Chapter 1

Some Basic Concepts of Chemistry

Solutions

SECTION – A

Objective Type Questions

(Mole Concept, Equivalent Mass)

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

(1) 0.265 (2) 0.795 (3) 1.06 (4) 4.00

Sol. Answer (3)

In $(NH_4)_3PO_4$ 12 moles of 'H' are present with 4 moles of oxygen atom.

$\therefore$ 3.18 moles of 'H' are present with = $\frac{4}{12}\times 3.18$ = 1.06 moles of oxygen atom.

2. Which has the maximum number of molecules among the following?

(1) 8 g H_2 (2) 64 g SO_2 (3) 44 g CO_2 (4) 48 g O_3

Sol. Answer (1)

Maximum number of moles have maximum number of molecules

$\therefore$ calculate number of moles.

8 g H_2 moles = $\frac{8}{2}$ = 4 moles

44 g of CO_2 = $\frac{44}{44}$ = 1 mol CO_2

64 g SO_2 moles = $\frac{64}{44}$ = 1 moles

48 g of O_3 = $\frac{48}{48}$ = 1 mol of O_3

3. The total number of electrons in 1.6 g of CH_4 to that in 1.8 g of H_2O

(1) Double (2) Same

(3) Triple (4) One fourth

Sol. Answer (2)

Number of e^- in 1.6 g of CH_4 = $\frac{1.6}{16}\times 10 \times N_0 = N_0$ [Total number of e^- in CH_4]

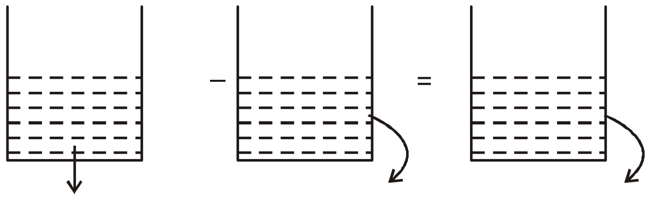
Number of e^- in 1.8 g of H_2O = $\frac{1.8}{18}\times 10 \times N_0 = N_0$ [Total number of e^- in H_2O]

4. When *x* molecules are removed from 200 mg of N_2O, 2.89×10^{-3} moles of N_2O are left. x will be

(1) 10^{20} molecules (2) 10^{10} molecules (3) 21 molecules (4) 10^{21} molecules

Sol. Answer (4)

From Equation



(200 mg of N_2O) − x molecules = 2.89×10^{-3} moles of N_2O

200 mg of N_2O have molecule = $\frac{200}{44} \times 10^{-3} \times 6.022 \times 10^{23}$

$\approx 2.7 \times 10^{21}$ molecule

$\therefore$ 2.89×10^{-3} moles of N_2O have molecule = $2.89 \times 10^{-3} \times 6.022 \times 10^{23}$

$= 1.7 \times 10^{21}$ molecules

$\therefore$ 200 mg of N_2O – x molecule = 2.89×10^{-3} moles of N_2O

[$2.7 \times 10^{21} - x = 1.7 \times 10^{21}$] molecule

[$x = (2.7 - 1.7) \times 10^{21}$] molecule

$= 10^{21}$ molecule

5. Which has maximum molecules?

(1) 7 g N_2O (2) 20 g H_2 (3) 16 g NO_2 (4) 16 g SO_2

Sol. Answer (2)

Maximum number of moles have maximum Number of molecules.

Moles of $N_2O = \frac{7}{44}$; moles of $H_2 = \frac{20}{2}$; moles of $NO_2 = \frac{16}{46}$

Moles of $SO_2 = \frac{16}{64}$

H_2 have maximum number of moles and have maximum number of molecules.

6. The number of molecules in 4.25 g of NH_3 is approximately

(1) 4×10^{23}

(2) 1.5×20^{23}

(3) 1×10^{23}

(4) 6×10^{23}

Sol. Answer (2)

Moles of $NH_3 = \frac{4.25}{17}$ = 0.25 moles

Number of molecule = $0.25 \times 6.022 \times 10^{23}$ molecule = 1.50×10^{23} molecule.

7. The maximum number of molecules is present in

(1) 15 L of H_2 gas at STP

(2) 5 L of N_2 gas at STP

(3) 0.5 g of H_2 gas

(4) 10 g of O_2 gas

Sol. Answer (1)

Gas have maximum number of moles will have maximum number of molecules 22.4 L at STP gas = 1 mole

Moles of $H_2(g) = \frac{15}{22.4} = 0.67$ mol; moles of $N_2 = \frac{5}{22.4} = 0.223$ mol

Moles of 0.5 g H_2 gas $= \frac{0.5}{2} = 0.25$ mol; moles of O_2 10 g $= \frac{10}{32} = 0.1325$

$\therefore$ $\boxed{\text{maximum number of molecules = 15 L of } H_2\text{ (g) at STP}}$

8. The number of atoms in 0.1 mol of a tetraatomic gas is ($N_A = 6.02 \times 10^{23}$ mol^{-1})

(1) 2.4×10^{22} (2) 6.026×10^{22} (3) 2.4×10^{23} (4) 3.600×10^{23}

Sol. Answer (3)

Total number of atom $= 0.1 \times \underset{\downarrow}{4} \times 6.022 \times 10^{23} = 2.4 \times 10^{23}$ atom

[4 atom are present as gas is tetra-atomic]

9. If the weight of metal chloride is x gram containing y gram of metal, the equivalent weight of metal will be

(1) $E = \frac{x}{y} \times 35.5$ (2) $E = \frac{8(y-x)}{x}$ (3) $E = \frac{y}{(x-y)} \times 35.5$ (4) $E = \frac{8(x-y)}{y}$

Sol. Answer (3)

$$\underset{y\,(g)}{M^{x+}} + \underset{(x-y)(g)}{x\,Cl} \longrightarrow \underset{x(g)}{MCl_x}$$

$$\boxed{\text{Equivalent mass of metal in case of chlorides} = \frac{\text{weight of metal}}{\text{weight of Cl}} \times 35.5}$$

$\therefore$ $\boxed{\text{equivalent mass } E = \frac{y}{(x-y)} \times 35.5}$

10. Volume occupied by one molecule of water (density = 1 g cm^{-3}) is

(1) 5.5×10^{-23} cm^3 (2) 9.0×10^{-23} cm^3 (3) 6.023×10^{-23} cm^3 (4) 3.0×10^{-23} cm^3

Sol. Answer (4)

As water is liquid its density = 1 g/mL

i.e., 1 g of H_2O have volume = 1 mL

Mass of one molecule $= \frac{18}{6.023 \times 10^{23}}$ g

$\therefore$ $\frac{18}{6.023 \times 10^{23}}$ g of H_2O have volume $= \frac{18}{6.022 \times 10^{23}}$ mL $= 3.0 \times 10^{-23}$ mL

11. An element, X has the following isotopic composition ^{200}X : 90% ^{199}X : 8% ^{202}X : 2.0%. The weighted average atomic mass of the naturally occurring element X is closest to

(1) 201 amu (2) 202 amu (3) 199 amu (4) 200 amu

Sol. Answer (4)

$$\text{Average atomic mass} = \frac{\Sigma \text{ percentage x atomic mass}}{100}$$

$$= \frac{(200 \times 90) + (199 \times 8) + (202 \times 2)}{100} = 199.96 \approx 200 \text{ amu}$$

(Stoichiometry & Stoichiometric Calculations)

12. Two metallic oxides contain 27.6% and 30% oxygen respectively. If the formula of the first oxide is X_3O_4, that of the second will be

(1) XO (2) XO_2 (3) X_2O_5 (4) X_2O_3

Sol. Answer (4)

This question can be solved by two methods.

Method I	Method II
Oxide I Oxide II X_3O_4 O = 27.6% O = 30% X = 72.4% X = 70% O = 27.6% X = 70% 72.4% of X = 3 mol of X $70\% \text{ of } X = \frac{3}{72.4} \times 70 = 2.90 \text{ mol of } X$	Formula of 1st X_3O_4 $\text{Eq. mass of X} = \frac{\text{wt of X}}{\text{wt of O}} \times 8$ $= \frac{72.4}{27.6} \times 8 = 20.9 = 21$ $\text{Positive charge of X} = 2 \times \frac{4}{3} = \frac{8}{3}$ $\therefore \text{ Atomic mass of X} = \frac{8}{3} \times 21 = 56 \text{ g}$
Similarly 27.6% of O = 4 mol of O $30\% \text{ of O} = \frac{4}{27.6} \times 3 = 4.34 \text{ atom of O}$ X : O 2.9 : 4.34 *i.e.*, 2 : 3 Formula will be : X_2O_3	$\therefore$ [Atomic mass = eq. mass × Valency] $\text{Eq. mass of X} = \frac{70}{30} \times 8 = 18.66$ Atomic mass of X = 56g Calculate from 1st oxide $\therefore \text{ Valency} = \frac{\text{Atomic mass}}{\text{Eq. mass}} = \frac{56}{18.6} = 3$ Formula will be : X_2O_3

13. Haemoglobin contains 0.334% of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (Atomic weight of Fe is 56) present in one molecule of haemoglobin is

(1) 4 (2) 6 (3) 3 (4) 2

Sol. Answer (1)

$$\text{Weight of Fe in heamoglobin} = \frac{0.334}{100} \times 67200 = 224.48 \text{ u}$$

Mass of one Fe atom = 56 u

$$\therefore \boxed{\text{Total number of Fe atom} = \frac{224.48}{56} \approx 4}$$

14. In the reaction, $2SO_2 + O_2 \rightarrow 2SO_3$

when 1 mole of SO_2 and 1 mole of O_2 are made to react to completion

(1) All the oxygen will be consumed (2) 1.0 mole of SO_3 will be produced

(3) 0.5 mole of SO_2 is remained (4) All of these

Sol. Answer (2)

$$2SO_2 + O_2 \longrightarrow 2SO_3$$

2 moles of SO_2 reacts with 1 mole of O_2 as 1 mol of SO_2 is present

$\therefore$ SO_2 will be limiting reagent will formed $\therefore$ $\boxed{\text{1 mol of } SO_3}$

15. 10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be

(1) 1 mol (2) 2 mol (3) 3 mol (4) 4 mol

Sol. Answer (4)

$$\underset{4\text{ g}}{2H_2} + \underset{32\text{ g}}{O_2} \longrightarrow \underset{2\text{ moles}}{2H_2O}$$

As 10 g of H_2 is to react with 64 g of O_2

$\therefore$ O_2 will complete consumed and will act as LR.

Calculation will be made on the basis of weight of O_2

$$\left\{\begin{matrix} 32\text{ g of } O_2 \text{ gives } H_2O = 2\text{ moles} \\ \boxed{64\text{ g of } O_2 \text{ gives } H_2O = 4\text{ moles}} \end{matrix}\right\}$$

16. Consider the following reaction sequence:

$S_8(s) + 8O_2(g) \rightarrow 8SO_2(g)$

$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

How many grams of SO_3 are produced from 1 mole S_8?

(1) 1280 g (2) 960 g (3) 640 g (4) 320 g

Sol. Answer (3)

1 mole $S_8 \equiv 8SO_3 \equiv 8 \times 80$ g = 640 g

17. What volume of oxygen gas (O_2) measured at 0°C and 1 atm, is needed to burn completely 1 L of propane gas (C_3H_8) measured under the same conditions?

(1) 10 L (2) 7 L (3) 6 L (4) 5 L

Sol. Answer (4)

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

For 1 mol propane 5 mol O_2 gas is needed.

22.4 L propane = 5 × 22.4 L of O_2 gas needed

$\therefore$ $\boxed{\text{1 L propane = 5 L of } O_2 \text{ gas is required}}$

(Reactions in Solutions)

18. 4 g of hydrogen reacts with 20 g of oxygen to form water. The mass of water formed is

(1) 24 g (2) 36 g (3) 22.5 g (4) 40 g

Sol. Answer (3)

$$\underset{4\text{ g}}{2H_2} + \underset{32\text{ g}}{O_2} \longrightarrow \underset{36\text{ g}}{2H_2O}$$

When 4 g of H_2 reacts with 32 g of O_2 gives 36 g of H_2O.

Now present oxygen is 20 g

$\therefore$ O_2 will be the limiting reagent and H_2O will be calculated from O_2

$\therefore$ 32 g of O_2 given = 36 g of H_2O

20 g of O_2 given = $\frac{36}{32} \times 20$ = 22.5 g H_2O

19. Calculate the molality of solution containing 3 g glucose dissolved in 30 g of water. (molar mass of glucose = 180)

(1) 0.50 m (2) 0.56 m (3) 0.091 m (4) 0.05 m

Sol. Answer (2)

Molality = $\dfrac{\text{moles of solute}}{\text{wt of solvent (kg)}} = \dfrac{n_B}{w_A(\text{kg})}$ $w_B = 3$ g, $w_A = 30$ g

Molality (m) = $\dfrac{\frac{3}{180}}{30} \times 1000 = \dfrac{1}{1800} \times 1000 = 0.56$ m.

20. How many grams of NaOH should be added to water to prepare 250 ml solution of 2 M NaOH?

(1) 9.6×10^3 (2) 2.4×10^3 (3) 20 (4) 24

Sol. Answer (3)

Moles of NaOH = $\dfrac{M \times V(\text{mL})}{1000} = \dfrac{2 \times 250}{1000}$ = 0.5 moles of NaOH

Moles = $\dfrac{\text{given mass}}{\text{mol.mass}}$ $\therefore$ 0.5 mole = $\dfrac{x}{40}$ $\boxed{\text{given mass} = 40 \times 0.5 = 20 \text{ g}}$

SECTION – B

Objective Type Questions

(Mole Concept)

1. The total number of electrons in 4.2 g of N^{3-} ion is (N_A is the Avogadro's number)

(1) 2.1 N_A (2) 4.2 N_A (3) 3 N_A (4) 3.2 N_A

Sol. Answer (3)

Total number of moles = $\dfrac{4.2}{14}$ = 0.3 mol

1 mol of N^{3-} have electrons = $10 \times N_0$.

$\therefore$ $\boxed{\text{Number of } e^- \text{ in 0.3 mol} = 0.3 \times 10 \times N_0 = 3 \times N_0}$

2. Suppose that A and B form the compounds B_2A_3 and B_2A. If 0.05 mole of B_2A_3 weighs 9 g and 0.1 mole of B_2A weighs 10 g, the atomic weight of A and B respectively are

(1) 30 and 40 (2) 40 and 30 (3) 20 and 5 (4) 15 and 20

Sol. Answer (2)

Let the atomic mass of B = y g ; A = x g

In B_2A_3

2y + 3x = mol. mass of $B_2 A_3$ = $\dfrac{\text{given weight}}{\text{mole}}$

$2y + 3x = \dfrac{9}{0.05}$ g

In B_2A

$\therefore$ $2y + x = \dfrac{10}{0.1}$ g

Solving x and y

$\begin{Bmatrix} x = 40 \\ y = 30 \end{Bmatrix}$

3. Number of Fe atoms in 100 g Haemoglobin if it contains 0.33% Fe. (Atomic mass of Fe = 56)

(1) 0.035×10^{23} (2) 35 (3) 3.5×10^{23} (4) 7×10^{8}

Sol. Answer (1)

Mass of Fe = $100 \times \dfrac{0.33}{100} = 0.33$ g

$\therefore$ Moles of Fe = $\dfrac{0.33}{56} = 5.89 \times 10^{-3}$ mole

$\therefore$ Number of atom of Fe = $5.89 \times 10^{-3} \times 6.022 \times 10^{23} = 0.035 \times 10^{23}$ atom

4. The number of electrons in 1.6 g of CH_4 is approximately

(1) 25×10^{24} (2) 1.5×10^{24} (3) 6×10^{23} (4) 3.0×10^{24}

Sol. Answer (3)

Moles of $CH_4 = \dfrac{1.6}{16} = 0.1$ mol

Number of e^- of $CH_4 = 0.1 \times 10 \times N_0$

$= \boxed{6\times10^{23}}$

5. Specific volume of cylindrical virus particle is 6.02×10^{-2} cc/gm whose radius and length are 7 Å and 10 Å respectively. If $N_A = 6.02 \times 10^{23}$, find molecular weight of virus.

(1) 15.4 kg/mol (2) 1.54×10^{4} kg/mol

(3) 3.08×10^{4} kg/mol (4) 3.08×10^{3} kg/mol

Sol. Answer (1)

One molecule (gm)

$$\boxed{d = \frac{\text{M.wt.}}{V}}$$

$$\frac{1}{6.02\times10^{-2}} = \frac{\text{M.wt.}}{\pi r^2 \times h}$$

M.Wt. (One molecule in gm) = $\dfrac{\pi\times(7\times10^{-8})^2\times10\times10^{-8}}{6.02\times10^{-2}}$

M.Wt. (One mole in kg) = $\dfrac{22}{7}\times\dfrac{7\times7\times6.02\times10^{-3}}{6.02\times10^{-2}} = 2.2 \times 7 = 15.4$ kg mol^{-1}

6. The number of mole of nitrogen in one litre of air containing 10% nitrogen by volume, under standard conditions, is

(1) 0.03 mole (2) 2.10 moles (3) 0.186 mole (4) 4.46×10^{-3} mole

Sol. Answer (4)

Volume of N_2 in 1 L *i.e.,* 1000 ml of $N_2 = \dfrac{10}{1000} \times 1000 = 100$ ml

22400 ml at STP = 1 mol.

$\therefore$ 100 ml at STP = $\dfrac{1}{22400} \times 100 = \dfrac{1}{224} = \boxed{4.46\times10^{-3}\text{ mol}}$

7. Number of significant figures in 6.62×10^{-34}.

(1) Two (2) Three

(3) Four (4) One

Sol. Answer (2)

Number of significant figures = Three

i.e., 6.62

(Stoichiometry & Stoichiometric Calculations)

8. Liquid benzene (C_6H_6) burns in oxygen according to $2C_6H_6\,(l) + 15O_2(g) \longrightarrow 12CO_2(g) + 6H_2O(g)$

How many litres of O_2 at STP are needed to complete the combustion of 39 g of liquid benzene?

(1) 74 L (2) 11.2 L (3) 22.4 L (4) 84 L

Sol. Answer (4)

$$\boxed{2C_6H_6\,(l) + 15\,O_2\,(g) \longrightarrow 12\,CO_2\,(g) + 6H_2O\,(g)}$$

2×78 g $\quad 15 \times 22.4$ L

From equation 15×22.4 L of O_2 is required for = 156 g of benzene

i.e., 156 g benzene for complete combustion required O_2(STP) = 15×22.4 L

39 g benzene for complete combustion required O_2(STP) = $\frac{15 \times 22.4}{156} \times 39 = \boxed{84 \text{ L of } O_2}$

9. 1 mol of $KClO_3$ is thermally decomposed and excess of aluminium is burnt in the gaseous product. How many moles of Al_2O_3 are formed?

(1) 1 (2) 2 (3) 1.5 (4) 3

Sol. Answer (1)

$$2KClO_3 \longrightarrow 2KCl + 3O_2$$

2 moles $\quad$ 3 moles

2 mol of $KClO_3$ gives = 3 mol O_2

1 mol of $KClO_3$ gives = $\frac{3}{2}$ mol O_2

For Al burning

$$2\,Al + \frac{3}{2}O_2 \longrightarrow \underbrace{Al_2O_3}_{1\,mole}$$

As $\frac{3}{2}$ mole of O_2 gives 1 mole Al_2O_3

$\therefore$ 1 mole Al_2O_3 formed.

10. The amount of zinc required to produce 1.12 ml of H_2 at STP on treatment with dilute HCl will be

(1) 65 g (2) 0.065 g (3) 32.5×10^{-4} g (4) 6.5 g

Sol. Answer (3)

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2\,(g)$$

1 moL $\quad 22.4\text{ L} = 22400$ ml

22400 ml of H_2 gas is produced from Zn = 65 g

1.12 ml of H_2 gas is produced from Zn = $\frac{65}{22400} \times 1.12$ g = 3.25×10^{-3} g

i.e., 32.5×10^{-4} g

11. Volume of CO_2 obtained at STP by the complete decomposition of 9.85 g Na_2CO_3 is

(1) 2.24 litre (2) Zero (3) 0.85 litre (4) 0.56 litre

Sol. Answer (2)

Na_2CO_3 is soda ash which does not decompose upon heating even to redness.

$\therefore$ CO_2 will not be evolved.

12. One litre of CO_2 is passed through red hot coke. The volume becomes 1.4 litres at same temperature and pressure. The composition of products is

(1) 0.8 litre of CO_2 and 0.6 litre of CO

(2) 0.7 litre of CO_2 and 0.7 litre of CO

(3) 0.6 litre of CO_2 and 0.8 litre of CO

(4) 0.4 litre of CO_2 and 1.0 litre of CO

Sol. Answer (3)

	$CO_2(g)$	+ $C(s)$	$\longrightarrow$ $2CO(g)$
Initial	1L	0	0
Final volume	(1– x)		2x

Final volume = 1 – x + x + 2x = 1.4 L

$\therefore$ $\boxed{x = 0.4\text{ L}}$

$\therefore$ Volume of CO = 2x = 2 × 0.4 = 0.8 L

Volume of CO_2 = (1 – x) = 1 – 0.4 = 0.6 L

13. An organic compound containing C and H gave the following analysis C = 40%, H = 6.7%. Its empirical formula would be

(1) CH_4 (2) CH_2O

(3) $C_2H_4O_2$ (4) C_2H_4

Sol. Answer (2)

	% age	Atomic mass	Moles	Simple ratio
C	40%	12	$\frac{40}{12} = 3.33$	1
H	6.7%	1	$\frac{6.7}{1} = 6.7$	2
O	53.3%	16	$\frac{53.3}{16} = 3.33$	1

$\therefore$ $\boxed{EF = CH_2O}$

14. How many litre of oxygen at STP is required to burn 60 g C_2H_6?

(1) 22.4 L (2) 11.2 L (3) 22.4 × 7 L (4) 8.5 L

Sol. Answer (3)

$$\underbrace{2C_2H_6}_{\text{2 moles}} + \underbrace{7O_2}_{\text{7 moles}} \longrightarrow 4\,CO_2 + 6\,H_2O$$

For 2 moles of C_2H_6 = 7 moles of O_2 required.

$\boxed{\text{i.e., for 60 g of } C_2H_6 = 7 \times 22.4\text{ L of } O_2 \text{ at STP required}}$

15. For the formation of 3.65 g of HCl gas, what volume of hydrogen gas and chlorine gas are required at NTP conditions?

(1) 1 L, 1 L (2) 1.12 L, 2.24 L (3) 3.65 L, 1.83 L (4) 1.12 L, 1.12 L

Sol. Answer (4)

$$\begin{array}{lll} H_2(g) + Cl_2(g) & \longrightarrow & 2HCl\,(g) \\ 1\,mol \quad 1\,mol & & 36.5\,g \times 2 \\ 22.4\,L \quad 22.4\,L & & 36.5\,g \times 2 \\ 1.12\,L \quad 1.12\,L & & 3.65\,g \end{array}$$

For (36.5 × 2) g of HCl volume of H_2 and Cl_2 required will be 22.4 L H_2 and 22.4 L of CL_2

$\therefore$ For 3.65 g and $\left.\begin{array}{l} 1.12\,L \text{ of } H_2 \\ 1.12\,L \text{ of } Cl_2 \end{array}\right\}$

16. The crystalline salt $Na_2SO_4.xH_2O$ on heating loses 55.9% of its mass ad becomes anhydrous. The formula of crystalline salt is

(1) $Na_2SO_4.5H_2O$ (2) $Na_2SO_4.7H_2O$

(3) $Na_2SO4.2H_2O$ (4) $Na_2SO_4.10H_2O$

Sol. Answer (4)

17. A certain amount of a metal whose equivalent mass is 28 displaces 0.7 L of H_2 at S.T.P. from an acid hence mass of the element is

(1) 1.75 g (2) 0.875 g (3) 3.50 g (4) 7.00 g

Sol. Answer (1)

Weight of metal whcih can displace 11.2 L of H_2 gas is equivalent mass.

$\therefore$ 11.2 L of H_2 (g) have mass = 28 g

0.7 L of H_2 have mass = $\frac{28}{11.2} \times 0.7$ = 1.75 g

(Reactions in Solutions)

18. When 100 ml of $\frac{M}{10}$ H_2SO_4 is mixed with 500 ml of $\frac{M}{10}$ NaOH then nature of resulting solution and normality of excess of reactant left is

(1) Acidic, $\frac{N}{5}$ (2) Basic, $\frac{N}{5}$ (3) Basic, $\frac{N}{20}$ (4) Acidic, $\frac{N}{10}$

Sol. Answer (3)

100 ml of $\frac{M}{10}$ H_2SO_4 $\downarrow$ $\frac{N}{5}$ H_2SO_4 [because N = M × n, n factor of H_2SO_4 = 2	500 ml of $\frac{M}{10}$ NaOH $\downarrow$ $\frac{N}{10}$ [because N factor is 1]
$\therefore$ meq of H_2SO_4 = $\left(100 \times \frac{1}{5}\right)$ = 20 meq	$\therefore$ meq of NaOH = $\left(500 \times \frac{1}{10}\right)$ = 50 meq

$$\text{For Neutralisation Reaction} = \frac{\text{larger meq} - \text{smaller meq}}{\text{Total volume}}$$

$$= \frac{50-20}{600} = \frac{1}{20}\text{ N NaOH} \quad \text{[because larger meq of NaOH will remain]}$$

$\therefore$ $\boxed{\text{Solution will be basic}}$

19. Mole fraction of solvent in aqueous solution of NaOH having molality of 3 is

(1) 0.3 (2) 0.05 (3) 0.7 (4) 0.95

Sol. Answer (4)

$$m = \frac{1000 \, . \, x_B}{x_A \, . \, m_A} \qquad \left\{\begin{array}{l} m = \text{molality} \\ x_B = \text{molality fraction of solute} \\ x_A = \text{molality fraction fo solvent} \end{array}\right\}$$

$\boxed{x_A + x_B = 1}$

$\therefore \quad x_A = (1 - x_B)$

$$m = \frac{1000 \, . \, x_B}{(1 - x_B)M_A}$$

Putting m = 3

M_A = 18 because aqueous solution is present

$$3 = \frac{1000 \, . \, x_B}{(1 - x_B)18} \Rightarrow 54\ (1 - x_B) = 1000\ x_B$$

$$= 54 - 54\ x_B = 1000\ x_B$$

$$x_B = \frac{54}{1054} \Rightarrow x_B = 0.05.$$

$\therefore \quad \boxed{x_A = (1 - x_B) = (1 - 0.05) = 0.95}$

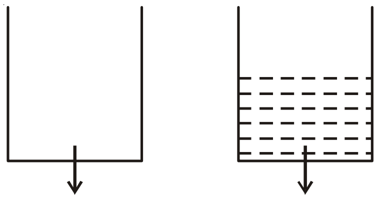
20. Concentrated aqueous sulphuric acid is 98% H_2SO_4 by mass and has a density of 1.80 gmL^{-1}. Volume of acid required to make one litre of 0.1 M H_2SO_4 solution is

(1) 16.65 mL (2) 22.20 mL (3) 5.55 mL (4) 11.10 mL

Sol. Answer (3)

Molarity of 98% H_2SO_4 by mass having density 1.80 g/ml will be

$$M = \frac{\%\ w/w \times d \times 10}{M.\ mass} = \frac{98 \times 1.80 \times 10}{98} = 18\ M.$$



M_1 = 18 M
V_1 = ?

M_2 = 0.1 m
V_2 = 1000 ml

Applying $M_1V_1 = M_2V_2$

$18 \times V_1 = 1000 \times 0.1$

$$V_1 = \frac{100}{18} = 5.55\ ml$$

21. Ammonia gas is passed into water, yielding a solution of density 0.93 g/cm^3 and containing 18.6% NH_3 by weight. The mass of NH_3 per cc of the solution is

(1) 0.17 g/cm^3

(2) 0.34 g/cm^3

(3) 0.51 g/cm^3

(4) 0.68 g/cm^3

Sol. Answer (1)

Molarity of NH_3 solution = $\frac{18.6\times0.93\times10}{17}$ =10.17 M

Strength (g/L) = molarity × mol. mass

= 10.17 × 17 = 172.9 g/L

i.e., 1000 mL of solution contain NH_3 = 172.9 g

1 mL or 1 cm^3 of solution contain NH_3 = $\frac{172.9}{1000}$ = 0.172 g ≈ 0.17 g

22. 6.025 × 10^{20} molecules of acetic acid are present in 500 ml of its solution. The concentration of solution is

(1) 0.002 M

(2) 10.2 M

(3) 0.012 M

(4) 0.001 M

Sol. Answer (1)

Moles of oxalic acid = $\frac{6.022\times10^{20}}{6.022\times10^{23}}$ = 10^{-3} moles

Molarity = $\frac{10^{-3}}{500}\times1000$

= $\boxed{2\times10^{-3}\text{M}}$ = $\boxed{0.002\,\text{M}}$

SECTION – C

Previous Years Questions

1. Suppose the elements X and Y combine to form two compounds XY_2 and X_3Y_2. When 0.1 mole of XY_2 weighs 10 g and 0.05 mole of X_3Y_2 weighs 9 g, the atomic weights of X and Y are **[NEET-Phase-2-2016]**

(1) 40, 30 (2) 60, 40 (3) 20, 30 (4) 30, 20

Sol. Answer (1)

For XY_2,

∵ 0.1 mole XY_2 ≡ 10 g

∴ 1 mole XY_2 ≡ 100 g

and X + 2Y = 100 …(i)

For X_3Y_2,

$\because$ 0.05 mole $X_3Y_2 \equiv 9$ g

$\therefore$ 1 mole $X_3Y_2 \equiv 180$ g

and $3X + 2Y = 180$ …(ii)

On solving,

$X = 40$

and $Y = 30$

2. What is the mass of the precipitate formed when 50 mL of 16.9% solution of $AgNO_3$ is mixed with 50 mL of 5.8% NaCl solution? (Ag = 107.8, N = 14, O = 16, Na = 23, Cl = 35.5) **[Re-AIPMT-2015]**

(1) 7 g
(2) 14 g
(3) 28 g
(4) 3.5 g

Sol. Answer (1)

$$n_{AgNO_3} = \frac{50 \times 16.9}{100 \times 169.8} \approx 0.05 \text{ Mole}$$

$$n_{NaCl} = \frac{50 \times 5.8}{100 \times 58.5} \approx 0.05 \text{ Mole}$$

$\therefore$	$AgNO_3$	+ NaCl	$\longrightarrow$ AgCl	+ $NaNO_3$
t = 0;	0.05 mole	0.05 mole	0	
t = t;	0	0	0.05 mole	

$\therefore$ Mass of AgCl $= 0.05 \times 143.3$

$= 7.16$

≈ 7 g

3. If Avogadro number N_A, is changed from 6.022×10^{23} mol^{-1} to 6.022×10^{20} mol^{-1}, this would change

(1) The ratio of chemical species to each other in a balanced equation **[Re-AIPMT-2015]**
(2) The ratio of elements to each other in a compound
(3) The definition of mass in units of grams
(4) The mass of one mole of carbon

Sol. Answer (4)

Fact.

4. 20.0 g of a magnesium carbonate sample decomposes on heating to give carbon dioxide and 8.0 g magnesium oxide. What will be the percentage purity of magnesium carbonate in the sample? (At. wt. : Mg = 24)

[Re-AIPMT-2015]

(1) 60
(2) 84
(3) 75
(4) 96

Sol. Answer (2)

$$\underset{\substack{84\text{ g}\\ x\text{ g}}}{MgCO_3} \xrightarrow{\Delta} \underset{\substack{40\text{ g}\\ 8\text{ g}}}{MgO} + CO_2$$

$\therefore \quad x = \frac{84 \times 8}{40} = 16.8$ g

$\therefore \quad$ % purity of $MgCO_3$ $= \frac{16.8}{20} \times 100$

$= 84\%$

5. A mixture of gases contains H_2 and O_2 gases in the ratio of 1 : 4 (w/w). What is the molar ratio of the two gases in the mixture? **[AIPMT-2015]**

(1) 2 : 1
(2) 1 : 4
(3) 4 : 1
(4) 16 : 1

Sol. Answer (3)

$$\frac{n_{H_2}}{n_{O_2}} = \frac{1/2}{4/32} = \frac{32}{2 \times 4} = \frac{4}{1}$$

6. 1.0 g of magnesium is burnt with 0.56 g O_2 in a closed vessel. Which reactant is left in excess and how much? (At. wt. Mg = 24; O = 16) **[AIPMT-2014]**

(1) Mg, 0.16 g
(2) O_2, 0.16 g
(3) Mg, 0.44 g
(4) O_2, 0.28 g

Sol. Answer (1)

$$\underset{2 \times 24\text{ g}}{2Mg} + \underset{32\text{ g}}{O_2} \longrightarrow 2MgO$$

$\because \quad O_2$ is limiting reagent

$\therefore \quad$ 32 g of O_2 will react with, $\frac{2 \times 24}{32}$ g

$\therefore \quad$ 0.56 g of O_2 will react with, $\frac{2 \times 24 \times 0.56}{32} = 0.84$ g

$\therefore \quad$ Excess of Mg = 1 – 0.84 = 0.16 g

7. When 22.4 litres of $H_2(g)$ is mixed with 11.2 litres of $Cl_2(g)$, each at STP, the moles of HCl(g) formed is equal to **[AIPMT-2014]**

(1) 1 mol of HCl(g)
(2) 2 mol of HCl(g)
(3) 0.5 mol of HCl(g)
(4) 1.5 mol of HCl(g)

Sol. Answer (1)

$$H_2 + Cl_2 \longrightarrow 2HCl$$

$\frac{n_{Cl_2}}{1} = \frac{n_{HCl}}{2}$ | $\frac{11.2}{22.4} = \frac{n_{HCl}}{2}$

$\boxed{n_{HCl} = 1}$

8. 6.02×10^{20} molecules of urea are present in 100 mL of its solution. The concentration of solution is **[NEET-2013]**

(1) 0.01 M (2) 0.001 M (3) 0.1 M (4) 0.02 M

Sol. Answer (1)

Moles of urea = $\boxed{\dfrac{6.02\times10^{20}}{6.02\times10^{23}} = 10^{-3} \text{ moles}}$

$\therefore$ Molarity = $\dfrac{\text{moles}}{\text{volume (mL)}}\times1000 = \dfrac{10^{-3}}{100}\times1000 = 10^{-2}$ M = 0.01 M

9. How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2 M HNO_3? The concentrated acid is 70% HNO_3? **[NEET-2013]**

(1) 90.0 g conc. HNO_3 (2) 70.0 g conc. HNO_3

(3) 54.0 g conc. HNO_3 (4) 45.0 g conc. HNO_3

Sol. Answer (4)

$\because$ M = $\dfrac{n_{HNO_3}}{V_{mL}}\times1000$,

$\therefore$ $n_{HNO_3} = \dfrac{2\times250}{1000} = 0.5$ mole

$\therefore$ Mass of concentrated acid required = $\dfrac{0.5\times63\times100}{70}$ = 45 g

10. Mole fraction of the solute in a 1.00 molal aqueous solution is **[AIPMT (Prelims)-2011]**

(1) 1.7700 (2) 0.1770

(3) 0.0177 (4) 0.0344

Sol. Answer (3)

$\chi_{solute} = \dfrac{1}{1+55.55} = 0.0177$

11. Which has the maximum number of molecules among the following? **[AIPMT (Mains)-2011]**

(1) 8 g H_2 (2) 64 g SO_2

(3) 44 g CO_2 (4) 48 g O_3

Sol. Answer (1)

Number of molecules in

$H_2 = \dfrac{8}{2} N_A = N_A$, $SO_2 = \dfrac{64}{64} N_A = N_A$

$CO_2 = \dfrac{44}{44} N_A = N_A$, $O_3 = \dfrac{48}{48} N_A = N_A$

$\therefore$ Maximum number of molecules is present in 8 g H_2

12. The number of atoms in 0.1 mol of a triatomic gas is ($N_A = 6.02 \times 10^{23}$ mol^{-1}) **[AIPMT (Prelims)-2010]**

(1) 6.026×10^{22} (2) 1.806×10^{23}

(3) 3.600×10^{23} (4) 1.800×10^{22}

Sol. Answer (2)

Number of atoms = $3 \times 0.1 \times 6.022 \times 10^{23} = 1.806 \times 10^{23}$

13. 25.3 g of sodium carbonate, Na_2CO_3 is dissolved in enough water to make 250 mL of solution. If sodium carbonate dissociates completely, molar concentration of sodium ion, Na^+ and carbonate ions, CO_3^{2-} are respectively (Molar mass of Na_2CO_3 = 106 g mol^{-1}) **[AIPMT (Prelims)-2010]**

(1) 0.955 M and 1.910 M (2) 1.910 M and 0.955 M

(3) 1.90 M and 1.910 M (4) 0.477 M and 0.477 M

Sol. Answer (2)

$$\text{Molarity of } Na_2CO_3 = \frac{\text{moles of } Na_2CO_3}{\text{volume (mL)}} \times 1000$$

$$\text{Moles of } Na_2CO_3 = \frac{25.3}{106}$$

$$\therefore \quad \text{Molarity of } Na_2CO_3 = \frac{\frac{25.3}{106}}{250} \times 1000 = \frac{25.3}{106} \times 4 = 0.955 \text{ M}$$

$$\boxed{Na_2CO_3 \longrightarrow 2Na^{\oplus} + CO_3^{2-}}$$

As one mole Na_2CO_3 gives 2 mol $Na^{\oplus}$ and 1 mol CO_3^{2-}

$\therefore$ Molarity of $Na^{\oplus}$ = 2 × molarity of Na_2CO_3 = $\boxed{2 \times 0.955 = 1.910 \text{ M}}$

Molarity of CO_3^{2-} = 1 × molarity of Na_2CO_3 = $\boxed{0.955 \text{ M.}}$

14. 10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be **[AIPMT (Prelims)-2009]**

(1) 3 mol (2) 4 mol

(3) 1 mol (4) 2 mol

Sol. Answer (2)

$$\begin{array}{llll} \therefore & 2H_2(g) \;+ & O_2(g) & \longrightarrow 2H_2O(l) \\ & 4\,g & 32\,g & 2 \text{ mole} \\ & 8\,g & 64\,g & 4 \text{ mole} \end{array}$$

Amount of water produced = 4 mol

15. How many moles of lead (II) chloride will be formed from a reaction between 6.5g of PbO and 3.2 g of HCl?

[AIPMT (Prelims)-2008]

(1) 0.029 (2) 0.044 (3) 0.333 (4) 0.011

Sol. Answer (1)

$$\begin{array}{llcl} PbO + & 2HCl & \longrightarrow & PbCl_2 + H_2O \\ 224\text{ g} & 73\text{ g} & & 1\text{ mol} \end{array}$$

As 73 g HCl reacts with 224 g of PbO

$\therefore$ On reaction for 3.2 g of HCl with PbO the required amount of PbO = $\frac{224}{73} \times 3.2 = 9.81$ g

But only 6.5 g PbO is present

$\therefore$ PbO will be the LR and calculation will be according to PbO.

224 g of PbO gives = 1 mol $PbCl_2$

6.5 g of PbO gives = $\frac{1}{224} \times 6.5 = \boxed{0.029 \text{ mole}}$

16. Volume occupied by one molecule of water (density = 1 g cm^{-3}) is **[AIPMT (Prelims)-2008]**

(1) 5.5×10^{-23} cm^3 (2) 9.0×10^{-23} cm^3

(3) 6.023×10^{-23} cm^3 (4) 3.0×10^{-23} cm^3

Sol. Answer (4)

$\because$ 18 g $H_2O \equiv 18$ mL

$\therefore$ 1 molecule $\equiv \frac{18}{6.022 \times 10^{23}} \approx 3.0 \times 10^{-23}$ cm^3

17. What volume of oxygen gas (O_2) measured at 0°C and 1 atm, is needed to burn completely 1 L of propane gas (C_3H_8) measured under the same conditions? **[AIPMT ((Prelims)-2008]**

(1) 10 L (2) 7 L (3) 6 L (4) 5 L

Sol. Answer (4)

$$\begin{array}{lcl} C_3H_8(g) + 5O_2(g) & \longrightarrow & 3CO_2(g) + 4H_2O(l) \\ \text{1L} \quad\quad \text{5L} & & \end{array}$$

18. An organic compound contains carbon, hydrogen and oxygen. Its elemental analysis gave C, 38.71% and H, 9.67%. The empirical formula of the compound would be **[AIPMT (Prelims)-2008]**

(1) CH_4O (2) CH_3O (3) CH_2O (4) CHO

Sol. Answer (2)

Element	%/At. wt.	Simplest Ratio	No. of Atoms
C	$(38.71)/12$	$(3.22)/3.22 = 1$	1
H	$(9.67)/1$	$(9.67)/3.22 = 3$	3
O	$(51.62)/16$	$(3.22)/3.22 = 1$	1
$\therefore$ Empirical formula = CH_3O			

19. An element, X has the following isotopic composition ; ^{200}X : 90% ; ^{199}X : 8.0% ; ^{202}X : 2.0%

The weighted average atomic mass of the naturally occurring element X is closest to :

[AIPMT (Prelims)-2007]

(1) 199 amu (2) 200 amu

(3) 201 amu (4) 202 amu

Sol. Answer (2)

Average atomic mass = $\dfrac{200\times90+199\times8+202\times2}{100}$ = 199.96 ≈ 200 amu

20. Concentrated aqueous sulphuric acid is 98% H_2SO_4 by mass and has a density of 1.80 g mL^{-1}. Volume of acid required to make one litre of 0.1 M H_2SO_4 is **[AIPMT (Prelims)-2007]**

(1) 5.55 mL (2) 11.10 mL

(3) 16.65 mL (4) 22.20 mL

Sol. Answer (1)

$$M = \frac{10\chi d}{M_B} = \frac{10\times98\times1.8}{98} = 18M$$

$\therefore$ $M_1V_1 = M_2V_2 \Rightarrow 18 \times V_1 = 0.1 \times 1000$

$\therefore$ $V_1 = \dfrac{100}{18}$ = 5.55 mL

21. How many grams of CH_3OH should be added to water to prepare 150 ml solution of 2 M CH_3OH?

(1) 9.6×10^3 (2) 2.4×10^3

(3) 9.6 (4) 2.4

Sol. Answer (3)

Moles of CH_3OH = $\dfrac{M\times V\text{ mL}}{1000} = \dfrac{2\times150}{1000}$ = 0.3 mole

$\therefore$ weight of CH_3OH = moles × mol. mass

= $\boxed{0.3\times32 = 9.6\text{ g}}$

22. The total number of valence electrons in 4.2 g of N_3^- ion is (N_A is the Avogadro's number)

(1) 2.1 N_A (2) 4.2 N_A

(3) 1.6 N_A (4) 3.2 N_A

Sol. Answer (3)

Moles of $N_3^{\ominus}$ = $\dfrac{4.2}{42}$ = 0.1 mol

$\therefore$ Total number of valence electrons in $N_3^{\ominus}$ = 0.1 N_A × 16 = 1.6 N_A

23. The number of mole of oxygen in one litre of air containing 21% oxygen by volume, under standard conditions, is

(1) 0.0093 mole (2) 2.10 moles

(3) 0.186 mole (4) 0.21 mole

Sol. Answer (1)

Volume of O_2 = $\frac{21}{100}$ × 1000 = 210 mL

Moles of O_2 at STP = $\frac{210}{22400}$ = 0.0093 mole

24. The amount of zinc required to produce 224 ml of H_2 at STP on treatment with dilute H_2SO_4 will be (Zn = 65)

(1) 65 g
(2) 0.065 g
(3) 0.65 g
(4) 6.5 g

Sol. Answer (3)

$$\underset{1\,\text{moL}}{Zn} + H_2SO_4 \longrightarrow ZnSO_4 + \underset{22400\ \text{mL at STP}}{H_2}$$

22400 mL of H_2 is produced by 1 mol Zn *i.e.,* = 65 g

224 mL of H_2 is produced by 1 mol Zn *i.e.,* = $\frac{65}{22400}$ × 224 = 0.65 g

25. Given the numbers : 161 cm, 0.161 cm, 0.0161 cm. The number of significant figures for the three numbers is

(1) 3, 3 and 4 respectively
(2) 3, 4 and 4 respectively
(3) 3, 4 and 5 respectively
(4) 3, 3 and 3 respectively

Sol. Answer (4)

All have same significant figures.

26. Change in volume when 100 mL PH_3 decomposed to solid phosphorus and H_2 gas.

(1) Increase in 50 mL
(2) Decrease in 50 mL
(3) Increase in 150 mL
(4) Decrease in 200 mL

Sol. Answer (1)

$$\underset{4\ \text{moles}}{4\,PH_3\,(g)} \longrightarrow P_4(s) + \underset{6\ \text{moles}}{6H_2\,(g)}$$

As 4 moles of PH_3 (g) converts into 6 moles H_2 (g)

∴ 4 × 22.4 L of PH_3 (g) will produce = 6 × 22.4 L of H_2

89.6 L of PH_3 (g) will produce = 134.4 L

1 L of PH_3 (g) will produce = $\frac{134.4}{89.6}$ = 1.5 L

100 mL of PH_3 (g) will produce = $\frac{134.4}{89.6}$ × 100 = 150 mL

∴ $\boxed{\text{Increase in volume wil be 50 mL}}$

27. In the reaction,

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l)$

When 1 mole of ammonia and 1 mole of O_2 are made to react to completion

(1) All the oxygen will be consumed
(2) 1.0 mole of NO will be produced
(3) 1.0 mole of H_2O is produced
(4) All the ammonia will be consumed

Sol. Answer (1)

$$4NH_3\ (g) + 5O_2\ (g) \longrightarrow 4NO\ (g) + 6H_2O\ (l)$$

4 mol NH_3 reacts with 5 mol O_2

1 mol NH_3 reacts with $\frac{5}{4}$ = 1.25 mol of O_2

as 1 mol of O_2 is taken therefore all the O_2 will be consumed.

28. An organic compound containing C, H and N gave the following analysis C = 40%, H = 13.33%, N = 46.67%. Its empirical formula would be

(1) CH_4N
(2) CH_5N
(3) $C_2H_7N_2$
(4) C_2H_7N

Sol. Answer (1)

	Percentage	At mass	Moles	Simple ratio
C	40%	12	$\frac{40}{12} = 3.33$	$\frac{3.33}{3.33} = 1$
H	6.7%	1	$\frac{6.7}{1} = 6.7$	$\frac{13.33}{3.33} = 4$
O	53.3%	16	$\frac{53.3}{16} = 3.33$	$\frac{3.33}{3.33} = 1$

$\therefore$ Empirical formula = CH_4N

29. How many g of dibasic acid (mol. weight 200) should be present in 100 ml. of the aqueous solution to give strength of 0.1 N?

(1) 10 g
(2) 2 g
(3) 1 g
(4) 20 g

Sol. Answer (3)

Amount of acid (in gram) = $\frac{N \times E \times V_{mL}}{1000}$

Here, E = $\frac{200}{2}$ = 100

$\therefore$ Amount of acid = $\frac{0.1 \times 100 \times 100}{1000}$ = 1 g

30. The number of atoms in 4.25 g of NH_3 is approximately

(1) 4×10^{23} (2) 2×20^{23}

(3) 1×10^{23} (4) 6×10^{23}

Sol. Answer (4)

moles of $NH_3 = \dfrac{4.25}{17} = 0.25$ mol

As 1 NH_3 have 4 atoms

$\therefore$ $\boxed{\begin{aligned}\text{Total number of atoms} &= 0.25 \times 4 \times 6.022 \times 10^{23} \text{ atoms} \\ &= 6.022 \times 10^{23} \text{ atoms}\end{aligned}}$

31. Volume of CO_2 obtained at STP by the complete decomposition of 9.85 gm $BaCO_3$ is (Mol. wt. of $BaCO_3$ = 197)

(1) 2.24 litre (2) 1.12 litre

(3) 0.85 litre (4) 0.56 litre

Sol. Answer (3)

$$\underset{1\,\text{mol}}{BaCO_3} \xrightarrow{\Delta} BaO + \underset{22.4\,\text{L}}{CO_2}$$

mol mass of $BaCO_3$ 197 + 12 + 48 = 257 g

moles of $BaCO_3 = \dfrac{9.85}{257}$ g = 0.038 mol

1 mol of $BaCO_3$ gives CO_2 = 22.4 L

0.038 moL of $BaCO_3$ gives CO_2 = 22.4 × 0.038 = 0.85 L

32. Percentage of Se in peroxidase anhydrous enzyme is 0.5% by weight (at. wt. = 78.4) then minimum molecular weight of peroxidase anhydrous enzyme is

(1) 1.568×10^4 (2) 1.568×10^3

(3) 15.68 (4) 2.136×10^4

Sol. Answer (1)

0.5% of Se by weight is present

$\therefore$ 0.5% of enzyme have weight = 78.4 g

100% of enzyme have wt $= \dfrac{78.4}{0.5} \times 100$

$= 15680 \text{ g} = 1.568 \times 10^4 \text{ g}$

33. 2.5 litre of 1 M NaOH solution mixed with another 3 litre of 0.5 M NaOH solution. Then find out molarity of resultant solution.

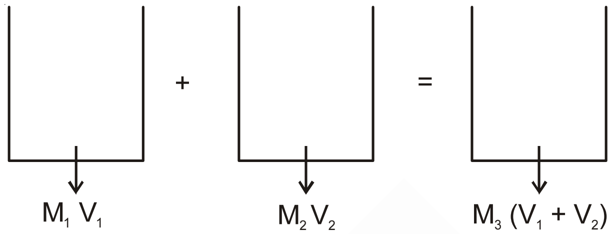
(1) 0.80 M (2) 1.0 M

(3) 0.73 M (4) 0.50 M

Sol. Answer (3)

$$\boxed{\text{for same solution}}$$
$$\downarrow$$
$$\boxed{M_1V_1 + M_2V_2 = M_3(V_1 + V_2)}$$

$(2.5 \times 1) + (3 \times 0.5) = M_3\ (2.5 + 3)$



$2.5 + 1.5 = M_3 \times 5.5$

$M_3 = \dfrac{4}{5.5} = 0.727 \approx 0.73$ M

34. Which has maximum molecules?

(1) 7 gm N_2 (2) 2 gm H_2 (3) 16 gm NO_2 (4) 16 gm O_2

Sol. Answer (2)

Maximum number of molecules of gas are present which are having maximum number of moles

for $N_2 = \dfrac{7}{28} = 0.28$ mol, for $NO_2 = \dfrac{16}{46} = 0.34$ mol

for $H_2 = \dfrac{2}{2} = 1$ mol, for $O_2 = \dfrac{16}{32} = 0.5$ mol

As H_2 have maximum number of moles

$\therefore$ H_2 will have maximum number of molecules.

35. In Haber process 30 litres of dihydrogen and 30 litres of dinitrogen were taken for reaction which yielded only 50% of the expected product. What will be the composition of gaseous mixture under the aforesaid condition in the end?

(1) 20 litres ammonia, 20 litres nitrogen, 20 litres hydrogen

(2) 10 litres ammonia, 25 litres nitrogen, 15 litres hydrogen

(3) 20 litres ammonia, 10 litres nitrogen, 30 litres hydrogen

(4) 20 litres ammonia, 25 litres nitrogen, 15 litres hydrogen

Sol. Answer (2)

	N_2 +	$3H_2 \longrightarrow$	$2NH_3$
at STP	10 L	30 L	20 L
for	30 L	30 L	

At STP 10 L of N_2 reacts with 30 L of H_2. gives 20 L NH_3

H_2 will be the LR because 30 L N_2 and 30 L H_2 are taken

Now the expected product will be = 50% i.e. 10 L NH_3

$$N_2 \quad + \quad 3H_2 \longrightarrow 2NH_3$$

$\therefore$ Initial conc^n 30 L 30 L 0

Final conc^n (30 – 5 L) (30 – 15 L) 10 L

{Final conc^n of $\boxed{NH_3 = 10\text{ L}}$ because 50% of product

{Final conc^n of $\boxed{N_2 = (30-5) = 25\text{ L}}$ because 10 L of NH_3 is formed from 5 L of N_2

{Final conc^n of $\boxed{H_2 = (30-15) = 15\text{ L}}$ because 10 L of NH_3 is formed from 15 L of H_2

36. The maximum number of molecules is present in

(1) 15 L of water at STP (2) 15 L of H_2O gas at STP

(3) 15 g of ice (4) Same in all

Sol. Answer (1)

As of H_2O is 1 g/mL or 1 kg/L

$\therefore$ 15 L of $H_2O \equiv$ 15 kg of H_2O

$\therefore \quad n_{H_2O} = \dfrac{15000}{18}$ moles.

Moles of 15 L of H_2O gas at STP = $\dfrac{15}{22.4}$ mole

Moles of 15 g of ice = $\dfrac{15}{18}$ mole

$\therefore$ Maximum number of moles are present in 15 L of H_2O

37. Concentrated aqueous sulphuric acid is 98% H_2SO_4 (w/v) and has a density of 1.80 gmL^{-1}. Molarity of solution

(1) 1 M (2) 1.8 M (3) 10 M (4) 1.5 M

Sol. Answer (3)

$$M = \frac{\%\frac{w}{v}\times 10}{\text{mol. mass}} = \frac{98\times 10}{98} = 10\text{ M}$$

38. An element, X has the following isotopic composition ^{56}X : 90% ^{57}X : 8% ^{59}X : 2.0%. The weighted average atomic mass of the naturally occurring element X is closest to

(1) 56.14 amu (2) 56.8 amu (3) 60 amu (4) 55 amu

Sol. Answer (1)

$$\frac{\sum \text{percentage} \times \text{atomic mass}}{100} = \frac{\sum \text{percentage abundance of each} \times \text{isotopic} \times \text{atomic mass}}{100}$$

$$= \frac{(56\times 90)+(57\times 8)+59\times 2}{100} = 56.14\text{ amu}$$

39. 10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Volume of gaseous product after reaction

(1) 1 × 22.4 L (2) 2 × 22.4 L

(3) 3 × 22.4 L (4) 4 × 22.4 L

Sol. Answer (1)

$$H_2\,(g) + \frac{1}{2}O_2\,(g) \longrightarrow H_2O\,(l)$$

10 g 64 g

From the reaction 2 g of H_2 (g) combine with 16 g of O_2

∴ 64 g of O_2 will combine with $H_2 = \frac{2}{16} \times 64 = 8$ g of $H_2(g)$

After the reaction 2 g of H_2 (g) *i.e.,* 1 mol of H_2 (g) will remain unreacted

∴ volume will be 1 × 22.4 L gaseous product.

Note: *Volume of H_2O will not be considered as only volume of gas is asked in the question.*

40. What is the $[OH^-]$ in the final solution prepared by mixing 20.0 mL of 0.050 M HCl with 30.0 mL of 0.10 M $Ba(OH)_2$?

(1) 0.12 M (2) 0.10 M

(3) 0.40 M (4) 0.0050 M

Sol. Answer (2)

It is neutralisation reaction

HCl	$Ba(OH)_2$
20 mL × 0.05 M	30 mL × 0.1 M
or 20 mL × 0.05 N	or 30 mL × 0.2 N
meq of $H^{\oplus}$ = 1	meq of $OH^{(-)}$ = 6

∴ $[OH^{(-)}] = \frac{6-1}{50} = \frac{5}{50} = 0.1\,M$

41. The number of atoms in 0.1 mol of a triatomic gas is ($N_A = 6.02 \times 10^{23}\ mol^{-1}$)

(1) 1.800×10^{22} (2) 6.026×10^{22}

(3) 1.806×10^{23} (4) 3.600×10^{23}

Sol. Answer (3)

As triatomic gas means 3 atoms are present in a molecule

Number of atoms = $0.1 \times 3 \times 6.022 \times 10^{23}$

$= 1.806 \times 10^{23}$ atoms

42. The total number of electrons in 2.0 g of D_2O to that in 1.8 g of H_2O

(1) Double (2) Same

(3) Triple (4) One fourth

Sol. Answer (2)

Both have same number of e^- [Both 2.0 g D_2O and 1.8 g H_2O have same number of atom]

Moles of $D_2O = \frac{2.0}{20} = 0.1$

Number of $e^- = 0.1 \times 10 \times N_0 = 1 \times N_0$

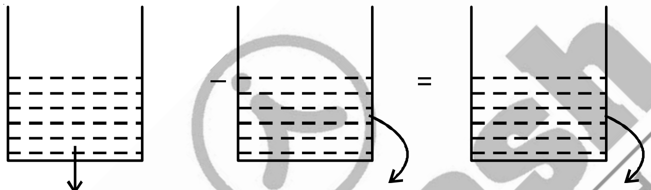
Moles of $H_2O = \frac{1.8}{18} = 0.1$

Number of $e^- = 0.1 \times 10 \times N_0 = 1 \times N_0$

43. From 200 mg of CO_2 when x molecules are removed, 2.89×10^{-3} moles of CO_2 are left. x will be

(1) 10^{20} molecules
(2) 10^{10} molecules
(3) 21 molecules
(4) 10^{21} molecules

Sol. Answer (4)



(200 mg of CO_2) − x molecules = 2.89×10^{-3} moles of CO_2

From Equation

200 mg of CO_2 have molecule $= \frac{200}{44} \times 10^{-3} \times 6.022 \times 10^{23}$

$= 2.7 \times 10^{21}$

$\therefore$ 2.89×10^{-3} moles of CO_2 have molecule $= 2.89 \times 10^{-3} \times 6.022 \times 10^{23}$

$= 1.7 \times 10^{21}$ molecule

$\therefore$ 200 mg of CO_2 – x molecule = 2.89×10^{-3} moles of CO_2

2.7×10^{21} – x molecule = 1.7×10^{21}

x = $(2.7 - 1.7) \times 10^{21}$ molecue

= 10^{21} molecule

$\therefore$ The value of x will be 10^{21}.

44. If the weight of metal oxide is x g containing y g of oxygen, the equivalent weight of metal will be

(1) $E = \frac{8x}{y}$
(2) $E = \frac{8(y-x)}{x}$
(3) $E = \frac{y}{8}$
(4) $E = \frac{8(x-y)}{y}$

Sol. Answer (4)

Equivalent mass of metal in oxide = $\frac{\text{weight of metal}}{\text{weight of oxygen}} \times 8$

$$\begin{array}{lll} M & +xO \longrightarrow & MO_A \\ (x-y) & yg & xg \end{array}$$

Equivalent weight of metal = $\frac{x-y}{y} \times 8$

$$\boxed{E = \frac{8(x-y)}{y}}$$

45. The number of significant figures in 2.653 × 10^4 is

(1) 8 (2) 4 (3) 7 (4) 1

Sol. Answer (2)

2.653 × 10^4 have only 4 significant figure

46. Mole fraction of solute in aqueous solution of 30% NaOH.

(1) 0.16 (2) 0.05 (3) 0.25 (4) 0.95

Sol. Answer (1)

30% NaOH means 30% by mass

i.e., $\frac{30 \text{ g of NaOH}}{100 \text{ g of solution}}$

Weight of NaOH = 30 g

Mol. mass NaOH = 40

Weight of H_2O = 100 – 30 = 70

Mol. mass = 18

Mol. fraction of NaOH = $\frac{\text{moles of NaOH}}{\text{moles of } H_2O + \text{moles of NaOH}} = \frac{\frac{30}{40}}{\frac{70}{18}+\frac{30}{40}} = \boxed{0.16}$

SECTION – D

Assertion–Reason Type Questions

1. A : 1 a.m.u. = 1.66 × 10^{-24} gram.

R : Actual mass of one atom of C–12 is equal to 1.99 × 10^{-23} g.

Sol. Answer (2)

Both are correct but R is not explanation of A because 1 amu = 1.66 × 10^{-24} g

and mass of 1 atom of C = 1.99 × 10^{-23} = $\frac{12}{6.022 \times 10^{23}}$ = 1.99 × 10^{-23} = g

Both A and R are correct.

2. A : Unit of specific gravity is gram–cc^{-1}.

R : Specific gravity is same as density of a liquid in normal conditions.

Sol. Answer (4)

Specific gravity have number units becuase it specific gravity = $\dfrac{\text{density of substance}}{\text{density of } H_2O \text{ at } 4°C}$

Both A and R are incorrect.

3. A : Number of atoms in 2 mole of NH_3 is equal to number of atoms in 4 mole of CH_4.

R : Both are chemically similar species.

Sol. Answer (4)

Number of atoms in $NH_3 = 2 \times 4 \times N_0 = 8\ N_0$

Number of atoms in $CH_4 = 4 \times 5 \times N_0 = 20\ N_0$

Both are chemically different

Both A and R are incorrect.

4. A : In the reaction

$$2NaOH + H_3PO_4 \longrightarrow Na_2HPO_4 + 2H_2O,$$

equivalent weight of H_3PO_4 is $\dfrac{M}{2}$, where M is its molecular weight.

R : Equivalent weight = $\dfrac{\text{Molecular weight}}{\text{n} - \text{factor}}$.

Sol. Answer (1)

$$2\,NaOH + H_3PO_4 \longrightarrow Na_2HPO_4 + 2H_2O$$

For above reaction n-factor = 2 $\therefore$ $\boxed{\text{equivalent mass} = \dfrac{M}{2}}$

As tow 'H' are replaced.

Equivalent mass = $\dfrac{\text{mol. mass}}{\text{n-factor}}$

A and R are correct R is correct explanation of A.

5. A : Mass of 1 gram molecule of H_2SO_4 is 98 gram.

R : One gram atom contains N_A atoms.

Sol. Answer (2)

mass of 1 g molecule means 1 mol of H_2SO_4 = 98 g

1 g atom = 1 mol atom = N_0

Both are correct but R is not explanation of A.

6. A : One mole of sucrose reacts completely with oxygen produces 268.8 litre of carbon dioxide at STP.

R : Amount of oxygen required for reaction is 268.8 litre.

Sol. Answer (2)

$$\underset{\text{(Sucrose)}}{C_{12}H_{22}O_{11}} + 12O_2\,(g) \longrightarrow 12\,CO_2\,(g) + 11H_2O$$

$$\begin{bmatrix} 1\,\text{mol sucrose produce } CO_2 = 12 \times 22.4 = 268.8\text{ L} \\ 1\,\text{mol sucrose requre } O_2 = 12 \times 22.4 = 268.8\text{ L} \end{bmatrix}$$

Both are correct but reason is not correct explanation of Assertion.

7. A : In the reaction

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O\,,$$

equivalents of NaOH, Na_2SO_4 and H_2SO_4 are equal.

R : Number of equivalents = number of moles × n–factor.

Sol. Answer (1)

All are having same equivalents

$$\underbrace{2NaOH}_{\substack{2\\ \text{n-factor}=1}} = \underbrace{H_2SO_4}_{\frac{1\times 2}{2}} = \underbrace{Na_2SO_4}_{\frac{1\times 2}{2}}$$

Both A and R are correct R is correct explanation of A.

8. A : When 4 moles of H_2 reacts with 2 moles of O_2, then 4 moles of water is formed.

R : O_2 will act as limiting reagent.

Sol. Answer (3)

$$\begin{array}{lll} 2H_2 & +\,O_2 \longrightarrow & 2H_2O \\ 2\text{ mol} & 1\text{ mol} & 2\text{ mol} \\ 4\text{ mol} & 2\text{ mol} & 4\text{ mol} \end{array}$$ [4 mol of H_2 when reacts with 2 moles O_2 produces moles of H_2O]

$\boxed{\text{When moles are taken in above reaction } H_2 \text{ will act on LR.}}$

A is correct but R is wrong.

9. A : 50 ml, decinormal HCl when mixed with 50 ml, decinormal H_2SO_4, then normality of H^+ ion in resultant solution is 0.1 N.

R : Here, $MV = M_1V_1 + M_2V_2$.

Sol. Answer (3)

meq of HCl = 50 × 0.1 = 5

meq. of H_2SO_4 = 50 × 0.1 = 5

Normality = $\dfrac{\text{Total meq}}{\text{Total volume}} = \dfrac{10}{100} = 0.1\text{N}$

when difference solutions of different n-factors are takne than $\boxed{N_1V_1 + N_2V_2 = N_3(V_1 + V_2)}$

A is correct but R is wrong.

10. A : 50 ml, decimolar H_2SO_4 when mixed with 50 ml, decimolar NaOH, then normality of resultant solution is 0.05 N.

R : Here, $NV = |N_1V_1 - N_2V_2|$.

Sol. Answer (1)

Meq of H_2SO_4 = N × V = 50 × 0.2 = 10

Meq of NaOH = N × V = 50 × 0.1 = 5

N = m × n = 0.1 × 2 = 0.2 N H_2SO_4

N = m × n = 0.1 × 1 = 0.1 N NaOH

$$N_{solution} = \frac{10-5}{100} = \frac{5}{100} = 0.05\text{ N}$$

$$\text{for neutralisation} = \frac{\text{larger NV - smaller NV}}{\text{Total volume}} = \frac{N_1V_1 - N_2V_2}{\text{Total volume}}$$

R is correct exp. of A.

11. A : Ratio of empirical formula mass and molecular formula mass may be a whole number.

R : Molecular formula mass = n × empirical formula mass, where n is the simplest whole number.

Sol. Answer (2)

= mol. formula = n × Emprical formula.

= mol. mass = n × formula mass (for ionic solids).

Both A and R are correct but R is not correct explanation of A

12. A : For a given solution (density = 1 gm/ml), molality is greater than molarity.

R : Molarity involves volume of solution while molality involves mass of solvent.

Sol. Answer (1)

If density u is 1 g/mL

∴ mass of solution > mass of solvent

$$\text{Molality} = \frac{\text{moles}}{\text{volume of solution}}$$

$$\text{Molality} = \frac{\text{moles}}{\text{mass of solvent}}$$

As weight of solvent is less therefore molality will be more.

Both A and R are correct R is the correct explanation of A.

13. A : 1 gram of salt in 1 m^3 of solution has concentration of 1 ppm.

R : ppm is defined as number of parts by mass of solute per million parts of solution.

Sol. Answer (1)

$$\text{ppm} = \frac{\text{weight of solvent}}{\text{weight of solution}} \times 10^6 = \frac{1}{1} \times 10^6 = \text{ppm} \approx 1\text{ ppm}$$

Both are A and R correct R is correct explanation of A.

14. A : Total charge on N_A ions of CO_3^{2-} is 1.93 × 10^5 coulomb.

R : Charge on one electron in 96500 coulomb.

Sol. Answer (3)

CO_3^{2-} as one CO_3^{2-} ion have two unit charge

$\therefore$ 1 mole *i.e.,* = N_A CO_3^{2-} have charge = 2 × 96500 C = 1.93×10^5 C

Charge on one mole electron = $1.602 \times 10^{-19} \times 6.022 \times 10^{23} \approx$ 96478 = 96500 C

A is true but R is false.

15. A : Number of ions in 9 gram of NH_4^+ is equal to Avogadro's number (N_A).

R : Number of ions is equal to number of atoms.

Sol. Answer (4)

Formula units = $\frac{9}{18}$ = 0.5 × NA

No formula units = moles = Number of molecules.

Both A and R are incorrect.

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