FINAL JEE–MAIN EXAMINATION – JANUARY, 2024

(Held On Tuesday 30th January, 2024) **TIME : 9 : 00 AM to 12 : 00 NOON**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

61. Given below are two statements:

Statement-I: The gas liberated on warming a salt with dil H_2SO_4, turns a piece of paper dipped in lead acetate into black, it is a confirmatory test for sulphide ion.

Statement-II: In statement-I the colour of paper turns black because of formation of lead sulphite.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both Statement-I and Statement-II are false

(2) Statement-I is false but Statement-II is true

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

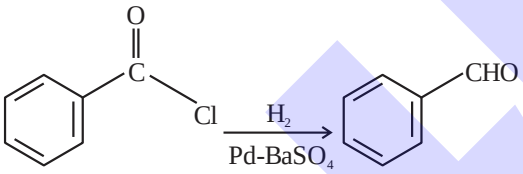
(4) Both Statement-I and Statement-II are true.

Ans. (3)

Sol. $Na_2S + H_2SO_4 \rightarrow Na_2SO_4 + H_2S$

$(CH_3COO)_2Pb + H_2S \rightarrow \underset{\text{Black lead sulphide}}{PbS} + 2CH_3COOH$

62.



This reduction reaction is known as:

(1) Rosenmund reduction

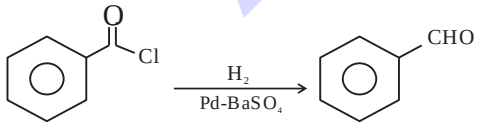
(2) Wolff-Kishner reduction

(3) Stephen reduction

(4) Etard reduction

Ans. (1)

Sol.



It is known as rosenmund reduction that is the partial reduction of acid chloride to aldehyde

63. Sugar which does not give reddish brown precipitate with Fehling's reagent is:

(1) Sucrose (2) Lactose

(3) Glucose (4) Maltose

Ans. (1)

Sol. Sucrose do not contain hemiacetal group.

Hence it does not give test with Fehling solution.

While all other give positive test with Fehling solution

64. Given below are the two statements: one is labeled as Assertion (A) and the other is labeled as Reason (R).

Assertion (A): There is a considerable increase in covalent radius from N to P. However from As to Bi only a small increase in covalent radius is observed.

Reason (R): covalent and ionic radii in a particular oxidation state increases down the group.

In the light of the above statement, choose the most appropriate answer from the options given below:

(1) (A) is false but (R) is true

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

(3) (A) is true but (R) is false

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

Ans. (2)

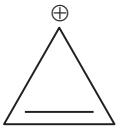
Sol. According to NCERT,

Statement-I : Factual data,

Statement-II is true.

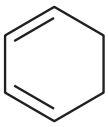
But correct explanation is presence of completely filled d and f-orbitals of heavier members

65. Which of the following molecule/species is most stable?

(1) 

(2) 

(3) 

(4) 

Ans. (1)

Sol.  it is aromatic species

66. Diamagnetic Lanthanoid ions are:

(1) Nd^{3+} and Eu^{3+} (2) La^{3+} and Ce^{4+}

(3) Nd^{3+} and Ce^{4+} (4) Lu^{3+} and Eu^{3+}

Ans. (2)

Sol. Ce : $[Xe]\ 4f^1 5d^1 6s^2$; Ce^{4+} diamagnetic

La : $[Xe]\ 4f^0 5d^1 6s^2$; La^{3+} diamagnetic

67. Aluminium chloride in acidified aqueous solution forms an ion having geometry

(1) Octahedral

(2) Square Planar

(3) Tetrahedral

(4) Trigonal bipyramidal

Ans. (1)

Sol. $AlCl_3$ in acidified aqueous solution forms octahedral geometry $[Al(H_2O)_6]^{3+}$

68. Given below are two statements:

Statement-I: The orbitals having same energy are called as degenerate orbitals.

Statement-II: In hydrogen atom, 3p and 3d orbitals are not degenerate orbitals.

In the light of the above statements, choose the **most appropriate** answer from the options given

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

(2) Both Statement-I and Statement-II are true.

(3) Both Statement-I and Statement-II are false

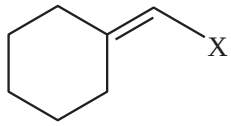
(4) Statement-I is false but Statement-II is true

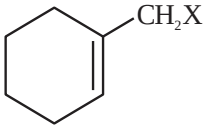
Ans. (1)

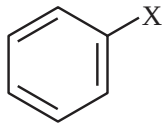
Sol. For single electron species the energy depends upon principal quantum number 'n' only. So, statement II is false.

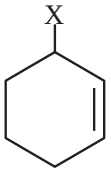
Statement I is correct definition of degenerate orbitals.

69. Example of vinylic halide is

(1) 

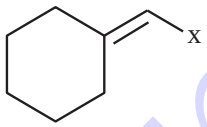
(2) 

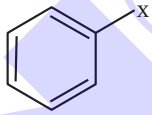
(3) 

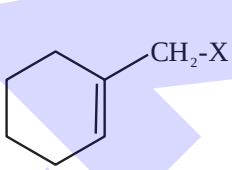
(4) 

Ans. (1)

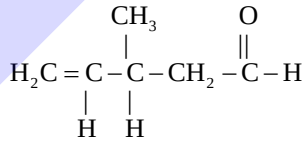
Sol. Vinyl carbon is sp^2 hybridized aliphatic carbon

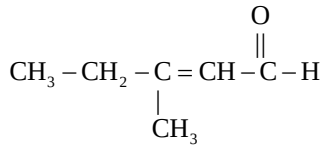
 is vinyl halide

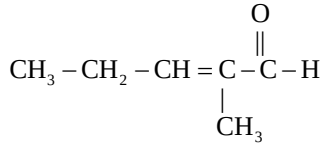
While  is aryl halide

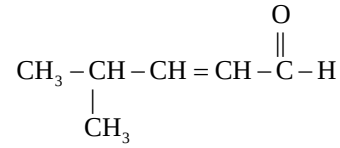
and  are allyl halide

70. Structure of 4-Methylpent-2-enal is

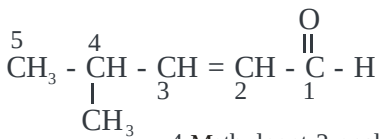
(1) 

(2) 

(3) 

(4) 

Ans. (4)

Sol. 

4-Methylpent-2-enal

71. Match List-I with List-II

List-I	**List-II**
Molecule	**Shape**
(A) BrF_5	(I) T-shape
(B) H_2O	(II) See saw
(C) ClF_3	(III) Bent
(D) SF_4	(IV) Square pyramidal

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

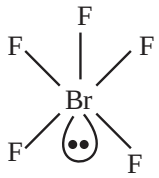
(2) (A) –II, (B)-I, (C)-III, (D)-IV

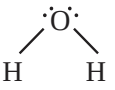
(3) (A)-III, (B)-IV, (C)-I, (D)-II

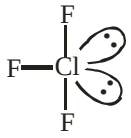
(4) (A)-IV, (B)-III, (C)-I, (D)-II

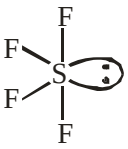
Ans. (4)

Sol.

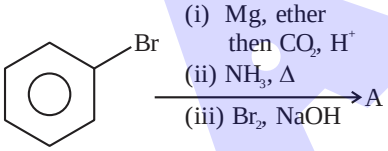
BrF_5  Square pyramidal

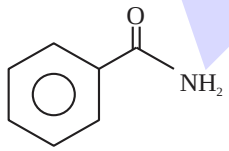
H_2O  Bent

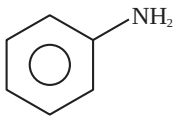
ClF_3  T-shape

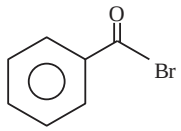
SF_4,  See-saw

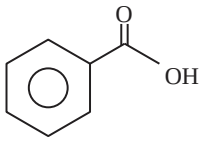
72. The final product A, formed in the following multistep reaction sequence is:



(1) 

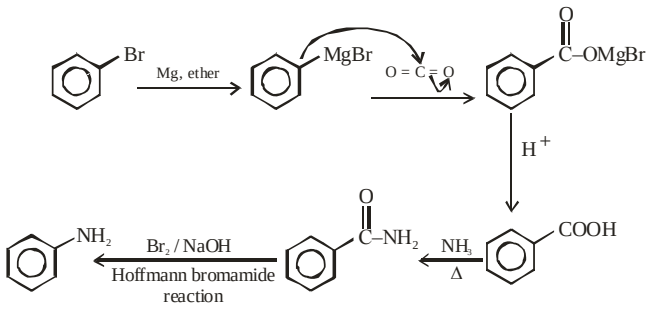
(2) 

(3) 

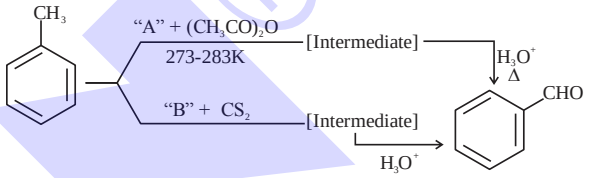
(4) 

Ans. (2)

Sol.



73. In the given reactions identify the reagent A and reagent B



(1) A-CrO_3 B-CrO_3

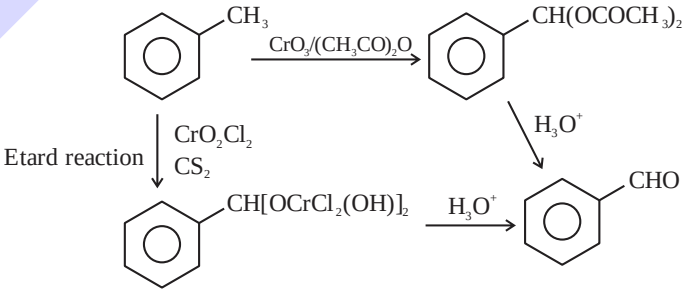
(2) A-CrO_3 B-CrO_2Cl_2

(3) A-CrO_2Cl_2 B-CrO_2Cl_2

(4) A-CrO_2Cl_2 B-CrO_3

Ans. (2)

Sol.



74. Given below are two statement one is labeled as **Assertion (A)** and the other is labeled as **Reason (R).**

Assertion (A): $CH_2 = CH - CH_2 - Cl$ is an example of allyl halide

Reason (R): Allyl halides are the compounds in which the halogen atom is attached to sp^2 hybridised carbon atom.

In the light of the two above statements, choose the **most appropriate** answer from the options given below:

(1) **(A)** is true but **(R)** is false

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

(3) **(A)** is false but **(R)** is true

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

Ans. (1)

Sol. $CH_2 = CH - CH_2 - Cl$

↑

It is allyl carbon and sp^3 hybridized

75. What happens to freezing point of benzene when small quantity of napthalene is added to benzene?

(1) Increases

(2) Remains unchanged

(3) First decreases and then increases

(4) Decreases

Ans. (4)

Sol. On addition of naphthalene to benzene there is depression in freezing point of benzene.

76. Match List-I with List-II

List-I **Species**	**List-II** **Electronic distribution**
(A) Cr^{+2}	(I) $3d^8$
(B) Mn^{+}	(II) $3d^3 4s^1$
(C) Ni^{+2}	(III) $3d^4$
(D) V^{+}	(IV) $3d^5 4s^1$

Choose the correct answer from the options given below:

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

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

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

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

Ans. (2)

Sol. $_{24}Cr \rightarrow [Ar]\ 3d^5 4s^1$; $Cr^{2+} \rightarrow [Ar]\ 3d^4$

$_{25}Mn \rightarrow [Ar]\ 3d^5 4s^2$; $Mn^{+} \rightarrow [Ar]\ 3d^5 4s^1$

$_{28}Ni \rightarrow [Ar]\ 3d^8 4s^2$; $Ni^{2+} \rightarrow [Ar]\ 3d^8$

$_{23}V \rightarrow [Ar]\ 3d^3 4s^2$; $V^{+} \rightarrow [Ar]\ 3d^3 4s^1$

77. Compound A formed in the following reaction reacts with B gives the product C. Find out A and B.

$$CH_3 - C \equiv CH + Na \rightarrow A \xrightarrow{B} \underset{(C)}{CH_3 - C \equiv C - CH_2 - \underset{\displaystyle CH_3}{\underset{|}{CH_2}}} + NaBr$$

(1) A=CH_3 –C≡ $\bar{C}N\overset{+}{a}$, B = $CH_3 - CH_2 - CH_2 - Br$

(2) A=CH_3–CH= CH_2, B = $CH_3 - CH_2 - CH_2 - Br$

(3) A = $CH_3 - CH_2 - CH_3$, B = $CH_3 - C \equiv CH$

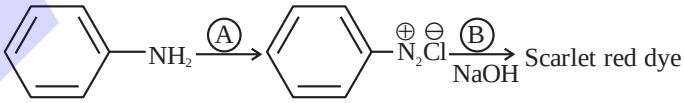
(4) A = $CH_3 - C \equiv \bar{C}N\overset{+}{a}$, B = $CH_3 - CH_2 - CH_3$

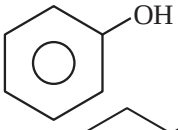
Ans. (1)

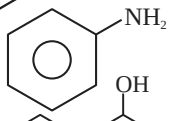
Sol.

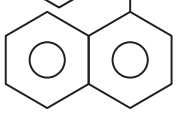
$$CH_3 - C \equiv CH \xrightarrow{Na} CH_3 - C \equiv C^- Na^+ \xrightarrow{CH_3CH_2CH_2 - Br} NaBr + CH_3 - C \equiv C - CH_2CH_2CH_3$$

78. Following is a confirmatory test for aromatic primary amines. Identify reagent (A) and (B)

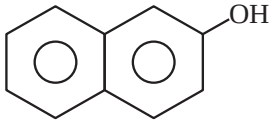


(1) A = HNO_3/H_2SO_4; B = 

(2) A= $NaNO_2$ + HCl, 0 – 5°C; B = 

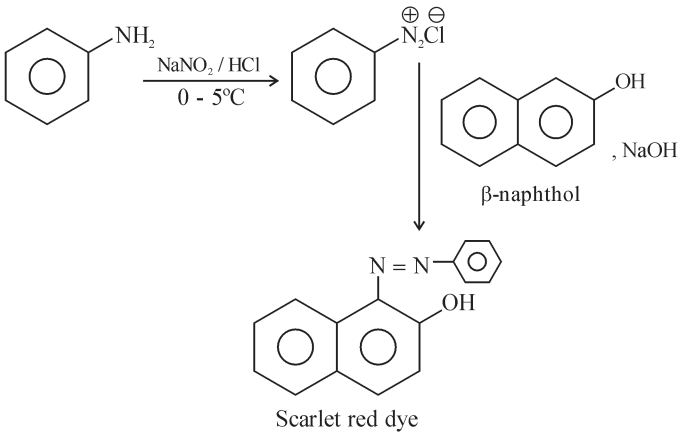
(3) A=$NaNO_2$ + HCl, 0 – 5°C; B = 

(4) A = $NaNO_2$ + HCl, 0 – 5°C;

B = 

Ans. (4)

Sol.



79. The Lassiagne's extract is boiled with dil HNO_3 before testing for halogens because,

(1) AgCN is soluble in HNO_3

(2) Silver halides are soluble in HNO_3

(3) Ag_2S is soluble in HNO_3

(4) Na_2S and NaCN are decomposed by HNO_3

Ans. (4)

Sol. If nitrogen or sulphur is also present in the compound, the sodium fusion extract is first boiled with concentrated nitric acid to decompose cyanide or sulphide of sodium during Lassaigne's test

80. Choose the correct Statements from the following:

(A) Ethane-1 2-diamine is a chelating ligand.

(B) Metallic aluminium is produced by elecrtrolysis of aluminium oxide in presence of cryolite.

(C) Cyanide ion is used as ligand for leaching of silver.

(D) Phosphine act as a ligand in Wilkinson catalyst.

(E) The stability constants of Ca^{2+} and Mg^{2+} are similar with EDTA complexes.

Choose the correct answer from the options given below:

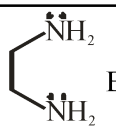
(1) (B), (C), (E) only

(2) (C), (D), (E) only

(3) (A), (B), (C) only

(4) (A), (D), (E) only

Ans. (3)

Sol.  Bidentate, chelating

Based on Hall-Heroults process

$[Rh(PPh_3)_3Cl]$ Wilkinson's catalyst

$$Ag_2S + NaCN \overset{Air}{\rightleftharpoons} Na[Ag(CN)_2] + Na_2S$$

Ca^{++} ion forms more stable complex with EDTA

SECTION-B

81. The rate of first order reaction is 0.04 mol L^{-1} s^{-1} at 10 minutes and 0.03 mol L^{-1} s^{-1} at 20 minutes after initiation. Half life of the reaction is _____ minutes. (Given log2=0.3010, log3=0.4771)

Ans. (24)

Sol. $0.04 = k[A]_0 e^{-k\times10\times60}$ …(1)

$0.03 = k[A]_0 e^{-k\times20\times60}$ …(2)

(1)/(2)

$$\frac{4}{3} = e^{600k(2-1)}$$

$$\frac{4}{3} = e^{600k}$$

$$\ln\frac{4}{3} = 600k$$

$$\ln\frac{4}{3} = 600\times\frac{\ln 2}{t_{1/2}}$$

$$t_{1/2} = 600\frac{\ln 2}{\ln\frac{4}{3}}\text{sec}$$

$$t_{1/2} = 600\times\frac{\log 2}{\log 4 - \log 3}\text{ sec.} = 10\times\frac{0.3010}{0.6020 - 0.477}\text{ min}$$

$t_{1/2} = 24.08$ min

Ans. 24

82. The pH at which $Mg(OH)_2$ [$K_{sp} = 1 \times 10^{-11}$] begins to precipitate from a solution containing 0.10 M Mg^{2+} ions is _____

Ans. (09)

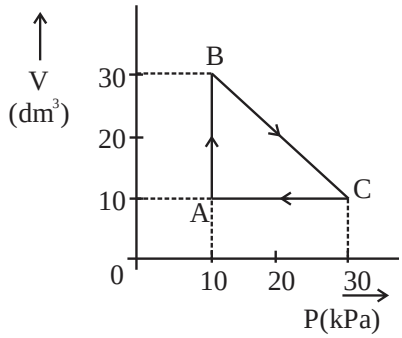
Sol. Precipitation when $Q_{sp} = K_{sp}$

$[Mg^{2+}][OH^-]^2 = 10^{-11}$

$0.1 \times [OH^-]^2 = 10^{-11} \Rightarrow [OH^-] = 10^{-5}$

$\Rightarrow$ pOH = 5 $\Rightarrow$ pH = 9

83.



An ideal gas undergoes a cyclic transformation starting from the point A and coming back to the same point by tracing the path A → B → C → A as shown in the diagram. The total work done in the process is _____ J.

Ans. (200)

Sol. Work done is given by area enclosed in the P vs V cyclic graph or V vs P cyclic graph.

Sign of work is positive for clockwise cyclic process for V vs P graph.

$W = \frac{1}{2} \times (30 - 10) \times (30 - 10) = 200\ kPa - dm^3$

$= 200 \times 1000\ Pa - L = 2\ L\text{-}bar = 200\ J$

84. if IUPAC name of an element is "Ununnnium" then the element belongs to nth group of periodic table. The value of n is_____

Ans. (11)

Sol. 111 belongs to 11^{th} group

85. The total number of molecular orbitals formed from 2s and 2p atomic orbitals of a diatomic molecule

Ans. (08)

Sol. Two molecular orbitals σ 2s and σ*2s.

Six molecular orbitals σ $2p_z$ and σ*$2p_z$.

π$2p_x$, π$2p_y$ and π*$2p_x$, π*$2p_y$

86. On a thin layer chromatographic plate, an organic compound moved by 3.5 cm, while the solvent moved by 5 cm. The retardation factor of the organic compound is _____ × 10^{-1}

Ans. (07)

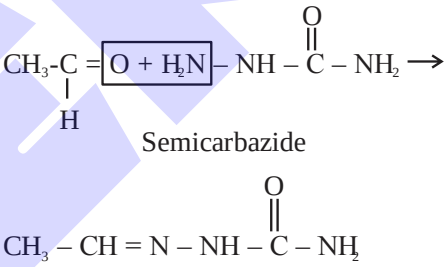
Sol. Retardation factor = $\frac{\text{Distance travelled by sample/organic compound}}{\text{Distance travelled by solvent}}$

$= \frac{3.5}{5} = 7 \times 10^{-1}$

87. The compound formed by the reaction of ethanal with semicarbazide contains _____number of nitrogen atoms.

Ans. (03)

Sol.



88. 0.05 cm thick coating of silver is deposited on a plate of 0.05 m^2 area. The number of silver atoms deposited on plate are _____ × 10^{23}. (At mass Ag = 108, d = 7.9 g cm^{-3})

Ans. (11)

Sol. Volume of silver coating = 0.05 × 0.05 × 10000 = 25 cm^3

Mass of silver deposited = 25 × 7.9 g

Moles of silver atoms = $\frac{25 \times 7.9}{108}$

Number of silver atoms = $\frac{25 \times 7.9}{108} \times 6.023 \times 10^{23}$

$= 11.01 \times 10^{23}$

Ans. 11

89. $2MnO_4^- + bI^- + cH_2O \rightarrow xI_2 + yMnO_2 + zOH^-$

If the above equation is balanced with integer coefficients, the value of z is _____

Ans. (08)

Sol.

Reduction Half	Oxidation Half
$2MnO_4^- \rightarrow 2MnO_2$	$2I^- \rightarrow I_2 + 2e^-$
$2MnO_4^- + 4H_2O + 6e^- \rightarrow 2MnO_2 + 8OH^-$	$6I^- \rightarrow 3I_2 + 6e^-$

Adding oxidation half and reduction half, net reaction is

$2MnO_4^- + 6I^- + 4H_2O \rightarrow 3I_2 + 2MnO_2 + 8OH^-$

$\Rightarrow z = 8$

$\Rightarrow$ Ans 8

90. The mass of sodium acetate (CH_3COONa) required to prepare 250 mL of 0.35 M aqueous solution is _____ g. (Molar mass of CH_3COONa is 82.02 g mol^{-1})

Ans. (7)

Sol. Moles = Molarity × Volume in litres

= 0.35 × 0.25

Mass = moles × molar mass

= 0.35 × 0.25 × 82.02 = 7.18 g

Ans. 7

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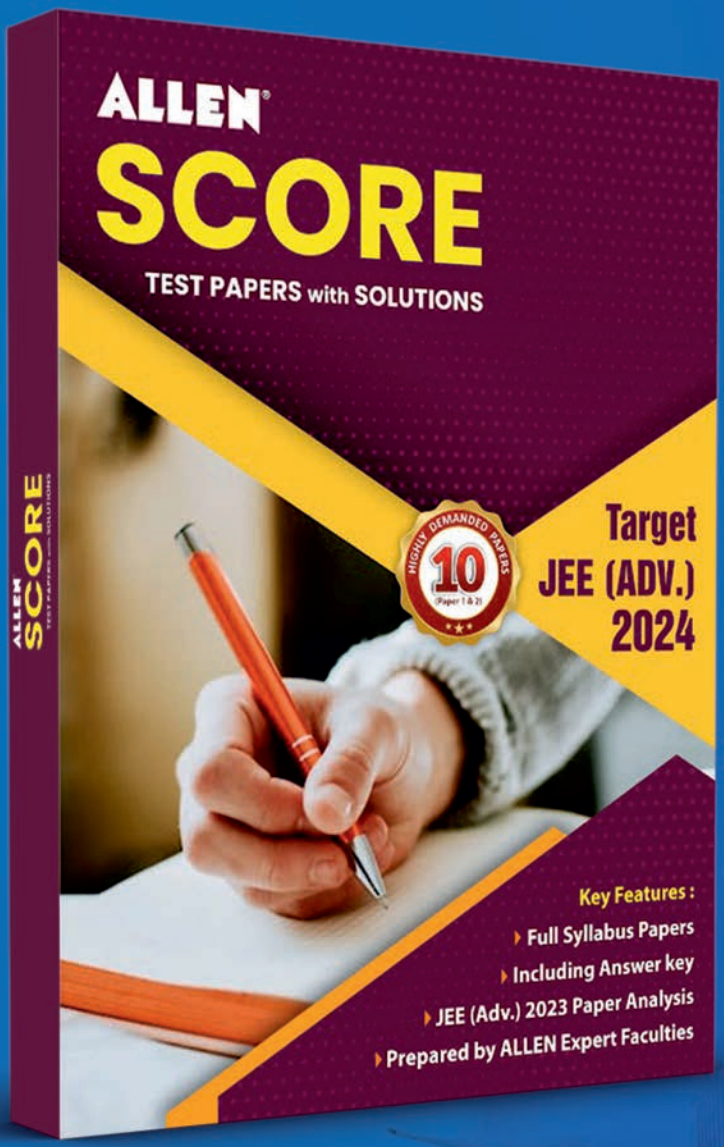

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