Solved Problems. (Page no 99)

I. Calculate the gram molar mass of the following.

1. H_2O. Atomic masses of $H = 1$, $O = 16$.

$\therefore$ Gram molar mass of $H_2O = (1 \times 2) + (16 \times 1)$

$= 2 + 16 = 18$.

Gram molar mass of H_2O = **18 g**

2. CO_2

Atomic masses of $C = 12$, $O = 16$.

$\therefore$ Gram molar mass of $CO_2 = (12 \times 1) + (16 \times 2)$

$= 12 + 32$

Gram molar mass of CO_2 = **44 g**

3. $Ca_3(PO_4)_2$.

Atomic masses of $Ca = 40$, $P = 31$, $O = 16$.

$\therefore$ Gram molar mass of $Ca_3(PO_4)_2 = (40 \times 3) + (31 \times 2) + (16 \times 8)$

$= 120 + 62 + 128$

Gram molar mass of $Ca_3(PO_4)_2$ = **310 g**

II 1. Calculate the number of moles in 46g of sodium?

Formula:

$$\text{Number of moles} = \frac{\text{Given mass}}{\text{Atomic mass}}.$$

Given:

Given mass = 46 g Atomic mass of Sodium = 23.

Solution:

$$\text{Number of moles} = \frac{46}{23} = 2.$$

2. Calculate the number of moles in 5.6 litre of oxygen at STP.

Formula:

$$\text{Number of moles} = \frac{\text{Given volume}}{\text{Molar volume}}.$$

Given:

Given volume = 5.6 l, Molar volume = 22.4 l.

Solution:

$$\text{Number of moles} = \frac{5.6}{22.4} = 0.25$$

3. Calculate the number of moles of a sample that contains 12.046×10^{23} atoms of iron?

Formula:

$$\text{Number of moles} = \frac{\text{Given no of atoms}}{\text{Avogadro number.}}$$

Given:

Given no of atoms $= 12.046 \times 10^{23}$, Avogadro no $= 6.023 \times 10^{23}$.

Solution:

$$\text{Number of moles} = \frac{12.046 \times 10^{23}}{6.023 \times 10^{23}}$$

$$= \underline{\underline{2 \text{ moles.}}}$$

III 1. Calculate the mass of 0.3 mole of Aluminium. (At. mass of Al = 27)

Formula:

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Atomic mass}}$$

$$\therefore \text{Mass} = \text{No of moles} \times \text{Atomic mass.}$$

Given:

No of moles = 0.3, At. mass of Al = 27.

Solution:

$$\text{Mass} = 0.3 \times 27 = \underline{\underline{8.1 \text{ g}}}$$

2. Calculate the mass of 2.24 litre of SO_2 gas at STP.

Formula:

$$\text{Number of moles} = \frac{\text{Given volume}}{\text{Molar volume.}}$$

$$\text{Mass} = \text{No of moles} \times \text{Molecular mass}$$

Given:

Given volume = 2.24 ℓr, Molar volume = 22.4 ℓr

Molecular mass of SO_2 = 64 g.

Solution:

$$\text{Number of moles} = \frac{2.24}{22.4} = 0.1$$

$$\text{Mass} = 0.1 \times 64 = \underline{\underline{6.4 \text{ g}}}$$

3. Calculate the mass of 1.51×10^{23} molecules of H_2O?

Formula:

$$\text{Number of moles} = \frac{\text{Given no of molecules}}{\text{Avogadro Number}}$$

$$\text{Mass} = \text{No of moles} \times \text{Molecular mass}.$$

Given:

Given no of molecules $= 1.51 \times 10^{23}$, M.M of $H_2O = 18g$.

Solution:

$$\text{No of moles} = \frac{1.51 \times 10^{23}}{6.023 \times 10^{23}} = 0.25.$$

$$\text{Mass} = 0.25 \times 18 = 4.5\,g.$$

4. Calculate the mass of 5×10^{23} molecules of glucose?

Formula: $$\text{Number of moles} = \frac{\text{Given no of molecules}}{\text{Avogadro Number}}$$

$$\text{Mass} = \text{No of moles} \times \text{Molecular mass}.$$

Given: Given no of molecules $= 5 \times 10^{23}$, M.M of glucose $(C_6H_{12}O_6) = 180\,g$.

Solution: $$\text{Number of moles} = \frac{5 \times 10^{23}}{6.023 \times 10^{23}} = 0.830$$

$$\text{Mass} = 0.830 \times 180 = 149.4\,g.$$

N1. Calculate the no of molecules in 11.2 litre of CO_2 at STP.

$$\text{Number of moles} = \frac{\text{Given volume}}{\text{Molar volume}} = \frac{11.2}{22.4} = 0.5 \text{ moles}.$$

$$\text{Number of molecules} = \text{No of moles} \times \text{Avogadro number}$$

$$= 0.5 \times 6.023 \times 10^{23} = 3.011 \times 10^{23}.$$

2. Calculate the no of atoms present in 1 gram of Gold?

$$\text{Number of atoms} = \frac{\text{Given mass} \times \text{Avogadro Number}}{\text{Atomic mass}}$$

$$= \frac{1 \times 6.023 \times 10^{23}}{197} = 3.0115 \times 10^{21}$$

3. Calculate the number of molecules in 54 grams of H_2O?

Number of moles $= \frac{\text{Given mass}}{\text{Molecular mass}} = \frac{54}{18} = \underline{3 \text{ moles}}$.

No of molecules = No of moles × Avogadro number.

$= 3 \times 6.023 \times 10^{23} = \underline{18.069 \times 10^{23}}$.

4. Calculate the no of atoms of oxygen and carbon in 5 moles of CO_2

1 mole of CO_2 contains 2 moles of oxygen & one mole of carbon

∴ 5 moles of CO_2 contains $(2 \times 5) = 10$ moles of oxygen and

$(1 \times 5) = 5$ moles of carbon.

Number of atoms = No of moles × Avogadro number.

∴ No of moles of oxygen $= 10 \times 6.023 \times 10^{23} = \underline{6.023 \times 10^{24}}$

∴ No of moles of carbon $= 5 \times 6.023 \times 10^{23} = \underline{3.011 \times 10^{24}}$

V. 1. Calculate the volume occupied by 2.5 moles of CO_2 at STP.

Formula: Number of moles $= \frac{\text{Given volume}}{\text{Molar volume}}$.

∴ Volume occupied by 2.5 moles of CO_2 at STP $= \underline{\text{No}}$ of moles × Molar volume

$= 2.5 \times 22.4 = \underline{56 \text{ litres}}$.

2. Calculate the volume occupied by 3.011×10^{23} of ammonia gas molecules.

Formula: Number of moles $= \frac{\text{Given no of molecules}}{\text{Avogadro number}}$.

$= \frac{3.011 \times 10^{23}}{6.023 \times 10^{23}} = \underline{0.5 \text{ moles}}$.

Volume = No of moles × Molar volume

$= 0.5 \times 22.4$

$= \underline{11.2 \text{ litres}}$.

3. Calculate the volume occupied by 14g of Nitrogen gas.

Number of moles $= \frac{\text{Given mass}}{\text{Molecular mass}} = \frac{14}{28} = 0.5$ moles

Volume = No of moles x Molar volume

$= 0.5 \times 22.4 = 11.2$ litres.

VI Calculate the percentage of 'S' in H_2SO_4.

Molar mass of $H_2SO_4 = (1\times2) + (32\times1) + (16\times4)$

$= 98$ g.

Percentage of 'S' in $H_2SO_4 = \frac{\text{Mass of sulphur}}{\text{M.M of } H_2SO_4} \times 100$

$= \frac{32}{98} \times 100.$

$= 32.65\%.$