CHEMISTRY

SECTION – A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

31. Cobalt chloride when dissolved in water forms pink coloured complex X which has octahedral geometry. This solution on treating with conc. HCl forms deep blue complex, Y which has a Z geometry. X, Y and Z, respectively, are

(1) X = $[Co(H_2O)_6]^{3+}$, Y = $[CoCl_6]^{3-}$, Z = Octahedral

(2) X = $[Co(H_2O)_4Cl_2]^{+}$, Y = $[CoCl_4]^{2-}$, Z = Tetrahedral

(3) X = $[Co(H_2O)_6]^{2+}$, Y = $[CoCl_6]^{3-}$, Z = Octahedral

(4) X = $[Co(H_2O)_6]^{2+}$, Y = $[CoCl_4]^{2-}$, Z = Tetrahedral

Answer (4)

Sol. $CoCl_2 \xrightarrow{H_2O} [Co(H_2O)_6]^{2+}$ (X) (Octahedral)

$\downarrow$ Conc HCl

$[CoCl_4]^{2-}$ (Y) Tetrahedral (Z)

Hence correct answer is option (4)

32. The correct order of basicity of oxides of vanadium is

(1) $V_2O_3 > V_2O_5 > V_2O_4$ (2) $V_2O_4 > V_2O_3 > V_2O_5$

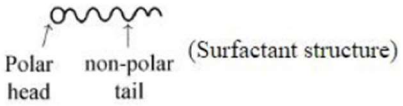
(3) $V_2O_3 > V_2O_4 > V_2O_5$ (4) $V_2O_5 > V_2O_4 > V_2O_3$

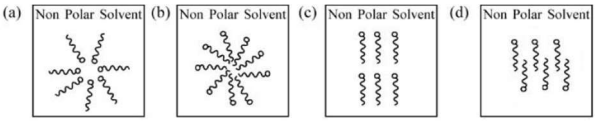
Answer (3)

Sol. $V_2O_3 > V_2O_4 > V_2O_5$

As positive oxidation state increases acidic nature increases and basic nature decreases.

33. Adding surfactants in non polar solvent, the micelles structure will look like



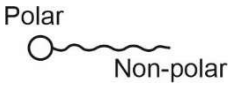


(1) c (2) a

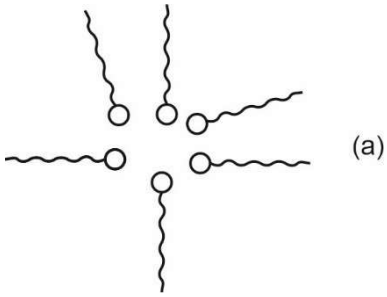
(3) d (4) b

Answer (2)

Sol.



In non-polar solvent non-polar part will point out



Non-polar part will interact with non-polar solvent.

34. Which one of the following statements is correct for electrolysis of brine solution?

(1) Cl_2 is formed at cathode

(2) H_2 is formed at anode

(3) O_2 is formed at cathode

(4) OH^- is formed at cathode

Answer (4)

Sol. During electrolysis of Brine

$2NaCl \rightarrow Na^+ + Cl^-$

$2H_2O \rightarrow 2H^+ + 2OH^-$

Cathode $2H^+ + 2e \rightarrow H_2$

Anode $2Cl^- \rightarrow Cl_2 + 2e.$

At cathode H_2 is liberated

At anode Cl_2 is formed.

35. When Cu^{2+} ion is treated with KI, a white precipitate, X appears in solution. The solution is titrated with sodium thiosulphate, the compound Y is formed. X and Y respectively are

(1) X = CuI_2 Y = $Na_2S_2O_3$

(2) X = CuI_2 Y = $Na_2S_4O_6$

(3) X = Cu_2I_2 Y = $Na_2S_4O_5$

(4) X = Cu_2I_2 Y = $Na_2S_4O_6$

Answer (4)

Sol. $2Cu^{2+} + 4KI \longrightarrow \underset{\text{White ppt.}}{Cu_2I_2} + I_2$

$I_2 + Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$

X = Cu_2I_2

Y = $Na_2S_4O_6$

36. Which transition in the hydrogen spectrum would have the same wavelength as the Balmer type transition from n = 4 to n = 2 of He^+ spectrum

(1) n = 2 to n = 1 (2) n = 3 to n = 4

(3) n = 1 to n = 2 (4) n = 1 to n = 3

Answer (1)

Sol. $\bar{\nu}_{He^+} = \frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]z^2$

$= R\left[\frac{1}{(2)^2} - \frac{1}{(4)^2}\right]4$

$= R\left[\frac{1}{1} - \frac{1}{4}\right]$

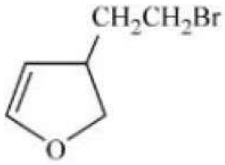
$= \frac{3}{4}R$

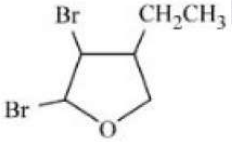
$\bar{\nu}_{2\to1} = \frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

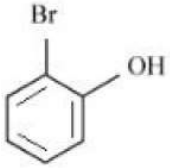
$= R\left[\frac{1}{1} - \frac{1}{(2)^2}\right]$

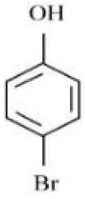
$= \frac{3}{4}R$

37. An organic compound 'A' with empirical formula C_6H_6O gives sooty flame on burning. Its reaction with bromine solution in low polarity solvent results in high yield of B. B is

(1) 

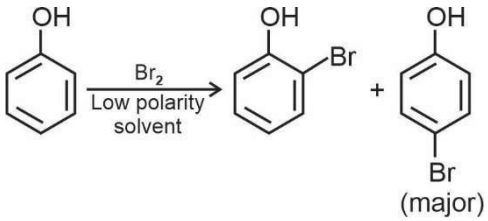
(2) 

(3) 

(4) 

Answer (4)

Sol.



38. Match **List I** with **List II**

	List I		List II
A.	XeF_4	I.	See-saw
B.	SF_4	II.	Square planar
C.	NH_4^+	III.	Bent T-shaped
D.	BrF_3	IV.	Tetrahedral

Choose the correct answer from the options given below:

(1) A - IV, B - III, C - II, D - I

(2) A - II, B - I, C - III, D - IV

(3) A - II, B - I, C - IV, D III

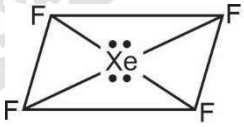
(4) A - IV, B - I, C - II, D - III

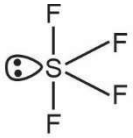
Answer (3)

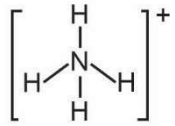
Sol.

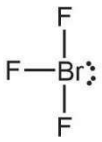
A-II B-I C-IV D-III

				Hybridisation
XeF_4	–	Square planar	–	sp^3d^2
SF_4	–	See Saw	–	sp^3d
NH_4^+	–	Tetrahedral	–	sp^3
BrF_3	–	Bent-T-shape	–	sp^3d









39. Consider the following reaction

$$\text{Propanal} + \text{Methanal} \xrightarrow[\substack{\text{(ii) }\Delta \\ \text{(iii) NaCN} \\ \text{(iv) } H_3O^+}]{\text{(i) dil.NaOH}} \underset{(C_5H_8O_3)}{\text{Product B}}$$

The correct statement for product B is. It is

(1) racemic mixture and gives a gas with saturated $NaHCO_3$ solution

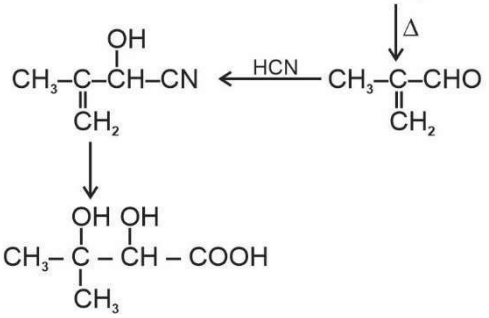
(2) optically active alcohol and is neutral

(3) optically active and adds one mole of bromine

(4) racemic mixture and is neutral

Answer (1)

Sol. $CH_3-CH_2CHO + HCHO \xrightarrow{\text{dil.base}} CH_3-\underset{\underset{CH_2OH}{|}}{CH}-CHO$



Racemic mixture effervescence with $NaHCO_3$

40. H_2O_2 acts as a reducing agent in

(1) $2Fe^{2+} + 2H^+ + H_2O_2 \rightarrow 2Fe^{3+} + 2H_2O$

(2) $Mn^{2+} + 2\,H_2O_2 \rightarrow MnO_2 + 2H_2O$

(3) $Na_2S + 4H_2O_2 \rightarrow Na_2SO_4 + 4H_2O$

(4) $2NaOCl + H_2O_2 \rightarrow 2\,NaCl + H_2O + O_2$

Answer (4)

Sol. H_2O_2 act as a reducing agent

$$\overset{+1}{2Na}\overset{-2}{O}\overset{+1}{Cl} + H_2O_2 \longrightarrow 2\,NaCl + H_2O + O_2$$

Cl from (+1) state changes to Cl^{-1}

41. Identify X, Y and Z in the following reaction. (Equation not balanced)

$$ClO^{\bullet} + NO_2 \rightarrow \underline{X} \xrightarrow{H_2O} \underline{Y} + \underline{Z}$$

(1) X = $ClONO_2$, Y = HOCl, Z = NO_2

(2) X = $ClONO_2$, Y = HOCl, Z = HNO_3

(3) X = $ClNO_3$, Y = Cl_2, Z = NO_2

(4) X = $ClNO_2$, Y = HCl, Z = HNO_3

Answer (2)

Sol. $ClO + NO_2 \longrightarrow \underset{(X)}{ClONO_2}$

$$ClONO_2 \xrightarrow{H_2O} \underset{(Y)}{HOCl} + \underset{(Z)}{HNO_3}$$

42. The correct increasing order of the ionic radii is

(1) $K^+ < S^{2-} < Ca^{2+} < Cl^-$ (2) $Cl^- < Ca^{2+} < K^+ < S^{2-}$

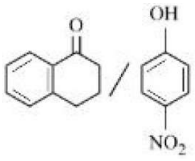
(3) $Ca^{2+} < K^+ < Cl^- < S^{2-}$ (4) $S^{2-} < Cl^- < Ca^{2+} < K^+$

Answer (3)

Sol. Given ions are isoelectronic more is nuclear charge per electron smaller is size

	Ca^{+2}	<	K^+	<	Cl^-	<	S^{2-}
p	20		19		17		16
e	18		18		18		18

43. Match items of columsn I and II

Column I (Mixture of compounds)		Column II (Separation Technique)	
(A)	H_2O / CH_2Cl_2	(i)	Crystallization
(B)		(ii)	Differential solvent extraction
(C)	Kerosene / Naphthalene	(iii)	Column chromatography
(D)	$C_6H_{12}O_6$ / NaCl	(iv)	Fractional Distillation

Correct match is

(1) A-(ii), B-(iii), C-(iv), D-(i)

(2) A-(ii), B-(iv), C-(i), D-(iii)

(3) A-(i), B-(iii), C-(ii), D-(iv)

(4) A-(iii), B-(iv), C-(ii), D-(i)

Answer (1)

Sol. Water and dichloromethane can be separated by differential extraction.

Which $C_6H_{12}O_6$ and NaCl can be separated by crystallization.

44. Choose the correct set of reagents for the following conversion.

trans (Ph – CH = CH – CH_3) →

cis (Ph – CH = CH – CH_3)

(1) Br_2, alc•KOH, $NaNH_2$, H_2 Lindlar Catalyst

(2) Br_2, aq•KOH, $NaNH_2$, Na (Liq NH_3)

(3) Br_2, alc•KOH, $NaNH_2$, Na (Liq NH_3)

(4) Br_2, aq•KOH, $NaNH_2$, H_2 Lindlar Catalyst

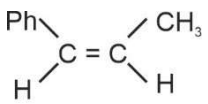
Answer (1)

Sol. $Ph-\underset{\text{Trans}}{CH}=CH-CH_3 \longrightarrow Ph-\underset{\text{cis}}{CH}=CH-CH_3$

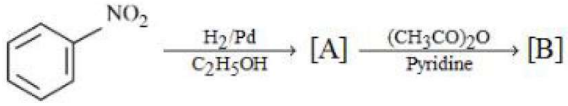
$$Ph-\underset{\text{Trans}}{CH}=CH-CH_3 \xrightarrow{Br_2}$$

$$Ph-\underset{\underset{Br}{|}}{\overset{\overset{Br}{|}}{CH}}-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow{\text{alc.KOH/NaNH}_2}$$

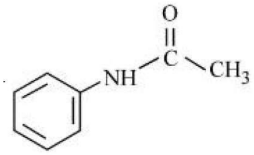
$$Ph-C\equiv C-CH_3 \xrightarrow{\text{Lindale's catalyst}}$$

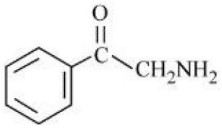


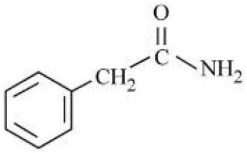
cis

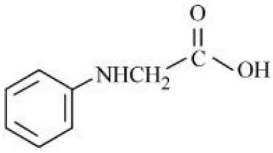
45. 

Consider the above reaction and identify the product B.

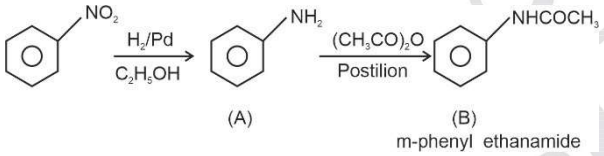
(1) 

(2) 

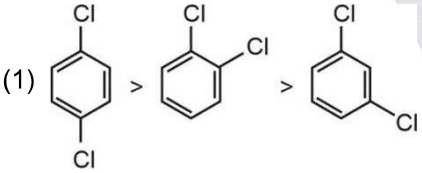
(3) 

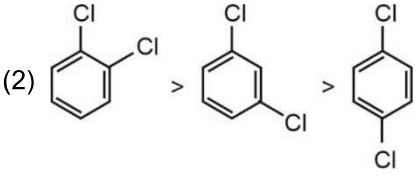
(4) 

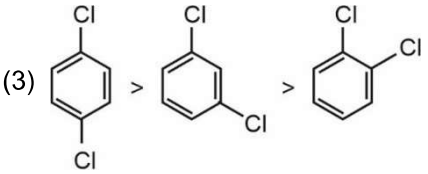
Answer (1)

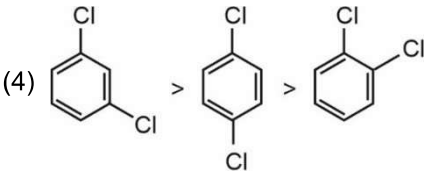
Sol. 

46. The correct order of melting points of dichlorobenzenes is

(1) 

(2) 

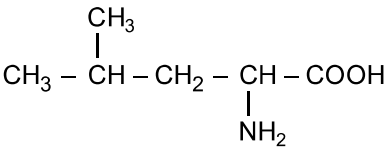
(3) 

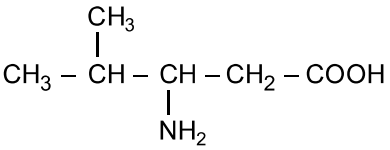
(4) 

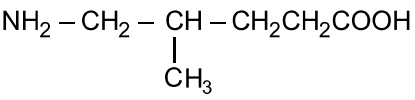
Answer (1)

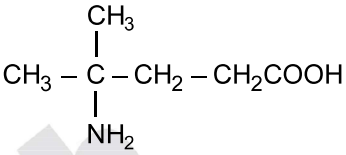
Sol. Out of o, m, p-dichlorobenzene para isomer has maximum melting point due to symmetrical nature.

47. A protein 'X' with molecular weight of 70,000 u, on hydrolysis gives amino acids. One of these amino acid is

(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. Protein upon hydrolysis gives α-amino acids. Only option (1) contains α-amino acid. Hence the correct answer is (1).

48. Nd^{2+} = _____

(1) $4f^3$ (2) $4f^4 6s^2$

(3) $4f^4$ (4) $4f^2 6s^2$

Answer (3)

Sol. Neodymium $Nd = 4f^4\ 6s^2$

$Nd^{2+} = 4f^4$.

49. Which of the following artificial sweeteners has the highest sweetness value in comparison to cane sugar?

(1) Sucralose (2) Aspartame

(3) Saccharin (4) Alitame

Answer (4)

Sol. Highest sweetness value is of Alitame

Sucralose = 600

Aspartame = 100

Saccharin = 550

Alitame = 2000

50. The methods NOT involved in concentration of ore are

A. Liquation B. Leaching

C. Electrolysis D. Hydraulic washing

E. Froth floatation

Choose the correct answer from the options given below

(1) B, D and C only (2) B, D and E only

(3) C, D and E only (4) A and C only

Answer (4)

Sol. (A) and (C) only

Liquation is used for purification of metal.

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

51. On complete combustion, 0.492 g of an organic compound gave 0.792 g of CO_2. The % of carbon in the organic compound is _____ (Nearest integer)

Answer (44)

Sol. Percentage of C $= \frac{W_{CO_2}}{W_{org.comp}} \times \frac{12}{44} \times 100$

$= \frac{0.792}{0.492} \times \frac{12}{44} \times 100$

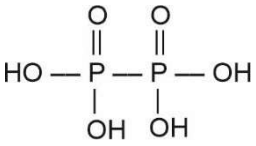
$= 43.90$

52. The oxidation state of phosphorus in hypophosphoric acid is + _____.

Answer (4)

Sol. Hypophosphoric acid $H_4P_2O_6$

Oxidation state is +4



53. For reaction : $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$

$K_p = 2\times10^{12}$ at 27°C and 1 atm pressure. The K_c for the same reaction is _____ $\times 10^{13}$. (Nearest integer)

(Given R = 0.082 L atm K^{-1} mol^{-1})

Answer (1)

Sol. $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$

$K_p = K_c (RT)^{\Delta n}$

$2 \times 10^{12} = K_c (0.082 \times 300)^{-½}$

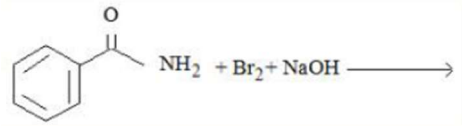
$K_c = 2 \times 10^{12} \times (0.082 \times 300)^{½}$

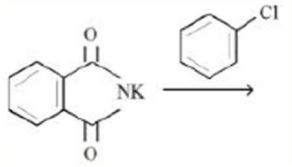
$= 9.9 \times 10^{12}$

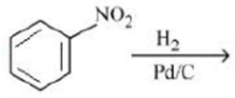
$= 0.99 \times 10^{13}$

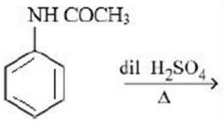
$\approx 1 \times 10^{13}$

54. How many of the transformations given below would result in aromatic amines?

(1) 

(2) 

(3) 

(4) 

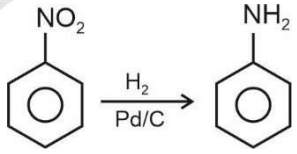
Answer (3)

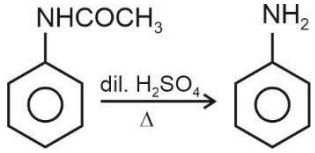
Sol. 1, 3, 4 will give Aniline.

Gabriel phthalimide synthesis cannot be used to prepare Aniline.

(1) $C_6H_5CONH_2 \xrightarrow{Br_2/NaOH} C_6H_5NH_2$

Hoffmann Bromamide synthesis

(3) 

(4) 

55. The enthalpy change for the conversion of $\frac{1}{2}Cl_2(g)$ to Cl^- (aq) is (–) _____ kJ mol^{-1} (Nearest integer)

Given : $\Delta_{dis}H^{\ominus}_{Cl_2(g)} = 240$ kJ mol^{-1},

$\Delta_{eg}H^{\ominus}_{Cl(g)} = -350$ kJ mol^{-1},

$\Delta_{hyd}H^{\ominus}_{Cl^-_{(g)}} = -380$ kJ mol^{-1}

Answer (610)

Sol. $\frac{1}{2}Cl_2(g) \longrightarrow Cl^-_{(aq)} \qquad \Delta H = ?$

$$\Delta H = \frac{1}{2}\Delta_{diss}H^\circ_{Cl_2} + \Delta_{eg}\Delta H^\circ_{Cl(g)} + \Delta_{hyd}H^\circ_{Cl^-_{(g)}}$$

$$= \frac{1}{2}\times 240 + (-350) + (-380)$$

$$= -610 \text{ kJ mol}^-$$

56. The total pressure of a mixture of non-reacting gases X (0.6 g) and Y (0.45 g) in a vessel is 740 mm of Hg. The partial pressure of the gas X is _____ mm of Hg. (Nearest integer)

(Given : molar mass X = 20 and Y = 45 g mol^{-1})

Answer (555)

Sol. P_{Total} = 740 mm of Hg

P_X = mole fraction of [X] P_{Total}

$$n_X = \frac{0.6}{20} = 0.03$$

$$n_Y = \frac{0.45}{45} = 0.01$$

$$\text{Mole fraction of X} = \frac{0.03}{0.01+0.03} = \frac{3}{4}$$

$$\text{Partial pressure of X} = \frac{3}{4}\times 740$$

$$= 555 \text{ mm of Hg}$$

57. The logarithm of equilibrium constant for the reaction $Pd^{2+} + 4Cl^- \rightleftharpoons PdCl_4^{2-}$ is _____. (Nearest integer)

Given : $\frac{2.303RT}{F} = 0.06V$

$$Pd^{2+}_{(aq)} + 2e^- \rightleftharpoons Pd(s) \quad E^\ominus = 0.83V$$

$$PdCl_4^{2-}(aq) + 2e^- \rightleftharpoons Pd(s) + 4Cl^-(aq) \quad E^\ominus = 0.65V$$

Answer (6)

Sol. $Pd^{2+} + 4Cl^- \rightleftharpoons [PdCl_4]^{2-}$

$$E^o = (0.83) - (0.65) = 0.18 \text{ V}$$

$$0 = 0.18 - \frac{0.06}{2}\log k_{eq}$$

$$0.18 = 0.03 \log k_{eq}$$

$$\boxed{\log k_{eq} = 6}$$

58. A→B

The rate constants of the above reaction at 200 K and 300 K are 0.03 min^{-1} and 0.05 min^{-1} respectively. The activation energy for the reaction is _____ J (Nearest integer)

(Given : ln 10 = 2.3

R = 8.3 J K^{-1} mol^{-1}

log 5 = 0.70

log 3 = 0.48

log 2 = 0.30)

Answer (2520)

Sol. $$\log\frac{k_2}{k_1} = \frac{E_a}{2.3\times 8.3}\left(\frac{1}{200} - \frac{1}{300}\right)$$

$$\log\frac{0.05}{0.03} = \frac{E_a}{2.3\times 8.3}\left(\frac{1}{600}\right)$$

$$(0.70 - 0.48) = \frac{E_a}{2.3\times 8.3}\times\frac{1}{600}$$

$$\Rightarrow 0.22 = \frac{E_a}{2.3\times 8.3}\times\frac{1}{600}$$

$$E_a = 2.3\times 8.3\times 600\times 0.22$$

$$= 2519.88$$

$$\approx 2520 \text{ J}$$

59. At 27°C, a solution containing 2.5 g of solute in 250.0 mL of solution exerts an osmotic pressure of 400 Pa. The molar mass of the solute is _____ g mol^{-1}. (Nearest integer)

(Given : R = 0.083 L bar K^{-1} mol^{-1})

Answer (62250)

Sol. $$400 = \frac{2.5}{mw}\times 4\times(.083\times 10^5)\times 300$$

$$mw = \frac{10\times 0.083\times 3}{4}\times 10^5$$

$$= 62250$$

60. Zinc reacts with hydrochloric acid to give hydrogen and zinc chloride. The volume of hydrogen gas produced at STP from the reaction of 11.5 g of zinc with excess HCl is _____ L. (Nearest integer)

(Given : Molar mass of Zn is 65.4g mol^{-1} and Molar volume of H_2 at STP = 22.7 L)

Answer (4)

Sol. $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

$$n_{Zn} = \frac{11.5}{65.4} = 0.176$$

$$V_{H_2} = 0.176\times 22.7 = 3.99 \text{ litre}$$