

## INTRODUCTION

Every matter is made up of very tiny particles called atoms. Molecules are formed from atoms. Atoms and molecules are too small to be seen through naked eye. They can only be seen through a powerful microscope. Let us know about atoms and molecules in detail.

## AN ATOM

The word **atom** comes from the word 'atomos' meaning 'indivisible' coined by a Greek philosopher Democritus (460-361 B.C.). He forwarded the idea that the universe was made up of tiny indivisible particles called atoms. In 1808, John Dalton an English scientist suggested that, an atom is the basic unit of matter.

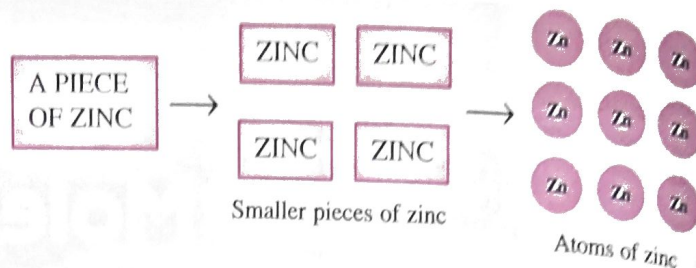
*An atom is the smallest particle of an element that exhibits all the properties of that element. It may or may not exist independently but takes part in every chemical reaction.*

**Example :** Take a small piece of zinc and crush it into smaller pieces. All these pieces show properties of zinc. On grinding crushed pieces further, they break up into very fine particles which still show the properties of zinc. But, there comes a stage when the particles cannot be further subdivided into particles exhibiting properties of zinc. These indivisible particles are the atoms of zinc.

"In other words atom is the smallest possible unit of an element".

*Atoms of the same element are all identical. They differ from the atoms of other elements.*

That is why different elements differ in their properties.



All the above show the properties of element zinc.



## Do You Know ?

Atoms are so small that it would take millions of them, just to cover a full stop.

**The main characteristics of atoms as suggested by John Dalton are :**

- An atom is the smallest particle of matter which cannot be divided further into smaller particles.
- Atoms of the same element are all identical but they differ from the atoms of other elements.
- An atom of an element exhibits all the properties of that element.
- Atoms can neither be created nor be destroyed.
- Atoms may or may not have independent existence but they can take part in chemical reactions.

Originally it was thought that atoms of an element can not be divided further, but studies in the early twentieth century showed that, an atom is itself made up of even smaller particles called fundamental particles or subatomic particles. They are :

- Electrons, • Protons and • Neutrons.

**Electrons :** Electrons are the negatively charged particles in an atom with one unit negative charge and negligible mass.

**Protons :** Protons are the positively charged particles present in an atom with one unit positive charge and one unit mass.

**Neutrons :** Neutrons are the particles with no electrical charge, so they are neutral but have one unit mass.

Following table shows the symbols, charge and mass of the three fundamental particles of an atom.

Particle	Symbol	Charge in coulombs	Mass in grams
Electron	$-1e^0$ or $e^-$	$1.602 \times 10^{-19}C$	$9.1 \times 10^{-28}$ gm
Proton	$+1p^1$ or $p^+$	$1.602 \times 10^{-19}C$	$1.6 \times 10^{-24}$ gm
Neutron	$0n^1$ or $n^0$	0	$1.6 \times 10^{-24}$ gm

The subscripts on  $e$ ,  $p$  and  $n$  as  $-1$ ,  $+1$  and  $0$  represent the charge while the superscript  $0$ ,  $1$ ,  $1$  represent the mass. The mass of an electron is very less hence considered to be negligible.

## A MOLECULE

"A molecule is the smallest particle of a pure substance (element or compound) which has independent existence. It exhibits all the properties of that pure substance" or a molecule is a group of two or more atoms that are chemically bonded together by attractive forces.

Molecules are of two types :

1. Molecules of an element.
2. Molecules of a compound.

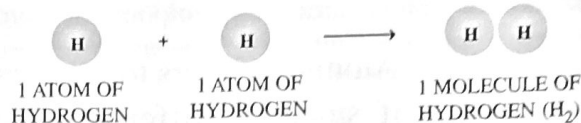
### Molecules of an element

Two or more atoms of the same element combine to form a molecule of that element. The atoms of certain elements, like oxygen, nitrogen, chlorine, etc., cannot exist independently. So they join to form molecules

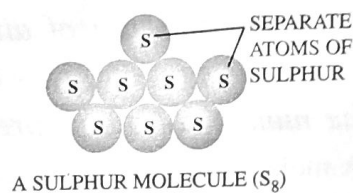
that have independent existence. To form molecules, atoms always join in whole numbers.

### Examples :

1. Two atoms of hydrogen join to form one molecule of the element hydrogen.



2. Eight atoms of sulphur join to form a molecule of sulphur.



## Atomicity

The number of atoms of an element that join together to form a molecule of that element is known as the *atomicity* of that molecule. Depending upon the atomicity, the molecules of elements can be divided into :

- (a) monoatomic molecules
- (b) diatomic molecules
- (c) triatomic molecules
- (d) polyatomic molecules.

**Monoatomic molecules :** They contain only one atom. Atoms of metals and metalloids do not combine with their own type of atoms. So, their atoms are regarded as their molecules too. Similarly, atoms of inert gases exist freely under all conditions. All these elements are said to have *monoatomic molecules*.

**Examples :** Na, Zn, Mg, etc., noble gases : He, Ne, Ar, Xe, etc.

**Diatomic molecules :** They contain two atoms of the same type.

**Examples :** H<sub>2</sub>, O<sub>2</sub>, N<sub>2</sub>, Cl<sub>2</sub>, etc.

**Triatomic molecules :** They contain three atoms.

**Examples :** Ozone  $O_3$ .

**Polyatomic molecules :** They contain more than three atoms.

**Examples :** Phosphorus ( $P_4$ ), sulphur ( $S_8$ ), etc.

**Note :** Atomicity refers to the sum total of atoms of same or different elements present in a molecule.

### Molecular formula of an element

The molecular formula of an element is the symbolic representation of its molecule. It indicates the number of atoms present in it.

**Example :** A molecule of chlorine is represented by ' $Cl_2$ ' which indicates that two atoms of chlorine join to form one molecule of chlorine. It also shows that the atomicity of chlorine is 2.

**Table 4.1 : Names, symbols, atomicity and state of the molecules of common elements**

Name of element	Symbol of molecules	Atomicity [Number of atoms in one molecule]	State
Hydrogen	$H_2$	2	Gas
Nitrogen	$N_2$	2	Gas
Oxygen	$O_2$	2	Gas
Fluorine	$F_2$	2	Gas
Chlorine	$Cl_2$	2	Gas
Bromine	$Br_2$	2	Liquid
Iodine	$I_2$	2	Solid
Ozone	$O_3$	3	Gas
Phosphorus	$P_4$	4	Solid
Sulphur	$S_8$	8	Solid

From the above it is clear that :

- (i) 'H' represents one atom of hydrogen and ' $H_2$ ' represents a molecule of hydrogen.
- (ii) ' $2H$ ' represents two atoms of hydrogen and ' $2H_2$ ' represents two molecules of hydrogen.

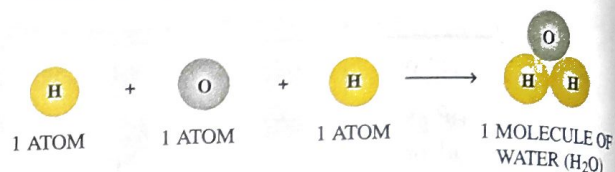
If a numeral is written on the left hand side of a symbol, it represents the number of atoms or molecules.

### MOLECULES OF COMPOUNDS

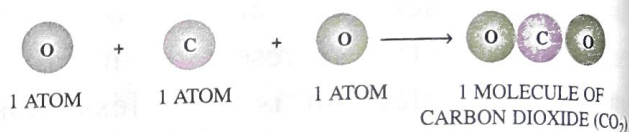
When atoms of two or more elements join together in a fixed ratio by mass, a molecule of a compound is formed.

**Examples :**

1. Two atoms of hydrogen and one atom of oxygen combine to form a molecule of water.



2. One atom of carbon combines with two atoms of oxygen to form a carbon dioxide molecule.



The smallest unit of a compound is its molecule. It exhibits all the properties of that compound. Every compound has its own specific molecules, which are same in all respects but differ in their properties from the atoms of which they are made.

Accordingly, a water molecule is a liquid, but hydrogen and oxygen atoms are gaseous.

Similarly, carbon dioxide is a gaseous compound but carbon is a solid element.

A molecule of a compound can be broken into its constituent elements using chemical methods.

**Examples :**

1. Mercuric oxide is a solid compound. When it is heated, it decomposes to give mercury and oxygen, which are elements.

11	November 2020						
WK	M	T	W	T	F	S	S
44/49	30						1
45	2	3	4	5	6	7	8
46	9	10	11	12	13	14	15
47	16	17	18	19	20	21	22
48	23	24	25	26	27	28	29

OCTOBER 2020

DAY 305-061 WEEK 44

SATURDAY

31

APPOINTMENT / MEETING

Class - XII  
 Sub - Chemistry  
 Chapter - 4 Atoms, molecules, radicals  
 part - 1

① What is atom?

② Name three subatomic particles of an atom.

③ What are electron, proton and neutron? Give their symbols, charge and mass in grams?

④ What are the main characteristics of John Dalton?

⑤ What is molecule?

⑥ What are the two types of molecule?

⑦ What are the molecules of an element? Give eg.

Sunday November 01

⑧ What is atomicity?

NOTES

02

2020 NOVEMBER

DAY 307 - 059 WEEK 45

MONDAY

November 2020							
Wk	M	T	W	T	F	S	S
44/49	30						1
45	2	3	4	5	6	7	8
46	9	10	11	12	13	14	15
47	16	17	18	19	20	21	22
48	23	24	25	26	27	28	29

APPOINTMENT / MEETING

8 9 Give eg. and definition for the following

9 monoatomic molecules, Diatomic molecules,  
10 triatomic molecules, polyatomic molecules.

11

12

P.S  
2-7-20

1

2

3

4