BEGINNER'S BOX–2

Given data : At wt. Si = 28, H = 1, O = 16, Na = 23, Cl = 35.5, P = 31, Cu = 64

1. Calculate the number of g-molecules (mole of molecules) in the following : [$N_A = 6 \times 10^{23}$]

(i) 3.2 gm CH_4 (ii) 70 gm nitrogen (iii) 4.5×10^{24} molecules of ozone

(iv) 2.4×10^{21} atoms of hydrogen (v) 11.2 L ideal gas at 0°C and 1 atm

(vi) 4.54 ml SO_3 gas at STP (vii) 8.21 L C_2H_6 gas at 400K and 2atm

(viii) 164.2 ml He gas at 27°C and 570 torr

(i) gm molecules means moles.

$$\text{moles} = \frac{3.2}{16} = 0.2$$

(ii)

$$\text{moles} = \frac{70}{28} = 2.5$$

iii) moles $= \frac{4.5 \times 10^{24}}{6 \times 10^{23}} = \frac{45}{6} = \frac{15}{2} = 7.5$

iv) $\frac{0.4}{\frac{2.4 \times 10^{24}}{6 \times 10^{23}}} = 4 \times 10^{-3}$ gramatom $= 2 \times 10^{-3}$ g molecule

v) moles $= \frac{11.2}{22.4} = 0.5$ moles.

vi) $\frac{4.54 \times 10^{-3}}{227} = 10^{-4}$ moles

vii) $PV = nRT$

$2 \times 8.21 = n \times 0.0821 \times 400$

$n = 0.5$ mol.

$$P = \frac{570}{760} = 0.75 \text{ atm}$$

$$V = 164.2 \text{ ml} = 164.2 \times 10^{-3} \text{ L}$$

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(0.75) \times 164.2 \times 10^{-3}}{0.0821 \times 300}$$

$$= \frac{1.5}{\frac{3000}{200}} = \frac{1}{200} \text{ mol.}$$

2+8=10

2. Find no. of protons in 180 ml H_2O. Density of water = 1 gm/ml.

mass of H_2O = 180 ml × 1 g/ml = 180 g

moles of H_2O = $\frac{180}{18}$ = 10

No of protons = moles of H_2O × NA × Protonocity

= 10 × 6.02×10^{23} × 10 = 6.02×10^{25}

3. What mass of $Na_2SO_4.7H_2O$ contains exactly 6.023×10^{22} atoms of oxygen ?

No of oxygen atom = moles of $Na_2SO_4 \cdot 10H_2O$ × NA × atomicity of O

6.022×10^{22} = moles of $Na_2SO_4 \cdot 10H_2O$ × 6.02×10^{23} × 11

Moles of $Na_2SO_4 \cdot 10H_2O = \frac{1}{11}$

Mass = mole × molar mass

$= \frac{1}{11} \times 322$

$= 29.27$ gram

4. What is number of atoms and molecules in 112 L of $O_3(g)$ at 0°C and 1atm ?

$PV = nRT$ $\qquad n = \frac{112}{22.4} = 5$

$1 \times 112 = n \times 0.082 \times 273$

No of molecule of ozone $= 5 N_A = 5 \times 6.02 \times 10^{23}$
$= 3.11 \times 10^{24}$

No of atoms = moles of $O_3 \times N_A \times$ atomicity

$= 5 \times 6.02 \times 10^{23} \times 3 = 9. \times 10^{24}$

5. How many g of element are present in 10 g atom of Si. (Given at. wt. of Si = 28.)

gram atom means moles of atom

Mass = mole x molar mass = $10 \times 28 = 280$ g

6. Calculate the no. of molecules in a drop of water weighing 0.09 g.

$$\text{Mole of molecule} = \frac{\text{gram molecule}}{}$$

$$= \frac{0.09}{18} = 0.005 \text{ mole}$$

7. Calculate no. of each atom present in 106.5 g of $NaClO_3$.

$$\text{mole of } NaClO_3 = \frac{106.5}{106.5} = 1 \text{ mol}$$

$$\text{No of Na atom} = 1 \times N_A \times \text{atomicity} = 1 \times 6.02 \times 10^{23} \times 1 = 6.02 \times 10^{23}$$

$$\text{No of Cl atom} = 1 \times N_A \times 1 = 6.02 \times 10^{23}$$

$$\text{No of O atom} = 1 \times N_A \times 3 = 1806 \times 10^{23}$$

8. Find the no. of mole of phosphorus in 93 g of phosphorus assuming that molecular formula of phosphorus is P_4. Also determine the no. of atoms and molecules of phosphorus in the sample.

$$\text{moles of } P_4 = \frac{93\text{ g}}{124} = \frac{3}{4} = 0.75$$

$$\text{No of atoms} = \text{moles of } P_4 \times N_A \times \text{atomicity}$$

$$= 0.75 \times N_A \times 4$$

$$= 3N_A$$

9. Calculate the number of moles in 5.75 g of sodium. (Atomic mass of sodium = 23.)

$$\text{Moles of Na} = \frac{5.75}{23} = 0.25$$

10. How many grams of each of the following elements must be taken to get 1 mol of substance in which element generally exists ?

(a) Sodium (b) Chlorine (c) Copper

mass = mole × molar mass

(a) Na, mass = 1 × 23 = 23 g/mol

(b) Cl_2, mass = 1 × 71 = 71 g/mol

(c) Cu, mass = 1 × 63.5 = 63.5 g/mol.

11*. The density of liquid mercury is 13.6gm/cm^3. How many moles of mercury are there in 1 litre of the metal? (Atomic mass of Hg = 200)

mass = volume × density = 1000 cm^3 × 13.6 g/cm^3

= 13600gm

moles of Hg = $\frac{13.6g}{200}$ = 63 mol.

12*. The charge on 1 gram ions of Al^{3+} is : [$e = 1.6 \times 10^{-19}$]

(A) $\frac{1}{27} N_A e$ coulomb (B) $\frac{1}{3} \times N_A e$ coulomb (C) $\frac{1}{9} \times N_A e$ coulomb ~~(D)~~ $3 \times N_A e$ coulomb

1gm ions means 1 mole of ion

the no of ion = 6.02×10^{23}

charge on ion = $(+3e) N_A$

13. Which of the following contains greatest number of oxygen atoms :

(A) 1 g of O moles = $\frac{1}{16}$ (B) 1 g of O_2 = $\frac{1}{32}$

(C) 1 g of O_3 moles = $\frac{1}{48}$ ~~(D)~~ all have the same number of atoms

No of atoms = moles × N_A × atomicity

(a) $\frac{1}{16} \times N_A \times 1$, (b) $\frac{1}{32} \times N_A \times 2 = \frac{N_A}{16}$ (c) $\frac{1}{48} \times N_A \times 3 = \frac{N_A}{16}$

14. A sample of ammonium phosphate, $(NH_4)_3PO_4$, contains 3.18 mol of hydrogen atoms. The number of moles of oxygen atoms in the sample is :

(A) 0.265 (B) 0.795 (C) 1.06 (D) 3.1

$(NH_4)_3PO_4$: N : H : O

1 3 12 4

3.18 x

$\frac{12}{3.18} = \frac{4}{x}$ $x = \frac{3.14}{3} = 1.06$

15. Four 1 litre flasks are separately filled with the gases H_2, He, O_2 and O_3 at the same temperature and pressure. The ratio of total number of atoms of these gases present in different flask would be :

(A) 1 : 1 : 1 : 1 (B) 1 : 2 : 2 : 3 (C) 2 : 1 : 2 : 3 (D) 3 : 2 : 2 : 1

According to berzelius hypothesis

Ratio of No of atoms is Ratio of atomicity

2 : 1 : 2 : 3