

(30.07.20)

Lecture-06 by Alok Kumar

CLASS-IX

SUB-SCIENCE

Chapter -03

Atoms and Molecules

Formula unit mass :-The formula unit mass of a substance is a sum of the atomic masses of all atoms in a formula unit of a compound . Formula unit mass is calculated in the same manner as we calculate the molecular mass.

The only the difference is that we use the word formula unit for these substances whose constituent

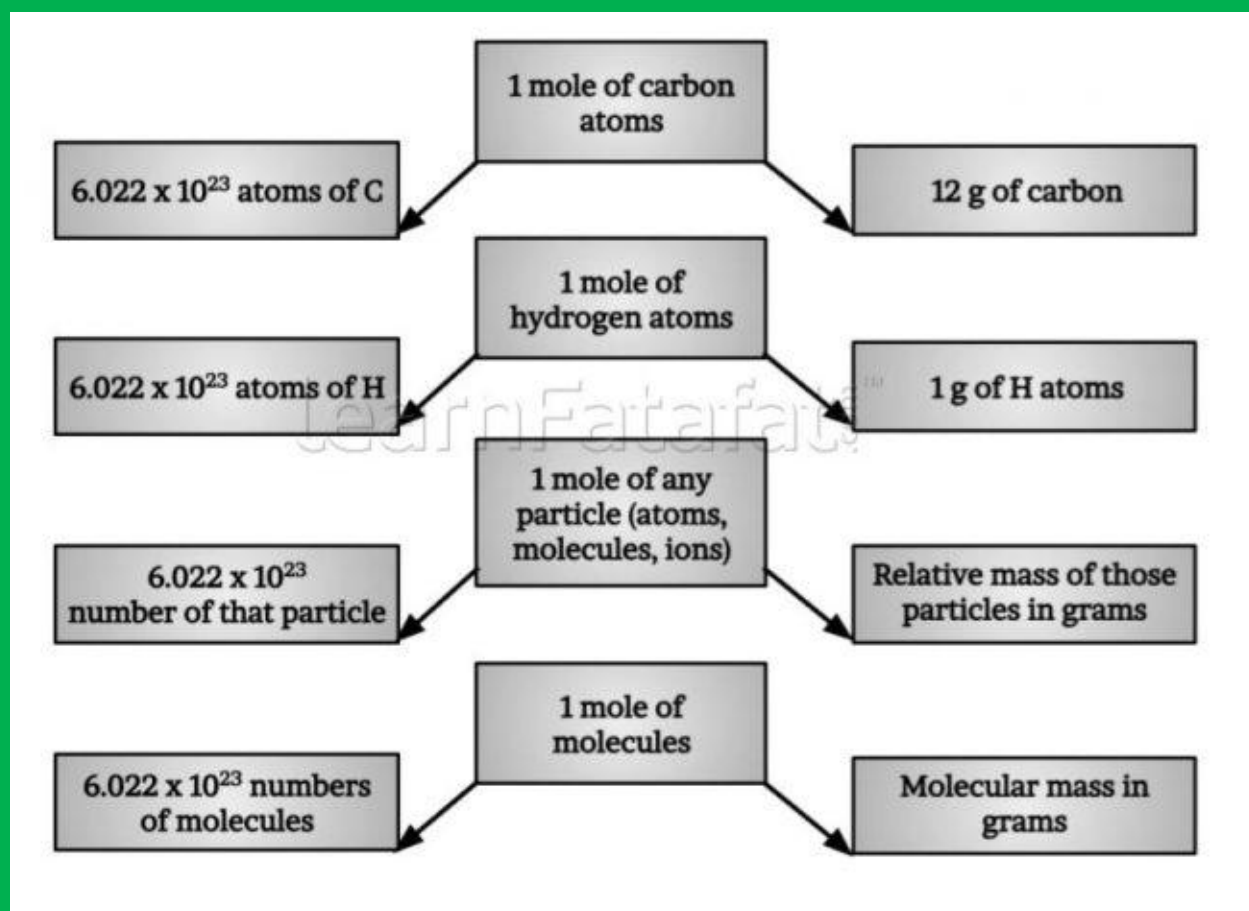
particles are ions. For example sodium chloride as discussed above, has a formula unit NaCl. Its formula unit mass can be calculated as :-

$$1 \times 23 + 1 \times 35.5 = 58.5 \text{ u}$$

Example: Calculate the formula unit mass of CaCl_2

Solutions :atomic mass of
 $\text{Ca} + (2 \times \text{atomic mass of Cl})$
 $= 40 + 2 \times 35.5 = 40 + 71 = 111 \text{u}$

Mole Concept



We buy certain things either by mass .for example we generally buy oranges ,eggs, bananas etc by number ,by dozen (1 dozen=12 n pieces) we buy most our vegetables by mass, gram or kilogram. The unit we choose to express the quantity is just a matter of convenience . Incidentally you will be amazed to know that in super markets of

USA/CANADA, bananas are sold by weight and not by numbers as done here in our country. So look! the choice of the unit depends upon the choice of the people like you and me.

In much the same way we buy a dozen of eggs or a kilogram of sweets , a chemist deals with a mole of

atoms ,molecules ,ions or electrons.

The number of particles (atoms ,molecules or ions) present in one mole of any substance is fixed ,with a value of 6.022×10^{23} . This is an experimentally obtained value. This number is called Avogadro constant or Avogadro Number (represented by N_0)

named in honour of the Italian scientist , Amedeo Avogadro.

1 mole (of anything)

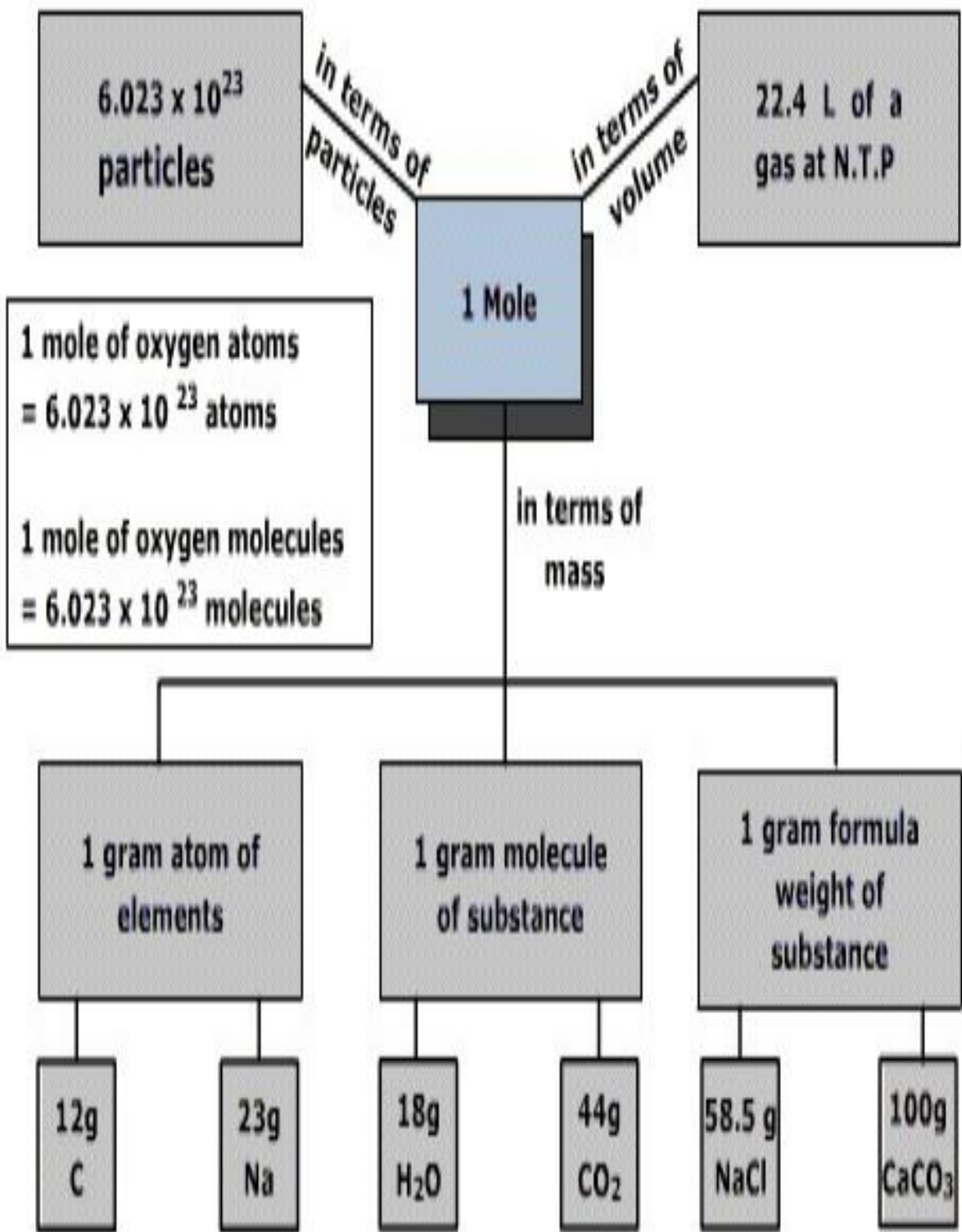
= 6.022×10^{23} in number,

1 dozen = 12 nos.

1 gross =144 nos.

The mass of 1 mole of a substance is equal to its relative atomic or molecular mass in grams .The atomic mass of an element gives us the mass of one atom of that

**element in atomic mass
units(u).**



THE MOLE CONCEPT

Substance	Atomic Mass (grams/mole)	Number of Particles (atoms)
Al	27.0 g/m	6.02×10^{23}
Fe	55.8 g/m	6.02×10^{23}
Ca	40.1 g/m	6.02×10^{23}
Na	23.0 g/m	6.02×10^{23}

Numericals based on the Mole concept:-

Examples.....

1) Calculation of the mass of 0.5 moles of N_2 gas:

The molecular mass of nitrogen is 28 u.

Mass = Molar mass \times Number of moles

$$\text{Mass} = 28 \text{ g} \times 0.5 = 14 \text{ g}$$

2) Calculation of the number of moles present in 18.066×10^{23} Particles of nitrogen: 1 mole = 6.022×10^{23}

$$\begin{aligned} \text{no. of moles} &= \frac{\text{given no. of particles}}{\text{avogadro number}} \\ &= \frac{18.066 \times 10^{23}}{6.022 \times 10^{23}} = 3 \end{aligned}$$

Therefore. the number of moles is 3.

Conversion of moles to grams

Sample problem:

How many grams are in 2.5 moles of Calcium sulfide?

Solution: Calculate the formula mass of compound.

First step:

$$\text{Ca} = 1 \times 40 \text{ g} = 40 \text{ g}$$

$$\text{S} = 1 \times 32 \text{ g} = \underline{32 \text{ g}}$$

$$72\text{g/mol}$$

Second step:

$$2.5 \text{ mol CaS} \times \frac{72 \text{ g CaS}}{1 \text{ mole CaS}} = 180 \text{ g CaS}$$

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1. How many moles are 5 gm of calcium?

Solutions:-

40 gm of calcium atoms=1mole of calcium

$$\text{5g of calcium} = \frac{1}{40} \times 5 \text{ mole}$$

$$= \frac{1}{8}$$

$$= 0.125 \text{ mole}$$

2. What is the mass of 4 moles of Aluminium atoms?

Solutions: -

1 mole of Al atoms = 27 g

**4 moles of Al atoms = 27×4
= 108 g**

3. Calculate the number of atoms in 0.2 mole of sodium(Na).

Solutions: - we know that 1 mole of atom contains 6.022×10^{23} atoms

1 mole of sodium atom contains 6.022×10^{23} atoms.

0.2 mole of sodium atom

contains $6.022 \times 10^{23} \times 0.2$ atoms

$$= 12.044 \times 10^{22} \text{ atoms}$$

4. How many moles are 9.033×10^{24} atoms of helium (He)?

Solutions: -

6.022×10^{23} atoms of He =

1mole

So 9.033×10^{24} atoms of helium

$$= (1/6.022 \times 10^{23}) \times 9.033 \times 10^{24}$$

=15 moles

5. Calculate the number of iron atoms in a piece of iron weighing 2.8g (Atomic mass of iron=56u)

Solution:-

56 g of iron contains

= 6.022×10^{23} atoms

2.8 g of iron contains

= $(6.022 \times 10^{23} / 56) \times 2.8$

= $3.011 \times 10^{22} / 2$

= 3.011×10^{22} atoms

6. Which has more number of atoms ,100grams of or 100 grams of irons?

(atomic masses : Na =23u ;Fe =56u)

**Solutions : Moles of sodium =
mass of sodium/molar mass of
sodium**

$$=100/23$$

$$=4.34$$

**Moles of iron = mass of
iron/molar mass of iron**

$$=100/56$$

$$=1.78$$

**7. Convert 22 g of carbon
dioxide (CO₂) into moles
(atomic masses: C=12 u; O=16
u)**

Solutions :-

**1 mole of CO₂ =molecular mass
of CO₂ in grams**

= mass of C+ mass of O_{x2}

=12 +16x2

=44g

Mass of 1 mole of carbon dioxide is 44 grams.

44 g of carbon dioxide = 1 mole

22g of carbon dioxide

$$= \frac{1}{44} \times 22 \text{mole}$$

$$= 1/2$$

$$= 0.5 \text{ mole}$$

8. what is the number of molecules in 0.25 moles of oxygen?

Solutions :-

**1 mole of oxygen contains =
 6.022×10^{23} molecules**

**0.25 moles of oxygen contains
= $6.022 \times 10^{23} \times 0.25$
= 1.505×10^{23} molecules**

