CHEMISTRY - ZENITH

FOUNDATION

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NOMENCLATURE

CARBON & IT'S COMPOUND

$$\text{Atomic Mass of an Elements} = \frac{\text{Mass of one atom of the element}}{\text{Mass of one of C}-12} \times 12$$

8. Atomic Mass Unit (amu) : It is defined as the mass of 1/12 th of the mass of 1 atom of carbon-12 isotope. Now latest unit of atomic mass is "written as U which means unified mass.

$$1 \text{ amu} = \text{Mass of one atom of C - 12} \times \frac{1}{12}$$

9. Relative Molecular Mass : It is defined as number of times a given molecule is heavier than 1/12 th of mass of 1 atom of carbon-12 isotope. The molecular mass of a substance is the sum of atomic masses of all the atoms in a molecule of the substance. Therefore, the relative average mass of a molecule expressed in atomic mass units. For example,

Molecular mass of H_2O =2 × 1 + 16 = 18 u, Molecular mass of NH_3 = l × l4 + 3 × l = 14 + 3 = 17 u

10. Relative Formula Mass : It is defined as number of times one formula unit of ionic compound is heavier than 1 atom of carbon-12 isotope. The formula mass of a substance is a sum of the atomic masses of all the atoms in a formula unit of a compound. It is calculated in the same manner as we calculate molecular mass. The only difference is that we use the word 'formula unit' for those substances whose constituting particles are ions, e.g., the formula unit of sodium chloride is NaCl.

Its formula mass is 1 × 23 + 35.5 × 1 = 58.5 u

Example :

Example : Molecular mass of H_2 = 2 × l = 2u

Molecular mass of O_2 = 2 × 16 = 32 u

Molecular mass of Cl_2 = 2 × 35.5 = 71 u

Molecular mass of CH_4 = 1 × 12 + 4 × 1 = 12 + 4 = 16 u

Molecular mass of CH_3OH = 1 × 12 + 4 × l + l × l6 = 12 + 4 + 16 = 32u

Molecular mass of CO_2 = 1 × 12 + 2 × 16 = 12 + 32 = 44 u

Molecular mass of HC1 =1 × 1 + 35.5 × l = l + 35.5 = 36.5 u

Molecular mass of Na_2O = 2 × 23 + 16 = 46 + 16 = 62 u

11. Mole Concept : Mole is a counting unit for atoms, molecules or ions and is equal to 6.022×10^{23} . This number is called Avogadro's Constant and is denoted by the symbol N_A. Mole is a counting unit just as dozen is for counting bananas or oranges.

Just like 1 dozen = 12
1 gross = 144

$$\begin{cases} 1 \text{ mole} = 6.022 \times 10^{23} \\ 1 \text{ mole} = 602\,200\,000\,000\,000\,000\,000\,000 \end{cases}$$

Mole is the amount of a substance which contains as many particles (atoms, ions or molecules) as in 12 g (0.012 kg) of C-12. Mole is also defined as the molecular weight expressed in grams which is also called Molar Mass (M) of a molecule.

SOLVED QUESTIONS

Ex.1 Calculate the molar mass of the following substances :

(A) C_2H_2(Ethyne)

(B) Sulphur molecule (S_8)

(C) Phosphorus molecule (P_4)

(D) Hydrochloric acid (HC1)

(e) Nitric acid (HNO_3)

Sol. (A) Molar mass of C_2H_2 (Ethyne)

= 2×l2 + l×2 = 26u

(B) Molar mass of Sulphur molecule (S_8)

= 8 × 32 = 256 u

(C) Molar mass of Phosphorus molecule (P_4)

= 4 × 31 = 124 u

(D) Molar mass of Hydrochloric acid (HC1)

= 1 + 35.5 = 36.5 u

(E) Molar mass of Nitric acid (HNO_3)

= 1 + 14 + 3 × 16 = 63 u

Ex.2 What is the mass of

(A) 1 mole of Nitrogen atoms ?

(B) 4 moles of Al atoms ?

(C) 10 moles of Sodium Sulphite (Na_2SO_3) ?

Sol. (A) 1 mole of Nitrogen atoms = 14 u

(B) 4 moles of Al atoms = 4 x 27 = 108 u

(C) 10 moles of Sodium Sulphite (Na_2SO_3) = 10 (2×23 + 32 + 3×16)

= 10 (46 + 32 + 48) = 10 (126) = 1260 u

Ex.3 Convert into Mole :

(a) 12 g of oxygen gas (b) 20g of H_2O

(c) 22g of CO_2

Sol. (a) Molecular weight of O_2 = 2 × 16 = 32 u l mole of O_2 = 2×l6 = 32g, 32 g of O_2 = l mole

12 g of O_2 = $\frac{1}{32}$ × 12 = 3/8 = 0.375 mole

(b) Molecular weight of H_2O = 2 + 16 = 18, 18g of H_2O = l mole

20 g of H_2O = $\frac{1}{18}$ × 20 = 10/9 = 1.10 mole

(c) Molecular weight of CO_2

= 12 + 2 × 16 = 44 u

1 mole of CO_2 = 12 + 2 × 16 = 12 + 32

= 44 g 44 g of CO_2 = l mole 22 g of CO_2

= $\frac{1}{44}$ x 22 = 1/2 = 0.5 mole

Ex.4 In 5 g atom of Ag (At. wt. of Ag = 108), calculate the weight of one atom of Ag -

(A) 17.93 × 10^{-23}gm

(B) 16.93 × 10^{-23} gm

(C) 17.93 × 10^{23} gm

(D) 36 × 10^{-23} gm

Sol. (A)

∵ N atoms of Ag weigh 108 gm

y 1 atom of Ag weigh = $\frac{108}{N}$

= $\frac{108}{6.023 \times 10^{23}}$

= 17.93 × 10^{-23} gm.

Ex.5 Calculate the mass in gm of 2N molecules of CO_2 -

(A) 22 gm (B) 44 gm

(C) 88 gm (D) None of these.

Sol. (C)

∵ N molecules of CO_2 has molecular mass = 44.

∴ 2N molecules of CO_2 has molecular mass

= 44 x 2 = 88 gm.

Ex.6 How many carbon atoms are present in 0.35 mol of $C_6H_{12}O_6$ -

(A) 6.023 × 10^{23} carbon atoms

(B) 1.26 × 10^{23} carbon atoms

(C) 1.26 × 10^{24} carbon atoms

(D) 6.023 × 10^{24} carbon atoms

Sol. (C)

∴ 1 mol of $C_6H_{12}O_6$ has

= 6 N atoms of C

∴ 0.35 mol of $C_6H_{12}O_6$ has

= 6 × 0.35 N atoms of C

= 2.1 N atoms

= 2.1 × 6.023 × 10^{23}

= 1.26 × 10^{24} carbon atoms

Ex.7 How many molecules are in 5.23 gm of glucose ($C_6H_{12}O_6$) -

(A) 1.65 × 10^{22} (B) 1.75 × 10^{22}

(C) 1.75 × 10^{21} (D) None of these

Sol. (B)

∵ 180 gm glucose has = N molecules

∴ 5.23 gm glucose has

= $\frac{5.23 \times 6.023 \times 10^{23}}{180}$

= 1.75 × 10^{22} molecules

17. 1 gm - atom of nitrogen represents -
(A) 6.02×10^{23} N_2 molecules
(B) 22.4 lit. of N_2 at N.T.P.
(C) 11.2 lit. of N_2 at N.T.P.
(D) 28 gm of nitrogen

18. If 3.01×10^{20} molecules are removed from 98 mg of H_2SO_4, then the number of moles of H_2SO_4 left are -
(A) 0.1×10^{-3} (B) 0.5×10^{-3}
(C) 1.66×10^{-3} (D) 9.95×10^{-2}

19. Total number of atoms of all elements present in 1 mole of ammonium dichromate $[(NH_4)_2Cr_2O_7]$ is -
(A) 14 (B) 19
(C) 6×10^{23} (D) 114×10^{23}

20. What mass of calcium chloride in grams would be enough to produce 14.35 gm of AgCl.
(At. mass Ca = 40, Ag = 108) -
(A) 5.55 gm (B) 8.295 gm
(C) 16.59 gm (D) 11.19 gm

21. Total no. of atoms in 44 gm of CO_2 is -
(A) 6.02×10^{23} (B) 6.02×10^{24}
(C) 1.806×10^{24} (D) 18.06×10^{22}

22. How many grams are contained in 1 gm-atom of Na -
(A) 13 gm (B) 23 gm
(C) 1 gm (D) 1/23 gm

23. Mass of H_2O in 1000 kg $CuSO_4.5H_2O$ is -
(Cu = 63.5)
(A) 360.5 kg (B) 36.05 kg
(C) 3605 kg (D) 3.605 kg

24. In the reaction $4A + 2B + 3C \rightarrow A_4B_2C_3$, what will be the number of moles of product formed, starting from one mole of A, 0.6 mole of B and 0.72 mole of C ?
(A) 0.25 (B) 0.3
(C) 0.24 (D) 2.32

25. 8 gm of O_2 has the same number of molecules as -
(A) 7 gm of CO (B) 14 gm of CO
(C) 14 gm of CO_2 (D) 12 gm of CO_2

ANSWER KEY

1.	A	2.	B	3.	B	4.	A
5.	B	6.	D	7.	D	8.	A
9.	B	10.	C	11.	D	12.	A
13.	B	14.	B	15.	D	16.	C
17.	C	18.	B	19.	D	20.	A
21.	C	22.	B	23.	A	24.	C
25.	A						