Atoms & Molecules

Rules of chemical combination:
Before Dalton, the concept of atom was merely philosophical. Dalton explained about the atom on the basis of the rules of chemical combination.

There are three rules of chemical combination.
1. Law of conservation of mass
2. Law of Constant Proportion
3. Law of Multiple Proportions

LAW OF CONSERVATION OF MASS:
French scientist Antoine L. Lavoisier founded the theory of the law of conservation of mass. The law of conservation of mass states, Mass can neither be created nor destroyed in a chemical reaction.

According to this law, the mass of an isolated system will remain constant with time. This means that when mass is enclosed in a system and no one is allowed in or out, its volume will never change. That is, mass will be conserved, and hence it is called the law of conservation of mass. This means that the total mass of the products is always equal to the total mass of the reactants. Since there is no loss in the mass of substances, that is, mass remains conserved, that is why Lavoisier called it the law of mass conservation.

For example, when wood burns, the mass of soot, ash, and gases is equal to the original mass of charcoal and oxygen when it first reacts. Therefore, the mass of the product is equal to the mass of the reactant.

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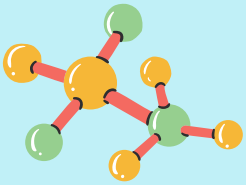
Law Of Constant Proportions states that the ratio of elements in a chemical compound is always exactly the same by mass. This rule is also called the law of definite proportion. Joseph Louis Proust gave this law, hence
this law is also called Proust's law.



Explanation of law:
Compounds are formed by the combination of two or more elements. The ratio of atoms or elements by mass in a compound always remains the same, regardless of the source of the compound. This means that a certain compound is always formed by the combination of atoms in the same ratio by mass. If the ratio of masses of constituent atoms is changed, a new compound is formed.

Example:
Water is formed by the combination of hydrogen and oxygen. Irrespective of the source of water, the ratio of masses of hydrogen and oxygen in water is always 1:8. Whether you collect water from a well, river, pond or anywhere, the ratio of their constituent atoms by mass will always be the same.

DALTON'S ATOMIC THEORY:
John Dalton, a British chemist and scientist, gave the atomic theory in 1808. This theory is known as Dalton's atomic theory in honor of John Dalton. He gave theories based on the rules of chemical combination and explained them properly. In his theory he explains about the atom

Main postulates of Dalton's atomic theory
1. Elements are made up of extremely small particles called atoms.
2. The atoms of a given element are similar in size, mass and other properties
3. Atoms of different elements differ in size, mass and other properties.
4. Atoms cannot be divided, created or destroyed.
5. Atoms of different elements combine in simple integer proportions to form chemical compounds.
6. In chemical reactions, atoms are combined, separated or rearranged

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Atom: Atom can be defined on the basis of Dalton's atomic theory. The smallest particles of matter are called atoms.

Characteristics of Atoms:

- Atom is the smallest particle of matter.
- All elements are made of small particles called atoms.
- Atoms are very small in size and cannot be seen with the naked eye.
- Atoms do not exist in free state in nature. But atoms take part in chemical reactions.
- The properties of a substance depend on the characteristics of the atoms.
- Atoms are the building blocks of an element like bricks that come together to form a building.
- The size of atoms is shown by its radius.
- In ancient times, atoms were considered indivisible.

ATOMIC MASS:

The mass of an atom is called atomic mass. Since atoms are very small, the actual mass of the resulting atom is very small. Thus relative atomic mass is used for convenience. Carbon-12 is considered the unit for calculating atomic mass. Carbon-12 is an isotope of carbon. The relative masses of all atoms are found relative to C-12. One atomic mass = 1/12 of the mass of one atom of C-12.

For example:

The atomic mass of oxygen is 16u, it means that one atom of oxygen is 1/12 times heavier than 16 carbon atoms.

Absolute mass or actual atomic mass:

It is found that, the actual atomic mass of carbon-12 atom is equal to 1.9926 X 10-23g. Thus by multiplying the relative atomic mass by 1.6605 × 10-24g we can get the absolute or real mass of an atom.

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Symbols of atoms in elements:

Dalton was the first scientist who used the symbols of elements in a very specific sense. When he used a symbol for an element, he also meant a certain amount of that element, i.e. one atom of that element.

Berzelius suggested that the symbols of the elements be made up of one or two letters of the element's name. Many symbols are the first one or two letters of the element's name in English. The first letter of a symbol is always written as a capital letter (uppercase) and the second letter as a small letter (lowercase). For convenience the elements are represented by unique symbols.

For example: Hydrogen is represented by 'H'. Oxygen is shown as 'O'. Nitrogen is represented by 'N'. Iron is represented by 'Fe'. Elements are represented by unique symbols. For example: Hydrogen is represented by 'H'. Oxygen is shown as 'O'. Nitrogen is represented by 'N'. Iron is represented by 'Fe'.

The symbols of many elements are taken from their English names, while the symbols of many elements are taken from their Greek or Latin names. Symbols of some elements are derived from their Latin names. Many elements are named after the place where they were discovered, such as 'copper' which was taken from Cyprus. Some elements are named after their colour, such as 'sona' which means yellow.

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EXISTENCE OF ATOMS

Atoms of most elements exist as molecules or ions, because they are the most reactive.

For example, hydrogen, oxygen, chlorine, etc. However, atoms of some elements, which are non-reactive, exist in free state in nature. For example helium, neon, argon etc.

Generally atoms exist in the following two forms –

- In the form of molecules
- In the form of ions

MOLECULE:

It is the smallest particle of an element or compound that can exist independently.

- Molecules of an element form atoms of the same type.
- Molecules can be monoatomic, diatomic or polyatomic
- Molecules of compounds join together in certain proportions and form different types of atoms.

Most atoms exist in the form of molecules. Molecules are formed by the combination of two or more elements. Example: Hydrogen molecule (H2), Oxygen molecule (O2), Nitrogen molecule (N2), etc.

- Molecules of elements
- Molecules of compounds

MOLECULES OF ELEMENTS:

When two more atoms of the same element join together to form a molecule, they are called molecules of the element.

Example:

Hydrogen molecule (H2). Hydrogen molecule (H2). Hydrogen molecule is formed by the combination of two hydrogen atoms. Oxygen molecule (O2). Oxygen molecule is formed by the combination of two oxygen atoms.

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ATOMICITY

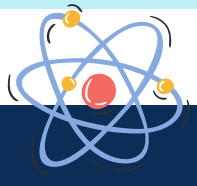
Monoatomic: When a molecule is made up of only one atom, it is called a monatomic molecule. Normally noble gases form monatomic molecules. For example: Helium (He), Neon (Ne), Argon (Ar), Kr (Krypton), Xenon (Xe), Randon (Rn).

Biatomic:
When a molecule is formed by the combination of two atoms, it is called a diatomic molecule. For example: Hydrogen (H2), Oxygen (O2) Nitrogen (N2), Chlorine (Cl2), etc.

Triatomic:
When a molecule is formed by the combination of three atoms, it is called a triatomic molecule. For example: ozone molecule (O3

TETRA-ATOM
When a molecule is formed by the combination of four atoms, it is called a tetragonal molecule. For example: phosphorus molecule (P4)

POLYATOMIC
When a molecule is formed by the combination of more than two atoms, it is called a polyatomic molecule. For example: sulfur molecule (S8)
molecules of compounds
When a molecule is formed by the combination of two or more atoms of different elements, it is called a compound molecule. Example: Water molecule (H2O). Water molecule is formed by the combination of two hydrogen and one oxygen atoms.



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IONS

Atoms of many elements exist in the form of ions. The atoms or molecules which have a negative or positive charge are called ions.

Cation: Ions which have a positive charge are called cations. For example: sodium ion (Na^+), potassium ion (K^+), etc.

Anion: Ions which have a negative charge are called anions. For eg: chloride ion (Cl^-), fluoride ion (F^-), etc.

Monatomic ions: Ions formed from a single atom are called monatomic ions. For eg: sodium ion (Na^+), potassium ion (K^+), chloride ion (Cl^-), etc.

Polyatomic ions: Ions formed from two or more atoms are called polyatomic ions. These are groups of atoms of different elements that behave as single units, and are known as polyatomic ions.

For example: Ammonium ion (NH_4^+), hydroxide ion (OH^-), etc.

WRITING CHEMICAL FORMULAS

The chemical formula of a compound is a symbolic representation of its structure.

To write the chemical formula of a compound, it is necessary to know the symbols and valencies of the constituent elements. The valency of an atom of an element can be thought of as a hand or arm of that atom.

points to remember

- The symbols or formulas of the constituent radicals of the compound are written together.

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- Positive radicals are written on the left and negative radicals are written on the right.
- Valencies of radicals are written below the respective symbols.
- Criss-cross method is applied to exchange the numerical value of valency of each radical. It is written as a subscript of other radicals.

The radical is enclosed in a nomogram and all parts are placed outside the vertices of the theory.

- Ambivalence factor is removed.
- If the prefix of the radix is one, it is discarded.

The parameters that you have to maintain while preparing the chemical formula are as follows:

- There must be accumulation or charge allocation on the ion.
- When a scientist has a metal and a metal, the name or symbol of the metal is written first. For example: Calcium Sodium Chloride (CaO), Sodium Chloride (NaCl), Iron Sodium Chloride (FeS), Copper Planter (CuO) etc., where Oxygen, Cement, Sodium Chloride etc. are and are written upwards, while Calcium , sodium chloride, iron and copper are metals, and are written on the left.
- In a stock composed of polyatomic ions, the ion is enclosed in parentheses before the number percent to follow the ratio. The simplest substances, which are made of two different elements, are called binary minerals.

For chemical formula formulation time, we outline the constituent components and their associates within the framework given below.

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Again the collectors of atoms installed in America will have to crossover. Ionic is the ratio of the absolute number of positive to negative ions in the atomic structure of ions.
For magnesium, we first write the cation symbol (Mg2+) and then the anion symbol (Cl-). Then his colleagues received the formula to criss-cross.

MOLECULAR MASS:

Atomic Mass: The atomic mass of an element is the mass of one atom of that element in atomic mass units or (u).

Atomic mass unit (amu): Atomic mass unit is 1/12th of the atomic mass unit of carbon-12. It is a unit of mass used to relate atomic mass and atomic mass.

Molar Mass: Molar mass of any element is equal to the numerical value of its atomic mass. However, in case of molar mass, the group is changed from 'U' to 'G'. The mass of any atom is also known as gram atomic mass. For example, atomic mass of carbon = 12 atomic mass units. Basically, atomic mass of carbon = 12 grams.

Atomic mass of an atom: The atomic mass of all the atoms in an atom of a substance is the sum of its atomic masses.

Mass Mass - Calculation:
Generally we use the relative atomic mass of 1 mole of an atomic or ionic substance.
Example: Elemental mass of H2SO4 = 1 Atomic mass of oxygen = 32 Atomic mass of oxygen = 16 Atomic mass of H2SO4 = 2 (atomic mass of hydrogen) + 1 (atomic mass of sulfur + 4 mass of oxygen) = 2×1 + 32 + 4× 16 = 98 units.

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Calculation of Raw Material Store:
Atomic mass of parent + atomic mass of atom = 1 + 35.5 = 36.5 u.
Formula Unit Mass The formula unit mass of a substance is the sum of the atomic masses of all the atoms in a scientist's formula unit. The term 'formula unit' is used for substances which are made up of ions.
Atomic mass of NaCl: 1 x atomic mass of Na + 1 x atomic mass of Cl 1 x 23 +1 x 35.5 = 58.5 atomic mass.

MOLE CONCEPT:

Mole: Mole is a measurement in chemistry. It is used to compare the amount of a chemical substance. One mole is specified as the amount of substance of a system consisting of as many components as atoms, molecules and ions such that 12 grams of carbon contains atoms – 12.

Avogadro number:
The number of substances present in one mole of any substance is equal to 6.022x1023. This is called Avogadro's number or Avogadro's constant.
Number of particles in 1 mole:
1 mole of hydrogen atoms represents 6.022 × 1023 hydrogen atoms.
1 mole of hydrogen molecules represents 6.022 × 1023 hydrogen molecules.
1 mole of water molecules represents 6.022 × 1023 water molecules.

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Mole Concept Calculation:
Step 1:- To establish the relation between molar mass and number (NA) or moles of that particular unit (atom, molecule or ion).
Step 2:- Use the unitary method to calculate what is asked in the question.

Note:- When we say that the weight of oxygen gas is 32 grams, what we mean is that the weight of 1 mole of oxygen molecule (O2) is 32 grams, not the weight of 1 mole of oxygen atom which is O. This is because in natural form, oxygen exists in the form of O2. Molecules.