Physical and Chemical Changes

One of the basic areas of interest for chemists is the study of the regrouping of atoms to form new substances. In order to determine if such a chemical change has occurred, there should be a change in the properties of the reactants that can be observed. The reaction, for example, of two colorless solutions to produce a mixture of two new colorless solutions could be quite difficult for us to observe. It would be much easier to follow the course of a reaction if one of the following occurred:

1. An unexpected color change occurred during the reaction.

2. One of the new materials was a gas that was insoluble in the solution and escaped to the atmosphere as bubbles.

3. One of the new materials was a precipitate that settled out of solution.

4. A characteristic odor (gas) either appeared or disappeared.

Other changes that only involve changes in form or appearance are called physical changes. These do not produce new substances but only change the physical properties of the material; for instance, when wheat is ground to make flour or when water is frozen to make ice. Simply mixing two substances to form a mixture, such as the mixing of sand and salt, is another example of a physical change.

Changes in temperature often accompany both chemical and physical changes. A temperature change, therefore, only indicates that there has been a change, but one must investigate the reaction further to determine whether the change was chemical or physical.

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BEFORE LAB: Write the formula and state notation for each reactant so you are able to find the reagents.

REPORT: For the lab report, in the conclusion column indicate whether a chemical or physical change has occurred. If a gas forms, identify the gas by name or formula (possible gasses: O_2, N_2, NO_2, CO_2, SO_2, and C_2H_2). Where there is a space for the reaction, write the balanced, molecular equation including state notations, (s), (*l*), (g) or (aq). For physical changes, the reaction could actually produce no new products or it could be simple dissolving of a solid. (For simply dissolving a solid, write a net ionic equation.) You are strongly encouraged to refer to other labs, your text, other texts and your notes for help with the more complex reactions.

GLOWING SPLINTS: To use a glowing (or burning) splint safely, hold it and gently dip it into the top 1 cm of the test tube. Do **NOT** drop the splint into the test tube. It is best to have the test tube in the test tube rack before you apply the glowing splint.

WASTE: drain – down the drain with water; HM – heavy metal waste container.

EXPERIMENT	OBSERVATIONS	CONCLUSION	WASTE
1. IN THE HOOD, add a small piece of copper metal to 2 mL of concentrated nitric acid.		CHANGE: GAS:	HM
REACTION:			
2. Heat a few crystals of solid potassium chloride in a dry test tube over a Bunsen burner.		CHANGE:	cool then drain with water

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3. Observe the color of solid iodine. Place a couple crystals of iodine into 1 mL hexane (C_6H_{14}).		CHANGE:	organic
4. Drop a piece of zinc metal into 5 mL of dilute hydrochloric acid. Place a burning splint into the mouth of the test tube.		CHANGE: GAS:	HM
REACTION:			
5. Mix 1 mL of copper(II) sulfate solution with 1 mL of sodium carbonate solution.		CHANGE:	HM
REACTION:			
6. Add 1 mL of nickel(II) sulfate solution to 1 mL of aqueous hydrochloric acid.		CHANGE:	HM
REACTION:			

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7. Add a small piece of copper metal to 2 mL of silver nitrate solution. Observe immediately and after approximately 15 minutes.		CHANGE:	HM
REACTION:			
8. Record the temperature of 5 mL of water. Add a dime-sized amount of solid calcium chloride to the water. Swirl. Record the temperature after swirling.		CHANGE:	drain
REACTION:			
9. Add 1 mL of potassium chloride solution to 1 mL of silver nitrate solution.		CHANGE:	HM
REACTION:			
10. Mix 3 mL of iron(III) chloride with 6 drops of potassium thiocyanate.		CHANGE:	HM

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11. Burn a small piece of wood splint in a crucible.		CHANGE:	cool then trash
12. Place 5 mL of dilute hydrochloric acid in a test tube. Place a thermometer in the acid and record the temperature. Add 5 mL of dilute sodium hydroxide solution. Record the temperature of the mixture after adding the sodium hydroxide.		CHANGE:	drain
REACTION:			
13. Mix 3 mL of dilute nitric acid with a dime-sized amount of solid sodium carbonate. Put a burning splint into the mouth of the test tube.		CHANGE: GAS:	drain
REACTION:			

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14. a) (Have a glowing splint ready before you add the water.) Place a pea-sized amount of calcium carbide (CaC_2) in a medium test tube. Add 5 mL of distilled water. b) Burn (combust in the presence of oxygen) the gas you generated in step (a) by placing the glowing splint into the mouth of the test tube.	a) b)	a) CHANGE: a) GAS: b) CHANGE:	drain (with LOTS of water)
REACTION: (For part a only.)			
15. Mix 1 mL of potassium permanganate solution with 1 mL dilute hydrochloric acid and 1 mL of 3% hydrogen peroxide solution. Place a glowing splint into the mouth of the test tube.		CHANGE: GAS:	HM
REACTION: (Find the reaction between hydrogen peroxide and potassium permanganate in an acidic solution. You may write either the net ionic equation or the molecular equation.)			

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PRESTUDY

1. (1) Classify the following as chemical (**C**) or physical (**P**) changes.

a. A clear colorless solution is poured on a solid and bubbles form. _____

b. A blue solution is mixed with a yellow solution and a green solution forms. _____

2. (2) Write the following underlined reaction in terms of a balanced equation. Write each reactant and product (you have to determine the products) as a formula, including state notations. All solutions are aqueous and colorless. A solution of lead(II) acetate is mixed with a solution of potassium bromide resulting in the formation of a white precipitate and a solution.

3. (1) Look up the reaction between solid copper and the oxidizing agent nitric acid that produces nitrogen monoxide gas (NO, aka nitric oxide). Write the source for which you found the reaction AND write the balanced equation.

Source: _____

Equation:

4. (6) Look up the properties of the following gases. You may use the CRC Handbook of Chemistry and Physics, the Merck Index (check out the information on WebCT), the Internet, your textbook or another suitable written source. Fill in the following table.

GAS	***Supports Combustion****	***Burns (Flammable)***	***Odor***	***Color***
	(Yes or No)		(None or if any, describe it)	
a. acetylene (C_2H_2)				
b. carbon dioxide (CO_2)				
c. hydrogen (H_2)				
d. nitrogen (N_2)				
e. nitrogen dioxide (NO_2)	No	No		
f. oxygen (O_2)				
g. sulfur dioxide (SO_2)	No	No		

*Supports combustion means that it must be present in order for burning of other substances to occur. Supports combustion does not mean flammable.