FINAL JEE–MAIN EXAMINATION – JANUARY, 2023

(Held On Tuesday 31st January, 2023) **TIME : 9 : 00 AM to 12 : 00 NOON**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

31. Nd^{2+} = _____

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

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

Official Ans. by NTA (2)

Allen Ans. (2)

Sol Nd(60) = [Xe] $4f^4\ 5d^0\ 6s^2$

Nd^{2+} = [Xe] $4f^4\ 5d^0\ 5s^0$

32. 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) C, D and E only

(3) A and C only

(4) B, D and E only

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Methods involved in concentration of one are

(i) Hydraulic Washing

(ii) Froth Flotation

(iii) Magnetic Separation

(iv) Leaching

33. Consider the following reaction

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

The correct statement for product B is. It is

(1) optically active and adds one mole of bromine

(2) racemic mixture and is neutral

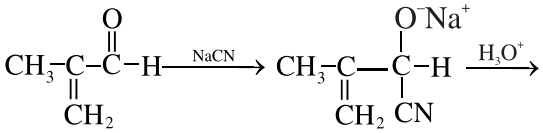
(3) racemic mixture and gives a gas with saturated $NaHCO_3$ solution

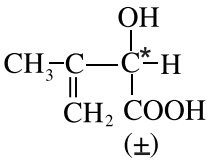
(4) optically active alcohol and is neutrall

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. $CH_3-CH_2-CHO + HCHO \xrightarrow[\Delta]{OH^-}$





Carboxylic acid will give CO_2 gas, with $NaHCO_3$ solution

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

(1) $V_2O_3 > V_2O_4 > V_2O_5$

(2) $V_2O_3 > V_2O_5 > V_2O_4$

(3) $V_2O_5 > V_2O_4 > V_2O_3$

(4) $V_2O_4 > V_2O_3 > V_2O_5$

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. With increase in % of oxygen acidic nature of oxide of an element increase and basic nature decreases

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) $X = Cu_2I_2$ $Y=Na_2S_4O_5$

(2) $X=Cu_2I_2$ $Y=Na_2S_4O_6$

(3) $X=CuI_2$ $Y=Na_2S_4O_3$

(4) $X=CuI_2$ $Y=Na_2S_4O_6$

Official Ans. by NTA (2)

Allen Ans. (2)

Sol.

$$Cu^{2+} + 2KI \longrightarrow \underset{\text{Unstable}}{CuI_2}\downarrow + 2K^+$$

I^- is strong R.A it reduces Cu^{2+} to Cu^+

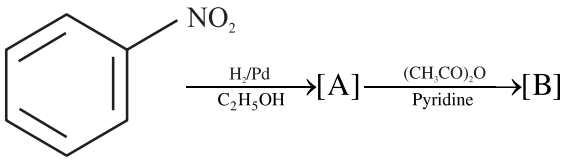
$$2CuI_2 \longrightarrow \underset{\text{(White) 'X'}}{Cu_2I_2}\downarrow + I_2$$

$$KI + I_2 \longrightarrow K^+I_3^- (\text{Brown solution})$$

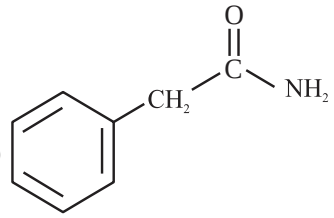
$$I_3^- \rightleftharpoons I_2 + I^-$$

$$KI_3 + Na_2S_2O_3 \rightarrow KI + \underset{(Y)}{Na_2S_4O_6}$$

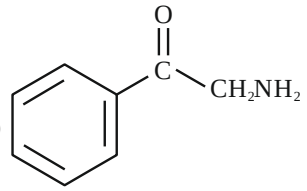
36.



(1)



(2)



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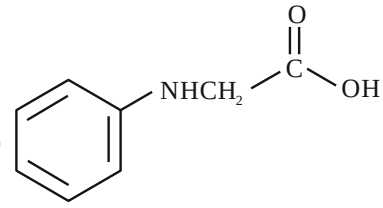

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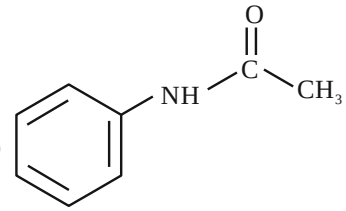
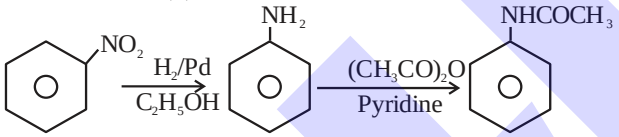


Official Ans. by NTA (4)
Allen Ans. (4)

Sol.



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

(1) X=$[Co(H_2O)_6]^{2+}$, Y=$[CoCl_4]^{2-}$, Z=Tetrahedral
(2) X=$[Co(H_2O_6)]^{2+}$, Y=$[CoCl_6]^{3-}$, Z=Octahedral
(3) X=$[Co(H_2O)_6]^{3+}$, Y=$[CoCl_6]^{3-}$, Z=Octahedral
(4)X=$[Co(H_2O)_4Cl_2]^{+}$, Y=$[CoCl_4]^{2-}$, Z=Tetrahedral

Official Ans. by NTA (1)
Allen Ans. (1)

Sol.

$$CoCl_2 + 6H_2O \longrightarrow [Co(H_2O)_6]Cl_2$$

Pink(X)
octahedral
$\downarrow$ +HCl(conc.)
$[CoCl_4]^{2-}$
(Y)Blue solution
(Z)Tetrahedral

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

$$\dot{Cl}O + NO_2 \rightarrow \underline{X} \xrightarrow{H_2O} \underline{Y} + \underline{Z}$$

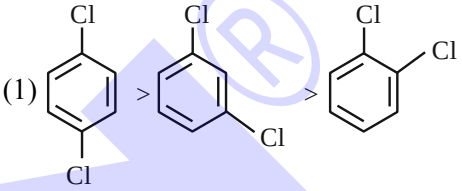
(1) X=$ClONO_2$, Y=HOCl, Z = NO_2
(2) X=$ClNO_2$, Y=HCl, Z=HNO_3
(3) X=$ClONO_2$, Y=HOCl, Z=HNO_3
(4) X=$ClNO_3$, Y=Cl_2, Z=NO_2

Official Ans. by NTA (3)
Allen Ans. (3)

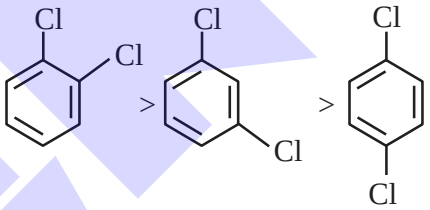
Sol. $\dot{Cl}O + NO_2 \longrightarrow \underset{(X)}{ClONO_2} \xrightarrow{+H_2O} \underset{(Y)}{HOCl} + \underset{(Z)}{HNO_3}$

39. The correct order of melting point of dichlorobenzenes is

(1)



(2)



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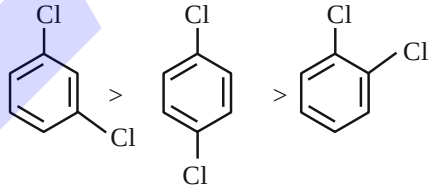
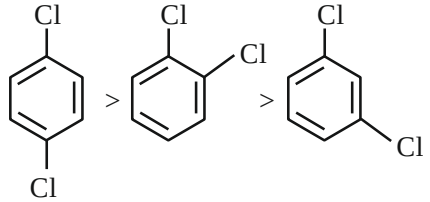
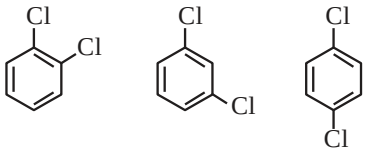


(4)

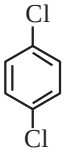


Official Ans. by NTA (4)
Allen Ans. (4)

Sol.

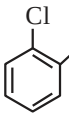


b.p / K	453	446	448
m.p / K	256	249	323



$\Rightarrow$ More Symmetrical & better Crystal fitting

M.P a Packing efficiency



$\Rightarrow \mu_{max}$

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

(1) $NH_2-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2CH_2COOH$

(2) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH$

(3) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\underset{\displaystyle NH_2}{\underset{|}{CH}}-CH_2COOH$

(4) $CH_3-\underset{\displaystyle NH_2}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}-CH_2-CH_2COOH$

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. Only in option (2) α-Amino acid is given all the other options are not α-Amino acids.

41. 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 = 1 to n = 3

(3) n = 1 to n = 2

(4) n = 3 to n = 4

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. He^+ ion :

$$\frac{1}{\lambda(H)} = R(1)^2\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$$

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

Given $\lambda(H) = \lambda(He^+)$

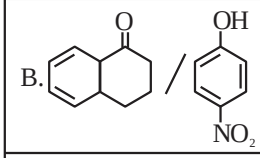
$$R(1)^2\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right] = R(4)\left[\frac{1}{2^2}-\frac{1}{4^2}\right]$$

$$\frac{1}{n_1^2}-\frac{1}{n_2^2} = \frac{1}{1^2}-\frac{1}{2^2}$$

On comparing n_1=1 & n_2=2

Ans. 1

42. Match items of column 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-(iii), B-(iv), C-(ii), D-(i)

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

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

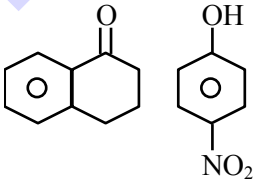
(4) A-(ii), B-(iv), C-(i), D-(iii)

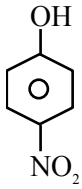
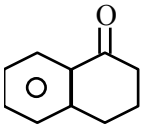
Official Ans. by NTA (3)

Allen Ans. (3)

Sol. **A.** $H_2O/CH_2Cl_2 \rightarrow$ ii, $CH_2Cl_2 > H_2O$ (density) so they can be separated by differential solvent extraction.

B.

 iii. column chromatography

Due to H-bonding in  it can be separated from  by column chromatography.

C. Kerosene / Naphthalene → iv. Fractional distillation.

Due to different B.P. of kerosene and Naphthalene it can be separated by fractional distillation.

D. $C_6H_{12}O_6$/NaCl → i. Crystallization.

NaCl (ionic compound) can be crystallized.

43. The correct increasing order of the ionic radii is

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

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

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

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

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. In isoelectronic species size $\propto \frac{1}{Z}$

$Ca^{2+} < K^+ < Cl^- < S^{2-}$: Size

Z : 20 19 17 18

44. H_2O_2 acts as a reducing agent in

(1) $2NaOCl + H_2O_2 \rightarrow 2NaCl + H_2O + O_2$

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

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

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

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. $\overset{+1}{NaOCl} + \overset{-1}{H_2O_2} \rightarrow 2NaCl + H_2O + \overset{0}{O_2}$ (–1)

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

(1) Aspartame

(2) Sucralose

(3) Alitame

(4) Saccharin

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Sweetness value order wrt cane sugar

Alitame > Sucralose > Saccharin > Aspartame

46. 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

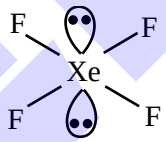
(3) A-IV, B-I, C-II, D-III

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

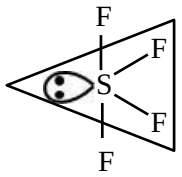
Official Ans. by NTA (4)

Allen Ans. (4)

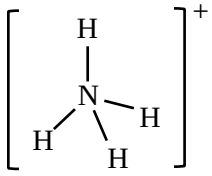
Sol.

(A) 

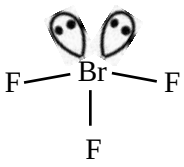
Square planer

(B) SF_4 

See-Saw

(C) NH_4^+ 

Tetrahedral

(D) BrF_3 

Bent T- Shaped

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

trans (Ph-CH=CH–CH_3) $\rightarrow$ cis (Ph-CH=CH–CH_3)

(1) Br_2, alc KOH, $NaNH_2$, Na(Liq NH_3)

(2) Br_2, alc KOH, $NaNH_2$, H_2 Lindlar Catalyst

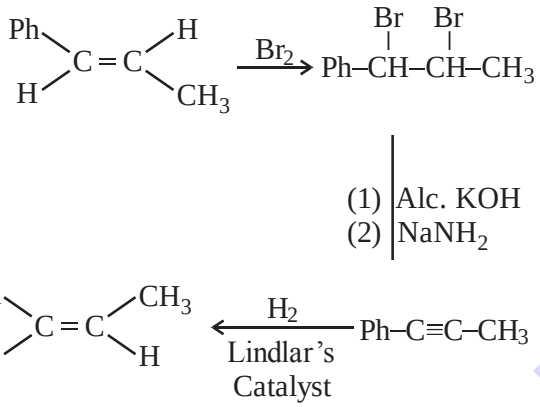
(3) Br_2, aq KOH, $NaNH_2$, H_2 Lindlar Catalyst

(4) Br_2, aq KOH, $NaNH_2$, Na(Liq NH_3)

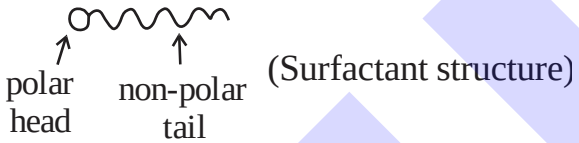
Official Ans. by NTA (2)

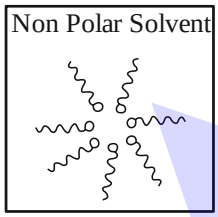
Allen Ans. (2)

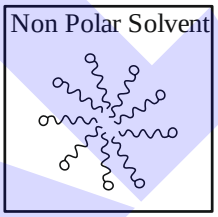
Sol.

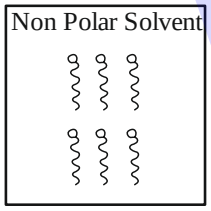


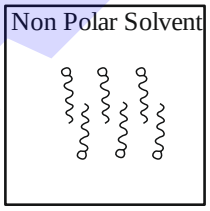
48. Adding surfactants in non polar solvent, the micelles structure will look like



(a) 

(b) 

(c) 

(d) 

(1) b

(2) c

(3) a

(4) d

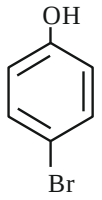
Official Ans. by NTA (3)

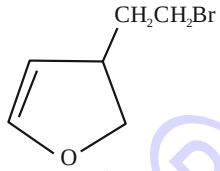
Allen Ans. (3)

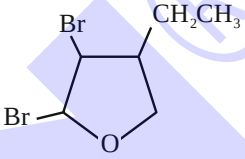
Sol. Non-Polar tail towards non-polar solvent

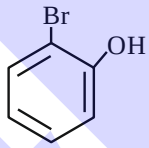
Ans. 3

49. 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) 

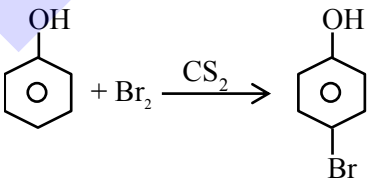
(3) 

(4) 

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. Aromatic compounds burns with sooty flame



(Major)

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

(1) Cl_2 is formed at cathode

(2) O_2 is formed at cathode

(3) H_2 is formed at anode

(4) OH^- is formed at cathode

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Electrolysis of brine solution

$$NaCl(aq.) \longrightarrow Na^+_{(aq)} + Cl^+_{(aq)}$$

At anode : $2Cl^+_{(aq.)} \longrightarrow \underset{\text{(Major)}}{Cl_2(g)} + 2e^-$

$$2H_2O_{(\ell)} \longrightarrow \underset{\text{Minor}}{O_{2(g)}} + 4H^+_{(aq)} + 4e^-$$

At Cathode : $2H_2O_{(\ell)} + 2e^- \longrightarrow H_{2(g)} \uparrow + 2OH^-_{(aq)}$

$$2Na^+ + 2OH^- \longrightarrow 2NaOH$$

SECTION-B

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

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

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

$PdCl_4^{2-}(aq) + 2e^- \rightleftharpoons Pd(s) + 4Cl^-(aq)$

$E^o = 0.65V$

Official Ans. by NTA (6)

Allen Ans. (6)

Sol. $\Delta G^o = -RT\ell n K$

$-nFE^o_{cell} = -RT \times 2.303(\log_{10} K)$

$\frac{E^o_{Cell}}{0.06} \times n = \log K \quad \ldots(1)$

$Pd^{+2}(aq.) + \not{2}e^- \rightleftharpoons Pd(s)\ ,\ E^o_{cat,red^n} = 0.83$

$Pd(s) + 4Cl^-(aq.) \rightleftharpoons PdCl_4^{2-},(aq) + 2e^-, E^o_{Anode,Oxid^n} = 0.65$

Net Reaction $\rightarrow Pd^{2+}(aq.) + 4Cl^-(aq.) \rightleftharpoons PdCl_4^{2-}(aq.)$

$E^o_{cell} = E^o_{cat,red^n} - E^o_{Anode,Oxid^n}$

$E^o_{cell} = 0.83 - 0.65$

$E^o_{cell} = 0.18 \quad \ldots(2)$

Also n = 2 $\quad \ldots(3)$

Using equation (1), (2) & (3)

logK = 6

52. $A \rightarrow B$

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

(Given : In 10 = 2.3

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

log5 = 0.70

log3=0.48

log2 = 0.30

Official Ans. by NTA (2520)

Allen Ans. (2520)

Sol.

$\log\frac{K_{300}}{K_{200}} = \frac{E_a}{2.3\times8.314}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

$\log\frac{0.05}{0.03} = \frac{Ea}{2.305\times8.314}\times\left[\frac{1}{200} - \frac{1}{300}\right]$

$E_a = 2519.88\ J \Rightarrow E_a = 2520\ J$

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

Given : $\Delta_{dis}H^o_{Cl_{2(g)}} = 240 kJmol^{-1}$.

$\Delta_{eg}H^o_{Cl_{(g)}} = -350 kJmol^{-1}$,

$\Delta_{hyd}H^o_{Cl^-_{(g)}} = -380 kJmol^{-1}$

Official Ans. by NTA (610)

Allen Ans. (610)

Sol. $\frac{1}{2}Cl_{2(g)} \rightarrow Cl_{(g)} \rightarrow Cl^-_{(g)} \rightarrow Cl^-_{(aq.)}$

$\Delta H^o = \frac{1}{2}\times240 + (-350) + (-380)$

$= -610$ ans.

54. 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)

Official Ans. by NTA (44)

Allen Ans. (44)

Sol. weight of C in 0.792 gm CO_2

$= \frac{12}{44}\times0.792 = 0.216$

$\%\ \text{of C in compound} = \frac{0.216}{0.492}\times100$

$= 43.90\%$

Ans : 44

55. 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})

Official Ans. by NTA (62250)

Allen Ans. (62250)

Sol. : $\pi = CRT$

$\frac{400Pa}{10^5} = \frac{\frac{2.5g}{M_o}}{250/1000L}\times0.83\frac{L-bar}{K.mol}\times300K$

$M_o = 62250$

56. 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 = 22.7L)
Official Ans. by NTA (4)
Allen Ans. (4)

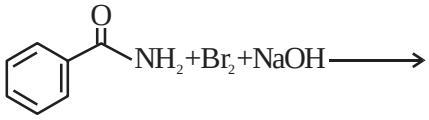
Sol. $Zn + 2HCl \rightarrow ZnCl_2 + H_2\uparrow$

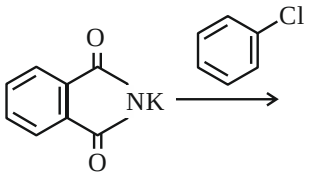
Moles of Zn used = $\frac{11.5}{65.4}$ = Moles of H_2 evolved

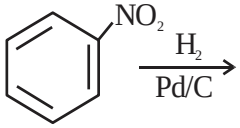
Volume of $H_2 = \frac{11.5}{65.4} \times 22.7L = 3.99L$

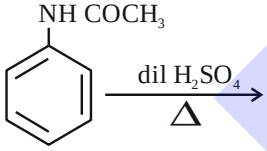
Ans : 4

57. How many of the transformation given below would result in aromatic amines?

(1) 

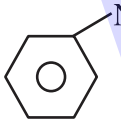
(2) 

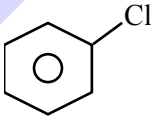
(3) 

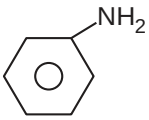
(4) 

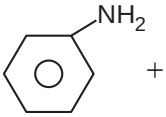
Official Ans. by NTA (3)
Allen Ans. (3)

Sol. Product in the given reactions are as follow-

1. 

2. No reactions will be observed as in Gabriel phthalimide synthesis  is poor substrate for SN^2

3. 

4.  + CH_3COOH

Aromatic amines will he formed in 1, 3 & 4
Ans : 3

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

$K_P = 2 \times 10^{12}$ 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})
Official Ans. by NTA (1)
Allen Ans. (1)

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

$K_P = 2 \times 10^{12}$ at 300 K

$K_P = K_C \times (RT)^{\Delta n_g}$

$2 \times 10^{12} = K_c \times (0.082 \times 300)^{-1/2}$

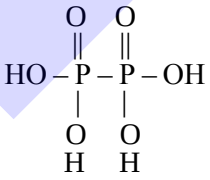
$K_C = 9.92 \times 10^{12}$

$K_C = 0.992 \times 10^{13}$

Ans. 1

59. The oxidation sate of phosphorus in hypophosphoric acid is + _____ .
Official Ans. by NTA (4)
Allen Ans. (4)

Sol. $H_4P_2O_6$



O.S. of P is +4

60. 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})

Official Ans. by NTA (555)

Allen Ans. (555)

Sol. $P_X = \chi_X P_T$

$= \frac{\frac{0.6}{20}}{\frac{0.6}{20} + \frac{0.45}{45}} \times 740$

P_X = 555 mm Hg