Ch 221 Recitation

The Law of Multiple Proportions:

When two elements combine to make two (or more) different compounds, the mass ratio of the two elements in the first compound, when divided by the mass ratio for the second compound, form simple whole number ratios (e.g. 3/2, 4/1 etc).

**Example Experiment 1:** Imagine John Dalton in 1805 performing the following experiments with two compounds containing sulfur and oxygen ("make two (or more) compounds")

**Compound #1:**

- decomposition of the compound resulted in 25.0 g of sulfur and 24.9 g of oxygen.

  ratio of sulfur to oxygen:

  \[
  \frac{25.0 \text{ g}}{24.9 \text{ g}} = 1
  \]

**Compound #2:**

- decomposition of the compound resulted in 25.0 g of sulfur and 37.4 g of oxygen.

  ratio of sulfur to oxygen:

  \[
  \frac{25.0 \text{ g}}{37.4 \text{ g}} = 0.67
  \]

Ratio of oxygens in each compound – always put the larger number over the smaller.

\[
\text{compound}\#1/\text{compound}\#2 = 1/0.67 = 1.5 = 3/2 ("form simple whole number ratios")
\]

another example on the back →
**Example Experiment II:** two compounds containing nitrogen and oxygen

**Compound #1:**

- decomposition of the compound resulted in 25.0 g of nitrogen and 42.9 g of oxygen

  ratio of nitrogen to oxygen:

  \[
  \frac{25.0 \text{ g}}{42.9} = 0.58
  \]

**Compound #2:**

- decomposition of the compound resulted in 25.0 g of nitrogen and 71.4 g of oxygen

  ratio of nitrogen to oxygen:

  \[
  \frac{25.0 \text{ g}}{71.4 \text{ g}} = 0.35
  \]

**Ratio of oxygens in each compound – always put the larger number over the smaller.**

\[
\text{compound } #1/\text{compound } #2 = 0.58/0.35 = 1.66 = 5/3
\]

another example on the back →
**Example Experiment III:** two compounds containing iron and oxygen

**Compound #1:**
- decomposition of the compound resulted in 25.0 g of iron and 7.2 g of oxygen
- ratio of iron to oxygen:
\[
\frac{25.0 \text{ g}}{7.2} = 3.5
\]

**Compound #2:**
- decomposition of the compound resulted in 25.0 g of iron and 10.7 g of oxygen
- ratio of iron to oxygen:
\[
\frac{25.0 \text{ g}}{10.7 \text{ g}} = 2.34
\]

**Ratio of oxygens in each compound — always put the larger number over the smaller.**

\[
\text{compound } #1/\text{compound } #2 = 3.5/2.34 = 1.5 = 3/2
\]
1. Nitrogen forms several compounds with oxygen. Measurements of the masses of nitrogen and oxygen that form upon decomposing these compounds indicates that one compound contains 2.28 g of oxygen for every 1.00 g of nitrogen, while the other compound contains 0.570 g oxygen for every 1.00 g of nitrogen. Calculate the simplest whole number ratio. $\text{ANSWER} = \frac{4}{1}$

\[
\text{cmpd #1: } \frac{2.28 \text{ g O}}{1.00 \text{ g N}} = 2.28 \\
\text{cmpd #2: } \frac{0.570 \text{ g O}}{1.00 \text{ g N}} = 0.570 \\
\text{ratio: } \frac{2.28}{0.570} = \frac{4}{1}
\]

2. Sulfur forms several compounds with fluorine. Upon decomposition one sample produces 4.45 g of fluorine and 1.25 g of sulfur, and the other compound produces 4.43 g of fluorine and 1.87 g of sulfur. Calculate the simplest whole number ratio. $\text{ANSWER} = \frac{3}{2}$

\[
\text{cmpd #1: } \frac{4.45 \text{ g F}}{1.25 \text{ g S}} = 3.56 \\
\text{cmpd #2: } \frac{4.43 \text{ g F}}{1.87 \text{ g S}} = 2.37 \\
\text{ratio: } \frac{3.56}{2.37} = 1.50 \text{ or } \frac{3}{2}
\]