

CHEMISTRY STUDY MATERIALS FOR CLASS 9

(NCERT based Revision of Atoms and molecules)

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NUMERICAL PROBLEMS BASED ON MOLE CONCEPT

Question12. Calculate the number of sulphate (SO_4^{2-}) ions in 100 ml of 0.001 M H_2SO_4 solution.

Solution12. Molarity = No. of moles of solute/ Volume of solution in Liters
 \Rightarrow No. of moles of solute (H_2SO_4) = Molarity \times volume of solution in Liters
 $= 0.001 \times 0.1$
 $= 0.0001$

1 molecule of H_2SO_4 contains 1 SO_4^{2-} ion
 \Rightarrow 0.0001 mole of H_2SO_4 contains 0.0001 mole SO_4^{2-}
 \therefore No. of sulphate (SO_4^{2-}) ions = $0.0001 \times 6.022 \times 10^{23}$
 $= 6.022 \times 10^{19}$.

Question13. Calculate the number of atoms in 100 u of He.

Solution13. Atomic mass of He = 4 u
So, mass of one He atom = 4 u
 \therefore No. of atoms in 100 u of He = $100/4 = 25$ He atoms.

Question14. If a mole were to contain 1×10^{24} particles, what would be the mass of
(i) One mole of oxygen, and (ii) a single oxygen molecule?

Solution14. Mass of one mole of oxygen molecule (O_2) = molecular mass in gram
 $= 32$ g.
Mass of a single oxygen molecule = $32/1 \times 10^{24}$
 $= 3.2 \times 10^{-23}$ g.

Question15. Calculate the standard molar volume of oxygen gas. The density of O_2 gas at NTP is 1.429g/L.

Solution15. Standard molar volume = volume occupied by 1 mole (i.e., 32g) O₂ gas
= Mass/density

$$\begin{aligned} [\because \text{density} &= \text{mass}/\text{volume} \Rightarrow \text{volume} = \text{mass}/\text{density}] \\ &= 32/1.429 \\ &= \mathbf{22.39 \text{ Liters.}} \end{aligned}$$

Question16. Calculate the mass of 1 mole He gas. The density of He gas is 1784g/L.

Solution16. Mass of 1 mole He = Density × Standard molar volume
= 0.1784 × 22.4 ≈ **4g.**

Question17. A metal M of atomic mass 54.94 has a density of 7.42g/cc.

Calculate the apparent volume occupied by one atom of the metal.

Solution17. Mass of 1 mole metal atoms = 54.94g
=> Mass of 1 metal atom = 54.94/6.022×10²³ g
= 9.12×10²³ g

$$\begin{aligned} \text{Volume occupied by one metal atom} &= \text{Mass of one metal atom}/\text{density} \\ &= 9.12 \times 10^{23} / 7.42 \\ &= \mathbf{1.23 \times 10^{23} \text{ cc.}} \end{aligned}$$

Question18. Calculate the number of moles, and number if atoms of H, S, and O in
5 mole of H₂SO₄.

Solution18. 1 mole of H₂SO₄ contains 2 mole of H, 1 mole of S, and 4 mole of O
=> 5 mole of H₂SO₄ contains 10 mole of H = 10 × 6.022×10²³
= 6.022×10²⁴ H atoms

$$\begin{aligned} 5 \text{ mole of S} &= 5 \times 6.022 \times 10^{23} \\ &= 3.011 \times 10^{24} \text{ S atoms} \\ 20 \text{ mole of O} &= 20 \times 6.022 \times 10^{23} \\ &= 1.204 \times 10^{25} \text{ O atoms.} \end{aligned}$$

Question 19. Calculate the number of oxygen atoms and its mass in 50 g of CaCO₃.

Solution19. Molecular mass of CaCO₃= 40+12+3×16

$$= 100$$

$$\text{No. mole of CaCO}_3 = 50\text{g}/100\text{g}$$

$$= 0.5$$

0.5 mole of CaCO_3 contains 1.5 moles of oxygen atoms

$$\text{No. of oxygen atoms} = 1.5 \times 6.022 \times 10^{23}$$

$$= \mathbf{9.033 \times 10^{23} \text{ atoms}}$$

$$\text{Mass of Oxygen atoms} = 1.5 \times 16$$

$$= \mathbf{24 \text{ g.}}$$

Question 20. Calculate the number of atoms of each element in 122.5 g of KClO_3 .

$$\text{Solution 20. Molecular mass of KClO}_3 = 39 + 35.5 + 3 \times 16 = 122.5$$

$$\text{No. of mole of KClO}_3 = 122.5\text{g}/122.5\text{g}$$

$$= 1 \text{ mole}$$

1 mole of KClO_3 contains

$$1 \text{ mole of K} = 6.022 \times 10^{23} \text{ K atoms}$$

$$1 \text{ mole of Cl} = 6.022 \times 10^{23} \text{ Cl atoms}$$

$$3 \text{ mole of O} = 3 \times 6.022 \times 10^{23}$$

$$= 1.806 \times 10^{24} \text{ O atoms.}$$

Question 21. Calculate the total number of electrons present in 1.6 g of CH_4 .

$$\text{Solution 21. Molecular mass of CH}_4 = 12 + 4 \times 1$$

$$= 16$$

$$\text{Moles of CH}_4 = 1.6/16$$

$$= 0.1$$

$$\text{No. of electron in 1 molecule of CH}_4 = 6 + 4$$

$$= 10 \text{ electrons}$$

$$\text{Total no. of electrons} = 0.1 \times 6.022 \times 10^{23} \times 10$$

$$= \mathbf{6.022 \times 10^{23} \text{ electrons.}}$$
