**FREEDOM INTERNATIONAL SCHOOL**

# 1 - SOME BASIC CONCEPTS OF CHEMISTRY

## WORKSHEET -1

1. Calculate the mass of an atom of silver and a molecule of carbon dioxide. (Given atomic mass of Ag = 108u)

i) For Ag, $\frac{m}{M} = \frac{\text{No. of atoms}}{N_A}$

$m = \frac{1 \times 108}{6.022 \times 10^{23}} = 17.9 \times 10^{-23} g$

ii) For $CO_2$, $\frac{m}{M} = \frac{\text{No. of molecules}}{N_A}$

$m = \frac{1 \times 44}{6.022 \times 10^{23}} = 7.3 \times 10^{-23} g$

2. How many atoms and molecules of sulphur are present in 64g of $S_8$?

1 mole of $S_8 = 8 \times 32 = 256g$

$\frac{m}{M} = \frac{\text{No. of molecules}}{N_A}$

No. of molecules $= \frac{64 \times 6.022 \times 10^{23}}{256}$

$= 1.5 \times 10^{23}$

1 molecule contains 8 - S atoms

$\therefore$ No. of atoms in 64g $= 8 \times 1.5 \times 10^{23}$

$= 12.0 \times 10^{23}$

3. What is the mass of one molecule of caffeine ( $C_8H_{10}N_4O_2$)?

$$\frac{m}{M} = \frac{\text{No. of molecules}}{N_A}$$

$$m = \frac{1 \times (12\times8 + 10 + 4\times14 + 2\times16)}{6.022\times10^{23}}$$

$$= 32.2\times10^{-23} g$$

4. Calculate the mass of $Na_2CO_3$ which will have the same number of molecules as contained in 12.3g of $MgSO_4.7H_2O$.

No. of molecules in 12.3g of $MgSO_4 \cdot 7H_2O$

$$\text{No. of molecules} = \frac{12.3 \times 6.022\times10^{23}}{246}$$

$$= 0.3011\times10^{23}$$

$$\text{mass of } Na_2CO_3 = \frac{0.3011\times10^{23} \times 106}{6.022\times10^{23}}$$

= 5.3g

5. Find out the volume of the following at STP: (i) 14g of nitrogen gas (ii) $6.023\text{x}10^{22}$ molecules of ammonia (iii) 0.1 mole of sulphur dioxide.

i) 28g of $N_2$ occupies 22.4L at STP

14g of $N_2$ occupies, $\frac{22.4\times14}{28} = 11.2L$ at STP

ii) $6.023\times10^{23}$ molecules = 1 mole occupies 22.4L at STP

ans - 2.24L

iii) 1 mole of $SO_2$ occupies 22.4L at STP
0.1 mole of $SO_2$ occupies $22.4 \times 0.1 =$
2.24L at STP

6. An atom of some element Y weighs $6.644 \times 10^{-23}$ g. Calculate the gram atomic mass.

$$\frac{m}{M} = \frac{\text{no. of atoms}}{N_A}$$

$$\frac{6.644 \times 10^{-23}}{M} = \frac{1}{6.022 \times 10^{23}}$$

$$M = 40.01 g/mol$$

7. Calculate the number of atoms of each type present in 3 moles of calcium phosphate [$Ca_3(PO_4)_2$].

1 molecule contains 3 atoms of Ca
2 atoms of P
8 atoms of O

1 mole of $Ca_3(PO_4)_2$ contains $3 \times N_A$ of Ca atoms
3 moles of $Ca_3(PO_4)_2$ contains, $3 \times 3 \times N_A$
$= 54.19 \times 10^{23}$ Ca atoms

OR

no. of atoms = no. of moles $\times N_A \times$ no. of atoms in a molecule

no. of P atoms $= 3 \times 6.022 \times 10^{23} \times 2$
$= 36.132 \times 10^{23}$ P atoms

no. of O atoms $= 3 \times 6.022 \times 10^{23} \times 8$
$= 144.5 \times 10^{23}$ O atoms

8. Calculate the number of molecules present in 1L of methane at STP.

22.4L of $CH_4$ at STP contains $6.022 \times 10^{23}$ molecules

1L of $CH_4$ at STP contains,

$$\frac{6.022 \times 10^{23}}{22.4} = 0.26 \times 10^{23} \text{ molecules}$$

9. Calculate the mass of 18.066 x $10^{23}$ molecules of $SO_2$.

$$\frac{m}{M} = \frac{\text{no. of molecules}}{N_A}$$

$$m = \frac{18.066 \times 10^{23} \times 64}{6.022 \times 10^{23}} = 192g$$

10. The number of water molecules is maximum in (i) 18 molecules of water, (ii) 1.8g of water, (iii) 18g of water, (iv) 18 moles of water.

$$\text{no. of molecules} = \frac{m}{M} \times N_A$$

i) no. of $H_2O$ molecules = 18

ii) no. of $H_2O$ molecules = $\frac{1.8}{18} \times 6.022 \times 10^{23}$

iii) no. of $H_2O$ molecules = $\frac{18}{18} \times 6.022 \times 10^{23}$

iv) no. of $H_2O$ molecules = $18 \times 6.022 \times 10^{23}$

$\therefore$ (iv) is the answer

11. Calculate the number of moles of oxygen in 1 L of air containing 21 % oxygen by volume, under standard conditions.

1 L of gas contains 21% of $O_2$

Volume of $O_2$ in 1000 mL of air is,

$$\frac{21}{100} \times 1000 = 210 mL$$

1 mole of $O_2$ occupies 22,400 mL

x moles of $O_2$ occupies 210 mL

$$x = \frac{210}{22400} = 0.0093 \text{ moles}$$

12. Specific volume of a cylindrical virus particle is 6.02 x $10^{-2}$ cc/g whose radius and length are 7Å and 10Å respectively. Calculate the molecular weight of virus.

radius = 7Å = $7 \times 10^{-8}$ cm; $l$ = 10Å = $10 \times 10^{-8}$ cm

Volume of 1 virus = $\pi r^2 l$

$$= \frac{22}{7} \times (7 \times 10^{-8})^2 \times 10 \times 10^{-8}$$

$$= 154 \times 10^{-23} cm^3$$

wt. of one particle = $\frac{\text{Volume of 1 virus}}{\text{Sp. volume}}$

$$= \frac{154 \times 10^{-23}}{6.02 \times 10^{-2}} g$$

Mol. wt of virus = wt. of avogadro no. of particles

$$= N_A \times \text{wt of 1 particle}$$

$$= 6.022 \times 10^{23} \times \frac{154 \times 10^{-23}}{6.02 \times 10^{-2}}$$

$$= 154 \times 10^2 g$$

13.In which case is the number of molecules of water maximum?

(A) 18 mL of water

(B) 0.18 g of water

(C) 0.00224 L of water vapours at 1 atm and 273 K

(D) $10^{-3}$ mol of water

a) 18ml of $H_2O$ = 18g

no. of molecules $= \frac{18}{18} \times 6.022 \times 10^{23}$

b) no. of molecules $= \frac{0.18}{18} \times 6.022 \times 10^{23}$

c) $6.022 \times 10^{23}$ molecules ⇒ 22.4 L at STP

$x$ molecules ⇒ 0.00224 L at STP

$x = \frac{6.022 \times 10^{23} \times 0.00224}{22.4}$

d) no. of molecules $= 10^{-3} \times 6.022 \times 10^{23}$

∴ (a) is correct

14.Calculate the number of atoms in 4.25 g of $NH_3$.

$n = \frac{m}{M} = \frac{4.25}{17} = 0.25$ moles

1 mole of $NH_3$ contains $4 \times N_A$ of atoms

0.25 moles of $NH_3$ $= 4 \times 6.022 \times 10^{23} \times 0.25$

$= 6.022 \times 10^{23}$

15.The maximum number of molecules is present in

(A) 15 L of $H_2$ gas at STP
(B) 5 L of $N_2$ gas at STP
(C) 0.5 g of $H_2$ gas
(D) 10 g of $O_2$ gas

$$\frac{\text{no. of molecules}}{N_A} = \frac{\text{Volume of gas}}{\text{Volume at STP}}$$

A) $$\text{no. of molecules} = \frac{15 \times 6.022 \times 10^{23}}{22.4}$$

$$= \underline{4.03 \times 10^{23}}$$

B) $$\text{no. of molecules} = \frac{5 \times 6.022 \times 10^{23}}{22.4}$$

$$= 1.34 \times 10^{23}$$

c) $$\frac{m}{M} = \frac{\text{no. of molecules}}{N_A}$$

$$\frac{0.5}{2} = \frac{\text{no. of molecules}}{6.022 \times 10^{23}} = 1.5 \times 10^{23}$$

d) $$\frac{10}{32} = \frac{\text{no. of molecules}}{6.022 \times 10^{23}} = 1.88 \times 10^{23}$$