NS D2 (pg 1 of 2) Mass Ratios and Mass % Composition

Name_____Per____

Law of Constant Composition

This law states that the mass ratios of individual elements in a particular compound will be constant.

We studied two compounds in the lab to demonstrate this law. In the first experiment a compound (SG) was heated to separate the parts and determine the ratio of the solid portion (S) to the gaseous portion (G) as shown in the data below.

mass of SG (g)	3.75	5.65	7.86	10.79	12.41	15.27
mass of S (g)	2.03	3.08	4.23	5.87	6.82	8.26
mass of G (g)	1.72	2.57	3.63	4.92	5.59	7.01
mass ratio of S/G	1.18	1.20	1.17	1.19	1.22	1.18

In the second experiment, we reacted an element (magnesium) with another element (oxygen) to produce a compound (magnesium oxide) and determined the ratio of the Mg to O as shown in the data below.

mass of Mg (g)	0.237	0.349	0.611	0.887	1.049	1.029
mass of MgO (g)	0.393	0.583	0.998	1.459	1.730	1.734
mass of O (g)	0.156	0.234	0.387	0.572	0.681	0.705
mass ratio of Mg/O	1.52	1.49	1.58	1.55	1.54	1.46

There is another way to present the results from these two experiments. It can be useful to calculate percent composition, meaning calculate the percentage, by mass, of each element in a compound. Consider the example using the magensium and oxygen data as shown below.

Experimental % Composition Using Lab Data

mass of Mg (g)	0.237
mass of MgO (g)	0.393
mass of O (g)	0.156

This data will allow % calculations of both the magnesium and the oxygen:

$$Mg \quad \frac{0.237g}{0.393g} \times 100 = 60.3\% \ magnesium$$

$$O \quad \frac{0.156g}{0.393g} \times 100 = 39.7\% \ oxygen$$

Theoretical % Composition − Using Molar Masses

Using water as an example, H_2O the mass percentages of this compound from the known formula is illustrated below.

H 2 (1.01 g/mole) + 16.0 g/mole = 18.02 g/mole total *(these numbers are the molar masses from the periodic chart.)*

$$H \quad \frac{2.02g}{18.02g} \times 100 = 11.2\% \qquad O \quad \frac{16.0g}{18.02g} \times 100 = 88.8\%$$

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What else can we do with % composition or mass ratio information?

A. If you were given 2.85 g of magnesium oxide, what mass of magnesium would be in this sample?

- From the percentages calculated on the previous page, we know that MgO is 60.7 % Mg
- Convert the 60.7% to a decimal and then multiply by the mass of the sample: $0.607 \times 2.85 g = 1.73 gMg$

B. If you were given 12.0 g of magnesium, what mass of magnesium oxide could be produced with enough oxygen?

- From percentages calculated on the previous page, we know that MgO is 60.7 % Mg, so we could set up a ratio.
- $\frac{12.0 gMg}{60.7\% Mg} = \frac{x\ g\ MgO}{100\% MgO} \qquad x = 19.8 gMgO$

C. If you were given 5.25 g of magnesium, what mass of oxygen would react with the magnesium?

- From mass ratio calculated on the previous page, we know that Mg/O is 1.19, so we could set up a ratio
- $\frac{1.19 gMg}{1 gO} = \frac{5.25 gMg}{xgO} \qquad x = 4.41 gO\ would\ react$