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EXPERIMENT 2

2 PHYSICAL AND CHEMICAL CHANGE

Text Reference
Section 2.4

PURPOSE

To investigate the criteria used to distinguish between physical and chemical changes in matter.

BACKGROUND

Matter has both physical and chemical properties. A *physical property* is a quality or condition of a substance that can be observed or measured without changing the composition of the substance. Color is an example of a physical property. During a *physical change,* some properties of a sample of matter change, but the composition of the sample does not change. Melting and dissolving are examples of physical changes. A *chemical change* produces matter with a different composition than the original sample. A *chemical property* describes the ability of a substance to undergo a specific chemical change. The ability to rust is a chemical property of iron.

In this experiment, you will observe various materials and describe their physical properties. You will then cause some of the materials to undergo changes. Based upon your observations, you will determine whether the changes are physical changes or chemical changes.

MATERIALS (PER PAIR)

(Student Experiment)
safety goggles
spatula
magnifying glass
magnet
12 small test tubes
test-tube rack
2 100-mL beakers
glass stirring rod
funnel
ring stand
ring support
evaporating dish
gas burner
watch glass
plastic wash bottle

crucible tongs
wire gauze
test-tube holder
9 pieces paper, 10 cm × 10 cm
magnesium ribbon, Mg [F] [T]
sulfur, powdered, S [F] [T]
iron filings, Fe
sodium hydrogen carbonate, $NaHCO_3$
sodium chloride, NaCl
sucrose, $C_{12}H_{22}O_{11}$
sand
distilled water
coarse filter paper
2 pieces of exposed film
6*M* hydrochloric acid, HCl [C] [T]

(Teacher Demonstration)
small test tube
centigram balance
fume hood

gas burner
test-tube holder
magnet

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PRELAB ASSIGNMENT

2 PHYSICAL AND CHEMICAL CHANGE

1. Give three examples of physical properties that can be easily observed or measured.

2. How is a *physical* change distinguished from a *chemical* change?

3. a. What cautions must be observed when using 6*M* HCl?

   b. Why is the burning of magnesium hazardous?

4. Briefly describe how to filter a mixture.

5. What substance will you heat in a clean, dry test tube?

6. Propose a reason for why the sulfur–iron mixture must be heated in a fume hood.

Experiment #2 Procedure

Day 1: You must wear your safety Glasses today!!!!

1. Cut a piece of paper into 8 sections. Using the scoopula provided for each substance, transfer a pea-sized amount of each substance to their correctly labeled papers. For the magnesium, you need to obtain a piece of magnesium metal that is 1-cm long. **Do not mix the scoopulas between the substances, it will cause contamination**!!

2. Examine each substance with a magnifying glass. Determine the physical state and color of the substance during this step. Record your observations in Data Table 1.

3. Carefully use your hand to "fan" the vapor from the substance toward your nose. After determining the odor of the substance, record it in Data Table 1. **Remember: do not inhale the substance!!**

4. Test the effect of a magnet on each substance by passing the magnet **under the sheet** of paper. **Do not touch the substance with the magnet**!!! Record your observations in Data Table 1. Indicate "attracted" to magnet or "not attracted" to magnet.

5. In a small test tube, test the solubility of the substances by mixing a small amount of each sample with 1-inch of tap water. (Solubility is the ability of a substance to dissolve in water.) You do not need to use the entire pea-sized amount to perform this test. Also, do not perform this test for Fe, Mg, and S; they will not dissolve in water. "Flick" each test tube to mix the contents. For this step, use 1 test tube and rinse it out with plenty of water between each test and dispose of the substances by pouring them down the drain. Record your observations in Data Table 1.

6. Mix the remaining iron filings with the remaining sulfur on the piece of paper marked "IRON & SULFUR MIXURE." Examine this mixture with a magnifying glass. Test the effect of the magnet by passing the magnet under the sheet of paper. Record your observation is Data Table 2. Return the iron filings and sulfur mixture to the beaker in the front of the laboratory.

7. Place a 1-cm piece of Magnesium into a clean & dry test tube. Add 8 drops of 6*M* hydrochloric acid. Touch the bottom of the test tube with your hand. Record your observations. Dispose of this in the sink. Clean and dry the test tube for the next step.

8. Place your remaining $NaHCO_3$ back into your clean & dry test tube. (If you need more $NaHCO_3$, you may obtain more for this test.) Add 8 drops of 6*M* hydrochloric acid. Touch the bottom of the test tube with your hand. Record your observations. Dispose in the sink.

9. Cleanup your lab area! Remember to return your iron filings and sulfur mixture to the beaker in the front of the laboratory. Make sure your test tube is thoroughly rinsed out and clean for the next use.

10. Your lab area should be exactly the way it was when you began today's experiment. Once your teacher approves the cleanliness of your lab station, you are dismissed. **Wait for your Day 1 Check mark...**

Day 2: You must wear your safety Glasses today!!!!

1. On a clean piece of paper, mix a pea-sized sample of sodium chloride and a pea-sized sample of sand. Examine this mixture with a magnifying glass and record observations. Test the effect of the magnet by passing the magnet under the sheet of paper. Record your observations on Data Table 2.

2. Transfer the sand-salt mixture to a clean 100-mL beaker. Add about 30-mL of tap water and stir with a stirring rod for 1 minute while attempting to dissolve the sand-salt mixture. **No graduated cylinder is needed!** Record the observations after stirring.

3. Prepare a filtration setup by inserting the pointed end of the funnel into a flask. Fold the filter paper in half twice and use your finger to create a cone. Insert the filter into the funnel. Pour the mixture of sand, salt, and water through the filter paper and funnel. **Important:** Make sure you swirl the sand-salt solution around in the beaker so that all of the sand, salt, and water is poured into the funnel.

4. The filtered material will be in the filter and the filtrate will be in the flask. The filtering process may take 10 minutes, so move on to step 5. You will not be using the filtered material or filtrate until step 7.

5. Light your Bunsen burner under the teacher's supervision. Obtain a 5-cm piece of magnesium. Set the watch glass next to the Bunsen burner on your table and hold the 5-cm piece of magnesium in your crucible tongs. ***Caution: Do not look directly at burning magnesium; look through the exposed film.*** Hold the magnesium in the flame until it ignites. Quickly place the burning magnesium over the watch glass and allow the combustion product to fall on the watch glass. **Do not place the burning magnesium on the watch glass, it will break**!!! Record your observations in Data Table 2.

6. Place the burned magnesium from the watch glass into a clean test tube. Add 8 drops of 6*M* hydrochloric acid to the test tube. Feel the bottom of the test tube and record your observation in Data Table 2.

7. Obtain an evaporating dish. Pour filtrate from the flask into the evaporating dish until it is half full. Place the evaporating dish on the wire mesh and heat the filtrate gently until it has completely evaporated. Use crucible tongs when handling the warm evaporating dish. Record your observations in Data Table 2.

8. Examine both the dry residue in the evaporating dish and the wet residue on the filter paper and record your observations in Data Table 2. The filtrate is the substance(s) that passes through the filter paper. The substance that is filtered should be in your filter paper. You are now done with the filter paper and may dispose of it in the trash. You may also dispose of your filtrate in the sink and rinse out your flask.

9. Clean up your area! Dispose of the filter paper in the garbage. When your evaporating dish has cooled, rinse it thoroughly with water.

10. Your lab area should be exactly the way it was when you began today's experiment. Once your teacher approves the cleanliness of your lab station, you are dismissed.

Day 3: You must wear your safety Glasses today!!!!

1. Put a small sample of sucrose into a test tube. ***Caution: when heating a test tube, never point the mouth of it at yourself or anyone else.*** Hold the test tube using a test tube holder and heat the tube gently in a burner flame. Watch carefully for changes. Periodically remove the tube from the flame and check for odors by fanning the fumes toward your nose. Hold the test tube about 3 – 5 inches from your nose while fanning the vapors toward your nose.

2. After checking the odor of your test tube, heat the test more vigorously for 1 – 2 minutes. ***Caution: be sure the test tube is cool before handling it.*** After cooling the test tube, use a scoopula to scrape some of the residue into a clean test tube.

3. Do not attempt to clean the test tube used in steps 1 & 2. Your teacher will give you directions.

4. Examine the residue and check for solubility by adding an inch of water to the residue. Remember: solubility means to dissolve in water.

5. Clean up your area! Dispose of the filter paper in the garbage. Make sure you rinse the test tubes thoroughly with plenty of water.

6. Your lab area should be exactly the way it was when you began today's experiment. Once your teacher approves the cleanliness of your lab station, you are dismissed.

PHYSICAL & CHEMICAL CHANGES LAB DATA SHEET

DATA TABLE 1: Physical Properties of Matter					
Substance and Formula	Physical State	Color	Odor	Dissolves In water	Magnetic
Sulfur, S					
Iron filings, Fe					
Sodium hydrogen carbonate, $NaHCO_3$					
Sodium chloride, NaCl					
Sucrose, $C_{11}H_{22}O_{11}$					
Sand, SiO_2					
Magnesium, Mg					

DATA TABLE 2: Observations of Physical and Chemical Changes	
System	Observations
Fe and S mixture - Appearance - Is it magnetic?	
Magnesium *(unburnt)* - Does it react with 6-*M* HCl?	
$NaHCO_3$ - Does it react with 6-*M* HCl?	
NaCl and Sand Mixture - Did it dissolve in water? - Can it be filtered? - Did filtrate evaporate?	
Magnesium *(unburnt)* - Did it burn in the flame?	
Magnesium *(Burnt Residue)* - Does it react with 6-*M* HCl?	
$C_{12}H_{22}O_{11}$ - What happened when heated? - Did residue dissolve?	

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ANALYSES AND CONCLUSIONS

1. The following is a list of changes you observed in Parts B and C. Indicate whether each change was a physical change or a chemical change and give reasons for your answer.

   a. Mixing iron and sulfur. (Part B, Step 6)

   b. Mixing salt, sand, and water. (Part B, Step 8)

   c. Burning magnesium. (Part B, Step 9)

   d. Mixing magnesium and the product of burning magnesium with hydrochloric acid. (Part B, Step 10)

   e. Heating sucrose. (Part B, Step 11)

   f. Mixing sodium hydrogen carbonate and hydrochloric acid. (Part B, Step 12)

   g. Heating iron and sulfur. (Part C, Step 14)

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2. Was mass conserved in the reaction of iron and sulfur? Explain.

Yes. The mass before and after heating is the same.

3. Except for the reaction between iron and sulfur, none of the reactions in this experiment can be used to demonstrate the law of conservation of mass. Explain why.

4. How do you decide whether an observed property of matter is a physical or chemical property?

5. What criteria are used to distinguish between a chemical change and a physical change?

6. State in your own words the law of conservation of mass.