FINAL JEE–MAIN EXAMINATION – JANUARY, 2023

(Held On Sunday 29th January, 2023) TIME : 3 : 00 PM to 6 : 00 PM

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

31. Given below are two statements:

Statement I : The decrease in first ionization enthalpy from B to Al is much larger than that from Al to Ga.

Statement II : The d orbitals in Ga are completely filled.

In the light of the above statements, choose the most appropriate answer from the options given below

(1) Statement I is incorrect but statement II is correct.

(2) Both the statements I and II are correct

(3) Statement I is correct but statement II is incorrect

(4) Both the statements I and II are incorrect

Official Ans. by NTA (2)

Ans. (1)

Sol. The first ionization energies (as in NCERT) are as follows:

B : 801 kJ/mol

Al : 577 kJ/mol

Ga : 579 kJ/mol

Ga : $[Ar]3d^{10}4s^24p^1$

32. Correct order of spin only magnetic moment of the following complex ions is:

(Given At. No. Fe: 26, Co:27)

(1) $[FeF_6]^{3-} > [CoF_6]^{3-} > [Co(C_2O_4)_3]^{3-}$

(2) $[Co(C_2O_4)_3]^{3-} > [CoF_6]^{3-} > [FeF_6]^{3-}$

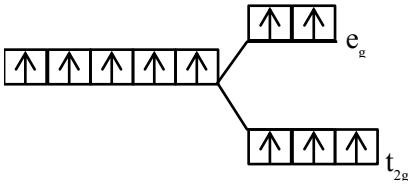
(3) $[FeF_6]^{3-} > [Co(C_2O_4)_3]^{3-} > [CoF_6]^{3-}$

(4) $[CoF_6]^{3-} > [FeF_6]^{3-} > [Co(C_2O_4)_3]^{3-}$

Official Ans. by NTA (1)

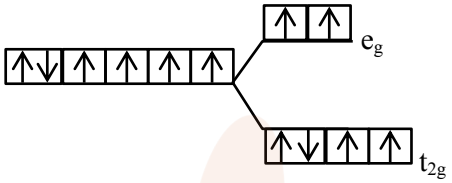
Ans. (1)

Sol. $[FeF_6]^{3-}$: $Fe^{3+} = 3d^5$ $\Delta_O < P$



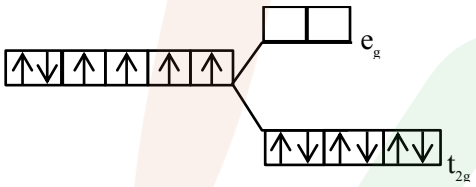
Number of unpaired $e^- = 5$ $\therefore$ $\mu = \sqrt{35}$ BM

$[CoF_6]^{3-}$: $Co^{3+} = 3d^6$ $(\Delta_O < P)$



Number of unpaired $e^- = 4$ $\therefore$ $\mu = \sqrt{24}$ BM

$[Co(C_2O_4)_3]^{3-}$: $Co^{3+} = 3d^6$ $(\Delta_O > P)$



Number of unpaired $e^- = 0$ $\therefore$ $\mu = 0$ BM

33. Match **List-I** and **List-II**.

List-I	List-II
A. Osmosis	I. Solvent molecules pass through semi permeable membrane towards solvent side.
B. Reverse osmosis	II. Movement of charged colloidal particles under the influence of applied electric potential towards oppositely charged electrodes.
C. Electro osmosis	III. Solvent molecules pass through semi permeable membrane towards solution side.
D. Electrophoresis	IV. Dispersion medium moves in an electric field.

Choose the correct answer from the options given below:

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

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

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

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

Official Ans. by NTA (2)

Ans. (2)

Sol.

A. Osmosis	III
B. Reverse osmosis	I
C. Electro osmosis	IV
D. Electrophoresis	II

34. The set of correct statements is:

(i) Manganese exhibits +7 oxidation state in its oxide.

(ii) Ruthenium and Osmium exhibit +8 oxidation in their oxides.

(iii) Sc shows +4 oxidation state which is oxidizing in nature.

(iv) Cr shows oxidising nature in +6 oxidation state.

(1) (ii) and (iii) (2) (i), (ii) and (iv)

(3) (i) and (iii) (4) (ii), (iii) and (iv)

Official Ans. by NTA (2)

Ans. (2)

Sol. (i), (ii) and (iv) correct.

Manganese exhibits +7 oxidation state in its oxide. (Mn_2O_7)

Ru & Os from RuO_4 & OsO_4 oxide in +8 oxidation state

Cr in +6 oxidation act is oxidizing.

Sc does not show +4 oxidation state.

35. Match **List-I** and **List-II**.

List-I	List-II
A. Elastomeric polymer	I. Urea formaldehyde resin
B. Fibre polymer	II. Polystyrene
C. Thermosetting polymer	III. Polyester
D. Thermoplastic polymer	IV. Neoprene

Choose the correct answer from the options given below:

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

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

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

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

Official Ans. by NTA (3)

Ans. (3)

Sol. Neoprene : Elastomer

Polyester : Fibre

Polystyrene : Thermoplastic

Urea–Formaldhyde Resin: Thermosetting polymer

36. An indicator 'X' is used for studying the effect of variation in concentration of iodide on the rate of reaction of iodide ion with H_2O_2 at room temp. The indicator 'X' forms blue colored complex with compound 'A' present in the solution. The indicator 'X' and compound 'A' respectively are

(1) Starch and iodine

(2) Methyl orange and H_2O_2

(3) Starch and H_2O_2

(4) Methyl orange and iodine

Official Ans. by NTA (1)

Ans. (1)

Sol. $I^- + H_2O_2 \longrightarrow \underset{(A)}{I_2} + H_2O$

$I_2 + \underset{(Indicator)}{Starch} \longrightarrow Blue$

37. A doctor prescribed the drug Equanil to a patient. The patient was likely to have symptoms of which disease?

(1) Stomach ulcers

(2) Hyperacidity

(3) Anxiety and stress

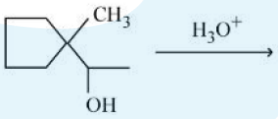
(4) Depression and hypertension

Official Ans. by NTA (4)

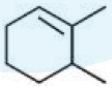
Ans. (4)

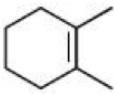
Sol. Theory based.

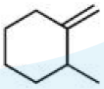
38. Find out the major product for the following reaction.



Major Product

(1) 

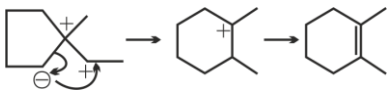
(2) 

(3) 

(4) 

Official Ans. by NTA (2)

Ans. (2)

Sol. 

39. The one giving maximum number of isomeric alkenes on dehydrohalogenation reaction is (excluding rearrangement)

(1) 1-Bromo-2-methylbutane

(2) 2-Bromopropane

(3) 2-Bromopentane

(4) 2-Bromo-3,3-dimethylpentane

Official Ans. by NTA (3)

Ans. (3)

Sol. $CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-Br \longrightarrow \underset{\displaystyle C-C-\underset{\displaystyle C}{\underset{|}{C}}=C}{}$ (1)

$CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3 \longrightarrow CH_3CH=CH_2$ (1)

$CH_3-CH_2-CH_2-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3 \longrightarrow$

C-C-C-C=C + C-C-C=C-C, cis & trans (3)

$C-C-\underset{\displaystyle CH_3}{\underset{|}{C}}-\underset{\displaystyle Br}{\underset{|}{C}}-C \longrightarrow C-C-\underset{\displaystyle C}{\underset{|}{C}}-C=C$ (1)

40. When a hydrocarbon A undergoes combustion in the presence of air, it requires 9.5 equivalents of oxygen and produces 3 equivalents of water. What is the molecular formula of A?

(1) C_8H_6 (2) C_9H_9

(3) C_6H_6 (4) C_9H_6

Official Ans. by NTA (1)

Ans. (1)

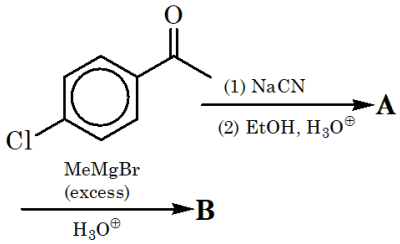
Sol. $C_xH_y + \left(x + \frac{y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$

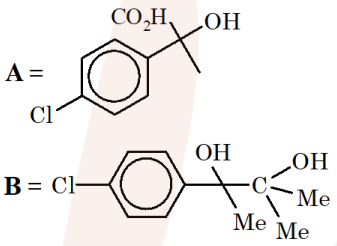
$x + \frac{y}{4} = 9.5$

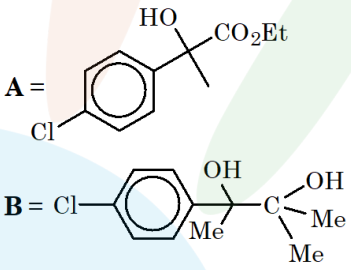
$\frac{y}{2} = 3$

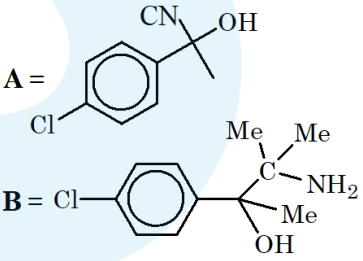
$\Rightarrow x = 8, y = 6$

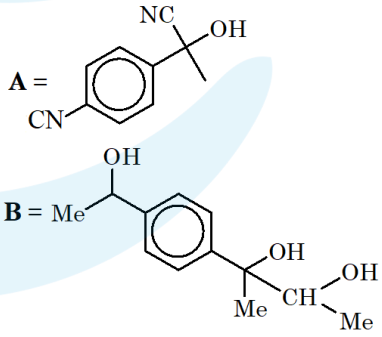
41. Find out the major products from the following reaction sequence.



(1) 

(2) 

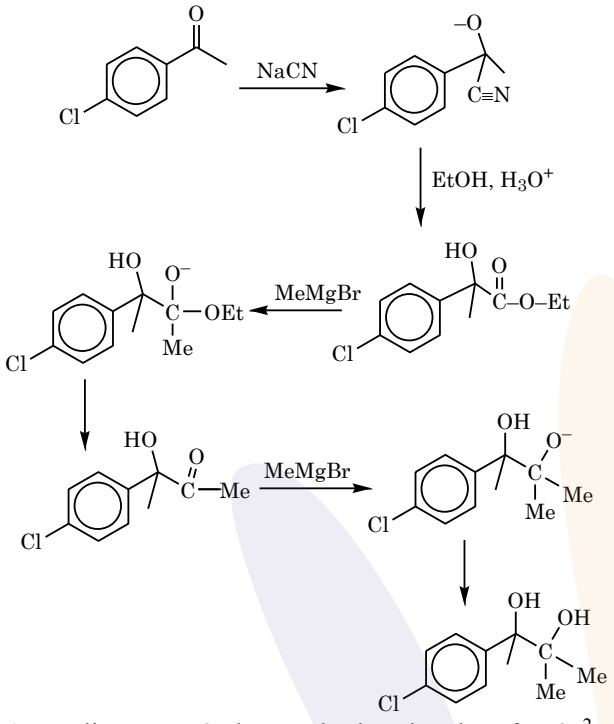
(3) 

(4) 

Official Ans. by NTA (2)

Ans. (2)

Sol.



42. According to MO theory the bond orders for O_2^{2-}, CO and NO^+ respectively, are

(1) 1, 3 and 3 (2) 1, 3 and 2

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

Official Ans. by NTA (1)

Ans. (1)

Sol. Theory based.

43. A solution of CrO_5 in amyl alcohol has a….colour

(1) Green (2) Orange–Red

(3) Yellow (4) Blue

Official Ans. by NTA (4)

Ans. (4)

Sol. A solution of CrO_5 in amyl alcohol has a blue colour. So, option (4) is correct.

44. The concentration of dissolved Oxygen in water for growth of fish should be more than X ppm and Biochemical Oxygen Demand in clean water should be less than Y ppm. X and Y in ppm are, respectively.

(1) X Y 6 5 (2) X Y 4 8

(3) X Y 4 15 (4) X Y 6 12

Official Ans. by NTA (1)

Ans. (1)

Sol. The growth of fish gets inhibited if the concentration of dissolved Oxygen in water is less than 6 ppm and Biochemical Oxygen demand in clean water should be less than 5 ppm.

45. Reaction of propanamide with Br_2 / KOH (aq) produces :

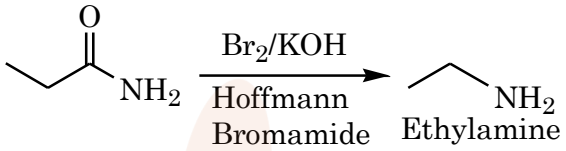
(1) Ethylnitrile (2) Propylamine

(3) Propanenitrile (4) Ethylamine

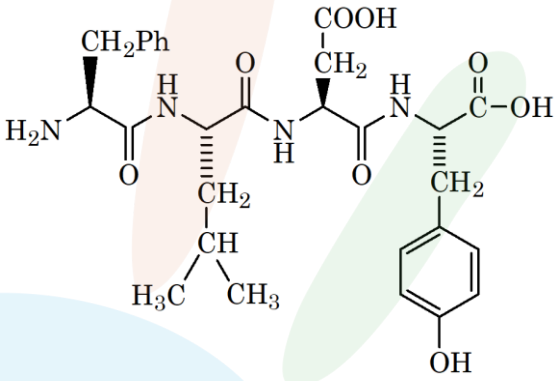
Official Ans. by NTA (4)

Allen Ans. (4)

Sol.



46. Following tetrapeptide can be represented as



(F, L, D, Y, I, Q, P are one letter codes for amino acids)

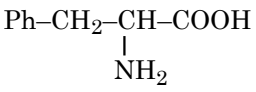
(1) FIQY (2) FLDY

(3) YQLF (4) PLDY

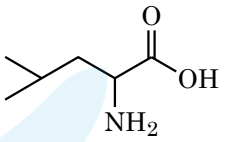
Official Ans. by NTA (2)

Ans. (2)

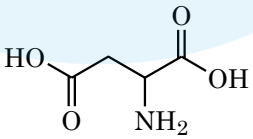
Sol. Hydrolysis of the given tetrapeptide will give the following:



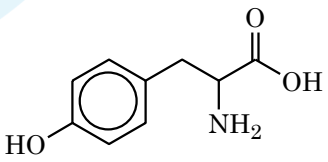
(F)
(Phenylalanine)



(L)
(Leucine)



(D)
(Aspartic acid)



(Y)
(Tyrosine)

47. Which of the following relations are correct?

(A) $\Delta U = q + p\Delta V$ (B) $\Delta G = \Delta H - T\Delta S$

(C) $\Delta S = \frac{q_{rev}}{T}$ (D) $\Delta H = \Delta U - \Delta nRT$

Choose the most appropriate answer from the options given below :

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

(3) A and B only (4) B and D only

Official Ans. by NTA (2)

Ans. (2)

Sol. Only (B) and (C) are correct.

(B) $G = H - TS$

At constant T

$\Delta G = \Delta H - T\Delta S$

(A) First law is given by

$\Delta U = Q + W$

If we apply constant P and reversible work.

$\Delta U = Q - P\Delta V$

(C) By definition of entropy change

$dS = \frac{dq_{rev}}{T}$

At constant T

$\Delta S = \frac{q_{rev}}{T}$

(D) $H = U + PV$

For ideal gas

$H = U + nRT$

At constant T

$\Delta H = \Delta U + \Delta nRT$

48. The major component of which of the following ore is sulphide based mineral?

(1) Calamine (2) Siderite

(3) Sphalerite (4) Malachite

Official Ans. by NTA (3)

Ans. (3)

Sol. Calamine : $ZnCO_3$

Siderite : $FeCO_3$

Sphalerite : ZnS

Malachite : $CuCO_3.Cu(OH)_2$

49. Given below are two statements:

Statement I : Nickel is being used as the catalyst for producing syn gas and edible fats.

Statement II : Silicon forms both electron rich and electron deficient hydrides.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both the statements I and II are correct

(2) Statement I is incorrect but statement II is correct

(3) Both the statements I and II are incorrect

(4) Statement I is correct but statement II is incorrect

Official Ans. by NTA (4)

Ans. (4)

Sol. Statement–I is correct.

Ni is used in Hydrogenation of unsaturated fat to make edible fats.

Statements–II is false as hydride of Silicon is electron precise & neither electron deficient nor electron rich.

50. Match **List I** with **List II**.

List I		List II	
A.	van't Hoff factor, i	I.	Cryoscopic constant
B.	k_f	II.	Isotonic solutions
C.	Solutions with same osmotic pressure	III.	$\frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$
D.	Azeotropes	IV.	Solutions with same composition of vapour above it

Choose the correct answer from the options given below :

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

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

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

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

Official Ans. by NTA (1)

Ans. (1)

Sol. (A) van't Hoff factor, i

$i = \frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$

(B) k_f = Cryoscopic constant

(C) Solutions with same osmotic pressure are known as isotonic solutions.

(D) Solutions with same composition of vapour over them are called Azeotrope.

SECTION-B

51. On heating, $LiNO_3$ gives how many compounds among the following?

Li_2O, N_2, O_2, $LiNO_2$, NO_2

Official Ans. by NTA (3)

Ans. (3)

Sol. $2\,LiNO_3 \xrightarrow{\Delta} Li_2O + 2NO_2 + \frac{1}{2}O_2$

Hence three products Li_2O, NO_2 and O_2

52. At 298 K

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g), K_1 = 4 \times 10^5$

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g), K_2 = 1.6 \times 10^{12}$

$H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(g), K_3 = 1.0 \times 10^{-13}$

Based on above equilibria, the equilibrium constant of the reaction,

$2NH_3(g) + \frac{5}{2}O_2(g) \rightleftharpoons 2NO(g) + 3H_2O(g)$

is ___ $\times 10^{-33}$ (Nearest integer)

Official Ans. by NTA (4)

Ans. (4)

Sol. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g), K_1 = 4 \times 10^5$ ...(i)

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g), K_2 = 1.6 \times 10^{12}$ ...(ii)

$H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(g), K_3 = 1.0 \times 10^{-13}$ ...(iii)

(ii) + 3×(iii) – (i)

$2NH_3(g) + \frac{5}{2}O_2(g) \rightleftharpoons 2NO(g) + 3H_2O(g)$

$k_{eq} = \frac{k_2 \times k_3^3}{k_1} = \frac{1.6 \times 10^{12} \times (10^{-13})^3}{4 \times 10^5}$

$= \frac{1.6}{4} \times 10^{-32} = 4 \times 10^{-33}$

53. For conversion of compound A $\rightarrow$B, the rate constant of the reaction was found to be 4.6×10^{-5} L mol^{-1} s^{-1}. The order of the reaction is _____ .

Official Ans. by NTA (2)

Ans. (2)

Sol. As unit of rate constant is $(conc.)^{1-n}$ $time^{-1}$

$\Rightarrow$ (L mol^{-1}) $\Rightarrow$ 1–n = –1

n = 2

54. Total number of acidic oxides among N_2O_3, NO_2, N_2O, Cl_2O_7, SO_2, CO, CaO, Na_2O and NO is _____ .

Official Ans. by NTA (4)

Ans. (4)

Sol. Acidic oxides are N_2O_3, NO_2, Cl_2O_7, SO_2

55. When 0.01 mol of an organic compound containing 60% carbon was burnt completely, 4.4 g of CO_2 was produced. The molar mass of compound is _____ g mol^{-1} (Nearest integer)

Official Ans. by NTA (200)

Ans. (200)

Sol. Let M is the molar mass of the compound (g/mol)

mass of compound = 0.01 M gm

mass of carbon = $0.01\ M \times \frac{60}{100}$

moles of carbon = $\frac{0.01M}{12} \times \frac{60}{100}$

moles of CO_2 from combustion = $\frac{4.4}{44}$ = moles of carbon

$\frac{0.01M}{12} \times \frac{60}{100} = \frac{4.4}{44}$

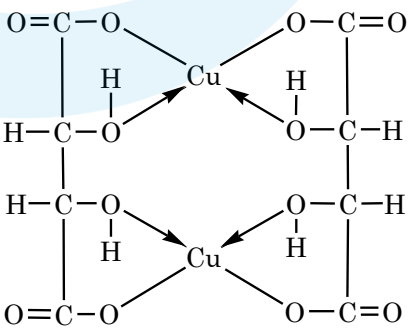
$M = \frac{4.4}{44} \times \frac{100}{60} \times \frac{12}{0.01} = 200 gm/mol$

56. The denticity of the ligand present in the Fehling's reagent is _____ .

Official Ans. by NTA (4)

Ans. (4)

Sol.



Copper tartarate complex

Denticity = 2

57. A metal M forms hexagonal close-packed structure. The total number of voids in 0.02 mol of it is _____ $\times 10^{21}$ (Nearest integer)
(Given $N_A = 6.02 \times 10^{23}$)

Official Ans. by NTA (36)

Ans. (36)

Sol. One unit cell of hcp contains = 18 voids

No. of voids in 0.02 mol of hcp

$$= \frac{18}{6} \times 6.02 \times 10^{23} \times 0.02$$

$$\approx 3.6 \times 10^{22}$$

$$\approx 36 \times 10^{21}$$

58. Assume that the radius of the first Bohr orbit of hydrogen atom is 0.6 Å. The radius of the third Bohr orbit of He^+ is _____ picometer. (Nearest Integer)

Official Ans. by NTA (270)

Ans. (270)

Sol. $r \propto \frac{n^2}{Z}$

$$r_{He^+} = r_H \times \frac{n^2}{Z}$$

$$r_{He^+} = 0.6 \times \frac{(3)^2}{2}$$

$$= 2.7 \text{ Å}$$

$$r_{He^+} = 270 \text{pm}$$

59. The equilibrium constant for the reaction $Zn(s) + Sn^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Sn(s)$ is 1×10^{20} at 298 K. The magnitude of standard electrode potential of Sn/Sn^{2+} if $E^o_{Zn^{2+}/Zn} = -0.76$ V is _____ $\times 10^{-2}$ V. (Nearest integer)

Given : $\frac{2.303RT}{F} = 0.059V$

Official Ans. by NTA (17)

Ans. (17)

Sol. $Zn(s) + Sn^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Sn(s)$

$$\Delta G^\circ = -2.303RT \log_{10} Keq$$

$$-nF\left(E^0_{cell}\right) = -2.303RT \log_{10} Keq$$

$$E^0_{Zn/Zn^{2+}} + E^0_{Sn^{2+}/Sn} = \frac{0.059}{2} \log_{10} Keq$$

$$0.76 + E^0_{Sn^{2+}/Sn} = \frac{0.059}{2} \log_{10} 10^{20}$$

$$0.76 + E^0_{Sn^{2+}/Sn} = \frac{0.059 \times 20}{2}$$

$$E^0_{Sn^{2+}/Sn} = 0.59 - 0.76 = -0.17$$

$$E^0_{Sn/Sn^{2+}} = 17 \times 10^{-2} \text{ V}$$

Ans. = 17

60. The volume of HCl, containing 73 g L^{-1}, required to completely neutralise NaOH obtained by reacting 0.69 g of metallic sodium with water, is _____ mL. (Nearest Integer)
(Given : molar Masses of Na, Cl, O, H are 23, 35.5, 16 and 1 g mol^{-1} respectively)

Official Ans. by NTA (15)

Ans. (15)

Sol. Mole of Na $= \frac{0.69}{23} = 3 \times 10^{-2}$

$$Na + H_2O \longrightarrow NaOH + \frac{1}{2} H_2$$

By using POAC

Moles of NaOH = 3×10^{-2}

NaOH reacts with HCl

No. of equivalent of NaOH = No. of equivalent of HCl

$$3 \times 10^{-2} \times 1 = \frac{73}{36.5} \times V(\text{in L}) \times 1$$

$V = 1.5 \times 10^{-2}$ L

Volume of HCl = 15 ml.