*Heading & Title*

**Introduction**

**Purpose**

The purpose of this experiment is to investigate the validity of the Law of Definite proportions using a decomposition reaction.

**Background Information**

The Law of Definite Proportions, also known as Proust's Law, states that in the same compound, the elements are chemically combined in a fixed ratio by mass. Another way of stating the law is that different samples of a pure compound always contain the same elements in the same proportions according to the mass.

For example, water (H2O) is the chemical combination of hydrogen (2 x 1 g/mol) with oxygen (1 x 16 g/mol), forming a 2:16 or 1:8 ratio by mass. This mass ratio never changes for water.

In this lab, the law of definite proportions will be tested by determining the mass percent of oxygen lost in a compound (decomposition of Potassium Chlorate). Two different mass samples of the same chemical compound, KClO3 (s), can be compared to see if the mass percent of oxygen remains constant.

Note the use of subscripts to indicate the number of atoms of each element in a compound. The subscripts for KClO3 are 1:1:3, meaning there are 1 K, 1 Cl, and 3 O atoms in each potassium chlorate compound.

This experiment will utilize theoretical molar mass and experimental mass of the compound potassium chlorate, KClO3 to calculate theoretical and experimental mass percent of oxygen. The atomic weights of elements K, Cl, and O are theoretically determined using a periodic table. The experimental mass of KClO3 and oxygen alone are determined by using a decomposition reaction. Mass percent is calculated by dividing the mass of oxygen alone by the total mass of the compound, KClO3 and multiplying by 100%.

**Hypothesis**

<http://somup.com/cqhv2YnGxa>

**Equipment/Materials**

Experiment #1:

* Electronic balance
* Crucible and cover
* Crucible tongs
* Bunsen burner with crucible stand and wire gauze
* Manganese (IV) oxide (0.100 g)
* Potassium Chlorate Sample 1 (20.0 g)
* Waste Bin

Experiment #2:

* Electronic balance
* Crucible and cover
* Crucible tongs
* Bunsen burner with crucible stand and wire gauze
* Manganese (IV) oxide (0.100 g)
* Potassium Chlorate Sample 2 (40.0 g)
* Waste Bin

**Procedures**

*Refer to the video, “Law of Definite Proportions,” for more detailed instructions regarding this lab.*

**Experiment 1**

1. A crucible was placed onto the workbench.

2. A balance and a Bunsen burner were placed onto the workbench.

3. 0.100 g of manganese (IV) oxide (MnO2) was added to the crucible.

4. The crucible was moved onto the balance and was weighed.

5. The total mass of the crucible and its contents was recorded.

6. 20.0 g of Potassium Chlorate Sample 1 (KClO3) was added to the crucible.

7. The total mass of the crucible and its contents was recorded.

8. The crucible was moved from the balance to the stand over the Bunsen burner.

9. The Bunsen burner was turned onto a low flame.

10. The crucible was left to sit over the flame for approximately 2 minutes.

11. The crucible was moved onto the workbench to cool for approximately 1 minute.

12. The crucible was moved onto the balance and was weighed.

13. The total mass of the crucible and its contents was recorded.

**Experiment 2**

1. A crucible was placed onto the workbench.

2. A balance and a Bunsen burner were placed onto the workbench.

3. 0.100 g of manganese (IV) oxide (MnO2) was added to the crucible.

4. The crucible was moved onto the balance and was weighed.

5. The total mass of the crucible and its contents was recorded.

6. 40.0 g of Potassium Chlorate Sample 2 (KClO3) was added to the crucible.

7. The total mass of the crucible and its contents was recorded.

8. The crucible was moved from the balance to the stand over the Bunsen burner.

9. The Bunsen burner was turned onto a low flame.

10. The crucible was left to sit over the flame for approximately 2 minutes.

11. The crucible was moved onto the workbench to cool for approximately 1 minute.

12. The crucible was moved onto the balance and was weighed. The total mass of the crucible and its contents was recorded. 40.0 g of Potassium Chlorate Sample 2.

**Calculations and Data**

**\*All masses must be in grams.**

**Experiment 1**

1. Record data and calculate the following for Experiment 1 using sample 1 of KClO3:

a. mass of the crucible with manganese (IV) oxide

b. mass of the crucible after potassium chlorate has been added

c. mass of potassium chlorate alone [“b” minus “a”]

d. mass of the crucible after heating [*KCl + crucible*]

e. mass of oxygen in sample of potassium chlorate [“b” minus “d”]

|  |  |
| --- | --- |
| mass of the crucible with manganese (IV) oxide |  |
| mass of the crucible after potassium chlorate has been added |  |
| mass of potassium chlorate alone |  |
| mass of the crucible after heating |  |
| mass of oxygen in sample of potassium chlorate |  |

2. Calculate the **experimental mass percent of oxygen** in KClO3 according to:

[mass of oxygen lost (1e)] / [mass of KClO3 added to the crucible (1c)] x 100%

*Assume the mass lost is due to oxygen*.

3. Using a periodic table, find the atomic weights of elements K, Cl, and O. Use these to calculate a **theoretical mass percent of oxygen** in KClO3 according to:

(mass of 3 oxygen atoms) / (molecular weight of KClO3) x 100%

4. Calculate the **percent error** in the experiment using the experimental and theoretical values of the mass percent of oxygen. The percent error is defined as:

|(experimental value) − (theoretical value)| / theoretical value x 100%

**Experiment 2**

1. Record data and calculate the following for Experiment 2 using sample 2 of KClO3:

a. mass of the crucible with manganese (IV) oxide

b. mass of the crucible after potassium chlorate has been added

c. mass of potassium chlorate alone [“b” minus “a”]

d. mass of the crucible after heating (in grams) [*KCl + crucible*]

e. mass of oxygen in sample of potassium chlorate [“b” minus “d”]

|  |  |
| --- | --- |
| mass of the crucible with manganese (IV) oxide |  |
| mass of the crucible after potassium chlorate has been added |  |
| mass of potassium chlorate alone |  |
| mass of the crucible after heating |  |
| mass of oxygen in sample of potassium chlorate |  |

2. Calculate the **experimental mass percent of oxygen** in KClO3 according to:

[mass of oxygen lost (1e)] / [mass of KClO3 added to the crucible (1c)] x 100%

*Assume the mass lost is due to oxygen*.

3. Use the same theoretical value for the mass percent of oxygen from Experiment 1 to calculate the **percent error** of the mass percent of oxygen in Experiment 2. The percent error is defined as:

|(experimental value) − (theoretical value)| / theoretical value x 100%

**Conclusion**

**Address Hypothesis**

**Analysis**

**Questions**

1. Did the results of this lab confirm the law of definite proportions? Use evidence to support your answer.

2. What was the purpose for heating potassium chlorate in this experiment?

3. What percent error did you calculate for both experiments 1 and 2? If one was to perform this experiment in an actual live lab situation, what percent error would exist for the mass percent of oxygen if experiment 2 had a yield of 116.839 grams of KCl + crucible after (row 4 in the data table) the oxygen was removed? Show Work.

**Errors**

**Bibliography**