

I. INTRODUCTION

A pure substance is a sample of matter in which the atoms, ions, or molecules of which it is composed are all alike. As a result it appears (looks) homogeneous. The pure substances are the elements and compounds. Each pure substance exhibits a unique set of physical and chemical properties that distinguishes it from all other substances. In this experiment you will observe some physical properties of substances and some physical and chemical changes.

A. Physical and Chemical Properties

1. Physical properties are characteristics of the substance by itself. Common physical properties include:

color	density	solubility in water
melting/freezing point	boiling point	conductivity

Taste and odor are not usually considered to be physical properties since they cannot be objectively measured.

2. Chemical properties of a substance describe the interactions of the substance with other substances, or its tendency to react.

B Physical & Chemical Changes

1. A physical change occurs without a change in the identity of the substance. (No new substance is formed). Physical changes include changes of state. These are:

melting (solid → liquid)	boiling or vaporization (liquid → gas)	sublimation (solid → gas)
freezing (liquid → solid)	condensation (gas → liquid)	crystallization (gas → solid)

2. A chemical change (chemical reaction) is a change 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). 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:
 - a. Change of color: Since color is a physical property that is characteristic of a substance, the appearance of a new color indicates that a new substance has formed.
 - b. Cloudiness: When 2 transparent (clear) liquids are mixed that mixture becomes cloudy because the new substance formed in the chemical change is a solid that is insoluble in water. The solid will eventually settle to the bottom. The general name for an insoluble solid that is formed in a chemical reaction is precipitate.
 - c. Bubbles: Bubbles (or "fizzing") may be observed upon mixing of a clear liquid and a solid. The new substance formed in the chemical reaction is a gas.
 - d. Heat, cold, light: When a chemical reaction occurs a change in energy usually occurs. In some cases the energy change results in the reaction mixture getting warmer or cooler, or emitting light.

C. Classification of Matter: Metals and Nonmetals

The terms metal and nonmetal are not really that definite. The heavy staircase 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 staircase line (metalloids).

1. 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)

2. Nonmetals are generally described as having the following characteristics:

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

3. 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.

II. 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. INSTRUCTOR DEMONSTRATION: Decomposition of water.

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? (circle the letter) (a) change of color
(b) bubbles (c) precipitate formed (d) heat or light (e) cooling (f) none of these

Chemical Change or Physical Change? _____

2. INSTRUCTOR DEMONSTRATION: Sublimation of Iodine

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? (circle the letter) (a) change of color
(b) bubbles (c) precipitate formed (d) heat or light (e) cooling (f) none of these

Chemical Change or Physical Change? _____

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

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? (circle the letter) (a) change of color
(b) bubbles (c) precipitate formed (d) heat or light (e) cooling (f) none of these

Chemical Change or Physical Change? _____

4. INSTRUCTOR DEMONSTRATION : Zinc and Sulfur

Observations:

Before: _____

During: _____

After: _____

What evidence for a chemical change did you observe? (circle the letter) (a) change of color
(b) bubbles (c) precipitate formed (d) heat or light (e) cooling (f) none of these

Chemical Change or Physical Change? _____

5. 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? (circle the letter) (a) change of color
(b) bubbles (c) precipitate formed (d) heat or light (e) cooling (f) none of these

Chemical Change or Physical Change? _____

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

6. 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? (circle the letter) (a) change of color
(b) bubbles (c) precipitate formed (d) heat or light (e) cooling (f) none of these

Chemical Change or Physical Change? _____

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

7. 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? (circle the letter) (a) change of color
(b) bubbles (c) precipitate formed (d) heat or light (e) cooling (f) none of these

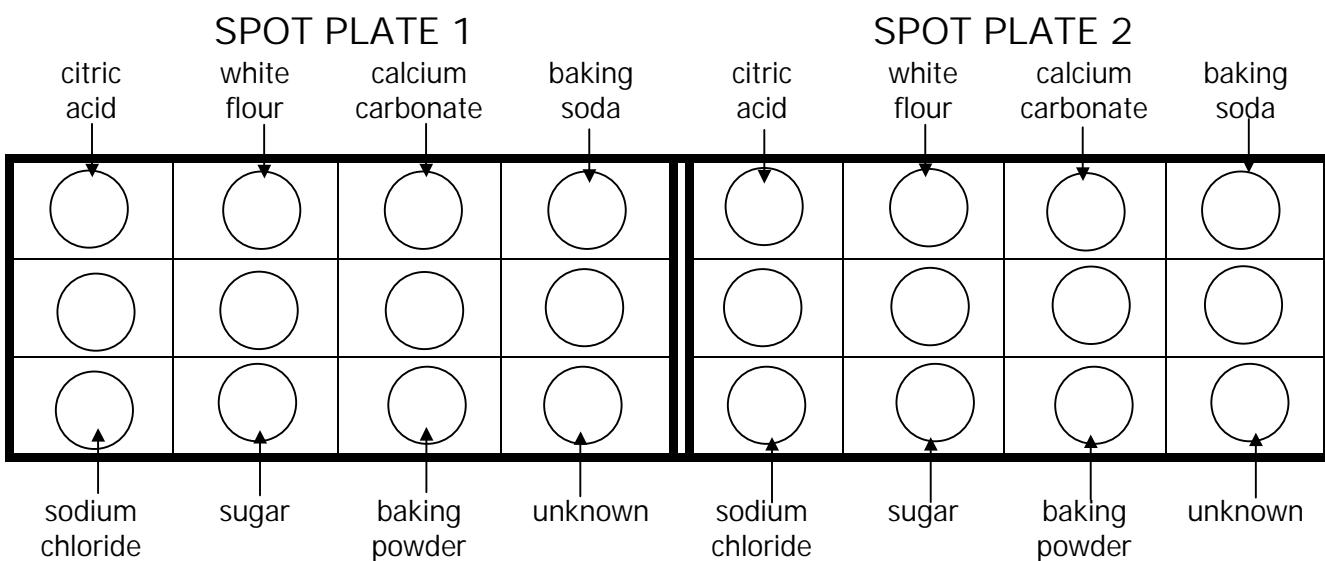
Chemical Change or Physical Change? _____

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

1. Your instructor will assign to you an unknown. Write its letter here _____ and at the bottom of page 5.

You will examine the physical and chemical properties of your unknown as well as those of seven known materials: sodium chloride, sugar (sucrose), baking powder, baking soda, citric acid, white flour, and calcium carbonate. You will compare the physical and chemical properties of your unknown to those of the seven "knowns" to determine the identity of your unknown.

2. Take 2 spot plates, one at a time, to the reagent bench. Place a EXTREMELY SMALL sample of each of the seven solids into each spot plate as shown below. Also put a very small sample of your unknown in each of the two spot plates. Label paper towels to identify each of the samples and place them under your spot plates



3. Look carefully at each material and describe its appearance (color, luster, and so on) in Table 5.1 below.
4. To each of the samples in Spot Plate 1 add about 1 mL of deionized water and stir. Note whether the sample dissolves in water or not, and describe any additional changes you observe, in Table 5.1.
5. To Spot Plate 1 (which has the samples to which you added water in the previous step) add 3 drops of universal indicator (in a dropper bottles on the reagent bench) to each one. Note the color of the mixture in Table 5.1.
6. Take Spot Plate 2 to the reagent bench and add 3 drops of acetic acid solution (vinegar) to each sample. Record your observations in Table 5.1.
7. Get a piece of aluminum foil from the reagent bench and cover your wire gauze with it. Then take the covered gauze to the reagent bench and place on it evenly -spaced pea-sized samples of each of the 7 materials, plus your unknown. Be sure to label the Al foil so that you know which sample is which. Take the wire gauze plus samples to the HOOD and place it on a ring on a ring stand. Light a Bunsen burner and move the burner under each sample to see what happens when the sample is heated. Record your observations in Table 5.1.

Table 5.1

	OBSERVATIONS				
	Appearance	Soluble or Insoluble in Water	Universal Indicator Color	Acetic Acid Solution	Heat
Sodium Chloride					
Sugar (Sucrose)					
Baking Powder					
Baking Soda (Sodium Bicarbonate)					
Citric Acid					
White Flour					
Calcium Carbonate					
Unknown _____					

Using your observations in table 5.1, determine the identity of the unknown sample. _____

Describe how you arrived at your conclusion. (Site observations that support your conclusions).

C. Classifying Metals & Non-metals on the Basis of Their Appearance

A number of elements in labeled bottles are on display. Look at each of the elements and determine whether it looks shiny or dull. Based on your observation, decide whether the element is a metal or a nonmetal in the appropriate column in Table 5.2

Table 5.2

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

Name _____ Date _____

Lab Section _____ Initials _____

A. Chemical & Physical Changes:

1. Copper (II) sulfate and sodium hydroxide.

Observations Summary: _____

Chemical change or physical change? (Circle the letter.) C P

2. Milk and vinegar

Observations Summary: _____

Chemical change or physical change? (Circle the letter.) C P

3. Magnesium Ribbon

Summary of Observations: _____

Chemical change or physical change? (Circle the letter.) C P

4. Distillation of copper (II) sulfate solution.

Observations Summary: _____

Chemical change or physical change? (Circle the letter.) C P

5. Sublimation of iodine.

Observations: _____

Chemical Change or Physical Change? _____

6. Decomposition of Water.

Observations Summary: _____

Chemical change or physical change? (Circle the letter.) C P

7. Zinc and Sulfur.

Observations Summary: _____

Chemical change or physical change? (Circle the letter.) C P

8. Sodium and Water.

Observations Summary: _____

Chemical change or physical change? (Circle the letter.) C P

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

	OBSERVATIONS				
	Appearance	Soluble or Insoluble in Water	Universal Indicator Color	Acetic Acid Solution	Heat
Sodium Chloride					
Sugar (Sucrose)					
Baking Powder					
Baking Soda (Sodium Bicarbonate)					
Citric Acid					
White Flour					
Calcium Carbonate					
Unknown _____					

Unknown # _____

Identify the unknown _____

C. Classifying Metals & Non-metals on the Basis of Their Appearance

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

D. Questions:

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

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

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