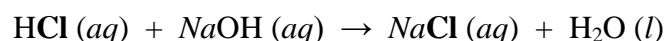


# Chemical Reactions Lab

## Objectives:

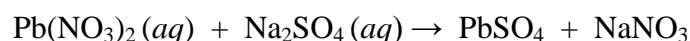
1. To examine a variety of reactions including precipitation, acid-base, gas forming, and oxidation-reduction reactions.
2. To identify the products formed in these reactions and summarize the chemical changes in terms of balanced chemical equations and net ionic equations.
3. To identify the species being oxidized and reduced in oxidation-reduction reactions and determine which species is the oxidizing agent and the reducing agent.

Chemical equations represent what occurs in a chemical reaction. For example, the equation

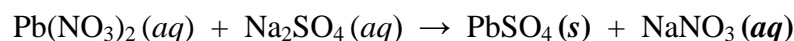


describes an acid-base reaction, a type of exchange reaction in which the driving force is the formation of water. **In an exchange reaction, the anion of one reactant changes places with the anion of the other reactant.** Most exchange reactions take place in aqueous solutions. Other types of exchange reactions include precipitation and gas forming reactions.

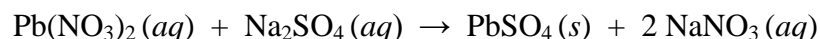
When a solution of lead (II) nitrate and sodium sulfate are mixed, you observe that a precipitate is formed. What is the identity of the precipitate and what is the balanced molecular equation and net ionic equation describing this reaction? To determine the answers to these questions, you must first be able to write the **CORRECT FORMULAS** for the reactants *and* the products for this reaction. The following represents these formulas in an *unbalanced* chemical equation:



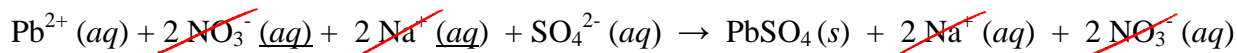
Which product is the precipitate? One cannot know the answer to this question without using the solubility rules (Tro text, Table 4.1, p. 136). By using this table it can be determined that  $\text{PbSO}_4$  is an insoluble salt whereas  $\text{NaNO}_3$  is soluble. Consequently, one can write the subscripts for the products indicating which product is the precipitate.



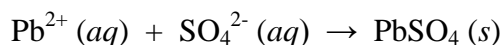
Is this equation balanced? No. So, it now needs to be balanced.



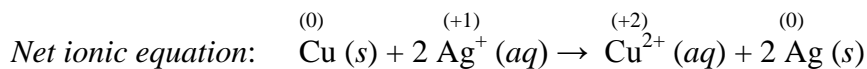
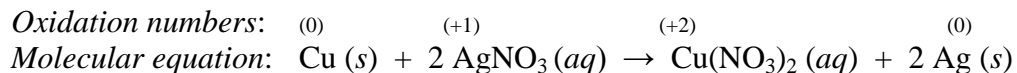
To write the net ionic equation, the above equation should be written as a complete ionic equation and then the spectator ions (the underlined ions) are cancelled.



So, the net ionic equation for this precipitation reaction is:



Oxidation-reduction (redox) reactions are another important class of chemical reactions. In redox reactions electrons are transferred from one substance to another. For example, if a copper wire is placed in a solution of silver nitrate a redox reaction occurs and silver metal is formed along with copper (II) nitrate.



The oxidation numbers for the metallic elements in this equation (See oxidation number rules, Tro text, p. 148) show us that copper metal is being oxidized while the silver ion is being reduced. Copper is therefore the *reducing agent* while silver nitrate is the *oxidizing agent*.

## PROCEDURE

**YOU NEED TO WEAR GOGGLES AT ALL TIMES WHILE PERFORMING THIS EXPERIMENT. Chemical waste can be disposed of in the waste beakers supplied in the hoods.**

### Part I: Exchange Reactions:

1. Obtain 7 small, clean test tubes. For the purposes of this lab, the test tubes need only be clean, not totally dry. A hose connected to the air supply in the hood may be used to quickly remove most water from the test tubes.
2. Place 10 drops of 0.5 M CaCl<sub>2</sub> into each of the 7 test tubes.
3. Next, add 10 drops of 0.5 M solutions of each of the following solutions to the indicated test tubes, and record your observations. Allow at least 5 minutes for reactions to occur before disposing your solutions.

Test Tube	1	2	3	4	5	6	7
	MgSO <sub>4</sub>	(NH <sub>4</sub> ) <sub>2</sub> C <sub>2</sub> O <sub>4</sub>	KNO <sub>3</sub>	Na <sub>3</sub> PO <sub>4</sub>	KBr	NaOH	K <sub>2</sub> CO <sub>3</sub>

4. Dispose of the solutions and any precipitates in the waste beakers located in the hoods. Wash your test tubes with soap and water. Rinse with tap water, then deionized water.
5. Add an amount equivalent to the size of a small pea of baking soda (sodium hydrogen carbonate) to a clean test tube. Add 10-20 drops of vinegar. (Vinegar is an aqueous solution of acetic acid, HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>). Record your observations.
6. IN THE HOOD, add an amount equivalent to the size of a small pea of sodium sulfite, Na<sub>2</sub>SO<sub>3</sub>, to a test tube. Add 10-20 drops of 6 M HCl. Record your observations.

- Put 10 drops of 0.5 M nitric acid and 10 drops of 0.5 M phosphoric acid into separate test tubes. Add 1 drop of phenolphthalein to each test tube. Add drops of dilute (0.5 M) sodium hydroxide solution into each of the test tubes until a permanent color change is observed. (NOTE: Phenolphthalein is an acid-base indicator that is colorless in acidic and neutral solutions, but pink in basic solutions). **HINT:** When writing your net ionic equations: nitric acid is a *strong* acid while phosphoric acid is a *weak* acid.

## Part II: REDOX REACTIONS:

- Add a small piece of zinc to a test tube containing 30 drops of 6 M HCl and record what happens.
- Add a 1 inch piece of copper wire to a test tube containing 30 drops of 6 M HCl and record what happens. (Is copper an active metal or inactive metal with HCl? Look up an activity series of metals online to check).
- IN THE HOOD, take a 2 inch piece of magnesium ribbon and hold it with a pair of crucible tongs. Light the magnesium metal with a Bunsen burner and record your observations. DO NOT LOOK DIRECTLY AT THE BURNING MAGNESIUM.

## LABORATORY REPORT

Students will write an individual or group laboratory report at the discretion of the professor. Include the following information in your laboratory report, due at the beginning of the laboratory period next week.

- Title. Title of the experiment, your name, your partner's name and the date the laboratory was performed.
- Introduction. This will be your opportunity to practice writing introductions. The introduction to the lab should be about chemical reactions in general (why they are important, examples of specific types of chemical reactions such as combustion, precipitation, redox, etc.), *not* about how to write and balance an equation. For complete guidelines, go to "Laboratory Reports" on the Chem 1061 website.
- Experimental Details. A description of the procedure you followed to produce the experimental data and results. Alternatively, you may reference the procedure by citing the URL's (web addresses).
- Results. A table or tables of your experimental data, clearly labeled with the proper units. Remember to use subscripts and superscripts where appropriate (examples:  $\text{cm}^3$  or  $\text{H}_2\text{O}$ ). A **neat** table which includes your observations from the precipitation reactions (steps 2-3) should be included in a results section as well as any observations from the remainder of the reactions in parts I and II.
- Discussion and Conclusion. For all the reactions observed (exchange reactions and redox), write the **balanced** molecular equation and net ionic equation for **each** reaction. For each reaction, place phase labels, [(s), (l), (g), or (aq)], after each reactant and product. In addition,

for the redox reactions in part II, indicate which reactant is the oxidizing agent and which one is the reducing agent. *There is no need to write equations for combinations that produced no reaction.* For each reaction that you observed and for which you write equations, you may provide any additional insights that you have into the reaction (was it easy/hard to observe, interesting things to note, etc.). You will also want to correlate things learned or observed with what you discussed in the introduction about reactions in general.

6. References. Citations and references to any sources you may have used for the introduction or to perform, complete, or analyze the results of the lab.
7. Follow your instructor's directions for submission of this lab report. If you submit by email, please attach a single file with a filename convention of *Lastname Firstname Reactions* and a subject line of "Chem 1061: Reactions Lab".