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JEE (Main)

PAPER-1 (B.E./B. TECH.)

2023

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 31 January, 2023 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 p.m.)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: CHEMISTRY

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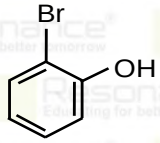
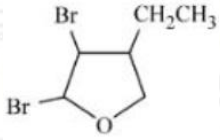
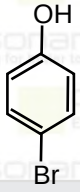
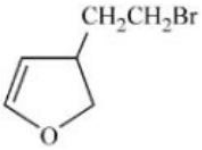
PART : CHEMISTRY

31. An organic compound 'A' with emperical 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

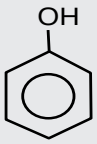
(1) 

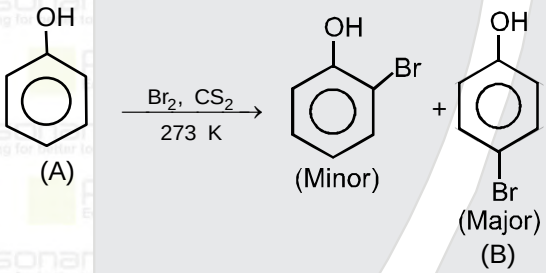
(2) 

(3) 

(4) 

NTA. (3)
RESO. (3)

Sol. Compound A is  which gives sooty flame on burning.



32. 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 = 1 to n = 3 (2) n = 1 to n = 2 (3) n = 2 to n = 1 (4) n = 3 to n = 4

NTA (3)
RESO. (3)

Sol. $\lambda_H = \lambda_{He^+}$

$$R_H \times (1)^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = R_H \times (2)^2 \left(\frac{1}{(2)^2} - \frac{1}{(4)^2}\right)$$

$$\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = \left(\frac{4}{4}\right) - \left(\frac{4}{16}\right)$$

$$\frac{1}{n_1^2} - \frac{1}{n_2^2} = \frac{1}{1} - \frac{1}{4}$$

$n_1 = 1$; $n_2 = 2$ for H-atom

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

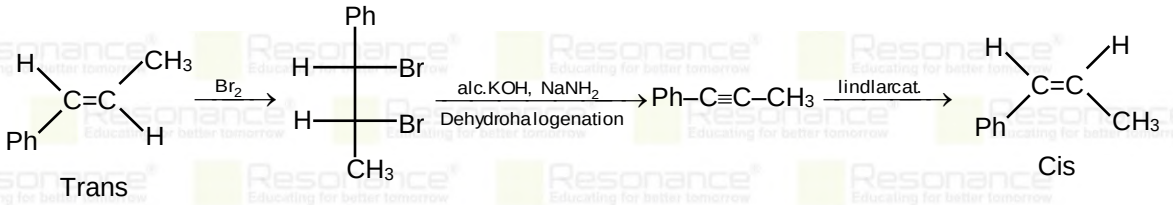
trans (Ph–CH=CH–CH_3) → cis (Ph–CH=CH–CH_3)

(1) Br_2, alc • KOH, $NaNH_2$, Na (Liq NH_3) (2) Br_2 , alc • KOH, $NaNH_2$, H_2 Lindlar Catayst

(3) Br_2, alc •KOH, $NaNH_2$, H_2 Lindlar Catayst (4) Br_2, aq •KOH, $NaNH_2$, Na (Liq NH_3)

NTA (2)
RESO. (2)

Sol.



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

(1) OH^- is formed at cathode (2) Cl_2 is formed at cathode

(3) O_2 is formed at cathode (4) H_2 is formed at cathode

NTA (1)

RESO. (1)

Sol. Brine solution – NaCl(aq)

at Cathode : $H_2O(\ell) + e^- \longrightarrow \frac{1}{2}H_2(g) + OH^-(aq)$

at Anode : $Cl^-(aq) \longrightarrow \frac{1}{2}Cl_2(g) + e^-$

35. Nd^{2+} = _____

(1) $4f^3$ (2) $4f^46s^2$ (3) $4f^26s^2$ (4) $4f^4$

NTA (4)

RESO. (4)

Sol. $Nd(Z = 60) = 4f^46s^2$

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

36. When Cu^{2+} ion is treated with KI, a white precipitate, X appears in solution. The solution is titrated with sodium thiosuphate, 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 = $Na_2S_4O_6$ (4) X = Cu_21_2 Y = $Na_2S_4O_5$

NTA (3)

RESO. (3)

Sol. $Cu^{2+} + 4I^- \longrightarrow \underset{\text{White}}{\underset{\text{'X'}}{Cu_2I_2}} + I_2$

$I_2 + 2Na_2S_2O_3 \longrightarrow \underset{\text{'y'}}{2Na_2S_4O_6} + 2NaI$

x = Cu_2I_2 & y = $Na_2S_4O_6$

37. 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 = $ClNO_3$, Y=Cl_2, Z = NO_2 (2) X=$ClONO_2$, Y=HOCl, Z=HNO_3

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

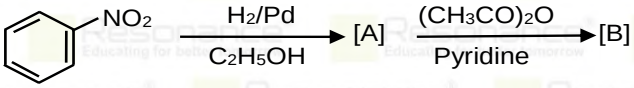
NTA (2)

RESO. (2)

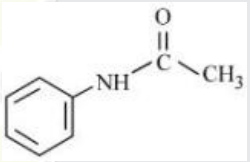
Sol. $ClO^{\bullet}(g) + NO_2(g) \longrightarrow ClONO_2(g)$

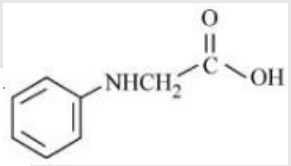
$ClONO_2(g) + H_2O(g) \longrightarrow HOCl + HNO_3(g)$

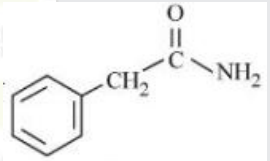
from NCERT

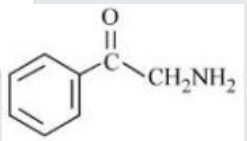
38. 

Consider the above reactions and identify the product B.

(1) 

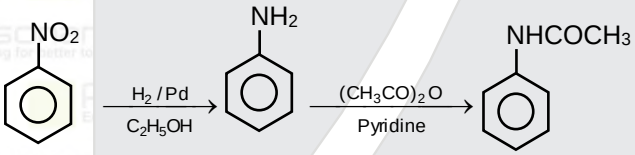
(2) 

(3) 

(4) 

NTA (1)

RESO. (1)

Sol. 

39. Consider the following reaction

Propanal + Methanal $\xrightarrow[\text{(ii) } \Delta \\ \text{(iii) NaCN} \\ \text{(iv) } H_3O^+]{\text{(i) di.NaOH}}$ 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) optically active alcohol and is neutral

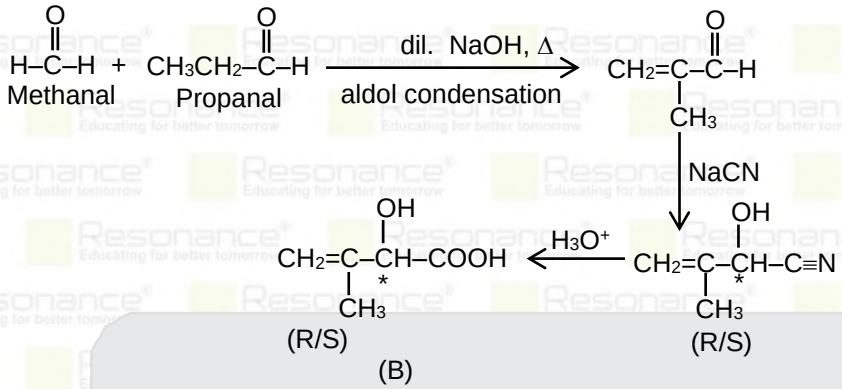
(3) racemic mixture and gives a gas with saturated NaHCO3 solution

(4) racemic mixture and is neutral

NTA (3)

RESO. (3)

Sol.



40. H_2O_2 acts as a reducing agent in

(1) $Na_2S + 4H_2O_2 \rightarrow Na_2SO_4 + 4H_2O$ (2) $Mn^{2+} + 2H_2O_2 \rightarrow MnO_2 + 2H_2O$

(3) $2Fe^{2+} + 2H^+ + H_2O_2 \rightarrow 2Fe^{3+} + 2H_2O$ (4) $2NaOCl + H_2O_2 \rightarrow 2\ NaCl + H_2O + O_2$

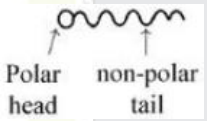
NTA (4)

RESO. (4)

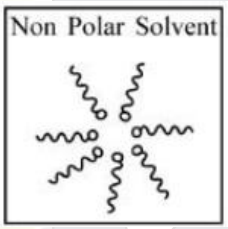
Sol. H_2O_2 acts an reducing agent in the following reaction.

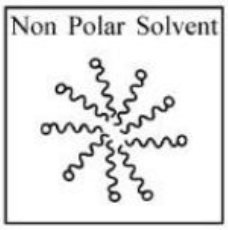
$NaOCl + H_2O_2 \longrightarrow 2NaCl + H_2O + O_2$

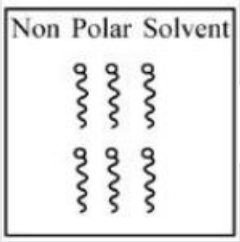
41. Adding surfactants in non polar solvent, the micelles structure will look like

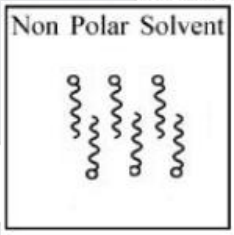


(Surfactant structure)

(a) 

(b) 

(c) 

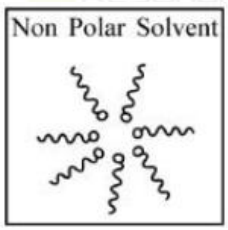
(d) 

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

NTA (4)

RESO. (4)

Sol. When surfactant added in polar solvent following micelles structure is obtained.



42. 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:

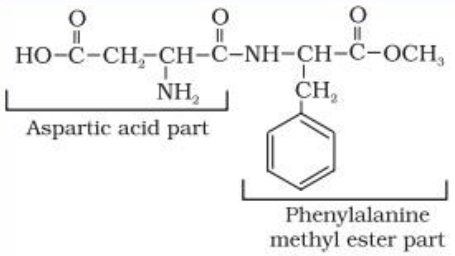
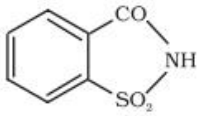
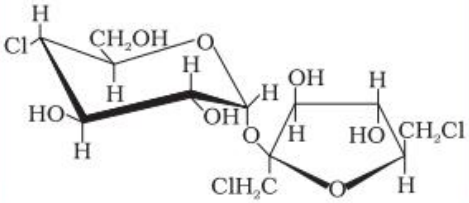
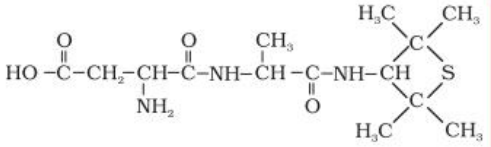
(1) B, D and E only (2) C, D and E only (3) A and C only (4) B, D and C only

NTA (3)
RESO. (3)
Sol. Concentration processes
(B) Leaching
(D) Hydraulic washing
(E) Froth floatation method

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

(1) Alitame (2) Saccharin (3) Aspartame (4) Sucralose

NTA (1)
RESO. (1)
Sol. Alitame has highest sweetness value in comparison to cane sugar.

Artificial sweetener	Structural formula	Sweetness value in comparison to cane sugar
Aspartame		100
Saccharin		550
Sucrolose		600
Alitame		2000

44. Match List I with List II

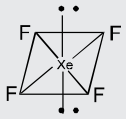
List I	List II
A. XeF_4	I. See-saw
B. SF_4	II. Square planar
C. NH_4^+	III. Bent T-shaped
D. BrF_3	IV. Tetrahedral

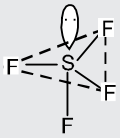
Choose the correct answer from the options given below:

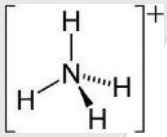
(1) A-IV, B-I, C-II, D-III (2) A-II, B-I, C-III, D-IV (3) A-II, B-I, C-IV, D-III (4) A-IV, B-III, C-II, D-I

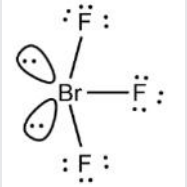
NTA. (3)

RESO. (3)

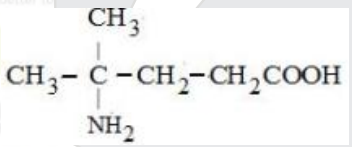
Sol. (A) XeF_4 -  Square Planar

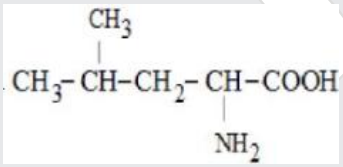
(B) SF_4 -  See saw

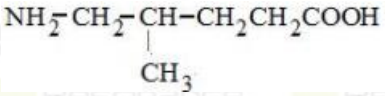
(C) NH_4^+ -  Tetrahedral

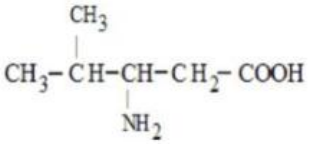
(D) BrF_3 -  Bent-t-shaped

45. A protein 'X' with molecular weight of 710,000 u, on hydrolysis gives amino acids. One of these amino acid is

(1) 

(2) 

(3) 

(4) 

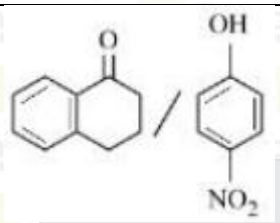
NTA. (2)

RESO. (2)

Sol. All proteins are polymers of α-amino acids

46. Match items of column I and II

Match List I with List II

List I	List II
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

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

NTA (4)

RESO. (4)

Sol. (A) CH_2Cl_2 and H_2O do not mix & form two separate layer so they can be separated by Differential solvent extraction.

(B) Column chromatography.

(C) Fractional Distillation, kerosene and naphthalene are different types of hydrocarbons that have different boiling points.

(D) Crystallization, $C_6H_{12}O_6$ and NaCl are different compounds with different chemical and physical properties. As a result they can be separated from each other by crystallization.

47. Cobalt chloride when dissolved in water forms pink colored 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 = $[Co(H_2O)_4Cl_2]^+$, Y = $[CoCl_4]^{2-}$, Z = Tetrahedral
(2) X = $[Co(H_2O)_6]^{2+}$, Y = $[CoCl_6]^{3-}$, Z = Octahedral
(3) X = $[Co(H_2O)_6]^{2+}$, Y = $[CoCl_4]^{2-}$, Z = Tetrahedral
(4) X = $[Co(H_2O)_6]^{3+}$, Y= $[CoCl_6]^{3-}$, Z = Octahedral

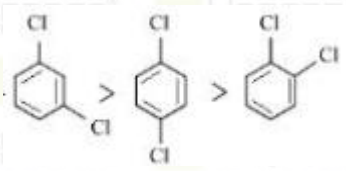
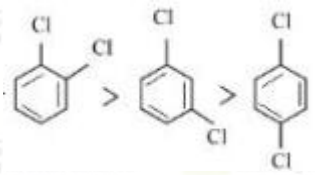
NTA (3)

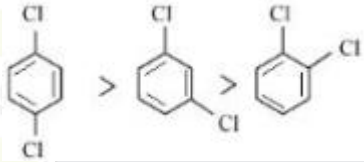
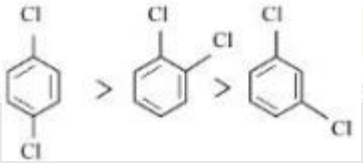
RESO. (3)

Sol. $CoCl_2 + H_2O \longrightarrow \underset{\substack{\text{Pink colour}\\\text{Octahedral}\\\text{'X'}}}{[Co(H_2O)_6]^{2+}} \xrightarrow{\text{conc. HCl}} \underset{\substack{\text{Deep blue}\\\text{Tetrahedral (Z)}\\\text{'Y'}}}{[CoCl_4]^{2-}}$

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

48. The correct order of melting points of dichlorobenzene is

(1)  (2) 

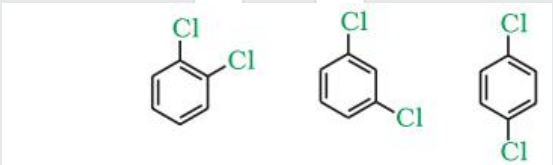
(3)  (4) 

NTA (4)

RESO. (4)

Sol. Boiling points of isomeric dihalobenzenes are very nearly the same.

However, the para-isomers are high melting as compared to their orthoand meta-isomers. It is due to symmetry of para-isomers that fits in crystal lattice better as compared to ortho- and meta-isomers.



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

Bromo, iodo and polychloro derivatives of hydrocarbons are heavier than water. The density increases with increase in number of carbon atoms, halogen atoms and atomic mass of the halogen atoms.

49. The correct increasing order of the ionic radii is

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

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

NTA (1)

RESO. (1)

Sol. The correct increasing order of size is

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

50. 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) $V_2O_5 > V_2O_4 > V_2O_3$

NTA (3)

RESO. (3)

Sol. Basic strength of oxides $\propto \frac{1}{\text{O.N.}}$ of element

oxide	V_2O_3	V_2O_4	V_2O_5
O.N.	+3	+4	+5

Basic strength : V_2O_5 < V_2O_4 < V_2O_3

Acidic Amphoteric less basic

51. 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})

NTA (1)

RESO. (1)

52. 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 : In 10 = 2.3

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

log 5 = 0.70

log 3 = 0.48

log 2 = 0.30)

NTA (2520)

RESO. (2520)

Sol. $$\log\left(\frac{K_2}{K_1}\right) = \frac{E_a}{2.303R}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$$

$$\log\left(\frac{0.05}{0.03}\right) = \frac{E_a}{2.303\times 8.3}\left[\frac{1}{200}-\frac{1}{300}\right]$$

$$0.22 = \frac{E_a}{2.303\times 8.3}\left[\frac{100}{300\times 200}\right]$$

$E_a = 0.22 \times 2.303 \times 8.3 \times 300 \times 2$ J

$E_a = 2519.88$ J

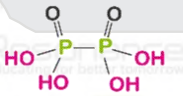
$E_a = 2520$ J

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

NTA (4)

RESO. (4)

Sol. Hypophosphoric acid — $H_4P_2O_6$



$4\times1 + 2\times x + 6\times(-2) = 0$

$\therefore x = +4$

54. The total pressure of a mixture of non-reacting 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 : mole mass X = 20 and Y = 45 g mol^{-1})

NTA (555)

RESO. (555)

Sol. Number of moles of gas X = $\frac{0.6}{20}$ = 0.03

Number of moles of gas Y = $\frac{0.45}{45}$ = 0.01

Total number of moles = 0.03 + 0.01 = 0.04 mole

Partial pressure of gas X = Mole fraction × Total pressure

$= \frac{0.03}{0.04} \times 740 = 555$

55. At 27ºC, a solution containing 2.5 g of solute in 250.0 mL of solution exerts and osmotic pressure of 400 Pa. The molar mass of the solute is _____ g mo^{-1}

(Nearest Integer)

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

NTA (62250)

RESO. (62250)

Sol. $\pi = CRT$

$$\frac{400\times10^{-5}}{(1.01325)} = \left[\frac{2.5\times1000}{M_{solute}\times250}\right]0.083 \times 300$$

$$400 \times 10^{-5} = \frac{10}{M_{solute}} \times 0.083 \times 300$$

$$M_{solute} = \frac{10\times0.083\times300}{400} \times 10^5$$

$$= \left[\frac{10\times0.083\times3}{4}\right] \times 10^5$$

= 62250 gram/mole

56. 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 _____ g mol^{-1}

(Nearest integer)

NTA (44)

RESO. (44)

Sol. 44 gm of CO_2 contains 12 g carbon

0.792 gm of CO_2 contains $\frac{0.792\times12}{44}$ g of carbon

% of carbon = $\frac{0.216}{0.492}\times100$

= 43.9% ≃ 44%

57. 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)

NTA (4)

RESO. (4)

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

No. of moles of Zn = $\frac{11.5}{65.3}$ = No. of moles of H_2

No. of H_2 liberated = 0.176 × 22.7 Lt.

= 3.99 L ≈ 4 Lt.

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

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

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

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

NTA (6)

RESO. (6)

Sol. Given reaction

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

$E^o_{cell} = E^o_{Pd^{2+}|Pd} - E^o_{(PdCl_4)^{2-}|Pd}$

$= 0.83 - 0.65$

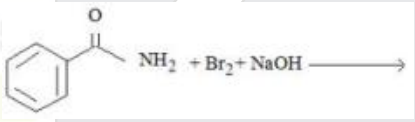
$= 0.18$

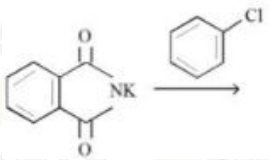
$E^o_{cell} = \frac{0.06}{2} \log K_{eq}$

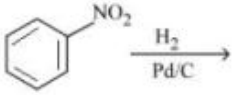
$0.18 = \frac{0.06}{2} \log K_{eq}$

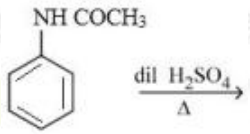
$\log K_{eq} = 6$

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

(1) 

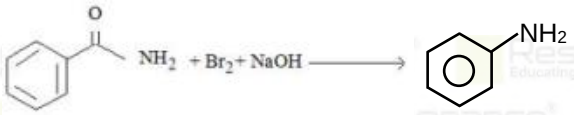
(2) 

(3) 

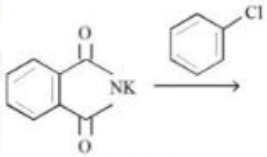
(4) 

NTA (3)

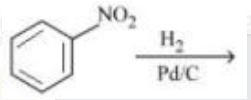
RESO. (3)

Sol. (1) 

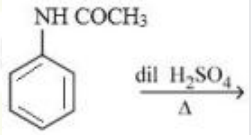
(Hoffmann bromamide reaction)

(2) 

No reaction (aryl halides do not give Gabriel phthalimide reaction)

(3) 

(Reduction)

(4) 

(Hydrolysis)

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

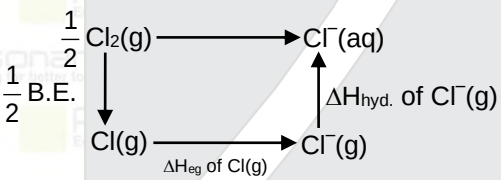
Given : $\Delta_{dis}H^-_{Cl_2(g)} = 240 kJ\ mol^{-1}$, $\Delta_{eg}H^-_{Cl_{(g)}} = -350 kJ\ mol^{-1}$,

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

NTA (610)

RESO. (610)

Sol.



$\Delta H^0_r = \frac{1}{2} \times B.E. + \Delta H_{eg} + \Delta H_{hyd.}$

$\Delta H^0_r = \frac{1}{2} \times 240 + (-350) + (-380) = -610$ kJ/mole

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