Atomic Theory

Law of conservation of mass

If a piece of magnesium is burnt, will there be a gain or a loss in mass? Why?

Activity

Measure the mass of 500 cm^3 of your favorite drink. Then compare your body mass before and after drinking it.

Initial mass (kg)	Final mass (kg)	Change in mass (kg)

Dissolve 100g table salt in 1 liter of water. Compare the masses of solute, solvent and the resulting solution.

Initial mass (g)	Final mass (g)	Change in mass (g)

What can you conclude from the above activities?

The Law of Conservation of Mass was put forward by Antoine Lavoisier in 1774. Lavoisier is known as the father of the modern chemistry. Find out more about his investigations!

How did he demonstrate the Law of Conservation of Mass?

Law of definite proportions

Activity

At the end of 1700s, scientists were trying very hard to discover laws or "regularities" in Nature. Some chemists tried to mix different elements to see how they reacted with each other. They could measure the mass of the reactants and products very accurately.

Here are some data, or experimental results, they obtained from the reaction of carbon with oxygen to form carbon dioxide.

Mass of oxygen reacting (g)	**Mass of carbon reacting (g)**
32	12
64	24
96	36

Under some other conditions, carbon reacts differently with oxygen to produce carbon monoxide. Here are the data for these reactions.

Mass of oxygen reacting (g)	**Mass of carbon reacting (g)**
16	12
32	24
48	36

Below are the data for the reaction between copper and oxygen.

Mass of oxygen reacting (g)	**Mass of copper reacting (g)**
16	64
32	127
48	191

Can you discover any patterns in these data? What conclusion can you draw from these experimental results?

Dalton's Atomic Theory

The Law of Conservation of Mass and the Law of Definite Proportion were great discoveries. At that time, nobody could explain the laws.

An early nineteenth century English scientist, John Dalton (1766-1844), reasoned that if atoms really exist, they must have certain properties to account for the two laws of chemical combination. He developed the first useful atomic theory of matter around 1803. John Dalton's Atomic Theory is summarized below –

Dalton's Atomic Theory

- All matter consists of tiny particles.
- Atoms are indestructible and unchangeable.
- All atoms of the same element have identical weights, Dalton asserted. Atoms of different elements have different weights.
- When elements react, their atoms combine in simple, whole-number ratios.
- When elements react, their atoms sometimes combine in more than one simple, whole-number ratio.
- When atoms combine in only one ratio it must be presumed to be a binary one.

How can this theory explain the Law of Conservation of Mass and the Law of Definite Proportions?

Comment on the theory with reference to your knowledge in Chemistry. Can all statements still considered to be true?

Law of combining volumes

In 1808, Joseph Gay-Lussac (1778-1850) began a series of experiments with the volumes of reacting gases. He found that two volumes of hydrogen react with one of oxygen to form two volumes of steam; three volumes of hydrogen react with one of nitrogen to yield two volumes of ammonia; and one volume of hydrogen reacts with one of chlorine to produce two volumes of HCl gas. An initial excess of either gas is left over at the end of the reaction.

What inference can you draw from Gay-Lussac's experiments?

Avogadro's number and Mole

A mole is defined as the number of grams of a compound equal to its molecular weight. A mole of any compound has the same number of molecules 6.022×10^{23}.

Checkpoint

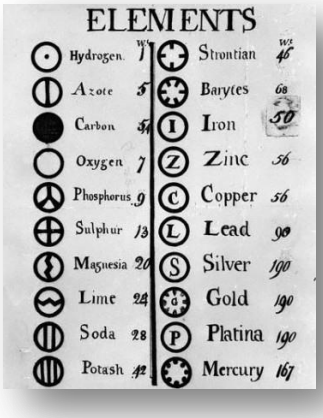
What is the weight of 1 mole of Carbon?

How many moles of oxygen molecules are present in 64g of oxygen gas?

How many electrons are there in 4g moles of Hydrogen gas?

Symbols for atoms

List the elements that you know and write the symbols used to represent them. You can refer to the periodic table to find the symbol of the elements.



How many elements are known to us? How many of these are naturally occurring and how many have been prepared artificially?

Ion, molecule and compound

Atoms combine with each other in two broad general ways - molecular compounds and ionic compounds. What is the main difference between the two?

List the names and valences (combining power) of ions known to you. Also name the compound in which that ion is found.

Name	Symbol	Valency	Compound(s)