

AP Chem Experiment #1

Lab - Determining the Empirical Formula of Silver Oxide

Materials:

Crucible with lid

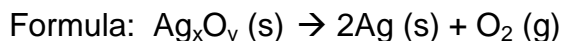
Ring stand with clay pipestem triangle and ring

Bunsen burner

Crucible tongs

Balance

Silver oxide sample, 0.5 g



Purpose: In this experiment the percent composition and empirical formula of silver oxide will be determined. Silver oxide decomposes to silver metal and oxygen when strongly heated. Heating silver oxide causes the oxygen to be driven off, leaving only the silver metal behind. According to the Law of Conservation of Mass, the total mass of the products of a chemical reaction must equal the mass of the reactants. In the case of the decomposition of silver oxide, the following equation must be true:

$$\text{Mass of silver oxide} = \text{mass of silver metal} + \text{mass of oxygen}$$

If both the initial mass of silver oxide and the final mass of the silver metal are measured, the decrease in mass must correspond to the mass of oxygen that combined with silver. The percent composition and empirical formula of silver oxide can then be calculated, based on combining the ratios of silver and oxygen in the reaction. The decomposition of silver oxide into silver and oxygen gas will use a heat source to speed the decomposition. The experiment is designed to allow students to determine the values of x and y in the formula above.

Pre-Lab Questions:

A piece of iron weighing 85.650 grams was burned in air. The mass of iron oxide produced was 118.370 g.

- Use the molar mass of iron to convert the mass of iron to moles.
- According to the Law of Conservation of Mass, what is the mass of oxygen that reacted with iron and how many moles of oxygen are there in the product?
- Using the moles of iron and moles of oxygen, determine the empirical formula for iron oxide. Note: Fractions of atoms do not exist in compounds. In the case where the ratio of atoms is not a whole number (or really close to a whole number), the ratio of each should be multiplied by a constant to give whole number ratios for all atoms.

Procedure:

- Assemble the ring stand, ring, clay triangle and Bunsen burner per the example on the front table.
- Obtain a crucible and lid.
- Place the crucible and lid in the clay triangle per the example on the front table.
- Light your Bunsen burner. Gently warm the crucible for about 1 min, then place the Bunsen burner under the crucible and heat the crucible and lid for an additional 4 minutes. Turn off the Bunsen burner.

- Allow the crucible to cool on the clay pipestem for about 5 minutes. Then remove it from the clay pipestem and place it on the wire gauze pad. When the crucible is cool (about 10 minutes), take the crucible to the electronic balance and mass it to the nearest 0.001 g. Record the value in the data table provided below.
- With the lid and crucible still on the electronic balance, add enough silver oxide to the crucible such that the overall mass increases at least 0.5 grams. Record the value in the data table.
- Set the crucible back on the clay pipestem. Adjust it so the lid is just off the crucible. Relight the Bunsen burner. Gently warm the crucible and contents for 2 minutes. Then place the burner under the crucible for an additional 12 minutes. After this time ask the instructor to assist you in maximizing the flame. Heat the crucible in the most intense part of the flame for 12 minutes. CAUTION: Do not inhale the smoke. Do not lean over the crucible. Stay about an arm's length away from the crucible.
- After 12 minutes, turn off the gas source and remove the burner. Allow the crucible to cool for a few minutes while sitting on the clay triangle
- Using tongs, remove the crucible lid and place it on the wire gauze on the bench top. With the tongs, remove the crucible from the clay triangle and place it on the wire gauze.
- Allow the crucible and contents to cool completely (at least 10 minutes).
- Measure the combined mass of the crucible, crucible lid, and silver metal product. Record the mass in the data table.
- Dispose of the silver product in the container provided by the instructor.
- Repeat the experiment using a new sample of silver oxide.

DATA TABLE

	Trial 1	Trial 2
1. Mass of crucible and lid, g		
2. Mass of crucible, lid, and silver oxide, g		
3. Mass of crucible, lid, and silver metal, g		

- Complete the Data Results Table

Data Results Table

DT = Data Table Entry	Trial 1	Trial 2
1. Mass of silver oxide, g (DT2 -DT1)		
2. Mass of silver, g (DT3-DT1)		
3. Mass of oxygen produced, g (DT2-DT3)		
4. % composition of silver ¹		
5. % composition of oxygen ²		
6. Moles of O in silver oxide ³		
7. Moles of silver in silver oxide ⁴		
8. Mole ratio ⁵		

9. % error		
10. Empirical formula ⁶		

1. % composition = mass of silver divided by mass of silver oxide times 100%
2. % composition = mass of oxygen divided by mass of silver oxide times 100%
3. Moles of O in silver oxide = mass of oxygen divided by 16.00
4. Moles of Ag in silver oxide = mass of silver divided by 107.9
5. Divide the moles of silver and the moles of oxygen by the smaller of the two numbers. One of the numbers will equal 1.
6. The empirical formula is Ag_xO_y where x and y are the mole ratios obtained in 5. Ideally, they are 2 to 1 as the empirical formula is Ag_2O (the one is not written). Do not force the answer. If the ratios you get are not 2 to 1, that is OK. If the other number is not close to a whole number, then multiply both numbers by a whole number until both numbers are close to a whole number. For example – you get 2.5 for one ratio and 1 for the other. Multiply both by 2 and you get 5 and 2. These are the subscripts you use to write the empirical formula.
7. Explain what might have gone wrong and how you could improve the procedure/experiment..