

FINAL JEE-MAIN EXAMINATION – JANUARY, 2023

(Held On Monday 30th January, 2023)

TIME : 3 : 00 PM to 6 : 00 PM

CHEMISTRY

SECTION-A

31. Which of the following reaction is correct ?

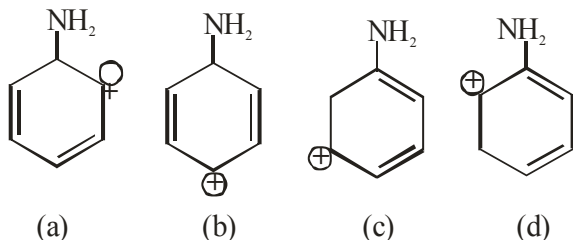
- (1) $2\text{LiNO}_3 \xrightarrow{\Delta} 2\text{LiNO}_2 + \text{O}_2$
 (2) $4\text{LiNO}_3 \xrightarrow{\Delta} 2\text{Li}_2\text{O} + 2\text{N}_2\text{O}_4 + \text{O}_2$
 (3) $4\text{LiNO}_3 \xrightarrow{\Delta} 2\text{Li}_2\text{O} + 4\text{NO}_2 + \text{O}_2$
 (4) $2\text{LiNO}_3 \xrightarrow{\Delta} 2\text{Li} + 2\text{NO}_2 + \text{O}_2$

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. $4\text{LiNO}_3 \xrightarrow{\Delta} 2\text{Li}_2\text{O} + 4\text{NO}_2 + \text{O}_2$

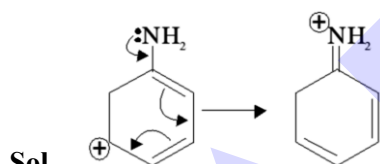
32. The most stable carbocation for the following is:



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

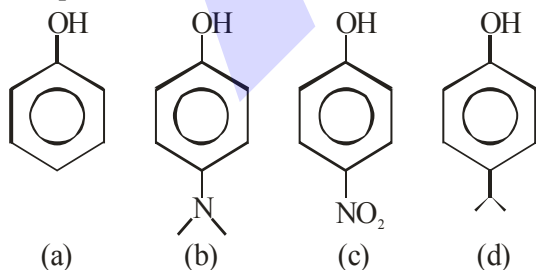
Official Ans. by NTA (1)

Allen Ans. (1)



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) $a > b > c > d$

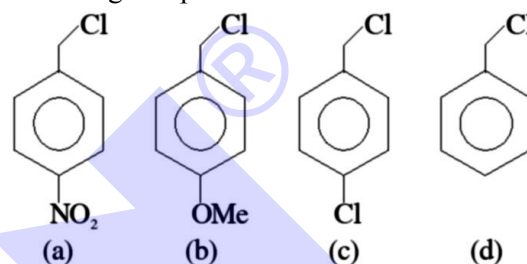
Official Ans. by NTA (2)

Allen Ans. (2)

TEST PAPER WITH SOLUTION

Sol. Due to -M effect of $-\text{NO}_2$ group, it increases acidity
 +M effect of $\text{N}(\text{CH}_3)_2$ decreases acidity.
 Hyperconjugation of isopropyl decrease acidity
 \therefore order of acidic strength
 (c) > (a) > (d) > (b)

34. Decreasing order towards $\text{S}_{\text{N}}1$ reaction for the following compounds is:

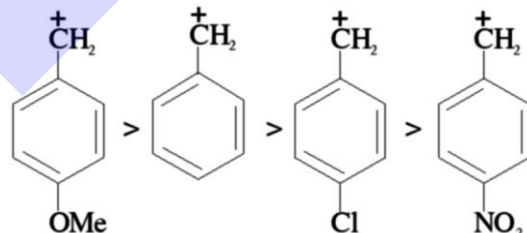


- (1) $a > c > d > b$ (2) $a > b > c > d$
 (3) $b > d > c > a$ (4) $d > b > c > a$

Official Ans. by NTA (3)

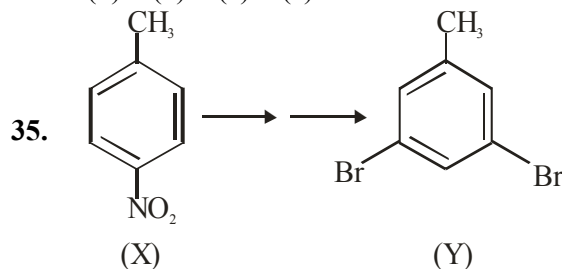
Allen Ans. (3)

Sol. The rate of $\text{S}_{\text{N}}1$ reaction depends upon stability of carbocation which follows the order



\therefore Reactivity order

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



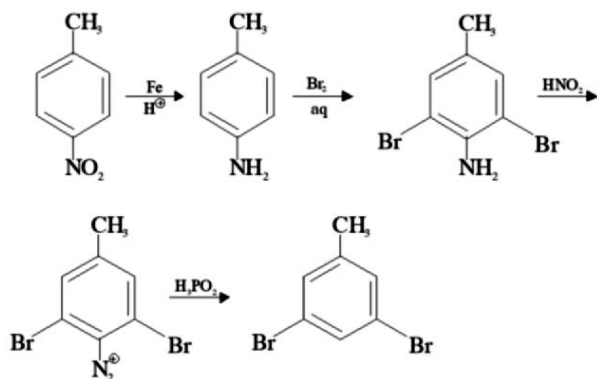
In the above conversion of compound (X) to product (Y), the sequence of reagents to be used will be:

- (1) (i) Br_2, Fe (ii) Fe, H^+ (iii) LiAlH_4
 (2) (i) $\text{Br}_2(\text{aq})$ (ii) LiAlH_4 (iii) H_3O^+
 (3) (i) Fe, H^+ (ii) $\text{Br}_2(\text{aq})$ (iii) HNO_2 (iv) CuBr
 (4) (i) Fe, H^+ (ii) $\text{Br}_2(\text{aq})$ (iii) HNO_2 (iv) H_3PO_2

Official Ans. by NTA (4)

Allen 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)

Allen 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)	$[\text{Ni}(\text{CO})_4]$	I	sp^3
(B)	$[\text{Cu}(\text{NH}_3)_4]^{2+}$	II	dsp^2
(C)	$[\text{Fe}(\text{NH}_3)_6]^{2+}$	III	sp^3d^2
(D)	$[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$	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)

Allen Ans. (BONUS)

Sol. For $[\text{Fe}(\text{NH}_3)_6]^{2+}$, $\Delta_0 < P$, hence the pairing of electrons does not occur in t_{2g} . Therefore complex is outer orbital and its hybridisation is sp^3d^2 .

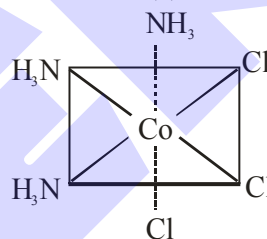
List I (Complexes)	List II (Hybridisation)
$[\text{Ni}(\text{CO})_4]$	sp^3
$[\text{Cu}(\text{NH}_3)_4]^{2+}$	dsp^2
$[\text{Fe}(\text{NH}_3)_6]^{2+}$	sp^3d^2
$[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$	sp^3d^2

38. The Cl – Co – Cl bond angle values in a fac- $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ complex is/are:

- (1) 90° & 180°
- (2) 90°
- (3) 180°
- (4) 90° & 120°

Official Ans. by NTA (2)

Allen 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

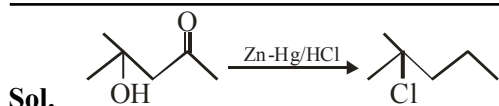
Reason R : Zn-Hg/HCl is used to reduce carbonyl group to $-\text{CH}_2-$ group.

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)

Allen Ans. (1)



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)

Allen 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)

Allen 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)

Allen Ans. (4)

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

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

$$\therefore r_0 = 2a_0$$

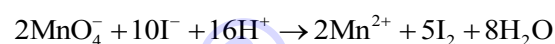
43. KMnO_4 oxidises I^- in acidic and neutral/faintly alkaline solution, respectively to

- (1) I_2 & IO_3^-
(2) IO_3^- & I_2
(3) IO_3^- & IO_3^-
(4) I_2 & I_2

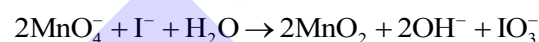
Official Ans. by NTA (1)

Allen Ans. (1)

- Sol. In acidic medium



In neutral/faintly alkaline solution



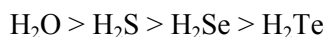
44. Bond dissociation energy of E-H bond of the “ H_2E ” hydrides of group 16 elements (given below), follows order.

- (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)

Allen Ans. (1)

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



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)

Allen 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)	$\text{CHCl}_3 + \text{C}_6\text{H}_5\text{NH}_2$	I	Steam distillation
(B)	$\text{C}_6\text{H}_{14} + \text{C}_5\text{H}_{12}$	II	Differential extraction
(C)	$\text{C}_6\text{H}_5\text{NH}_2 + \text{H}_2\text{O}$	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)

Allen Ans. (2)

Sol.

List I (Mixture)	List II (Separation Technique)
$\text{CHCl}_3 + \text{C}_6\text{H}_5\text{NH}_2$	Distillation
$\text{C}_6\text{H}_{14} + \text{C}_5\text{H}_{12}$	Fractional distillation
$\text{C}_6\text{H}_5\text{NH}_2 + \text{H}_2\text{O}$	Steam distillation
Organic compound in H_2O	Differential extraction

NCERT (XI) Vol. 2 Page No. 359, 360.

47. Boric acid is 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)

Allen 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)

Allen 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)

Allen Ans. (3)

Sol. Nessler's reagent is K_2HgI_4 .

50. 1 L, 0.02 M solution of $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ is mixed with 1L, 0.02 M solution of $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$. 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)

Allen Ans. (2)

Sol.
$$\begin{array}{ccccc} [\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br} + \text{AgNO}_3 & \rightarrow & \text{AgBr} \downarrow \\ 0.01 \text{ mol} & \text{excess} & 0.01 \text{ Mol} \end{array}$$

$$\begin{array}{ccccc} [\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4 + \text{BaCl}_2 & \rightarrow & \text{BaSO}_4 \downarrow \\ 0.01 \text{ mol} & \text{excess} & 0.01 \text{ Mol} \end{array}$$

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 $C_V = 20 \text{ J mol}^{-1} \text{ K}^{-1}$.

Official Ans. by NTA (150)

Allen Ans. (150)

Sol. $q = 0$

$$\Delta U = w$$

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

$$T_2 - 300 = -150$$

$$T_2 = 150 \text{ K}$$

52. Iron oxide FeO, crystallises in a cubic lattice with a unit cell edge length of 5.0 Å. 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 16 g mol⁻¹ respectively.

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

Official Ans. by NTA (4)

Allen Ans. (4)

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

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

$$Z = 4.166 \approx 4$$

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).

$$\text{Given : } \ln 10 = 2.3; \log 2 = 0.3$$

Official Ans. by NTA (1350)

Allen 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 H₂SO₄. 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).

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

Official Ans. by NTA (243)

Allen Ans. (243)

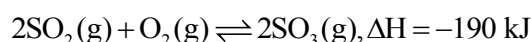
Sol. $\Delta T_f = i \cdot K_f \cdot m$

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

$$\Rightarrow \Delta T_f = 30.05$$

$$\therefore \text{F.P.} = 243 \text{ K}$$

55. Consider the following equation :



The number of factors which will increase the yield of SO₃ at equilibrium from the following is _____

- Increasing temperature
- Increasing pressure
- Adding more SO₂
- Adding more O₂
- Addition of catalyst

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. The yield of SO₃ at equilibrium will be due to :

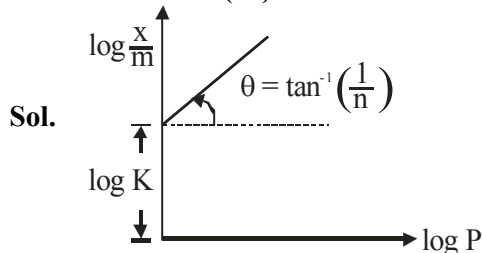
- Increasing pressure
- Adding more SO₂
- Adding more O₂

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)

Allen Ans. (16)



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

$$\frac{1}{n} = \tan 45^\circ = 1$$

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

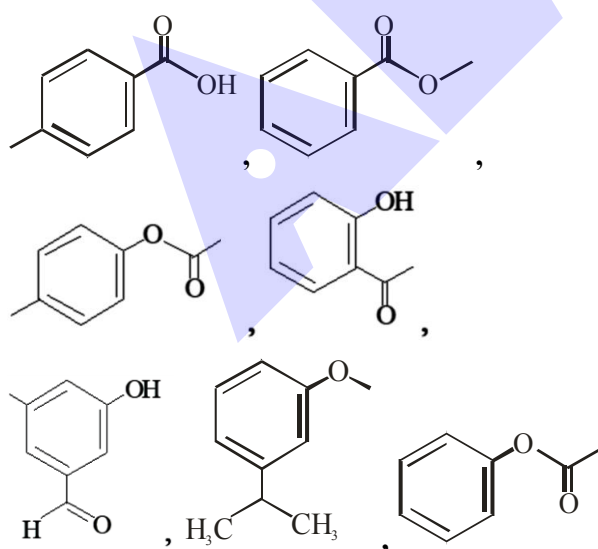
$$\Rightarrow K = 4$$

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

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

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

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)

Allen 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)

Allen 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.

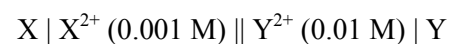
Official Ans. by NTA (150)

Allen Ans. (150)

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

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

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



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

$$\text{Given : } E_{\text{X}^{2+}|\text{X}}^0 = -2.36 \text{ V}$$

$$E_{\text{Y}^{2+}|\text{Y}}^0 = +0.36 \text{ V}$$

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

Official Ans. by NTA (275)

Allen Ans. (275)

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

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

$$\begin{aligned} E_{\text{Cell}} &= 2.72 - \frac{0.06}{2} \log \frac{0.001}{0.01} \\ &= 2.72 + 0.03 = 2.75 \text{ V} \\ &= 275 \times 10^{-2} \text{ V} \end{aligned}$$