

Mole Concept

We can express the quantity of a substance is expressed in terms of mole.

The mole is a fundamental unit in the System International d' Unités, the SI system, and it is used to measure the amount of substance In Latin mole means a "massive heap" of material Mole is defined as the amount of substance that contains as many specified elementary particles as the number of atoms in 12g of carbon-12 isotope.

One mole is also defined as the amount of substance which contains Avogadro number (6.023×10^{23}) of particles.

Avogadro number: Number of atoms or molecules or ions present in one mole of a substance is called Avogadro number. Its value is 6.023×10^{23}

Therefore, one mole of any substance contains Avogadro number of particles. The particles may be atoms, molecules, ions etc

E.g. 1 mole of oxygen atoms = 6.023×10^{23} atoms, molecules, ions etc of oxygen
= 32g of O_2

Problems (based on mole concept)

1. When the mass of the substance is given:

a. Calculate the number of moles in

i) 81g of aluminium

Sol: 1. Atomic mass of Al= 27gm

27g of aluminium = 1 mole of aluminium

81g of aluminium = $1/27 \times 81=3$ moles of aluminium

OR, Use formula , Number of moles = given mass/atomic mass

Self: ii) 4.6g sodium iii) 5.1g of Ammonia iv) 90g of water v) 2g of NaOH

b. Calculate the mass of 0.5 mole of iron

Atomic mass of iron = 55.9 g

Mass of the 1 mole of iron = 55.9 g

Mass of the 0.5 mole of iron = $0.5 \times 55.9 \text{ g} = 27.95 \text{ g}$

Or, Using formula: mass = atomic mass x number of moles

FOLLOW UP: Find the mass of 2.5 mole of oxygen atoms

2. Calculation of number of particles when the mass of the substance is given:

Number of particles = Avogadro number x given mass / gram molecular mass

Calculate the number of molecules in 11g of CO₂

Solution: gram molecular mass of CO₂ = 44g

44g of CO₂ = 6.023 x 10²³ molecules

1 g of CO₂ = (6.023 x 10²³ ÷ 44 g) molecules

11g of CO₂ = (6.023 x 10²³ ÷ 44 g) x 11 = **1.51 x 10²³ molecules**

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FOLLOW UP: Calculate the number of molecules in 360g of glucose

3. Calculation of mass when number of particles of a substance is given:

Mass of a substance = gram molecular mass x number of particles/ 6.023 x 10²³

Eg. Calculate the mass of 18.069 x 10²³ molecules of SO₂

Sol: Gram molecular mass SO₂ = 64g

6.023 x 10²³ molecules of SO₂ = 64 gm

1 molecules of SO₂ = 64/(6.023 x 10²³) gm

18.069 x 10²³ molecules of SO₂ = [64/(6.023 x 10²³) x 18.069 x 10²³] gm = 192 g

Calculate the mass of glucose in 2 x 10²⁴ molecules

Gram molecular mass of glucose = 180g

Mass of glucose [180 x 2 x 10²⁴] / [6.023 x 10²³] = 597.7g

FOLLOW UP: Calculate the mass of 12.046 x 10²³ molecules in CaO.

4. Calculation of number of moles when you are given number of molecules:

Number of moles = Number of molecules/Avogadro Number

$$= [3.0115 \times 10^{23}] / [6.023 \times 10^{23}] = 0.5 \text{ moles}$$

FOLLOW UP

Calculate number of moles in 12.046 x 10²² atoms of copper

Calculate the number of moles in 24.092 x 10²² molecules of water