

Laws of Chemical Combination:

In order to understand the composition of the compounds, it is necessary to have a theory which accounts for both qualitative and quantitative observations during chemical change. These observations of chemical reactions were most significant in the development of a satisfactory theory of the nature of matter. These observations of chemical reactions are summarized in certain statements known as laws of chemical combination.

(i) Law of conservation of Mass : The law was first stated by Lavoisier in 1774. It is also known as the law of indestructibility of matter. According to this law in “all chemical change the total mass of the system remains constant” or “in a chemical change mass is neither created nor destroyed”. This law was tested by Landolt. All chemical reactions follow this law.

In chemical change,

Total masses of reactants = Total masses of products

This relationship holds good when reactants are completely converted into products.

In case the reacting materials are not completely consumed, the relationship will be

Total masses of reactants = Total masses of products
+ Masses of unreacted reactants

(ii) Law of Definite or Constant Proportions : This law was presented by Proust in 1799 and may be stated as follows:

“A chemical compound always contains the same elements combined together in fixed proportion by mass, i.e., chemical compound has a fixed composition and it does not depend on the method of its preparation or the source from which it has been obtained”.

For example, carbon dioxide can be obtained by using any one of the following methods:

- By heating calcium carbonate,
- By heating sodium bicarbonate,
- By burning carbon in oxygen,
- By reacting calcium carbonate with hydrochloric acid, Whatever sample of carbon dioxide is taken, it is observed that carbon and oxygen are always combined in the ratio of 12 : 32 or 3 : 8.

(iii) Law of Multiple Proportions : This law was put forward by Dalton in 1808. According to this law “If two elements combine to form more than one compound, then the different masses of one element which combine with a fixed mass of the other element, bear a simple ratio to one another”.

Hydrogen and oxygen combine to form two compounds H₂O (water) and H₂O₂ (hydrogen peroxide)

In water,	Hydrogen 2 parts	Oxygen 16 parts
In Hydrogen peroxide,	Hydrogen 2 parts	Oxygen 32 parts

The masses of oxygen which combine with same mass of hydrogen in these two compounds bear a simple ratio 1 : 2.

Nitrogen forms five stable oxides.

N ₂ O	Nitrogen 28 parts	Oxygen 16 parts
N ₂ O ₂	Nitrogen 28 parts	Oxygen 32 parts
N ₂ O ₃	Nitrogen 28 parts	Oxygen 48 parts
N ₂ O ₄	Nitrogen 28 parts	Oxygen 64 parts
N ₂ O ₅	Nitrogen 28 parts	Oxygen 80 parts

The masses of oxygen which combine with same mass of nitrogen in the five compounds bear a ratio 16 : 32 : 48 : 64 : 80 or 1 : 2 : 3 : 4 : 5.

(iv) Law of Reciprocal Proportions : This law was given by Richter in 1794. The law states that when definite mass of an element A combine with two other elements B and C to form two compounds and if B and C also combine to form a compound, their combining masses are in same proportion or bear a simple ratio to the combining masses of B and C which combine with a constant mass of A.

For example, hydrogen combines with sodium and chlorine to form compounds. NaH and HCl, respectively.

In NaH,	Sodium 23 parts	Hydrogen one part
In HCl,	Chlorine 35.5 parts	Hydrogen one part

Sodium and chlorine also combine to form NaCl in which 23 parts of sodium and 35.5 parts of chlorine are present. These are the same parts which combine with one part of hydrogen in NaH and HCl respectively.

(v) Law of Gaseous Volumes : This law was enunciated by Gay-Lussac in 1808. According to this law, gases react with each other in the simple ratio of their volumes and if the product is also in gaseous state, the volume of the product also bears a simple ratio with the volumes of gaseous reactants when all volumes are measured under similar conditions of temperature and pressure.

