EXPERIMENT 1:

# PHYSICAL AND CHEMICAL CHANGES

## I. PURPOSE:

To become familiar with the principles used in differentiating between physical and chemical changes.

## II. DISCUSSION:

A chemical change is one in which different substances are produced. Since each substance possesses its own set of specific properties, chemical changes are always accompanied by the appearance of new sets of specific properties corresponding to formation of new substances. Wood burning, iron rusting, and the heating of mercury to form a red power are all examples of chemical changes. Chemical changes always involve a change in energy, while physical changes only require a change in the form or physical state. The energy content of substances is also a specific property, so one would expect that the difference in energy content of reactants and products would be evidenced as energy lost or gained as the reaction proceeds. Although energy may be gained or lost in several forms, heat is by far the most common form. Physical changes refers to those characteristics of a substance that can be referred to as a change in form or physical state of the substance but does not involve the production of a new substance. Examples of physical changes include boiling, melting, dissolving, heating, and changing size or amount.

## III. EXPERIMENTAL PROCEDURE

A. EQUIPMENT - crucible tongs, crucible, wire triangle, watch glass, test tubes, magnesium (Mg) ribbon, nichrome wire, copper (Cu) wire, solutions marked A & B, calcium carbonate ($CaCO_3$), 1 M hydrochloric acid (HCl), 0.1 M sodium chloride (NaCl), 0.1 M silver nitrate ($AgNO_3$), 0.1 M sodium iodide solution (NaI), bromine water ($Br_2$), unknown solution

| KNOWN STANDARDS | TEST REAGENTS |
|---|---|
| barium nitrate [ $Ba(NO_3)_2$ ] | sodium hydroxide (NaOH) |
| cobalt(II) nitrate [$Co(NO_3)_2$ ] | sodium carbonate ($Na_2CO_3$) |
| nickel(II) nitrate [$Ni(NO_3)_2$ ] | sodium phosphate ($Na_3PO_4$) |
| iron(III) nitrate [ $Fe(NO_3)_3$ ] | sodium chloride (NaCl) |
| copper(II) nitrate, $Cu(NO_3)_2$ | |
| aluminum nitrate, $Al(NO_3)_3$ | |

B. SAFETY - Goggles must be worn at all times. Wash your hands thoroughly at the conclusion of the lab. All solutions and solids must be disposed of in an inorganic waste bottle. Silver nitrate will stain the skin. Bromine water will burn the skin. Do NOT use your thumb to cap a test tube! ! !

C. PROCEDURE:

PART ONE - Some Examples of Physical and Chemical Changes

Note carefully any changes which occur in parts A through G, below, and on the basis of these observations classify each result as a physical change or a chemical change. Give your reason in each case.

A. Hold a 1-inch strip of magnesium ribbon in a flame by means of tongs.
B. Mix 5 mL of solution A with 5 mL of solution B.
C. Hold a nichrome wire in the flame by means of tongs
D. Hold a piece of copper wire or foil in the flame.
E. Add a few drops 1M hydrochloric acid to a small amount of solid calcium carbonate.
F. Add a few drops of 0.1M sodium chloride to a like amount of 0.1M silver nitrate.
G. Add a few drops of 6M HCl to a 1 cm strip of magnesium ribbon.

PART TWO - Determination of Knowns and an Unknown

In this part of the experiment you will run profiles on six knowns and compare them with the profiles of one unknown to determine the unknown sample.

A. Arrange 4 small test tubes in a test tube rack and label them to indicate the following compounds: NaI (sodium iodide), NaOH (sodium hydroxide), $Na_2CO_3$ (sodium carbonate), and $Na_3PO_4$ (sodium phosphate).
B. Add about 2 mL NaI solution to the first tube, 2 mL NaOH to the second, and so on.
C. To each tube add an equal volume of a solution of barium nitrate, $Ba(NO_3)_2$, and record the results of your observation.
D. Empty the test tubes, rinse them with deionized water, and repeat the procedure, replacing the barium nitrate with copper(II) nitrate, $Cu(NO_3)_2$, aluminum nitrate, $Al(NO_3)_3$, iron(III) nitrate, $Fe(NO_3)_3$, cobalt(II) nitrate, $Co(NO_3)_2$, and nickel(II) nitrate, $Ni(NO_3)_2$, respectively.
E. Obtain an unknown, record the unknown number, run a profile and identify the unknown salt. If the unknown is a solid, dissolve a small amount in d.i. water to make a solution.

## V. DATA and RESULTS - (suggested format should repeat for each procedure a-g)

PART ONE -

| Procedure | (a) burn magnesium in flame | (b) mix soln A + soln B |
|---|---|---|
| Observation *(what you saw)* | | |
| Conclusion *(phys. or chem. chg.)* | | |
| Explanation *(why?)* | | |

PART TWO -

| | Test Reagents | | | | |
|---|---|---|---|---|---|
| Substance | NaI | NaOH | $Na_2CO_3$ | $Na_3PO_4$ | |
| $Ba(NO_3)_2$ | | | | | |
| $Cu(NO_3)_2$ | | | | | |
| $Al(NO_3)_3$ | | | | | |
| $Fe(NO_3)_3$ | | | | | |
| $Co(NO_3)_2$ | | | | | |
| $Ni(NO_3)_2$ | | | | | |
| unknown | | | | | |

Show your data to your teacher before you leave the laboratory, and have your teacher initial your data in your notebook.

## VIII. POST LABORATORY ASSIGNMENT: Physical & Chemical Changes

1. What evidence would you look for to confirm that a chemical change has occurred?

2. A hectare is exactly $1 \times 10^4 m^2$, whereas an acre is 4840 $yd^2$. How many acres are there in 1.000 hectare?

Answer:

3. Classify the following properties of sodium metal as physical (ph) or chemical (ch).
   a) silver metallic color _____
   b) turns gray in air _____
   c) melting point is 98°C _____
   d) density of 0.97 $g/cm^3$ _____
   e) reacts explosively with chlorine gas _____
   f) dissolves in water to produce a gas _____
   g) insoluble in ether _____

4. Indicate whether these observations are most likely evidence for physical (ph) or chemical (ch) change.
   a) steam condenses to a liquid on a cool surface _____
   b) baking soda dissolves in vinegar, generating bubbles _____
   c) steel electroplates out silver in silver nitrate solution _____
   d) mothballs gradually disappear at room temperature _____
   e) mercury cools to –40°C forming a solid _____
   f) iron filings being attracted to a magnet _____
   g) sugar dissolving in water _____

5. Use any reference source and give the values of four physical properties of
   a) beryllium b) potassium metal

6. How much does 8.60 ounces of plutonium (Pu) cost if $4.053 \times 10^{-22}$ grams cost $1.00?