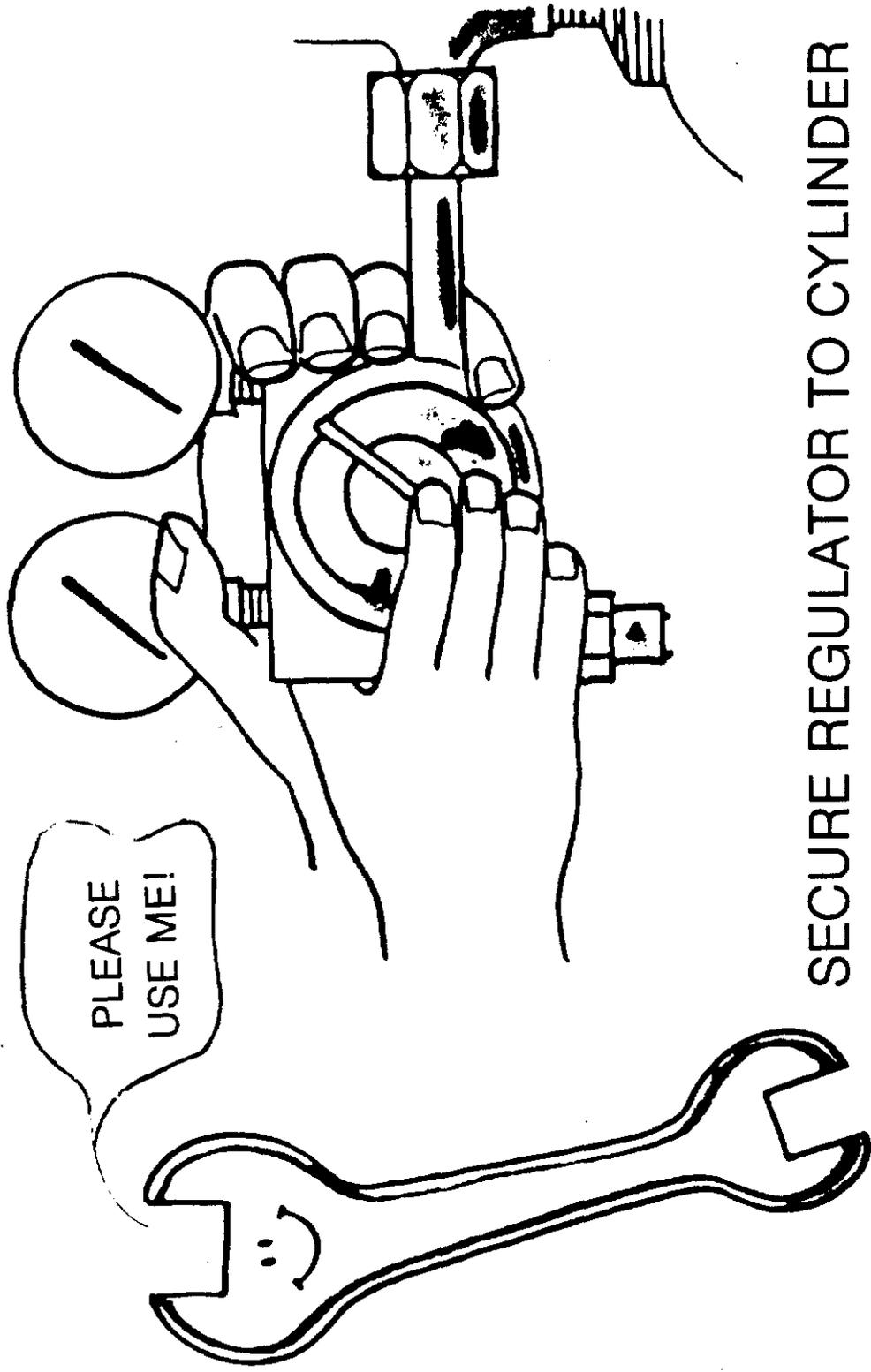
DON'T TAMPER WITH  
CYLINDER SAFETY DEVICES





## CRACKING OF CYLINDER VALVES





SECURE REGULATOR TO CYLINDER  
WITH PROPER WRENCH

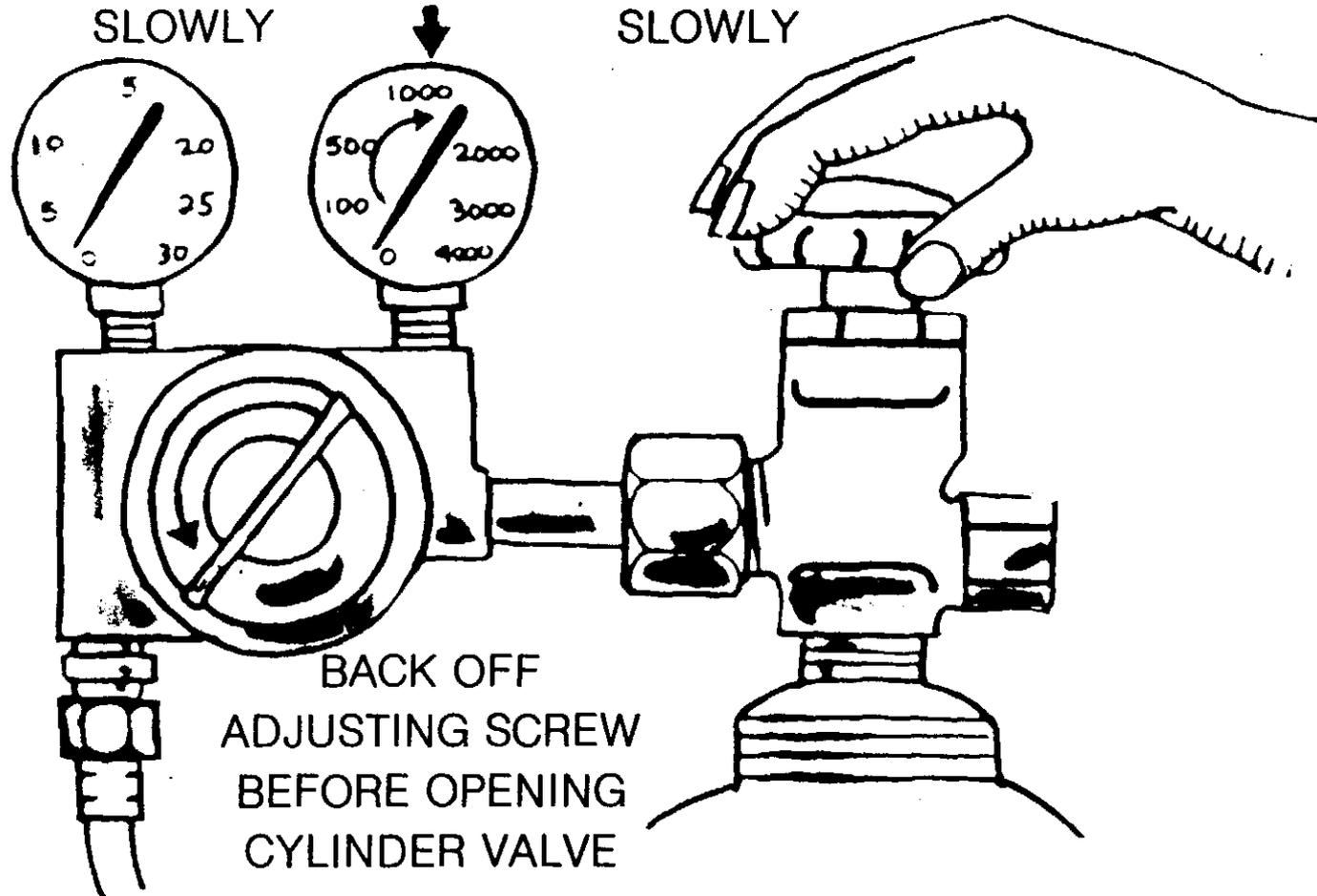
1

2

3

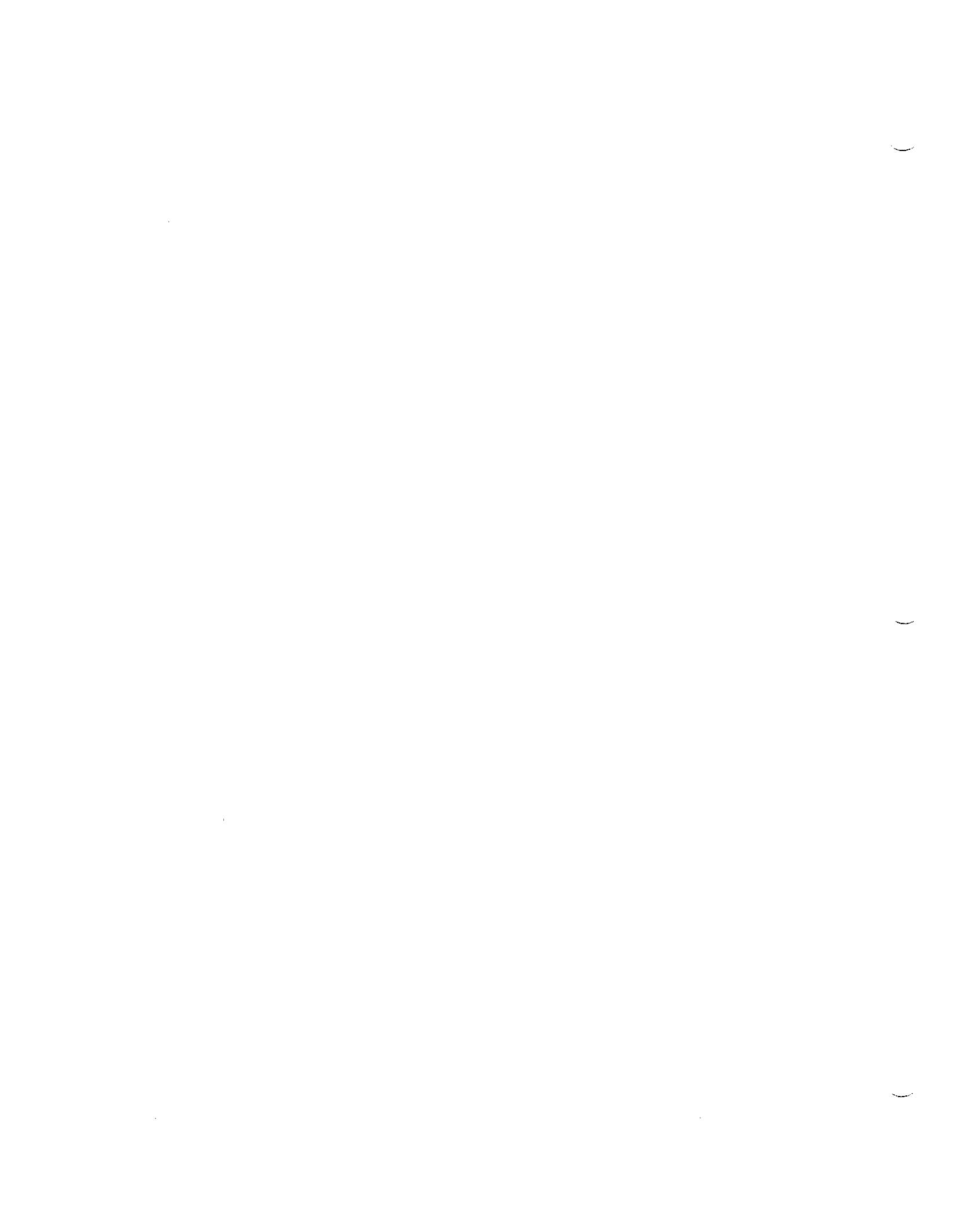
BUILD PRESSURE  
SLOWLY

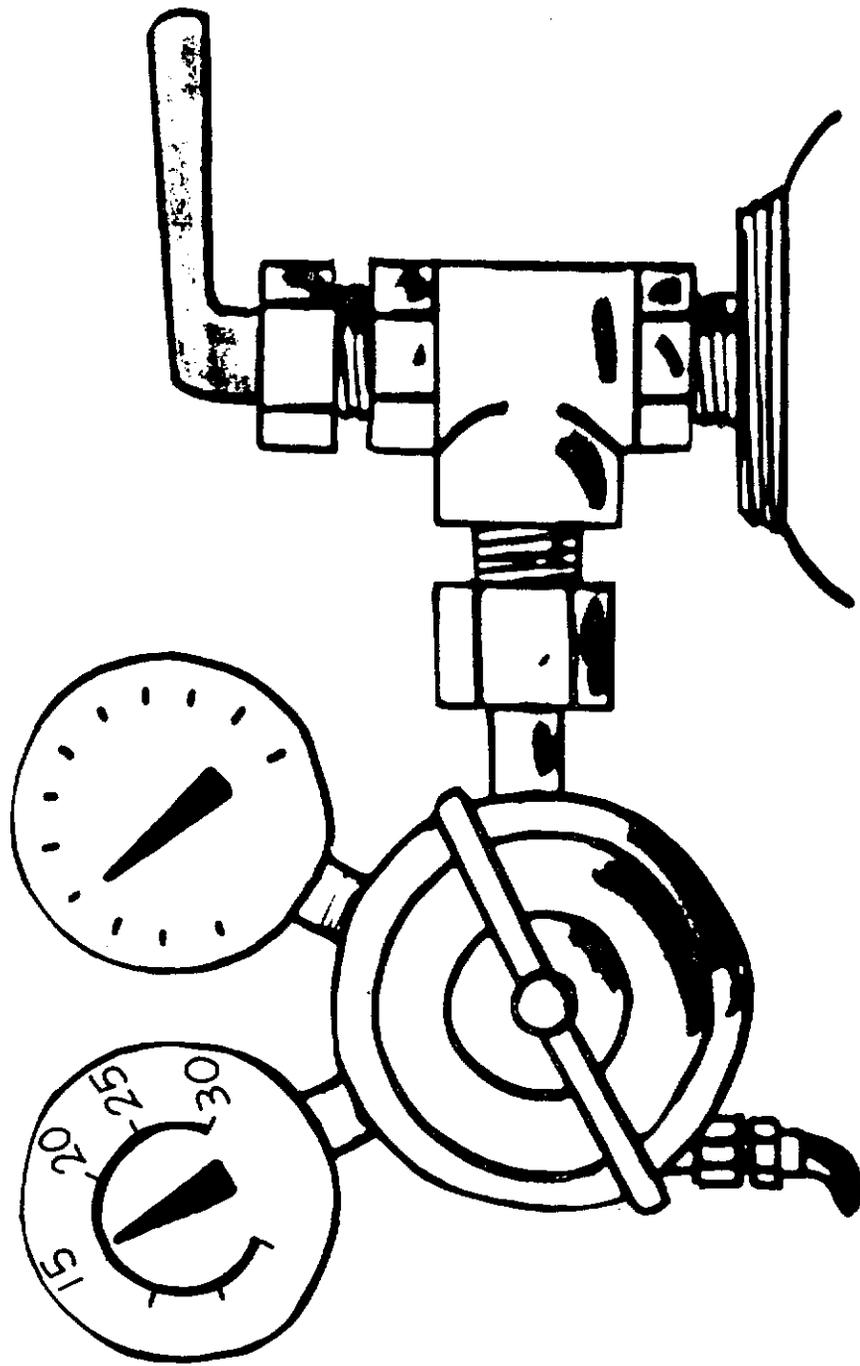
ROTATE  
SLOWLY



BACK OFF  
ADJUSTING SCREW  
BEFORE OPENING  
CYLINDER VALVE

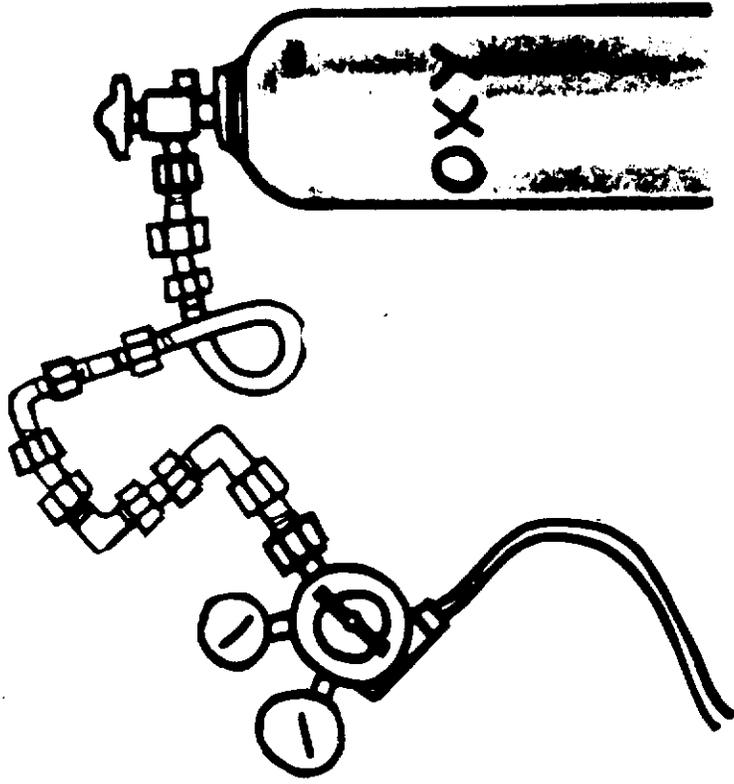
OPEN CYLINDER VALVE SLOWLY





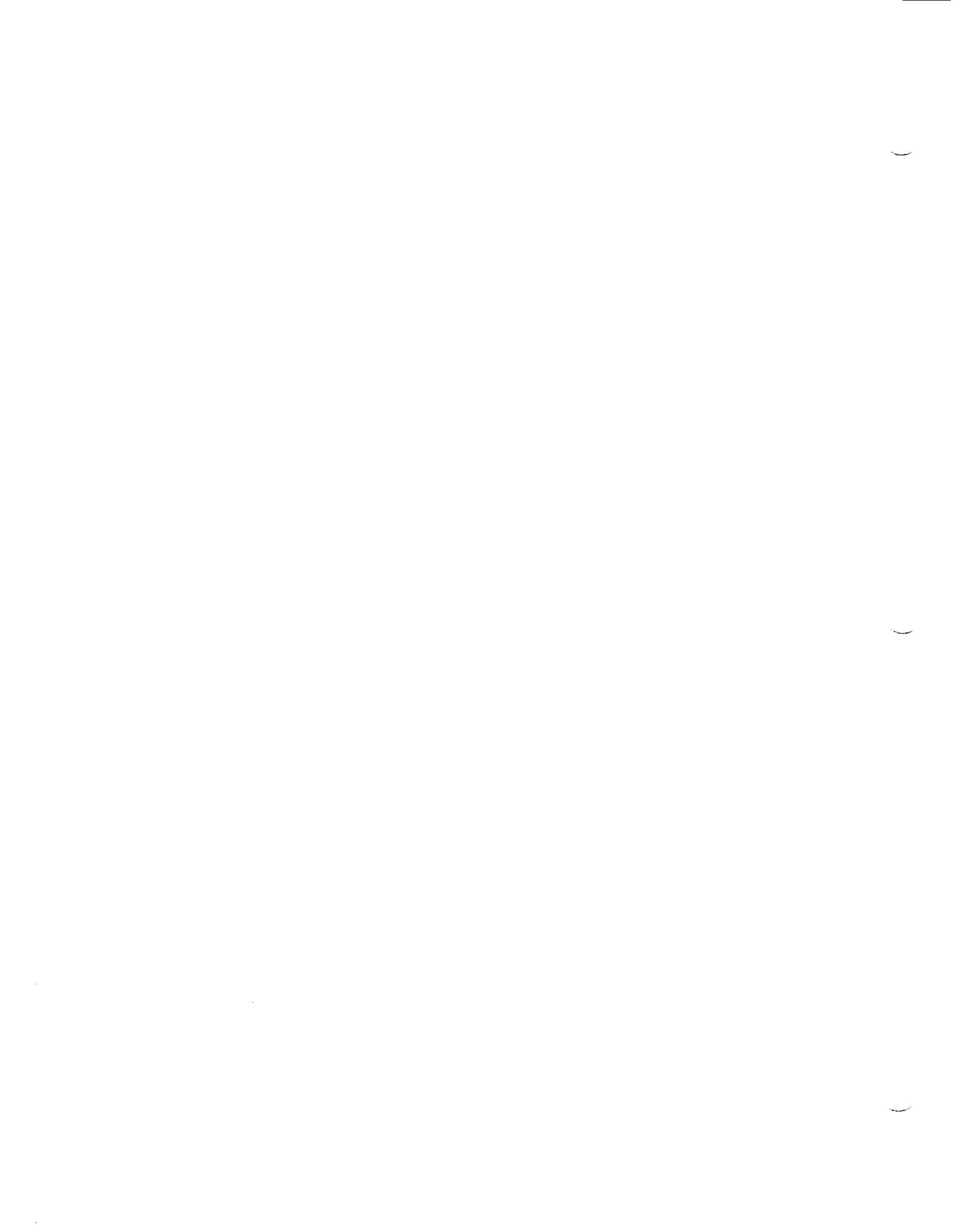
SAFE USE OF ACETYLENE





FUEL  
GAS  
REGULATOR

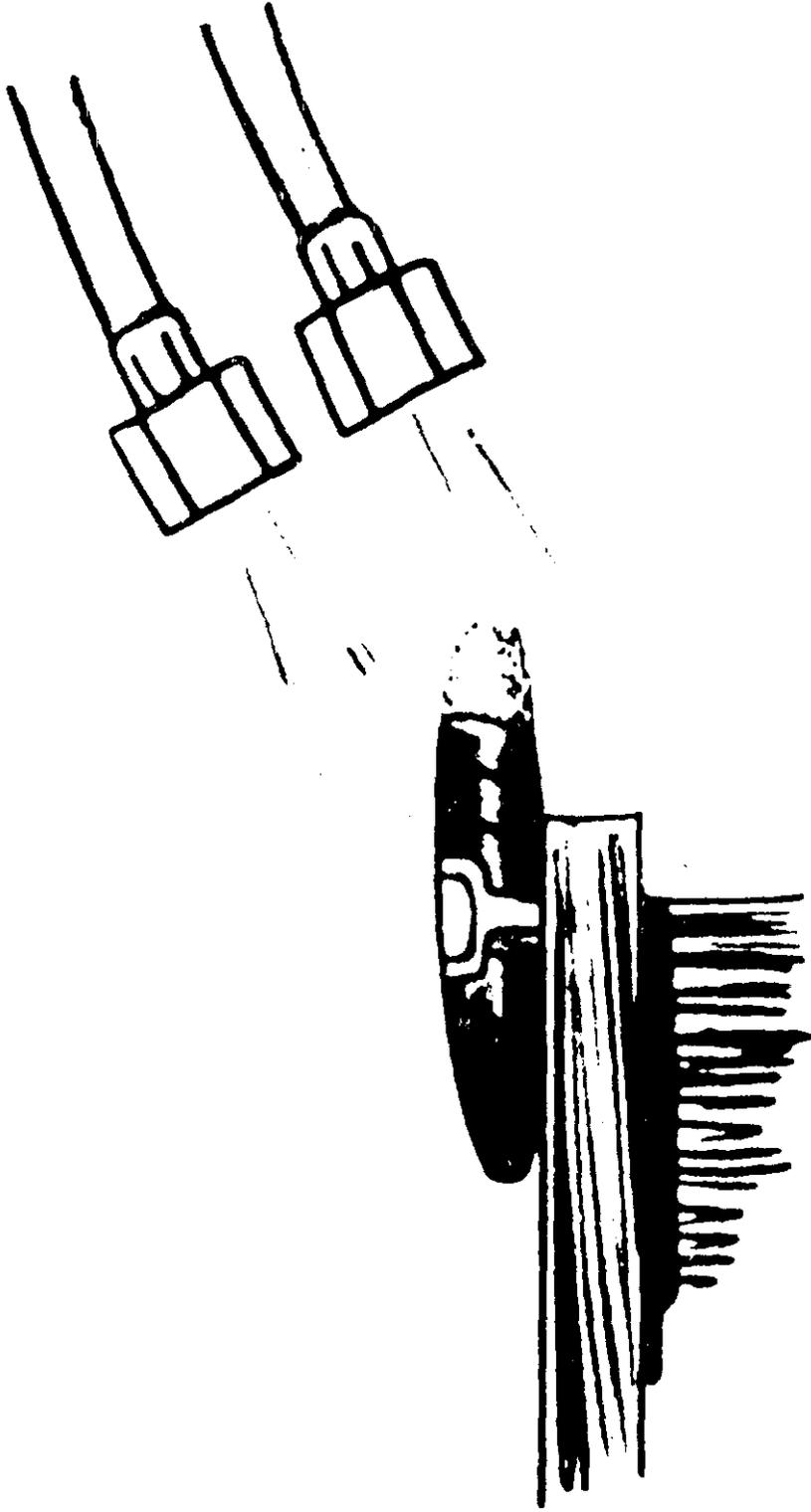
NEVER USE A REGULATOR FOR A GAS  
OTHER THAN THAT FOR WHICH  
IT WAS INTENDED



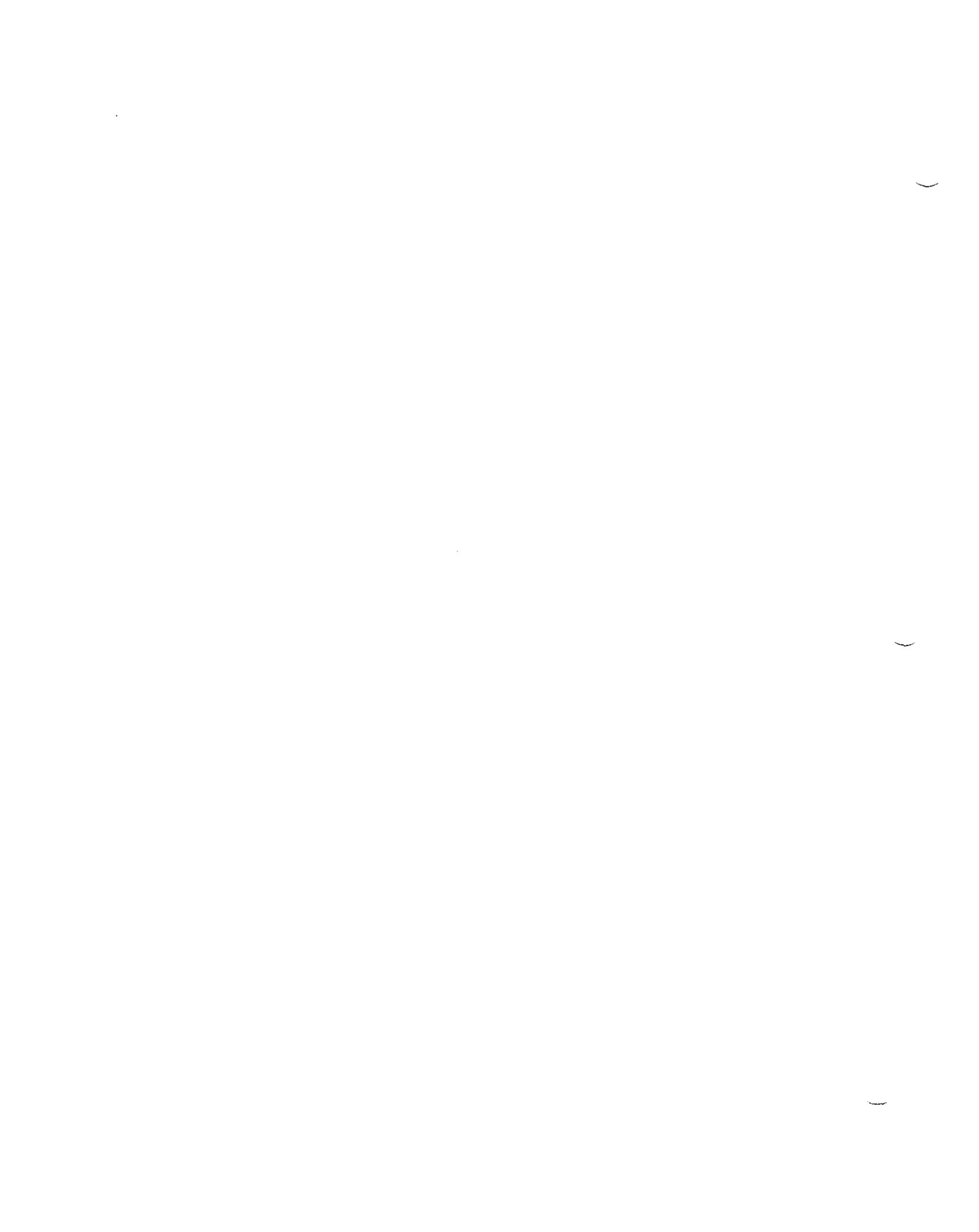
WELDING TIP DATA CHART	
TIP SIZE	OXY-ACETY PRESSURE P.S.I.G.
GXU-72	2
GXU-68	3
GXU-62	4
GXU-58	5
GXU-55	5
GXU-53	6
GXU-50	7
GXU-46	8
GXU-42	9
GXU-36	10
GXU-31	12

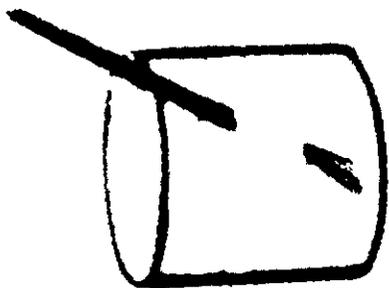
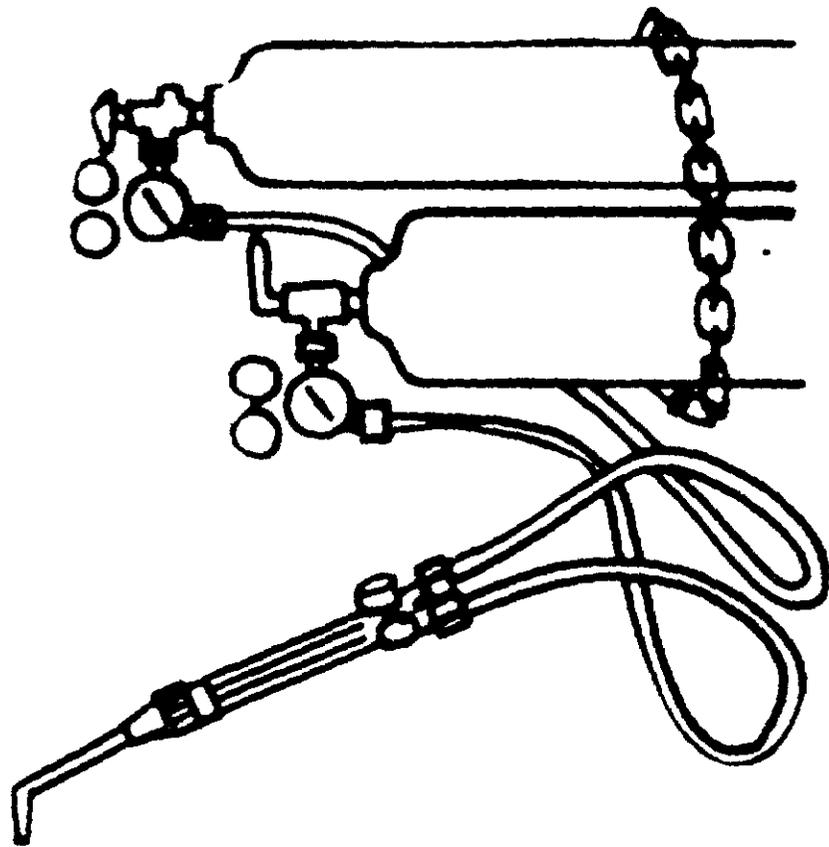
PROPER OPERATING PRESSURES





BLOWING OUT WELDING HOSE

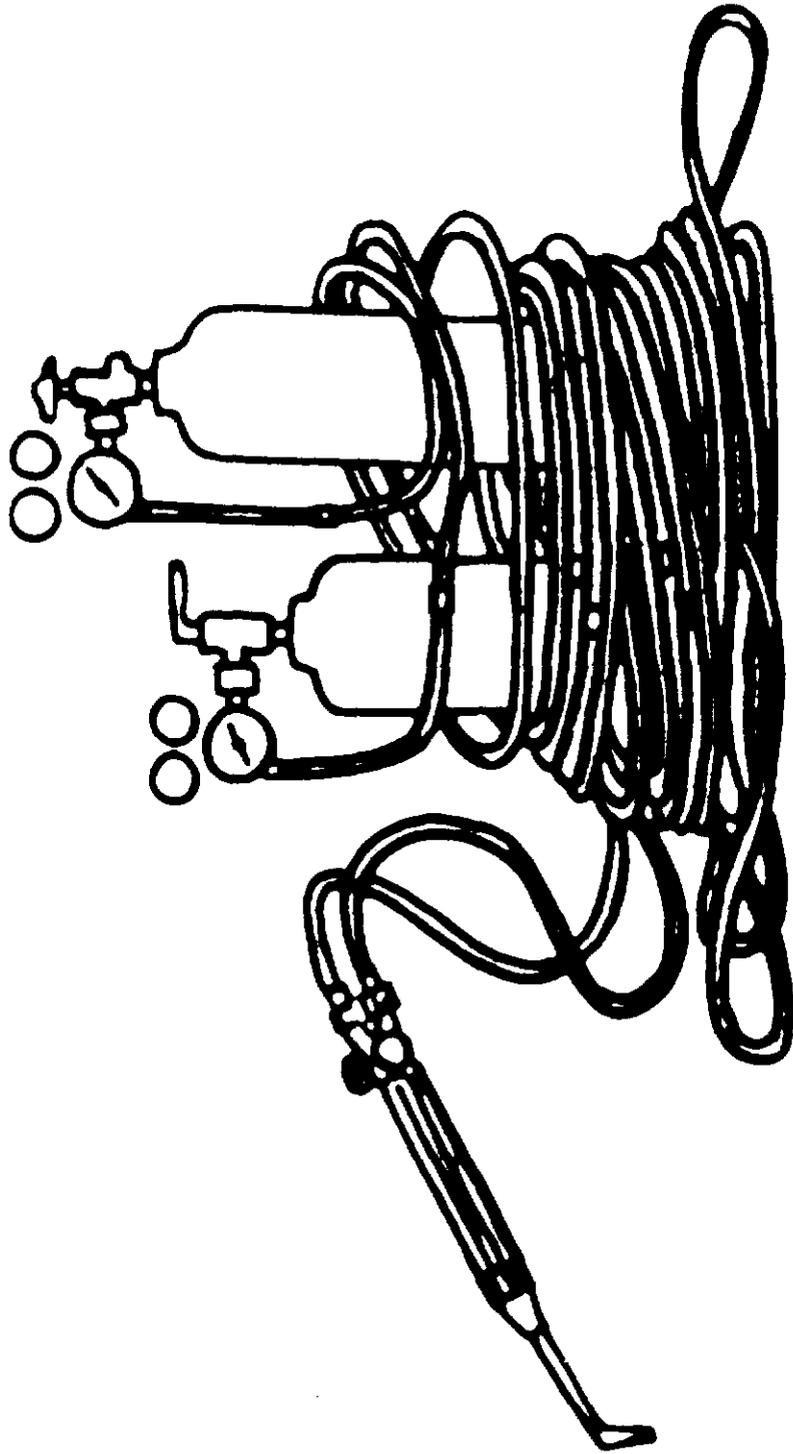




SOAPY WATER

# PRE-OPERATION SAFETY CHECK





USE PROPER HOSE LENGTH



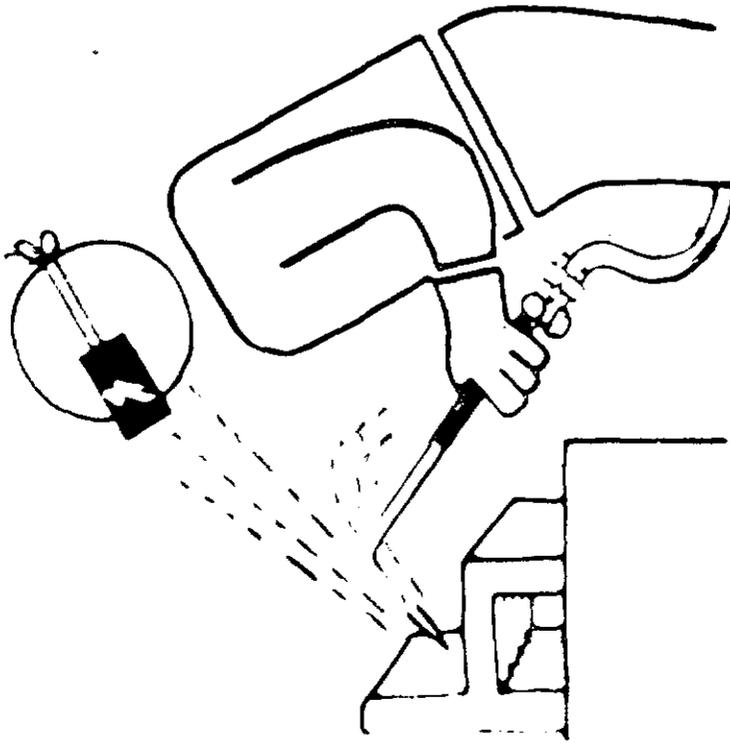
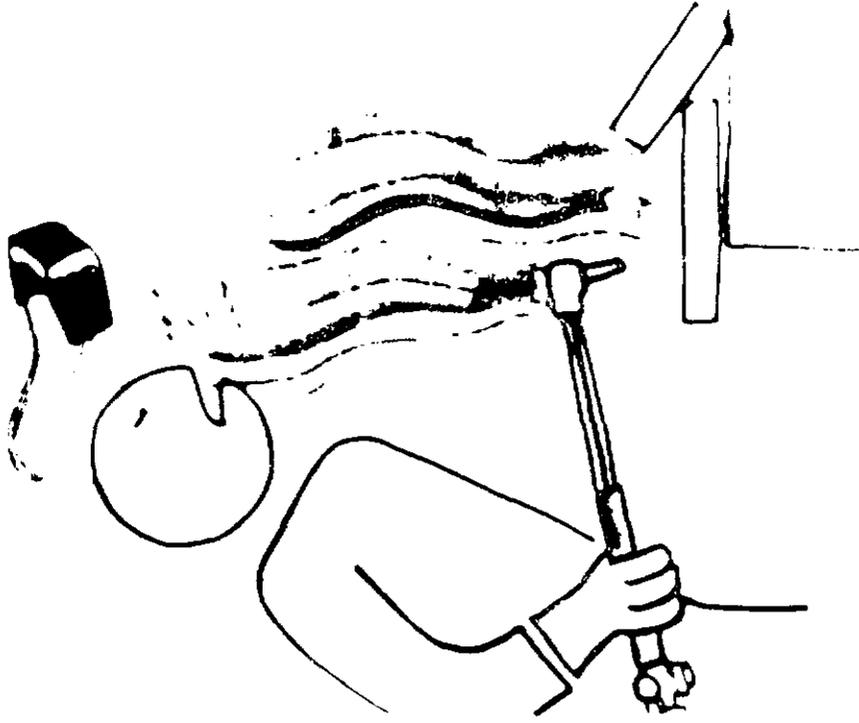


LIGHTING TORCH TIP

1

2

3



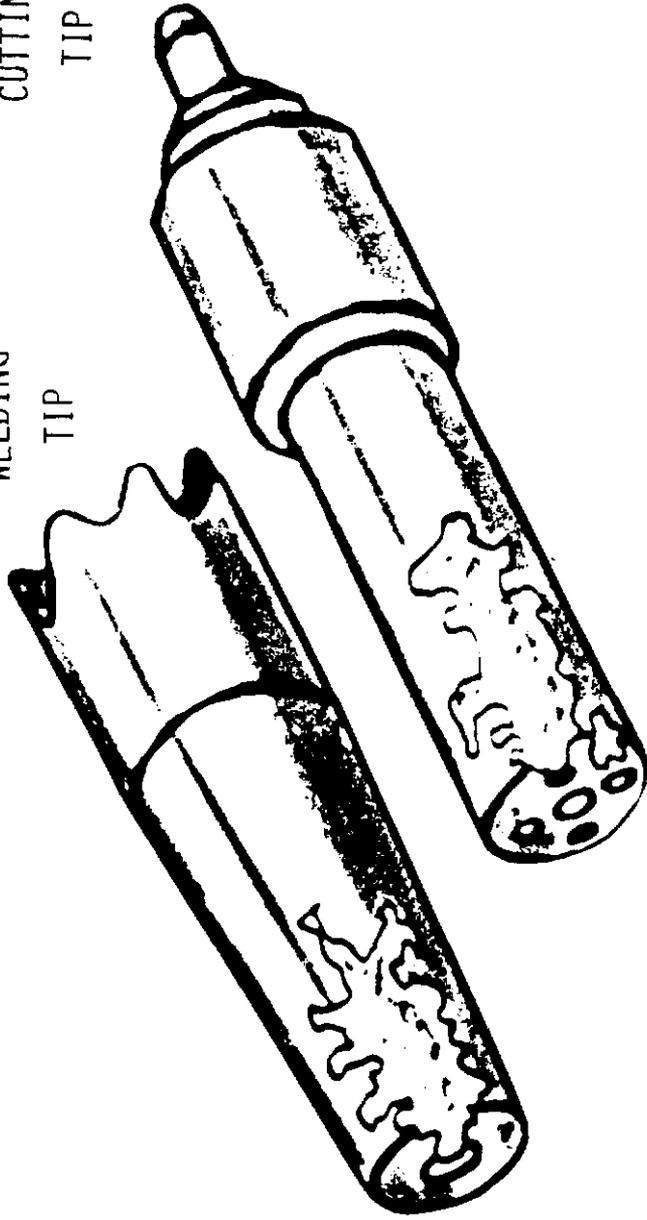
PROPER EYE  
PROTECTION

PROPER VENTILATION

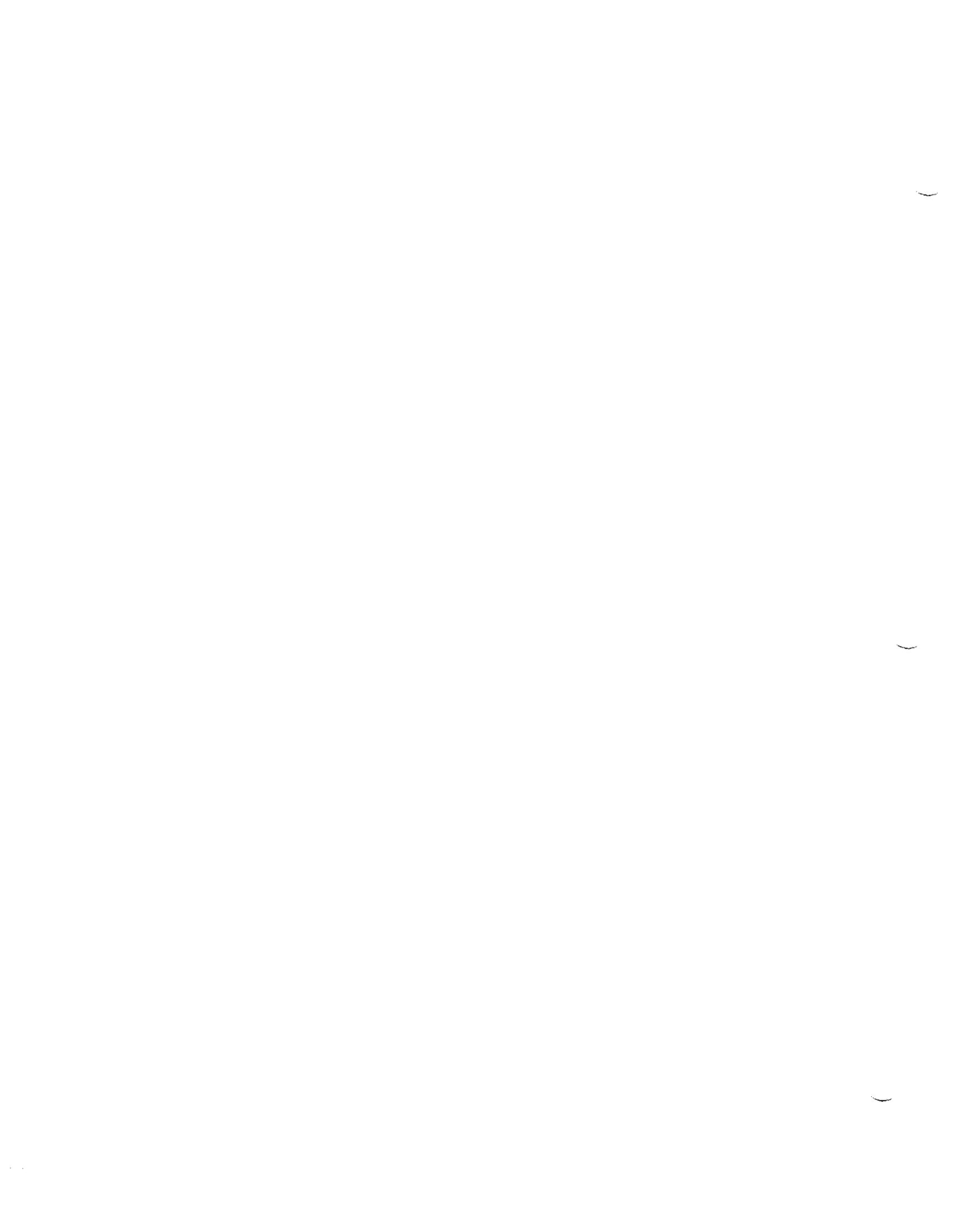


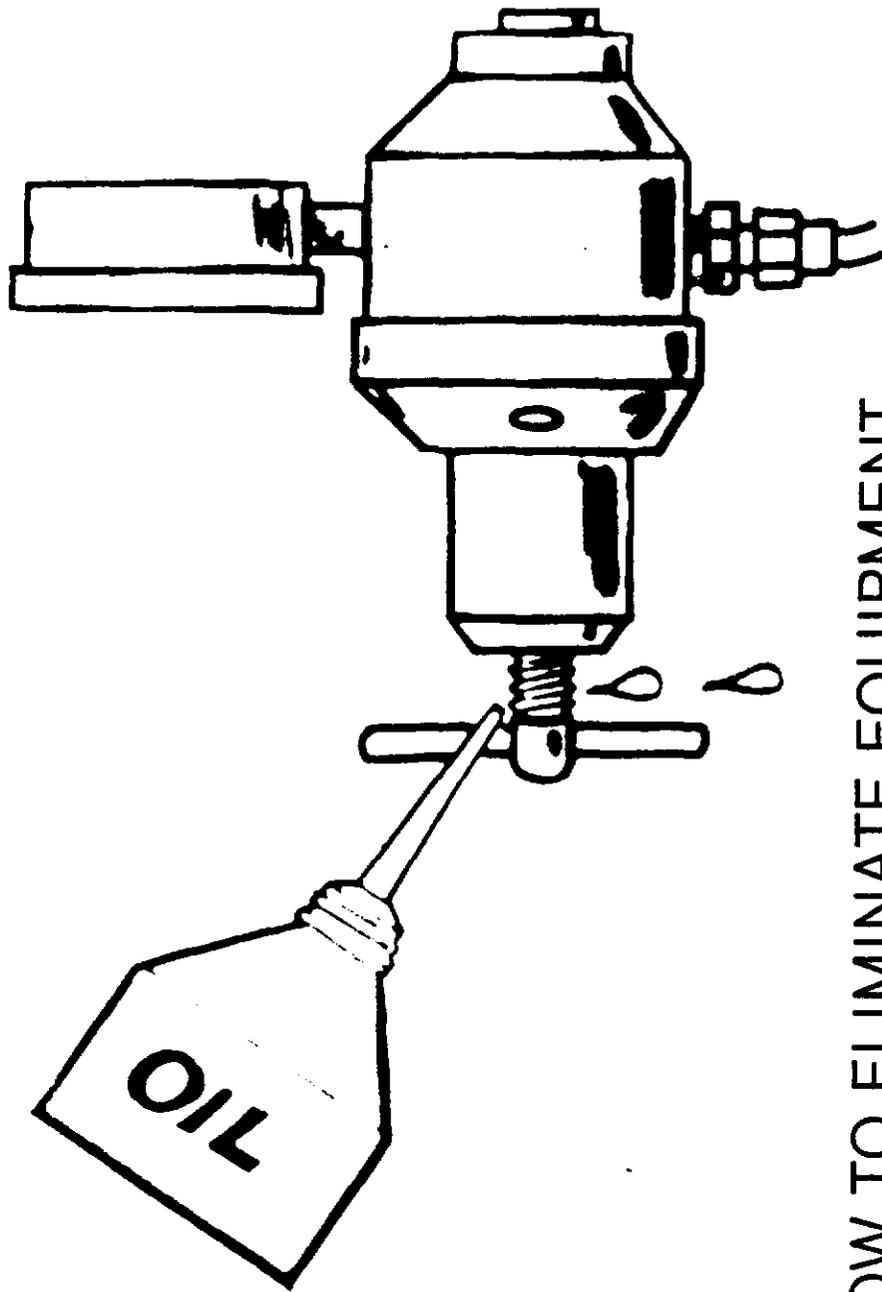
CUTTING  
TIP

WELDING  
TIP



KEEP TIPS CLEAN



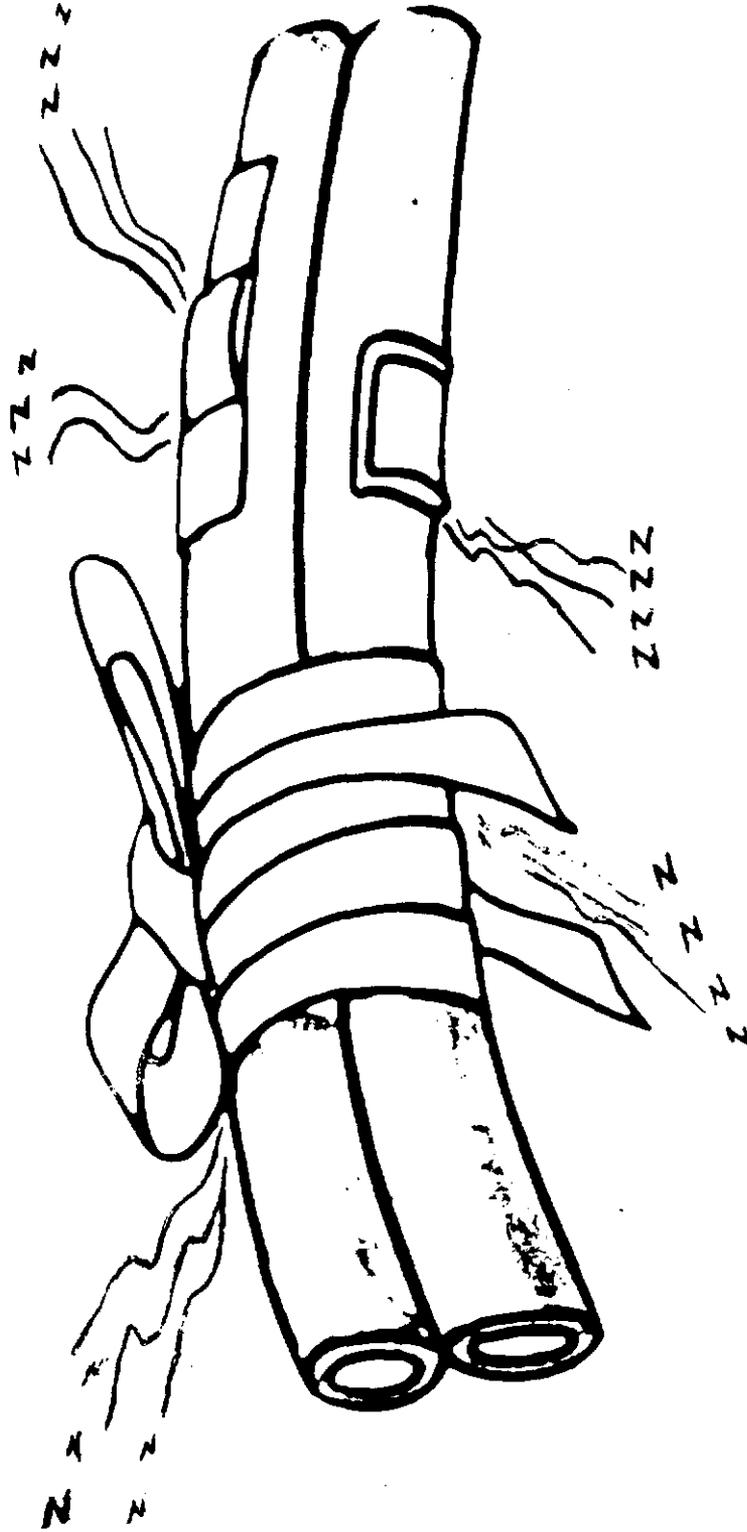


HOW TO ELIMINATE EQUIPMENT  
"SQUEAKS" AND "YOURSELF"

)

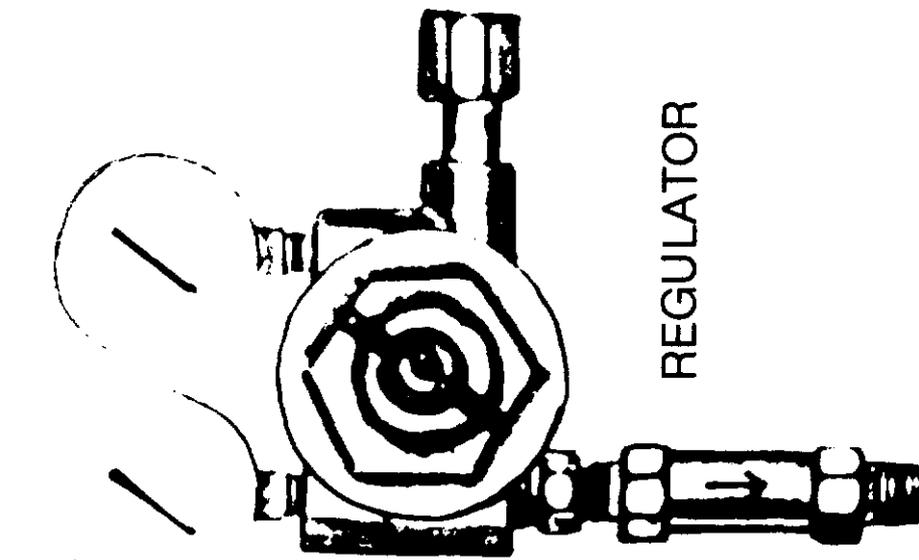
)

)

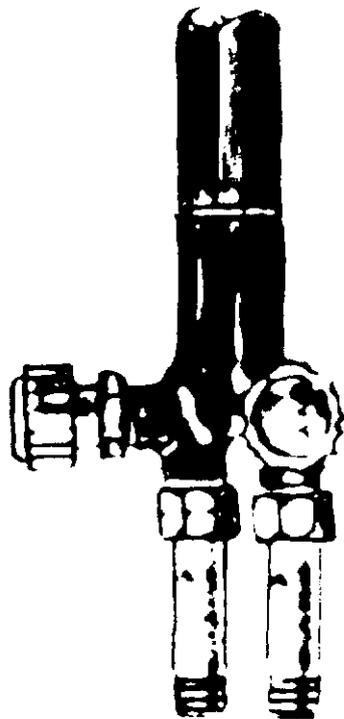


WORN WELDING HOSE  
DO NOT REPAIR!-  
REPLACE!!!

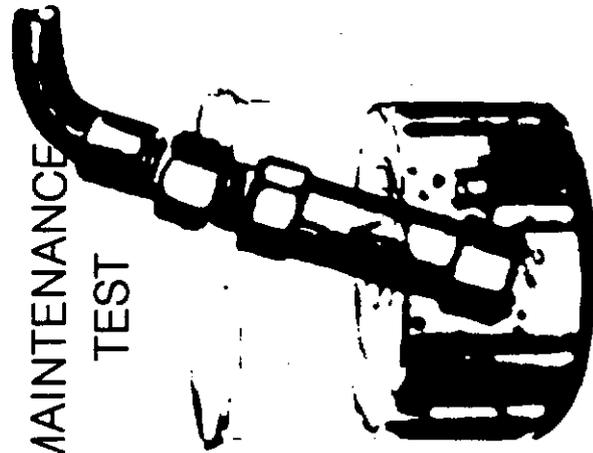




REGULATOR



TORCH



MAINTENANCE  
TEST

COMPRESSED  
AIR

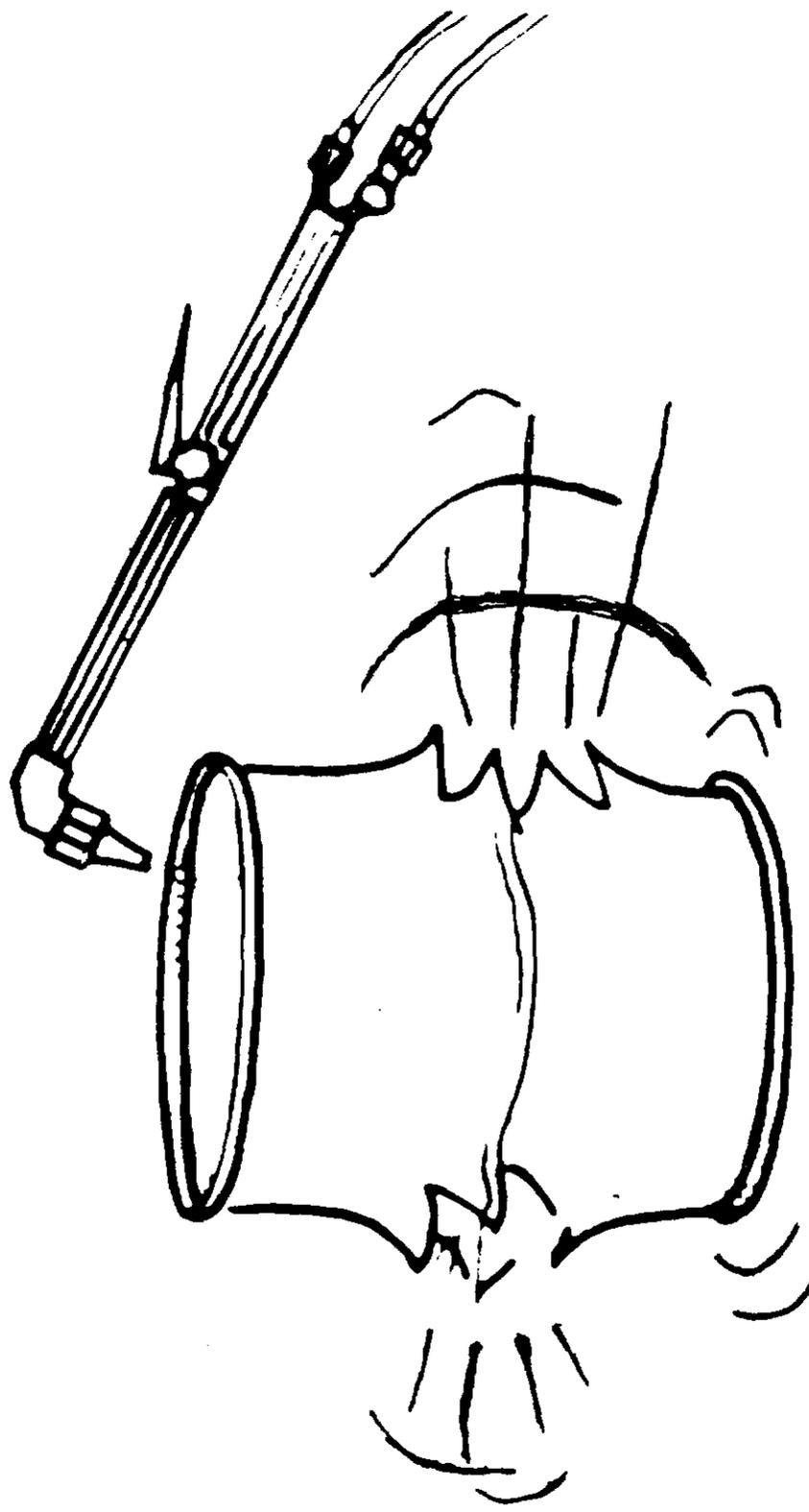
WATER

# MAINTAIN BACK-FLOW CHECK VALVES

)

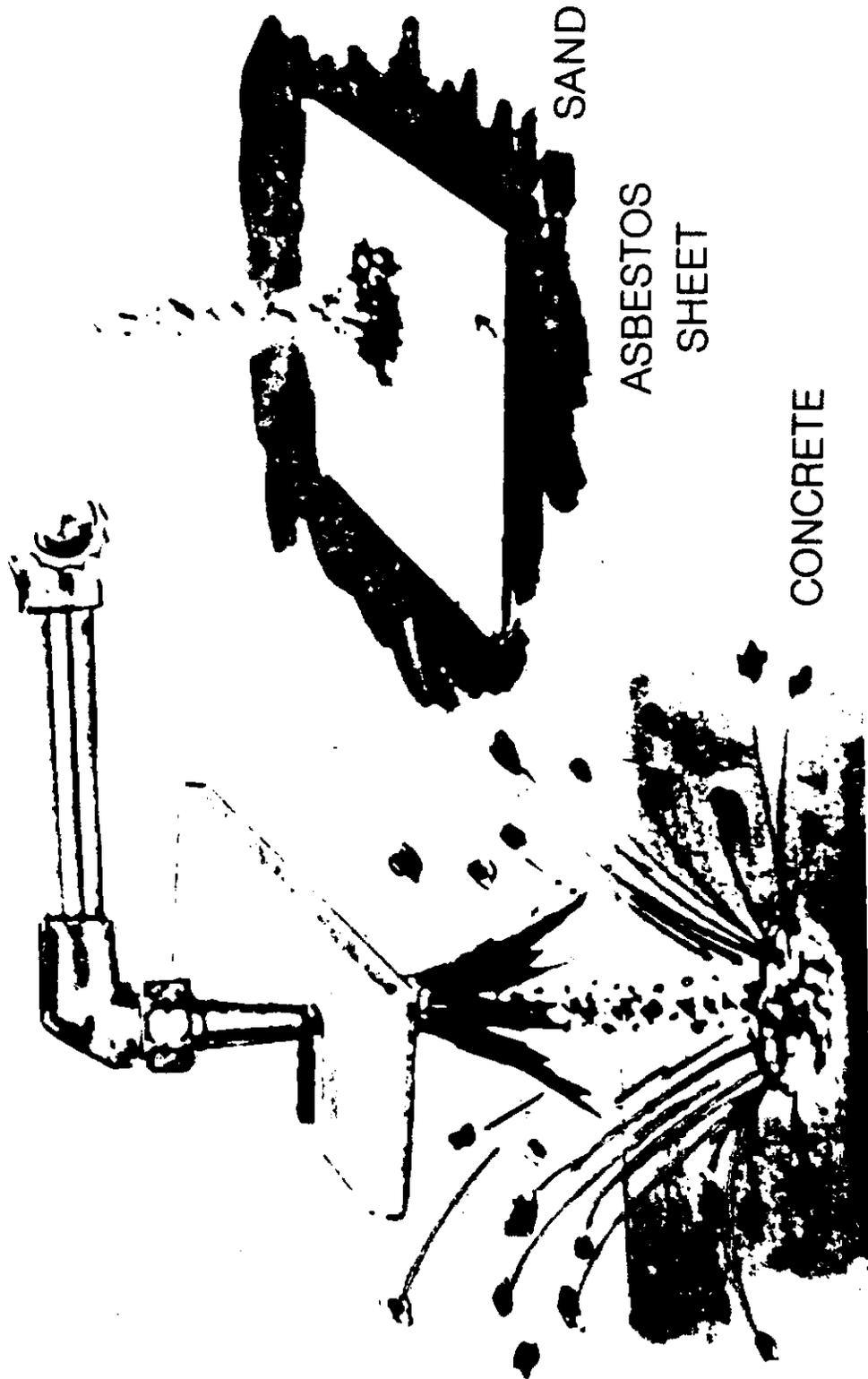
)

)



CAUTION! - THE NEXT CUT MADE  
MAY BE YOUR THROAT!





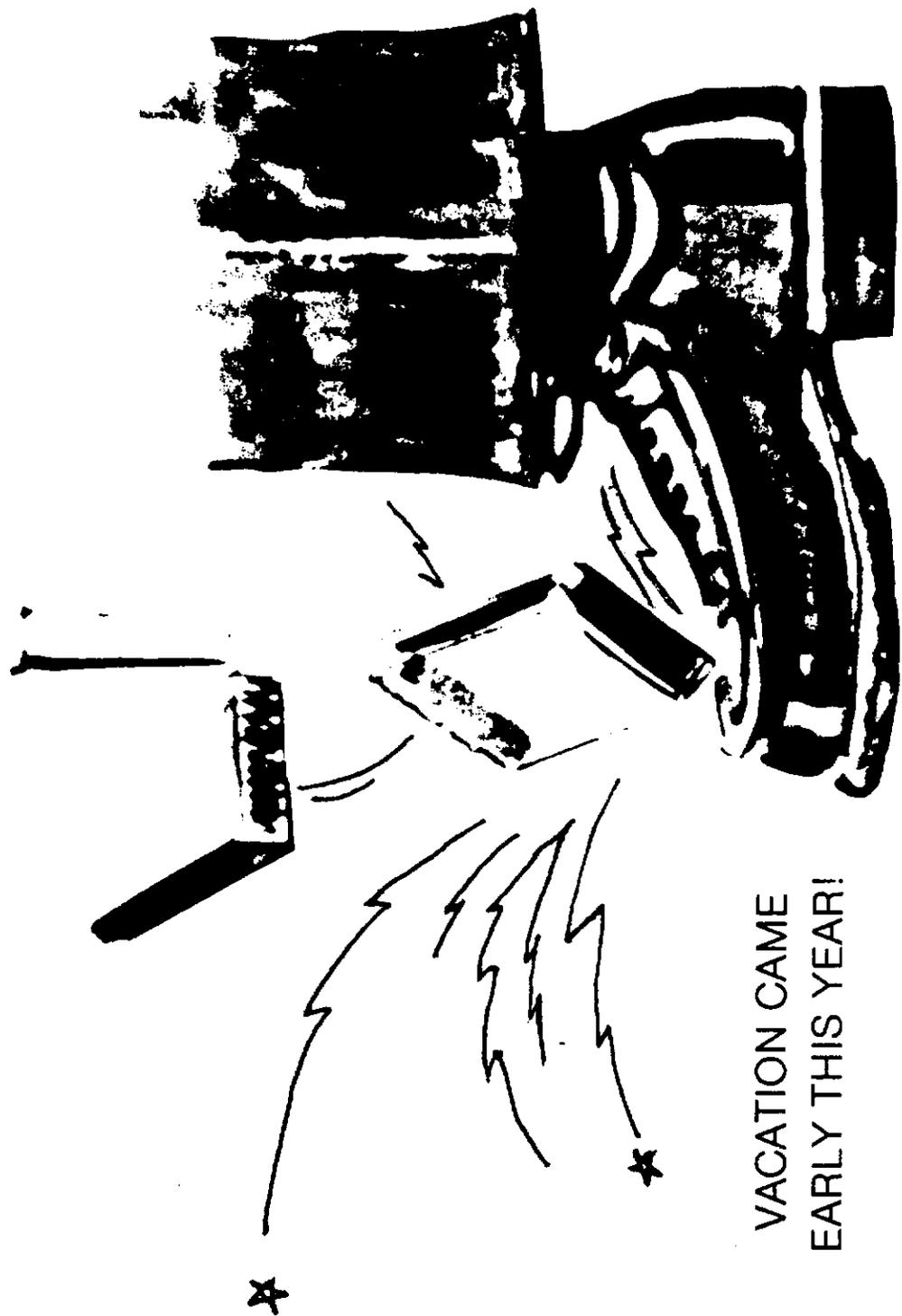
SAND

ASBESTOS  
SHEET

CONCRETE

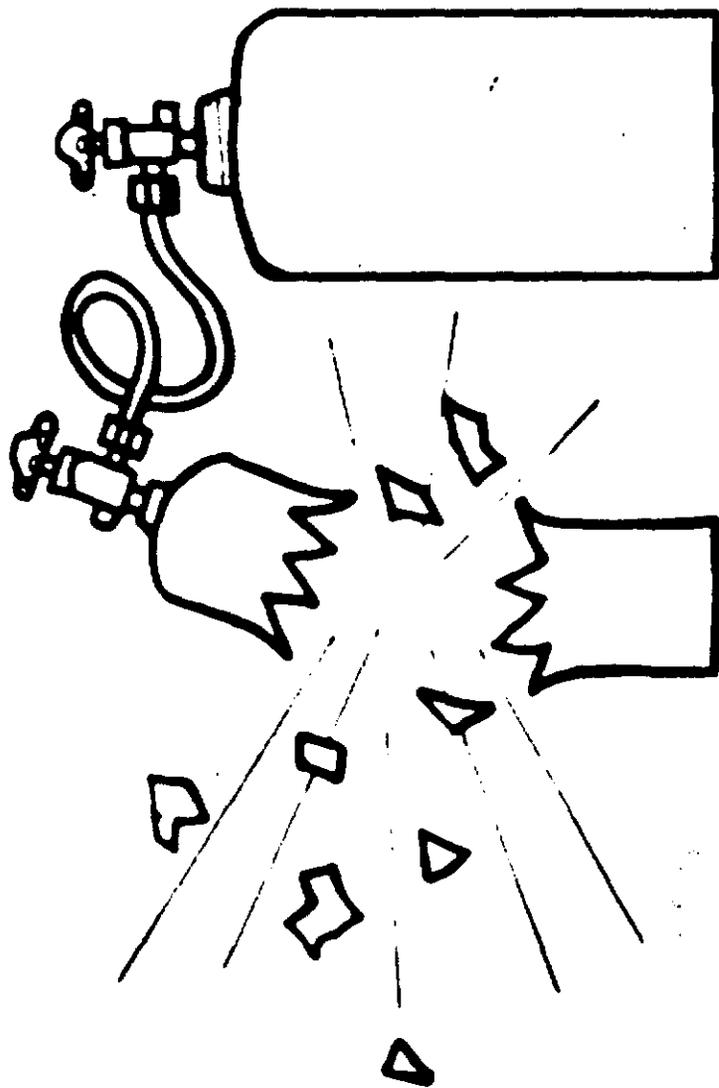
BEWARE OF FLYING CONCRETE CHIPS!





VACATION CAME  
EARLY THIS YEAR!





**LEAVE FILLING OF CYLINDER  
TO THE MANUFACTURER**



RECOMMENDED  
SAFETY PUBLICATIONS

SAFETY-IN WELDING AND CUTTING, AMERICAN NATIONAL STANDARD Z49.1, ISSUED BY THE AMERICAN WELDING SOCIETY, 2501 NORTHWEST 7th STREET MIAMI, FLORIDA 33125.

CUTTING AND WELDING PROCESSES, N.F.P.A. STANDARD NO. 51B, ISSUED BY THE NATIONAL FIRE PROTECTION ASSOCIATION, 470 ATLANTIC AVE., BOSTON, MASS. 02210.

REGO WELDING AND CUTTING HANDBOOK, STOCK NO. 400124, OBTAINABLE AT YOUR LOCAL REGO WELDING EQUIPMENT DISTRIBUTOR.

## REFERENCES

Materials were selected and reviewed from the following sources, and in some instances were incorporated in the production of the preceding unit.

1. Airco Welding Products
2. American Welding Society
3. Miller Electric Manufacturing Company
4. National Institute for Occupational Safety and Health - U.S. Dept. of Health, Education, and Welfare
5. Occupational Safety and Health Administration, U. S. Department of Labor
6. Rego Company
7. Rexarc Inc.
8. University of Illinois, College of Agriculture
9. Utah State Dept. of Ed., Industrial Education Safe Guide
10. Victor - Welding and Cutting Division
11. Washington State Dept. of Education, Industrial Arts Safety Guide

## **PART 8:**

### **EQUIPMENT FOR AUTOMOTIVE MECHANICS**

Battery Charger

Brake Drum/Rotor Lathe

Engine Analyzer

High Speed Wheel Balancer

Car Lift

Engine Crane and Hoist

Hydraulic Floor Jack

Automotive End Lift

Hot Caustic Tank

Solvent Tank

Steam Cleaner

Storage Battery

Auto Tire Changer

Truck Tire Inflation Cage

Valve Reconditioner

Pages 633-643 were adapted from Safety Compliance Manual, produced by Indiana Curriculum Materials Center, Bloomington, Indiana, 1975.

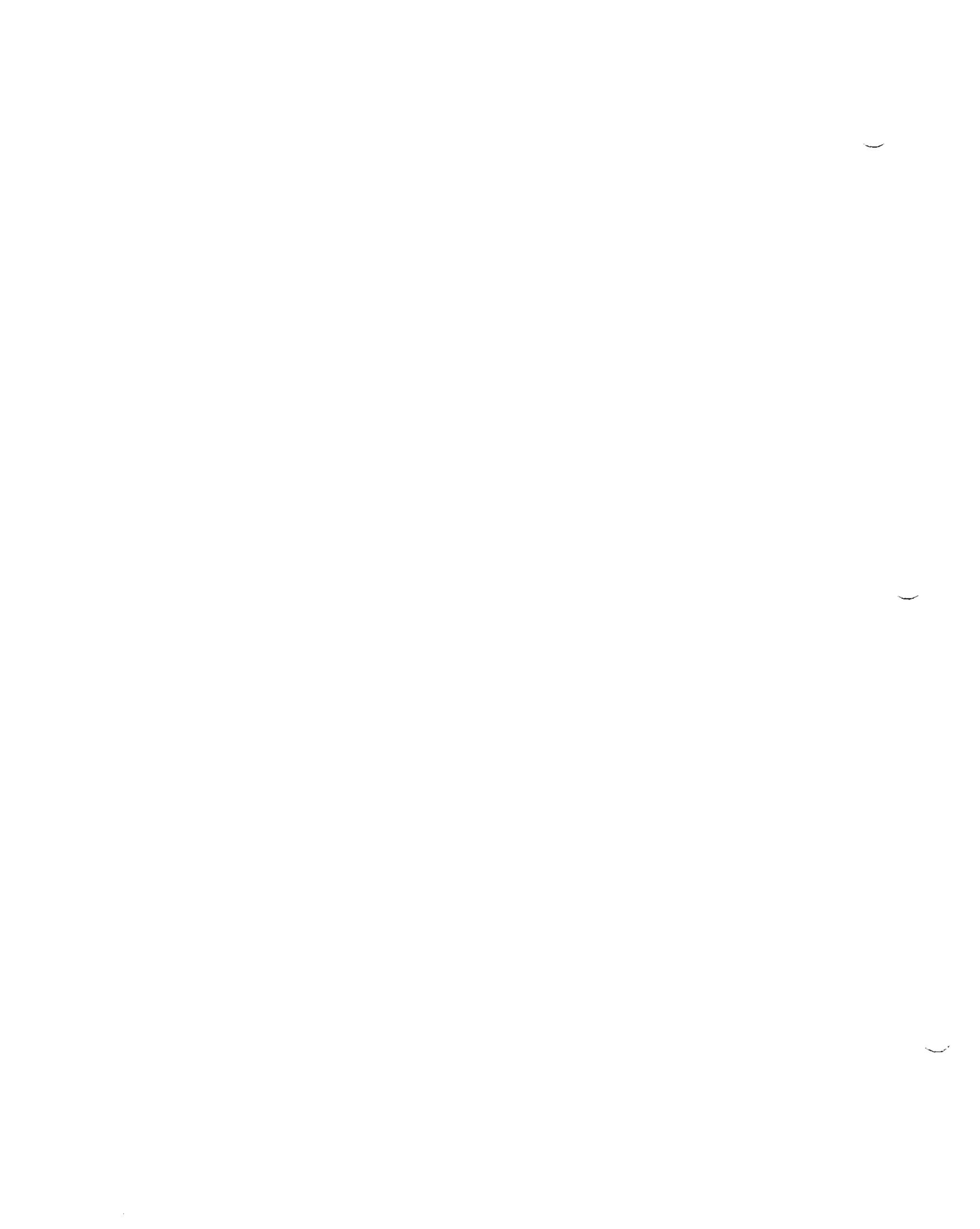
Pages 645-739 were adapted from Safety Education Handbook, produced by Kansas State Department of Education, Wichita, Kansas, 1981.

## AUTOMOBILE AND POWER MECHANICS RULES

1. Sound the horn before driving through entrance or exit doors.
2. Use traffic lanes, parking zones and aisles only for the purpose intended.
3. Stand to the side rather than in front of a vehicle when guiding it into a service bay.
4. Keep the pit floor free of grease, oil, tools, and discarded old parts.
5. Discard all disposable or junk parts in designated places.
6. Keep flammable liquids away from any ignition source.
7. Clean up spillage of flammable liquids immediately.
8. Be constantly aware of possible sources of accidental ignition.
9. Do not dump oil or gasoline into a sewer or septic tank.
10. Always hook up exhaust-eliminating system hoses when running engines indoors.
11. Keep all hand tools clean.
12. Keep all portable and stationary electrical equipment clean and free from metal filings, dust, and grease.
13. Always wear goggles or a face shield for all operations such as chipping, grinding, sanding, drilling, welding, spray painting, or working with liquid chemicals.
14. Always wear a filter respirator for protection from dust.
15. While working in the shop, avoid wearing ties, long sleeves, rings, or watches with metal bands.
16. When replacing glass, wear gloves to avoid cutting yourself.
17. Never allow sharp objects to protrude from your hip pockets.
18. Do not stand on a wet floor when using electric tools.
19. Do not use power equipment without proper guards in place.
20. Always lock the ignition and remove the key when working on the engine.
21. Do not attempt to start an engine by pouring gasoline into the carburetor while the engine is being turned over.

22. Check air hoses, couplings, and air accessories before using them.
23. Always stand to one side when inflating tires to avoid being injured by blowouts.
24. When removing a battery, always disconnect the battery ground cable first; when installing a battery, connect the ground cable last.
25. Always use a battery carrier strap to remove batteries.
26. Disconnect the battery when working in confined areas where a short or a fire may occur.
27. Always wear a helmet or goggles when doing any welding.
28. Do not lubricate fittings or parts of welding or torch cutting equipment.
29. Do not do any welding near or around the vehicle's gas tank, regardless of the situation.
30. Use only correct procedures when removing cooling system caps.
31. Protect your hands and face from any rush of steam and hot water by using a heavy cloth over the radiator cap.
32. Never work under an automobile unless jack stands are in place.
33. Inspect lifts, jacks, hoists and stands before using them.
34. Never use lifts and hoists unless they are in excellent condition.
35. Learn the correct procedures and capacities before using lifts, jacks, hoists, and stands.
36. Follow the labeled weight capacity when using lifts, jacks, hoists, and stands.
37. Never jack up a car when someone is working under it.
38. Always support the car or truck with support stands after using a hydraulic jack.
39. Never use bumper jacks as stands or supports when working under a car.
40. If the vehicle has a nonslip differential, do not put the transmission in gear while the engine is running and one rear wheel is jacked up.
41. When using a drive-on lift, always block the wheels to prevent the vehicle from rolling.
42. Lift the car until the wheels clear the floor, then recheck for proper positioning.

43. Never walk under the lift while it is being raised.
44. Make sure the lift safety leg or hoist safety pin is in position when the lift is fully raised.
45. Do not allow a jack handle to stick out from under a car.
46. Jack handles should be in the up position when not in use.
47. Creepers should be stored in an upright position or under a work bench when not in use.



## AUTOMOBILE AND POWER MECHANICS SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

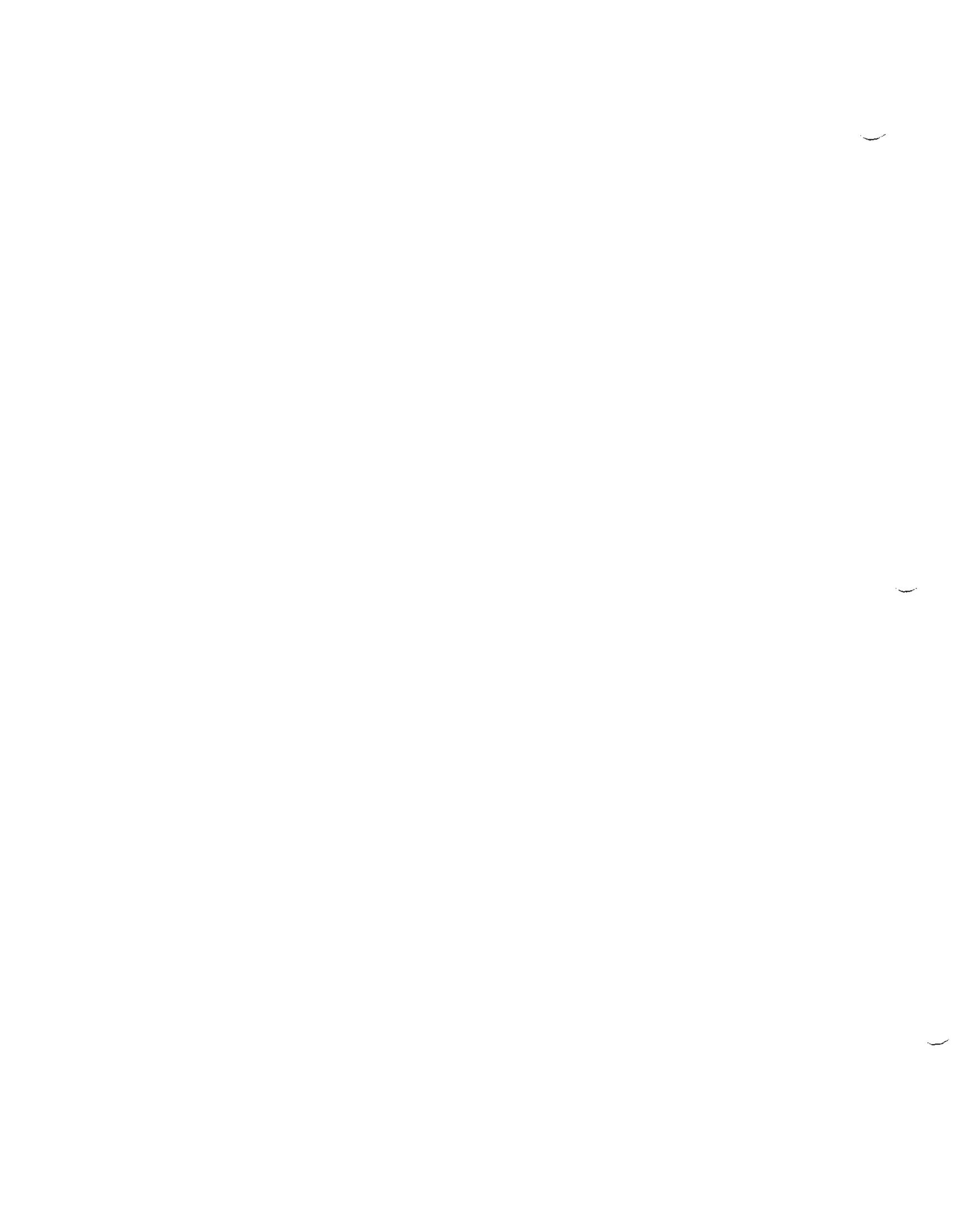
---

### True or False:

1. \_\_\_\_\_ It's always safe to run an automobile in gear with one wheel jacked up.
2. \_\_\_\_\_ Do not lift more than the capacity stated on lifts, jacks, hoists, and stands.
3. \_\_\_\_\_ You must always be aware of the hoist capacity and procedure, although you do not always have to abide by the rules.
4. \_\_\_\_\_ It is safe to work under a car that is supported with a bumper jack.
5. \_\_\_\_\_ Stands should be in position before you get under a vehicle, but they are not necessary.
6. \_\_\_\_\_ A jack handle can stick out from under a car as long as a red flag is placed on the handle.
7. \_\_\_\_\_ Once you start lifting the car, raise it to the desired position immediately.
8. \_\_\_\_\_ Never walk under the lift while it is being raised.
9. \_\_\_\_\_ All hoists and lifts should be checked for proper working condition about once a month.
10. \_\_\_\_\_ It is not necessary to check the position of the safety leg or hoist safety pin once the lift has been fully raised.
11. \_\_\_\_\_ After using a hydraulic jack, always support the car or truck with support stands.
12. \_\_\_\_\_ After pulling onto a drive-on lift, you should block the wheels to prevent the vehicle from rolling.
13. \_\_\_\_\_ Never jack up a car while someone is working under it.
14. \_\_\_\_\_ A jack handle should be left in the down position when not in use.

15. \_\_\_\_\_ There is no way that ignition could be caused accidentally while you are working on an engine.
16. \_\_\_\_\_ Cleaning up all flammable liquid spillage is a good practice.
17. \_\_\_\_\_ All flammable liquids should be stored in locked metal cabinet away from ignition sources.
18. \_\_\_\_\_ Air hoses, couplings, and accessories do not have to be checked as often as the air compressor.
19. \_\_\_\_\_ When inflating tires, you should lean over the tire so you can see if the tire seals on the rim.
20. \_\_\_\_\_ The ground cable should be disconnected first when the battery is being removed and reconnected first when the battery is being installed.
21. \_\_\_\_\_ You should always use a battery carrier strap when removing the battery from the vehicle.
22. \_\_\_\_\_ Students should always disconnect the battery when working around flammable liquids or when a short circuit may occur.
23. \_\_\_\_\_ A helmet is the only personal protection needed when welding.
24. \_\_\_\_\_ Acetylene valves and gauges are never to be lubricated with oil.
25. \_\_\_\_\_ It is a safe practice to weld near a vehicle's gas tank as long as you are not welding onto it.
26. \_\_\_\_\_ Safety awareness is a must when you remove a radiator cap.
27. \_\_\_\_\_ When opening the radiator cap, always use a heavy cloth to protect yourself.
28. \_\_\_\_\_ If you run the automobile engine for less than 15 seconds, exhaust-eliminating system hoses are not necessary.
29. \_\_\_\_\_ Dumping flammable liquids into a sewer is permitted.
30. \_\_\_\_\_ Always stand in front of the vehicle while guiding it into a service bay.
31. \_\_\_\_\_ Always store tools on the pit steps.
32. \_\_\_\_\_ You should sound the horn before driving through entrance or exit doors.
33. \_\_\_\_\_ It is not necessary to keep hand tools clean when using them.
34. \_\_\_\_\_ Wearing rings and watches does not present a safety hazard when you tune up a vehicle.

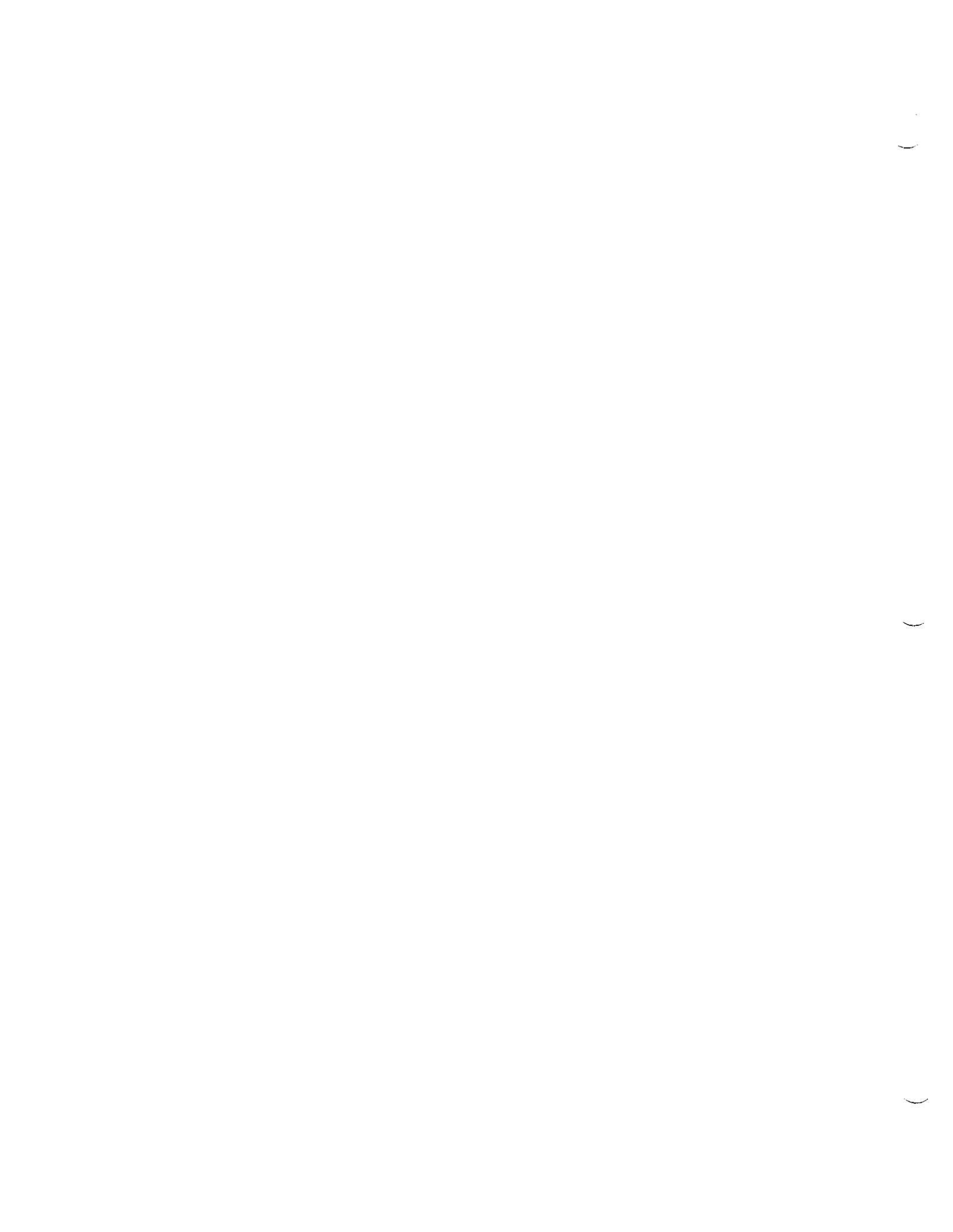
35. \_\_\_\_\_ Wear gloves when replacing glass in a vehicle.
36. \_\_\_\_\_ When working on the engine, it is permissible to leave the ignition on in order to listen to the radio.
37. \_\_\_\_\_ Do not stand on a wet floor when using electric tools.
38. \_\_\_\_\_ Metal filings, dust, grease, and moisture on electrical equipment not present any particular problem.
39. \_\_\_\_\_ It is not dangerous to carry tools or other sharp objects in your pockets.
40. \_\_\_\_\_ Before using grinders and other equipment with moving parts, protective guards should be in place.
41. \_\_\_\_\_ When not in use, creepers should not be stored in an upright position.
42. \_\_\_\_\_ It is not safe to pour gasoline into the carburetor while the engine is being turned over.
43. \_\_\_\_\_ It is not necessary to pay attention to the marks around aisles, parking zones, and working bays.
44. \_\_\_\_\_ All junk or disposable parts should be left near the spot where they were removed.
45. \_\_\_\_\_ Safety glasses or goggles must always be worn in the shop.
46. \_\_\_\_\_ It is not necessary for students to wear a filter respirator for protection against dust.



## SMALL GASOLINE ENGINE OPERATION

### RULES

1. Eye protection is required for operating a small gasoline engine.
2. Report any accident or trouble to the teacher.
3. Locate and learn to operate all switches and controls before starting the engine.
4. Make sure the engine is secure before operation.
5. When starting a mower with a blade, make sure the mower is on the floor.
6. Do not play around or leave unattended any engine that is running.
7. Do not operate a small gasoline engine without proper exhaust facilities.
8. Do not fill the gas tank while the engine is running or is hot.
9. Do not make any adjustments to machinery driven by a small engine without first stopping the engine and removing the lead from spark plug.
10. Keep gasoline in an approved safety can, away from fire or open flame.



## SMALL GASOLINE ENGINE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

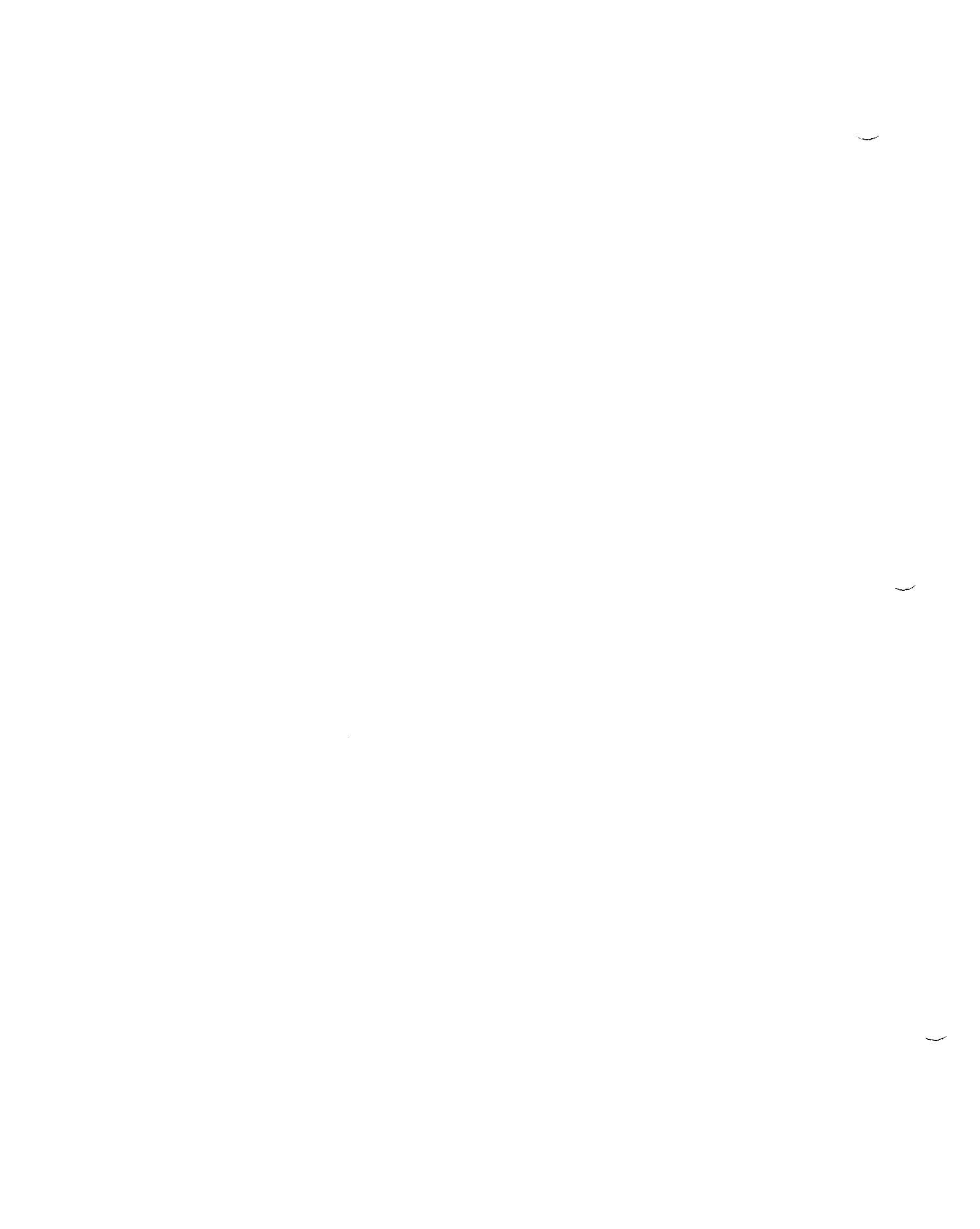
---

### Explain:

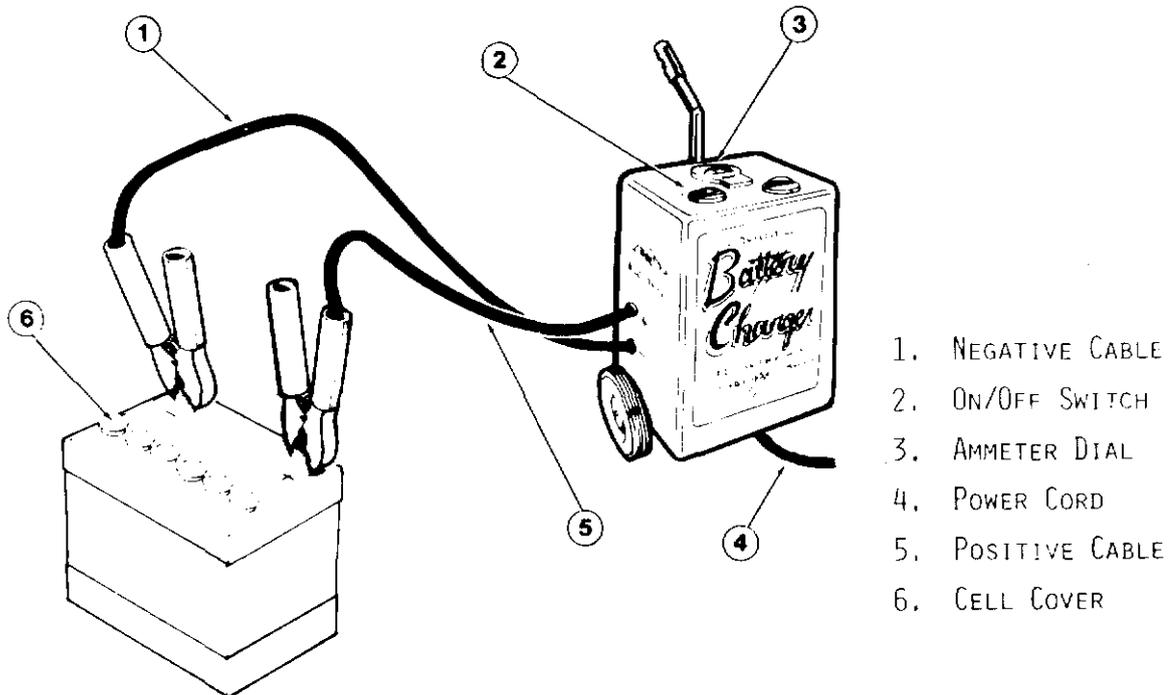
1. Why should an engine be secured before you start it?
2. How should an engine be shut off?
3. Any lawn mower that has a blade on it should be started where?
4. Why should you not leave an engine unattended when it is running?
5. How can exhaust fumes be dangerous? How can they be removed?
6. What may happen if you fill a gas tank while the engine is running?
7. Tell of the danger in making adjustments on an engine or machinery while the engine is running.
8. What are the fire regulations for storing gasoline?

### True or False:

9. \_\_\_\_\_ Eye protection is not required while you operate a small gasoline engine.
10. \_\_\_\_\_ You should report any accident or trouble to the nurse.



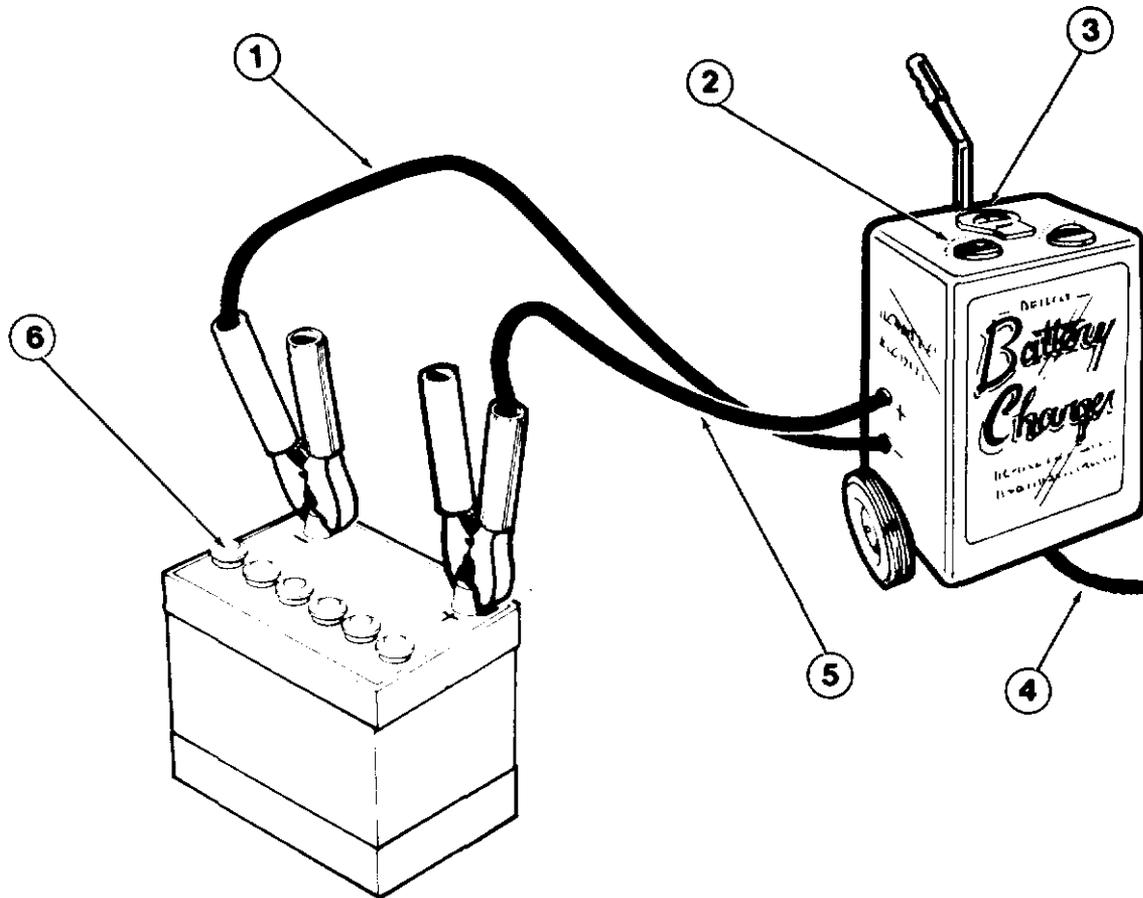
## BATTERY CHARGER



1. Observe eye protection rules. Always use safety glasses when servicing a storage battery.
2. Check the battery electrolyte level before attaching charger cables. Fill only to the recommended level. Do not overfill. Never use a match or lighter to check the electrolyte level.
3. Smoking is prohibited in the charging area.
4. Replace cell covers during charging.
5. Provide ample ventilation when using a charger.
6. Make sure that the battery charger is turned off and the power cord is unplugged before connecting or disconnecting the charger leads.
7. Always connect the charger cables according to the polarity of the battery; negative to negative and positive to positive.
8. Disconnect the battery ground cable before charging.
9. When connecting cables, connect the ground cable last; disconnect the ground cable first.
10. Follow the manufacturer's instructions to turn the charger on and adjust the charging rate. A very fast charge rate is not recommended. If the battery gasses excessively, or feels warm to the touch, lower the charge rate.

11. Do not stand with your face directly over the battery.
12. If sparks occur at the battery when the charger is turned on, turn off the charger and reconnect the charger clips to improve the connection.
13. Match the voltage and manufacturer's recommended amperage charge to the dial setting on the charger. Do not overcharge the battery.
14. If a battery explosion should occur, immediately wash any part of your body or clothing that has come into contact with acid, using plenty of water.
15. Acid spills can be neutralized with a weak ammonia solution, a bicarbonate of soda solution, or by diluting with large quantities of water, applied immediately.

# BATTERY CHARGER



1. NEGATIVE CABLE
2. ON/OFF SWITCH
3. AMMETER DIAL
4. POWER CORD
5. POSITIVE CABLE
6. CELL COVER

~

~

~

## BATTERY CHARGER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

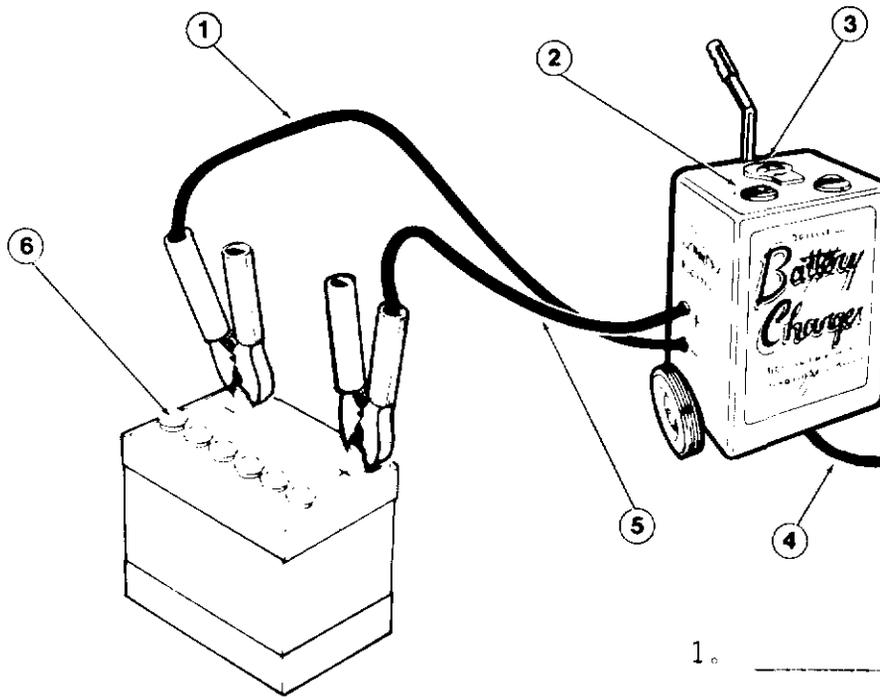
---

True or False:

(Circle true or false)

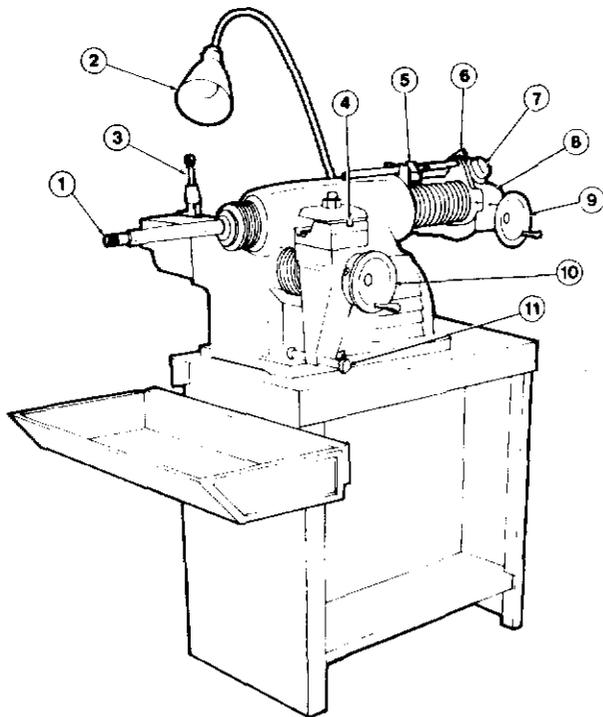
- |  |   |   |
|--|---|---|
| 1. Never use a match or lighter to inspect the electrolyte level of the battery.   | T | F |
| 2. When connecting the battery cables, connect the ground cable first.   | T | F |
| 3. It is best to charge a battery very quickly so that the charger doesn't have time to damage the battery.  | T | F |
| 4. The cell covers must be in place during a charge.   | T | F |
| 5. Batteries shall be charged in an enclosed area.   | T | F |
| 6. Keep your face directly over the battery while charging it so that you can see the electrolyte better.  | T | F |
| 7. The battery electrolyte should be slightly over-filled during charging, so the plates will be well covered.   | T | F |
| 8. Attach the positive charger cable to the positive battery terminal; the negative to the negative battery terminal.                                    | T | F |
| 9. If a spark occurs when the charger is turned on, turn the charger off and reconnect the cables.   | T | F |
| 10. If a battery explodes, one must immediately wash all parts of the body and clothes that might have come in contact with acid, using plenty of water. | T | F |

11. Identify the parts of a battery charger.



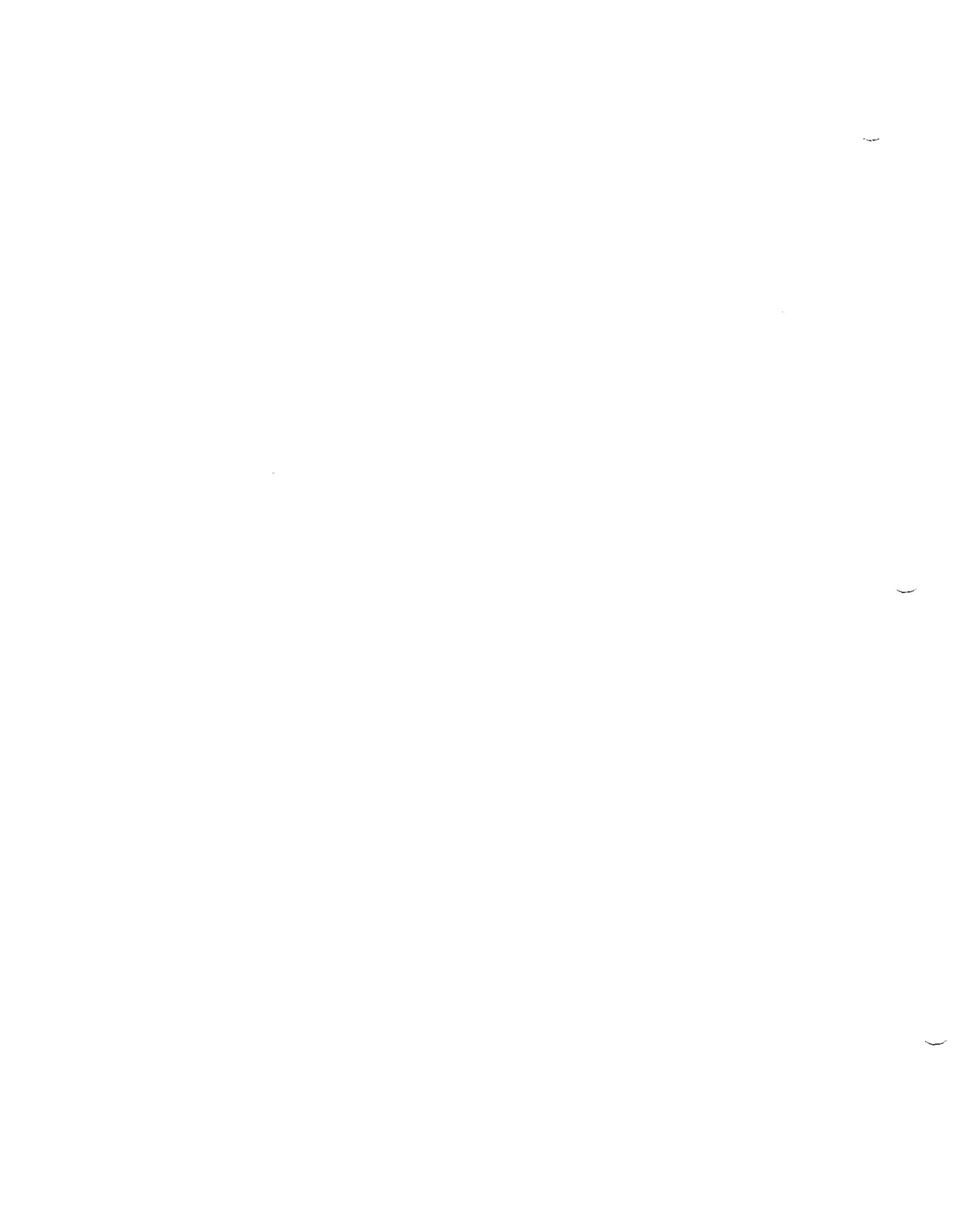
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_

## BRAKE DRUM/ROTOR LATHE

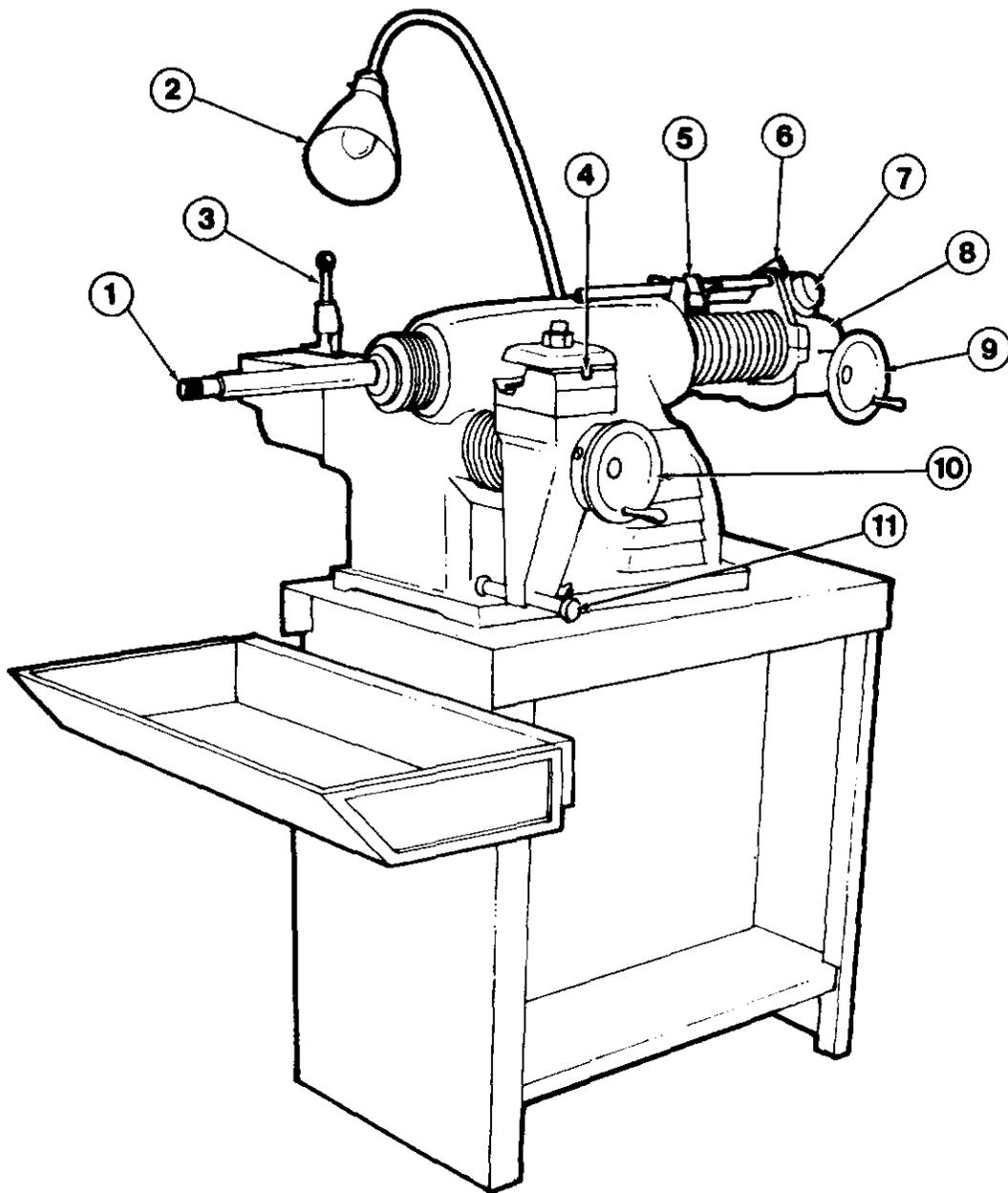


1. ARBOR
2. WORK LIGHT
3. CROSS FEED ENGAGING LEVER
4. TOOL BAR CLAMP
5. SPINDLE LOCK
6. SPINDLE FEED ENGAGING LEVER
7. SPINDLE FEED DIAL
8. INFIMATIC VARIABLE FEED GEAR BOX ASSEMBLY
9. SPINDLE FEED HAND WHEEL
10. CROSS FEED HAND WHEEL
11. CROSS SLIDE LOCK

1. Observe eye protection safety rules.
2. Do not remove the belt guards or shields, or in any way change or shortcut the controls and operations.
3. The spindle feed hand wheel will not operate unless the spindle feed engaging lever is in the off position.
4. The feed speed shall be adjusted only when the spindle is turning.
5. Be sure that the drums and rotors are mounted accurately and squarely before starting a cut. Ask the teacher to check the setup.
6. Be careful not to let any loose clothing or items of jewelry (rings, wristwatches, necklaces, etc.) get caught in the moving parts. Remove these things if they might catch on moving machinery.
7. Do not overload the lathe. Follow the manufacturer's recommendations.
8. Do not turn on any switch unless you are thoroughly familiar with the operation of the lathe and until you have obtained the teacher's permission.
9. Keep the floor area around the lathe clean and free from obstacles. Do not clean the lathe or the table with compressed air. Use a counter brush.



## BRAKE DRUM/ROTOR LATHE



- |                               |   |
|-------------------------------|---|
| 1 ARBOR                       | 7 SPINDLE FEED DIAL                         |
| 2 WORK LIGHT                  | 8 INFINITIC VARIABLE FEED GEAR BOX ASSEMBLY |
| 3 CROSS FEED ENGAGING LEVER   | 9 SPINDLE FEED HAND WHEEL                   |
| 4 TOOL BAR CLAMP              | 10 CROSS FEED HAND WHEEL                    |
| 5 SPINDLE LOCK                | 11 CROSS SLIDE LOCK                         |
| 6 SPINDLE FEED ENGAGING LEVER |   |



## BRAKE DRUM/ROTOR LATHE SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

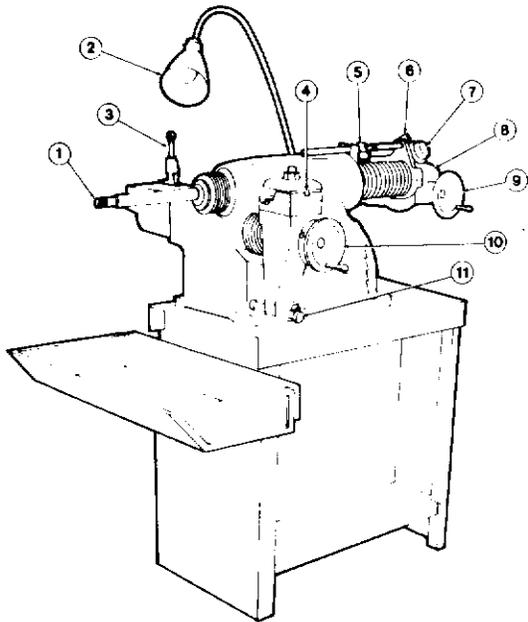
---

True or False:

(Circle true or false)

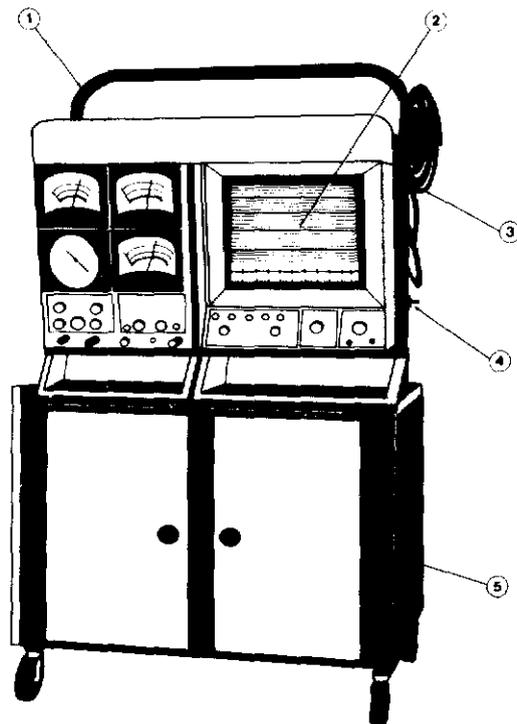
- |   |   |   |
|---|---|---|
| 1. Remove belt guards and shields if they are in the way.   | T | F |
| 2. Adjust the feed speed only when the spindle is turning.  | T | F |
| 3. Keep loose clothing away from moving parts.  | T | F |
| 4. Eye protection is not necessary if the shield is used.   | T | F |
| 5. Be sure to step over or around any obstacles around the lathe.   | T | F |
| 6. Do not overload the lathe.   | T | F |
| 7. Make a cut with the lathe before having the teacher check the setup.   | T | F |
| 8. Do not take time to remount a drum or rotor that is not mounted squarely because the lathe will compensate for it. | T | F |

9. Identify the parts of the brake drum/rotor lathe



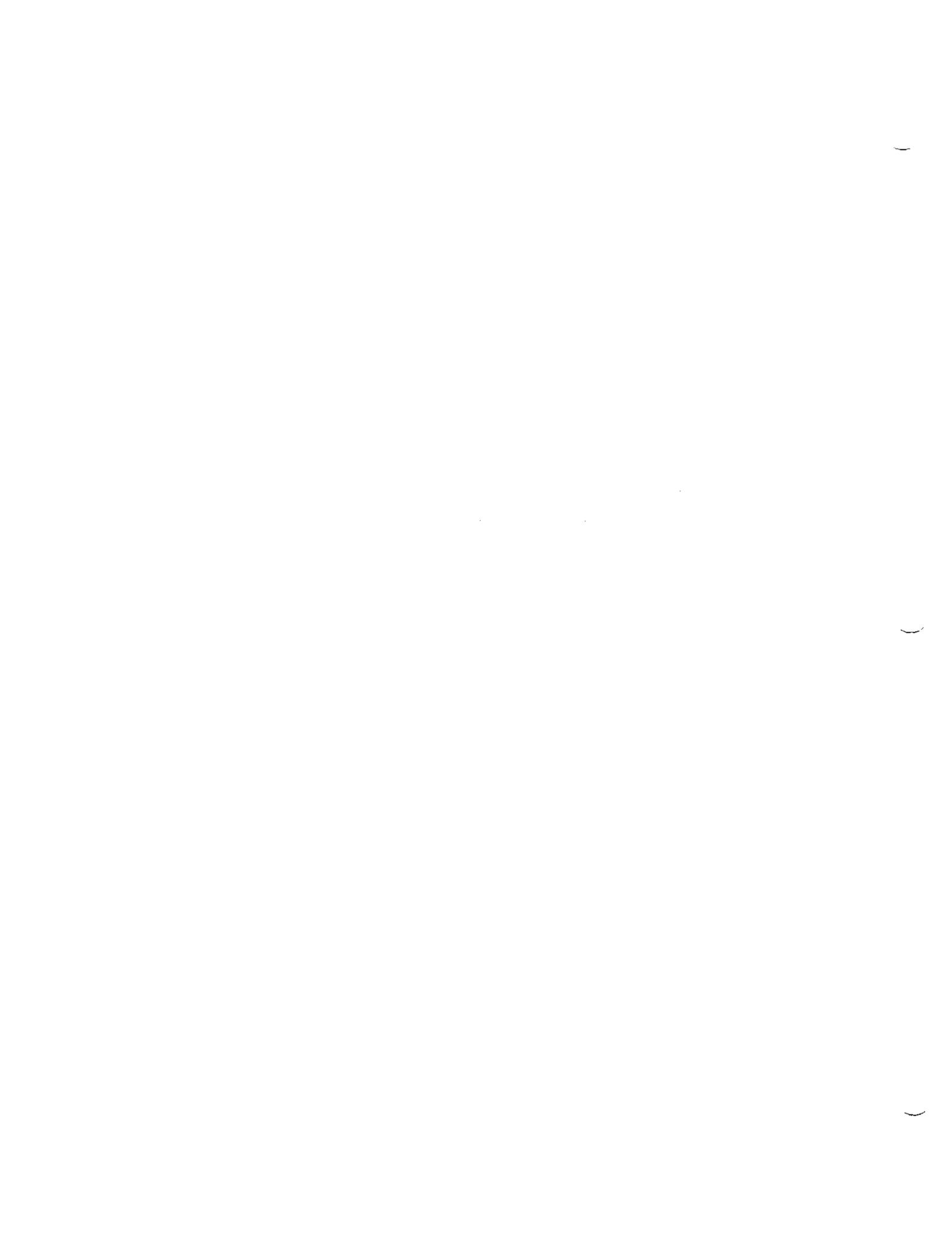
- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_
- 9. \_\_\_\_\_
- 10. \_\_\_\_\_
- 11. \_\_\_\_\_

## ENGINE ANALYZER

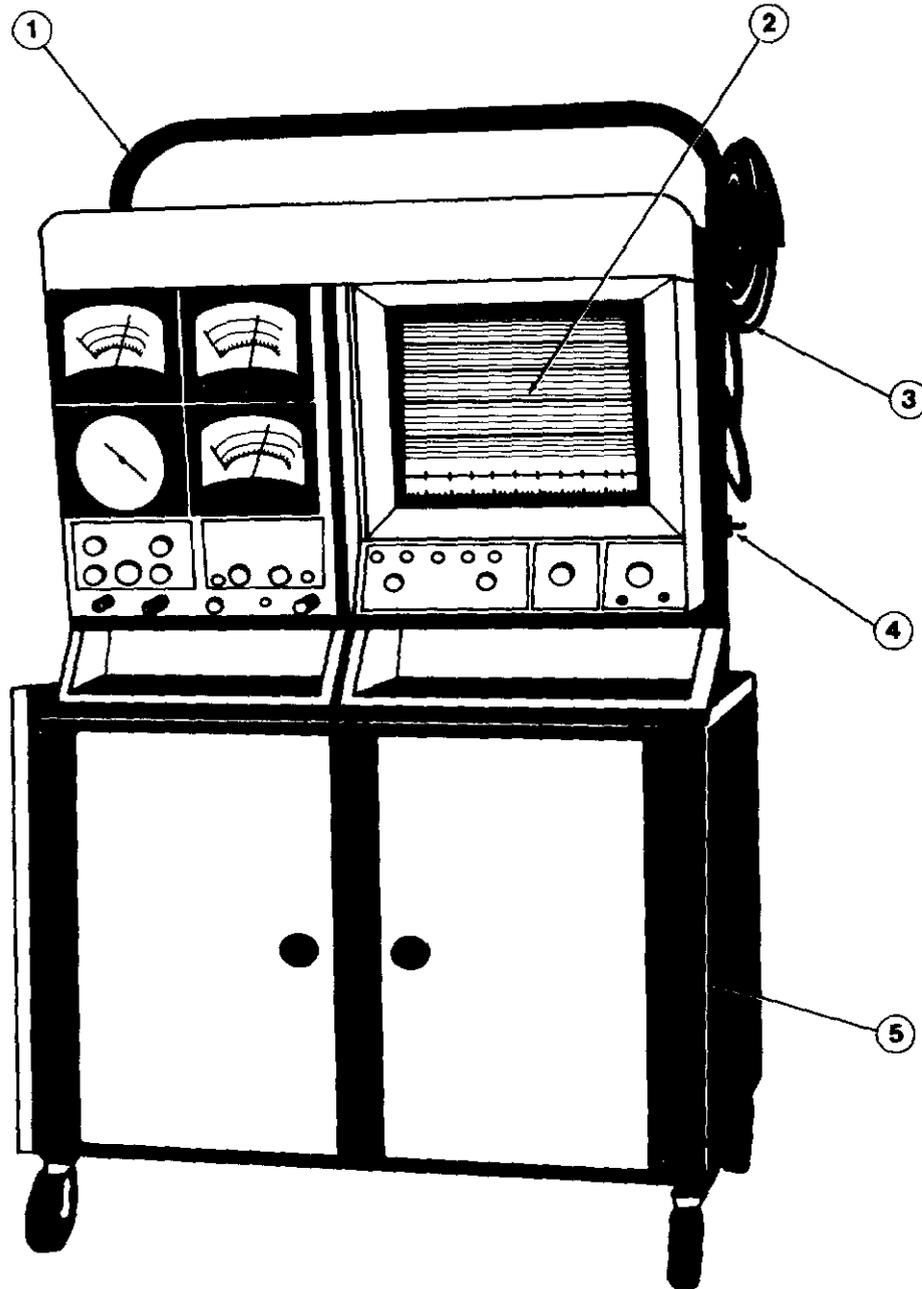


1. BOOM
2. OSCILLOSCOPE
3. LEADS
4. MASTER SWITCH
5. CABINET

1. Obtain the teacher's permission before using the engine analyzer.
2. The engine analyzer is top-heavy and can tip over easily. Never move it from one place to another by yourself.
3. The engine must be turned off while the analyzer leads are attached to it.
4. Check the leads to see that they cannot fall into the fan blades or into the engine belts. Also, make sure that the leads do not come into contact with the exhaust manifold.
5. The engine operator must obey the instructions of only one person: the one making the tests. Instructions coming from a group of mechanics are confusing and dangerous. Instructions must be clear and understood by all mechanics. "Crank it over" does not mean "Start it up." "Bump it" does not mean "Pump it," etc.
6. No one is to have his/her hands resting on any part of the engine or radiator during the testing.
7. The hand brake must be on. The transmission must be in park if the vehicle has an automatic transmission; in neutral if it has a standard transmission.
8. The shop exhaust ventilator tube must be in place with the exhaust fan turned on.



# ENGINE ANALYZER



1. BOOM
2. OSCILLOSCOPE
3. LEADS
4. MASTER SWITCH
5. CABINET



## ENGINE ANALYZER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

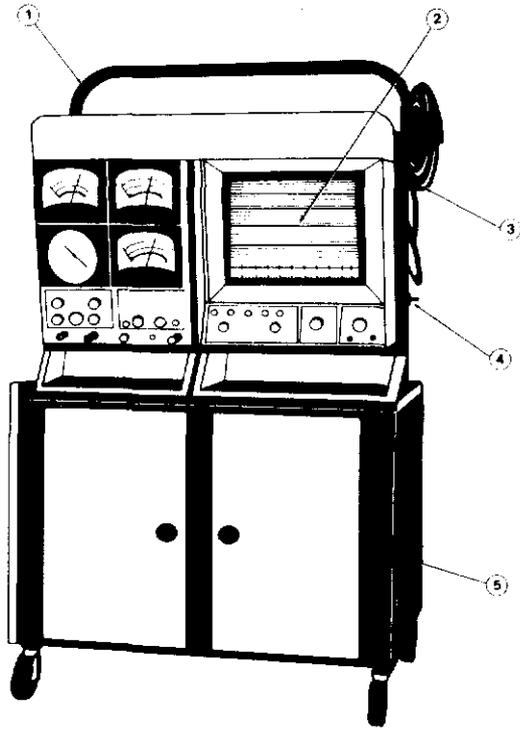
---

True or False:

(Circle true or false)

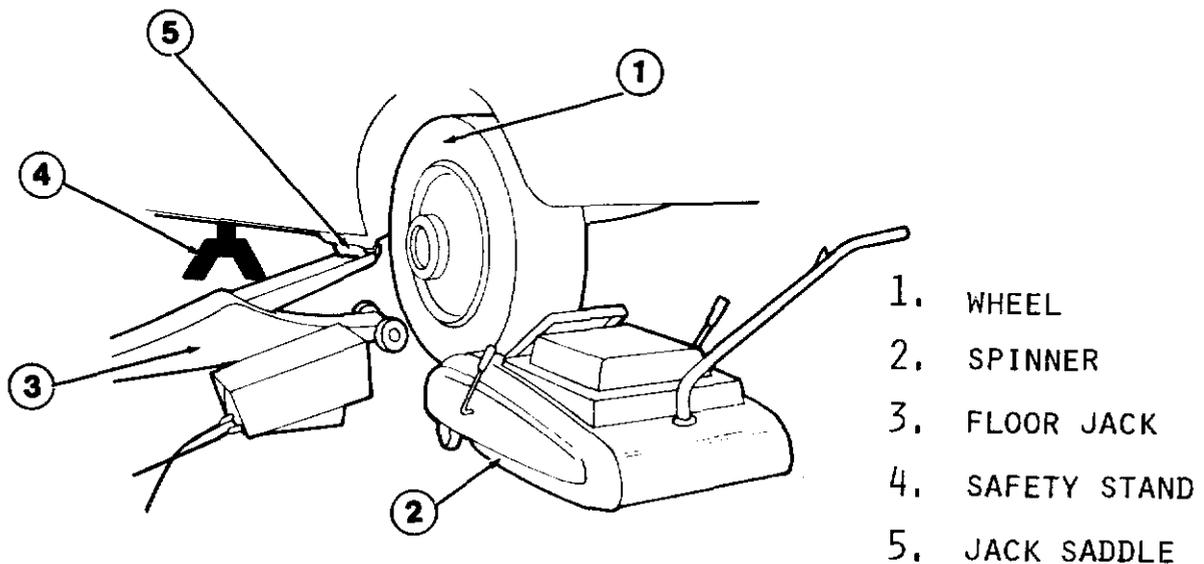
- |  |   |   |
|--|---|---|
| 1. In order to avoid confusion, only one person should move the analyzer from one place to another.                    | T | F |
| 2. You should make sure the analyzer leads do not make contact with the intake manifold.                               | T | F |
| 3. If several mechanics are making the test, they must all be responsible for giving the engine operator instructions. | T | F |
| 4. No one should rest his/her hands on the engine or radiator during the tests.  | T | F |
| 5. One should keep the analyzer leads away from the fan blades or fan belts.   | T | F |
| 6. The engine must be running during the analyzer hookup in order to see that the meters are working properly.         | T | F |
| 7. One must hook up the shop exhaust ventilation system only if the shop begins to smoke.                              | T | F |
| 8. The vehicle hand brake must be applied during the test.   | T | F |

9. Identify the parts of the engine analyzer.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

## HIGH SPEED WHEEL BALANCER



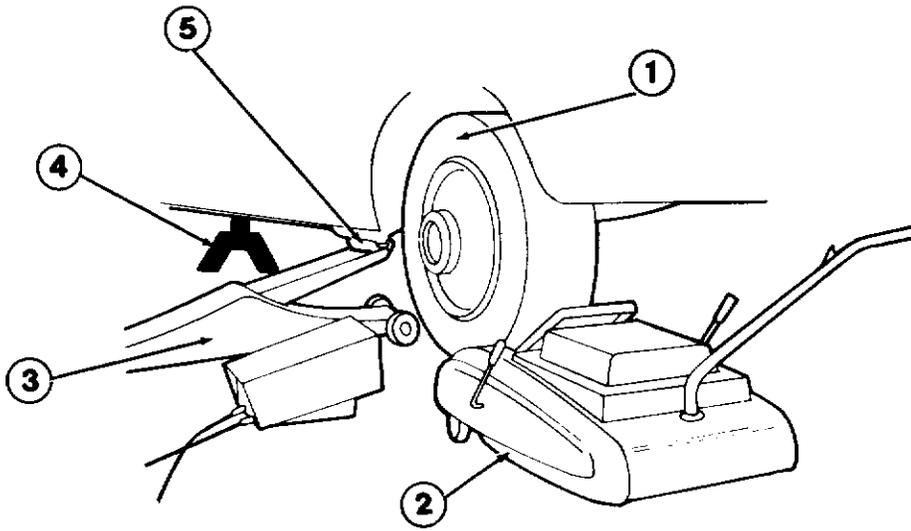
1. Obtain permission from the teacher before using the balancer.
2. Observe eye safety regulations.
3. Jack up the vehicle so that the wheel being balanced is off the floor by about 2 inches.
  - A. Follow the jack safety instructions.
  - B. Locate the jack saddle directly under the part to be raised.
  - C. Make sure only the wheel being balanced is off the floor.
4. Set the car hand brake, if possible.
5. Check to see that the wheel turns freely. Eliminate all friction drag on the wheel such as brakes, bearings, etc.
6. Remove any clumps of mud, dirt, or grease from the wheel rim. Remove any gravel or other objects from the tire tread. Use safety stands under the car if it is necessary to get under it.
7. Ask the teacher to check the installation before spinning the wheel.
8. Do not allow anyone to stand in a direct line with the spinning wheel.
9. Do not stop the rotation of the wheel with the car brakes.
10. If the wheel vibrates excessively, stop spinning it and check the installation. Also check for loose wheel bearings or lug nuts. If everything looks satisfactory, ask the teacher to check it over.

)

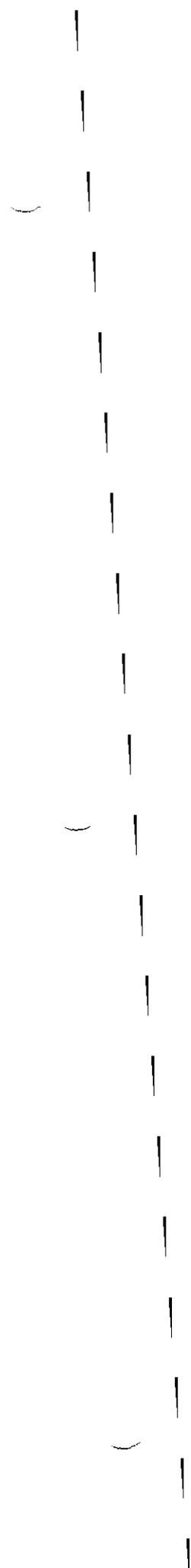
)

)

# HIGH SPEED WHEEL BALANCER



1. WHEEL
2. SPINNER
3. FLOOR JACK
4. SAFETY STAND
5. JACK SADDLE



# HIGH SPEED WHEEL BALANCER SAFETY QUIZ

NAME \_\_\_\_\_

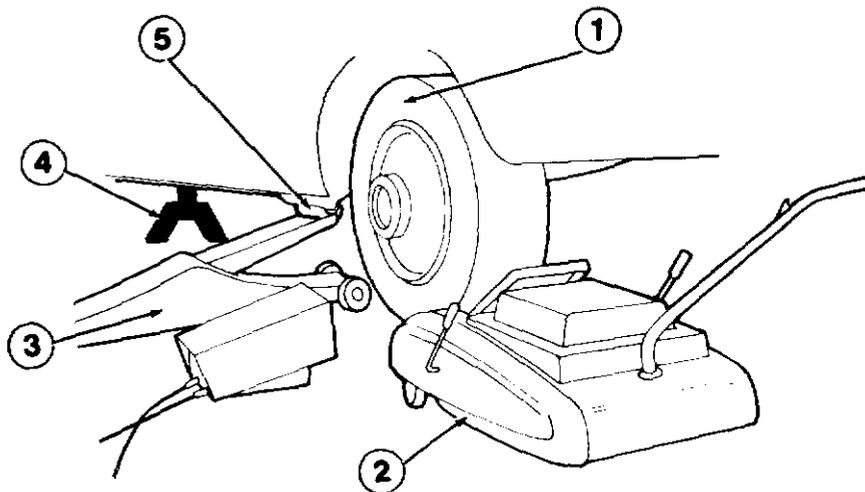
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

True or False:

(Circle true or false)

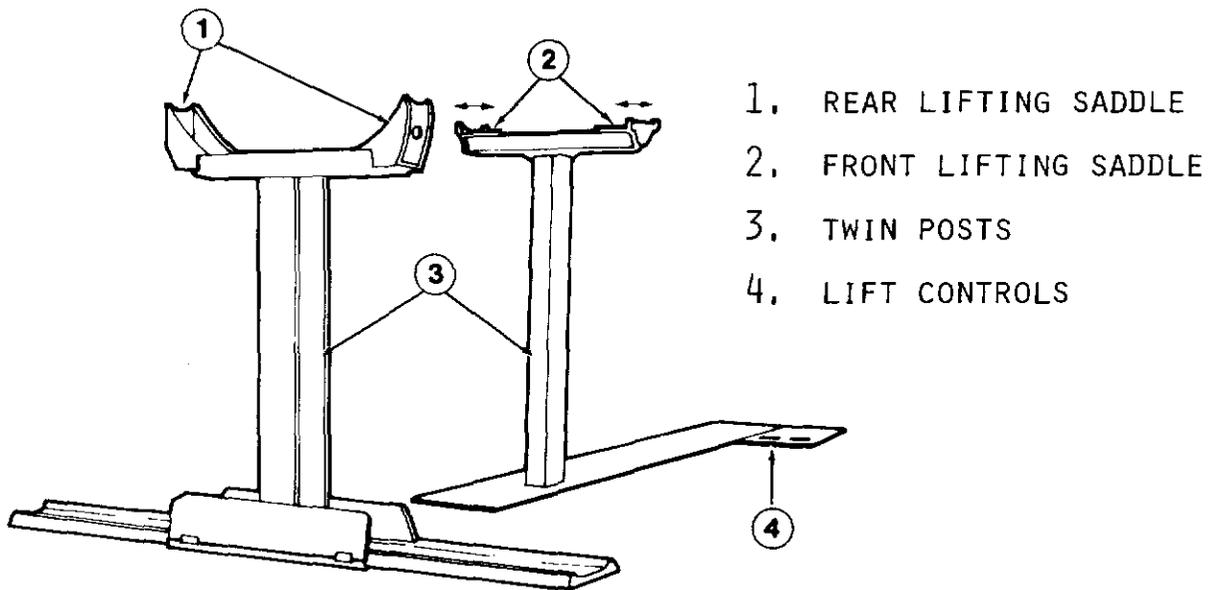
- |   |   |   |
|---|---|---|
| 1. The safest place to stand and observe the balancing is in a direct line with the wheel.                      | T | F |
| 2. Spin the wheel to see if it needs balancing before getting the teacher to check the installation.            | T | F |
| 3. Eye safety regulations must be observed at all times.  | T | F |
| 4. Never stop the wheel from rotating with the car's brakes during the balancing.                               | T | F |
| 5. All four wheels must be off the floor during the balancing of one wheel.                                     | T | F |
| 6. Clean off the rim of the wheel before balancing it.  | T | F |
| 7. If the wheel vibrates excessively when you start spinning it, don't be alarmed. Continue with the balancing. | T | F |
| 8. Identify the parts of the high speed wheel balancer.   |   |   |



1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

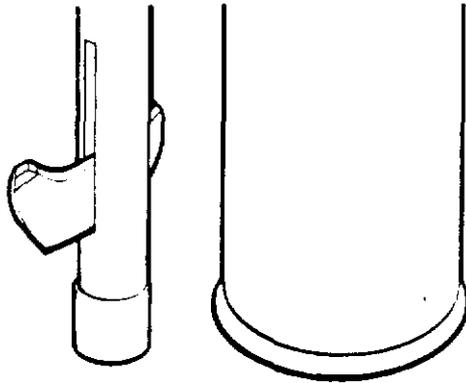


## CAR LIFT



1. Wear eye protection.
2. Obtain permission from the teacher before using the car hoist.
3. Practice using the lift controls until they become familiar.
4. Place the car directly over the lift with the rear and front wheels centered over the hoist contact points. Release the brakes and put the transmission in neutral.
  - A. Stand to one side when directing the driver of the car onto the lift area.
  - B. The driver shall not wear safety glasses with vision-restricting side shields while driving a vehicle within the shop.
  - C. The driver must have the side window down and the radio turned off.
  - D. Only licensed drivers may drive the vehicles, and no one should drive a vehicle equipped with standard transmission if s(he) is not familiar with it.
5. Position the lifting saddles in the proper location on the vehicle, according to the type of lift being used.
6. Ask the teacher to inspect the location of the lift saddles before the car is raised.

7. Make sure all persons and obstructions are clear before raising or lowering the vehicle.
8. Lift the vehicle a few inches off the floor and recheck the saddle positions.
9. Regulate the control valves to raise both ends of the car at the same time if the lift is the twin-post type.
10. After the vehicle is raised to the full height, close both control valves. Turn the air valve to its neutral position, locking the air in the tanks.
11. The lift should be equipped with a mechanical locking device.



MAKE CERTAIN THE DEVICE IS IN PLACE WHEN THE LIFT IS UP.

(WARNING)

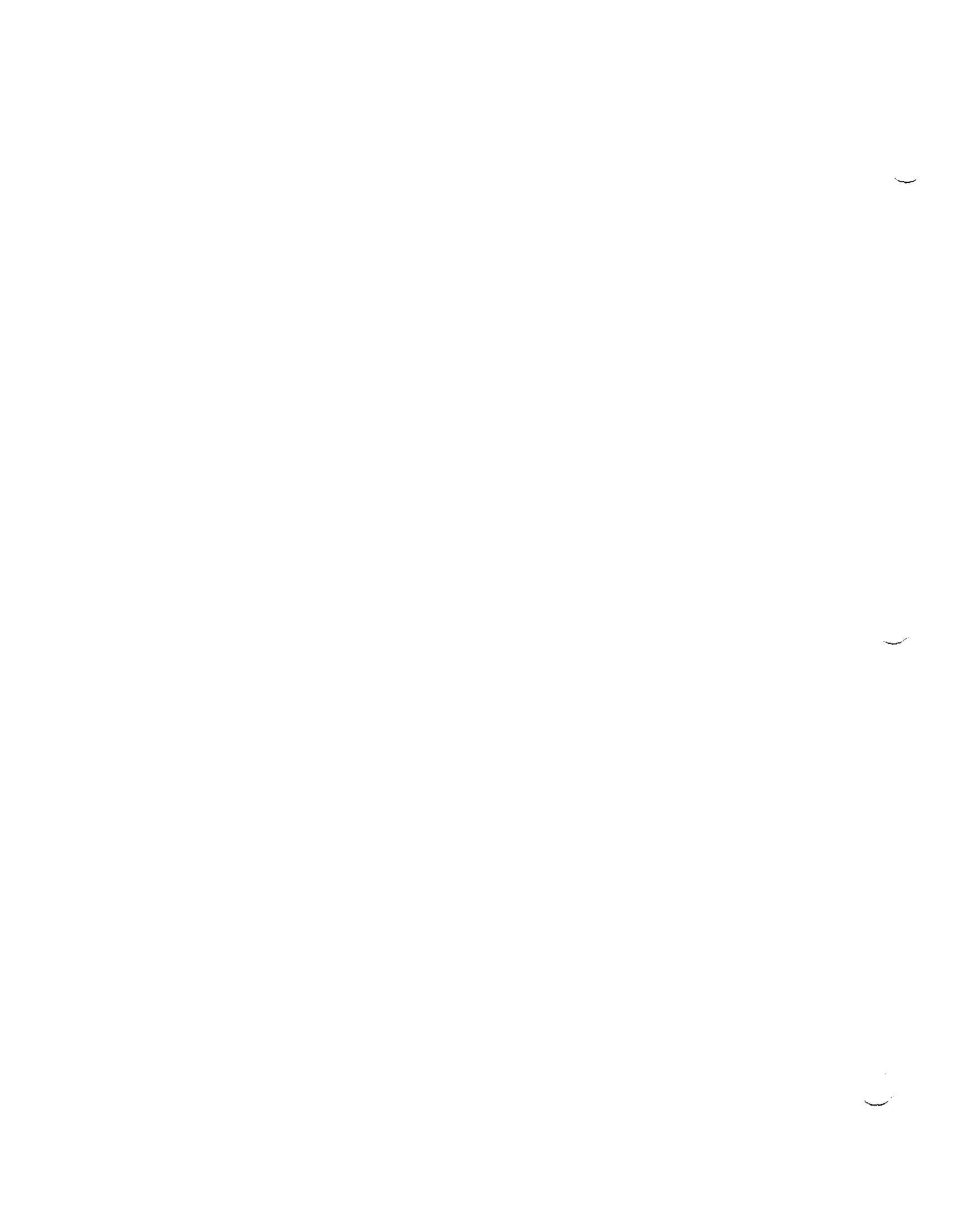
DON'T USE THE LIFT IF IT:

1. jerks or jumps when raised
2. slowly settles down after being raised
3. slowly rises, either when in use or when not in use
4. comes down very slowly
5. blows oil out of the exhaust line
6. leaks oil at the packing gland

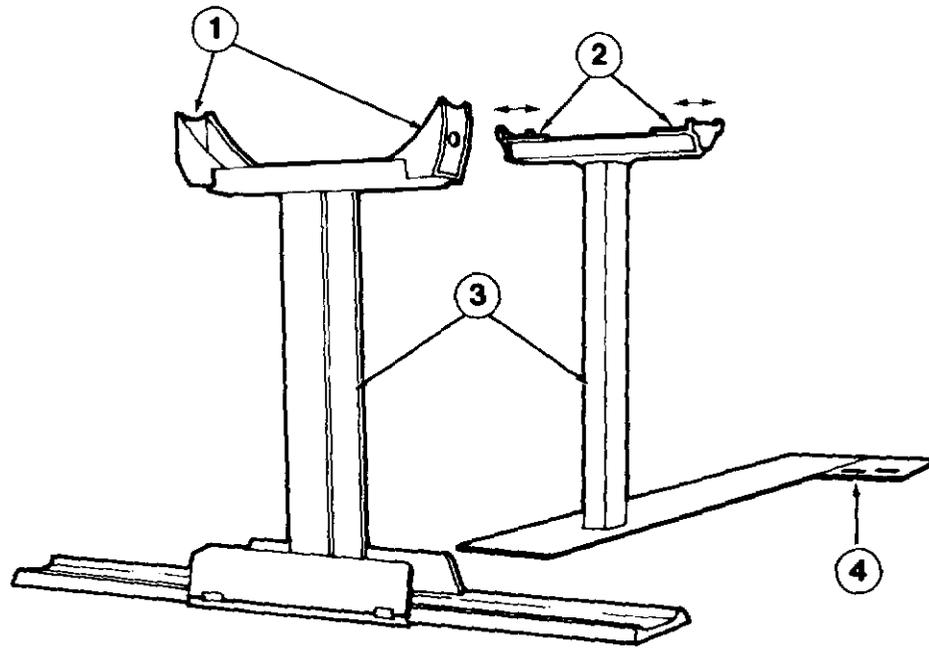
Tell the teacher if any of these problems are observed.

12. If the vehicle has curb feelers installed, cover them or tuck them under the fender as a protection to the eyes and face.

13. When removing the rear axle assembly, rear springs, shackles, or transmission, support the vehicle with the proper stands. (Twin-post type only.)
14. Ask the teacher to check the placement of these stands.
15. Lower the vehicle so that both ends come down at the same time.
16. Check to see that the lift saddles go completely down into the pits before the vehicle is driven off the lift.
17. Report any lift malfunction to the teacher.



# CAR LIFT



1. REAR LIFTING SADDLE
2. FRONT LIFTING SADDLE
3. TWIN POSTS
4. LIFT CONTROLS



# CAR LIFT SAFETY QUIZ

NAME \_\_\_\_\_

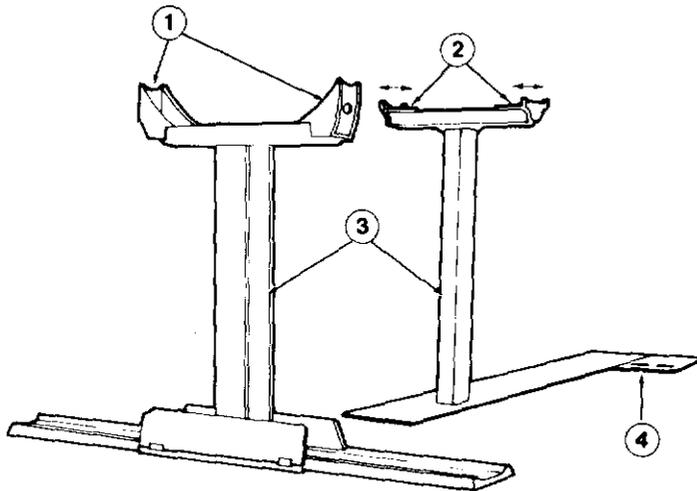
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

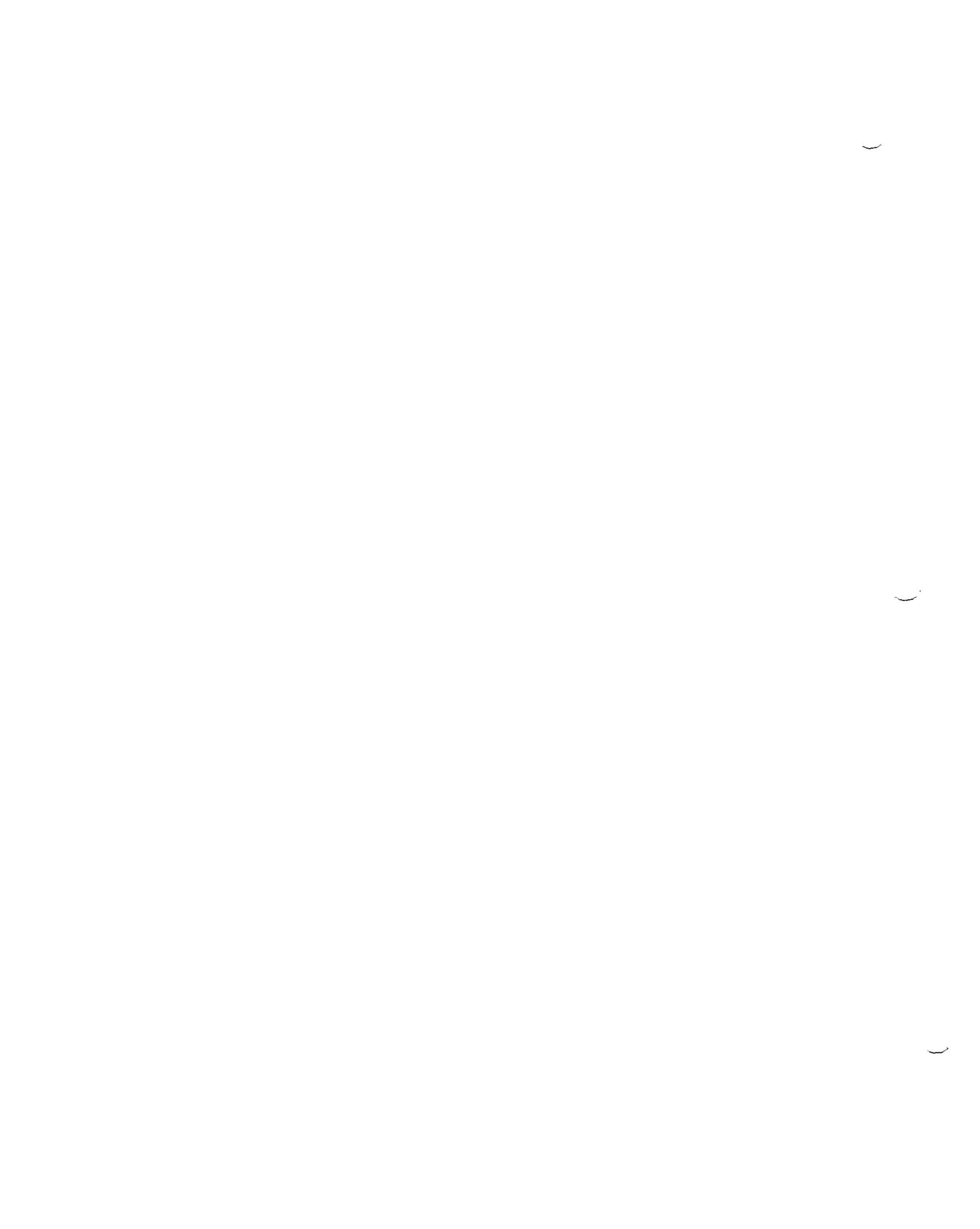
True or False:

(Circle true or false)

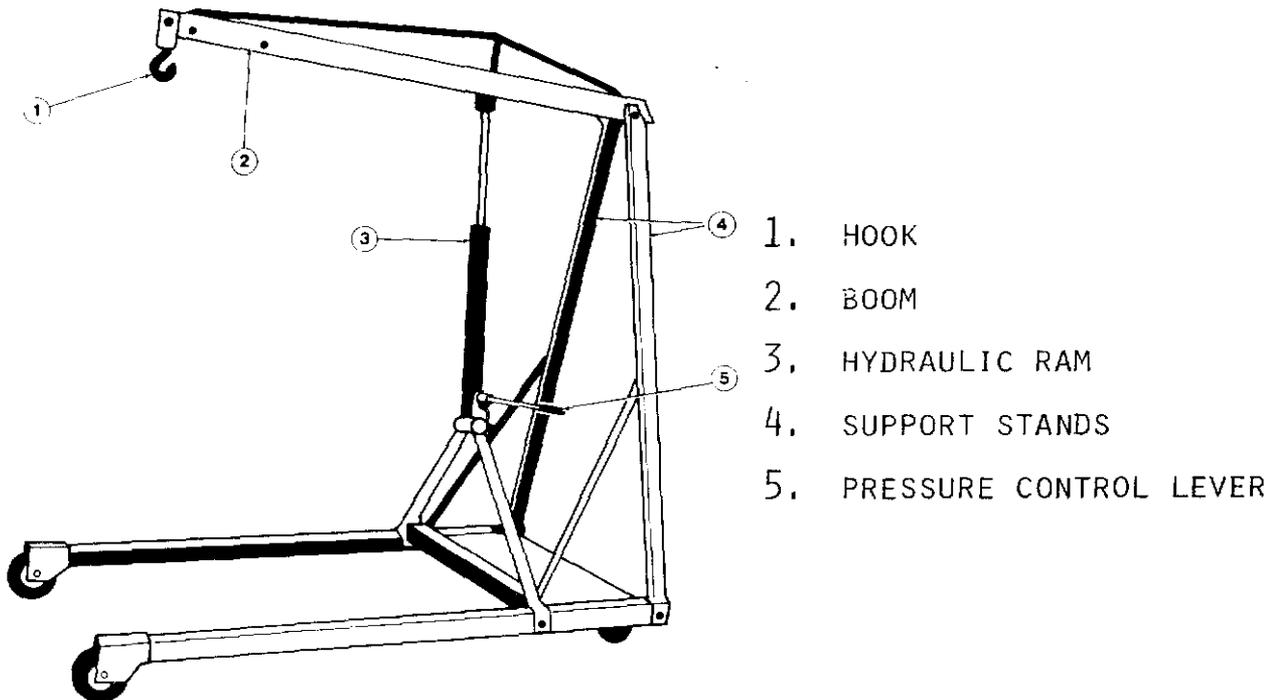
- |  |   |   |
|--|---|---|
| 1. One must stand directly in front of the vehicle when directing it on the lift so that it can be carefully centered. | T | F |
| 2. When the car is raised, place the air valve in neutral to trap air in the tanks.                                    | T | F |
| 3. When lifting the vehicle, raise one end at a time.  | T | F |
| 4. Check to see that the lift saddles are completely down into their pits before driving the vehicle off the lift.     | T | F |
| 5. It is best to raise the car completely before asking the teacher to check it.                                       | T | F |
| 6. Use special stands to support the vehicle when removing the rear springs if the lift is a twin-post type.           | T | F |
| 7. Drivers shall not wear safety glasses with restrictive eye shields while driving within the shop.                   | T | F |
| 8. Identify the parts of the car lift.   |   |   |



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_



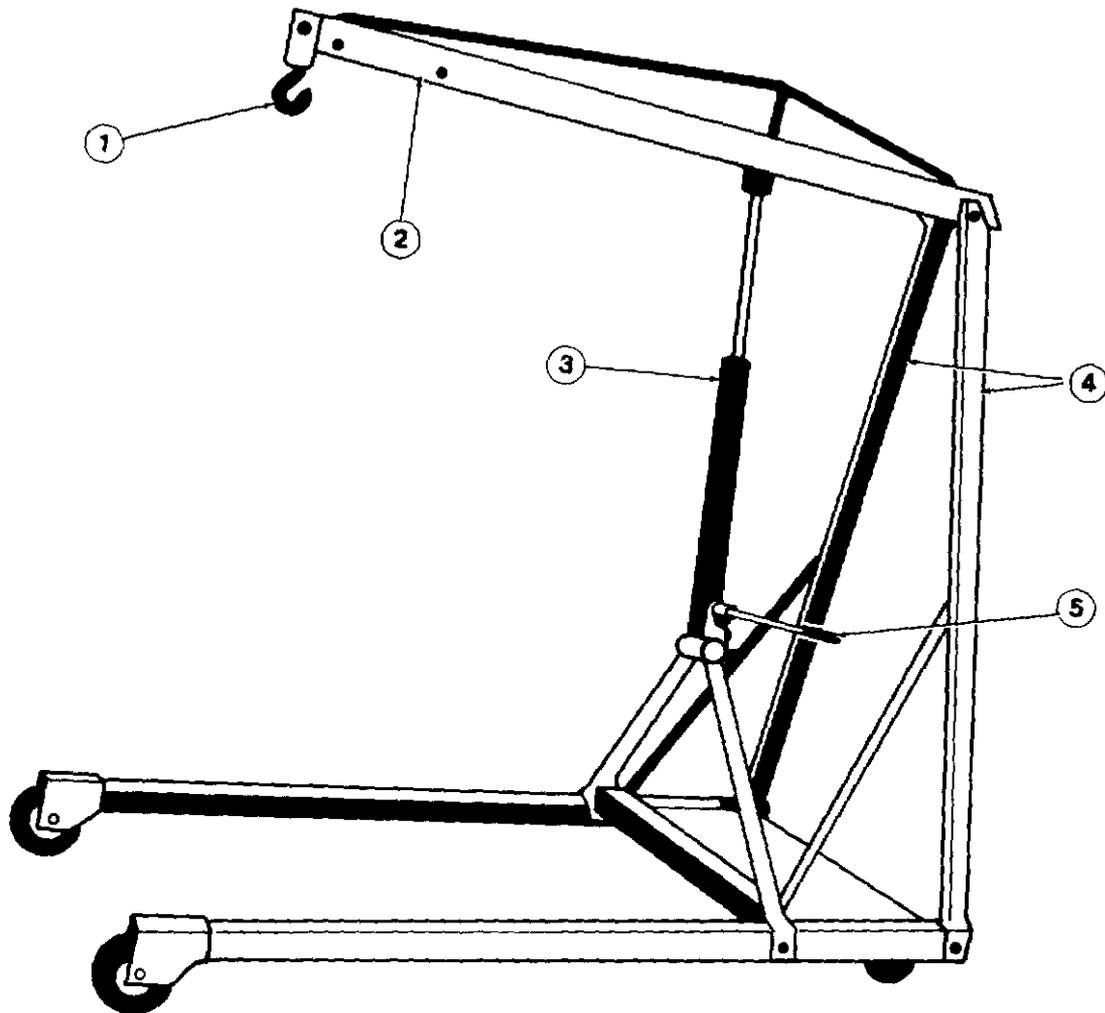
## ENGINE CRANE AND HOIST



1. Obtain permission from the teacher before using a hoist or crane.
2. Place the crane or hoist directly over the object to be lifted.
3. Inspect the chain, cable, or rope each time it is used for lifting.
4. Attach the lifting device to the object, using no less than 3/8 inch diameter bolts. Use large washers and fasten the lifting device firmly to the object so that the head of the bolt is tight against the lifting device.
5. Double check the fastening of the chain, cable, or rope to make sure it is secure and that it cannot slip from the object being hoisted.
6. The load must be balanced before lifting.
7. Make sure all persons and obstructions are clear before raising or lowering the object. No one is permitted under the vehicle at this time.
8. Keep all hands clear and raise the engine until the motor mounts are clear. Shake the engine from side to side to see that it is free.
9. Raise the engine slowly while watching for any binding. Do not allow the hoist control chain to drag on the vehicle, or catch on any obstructions in the engine compartment.

10. After the engine is free of the vehicle, either move the vehicle back or the hoist forward until the engine can be lowered to the floor. Do not leave the load in a high position on the hoist.
11. Use care when the hoist is moved from one point to another so that it will not strike anyone or anything as it is moved.
12. Make sure that the size of the load on any crane or hoist does not exceed its rated load. (OSHA)
13. It is important to inspect chain slings regularly and to keep a record of individual chain inspection. Before inspecting, clean the chains so that marks, nicks, wear, and other defects can be seen.
14. Each chain link should be inspected for twists or bends, nicks or gouges, excessive wear at bearing points, stretched links, distorted or damaged master links, coupling links, or attachments.  
  
Each link or attachment having any of these defects must be marked with paint to plainly indicate the rejection, and it shall be eliminated from service until properly repaired.
15. When using the chain, avoid sudden jerks in lowering or lifting.
16. Make sure the load is balanced.
17. Never overload the chain.
18. Free all twists, knots, or kinks. Don't drop the load on the chain.
19. Chains should be oiled before prolonged storage.
20. Store chains on an A-frame in a clean dry place.
21. Do not use the hoist chain for anything but lifting.

# ENGINE CRANE AND HOIST



1. HOOK
2. BOOM
3. HYDRAULIC RAM
4. SUPPORT STANDS
5. PRESSURE CONTROL LEVER



# ENGINE CRANE AND HOIST SAFETY QUIZ

NAME \_\_\_\_\_

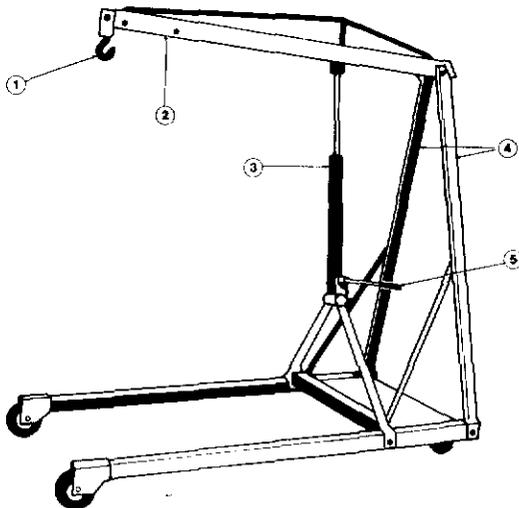
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

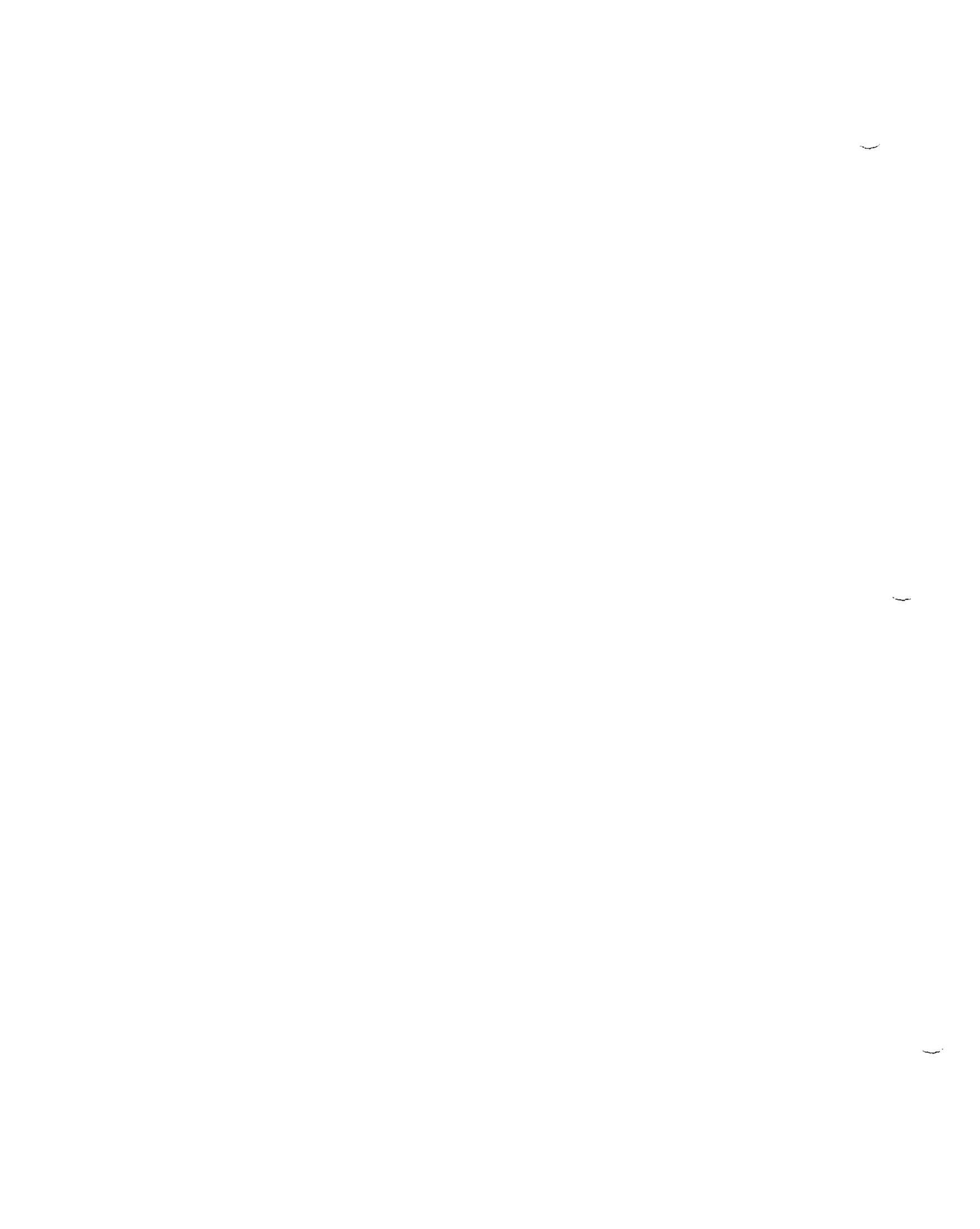
True or False:

(Circle true or false)

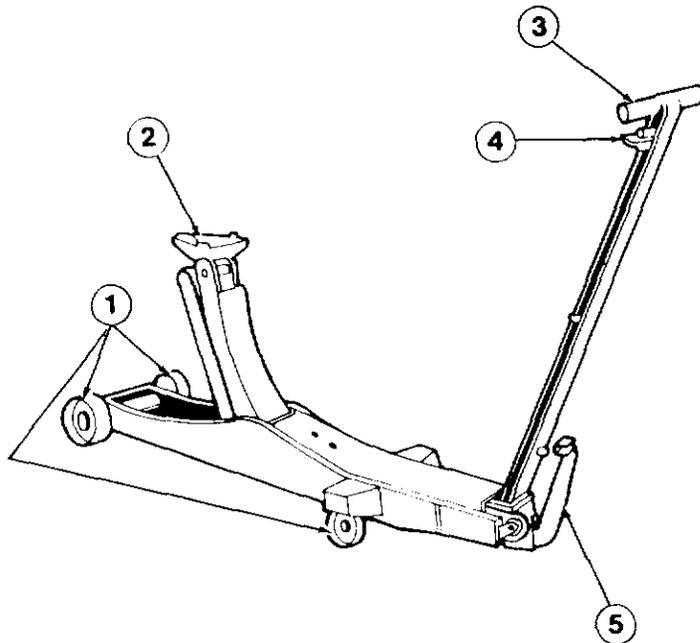
- |  |   |   |
|--|---|---|
| 1. Attach the lifting device to the object with bolts that are no less than 1/4 inch in diameter.  | T | F |
| 2. Keep all hands clear and raise the engine until the motor mounts are clear; then shake the engine from side to side to see if it is free.             | T | F |
| 3. Be sure that someone is under the vehicle to check the engine while it is being raised.   | T | F |
| 4. After the engine is free of the vehicle, move the vehicle out of the way and keep the engine at eye level so that other pupils will not walk into it. | T | F |
| 5. Place the crane or hoist slightly in front of the object to be raised so that the object will swing clear when it is lifted.                          | T | F |
| 6. Identify the parts of the engine crane and hoist.   |   |   |



1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_



## HYDRAULIC FLOOR JACK



1. CASTERS
2. SADDLE
3. HANDLE
4. CONTROL VALVE
5. RAPID RISE FOOT PUMP

1. Know exactly how to operate the lifting and lowering controls of the hydraulic jack before using it. Practice without a load on the saddle.
2. The operator must make sure that the jack used has a rating sufficient to lift and sustain the load.
3. Do not use the jack if there is any doubt about its safe operation.
4. Do not place the jack or stand under an inclined surface. Always place it under a horizontal or flat surface to avoid slipping.
5. Locate the jack saddle directly under the part to be raised. Take care that the lifting point is solid. Avoid contact with the oil pans, fuel tank, exhaust pipes, etc.
6. Do not work under any car or object that is supported by a jack alone. Always place safety stands under the frame or wheel support systems before getting under the car.
7. Do not permit anyone to work on the vehicle while it is being raised or lowered. Never raise or lower a vehicle if someone is underneath.
8. Wear eye protection.

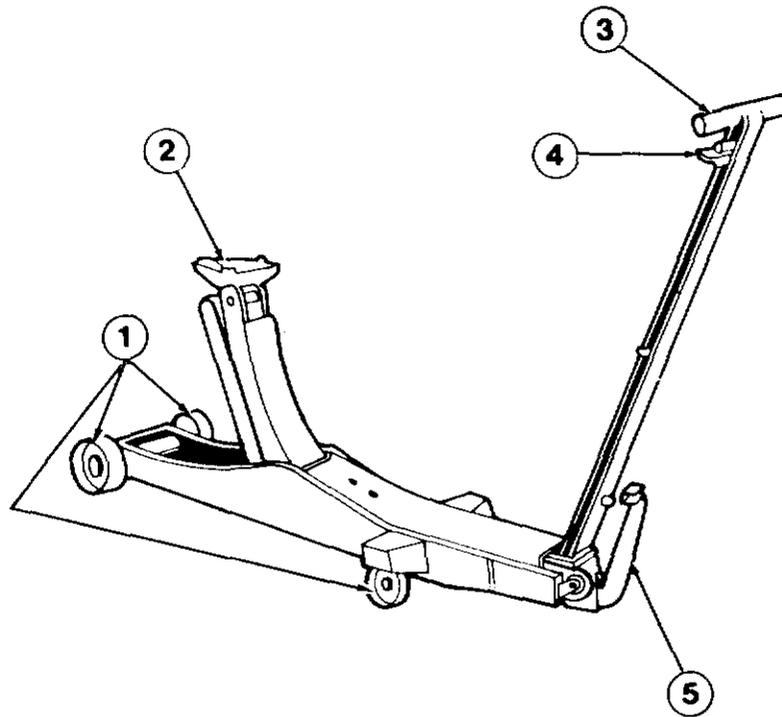
9. If the jack must be left under the vehicle, the handle should be left in the raised position or positioned under the vehicle so other pupils will not bump into it. This makes it easier to see and does not cause a tripping hazard.
10. Do not work under a raised car until the teacher's approval has been received.
11. Use only school jacks to lift the vehicles in the auto shop.
12. Operate the jack handle only while facing the load.
13. When lowering the vehicle, do so slowly, after checking to see that all tools, drop lights, creepers, etc. are clear.
14. Each jack shall be thoroughly inspected every six months.
15. Jacks which are out of order shall be tagged accordingly and not used until repairs are made.
16. Do not continue to use a jack that malfunctions. Report any unusual actions to the teacher.

### HYDRAULIC JACK MALFUNCTIONS

1. Jerks or jumps when raised.
2. Slowly settles down after being raised.
3. Slowly rises when not in use.
4. Rises slowly when in use.
5. Comes down very slowly.
6. Blows oil out of the exhaust line.
7. Leaks oil at the packing gland.

REPORT ANY OF THESE MALFUNCTIONS TO THE TEACHER AT ONCE.

# HYDRAULIC FLOOR JACK



1. CASTERS
2. SADDLE
3. HANDLE
4. CONTROL VALVE
5. RAPID RISE FOOT PUMP

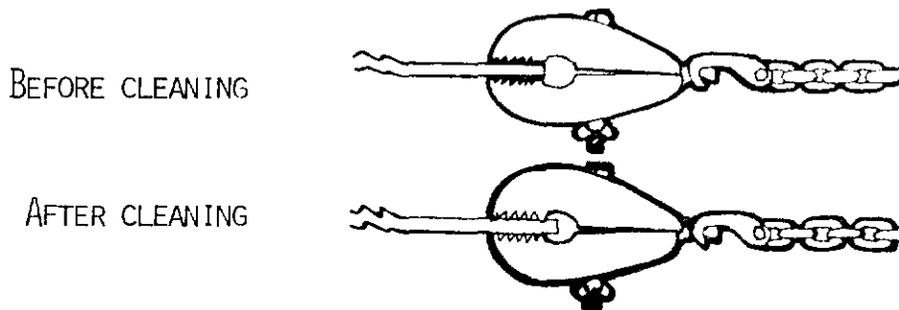


## HYDRAULIC JACKS--USE IN THE BODY SHOP

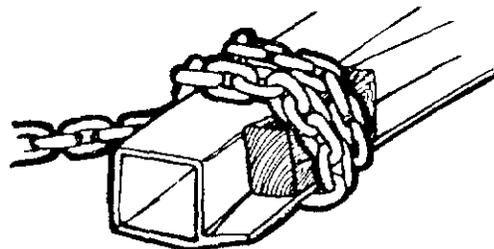
The hydraulic jack is one of the most useful tools in a body shop. But whether it is used as a frame straightener or as a simple body lift, a jack can be as dangerous as it is useful.

**PULLING**--When using the jack for pulling jobs, the clamp or chain may let go for several reasons: the clamp teeth may be unclean or worn; the clamp may have been fastened to undercoating rather than the metal itself; the clamp may not have been tightened enough; the metal may give way, especially when the operator is pulling a rusted panel; the chain or clamp may break. The following rules should be observed before starting a pulling job.

1. Clean the teeth of clamps regularly with a wire brush.



2. Inspect clamps and chains for wear before use. Replace the clamp if its teeth are worn. Replace the chain if it is nicked or otherwise damaged. All chains should be replaced at regular intervals, regardless of wear.
3. Make sure all undercoating is removed where the clamp is attached.
4. When the clamp is to be attached to a rusted panel, tack weld a metal brace to the panel for support.
5. Have the car on its wheels or bolted to mobile safety stands when pulling. This will prevent the car from falling off the stand during the pull.
6. Wrap the chain around a frame member several times. This will spread the load over as many links as possible. Make sure the chain isn't twisted.
7. If the chain links are drawn across sharp corners, provide padding for the links so that they won't break when pressure is applied.



8. Make sure the chain hook is connected to a link with a firm grip. Test it before applying hydraulic pressure.
9. Cover the chain and clamp with a heavy blanket before starting the pull. They will be less likely to fly back at the operator if a slip or break occurs.
10. Stand to either side of the jack--never behind it. Make sure all others are clear of the jack before starting the pull.
11. If possible, stand behind a strong acrylic plastic or safety glass shield during all but the lightest pulls.
12. Make sure all body attachments are screwed on tightly. Be careful not to damage the threads on the attachments.

Working on a car held up by only a hydraulic jack can lead to a serious accident. Always use the "horses" or jack stands. They will keep the car from falling on the operator if the jack is accidentally released. Check and recheck all safety devices and latches on hydraulic jacks. Don't try to bypass them.

## HYDRAULIC FLOOR JACK SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

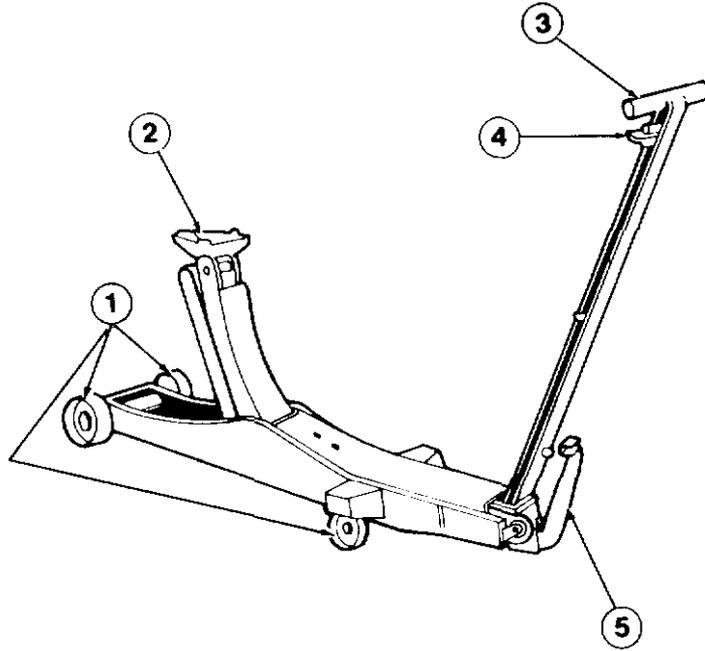
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

True or False:

(Circle true or false)

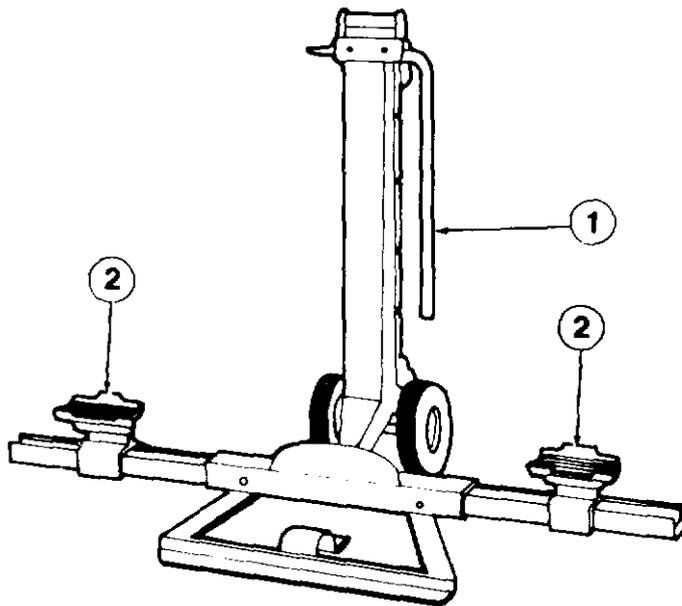
1. It is the responsibility of the school to make sure that the jack being used has sufficient rating for the load. T F
2. Do not place the jack under an inclined surface. T F
3. It is considered safe to crawl under a vehicle that is supported by the jack alone if one prepares oneself to get out of the way very quickly. T F
4. When lowering the vehicle to the floor, do it very quickly so no one can slip underneath before it is lowered. T F
5. It is permitted to use the bumper jack from the trunk of the car to raise the car if all other jacks are in use. T F
6. The engine oil pan is flat and therefore can be used as a contact point to lift the car. T F
7. You should not permit anyone to work on the car while it is being raised or lowered. T F
8. You must not use the jack if there is any doubt about its safe operation. T F
9. It is best to face away from the vehicle when raising it with the jack so that you can move away quickly. T F
10. An operator must know exactly how to operate the jack before trying to lift a vehicle. T F
11. It is permissible to use a jack that has been tagged "Out of order" if a person is careful in its use, and if the teacher is not looking. T F

12. Identify the parts of the hydraulic floor jack.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

## AUTOMOTIVE END LIFT

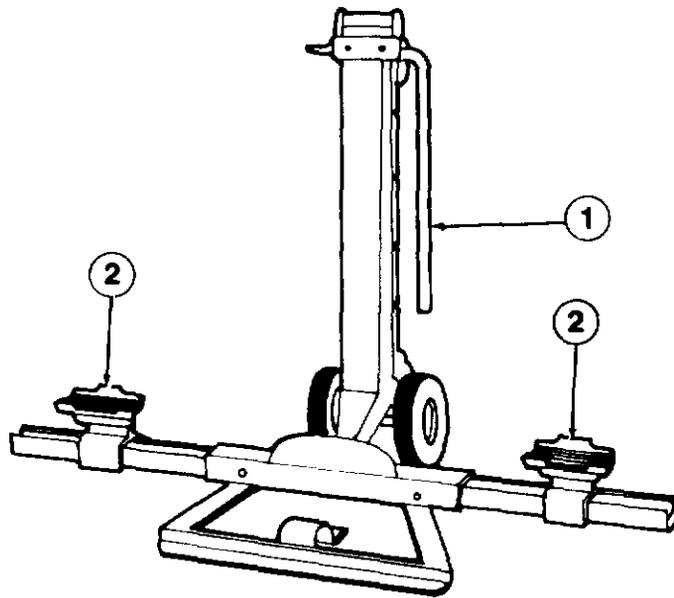


1. HANDLE
2. SADDLE

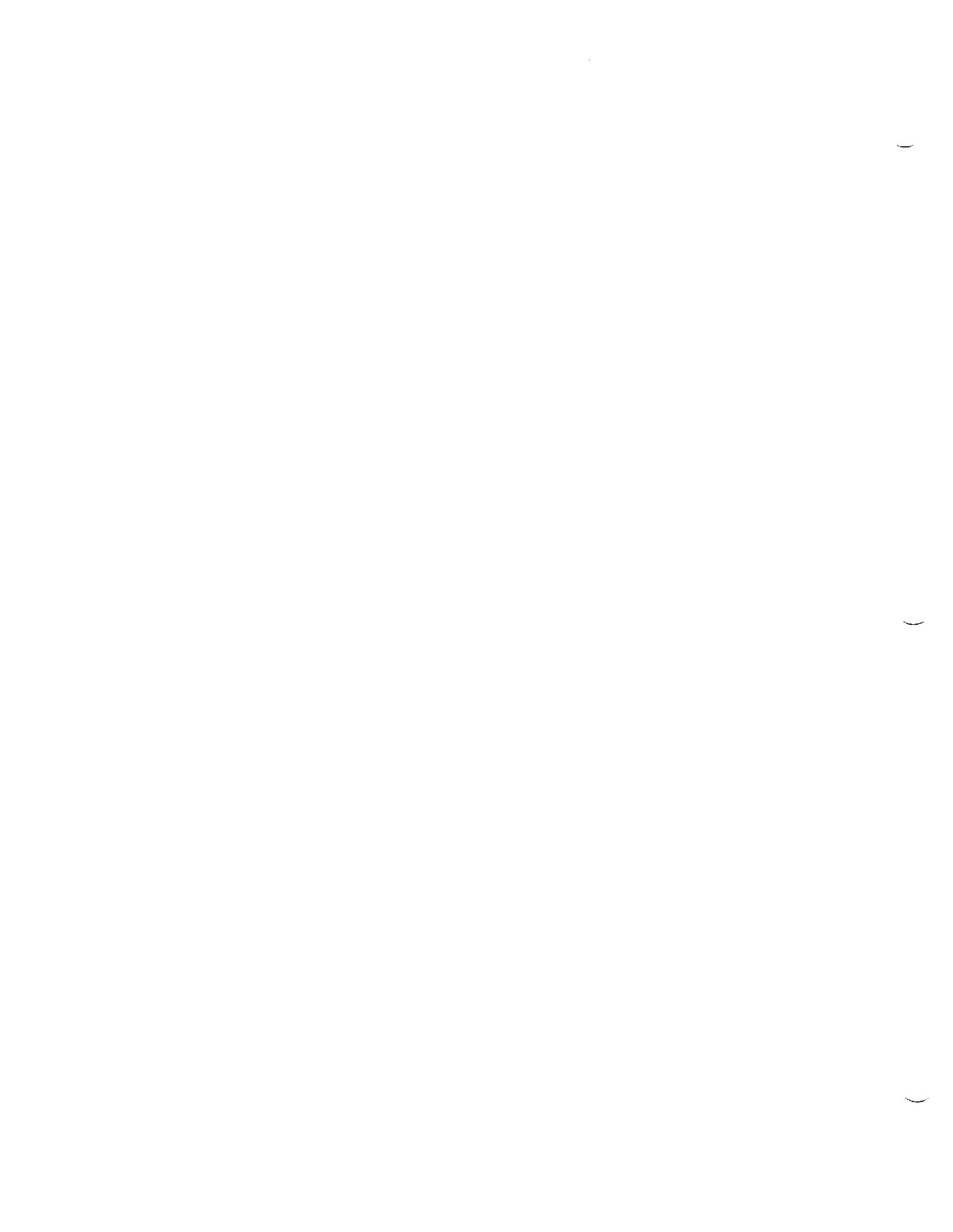
1. Know exactly how to operate the lifting and lowering controls of the end lift before using it. Check with the teacher and practice without a load on the saddles.
2. The operator must make sure that the jack which is used has a rating sufficient to lift and sustain the load.
3. Do not use the end lift if there is any doubt about its safe operation.
4. Position end lift saddles under the front or rear bumper and carefully locate the manufacturer's approved lifting points on the vehicle being lifted. CAUTION! All vehicles cannot be lifted by the bumper.
5. Slowly lift the saddles to about one inch from the lift points on the vehicle and adjust the lift so that they are in the correct location.
6. The teacher must check the position of the lift if it is the first time that this type of vehicle has been lifted by the pupil.

7. Place the transmission in neutral and release the hand brake if the front end of the vehicle is to be raised.
8. Slowly raise the end lift saddles until contact with the vehicle is made.
9. Permit no one to work on or under the vehicle while it is being raised or lowered.
10. Raise the vehicle slowly to the height desired.
11. Place safety stands under the vehicle at the frame or the suspension supports and lower it either to the stands or to the safety stop position on the end lift. Do not work under a car that is supported by the end lift alone.
12. When lowering the vehicle with the end lift, first raise it to release the safety stop and remove the safety stands.
13. Check to see that all tools, tool boards, creepers, drop lights, etc. are clear and that no one is working on or under the vehicle; then slowly lower it to the floor.
14. Replace the end lift in its proper place in the shop.

# AUTOMOTIVE END LIFT



- 1. HANDLE
- 2. SADDLE



# AUTOMOTIVE END LIFT SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

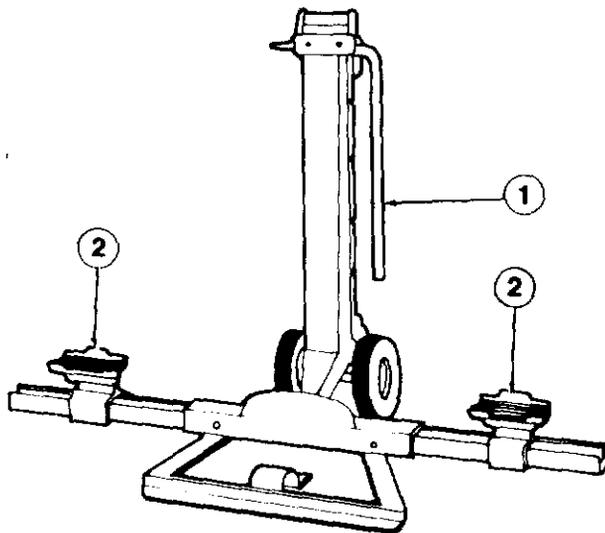
DATE \_\_\_\_\_ GRADE \_\_\_\_\_

---

True or False:

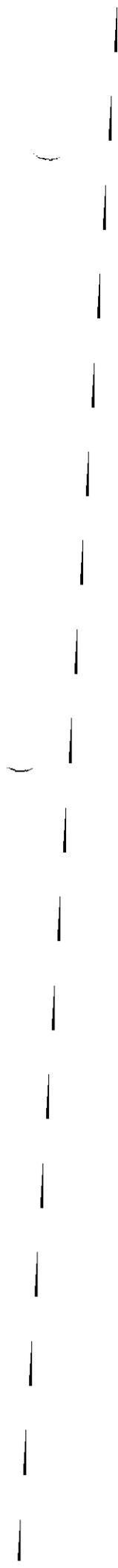
(Circle true or false)

1. All vehicles can be lifted by their bumpers.            T            F
2. Someone must be under the vehicle while it is being raised in case something starts to slip.            T            F
3. Safety stands are not needed when an end lift is used, because it has built-in safety stops.            T            F
4. You must place the transmission in neutral and release the parking brake if the front end of the vehicle is to be raised.            T            F
5. The teacher must check the position of the saddles if it is the first time that a pupil has lifted this type of vehicle.            T            F
6. The operator must check to see that the floor area under the vehicle is clear before it is lowered to the floor.            T            F
7. Identify the parts of the automotive end lift.

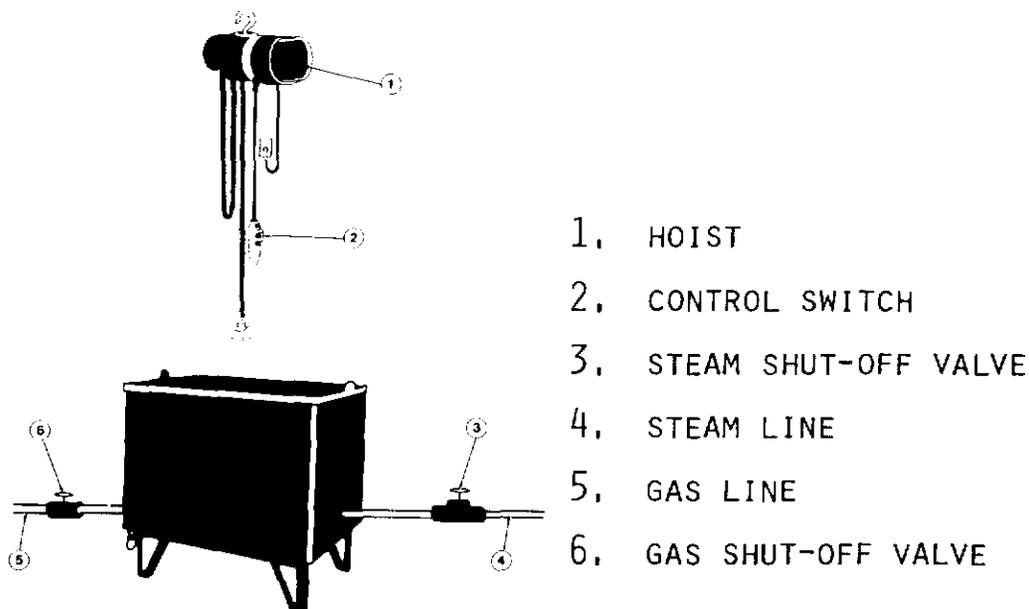


1. \_\_\_\_\_

2. \_\_\_\_\_



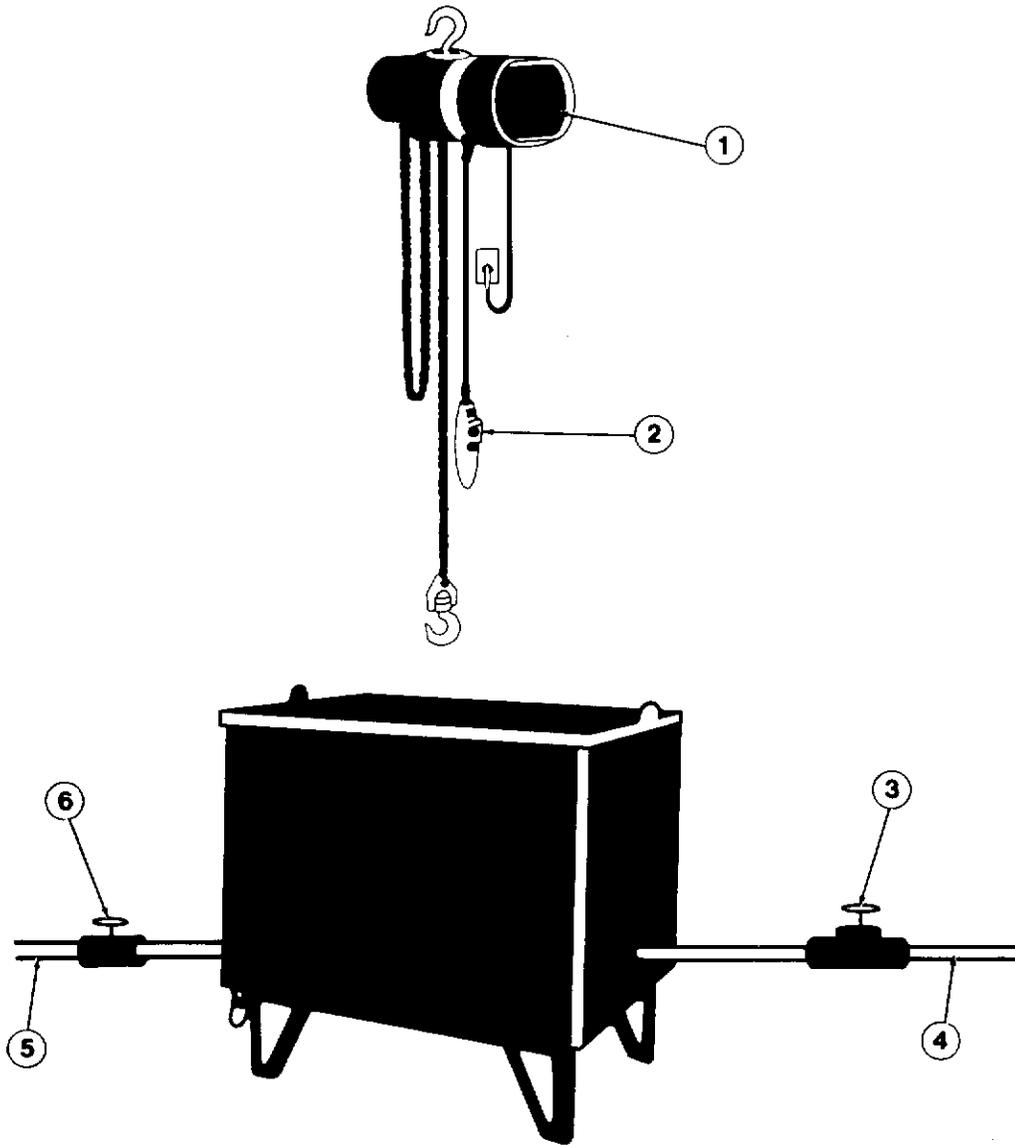
## HOT CAUSTIC TANK



1. Wear a face shield, plastic or rubber gloves, long sleeves, and foot protection.
2. Permit no one near the tank during the time that objects are being placed in it or removed from it, unless the person is wearing the proper protective clothing.
3. Obtain permission from the teacher before using the caustic tank.
4. Use a suitable lifting device to raise or lower the tank lid so that live steam is not released into your face.
5. Become familiar with the hoist operation before lifting any object with it.
6. Do not place aluminum in the caustic.
7. Wash splashes on the skin immediately, using soap and water.
8. Ask the teacher to light the gas burners. Lighting should not be done by a pupil.
9. Secure the chains with wire so that they can be located for easy hookup to the hoist when they are being removed from the tank.
10. Remove the caustic from the objects by hosing it with hot water. Take care not to splash the caustic on anyone.
11. Wash the caustic from any personal protective clothing that was used.



# HOT CAUSTIC TANK



1. HOIST
2. CONTROL SWITCH
3. STEAM SHUT-OFF VALVE
4. STEAM LINE
5. GAS LINE
6. GAS SHUT-OFF VALVE



## HOT CAUSTIC TANK SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

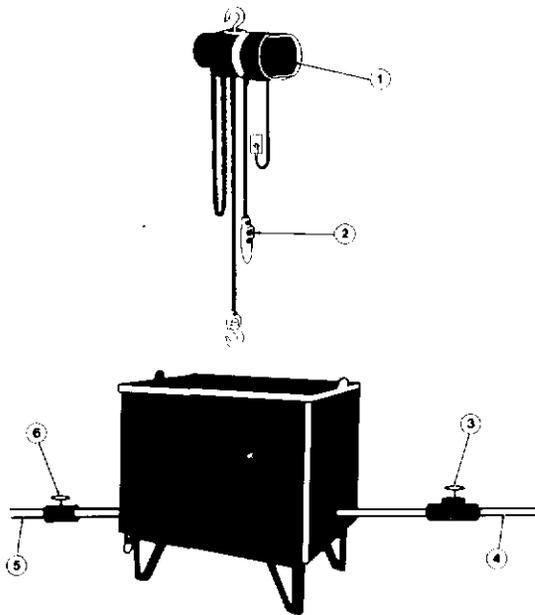
---

True or False:

(Circle true or false)

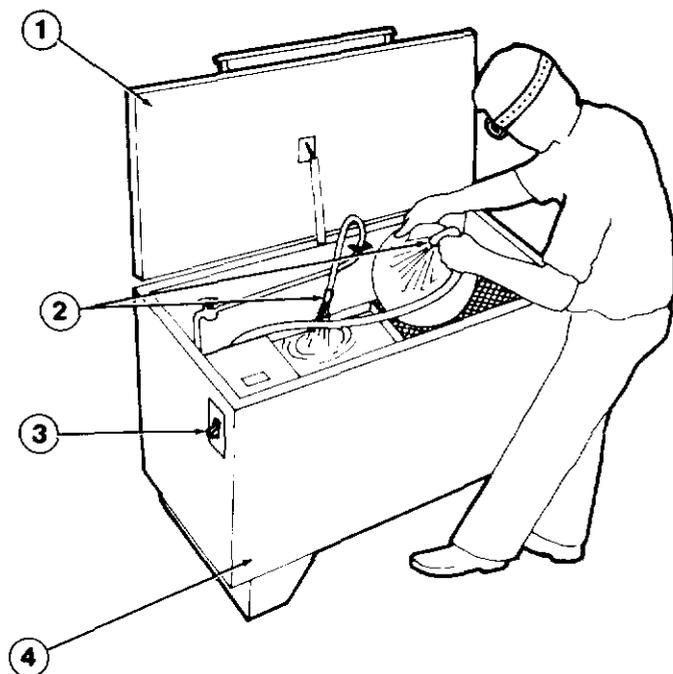
- |  |   |   |
|--|---|---|
| 1. Use solvent to wash off any splashes of caustic that get on the skin.   | T | F |
| 2. Obtain permission from the teacher before using the caustic tank.   | T | F |
| 3. Always wear proper safety apparel when using the caustic tank.  | T | F |
| 4. An observer does not need safety apparel when near the caustic tank.  | T | F |
| 5. Do not place cast iron in the caustic tank.   | T | F |
| 6. Turn on the burners under the tank when ready to use it.  | T | F |
| 7. Lift the tank lid while standing directly in front of it.   | T | F |
| 8. Secure the lifting chains with wire so that they can be located for easy hookup to the hoist when they are being removed from the tank. | T | F |
| 9. Hose off caustic from the objects with hot water.   | T | F |
| 10. Learn how to use the tank hoist before trying to lift heavy objects.   | T | F |
| 11. Do not place aluminum objects in the caustic tank.   | T | F |

12. Identify the parts of the hot caustic tank.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_

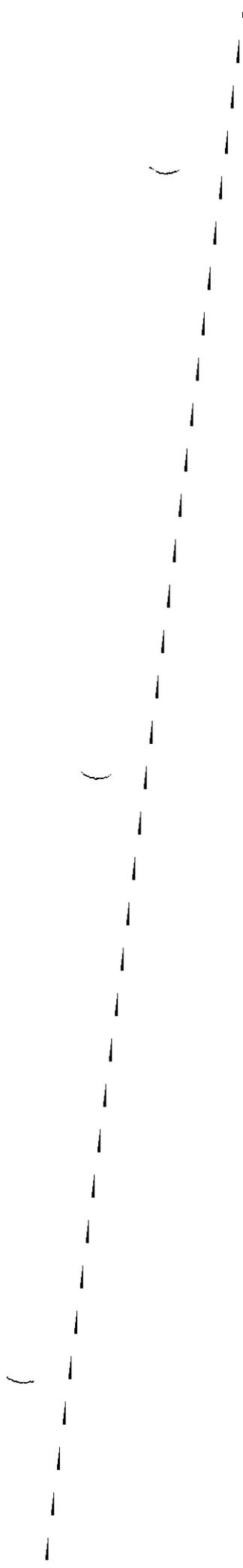
## SOLVENT TANK



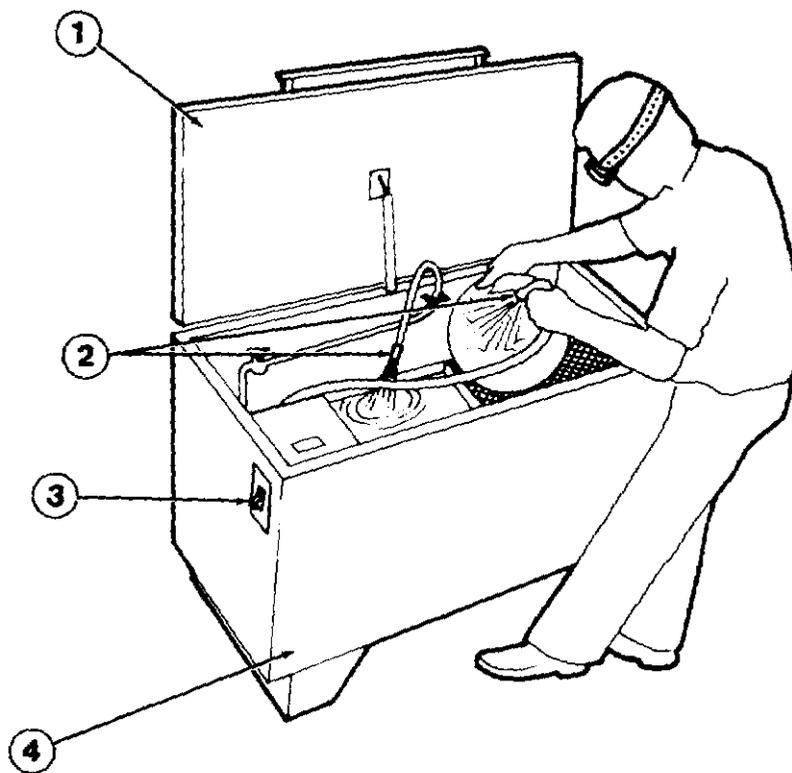
1. LID
2. NOZZLES
3. ON/OFF SWITCH
4. TANK

1. Wear eye protection at all times.
2. Solvent will remove all natural oils from the skin. Hands shall be washed with soap and water and thoroughly dried as soon as possible after contamination. Persons with sensitive skin need to wear rubber or plastic gloves.
3. Be sure that the fluid nozzle is directed downward toward the reservoir before turning on the pump switch.
4. Solvent becomes very slippery when splashed on the floor. This is especially true if water is also present. Wipe up all spills immediately.
5. Solvent will burn. Permit no sparks, open flames, or very hot metals near it.
6. Upon completion of the use of the solvent tank, turn off the pump switch.

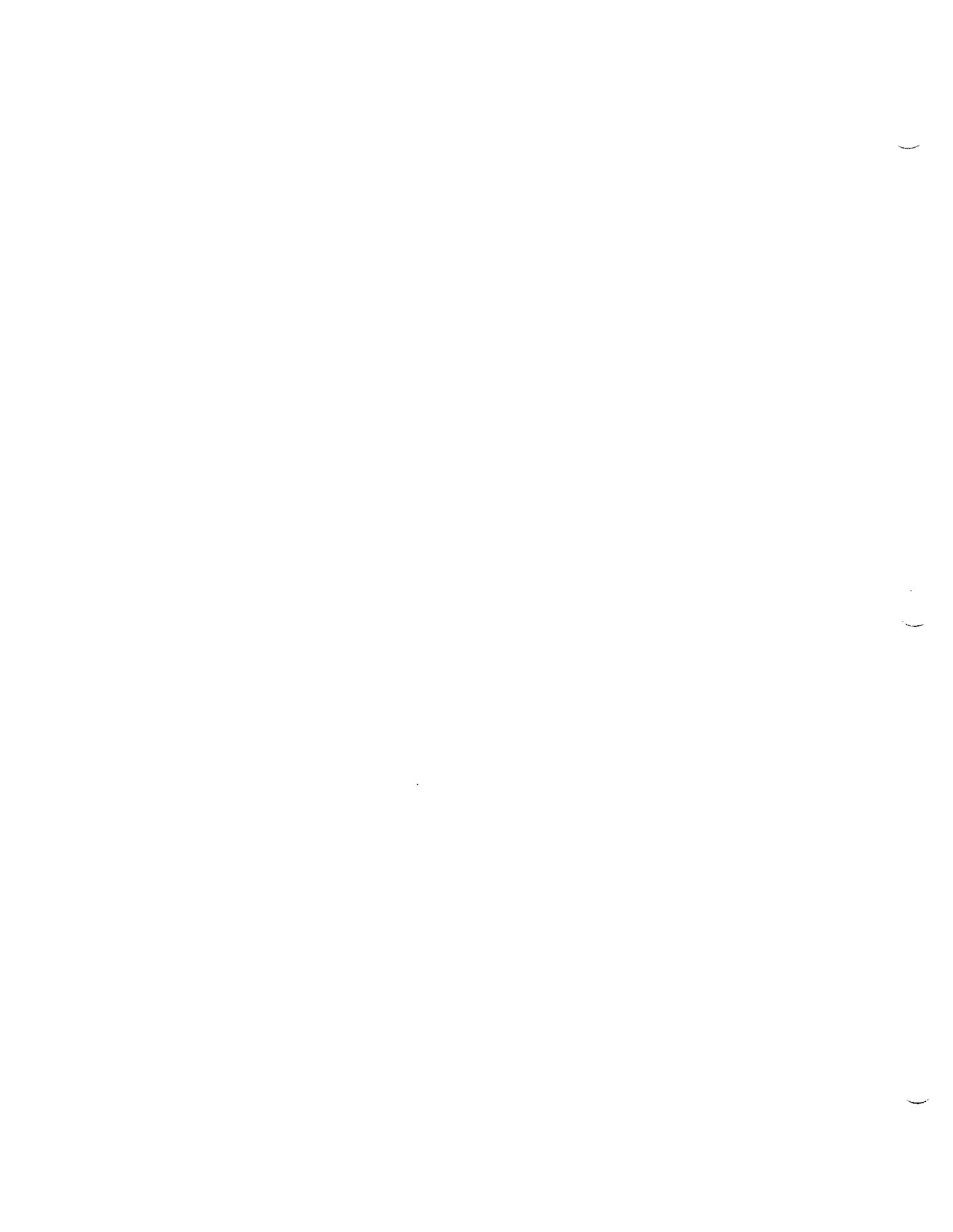
-



# SOLVENT TANK



1. LID
2. NOZZLES
3. ON/OFF SWITCH
4. TANK



# SOLVENT TANK SAFETY QUIZ

NAME \_\_\_\_\_

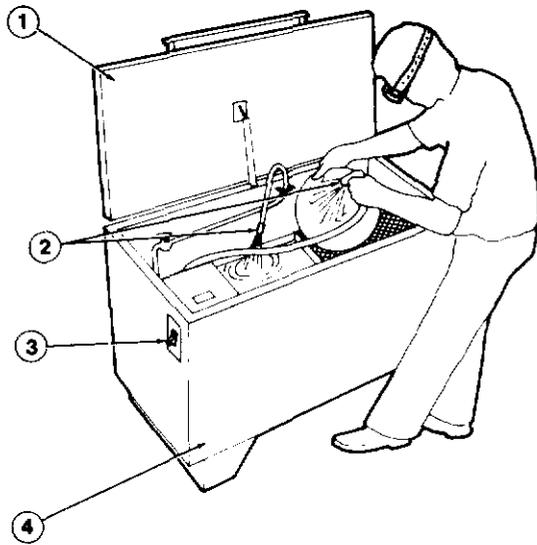
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

True or False:

(Circle true or false)

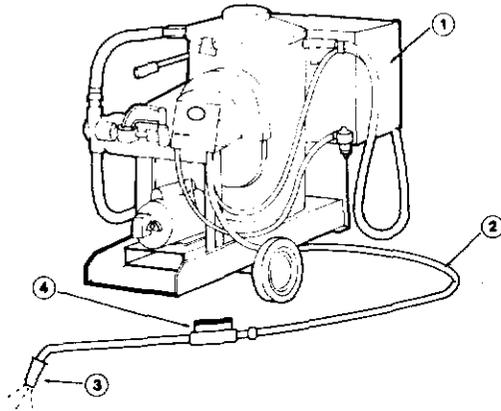
- |  |   |   |
|--|---|---|
| 1. Solvent is safe and will not burn.  | T | F |
| 2. Wipe up spills immediately because solvent makes floors slippery.               | T | F |
| 3. Solvent is a good skin conditioner.   | T | F |
| 4. Wear eye protection at all times.   | T | F |
| 5. The fluid nozzle should be directed upward before the pump switch is turned on. | T | F |
| 6. Identify the parts of the solvent tank.   |   |   |



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_

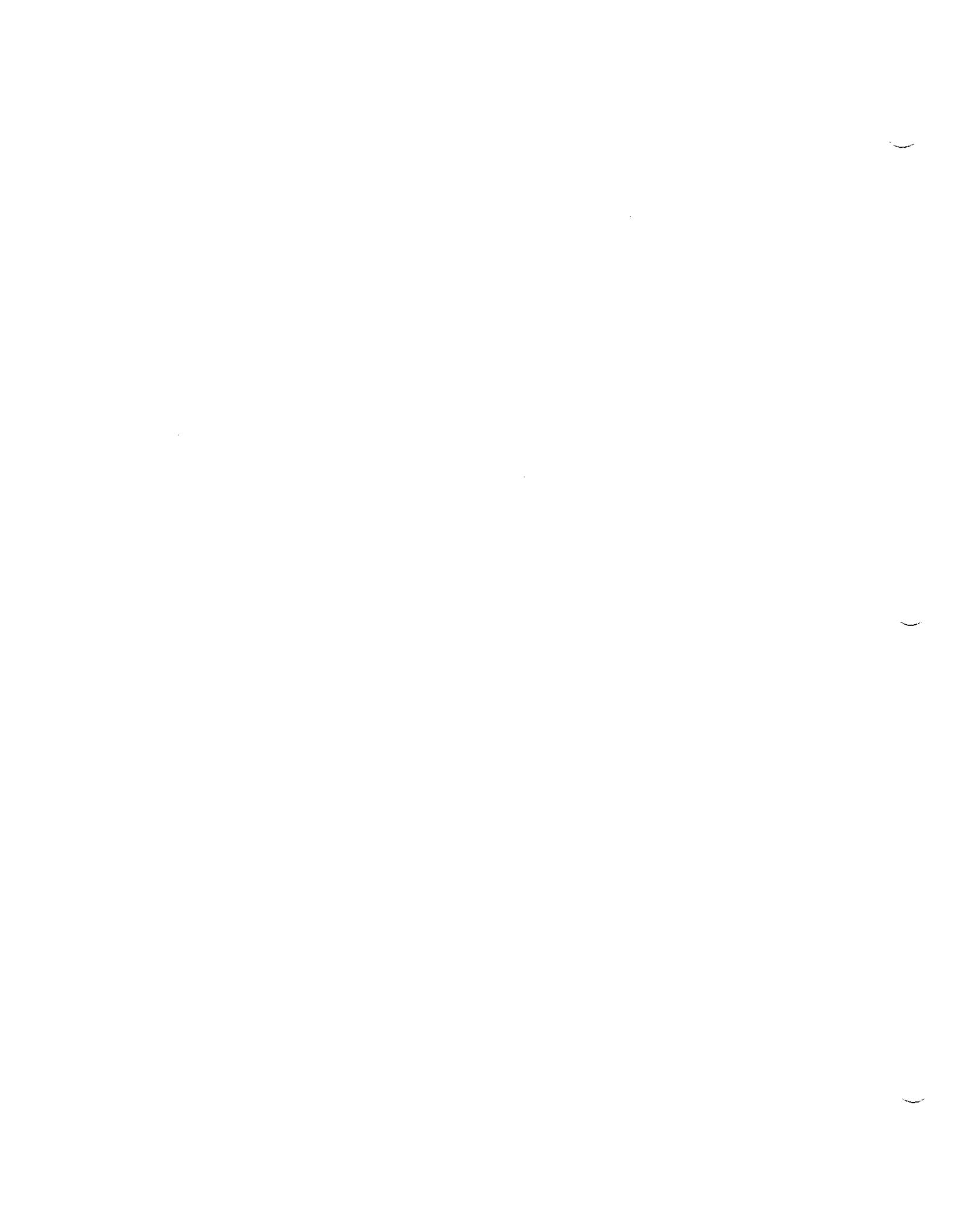


## STEAM CLEANER

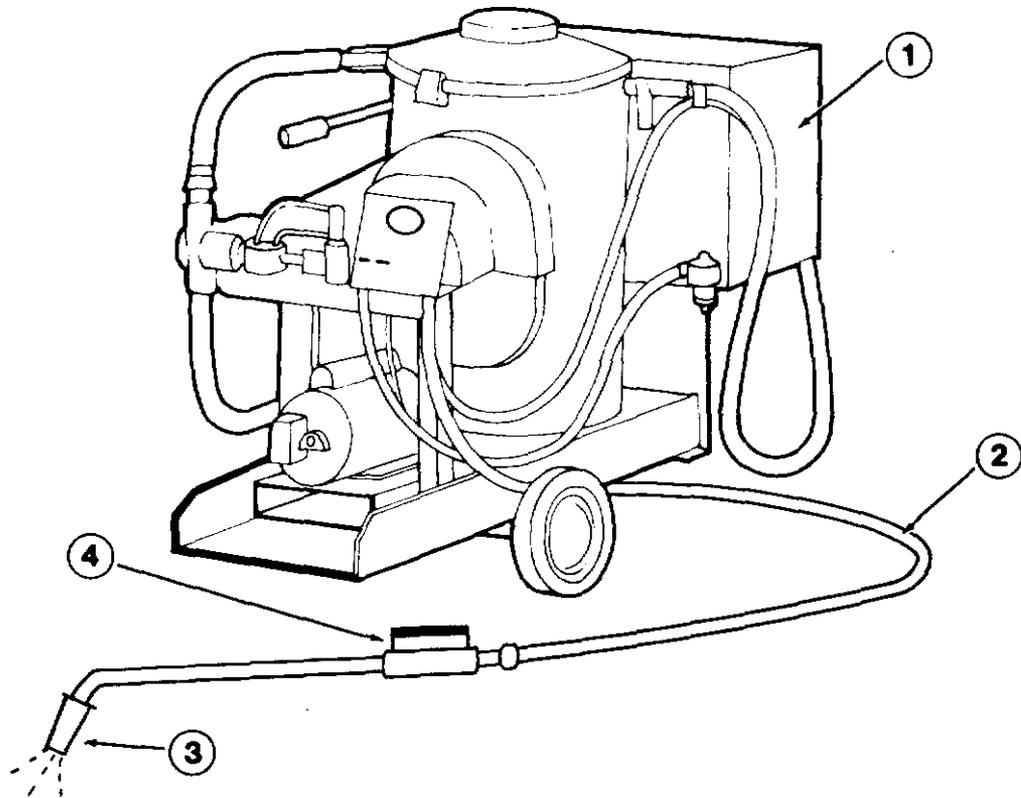


1. SOAP SOLUTION TANK
2. STEAM HOSE
3. NOZZLE
4. HANDLE

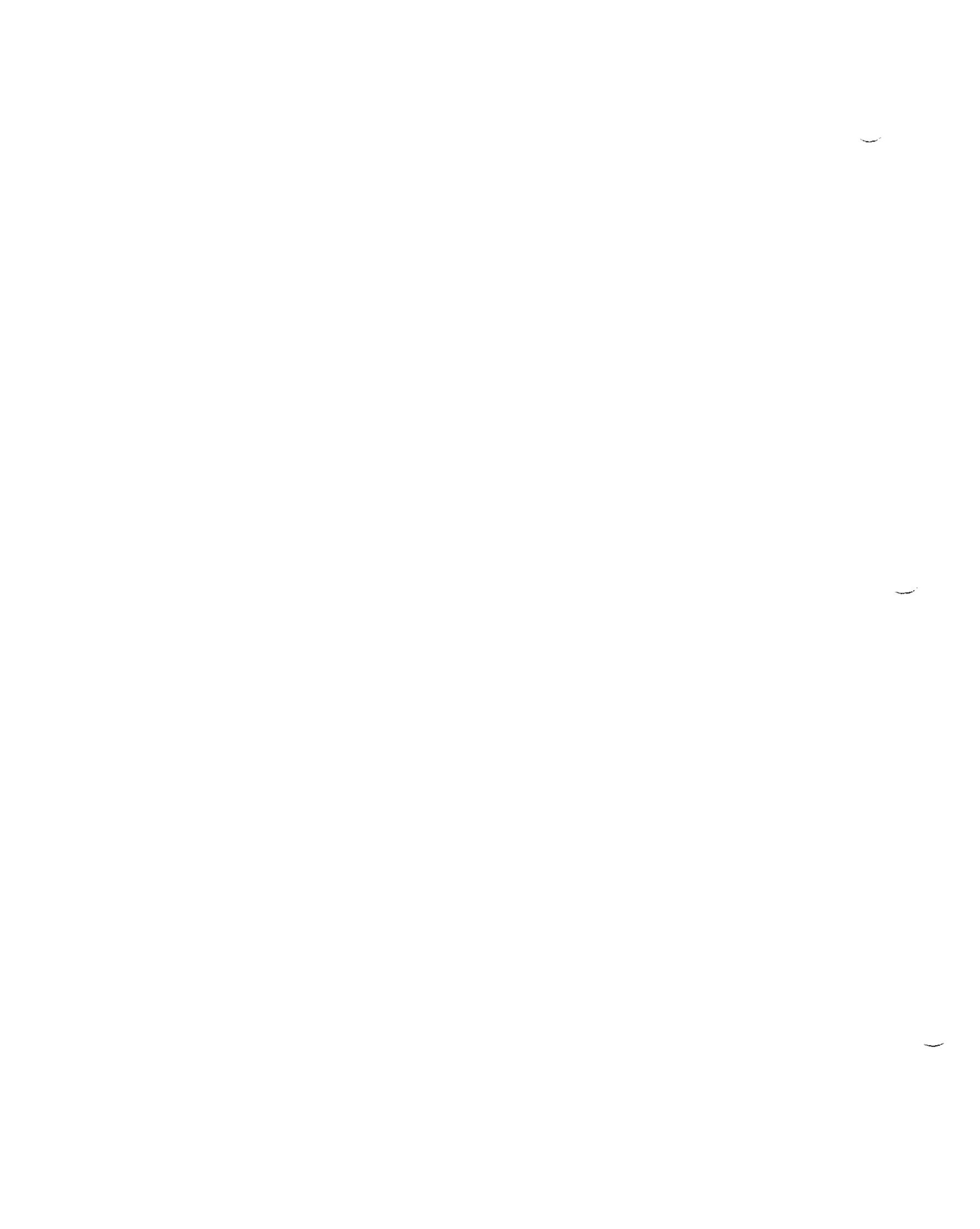
1. Obtain permission from the teacher before using the steam cleaner.
2. Wear protective clothing. Face shield, gloves, rubber footwear, and a rubber apron shall be worn when handling the steam cleaning soap or the steam nozzle.
3. Work in a well-ventilated area.
4. Add soap according to the manufacturer's instructions.
5. Turn the water valve on fully.
6. When water is flowing from the steam nozzle, turn on the burner control and adjust it to the limit set by the manufacturer. Check with the teacher if unsure of this setting. Do not overheat the boiler tubes.
7. Permit no one else in the steam room while using the steam cleaner, unless the person is wearing protective clothing.
8. When steam is coming from the nozzle, open the soap valve and direct the steam to the object being cleaned. Do not lay the nozzle down unless a special place to do so has been designated by the teacher.
9. Shut down the steam cleaner if any unusual noise is heard from the unit, or if steam pressure seems to rise rapidly. Report this to the teacher.
10. Shut down the steam cleaner by turning off the gas burner control. Wait for the steam from the nozzle to turn to water, then turn off the water valve. Be sure that the soap valve is off.
11. Place the hose and nozzle in the proper location, then hose down the floor and dry it with a squeegee.
12. Clean the protective clothing with solvent and/or soap and water and put all articles in their proper places.



# STEAM CLEANER



1. SOAP SOLUTION TANK
2. STEAM HOSE
3. NOZZLE
4. HANDLE



# STEAM CLEANER SAFETY QUIZ

NAME \_\_\_\_\_

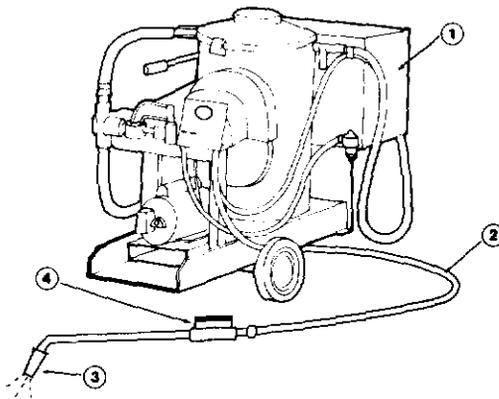
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

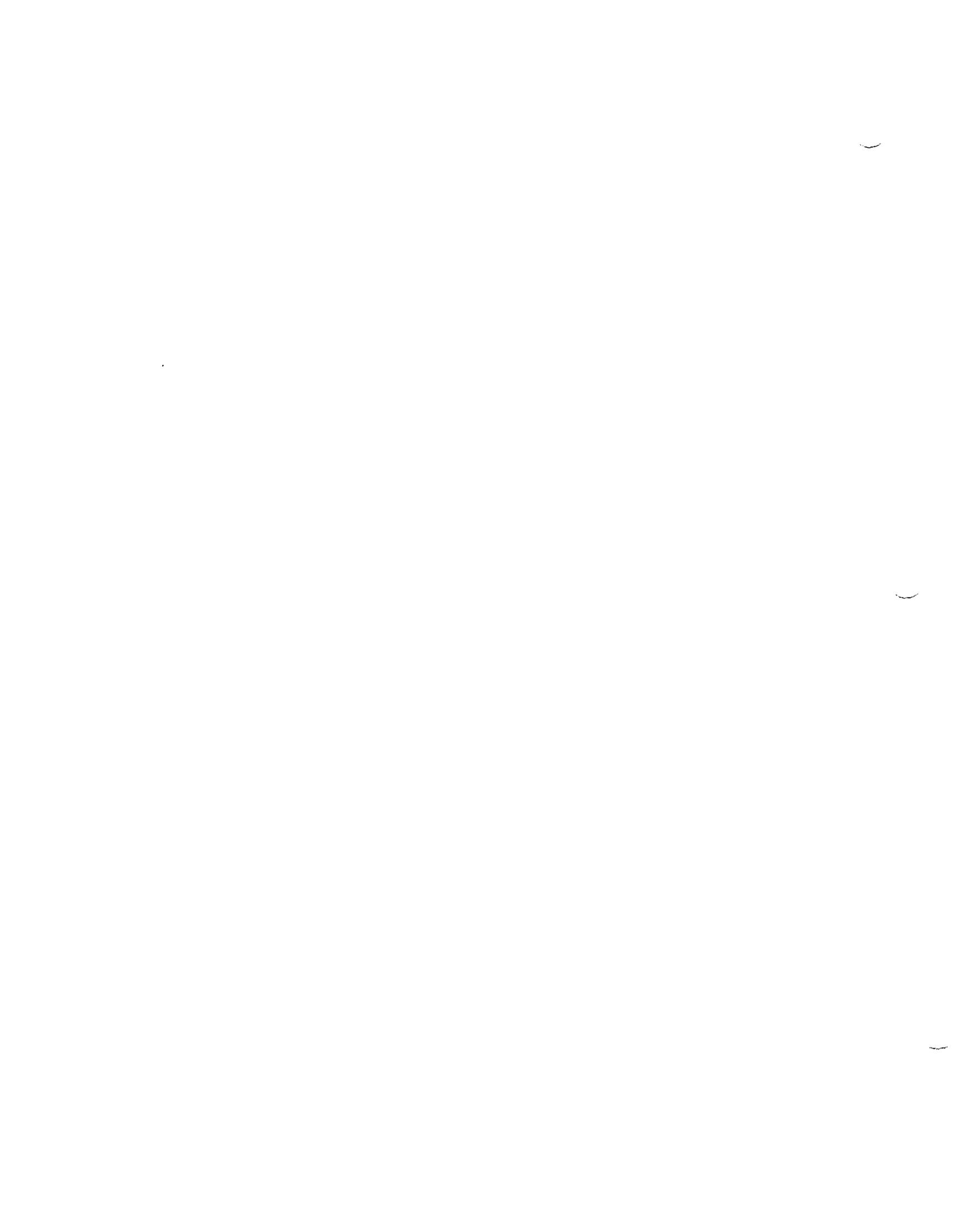
True or False:

(Circle true or false)

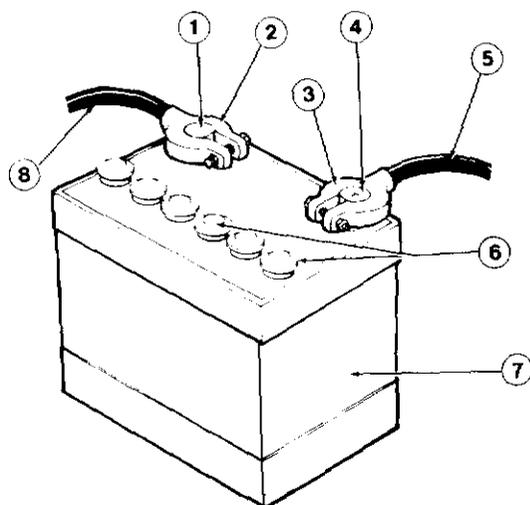
- |   |   |   |
|---|---|---|
| 1. The water valve shall be turned on fully before turning on the burners.  | T | F |
| 2. The gas burner control must be turned on fully.  | T | F |
| 3. Protective clothing must be worn while steam cleaning.   | T | F |
| 4. The operator should never lay the steam nozzle down while steam is coming from it unless a special place has been designated by the teacher. | T | F |
| 5. If any unusual noise comes from the steam cleaner, it can be ignored because safety valves will protect the user.                            | T | F |
| 6. When turning off the steam cleaner, you should first turn off the water valve.   | T | F |
| 7. Permission must be obtained from the teacher before using the steam cleaner.   | T | F |
| 8. Identify the parts of the steam cleaner.   |   |   |



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_



## STORAGE BATTERY



1. NEGATIVE TERMINAL POST
2. NEGATIVE CLAMP
3. POSITIVE CLAMP
4. POSITIVE TERMINAL POST
5. POSITIVE CABLE
6. VENT CAPS OR CELL COVERS
7. BATTERY CASING
8. NEGATIVE CABLE

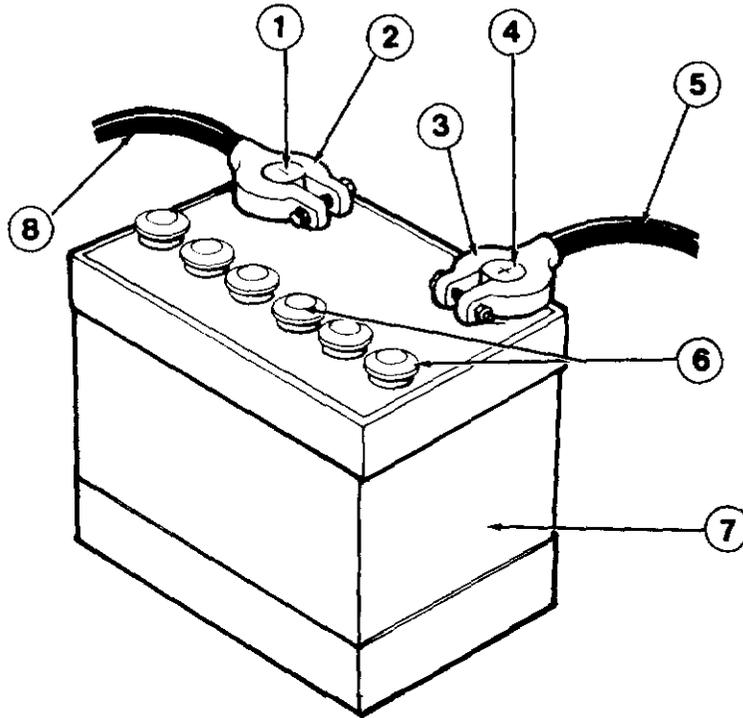
The automotive storage battery is one of the most potentially dangerous objects in the automotive shop. It is filled with corrosive acid and the gases that are given off from it are extremely explosive and poisonous. Great care must be observed in handling the battery. Most accidents occur when batteries are jumped or charged.

1. Obtain permission from the teacher before servicing or charging a storage battery.
2. EYE PROTECTION MUST BE OBSERVED. Face, hand, and clothing protection shall be used.
3. Always use the proper instruments for testing a battery. Do not short across the battery terminals. The resulting spark could cause an explosion.
4. Avoid overfilling a battery, especially if it is soon to be charged.
5. Handle battery and acid with care. Immediately wash any part of your body or clothing that comes into contact with acid. Transport a battery properly by using a battery carrier. If the cell covers have been removed, replace them before moving the battery.
6. An acid spill can be neutralized with a weak ammonia solution or with a bicarbonate of soda solution, or one can dilute the spill by using large quantities of water, applied immediately. Avoid spilling or dripping electrolyte when using a hydrometer.
7. Deluge showers and eye baths should be provided adjacent to the battery charging area. If acid gets in the eyes, flush them out immediately with a large amount of water and notify the teacher.

## STORAGE BATTERY (CONT.)

8. Batteries should be stored and charged only in well-ventilated areas. Do not breathe fumes from the battery.
9. All sources of ignition should be remote from the battery charging or storage area. There must be no smoking, no lighted matches or lighters, and no sparking from tools.
10. Do not work on batteries while they are being charged or discharged.
11. Metal jewelry such as rings, bracelets, or necklaces shall not be worn around batteries.
12. A battery charger shall be connected or disconnected only when the charger is turned off and unplugged, and the vent caps are in place.
13. Remove and replace battery clamps in the correct order:
  - A. Battery removal--disconnect the grounded clamp first.
  - B. Battery installation--connect the grounded battery clamp last.
14. Disconnect the ground cable while working on any rotating parts of the vehicle.
15. Never stand with your face directly over a battery being charged. The fumes are deadly, and an explosion could spray acid into your face.
16. Do not jump a frozen battery.

## STORAGE BATTERY



1. NEGATIVE TERMINAL POST
2. NEGATIVE CLAMP
3. POSITIVE CLAMP
4. POSITIVE TERMINAL POST
5. POSITIVE CABLE
6. VENT CAPS OR CELL COVERS
7. BATTERY CASING
8. NEGATIVE CABLE



## STORAGE BATTERY SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

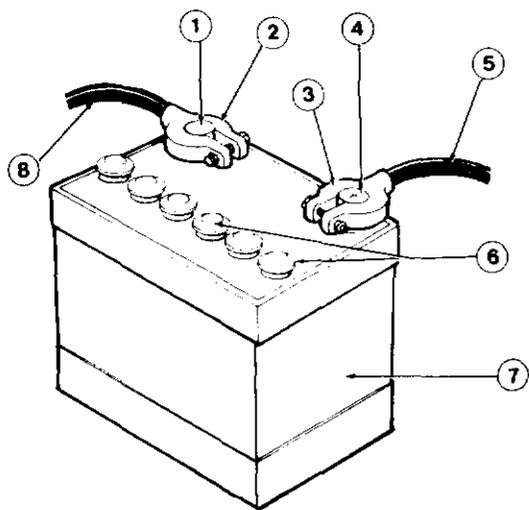
---

True or False:

(Circle true or false)

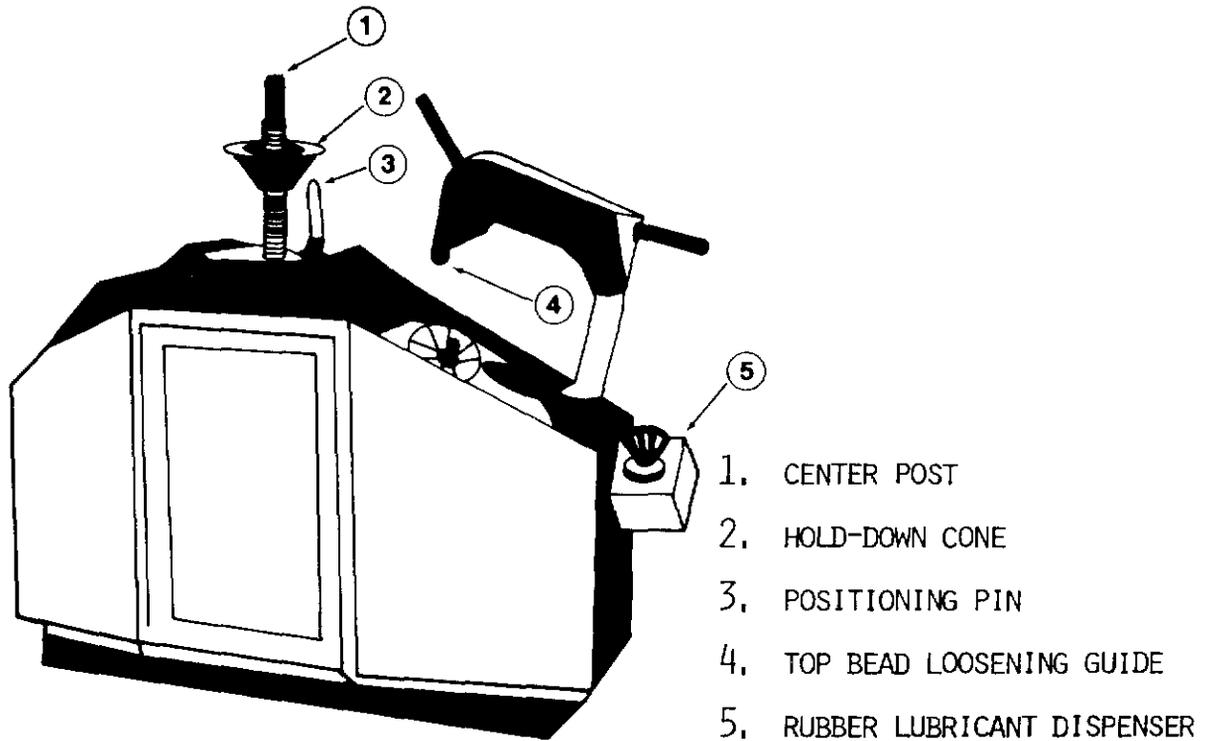
- |   |   |   |
|---|---|---|
| 1. You should never stand with your face directly over a battery being charged.   | T | F |
| 2. It is all right to work on batteries while they are being charged or discharged.   | T | F |
| 3. You should place extra water in the battery during charging to compensate for the loss of water due to heat.             | T | F |
| 4. Acid spills can be neutralized by solvent.   | T | F |
| 5. Eye protection must be observed when working with a battery.   | T | F |
| 6. Batteries shall be charged in a sealed area to keep deadly fumes from escaping.  | T | F |
| 7. When removing the battery from a vehicle, the ground cable shall be disconnected last.                                   | T | F |
| 8. A person must test a battery by shorting a pair of pliers across the terminals.  | T | F |
| 9. You must disconnect the ground cable while working on any rotating part of the drive line, such as the universal joints. | T | F |
| 10. When attaching a battery to the vehicle, you must fasten the ground cable last.   | T | F |
| 11. If acid is splashed in the eyes, you should flush them out with plenty of water and notify the teacher.                 | T | F |
| 12. The vent caps should be removed while transporting a battery.   | T | F |

13. Identify the parts of the storage battery.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_

## AUTO TIRE CHANGER



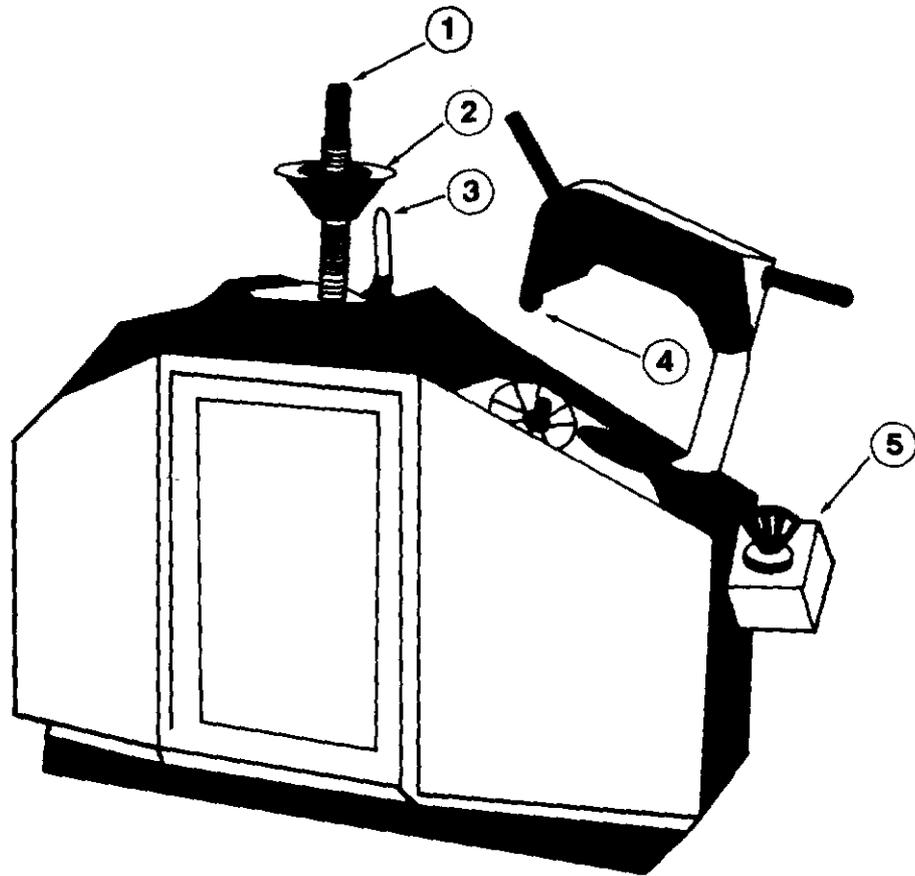
1. Removing and replacing tires on rims can be dangerous. Do not attempt this job unless thoroughly instructed on the use of the equipment. Always get the teacher's permission before using it.
2. Wear eye protection.
3. Each manufacturer of tire changing equipment has step-by-step procedures to follow for that particular piece of equipment. Follow these steps. Do not take chances with shortcuts.
4. Use only the approved tools needed for the job.
5. Do not be careless.
6. If the tire does not seem to fit the rim, do not force it. Notify the teacher that there is a problem.
7. Inspect the rims for cracks and other damage.
8. Do not attempt to weld on an inflated tire-rim assembly.
9. Magnesium rims are brittle. Handle them with care and keep fire away from this type of rim.

10. Always exhaust all the air from the tire before attempting to demount it.
11. Never let go of a tire iron when prying. The iron may spring back with terrific force.
12. Do not try to remove large sections of the tire from the rim with each bite.
13. Stay well balanced. Do not lean over the wheel or rim assembly.
14. Keep the floor area clear of debris. Sand, gravel, or mud can cause one to slip.
15. Use a rubber lubricant to aid the removal and replacement of the tire on the rim.
16. Keep hands clear of any power-assisted tools.

### INFLATION OF TIRES

1. When inflating tires, use an extension hose with a clip-on chuck.
2. Keep the hands and face clear of the expanding bead.
3. Never place the fingers between the tire bead and the rim.
4. The tire bead will snap into place with a loud "pop." Be prepared for it.
5. Do not inflate a tire that has been run flat. Remove it and inspect the rim and tire for internal damage.
6. If the tire bead does not seat in at 35 psi., deflate the tire, reposition it slightly on the rim, lubricate the bead, and reinflate.

# AUTO TIRE CHANGER



- 1 CENTER POST
- 2 HOLD-DOWN CONE
- 3 POSITIONING PIN
- 4 TOP BEAD LOOSENING GUIDE
- 5 RUBBER LUBRICANT DISPENSER



## AUTO TIRE CHANGER SAFETY QUIZ

NAME \_\_\_\_\_

CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

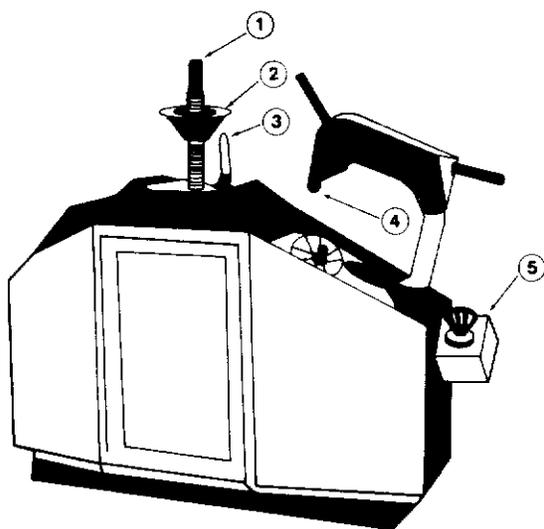
---

True or False:

(Circle true or false)

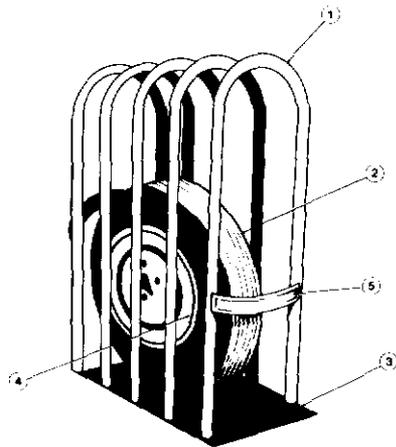
- |   |   |   |
|---|---|---|
| 1. To improve speed in mounting tires, skip some of the procedures recommended by the manufacturer.   | T | F |
| 2. If the tire does not seem to fit the rim, you should apply more rubber lubricant and force it on.  | T | F |
| 3. It is permitted to weld on an inflated tire-rim assembly.  | T | F |
| 4. Fire is good for magnesium rims.   | T | F |
| 5. It is better to remove as large a section of the bead from the rim as can be done at one time.   | T | F |
| 6. You should never let go of a tire iron when prying the bead from the rim.  | T | F |
| 7. Some of the air must be retained in the tire when demounting it in order to protect the bead.  | T | F |
| 8. Motor oil can be used as a lubricant when mounting tires.  | T | F |
| 9. You should never place your fingers between the rim and the bead when inflating the tire.  | T | F |
| 10. If the bead snaps into place on the rim with a loud "pop" while it is being inflated, something is wrong, and the tire should be demounted. | T | F |

11. Identify the parts of an auto tire changer.



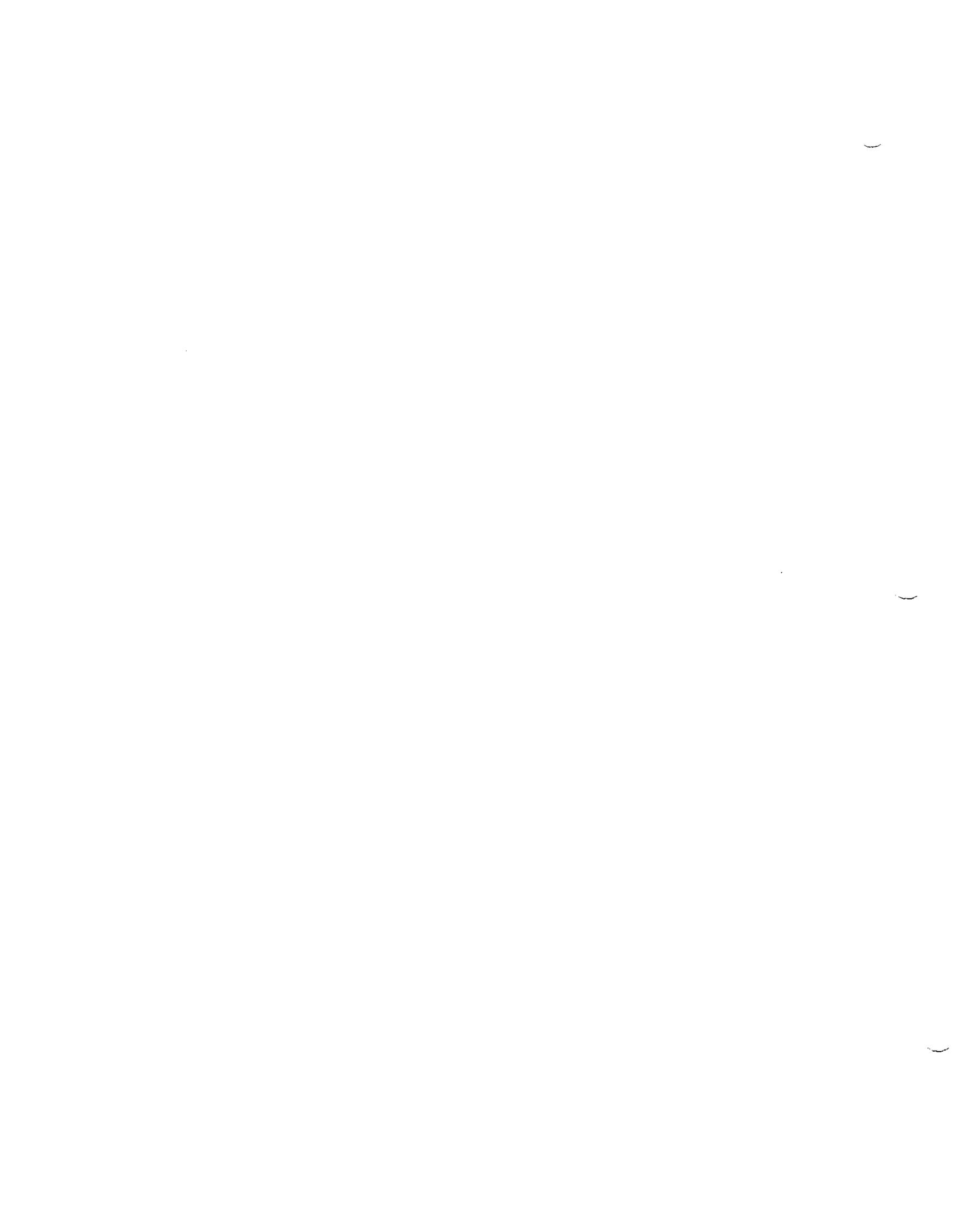
- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

## TRUCK TIRE INFLATION CAGE

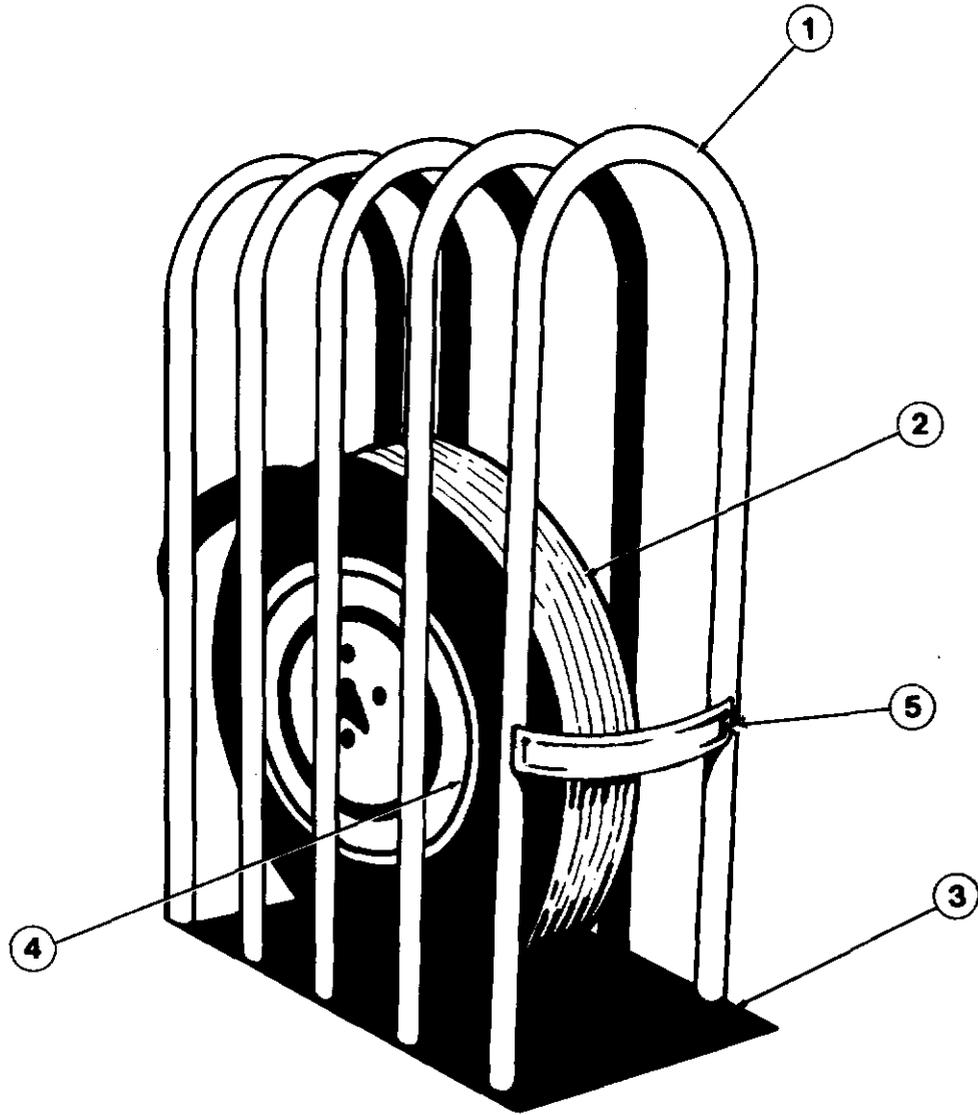


1. CAGE
2. TIRE
3. BASE
4. SPLIT RIM
5. SIDE GUARD

1. Follow safety rules number 1 through 16 in the Auto Tire Changer Unit.
2. **IMPORTANT:** Many truck and tractor tires have split rims. Changing these tires is hazardous for inexperienced persons, especially if proper equipment is not available. If a tire explodes, a lock ring blows off, or a hydraulic bead breaker slips, a person could be struck with instant killing force. Always get the teacher's permission to use the truck tire changer.
3. Get help when handling large tractor tires. They are so heavy that they can tip and fall easily, injuring the back or crushing the legs.
4. Always exhaust all the air from a single tire and from both tires of a dual assembly prior to removing any rim or wheel components, such as nuts and rim clamps. Check the valve stem by running a piece of wire through the stem to make sure it is not plugged.
5. Use caution when removing side ring, flange, or lock ring. Support them on the thigh and roll them slowly to the ground.
6. Do not reinflate a tire that has been run flat without first inspecting the tire, rim, and wheel assembly. Double check the side and lock rings for damage and make sure that they are secure in the gutter before inflation.
7. A safety tire rack, cage, or equivalent protection shall be provided and used when inflating, mounting, or demounting tires installed on split rims, or rims equipped with locking rings or similar devices.



# TRUCK TIRE INFLATION CAGE



1. CAGE
2. TIRE
3. BASE
4. SPLIT RIM
5. SIDE GUARD



# TRUCK TIRE INFLATION CAGE SAFETY QUIZ

NAME \_\_\_\_\_

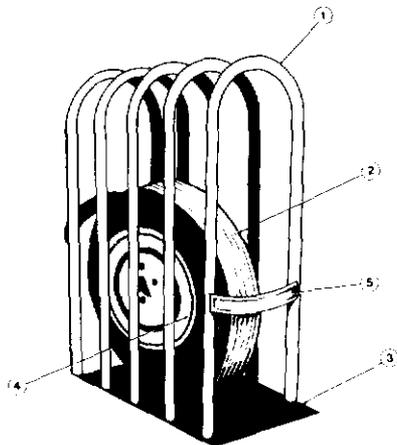
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

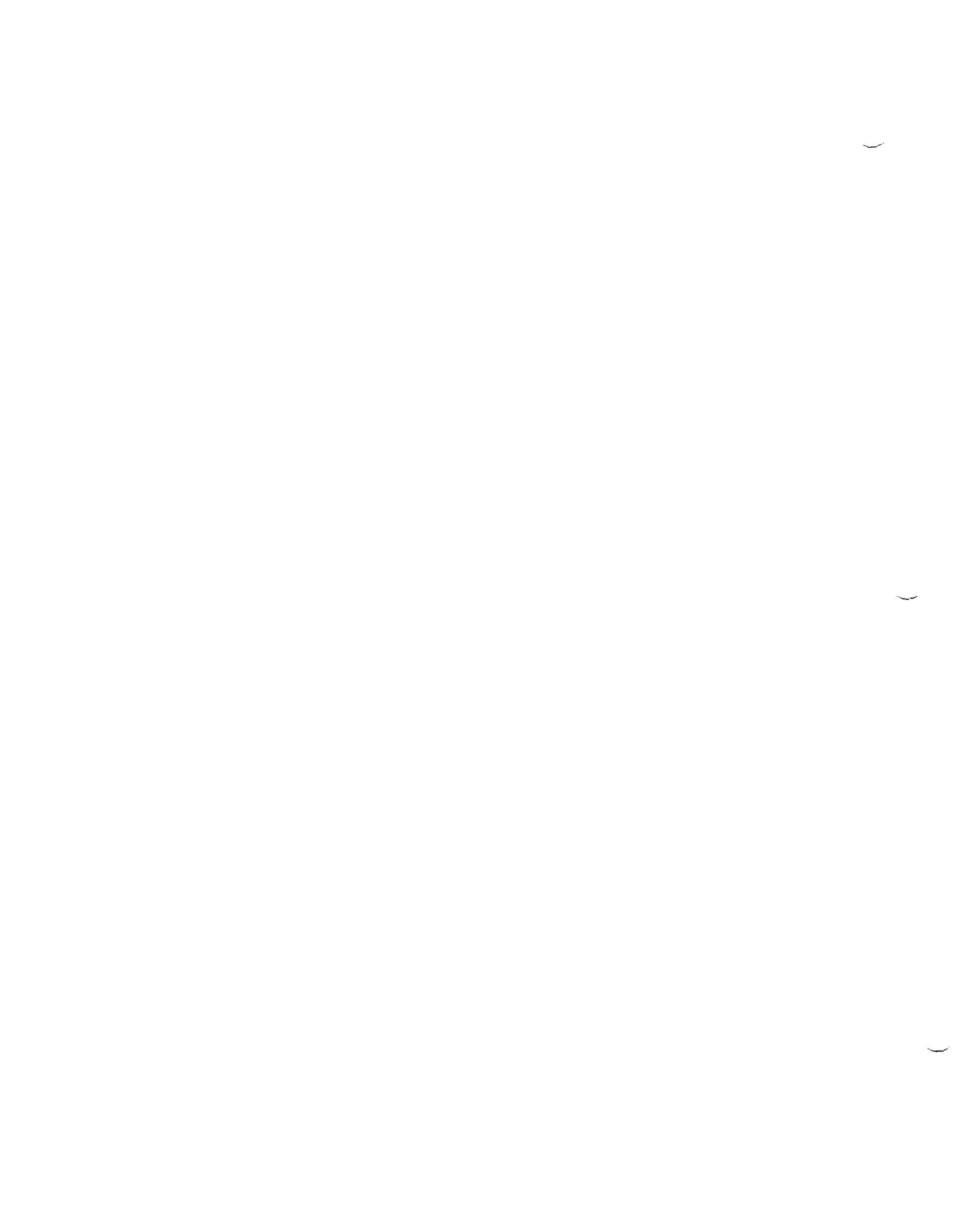
True or False:

(Circle true or false)

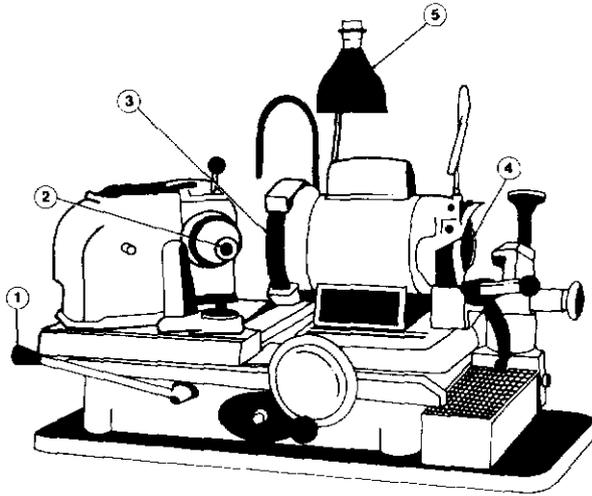
- |  |   |   |
|--|---|---|
| 1. You must get help when handling large tractor tires.  | T | F |
| 2. You must always exhaust all air from the tire before removing any rim components.             | T | F |
| 3. Split rims are dangerous because they are too heavy.  | T | F |
| 4. The best way to see if all the air is out of the tire is by sticking a wire through the tube. | T | F |
| 5. Tires installed on split rims must always be inflated in a safety cage.                       | T | F |
| 6. A tire that has been run flat must be carefully inspected before it is inflated.              | T | F |
| 7. You should always obtain permission from the teacher before changing truck or tractor tires.  | T | F |
8. Identify the parts of the truck tire inflation cage.



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

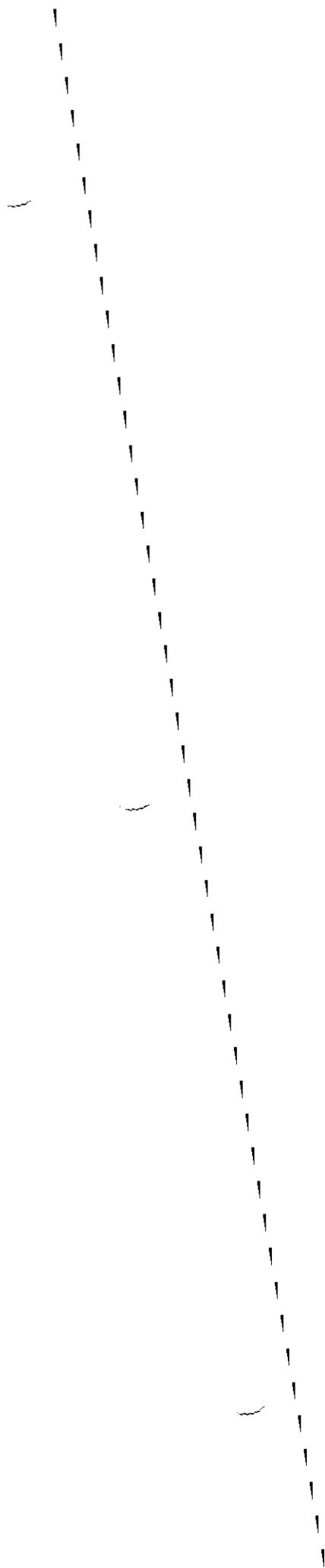


## VALVE RECONDITIONER

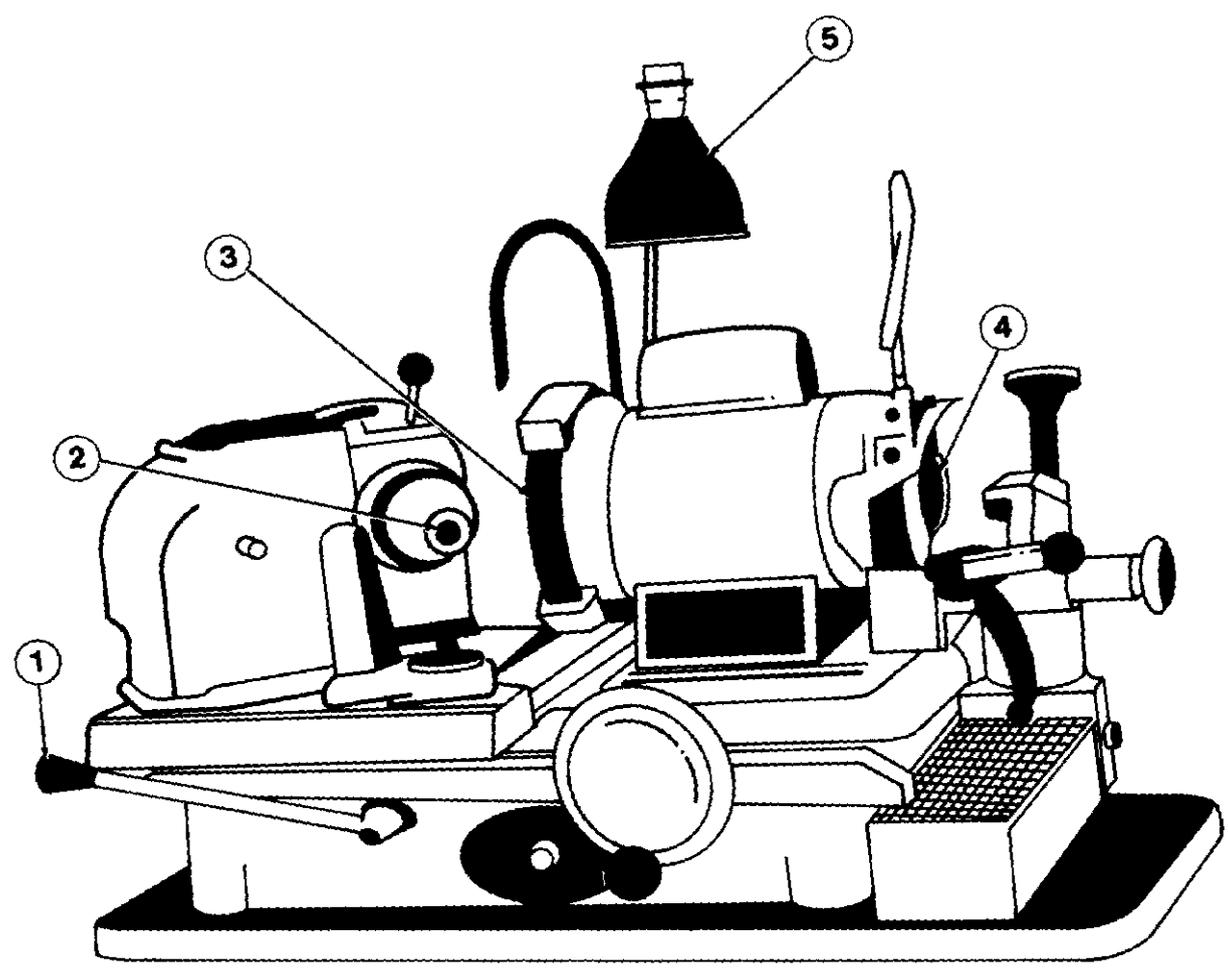


1. LEVER
2. VALVE CHUCK
3. VALVE FACE GRINDING WHEEL
4. VALVE TIP GRINDING WHEEL
5. LIGHT

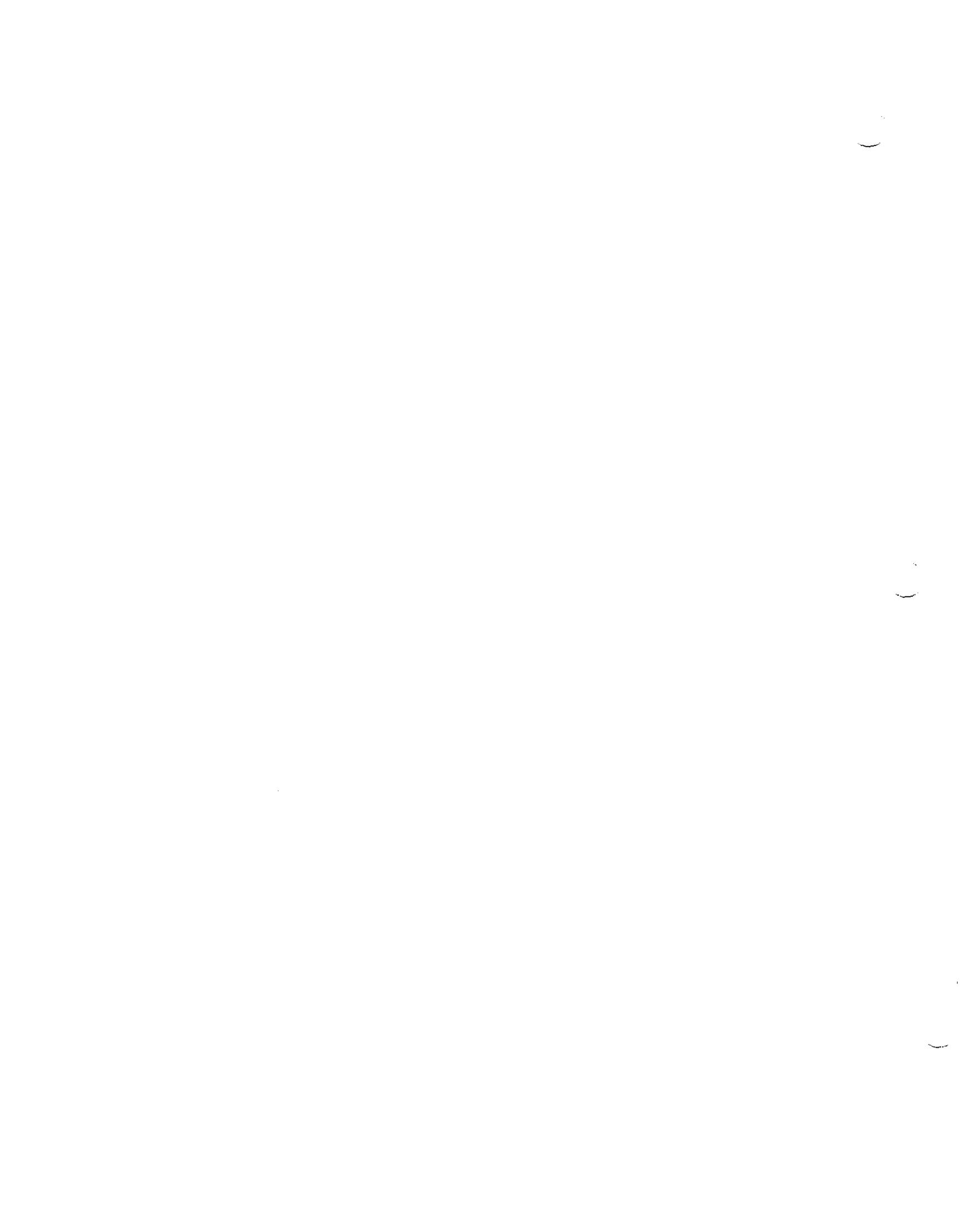
1. Wear eye protection at all times.
2. Obtain permission from the teacher before using the valve reconditioner.
3. Long hair and loose clothing must be contained.
4. Keep the floor area around the machine clean, dry, and free from debris.
5. Do not grind any valve unless you are completely familiar with the machine. Practice with a spare valve and move the controls to learn the action before turning on the machine.
6. Check and adjust the grinding angle and adjust the depth stop so the valve stem cannot be ground.
7. Make no adjustments with the grinding wheel turned on.
8. Make several light cuts rather than one heavy one.
9. If the normal sound of the grinder changes, shut it off immediately and notify the teacher.
10. Do not allow any distractions to occur while using the grinder. Concentrate on the job.
11. Turn the grinder off if the machine must be left even for only a moment.



# VALVE RECONDITIONER



- 1. LEVER
- 2. VALVE CHUCK
- 3. VALVE FACE GRINDING WHEEL
- 4. VALVE TIP GRINDING WHEEL
- 5. LIGHT



# VALVE RECONDITIONER SAFETY QUIZ

NAME \_\_\_\_\_

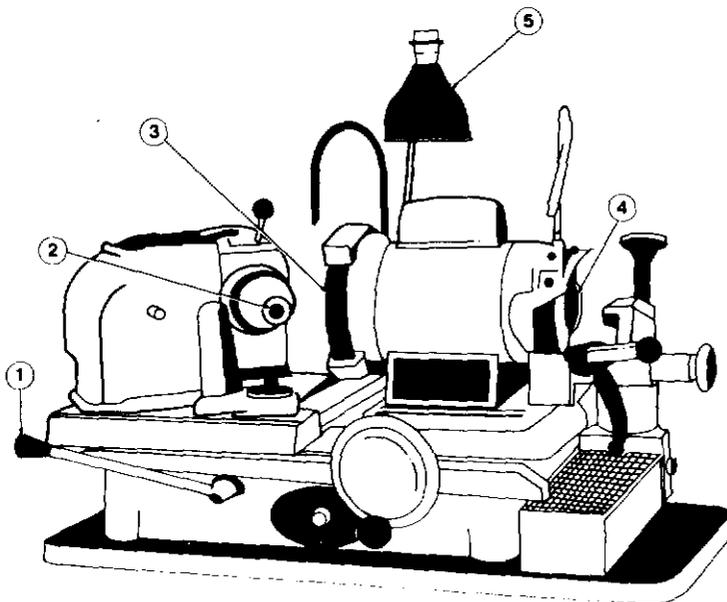
CLASS \_\_\_\_\_

DATE \_\_\_\_\_ GRADE \_\_\_\_\_

True or False:

(Circle true or false)

- |   |   |   |
|---|---|---|
| 1. Do not make adjustments on the machine while the grinding wheel is turning.                            | T | F |
| 2. If the normal sound of the grinder changes, hurry and finish grinding in case the machine stops.       | T | F |
| 3. Keep the floor area around the grinder clean, dry, and free of debris.                                 | T | F |
| 4. Keep the grinder running even if it is only left for a moment, so others will know it is still in use. | T | F |
| 5. Long hair and loose clothing must be contained.  | T | F |
| 6. Heavy cuts are better than light ones because the grinder does not have to run so long.                | T | F |
| 7. Identify the parts of the valve reconditioner.   |   |   |



- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

## REFERENCES

Materials were selected and reviewed from the following sources, and in some instances were incorporated in the production of the preceding unit.

Adams, Virgil, Auto Mechanics Teacher, Wichita High School Heights

Ammco Tools, Inc.

California State Safety Guide, "Industrial Arts Safety Instruction"

CM Chain Co., "Chain Safety"

U. S. Dept. of Labor, "General Industry Safety and Health Standards,"  
OSHA #2206

Hawaii State Dept. of Education, "Instructional Guide for Auto Mechanics"  
and "Industrial Education Safety Instructional Guide"

Kansas State Safety Guide, "Safety Practices in the Auto, Diesel, and  
Agriculture Mechanics Shops." by Janice Parr, Kansas Curriculum  
Materials Dissemination Center, Pittsburg State University

National Institute for Occupational Safety and Health, NIOS, "Health  
and Safety Guide," U.S. Dept. of Health, Education, and Welfare.

Ohio State Safety Guide , "Industrial Arts and Vocational Education  
Safety"

Oklahoma State Safety Guide, "Accident Prevention for Industrial Arts,  
Vocational and Technical Education Programs," Oklahoma State Board  
of Vocational and Technical Education

Shawnee Mission Public Schools Safety Guide, "Safety Guide"

Utah State Safety Guide, "Industrial Education Safety Recommendations  
and OSHA Standards"

Washington State Industrial Arts Safety Guide

Wyoming State Safety Guide, "Occupational Education Safety Manual"

**ANNOTATED BIBLIOGRAPHY**

**ANNOTATED BIBLIOGRAPHY**



## ANNOTATED BIBLIOGRAPHY

Bell, Herbert, and Garner, James. Eye Safety in Washington. Olympia, Wash.: Office of the State Superintendent of Public Instruction, Division of Vocational Education, 1969.

**Format:** Teacher's guide.  
**Content:** Material on eye protection devices and safeguards.  
**Outstanding**  
**Characteristics:** Includes material on many eye-protection devices and laws relating to eye protection.  
**Audience:** Students grades 7-14, teachers.

Essentials of Machine Guarding. Safe Work Practices Series. Washington, D.C.: U.S. Department of Labor, Occupational Safety and Health Administration, 1975. (OSHA 2227)

**Format:** Printed pamphlet.  
**Content:** A discussion of all types of machine guarding.  
**Outstanding**  
**Characteristics:** Useful, captioned illustrations.  
**Audience:** Teachers.

Eye Protection for Students, Teachers and Observers: A Guide for Elementary, Secondary, Post-Secondary and Adult Classes. Atlanta, Ga.: Georgia Department of Education, Division of Vocational Education, 1980.

**Format:** Programmed text.  
**Content:** General information pertaining to eye safety in Georgia schools, including school board policies concerning the implementation of an eye protection program.  
**Audience:** Students grades 7-14, teachers, administrators.

Eye Protection in Educational Institutions. Trenton, N.J.: New Jersey Department of Education, Division of Vocational Education and Career Preparation, 1980.

**Format:** Programmed text, teacher's guide.  
**Content:** General information and safety charts pertaining to eye safety and eye-safety devices.  
**Outstanding**  
**Characteristics:** Very thorough overall content, well-designed safety charts, and useful appendix materials.  
**Audience:** Students grades 7-14, teachers, administrators.

Firenze, Robert J., and Walters, James B. Safety and Health for Industrial Vocational Education NIOSH/OSHA. Washington, D.C.: U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, July 1981.

**Format:** Teacher's guide.

**Content:** Material dealing with health programs and the characteristics of effective safety in schools.  
**Audience:** Teachers, administrators.

Hair, Richard, and others. Vocational Safety Guide. Tampa, Fla.: Hillsborough County Public Schools, August 1980.

**Format:** Teacher's guide.  
**Content:** Material on safety in industrial arts classes.  
**Outstanding Characteristics:** Very comprehensive, detailed lists of proper and safe equipment and guidelines for tool and material use.  
**Audience:** Teachers, administrators.

Hand Tools: Selecting, Using, and Caring for Hand Tools. Trainee's Guide. Barrington, Ill.: Technical Publishing Co., 1973.

**Format:** Programmed text, student workbook, tests, teacher's guide.  
**Content:** Hand tool information, including safety in the use of hand tools.  
**Outstanding Characteristics:** Presents a very complete, handsomely illustrated program on hand tools.  
**Audience:** Students grades 7-14, teachers.

Health and Safety Resource Guide for Trades and Industry and Industrial Arts Programs in the Maryland Educational System. Cresaptown, Md.: Western Maryland Vocational Resource Center, 1979.

**Format:** Printed material.  
**Content:** General safety resource guide covering all aspects of safety.  
**Outstanding Characteristics:** Includes audiovisual aids, a complete section on resource materials, and information on teacher liability.  
**Audience:** Students grades 7-14, teachers, administrators.

Hoerner, Thomas A., and Bettis, Mervin D. Power Tool Safety and Operation: Woodworking, Metalworking, Metals and Welding. St. Paul, Minn.: Hobar Publications, 1973.

**Format:** Programmed text, performance checklists, transparency masters, tests.  
**Content:** For each of the 24 power tools covered, there is a section on part identification, safe operational procedures, general safety practices, and completion questions. (An instructor's guide entitled Power Tool Safety and Operation: Instructor Packet is to be used in conjunction with this manual.)  
**Outstanding Characteristics:** A good, complete program.  
**Audience:** Students grades 7-14, teachers.

Power Tool Safety and Operation: Instructor Packet. St. Paul, Minn.: Hobar Publications, 1973.

**Format:** Instructor's guide.  
**Content:** Contains suggested teacher and student activities, a transparency master on part identification, and a safety exam. (A student manual entitled Power Tool Safety and Operation: Woodworking, Metalworking, Metals and Welding is to be used in conjunction with this instructor's guide.)

**Outstanding Characteristics:**  
**Audience:** A good, complete program.  
Teachers.

Industrial Arts Curriculum Guide for Safety. Hartford, Conn.: Connecticut State Department of Education, Division of Vocational Education, Bureau of Vocational Services, May 1981.

**Format:** Teacher's guide, tests, catalog of competencies and objectives.  
**Content:** A curriculum for industrial arts with special emphasis on safety.

**Outstanding Characteristics:** A very comprehensive and detailed manual. Includes quizzes and reproducible pictures of shop equipment.  
**Audience:** Mentally and physically handicapped students, students grades K-14, teachers, administrators.

Jacobs, Clinton O., and Turner, J. Howard. Developing Shop Safety Skills. Athens, Ga.: American Association for Vocational Instructional Materials, 1981.

**Format:** Teacher's guide, student workbook, performance checklists, lab manual, cassettes, slides.  
**Content:** An explanation of how one can develop safety skills in a shop.

**Outstanding Characteristics:** A very thorough and complete workbook that uses an AV set to parallel the teacher's guide and lab manual.  
**Audience:** Students grades 7-12, teachers.

Jeffus, Larry F. Safety for Welders. Albany, N.Y.: Delmar Publishers, 1980.

**Format:** Programmed text, performance checklists, teacher's guide, tests.

**Content:** Good illustrated safety materials for welders.

**Outstanding Characteristics:** A complete program arranged in easy-to-work-with units.

**Audience:** Students grades 10-14, teachers.

Lewis, Gaspar J. Safety for Carpenters and Woodworkers. Albany, N.Y.: Delmar Publishers, 1981.

**Format:** Programmed text, teacher's guide.  
**Content:** Good material for carpentry and woodworking classes.  
**Outstanding Characteristics:** Contains detailed instructions with tests for specific tools and equipment. Well illustrated and easy to use.  
**Audience:** Students grades 7-14, teachers.

Mississippi State Department of Education, Division of Vocational-Technical Education. Eye Safety. Mississippi State, Miss.: Mississippi State University, College of Education, Research and Curriculum Unit for Vocational-Technical Education, November 1981.

**Format:** Teacher's guide.  
**Content:** Eye safety guide for industrial arts teachers.  
**Audience:** Teachers.

National Safety Council. Making Safety Work. New York: Gregg Division/McGraw-Hill Book Company, 1976.

**Format:** Programmed text, teacher's guide, tests.  
**Content:** Good illustrated safety materials covering housekeeping, fire prevention, materials handling, hand tools, power tools, and making safety a habit.  
**Outstanding Characteristics:** A well-written, well-illustrated, and complete set of activities.  
**Audience:** Students grades 7-14, teachers.

An Option to See: Educators' Resource Guide. New York: National Society for the Prevention of Blindness, 1977.

**Format:** Teacher's guide, tests, duplicating masters, transparencies, films.  
**Content:** Material on better eye safety and eye-safety instruction.  
**Outstanding Characteristics:** Contains transparencies and duplicating masters and a 16mm film for student orientation.  
**Audience:** Mentally handicapped, physically handicapped, educationally disadvantaged, students grades 7-12, teachers.

Portable Power Tools: Safe Practices for Care and Handling on the Job. Trainee's Guide. Barrington, Ill.: Technical Publishing Co., 1974.

**Format:** Teacher's guide, performance checklists, student workbook, tests, programmed text.  
**Content:** Information on the safe handling of portable power tools.

**Outstanding**

**Characteristics:** A very complete, handsomely designed program on power tools for both student and teacher use.

**Audience:** Students grades 7-14, teachers.

Preventive Maintenance Workbook. McMinnville, Tenn.: Powermatic Houdaille, n.d.

**Format:** Teacher's guide.

**Content:** A guide to preventive maintenance of powermatic equipment and tools.

**Outstanding**

**Characteristics:** Contains very detailed instructions for teaching preventive maintenance.

**Audience:** Teachers.

Proper Uses and Common Abuses of Wrenches and Pliers. New York: Hand Tool Institute, 1974.

**Format:** Pamphlet.

**Content:** Information on hand tool use--specifically wrenches and pliers.

**Outstanding**

**Characteristics:** Cartoon characters illustrate the "dos and don'ts" of hand tool use.

**Audience:** Students grades 7-14, teachers.

Pryor, Robert O. Safety and Maintenance. Miami, Fla.: Florida International University, 1981.

**Format:** Teacher's guide and transparency masters.

**Content:** Information on maintaining shop equipment.

**Outstanding**

**Characteristics:** Good transparency masters.

**Audience:** Students grades 7-14, teachers.

Ronan, William. Shop and Home Safety. St. Louis, Mo.: Milliken Publishing Co., 1975.

Personal Safety, 1975.

Using Hand Tools, Part 1, 1975.

Using Hand Tools, Part 2, 1975.

Using Power Tools, 1975.

**Format:** Transparency masters, duplicating masters, tests.

**Content:** Information on safety in the shop and at home.

**Outstanding**

**Characteristics:** Excellent materials that can be used to implement or supplement vocational programs. The transparencies, study guides, and tests lend themselves to easy duplication.

**Audience:** Mentally and physically handicapped, educationally disadvantaged, students grades 7-14, teachers.

Safety for Industrial Education and Other Vocational Programs. Miami, Fla.:  
Dade County Public Schools, Division of Vocational and Adult Education,  
n.d.

**Format:** Teacher's guide.  
**Content:** Rules and regulations for safe practices.  
**Outstanding**  
**Characteristics:** Includes safety rules, safety labels, and a sample  
student power tool permit.  
**Audience:** Students grades 7-14, teachers.

Safety Guide for Industrial Education. Commerce, Tex.: East Texas State Uni-  
versity, Occupational Curriculum Laboratory, 1975.

**Format:** Teacher's guide with transparency masters.  
**Content:** Basic safety rules for using machines.  
**Outstanding**  
**Characteristics:** Good transparency masters; photo-illustrated safety  
rules.  
**Audience:** Students grades 7-14, teachers.

A Safety Guide for Vocational Education Programs. Rockledge, Fla.: The  
School Board of Brevard County, Vocational Education Department, 1981.

**Format:** Teacher's guide.  
**Content:** Safety responsibilities, rules and regulations for  
using machines.  
**Outstanding**  
**Characteristics:** Safety rules for individual machines; much supple-  
mental information.  
**Audience:** Students grades 7-14, teachers.

Safety Steering Committee. Pennsylvania Industrial Arts Safety Guide.  
2d ed. Harrisburg, Pa.: Pennsylvania Department of Education, 1981.

**Format:** Teacher's guide, tests.  
**Content:** Information about industrial arts safety.  
**Outstanding**  
**Characteristics:** Comprehensive student tests, using labeled pictures of  
equipment and tools; can be easily duplicated for stu-  
dent use; includes section on teacher liability.  
**Audience:** Students grades 7-12, teachers, administrators.

Washington State Industrial Arts Safety Guide. Olympia, Wash.: Office of  
Public Instruction, 1980.

**Format:** Programmed text, teacher's guide, tests.  
**Content:** Safety practices, specific rules, general safety pro-  
cedures, and suggested outlines.  
**Outstanding**  
**Characteristics:** Witty cartoons illustrate the rules and dangers of  
various shop machines.  
**Audience:** Students grades 7-12, teachers.

Woodburn, Clint H. Safety for the Industrial Student. College Station, Tex.: Texas A and M University, Vocational Instructional Services, n.d.

**Format:** Teacher's guide, student workbook, student modules, tests.  
**Content:** Individual units on various safety subjects.  
**Outstanding**  
**Characteristics:** Useful information sheets, assignment sheets, and tests.  
**Audience:** Students grades 7-14, teachers, administrators.

Wren, James E., and Smith, William G. Safety Color Coding for the Shop. Athens, Ga.: American Association for Vocational Instructional Materials, 1982.

**Format:** Audiovisual (slides, cassette) with teacher's guide.  
**Content:** Introductory material about the ANSI and OSHA standard color coding system. The system considers nine safety colors and their use as alerting agents for shop safety.  
**Outstanding**  
**Characteristics:** Narrated in a brief, easy-to-understand style using excellent photos to back up the narrative. Script can be purchased separately.  
**Audience:** Teachers, administrators.

Should you wish to obtain any of the materials cited in this bibliography, please check with your local library for publishers' complete mailing addresses. If you have any difficulty obtaining this address information, please feel free to contact FEIS, and we will be most happy to assist you.

Name \_\_\_\_\_ Position \_\_\_\_\_

Address \_\_\_\_\_  
(institution, school, or agency) (street or P.O.)

\_\_\_\_\_  
(city) (state) (zip code)

Phone \_\_\_\_\_ Date \_\_\_\_\_

Is this request the result of an FEIS search done for you? \_\_\_\_ Yes \_\_\_\_ No

Please list, in NUMERICAL ORDER, the document ACCESSION NUMBERS for the documents requested. If you request a microfiche copy of a VT document, include the AIM/ARM issue number, if possible.

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Remember, some documents listed in Resources in Education (RIE) are not available on microfiche. Journal articles are not available on microfiche. Use the enclosed Journal Article Order Form to request photocopies of articles. For other documents unavailable on microfiche, check the document abstract for availability information.

**Return this form to: Florida Educators' Information Service**

The Center for Studies in Vocational Education, P.O. Box 2617, Tallahassee, FL 32304, (904) 644-6454

FOR OFFICE USE ONLY:

Invoice no. \_\_\_\_\_

Total cost @ 30¢ per sheet \_\_\_\_\_

(1 sheet of microfiche = 96 printed pages)

Number of documents \_\_\_\_\_

Number of fiche \_\_\_\_\_

Date request completed \_\_\_\_ by \_\_\_\_

## ADDITIONAL RESOURCES

ADDITIONAL RESOURCES

Pages 751-773 were adapted from Safety and Health Instructional Materials for Vocational Education: A State of the Art Report.  
© 1981 by the Technical Education Research Center-Southwest.  
Used with permission of the Center for Occupational Research and Development, Waco, Texas.

## INTRODUCTION

The following pages contain a listing of materials that can be used by teachers to supplement this safety package. The materials are classified into two categories: print and nonprint materials.

### Print Materials

The classification of print materials is as follows:

- |           |  |
|-----------|--|
| Posters   | -- Usually a wall-mounted document providing information on a specific topic (also includes charts).   |
| Leaflets  | -- One page of printed information usually addressing a single topic or concept (includes fliers).   |
| Pamphlets | -- Unbound pieces of literature, usually with a paper cover or no cover at all (includes booklets). In most cases, they contain fewer than 100 pages.    |
| Books     | -- Includes both soft cover and hardbound types, usually with a specified author, frequently exceeding 100 pages, and printed by a commercial publisher. |
| Catalogs  | -- Sources of materials available from private producers.  |
| Others    | -- Includes unique items such as ERIC printouts and newsletters.   |

### Nonprint Materials

The other major category of existing materials is in the nonprint form. Classifications in the nonprint format include:

- |                                |  |
|--------------------------------|--|
| Slide or<br>Filmstrip/<br>Tape | -- These materials have sequenced visuals and accompanying audio tapes. Some have printed learning materials complementing the presentation. |
|--------------------------------|--|

16 mm Films -- The greatest number of nonprint materials exist in the 16 mm format. Most have associated sound tracks and many are in color.

Video  
Cassettes -- Video equipment is more expensive to purchase and maintain but has the advantage of simplicity of use and multiple monitors for remote site viewing. It is also a common medium to which users can relate.

## I PRINT MATERIALS

### THE ABC'S OF FIRE PROTECTION

FORMAT: Chart  
AVAILABILITY: Free  
SOURCE: Walter Kidde & Company  
DESCRIPTION: This chart provides graphical information as to classifications of extinguishing agents, classes of fires, and specifications of extinguishers.

### AN ACCIDENT PREVENTION PROGRAM FOR INDUSTRIAL ARTS AND VOCATIONAL EDUCATION

FORMAT: Book, 107 pages, 1978  
AVAILABILITY: Sale  
SOURCE: Tulsa, Oklahoma, Public Schools  
DESCRIPTION: The purpose of this guide is to assist instructors and administrators in their efforts to prevent accidents and injuries in school shops and laboratories. This guide includes the following sections: general safety requirements, program of safety instruction, and safety instructions for operation of equipment.

### AN ACCIDENT PREVENTION PROGRAM FOR SCHOOL SHOPS AND LABORATORIES

AUTHOR: William A. Williams, Ph.D.  
FORMAT: Book, 245 pages  
AVAILABILITY: Sale  
SOURCE: National Safety Council  
DESCRIPTION: This guide outlines a comprehensive program of school shop and laboratory safety education. Major topics include: organizing for safety prevention, administering the accident prevention program, implementing the accident prevention program, education and training for accident prevention.

ALAMO FIRE & SAFETY EQUIPMENT COMPANY

FORMAT: Catalog, 1979, 126 pages  
AVAILABILITY: Free  
SOURCE: Alamo Fire & Safety Equipment Company  
DESCRIPTION: This is a catalog of fire and safety equipment supplied by Alamo Fire & Safety Equipment Company.

AMERICAN ASSOCIATION FOR VOCATIONAL INDUSTRIAL MATERIAL

FORMAT: Catalog  
AVAILABILITY: Free  
SOURCE: American Association for Vocational Industrial Material  
DESCRIPTION: This catalog describes courses, audiovisual aids, and cassettes developed by the American Association for Vocational Industrial Materials.

BILSOM SIGN LANGUAGE POSTER

FORMAT: Poster  
AVAILABILITY: Free  
SOURCE: Bilsom International, Inc.  
DESCRIPTION: This poster illustrates the following statement: If you work in a noisy place without using hearing protection, you might sooner or later have to learn sign language.

DIRECTORY OF ACADEMIC PROGRAMS IN OCCUPATIONAL  
SAFETY AND HEALTH

AUTHORS: William J. Weiss, III; Thomas C. Purcell, Ph.D.;  
Mathew H. Street; and Peter A. Kendrick

FORMAT: Other - Directory, 116 pages, 1979

AVAILABILITY: USGPO: 1979-657-061/1905

SOURCE: NIOSH

DESCRIPTION: This book is to help students, educators, guidance  
counselors, professional societies, employers and  
employees who need basic information concerning various  
academic programs being offered in the field of occupa-  
tional safety and health.

EMPLOYMENT SAFETY AND HEALTH - INDUSTRY CHECKLIST

FORMAT: Pamphlet, 26 pages, 1973

AVAILABILITY: Commerce Clearing House, Inc.

SOURCE: OSHA

DESCRIPTION: This pamphlet lists OSHA standards, 29CFR1910, broken  
down into six major categories and their location in the  
Employment Safety & Health Guide by CCH paragraph number.  
Categories include: workplace standards, machines and  
equipment standards, materials standards, employee  
standards, power source standards, and process standards.

ESSENTIALS OF MATERIALS HANDLING

FORMAT: Pamphlet, 22 pages, 1978

AVAILABILITY: USGPO 1979-0-287-182

SOURCE: OSHA

DESCRIPTION: This pamphlet presents a summary of the basic safety  
procedures necessary in materials handling based on  
OSHA regulations.

## A FEW SOUND WORDS ABOUT HEARING PRACTICES

FORMAT: Pamphlet, 8 pages  
AVAILABILITY: Free  
SOURCE: Vought Corporation Systems Division (LTV)  
DESCRIPTION: This booklet provides supplementary information to assist you in a better understanding of the Vought Hearing Conservation Program.

## FIBERGLASS LAYUP AND SPRAYUP

FORMAT: Pamphlet, 32 pages, 1976  
AVAILABILITY: Single copy, free (NIOSH) #76-158  
SOURCE: NIOSH  
DESCRIPTION: This booklet identifies common problems and suggests work practices you can follow to stay safe, healthy, and on the job in the fiberglass reinforced plastics layup and sprayup industry. Defines terms and gives information about materials worked with and good practices in handling them.

## A FIVE-YEAR PROGRAM TO STIMULATE SAFETY TRAINING AND ACTION IN VOCATIONAL EDUCATION

FORMAT: Proposal, 74 pages, 1979  
AVAILABILITY: Free  
SOURCE: National Safety Council  
DESCRIPTION: This is a proposal from the National Safety Council to launch a five-year program in conjunction with the American Vocational Association. The program would establish teacher-student safety training programs; create safety awareness among youth; prepare a bibliography of safety materials; and generate cooperation in and support from management, labor, and federal and state government officials.

## GENERAL INDUSTRY

FORMAT: Pamphlet, 52 pages, 1975  
AVAILABILITY: Single copy, free OSHA #2201  
SOURCE: USGPO 1975-029-016-00027-5  
DESCRIPTION: This booklet is a digest of general industry standards to aid in voluntary compliance with OSHA standards at the workplace.

### HOW TO GET ALONG WITH YOUR SOLVENT

FORMAT: Pamphlet, 68 pages, 1975  
AVAILABILITY: Single copy, free NIOSH  
SOURCE: USGPO #76-108  
DESCRIPTION: This is an illustrated safety guide for solvent handlers.

### HOW TO SELECT THE RIGHT FUME HOOD

FORMAT: Pamphlet, 6 pages, 1977  
AVAILABILITY: Free  
SOURCE: Labconco Corp.  
DESCRIPTION: This brochure discusses basic specifications and uses of various types of fume hoods.

### NATIONAL DIRECTORY OF SAFETY FILMS

FORMAT: Catalog, 1978, 64 pages  
AVAILABILITY: Free  
SOURCE: National Safety Council  
DESCRIPTION: This is a catalog of safety films supplied by the National Safety Council.

SAFETY & HEALTH IN ARC WELDING AND  
GAS WELDING AND CUTTING

FORMAT: Booklet, 52 pages, 1978  
AVAILABILITY: Single copy, free NIOSH  
SOURCE: Public Health Service, NIOSH  
USGPO 1978-757.134/1731  
DESCRIPTION: This booklet describes training techniques, worksite preparation, equipment check, fire protection, health hazards, personal protective equipment, welding techniques, special requirements, and first aid for welding industry.

SAFETY YELLOW - ELECTRICAL SPECIALISTS  
INSURE GOOD ELECTRICAL HYGIENE

FORMAT: Poster, 1973  
AVAILABILITY: Free  
SOURCE: Daniel Woodhead Co.  
DESCRIPTION: This poster depicts OSHA national electrical code.

SPRAY PAINTING - GOOD PRACTICES FOR EMPLOYEES

FORMAT: Booklet, 22 pages, 1976  
AVAILABILITY: Single copy, free NIOSH  
SOURCE: USGPO #76-178  
DESCRIPTION: This booklet describes safe methods of spray painting, including operations and processes, other hazards of spray painting operations, controls of hazards, operator protection, and accident prevention.

## II NONPRINT MATERIALS

### ANATOMY OF ELECTRIC SHOCK

FORMAT: Filmstrip, 35mm color, 12 minutes  
w/sound (33 1/3 rpm phono record)

AVAILABILITY: Loan

SOURCE: Travelers Film Library

DESCRIPTION: Presents facts about electric shock, especially low-voltage shocks. Discusses ventricular fibrillation, paralysis of the respiratory system, and burns caused by different current values.

### AUTOVATION

FORMAT: Filmstrips and cassettes, 1978

AVAILABILITY: Rental

SOURCE: 2000 Company

DESCRIPTION: This unit is designed to motivate students to seek careers in automobile mechanics. Shows refurbishing of classic cars and auto-body shop work, and emphasizes the motivation necessary for three occupations.

### A BETTER LIFE: SAFETY ATTITUDE

FORMAT: Film, 13 minutes

AVAILABILITY: Loan

SOURCE: Employers Insurance of Wausau

DESCRIPTION: In high-hazard jobs, safety is a way of life--a better life. To a victim, an accident is something unavoidable. He or she, therefore, looks for someone else to blame. This is an attitude problem. We must assume responsibility for our own behavior. Eighty-five percent of all accidents are controllable or avoidable. Wrong attitudes foster wrong responses. Safety is a state of mind. Are you in control?

## CAREERS WITH FUTURES, PIPEFITTING

FORMAT: Film, 16mm color, 20 minutes  
AVAILABILITY: Loan  
SOURCE: Brown & Root  
DESCRIPTION: This film illustrates the art of pipe fitting in heavy construction. It describes the skill required and shows how the workers are trained.

## CHECK LIST

FORMAT: Film, 16mm color, 15 minutes  
AVAILABILITY: Loan  
SOURCE: Cummins Diesel Engine  
DESCRIPTION: This film is about safety in the workplace for mechanics and automotive and mechanical personnel. Topics covered include: chemical dip tanks, welding eye damage, examples of safety glasses, examples of horseplay, improper tool use and resulting infection, improper lifting (hernia) of engines, and safety around a dyno.

## COLOR FOR SAFETY

FORMAT: Film, 16mm color, 20 minutes  
AVAILABILITY: Loan  
SOURCE: US Bureau of Mines, #812  
DESCRIPTION: This is a general film on how colors are used in industry. It does not, however, stress the OSHA color code system. It illustrates how the six basic colors can be used in the mining, chemical, and machinery industries.

### DON'T LET HIM DIE

FORMAT: Film, 16mm color, 22 minutes  
AVAILABILITY: Loan  
SOURCE: Red Cross  
DESCRIPTION: This film is a bit "bloody" but shows how to save a human life. Describes procedures for dealing with 1) shock, 2) open wound bleeding, 3) stopped heart, 4) drowning. Excellent film on how to handle people who have been in an accident or who are suffering from shock.

### DON'T PUSH YOUR LUCK

FORMAT: Film, 16mm color, 13 minutes  
AVAILABILITY: Loan  
SOURCE: Travelers Film Library  
DESCRIPTION: A new film of the National Society for the Prevention of Blindness. This film points out the eye hazards in shops and plants and portrays the specific eye safety equipment for each.

### DOWN TO EARTH

FORMAT: Film, 16mm color, 18 minutes, 1971  
AVAILABILITY: Loan  
SOURCE: BNA Communications, Inc.  
DESCRIPTION: This is a film on electrical safety in construction. It is a humorous story of "Tough Foreman" trying to make "Joe" shape up. In the end "Joe" is disposed of as a result of his poor safety practices.

## EVERYTHING TO LOSE

FORMAT: Film, 16mm color, 21 minutes  
AVAILABILITY: Loan  
SOURCE: Travelers Film Library  
DESCRIPTION: The consequences of ignoring plant safety rules are graphically portrayed by professional stunt men. This film shows one character playing "Russian Roulette" - the odds he accepts are not far from those accepted by the safety rule breaker.

## EXTINGUISH THAT FIRE

FORMAT: Film, 16mm color, 24 minutes, 1976  
AVAILABILITY: Loan  
SOURCE: US Information Service - Cinesound Co.  
DESCRIPTION: A film showing fire extinguishers, especially the dry chemical powder type being used. It has good coverage of how to extinguish a metal fire. The film illustrates people using the different types of extinguishers on the various classes of fires.

## FACTS ABOUT BACKS

FORMAT: Film, 16mm color, 14 minutes  
AVAILABILITY: Loan  
SOURCE: Bell Films  
DESCRIPTION: This film describes how the spine and back function. It also shows the ways that people abuse the back. Film demonstrates proper lifting methods. Outstanding for use in discussions of physical hazard safety.

## FIRE - CAUSES FOR ALARM

FORMAT: Film, 16mm color, 12 1/2 minutes  
AVAILABILITY: Loan  
SOURCE: Association of Films, Dallas  
DESCRIPTION: Film describes the dangers of various unsafe smoking habits. It demonstrate the office extinguisher.

## FIRE SAFETY

FORMAT: Audiovisual filmstrip and cassette, 1978  
AVAILABILITY: Rental  
SOURCE: 2000 Company  
DESCRIPTION: Emphasizes the fire safety hazards in a typical school shop, class or other classroom. Provides information on fire prevention, escape procedures, and use of fire extinguishers.

## FLAMMABLE LIQUID FIRE SAFETY

FORMAT: Film, 16mm color, 20 minutes  
AVAILABILITY: Loan  
SOURCE: Travelers Film Library  
DESCRIPTION: Characteristics of flammable liquids are shown so that the employee can see how hazardous situations develop. Shows the right way to handle the liquids and the absolute importance of using safety containers and approved equipment.

## FOR GOOD SOUND REASONS

FORMAT: Film, 16mm color, 18 minutes

AVAILABILITY: Loan

SOURCE: West Glen Films

DESCRIPTION: Film shows how a person working in a steel foundry for years becomes used to the noise when actually he is becoming deaf. He develops the habit of talking loudly because of the affliction. The film gives the sound levels of the various machines in an industrial plant. Explains the various types of ear protection and shows instruments that can be placed on workers to determine noise levels.

## GRINDER, BUFFER, DRILL PRESS AND HAND TOOL SAFETY LATHE SAFETY MILLING MACHINE SAFETY

FORMAT: Audiovisual (3 parts)

AVAILABILITY: Rental

SOURCE: 2000 Company

DESCRIPTION: This audiovisual program is divided into three parts and each is described below.

Part A shows the safety hazards in a typical machine/metal shop or automobile shop. It teaches proper use of the grinder, buffer, drill press, and hand drill.

Part B offers close-up photography of safety techniques when using the lathe.

Part C demonstrates safety techniques when using the milling machine.

## THE HAND-TRAP TEST

FORMAT: Film, 16 mm color, 20 minutes

AVAILABILITY: Loan

SOURCE: Employers Insurance of Wausau

DESCRIPTION: This film shows various hazards to hands. It then quizzes the students by having them select or find hazardous conditions in a given situation.

## HEY MAN, YOU'RE IT

FORMAT: Film, 16mm color, 10 minutes  
AVAILABILITY: Loan  
SOURCE: Employers Insurance of Wausau  
DESCRIPTION: A safety film on construction safety programs at the work site. Most of the unsafe acts and accidents are caused by careless employees, and accident-prone workers are not tolerated very long on the job. The film shows many examples of unsafe acts that are performed by workers.

## HOUSEKEEPING MEANS SAFEKEEPING

FORMAT: Film, 16 mm color, 12 minutes  
AVAILABILITY: Loan  
SOURCE: Journal Films, Inc. - National Safety Council  
DESCRIPTION: This film shows the need for good housekeeping in an industrial plant. It describes workers' indifference to keeping the work place clean.

## HOW TO AVOID MUSCLE STRAINS (Spanish Version)

FORMAT: Film, 16mm black and white, 15 minutes  
AVAILABILITY: Loan  
SOURCE: Travelers Film Library  
DESCRIPTION: This film deals with the physiology of those parts of the body involved in lifting. Shows by cartoon drawings how the muscles involved react and where they are located. This gives the viewer a better understanding of what goes on in his or her own body when s(he) lifts and why it should be done properly and safely.

## HOW TO WELD

FORMAT: Film, 16mm color, 18 minutes  
AVAILABILITY: Loan  
SOURCE: Association of Films, SU-114-105  
DESCRIPTION: The proper techniques to be used in welding the US steels T-1 are demonstrated, stressing the importance of using the right type of electrodes and proper level of hydrogen. The film depicts safe ways to keep electrodes dry and away from moisture and demonstrates the type of ovens to be used to dry them out. It gives all the safety precautions that should be taken in welding.

## INTRODUCTION TO AUTO SHOP SAFETY

FORMAT: Audiovisual filmstrip and cassette, 1977  
AVAILABILITY: Rental  
SOURCE: 2000 Company  
DESCRIPTION: This program presents guidelines for preventing on-the-job injuries in an automobile repair shop.

## INTRODUCTION TO ELECTRICITY/ELECTRONICS SHOP SAFETY

FORMAT: Audiovisual filmstrips and cassettes, 1978  
AVAILABILITY: Rental  
SOURCE: 2000 Company  
DESCRIPTION: Gives introductory safety guidelines for the beginning electricity or electronics shop student. Emphasizes the safety hazards in a typical school electricity/electronics shop.

## INTRODUCTION TO GRAPHIC ARTS SAFETY

FORMAT: Audiovisual filmstrip and cassettes, 1978  
AVAILABILITY: Rental  
SOURCE: 2000 Company  
DESCRIPTION: This program illustrates the safety hazards involved in a typical school print shop.

## INTRODUCTION TO MACHINE METAL SHOP SAFETY

FORMAT: Audiovisual filmstrip and cassette, 1978  
AVAILABILITY: Rental  
SOURCE: 2000 Company  
DESCRIPTION: This program uses close-up photography to offer instruction on tool safety in the machine shop.

## INTRODUCTION TO WELDING SAFETY

FORMAT: Audiovisual filmstrip and cassette  
AVAILABILITY: Rental  
SOURCE: 2000 Company  
DESCRIPTION: This unit gives an introduction to welding safety and also covers oxyacetylene welding and arc welding.

## INTRODUCTION TO WOODSHOP/CARPENTRY SAFETY

FORMAT: Audiovisual, 1978  
AVAILABILITY: Rental  
SOURCE: 2000 Company  
DESCRIPTION: Safe methods of using woodshop equipment and the hazards involved are demonstrated through close-up photography.

## IT'S UP TO YOU

FORMAT: Film, 16mm color, 12 minutes  
AVAILABILITY: Loan  
SOURCE: Modern Talking Pictures  
DESCRIPTION: This film is on eye protection.

## THE MAGIC OF FIRE

FORMAT: Film, 16mm color, 18 minutes  
AVAILABILITY: Loan  
SOURCE: US Bureau of Mines, #809  
DESCRIPTION: This film is an introduction to the basic elements required to make a fire. The film traces the beginning of oil and its by-products--gasoline, kerosene, and cleaning solvents. It shows a laboratory test for butane, the different characteristics of natural gas vs butane, the proper containers to be used for storing or handling flammables, and the danger of lawn mowers.

## MECHANICAL AIDS

FORMAT: Film, 16mm color, 12 minutes  
AVAILABILITY: Loan  
SOURCE: BNA Communications, Inc.  
DESCRIPTION: This film shows safety hazards in the construction industry. It describes excellent safety features of the various saws, power tools, and other equipment used on construction sites. The film also shows how overconfidence of workers on construction sites can lead to carelessness.

## THE MILLING MACHINE

FORMAT: Film, 16mm black and white  
AVAILABILITY: Loan  
SOURCE: USOE  
DESCRIPTION: The application and operation of milling machines are described in this film.

## NEW WAY TO LIFE

FORMAT: Film, 16mm color, 10 minutes  
AVAILABILITY: Loan  
SOURCE: Travelers Film Library  
DESCRIPTION: This film shows the right way to lift heavy objects. It describes the six parts of a perfect lifting unit and explains the importance of each to a properly executed lift. The film demonstrates the palmar grip; the proper position of the back, chin, arms, and feet; and the correct distribution of body weight.

A unique quality of the lifting procedure described is that it can be used in any lifting situation regardless of the size or shape of the load. It can also be used when lowering objects, turning the body to move a load, or when two persons are working together.

## OH! MY ACHING BACK

FORMAT: Film, 16mm color, 20 minutes  
AVAILABILITY: Loan  
SOURCE: US Bureau of Mines, #810  
DESCRIPTION: Film opens with a man working on a large machine. He lifts a large piece of metal stock wrong and collapses. Then at the hospital a doctor, using remarkable training aids, explains the working of the spine and the back and leg muscles. A good simple medical explanation of the working of the spine, back, and legs in lifting is given. It also shows proper lifting techniques.

## ON EVERY HAND

FORMAT: Film, 16mm color, 12 minutes  
AVAILABILITY: Loan  
SOURCE: Employers Insurance of Wausau  
DESCRIPTION: This film shows the danger of various types of machines and equipment, and depicts examples of workers getting caught in equipment.

### POWER HAND SAW SAFETY

FORMAT: Film, 16mm color, 15 minutes  
AVAILABILITY: Loan  
SOURCE: Employers Insurance of Wausau  
DESCRIPTION: This film explains detailed safety procedures to be followed by skilled carpenters using power hand saws.

### PRINT SHOP SAFETY

FORMAT: Filmstrip and audio tape  
AVAILABILITY: Loan  
SOURCE: Bergwall Productions, Inc.  
DESCRIPTION: This filmstrip and audio tape describe safety procedures to be used in the operation of printing presses and other print shop equipment. Personal protective devices are described and their proper use specified.

### R.I.P. HARRY SPARKS

FORMAT: Film, 16mm color, 20 minutes, 1976  
AVAILABILITY: Loan  
SOURCE: International Film Bureau  
DESCRIPTION: An electrical safety film featuring Harry Sparks, an electrician who has been killed and returns to earth as a guardian angel whose job is keeping electrical workers from making a fatal mistake. The film shows basic electrical hazards, how electric current flows through the body, and what electrical shocks can do to the human body.

## SAFE AUTO BODY SHOP

FORMAT: Audiovisual, filmstrip  
AVAILABILITY: Rental  
SOURCE: Bergwall Productions, Inc.  
DESCRIPTION: This filmstrip is useful for introducing safety practices in an auto body repair shop and the tools associated with the repair of metal and fiberglass. Personal protective equipment and its use is also described. Some emphasis is also placed on making workers aware of the hazards of operating auto body equipment.

## SAFTITUDES

FORMAT: Audiovisual, 4 filmstrips and 2 tapes  
AVAILABILITY: Rental  
SOURCE: 2000 Company  
DESCRIPTION: This filmstrip/tape presentation uses stories and cartoon characters to assist students in analyzing the attitudes on safety and to stimulate discussion about attitude importance.

## STOP THE FIRE BEFORE IT STARTS

FORMAT: Film, 16mm color, 14 minutes  
AVAILABILITY: Loan  
SOURCE: Journal Films  
DESCRIPTION: This basic fire prevention film shows 1) fires started in welding, 2) explosive dusts igniting from sparks, 3) glues and other low flash point liquids catching on fire, and 4) flammable hydraulic fluids and the ease with which leaking lines catch on fire.

## STRAIGHT TALK ON EYE SAFETY

FORMAT: Film, 16mm color, 12 minutes

AVAILABILITY: Loan

SOURCE: Travelers Film Library

DESCRIPTION: A hard-hitting film. Two veteran campaigners in the battle for eye safety speak on the need for 100% eye and face protection in shops and plants and the need to teach eye safety to young people in school shops and labs.

Bill Frank, blinded in a shop accident, speaks directly to employees. He warns them of the tragic consequences that will result from blinding accidents, of what such an accident will mean to their spouses and their kids, and delivers a fighting plea for eye protection in every shop and plant.

Jim O'Neill of the National Society for the Prevention of Blindness adds his strong voice in support of the safety program. Jim hits hard on the need for eye protection in industry, in school shops and labs, and in the home.

## TO BE FORGED

FORMAT: Film, 16mm color, 18 minutes

AVAILABILITY: Loan

SOURCE: Modern Talking Pictures, #2705

DESCRIPTION: This film shows the machinery required for making tools and parts. Also shown is the design and the various art techniques of forging -- including the metals used.

## THE TRAP

FORMAT: Film, 16mm black & white, 20 minutes, 1961

AVAILABILITY: Loan

SOURCE: Harvest Film Co.

DESCRIPTION: This film illustrates worker's injuries in industry as the result of poor housekeeping and disregard of machine guards. Also included are interviews with victims.

## THE UNPLANNED

FORMAT: Film, 16mm color, 20 minutes  
AVAILABILITY: Loan  
SOURCE: Employers Insurance of Wausau  
DESCRIPTION: The film deals with the need for careful investigation of accidents. The story outlines an accident in the making. It takes place in a general machine shop and drafting office. It is an outstanding training film because it presents flashbacks in which we are able to review the information given by each of the witnesses at the investigation. It is an excellent opportunity for the student to fill out an "Accident Investigation Form."

## WE'LL SEE TO-MORROW

FORMAT: Film, 16mm color, 10 minutes, 1971  
AVAILABILITY: Loan  
SOURCE: Gilbert Altschul Productions  
DESCRIPTION: A film about a man who was very safety conscious at work, but at home he didn't use eye protection equipment and while working got a chip in his eye. It also gives a lecture on the dangers to the eyes and shows the eye protection required in industry. It presents shop hazards that cause eye injuries: intense light, heat, hot liquids, and flying sparks; and shows equipment that can prevent accidents.

## WRONG PLACE, WRONG TIME, WRONG SHOES

FORMAT: Film, 16mm color  
AVAILABILITY: Loan  
SOURCE: Employers Insurance of Wausau  
DESCRIPTION: 70,000 foot accidents occur each year in industry, most as the result of workers not wearing steel-toe safety shoes. This film shows a number of accidents and how they could have been avoided. Detailed information is given on tests that are conducted on safety shoes. Also shown is how attractive safety shoes are being styled today, similar to dress shoes in appearance.

3

2

1

# ORGANIZATIONS

ORGANIZATIONS

Pages 777-781 were adapted from Safety Education Handbook, produced by Kansas State Department of Education, Wichita, Kansas, 1981.

## ORGANIZATIONS

The following organizations, comprised of professional associations and manufacturers of equipment and supplies, have submitted material to be reviewed by the writing teams of this handbook. Their contributions to our endeavors are greatly appreciated. Their enthusiastic response is indicative of their concern for the health and safety of pupils, school personnel, and citizens in the public sector.

A. B. Dick Company, 5700 West Touhy Avenue, Chicago, IL 60648  
Ablah Hotel Supply Corp., 800 E. 11th St., Wichita, KS 67214  
Addressograph Multigraph Corp., 1200 Babbitt Road, Cleveland, OH 44117  
Aget Manufacturing Company, Adrian, MI 49221  
Airco Welding Products, P.O. Box 486, Union, NJ 07083  
American Mason Safety Tread Company, P.O. Box 310, Lowell, ME 01583  
American National Standards Institute, Inc., 1430 Broadway, NY 10018  
American Optical Corporation, 14 Mechanic St., Southbridge, MA 01550  
American School and Community Safety Association, 1201 Sixteenth St.,  
N.W. Washington, D.C. 20036  
American Society of Safety Engineers, 850 Busse Highway, Park Ridge,  
IL 60068  
American Technology, 2340 Susquehanna Street, Harrisburg, PA 17110  
American Welding Society, 2501 Northwest 7th St., Miami, FL 33125  
AMMCO-Tools, Inc. 211 Commonwealth Avenue, North Chicago, IL 60064  
AMPCO Metal, P.O. Box 37014, Cincinnati, OH 45222  
APEX Safety Products, P.O. Box 250, Sanford, NC 27330  
Applied Ultra Violet Tech., 1301 E. Lincoln Avenue, Goshen, IN 46526  
ARCAIR, P.O. Box 406, Lancaster, OH 43130  
Armstrong Brothers Tool Company, 5200-5300 W. Armstrong Ave., Chicago,  
IL 60646  
Armstrong Cork Company, West Liberty St., Lancaster, PA 17540  
ARTCO Corporation, Penn Avenue, Hatfield, PA 19440  
Atlantic India Rubber Company, 571 W. Polk St., Chicago, IL 60607  
  
Baker (J.T.) Chemical Company, 222 Red School Lane, Phillipsburg,  
NJ 08865  
Baldor Electric Company, Fort Smith, AR 72902  
Bausch & Lomb, Box 450, Dept. 3506-B, Rochester, NY 14613  
Binks Mfg. Company, P.O. Box 66090, Chicago, IL 60666  
Black & Decker Mfg. Company, Towson, MD 21204  
Blu-Ray, Inc., 747 Westbrook Road, Essex, CT 06426  
Bona Venture Supply Company, 17 Village Square, Hazelwood, MO 63042  
Bouton Company (H.L.) Buzzards Bay, MA 02532  
C.W. Brabender Instruments Inc., 50 East Wesley St., P.O. Box 2127  
South Hackensack, NJ 07606

Bradley Corp. W142 N9101 Fountain Blvd., Menomonee Falls, WI 53051.  
Brett-Guard Div. Foredom Electric Company, RR #6 Bethel, CT 06801.  
Bridgeport Textron Machines Division, 500 Lindley St., Bridgeport, CT  
06606.  
Brilliant Abrasive Company, 4330 Clary Blvd., Kansas City, MO 64130.  
Brodhead-Garrett Company, 4560 East 71st St., Cleveland, OH 44105.  
Bruning (Charles) Company, Div. A-M Corp., 1800 West Central, Mount  
Prospect, IL 60056.

Cadillac Plastic & Chemical Co., Box 810, Detroit, MI 48232.  
CESCO Safety Products, 100 East 16th St., Kansas City, MO 64108.  
Challenge Machinery Company, P.O. Box 326, Grand Haven, MI 49417.  
Coilhose Pneumatics, 201 Pond Ave., Middlesex, NJ 08846.  
Columbian Vise & Mfg. Company, 9021 Bessemer Ave., Cleveland, OH 44104.  
Columbus McKinnon Corp., Fremont Avenue, Tonawanda, NY 14150. (CM Chain  
Divison)  
Compugraphic 80 Industrial Way, Wilmington, MA 01887.  
Cooperative Extension Service, K.S.U., Manhattan, KS 66506

D & M Guard Company, 889 Military Road, Buffalo, NY 14217.  
Delaware Valley Safeguards Company, Leesport, PA 19533  
Di-Acro Houdaille, Houdaille Industrices, Inc., Lake City, MN 55041.  
Dustvent, Inc., 110 West Fay St., Addison, IL 60101.  
Dyna Technology, Inc., P.O. Box 3263, Sioux City, IA 51102.  
DAKE Corporation, Grand Haven, MI 49417.

Eagle Mfg. Company, Main Street, Wellsburg, WV 26070.  
Eastern Safety Equipment, 45-17 Pearson St., Long Island City, NY 11101.  
Educational Machinery Corp., Box 146, Glenville Station, Greenwich,  
CT 06830.  
Ellwood Safety Appliance Co., Gray Building, 225 Sixth St., Ellwood City,  
PA 16117.

Energy Concepts, Inc., 3956 West Belmont Ave., Chicago, IL 60618.  
Equipment Company of America, 1075 Hialeah Dr., Hialeah, FL 33010  
Equipto (Gary DeWitt) 225 South Highland, Aurora, IL 60507.  
ESB Inc., Safety Products Division, 2nd & Washington Street, Reading,  
PA 19603.

Falcon Safety Products, Inc., 1065 Bristol Rd., Mountainside, NJ 07092.  
Fibre-Metal Products Co., Concordville, PA 19331.  
Frank Paxton Lumber Co., 6311 St. John, Kansas City, MO 64123.  
Frommelt Industries, Inc., 465 Huff St., Dubuque, IA 52001.

General Scientific Equipment Co., P.O. Box 27309, Philadelphia, PA 19150.  
Glendale Optical Company, Inc., 130 Crossways Park Drive, Woodbury,  
Long Island, NY 11797.  
Graymark International Inc., P.O. Box 17359, Irvine, CA 92713.  
Grinding Wheel Institute, 712 Lakewood Center, North Cleveland, OH 44107.  
Hamilton Beach, Washington, NC 27889

Hammond Machinery Builders, Inc. 1604 Douglas Ave., Kalamazoo, MI 49007.  
Hand Tools Institute, 707 Westchester Ave., White Plains, NY 10604.  
Harper Trucks, Inc., P.O. Box 33, Wichita, KS 67201.  
HAWS Drinking Faucet Company, 4th and Page Streets, Berkeley, CA 94710.  
Hickok Teaching Systems Inc., Wheeling Avenue, Wobur, MA 01801.  
Homestead Industries, Box 348, Corapolis, PA 15108.  
Human Society of The United States, Washington, D.C. 20037.

Industrial Commission of Ohio, 700 West 3rd Ave., Columbus, OH 43212.  
Ingersoll-Rand (Miller Falls Div.) South Deerfield, MA 01373.  
Ingersoll-Rand Company (Prot Tool Div.) 2600 E. Nutwood Avenue,  
Fullerton, CA 92631  
Institute of Gas Technology, 3424 S. State St., Chicago, IL 60544.

Justrite Manufacturing Company, 2354 Dempster St., Des Plaines, IL 60016.

Kellogg-American, Inc., 565 Cedar Way, Oakmont, PA 15139.  
Kelvin Electronics, Inc., 1900 New Highway, Farmingdale, NY 11735.  
Ken Cook Company, Automated Teaching, 9929 West Silver Spring Road,  
Milwaukee, WI 53225.  
Kidde Belleville (Walter) 675 Main Street, Belleville, NJ 07109.

Lab-Line Instruments, Inc., 15th & Bloomingdale Ave., Melrose Park,  
IL 60160.

Lab Safety Supply Company, P.O. Box 1368, 3430 Palmer Drive, Janesville,  
WI 53545.

K.O. Lee Company, P.O. Box 970, 200 South Harrison, Aberdeen, SD 57401.  
Lincoln Electric Company, 22801 St. Clair Ave., Cleveland, OH 44117.  
Link Electric & Safety Control, P.O. Box 100, Kingston Springs, IN 37082.  
Loge/Robertson Photo-Mechanic, 250 Willie Road, Des Plaines, IL 60018  
Lowel-Light Mfg. Inc., 421 West 54th St., New York, NY 10019.

McEnglevan Heat Treating Mfg. Company, P.O. Box 31, Danville, IL 61832.

McGill Mfg. Company, Inc., Valparaiso, IN 46383.

McKnight & McKnight Publishing Co., Dept. B-3, Bloomington, IL 61701.

McNeil Akron, Inc., 96 East Crosier St., Akron, OH 74311.

Macy's, 121 S. Broadway, Wichita, KS 67202

MacMillan Arts & Crafts, Inc., 9645 Gerwig Land, Columbia, MD 21046.

Manufacturers Brush Company, 12501 Elmwood Ave., Cleveland, OH 44111.

Marion Health & Safety Inc., 9233 Ward Parkway, Kansas City, MO 64114.

Marketing Matheson, P.O. Box E, Lyndhurst, NJ 07071.

Mathewson Gas Products, 932 Paterson Plank Road, P.O. Box 85, East  
Rutherford, NJ 07073.

Megatech Corp., 29 Cook Street, Billerica, MA 01866.

Met-L-Chek Company, Inc., P.O. Box 5427, Inglewood, CA 90310.

Michael Business Machines, 145 West 45th St., New York, NY 10036.

Mid-Continent Fire & Safety, Inc., 1641 N. Mosley, Wichita, KS 67214.

Midwest Sewing Center, 111 Pattie, Wichita, KS 67211

Miller Equipment Divison, ESB Inc., Franklin, PA 16323.

Milwaukee Electric Tool Corp., 13135 W. Lisbon Road, Brookfield, WI 53005.

Modern School Supplies, Inc., P.O. Box 956, Hartford, CT 06101.

Morse Mfg. Company, Inc., 780 West Manlius St., East Syracuse, NY 13057.

National Electrical Contractors Association, Kansas Chapter, Wichita, KS.

National Fire Protection Association, 470 Atlantic Ave., Boston, MA 02210.

National Society for Prevention of Blindness, 79 Madison Ave., New York, NY

Newbury Industries, Inc., 10975 Kinsman Road, Newbury, OH 44065.

Nisson Corp., 930 27th Avenue, S.W., P.O. Box 1270, Cedar Rapids, IA 52406.

Norton Company, 2000 Plainfield Pike, Cranston, RI 02920.

NuArc Company, Inc., 4110 West Grand Ave., Chicago, IL 60651.

Occupational Safety & Health Administration, 216 N. Waco, Wichita, KS 67202.

Paragon Industries, Inc., Box 10133, Dallas, TX 75207.

Pittsburg Industrial Teachers Service Co., P.O. Box 26, Pittsburg, KS 66762.

Photo Materials Company, 500 N. Spaulding Ave., Chicago, IL 60624.

Positive Safety Manufacturing Co., 34990 Melinz Parkway, Eastlake, OH 44094.

Power Tool Institute, Inc., 5101 Toll View Drive, Rolling Meadows, IL.

Powermatic Houdaille, Inc., McMinnville, TN 37110.

Protectoseal Company, 225 West Foster Ave., Bensenville, IL 60106

Proto Professional Tools, 2600 E. Nutwood Ave., Fullerton, CA 92631.

Pitsco Inc., Pittsburg Industrial Teachers Service Company, P.O. Box 26, Pittsburg, KS 66762.

Radatron Corp., 2424 Niagara Falls Blvd., N. Tonawanda, NY 14120.

Refrigeration Service Engineers Society, Wichita, KS.

REGO Company, 4201 West Peterson Ave., Chicago, IL 60646.

Rexarc Inc., P.O. Box 47, W. Alexandria, OH 45381.

Ridge Tool Company, 400 Clark Street, Elyria, OH 45381.

Robertson Photo-Mechanix, Inc., 1250 Touhy Ave., Elk Grove Village, IL 60007.

Rockford Safety Equipment Company, P.O. Box 5166, 4620 Hydraulic Road, Rockford, IL 61125.

Rockwell International, 400 N. Lexington Ave., Pittsburg, PA 15208.

Roper Whitney, Inc., 2833 Huffman Blvd., Rockford, IL 61101.

Rose Manufacturing Company, 2250 Tejon St., Englewood, CO 80110.

Safeguard Manufacturing Company, Pomperaug Ave., Woodbury, CT 06798.

Salisbury & Company, 7520 N. Long Ave., P.O. Box 1080, Skokie, IL 60077.

School Tools, Inc., 901 East 79th Street, Minneapolis, MN 55420.

Screen Printing & Drying Machine Company, 4434 Olive St., St. Louis, MO 63108.

Seal, Inc., Naugatuck, CN 06770

Sellstrom Mfg. Company, Sellstrom Industrial Park, Palatine, IL 60067

Shawnee Mission, Director of Practical Arts, 6649 Lamar, Shawnee Mission, KS 66202.

Singer Safety Products, 444 North Lake Shore Drive, Chicago, IL 60611.  
Sioux Tools Inc., 2901 Floyd Blvd., Sioux City, IA 51102.  
Snap-on Tools Inc., Kenosha, WI 53140.  
Society of Plastics Industry, Inc., 355 Lexington Ave., New York, NY  
10017.  
South Bend Lathe, Inc., 400 West Sample St., South Bend, IN 46621.  
Stanley Tools, New Britain, CN 06050.  
SSP Brown Camera, Inc., 610 E. Judd St., P.O. Box 471, Woodstock, IL  
60098.  
Stark Lumber Company, Fairfax Industrial District, Kansas City, KS 66115.  
Steel Grip Safety Apparel Company, 700 Garfield St., Danville, IL 61832.  
Sterling Extruder Corp., 901 Durhan Ave., S. Plainfield, NJ 07080.  
Surty Manufacturing Company, Route #2, Gleason, WI 54435.  
Society of Plastics Engineers, Inc., 656 West Putnam Ave., Greenwich,  
CT 06830.  
Three M (3M) St. Paul, MN 55101.  
Toolmark Company, 6840 Shingle Creek Parkway, Minneapolis, MN 55430.  
Torit Division, Donaldson Co., Inc., Box 3217 St. Paul, MN 55165.  
  
Unimax Switch Corporation, Ives Road, Wallingford, CT 06492.  
United Air Specialists, Inc., 6665 Creek Road, Cincinnati, OH 45242.  
United HEW - NIOSH - 4676 Columbia Parkway, Cincinnati, OH 45226.  
U.S. Mat and Rubber Company, Inc., 93 Pleasant St., Brockton, MA 02401.  
U.S. Safety Service Company, 1535 Walnut St., Box 1237, Kansas City,  
MO 64141.  
Uniweld Products, Inc., P.O. Box 8427, Ft. Lauderdale, FL 33310.  
Universal Grinding Wheel Company, Inc., 712 Lakewood Center North,  
Cleveland, OH 44107.  
University of Northern Iowa, Cedar Falls, IA 50613.  
  
V and E Manufacturing Company, 766 S. Fair Oaks Ave., Pasadena, CA 91105.  
Victor Equipment Company, P.O. Box 1007, Denton, TX 76201.  
Vivitar, 1630 Stewart Street, Santa Monica, CA 90406.  
  
Weller, Division of Cooper Industries, 100 Wellco Road, Easton, PA 18042.  
Wells & Sons, North on U.S. 131, Three Rivers, MI 49093.  
Western Drinking Fountains (Safety Div.) P.O. Box 47, Glen Riddle,  
PA 19037.  
Wilton Corporation, Machinery Division, 2400 East Devon Ave., Des Plaines,  
IL 60018.

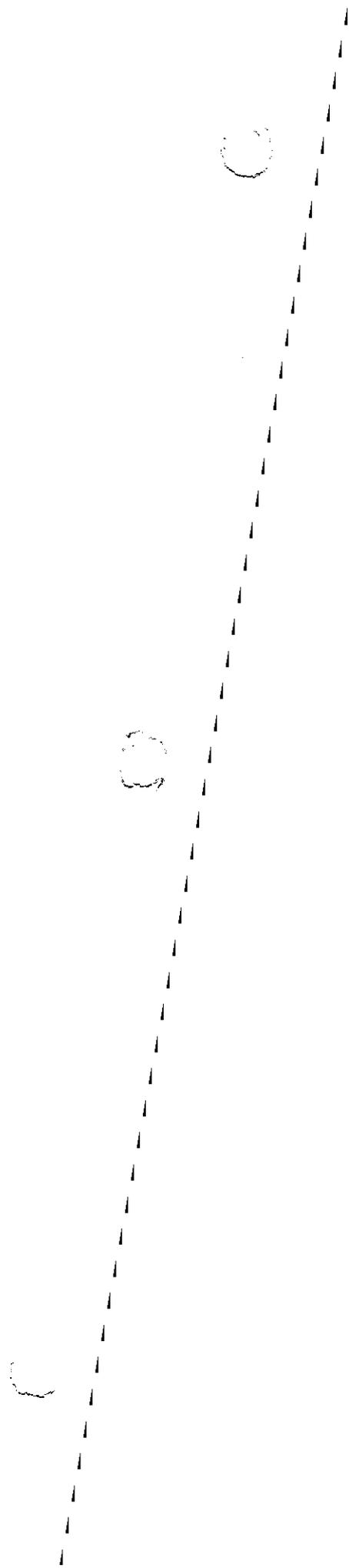
11

12

13

**INDEX**  
OF TOOLS, MACHINES, AND EQUIPMENT

**INDEX OF TOOLS, MACHINES, AND EQUIPMENT**



## INDEX

Adhesives, spray, 459-461  
Air impact wrench, 327-331  
Arc welder, 553-558  
Auto tire changer, 721-726  
Automotive end lift, 691-695

Band saw (metals), 39-44  
Band saw (woods), 211-217  
Bar folder, 113-118  
Battery. See Storage battery  
Battery charger, 645-650  
Bayonet saw, 285-289  
Belt and disc sander, 259-261, 265-267  
Belt sander, 303-307. (See also Sander, belt and disc.)  
Box and pan brake, 119-124  
Brake, box and pan, 119-124  
Brake drum, 651-656  
Buffer, 125-130

Camera, process, 421, 425-433  
Car lift, 669-675  
Cathode-ray tube, 469-473  
Caustic tank, 697-702  
Circuit boards, 475-480  
Circular saw, 291-296  
Circular table saw, 197-202  
Cleaner, steam, 709-713  
Cleaners, film, 459-461  
Combination rotary machine, 137-142  
Composer, 359-361, 367-368  
Contact printer, 421-423, 429-431  
Crane. See Engine crane and hoist  
CRT, 469-473  
Crucible furnace, 45-53  
Cutting tools, paste-up, 459-461

Darkroom equipment, 415-433  
Disc sander, 259-260, 263-267  
Disc sander, portable, 309-313  
Drill, electric, 279-284  
Drill, paper, 403-408  
Drill press, 251-257  
Dry mount press, 451-453, 460-463

Electric drill, 279-284  
Engine analyzer, 657-662  
Engine crane and hoist, 677-681  
Enlarger, 417-419  
Etched-circuit PC board, 481-486

Film cleaners, 459-461  
Finishing sander, 315-319

Folder, 397-402  
Forge, gas, 55-60  
Furnace, crucible, 45-53  
Furnace, soldering, 61-66

Gas forge, 55-60  
Generator, signal, 505-509  
Gold stamp press, 441-445  
Granulator, plastics, 179-184  
Grinder, 67-73, 309-313  
Grinder, surface, 75-80

Hacksaw, power, 95-100  
Hand-operated paper cutter, 447-449, 460-462  
Heating oven, 159-161, 165  
High speed wheel balancer, 663-667  
Hoist. See Engine crane and hoist  
Hot caustic tank, 697-702  
Hydraulic floor jack, 683-690

Injection molder, 167-178

Jack, hydraulic floor, 683-690  
Jig saw, 219-224  
Jointer, 237-243

Lathe, 81-87  
Lathe, rotor, 651-656  
Lathe, wood, 245-250  
Lift, automotive end, 691-695  
Lift, car, 669-675  
Light table, 363-368

Metal inert gas welder, 559-563, 567-570  
MIG welder, 559-563, 567-570  
Milling machine, 89-94  
Miter box saw, 225-230  
Molder, injection, 167-178  
Multimeter, 487-491

Offset composition, 359-368  
Offset press, 369-377  
Oscilloscope, 493-497  
Oxyacetylene welder, 537-545

Paper cutter, 391-396  
Paper cutter, hand-operated, 447-449, 460-462  
Paper drill, 403-408  
PC board, 481-486  
Phototypesetter, 359-361, 367-368  
Planer, 231-236  
Planer, portable, 321-326  
Plastics granulator, 179-184  
Platemaker, 385-390

Platen press, 349-357  
Power hacksaw, 95-100  
Power plane, 321-326  
Power supply, 499-503  
Press, dry mount, 451-453, 460-463  
Press, offset, 369-377  
Press, platen, 349-357  
Press, proof, 379-384  
Press, rubber stamp, 441-445  
Print dryer, 455-457, 460-462  
Printer, contact, 421-423, 429-431  
Printer, screen, 435-440  
Process camera, 421, 425-433  
Proof press, 379-384

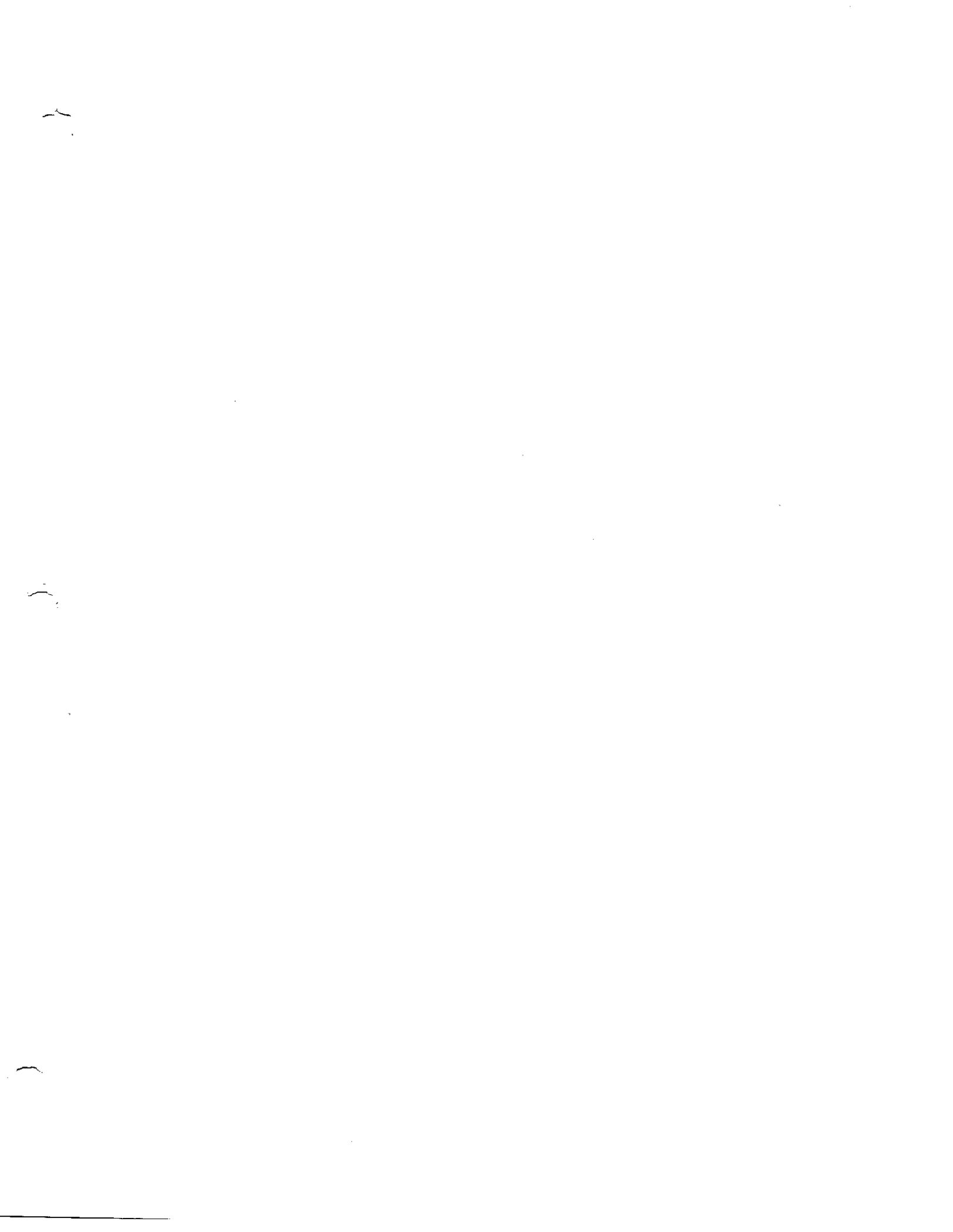
Radial saw, 203-209  
Rotary machine, combination, 137-142  
Rotor lathe, 651-656  
Router, 297-302  
Rubber stamp press, 441-445

Sander, belt, 303-307. (See also Sander, belt and disc.)  
Sander, belt and disc, 259-267  
Sander, disc, 309-313  
Sander, finishing, 315-319  
Saw, band (metals), 39-44  
Saw, band (woods), 211-217  
Saw, bayonet, 285-289  
Saw, circular table, 197-202  
Saw, circular, 291-296  
Saw, miter box, 225-230  
Saw, radial, 203-209  
Saw, scroll, 219-224  
Screen printer, 435-440  
Scroll saw, 219-224  
Shaper, 101-106  
Signal generator, 505-509  
Signal tracer, 511-515  
Slip roll forming machine, 131-136  
Solder gun, 333-337  
Soldering furnace, 61-66  
Soldering irons, 344-345  
Solvent tank, 703-707  
Spot welder, 565-570  
Spray adhesives, 459-461  
Squaring shear, 107-112  
Stamp press. See Press, rubber stamp  
Stapler, 409-414  
Steam cleaner, 709-713  
Storage battery, 715-720  
Strip heater, 159, 163-166  
Surface grinder, 75-80  
Surfacer. See Planer

Tank, hot caustic, 697-702  
Tank, solvent, 703-707  
TIG welder, 559-563, 567-570  
Tire changer, auto, 721-726  
Tire inflation cage, truck, 727-731  
Tracer, signal, 511-515  
Transformer, 517-521  
Truck tire inflation cage, 727-731  
Tungsten inert gas welder, 559-563, 567-570

Vacuumformer, 185-190  
Valve reconditioner, 733-737

Waxer, 363-368  
Welder, arc, 553-558  
Welder, MIG, 559-563, 567-570  
Welder, oxyacetylene, 537-545  
Welder, spot, 565-570  
Welder, TIG, 559-563, 567-570  
Wheel balancer, high speed, 663-667  
Wood lathe, 245-250  
Wrench, air impact, 327-331





State of Florida  
Department of Education  
Ralph D. Turlington, Commissioner of Education  
Tallahassee, Florida  
Affirmative action/equal opportunity employer

*Division of Vocational Education*