

Laws of Chemical Combination

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Introduction

Everything around us in the universe is made up of matter. [Matter](#) has mass and occupies space and volume. Generally, matter is classified on the basis of its [physical properties](#) and chemical properties. Properties such as shape, color, hardness, boiling point and melting point come under its physical properties while the ability of matter to form completely new substance of different composition comes under its chemical properties.

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[chemical combination-1](#)

Various experiments have been done on this chemical classification of matter, which has resulted to some common conclusions.

Antoine L. Lavoisier was the first to establish the important laws of chemical combination. According to him, when two or more [chemical elements](#) combine or react together, they obey certain laws of chemical combination to form a completely new substance or product. These laws eventually led to the concept of Dalton theory.

There are three basic laws of chemical combination. They are

1. Law of conservation of mass
2. Law of constant composition
3. Law of multiple proportion

Law of Conservation of Mass

The Law of Conservation of Mass comes under the group of laws based on the physical properties. Antoine L. Lavoisier stated that "During any physical or chemical change, the total mass of matter remains constant". It implies in any chemical reaction the total mass of reactants is equal to the total mass of products in any [closed system](#). It can also be stated as mass can neither be created nor destroyed, it can only transform from one form to another. A simple example is the reaction of carbon with oxygen to form carbon dioxide. According to the law of conservation of mass the number of atom or element on right side of equation is equal to the number of atom or element on left side of equation.

Example:

Carbon + Oxygen	?	Carbon Dioxide
12 g 32 g		44g

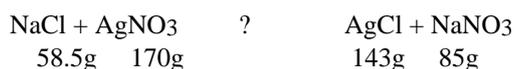
It is also known as 'Law of indestructibility of matter'.

chemical combination-5	+	2*16.00g	=	44g
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Therefore the total mass of the reactants (12 gram + 32 gram = 44 gram) balances with the total mass of the products (44 gram) in above reaction. Thus, mass is conserved during a chemical reaction. This statement is true for all [balanced chemical reactions](#).

Verification of the law of conservation of mass

The law of conservation of mass can be verified by an experiment given below. This experiment was done by Landolt to verify Law of conservation of mass in double decomposition reaction. Solution of sodium chloride and silver nitrate were taken in two different limb of a U tube. The tube was sealed and weighed and then tilted as to mix the solutions thoroughly. Chemical reaction takes place in both the reactants to form precipitate of silver chloride. The tube is then again weighed. It was found that the total mass of NaCl and AgNO₃ (reactant) is equal to the total mass of AgCl and NaNO₃ (products).



Total mass of reactants= 58.5g + 170g = 228.5g

Total mass of products=143g + 85g = 228.5g

Therefore, the total mass of reactants= total mass of products.

Thus, it verifies the Law of conservation of mass.

Law of Constant Proportion

Joseph Proust stated the Law of constant proportion as "In a chemical [compound](#) or substance the elements are always combined together in definite proportions by mass".

Example

Different samples of water contain hydrogen and oxygen in the ratio of 1:8 whether it may come from river, ocean or spring.

- Similarly CO₂ contain carbon and oxygen in the ratio of 3: 8 whether it is produced by burning of coal or by action of acid on marble pieces or metal carbonates.

Verification of the Law of Constant Proportion

Prepare cupric oxide by two different methods:

1. By heating copper metal in air
2. By heating copper carbonate

In both the reactions, copper and oxygen are present in fixed ratio of 4:1 by weight. This proves the law of constant proportion.

Law of Multiple Proportions

Law of multiple proportions was given by John Dalton (1803). It states "When two elements combine together to form two or more compounds, the ratio of the mass of one the element to the fixed mass of the other element bears a simple whole number ratio".

Example

Carbon when react with oxygen it forms two oxides that is [carbon monoxide](#) and [carbon dioxide](#).

In carbon mono oxide (CO), 12 grams of carbon is combined with 16 grams of oxygen where as in carbon dioxide (CO₂) the 12 grams of carbon is combined with 32 grams of oxygen.

The ratio of the oxygen mass combining with a fixed mass of carbon in both the cases is 1:2.

Verification of law of multiple proportion

The law of multiple proportions is simply verified by the study of Cu₂O and the CuO which are the two oxides of copper. Both the oxides are taken separately in equal amount say 10 gram each and then hydrogen current is passed through it to form metallic copper. The mass of the metallic Cu is estimated. Subtracting the respective mass of copper oxide with the respective mass of copper, the respective mass of [oxygen](#) is determined. Now, the dissimilar weights of oxygen that combines with the same weight of copper are calculated. These weights are found to have a simple whole number ratio. Thus the law of multiple proportions is verified.

What are the basic laws of chemical combination?

Try to answer. Still need help? Want to know more about it? [Click here](#) to schedule live help from a certified tutor!

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Reference Links:

- <http://en.wikipedia.org/wiki/Atom>
- http://www.sky-web.net/science/balancing_chemical_equations.htm

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