

Name _____ Partner _____

Lab Section M Tu W Th F

Chemistry 130

Physical and Chemical Change

Introduction

Changes that may occur in matter are classified into two general categories: physical and chemical. Heat energy often plays an important role in nature and may bring about both physical and chemical changes. The melting of ice (heat absorption) is an example of a physical change. There was no change in the chemical composition of the substance - simply a change of state (solid to liquid). Whereas the “browning” of sugar (heat absorption) by strong heating represents a chemical change (that is, burned sugar cannot be made “unburned”). Heat may also be given off as a result of either a physical or chemical change. The burning of gasoline (heat released) is an example of a chemical reaction in which heat is given off. Such reactions may be called *exothermic* reactions (and the heat evolved may be considered to be a product of the reaction). Reactions which proceed by absorbing heat may be called *endothermic* reactions (and the heat necessary for the reaction to proceed may be considered as one of the reactants). Interaction of substances to form a new substance (or new substances) is classified as a chemical reaction. The types of chemical reactions which occur are relatively few, and a general listing follows:

- Combination
- Decomposition
- Single Replacement
- Double replacement
- Oxidation / Reduction [Redox]

Procedure 1: [This will be a demonstration, although you will make your own observations]

A. Obtain a small strip of magnesium metal ribbon. Hold the ribbon on one end of the ribbon with a pair of crucible tongs. Ignite the other end of the ribbon with the flame of the Bunsen burner. The magnesium will burn brightly giving off both visible and ultraviolet light. *Do not look directly at the flame!!!* Hold the burning ribbon over a clean evaporating dish and allow the ash formed to fall into the dish. When the burning is complete, examine both the contents of the dish and the tip of the tongs. Record your observations:

Was any noted change a physical or chemical change? If you decided that this was a chemical change, write a balanced reaction equation for this change (including heat and light as a part of your equation). The reaction of magnesium with the oxygen in air [O₂] is an example of a combination reaction. [**A + B → AB**]

B. Now add about ten (10) drops of water to the ash in the evaporating dish and stir the contents with a clean glass rod. Touch the tip of the rod, wet with the solution, to both types of litmus paper: blue and red. Do *not* place the litmus into the solution! [Litmus is a colored compound sensitive to acidic and basic mediums; red litmus turns blue in a basic medium and blue litmus turns red in an acidic medium.] Observe the spotted litmus papers and record your observations. Is the solution in the dish acidic, basic, or neutral?

Was any noted change a physical or chemical change? If you decided that this was a chemical change, write a balanced reaction equation for this change.

Procedure 2:

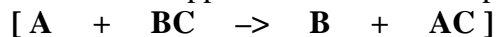
Half fill a 15 x 100 mm test tube with an aqueous solution of copper sulfate (it will be blue). Place some pieces of zinc metal into the solution. Observe any changes after one, five, and fifteen minutes. Record your observations:

one minute:

five minutes:

fifteen minutes:

Was any noted change a physical or chemical change? If you decided that this was a chemical change, write a balanced reaction equation for this change. The reaction of zinc metal with a solution of copper sulfate is an example of a single replacement reaction.



Procedure 3:

- A. While waiting for results of part 3 above, half fill a 15 x 100 mm test tube with 0.10 M. aqueous hydrochloric acid [HCl] solution. Place the test tube into the test tube rack and insert a thermometer into the solution and measure the temperature of the solution.

Record the beginning temperature here _____ °C.

- B. Weigh a clean zinc strip on the analytical balance.

Record initial zinc strip weight here _____ g.

- C. Place the zinc strip into the test tube which is half filled with dilute hydrochloric acid (The zinc strip should be totally immersed in the acid solution). Note any temperature change by recording the highest temperature you observe.

Record highest temperature here _____ °C.

Record your other observations here:

Is this reaction *endothermic* or *exothermic* ?

- D. After ten (10) minutes, remove the zinc strip from the solution and wash it with water from the squeeze bottle. Dry the strip with a paper towel. Reweigh the strip on the same balance used initially.

Record final zinc strip weight here _____ g.

Was any noted change a physical or chemical change? If you decided that this was a chemical change, write a balanced reaction equation for this change. This is another example of a single replacement reaction. How does your equation account for any weight change in the zinc strip.

What mass of zinc was lost? Mass of zinc lost _____ g.

How many moles of zinc were lost? [Atomic mass of Zn = 65.39]

_____ moles Zn lost

How many moles of hydrogen gas [H₂] were formed? [Molar mass of H₂ = 2.016]

_____ moles H₂ lost

Postlude:

The reactions in this experiment are also *redox* reactions. In a redox reaction one reactant will *lose* electrons and another reactant will *gain* electrons. By definition a process which loses electrons is *oxidation*; and a process which gains electrons is *reduction*. Both must occur together, of course.

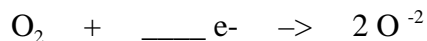
Consider the reaction in procedure 2. The original copper sulfate solution is blue because of the presence of a Cu^{+2} ion dissolved in water. Why did the color fade? Because during the reaction the copper(II) ion gained electrons to become copper atoms (copper metal). Where did those electrons come from? The other reactant, of course (that is, the zinc metal). So the zinc metal started out as zinc atoms and during the reaction became Zn^{+2} ions. These two processes can be represented:



NOTE: The sulfate ion [SO_4^{-2}], which is also present, is not involved in the reaction at all! Such ions are called *spectator ions*.

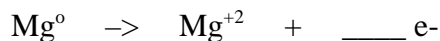
Consider the reactants (stuff you started with) in procedure 1. Magnesium metal and oxygen gas (from the air). Please write the electron gain and loss process equations for this reaction [these two equations will be of the form immediately above for the copper(II) ion and zinc metal reaction].

Reduction - gain of electrons:



You need to fill in the blanks.

Oxidation - loss of electrons:



And, since the gain and loss of electrons must be equal, *two* (2) magnesium atoms must each lose two electrons for every one oxygen gas molecule. Hopefully this matches your balanced equation in procedure 1!