Some Basic Concepts of Chem

Chemistry deals with the composition, structure & p of matter. Chemistry is the science of atoms a molecules.

* Importance of Chemistry →

Chemistry is the branch science that studies the composition, properties & interaction of matter. Ch are interested in knowing chemical transformations achi

Chemistry plays a central role in science & often intertwined with othe branches of science like ph biology, geology etc. It als plays an important role in

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(i) Solids have definite volume & definite shape.

(ii) Liquids have definite volume but not definite shape.

(iii) Gases have neither definite shape neither definite volume.

✳ Laws of Chemical Combination

(1) Law of Conservation of Mass ⇒ It states that, "Matter can neither be created nor destroyed."

This law was put forth by Antonie Lavoisier in 1789 with several developments

(2) Law of Definite Proportion ⇒ This law was given by a French chemist, Joseph Proust. He stated that, "A given compound always contains exactly the same proportion of elements by weight."

(3) Law of Multiple Proportions ⇒ This law was proposed by Dalton in 1803. According to this law, "if two elements can combine to form more than one compound, the masses of one element that combine with a fixed mass of a other element, are in ratio of small whole numbers."

(4) Gay Lussac's Law of Gaseous Volumes ⇒ This law was given by Gay Lussac in 1808. He observed that when gases combine or are produced in a chemical reaction they do so in a simple ratio by volume provided all gases are at same temperature & pressure.

(5) Avogadro's Law ⇒ It states that equal volume of all the gases contain equal number of molecules at same temperature & pressure.

* Dalton's Atomic Theory →

→ Every matter is made up of indivisible particles called atoms.

→ It can neither be created nor be destroyed.

→ Atoms of same elements are identical in all respects.

→ Atoms of different elements are different from each other in all respects.

→ Atoms of different elements combine with each other to from compounds, this they do so in a simple ratio.

* Mole Concept →

1 Mole ⇒ It is the SI unit of amount of substance that contain as much number of particles as present in [illegible] Carbon atom.

1 Mole of element = Gram Atomic Mass $= 6.022 \times 10^{23} = 22.4$ L at S.T.P. if it is a gas

$$N_A = 6.022 \times 10^{23} \text{ atoms}$$

① Calculate no. of particles present in 34 g of NH_3 & also its volume at S.T.P.

⇒ Mass of NH_3 = 34 g

∵ 17 g NH_3 = 1 mol
∴ 34 g NH_3 = 2 mol particles
$= 2 \times 6.022 \times 10^{23}$ particles
$= 12.044 \times 10^{23}$ particles

Also, Volume of 17 g NH_3 = 22.4 L
∴ Volume of 34 g $NH_3 = \frac{22.4 \times 34}{17}$
= 44.8 L

$$\text{No. of Moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

(2) Calculate no. of moles present in 8 g of Methane. Also find the no. of particles present &

volume occupied by it.

⇒ No. of moles = $\frac{\text{Mass}}{\text{Molar mass}}$

$= \frac{8\ g}{16\ g/mol}$

$= 0.5$ mol

No. of particles $= 0.5\ N_A$

$= 3.011 \times 10^{23}$ particles

Volume of 1 mol $CH_4 = 22.4$ L

∴ Volume of 0.5 mol $CH_4 = \frac{22.4}{1} \times 0.5$

$= 11.2$ L

(3) Find out the no. of moles in (i) 52g of He.
(ii) 52 u of He.

⇒ (i) No. of moles $= \frac{\text{Mass}}{\text{Molar mass}}$

$= \frac{52\ g}{4\ g/mol}$

$= 13$ mol

(ii) ∵ 4u He contains 1 moles

∴ 52u He contains $= \frac{1}{4} \times 52$

$= 13$ moles.

$= 13\ N_A$ particles.

* Numericals based on Chemical equations ⟶

Stoichiometry & Stoichiometric calculations :-

→ 1 molecule of $CaCO_3$ decomposes to give 1 molecule of CaO & 1 molecule of CO_2.

→ 1 mole of $CaCO_3$ decomposes to give 1 mol of CaO and 1 mol of CO_2.

→ 100g $CaCO_3$ decomposes to give 56 g CaO & 44g of CO_2

→ 1 mole of $CaCO_3$ decomposes to give 1 mole of CaO and 22.4 L of CO_2 at S.T.P.

(1) 2.2 g of gas A occupied 1.12 L of volume at S.T.P. Find molecular mass of that gas

Shot on Y83 Pro
vivo dual camera

$\Rightarrow$ No. of moles $= \frac{Mass}{Molecular\ mass}$

No of moles $= \frac{2.2}{Molar\ mass} \longrightarrow$ (i)

Also, No. of moles $= \frac{Volume}{22.4\ L\ at\ S.T.P}$

$\Rightarrow$ No. of moles $= \frac{1.12}{22.4} \longrightarrow$ (ii)

Using eq^n (i) & (ii)

$$\frac{2.2}{Molar\ mass} = \frac{1.12}{22.4} = \frac{1}{20}$$

$\therefore$ Molar mass $= 20 \times 2.2$
$= 44g$

(2) What volume of ammonia reproduced from 0.7 g of N_2 on heating with H_2.

$\Rightarrow$ $3H_2 + N_2 \longrightarrow 2NH_3$

3 mol	1 mol	2 mol
3g	28g	34g
3×22.4 L	22.4 L	2×22.4 L

$\because$ 28g N_2 gives volume of NH_3
$= 44.8$ L

$\therefore$ 0.7 g N_2 gives volume $= \frac{44.8}{28} \times 0.7$
$= \left(\frac{44.8}{40}\right)$ L
$= 1.12$ L

* Empirical Formula $\rightarrow$

It is a formula that represent the ratio of no. of moles of various elements present in any compound.

(1) Chlorine is prepared .... dioxide?

$\Rightarrow$ $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$

1 mol	4 mol	1 mol	1 mol	2 mol
87g	146g	126g	71g	36g

$\because$ 87g of MnO_2 requires 146 g HCl

$\therefore$ 0.5g MnO_2 requires HCl $= \frac{146}{87} \times 0.5$
$= 0.839$ g
$= 0.84$ g

(2) 5 kg of N_2 is required per hectare of field. Calculate

the mass of $Ca(NO_3)_2$ required for the cultivation of wheat in 5 hectares.

⇒ Molecular mass of $Ca(NO_3)_2$
$= (40 + 28 + 96)\,g$
$= 164\,g$

Total amount of N_2 required for 5 hectares $= (5 \times 5)\,kg$
$= 25\,kg$
$= 25000\,g$

Total amount of N_2 in $Ca(NO_3)_2$
$= 2$ moles
$= 28\,g$

∴ Total amount of $Ca(NO_3)_2$ required to release 25000g $N_2 = 25000 \times \frac{164}{28}$

$\equiv 146428.5\,g$
$146.43\,kg$

(3) On putting the signature 0.3g of graphite pencil is consumed. Calculate the no. of particles atoms of carbon present in it.

⇒ No. of moles $= \frac{\text{No. of atoms}}{N_A}$ → (i)

Also, No. of moles $= \frac{\text{Mass}}{\text{Molar mass}}$ → (ii)

Using eqns (i) & (ii)

$\frac{\text{No. of atoms}}{N_A} = \frac{\text{Mass}}{\text{Molar mass}}$

⇒ $\frac{\text{No. of atoms}}{6.022 \times 10^{23}} = \frac{0.3}{12}\ \frac{1}{40}$

⇒ No. of atoms $= \frac{6.022 \times 10^{23}}{40}$
$= 0.1505 \times 10^{23}$
$= 1.505 \times 10^{22}$

* Ways of expression of concentration of solutions →

(i) % by mass (w/w) ⇒

$\frac{\text{Weight of solute}}{\text{Weight of solution}} \times 100$

(ii) PPM (parts per million) ⇒

$\frac{\text{Weight of solute}}{\text{Weight of solution}} \times 10^6$

(1) 25% NaCl solution.

⇒ Let mass of solute = 25g
∴ mass of solution = 100g

$$\therefore PPM = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 10^6$$
$$= \frac{25}{100} \times 10^6$$
$$= 25 \times 10^4 \text{ PPM}$$

(iii) Mole fraction ⇒

$$X_{solute} = \frac{n_{solute}}{n_{solute} + n_{solvent}}$$

(1) Calculate mole fraction of solute & solvent in 20% solution of glucose in water.

⇒ Molecular mass of H_2O = 18g
Molecular mass of Glucose = 180g

$$\therefore \text{No. of moles of glucose} = \frac{20}{180} = 1/9 \text{ mol}$$

$$\text{Also, No. of moles of water} = 80/18 = 40/9 \text{ mol}$$

$$x_{glucose} = \frac{\frac{1}{9}}{\frac{1}{9} + \frac{40}{9}} = \frac{\frac{1}{9}}{\frac{41}{9}} = 1/41 = 0.024$$

$$x_{water} = \frac{\frac{40}{9}}{\frac{40}{9} + \frac{1}{9}} = \frac{\frac{40}{9}}{\frac{41}{9}} = 40/41 = 0.976$$

(IV) Molarity →

☆ $$\text{Molarity} = \frac{\text{No. of moles of solute}}{\text{Volume of solution}}$$

☆ $$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass} \times \text{Volume of solution}}$$

When % of mass of solute & volume of sol^n is given →

☆ $$\text{Molarity} = \frac{\% \times d \times 10}{\text{Molar mass}}$$

(1) Find out the molarity of 25