Chemistry Study Materials for Class 9
(NCERT based Revision of Atoms and molecules)
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Numerical problems based On Mole Concept

Question 22. Find the charge of 1 g-ion of N^{3-} in *Coulombs*.

Solution22. Charge on 1 N^{3-} ion = 3 e^{-} = 3 × 1.602×10^{-19} *Coulombs*

Charge on 1 g-ion of N^{3-} = 3 × 1.602×10^{-19} × 6.022×10^{23} *Coulombs*

= **2.894×10^{5} *Coulombs***.

Question 23.Find the charge of 27 g of Al^{3+} ions in *coulombs*.

Solution23. Atomic mass of Al = 27

No. of moles Al =27/27

= 1 mole

Charge on 1 Al^{3+} ion = 3 e

= 3 × 1.602×10^{-19} *Coulombs*

Charge on 1 mole Al^{3+} ions = 3 × 1.602×10^{-19} × 6.022×10^{23} *Coulombs*

= **2.894×10^{5} *Coulombs***.

Question 24. Equal masses of oxygen, hydrogen and methane are taken in a container in identical conditions. Find the ratio of the volumes of the gases.

Solution24. Let X g of each gas is taken. Then,

Mole ratio = O_2 : H_2 : CH_4

= X/32 : X/2 : X/16

= 1:16:2.

= Volume ratio

[∵ Avogadro's Principle – the molar ratios are also volume ratios for gases]

∴ O_2 : H_2 : CH_4 = **1 : 16 : 2**.

Question 25. If the components of the air are N_2, 78%; O_2, 21%; Ar, 0.9% and CO_2, 0.1% by volume, what would be the molecular mass of air?

Solution 25. The molar ratios are also volume ratios for gases (Avogadro's principle)

$$\text{Molecular mass of air} = \frac{(78\times28 + 21\times32 + 0.9\times40 + 0.1\times44)}{(78 + 21 + 0.9 + 0.1)}$$

$$= \mathbf{28.964}.$$

Question 26. The atomic masses of two elements (A and B) are 20 and 40 respectively. x g of A contains y atoms, how many atoms are present in 2x g of B?

Solution26. No. of mole of A = x/20

No. of atoms of A = (x/20) × N [N is Avogadro constant]

∴ y = x × N/20

=> x = 20y/N

Now,

No. of mole of B = 2x/40

No. of atoms of B = (2x/40) × N

= 2N/40 × 20y/N

= **y**.

Question 27. Oxygen is present in a 1-liter flask at a pressure of 7.6×10^{-10} mm of Hg at 0^oC. Calculate the number of oxygen molecules in the flask.

Solution 27. Pressure = 7.6×10^{-10} mm Hg = $7.6 \times 10^{-10}/ 760$ [1 atm = 760 mm Hg]

= 10^{-12} atm

Volume = 1 liter

Temperature = 0^oC = 273 K

We know pV = nRT => n = pV/RT

$n = (10^{-12} \times 1)/(0.0821 \times 273)$

$= 0.44\times10^{-13}$

No. of molecules = no. of moles × Avogadro constant

$= 0.44\times10^{-13} \times 6.022 \times 10^{23}$

= $\mathbf{2.65 \times 10^{10}}$.

Question 28. Calculate approximately the diameter of an atom of mercury, assuming that each atom is occupying a cube of **edge length equal to the diameter** of the mercury atom. The density of mercury is 13.6 g/cc.

Solution28. Suppose the side of cube = x cm = diameter of mercury atom

∴ Volume of 1 Hg atom = x^3 and

Mass of 1 Hg atom = density × volume

$= 13.6 \times x^3$

Mass of 1 Hg atom = Atomic mass/ Avogadro constant

$= 200/6.022\times10^{23}$

$13.6 \times x^3 = 200/6.022\times10^{23}$

$\Rightarrow x^3 = 200/(13.6 \times 6.022\times10^{23}) = 2.44\times10^{-23}$

$\Rightarrow x = (2.44\times10^{-23})^{1/3} =$ **2.9×10^{-8} cm**.

Question 29.The density of a particular crystal of LiF is 2.65 g/cc. X-ray analysis shows that Li^+ and F^- ions are arranged in a cubic array at a spacing of 2.01 Å. From these data calculate the apparent Avogadro constant.

[Li = 6.639u, F = 18.998u (1 Å = 10^{-8} cm)]

Solution 29. Avogadro constant = No. of LiF molecules present in 1 mole

(6.639+18.998=**25.937g**)

Volume of 1 mole LiF arranged in cube= mass/density

= 25.937/2.65 = 9.78 cc.

Length of edge of the cube = $(9.78)^{1/3}$ = 2.138 cm

No. of ions present in one edge of the cube= $2.138/2.01\times10^{-8}$

$= 1.063\times10^{8}$

No. of ions (Li^+ and F^-) present in the cube= $(1.063\times10^{8})^3$

$= 1.201\times10^{24}$

No. of LiF molecule per mole= Avogadro constant

$= 1.201\times10^{24}/2$

= **6.01×10^{23}**.

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