

CHEMISTRY - MODULE 2

SYLLABUS: MOLE CONCEPT & REDOX (EXCEPT TITRATIONS)

Single Correct Solution Type

1. Explanation : 1 mole of electrons weighs = $9.1 \times 10^{-31} \text{ kg} \times 6.023 \times 10^{23}$
= $54 \times 10^{-8} \text{ kg}$
= $54 \times 10^{-8} \times 1000 = 54 \times 10^{-5} \text{ g}$
= $54 \times 10^{-5} \text{ g} \times 10^3 \text{ mg}$
= $54 \times 10^{-2} \text{ mg}$
= 0.54 mg

is not correct because charge on 1 e is $1.6 \times 10^{-19} \text{ C}$ and not on 1 mole of electrons. (C) and (D) ruled out as explained above.

2. Explanation : $m = \frac{M \times 1000}{(1000 \times d - M \times \text{M.Wt.})}$ where 'm' is molality, M is molarity.

$$= \frac{10^{-2} \times 1000}{(1000 \times 1.1 - 10^{-2} \times 106)}$$
$$= \frac{10}{1100 - 1.6} = \frac{10}{1099.4} = 9.00 \times 10^{-3}$$

[Take 1099.4 = 1100]

3. Explanation : $2 \text{ Ag} + \text{ S} \rightarrow \text{ Ag}_2 \text{ S}$
 $2 \times 108 \text{ g of Ag reacts with } 32 \text{ g of sulphur}$

$$10 \text{ g of Ag reacts with } \frac{32}{216} \times 10 = \frac{320}{216} > 1 \text{ g}$$

It means 'S' is limiting reagent

$$32 \text{ g of S reacts to form } 216 + 32 = 248 \text{ g of Ag}_2\text{S}$$

$$1 \text{ g of S reacts to form } = \frac{248}{32} = 7.75 \text{ g}$$

Alternately

$$n_{\text{eq}} \text{ of Ag} = \frac{10}{108} = 0.0925 \qquad n_{\text{eq}} \text{ of S} = \frac{1}{16} = 0.0625 \qquad (n_{\text{eq}} = \text{number of equivalents})$$

Since n_{eq} of S is less than n_{eq} of Ag

\Rightarrow 0.0625 eq of Ag will react with 0.0625 eq of S to form 0.0625 eq of Ag_2S

$$\begin{aligned} \text{Hence, amount of } \text{Ag}_2\text{S} &= n_{\text{eq}} \times \text{Eq. wt. of } \text{Ag}_2\text{S} \\ &= 0.0625 \times 124 = 7.75 \text{ g} \end{aligned}$$

4. Explanation : M. wt. of $\text{NaNO}_3 = 85$

70 mg of Na^+ are present in 1 mL

50 ml of solution contains $50 \times 70 = 3500 \text{ mg} = 3.5 \text{ g } \text{Na}^+$ ion

23 g of Na^+ are present in 85 g of NaNO_3

$$3.5 \text{ g of } \text{Na}^+ \text{ are present in } \frac{85}{23} \times 3.5 = 12.934 \text{ g of } \text{NaNO}_3$$

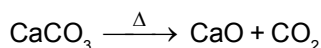
5. Use reaction $\text{C}_{12}\text{H}_{22}\text{O}_{11} + 12\text{O}_2 \rightarrow 12\text{CO}_2 + 11\text{H}_2\text{O}$.

$$\text{In 24 hr. moles of sucrose consumed} = \frac{34}{342} \times 24.$$

$$\therefore \text{In 24 hr. moles of } \text{O}_2 \text{ required} = \frac{34}{342} \times 24 \times 12. \text{ (according to stoichiometry).}$$

$$\text{mass of } \text{O}_2 \text{ required} = \frac{34}{342} \times 24 \times 12 \times 32 = 916.2 \text{ gm.}$$

6. $\text{CaCl}_2 + \text{Na}_2\text{CO}_3 \longrightarrow \text{CaCO}_3 + 2 \text{NaCl}$



$$\text{Mole of } \text{CaCl}_2 = \text{mole of } \text{CaCO}_3 = \text{mole of } \text{CaO} = \left(\frac{1.62}{56} \right)$$

$$\text{Mass of } \text{CaCl}_2 = \left(\frac{1.62}{56} \right) \text{ Molar mass of } \text{CaCl}_2$$

$$= \left(\frac{1.62}{56} \right) \times 111 \text{ gm.}$$

$$\% \text{ of } \text{CaCl}_2 = \frac{3.21}{10} \times 100 = 32.1 \%$$

$$7. \frac{\text{Density of ozone}}{\text{Density of oxygen}} = \frac{\text{Molar mass of ozone}}{\text{Molar mass of oxygen}} = \frac{48}{32} = 1.5$$

8. KI is limiting reagent

\therefore 3 mole of KI will give 33 mole of NO_2 according to stoichiometry.

9. $\text{MCl}_x + x \text{AgNO}_3 \longrightarrow x \text{AgCl} + \text{M}(\text{NO}_3)_x$

$$\frac{\text{Mole of } \text{MCl}_x}{1} = \frac{\text{Mole of } \text{AgNO}_3}{x}$$

$$0.1 = \frac{1}{x} (0.5 \times 0.8)$$

$$x = \frac{0.4}{0.1} = 4$$

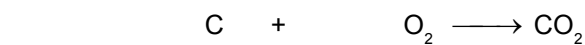
10. At 4°C i.e. 277 K density of water = 1 gm/ml

\therefore 1 kg water \Rightarrow 1000 ml water = 1 lit.

\therefore Molality & molarity remains same.

11.
$$\text{Molarity} = \frac{(\%w/w) \times \text{density} \times 10}{\text{Molar mass of solute}} = \frac{98 \times 1.84 \times 10}{98} = 18.4 \text{ M}$$

12. Let mass of C = X gm



$$\text{Initial mole} \quad \frac{x}{12} \quad \text{---} \quad 0$$

$$\text{final mole} \quad 0 \quad \quad \quad 2a$$



$$\text{Initial mole} \quad \frac{12-x}{32} \quad \text{---} \quad 0$$

$$\text{final mole} \quad 0 \quad \quad \quad a$$

$$\text{Mole of C} = \text{Mole of CO}_2$$

$$\frac{x}{12} = 2a$$

$$\text{Mole of S} = \text{Mole of SO}_2$$

$$\frac{12-x}{32} = a$$

$$\therefore \frac{x \times 32}{(12-x)12} = 2$$

$$x = \frac{24}{32} (12-x)$$

$$4x = 36 - 3x$$

$$x = \frac{36}{7} = 5.14 \text{ gm.}$$

13.
$$\text{Mole of NO}_2 = \frac{112}{22400} = 5 \times 10^{-3}$$

$$\text{Mass of NO}_2 = 5 \times 10^{-3} \times 46 = 0.23 \text{ gm}$$

$$\text{Volume of NO}_2 = \frac{\text{Mass}}{\text{Density}} = \frac{0.23}{1.15} = 0.2 \text{ ml}$$

$$\text{Number of molecule} = 5 \times 10^{-3} \times 6.023 \times 10^{23} = 3.1 \times 10^{21}.$$

14.
$$\text{Mole of NaCl} = \frac{5.85}{58.5} = 0.1$$

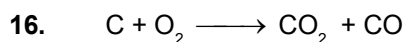
$$\text{Molarity} = \frac{0.1}{1} = 0.1 \text{ M}$$

$$\text{Moles in 1 ml of solution} = MV = 0.1 \times 10^{-3} = 10^{-4} \text{ mole.}$$

$$\text{Number of ions in 1 ml} = 2 \times 10^{-4} \times 6.023 \times 10^{23} = 1.204 \times 10^{20}.$$

15. 1 gm molecule is 1 mole

$$\text{Mole of SO}_4^{2-} \times 4 \times 1 = 4 \text{ gm ion.}$$



POAC on 'C' atom

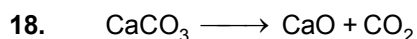
$$1 (\text{mole of C}) = 1 (\text{mole of CO}_2) + 1 (\text{mole of CO})$$

$$\frac{240}{12} = \text{mole of CO}_2 + \frac{280}{28}$$

$$\text{Mole of CO}_2 = 20 - 10 = 10$$

$$\text{Mole \% of CO}_2 = \frac{10}{20} \times 100 = 50\%$$

17. For reaction with 2 moles NaOH
 1M H₂SO₄ 1 lit. volume required
 1M HCl 2 lit. volume required
 ∴ cheapest will be 1 M H₂SO₄ 1 lit.



$$\frac{5.6}{22.4} = \frac{1}{4} \text{ mole}$$

$$\text{mole of CaO} = \text{mole of Ca} = \frac{1}{4}$$

$$\text{mass of Ca} = \frac{1}{4} \times 40 = 10$$

$$\% \text{ of Ca in sample} = \frac{10}{100} \times 100 = 10\%$$

19.

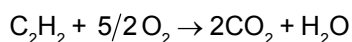
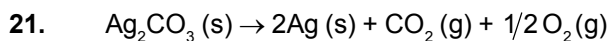
	C	H	O
mass	24	8	32
moles	$\frac{24}{12}$	$\frac{8}{1}$	$\frac{32}{16}$
ratio	2	8	2
Simple integer ratio	1	4	1

Hence empirical formula is CH₄O

20. $\frac{32}{2x + 3y} = 0.2$

$$\frac{92.8}{3x + 4y} = 0.4$$

Hence: x = 56 & y = 16



By Stoichiometry of reaction

$$\text{Moles of CO}_2 \text{ formed} = \frac{11.2}{22.4} = \frac{1}{2}$$

$$\text{Moles of O}_2 \text{ required} = \frac{5}{4} \times \frac{1}{2} = \frac{5}{8}$$

$$\therefore \text{Moles of Ag}_2\text{CO}_3 \text{ required} = 2 \times \frac{5}{8} = \frac{5}{4}$$

$$\text{Mass of Ag}_2\text{CO}_3 \text{ required} = \frac{5}{4} \times 276 = 345 \text{ g}$$

22. H_3BO_3 is a mono basic acid

$$\text{So } \frac{M}{1} = \text{equivalent mass}$$

23. Equivalents of $\text{FeC}_2\text{O}_4 = \text{equivalents of } \text{KMnO}_4$
 $x (\text{mole}) \times 3 = 1 \times 5$

$$x = \frac{5}{3}$$

24. Total mass of $\text{NaOH} = 30 + 90 = 120 \text{ gm}$
 total volume of solution = $100 + 100 = 200 \text{ ml}$

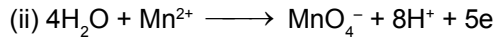
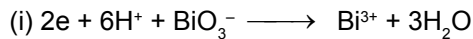
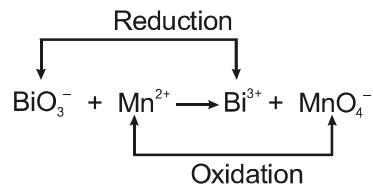
$$\text{Molarity} = \frac{120/40}{200} \times 1000 = 15 \text{ M}$$

25. $\text{Na}_2 \overset{+2}{\text{S}}_2 \text{O}_3 \longrightarrow \text{Na}_2 \overset{+6}{\text{S}} \text{O}_4$

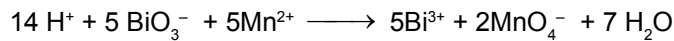
see the total change in oxidation number = $4 \times 2 = 8$

$$\therefore E_{\text{Na}_2\text{S}_2\text{O}_3} = \frac{\text{mol. wt.}}{\text{V.f}} = \frac{M}{8}$$

26.



(i) $\times 5$ + (ii) $\times 2$ we get



is the correct balance reaction

27. $3 \text{NaOH} + \text{FeCl}_3 \longrightarrow \text{Fe(OH)}_3 + 3\text{NaCl}$

m.e. of $\text{NaOH} = \text{m.e. of } \text{Fe(OH)}_3$

$$100 \times N = \frac{W}{E} \times 1000 \left(E_{\text{Fe(OH)}_3} = \frac{\text{mol. wt.}}{3} \right)$$

$$N = \frac{1.425 \times 10 \times 3}{107} = 0.399 = 0.4 \text{ N}$$

28. 1 gram ion = 1 mole
 charge on 1 mole Al^{3+} is = $3 \times e (N_A)$.

29.

		H_2	:	He	:	O_2	:	O_3
Ratio of total no. of molecules =	1	:	1	:	1	:	1	
So ratio of total no. of atoms =	2	:	1	:	2	:	3	

30. weight of $\text{CO}_2 = 8.8 \text{ gm}$

$$\text{mole of } \text{CO}_2 = \frac{8.8}{44} = 0.2$$

mole of C = 0.2

$$\text{wt. of C} = 0.2 \times 12 = 2.4 \text{ g}$$

$$\text{mole of H}_2\text{O} = \frac{5.4}{18} = 0.3$$

so mole of 'H₂' = 0.3

wt. of hydrogen = 0.3 × 2 = 0.6

wt. of carbon + hydrogen = 2.4 + 0.6 = 3

= Initial wt. of hydrocarbon

∴ It illustrates law of conservation of mass.

31.

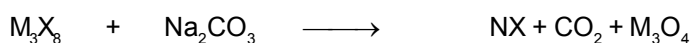
Elements	%	% / Atomic mass	Simple ratio	Simplest whole no.
Ca	20	20/40 = 0.5	1	1
Br	80	80/80 = 1	2	2

Hence : Empirical formula = CaBr₂

$$n = \frac{200}{200} = 1$$

Hence : Molecular formula = CaBr₂

32.



$$\text{mole of NX} = \frac{206}{103} = 2$$

POAC for X Atom :

No. of X atom in M₃X₈ = No. of X Atom in NX

8 [No. of mole of M₃X₈] = 1 [No. of mole of NX]

$$\text{No. of mole of M}_3\text{X}_8 = \left[\frac{2}{8} \right] = \frac{1}{4} \text{ mole}$$

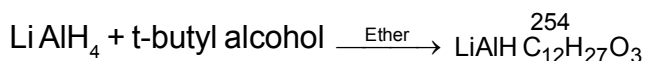
Now POAC for M Atom

3 [No. of mole of M₃X₈] = 1 × [No. of Mole of M]

$$\therefore 3 \times \frac{1}{4} = \text{No. of mole of M}$$

$$\text{weight of M atom} = \frac{3}{4} \times 56 = 42 \text{ gram}$$

33.



0.05 mole

12.7 gram

$$= \frac{12.7}{254} = 0.05 \text{ mole}$$

Li atom remain conserved so

No. of mole of LiAlH₄ = No. of mole of LiAlHC₁₂H₂₇O₃

So No. of mole of LiAlHC₁₂H₂₇O₃ = 0.05

$$\% \text{ yield} = \frac{0.05}{0.05} \times 100 = 100\%$$

34.

Br₂ undergoes disproportionation, i.e. it undergoes both oxidation & reduction.

35.



$$M = \frac{63 \times 1000}{126 \times 100}$$

$$M = \frac{40 \times 1000}{40 \times 100}$$

$$M = 5$$

$$M = 10$$

CHEMISTRY - MODULE 2

SYLLABUS: MOLE CONCEPT & REDOX (EXCEPT TITRATIONS)

Multiple Correct Solution Type

1. Let W gas of SO_2 and O_2 are taken

$$\text{moles of SO}_2 = \frac{W}{64}$$

$$\text{moles of O}_2 = \frac{W}{32}$$

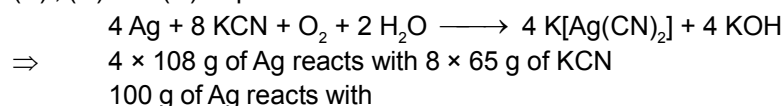
$$\text{molecules of O}_2 = \frac{WN_A}{32}$$

$$\text{molecules of SO}_2 = \frac{WN_A}{64}$$

hence molecules of $\text{O}_2 >$ molecules of SO_2

since moles of $\text{O}_2 >$ moles of SO_2 , hence volume of O_2 at STP $>$ volume of SO_2 at STP.

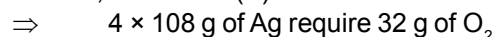
2. (A), (C) and (D) Explanation :



$$\frac{8 \times 65}{4 \times 108} \times 100 = 120$$

Hence, to dissolve 100 g of Ag, the amount of KCN required = 120 g

Hence, statement (A) is correct.



$$1 \text{ g of Ag require } \frac{32}{4 \times 108} = 0.0740 \text{ g}$$

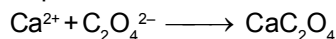


Hence, choice (C) is correct.

$$\text{Hence, volume of O}_2 \text{ required} = \frac{7.4}{32} \times 22.4 = 5.20 \text{ litre}$$

Hence, (A), (C), (D) are correct while (B) is incorrect.

3. (A), (C) and (D) Explanation :



100 ml of 0.06 M $\text{Ca}(\text{NO}_3)_2$ contains $100 \times 0.06 = 6$ millimole

50 ml of 0.06 M $\text{Na}_2\text{C}_2\text{O}_4$ contains $50 \times 0.06 = 3$ millimole

3 millimoles of $\text{C}_2\text{O}_4^{2-}$ will react with 3 millimoles of Ca^{2+} for 3 millimoles of CaC_2O_4

$$= \frac{3}{1000} = 0.003 \text{ moles}$$

(A) is correct.

$$\text{Excess of Ca}^{2+} \text{ left} = 6 - 3 = 3 \text{ millimoles} = \frac{30}{1000} = 0.003 \text{ moles.}$$

(C) is correct because sodium oxalate is present in smaller amount than required.

(D) is correct because $\text{Ca}(\text{NO}_3)_2$ is present in large amount.

4. (A) and (B) Explanation :

$$\text{M. Wt.} = 0.001293 \times 22400 = 28.96$$

$$\text{M.Wt.} = d \times \text{volume of 1 mole of gas at STP}$$

$$\text{V. D} = \frac{28.96}{2} = 14.48$$

So (A) and (B) are correct answer.

5. (A) and (B) Explanation : 30% of molecule dissociated $N_2 \rightarrow 2N$

$$\text{Amount of } N_2 \text{ left} = \frac{2.8}{28} \times \frac{70}{100} = 0.1 \times 0.7 = 0.07$$

(in moles)

$$\text{No. of moles of N atoms formed} = 2 \times \frac{30}{100} \times 0.1 = 0.06$$

(A) Total no. of moles = 0.07 + 0.06 = 0.13

(B) Total number of molecules = 0.07 \times 6.023 \times 10²³ = 4.2 \times 10²² molecule = 0.421 \times 10²³

\therefore We have to calculate molecule of nitrogen not atoms.

6. (A) and (B) Explanation :

$$M = \frac{\% \text{ by Wt.} \times 10 \times d}{\text{M.Wt.}} \quad [\text{M. Wt. of } Na_2S_2O_3 = 46 + 64 + 48 = 158]$$

$$3 = \frac{\% \text{ by Wt.} \times 10 \times 1.25}{\text{M.Wt.}}$$

$$\% \text{ by wt.} = \frac{3 \times 158}{12.5} = \frac{474}{12.5} = 37.92 \quad (\text{A) is correct.}$$

$$m = \frac{M \times 1000}{1000 \times d - M \times \text{M.Wt.}} = \frac{3 \times 1000}{1000 \times 1.25 - 3 \times 158} = \frac{3000}{1250 - 474} = \frac{3000}{776} = 3.86$$

$$x_B = \frac{3.86}{3.86 + \frac{1000}{18}} = \frac{3.86}{3.86 + 55.80} = \frac{3.86}{59.36} = 0.065 \quad (\text{B) is correct.}$$

7. Hydrocarbon \longrightarrow CO₂ + H₂O

0.5 litre	2.5 litre	3 litre
0.5 mole	2.5 mole	3 mole
1 mole	5 mole	6 mole

moles of C in CO₂ = 1 \times mole of CO₂ = 1 \times 5

mole of H in H₂O = 2 \times moles of H₂O = 2 \times 6 = 12

i.e molecular formula is C₅H₁₂

Ans. 72 gm

8. Cation concentration = $\frac{100 + 300 + 200}{400} = \frac{3}{2}$ M

anion concentration = $\frac{100 + 300 + 400}{400} = 2$ M

ratio = $\frac{3}{4}$

[Cl⁻] = 2 M

9. (A) Molarity of second solution is = $\frac{10 \times d \times x}{M} = 1$ M

(B) Volume = 100 + 100 = 200 ml

(D) Mass of H₂SO₄ = $\frac{200 \times 1}{1000} \times 98 = 19.6$ gm.

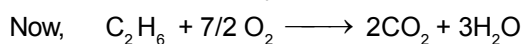
10. Moles of C₂H₆ = 3

moles of C₂H₆ mixed = $\frac{60}{30} = 2$

total mole of C₂H₆ = 5

$$\text{moles removed} = \frac{2.4 \times 10^{24}}{6 \times 10^{23}} = 4$$

$$\therefore \text{ moles of } C_2H_6 \text{ left} = 1$$



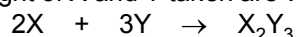
clearly 3 moles of H_2O or 54 gm H_2O will be formed

volume of $H_2O = 54 \text{ ml}$

11. Fe_3O_4 can be written as $FeO \cdot Fe_2O_3$.
In FeO , Fe has oxidation state + 2, in Fe_2O_3 has oxidation state + 3.

$$\text{resultant oxidation number} = \frac{1 \times 2 + 2 \times 3}{3} = \frac{8}{3}$$

12. Let weight of X and Y taken are W g each.



$$\text{moles : } \frac{W}{36} \quad \frac{W}{24}$$

mole ratio of X : Y = $\frac{W}{36} : \frac{W}{24} = \frac{2}{3}$. Hence, no reactant will be left over.

Hence, mass of X_2Y_3 formed = mass of X (W) + mass of Y (W) = 2W

13. Final molarity = $\frac{V_1 \times 1 + V_2 \times 0.25}{(V_1 + V_2)} = 0.75$

$$0.75 (V_1 + V_2) = V_1 + V_2 \times 0.25$$

$$0.75 V_1 + 0.75 V_2 = V_1 + V_2 \times 0.25$$

$$0.5 V_2 = 0.25 V_1$$

$$\frac{V_1}{V_2} = 2 \quad (\text{All options are possible})$$

14. equivalent of oxidising agent = equivalents of reducing agent.

$$Eq_{MnO_4^-} = Eq_{Fe^{2+}}$$

$$n_{MnO_4^-} \times 5 = n_{Fe^{2+}} \times 1$$

$$Eq_{Cr_2O_7^{2-}} = Eq_{Fe^{2+}}$$

$$n_{Cr_2O_7^{2-}} \times 6 = n_{Fe^{2+}} \times 1$$

$$Eq_{MnO_4^-} = Eq_{Cu_2S}$$

$$n_{MnO_4^-} \times 6 = n_{Cu_2S} \times 8$$

$$Eq_{Cr_2O_7^{2-}} = Eq_{Cu_2S}$$

$$n_{Cr_2O_7^{2-}} \times 6 = n_{Cu_2S} \times 8$$

15. (A, B, C)



In each mole of MCl_x there are x moles of Cl^-

$$\Rightarrow [Cl^-] = x \times 0.01$$

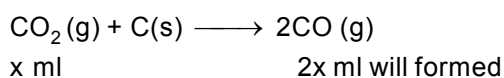
$$\text{conc. of } [M^{x+}] = 0.01$$

16. (A, B, C)

For same number of molecule, number of moles should be same.

17. (A, B, D)

When mixture is passed through hot graphite the following reaction will occur.



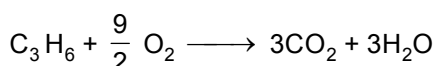
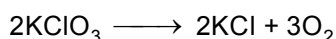
∴ Total volume of mixture = 160

$$100 - x + 2x = 160$$

$$x = 60 \text{ ml}$$

$$\text{volume of CO} = 100 - x = 40 \text{ ml}$$

18. (A, B, D)



$$\text{moles of H}_2\text{O} = \frac{54}{18} = 3$$

∴ moles of O₂ needed for the reaction

$$= \frac{9}{2}$$

$$\therefore \text{moles of KClO}_3 \text{ required} = \frac{2}{3} \times \frac{9}{2} = 3 \text{ mole}$$

volume of CO₂ at STP = 3 × 22.4 = 67.2 Ltr.

mass of hydrocarbon combusted = 1 × 42 = 42 gm

19. (A*) Valency

20. (A*) constant proportions

21. (A*) Concentration of H₂O₂ solution is 11.2 volume

(C*) Normality of H₂O₂ is 2 N

(D*) By percentage concentration of H₂O₂ is 3.4%

22. (A*) 'n' factor of Na₂S₂O₃ is one

(C*) Percentage of Cu²⁺ in sample is 63.5%

23. (A*) 'n' factor of bromine is $\frac{5}{3}$

(B*) This reaction is a disproportionation reaction

(D*) The equivalent weight of BrO₃⁻ is $\frac{M}{5}$

24. (A*) If only first series salt is formed then normality of resulting solution is 0.4 N

(C*) The resulting solution of H₂S if only second series salt is formed is completely neutralized by

$$1 \text{ L } \frac{2 \text{ N}}{5} \text{ NaOH}$$

25. (B*) CO

(D*) C₂H₂

26. (C*) 0.05 M NaCl

(D*) 10⁻⁷ M of H⁺ ion

27. (A*) $2\text{RCHO} \xrightarrow{\text{Al(OEt)}_3} \text{RCOOCH}_2\text{R}$
 (B*) $4\text{H}_3\text{PO}_3 \xrightarrow{\Delta} 3\text{H}_3\text{PO}_4 + \text{PH}_3$
28. (A*) equivalent weight of H_3PO_4 is 49
 (B*) resulting mixture is neutralised by 1 mol of KOH
 (C*) CaHPO_4 is an acid salt
 (D*) 1 mol of H_3PO_4 is completely neutralised by 1.5 mol of Ca(OH)_2 .
29. (A*) equivalent weight of $\text{H}_2\text{C}_2\text{O}_4$ and NaHC_2O_4 are equal to their molecular weights when behaving as reducing agents
 (B*) 100 ml of 1 N solution of each is neutralised by equal volume of 1M Ca(OH)_2
30. (A*) ionic mass of M^+ is 18
 (B*) mixture has equal mole fraction of MCl and NaCl
 (D*) ionic mass of M^+ is 10

CHEMISTRY - MODULE 2

SYLLABUS: MOLE CONCEPT & REDOX (EXCEPT TITRATIONS)

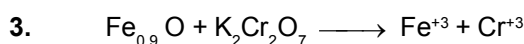
Comprehension Type

Paragraph for Question Nos. 1 to 2

1. A

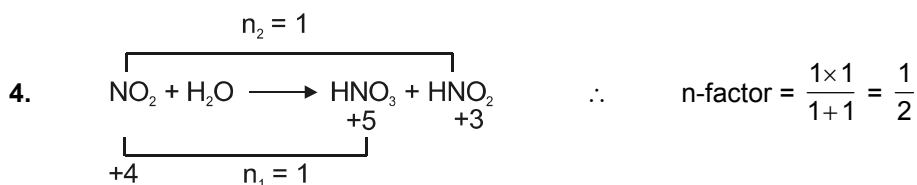
2. A

Paragraph for Question Nos. 3 to 4 Equivalent Mass



$$n \text{ factor of } \text{Fe}_{0.9}\text{O} = 0.9 \left(3 - \frac{2}{0.9} \right) = 0.7$$

$$\therefore \text{Eq mass} = \frac{M}{0.7} = \frac{10M}{7}$$



$$\text{so, eq. wt. of NO}_2 = \frac{46}{1/2} = 92$$

Paragraph for Question Nos. 5 to 6

5. Let wg water in added to 16 g CH₃OH

$$\text{molality} = \frac{16 \times 1000}{W \times 32} = \frac{500}{W}$$

$$\frac{500}{W} = \frac{x_A \times 1000}{(1 - x_A)m_B} = \frac{0.25 \times 1000}{0.75 \times 18} \quad W = 27 \text{ gm.}$$

6. Mass of solution = 1.5 × 1500 = 2250 gm

$$\therefore \text{Mass of solvent} = 2232 \text{ gm}$$

$$2232 \text{ g solvent} \text{ ----- } \frac{18}{60} \text{ (mole urea)}$$

$$1000 \text{ g solvent} \text{ } \frac{18 \times 1000}{60 \times 2232} = 0.134 \text{ (molality)}$$

CHEMISTRY - MODULE 2

SYLLABUS: MOLE CONCEPT & REDOX (EXCEPT TITRATIONS)

Matrix-Match Type

- (A) – p,s ; (B) – q,r ; (C) p,q,s ; (D) – r
- (A) – q, r ; (B) – p, s ; (C) – p, s ; (D) – q, r
- (A) – q, s ; (B) – p, r ; (C) – p, r ; (D) – q, s ;

1.

Sol. (A) Eq. of base = $N \times V_L = 0.5 \times 0.2 = 0.1$

$$\text{Eq. of H}_2\text{SO}_3 = \frac{4.1}{82} \times 2 = 0.1$$

$$\text{Millimoles of O-atoms} = (\text{Millimoles of H}_2\text{SO}_3) \times 3 = \left(\frac{4.1}{82} \times 1000 \right) \times 3 = 150$$

S is in + 4 oxidation state (Max = + 6)

It may react with an oxidising agent and S may get oxidised from + 4 to + 6.

$$\text{(B) Eq of H}_3\text{PO}_4 = \frac{4.9}{98} \times 3 = 0.15$$

$$\text{Millimoles of O-atoms} = (\text{Millimoles of H}_3\text{PO}_4) \times 4 = \left(\frac{4.9}{98} \times 1000 \right) \times 4 = 200$$

P is in + 5 oxidation state (Max = +5)

It will not react with an oxidising agent as P is already in max O.S.

$$\text{(C) Eq of H}_2\text{C}_2\text{O}_4 = \frac{4.5}{90} \times 2 = 0.1.$$

$$\text{Millimoles of O-atoms} = (\text{Millimoles of H}_2\text{C}_2\text{O}_4) \times 4 = \left(\frac{4.5}{90} \times 1000 \right) \times 4 = 200$$

C is in + 3 oxidation state (Max = + 4).

It may react with an oxidising agent and C may get oxidised from + 3 to + 4.

(D) Na_2CO_3 is itself basic in nature, so it will not react with a base.

$$\text{Millimoles of O-atoms} = (\text{Millimoles of Na}_2\text{CO}_3) \times 3 = \left(\frac{5.3}{106} \times 1000 \right) \times 3 = 150.$$

C is in + 4 oxidation state (Max = + 4).

It will not react with an oxidising agent as C is already in max oxidation state.

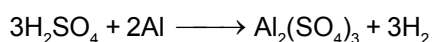
CHEMISTRY - MODULE 2

SYLLABUS: MOLE CONCEPT & REDOX (EXCEPT TITRATIONS)

Integer Type

1. Molarity of $\text{H}_2\text{SO}_4 = \frac{\text{sp. gravity} \times \% \text{ w/w} \times 10}{\text{Molecular mass}}$

$$= \frac{1.2 \times 25 \times 10}{98} = \frac{12 \times 25}{98} = 3.06 \text{ M}$$



$$\frac{2.7}{27} = 0.1$$

$$\text{Mole of } \text{H}_2\text{SO}_4 \text{ used} = \frac{3}{2} \times 0.1 = 0.15$$

$$\text{Initial mole of } \text{H}_2\text{SO}_4 = 0.75 \times 3.06 = 0.2295$$

$$\text{Mole of } \text{H}_2\text{SO}_4 \text{ remaining} = 0.2295 - 0.15$$

$$\text{Molarity of final } \text{H}_2\text{SO}_4 = \frac{0.0795}{0.4} = 0.198 \text{ M.}$$

2. (1)

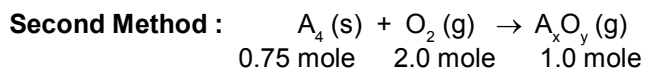
3. **First Method** : As both A_4 and O_2 are consumed

$$\frac{\text{moles of } \text{A}_4}{\text{moles of } \text{O}_2} = \frac{0.75}{2.0}$$

$$\frac{(\text{moles of A})/4}{(\text{moles of O})/2} = \frac{0.75}{2.0}$$

$$\frac{\text{moles of A}}{\text{moles of O}} = \frac{3}{4}$$

Thus the empirical formula of the product is A_3O_4 , Further, as 2 moles of O_2 give 1 mole of A_3O_4 (for gases, pressure \propto mole at constant temperature and volume), A_3O_4 is also the molecular formula of the product.



Applying POAC for A atoms,

$$\begin{aligned} 4 \times \text{moles of } \text{A}_4 &= x \times \text{moles of } \text{A}_x\text{O}_y \\ 4 \times 0.75 &= x \times 1 ; x = 3 \end{aligned}$$

Applying POAC for O atoms,

$$\begin{aligned} 2 \times \text{moles of } \text{O}_2 &= y \times \text{moles of } \text{A}_x\text{O}_y \\ 2 \times 2 &= y \times 1 ; y = 4 \end{aligned}$$

4. (8)

5. Volume of virus

$$\begin{aligned} &= \pi r^2 \ell = \frac{22}{7} \times \frac{150}{2} \times \frac{150}{2} \times 10^{-16} \times 5000 \times 10^{-8} \\ &= 0.884 \times 10^{-16} \text{ cm}^3 \end{aligned}$$

$$\therefore \text{Weight of one virus} = \frac{0.884 \times 10^{-16}}{0.75} \text{ g} = 1.178 \times 10^{-16} \text{ g}$$

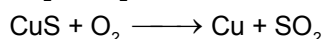
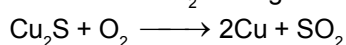
$$\therefore \text{Mol. wt. of virus} = 1.178 \times 10^{-16} \times 6.023 \times 10^{23} \\ = \mathbf{7.095 \times 10^7}$$

6. Percentage is 47%

7. (4)

8. Mass of Cu_2S & CuS = $100 - 4.5 = 95.5$ gm

Let mass of Cu_2S is x gm.



Mass of Cu from Cu_2S + Mass of Cu from CuS = 71.8

$$\frac{x}{159} \times 63.3 \times 2 + \frac{(95.5-x)}{95.5} 63.5 = 71.8$$

$$x \left(\frac{127}{159} - \frac{63.5}{95.5} \right) = 8.3$$

$$x = \frac{8.3}{0.134} = 62.01 \text{ gm.}$$

\therefore % of Cu_2S is 62.

9. $\text{NaH}_2\text{PO}_4 + \text{Mg}^{2+} + \text{NH}_4^+ \rightarrow \text{Mg}(\text{NH}_4)\text{PO}_4 \cdot 6\text{H}_2\text{O} \xrightarrow{\text{heated}} \text{Mg}_2\text{P}_2\text{O}_7$

Since P atoms are conserved, applying POAC for P atoms,

moles of P in NaH_2PO_4 = moles of P in $\text{Mg}_2\text{P}_2\text{O}_7$

$1 \times$ moles of $\text{NaH}_2\text{PO}_4 = 2 \times$ moles of $\text{Mg}_2\text{P}_2\text{O}_7$

(\therefore 1 mole of NaH_2PO_4 contains 1 mole of P and 1 mole of $\text{Mg}_2\text{P}_2\text{O}_7$ contains 2 moles of P)

$$\frac{\text{wt. of NaH}_2\text{PO}_4}{\text{mol. wt. of NaH}_2\text{PO}_4} = 2 \times \frac{\text{wt. of Mg}_2\text{P}_2\text{O}_7}{\text{mol. wt. of Mg}_2\text{P}_2\text{O}_7}$$

$$\frac{\text{wt. of NaH}_2\text{PO}_4}{120} = 2 \times \frac{1.054}{222}$$

$$\text{Wt. of NaH}_2\text{PO}_4 = 1.14 \text{ g.}$$

10. $2\text{Al} + \frac{3}{2}\text{O}_2 \rightarrow \text{Al}_2\text{O}_3$

$$\text{Number of m moles of O}_2 \text{ used} = \frac{PV}{RT} = \frac{\left(\frac{780}{760}\right) \times 30}{.0821 \times 300} \text{ millimole} = 1.25$$

$$\text{Number of m mole of Al required} = 1.25 \times \frac{4}{3}$$

$$\text{Weight (in mg) of Al required} = 1.25 \times \frac{4}{3} \times 27 = 45 \text{ mg.}$$

11. Let volume is V ml

$$\text{H}_2\text{SO}_4 + 2 \text{NaOH} \longrightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$$
mmole $0.2V$ 40×0.1

$$\text{m. moles of H}_2\text{SO}_4 \text{ remains} = 0.2V - \frac{40 \times 0.1}{2}$$

$$\frac{0.2V - \frac{40 \times 0.1}{2}}{V + 40} = \frac{6}{55}$$

$$V = 70 \text{ ml}$$

12. Let the volume of solution is 1 Litre
 \therefore moles of $\text{CaCl}_2 = 5$ and moles of $\text{Cl}^- = 10$
Mass of CaCl_2 in solution = $5 \times 111 = 555$ g
Let mass of MgCl_2 is x g.
so, total mass of 1 Litre solution = $555 + x + W_{\text{H}_2\text{O}} = 1000 \times 1.05 = 1050$
 $\therefore W_{\text{H}_2\text{O}} = (495 - x)$ g
given, molality of $\text{MgCl}_2 = 5$ m

$$\left(\frac{\frac{x}{95}}{495 - x} \right) \times 1000 = 5$$

On solving we get,
 $x = 159.4$

$$\therefore \text{moles of MgCl}_2 = \frac{159.4}{95} = 1.68$$

$$\therefore \text{moles of Cl}^- = 3.36$$

Total moles of $\text{Cl}^- = 10 + 3.36 = 13.36$ in 1 litre solution.

$[\text{Cl}^-] = 13.36 \text{ M Ans.}$

13. Milli equivalent of $\text{Ce}^{4+} =$ milli equivalent of Sn^{2+}
 $1 \times \text{v.f.} \times 40 = 1 \times 2 \times 20$
so v.f. = 1
 Ce^{4+} reduced in Ce^{3+} .

14. (2)

15. Suppose the weight of pyrolusite is X g.

$$\therefore \text{wt. of MnO}_2 = \frac{80}{100} \times X = 0.8X$$

$$\text{wt. of SiO}_2, \text{ etc.} = \frac{15}{100} \times X = 0.15X$$

$$\text{wt. of water} = \frac{5}{100} \times X = 0.05X$$

When pyrolusite is ignited, MnO_2 changes to Mn_3O_4 and H_2O evaporates. The residue contains, therefore, SiO_2 , etc., and Mn_3O_4 .

Now, we know, $\text{MnO}_2 \rightarrow \text{Mn}_3\text{O}_4$
 $0.8X$ g

Applying POAC for Mn atoms,

moles of Mn in $\text{MnO}_2 =$ moles of Mn in Mn_3O_4

$$1 \times \text{moles of MnO}_2 = 3 \times \text{moles of Mn}_3\text{O}_4 \quad \text{.....(i)}$$

$$\frac{0.8X}{87} = 3 \times \frac{\text{wt. of Mn}_3\text{O}_4}{229} \quad \left[\begin{array}{l} \text{MnO}_2 = 87 \\ \text{Mn}_3\text{O}_4 = 229 \end{array} \right]$$

$$\text{Wt. of Mn}_3\text{O}_4 = 0.702 X \text{ g.}$$

$$\therefore \text{Wt. of the residue} = \text{wt. of Mn}_3\text{O}_4 + \text{wt. of SiO}_2, \text{ etc.} \\ = 0.702 X + 0.15 X = 0.852 X \text{ g.}$$

Now, since Mn atoms are conserved,
moles of Mn = moles of Mn in Mn_3O_4
= moles of Mn in MnO_2
= 1 × moles of MnO_2

$$= \frac{0.8X}{87} \quad (\text{MnO}_2 = 87).$$

\therefore wt. of Mn = moles of Mn × at. wt. of Mn

$$= \frac{0.8X}{87} \times 55 \text{ g.}$$

$$\% \text{ of Mn in residue} = \frac{\text{wt. of Mn}}{\text{wt. of residue}} \times 100$$

$$= \frac{0.8X \times 55}{87} \times \frac{100}{0.852X} = 59.37\%.$$