Chemistry - Laboratory #3
Thermal Decomposition of Sodium Chlorate

ROUGH DRAFT pre-lab (goal through procedure) DUE WEDNESDAY, 10/13/10
FINAL DRAFT of lab (title page through procedure) in lab book DUE FRIDAY, 10/15/10
LAB WILL BE ON FRIDAY, OCTOBER 15, 2010

**Goal**

The goal of this lab is to determine the percent of oxygen in sodium chlorate.

**Research Questions**

1. What is thermal decomposition? (Hint: define each word then put them together!) Is thermal decomposition a physical or chemical change? Why do you think so?
2. What does molten mean? What are two examples of things that can be molten?
3. What is the chemical formula for sodium chlorate? What does each part of the formula mean?
4. What is the reaction equation for this lab? What two things will be produced?
5. Describe a test for oxygen gas. Does this test a physical or chemical property of oxygen? Where did you find this test?
6. Describe gas collection using the water displacement method. Include a diagram. How does this method avoid creating a bomb? (Hint: Textbook chapter 12!)
7. What is the actual percentage (literature value, correct answer) of oxygen in $NaClO_3$? Where (or how) did you find this percentage?

**Background and Introduction**

Compounds are substances which are composed of more than one type of atom linked together by a chemical bond. There are 112 elements (with new ones being discovered every decade), but those elements are used to form hundreds of thousands of different compounds. Sodium chlorate is a compound composed of sodium, chlorine, and oxygen atoms.

Compounds are able to be decomposed into simpler substances when enough energy is supplied. Energy may be supplied in the form of heat, light, mechanical shock, or electricity. Sodium chlorate is considered to be thermally unstable because it will decompose into sodium chloride and oxygen gas with the application of a relatively small amount of heat. It melts at 248 °C and will decompose at 300 °C. The reaction equation for the thermal decomposition of sodium chlorate is

$$2\ NaClO_{3\ (s)} + \text{heat} \text{ -----> } 2\ NaCl_{\ (s)} + 3\ O_{2\ (g)}$$

Sodium chlorate is often used in explosives because it releases pure oxygen during the explosion to increase the combustion of the other chemicals as well as reacting with them directly.

Joseph Proust determined that all compounds are composed in a constant mass ratio. This became known as the Law of Definite Proportions. Based on this law, we can expect that everyone will calculate the same percent of oxygen.

To calculate percent of oxygen, divide the mass of oxygen released by the original mass of sodium chlorate used. Determine your group's personal percent error in the same method we used in Lab #2.

**Guidelines**

1. Use 4.00 grams of sodium chlorate.
2. Use a NEW or PRE-CLEANED 25x150 mm test tube as the container to heat the chemical in.
3. Use a thin fiberglass plug to protect the rubber stopper from the hot molten sodium chlorate, or the stopper will explode.
4. It will be necessary to heat the test tube directly; you are not to use a wire gauze. After adding the sodium chlorate, you will need to warm the test tube first (for 1-2 minutes) with the cool part of the flame and then heat it strongly with the hottest part of the flame to help prevent the test tube from shattering.
5. The test tube should be at a 45° angle during heating.
6. Collect the oxygen in several (at least 2) wide-mouth gas collection bottles using the water displacement method of gas collection. Other types of glass containers may also be used.
7. Test the gas collected to show that it is indeed oxygen gas. You will need to check the literature to find a reliable test for oxygen gas. Be sure to document your resource in your research section.
8. To make sure that all the solid in the test tube has been heated thoroughly (and decomposed to oxygen gas), continue to heat the sample for approximately 10 minutes after no further change is observed.
9. Even though you are capturing SOME of the gas in this lab for testing purposes, you should use the law of conservation of mass to calculate the total mass of oxygen gas released.
10. Note: This is a one-day lab!
11. You need three signatures during this lab: pre-lab, oxygen gas test, and clean-up.