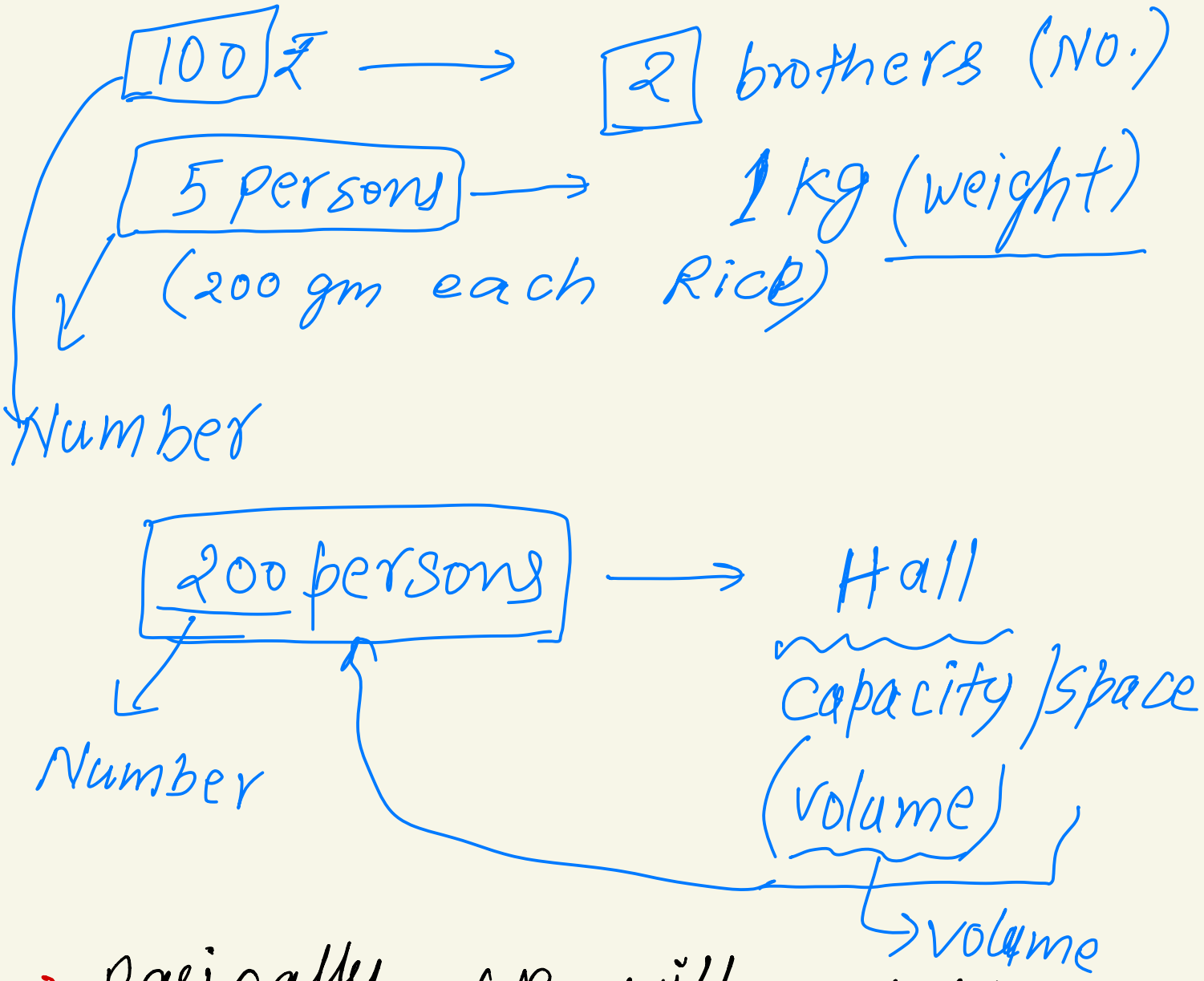
MOLE CONCEPT



→ Basically we will establish relation between Number(s), mass and volume.

10 in No. = Ten

12 in No. = dozen

100 " " = Hundred

144 " " = Gross

100000 " = 10^5 = 1 Lakh

10^7 " = 1 cr.

6.022×10^{23} in No. = 1 mole

1 dozen pen = 12 pens

4 dozen pen = 48 "

1 mole book = 6.022×10^{23} books

1 mole atom = 6.022×10^{23} atoms

1 mole molecule = " molecules

1 mole ion = " ions

Mole :— It is basically a number. equals to 6.022×10^{23}.

→ Also called Avogadro NO.

→ denoted by 'N_A'

Avogadro NO. = $N_A = 6.022 \times 10^{23}$

* → Counting unit

* → mole is SI unit for amount of substance.

** Unitary method

Ques:- How many atoms are there in 5 moles of atoms?

1 mole ⟶ 6.022×10^{23}

5 moles ⟶ $5 \times 6.022 \times 10^{23}$

$= 31.01 \times 10^{23}$

$= 3.101 \times 10^{24}$

ans:- How many moles of H_2 molecules are there in 12.044×10^{23} H_2 molecules?

6.022×10^{23} ——— 1 mole

1 ——— $\frac{1}{6.022 \times 10^{23}}$ mole

12.044×10^{23} ——— $\frac{1}{6.022 \times 10^{23}} \times 12.044 \times 10^{23}$ moles

$= 2$ moles H_2 molecules

No. of moles of entity $= \frac{\text{No. of that entity}}{N_A}$

Ques:- No. of Na atoms in 0.01 mole Na atom.

$$\text{moles} = \frac{\text{Number (entity)}}{N_A}$$

$$10^{-2} = 0.01 = \frac{\text{No. of Na atoms}}{6.022 \times 10^{23}}$$

$$\text{No. of Na atoms} = 6.022 \times 10^{23} \times 10^{-2}$$
$$= 6.022 \times 10^{21} \text{ Ans}$$

Ques:- How many moles of He atoms in 18.066×10^{24} He atom

$$\text{moles} = \frac{\text{Number}}{N_A}$$

$$= \frac{18.066 \times 10^{24}}{6.022 \times 10^{23}}$$

$$= 3 \times 10^{1}$$

$$= 30 \text{ moles of He atom}$$

Atom

:- It is smallest particle of an element. (further)

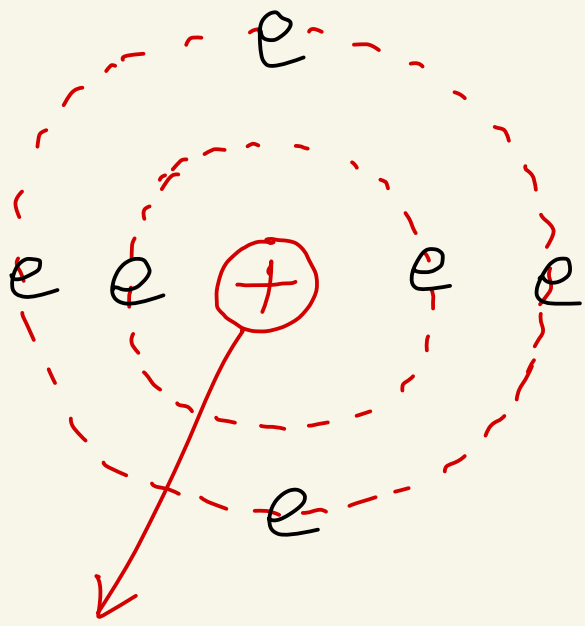
fe element (Iron)

* Carbon → C

one atom of carbon (C) → C_6^{12}

(Atomic No.) (Z)

No. of proton



(A) mass No. − No. of (p+n)

* $^{A}_{Z}X$

$A \rightarrow$ mass No. (No. of p+n)

$Z \rightarrow$ Atomic No. (No. of protons)

$Z \downarrow$ element

** one atom of carbon – C^{12}_{6}

- → 6 protons ✓
- → 6 neutrons ✓
- → 6 electrons ✓

{ neutral, e = p }

$M_e = 9.1 \times 10^{-28}$ g

$M_p = 1.67 \times 10^{-24}$ g

$M_n = 1.67 \times 10^{-24}$ g

{ → amu (Atomic mass Unit) }

$q_n = 0$

$q_p = +1.6 \times 10^{-19}$ C

$q_e = -1.6 \times 10^{-19}$ C

$$M_e = \frac{1}{1837} M_p$$

mass of one atom of Carbon =

mass of $(6p + 6n + 6e)$

{example - wt. of plastic bag}

$= \text{mass of } (6p + 6n)$

$= \text{mass of } 12p \quad \{p = n\}$

$= 12 \times 1.67 \times 10^{-24} g$

$= 12 \text{ amu}$

(Atomic mass)

Atomic mass :- mass of one atom of an element.

→ expressed in amu.

eg- Atomic mass of Carbon = 12amu

" " " Oxygen = 16amu

$$\frac{\text{mass of 1 atom of } C^{12}}{12} = \frac{\cancel{12}\ \text{amu}}{\cancel{12}}$$

(divide 12 both side)

$$1\ \text{amu} = \frac{1}{12}\left\{\text{mass of 1 atom of } C^{12}\right\}$$

mass of 1 atom of $C^{12} = 12$ amu

" " 2 atoms of $C^{12} = 24$ amu

" " 10^5 atoms of $C^{12} = 12 \times 10^5$ amu

" " 6.022×10^{23} atoms of $C^{12} = 12 \times 6.022 \times 10^{23}$ amu

Molar mass or GAM

$= 12 \times 6.022 \times 10^{23} \times 1.67 \times 10^{-24}$ g

$= 12 \times 10.06 \times 10^{-1}$ g

Mass of 1 mole atoms of $C^{12} = 12$ g

Gram Atomic Mass (GAM) :-

when atomic mass of an atom is expressed in gram then it is called Gram Atom mass.

(OR)

GAM :- Mass of 1 mole atoms or Mass of N_A atoms

eg- C^{12} (GAM) = 12g $(O^{16} \rightarrow 16g)$

Mole :- One mole is that quantity which contains as many entities as there are atoms in exactly 12 gm of C^{12} atoms.

$$1 amu = \frac{1}{12} \left\{ \text{mass of 1 atom of } C^{12} \right\} \quad \text{—(1)}$$

mass of N_A atoms of $C^{12} = 12\,g$

" " 1 atom of $C^{12} = \frac{12}{N_A}\,g$

from eq ① and ⑪ $= \left(\frac{12}{N_A}\right) g$ — ⑪

$1\ amu = \frac{1}{12}\left\{\frac{12}{N_A}\,g\right\}$

$$1\ amu = \frac{1}{N_A}\,g$$

$$1\ amu \times 1\ N_A = 1\,g$$

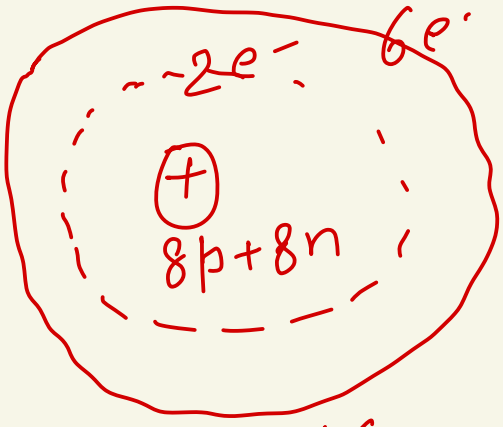
$$1\ amu = \frac{1}{N_A}\ g$$

$$= \frac{1}{6.022 \times 10^{23}}\ g$$

$$= \frac{\cancel{10}}{\cancel{6.022} \times 10^{24}}\ g$$

$$\boxed{1\ amu = 1.67 \times 10^{-24}\ g}$$

Ans:- calculate A.m. & GAM of Oxygen-atom.



At. mass = 16 amu

GAM = 16 g

A = 16

Z = 8

ques:- find the mass of 5 mole atoms of N-atom? (N_7^{14})

mass of 1 atom of N-atom = 14 amu

" " N_A atoms = $14 \times N_A$ amu

" " 1 mole atoms = 14g

" " 5 mole atoms = $14 \times 5 = 70g$

N-GRAM = 14g

ques:- find the moles of O-atom in 64 gm of O-atoms?

O_8^{16}

mass of 1 mole of O-atom = 16g

1g O-atoms = $\frac{1}{16}$ mole

64g " = $\frac{1}{16} \times 64$ moles

64g O-atoms = 4 moles of O-atoms

$$\text{No. of moles of atom} = \frac{\text{Wt. of atoms in (g)}}{\text{GAM}}$$

Ans:- find the No. of moles?

(i) in 28 g of N-atom $\left(N_7^{14}\right)$

$$\text{moles} = \frac{28\,g}{14\,g} = 2 \text{ moles of N-atom}$$

(ii) 32 g of S-atom $\left(S_{16}^{32}\right)$

$$\text{moles} = 1 \text{ moles of S-atom}$$

(iii) 14 g of H-atom $\left(H_1^1\right)$

$$\text{moles} = \frac{14}{1} = 14 \text{ moles of H-atom}$$

* Gram Atom :- (mole)

1 gram Atom = GRAM

1 gam atom = 1 mole

Ques:- mass of 1 g atom of carbon =

= 1 mole of carbon atom

= GRAM

= 12g

Ques:- mass of 8 g atom of H-atom.

mass = 8 g

Ques:- How many gram atom present in 36 g of C-atom.

12g — 1 g atom / 36g — 3 g atom

Ques:- How many atoms are there in 46 g of Na-atoms?

(Na^{23}_{11})

$$\text{moles} = \frac{\text{Wt (g)}}{\text{GAM}}$$

$$= \frac{46\ (g)}{23\ (g)}$$

$$= 2 \text{ moles of Na-atom}$$

1 mole of Na-atom = N_A atoms

2 " " " " = $2 \times N_A$ atoms

$= 2 \times 6.022 \times 10^{23}$ atoms

$$\text{mole} = \frac{\text{Number}}{N_A}$$

$= 1.2044 \times 10^{24}$ Na-atoms

$$2 = \frac{\text{Number}}{N_A}$$

Number of Na-atoms $= 2N_A$

Ques:- How many gram atom present in 3.011×10^{22} atoms of H-atom. also calculate mass of H-atom.

$$\text{gram Atom} = \text{moles} = \frac{\text{Number}}{N_A}$$

$$= \frac{3.011 \times 10^{22}}{6.022 \times 10^{23}}$$

$$= \frac{1}{2 \times 10}$$

$$= \frac{1}{20}$$

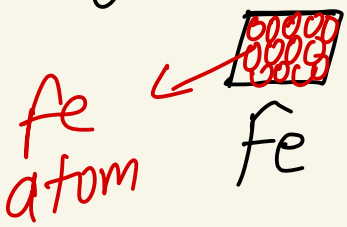
$$= 0.05 \text{ gram atom/moles}$$

$$\text{moles} = \frac{wt\ (g)}{GAM}$$

$$0.05 = \frac{wt}{1} \Rightarrow wt = 0.05\ g$$

Element :- made up of same type of atoms as well as monoatomic substance.

eg - Na, He, C, S_8, diamond



molecule :- molecule is formed when more than one atoms are chemically combined either same or different and exist in discrete form.