Basic Skills for Chemistry
CHEM-1020
Experiment No. 5

Physical and Chemical Changes

Introduction: Matter may undergo two kinds of changes, classified by chemists as *Physical Changes* or *Chemical Changes*. In this experiment, you will treat several samples of matter in a way that will cause them to undergo physical or chemical changes. Your job will be to make careful observations of the change that take place and to classify the changes as to which type has occurred.

Physical changes may involve changes in size and shape or changes of state but with *no loss of identity*. No new substances are formed during physical changes. One type of physical change is the process of *solution* where a substance classed as a *solute* dissolves in another substance, called the *solvent*, typically, but not always a liquid. The solute can be recovered unchanged simply by evaporating the solvent. Physical changes may be also be brought about by cutting a substance into small pieces or by heating or cooling to change its physical state. Melting and vaporization are other examples of physical change. When two colored substances such as blue and yellow paint are mixed together and the intermediate color green results, the change is considered to be physical, since no new substance has been created.

In a chemical change, the *identity of a* substance is lost and entirely different substances are formed. Chemical changes are typically more difficult to reverse although a few can be reversed easily. Chemical changes occur when a substance decomposes into simpler substances or when two chemicals combine to form an entirely new substance. Evidence of a chemical reaction may be the production of a different physical state such as a gas even when the system is not heated or a solid produced by mixing two clear solutions even though the system is not cooled. Other evidence might be an unexpected color change or a new odor from a new gas. Many chemical changes are accompanied by the release of heat, light or electrical energy. Formation of a *new color*, even if the color change is reversible, almost always indicates a chemical change.

In a chemical change, the bonds that hold atoms together are broken and new bonds are formed. The new substances formed have different compositions and different chemical and physical properties from the original starting materials. However, mass is always conserved. Even though loss of identity occurs in chemical changes, *no atoms are ever created or destroyed*. Two examples of chemical changes are rusting and photosynthesis.

In this experiment, you will note the initial appearances of 14 substances or chemical systems. Then you will heat or mix the substances with other reagents as directed. From interpretation of the results, you will classify each process as a chemical or a physical change. It is also possible that no change will occur.

Safety: Be sure to follow the procedures you were given for the correct and safe operation of the Bunsen burner. As with all laboratory experiments, you must wear a lab coat or plastic apron and chemical splash goggles. Be sure to dispose of each chemical system properly as directed to avoid an unwanted chemical reaction or harm to the environment.

Experimental: Carry out the following procedures as directed and record your observations in the data table. Dovetail the procedures so as not to waste time standing by and waiting for a system to cool or for other changes to occur. For each procedure, record your observations on the data page. For your lab report, conclude whether a physical change, a chemical change or no change has taken place. For full credit, *explain the reason for each of your conclusions.*

1. Support a porcelain crucible about 25 cm about the laboratory bench top using a clay triangle, ring stand and iron ring. Roll a 2-cm length of copper wire into a loose ball, place it in the crucible and heat strongly for five minutes with a blue Bunsen burner flame. Record your observations, let the crucible cool and discard the copper wire as ordinary trash.

2. Place a 1 to 2 g zinc nugget in a clean, room temperature crucible and poke it with a metal spatula. Place the crucible in the clay triangle, heat it strongly for five minutes with the Bunsen burner and poke the zinc again while it is still hot. After the crucible cools to room temperature, poke the zinc with the spatula one more time. Dispose of the zinc in the heavy metal waste collection container.

3. Place one gram of paraffin wax granules in a room temperature crucible and heat gently until the wax melts completely. Do not overheat. Stop heating and let the crucible cool to room temperature. (Have a wire gauze within reach so you can place it on top of the crucible if the wax catches fire.) Carefully scrape the wax out with your metal spatula before it hardens completely. Dispose of the wax as ordinary trash.

4. Light a wooden splint in the burner flame. Extinguish the flame and wet the splint under the faucet before you dispose of it in the trash.

5. Put an ice cube on a watch class and observe what happens over a 30-minute period.

6. Place of piece of dry ice (solid carbon dioxide, CO_2) on a piece of paper and observe it over a 30-minute period.

7. In a test tube, mix 2 mL of iron chloride ($FeCl_3$) solution with 4 drops of potassium thiocyanate (KSCN) solution. Shake the test tube from side to side to mix the contents. After you make your observations, flush the mixture down the drain.

8. Pour 1 mL 0.1 M NaOH (dilute sodium hydroxide) solution into a test tube, add one drop of phenolphthalein indicator dye solution and shake the test tube from side to side to mix the solutions. Then, add two drops of 6 M HCl and shake again. Discard this mixture in the heavy metal waste container.

9. Roll a 2-cm piece of copper wire into a loose ball, place it in a medium (15 cm) test tube and add 2 mL of 6 M HCl (called dilute or six molar hydrochloric acid). Let the test tube and contents sit for five minutes. Record your observations and discard the wire and acid together in the heavy metal waste container.

10. Obtain a zinc nugget weighing less than one gram and place it in a 15 cm test tube. Add 2 mL of 6M HCl (hydrochloric acid) and let the mixture stand for five minutes. After you record your observations, discard the metal and acid in the heavy metal waste container.

11. Place 1 g of solid $NaHCO_3$ (sodium bicarbonate) in a medium 15 cm test tube and add 2 mL of 6M HCl. Let the test tube sit for five minutes. Record your observations, and discard the mixture in the heavy metal waste container.

12. Pour 1 mL of 6 M HCl into a 15 cm test tube. Add one drop of 0.01 M silver nitrate ($AgNO_3$) solution and shake the test tube from side to side. After you record your observations, discard the mixture in the heavy metal waste container.

13. Weigh out 0.1 g of sodium acetate into a large (2 cm wide) test tube. Add 4 mL of distilled water and shake the test tube from side to side. After the solid has dissolved, heat the solution gently until all the water is gone. When the test tube has cooled, rinse it with tap water and discard the washings in the sink with flushing.

14. Add 1 mL pf 6M HCl to a medium test tube and feel the bottom of the test tube. Add 1 mL of 6M NaOH (sodium hydroxide solution) and gently shake the test tube from side to side. Feel the bottom of the test tube again. Has the appearance of the solution changed?

Basic Skills for Chemistry, CHEM-1020
Experiment No. 5
Physical and Chemical Changes
Data Page

Exp No.	System	Observations Before Procedure	Observations After Procedure
1	Copper Wire		
2	Zinc Nugget		
3	Paraffin Wax		
4	Wood Splint		
5	Ice Cube		
6	Dry Ice		
7	$FeCl_3$ and KSCN Solutions		
8	NaOH and HCl Solutions		
9	Copper Wire and HCl Solutions		
10	Zinc and 6M HCl Solution		
11	$NaHCO_3$ and 6M HCl		
12	6 M HCl and $AgNO_3$ Solutions		
13	Sodium Acetate and Water		
14	6 M HCl and 6M NaOH Solutions		

Basic Skills for Chemistry
CHEM-1020
Experiment No. 5
Physical and Chemical Changes
Report Page

Exp No.	System	Summary of Observations Before Procedure	Summary of Observations After Procedure	Conclusion (Physical or Chemical Change)	Reason for Conclusion
1	Copper Wire				
2	Zinc Nugget				
3	Paraffin Wax				
4	Wood Splint				
5	Ice Cube				
6	Dry Ice				
7	$FeCl_3$ and KSCN Solutions				
8	NaOH and HCl Solutions				
9	Copper Wire and HCl Solutions				

Basic Skills for Chemistry
CHEM-1020
Experiment No. 5
Physical and Chemical Changes
Report Page

Exp No.	System	Observations Before Experiment	Observations After Experiment	Conclusion (Physical or Chemical Change)	Reason for Conclusion
10	Zinc and 6M HCl Solution				
11	$NaHCO_3$ and 6M HCl Solutions				
12	6 M HCl and $AgNO_3$ Solutions				
13	Sodium Acetate and Water				
14	6 M HCl and 6M NaOH Solutions				

Questions:

1) Indicate which of the following are chemical and which are physical changes. (3 points)

Iodine subliming _____
Leaves turning red in the autumn _____
Water boiling _____
A tomato rotting _____
Hydrogen peroxide bubbling when poured onto a wound _____
Paper cut into smaller pieces _____

2) Name three chemical and three physical changes not discussed in this experiment. (3 points)