Q: Calculate the molecular mass of sulphuric acid (H_2SO_4)

Ans Mass of H = 1 u
" " S = 32 u
" " O = 16 u

So, Molecular Mass of $H_2SO_4 = (2 \times 1) + 32 + (4 \times 16$

$= 2 + 32 + 64$

$= 98$ u

IONS

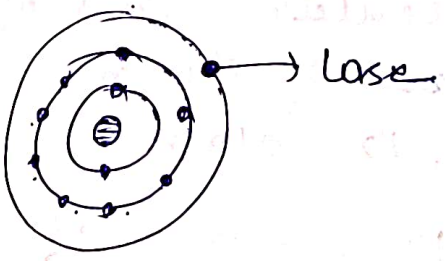
- Ions are positively or negatively charged atom
- Types of ions:

1. **Cations** → (+)

- Positively charged ions are called cations. For eg Mg^{2+}, Na^{+}, Al^{3+} etc.
- It is formed when an atom loses one or more electrons. That's why cation contains less electron than normal atom.
- All metals can lose electron easily, so all metal form cations.

For e.g Sodium (Na)

Atomic No. = 11



$Na - 1e^- \longrightarrow Na^+$

Other examples → Mg^{2+}, K^+, Ba^{2+}, Ca^{2+}, Fe^{3+}, B^{3+}, Al^{3+}, Ga^{3+}

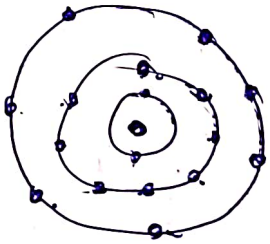
2. Anion : (−)

- Negatively charged ions are called anions.
- It is formed by gain of one or more electron That's why an anion contain more electrons than normal atom.

All non-metals gain electrons easily, so non-metal are anions.

For eg Chlorine (Cl)

Atomic no. = 17



$$Cl + 1e^- \longrightarrow Cl^-$$

Other examples : F^-, I^-, Br^-, O^{2-}, Se^{2-}, Sc^{2-}, N^{3-}, P^{3-}

MONOATOMIC IONS AND POLYATOMIC IONS :

Monoatomic Ions

They are formed by single atom.

For e.g

Na^+	Sodium ion
K^+	Potassium ion
Mg^{2+}	Magnesium ion
Ca^{2+}	Calcium ion
Cu^{2+}	copper ion
Zn^{2+}	Zinc ion
Fe^{2+}	Iron ion
Al^{3+}	Aluminium ion
Cl^-	Chlorine ion

Polyatomic ions

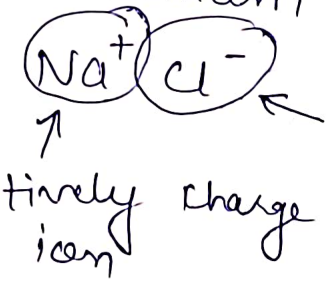
- They are formed from groups of atom.
- For e.g

NH_4^+	Ammonium ion
OH^-	Hydroxide ion
NO_3^-	Nitrate ion
CO_3^{2-}	Carbonate ion
SO_4^{2-}	Sulphate ion
PO_4^{3-}	Phosphate ion

Ionic Compounds:

- Those compounds which are made up of ions.
- Ionic compound consist of equal number of positive ion and negative ion so overall charge on an ionic compound is zero. For e.g.

NaCl → sodium chloride.



- Ionic compound is made up of a combination of metal and non metal.
- Some important ionic compounds:

1. NaCl — Sodium chloride → Na^+Cl^-
2. KCl → Potassium chloride → K^+Cl^-
3. $MgCl_2$ → Magnesium chloride → $Mg^{2+}Cl^-$
4. $CaCl_2$ → Calcium chloride → $Ca^{2+}Cl^-$
5. MgO → Magnesium oxide → $Mg^{2+}O^{2-}$
6. CaO → Calcium oxide → $Ca^{2+}O^{2-}$
7. Al_2O_3 → Aluminium oxide → $Al^{3+}O^{2-}$
8. NaOH → Sodium Hydroxide → Na^+OH^-
9. $CuSO_4$ → Copper sulphate → $Cu^{2+}SO_4^{2-}$

Q. Write down names of compound and also show ions present in them.

(i) $Al_2(SO_4)_3$ → Aluminium sulphate → $Al^{3+}SO_4^{2-}$

(ii) $CaCl_2$ → Calcium Chloride → $Ca^{2+}Cl^-$

(iii) K_2SO_4 → Potassium Sulphate → $K^+SO_4^{2-}$

(iv) KNO_3 → Potassium Nitrate → $K^+NO_3^-$

(v) $CaCO_3$ → Calcium carbonate = $Ca^{2+}CO_3^{2-}$

Q. Calculate the formula mass of potassium carbonate K_2CO_3: Atomic mass of K = 39 u, C = 12 u, O = 16 u

Ans Formula Mass of K_2CO_3 is $(2 \times 39) + 12 + (3 \times 16)$

$= 78 + 12 + 48$

$= 138$ u.

Q. Define Chemical Formula.

Ans. We use chemical formula to represent the composition of a compound in the form of symbols. To write a chemical formula we must know two things:

1. Symbols of elements
2. Valency

Valency:

It is also known as combining capacity of an element. Valency explains how atoms of one element will mix with atoms of another element.

For example:

Hydrogen ion → H^+ Valency = 1

Oxygen ion → O^{2-} Valency = 2

Electronic Configuration

Atomic No.	Electronic configuration	Elements	Valency	Charge
1	1	H	1	H^+
2	2	He	0	—
3	2, 1	Li	1	Li^+
4	2, 2	Be	2	Be^{2+}
5	2, 3	B	3	B^{3+}
6	2, 4	C	—	—
7	2, 5	N	3	N^{3-}
8	2, 6	O	2	O^{2-}
9	2, 7	F	1	F^-
10	2, 8	Ne	0	—
11	2, 8, 1	Na	1	Na^+
12	2, 8, 2	Mg	2	Mg^{2+}
13	2, 8, 3	Al	3	Al^{3+}
14	2, 8, 4	Si	—	—
15	2, 8, 5	P	3	P^{3-}
16	2, 8, 6	S	2	S^{2-}
17	2, 8, 7	Cl	1	Cl^-
18	2, 8, 8	Ar	0	—
19	2, 8, 8, 1	K	1	K^+
20	2, 8, 8, 2	Ca	2	Ca^{2+}

Rules of Writing a chemical Formula :

- Valencies of ions must balance.
- In case where metal and non-metal substances are present in a compound, the name of metal

is always written first in chemical formula.

For e.g Na Cl

↓ Metal ↓ Non-metal

3. If compound consists of polyatomic ions. The ion is enclosed in a bracket before writing the number to indicate the ratio.

For e.g $[SO_4]^{2-}$

$H^+ SO_4^{2-} \longrightarrow H_2SO_4$

Q. What are polyatomic ions? Give example.

Ans A polyatomic ion is a covalently bonded set of two or more atoms that can be considered as single unit.

For example :

NO_2^- → Nitrite ion
NO_3^- → Nitrate ion
OH^- → Hydroxide ion
HCO_3^- → Hydrogen Carbonate ion
} Valency 1

SO_4^{2-} → Sulphate ion
CO_3^{2-} → Carbonate ion
} Valency 2

PO_4^{3-} → phosphate ion — Valency -3

Gram atomic Mass & Gram Molecular Mass

- **Gram atomic Mass** :- The amount of substance whose mass in grams is numerically equal to its atomic Mass.

or e.g Atomic Mass of Oxygen = 16 u

Gram atomic mass of O = 16 g

Gram atomic mass = Molar mass = Atomic Mass

(g) (g/mol) (u)

Q. Calculate Molar mass of —

i) C_2H_2

= 2 × Mass of C + 2 × Mass of H

= 2 × 12 + 2 × 1

= 26 g/mol.

ii) S_8

= 8 × Mass of Sulphur

= 8 × 32

= 256 g/mol

iii) HNO_3

= Mass of H + Mass of N + 3 × Mass of O

= 1 + 14 + 3×16

= 63 g/mol

iv) HCl

Mass of H + Mass of Cl

= 1 + 35.5 ⇒ 36.5 g/mol

Gram Molecular Mass :

Amount of substance whose mass in gram is equal to its molecular mass.

For e.g Molecular mass of O_2 = 2×16
= $32\ u$

Gram Molecular Mass of O_2 = $32\ g$

Gram Molecular Mass =	Molar Mass =	Molecular Mass
(g)	(g/mol)	(u)

MOLE Concept :

- It is defined as one mole of any atom, molecules, ions or particles is that quantity in number having mass equal to its atomic or molecular mass in grams.

1 mole of atom = 6.022×10^{23} atoms

1 mole of molecules = 6.022×10^{23} atoms

where 6.022×10^{23} is known as Avagadro number.

$$\text{No. of moles} = \frac{\text{Mass of element (g)}}{\text{Molar Mass}}$$

$$1 \text{ atom of element} = \frac{\text{Mass}}{\text{Avagadro No.}}$$

Laws of Chemical Combination

There are three important laws of chemical combination:

(i) Law of Conservation of mass
(ii) " " constant proportion
(iii) " " multiple proportion.

(i) Law of Conservation of Mass :

- This law was given by Antoine Lavoisier in 1789.
- The law states that:
Mass can neither be created nor be destroyed in chemical reaction.
- In all physical and chemical changes,

Total mass of reactants	=	Total mass of product

Eg

$$2Na + Cl_2 \longrightarrow 2NaCl$$
$$46\,g \quad 70.9\,g \quad 116.9\,g$$

Total mass of $(2Na + Cl_2)$	=	Total mass of NaCl

Q. Sodium carbonate reacts with ethanoic acid to form sodium ethanoate, carbon dioxide and water. Show that this data varifies law of conservation of mass.

Sodium carbonate 5.3 g + Ethanoic acid 6 g → Sodium ethanoate 8.2 g + CO_2 2.2 g + H_2O 0.9 g

Mass of reactants = Mass of sodium carbonate + Mass of ethanoic acid

$= 5.3 + 6 = 11.3$ g

Mass of products $= 8.2 + 2.2 + 0.9$

$= 11.3$ g

So, **Mass of reactants = Mass of products**

which varies laws of conservation of mass.

Q. Calcium carbonate (10g) → Calcium oxide (5.6 g) + CO_2

what is the mass of CO_2.

Ans Acc. to law of conservation of mass,

Mass of reactant = Mass of products

$10\text{g} = 5.6 + CO_2$

$CO_2 = 10 - 5.6 = 4.4$ g.

2. Law of Constant proportion :

- This law was discovered by French chemist J.L Proust in 1799.
- The law states that :

A chemical compound is always found to be made up of same elements combined together in same fixed proportion by mass.

For e.g

1. water is a compound which decompose by passing electricity, then two elements are obtained hydrogen and oxygen. So, water always consists of same two elements H_2 and O_2 combined together in

same constant proportion of 1:8 by mass.

2. Carbon dioxide is made up of same element i.e carbon and oxygen combine together in same proportion of 3:4 by mass.

Q. A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the % composition of compound by mass.

Ans Mass of compound = 0.24 g.

Mass of boron = 0.096 g.

% of Boron = $\frac{0.096}{0.24} \times 100$

= 40 %.

Mass of Oxygen = 0.144 g

% of oxygen = $\frac{0.144}{0.24} \times 100$

= 60 %.

DALTON'S ATOMIC THEORY :

- In 1808, John Dalton stated all matter was made up of small, individual particles known as 'atom'.

POSTULATES (Assumptions) :

1. All matter is made up of tiny, indivisible particles called atoms.
- All atoms of specific elements are identical in mass, size and other properties.

- Atoms can neither be created nor destroyed so it can not divided into smaller particles.
- Atoms of different elements can combined with each other in fixed whole no. ratio in order to form compounds.
- Atoms can be rearranged, combined or seperated in chemical reaction.

LIMITATIONS (Drawback)

- He stated that atoms ~~are~~ were indivisible but ~~were~~ discovery of subatomic particles (such as protons, electrons, neutrons) disproved this postulates.
- He stated that all atoms have identical masses and densities. But different isotopes of elements have different atomic masses. For e.g. $^{1}_{1}H$, $^{2}_{1}H$, $^{3}_{1}H$ (tritium).
  - $^{1}_{1}H$ → hydrogen
  - $^{2}_{1}H$ → deuterium
- His theory does not account for isobars and allotropes.

MERITS

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