Chemistry 140, Fall 2006 Name(s):

Exercise 5: Types of chemical reactions

Objective: **Determine characteristic signs of reactions.**

Introduction

A chemical reaction consists of reactants and products. The reactants are what you start with (also called starting materials) and the products are the new compounds that form during the reaction. Chemical reactions can be classified into four general categories: (1) Combination (2) Decomposition (3) Displacement (single and double) (4) Combustion. These reaction types can be represented by generic chemical equations as follows:

Combination: $A + B \rightarrow AB$
Decomposition: $AB \rightarrow A + B$
Single-displacement: $A + BC \rightarrow AC + B$
Double-displacement: $AB + CD \rightarrow AD + CB$
Combustion: $A + O_2 \rightarrow AO_2$ or $AH_4 + O_2 \rightarrow AO_2 + H_2O$

Within the above categories, reactions can be further categorized as **precipitation**, **acid-base neutralization** or **oxidation-reduction** (**redox**) reactions (there are others that we will not study here). During a precipitation reaction, an insoluble solid (precipitate) is formed as a product. An acid-base reaction involves the donation of a proton by an acid and the acceptance of the proton by a base (Bronsted-Lowry). A redox reaction occurs when electrons are exchanged between the reactants. In addition, reactions can be classified as **exothermic** (releasing heat) or **endothermic** (consuming heat). In this exercise, you will carry out various reactions, express them as balanced chemical equations and determine what type, or types, of reaction has taken place.

Procedure: Work in pairs. Wear your lab goggles. Perform the reactions below. Reactions may be done in any order but discuss them in your report in the numerical order given in the procedure (for instance, "Fourth reaction"). When you are done, please **place the waste in the appropriate labeled containers! Nothing down the sink!**

Evidence for reactions are: (a) precipitate formation, (b) gas evolution, (c) pH change, (d) heat released or absorbed, and (e) color change. Some of these don't always indicate reaction, but usually do. Look for each of them in each reaction.

The reactions:

Reaction 1: Clean a strip of Mg with glass wool. Make sure the Mg is really shiny before attempting to burn. Using tongs to hold the Mg strip, burn the strip using a Bunsen burner. Try to place the strip in the hottest part of the flame. Dispose of the product in the solid waste container.

Reaction 2: Wet a piece of pH paper with distilled water. Then hold it over (but not touching) an open bottle of concentrated ammonia hydroxide. Record your

observations of the pH paper and any other observations. Throw the pH paper in the trash.

Reaction 3: Clean a strip of Mg with glass wool and place it in 1 mL of 1.0 M HCl. Observe the reaction for a few minutes and then dispose of it in the liquid waste container.

Reaction 4: Mix 1 mL of 0.1 M HCl with 1 mL 0.1 M $AgNO_3$ and mix well. Observe the results and then dispose of it in the liquid waste container.

Reaction 5: Measure the pH of 0.1 M HCl and 0.1 M NaOH by placing a drop of each on pH paper (don't let the drops touch). **Do not dip the paper into the solution!** Determine the pH using the chart on the container and record your results. Then combine 1 mL of each solution, mix with a stir rod and determine the pH. Dispose of the solution in the liquid waste container.

Reaction 6: Place a small amount of $CaCO_3$(s) in 2 mL of 1.0 M HCl. Observe the reaction for a few minutes and then dispose of it in the liquid waste container.

Reaction 7: Place a small piece of Cu(s) in 1 mL of 1.0 M $ZnSO_4$. Observe the reaction, then leave the reaction until the end of lab and observe again. Then dispose of it in the liquid waste container.

Reaction 8: Place a small piece of Zn(s) in 1 mL of 1.0 M $CuSO_4$. Observe the reaction, then leave the reaction until the end of lab and observe again. Then dispose of it in the liquid waste container.

Writeup (on a separate sheet of paper, stapled to this one):

For *each* reaction:

• list **all the evidence** for reaction that you observed (see a through e in the introduction)

• write the **balanced equation** for the reaction

• **classify** each reaction as either "combustion", "combination", "decomposition", "single-displacement" or "double-displacement"