Chemistry Study Materials for Class 9

(NCERT based Revision of Atoms and molecules)

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Numerical problems based On Mole Concept

Question 30. To 50 ml of 0.5 M H_2SO_4, 75 ml of 0.25 M H_2SO_4 is added. What is the concentration of the final solution if its volume is 125 ml?

Solution30.No. of moles in 0.05 liter of H_2SO_4= M × V(in liter)

= 0.5 × 0.05

= 0.025

No. of moles in 0.075 liter of H_2SO_4 added= 0.25 × 0.075

= 0.01875

Total no. of moles in 0.125 liter of H_2SO_4= 0.025 + 0.01875

= 0.04375

∴ Molarity of H_2SO_4 = 0.04375/0.0125 = **0.35 M**.

Question 31. It has been estimated that 93% of all atoms in the entire universe are hydrogen and that the vast majority of those remaining are helium. Based on only these two elements, estimate the mass percentage composition of the universe.

Solution31. It is given that out of 100 atoms, 93 atoms are Hydrogen and 7 atoms are He.

Mass of Hydrogen atoms = 93×1

= 93

Mass of Helium atoms = 7×4

=28

∴ Mass percentage of Hydrogen = (93/93+28) × 100

= **76.86%**,

Mass percentage of Helium = (28/93+28) × 100

= **23.14%**.

Question 32. A sample of ethane has the same mass as 10.0 million molecules of methane. How many C_2H_6 molecules does the sample contain?

Solution32. Mass of given sample of C_2H_6 = mass of 10^7 CH_4 molecules

$= 16 \times 10^7$/Av. const.

No. of C_2H_6 molecules = Mass / 30 × Av. const.

$= (16 \times 10^7/\text{Av. const} \times 30) \times \text{Av. const.}$

$=$ **5.34×10^6**.

Question 33. How many grams of $CaWO_4$ would contain the same mass of tungsten that is present in 569g of $FeWO_4$? (W=184)

Solution33. Let the mass of $CaWO_4$ be w g. As given,

Mass of W in w g of $CaWO_4$ = mass of W in 569g of $FeWO_4$

Moles of W in $CaWO_4$ × at. mass of W

= Moles of W in $FeWO_4$ × at. mass of W

As both $CaWO_4$ and $FeWO_4$ contains 1 atom of W each,

∴ moles of $CaWO_4$ × at. mass of W = Moles of $FeWO_4$ × at. mass of W

$\Rightarrow (w/288) \times 184 = (569/304) \times 184$

$\Rightarrow w =$ **539.05 g**.

Question 34. 0.75 mole of solid 'A_4' and 2 moles of gaseous O_2 are heated in a sealed vessel, completely using up the reactants and producing only one compound. It is found that when the temperature is reduced to the initial temperature, the contents of the vessel exhibit a pressure equal to half the original pressure. What conclusions can be drawn from these data the product of the reaction?

Solution 34. $A_4(s) + O_2(g) \rightarrow A_xO_y$

Applying POAC for A atoms,

4 × moles of A_4 = x × moles of A_xO_y

$\Rightarrow 4 \times 0.75 = x \times 1$

$\Rightarrow x = 3$

Applying POAC for O atoms,

2 × moles of O_2 = y × moles of A_xO_y

=> 2 × 2 = y × 1

=> y = 4

Thus, the formula of the product is $\mathbf{A_3O_4}$.

Question 35.

Find the number of atoms in 48 g of ozone at NTP.

Solution 35. Molecular mass (O_3) = 48

No. of moles of O_3 = 48/48 = 1

No. of oxygen atoms = $3 \times 1 \times 6.022 \times 10^{23}$

= $\mathbf{1.8066 \times 10^{24}}$.

Question 36. What is the ratio of the volumes occupied by 1 mole of O_2 and 1 mole of O_3 in identical conditions?

Solution 36. Volume ratio = Molar ratio

(Avogadro's principle – the molar ratios are also volume ratios for gases)

= **1:1**.

Question 37. Calculate the mass of 5 moles of $CaCO_3$ in g.

Solution 37. Molar mass (i.e., molecular mass in g) = 40+12+3×16

= 100g

Mass of 5 moles of $CaCO_3$ = 5 × 100

= **500g**.

Question 38. Calculate the volume occupied by 11.2 g of the gas at NTP. Given that the vapour density of a gas is 11.2.

Solution 38. Molecular mass of gas = 2 × Vapour density

= 2×11.2

= 22.4

No. of moles of gas = 11.2/22.4 = 0.5

Volume occupied by gas at NTP = moles × 22.4

$= 0.5 \times 22.4$

$= \mathbf{11.2\ liters}$.

Question 39. Calculate the number of oxygen atoms in 0.2 mole of $Na_2CO_3.10H_2O$.

Solution 39. Moles of oxygen atoms in 1 mole of $Na_2CO_3.10H_2O = 3+10 = 13$

Moles of oxygen atoms in 0.2 mole of $Na_2CO_3.10H_2O = 0.2 \times 13 = 2.6$

$\therefore$ Number of oxygen atoms $= 2.6 \times 6.022\times10^{23}$

$= \mathbf{1.565\times10^{24}}$.

Question 40. Calculate the number of moles of $CuSO_4$ contained in 100mL of 1 M $CuSO_4$ solution. Also, find the number of SO_4^{-2} ions in it.

Solution40. No. of moles in 0.1 liter of $CuSO_4$ solution= M × V(in liter)

($\because$ Molarity = moles of solute/vol. of solution in L)

$= 1 \times 0.1$

$= \mathbf{0.1}$

1 $CuSO_4$ molecule contains 1 SO_4^{-2} ion,No. of SO_4^{-2} ions$= 0.1 \times 6.022\times10^{23}$

$= \mathbf{6.022\times10^{22}}$.

Question 41.

Find the total number of nucleons present in 12g of ^{12}C atoms.

Solution 41.No. moles of carbon atoms = 12/12 = 1

A C-12 atom contains 12 nucleons (6 protons and 6 neutrons, A = Z + N)

$\therefore$ The total number of nucleons $= 12 \times 6.022\times10^{23}$

$= \mathbf{7.226\times10^{24}}$.

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