JEE Main 2025 April 3 Shift 1 Question Paper with Solutions

Time Allowed :3 Hours	Maximum Marks :300	Total Questions :75

General Instructions

Read the following instructions very carefully and strictly follow them:

1. Multiple choice questions (MCQs)
2. Questions with numerical values as answers.
3. There are three sections: **Mathematics, Physics, Chemistry**.
4. **Mathematics:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory.
5. **Physics:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory..
6. **Chemistry:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory.
7. Total: 75 Questions (25 questions each).
8. 300 Marks (100 marks for each section).
9. **MCQs:** Four marks will be awarded for each correct answer and there will be a negative marking of one mark on each wrong answer.
10. **Questions with numerical value answers:** Candidates will be given four marks for each correct answer and there will be a negative marking of 1 mark for each wrong answer.

Chemistry

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

Correct Answer: (4)

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

Quick Tip

Bohr's model assumes electrons move in circular orbits, while quantum mechanics describes electrons in terms of probability distributions (orbitals).

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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

Correct Answer: (2)

Solution: N-N single bond weaker than P-P due to more lp-lp repulsion. Bond length $d_{N-N} > d_{P-P}$ (size↑, B.L.↑) In group 15 elements only N and P show disproportionation in +3 oxidation state. As, Sb and Bi have almost inert for disproportionation in +3 oxidation state. So both statements are false.

Quick Tip

Consider the bond strengths and lengths in nitrogen and phosphorus. Recall the trend of disproportionation reactions in group 15 elements.

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

Correct Answer: (2)

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

Quick Tip

A catalyst affects the rate of a reaction, but not the equilibrium constant. It can alter the equilibrium composition by changing the forward and reverse reaction rates equally.

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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^{2+} Choose the correct answer from the options given below

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

Correct Answer: (4)

Solution: Given magnetic moment = 4.9 B.M.
We know, M.M = $\sqrt{n(n+2)}$ B.M.
Where, n = Number of unpaired electrons (e^-)
$4.9 = \sqrt{n(n+2)}$
We get $n = 4$
(A) $Cr^{2+} = [Ar]\, 3d^4$ (4 unpaired e^-)
(B) $Fe^{2+} = [Ar]\, 3d^6$ (4 unpaired e^-)
(C) $Fe^{3+} = [Ar]\, 3d^5$ (5 unpaired e^-)
(D) $Co^{2+} = [Ar]\, 3d^7$ (3 unpaired e^-)
(E) $Mn^{2+} = [Ar]\, 3d^5$ (5 unpaired e^-)

Quick Tip

Use the spin-only magnetic moment formula to calculate the number of unpaired electrons. Then, determine the electronic configurations of the given metal ions and identify those with 4 unpaired electrons.

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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

Correct Answer: (4)

Solution:

$$\text{Given: } [A]_0 = 8[B]_0$$

$$t_{1/2(A)} = 10 \text{ min}$$

$$t_{1/2(B)} = 40 \text{ min}$$

$$1^{st} \text{ order kinetics}$$

$$t = ?$$

$$[A] = [B]$$

$$-k_A \times t = \ln \frac{[A]}{[A]_0}$$

$$[A] = [A]_0 e^{-k_A t}$$

$$[B] = [B]_0 e^{-k_B t}$$

$$[A] = [B]$$

$$[A]_0 e^{-k_A t} = [B]_0 e^{-k_B t}$$

$$8[B]_0 e^{-k_A t} = [B]_0 e^{-k_B t}$$

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

$$\ln 8 = (k_A - k_B)t$$

$$t = \frac{\ln 8}{k_A - k_B}$$

$$t = \frac{\ln 8}{\frac{\ln 2}{10} - \frac{\ln 2}{40}}$$

$$t = \frac{\ln 2^3}{\frac{\ln 2}{10} - \frac{\ln 2}{40}}$$

$$t = \frac{3 \ln 2}{\ln 2 \left(\frac{1}{10} - \frac{1}{40}\right)}$$

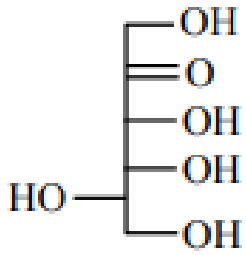
$$t = \frac{3}{\frac{4-1}{40}} = \frac{3}{\frac{3}{40}}$$

$$t = 40 \text{ min}$$

Quick Tip

Use the first-order rate law and the given half-lives to find the time when the concentrations of A and B are equal.

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



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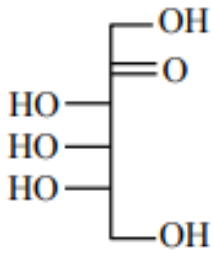

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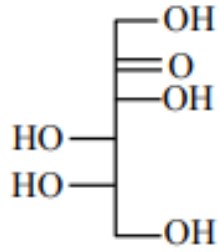

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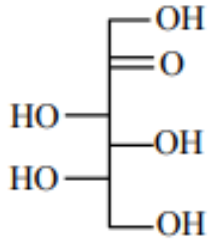
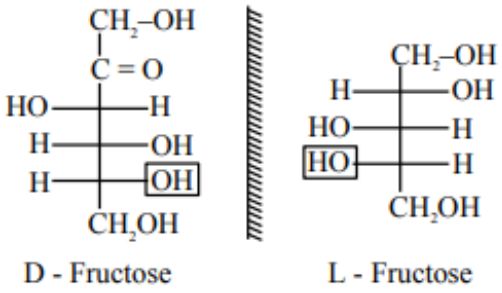


(4)

Correct Answer: (3)

Solution:



Quick Tip

Remember the structure of L-fructose, including the position of the hydroxyl groups and the orientation of the chiral centers.

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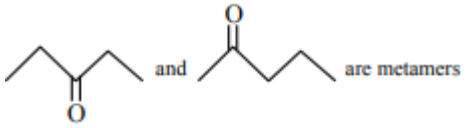
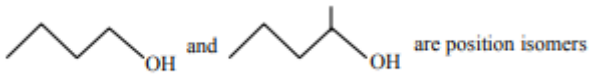
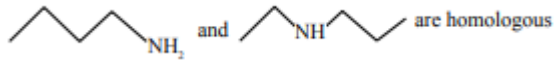
57. Identify the correct statements from the following

A. 

B. 

C. 

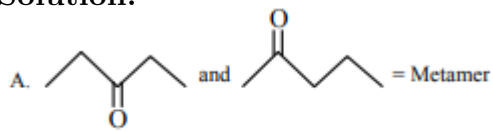
D. 

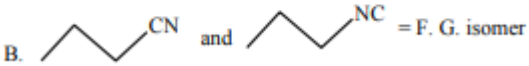
Choose the **correct** answer from the options given below

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

Correct Answer: (3)

Solution:

A. 

B. 

In option C are momologues to each - other and option D are only organic molecule not isomers.

Quick Tip

Remember the definitions of metamers, functional isomers, position isomers, and homologous series. Identify the relationships between the given pairs of compounds based on their structures and functional groups.

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58. Among 10^{-10} 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

Correct Answer: (2)

Solution:

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

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

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

Quick Tip

The number of atoms in a given mass is inversely proportional to the molar mass of the element.

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59. Which of the following statements are correct? 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 1 Choose the correct answer from the options given below

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

Correct Answer: (1)

Solution:

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

(B) Be: $1s^2 2s^2$
B: $1s^2 2s^2 2p^1$
In Be, the 2s subshell is fully filled.
So, high energy is needed to remove an e^- as compared to B.

(D) In CCl_4, due to partially positive charge, $Z_{eff} \uparrow$
So, EN of C: $CCl_4 > CH_4$

(E) Cs is most electropositive

Quick Tip

Review the definitions of electron affinity, ionization energy, electronegativity, and electropositivity. Consider the electronic configurations and trends in the periodic table.

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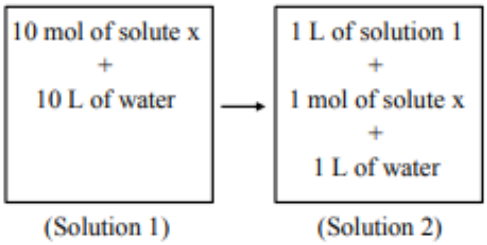
60. Which of the following properties will change when system containing solution 1 will become solution 2 ?



(1) Molar heat capacity
(2) Density
(3) Concentration
(4) Gibbs free energy

Correct Answer: (4)

Solution: Sol. Both solutions are having same composition, which is 1 mole of 'x' in 1L H_2O, 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.

Quick Tip

Distinguish between intensive and extensive properties. Intensive properties do not depend on the amount of substance, while extensive properties do.

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61. Number of molecules from below which cannot give iodoform reaction is:
Ethanol, Isopropyl alcohol, Bromoacetone, 2-Butanol, 2-Butanone, Butanal, 2-Pentanone, 3-Pentanone, Pentanal and 3-Pentanol

(1) 2
(2) 4
(3) 3
(4) 2

Correct Answer: (2)

Solution: Following will not give iodoform reaction/test. (1) Butanal
(2) 2-Pentanone
(3) Pentanal
(4) 3-Pentanol

Quick Tip

Remember the structural requirements for the iodoform test. The compound must have a CH_3CO- or $CH_3CH(OH)-$ group.

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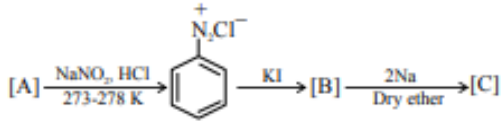
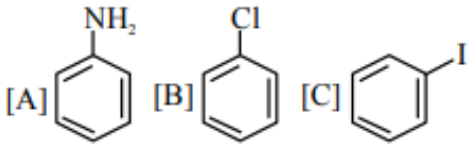
62. Identify [A], [B], and [C], respectively in the following reaction sequence :



(1)


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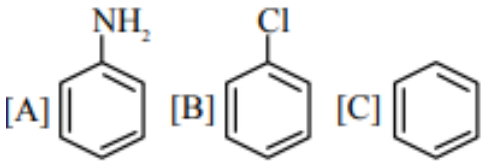

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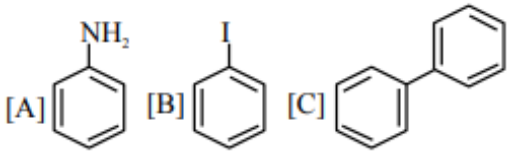

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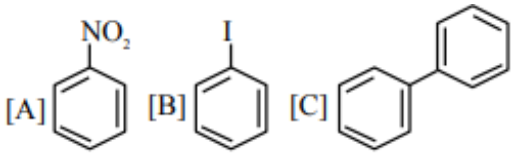
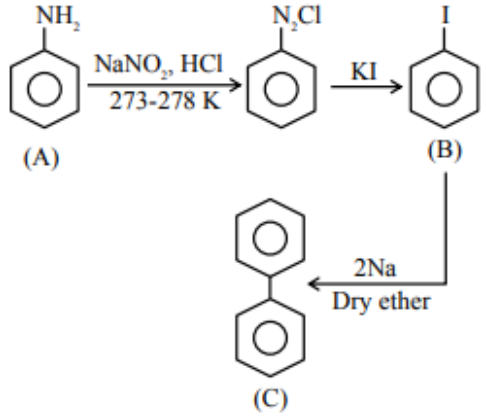


Correct Answer: (3)

Solution:



Quick Tip

Recognize the reactions involved: diazotization, Sandmeyer reaction, and coupling reaction.

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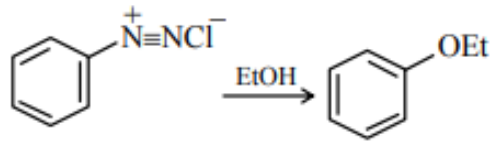
63. In the following reactions, which one is NOT correct?

(1)



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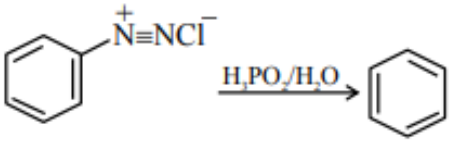

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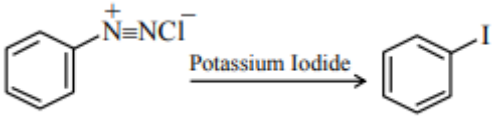

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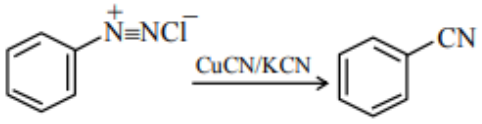
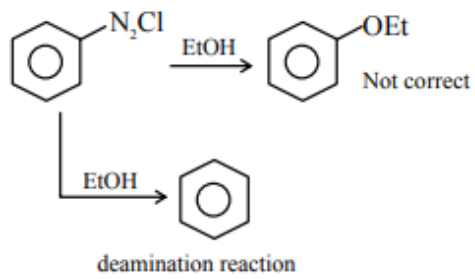


Correct Answer: (1)



Solution: Not correct

Quick Tip

Recognize the reactions involved: Sandmeyer reaction, hydrolysis, and nucleophilic substitution.

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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),
$[CoCl(NH_3)_5]^{2+}$ (D)

in terms of 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

Correct Answer: (1)

Solution:

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

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

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

Quick Tip

Remember the spectrochemical series and how it relates to the strength of ligands and the energy of absorbed light.

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 and p, the concentration of

(1) PCl_5 will increase
(2) Cl_2 will decrease
(3) PCl_5, PCl_3 and Cl_2 remain constant
(4) PCl_3 will increase

Correct Answer: (4)

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

Quick Tip

Adding an inert gas at constant pressure and temperature increases the volume of the container. This causes the equilibrium to shift towards the side with more moles of gas.

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 $= 0.52\,\text{K kg mol}^{-1}$)

(1) 379.2 K
(2) 377.3 K
(3) 375.3 K
(4) 277.3 K

Correct Answer: (2)

Solution:

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

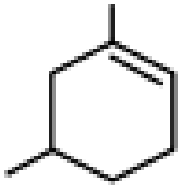
$$\Delta T_b = 1 \times \frac{2}{0.5} \times 0.52 + 1 \times \frac{2}{0.5} \times 0.52 = 4.16$$

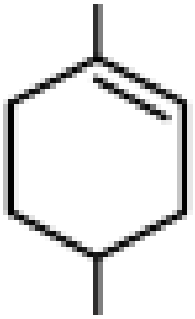
$$(T_b)_{\text{solution}} = 373.16 + 4.16 = 377.3 \text{ K}$$

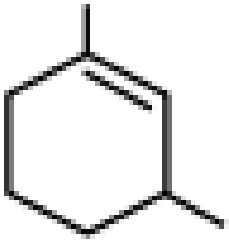
Quick Tip

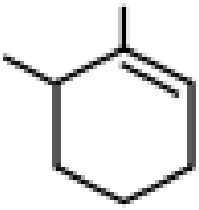
Use the formula for boiling point elevation. Remember to account for the van't Hoff factor (i) for each solute and the total molality of the solution.

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

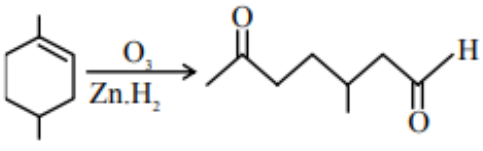
(1) 

(2) 

(3) 

(4) 

Correct Answer: (2)

Solution: 

3-Methyl-6-ketoheptanal 3-Methyl-6-ketoheptanal

Quick Tip

Remember that ozonolysis of alkenes cleaves the double bond and forms carbonyl compounds.

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68. Match the LIST-I with LIST-II

LIST-I	LIST-II
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

Correct Answer: (1)

Solution:

PF_5**:** $5\sigma + 0$ lone pair $\Rightarrow sp^3d$ hybridisation

SF_6**:** $6\sigma + 0$ lone pair $\Rightarrow sp^3d^2$ hybridisation

$Ni(CO)_4$**:** Ni oxidation state $= 0$

In presence of ligand field:

Ni(0): [Ar] $\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow$ ----

Orbitals: $3d$ $4s$ $4p$

$\Rightarrow sp^3$ hybridisation

$[PtCl_4]^{2-}$**:** Pt oxidation state $= +2$

In presence of ligand field:

Pt^{2+}: [Kr] $\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow$ ---

Orbitals: $5d$ $6s$ $6p$

$\Rightarrow dsp^2$ hybridisation

Quick Tip

Determine the hybridization of the central atom in each molecule/ion by counting the number of sigma bonds and lone pairs.

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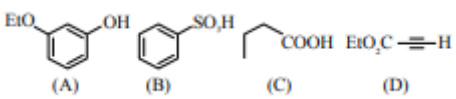
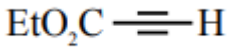
69. The least acidic compound, among the following is



(1) D

(2) A
(3) B
(4) C

Correct Answer: (1)



Solution:
C.B. of terminal alkyne will be sp hybridisation and localised. In other C.B. will be resonance stabilised.

Quick Tip

Acidity depends on the stability of the conjugate base. Consider the hybridization of the carbon atom from which the proton is removed and the possibility of resonance stabilization.

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

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

Correct Answer: (2)

Solution: Limiting Molar Conductivities of ions :

$$\lambda^0_{H^+} : 349.8 \text{ Sem}^2\text{mol}^{-1}$$

$$\lambda^0_{Na^+} : 50.11 \text{ Sem}^2\text{mol}^{-1}$$

$$\lambda^0_{K^+} : 73.52 \text{ Sem}^2\text{mol}^{-1}$$

$$\lambda^0_{Ca^{2+}} : 119 \text{ Sem}^2\text{mol}^{-1}$$

$$\lambda^0_{Mg^{2+}} : 106.12 \text{ Sem}^2\text{mol}^{-1}$$

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

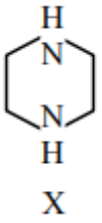
$$H^+ > Ca^{2+} > Mg^{2+} > K^+ > Na^+$$

Quick Tip

The limiting molar conductivity depends on the size and charge of the ion. Smaller and highly charged ions are more hydrated, leading to lower mobility and thus lower conductivity. However, H^+ has exceptionally high conductivity due to its movement through a proton hopping mechanism.

Section - B

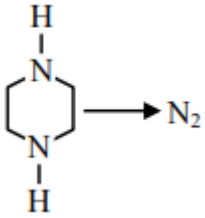
71. During estimation of Nitrogen by Dumas' method of compound X (0.42 g) :



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)

Correct Answer: (111)

Solution: M.wt of given compound = 86



Applying POAC on 'N' $n_N \times 2 = n_{N_2} \times 2$ $n_N = n_{N_2}$ Moles of N in 0.42 g compound = $\frac{0.42}{86} \times \frac{14\times1}{14} = \frac{0.42}{86}$ Moles of N_2 formed = $\frac{0.42}{86}$ Volume (N_2) at STP = $\frac{0.42}{86} \times 22.4L$ Volume (N_2) at STP = $0.1108L = 110.8mL \approx 111mL$

Quick Tip

In Dumas' method, all the nitrogen in the organic compound is converted to N_2 gas. Use the molar ratio of nitrogen in the compound to the moles of N_2 produced and then calculate the volume at STP.

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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)

Correct Answer: (80)

Solution: Organic Compound $\rightarrow$ CO_2
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 =

$$\frac{1.46}{44} \times \frac{12}{0.5} \times 100$$
$$= 79.63$$

Quick Tip

During combustion of an organic compound, all the carbon present in the compound is converted to CO_2. Use the molar mass ratio to find the mass of carbon in the CO_2 produced and then calculate the percentage of carbon in the organic compound.

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73. The number of optical isomers exhibited by the iron complex (A) obtained from the following reaction is _____ $FeCl_3 + KOH + H_2C_2O_4 \rightarrow A$

Correct Answer: (2)

Solution:

$$FeCl_3 + KOH + H_2C_2O_4 \rightarrow K_3[Fe(C_2O_4)_3]$$

(A)

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

So total optical isomers = 2

Quick Tip

For $[M(AA)_3]$ type complexes, where AA is a symmetrical bidentate ligand, the complex is chiral and exists as two optical isomers (d and l forms).

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74. Given: $\Delta H_f^0[C(graphite)] = 710$ **kJ mol¹** $\Delta_c H^0 = 414$ **kJ mol¹** $\Delta_{H-H}^0 = 436$ **kJ mol¹** $\Delta_{C-H}^0 = 611$ **kJ mol¹ The** $\Delta H_{C=C}^0$ **for** $CH_2 = CH_2$ **is _____ kJ mol^{-1} (nearest integer value)**

Correct Answer: (25)

Solution:

$$[\Delta H_f^0]_{C_2H_4(g)} = (2 \times 710) + (2 \times 436) - 611 - 4 \times 414$$
$$[\Delta H_f^0]_{C_2H_4(g)} = 1420 + 872 - 611 - 1656$$
$$[\Delta H_f^0]_{C_2H_4(g)} = 2292 - 2267 = 25 \text{ kJ mol}^{-1}$$

Final Answer: The final answer is $\boxed{25}$

Quick Tip

The enthalpy of formation of a compound can be related to the enthalpies of formation of its constituent atoms and the bond enthalpies of the bonds within the molecule. Set up an equation relating the enthalpy of formation of ethylene to the sublimation enthalpy of carbon, the bond enthalpy of hydrogen, and the bond enthalpies of C=C and C-H bonds, then solve for the C=C bond enthalpy.

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75. Consider the following reactions $A + HCl + H_2SO_4 \rightarrow CrO_2Cl_2 + SideProducts$ **Little amount** $CrO_2Cl_2(vapour) + NaOH \rightarrow B + NaCl + H_2O$ $B + H^+ \rightarrow C + H_2O$ **The number of terminal 'O' present in the compound 'C' is** _____

Correct Answer: (6)

Solution:

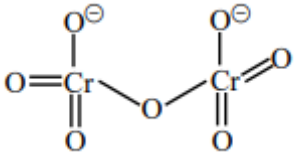
$$Cr_2O_7^{2-} + HCl + H_2SO_4 \rightarrow CrO_2Cl_2$$

$$CrO_2Cl_2(vapour) + NaOH \rightarrow Na_2CrO_4 + NaCl + H_2O$$

$$Na_2CrO_4 + H^+ \rightarrow Na_2Cr_2O_7 + H_2O$$

$$2Na_2CrO_4 + 2H^+ \rightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$$

$$CrO_4^{2-} \xrightarrow{H^+} Cr_2O_7^{2-}$$



No of terminal "O" = 6

Quick Tip

Identify the chromium-containing species formed in each reaction. Chromyl chloride (CrO_2Cl_2) reacts with NaOH to form chromate ions (CrO_4^{2-}), which in acidic solution convert to dichromate ions ($Cr_2O_7^{2-}$). Draw the structure of the dichromate ion to count the terminal oxygen atoms.
