JEE–MAIN EXAMINATION – APRIL 2025

(HELD ON THURSDAY 03rd APRIL 2025) **TIME : 9:00 AM TO 12:00 NOON**

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

51. Which of the following postulate of Bohr's model of hydrogen atom in not in agreement with quantum mechanical model of an atom ?

(1) An atom in a stationary state does not emit electromagnetic radiation as long as it stays in the same state

(2) An atom can take only certain distinct energies E_1, E_2, E_3, etc. These allowed states of constant energy are called the stationary states of atom

(3) When an electron makes a transition from a higher energy stationary state to a lower energy stationary state, then it emits a photon of light

(4) The electron in a H atom's stationary state moves in a circle around the nucleus

Ans. **(4)**

Sol. The electron in a H-atom's stationary state moves in a spherical path.

52. Given below are two statements

Statement I : The N–N single bond is weaker and longer than that of P–P single bond

Statement II : Compounds of group 15 elements in +3 oxidation states readily undergo disproportionation reactions.

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

(1) Statement I is true but statement II is false

(2) Both statement I and statement II are false

(3) Statement I is false but statement II is true

(4) Both statement I and statement II are true

Ans. **(2)**

Sol. $\overset{\bullet\bullet}{N}-\overset{\bullet\bullet}{N}$ single bond weaker than $\overset{\bullet\bullet}{P}-\overset{\bullet\bullet}{P}$ due to more ℓp-ℓp repulsion.

Bond length $\Rightarrow d_{p-p} > d_{N-N}$ (size$\uparrow$, B.L.$\uparrow$)

In group 15 elements only N & P show disproportionation in +3 oxidation state, **As**, **Sb** & **Bi** have almost inert for disproportionation in +3 oxidation state.

So both statements are false.

53. Given below are two statements

Statement I : A catalyst cannot alter the equilibrium constant (K_C) of the reaction, temperature remaining constant

Statement II : A homogenous catalyst can change the equilibrium composition of a system temperature remaining constant

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

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are true

(3) Both Statement I and Statement II is false

(4) Statement I is true but Statement II is false

Ans. **(2)**

Sol. A catalyst can change equilibrium composition if it is added at constant pressure, but it can not change equilibrium constant.

54. The metal ions that have the calculated spin only magnetic moment value of 4.9 B.M. are

A. Cr^{2+}

B. Fe^{2+}

C. Fe^{3+}

D. Co^{2+}

E. Mn^{3+}

Choose the **correct** answer from the options given below

(1) A, C and E only (2) A, D and E only

(3) B and E only (4) A, B and E only

Ans. **(4)**

Sol. Given magnetic moment = 4.9 B.M.

We know M.M = $\sqrt{n(n+2)}$B.M.

Where, n $\rightarrow$ No. of unpaired e^-

$4.9 = \sqrt{n(n+2)}$

We get n = 4

(A) $_{24}Cr^{2+} \Rightarrow [Ar]3d^4$ (4 unpaired e^-)

(B) $_{26}Fe^{2+} \Rightarrow [Ar]3d^6$ (4 unpaired e^-)

(C) $_{26}Fe^{3+} \Rightarrow [Ar]3d^5$ (5 unpaired e^-)

(D) $_{27}Co^{2+} \Rightarrow [Ar]3d^7$ (3 unpaired e^-)

(E) $_{25}Mn^{3+} \Rightarrow [Ar]3d^4$ (4 unpaired e^-)

55. In a reaction A + B → C, initial concentrations of A and B are related as $[A]_0 = 8[B]_0$. The half lives of A and B are 10 min and 40 min. respectively. If they start to disappear at the same time, both following first order kinetics, after how much time will the concentration of both the reactants be same?

(1) 60 min (2) 80 min

(3) 20 min (4) 40 min

Ans. (4)

Sol. Given : $[A]_0 = 8[B]_0$

$[t_{1/2}]_A = 10$ min.

$[t_{1/2}]_B = 40$ min.

Ist order kinetics

t = ?

$[A]_t = [B]_t$

$-k_A \times t \quad -k_B \times t$

$\Rightarrow [A]_0 e = [B]_0 e$

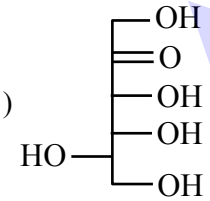
$$\Rightarrow \frac{[A]_0}{[B]_0} = e^{(k_A - k_B)t}$$

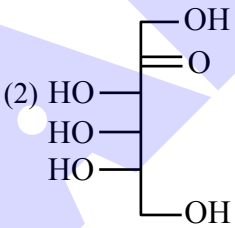
$$\Rightarrow 8 = e^{(k_A - k_B) \times t}$$

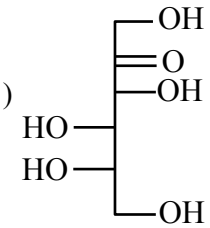
$$\Rightarrow \ell n8 = (k_A - k_B) \times t$$

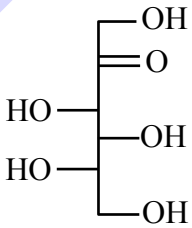
$$\Rightarrow \ell n8 = \ell n2\left(\frac{1}{(ta_2)_A} - \frac{1}{(ta_2)_B}\right) \times t$$

56. Which of the following is the correct structure of L-fructose ?

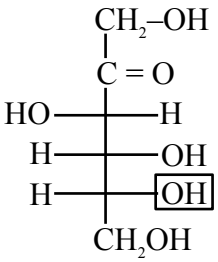
(1) 

(2) 

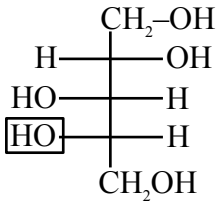
(3) 

(4) 

Ans. (3)

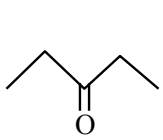
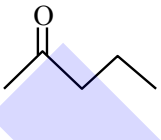
Sol. 

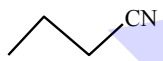
D - Fructose

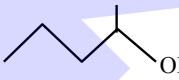


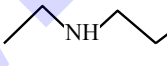
L - Fructose

57. Identify the correct statements from the following

A.  and  are metamers

B.  and  are functional isomers

C.  and  are position isomers

D.  and  are homologous

Choose the ***correct*** answer from the options given below

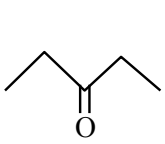
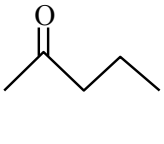
(1) C & D only

(2) B & C only

(3) A & B only

(4) A, B & C only

Ans. (3)

Sol. A.  and  = Metamer

B.  and  = F. G. isomer

In option C are momologoes to each – other and option D are only organic molecule not isomers.

58. Among 10^{-9} g (each) of the following elements, which one will have the highest number of atoms?

Element : Pb, Po, Pr and Pt

(1) Po

(2) Pr

(3) Pb

(4) Pt

Ans. **(2)**

Sol. No. of atoms $= \frac{\text{Mass in g}}{\text{Molar Mas(g/mol)}} \times N_A$

Therefore for the same Mass element having the least Molar mass will have the higher no. of atoms.

- $M_{Po} = 209$
- $\boxed{M_{Pr} = 141}$
- $M_{Pb} = 207$
- $M_{Pt} = 195$

59. Which of the following statements are <u>correct</u>?

A. The process of the addition an electron to a neutral gaseous atom is always exothermic

B. The process of removing an electron from an isolated gaseous atom is always endothermic

C. The 1st ionization energy of the boron is less than that of the beryllium

D. The electronegativity of C is 2.5 in CH_4 and CCl_4

E. Li is the most electropositive among elements of group I

Choose the ***correct*** answer from the options gives below

(1) B and C only

(2) A, C and D only

(3) B and D only

(4) B, C and E only

Ans. **(1)**

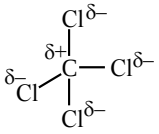
Sol. (A) The process of adding an e^- to a neutral gaseous atom is not always exothermic it may be exothermic or endothermic.

(C) Be B

$1s^2 2s^2$ $1s^2 2s^2 2p^1$

In Be 2s subshell in fully filled

So, need high energy to remove e^- as compared to B.

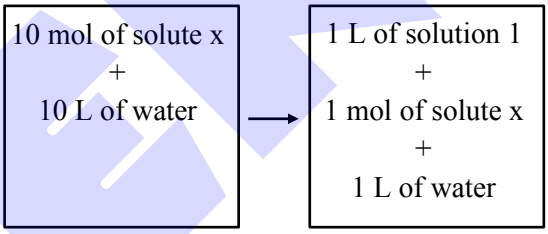
(D) In $CCl_4 \rightarrow$ 

due to partially positive charge $z_{eff}\uparrow$, EN$\uparrow$

So, EN of C $\Rightarrow$ $CCl_4 > CH_4$

(E) Cs is most electropositive.

60. Which of the following properties will change when system containing solution 1 will become solution 2 ?



(Solution 1) (Solution 2)

(1) Molar heat capacity

(2) Density

(3) Concentration

(4) Gibbs free energy

Ans. **(4)**

Sol. Both solutions are having same composition, which is 1 mole of 'x' in 1'ℓ' water, so all the intensive properties will remain same, but as total amount is greater in solution '1' compared to solution '2'. So extensive properties will be different hence Gibbs free energy will be different.

61. Number of molecules from below which <u>cannot</u> give ioddoform reaction is :

Ethanol, Isopropyl alcohol, Bromoacetone, 2-Butanol, 2-Butanone, Butanal, 2-Pentanone, 3-Pentanone, Pentanal and 3-Pentanol

(1) 5

(2) 4

(3) 3

(4) 2

Ans. **(2)**

Sol. Following will not give iodoform reaction/test.

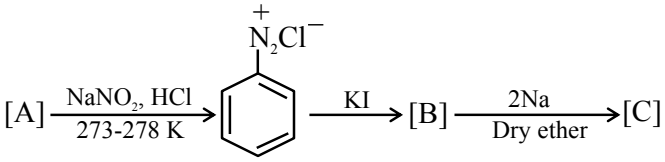
(1) Butanal

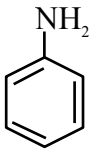
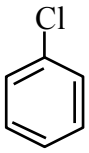
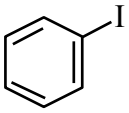
(2) 2-Pentanone

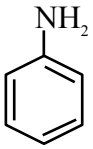
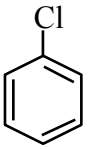
(3) Pentanal

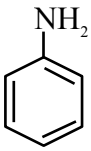
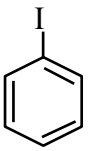
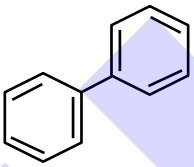
(4) 3- Pentanol

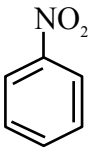
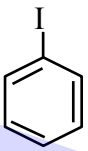
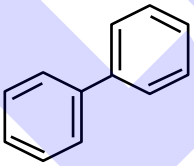
62. Identify [A], [B], and [C], respectively in the following reaction sequence :



(1) [A]  [B]  [C] 

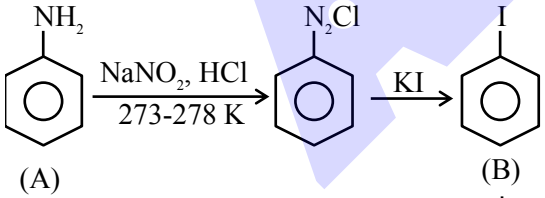
(2) [A]  [B]  [C] 

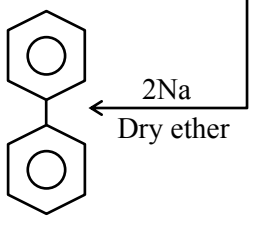
(3) [A]  [B]  [C] 

(4) [A]  [B]  [C] 

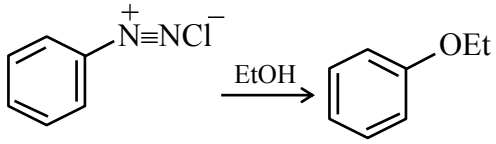
Ans. **(3)**

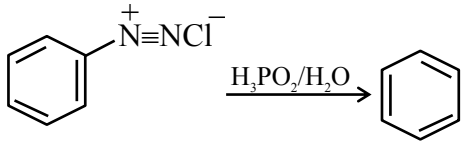
Sol.

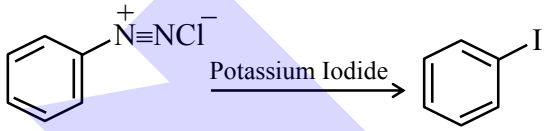


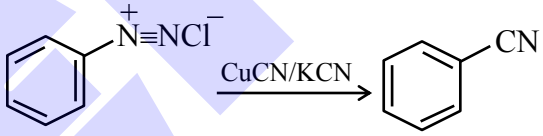


63. In the following reactions, which one is NOT correct?

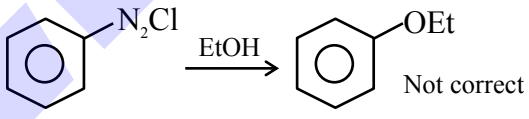
(1) 

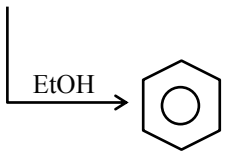
(2) 

(3) 

(4) 

Ans. **(1)**

Sol. 



deamination reaction

64. The correct order of the complexes $[Co(NH_3)_5(H_2O)]^{3+}$ (A), $[Co(NH_3)_6]^{3+}$ (B), $[Co(CN)_6]^{3-}$ (C) and $[CoCl(NH_3)_5]^{2+}$ (D) in terms wavelength of light absorbed is :

(1) D > A > B > C

(2) C > B > D > A

(3) D > C > B > A

(4) C > B > A > D

Ans. **(1)**

Sol. We know $E = h\nu = \frac{hC}{\lambda}$

$E \propto \frac{1}{\lambda}$

Here all Co in +3 oxidation state.

So, as the ligand field strength ↑, CFSE ↑

Order of field strength of ligand :

$CN^- > NH_3 > H_2O > Cl^-$

CFSE order : C > B > A > D

Wavelength order : D > A > B > C

65. In the following system,

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ at equilibrium, upon addition of xenon gas at constant T & p, the concentration of

(1) PCl_5 will increase

(2) Cl_2 will decrease

(3) PCl_5, PCl_3 & Cl_2 remain constant

(4) PCl_3 will increase

Ans. (4)

Sol. On addition of inert gas at constant P & T, reaction moves in the direction of greater no. of moles so it will shift in forward direction, so $[PCl_5]$ decrease and $[PCl_3]$ & $[Cl_2]$ will increase.

66. 2 moles each of ethylene glycol and glucose are dissolved in 500 g of water. The boiling point of the resulting solution is :

(Given : Ebullioscopic constant of water = 0.52 K kg mol^{-1})

(1) 379.2 K

(2) 377.3 K

(3) 375.3 K

(4) 277.3 K

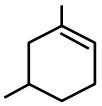
Ans. (2)

Sol. $\Delta T_b = i_1 m_1 k_b + i_2 m_2 k_b$

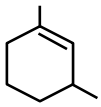
$= 1 \times \frac{2}{0.5} \times 0.52 + \frac{1 \times 2}{0.5} \times 0.52 = 4.16$

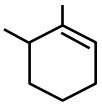
$(T_b)_{solution} = 373.16 + 4.16 = 377.3K.$

67. Which compound would give 3-methyl-6-oxoheptanal upon ozonolysis ?

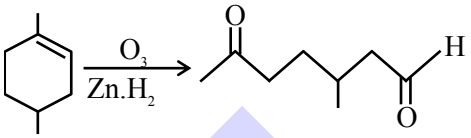
(1) 

(2) 

(3) 

(4) 

Ans. (2)

Sol. 

3-Methyl-6-ketoheptanal

68. Match the **LIST-I** with **LIST-II**

LIST-I (Molecules/ion)		**LIST-II (Hybridisation of central atom)**	
A.	PF_5	I	dsp^2
B.	SF_6	II.	sp^3d
C.	$Ni(CO)_4$	III.	sp^3d^2
D.	$[PtCl_4]^{2-}$	IV.	sp^3

Choose the ***correct*** answer from the options given below :

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

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

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

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

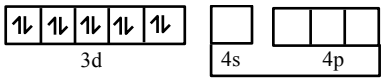
Ans. (1)

Sol. $PF_5 : 5\sigma + 0\ \ell p \rightarrow sp^3d$

$SF_6 : 6\sigma + 0\ \ell p \rightarrow sp^3d^2$

$Ni(CO)_4 : Ni \rightarrow 0$

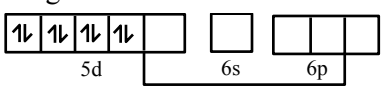
In presence of ligand field :-

Ni(0) : [Ar] 

sp^3 hybridisation

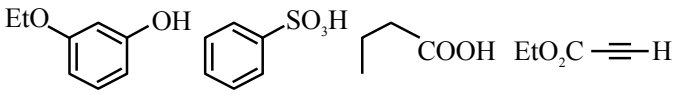
$[PtCl_4]^{2-} : Pt \rightarrow +2$

In presence of ligand field :-

Pt^{2+} : [Kr] 

dsp^2 hybridisation

69. The least acidic compound, among the following is:



(A) (B) (C) (D)

(1) D

(2) A

(3) B

(4) C

Ans. **(1)**

Sol. $EtO_2C-\equiv-H$

C.B. of terminal alkyne will be sp hybridisation and loculised. In other C.B. will be resonance stablised.

70. Correct order of limiting molar conductivity for cations in water at 298 K is :

(1) $H^+ > Na^+ > K^+ > Ca^{2+} > Mg^{2+}$

(2) $H^+ > Ca^{2+} > Mg^{2+} > K^+ > Na^+$

(3) $Mg^{2+} > H^+ > Ca^{2+} > K^+ > Na^+$

(4) $H^+ > Na^+ > Ca^{2+} > Mg^{2+} > K^+$

Ans. **(2)**

Sol. Limiting Molar Conductivities of Ions :

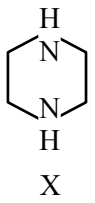
- $\overset{\oplus}{H}$: $349.8 Scm^2mol^{-1}$
- Na^+ : $50.11\ Scm^2mol^{-1}$
- K^+ : $73.52\ Scm^2mol^{-1}$
- Ca^{+2} : $119\ Scm^2mol^{-1}$
- Mg^{+2} : $106.12\ Scm^2mol^{-1}$

Therefore correct order of limiting molar conductivity of cations will be –

$\overset{\oplus}{H} > Ca^{+2} > Mg^{+2} > K^+ > Na^+$

SECTION-B

71. During estimation of nitrogen by Dumas' method of compound X (0.42 g) :



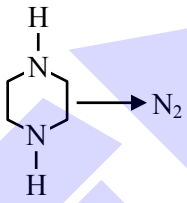
X

_____ mL of N_2 gas will be liberated at STP. (nearest integer)

(Given molar mass in g mol^{-1} : C : 12, H : 1, N : 14)

Ans. **(111)**

Sol. M.wt. of given compound = 86



Applying POAC on 'N'

$n_X \times 2 = n_{N_2} \times 2$

$\frac{0.42}{86} = n_{N_2}$

$\Rightarrow (Volume)_{N_2}$ at STP $= \frac{0.42}{86} \times 22.4\,L$

$= 0.1108\ L = 110.8\ m\ell$

72. 0.5 g of an organic compound on combustion gave 1.46 g of CO_2 and 0.9 g of H_2O. The percentage of carbon in the compound is ____. (Nearest integer)

[Given : Molar mass (in g mol^{-1}) C : 12, H : 1, O : 16]

Ans. **(80)**

Sol. Organic $\rightarrow CO_2$

Compound

Applying POAC on 'C'

(mole) of 'C' in compound $= n_{CO_2} \times 1$

So mass of 'C' in compound

$= \frac{1.46}{44} \times 12$

So, % of 'C' in compound $= \frac{1.46}{44} \times \frac{12}{0.5} \times 100$

$= 79.63$

73. The number of optical isomers exhibited by the iron complex (A) obtained from the following reaction is _____.

$FeCl_3 + KOH + H_2C_2O_4 \rightarrow A$

Ans. **(2)**

Sol. $FeCl_3 + KOH + H_2SO_4 \rightarrow \underset{(A)}{K_3[Fe(C_2O_4)_3]}$

$\Rightarrow [Fe(C_2O_4)_3]^{3-}$ is $[M(AA)_3]$ type complex.

So total optical isomers = 2

74. Given :

$\Delta H^{\ominus}_{sub}[C(graphite)] = 710 \text{ kJ mol}^{-1}$

$\Delta_{C-H}H^{\ominus} = 414 \text{ kJ mol}^{-1}$

$\Delta_{H-H}H^{\ominus} = 436 \text{ kJ mol}^{-1}$

$\Delta_{C=C}H^{\ominus} = 611 \text{ kJ mol}^{-1}$

The $\Delta H^{\ominus}_f$ for $CH_2{=}CH_2$ is _____ kJ mol^{-1} (nearest integer value)

Ans. **(25)**

Sol.

$$2C_{(S)} + 2H_{2(g)} \longrightarrow CH_2 = CH_{2(g)} : \left[\Delta H^{\circ}_f\right] C_2H_{4(g)}$$

$$\downarrow \qquad \nearrow$$

$$2C_{(g)} + 4H_{(g)}$$

$$\left[\Delta H^{\circ}_f\right]_{C_2H_{4(g)}} = 2\times\left[\Delta H^{\circ}_{sub}\right]_{C_{(s)}} + 2\times\Delta H^{\circ}_{H-H} - 1\times\Delta H^{\circ}_{C=C} - 4\times\Delta H^{\circ}_{C-H}$$

$\Rightarrow \left[\Delta H^{\circ}_f\right]_{C_2H_{4(g)}} = (2\times 710) + (2\times 436) - 611 - 4\times 414$

$\Rightarrow \left[\Delta H^{\circ}_f\right]_{C_2H_{4(g)}} = 25 \text{ kJ / mol}$

75. Consider the following reactions

$A + \underset{\text{Little amount}}{NaCl} + H_2SO_4 \rightarrow CrO_2Cl_2 + \text{Side Products}$

$CrO_2Cl_{2(Vapour)} + NaOH \rightarrow B + NaCl + H_2O$

$B + H^+ \rightarrow C + H_2O$

The number of terminal 'O' present in the compound 'C' is _____.

Ans. **(6)**

Sol. $Cr_2O_7^{2-} + NaCl + H_2SO_4 \rightarrow CrO_2Cl_2$

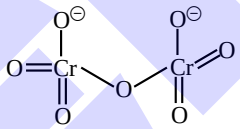
CrO_2Cl_2 (Vapour) + NaOH $\rightarrow$

$Na_2CrO_4 + NaCl + H_2O$

$Na_2CrO_4 + H^{\oplus} \rightarrow Na_2Cr_2O_7 + H_2O$

(C)

$Na_2Cr_2O_7 \rightarrow 2Na^{\oplus} + Cr_2O_7^{2-}$



No of terminal "O" = 6

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