FINAL JEE–MAIN EXAMINATION – JANUARY, 2023

(Held On Monday 30th January, 2023) **TIME : 3 : 00 PM to 6 : 00 PM**

SECTION-A

31. Which of the following reaction is correct ?

(1) $2LiNO_3 \xrightarrow{\Delta} 2LiNO_2 + O_2$

(2) $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 2N_2O_4 + O_2$

(3) $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$

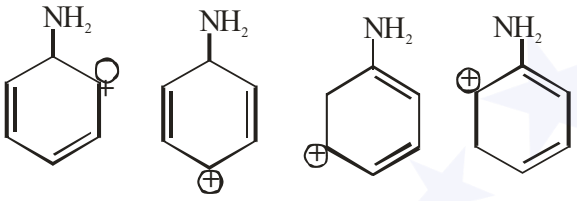
(4) $2LiNO_3 \xrightarrow{\Delta} 2Li + 2NO_2 + O_2$

Official Ans. by NTA (3)

Ans. (3)

Sol. $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$

32. The most stable carbocation for the following is:



(a) (b) (c) (d)

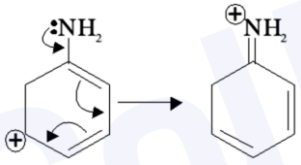
(1) c (2) d

(3) b (4) a

Official Ans. by NTA (1)

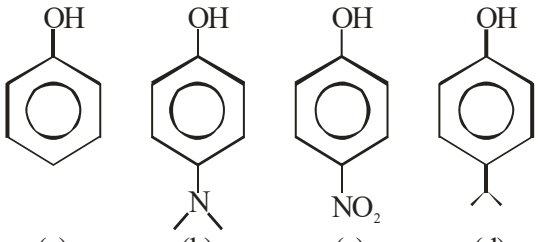
Ans. (1)

Sol.



The +M effect of NH_2 is stabilizing the carbocation.

33. The correct order of pK_a values for the following compounds is:



(a) (b) (c) (d)

(1) c > a > d > b (2) b > d > a > c

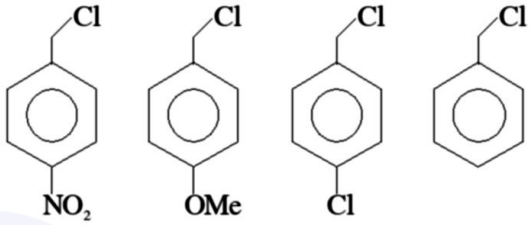
(3) b > a > d > c (4) a > b > c > d

Official Ans. by NTA (2)

Ans. (2)

Sol. Due to –M effect of $-NO_2$ group, it increases acidity
+M effect of N $(CH_3)_2$ decreases acidity.
Hyperconjugation of isopropyl decrease acidity
$\therefore$ order of acidic strength
(c) > (a) > (d) > (b)

34. Decreasing order towards S_N1 reaction for the following compounds is:



(a) (b) (c) (d)

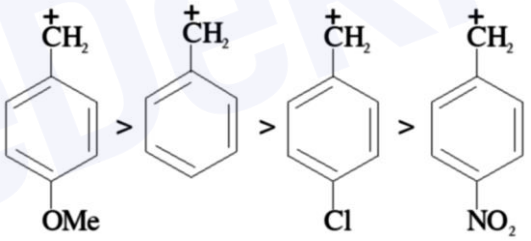
(1) a > c > d > b (2) a > b > c > d

(3) b > d > c > a (4) d > b > c > a

Official Ans. by NTA (3)

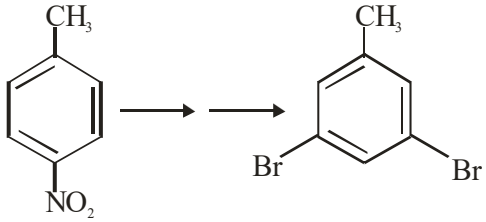
Ans. (3)

Sol. The rate of S_N1 reaction depends upon stability of carbocation which follows the order



$\therefore$ Reactivity order
(b) > (d) > (c) > (a)

35.



(X) (Y)

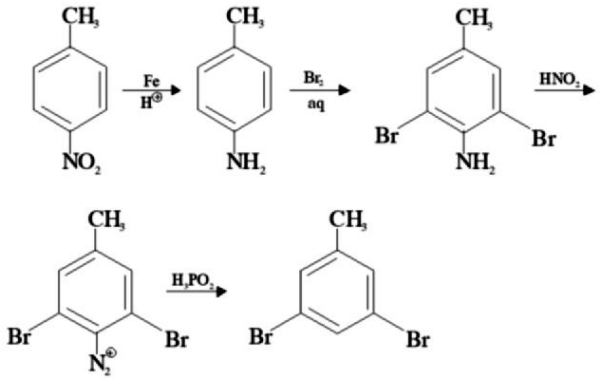
In the above conversion of compound (X) to product (Y), the sequence of reagents to be used will be:

(1) (i) Br_2, Fe (ii) Fe, H^+ (iii) $LiAlH_4$
(2) (i) Br_2(aq) (ii) $LiAlH_4$ (iii) H_3O^+
(3) (i) Fe, H^+ (ii) Br_2(aq) (iii) HNO_2 (iv) CuBr
(4) (i) Fe, H^+ (ii) Br_2(aq) (iii) HNO_2 (iv) H_3PO_2

Official Ans. by NTA (4)

Ans. (4)

Sol.



36. Maximum number of electrons that can be accommodated in shell with n = 4 are:

(1) 16

(2) 32

(3) 50

(4) 72

Official Ans. by NTA (2)

Ans. (2)

Sol. The number of electrons in the orbitals of sub-shell of n = 4 are

4s	2
4p	6
4d	10
4f	14
(Total)	**32**

37. Match List I with List II:

	List I (Complexes)		List II (Hybridisation)
(A)	$[Ni(CO)_4]$	I	sp^3
(B)	$[Cu(NH_3)_4]^{2+}$	II	dsp^2
(C)	$[Fe(NH_3)_6]^{2+}$	III	sp^3d^2
(D)	$[Fe\quad)_6]^{2+}$	IV	d^2sp^3

(1) A – II, B – I, C – III, D – IV

(2) A – I, B – II, C – III, D – IV

(3) A – II, B – I, C – IV, D – III

(4) A – I, B– II, C – IV, D – III

Official Ans. by NTA (4)

Ans. (BONUS)

Sol. For $[Fe(NH_3)_6]^{+2}$, $\Delta_0 < P$, hence the pairing of electrons does not occur in t_{2g}. Therefore complex is outer orbital and its hybridisation is sp^3d^2.

List I (Complexes)	List II (Hybridisation)
$[Ni(CO)_4]$	sp^3
$[Cu(NH_3)_4]^{2+}$	dsp^2
$[Fe(NH_3)_6]^{2+}$	sp^3d^2
$[Fe(H_2O)_6]^{2+}$	sp^3d^2

38. The Cl – Co – Cl bond angle values in a fac-$[Co(NH_3)_3Cl_3]$ complex is/are:

(1) 90° & 180°

(2) 90°

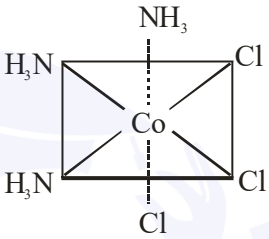
(3) 180°

(4) 90° & 120°

Official Ans. by NTA (2)

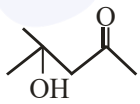
Ans. (2)

Sol.



The Cl – Co – Cl bond angle in above octahedral complex is 90°

39. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A :  can be easily reduced using Zn-Hg/ HCl to 

Reason R : Zn-Hg/HCl is used to reduce carbonyl group to $-CH_2-$ group.

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

(1) A is false but R is true

(2) A is true but R is false

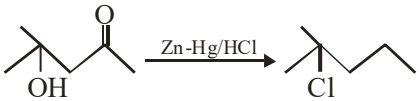
(3) Both A and R are true but R is not the correct explanation of A

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

Official Ans. by NTA (1)

Ans. (1)

Sol.



The acid sensitive alcohol group reacts with HCl, hence Clemmenson reduction is not suitable for above conversion.

40. Chlorides of which metal are soluble in organic solvents:

(1) Ca (2) Mg

(3) K (4) Be

Official Ans. by NTA (4)

Ans. (4)

Sol. $BeCl_2$ having covalent nature is soluble in organic solvent.

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

Assertion A: Antihistamines do not affect the secretion of acid in stomach.

Reason R : Antiallergic and antacid drugs work on different receptors.

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

(1) A is false but R is true

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

(3) A is true but R is false

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

Official Ans. by NTA (2)

Ans. (2)

Sol. Antiallergic and antacid drugs work on different receptors

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42. The wave function (Ψ) of 2s is given by

$$\Psi_{2s} = \frac{1}{2\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{1/2}\left(2-\frac{r}{a_0}\right)e^{-r/2a_0}$$

At $r = r_0$, radial node is formed. Thus, r_0 in terms of a_0

(1) $r_0 = a_0$ (2) $r_0 = 4a_0$

(3) $r_0 = \frac{a_0}{2}$ (4) $r_0 = 2a_0$

Official Ans. by NTA (4)

Ans. (4)

Sol. At node $\Psi_{2s} = 0$

$$\therefore 2 - \frac{r_0}{a_0} = 0$$

$$\therefore r_0 = 2a_0$$

43. $KMnO_4$ oxidises I^- in acidic and neutral/faintly alkaline solution, respectively to

(1) I_2 & IO_3^-

(2) IO_3^- & I_2

(3) IO_3^- & IO_3^-

(4) I_2 & I_2

Official Ans. by NTA (1)

Ans. (1)

Sol. In acidic medium

$$2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$$

In neutral/faintly alkaline solution

$$2MnO_4^- + I^- + H_2O \rightarrow 2MnO_2 + 2OH^- + IO_3^-$$

44. Bond dissociation energy of E–H bond of the "H_2E" hydrides of group 16 elements (given below), follows order.

(A) O

(B) S

(C) Se

(D) Te

(1) A > B > C > D

(2) A > B > D > C

(3) B > A > C > D

(4) D > C > B > A

Official Ans. by NTA (1)

Ans. (1)

Sol. Bond dissociation energy of E–H bond in hydrides of group 16 follows the order

$H_2O > H_2S > H_2Se > H_2Te$

45. The water quality of a pond was analysed and its BOD was found to be 4. The pond has

(1) Highly polluted water

(2) Water has high amount of fluoride compounds

(3) Very clean water

(4) Slightly polluted water

Official Ans. by NTA (3)

Ans. (3)

Sol. Clean water as BOD value of < 5 while polluted water has BOD of 15 or more.

46. Match List I with List II:

	List I (Mixture)		List II (Separation Technique)
(A)	$CHCl_3 + C_6H_5NH_2$	I	Steam distillation
(B)	$C_6H_{14} + C_5H_{12}$	II	Differential extraction
(C)	$C_6H_5NH_2 + H_2O$	III	Distillation
(D)	Organic compound in H_2O	IV	Fractional distillation

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

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

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

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

Official Ans. by NTA (2)

Ans. (2)

Sol.

List I (Mixture)	List II (Separation Technique)
$CHCl_3 + C_6H_5NH_2$	Distillation
$C_6H_{14} + C_5H_{12}$	Fractional distillation
$C_6H_5NH_2 + H_2O$	Steam distillation
Organic compound in H_2O	Differential extraction

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47. Boric acid in solid, whereas BF_3 is gas at room temperature because of

(1) Strong ionic bond in Boric acid

(2) Strong van der Waal's interaction in Boric acid

(3) Strong hydrogen bond in Boric acid

(4) Strong covalent bond in BF_3

Official Ans. by NTA (3)

Ans. (3)

Sol. Boric acid has strong hydrogen bonding while BF_3 does not. Therefore boric acid is solid.

48. Given below are two statements:

Statement I: During Electrolytic refining, the pure metal is made to act as anode and its impure metallic form is used as cathode.

Statement II: During the Hall-Heroult electrolysis process, purified Al_2O_3 is mixed with Na_3AlF_6 to lower the melting point of the mixture.

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 Statement I and Statement II are incorrect

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

(4) Both Statement I and Statement II are correct

Official Ans. by NTA (1)

Ans. (1)

Sol. In Electrolytic refining, the pure metal is used as cathode and impure metal is used as anode.

Na_3AlF_6 is added during electrolysis of Al_2O_3 to lower the melting point and increase conductivity.

49. Formulae for Nessler's reagent is:

(1) KHg_2I_2 (2) $KHgI_3$

(3) K_2HgI_4 (4) HgI_2

Official Ans. by NTA (3)

Ans. (3)

Sol. Nessler's reagent is K_2HgI_4.

50. 1 L, 0.02 M solution of $[Co(NH_3)_5SO_4]Br$ is mixed with 1L, 0.02 M solution of $[Co(NH_3)_5Br]SO_4$. The resulting solution is divided into two equal parts (X) and treated with excess $AgNO_3$ solution and $BaCl_2$ solution respectively as shown below:

1 L Solution (X) + $AgNO_3$ solution (excess)$\rightarrow$Y

1 L Solution (X) + $BaCl_2$ solution (excess)$\rightarrow$Z

The number of moles of Y and Z respectively are

(1) 0.02, 0.02

(2) 0.01, 0.01

(3) 0.02, 0.01

(4) 0.01, 0.02

Official Ans. by NTA (2)

Ans. (2)

Sol. $\underset{0.01\ \text{mol}}{[Co(NH_3)_5SO_4]Br} + \underset{\text{excess}}{AgNO_3} \rightarrow \underset{0.01\ \text{Mol}}{AgBr}\downarrow$

$\underset{0.01\ \text{mol}}{[Co(NH_3)_5Br]SO_4} + \underset{\text{excess}}{BaCl_2} \rightarrow \underset{0.01\ \text{Mol}}{BaSO_4}\downarrow$

SECTION-B

51. 1 mole of ideal gas is allowed to expand reversibly and adiabatically from a temperature of 27°C. The work done is 3 kJ mol^{-1}. The final temperature of the gas is _____K (Nearest integer). Given C_v=20 J $mol^{-1}K^{-1}$.

Official Ans. by NTA (150)

Ans. (150)

Sol. $q = 0$

$\Delta U = w$

$1 \times 20 \times [T_2 - 300] = -3000$

$T_2 - 300 = -150$

$T_2 = 150$ K

52. Iron oxide FeO, crystallises in a cubic lattice with a unit cell edge length of 5.0Å. If density of the FeO in the crystal is 4.0 g cm^{-3}, then the number of FeO units present per unit cell is _____ (Nearest integer)

Given : Molar mass of Fe and O is 56 and 16g mol^{-1} respectively.

$N_A = 6.0 \times 10^{23}$ mol^{-1}

Official Ans. by NTA (4)

Ans. (4)

Sol. $$d = \frac{Z \times M}{N_0 \times a^3}$$

$$4 = \frac{Z \times 72}{6 \times 10^{23} \times 125 \times 10^{-24}}$$

$$Z = 4.166 \simeq 4$$

53. An organic compound undergoes first order decomposition. If the time taken for the 60% decomposition is 540 s, then the time required for 90% decomposition will be is _____ s. (Nearest integer).

Given : ln 10 = 2.3; log 2 = 0.3

Official Ans. by NTA (1350)

Ans. (1350)

Sol. $$\frac{t_1}{t_2} = \frac{\frac{1}{K}\ln\frac{a_0}{0.4a_0}}{\frac{1}{K}\ln\frac{a_0}{0.1a_0}}$$

$$\frac{540}{t_2} = \frac{\ln\frac{10}{4}}{\ln 10}$$

$$\frac{540}{t_2} = \frac{\log 10 - \log 4}{\log 10}$$

$$\frac{540}{t_2} = \frac{1 - 0.6}{1}$$

$$\Rightarrow \frac{540}{t_2} = 0.4$$

$$\Rightarrow t_2 = \frac{540}{0.4} = 1350 \text{ sec}$$

54. Lead storage battery contains 38% by weight solution of H_2SO_4. The van't Hoff factor is 2.67 at this concentration. The temperature in Kelvin at which the solution in the battery will freeze is ____ (Nearest integer).

Given K_f = 1.8 K kg mol^{-1}

Official Ans. by NTA (243)

Ans. (243)

Sol. $\Delta T_f = i.K_f.m$

$$\Rightarrow \Delta T_f = 2.67 \times 1.8 \times \frac{38}{98} \times \frac{1000}{62}$$

$$\Rightarrow \Delta T_f = 30.05$$

$\therefore$ F.P. = 243 K

55. Consider the following equation :

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g), \Delta H = -190 \text{ kJ}$$

The number of factors which will increase the yield of SO_3 at equilibrium from the following is _____

A. Increasing temperature
B. Increasing pressure
C. Adding more SO_2
D. Adding more O_2
E. Addition of catalyst

Official Ans. by NTA (3)

Ans. (3)

Sol. The yield of SO_3 at equilibrium will be due to :

B. Increasing pressure

C. Adding more SO_2

D. Adding more O_2

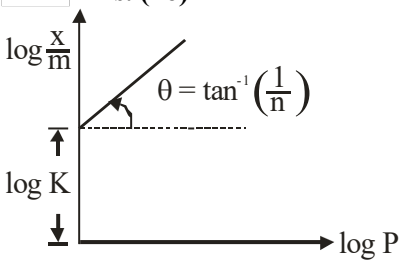
56. The graph of $\log\frac{x}{m}$ vs log p for an adsorption process is a straight line inclined at an angle of 45° with intercept equal to 0.6020. The mass of gas adsorbed per unit mass of adsorbent at the pressure of 0.4 atm is _____$\times 10^{-1}$ (Nearest integer)

Given : log 2 = 0.3010

Official Ans. by NTA (16)

Ans. (16)

Sol.



$$\log\frac{x}{m} = \log k + \frac{1}{n}\log P$$

$$\frac{1}{n} = \tan 45° = 1$$

$$\log k = 0.6020 = \log 4$$

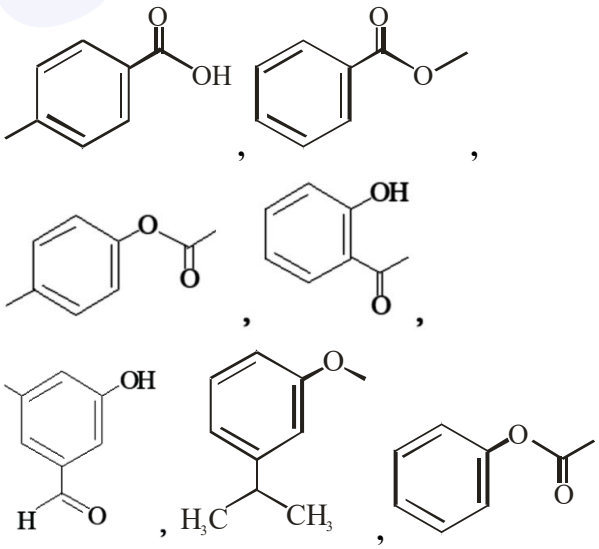
$$\Rightarrow K = 4$$

$$\therefore \frac{x}{m} = K.P^{1/n}$$

$$\frac{x}{m} = 4(0.4) = 1.6$$

$$\frac{x}{m} = 1.6 = 16 \times 10^{-1}$$

57. Number of compounds from the following which will not dissolve in cold $NaHCO_3$ and NaOH solutions but will dissolve in hot NaOH solution is _____.



Official Ans. by NTA (3)

Ans. (3)

Sol. Compound 2, 3, 7

58. A short peptide on complete hydrolysis produces 3 moles of glycine (G), two moles of leucine (L) and two moles of valine (V) per mole of peptide. The number of peptide linkages in it are _____ .

Official Ans. by NTA (6)

Ans. (6)

Sol. Number of peptide linkage = (amino acid – 1)

= 7 – 1 = 6

59. The strength of 50 volume solution of hydrogen peroxide is _____ g/L (Nearest integer).

Given:

Molar mass of H_2O_2 is 34 g mol^{-1}

Molar volume of gas at STP = 22.7 L.

Official Ans. by NTA (150)

Ans. (150)

Sol. $\text{Molarity} = \frac{50}{11.35}$

$\therefore$ Strength in gm/L $= \frac{50}{11.35} \times 34$

60. The electrode potential of the following half cell at 298 K.

$X \mid X^{2+}(0.001\ M) \parallel Y^{2+}(0.01\ M) \mid Y$

is _____$\times 10^{-2}$ V (Nearest integer).

Given : $E^0_{x^{2+}|x} = -2.36V$

$E^0_{Y^{2+}|Y} = +0.36V$

$\frac{2.303RT}{F}$ V

Official Ans. by NTA (275)

Ans. (275)

Sol. $X + Y^{2+} \rightarrow Y + X^{2+}$

$$E^0_{Cell} = 0.36 - (-2.36) = 2.72 \text{ V}$$

$$E_{Cell} = 2.72 - \frac{0.06}{2} \log \frac{0.001}{0.01}$$

$$= 2.72 + 0.03 = 2.75 \text{ V}$$

$$= 275 \times 10^{-2} \text{ V}$$