

oms.

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 its 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 :

'H' represents one atom of hydrogen and ' H_2 ' represents a molecule of hydrogen.

'2H' represents two atoms of hydrogen and $2H_2$ represents two molecules of hydrogen.

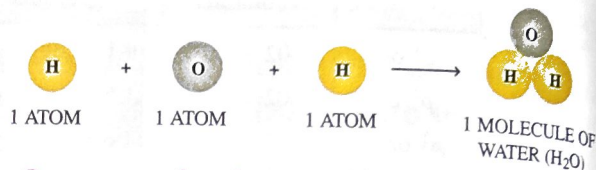
If a numeral is written on the left hand side of a symbol, it represents the number of atoms or molecules.

MOLECULES OF COMPOUNDS

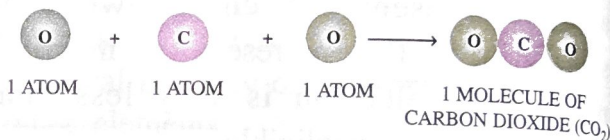
When atoms of two or more elements join together in a fixed ratio by mass, a molecule of a compound is formed.

Examples :

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



- 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 :

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

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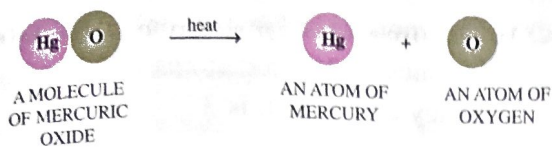
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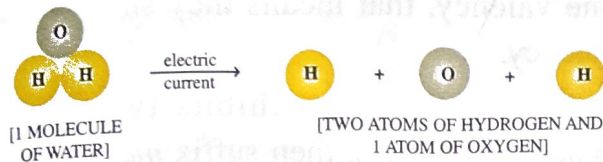
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Atoms,



2. When electric current is passed through acidulated water, it ionises to give hydrogen and oxygen gases in the ratio of 2 : 1 [by volume]. From whatever source water is taken and ionised, the ratio of gases hydrogen and oxygen is found to be the same.



Note : Molecules of different compounds show different properties. e.g. : Water molecules and sugar molecules are different from each other.

RADICALS

“A radical is an atom of an element or a group of atoms of different elements that behaves as a single unit with a positive or negative charge on it”.

Radicals are of two types :

- Basic radical :** They have positive charge and are also called cations. All metallic ions and ammonium ion are basic radicals.
- Acid radical :** They have negative charge and are also called anions. Most of the non-metallic ions and groups of non-metallic atoms with negative charge are acid radicals.

Ions : Electrically charged atoms or groups of atoms formed by losing or gaining electrons are called ions.

A molecule of a compound is usually made up of two parts. *Example :* Sodium chloride molecule is made up of sodium ion and chloride ion. Sodium ion is positively charged while

chloride ion is negatively charged, represented by the symbols Na^+ and Cl^- respectively. The charge on these radicals show their combining capacity *i.e.* valency. These radicals keep their identity in many reactions.

Table 4.2 : Representation of some positive radicals and their valency

Name of radical	Representation	Valency
Hydrogen	H^+	1
Sodium	Na^+	1
Potassium	K^+	1
Silver	Ag^+	1
Ammonium	NH_4^+	1
Magnesium	Mg^{2+}	2
Calcium	Ca^{2+}	2
Zinc	Zn^{2+}	2
Iron (II)	Fe^{2+}	2
Copper (II)	Cu^{2+}	2
Iron (III)	Fe^{3+}	3
Aluminium	Al^{3+}	3
Gold	Au^{3+}	3
Tin (IV)	Sn^{4+}	4
Platinum (IV)	Pt^{4+}	4

Table 4.3 : Representation of some negative radicals and their valency

Name of radical	Representation	Valency
Chloride	Cl^-	1
Bromide	Br^-	1
Iodide	I^-	1
Hydroxide	OH^-	1
Acetate	CH_3COO^-	1
Nitrate	NO_3^-	1
Nitrite	NO_2^-	1
Bisulphate	HSO_4^-	1
Bisulphite	HSO_3^-	1
Bicarbonate	HCO_3^-	1
Oxide	O^{2-}	2
Carbonate	CO_3^{2-}	2
Sulphate	SO_4^{2-}	2
Sulphite	SO_3^{2-}	2
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$	2
Nitride	N^{3-}	3
Phosphate	PO_4^{3-}	3

Table 4.4 : Differences between atoms, molecules and radicals

Atoms	Molecules	Radicals
1. An atom is the smallest particle of an element (matter) which may or may not have independent existence.	A molecule is the smallest particle of an element or a compound capable of independent existence, made up of one or more than one atom of same or different types.	A radical is a single atom of an element or a group of atoms of different elements behaving as a single unit with positive or negative charge on it.
2. An atom represents all the properties of that element.	A molecule represents all the properties of that element or compound.	Oppositely charged radicals combine to form molecules of compounds
3. E.g. : Na and Cl represent atoms of sodium and chlorine elements respectively.	E.g. : H ₂ O and CO ₂ are the molecules of compounds water and carbon dioxide respectively. H ₂ and O ₂ are the molecules of elements hydrogen and oxygen respectively.	E.g. : Cl ⁻ , NH ₄ ⁺ , SO ₄ ²⁻ ions are the radicals of chloride ion, ammonium ion and sulphate ion respectively. (NH ₄ ⁺ and Cl ⁻ are oppositely charged ions which can combine to form a compound ammonium chloride [NH ₄ Cl]).

Valency

Valency is the combining capacity of an element or of a radical.

The valency of an element or of a radical can be defined as, the number of hydrogen atoms that will combine with or displace one atom of that element or radical.

Examples : The valency of hydrogen is taken as 1.

- In hydrogen chloride molecule (HCl) one atom of chlorine combines with one atom of hydrogen, hence valency of chlorine is 1.
- In water (H₂O), one atom of oxygen combines with two atoms of hydrogen; hence valency of oxygen is 2.

(c) In ammonia (NH₃) gas, one atom of nitrogen combines with three atoms of hydrogen; hence valency of nitrogen is 3.

(d) In a methane (CH₄) molecule, one carbon atom combines with four atoms of hydrogen; hence valency of carbon is 4.

Variable valency

Certain elements exhibit more than one valency, that means they show variable valency.

If an element exhibits two different positive valencies, then suffix *ous* is used for lower valency and suffix *ic* is used for higher valency or their valency is represented in Roman numerals beside their names.

Table 4.5 : Variable positive valency

Metal	Radicals	Valency
Iron	Ferrous [Iron (II)]	2
	Ferric [Iron (III)]	3
Copper	Cuprous [Copper (I)]	1
	Cupric [Copper (II)]	2

Non-metals like nitrogen, phosphorus and sulphur also show variable valency. Nitrogen and phosphorus show valencies of 3 and 5 while sulphur exhibits valency of 2, 4 and 6.

RELATIONSHIP BETWEEN VALENCY OF ELEMENTS AND PERIODIC TABLE

You know that, valency is the combining capacity of an atom of an element with the atoms of other elements.

Let us study the table given below in which symbols and valency of first twenty elements of the periodic table are given :

12

December 2020

Wk	M	T	W	T	F	S	S
49		1	2	3	4	5	6
50	7	8	9	10	11	12	13
51	14	15	16	17	18	19	20
52	21	22	23	24	25	26	27
53	28	29	30	31			

NOVEMBER 2020

DAY 312-054 WEEK 45

SATURDAY

07

APPOINTMENT / MEETING

Sub-Chemistry
Class - VII

8

Chapter - 4 Atoms, Molecules and
Radicals Part - 2

Date - 7.11.20

10) What do you understand by
molecular formula? Give eg.

11) Give differences between $2H$ and
12) $2H_2$.

13) What do you understand by
molecules of compounds? Give eg.

14) What do you understand by
15) Radicals?

16) What is acid and basic radical?
Give eg.

17) What is ion?

18) What is anion and cation?
Give eg.

Sunday 08

NOTE

19) Give differences of Atoms,
molecules and radicals.

P.S. 7.20
4.7.20