

# Mole Concept

## SOME IMPORTANT DEFINITIONS

### Discussion

Ques - 1 : 22.

mass of 1 oxygen molecule = 32 amu  
( $O_2$ )

mass of 1 molecule of  $SO_2$  = 80 amu

$$20 \left( \overset{10}{\cancel{80 \text{ amu}}} \right) = n \left( \overset{4}{\cancel{32 \text{ amu}}} \right)$$

$$200 = 4n$$

$$n = 50$$

## Mole Concept

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Race-2



$$p = 13, \quad n = 14, \quad e = 13$$

(a)

(c)

(b)

$$c : b : a \Rightarrow 14 : 13 : 13$$

Race-3 ÷

# Mole Concept

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• illustration: 8 / module / Page No - 12

25 mg

Atomic mass of an element = 50

(i) RAM = 50 amu

Mass of 1 atom in gram =  $\frac{50}{6.02 \times 10^{23}}$  OR =  $50 \times 1.67 \times 10^{-23}$

(ii) Molar mass =  $\frac{50}{6.02 \times 10^{23}} \times 6.02 \times 10^{23} = 50 \text{ g/mol.}$

$\left\{ \begin{array}{l} 50 \text{ g} \\ ? \end{array} \right\} \xrightarrow{\quad} \frac{6.02 \times 10^{23}}{3.01 \times 10^{20} \text{ atom}} = \frac{25}{50} \times \frac{3.01 \times 10^{20}}{6.02 \times 10^{23}} = \frac{25}{2 \times 10^3}$

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(ii)  $6.022 \times 10^{23}$  atom  $\xrightarrow{\quad} 50g$   
 $\quad \quad \quad ? \quad \quad \quad \xrightarrow{\quad} 10g$

$$= \frac{\cancel{10} \times 6.022 \times 10^{23}}{50} = \underline{1.204 \times 10^{23} \text{ atoms.}}$$

Ex. Find the no. days required to spent 1 mol Rupees  
if you spent 1 million per second.? An

$$10^6 \text{ Rs} \quad \xrightarrow{\quad} \quad 1 \text{ Se.}$$

$$6 \times 10^{23}$$

$$\xrightarrow{\quad} ?$$

$$\frac{6 \times 10^{23}}{10^6} \\ = 6 \times 10^{17} \text{ sec.}$$

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$$\begin{aligned}\text{No of days} &= \frac{6 \times 10^{16}}{60 \times 60 \times 24} \\ &= \frac{10^{16}}{60 \times 24}\end{aligned}$$

$$= 6.944 \times 10^{12} \text{ days}$$

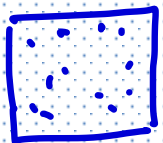
$$= \underline{6944000000000}$$

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Mole ÷ 7<sup>th</sup> basic SI unit of measurement of amount of substance.

- Definition : ÷ ① The one mole is mass of substance that is exactly equals to its molar mass.



44g



44g CO<sub>2</sub> contains = 1 moles of CO<sub>2</sub>

32g SO<sub>2</sub> contains = 0.5 mole of SO<sub>2</sub>

180g H<sub>2</sub>O contains = 10 mole.

$$\text{No of moles} = \frac{\text{Given mass g}}{\text{molar mass g/mol}} = \text{mol}$$

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Ex. Find the number of moles in 49 g of  $\text{H}_2\text{SO}_4$ ?

$$\begin{aligned}\text{No of moles} &= \frac{\text{Given mass}}{\text{Molar mass}} \\ &= \frac{49 \text{ g}}{98 \text{ g/mol}} = 0.5 \text{ mol.}\end{aligned}$$

Ex. Find the mass of 2 moles of Heavy water?

$$\text{Moles} = \frac{\text{Given mass}}{\text{Molar mass}}$$

$$2 = \frac{x}{20} \quad x = \underline{40 \text{ gram}}$$

$$\begin{aligned}(\text{D}_2\text{O}) \\ 2 \times 2 + 16 \\ = 20 \text{ g/mol}\end{aligned}$$

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Definition (2) "For gas"

1 mole is volume of gas that contains 22.4 L volume at (NTP / STP)

- Volume of a container containing  $\text{CO}_2$  is 11.2 L at STP find no of moles.

$\Rightarrow$  0.5 moles.

$$\text{No of moles} = \frac{\text{Volume of gas (L) at NTP/STP (L)}}{22.4 \text{ (L/mol)}}$$



## Mole Concept

### SOME IMPORTANT DEFINITIONS

Definition (3) : The 1 mole is amount of substance that contains exactly  $6.022 \times 10^{23}$

No of particles (atoms/molecules/ions)

$$\text{No of moles} = \frac{\text{No of particles}}{6.022 \times 10^{23}}$$

of particle

Ex. Find the no of moles of  $O_2$  if a container contains  $3.01 \times 10^{22}$  molecules of  $O_2$ ?

$$\text{No of moles of } O_2 = \frac{3.01 \times 10^{22}}{6.02 \times 10^{23}} = 0.05$$

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$$\frac{1.996482 \times 10^{-23} \text{ g}}{12 \text{ g}} \longrightarrow \frac{1 \text{ atom of C-12}}{?}$$

$$= \frac{12}{1.996482 \times 10^{-23}} = 6.02 \times 10^{23} = N_A.$$

$$1 \text{ amu} = \frac{1}{12} \times 1.996482 \times 10^{-23}$$

$$1 \text{ amu} = \frac{1}{N_A}$$

# Mole Concept

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# Mole Concept

## MOLE

**Mole :** standard definition :

One mole is the amount of a substance that contains as many entities or particles as there are atoms in exactly 12 g (or 0.012 kg) of the C-12 isotope.

$$\underline{1 \text{ mole}} = \frac{12 \text{ g}}{1.994682 \times 10^{-23} \text{ g}} \quad \checkmark$$

**Molar Mass (M<sub>w</sub>) :**

The mass of 1 mole of a substance in gram is called its molar mass.

$$= 6.02 \times 10^{23} = N_A$$

**Example :**

Molar mass of NO<sub>2</sub> = 14 + 2 (16) = 46 g

$$\underline{1 \text{ amu}} = \frac{1.996482 \times 10^{-23}}{12}$$

$$\boxed{1 \text{ amu} = \frac{1}{N_A}}$$

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$$\text{No of molecules} = \text{no of mole} \times N_A \text{ of molecule}$$

Ex. Find the no of molecules of  $O_2$  containing 3.2 mg of  $O_2$ .

$$\text{No of moles of } O_2 = \frac{3.2 \times 10^{-3} \text{ g}}{32 \text{ g/mol}} = 10^{-4} \text{ mol.}$$

$$\begin{aligned} \text{No of molecules of } O_2 &= 10^{-4} \times 6.02 \times 10^{23} \\ &= 6.02 \times 10^{19} \text{ molecules.} \end{aligned}$$

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Ex. Find No of oxygen atom in 60 molecules of Ozone ( $O_3$ )

$$\text{No of oxygen atom} = 60 \times 3 = 180 \text{ atom}$$

Formula :

$$\text{No of atoms} = \text{No of molecules} \times \text{Atomicity}$$

✓ 
$$\text{No of atoms} = \text{No of moles of molecule} \times N_A \times \text{atomicity}$$

$$\text{No of atoms} = \text{No of moles of atom} \times N_A$$

## SOME IMPORTANT DEFINITIONS

### Mole Concept

No of moles of  $x$  atomicity = No of moles of atom  
molecule

Ex: → A sample of gas contains 3 moles of  $O_2$ .

(1) No of moles of  $O = 3 \times 2 = 6$  moles.

(2) No of molecules of  $O_2 = 3 \times N_A$

(3) No of atoms of  $O = 6 \times N_A$

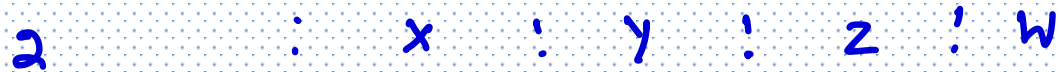
(4) Mass of sample =  $(3) \times 32 = 96$  gram.

$$\begin{array}{lcl} O_2 & : & 0 \\ 1 & : & 2 \\ 3 & : & x \\ \frac{1}{3} & = & \frac{2}{x} \\ & & x = 6 \end{array}$$

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Ex find the no of each atoms in 2 moles of  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ .



$$\frac{1}{2} = \frac{2}{x}$$

$$x = 4$$

No of moles of N atom = 4

No of Nitrogen atom =  $4 N_A$