STATION 1 – GENERAL SAFETY RULES

Read/review the safety contract and answer the following question:

- What do you think are the FIVE most important/practical "general rules" for lab safety in this class?
- Summarize your choices

GENERAL RULES

1. Conduct yourself in a responsible manner at all times in the laboratory.
2. Follow all written and verbal instructions carefully. If you do not understand a direction or part of a procedure, ask the instructor before proceeding.
3. Never work alone. No student may work in the laboratory without an instructor present.
4. When first entering a science room, do not touch any equipment, chemicals, or other materials in the laboratory area until you are instructed to do so.
5. Do not eat food, drink beverages, or chew gum in the laboratory. Do not use laboratory glassware as containers for food or beverages.
6. Perform only those experiments authorized by the instructor. Never do anything in the laboratory that is not called for in the laboratory procedures or by your instructor. Carefully follow all instructions, both written and oral. Unauthorized experiments are prohibited.
7. Be prepared for your work in the laboratory. Read all procedures thoroughly before entering the laboratory.
8. Never fool around in the laboratory. Horseplay, practical jokes, and pranks are dangerous and prohibited.
9. Observe good housekeeping practices. Work areas should be kept clean and tidy at all times. Bring only your laboratory instructions, worksheets, and/or reports to the work area. Other materials (books, purses, backpacks, etc.) should be stored in the classroom area.
10. Keep aisles clear. Push your chair under the desk when not in use.
11. Know the locations and operating procedures of all safety equipment including the first aid kit, eyewash station, safety shower, fire extinguisher, and fire blanket. Know where the fire alarm and the exits are located.
12. Always work in a well-ventilated area. Use the fume hood when working with volatile substances or poisonous vapors. Never place your head into the fume hood.
13. Be alert and proceed with caution at all times in the laboratory. Notify the instructor immediately of any unsafe conditions you observe.
14. Dispose of all chemical waste properly. Never mix chemicals in sink drains. Sinks are to be used only for water and those solutions designated by the instructor. Solid chemicals, metals, matches, filter paper, and all other insoluble materials are to be disposed of in the proper waste containers, not in the sink. Check the label of all waste containers twice before adding your chemical waste to the container.
15. Labels and equipment instructions must be read carefully before use. Set up and use the prescribed apparatus as directed in the laboratory instructions or by your instructor.
16. Keep hands away from face, eyes, mouth and body while using chemicals or preserved specimens. Wash your hands with soap and water after performing all experiments. Clean all work surfaces and apparatus at the end of the experiment. Return all equipment clean and in working order to the proper storage area.
17. Experiments must be personally monitored at all times. You will be assigned a laboratory station at which to work. Do not wander around the room, distract other students, or interfere with the laboratory experiments of others.
18. Students are never permitted in the science storage rooms or preparation areas unless given specific permission by their instructor.
19. Know what to do if there is a fire drill during a laboratory period; containers must be closed, gas valves turned off, fume hoods turned off, and any electrical equipment turned off.
20. Handle all living organisms used in a laboratory activity in a humane manner. Preserved biological materials are to be treated with respect and disposed of properly.
21. When using knives and other sharp instruments, always carry with tips and points pointing down and away. Always cut away from your body. Never try to catch falling sharp instruments. Grasp sharp instruments only by the handles.
22. If you have a medical condition (e.g., allergies, pregnancy, etc.), check with your physician prior to working in lab.

STATION 2 –SAFETY RULES, Part 1

Read/review the safety contract rules and answer the following question:

- Read the safety rules for CLOTHING summarize them into ONE rule for clothing.
- Read the safety rules for ACCIDENTS AND INJURIES and summarize them into ONE rule for this section.

CLOTHING

23. Any time chemicals, heat, or glassware are used, students will wear laboratory goggles. There will be no exceptions to this rule!
24. Contact lenses should not be worn in the laboratory unless you have permission from your instructor.
25. Dress properly during a laboratory activity. Long hair, dangling jewelry, and loose or baggy clothing are a hazard in the laboratory. Long hair must be tied back and dangling jewelry and loose or baggy clothing must be secured. Shoes must completely cover the foot. No sandals allowed.
26. Lab aprons have been provided for your use and should be worn during laboratory activities.

ACCIDENTS AND INJURIES

27. Report any accident (spill, breakage, etc.) or injury (cut, burn, etc.) to the instructor immediately, no matter how trivial it may appear.
28. If you or your lab partner are hurt, immediately yell out "Code one, Code one" to get the instructor's attention.
29. If a chemical splashes in your eye(s) or on your skin, immediately flush with running water from the eyewash station or safety shower for at least 20 minutes. Notify the instructor immediately.
30. When mercury thermometers are broken, mercury must not be touched. Notify the instructor immediately.

STATION 3 – SAFETY RULES, Part 2

Read/review the safety contract rules and answer the following question:

- Read the safety rules for HANDLING CHEMICALS summarize them into TWO rules for handling chemicals.
- Read the safety rules for HANDLING GLASSWARE & EQUIPMENT and summarize them into TWO rules for this section.

HANDLING CHEMICALS

31. All chemicals in the laboratory are to be considered dangerous. Do not touch, taste, or smell any chemicals unless specifically instructed to do so. The proper technique for smelling chemical fumes will be demonstrated to you.
32. Check the label on chemical bottles twice before removing any of the contents. Take only as much chemical as you need.
33. Never return unused chemicals to their original containers.
34. Never use mouth suction to fill a pipet. Use a rubber bulb or pipet pump.
35. When transferring reagents from one container to another, hold the containers away from your body.
36. Acids must be handled with extreme care. You will be shown the proper method for diluting strong acids. Always add acid to water, swirl or stir the solution and be careful of the heat produced, particularly with sulfuric acid.
37. Handle flammable hazardous liquids over a pan to contain spills. Never dispense flammable liquids anywhere near an open flame or source of heat.
38. Never remove chemicals or other materials from the laboratory area.
39. Take great care when transporting acids and other chemicals from one part of the laboratory to another. Hold them securely and walk carefully.

HANDLING GLASSWARE AND EQUIPMENT

40. Carry glass tubing, especially long pieces, in a vertical position to minimize the likelihood of breakage and injury.
41. Never handle broken glass with your bare hands. Use a brush and dustpan to clean up broken glass. Place broken or waste glassware in the designated glass disposal container.
42. Inserting and removing glass tubing from rubber stoppers can be dangerous. Always lubricate glassware (tubing, thistle tubes, thermometers, etc.) before attempting to insert it in a stopper. Always protect your hands with towels or cotton gloves when inserting glass tubing into, or removing it from, a rubber stopper. If a piece of glassware becomes "frozen" in a stopper, take it to your instructor for removal.
43. Fill wash bottles only with distilled water and use only as intended, e.g., rinsing glassware and equipment, or adding water to a container.
44. When removing an electrical plug from its socket, grasp the plug, not the electrical cord. Hands must be completely dry before touching an electrical switch, plug, or outlet.
45. Examine glassware before each use. Never use chipped or cracked glassware. Never use dirty glassware.
46. Report damaged electrical equipment immediately. Look for things such as frayed cords, exposed wires, and loose connections. Do not use damaged electrical equipment.
47. If you do not understand how to use a piece of equipment, ask the instructor for help.
48. Do not immerse hot glassware in cold water; it may shatter.

STATION 4 – SAFETY RULES, Part 3

Read/review the safety contract rules and answer the following question:

- Read the safety rules for HEATING SUBSTANCES summarize them into TWO rules for heating substances.

HEATING SUBSTANCES

49. Exercise extreme caution when using a gas burner. Take care that hair, clothing and hands are a safe distance from the flame at all times. Do not put any substance into the flame unless specifically instructed to do so. Never reach over an exposed flame. Light gas (or alcohol) burners only as instructed by the teacher.
50. Never leave a lit burner unattended. Never leave anything that is being heated or is visibly reacting unattended. Always turn the burner or hot plate off when not in use.
51. You will be instructed in the proper method of heating and boiling liquids in test tubes. Do not point the open end of a test tube being heated at yourself or anyone else.
52. Heated metals and glass remain very hot for a long time. They should be set aside to cool and picked up with caution. Use tongs or heat-protective gloves if necessary.
53. Never look into a container that is being heated.
54. Do not place hot apparatus directly on the laboratory desk. Always use an insulating pad. Allow plenty of time for hot apparatus to cool before touching it.
55. When bending glass, allow time for the glass to cool before further handling. Hot and cold glass have the same visual appearance. Determine if an object is hot by bringing the back of your hand close to it prior to grasping it.

STATION 5 – SAFETY SYMBOLS

Using the information below, ***identify***, ***sketch***, and ***explain*** FIVE safety symbols below:

Safety Symbols

Take appropriate precautions whenever any of the following safety symbols appear in an experiment.

Eye Safety
Wear safety goggles.

Clothing Protection
Wear a lab coat or apron when using corrosive chemicals or chemicals that can stain clothing.

Skin Protection
Wear plastic gloves when using chemicals that can irritate or stain your skin.

Broken Glass
Do not use chipped or cracked glassware.
Do not heat the bottom of a test tube.

Open Flame
Tie back hair and loose clothing. Never reach across a lit burner.

Flammable Substance
Do not have a flame near flammable materials.

Corrosive Substance
Wear safety goggles, an apron, and gloves when working with corrosive chemicals.

Poison
Don't chew gum, drink, or eat in the laboratory.
Never taste a chemical in the laboratory.

Fume
Avoid inhaling substances that can irritate your respiratory system.

Thermal Burn
Do not touch hot glassware or equipment.

Electrical Equipment
Keep electrical equipment away from water or other liquids.

Sharp Object
To avoid a puncture wound, use scissors or other sharp objects only as intended.

Disposal
Dispose chemicals only as directed.

Hand Washing
Wash your hands thoroughly with soap and water.

STATION 6 – BURNS

Using the given information, answer the questions:

1. Differentiate between *thermal* and *chemical* burns.
2. How can thermal and chemical burns be prevented?
3. How should thermal burns and chemical burns be treated?
4. How can acids and bases be handled to avoid chemical burns?
5. What are the symbols for *corrosive* and *irritant*?

Thermal Burns

A thermal burn can occur if you touch hot equipment or come too close to an open flame. You can prevent thermal burns by being aware that hot and cold equipment look the same. If a gas burner or hot plate has been used, some of the equipment nearby may be hot. Hold your hand near an item to feel for heat before touching it. Treat a thermal burn by *immediately* running cold water over the burned area. Continue applying the cold water until the pain is reduced. This usually takes several minutes. In addition to reducing pain, cooling the burned area also serves to speed the healing process. Greases and oils should not be used to treat burns because they tend to trap heat. Medical assistance should be sought for any serious burn. *Notify your teacher immediately if you are burned.*

Chemical Burns

A chemical burn occurs when the skin or a mucous membrane is damaged by contact with a substance. The Materials section of each exercise indicates which substances can cause chemical burns. [C] **stands for corrosive.** It indicates that the chemical can cause severe burns. [I] **stands for irritant.** It indicates that the chemical can irritate the skin and the membranes of the eye, nose, throat, and lungs. Chemicals that are marked [C] or [I] should be treated with special care. Chemical burns can be severe. Permanent damage to mucous membranes can occur despite the best efforts to rinse a chemical from the affected area.

The best defense against chemical burns is prevention. *Without exception, wear safety goggles during all phases of the laboratory period—even during cleanup.* Should any chemical splash in your eye, immediately use a continuous flow of running water to flush your eye for a period of 20 minutes. Call for help. If you wear contact lenses, remove them immediately. This is especially crucial if the chemical involved is an acid or base. It can concentrate under the lens and cause extensive damage. Wear a laboratory apron and close-toed shoes (no sandals) to protect other areas of your body. If corrosive chemicals should contact your exposed skin, wash the affected area with water for several minutes.

An additional burn hazard exists when concentrated acids or bases are mixed with water. The heat released in mixing these chemicals with water can cause the mixture to boil, spattering corrosive chemical. The heat can also cause non-Pyrex containers to break, spilling corrosive chemical.

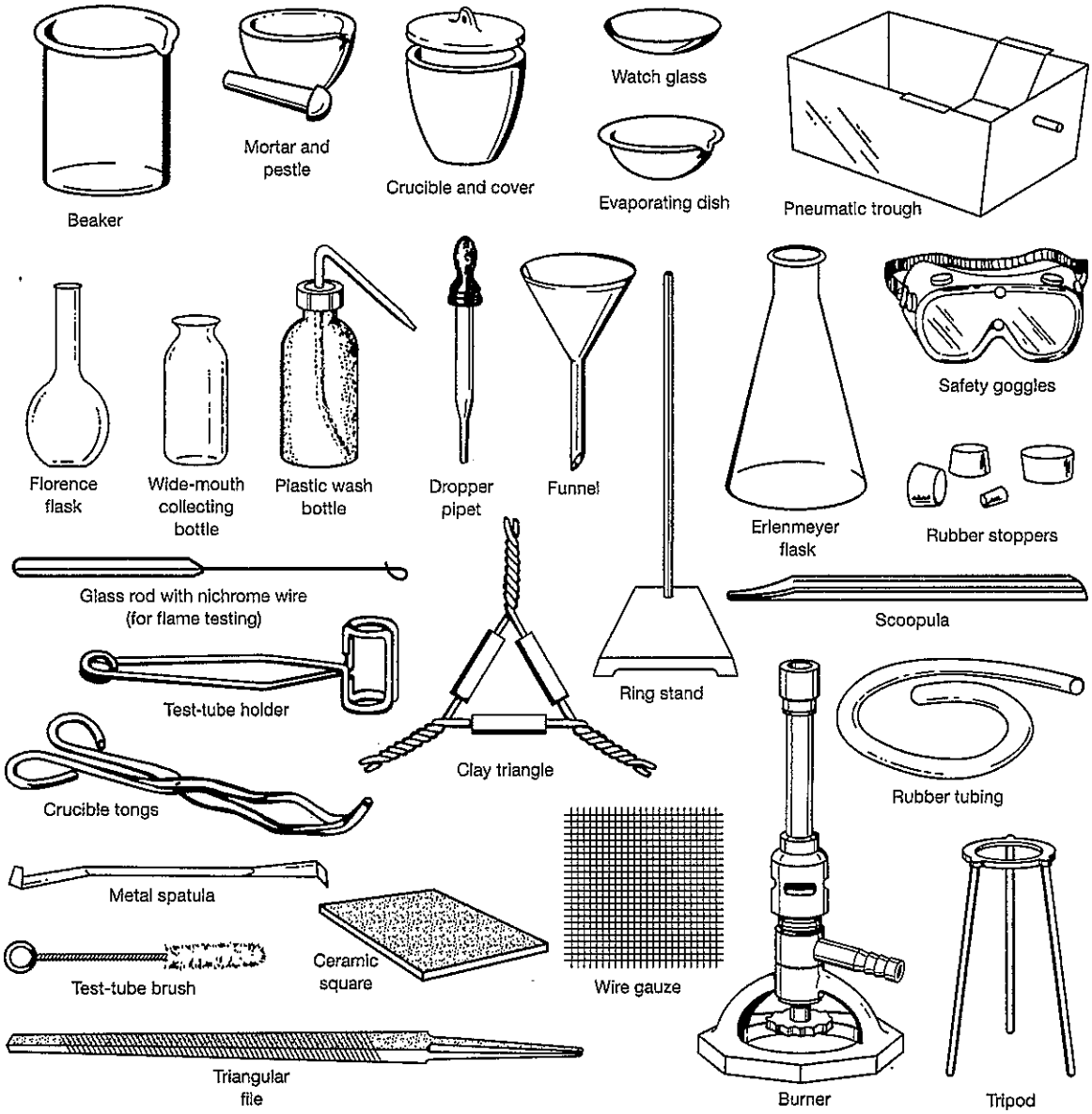
To avoid these hazards, follow these instructions: Always add acid or base to water, very slowly while stirring; never the reverse. One way to remember this critical advice is to think of the phrase "Pouring acid into water is doing what you ought-er."

STATION 7 – LAB EQUIPMENT

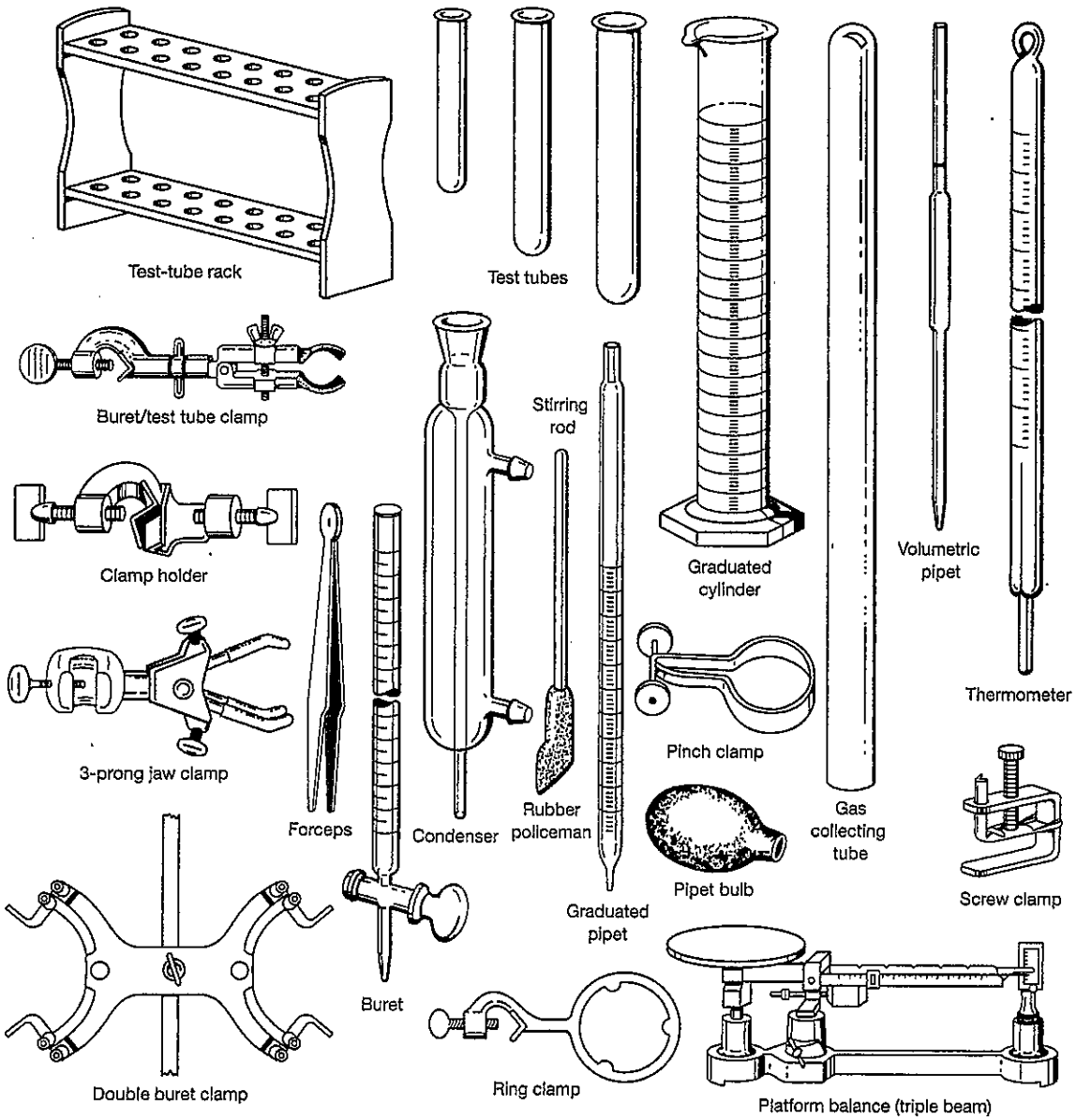
Using the information provided, differentiate between the purpose and use of each of the following lab equipment items:

1. Beaker vs Erlenmeyer flask
2. Dropper Pipette vs. spatula/scoopula
3. Crucible tongs vs test tube holder
4. Graduated cylinder vs test tube
5. Stirring rod vs thermometer

Laboratory Equipment



Beaker: glass or plastic; common sizes are 50 mL, 100 mL, 250 mL, 400 mL; glass beakers may be heated.
Buret: glass; common sizes are 25 mL and 50 mL; used to measure volumes of solutions in titrations.
Ceramic square: used under hot apparatus or glassware.
Clamps: the following types of clamps may be fastened to support apparatus: buret/test-tube clamp, clamp holder, double buret clamp, ring clamp, 3-pronged jaw clamp.
Clay triangle: wire frame with porcelain supports; used to support a crucible.
Condenser: glass; used in distillation procedures.
Crucible and cover: porcelain; used to heat small amounts of solid substances at high temperatures.
Crucible tongs: iron or nickel; used to pick up and hold small items.
Dropper pipet: glass tip with rubber bulb; used to transfer small volumes of liquid.
Erlenmeyer flask: glass; common sizes are 100 mL, 250 mL; may be heated; used in titrations.
Evaporating dish: porcelain; used to contain small volumes of liquid being evaporated.
Florence flask: glass; common sizes are 125 mL, 250 mL, 500 mL; may be heated; used in making and for storing solutions.
Forceps: metal; used to hold or pick up small objects.
Funnel: glass or plastic; common size holds 12.5-cm diameter filter paper.
Gas burner: constructed of metal; connected to a gas supply with rubber tubing; used to heat chemicals (dry or in solution) in beakers, test tubes, and crucibles.
Gas collecting tube: glass; marked in mL intervals; used to measure gas volumes.
Glass rod with nichrome wire: used in flame tests.
Graduated cylinder: glass or plastic; common sizes are 10 mL, 50 mL, 100 mL; used to measure approximate volumes; must not be heated.
Graduated pipet: glass; common sizes are 10 mL, 25 mL; used to measure solution volumes; less accurate than a volumetric pipet.
Mortar and pestle: porcelain; may be used to grind crystals and lumpy chemicals to a powder.
Pipet bulb: rubber; used in filling a pipet with a solution; a pipet must never be filled by mouth.



Plastic wash bottle: flexible plastic; squeeze sides to dispense water.
Platform balance: also known as a triple-beam balance.
Pneumatic trough: galvanized container with shelf; used in experiments where a gas is collected.
Ring stand: metal rod fixed upright in a heavy metal base; has many uses as a support.
Rubber stoppers: several sizes.
Rubber tubing: used to connect apparatus to transfer liquids or gases.
Safety goggles: plastic; must be worn at all times while working in the laboratory.
Screw clamp, pinch clamp: metal; used to block off rubber tubbing.
Spatula, scoopula: metal or porcelain; used to transfer solid chemicals; the scoopula has a larger capacity.
Stirring rod and rubber policeman: glass with rubber sleeve; used to stir, assist in pouring liquids, and for removing precipitates from a container.
Test-tube brush: bristles with wire handle; used to scrub small-diameter glassware.
Test-tube holder: spring metal; used to hold test tubes or glass tubing.
Test-tube rack: wood or plastic; holds test tubes in a vertical position.
Test tubes: glass; common sizes small (13 mm × 100 mm), medium (20 mm × 150 mm), large (25 × 200 mm); may be heated.
Thermometer: non-mercury; common range −10°C to 110°C.
Triangular file: metal; used to scratch glass tubing prior to breaking to desired length.
Tripod: iron; used to support containers of chemicals above the flame of a burner.
Volumetric pipet: glass; common sizes are 10 mL, 25 mL; used to measure solution volumes accurately; must not be heated.
Watch glass: glass; used to cover an evaporating dish or beaker.
Wide-mouth bottle: glass; used with pneumatic trough.
Wire gauze: used to spread the heat of a burner flame.

STATION 8 – CUTS, FIRE, & POISONING

Using the given information, answer the questions below:

1. How can cuts be avoided?
2. How can poisoning be prevented?
3. What should be done if hair or clothing catches fire?
4. What are the symbols for *flammable* and *toxic* chemicals?
5. How should odors be detected in the lab?

Cuts from Glass

Cuts occur most often when thermometers or pieces of glass tubing are forced into rubber stoppers. Prevent cuts by using the correct technique for this procedure. The hole should be lubricated with glycerol or water to facilitate the movement of the glass tubing. The glass should not be gripped directly with the hands, but rather by means of cloth towels. The towels will protect your hands if the glass should break. Use a gentle twisting motion to move the tube smoothly into the stopper.

Avoid cuts from other sources by discarding chipped and cracked glassware according to your teacher's instructions. If you should receive a minor cut, allow it to bleed for a short time. Wash the injured area under cold running water, and notify your teacher. Serious cuts and deep puncture wounds require immediate medical help. Notify your teacher immediately. While waiting for assistance, control the bleeding by applying pressure with the fingertips or by firmly pressing with a clean towel or sterile gauze.

Fire

A fire may occur if chemicals are mixed improperly or if flammable materials come too close to a burner flame or hot plate. When using lab equipment, prevent fires by tying back long hair and loose-fitting clothing. Do not use a burner when flammable chemicals are present. **Flammable chemicals are designated with the symbol** [F] in the Materials section for each exercise. Use a hot plate as a heat source instead of a burner when flammable chemicals are present.

If hair or clothing should catch fire, *do not* run, because running fans a fire. Drop to the floor and roll slowly to smother the flames. Shout for help. If another person is the victim, get a fire blanket to smother the flames. If a shower is nearby, help the victim to use it.

In case of a fire on a laboratory bench, turn off all accessible gas outlets and unplug all accessible appliances. A fire in a container may be put out by covering the container with a nonflammable object. It could also be smothered by covering the burning object with a damp cloth. If not, call for a fire extinguisher. Spray the base of the fire with foam from the extinguisher. **CAUTION:** *Never direct the jet of a fire extinguisher into a person's face.* Use a fire blanket instead. If a fire is not extinguished quickly, leave the laboratory. Crawl to the door if necessary to avoid the smoke. Do not return to the laboratory.

Poisoning

Many of the chemicals used in this manual are toxic. **Toxic chemicals are identified in the Materials sections with the symbol** [T] .

You should do several things to prevent poisoning. Never eat, chew gum, or drink in the laboratory. Do not touch chemicals. Clean up spills. Keep your hands away from your face. In this way you will prevent chemicals from reaching your hands, mouth, nose, or eyes.

In some cases, the detection of an odor is used to indicate that a chemical reaction has taken place. It is important to note, however, that many gases are toxic when inhaled. If you must detect an odor, use your hand to waft some of the gas toward your nose. Sniff the gas instead of taking a deep breath. This will minimize the amount of gas sampled.

STATION 9 – MEASURING MASS

Using the information below, complete the following:

1. Summarize the steps for measuring masses on an electronic balance.

2. Practice measuring mass. (HAVE MRS LAPLACA SIGN OFF ON THIS STATION)
   a. Use the weighing dish and measure out 3.50 grams of sugar.
   b. ***Separately***, measure out 0.5 grams of baking soda.
   c. Test your measuring precision by combining the two samples.
   d. What is your total mass?

STEPS FOR MEASURING MASS ON AN ELECTRONIC BALANCE:

1. Remove the cover and turn the balance ON.
2. Place a weighing dish on the balance.
3. ZERO/tare out the mass.
4. Add your sample to the weighing dish *carefully* so that you don't spill on the balance or remove the weighing dish and replace it on the balance when the sample has been added (be sure you've accounted for the mass of the dish first).

STATION 10 – MEASURING VOLUME, Part 1

Use the information below to answer the following questions:

1. In what unit are most laboratory volume measurements made?

2. What lab equipment should be used to make accurate volume measurements?

3. Sketch ***Figure 9*** and label the ***meniscus***. What is the volume measurement in this diagram?

Measuring Volume

Volume measurements are important in many experimental procedures. Sometimes volume measurements must be accurate; other times they can be approximate. Most volume measures in the laboratory are made using equipment calibrated in milliliters. Although some beakers have graduation marks, these marks are designed only for quick, rough estimates of volume. Accurate volumes must be measured with pipets, burets, or volumetric flasks.

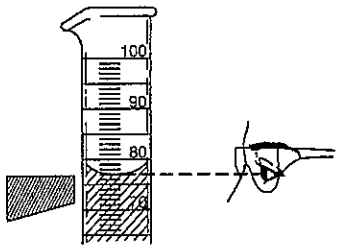


Figure 9 *Reading volume in a graduated cylinder.*

Using a Graduated Cylinder

Half-fill a 100-mL graduated cylinder with water, and set the cylinder on your laboratory bench. Examine the surface of the water. Notice how the surface curves upward where the water contacts the cylinder walls. This curved surface is called a *meniscus.*

A volume measurement is always read at the bottom of the meniscus, with your eye at the same level as the liquid surface. To make the meniscus more visible, you can place your finger or a dark piece of paper behind and just below the meniscus while making the reading (Figure 9).

Graduated cylinders are available in many capacities. The 100-mL cylinder is marked in 1-mL divisions, and volumes can be estimated to the nearest 0.1 mL. The last digit in these measurements is therefore significant but uncertain.

STATION 11 – MEASURING VOLUME Part 2

Now that you know *how* to measure volume, it's time to practice.

1. Complete the following measurement:
    a. Measure 10 mL of water in a 10-mL Graduated Cylinder.
    b. Pour this water into a 25 mL Graduated cylinder and verify the volume measurement.
    c. Pour the water from the 25-mL Graduated cylinder into a 100-mL graduated cylinder and verify the volume measurement.
2. How do your measurements compare in precision?
3. Measure 1 mL of water using a pipette and transfer it into a 10-mL graduated cylinder.
4. How precise is this measurement?

To measure using a pipette:

- Squeeze the bulb about half way
- Insert the pipette tip below the liquid surface.
- Release the bulb ***slowly*** as the liquid column rises
- Remove pipette tip from liquid
- Transfer liquid and slowly squeeze the bulb to release the liquid from the pipette

*Must be completed AFTER Station 10

STATION 12 – SCAVENGER HUNT

Describe/Identify the location of each of the following items in the classroom:

1. The Fire Extinguisher
2. The Fire Blanket
3. The Sink
4. The Safety goggle cabinet
5. Student Aprons
6. Broom & Dustpan
7. Exit