CHAPTER 1

STOICHIOMETRY

MOLE AND AVOGADRO'S NUMBER

Atomic mass / Molecular mass / Formula mass expressed in grams is called mole.

Mole is also called:

1) g-atom (for elements)
2) gram-molecule (for covalent compound)
3) gram-formula (for ionic compound)
4) gram-ion (for ionic element)

AVOGADRO'S NUMBER: (N_A)

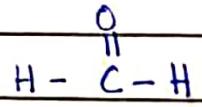
Number of particles present in one mole of any substance.

AVOGRAM:

Reciprocal of N_A

* Find total number of atoms present in 0.25mol of formaldehyde.

Ans:



Number of atoms = $4 \times 0.25\ N_A$

$= 1\ N_A$

* FORMULA FOR TOTAL NUMBER OF ATOMS

Total Number of Atoms = $n \times$ Atomicity $\times N_A$

n : no. of moles

* CALCULATION OF MOLES

$$n = \frac{\text{Mass in grams}}{\text{Molar mass}}$$

$$n = \frac{\text{No. of particles}}{N_A}$$

CALCULATIONS INVOLVING GASES

$$n = \frac{\text{Volume (in } dm^3)}{\text{Molar Volume } (22.4\ dm^3/\text{litre})}$$

$1\ dm^3 = 1000\ cm^3 = 1$ litre

AVOGADRO'S LAW

Equal volumes of all gases at the same temperature and pressure contain equal number of particles

STP → Temperature : 0°C or 273 K
Pressure : 1 atm

RTP → Temperature : 25°C or 298 K
Pressure : 1 atm

At STP : Volume = $22.4\ dm^3$

PERCENTAGE COMPOSITION

$$\% \text{ of element} = \frac{\text{Total mass of element in compound}}{\text{Total mass of compound}} \times 100$$

$$\% \text{ of element} = \frac{\text{Atomic mass of element} \times \text{No. of atoms in compound}}{\text{Molar mass of compound}} \times 100$$

MCQ: A compound X contain 72% C, 16% Oxygen, 12% Hydrogen. The empirical formula of X is

Ans: $C_6H_{12}O$

Explanation: Mole of C $= \frac{\%\text{ of C}}{\text{Atomic Mass}}$

$= \frac{72}{12} = 6$

Mole of H = 12 mol

Mole of O $= \frac{16}{16} = 1$ mol

MCQ#2 Sodium Carbonate contains 45% Na. What is number of moles of sodium

Ans: 2 mole

Explanation:

$$\text{No. of moles} = \frac{\% \text{ of Na}}{\text{Atomic Mass}}$$

$$= \frac{45}{23}$$

$$= 1.9$$

$$= 2$$

MCQ#3 50g of bone burn to produce 14g CaO. What is percentage of Ca in bone

Ans: 20%

$$2Ca + O_2 \rightarrow 2CaO$$

CALCULATING LIMITING REAGENT

1. The amounts of the reactants (if given in mass units) are first converted into moles.
2. Using balanced chemical equations, the moles of the required product are calculated from the available moles of each reactant.
3. The reactant which gives the least number of moles of the required product will be limiting reagent.

MCQ: In the reaction:

$$CO_2 + H_2O \rightarrow H_2CO_3$$

If 120 g of CO_2 is dissolved in 80g of water then identify limiting Reagent.

1) Moles of $CO_2 = \frac{120}{44} = 2.7$ moles

Moles of $H_2O = \frac{80}{18} = 4.44$ moles

2) 1 mole of $CO_2 \cong$ 1 mole of H_2CO_3

2.7 mole of $CO_2 \cong$ 2.7 mole of H_2CO_3

4.44 mol of $H_2O \cong$ 4.44 mol of H_2CO_3

3) Since 120 g of CO_2 produce less number of moles of H_2CO_3, so CO_2 is the limiting Reagent and H_2O is the reagent in excess

PERCENTAGE YIELD

$$\% \text{ Yield} = \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100$$

Actual Yield will reach the ideal (theoretical) value if the % Yield of the reaction is 100%.

MCQ: A mixture of 5ml of CH_4 and 10ml of C_2H_6 will produce _____ amount of CO_2 on complete combustion

Ans : 25ml

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

1ml 1ml

5ml 5ml

$C_2H_6 + 7/2\ O_2 \rightarrow 2CO_2 + 3H_2O$

1ml 2ml

10ml 20ml

A mixture of 5ml of CH_4 and 10ml of C_2H_6 will produce 5ml + 20ml = 25ml of CO_2 on complete combustion

MCQ: If combustion of 0.8g of a compound released 0.2g of CO_2. Then the number of gram atoms of carbon in the compounds is?

Ans: 0.56 g

Explanation:

% composition of Carbon = $\frac{0.2}{0.8} \times \frac{12}{44} \times 100$

$= 6.8\ \%$

No. of g-atoms = $\frac{6.8}{12} = 0.56$