CHEMICALS AND THEIR PROPERTIES

PURPOSE: The purpose of this experiment is to distinguish between chemical and physical changes, make observations, make conclusions based on evidence, and classify samples of matter.

I. Equipment Box Assignment

Your instructor will assign you an equipment box and give you an inventory sheet for you to complete. Place your equipment box in the drawer at your station. Remove the equipment to your bench top and inspect each item for chips or cracks. If the item is broken or chipped or cracked set it aside, but if it is not, return it to your equipment box and put a check mark on the inventory sheet. If an item is missing, write the word "missing" next to it on the inventory sheet. Ask your instructor to verify that it is missing and initial your inventory sheet. After you have checked all of your equipment, take your inventory sheet and any chipped, cracked or broken equipment to the stockroom (see below) and the stockroom will replace missing and broken items. Upon receiving the items, sign your inventory sheet, write your student I.D. number on it, and turn it in to the stockroom.

Before you leave the lab each day, you must clean and dry (as much as possible) all of your equipment. Never store dirty equipment or any reagents in your equipment box. If you pack the equipment box carefully, you may be able to find space for your goggles.

Chemistry Stockroom

The Chemistry stockroom (the sign says "prep room") is located in across from S-222 and S-224, halfway down the hall. The stockroom will be open during your assigned lab time as well as at other times. Stockroom hours are posted outside the door. To obtain extra equipment needed for experiments you will need to fill out a lab slip (Bring your own pencil). For example, let's say you need two 500 mL beakers and one 50 mL graduated cylinder for your experiment, you would fill out the form (at stockroom counter) as follows:

Name _____**Jane Doe**_____

Room No _____**S-219**_____

Section: _____ Date _____ — Ticket number for your lab section

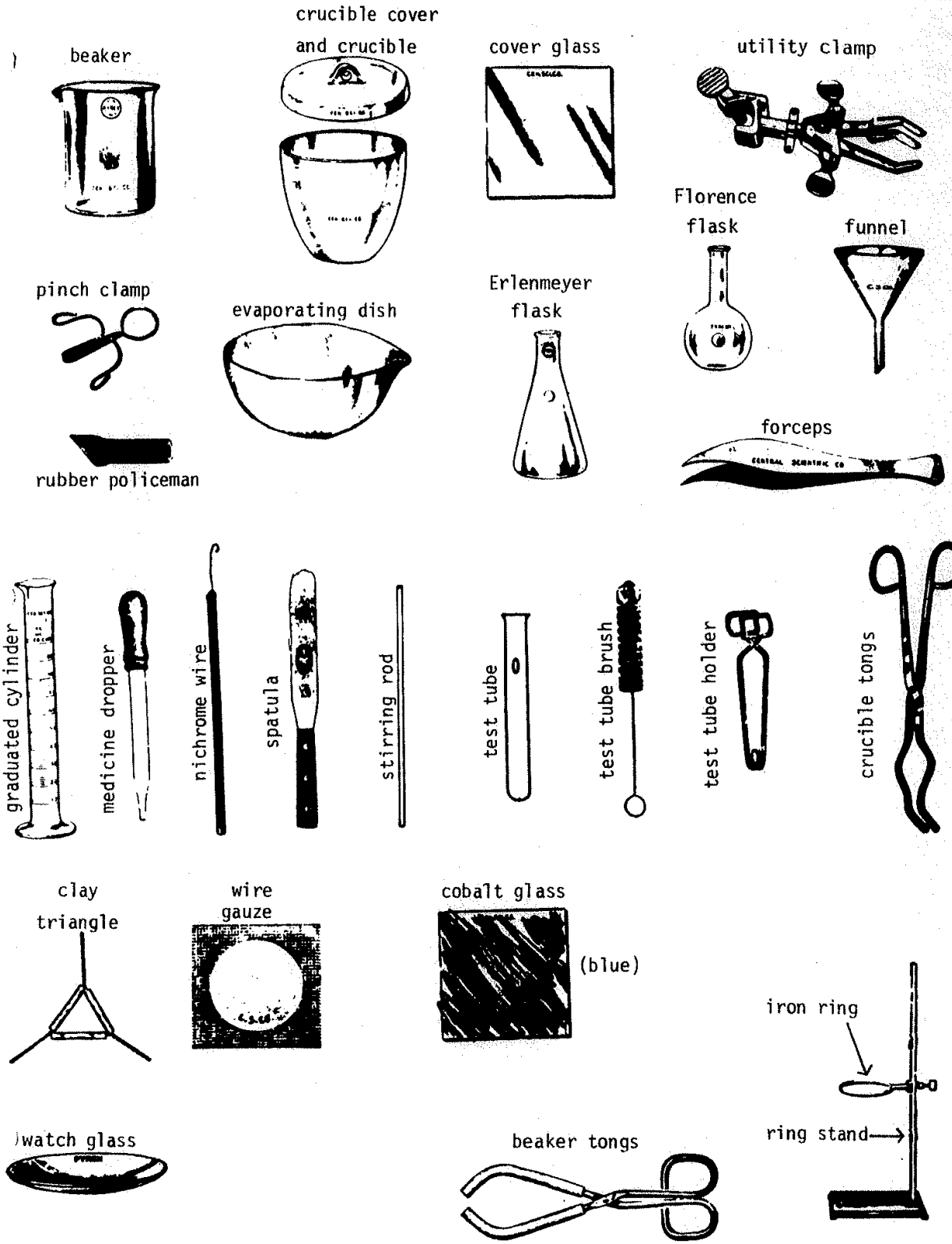
I ITEMS:

2 - 500 mL beaker
1 - 50 mL graduated cylinder

NOTES:

- Fill out the lab slip before summoning the stockroom attendant.
- Students are not allowed in the stockroom.

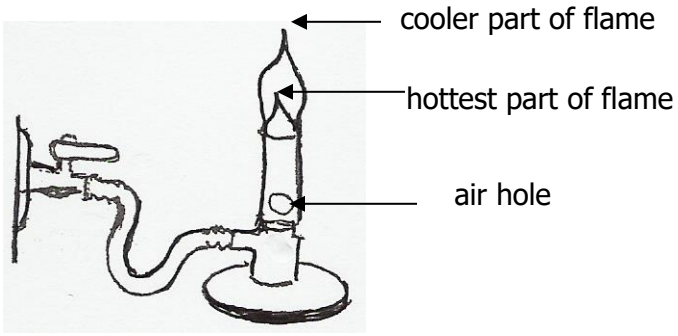
LABORATORY APPARATUS



II. Techniques

1. Lighting a Bunsen burner

1. Check your gas tubing for cracks. If it is cracks are visible, see your instructor for a new piece of tubing or to cut the damaged piece of tubing.
2. Attach the Bunsen burner to the gas valve at the center of the lab bench.
3. Close the air vent at the bottom of the Bunsen burner
4. When ready to light, open the gas valve, hold the striker at a 45° angle above the Bunsen burner and use the striker to generate sparks to ignite the Burner.
5. Once the burner has been lit you may adjust the temperature of the flame by opening the air valve and the height of the flame using the gas valve.
6. **DO NOT** leave a open flame unattended
7. Shut off the gas when you are done using the burner.

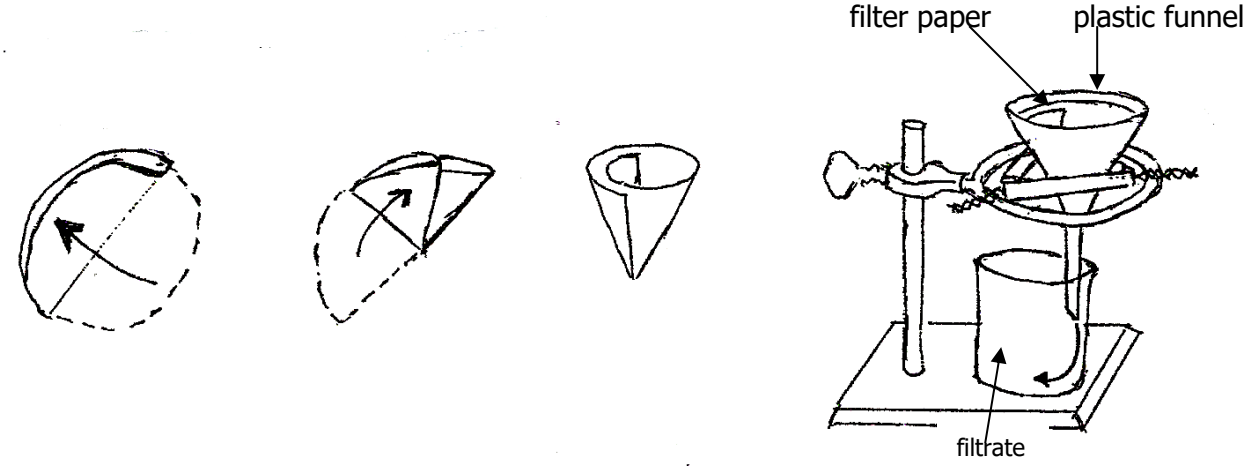


2. Filtration

Set up a filtration apparatus as shown below. Place your funnel in the ring. If the ring is a small one the funnel will just fit in it. If it is a larger ring you will need to put your clay triangle on top of the ring and place your funnel in the clay triangle. Place your 250 mL beaker beneath the funnel and adjust the height of the ring on the ring stand so that the stem of the funnel is touching the inside wall of the beaker. (This will prevent the filtrate—the liquid that passes through the filter paper-- from splashing as it passes out of the funnel.)

Get a piece of filter paper from the labeled drawer. (Your instructor may ask you to use something other than filter paper as filter paper is quite expensive.) Fold the filter paper in half, then in half again. Open the paper so that three thicknesses are held together and a cone is formed. Place the filter paper in your funnel and moisten it with a small amount of deionized water. It should make a seal against the plastic.

Add the sand to approximately 25 mL of water. Mix the sand and water and filter the mixture through filter paper.



III. INTRODUCTION

A pure substance is a sample of matter that has a definite, fixed composition, and the same properties throughout the sample. Each pure substance has its own set of characteristic properties.

1. Physical properties can be observed without changing the chemical composition of the substance. Physical properties are characteristics of the substance by itself. Common physical properties that can be measured without changing the chemical composition are:

color	conductivity	solubility
melting point	boiling point	density

Taste and odor are usually considered to be physical properties although they depend on the physiology of the person making the observations.

2. Chemical properties of a substance describe the interactions of the substance with other substances, or its tendency to react. An example chemical property would be how "iron rusts in air". A chemical property describes the ability of a substance to react and change into another substance with a different chemical composition. The new substance would have new properties.

3. Physical changes do not cause a change in chemical composition, but only a change in appearance. When a substance simply changes from a solid to a liquid, liquid to a gas or vice-versa (liquid water to solid water, for example) without a change in composition it is a change in state. This is a physical change. (The three physical states are: gas, liquid, and solid).

4. Chemical changes (chemical reactions) are changes in which a new substance (or substances) is formed. The new substance formed will have different chemical and physical properties from the original substance(s). Old chemical bonds are broken and new chemical bonds may be formed. There are four kinds of evidence that a chemical change is occurring. That is, when a chemical change occurs you may observe (detect through your senses--see, feel, etc) one or more of the following:

Evidence that a chemical change is taking place includes:

a. A color change
b. A solid product, called a precipitate, is formed. This may make the contents of the test tube appear opaque. A solid has formed which may eventually settle on the bottom of the container.
c. Bubbles due to the formation of a gas.
d. Energy such as heat, light or electricity is produced. Usually all chemical reactions involve energy change.

Classification of Matter: Metals, Metalloids and Nonmetals

The terms metal and nonmetal are not really that definite. The heavy stairstep line on the periodic chart only serves to separate those elements that act more like metals from those elements that act more like nonmetals. You may find some elements on the nonmetal side of the line that are more like metals and vice versa. This is especially true of the elements close to the heavy stairstep line (metalloids).

Metals are generally described as having the following characteristics or properties:

- Metallic luster (shiny)
- Good conductors of heat and electricity
- Somewhat soft, and not brittle (in the solid state)
- Ductile (can be stretched into a wire or other shape without breaking or returning to its original shape)
- Malleable (can be hammered thin without breaking or returning to its original shape)
- Tarnishable (their shiny surface can be made dull by reaction with oxygen in the air)

Nonmetals are generally described as having the following characteristics:

- Dull (not shiny)
- Not good conductors of heat and electricity
- Brittle
- Not ductile and malleable

Distinguishing Metals and Nonmetals by their Appearance

In today's experiment you will examine samples of some elements and describe their physical properties. These will include such things as color, luster, state of matter (solid, liquid or gas) at room temperature, and any other characteristics that distinguish the appearance of the element. In particular, you will use an element's luster (shine) or lack of luster (no shine, dull) to classify it as metal or nonmetal.

III. PROCEDURE

Safety goggles **must** be worn at all times
Hydrochloric acid (HCl) and sodium hydroxide (NaOH) can harm eyes, skin, and clothing. Handle with care. Any acid spilled on the skin should be rinsed with a large volume of water for 15 minutes.

Wash your hands before you leave the lab.

A Classifying Physical and Chemical Change:

Experiment

A. Physical and Chemical Changes

For each of the following, record your observations. (When observing a change, your description of that change must include what you observe **before** the change, **during** the change, and **after** the change.) From your observations, decide whether it is a chemical change or a physical change.

1. **INTRUCTOR DEMONSTRATION**: Decomposition of water.

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe?_____

Chemical Change or Physical Change? _____

Was a new substance formed?_____

2. **INSTRUCTOR DEMONSTRATION**: Sublimation of Iodine

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? _____

Chemical Change or Physical Change? _____

Was a new substance formed?_____

3. **INSTRUCTOR DEMONSTRATION**: Distillation of an aqueous copper (II) sulfate solution.

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? _____

Chemical Change or Physical Change? _____

Was a new substance formed?_____

4. **INSTRUCTOR DEMONSTRATION**: Zinc and Sulfur

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? _____

Chemical Change or Physical Change? _____

Was a new substance formed?_____

5. INSTRUCTOR DEMONSTRATION: Sodium in water

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? _____

Chemical Change or Physical Change? _____

Was a new substance formed?_____

6. Take two small clean labeled beakers to the reagent bench and pour about 2 mL of copper (II) sulfate solution into one beaker and about 2 mL of sodium hydroxide solution into the other. Add the sodium hydroxide solution to the copper (II) sulfate solution and mix.

CAUTION: NaOH solution can harm eyes, skin, and clothing. Handle with care.

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? _____

Chemical Change or Physical Change? _____

Was a new substance formed?_____

DISPOSE OF REACTION MIXTURE IN THE LABELED FILTER/FLASK THAT YOUR INSTRUCTOR HAS SET UP ON THE REAGENT BENCH.

7. Go the reagent bench and get about 10 mL of milk and about 3 mL of acetic acid solution (vinegar). At your bench, mix the vinegar and milk, then stir with your stirring rod.

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? _____

Chemical Change or Physical Change? _____

Was a new substance formed?_____

DISPOSE OF REACTION MIXTURE IN THE LABELED FILTER/FLASK THAT YOUR INSTRUCTOR HAS SET UP ON THE REAGENT BENCH.

8. Get a piece of magnesium ribbon from the reagent bench and take it and your crucible tongs to the **HOOD.** Holding the magnesium with your crucible tongs light the magnesium with the Bunsen burner. Do not look directly at the flame. Place the ash on the watch glass provided.

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? _____

Chemical Change or Physical Change? _____

B. Using Chemical and Physical Changes to Identify an Unknown Substance

The following procedures 1-3 do not need to be done in order. Obtain a sample of unknown substance from your instructor to be used in procedures 1-4. The unknown is a sample of one of the known substances you are testing.

1. At the back counter are samples of 7 common substances. In a spot plate place small pea-sized amounts of each substance in 2 different rows of wells. Be careful to note which substance is in which well. (On a paper towel write the name of each substance in the order it is placed in your spot plate and place this next to the spot plate.) Observe each sample and then record your observations as to the color texture and any other important properties. **Record your observations in Table 1: Determining the identity of an Unknown substance on page 7.**

2. Into the first row of wells of the different substances, half-fill the well with de-ionized water. Stir if necessary. See if the substances dissolve or change in any other way. Record any evidence of change that occurs.

3. In the row of wells that contains the substances mixed with water put 3 drops of universal indicator. Record any evidence of change.

4. In another row of wells put 3 drops of dilute acetic acid (vinegar) and record any evidence of change on the chart below.

5. Cover your wire gauze with a piece of the aluminum foil that is set out on the reagent bench. Place about pea sized amounts of each substance onto the gauze-covered foil evenly spaced between each sample. Place the gauze on the ring stand with ring that is **in the fume hood**. Light the burner and place the heat under each sample to see if any change occurs. Record any evidence of change.

6. Using the data that you recorded in Table 1 of the lab report (page 7), determine the identity of the unknown sample and Write a paragraph explaining how you used evidence to conclude the identity of your substance. Make a claim about the identity of your unknown and then back it up with very specific and clear evidence.

C. Classifying compounds elements, heterogeneous and homogeneous mixtures by appearance

On the reagent bench are several samples of various substances. Write the name of the substance, a brief description of its state, color and any other pertinent observation, state if the substance appears homogeneous or heterogeneous and finally classify it as a compound element or mixture.
Put your responses in Table 2 on page 8

D. Classifying Elements by Physical Properties :

A number of elements in labeled bottles are on display. Your instructor will show you a sample of sodium. Classify them as metals, nonmetals and those you are unsure of. Put them in a table that shows their name and classification. **Put your responses in Table 3: Classifying Elements by Appearance on page 8**

Leave blank for double sided printing

Chemistry 110 Lab Report

Name _____ Date _____

Lab Section _____ Initials_____

EXPERIMENT 4
CHEMICALS AND THEIR PROPERITIES

A Classifying Physical and Chemical Change:

For the following, record your observations, decide if the change is chemical or physical, and give a reason for your conclusion.

1. Magnesium in the flame.

   Type of Change:_____ Evidence:_____

   Was a new substance(s) present at the end of this change?_____

2. Copper sulfate solution mixed with sodium hydroxide solution the tube.

   Type of Change:_____ Evidence:_____

   Was a new substance(s) present at the end of this change?_____

3. Vinegar mixed with milk.

   Type of Change:_____ Evidence:_____

   Was a new substance(s) present at the end of this change?_____

Demonstrations by the instructor

4. Distillation

   Type of Change:_____ Evidence:_____

   Was a new substance(s) present at the end of this change?_____

5. Change of state of iodine

   Type of Change:_____ Evidence:_____

   Was a new substance(s) present at the end of this change?_____

6. Electrolysis of water

   Type of Change:_____ Evidence:_____

   Was a new substance(s) present at the end of this change?_____

7. Reaction of Zinc and sulfur

   Type of Change:_____ Evidence:_____

   Was a new substance(s) present at the end of this change?_____

8. Reaction of Sodium in water

   Type of Change:_____ Evidence:_____

   Was a new substance(s) present at the end of this change?_____

B. Using Chemical and Physical Changes to Identify an Unknown Substance

Table 1: Determining the identity of an Unknown substance

	Appearance	Reaction with water	Reaction with universal indicator	Reaction with vinegar	Reaction with heat
Sodium Chloride					
Sugar (Sucrose)					
Baking Powder					
Baking Soda (Sodium Bicarbonate)					
Citric Acid					
White Flour					
Calcium Carbonate					
Unknown #					

Unknown #_____

What was the identity of the unknown substance?_____

Write a paragraph explaining how you used evidence to conclude the identity of your substance. Make a claim and then back it up with very specific and clear evidence.

C. Classifying compounds elements, heterogeneous and homogeneous mixtures by appearance

Table 2: Classifying Types of Matter by Appearance

Substance	Description	Homogeneous or heterogeneous	Classification : Compound Element or Mixture

D. Classifying Elements by Physical Properties :

Table 3: Classifying Elements by Appearance

ELEMENT	Shiny or Dull	Metal or Nonmetal (or can't decide)
Ge		
S		
Al		
Cu		
As		
Ni		
Sn		
Ag		
C		
Se		
I		
B		
P		

Questions:

1. Explain the difference between chemical and physical change? (You can use examples from this lab in your explanation.)

2. What is the difference between and element, such as zinc, and a compound of such as the compound zinc sulfide?

3. Explain how today's lab did or did not help you understand the difference between chemical and physical change?