

## SAFETY TRAINING

- Safety is an integral part of working in the chemistry laboratory, and a responsibility shared by students and instructors.
- Learning about safety is part of your education; skills you gain in the lab will serve you in future careers and in life...If nothing else, they will make you a better cook!

**Be Prepared** - where is the.....

- **Lab exit** - know how to get out fast in an emergency.
- **Nearest phone** - dial 911 or local emergency number.
- **Fume hood** - use for any noxious reagent.
- **Eyewash station and safety shower** - for washing skin or eyes exposed to chemicals.
- **Fire extinguisher** - use to douse small fires.



### Personal Responsibility:

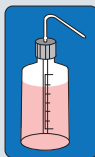
\* **Rule 1:** Protect yourself! Your mistakes will likely harm **you** more than anyone else.

\* **Rule 2:** Read the lab manual before class. Come to lab prepared to work on the assigned experiment.

\* **Rule 3:** Always pay attention as you work. Watch other students; you are impacted by their mistakes.

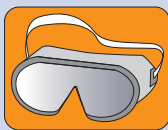
\* **Rule 4:** Clean up your own mess...You are a partner in maintaining a safe lab.

- Keep your work space clean and organized.
- Wash labware with detergent; rinse with de-ionized or distilled water; use a **wash bottle** to conserve water; drain excess liquid, allow object to dry before storing.
- Shared equipment: Wash before and after each use.
- After each lab session, return reagents and equipment to the designated storage areas.



## GENERAL LAB GUIDELINES

- Always work with instructor **supervision**.
- Always wear **goggles** in the lab, even over eyeglasses; replace contact lenses with eyeglasses.
- Wear an **apron, lab coat** and **gloves** to limit your chemical exposure and to save clothing from chemical stains.
  - Wear **closed-toe** shoes and long pants to protect your feet and legs.
- Tie back hair and avoid bulky sleeves which **interfere** with work.
- Food and drink **should not** be in the lab.
- **Wash** your hands after each session, before leaving the lab.



## EXPOSURE TO CHEMICALS

While working in the lab, you will use a number of reagents, giving ample chance for exposure to the harmful effects of chemicals.

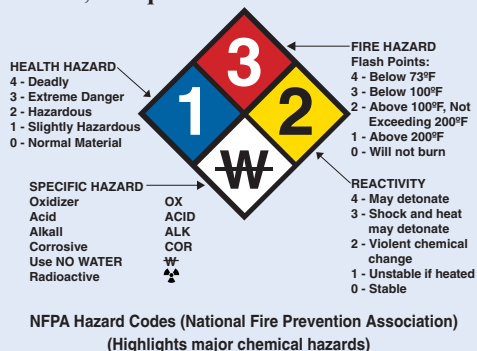
### Possible risks:

- Inhaling chemical powder or vapor.
- Ingesting solid or liquid chemicals by mouth.
- Puncturing skin with a sharp object and injecting chemicals into your body.
- Absorbing chemicals through your skin.



## KNOW YOUR LAB REAGENTS



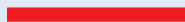
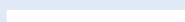

Some chemicals are toxic; all can cause harm if used incorrectly. Learn about reagents **before** using them in an experiment. Read your lab manual and textbook, talk to your instructor; if in doubt, **ask questions!**



**Material Safety Data Sheet (MSDS)** gives a description of the hazard a substance may pose.

### Chemical Storage Codes

Chemicals in the same color group can normally be stored together; exceptions noted on the label.

- **Health Hazard** 
- **Reactive and Oxidizing** 
- **Flammable** 
- **Corrosive** 
- **Minimal Hazard** 

## WORKING WITH CHEMICALS

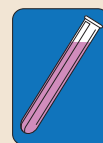
### Heating labware:

- Use tongs to handle labware while it is heated by a burner or hotplate.
- Allow the item to cool to room temperature before weighing.



### For liquid reagent:

- Cover the beaker with a watch glass.
- Use “boiling stones” to promote smooth boiling.
- Flammable solvent: Take care when heating with hot plate; avoid use of gas burner.
- Handle test tube with wire-holder.



### For solid reagent:

- Use a weighing dish on the balance.
- Cover the dish to prevent loss, spills or contamination.

## FIRST AID

Check with instructor for local guidelines.



### Burn from hot labware:

*Minor:* Apply cold water.

*Serious:* Contact medical help.

### Cut from broken glassware:

*Minor:* Wash with soap, apply antiseptic and sterile bandage.

*Serious:* Control bleeding by applying pressure with sterile pad, contact emergency medical help.

### Skin—exposure to a chemical:

Rinse with water; if condition develops, contact medical personnel.

### Feel lightheaded (or passing out):

Move affected person to fresh air outside of the lab; contact medical personnel if the condition persists.

### Burning clothing:

Do not panic, drop to the floor and smother the flame; use safety shower to treat burn; contact emergency medical personnel.

## CHEMICAL SPILLS

### On the floor or benchtop:

- For **small spill**: Wear gloves, neutralize acid/base; absorb using paper towels and discard in a labeled bag.
- **Larger spill**: Notify the instructor; wear gloves and shoe protectors, use a spill kit designed for the chemical.
- Clean up all spills **promptly** to prevent further accidents.



### On your clothing or skin:

- Remove affected article of clothing; wash exposed skin with water and apply first aid. Treat promptly to minimize harm.
- If a large area is exposed, use the safety shower, then apply first aid.

## WASTE MANAGEMENT

- Follow the instructor's directions for disposal of all lab materials. Most chemicals should not be poured down the drain.
- All toxic metals and halogenated solvents must be collected for proper disposal.

**Waste Prevention:** Use only the required amount of reagent; excess material cannot be returned to reagent jar; it is “waste.”

A spot plate is an excellent means to conserve reagents.



## USEFUL CHEMICAL INFORMATION

## Liquid Solubility Rule: "Like Dissolves Like"

## Water "The Universal Solvent"

- Boiling pt: 100.00° C
- Freezing pt: 0.00° C
- Density: 1.00 g/mL at 4° C
- Molar mass: 18.015 g
- Vapor pressure: 23.8 mm Hg, 25° C.

## Organic compounds: General rules

- Non-polar (alkane, oil, benzene) are soluble in non-polar organic solvent, but insoluble in water.
- Polar compounds (amine, alcohol, organic acid) tend to dissolve in water.



## Organic solvents:

	Bpt	D	M	
ethanol	79	0.79	46.07	Polar
methanol	65	0.79	32.04	Polar
acetone	56	0.79	58.08	Polar
isopropanol	82	0.79	60.11	Polar
benzene	80	0.88	78.12	Nonpolar
toluene	111	0.87	92.15	Nonpolar

Bpt = Boiling pt (°C) D = Density (g/mL) M = molar mass (g/mole)

## Acid:

	Commercial Reagent	
Hydrochloric, HCl	11.6 M	Pungent
Nitric, HNO <sub>3</sub>	16.0 M	Oxidizer
Sulfuric, H <sub>2</sub> SO <sub>4</sub>	18.0 M	Dehydrating Agent
Acetic	6.27 M	
Glacial acetic	17.4 M	
Phosphoric	14.7 M	



## Base:

NaOH and KOH, hygroscopic pellets		
	Commercial Reagent	
NaOH	19.1 M	
Aqueous ammonia	14.8 M	pungent

## Dangerous chemical combinations:

- \* Acid + base: react exothermically
- \* CN<sup>1-</sup> + acid => HCN deadly gas
- \* S<sup>2-</sup> + acid => H<sub>2</sub>S poisonous gas

## SAFE USE OF LAB EQUIPMENT

- Lab equipment is delicate and expensive; learn to use it correctly; ask for assistance if you need help.
- Do not use worn or frayed electrical cords.
- Be aware of the risk of static electricity—it may harm computers and can ignite flammable solvents.
- Watch out for chipped or cracked glassware; discard in the glass-recycle box.

**Thermometer:** Use "non-mercury" for routine work.

**Refrigerator:** Store chemicals in sealed containers; do not store food with chemicals.

**Compressed-gas cylinders:** Secure to a wall or bench; falling cylinders cause serious injuries.

## Types of material:

- Plastic (melts if heated; may dissolve in acetone)
- Borosilicate glass (Pyrex, high temp)
- Flint-glass (for room temp)
- Ceramic (high temp; stain-resistant); crucible, clay triangle
- Metal (high temp)



## HOW TO:

## ....Dispense liquid



- Choice of equipment depends on desired precision.
- Use a small beaker to obtain the needed amount from the reagent bottle.
- Use **funnel** to transfer to a flask.



## ....Dispense solid

- Use a **weighing dish** to hold the sample; dispense from a beaker using a spatula, not from the reagent bottle (this may contaminate the entire supply).
- Use funnel to transfer into bottle or flask.

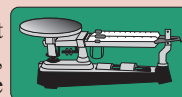
## ....Use a pipet

- Use a suction bulb to draw liquid into the **pipet**, past desired "mark" on the stem of the pipet.
- Quickly replace bulb with your finger; carefully release the vacuum and allow the liquid to drain from the pipet.
- Stop the flow at the desired "mark." Insert pipet into the flask, and release the liquid.



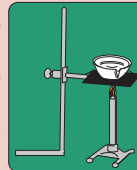
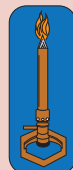
## ....Use a balance

- Clean the pan with a soft brush; if the pan is stained, with the assistance of the instructor, remove and clean the pan.
- Zero the balance **before** use, otherwise, all of your mass data will be incorrect.
- Use a weighing dish to hold the sample; pre-weigh the dish, add the sample, re-weigh sample and dish; determine sample mass by difference.



## ....Use a gas-burner

- Securely connect burner to the gas supply with rubber tubing.
- Gradually increase gas flow and ignite the flame.
- Adjust the air/gas mix to give a quiet, hot flame.



## PREPARING A SOLUTION CONTINUED:

## Inorganic Salts:

- **Soluble:** Acetate, nitrate, alkali metal (Na, K, Li, Rb, Cs), ammonium, perchlorate
- **Mostly soluble:** Chloride, bromide, iodide (except Ag, Pb, Hg(I)); sulfate (except Ba, Pb and Hg(I))
- **Mostly insoluble:** Carbonate, hydroxide, oxide, sulfide, phosphate, chromate (except for "soluble")

## pH and acid/base concentration:

- pH = -log<sub>10</sub> [H<sup>+</sup>]; molar concentration
- Base turns red-litmus blue; acid turns blue-litmus red
- **Acidic salt:** NH<sub>4</sub>Cl (from weak base + strong acid)
- **Basic salt:** NaCN (from strong base + weak acid)
- **Neutral salt:** NaCl (from strong acid + strong base)

## DATA MANIPULATION

## Lab Units and Conversion Factors:

- All data has a "number" and a "unit."
- Mass (gram, g) (1,000 g = 1 kg)
  - Time (second, s) (60 s = 1 minute)
  - Length (meter, m) (1 m = 100 cm)
  - Volume (liter, L) (1,000 mL = 1 L)
  - Temperature (°C, Centigrade)
  - Fahrenheit: °F = °C (9/5) + 32
  - Kelvin: K = °C + 273.15
  - Pressure: (pascal, Pa)
  - 760 mm Hg = 1 atm = 14.70 lb/in<sup>2</sup>
  - 1 atm = 101,325 Pa = 1.01325 bar

## Significant Figures (sigfig):

- Record the # of digits appropriate for the measuring device, plus record one "approximate" digit. Exponents are always significant.
- Add/subtract: For final answer: # of decimal places is given by datum with least # of decimal places.
- Multiply/divide: For the final answer: # of sigfigs is given by the datum with the least # of sigfigs.

## Graphing (x,y) data

Set range to use all of the graph page; label axes and clearly mark data points.

- **Equation for a line (x,y):**  
y = mx + b (m = slope, b = intercept)
- **Average or Mean Value:** Sum all data values and divide by the # of data points.

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