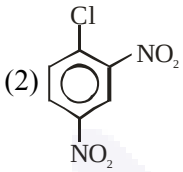
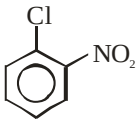
FINAL JEE–MAIN EXAMINATION – JANUARY, 2023
Held On Wednesday 25th January, 2023
TIME : 09:00 AM to 12:00 PM

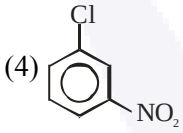
SECTION-A

31. The compound which will have the lowest rate towards nucleophilic aromatic substitution on treatment with OH^- is

(1) 

(2) 

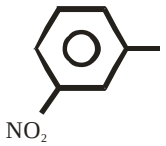
(3) 

(4) 

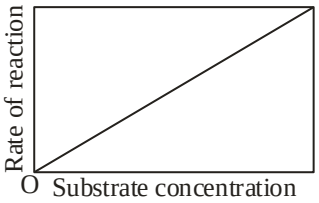
Official Ans. by NTA (4)

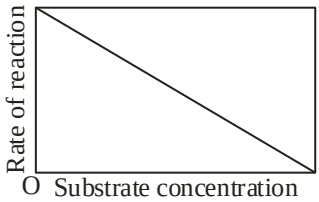
Ans. (4)

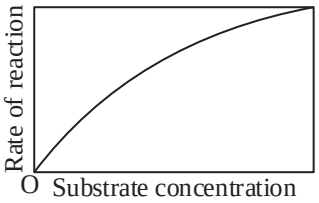
Sol. Electron withdrawing groups are highly ineffective at meta position in nucleophilic aromatic substitution reactions.

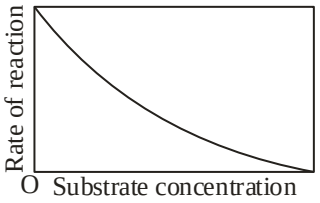
Hence compound  will have lowest rate in nucleophilic aromatic substitution.

32. The variation of the rate of an enzyme catalyzed reaction with substrate concentration is correctly represented by graph

(a) 

(b) 

(c) 

(d) 

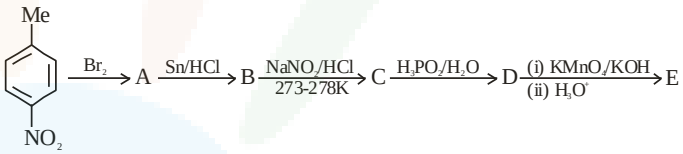
(1) b (2) c (3) d (4) a

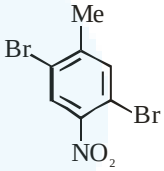
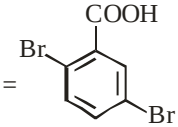
Official Ans. by NTA (2)

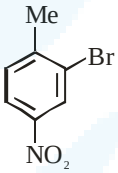
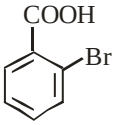
Ans. (2)

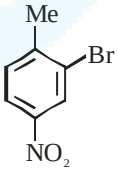
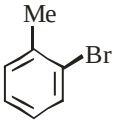
Sol. Fact base.

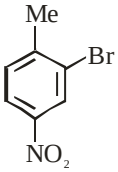
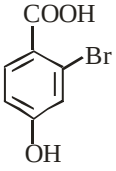
33. Identify the product formed (A and E)



(1) A =  , E = 

(2) A =  , E = 

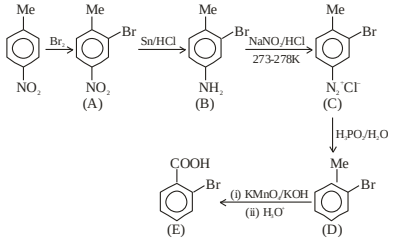
(3) A =  , E = 

(4) A =  , E = 

Official Ans. by NTA (2)

Ans. (2)

Sol.



34. Match List I with List II

List I		List II	
Elements		Colour imparted to the flame	
A	K	I	Brick Red
B	Ca	II	Violet
C	Sr	III	Apple Green
D	Ba	IV	Crimson Red

Choose the correct answer from the options given below:

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

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

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

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

Official Ans. by NTA (3)

Ans. (3)

Sol.

Element	Colour in flame test
K	Violet
Ca	Brick red
Sr	Crimson red
Ba	Apple green

35. Reaction of thionyl chloride with white phosphorus forms a compound [A], which on hydrolysis gives [B], a dibasic acid. [A] and [B] are respectively

(1) P_4O_6 and H_3PO_3

(2) PCl_3 and H_3PO_3

(3) PCl_5 and H_3PO_4

(4) $POCl_3$ and H_3PO_4

Official Ans. by NTA (2)

Ans. (2)

Sol. $P_4 + 8SOCl_2 \rightarrow \underset{[A]}{4PCl_3} + 4SO_2 + 2S_2Cl_2$

$PCl_3 + 3H_2O \rightarrow \underset{[B]}{H_3PO_3} + 3HCl$

36. A cubic solid is made up of two elements X and Y. Atoms of X are present on every alternate corner and one at the center of cube. Y is at $\frac{1}{3}^{rd}$ of the total faces. The empirical formula of the compound is

(1) $X_2Y_{1.5}$ (2) $X_{2.5}Y$

(3) $XY_{2.5}$ (4) $X_{1.5}Y_2$

Official Ans. by NTA (2)

Ans. (Bonus)

Sol. $X_{4\times\frac{1}{8}+1\times1}\ Y_{6\times\frac{1}{3}\times\frac{1}{2}}$

$\Rightarrow X_{\frac{1}{2}+1}\ Y_1$

$\Rightarrow X_{\frac{2}{3}}\ Y_1$

$\Rightarrow X_{1.5}\ Y_1$

$\Rightarrow X_3\ Y_2$

37. The radius of the 2nd orbit of Li^{2+} is x. The expected radius of the 3rd orbit of Be^{3+} is

(1) $\frac{9}{4}x$ (2) $\frac{4}{9}x$

(3) $\frac{27}{16}x$ (4) $\frac{16}{27}x$

Official Ans. by NTA (3)

Ans. (3)

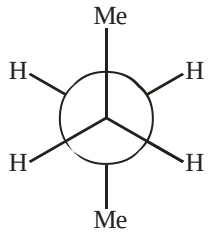
Sol. Li^{2+} | Be^{3+}

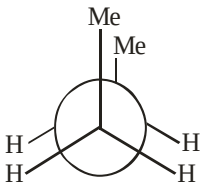
$r_2 = x = k\times\frac{2^2}{3} = \frac{4k}{2}$ | $r_3 = y = k\times\frac{3^2}{4}$

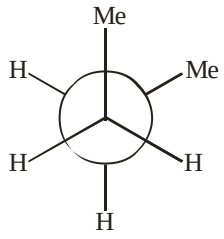
$\frac{y}{x} = \frac{9}{4}\times\frac{3}{4} = \frac{27}{16}$

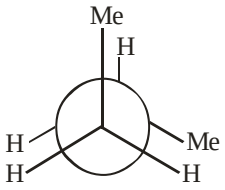
$y = \frac{27}{16}x$

38. Which of the following conformations will be the most stable ?

(1) 

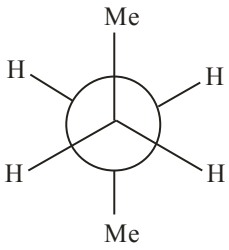
(2) 

(3) 

(4) 

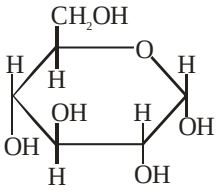
Official Ans. by NTA (1)

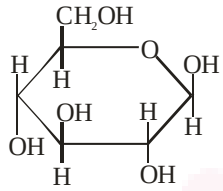
Ans. (1)

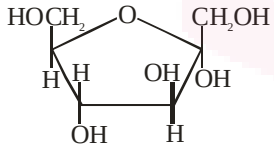
Sol. Conformation  has lowest vanderwaal and torsional strain. Hence it must be most stable.

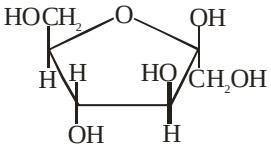
39. Match items of Row I with those of Row II.

Row I :

(P) 

(Q) 

(R) 

(S) 

Row II :

(i) α-D-(–) Fructofuranose.

(ii) β-D-(–) Fructofuranose

(iii) α-D-(-) Glucopyranose.

(iv) β-D-(-) Glucopyranose

Correct match is

(1) P→iv, Q→iii, R→i, S→ii

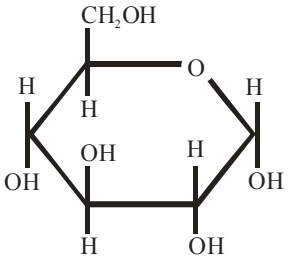
(2) P→i, Q→ii, R→iii, S→iv

(3) P→iii, Q→iv, R→ii, S→i

(4) P→iii, Q→iv, R→i, S→ii

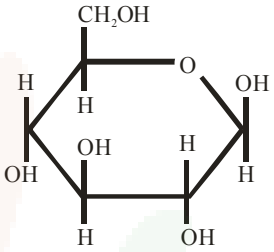
Official Ans. by NTA (4)

Ans. (4)

Sol. Structure 

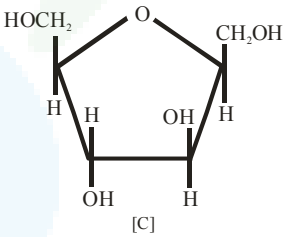
[A]

Represents α-D-(+) Glucopyranose

Structure 

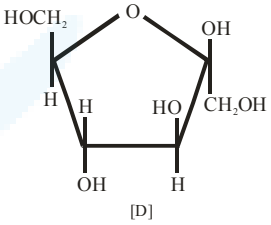
[B]

Represents β-D-(+) Glucopyranose

Structure 

[C]

Represents β-D-(–) Fructofuranose

Structure 

[D]

Represents β-D-(–) Fructofuranose

(from the given options best answer is D)

40. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R** :

Assertion A : Acetal/Ketal is stable in basic medium.

Reason R : The high leaving tendency of alkoxide ion gives the stability to acetal/ketal in basic medium.

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

(1) A is true but R is false

(2) A is false but R is true

(3) Both A and R are true and R is the correct explanation of A

(4) Both A and R are true but R is NOT the correct explanation of A

Official Ans. by NTA (1)

Ans. (1)

Sol. For Assertion :Acetal and ketals are basically ethers hence they must be stable in basic medium but should break down in acidic medium.

Hence assertion is correct.

For reason: Alkoxide ion (RO^-) is not considered a good leaving group hence reason must be false.

41. Inert gases have positive electron gain enthalpy. Its correct order is

(1) Xe < Kr < Ne < He

(2) He < Ne < Kr < Xe

(3) He < Xe < Kr < Ne

(4) He < Kr < Xe < Ne

Official Ans. by NTA (3)

Ans. (3)

Sol.

Element	ΔegH[KJ/mol]
He	+48
Ne	+116
Kr	+96
Xe	+77

From NCERT

So, order is Ne > Kr >Xe> He

42. Which one of the following reactions does not occur during extraction of copper ?

(1) $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$

(2) $2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$

(3) $CaO + SiO_2 \rightarrow CaSiO_3$

(4) $FeO + SiO_2 \rightarrow FeSiO_3$

Official Ans. by NTA (3)

Ans. (3)

Sol. $CuFeS_2 + O_2 \xrightarrow{\text{Partial roasting}}$

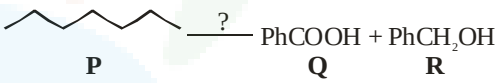
$Cu_2S + FeO + SO_2 + \underset{\text{very small}}{FeS} + \underset{\text{very small}}{Cu_2O}$

$Cu_2S + O_2 \rightarrow Cu_2O + SO_2$

$FeS + O_2 \rightarrow FeO + SO_2$

$FeO + SiO_2 \rightarrow FeSiO_3$

No formation of calcium silicate ($CaSiO_3$) in extraction of Cu.

43. 

The correct sequence of reagents for the preparation of Q and R is :

(1) (i) Cr_2O_3, 770 K, 20 atm ;
(ii) CrO_2Cl_2, H_3O^+ ;
(iii) NaOH ;
(iv) H_3O^+

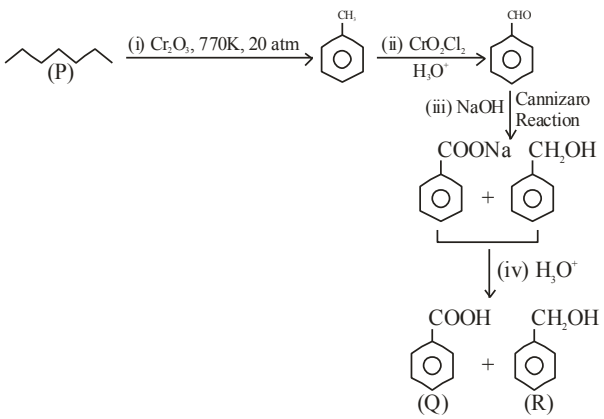
(2) (i) CrO_2Cl_2, H_3O^+ ; (ii) Cr_2O_3, 770 K, 20 atm;
(iii) NaOH ; (iv) H_3O^+

(3) (i) $KMnO_4$, OH^- ; (ii) Mo_2O_3, A; (iii) NaOH ;
(iv) H_3O^+

(4) (i) Mo_2O_3, Δ ; (ii) CrO_2Cl_2, H_3O^+ ; (iii) NaOH ;
(iv) H_3O^+

Official Ans. by NTA (1)

Ans. (1)

Sol. 

44. The correct order in aqueous medium of basic strength in case of methyl substituted amines is :

(1) $Me_2NH > MeNH_2 > Me_3N > NH_3$

(2) $Me_2NH > Me_3N > MeNH_2 > NH_3$

(3) $NH_3 > Me_3N > MeNH_2 > Me_2NH$

(4) $Me_3N > Me_2NH > MeNH_2 > NH_3$

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. In aqueous medium basic strength is dependent on electron density on nitrogen as well as solvation of cation formed after accepting H^+. After considering all these factors overall basic strength order is $Me_2NH > MeNH_2 > Me_3N > NH_3$

45. '25 volume' hydrogen peroxide means

(1) 1 L marketed solution contains 250 g of H_2O_2.

(2) 1 L marketed solution contains 75 g of H_2O_2.

(3) 100 mL marketed solution contains 25 g of H_2O_2.

(4) 1 L marketed solution contains 25 g of H_2O_2.

Official Ans. by NTA (2)

Ans. (2)

Sol.

Volume = 11.35 × M

Strength

$$M = \frac{25}{11.35} M$$

g/L = 25 × 34/11.35

= 74.889

46. Which of the following statements is incorrect for antibiotics?

(1) An antibiotic must be a product of metabolism.

(2) An antibiotic is a synthetic substance produced as a structural analogue of naturally occurring antibiotic.

(3) An antibiotic should promote the growth or survival of microorganisms.

(4) An antibiotic should be effective in low concentrations.

Official Ans. by NTA (3)

Ans. (3)

Sol. An antibiotic should not promote growth or survival of microorganisms. Antibiotics should inhibit growth of microbes.

47. Compound A reacts with NH_4Cl and forms a compound B. Compound B reacts with H_2O and excess of CO_2 to form compound C which on passing through or reaction with saturated NaCl solution forms sodium hydrogen carbonate. Compound A. B and C, are respectively.

(1) $CaCl_2$, NH_3, NH_4HCO_3

(2) $CaCl_2$, NH_4^+, $(NH_4)_2CO_3$

(3) $Ca(OH)_2$, NH_3, NH_4HCO_3

(4) $Ca(OH)_2$, NH_4^+, $(NH_4)_2CO_3$

Official Ans. by NTA (3)

Ans. (3)

Sol.

$$\underset{(A)}{Ca(OH)_2} + 2NH_4Cl \xrightarrow{\Delta} \underset{(B)}{2NH_3} + CaCl_2 + 2H_2O$$

$$\underset{(B)}{NH_3} + H_2O + \underset{(exc)}{CO_2} \longrightarrow \underset{(C)}{NH_4HCO_3}$$

$$\underset{(C)}{NH_4HCO_3} + NaCl \longrightarrow NaHCO_3 \downarrow + NH_4Cl$$

48. Some reactions of NO_2 relevant to photochemical smog formation are

$$NO_2 \xrightarrow{\text{Sunlight}} \begin{matrix} X + Y \\ | \\ A \\ | \\ B \end{matrix}$$

Identify A, B, X and Y

(1) X = [O], Y = NO, A = O_2, B = O_3

(2) X = N_2O, Y = [O], A = O_3, B = NO

(3) X = $\frac{1}{2}O_2$, Y = NO_2, A = O_3, B = O_2

(4) X = NO, Y = [O], A = O_2, B = N_2O_3

Official Ans. by NTA (1)

Ans. (1)

Sol.

$$NO_2 \xrightarrow{\text{Sun light}} \underbrace{[O]}_{X} + \underbrace{NO}_{Y}$$

$$\Big| \; O_2 \} A$$

$$\underbrace{O_3}_{B}$$

49. Match the **List-I** with **List-II** :

Cations	Group reaction
P → Pb^{2+}, Cu^{2+}	(i) H_2S gas in presence of dilute HCl
Q → Al^{3+}, Fe^{3+}	(ii) $(NH_4)_2CO_3$ in presence of NH_4OH
R → Co^{2+}, Ni^{2+}	(iii) NH_4OH in presence of NH_4CI
S → Ba^{2+}, Ca^{2+}	(iv) H_2S in presence of NH_4OH

(1) P→i, Q→iii, R→ii, S→iv

(2) P→iv, Q→ii, R→iii, S→i

(3) P→iii, Q→i, R→iv, S→ii

(4) P→i, Q→iii, R→iv, S→ii

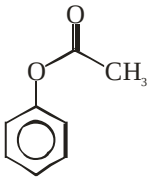
Official Ans. by NTA (4)

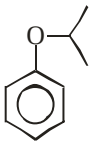
Ans. (4)

Sol.

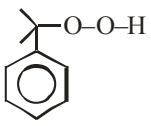
Cations	Group No.	Group reagent
Pb^{+2},Cu^{+2}	II	H_2S(g) in presence of dilHCl
Al^{+3}, Fe^{+3}	III	NH_4OH in presence of NH_4Cl
CO^{+2}, Ni^{+2}	IV	H_2S in presence of NH_4OH
Ba^{+2}, Ca^{+2}	V	$(NH_4)_2CO_3$ in presence of NH_4OH

50. In the cumene to phenol preparation in presence of air, the intermediate is

(1) 

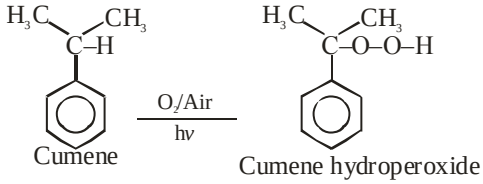
(2) 

(3) 

(4) 

Official Ans. by NTA (4)

Ans. (4)

Sol. 

SECTION-B

51. An athlete is given 100 g of glucose ($C_6H_{12}O_6$) for energy. This is equivalent to 1800 kJ of energy. The 50% of this energy gained is utilized by the athlete for sports activities at the event. In order to avoid storage of energy, the weight of extra water he would need to perspire is_____g (Nearest integer)

Assume that there is no other way of consuming stored energy.

Given : The enthalpy of evaporation of water is 45 kJ mol^{-1}

Molar mass of C, H & O are 12. 1 and 16 g mol^{-1}.

Official Ans. by NTA (360)

Ans. (360)

Sol. $C_6H_{12}O_6(s) + 6O_2 \rightarrow 6CO_2(g) + 6H_2O(l)$

Extra energy used to convert $H_2O(l)$ into $H_2O(l)$ into $H_2O(g)$

$$= \frac{1800}{2} = 900\text{kJ}$$

$$\Rightarrow \quad 900 = n_{H_2O} \times 45$$

$$n_{H_2O} = \frac{900}{45} = 20 \text{ mole}$$

$$W_{H_2O} = 20 \times 18 = 360 \text{ g}$$

52. A litre of buffer solution contains 0.1 mole of each of NH_3 and NH_4Cl. On the addition of 0.02 mole of HCl by dissolving gaseous HCl, the pH of the solution is found to be _____$\times 10^{-3}$ (Nearest integer)

[**Given** : $pK_b(NH_3) = 4.745$

log 2 = 0.301

log 3 = 0.477

T = 298 K]

Official Ans. by NTA (9079)

Ans. (9079)

Sol. In resultant solution

$$n_{NH_3} = 0.1 - 0.02 = 0.08$$

$$n_{NH_4Cl} = n_{NH_4^+} = 0.1 + 0.02 = 0.12$$

$$pOH = pK_b + \log\frac{[NH_4^+]}{[NH_3]}$$

$$= 4.745 + \log\frac{0.12}{0.08}$$

$$= 4.745 + \log\frac{3}{2}$$

$$= 4.745 + 0.477 - 0.301$$

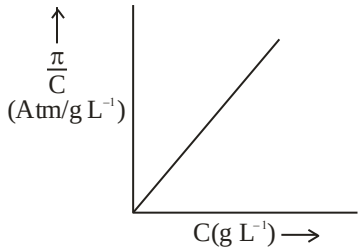
$$pOH = 4.921$$

$$pH = 14 - pH$$

$$= 9.079$$

53. The osmotic pressure of solutions of PVC in cyclohexanone at 300 K are plotted on the graph.

The molar mass of PVC is_____g mol^{-1} (Nearest integer)



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

Official Ans. by NTA (41500)

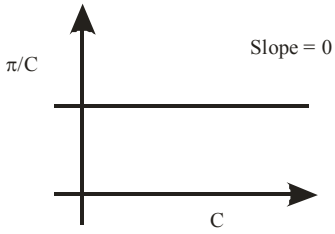
Ans. (Bonus/41500)

Sol. $\pi = M'RT = \left(\frac{W/M}{V}\right)RT$

$$\Rightarrow \quad \pi = \left(\frac{W}{V}\right)\left(\frac{1}{M}\right)RT = C\left(\frac{RT}{M}\right)$$

$$\Rightarrow \quad \frac{\pi}{C} = \frac{RT}{M} \neq f(c)$$

If we assume graph between $\frac{\pi}{C}$ and C



Assuming π vs C graph

$$\text{Slope} = \frac{RT}{M} = \frac{0.083 \times 300}{M} = 6 \times 10^{-4}$$

$$\therefore \quad M = \frac{0.083 \times 300}{6 \times 10^{-4}} = \frac{830 \times 300}{6}$$

= 41,500 gm/mole

54. How many of the following metal ions have similar value of spin only magnetic moment in gaseous state ?_____

(Given: Atomic number : V, 23 ; Cr, 24 ; Fe, 26 ; Ni, 28)

V^{3+}. Cr^{3+}, Fe^{2+}, Ni^{3+}

Official Ans. by NTA (2)

Ans. (2)

Sol. $\mu_s = \sqrt{n(n+2)}BM$ (n=no. of unpaired electrons)

	n
V^{3+} : [Ar] $3d^2 4s^0$	2
Cr^{3+} : [Ar] $3d^3 4s^0$	3
Fe^{2+} : [Ar] $3d^6 4s^0$	4
Ni^{3+} : [Ar] $3d^7 4s^0$	3

Cr^{3+}& Ni^{3+} have same value of μ_s

55. The density of a monobasic strong acid (Molar mass 24.2 g mol) is 1.21 kg L. The volume of its solution required for the complete neutralization of 25 mL of 0.24 M NaOH is_____× 10^{-2} mL (Nearest integer)

Official Ans. by NTA (12)

Ans. (12)

Sol. millimole of NaOH = 0.24 × 25

$\therefore$ millimole of acid = 0.24 × 25

$\Rightarrow$ mass of acid = 0.24 × 25 × 24.2 mg

for pure acid,

$$V = \frac{w}{d};\ (d = 1.21\ kg/L\ = 1.21\ g/ml)$$

$$\therefore V = \frac{0.24 \times 25 \times 24.2}{1.12} \times 10^{-3}$$

$= 120 \times 10^{-3}$ ml

$= 12 \times 10^{-2}$ ml

56. For the first order reaction A $\rightarrow$ B Br the half life is 30 mm. The time taken for 75% completion of the reaction is_____mm. (Nearest mteger)

Given : log 2 = 0.3010

log 3 = 0.4771

log 5 = 0.6989

Official Ans. by NTA (60)

Ans. (60)

Sol. $t_{1/2} = T_{50} = 30$ min

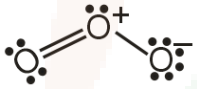
$T_{75} = 2t_{1/2} = 30 \times 2 = 60$ min

57. The total number of lone pairs of electrons on oxygen atoms of ozone is_____

Official Ans. by NTA (6)

Ans. (6)

Sol. (Total no, of lone pairs on oxygen atoms = 6



58. In sulphur estimation. 0.471 g of an organic compound gave 1.4439 g of barium sulphate.

The percentage of sulphur in the compound is_____(Nearest Integer)

(Given: Atomic mass Ba: 137 u: S: 32 u, O: 16 u)

Official Ans. by NTA (42)

Ans. (42)

Sol

$$\%\text{sulphur} = \frac{32}{233} \times \frac{\text{weight of } BaSO_4 \text{formed}}{\text{weight of organic compound}} \times 100$$

$$= \frac{32}{233} \times \frac{1.4439}{0.471} \times 100$$

$= 42.10$

Nearest integer 42

59. The number of paramagnetic species from the following is_____.

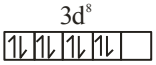
$[Ni(CN)_4]^{2-}$, $[Ni(CO)_4]$, $[NiCl_4]^{2-}$

$[Fe(CN)_6]^{4-}$, $[Cu(NH_3)_4]^{2+}$

$[Fe(CN)_6]^{3-}$ and $[Fe(H_2O)_6]^{2+}$

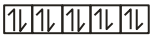
Official Ans. by NTA (4)

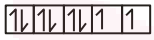
Ans. (4)

Sol. $\left[Ni(CN)_4\right]^{2-}: Ni^{+2} =$  :

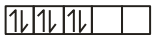
diamagnetic

^-CN : strong field ligand

$\left[Ni(CO)_4\right]: Ni =$  :diamagnetic

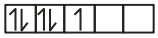
$[NiCl_4]^{2-}: Ni^{2+} =$  :paramagnetic

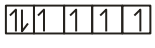
Cl^- : weak field ligand

$\left[Fe(CN)_6\right]^{4-}: Fe^{2+}$  :diamagnetic

^-CN : strong field ligand

$[Cu(NH_3)_4]^{+2}$: $Cu^{+2} \Rightarrow$ one unpaired electron : paramagnetic

$[Fe(CN)_6]^{3-}$: Fe^{+3} :  : paramagnetic, ^-CN : strong field ligand

$[Fe(H_2O)_6]^{2+}$: Fe^{2+} :  : paramagnetic H_2O : Weak field ligand

60. Consider the cell

$$Pt(s)\left|H_2(s)(1atm)\right|H^+(aq,[H^+]=1)\left\|Fe^{3+}(aq),Fe^{2+}(aq)\right|Pt(s)$$

Given : $E^\circ_{Fe^{3+}/Fe^{2+}} = 0.771V$ and $E^\circ_{H^+/\frac{1}{2}H_2} = 0V, T = 298K$

If the potential of the cell is 0.712 V the ratio of concentration of Fe^{2+} to Fe^{2+} is_____(Nearest integer)

Official Ans. by NTA (10)

Ans. (10)

Sol. $\frac{1}{2}H_2(g) + Fe^{3+}(aq.) \longrightarrow H^+(aq) + Fe^{2+}(aq.)$

$$E = E^o - \frac{0.059}{1}\log\frac{[Fe^{2+}]}{[Fe^{3+}]}$$

$$\Rightarrow \quad 0.712 = (0.771 - 0) - \frac{0.059}{1}\log\frac{[Fe^{2+}]}{[Fe^{3+}]}$$

$$\Rightarrow \quad \log\frac{[Fe^{2+}]}{[Fe^{3+}]} = \frac{(0.771 - 0712)}{0.059} = 1$$

$$\Rightarrow \quad \frac{[Fe^{2+}]}{[Fe^{3+}]} = 10$$