EXPERIMENT 2

Physical Changes, Chemical Properties and Reactions

Objectives:

1. To observe some physical and chemical properties of a group of substances.
2. To observe several changes in matter and to determine if they are physical changes or chemical reactions.
3. To observe chemical changes and reactions in solutions.

Introduction:

A substance is recognized by its properties, and by its use of them, it can often be separated from other substances.

The properties of a substance also determine its use. **A physical property** can be observed without changing the composition of a substance.

Melting point, boiling point, color, and density are examples of physical properties. **Chemical properties** are observed when a substance reacts to produce one or more different substances in a chemical change. Such changes can usually be recognized *by the evolution of a gas, formation of a precipitate, the evolution or absorption of heat, evolution of light, or the production of an electric current.*

When a solid changes to a liquid at its melting point, a physical change occurs. Physical changes involve a change in "form" without a change in chemical identity. Likewise, a liquid changing to a gas at its boiling point or evaporation of the liquid at a lower temperature is a physical change because the form (but not the identity) changes. Chemical properties usually, but not always, are manifested by chemical changes producing new substances. Thus, the tendency for a substance to burn (combustibility) is a chemical property and the process of burning is a

chemical property. The inability of some substances to burn is also a chemical property, but no chemical change is associated with lack of burning.

In a *physical change* the appearance of a substance changes but its composition and identity are unaltered.

In a *chemical reaction* a change in the composition and identity of a substance occurs. Some chemical reactions are the burning of wood to form carbon dioxide and water, the rusting of iron to form iron oxide, and the heating of limestone to form lime and carbon dioxide. The substances present before a chemical reaction occurs are called **reactants.** The substance or substances formed are called the **product(s),** and these product(s) have physical and chemical properties that are different from those of the reactants. *Chemical properties* are displayed when a substance undergoes a chemical reaction to produce products. Reversing a chemical reaction usually requires an involved process of several steps.

Procedure:

A. Changes Caused by Heat.

1. Melting point of naphthalene .

Fill a l50 mL beaker about half full of water, mount it on a ring stand and put a small ring around it to reduce danger of spillage. Obtain a melting point tube (capillary tube). Press the open end of the glass tube repeatedly against a naphthalene sample on a piece of paper, turn the tube closed end down, and tap it on the desk top. The vibration causes the crystals to fall to the closed end. When about 1/4 inch (≈0.6 cm) of the sample has been transferred to the tube, slip the rubber band over your thermometer and

move it up until it is 2-3 inches(≈5-7 cm) above the bulb and the lower part of the sample tube will be immersed in water.

Use a thermometer clamp to clamp the thermometer and the capillary tube, and make sure both are immersed in the water bath. ***Heat the water gently***. The rubber tube should not touch the water. Bring the temperature up slowly, watching the sample and the temperature. Record the temperature at which the sample melts. If the water bath is heated too rapidly the reading may be indefinite. Replace the water with cool water while preparing another sample. Then heat at 2-3 degrees per minute to obtain an exact melting point. ***Record your results***.

2.Observe and record what happens upon heating each of the following:

a. 0.5 g of solid iodine (I_2) placed in a small beaker covered with a watch glass and placed on a sand bath (Demonstration in the hood).
b. 0.5 cm strip of magnesium metal (use a crucible tongs)
c. 0.2 g of $CuSO_4.5H_2O$ (in a clean and dry test tube)

   →save the product in the test tube for part B←
d. 0.2 g (match-head size portion) of naphthalene on a metal spatula.
e. 0.2 g (match-head size portion) of NaCl on a metal spatula.

B. Changes Caused by Pure Liquids and Solutions(All tests should be done in a clean small test tube):

a. Addition of 2 mL of deionized H_2O to the heated $CuSO_4$ (from part A).
b. Addition of just two drops of 6 M NH_4OH to the above solution.
c. Addition of excess 6 M NH_4OH to the above solution to observe a real change in the solution.

d. Addition of 2 mL of 6 M HCl to Zn metal granules (Try to trap as much as you can of the evolved gas to apply a glowing splint test).
e. Addition of just two drop of 0. 2 M HCl to ten drops of 0.2 M $Pb(NO_3)_2$.

Report Sheet

Physical Changes, Chemical Properties and Reactions

1. The average melting point of naphthalene is :_____
   Is the change physical or chemical?

2. Describe what did you observe when solid iodine (I_2) was heated. What is the name of this physical change?
   Is the change physical or chemical?

3. What observations can you conclude when you heated naphthalene directly and strongly on the Bunsen burner? Is the change physical or chemical?

4. What observations can you conclude when you heated NaCl directly and strongly on the Bunsen burner? Is the change physical or chemical?

5. Complete the following equations:

a. $Mg + O_2 \xrightarrow{\Delta}$

b. $CuSO_4.5H_2O \xrightarrow{\Delta}$

c. $Cu^{2+}_{(aq)} + (few\ drops)NH_4OH \rightarrow$

d. $Cu^{2+}_{(aq)} + (excess)NH_4OH \rightarrow$

e. $Zn + HCl \rightarrow$

f. $Pb^{2+}_{(aq)} + Cl^{-}_{(aq)} \rightarrow$