1. How is a chemical property different from a physical property?

2. How is a chemical change different from a physical change?

3. Give two examples of chemical changes from your everyday experience.
   a. 
   b. 

4. Do you think that the absence of a chemical change could indicate a chemical property? For example, water does not burn. Could that be considered a chemical property of water?
DISCUSSION

All substances have both physical and chemical properties. Physical properties are often more obvious—characteristics like color, odor, density, melting point, etc. Chemical properties are defined by how a substance does or does not react with other substances. Examples of chemical properties include reactivity with water or acid, bonding ability, etc.

In this lab we will observe a chemical change, which is a reaction that changes the chemical properties of the reactants. We will effect this chemical change through combustion (burning). Combustion is one of the most familiar and easily recognized chemical changes. A substance that burns is said to be combustible. Wood and gasoline, for example, are combustible. (The term “flammable” often is used for things that burn rapidly or ignite easily. Gasoline is combustible and also flammable.) These are chemical properties of wood and gasoline. In all common examples of combustion, the chemical change involves a reaction with oxygen in the air. Oxygen itself is not combustible, but it supports combustion.

Many chemical changes result in the formation of a gas. Other chemical changes result in the formation of a solid, usually referred to as a precipitate. Essentially all chemical changes involve energy changes. Some release energy and are referred to as exothermic. Combustion is an obvious example of this kind of reaction. But flames are not essential for a reaction to be exothermic. When there is no flame, the energy release results in an increase in the temperature of the reaction mixture. Other chemical changes absorb energy and are referred to as endothermic. Such changes cause a drop in the temperature of the reaction mixture. You will discover some of the chemical properties of several substances as you identify the gases produced when they are combined, observe precipitates formed, and determine whether a reaction releases or absorbs energy.

PROCEDURES

Part 1: Combustion

1. Combustion of Metals
   a. Following the directions given by your instructor, light a Bunsen burner. The flame above a properly adjusted burner will have no yellow in it. Have your instructor check your burner for proper adjustment, then sketch the flame and describe it on the report sheet. Note the different colors on your sketch.
   b. Grasp a piece of copper wire with tongs (not with your fingers - metals conduct heat really well), then hold it in the flame and determine where the hottest part of the flame is by observing where the copper glows most brightly (or melts). Is it near the base of the flame, or near the top? Show where the hottest part of the flame is on your sketch. Is the change in the copper a chemical change? Why or why not? Try taking a paper towel and rubbing the piece of copper where it was in the flame. What do you see?
   c. Some metals are combustible. Grasp a short piece of magnesium with tongs, and hold it in the burner flame. DO NOT look directly at the magnesium flame. If you do, the bright light may damage the retinas of your eyes. Describe the residue remaining after the magnesium burns. What chemical property distinguishes magnesium from copper?
2. Combustion of Gases

**NOTE:** UNDER THE HOODS, you will see balloons filled with various gasses. The balloons are attached to rubber tubing and a valve that allows you to turn the gas on and off. You should also see large tubs filled with water. You may only fill your test tubes under the hood. Turn off your Bunsen burner as you leave your station.

a. Fill a large test tube to the brim with water. Insert a stopper so that there is no air in the tube, only water.
b. Under the hood, invert your test tube underwater in one of the large tubs of water. Remove the stopper. Insert tubing from the butane balloon up inside the inverted test tube.
c. Turn the valve on the balloon just enough to allow butane to bubble slowly into the test tube (it will displace the water). The test tube is full when you see gas bubbles escaping outside the tube. Close the valve to stop the flow of gas, and remove the tubing from your test tube. KEEP YOUR TEST TUBE UNDERWATER. Stopper the tube so it contains only gas (no water), and remove it from the tub.
d. Return to your Bunsen burner, remove the stopper from the test tube, and hold the mouth of the tube next to the flame. Record your observations. Is butane combustible? (Flames at the mouth of the tube indicate combustibility.)
e. Repeat steps a and b to fill a large test tube with oxygen, hydrogen, and carbon dioxide. Perform the following test on each of those gasses:
   i. Ignite a small piece of wood in your burner flame.
   ii. Insert the glowing end of the wood into a test tube filled with one of the gases you are examining. If the gas is combustible, you will hear a pop. If the gas supports combustion, the wood should glow more brightly or perhaps even burst into flame. If the gas doesn’t support combustion, the wood will stop glowing.
   iii. Record your observations. (Hint: Of the four gases you have tested, two are combustible, one supports combustion, and one is neither combustible nor supports combustion.)

Part 2: Chemical Changes

1. Gas Formation

**NOTE:** Some of the supplies for these tests are NOT in the kit at your lab station. They can be found at the end of each bench. Please take what you need for your test, but leave the containers there so other students can find them.

a. Test 1: Zinc metal + hydrochloric acid (HCl)
   i. To a small test tube containing zinc metal, add a small quantity of a hydrochloric acid solution through the funnel. Record your observations.
   ii. Stopper the test tube to allow gas to build up for a few seconds. Once a sample of the gas is collected (adding more hydrochloric acid if needed), unstopper the tube and place burning wood in the mouth of the tube. Determine whether the gas is carbon dioxide, hydrogen or oxygen.
   iii. When you have finished your observations and tests, please dispose of the zinc and hydrochloric acid in the marked container.

b. Test 2: Calcium carbonate (Tums) + hydrochloric acid (HCl)
   i. Crumble up a Tums tablet into a small flask. Add a small quantity (a few mL) of hydrochloric acid (which, by the way, is stomach acid) to the flask containing Tums tablets. Record your observations.
   ii. Stopper the flask to allow gas to build up for a few seconds. Once a sample of the gas is collected (adding more hydrochloric acid if needed), unstopper the flask and place burning
wood in the mouth of the flask. Determine whether the gas produced in the flask (and in your stomach when you take Tums) is carbon dioxide, hydrogen or oxygen.

iii. When you have finished your observations and tests, you may rinse the contents of your flask down the drain.

c. **Test 3: Decomposition of hydrogen peroxide (H₂O₂)**
   i. Place a tiny bit of yeast into a small flask. Add a small quantity (a few mL) of hydrogen peroxide to the flask containing the yeast. The yeast contains an enzyme that decomposes hydrogen peroxide. Be sure to add small quantities of hydrogen peroxide to avoid frothing.
   ii. Stopper the flask to allow gas to build up for a few seconds. Once a sample of the gas is collected (adding more hydrogen peroxide if needed), unstopper the flask and place burning wood in the mouth of the flask. Determine whether the gas produced in the flask is carbon dioxide, hydrogen or oxygen.
   iii. When you have finished your observations and tests, you may rinse the contents of your flask down the drain.

2. **Energy changes**
   a. Pour enough vinegar into a small flask so that you can measure its temperature. Record the temperature and observations (e.g. physical properties like color, whether it's clear or cloudy, smell, the volume in the flask, etc.).
   b. Pour the same amount of sodium hydroxide solution (an ingredient in some commercial drain cleaners) into another flask. Measure and record its temperature and observations.
   c. Combine the two solutions. Immediately measure and record the temperature. Do you think a chemical change occurred? Was it exothermic or endothermic?
   d. Repeat steps a-c, but this time, instead of adding sodium hydroxide, slowly add some baking soda to the vinegar. Measure and record the temperature. Was this chemical change exothermic or endothermic? What gas is produced? If you don't already know, find out by stoppering the flask, collecting a sample of the gas, and testing it as you did in each of the tests in the last section.
Part 1: Combustion

Combustion of Metals
1. Sketch and describe the burner flame. Where is the hottest part of the flame? Did the copper undergo a chemical change? Why or why not?

2. How could you tell where the hottest part of the flame is? Is copper combustible? (Before answering, compare with magnesium in part b.)

3. Describe the residue remaining after the magnesium burns. What chemical property distinguishes magnesium from copper?

Combustion of Gases

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<thead>
<tr>
<th></th>
<th>Observations</th>
<th>Combustible?</th>
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<tbody>
<tr>
<td>Butane</td>
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<tr>
<td>Oxygen</td>
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<td>Hydrogen</td>
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<tr>
<td>Carbon Dioxide</td>
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Lab 3: Chemical Properties  
Chemistry 100

Part 2: Chemical Changes

**Gas Formation**

<table>
<thead>
<tr>
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<th>Observations</th>
<th>Gases produced</th>
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<tbody>
<tr>
<td>Zinc</td>
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<tr>
<td>Tums</td>
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<tr>
<td>Yeast</td>
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**Energy Changes**

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<thead>
<tr>
<th></th>
<th>Observations</th>
<th>Temperature</th>
<th>Endo/Exothermic?</th>
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<tbody>
<tr>
<td>Vinegar</td>
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<tr>
<td>Sodium Hydroxide</td>
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<td>Solution: Vinegar + Sodium Hydroxide</td>
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<tr>
<td>Vinegar</td>
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<tr>
<td>Solution: Vinegar + Baking Soda</td>
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What gas was produced in the final reaction listed above? _________________________________