

# CLASSIFICATION OF MATTER AND HOMOGENEOUS AND HETEROGENEOUS MIXTURES

## Classification of Matter

A **pure substance** is matter with definite and constant composition with distinct chemical properties. They are either elements or compounds.

**Elements** are composed of one type of atom such as copper (Cu), helium (He), or oxygen (O<sub>2</sub>). Note that there are seven elements which exist as diatomic molecules in their natural state.

**Compounds** are composed of two or more different atoms that are chemically-bound such as water (H<sub>2</sub>O), methyl alcohol (CH<sub>3</sub>OH), and calcium nitrate (Ca(NO<sub>3</sub>)<sub>2</sub>).

A **mixture** is composed of two or more substances that are not chemically bound such as salad dressing or salt water. Note that mixtures may not be uniformly mixed and are classified as either homogeneous and heterogeneous.

**Homogeneous mixtures**, which are also called solutions, are uniformly mixed throughout and have consistent properties throughout the sample. For example, a salt-water mixture is homogeneous because it has the same composition and properties all throughout.

**Heterogeneous mixtures** are not uniformly mixed throughout and have properties that vary within the sample. For example, an oil-water mixture is heterogeneous, having separate oil and water layers and a water and sand mixture is heterogeneous because the sand will settle at the bottom of a container.

The **solubility** of a substance is related to whether or not it forms a homogeneous or heterogeneous mixture when it is dissolved in a liquid, such as water. A substance is **soluble** if it forms a homogeneous mixture. A substance is **insoluble** if it forms a heterogeneous mixture.

## Gravity Filtration

Filtration is used to separate two substances such as solid particles from a liquid using a filter. Gravity filtration uses the force of gravity to draw the liquid through the filter. The liquid is able to pass through the filter, but the solids are too big and left behind. The liquid that is collected at the bottom of the flask is known as the **filtrate**.

1. Grab an Erlenmeyer flask and a glass funnel.
2. Place the glass funnel in the neck of the flask with the stem pointing down.
3. Fold a piece of filter paper into quarters and place it into the funnel.
4. Open the filter paper on one side, forming a pocket.
5. Pour a little bit of liquid (i.e. water) into the pocket to keep the filter paper in the funnel.

- Pour the sample into the pocket of the filter paper and allow it to drip through the filter and funnel into the flask.

## PROCEDURE

### A. Physical Appearance of Elements

Observe the physical state and color of following elements: cobalt, neon, silicon, sulfur, and tin. Classify each as metal, non-metal, or metalloid. Record your observations on your data sheet.

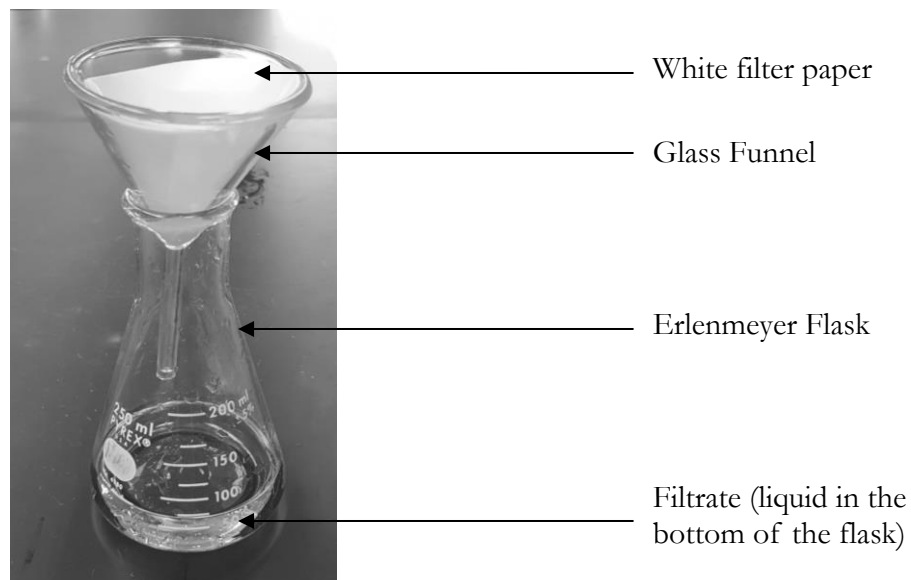
### B. Homogeneous and Heterogeneous Mixtures

Perform the following steps for each of the following compounds (one at a time):

- Sodium chloride (NaCl)
  - Iron (III) Chloride (FeCl<sub>3</sub>)
  - Calcium carbonate (CaCO<sub>3</sub>)
  - Iron (II) oxide (FeO)
- Weigh 0.10 g of **one** of the above compounds and place it in a 100 mL or 150 mL beaker.
  - Add approximately 40 mL of tap water to the beaker and put in a magnetic stir bar.
  - Place the beaker onto the middle of the stir/hot plate and turn the stirrer on to a medium speed. **Do NOT turn on the heat.** Continue stirring for 5 minutes.
  - Grab an Erlenmeyer flask, a glass funnel, and one piece of filter paper.
  - Place the glass funnel in the neck of the flask with the stem pointing down.
  - Fold a piece of filter paper into quarters and place it into the funnel. Open the filter paper on one side, forming a pocket.



- Place the filter paper corner side down into the funnel. Pour a little bit of water into the pocket to keep the filter paper in the funnel.



8. After stirring for 5 minutes, turn off the stir plate, take the beaker off the stir plate, and remove the stir bar using the magnetic retrieving wand.
9. Slowly pour the mixture from the beaker into the pocket of the filter paper and allow it to drip through the filter and funnel into the flask. You may need to rinse the beaker with a small amount of water to remove all of the mixture.

Make sure you do not fill the funnel above the top of the filter paper.

10. Record your observations.
11. Dispose of filtrate and filter papers in the appropriate waste containers and clean the funnel, flask, beaker, and stir bar between compounds.
12. Repeat steps 1-10 for the other two compounds using a new piece of filter paper each time.

Note: Begin stirring the next sample while the previous one is filtering to save you time and improve efficiency

### C. Solubility in Water

1. **Solids.** Into each of two test tubes, add 20 drops of distilled water. Using a spatula, add a pinch of magnesium hydroxide ( $\text{Mg}(\text{OH})_2$ ) to one and a pinch of copper (II) chloride ( $\text{CuCl}_2$ ) to the other. Shake and observe if the solid dissolves in water (forms a homogeneous mixture) or not (forms a heterogeneous mixture). Record as soluble or insoluble, respectively.

2. **Liquids.** Into each of two test tubes, add 20 drops of distilled water. Add a 10 drops of acetic acid to one and hexane to the other. Shake and observe the solubilities. The liquids are soluble if they mix completely without forming layers. They are insoluble if they do not mix and form separate layers.

### Notes

1. Most things take time to dissolve. Give your sample time to dissolve. However, not everything dissolves in water.
2. Shaking the test tube encourages mixing. Hold the test tube using the thumb and index finger of one hand near the top of the test tube. Gently shake back and forth. You can also tap the side of the test tube near the bottom with a finger from the other hand.
3. A homogeneous mixture is transparent and a heterogeneous is translucent or opaque (cloudy) or layered.

### CLEAN-UP

- Dispose of wastes and filter paper in the designated waste containers.
- Wash all glassware used. Return materials where they belong. Shake off excess water from washed test tubes and return to the test tube racks on your work station.

Name: \_\_\_\_\_  
Partner's Name: \_\_\_\_\_

Date: \_\_\_\_\_

## CLASSIFICATION OF MATTER AND HOMOGENEOUS AND HETEROGENOUS MIXTURES

### DATA AND OBSERVATIONS

#### A. Physical Appearance of Elements

Element	Symbol	Color and Physical State (Solid/Liquid/ Gas)	Classification (Metal/Nonmetal/ Metalloid)
Cobalt			
Neon			
Silicon			
Sulfur			
Tin			

#### B. Homogeneous and Heterogeneous Mixtures

##### a. Sodium Chloride (NaCl) Mixture

Mass of the NaCl \_\_\_\_\_

Colour of the NaCl \_\_\_\_\_

Colour of the water \_\_\_\_\_

Colour of the NaCl mixture before filtration \_\_\_\_\_

Colour of the Filtrate (liquid in the bottom of the flask) \_\_\_\_\_

Is the NaCl and water mixture Homogeneous or Heterogeneous?

**b. Iron (III) Chloride ( $\text{FeCl}_3$ ) Mixture**

Mass of the  $\text{FeCl}_3$  \_\_\_\_\_

Colour of the  $\text{FeCl}_3$  \_\_\_\_\_

Colour of the water \_\_\_\_\_

Colour of the  $\text{FeCl}_3$  mixture before filtration \_\_\_\_\_

Colour of the Filtrate (liquid in the bottom of the flask) \_\_\_\_\_

Is the  $\text{FeCl}_3$  and water mixture Homogeneous or Heterogeneous?

**c. Calcium Carbonate ( $\text{CaCO}_3$ ) Mixture**

Mass of the  $\text{CaCO}_3$  \_\_\_\_\_

Colour of the  $\text{CaCO}_3$  \_\_\_\_\_

Colour of the water \_\_\_\_\_

Colour of the  $\text{CaCO}_3$  mixture before filtration \_\_\_\_\_

Colour of the Filtrate (liquid in the bottom of the flask) \_\_\_\_\_

Is the  $\text{CaCO}_3$  and water mixture Homogeneous or Heterogeneous?

**d. Iron (II) oxide (FeO) Mixture**

Mass of the FeO \_\_\_\_\_

Colour of the FeO \_\_\_\_\_

Colour of the water \_\_\_\_\_

Colour of the FeO mixture before filtration \_\_\_\_\_

Colour of the Filtrate (liquid in the bottom of the flask) \_\_\_\_\_

Is the FeO and water mixture Homogeneous or Heterogeneous?

**C. Solubility in Water**

	Chemical	Soluble/Insoluble
Solids	magnesium hydroxide	
	copper (II) chloride	
Liquids	acetic acid	
	hexane	

**POST-LAB EXERCISES**

1. Classify as element or a compound.

a. sodium, Na \_\_\_\_\_

b. Magnesium chloride, MgCl<sub>2</sub> \_\_\_\_\_

c. nitrogen, N<sub>2</sub> \_\_\_\_\_

d. carbon dioxide, CO<sub>2</sub> \_\_\_\_\_

e. copper(II) nitrate, Cu(NO<sub>3</sub>)<sub>2</sub> \_\_\_\_\_

2. Classify as a homogeneous mixture or a heterogeneous mixture.

a. egg \_\_\_\_\_

b. coffee \_\_\_\_\_

c. stainless steel \_\_\_\_\_

d. rubber band \_\_\_\_\_

e. pizza \_\_\_\_\_

3. Are the following soluble or insoluble?

a. Olive oil is mixed with balsamic vinegar to form a salad dressing.

b. Sugar is dissolved in water to make a simple syrup.

c. A sample of swamp water contains water and dirt.