FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Saturday 06th April, 2024) **TIME : 9 : 00 AM to 12 : 00 NOON**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

61. Functional group present in sulphonic acid is :

(1) SO_4H (2) SO_3H

(3) $-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH$ (4) $-SO_2$

Ans. (2)

Sol. $-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH$

Group present in sulphonic acids

62. Match **List I** with **List II** :

List I (Molecule / Species)		List II (Property / Shape)	
A.	SO_2Cl_2	I.	Paramagnetic
B.	NO	II.	Diamagnetic
C.	NO_2^-	III.	Tetrahedral
D.	I_3^-	IV.	Linear

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

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

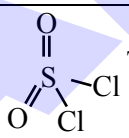
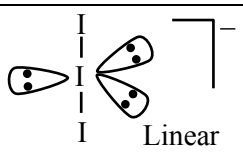
(2) A-III, B-I, C-II, D-IV

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

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

Ans. (2)

Sol.

(A)	SO_2Cl_2	sp^3	 Tetrahedral
(B)	NO		Paramagnetic
(C)	NO_2^-		Diamagnetic
(D)	I_3^-	sp^3d	 Linear

63. Given below are two statements :

Statement I : Picric acid is 2, 4, 6-trinitrotoluene.

Statement II : Phenol-2, 4-disulphuric acid is treated with conc. HNO_3 to get picric acid.

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

(1) Statement I is incorrect but Statement II is correct.

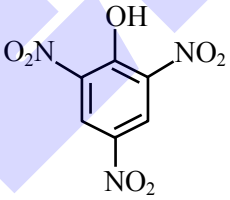
(2) Both Statement I and Statement II are incorrect.

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

(4) Both Statement I and Statement II are correct.

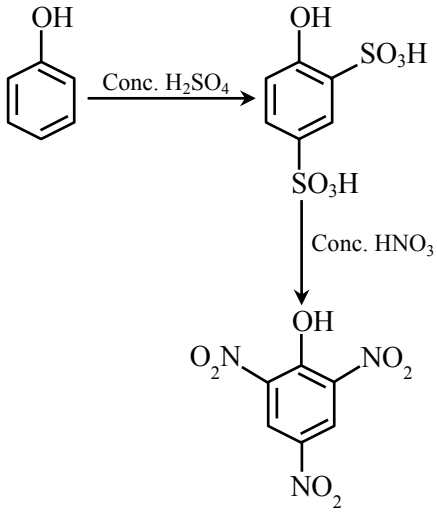
Ans. (1)

Sol.



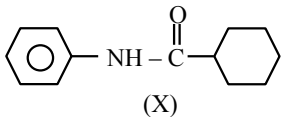
picric acid

(2, 4, 6 – trinitrophenol)

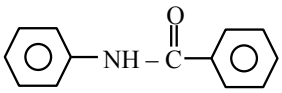


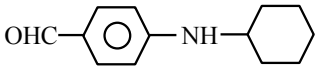
Picric acid

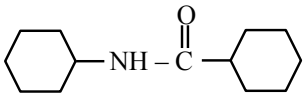
64. Which of the following is metamer of the given compound (X) ?

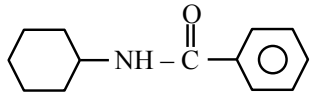


(X)

(1) 

(2) 

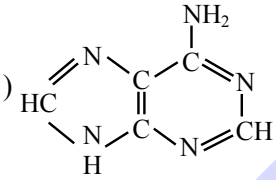
(3) 

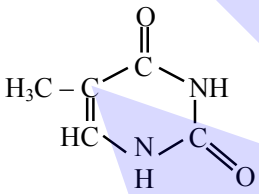
(4) 

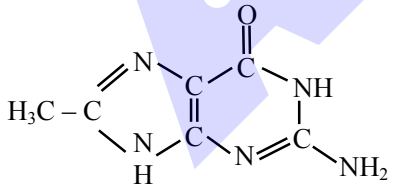
Ans. (4)

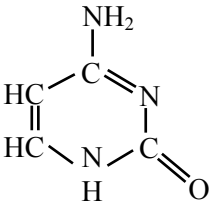
Sol. Metamer $\Rightarrow$ Isomer having same molecular formula, same functional group but different alkyl/aryl groups on either side of functional group.

65. DNA molecule contains 4 bases whoes structure are shown below. One of the structure is not correct, identify the **incorrect** base structure.

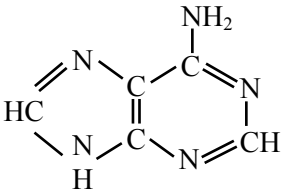
(1) 

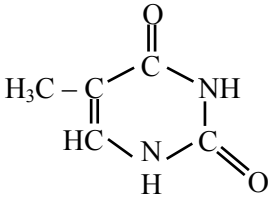
(2) 

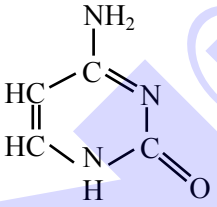
(3) 

(4) 

Ans. (3)

Sol.  $\Rightarrow$ Adenine

 $\Rightarrow$ Thymine

 $\Rightarrow$ Cytosine

Are bases of DNA molecule. As DNA contain four bases, which are adenine, guanine, cytosine and thymine.

66. Match **List I** with **List II** :

LIST I (Hybridization)		**LIST II (Orientation in Space)**	
A.	sp^3	I.	Trigonal bipyramidal
B.	dsp^2	II.	Octahedral
C.	sp^3d	III.	Tetrahedral
D.	sp^3d^2	IV.	Square planar

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

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

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

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

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

Ans. (4)

Sol. $sp^3 \rightarrow$ Tetrahedral

$dsp^2 \rightarrow$ Square planar

$sp^3d \rightarrow$ Trigonal Bipyramidal

$sp^3d^2 \rightarrow$ Octahedral

67. Given below are two statements :

Statement I : Gallium is used in the manufacturing of thermometers.

Statement II : A thermometer containing gallium is useful for measuring the freezing point (256 K) of brine solution.

In the light of the above statement, choose the correct 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) Both Statement I and Statement II are true.

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

Ans. **(4)**

Sol. **Statement** - I $\Rightarrow$ Correct

Statement - II $\Rightarrow$ False

Ga is used to measure high temperature

68. Which of the following statements are correct ?

A. Glycerol is purified by vacuum distillation because it decomposes at its normal boiling point.

B. Aniline can be purified by steam distillation as aniline is miscible in water.

C. Ethanol can be separated from ethanol water mixture by azeotropic distillation because it forms azeotrope.

D. An organic compound is pure, if mixed M.P. is remained same.

Choose the **most appropriate** answer from the options given below :

(1) A, B, C only

(2) A, C, D only

(3) B, C, D only

(4) A, B, D only

Ans. **(2)**

Sol. Option (B) is incorrect because aniline is immisible in water.

69. Match **List I** with **List II** :

LIST I (Compound / Species)		**LIST II (Shape / Geometry)**	
A.	SF_4	I.	Tetrahedral
B.	BrF_3	II.	Pyramidal
C.	BrO_3^-	III.	See saw
D.	NH_4^+	IV.	Bent T-shape

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

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

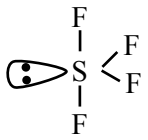
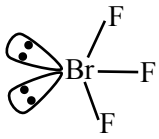
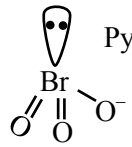
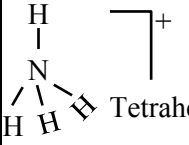
(2) A-III, B-IV, C-II, D-I

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

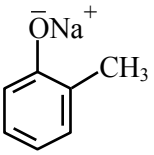
(4) A-III, B-II, C-IV, D-I

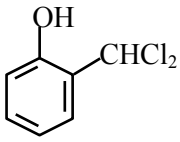
Ans. **(2)**

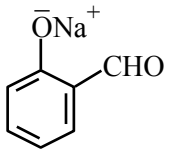
Sol.

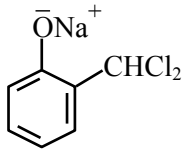
(A)	SF_4	sp^3d hybridisation	
(B)	BrF_3	sp^3d hybridisation	 Bent T-Shape
(C)	BrO_3^-	sp^3 hybridisation	 Pyramidal
(D)	NH_4^+	sp^3 hybridisation	 Tetrahedral

70. In Reimer - Tiemann reaction, phenol is converted into salicylaldehyde through an intermediate. The structure of intermediate is _____.

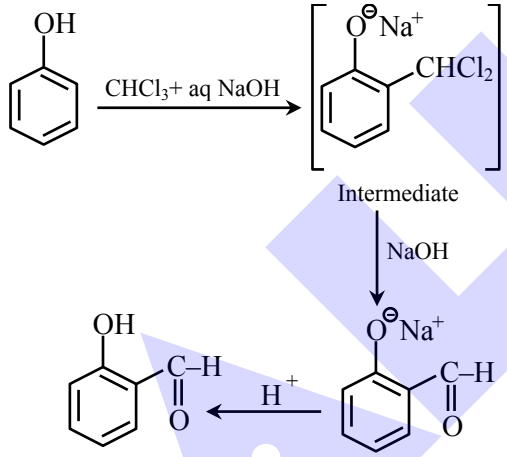
(1) 

(2) 

(3) 

(4) 

Ans. **(4)**

Sol. 

71. Which of the following material is not a semiconductor.

(1) Germanium

(2) Graphite

(3) Silicon

(4) Copper oxide

Ans. **(2)**

Sol. Graphite is conductor

72. Consider the following complexes.

$[CoCl(NH_3)_5]^{2+}$, $[Co(CN)_6]^{3-}$,

(A) (B)

$[Co(NH_3)_5(H_2O)]^{3+}$, $[Cu(H_2O)_4]^{2+}$

(C) (D)

The correct order of A, B, C and D in terms of *wavenumber* of light absorbed is :

(1) C < D < A < B

(2) D < A < C < B

(3) A < C < B < D

(4) B < C < A < D

Ans. **(2)**

Sol. As ligand field increases, light of more energy is absorbed

Energy ∝ wave number

$(\bar{\upsilon})$

73. Match **List I** with **List II** :

LIST I (Precipitating reagent and conditions)		**LIST II (Cation)**	
A.	$NH_4Cl + NH_4OH$	I.	Mn^{2+}
B.	$NH_4OH + Na_2CO_3$	II.	Pb^{2+}
C.	$NH_4OH + NH_4Cl + H_2S$ gas	III.	Al^{3+}
D.	dilute HCl	IV.	Sr^{2+}

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

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

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

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

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

Ans. **(3)**

Sol. Theory based question

74. The electron affinity value are negative for :

A. $Be \rightarrow Be^-$

B. $N \rightarrow N^-$

C. $O \rightarrow O^{2-}$

D. $Na \rightarrow Na^-$

E. $Al \rightarrow Al^-$

Choose the most appropriate answer from the options given below :

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

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

Allen Ans. (4)

NTA Ans. (1)

Sol. (A) $Be + e^- \rightarrow Be^-$, E.A = –ive

(B) $N + e^- \rightarrow N^-$ E.A = –ive

(C) $O + e^- \rightarrow O^-$

$O^- + e^- \rightarrow O^{-2}$ E.A = –ive

(D) $Na + e^- \rightarrow Na^-$ E.A = +ive

(E) $A\ell + e^- \rightarrow A\ell^-$ E.A = +ive

Ans. A,B and C only

75. The number of element from the following that do not belong to lanthanoids is :

Eu, Cm, Er, Tb, Yb and Lu

(1) 3 (2) 4

(3) 1 (4) 5

Ans. (3)

Sol. Cm is Actinide

76. The density of 'x' M solution ('x' molar) of NaOH is 1.12 g mL^{-1}. while in molality, the concentration of the solution is 3 m (3 molal). Then x is

(Given : Molar mass of NaOH is 40 g/mol)

(1) 3.5 (2) 3.0

(3) 3.8 (4) 2.8

Ans. (2)

Sol. $$\text{Molality} = \frac{1000 \times M}{1000 \times d - M \times (Mw)_{solute}}$$

$$3 = \frac{1000 \times x}{1000 \times 1.12 - (x \times 40)}$$

$x = 3$

77. Which among the following aldehydes is most reactive towards nucleophilic addition reactions?

(1) $H-\overset{\overset{O}{\|}}{C}-H$ (2) $C_2H_5-\overset{\overset{O}{\|}}{C}-H$

(3) $CH_3-\overset{\overset{O}{\|}}{C}-H$ (4) $C_3H_7-\overset{\overset{O}{\|}}{C}-H$

Ans. (1)

Sol. $H-\overset{\overset{O}{\|}}{C}-H$ has low steric hindrance at carbonyl carbon and high partial positive charge at carbonyl carbon.

78. At –20 °C and 1 atm pressure, a cylinder is filled with equal number of H_2. I_2 and HI molecules for the reaction

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the K_P for the process is $x \times 10^{-1}$. x = _____.

[Given : R = 0.082 L atm K^{-1} mol^{-1}]

(1) 2 (2) 1

(3) 10 (4) 0.01

Ans. (3)

Sol. $\Delta n_g = 0$ $K_p = \frac{(n_{HI})^2}{n_{H_2} n_{I_2}} \left(\frac{P_T}{n_T}\right)^{\Delta n_g}$

$n_{HI} = n_{H_2} = n_{I_2}$ so $K_P = 1$

$1 = x \times 10^{-1}$ $x = 10$

79. Match **List I** with **List II** :

LIST I (Compound)		**LIST II (Uses)**	
A.	Iodoform	I.	Fire extinguisher
B.	Carbon tetrachloride	II.	Insecticide
C.	CFC	III.	Antiseptic
D.	DDT	IV.	Refrigerants

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

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

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

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

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

Ans. (3)

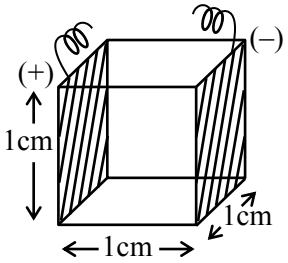
Sol. Iodoform – Antiseptic

CCl_4 – Fire extinguisher

CFC – Refrigerants

DDT – Insecticide

80. A conductivity cell with two electrodes (dark side) are half filled with infinitely dilute aqueous solution of a weak electrolyte. If volume is doubled by adding more water at constant temperature, the molar conductivity of the cell will -



(1) increase sharply

(2) remain same or can not be measured accurately

(3) decrease sharply

(4) depend upon type of electrolyte

Ans. **(2)**

Sol. Solution is already infinitely dilute, hence no change in molar conductivity upon addition of water

SECTION-B

81. Consider the dissociation of the weak acid HX as given below

$HX(aq) \rightleftharpoons H^+(aq) + X^-(aq)$, $Ka = 1.2 \times 10^{-5}$

[K_a : dissociation constant]

The osmotic pressure of 0.03 M aqueous solution of HX at 300 K is _____ $\times 10^{-2}$ bar (nearest integer).

[Given : R = 0.083 L bar Mol^{-1} K^{-1}]

Ans. **(76)**

Sol. $HX \rightleftharpoons H^+ + X^-$ $K_a = 1.2 \times 10^{-5}$

0.03M

$0.03 - x$ x x

$$K_a = 1.2 \times 10^{-5} = \frac{x^2}{0.03 - x}$$

$0.03 - x \approx 0.03$ (K_a is very small)

$$\frac{x^2}{0.03} = 1.2 \times 10^{-5}$$

$x = 6 \times 10^{-4}$

Final solution : $0.03 - x + x + x$

$= 0.03 + x = 0.03 + 6 \times 10^{-4}$

$\Pi = (0.03 + (6 \times 10^{-4})) \times 0.083 \times 300$

$= 76.19 \times 10^{-2} \approx 76 \times 10^{-2}$

82. The difference in the 'spin-only' magnetic moment values of $KMnO_4$ and the manganese product formed during titration of $KMnO_4$ against oxalic acid in acidic medium is _____ BM. (nearest integer)

Ans. **(6)**

Sol. Spin only magnetic moment of Mn in $KMnO_4 = 0$

Spin only value of manganese product fromed during titration of $KMnO_4$ aganist oxalic acid in acidic medium is = 6

Ans. 6

83. Time required for 99.9% completion of a first order reaction is _____ time the time required for completion of 90% reaction.(nearest integer).

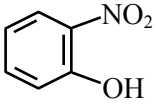
Ans. **(3)**

Sol. $$K = \frac{1}{t_{99.9\%}} \ell n\left(\frac{100}{0.1}\right) = \frac{1}{t_{90\%}} \ell n\left(\frac{100}{10}\right)$$

$$t_{99.9\%} = t_{90\%} \frac{\ell n(10^3)}{\ell n 10}$$

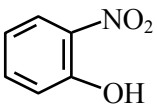
$t_{99.9\%} = t_{90\%} \times 3$

84. Number of molecules from the following which can exhibit hydrogen bonding is _____. (nearest integer)

CH_3OH, H_2O, C_2H_6, C_6H_6, 

HF, NH_3

Ans. **(5)**

Sol. CH_3OH, H_2O, 

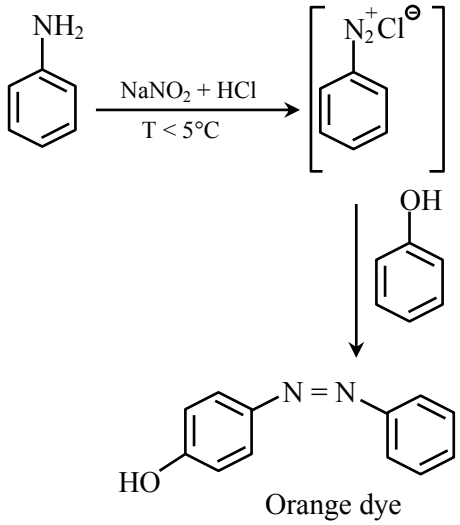
HF, NH_3

Can show H–bonding.

85. 9.3 g of pure aniline upon diazotisation followed by coupling with phenol gives an orange dye. The mass of orange dye produced (assume 100% yield/ conversion) is _____g. (nearest integer)

Ans. **(20)**

Sol.



Orange dye

Reaction suggests that 1 mole of aniline give 1 mole of orange dye.

so $(mol)_{aniline} = (mole)_{orange\ dye}$

$$\frac{9.3g}{93g\ mol^{-1}} = \frac{mass\ of\ orange\ dye}{199g\ mol^{-1}}$$

mass of orange dye = 19.9 g $\simeq$ 20 g

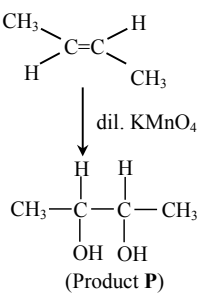
86. The major product of the following reaction is P.

$$CH_3C \equiv C - CH_3 \xrightarrow[(ii)dil.KMnO_4,\ 273K]{(i)Na/liq.NH_3} \text{'P'}$$

Number of oxygen atoms present in product 'P' is _____ (nearest integer).

Ans. **(2)**

Sol.



(Product **P**)

87. Frequency of the de-Broglie wave of election in Bohr's first orbit of hydrogen atom is ____ $\times 10^{13}$ Hz (nearest integer).

[Given : R_H (Rydberg constant) = 2.18×10^{-18} J. *h* (Plank's constant) = 6.6×10^{-34} J.s.]

Allen Ans. (661)

NTA Ans. (658)

Sol. $\lambda = \frac{h}{mv}$

$$\lambda = \frac{hv}{mv^2}$$

$$\frac{mv^2}{h} = \frac{v}{\lambda} = \nu \text{ (frequency)}$$

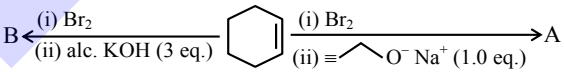
Given $\frac{1}{2}mv^2 = 2.18 \times 10^{-18}$ J

$h = 6.6 \times 10^{-34}$

$$\nu = \frac{4.36 \times 10^{-18}}{6.6 \times 10^{-34}} = 660.60 \times 10^{13} \text{ Hz}$$

$\approx 661 \times 10^{13}$ Hz

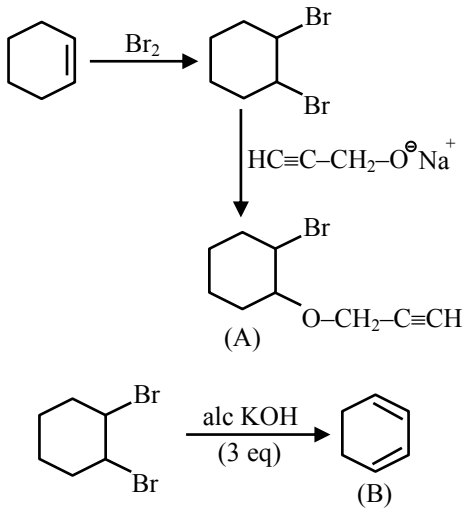
88. The major products from the following reaction sequence are product A and product B.



The total sum of π electrons in product A and product B are _____ (nearest integer)

Ans. **(8)**

Sol.



(A)

(B)

89. Among CrO, Cr_2O_3 and CrO_3, the sum of spin-only magnetic moment values of basic and amphoteric oxides is _____ 10^{-2} BM (nearest integer).

(Given atomic number of Cr is 24)

Ans. **(877)**

Sol. CrO Basic oxide

Cr_2O_3 Amphoteric oxide

In CrO, Cr exist as Cr^{+2} and have μ only = 4.90

In Cr_2O_3, Cr exist as Cr^{+3} and have μ only = 3.87

Sum of spin only magnetic moment

= 4.90 + 3.87 = 8.77

$\mu_{only} = 877 \times 10^{-2}$

Ans. 877

90. An ideal gas, $\overline{C}_V = \frac{5}{2}R$, is expanded adiabatically against a constant pressure of 1 atm untill it doubles in volume. If the initial temperature and pressure is 298 K and 5 atm, respectively then the final temperature is _____ K (nearest integer).

[$\overline{C}_V$ is the molar heat capacity at constant volume]

Ans. **(274)**

Sol. $\Delta U = q + w \ (q = 0)$

$nC_V\Delta T = -P_{ext}(V_2 - V_1)$

$V_2 = 2V_1$

$\frac{nRT_2}{P_2} = \frac{2nRT_1}{P_1}$

$P_1 = 5, \ T_1 = 298$

$P_2 = \frac{5T_2}{2\times 298}$

$n\frac{5}{2}R(T_2 - T_1) = -1\left(\frac{nRT_2}{P_1} - \frac{nRT_1}{P_1}\right)$

Put $T_1 = 298$

and $P_2 = \frac{5T_2}{2\times 298}$

Solve and we get $T_2 = 274.16$ K

$T_2 \approx 274$ K

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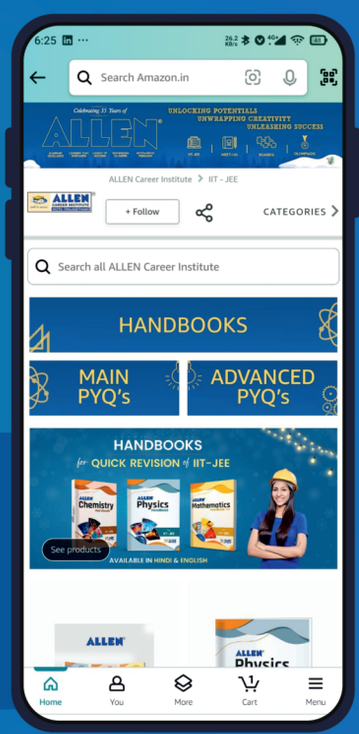

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