THREE FUNDAMENTAL CHEMICAL LAWS
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1. Law of Conservation of Mass
2. Law of Definite Proportions
3. Law of Multiple Proportions
#1 – LAW OF CONSERVATION OF MASS

Mass cannot be created or destroyed, it can only be rearranged or converted from one form to another

https://www.youtube.com/watch?v=2S6e11NBwiw
#1 – LAW OF CONSERVATION OF MASS

• We convert mass into energy during **nuclear chemical reactions**.

• In **normal chemical reactions** we simply rearrange the atoms to bond in different combinations to make new molecules.
#1 – LAW OF CONSERVATION OF MASS

If heating 10 grams of CaCO$_3$ produces 4.4 g of CO$_2$ and 5.6 g of CaO, show that these observations are in agreement with the law of conservation of mass.

$$4.4 \text{ g } + 5.6 \text{ g } = 10 \text{ g}$$
#1 – LAW OF CONSERVATION OF MASS

\[ 2H_2 + O_2 \rightarrow 2H_2O \]
No matter how a molecule is made, it will always have the same elements in the same ratios.

Example: No matter how you make it, \( \text{H}_2\text{O} \) will always be 2 hydrogen:1 oxygen.
#2 – LAW OF DEFINITE PROPORTIONS

10.000 g of water gives 1.119 g of hydrogen gas and 8.881 g of oxygen gas. Also 27.000 g of water produces 3.021 g hydrogen and 23.979 g oxygen. Show that this follows the law of definite proportions.

Show that each sample has the same ratios!

**Sample #1:**

\[
\begin{align*}
\frac{1.119 \text{ g H}_2 \text{ gas}}{10.000 \text{ g H}_2 \text{O}} & = 0.1119 \\
& \times 100 = 11.19\% \text{ H} \\
\frac{8.881 \text{ g O}_2 \text{ gas}}{10.000 \text{ g H}_2 \text{O}} & = 0.8881 \\
& \times 100 = 88.81\% \text{ O}
\end{align*}
\]

**Sample #2:**

\[
\begin{align*}
\frac{3.021 \text{ g H}_2 \text{ gas}}{27.000 \text{ g H}_2 \text{O}} & = 0.1119 \\
& \times 100 = 11.19\% \text{ H} \\
\frac{23.979 \text{ g O}_2 \text{ gas}}{27.000 \text{ g H}_2 \text{O}} & = 0.8881 \\
& \times 100 = 88.81\% \text{ O}
\end{align*}
\]

Same ratios! So it is water!
Elements can combine in different ratios, but they must always be whole number ratios! We cannot have $\frac{1}{2}$ an atom! Or $\frac{1}{4}$ of an atom! Etc.

**Example**: NO, NO$_2$, N$_2$O

**Not** NO$_{1.5}$
Which of the following pairs of compounds can be used to illustrate the “law of multiple proportions”?

- a) CH$_4$ & CO$_2$
- b) NH$_4$ & NH$_4$Cl
- c) SO$_2$ & SO$_3$
- d) H$_2$O & HCl
- e) ZnO$_2$ & ZnCl$_2$
- f) CO & CO$_2$
A LITTLE HISTORY BEHIND ALL THIS!

https://www.youtube.com/watch?v=QiiyvzZBKT8