LAW OF CONSERVATION OF MASS

Text modified from: <http://www.helium.com/items/1672816-law-of-convervation-of-mass>

The most basic and fundamental law of Science is called the law of conservation of mass. It forms the foundation for studying chemical reactions and the properties of compounds. It is a very simple concept that allows for scientists to study the true nature of chemical reactions and their products. This law states "mass cannot be created or destroyed, only transferred from state to state."

A simple way to understand it is that the **reactants**, or ingredients (the substances being reacted together), in any chemical reaction must have the same mass as the **products** of the reaction. An everyday example would be the burning of wood. When wood is burned, the resulting products appear to be lesser than the original wood. This is because much of the wood escaped into the atmosphere as carbon dioxide, water vapor, and other gases. This open, outdoor setting is an example of an **open system** because matter can escape as gas into the atmosphere. If you were to trap these gases and measure their mass along with the leftover ashes and char, the mass would be consistent with the original wood. This type of system that is sealed is known as a **closed system**.

This concept was first discussed as early 300 B.C. by Epicurus who made the realization that "the sum total of things was always such as it is now, and such it will ever remain," The law determines that mass simply changes form, or position in space, but never ceases to exist. It may be released as a gas, or be shot off into the atmosphere, or even dissolve in a liquid, but at some level it is still there. It may sometimes be difficult to trace the products of the equation, but they were produced nonetheless.

This concept was further developed and proven by the French chemist Antoine Lavoisier. He used experimental methods to show that the products of a reaction maintain the same mass as the reactants. He did this by containing simple reactions in a sealed container where gas could not escape. This research was later furthered by the invention of the vacuum pump, which removed the atmospheric buoyancy of gases and allowed them to be more easily measured on scales.

The concept has launched us into the era of chemistry rather than the alchemy of prior generations. Scientists are now able to measure all of the products on scales. This idea lead to the idea of chemical elements, and the discovery of many previously unknown gases. The conservation of mass principal has brought science to where it is today.

1. Define the Law of Conservation of Mass (LOCM).

2. According to the LOCM mass, the mass of reactants and products are….

3. What is the difference between an open system and a closed system?

4. Examine the data for the following combustion experiment and answer the questions based on analysis of the data.

REACTANT(S) PRODUCT(S)

**Magnesium + Oxygen ------> Magnesium Oxide**

48.6 g + 32.0 g -----> 80.6 g

a. What is the mass of each reactant?   
 Magnesium = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Oxygen = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. What is the mass of the product? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. What is the total mass of reactants? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. Does this experimental data support the Law of Conservation of Mass? Explain.

5. Use the LAW OF CONSERVATION OF MASS to fill out the missing information in the table below.   
 Hint: Mass of Reactants = Mass of Products

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Reaction** | **Reactant(s)** | | | **Product(s)** | |  |
|  | | | | | |  |
| **A)** | **H2 + O2 --> H2O** | | | | |  |
| **mass** | **3.4g** | | **10g** | **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | |  |
|  | | | | | |  |
| **B)** | **CH4 + O2 --> CO2 + H2O** | | | | |  |
| **mass** | **12.2g** | | **14g** | **\_\_\_\_\_\_** | **20.0g** |  |
|  | | | | | |  |
| **C)** | **HgO --> Hg + O2** | | | | |  |
| **mass** | **23.6g** | | | **\_\_\_\_\_\_\_\_** | **13.0g** |  |
|  | | | | | |  |
| **D)** | **Li + O2 --> Li2O** | | | | |  |
| **mass** | **\_\_\_\_\_\_\_\_\_\_\_\_\_** | | **5.7g** | **24.6g** | |  |

6. Examine the data for the following experiment :

REACTANT(S) PRODUCT(S)

**Magnesium + Oxygen ------> Magnesium Oxide + Oxygen**

48.6 g + 50.0 g ------> 80.6 g + ?

1. What is the mass of oxygen that will be left over after the reaction of 48.6 grams of magnesium with 50.0 grams of oxygen? Show your work.

7. When ammonium nitrate (NH4NO3) explodes, the products are nitrogen, oxygen, & water. When 40 grams of ammonium nitrate explode, 14 grams of nitrogen and 8 grams of oxygen form. How many grams of water form? Show your work.

NH4NO3 ----> N2 + O2 + H2O

8. Examine the data for the following combustion experiment.

REACTANT(S) PRODUCT(S)

**Magnesium + Oxygen ------> Magnesium Oxide**

12.2 g + 8.0 g -----> ? g

1. Assuming that magnesium and oxygen will react completely with one another, predict the mass of magnesium oxide that will be produced. Show your work.

9. A student adds 15 g of baking soda to 10 g of acetic acid in a beaker. A chemical reaction occurs and a gas is given off. After the reaction, the mass of the products remaining in the beaker is 23 g. Has mass been conserved in this reaction?

Claim *(circle one)* : Yes No

Explain how you know (use data, definitions, etc.):

Is this system open or closed? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_