later).

Dalton's atomic theory and the terms, elements and compounds

The Dalton's atomic theory helped the scientists to have a mental picture of matter. We have learnt that an element is the pure substance which can neither be broken nor built from simpler substances. However, according to Dalton's atomic theory all elements are composed of atoms. Thus,

an element is a pure substance which is made up of only one kind of atoms.

Thus, the ultimate particle of an element is an atom. To understand this, consider a piece of an element say gold. If we break this into smaller and smaller pieces, it will become so small that we will not be able to see it without a microscope. If we keep on breaking this particle, we will ultimately reach a stage when this particle cannot be further broken. This ultimate particle of an element is called an atom. Thus,

an atom is the smallest particle of an element which may or may not have independent existence.

Atoms of most of the elements are very reactive and take part in chemical combinations. For example,

hydrogen is composed of atoms of hydrogen, oxygen is composed of atoms of oxygen, copper and silver are composed of atoms of copper and silver respectively. There are about 118 elements known and obviously there are 118 different types of atoms. The atoms of certain elements, such as hydrogen, chlorine, nitrogen, oxygen etc., do not have independent existence. On the other hand, atoms of certain elements such as helium, neon, argon etc., have independent existence.

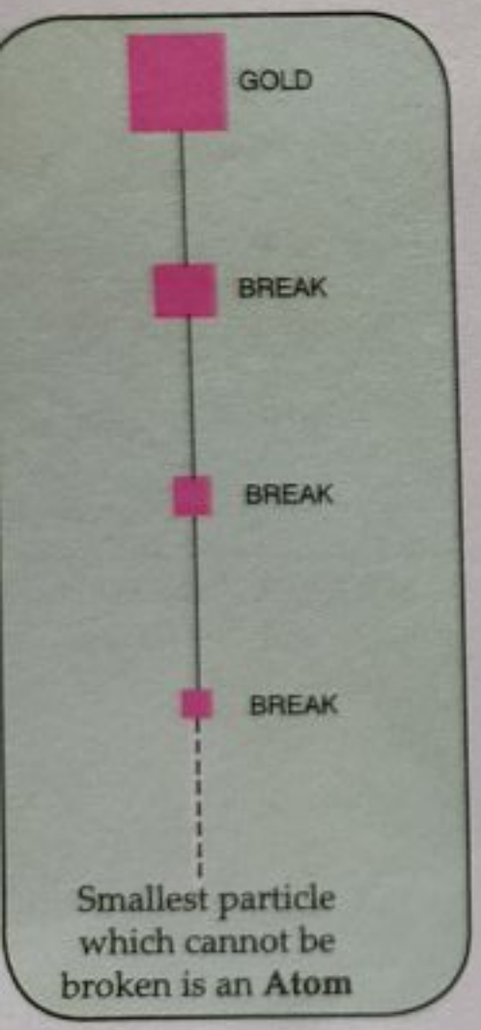
Just as the ultimate particle of an element is atom, the ultimate particle of a compound is called a **molecule.** Molecules are formed by the combination of atoms of the same or different elements and are capable of independent existence. For example, water molecule is made up of hydrogen and oxygen atoms, carbon dioxide is made up of carbon and oxygen atoms. Thus,

molecule is the smallest particle of a substance (element or compound) which is capable of independent existence under ordinary conditions and shows all the properties of that substance.

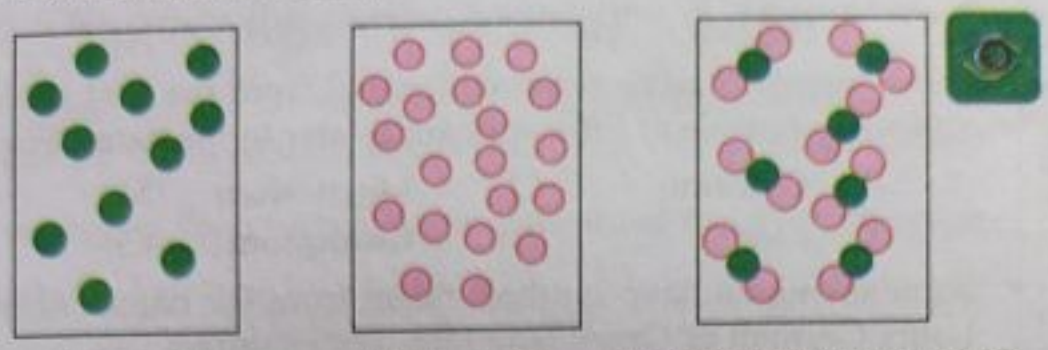
Thus, a molecule contains two or more atoms. For example, a molecule of water contains two atoms of hydrogen and one atom of oxygen. It is represented by H_2O. Similarly, a molecule of carbon dioxide contains one atom of carbon and two atoms of oxygen. It is represented as CO_2. The properties of a substance are the properties of its molecules.

Dalton's atomic theory and difference between an element and a compound

Dalton's atomic theory helps us to clearly understand the difference between an element and a compound. As already studied, an element has one type of atoms, which are alike in all respects but different from those of other elements. Fig. 3 shows atoms of two different elements A and B. All atoms of A are identical but different from atoms of B.



Now, a molecule is formed by the combination of different atoms. For example, Fig. 3(*c*) shows a compound having molecules AB_2 in which one atom of A combines with two atoms of B (compounds are formed by the combination of atoms in a fixed ratio).



(a) Atoms of A (b) Atoms of B (c) Molecules of compound AB_2

Fig. 3. Representation of (a) atoms of element A, (b) atoms of element B, (c) molecules of a compound AB2, in which one atom of A combines with two atoms of B (in definite ratio).

MODERN DAY SYMBOLS OF ATOMS OF THE ELEMENTS

The names of some elements are very ancient. They were generally named from the name of the place where they were found for the first time. For example the name copper is derived from **Cyprus**, where the element was once mined. Some names were taken from the specific colour of the element. For example, the word *gold* is derived from the old English word meaning *"yellow"*. Some names describe a characteristic property. For example, chlorine is a yellow green gas and its name is derived from the Greek word meaning *"yellow green"*. Some elements are named by the name of their discoverers or to honour some people or places. For example, Americium, Einsteinium, Nobelium, Cerium, etc.

Chemists have a useful system that saves writing out the full names of the elements. They represented elements with chemical symbols.

Thus, a **symbol** is **the shorthand representation of an element.**

Dalton was the first scientist to use the symbols for elements in a specific sense. The symbols for some elements as proposed by Dalton are given in Fig. 4. When he used a symbol for an element he also meant a definite quantity of that element *i.e.*, one atom of that element.

Dalton's symbols of elements were difficult to draw and inconvenient to use. These are only of historical importance. Berzilius suggested that the symbols of elements be made from one or two letters of the name of the element. **Some guidelines for writing the symbols of the elements** are given below:

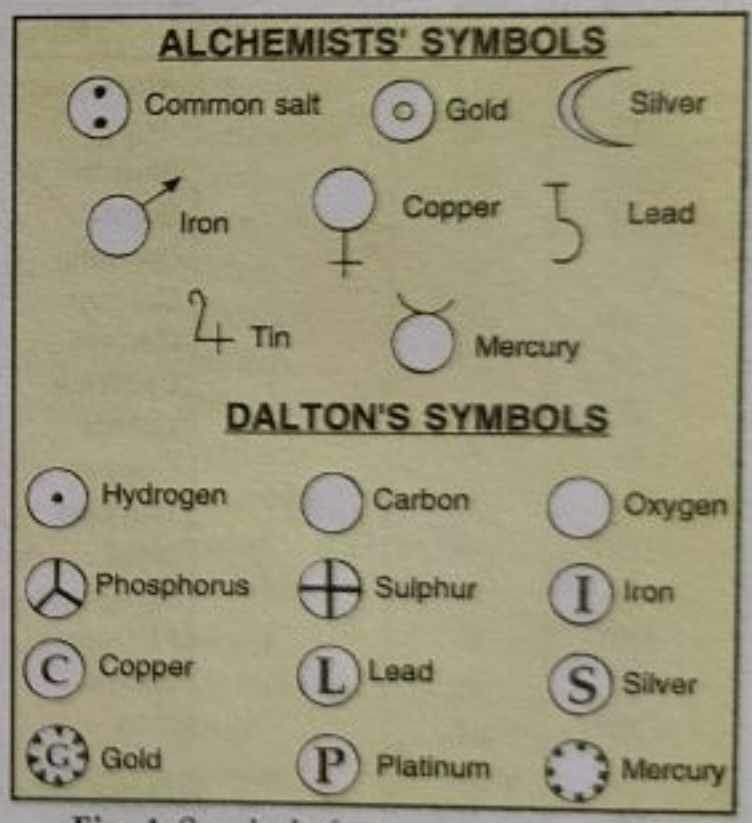


Fig. 4. Symbols for some elements as proposed by Alchemists and Dalton.

- The first letter of the name of the element represents its symbol. For example,

Boron	B	Nitrogen	N
Carbon	C	Oxygen	O
Hydrogen	H	Sulphur	S

- Some elements are represented by two letters. The necessity of adding another letter arises because there are number of elements whose names begin with the same letter. For example, barium, bromine, boron and beryllium begin with the letter 'b'. Therefore, names of these elements are

represented by two letters. The first letter of the symbol is capital and the second letter is small. For example, Aluminium is represented as Al and not AL. Similarly,

Cobalt	Co	Calcium	Ca
Helium	He	Nickel	Ni

- Some elements have symbols formed from the first letter of the name and some *prominent letter* appearing later in the name. For example,

Chlorine	Cl	Magnesium	Mg
Zinc	Zn	Chromium	Cr

- Some elements have symbols taken from the names of the elements in Latin, German or Greek language. For example:
  Iron has symbol Fe from its Latin name *ferrum*
  Sodium has symbol Na from its Latin name *natrium*
  Potassium has symbol K from its Latin name *kalium*
  Silver has symbol Ag from its Latin name *argentum*

  Now the International Union of Pure and Applied Chemistry known as **IUPAC**, approves names of elements.

  Thus, we see that each element has a name and a unique chemical symbol. The symbols of some common elements are given in Table 1.

Table 1. Names and symbols of some common elements.

Element	Symbol	Element	Symbol
Aluminium	Al	Lead	Pb
Argon	Ar	Magnesium	Mg
Barium	Ba	Manganese	Mn
Boron	B	Neon	Ne
Bromine	Br	Nitrogen	N
Calcium	Ca	Nickel	Ni
Carbon	C	Oxygen	O
Chlorine	Cl	Platinum	Pt
Cobalt	Co	Potassium	K
Copper	Cu	Silicon	Si
Fluorine	F	Silver	Ag
Gold	Au	Sodium	Na
Hydrogen	H	Sulphur	S
Helium	He	Tin	Sn
Iodine	I	Uranium	U
Iron	Fe	Zinc	Zn

Note. There is no need to memorise all the symbols at one go. With the passage of time and repeated usage, you will automatically be able to remember these symbols.

ATOMIC MASSES