ATOMS AND MOLECULES
IONS AND VALENCY

❖ **Valency: -**

Valency of ions : The valency of an ion is same as the Charge present on the ion.

* Monovalent cation (Valency of cation +1)

Example : Sodium ion (Na^{+}). Potassium ion (K^{+}), Hydrogen ion (H^{+}).

* Divalent cations (valency of cations + 2)

Example : Magnesium ion (Mg^{+2}) Ferrous ion (Fe^{+2})

* Trivalent cations (valency of cations + 3)

Example : Aluminum ion (Al^{+3}), Ferric ion (Fe^{+3}).

* Monovalent anion (anion of valency –1)

Example : Chloride ion (Cl^{-}), Bromide ion (Br^{-})

* Divalent anions (Anions of Valency –2)

Example : Oxide ion (O^{-2}), Peroxide ion (O_2^{-2}) etc.

Trivalent anion (anions of valency –3)

Example : Nitride ion (N^{-3}), Phosphate ion (PO_4^{-3}) etc.

Writing of formula of Molecular compound:

Steps: . The steps to be followed for writing the formula of molecular compound are-

- First, write the symbols of the elements contributing in the compound.
- Then, below each symbol, write its corresponding valency
- Finally, we exchange the valencies of the combining atoms that is with first atom, we write the valency of the second atom and with second atom, we write the valency of the first atom, the valencies to be written as subscripts to the symbols.
- If the valencies have any common factor, then the formula is divided by the common factor. This gives the required formula of the compound.

Example : To work out the formula of hydrogen sulphide

(1) Hydrogen sulphide compound is made up of hydrogen and sulphur elements. So first we write down the symbol of hydrogen and sulphur.

(2) The valency of hydrogen is 1 and the valency of sulphur is 2. So below the symbol H we write 1 and below the symbol S we write 2.

Symbol	H	S
Valencies	1	2

Cross-Over valencies

- We now cross-over the valencies of H and S atoms. With H atom we write the valency of S (which is 2) so that it becomes H_2 with S atom we write the valency of H (which is 1) so that it becomes S_1. Now, joining together H_2 and S_1 the formula of hydrogen sulphide becomes H_2S_1 or H_2S (This is because we don't write the subscript 1 with an atom in a formula).

Q. What is meant by the term chemical formula? **[NCERT]**

Q. How many atoms are present in a **[NCERT]**

(i) H_2S molecule and

(ii) PO_4^{3-} ion?

Q. What are polyatomic ions? Give examples **[NCERT]**

Q. Give the names of the elements present in the following compounds. **[NCERT]**

(a) Quick lime (b) Hydrogen bromide

(c) Baking powder (d) Potassium sulphate

Writing the formula of Ionic compound:

Steps:

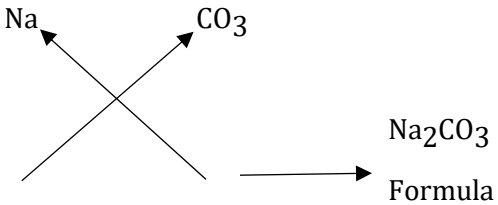
- First, write the symbols of the ions from which the ionic compound is made. As a convention, the cation is written on the left side while the anion is written on the right side.
- Then, the valencies of the respective cation and anion are written below their symbols.
- The valencies of the cation and anion are exchanged. The number of cation and anions in the formula of the compound are adjusted in such a way that total positive charge of cation become equal to the total negative charge of the anions making the ionic compound electrically neutral.
- The final formula of the ionic compound is then written but the charges present on the cation and the anion are not shown.

Example: To write the formula for sodium carbonate.

(1) First, write the symbol of sodium ion and carbonate ion and write their valencies below their symbols are shown.

Symbols	Na	CO_3
Valencies (or charges)	+1	–2

(2) Now, we exchange the valencies of sodium ion and carbonate ion,



1 –2

Cross-over Valencies

(3) So –2 gets associated with Na and +1 gets associated with CO_3 in this way we get Na_2 and CO_3 and final formula of sodium carbonate is Na_2CO_3.

Q. Write down the formulae of **[NCERT]**

(i) sodium oxide (ii) aluminium chloride (iii) sodium sulphide

(iv) magnesium hydroxide

Q. Write down the names of compounds represented by the following formulae :**[NCERT]**

(i) $Al_2(SO_4)_3$ (ii) $CaCl_2$ (iii) K_2SO_4

(iv) KNO_3 (v) $CaCO_3$

Q. Write the chemical formulae of the following. **[NCERT]**

(a) Magnesium chloride (b) Calcium oxide (c) Copper nitrate

(d) Aluminium chloride (e) Calcium carbonate

NAME OF THE COMPOUND	POSITIVE ION (CATION)			NEGATIVE ION (ANION)			Chemical Formula
	NAME	FORMULA	VALENCY NUMBER	NAME	FORMULA	VALENCY NUMBER	
Hydrogen chloride	Hydrogen	H	1	Chloride	Cl	1	HCl
Hydrogen sulphide	Hydrogen	H	1	Sulphide	S	2	H_2S
Sulphuric acid (hydrogen sulphate)	Hydrogen	H	1	Sulphate	SO_4	2	$H_2(SO_4)_1, H_2(SO_4)$
Sodium nitrate	Sodium	Na	1	Nitrate	NO_3	1	$Na_1(NO_3)_1$, $NaNO_3$
Aluminium Phosphate	Aluminium	Al	3	Phosphate	PO_4	3	$Al_3(PO_4)_3$, Al PO_4
Aluminium sulphate	Aluminium	Al	3	Sulphate	S	2	$Al_2(SO_4)_3$,
Ferrous sulphate	Ferrous	Fe	2	Sulphate	SO_4	2	$Fe_2(SO_4)_2$,$Fe(SO_4)_3$
Ferric sulphate	Ferric	Fe	3	Sulphate	SO_4	2	Fe $(SO_4)_3$
Potassium dichromate	Potassium	K	1	Dichromate	Cr_2O_7	2	$K_2(Cr_2O_7)_1$,$K_2Cr_2O_7$
Magnesium nitrate	Magnesium	Mg	2	Nitrate	NO_3	1	$Mg(NO_3)_2$
Silver chromate	Silver	Ag	1	Chromate	Cr_2O_4	2	Ag_2CrO_4

Barium carbonate	Barium	Ba	2	Carbonate	CO_3	2	$Ba_2(CO_3)_2$, $BaCO_3$
Potassium permanganate	Potassium	K	1	Permanganate	MnO_4	1	$KMnO_4$
Calcium hydroxide	Calcium	Ca	2	Hydroxide	OH	1	$Ca(OH)_2$
Aluminium oxide	Aluminium	Al	3	Oxide	O	2	Al_2O_3
Magnesium phosphate	Magnesium	Mg	2	Phosphate	PO_4	3	$Mg_3(PO_4)_2$
Ammonium sulphate	Ammonium	NH_4	1	Sulphite	SO_3	2	$(NH_4)_2SO_3$
Zinc phosphate	Zinc	Zn	2	Phosphate	PO_4	3	$Zn_3(PO_4)_2$

– 1 Charge

Fluoride F^-

Chloride Cl^-

Bromide Br^-

Iodide I^-

Hydride H^-

– 2 Charge

Sulphide S^{2-}

Oxide O^{2-}

– 3 Charge

Phosphide P^{3-}

Nitride N^{3-}

❖ **Ions: -**

IONS: An ion is a positively or negatively charged atom (or group of atoms)

These are two type of ions:

(1) cations

(2) anions

(1) **Cations:** A positively charged ion is known as cation. For example:

Sodium ion: Na^+, Magnesium ion: Mg^{2+}

A cation is formed by the loss of one or more electrons by an atom

For example: sodium atom, loses one electron to form a sodium ion Na^+

$$Na \xrightarrow{-1e-} Na^+ \text{ sodium ion}$$

Sodium atom (A cation)

(2) **Anions:** A negatively charged ion is known as anion. Cl^- (chloride ion), O^{-2} (oxide ion) etc. An anions is formed by the gain of one or more electrons by an atom. For example a chlorine atom gains one electron to form a chloride ion Cl^-.

$$Cl \xrightarrow{+e-} Cl^-$$

Chlorine atom Chloride ion (An anion)