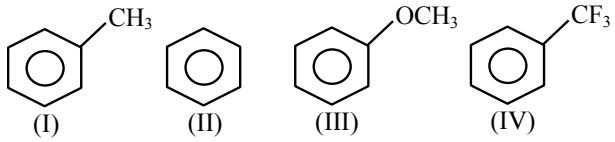
FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Saturday 06th April, 2024) **TIME : 3 : 00 PM to 6 : 00 PM**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

61. 

The **correct** arrangement for decreasing order of electrophilic substitution for above compounds

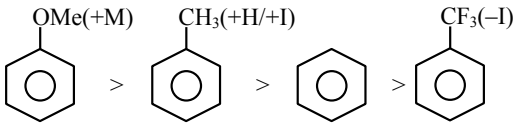
(1) (IV) > (I) > (II) > (III)

(2) (III) > (I) > (II) > (IV)

(3) (II) > (IV) > (III) > (I)

(4) (III) > (IV) > (II) > (I)

Ans. (2)

Sol. 

62. Molality (m) of 3 M aqueous solution of NaCl is:
(Given : Density of solution = 1.25 g mL^{-1}, Molar mass in g mol^{-1} : Na-23, Cl-35.5)

(1) 2.90 m (2) 2.79 m

(3) 1.90 m (4) 3.85 m

Ans. (2)

Sol. 3 moles are present in 1 litre solution

$$\text{molality} = \frac{3\times1000}{1.25\times1000-[3\times58.5]} = 2.79 \text{ m}$$

63. The incorrect statements regarding enzymes are:

(A) Enzymes are biocatalysts.

(B) Enzymes are non-specific and can catalyse different kinds of reactions.

(C) Most Enzymes are globular proteins.

(D) Enzyme - oxidase catalyses the hydrolysis of maltose into glucose.

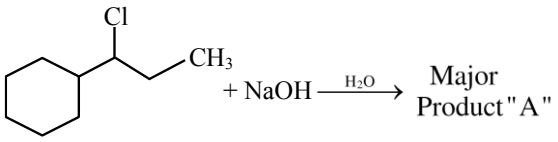
Choose the correct answer from the option given below:

(1) (B) and (C) (2) (B), (C) and (D)

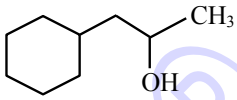
(3) (B) and (D) (4) (A), (B) and (C)

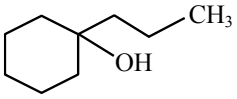
Ans. (3)

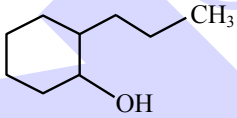
Sol. Direct NCERT Based

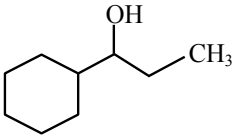
64. 

Consider the above chemical reaction. Product "A" is:

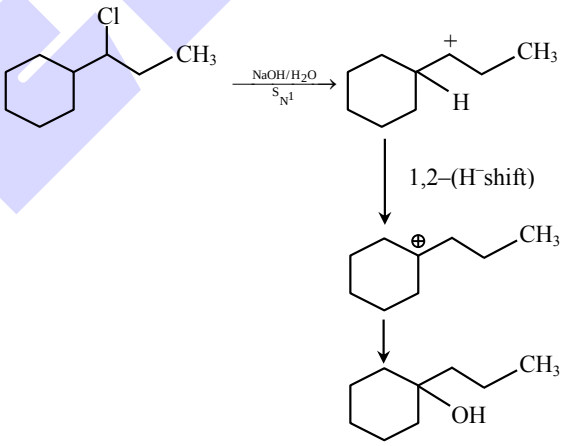
(1) 

(2) 

(3) 

(4) 

Ans. (2)

Sol. 

(Major Product)

65. During the detection of acidic radical present in a salt, a student gets a pale yellow precipitate soluble with difficulty in NH_4OH solution when sodium carbonate extract was first acidified with dil. HNO_3 and then $AgNO_3$ solution was added. This indicates presence of:

(1) Br^- (2) CO_3^{2-}

(3) I^- (4) Cl^-

Ans. (1)

Sol. $Ag^+ + I^- \rightarrow AgI$ Yellow ppt.

$Ag^+ + Cl^- \rightarrow AgCl$ White ppt

$Ag^+ + Br^- \rightarrow AgBr$ Pale yellow ppt

66. How can an electrochemical cell be converted into an electrolytic cell ?

(1) Applying an external opposite potential greater than E^0_{cell}

(2) Reversing the flow of ions in salt bridge.

(3) Applying an external opposite potential lower than E^0_{cell}.

(4) Exchanging the electrodes at anode and cathode.

Ans. (1)

Sol. Applied external potential should be greater than E^0_{cell} in opposite direction.

67. Arrange the following elements in the increasing order of number of unpaired electrons in it.

(A) Sc (B) Cr

(C) V (D) Ti

(E) Mn

Choose the correct answer from the options given below:

(1) (C) < (E) < (B) < (A) < (D)

(2) (B) < (C) < (D) < (E) < (A)

(3) (A) < (D) < (C) < (B) < (E)

(4) (A) < (D) < (C) < (E) < (B)

Ans. (4)

Sol. **Unpaired electron**

$Sc[Ar]\ 4s^2\ 3d^1$	1
$Cr[Ar]\ 4s^1\ 3d^5$	6
$V[Ar]\ 4s^2\ 3d^3$	3
$Ti : [Ar]\ 4s^2\ 3d^2$	2
$Mn : [Ar]\ 4s^2\ 3d^5$	5

68. Match **List-I** with **List-II.**

List-I **Alkali Metal**	**List-II** **Emission Wavelength in nm**
(A) Li	(I) 589.2
(B) Na	(II) 455.5
(C) Rb	(III) 670.8
(D) Cs	(IV) 780.0

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

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

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

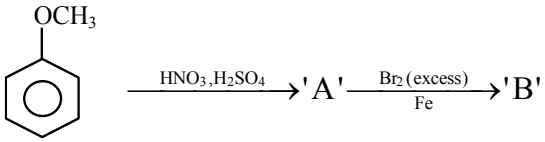
(3) (A)-(IV), (B)-(II), (C)-(I), (D)-(III)

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

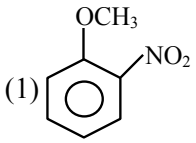
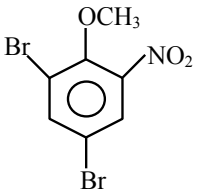
Ans. (2)

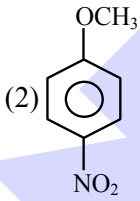
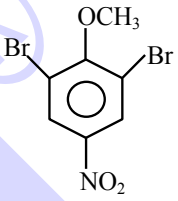
Sol. Fact Based

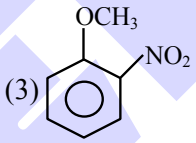
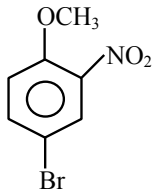
69. The major products formed:

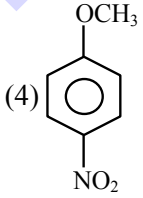
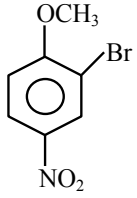


A and B respectively are:

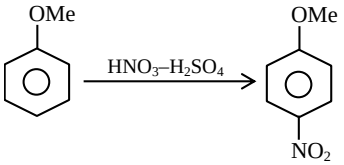
(1)  and 

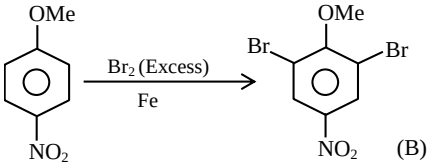
(2)  and 

(3)  and 

(4)  and 

Ans. (2)

Sol. 



70. The incorrect statement regarding the geometrical isomers of 2-butene is:

(1) cis-2-butene and trans-2-butene are not interconvertible at room temperature.

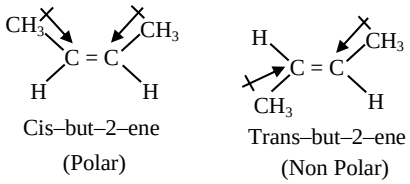
(2) cis-2-butene has less dipole moment than trans-2-butene.

(3) trans-2-butene is more stable than cis-2-butene.

(4) cis-2-butene and trans-2-butene are stereoisomers.

Ans. **(2)**

Sol.



Cis–but–2–ene has higher Dipole moment than trans–but–2–ene.

71. Given below are two statements:

Statement I: PF_5 and BrF_5 both exhibit sp^3d hybridisation.

Statement II: Both SF_6 and $[Co(NH_3)_6]^{3+}$ exhibit sp^3d^2 hybridisation.

In the light of the 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 true

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

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

Ans. **(3)**

Sol.

	Hybridisation		Hybridisation
PF_5	sp^3d	SF_6	sp^3d^2
BrF_5	sp^3d^2	$[Co(NH_3)_6]^{+3}$	d^2sp^3

Both Statement (1) and (2) are false.

72. The number of ions from the following that are expected to behave as oxidising agent is:

Sn^{4+}, Sn^{2+}, Pb^{2+}, Tl^{3+}, Pb^{4+}, Tl^{+}

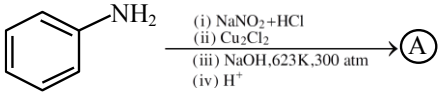
(1) 3 (2) 4

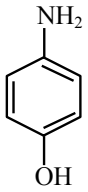
(3) 1 (4) 2

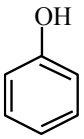
Ans. **(4)**

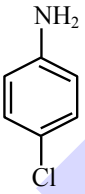
Sol. Due to inert pair effect; $T\ell^{+3}$ and Pb^{+4} can behave as oxidising agents.

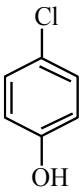
73. Identify the product (A) in the following reaction.



(1) 

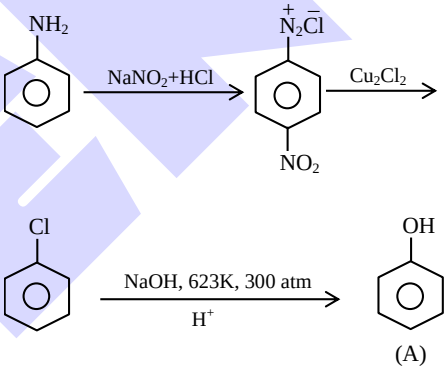
(2) 

(3) 

(4) 

Ans. **(2)**

Sol.



74. The correct statements among the following, for a "chromatography" purification method is:

(1) Organic compounds run faster than solvent in the thin layer chromatographic plate.

(2) Non-polar compounds are retained at top and polar compounds come down in column chromatography.

(3) R_f of a polar compound is smaller than that of a non-polar compound.

(4) R_f is an integral value.

Ans. **(3)**

Sol. Non polar compounds are having higher value of R_f than polar compound.

75. Evaluate the following statements related to group 14 elements for their correctness.

(A) Covalent radius decreases down the group from C to Pb in a regular manner.

(B) Electronegativity decreases from C to Pb down the group gradually.

(C) Maximum covalence of C is 4 whereas other elements can expand their covalence due to presence of d orbitals.

(D) Heavier elements do not form pπ-pπ bonds.

(E) Carbon can exhibit negative oxidation states.

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

(1) (C), (D) and (E) Only (2) (A) and (B) Only

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

Ans. **(1)**

Sol. (A) Down the group; radius increases

(B) EN does not decrease gradually from C to Pb.

(C) Correct.

(D) Correct.

(E) Range of oxidation state of carbon ; –4 to +4

76. Match **List-I** with the **List-II**

List-I **Reaction**	**List-II** **Type of redox reaction**
(A) $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$	(I) Decomposition
(B) $2Pb(NO_3)_{2(s)} \rightarrow 2PbO_{(s)} + 4NO_{2(g)} + O_{2(g)}$	(II) Displacement
(C) $2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq.)} + H_{2(g)}$	(III) Disproportionation
(D) $2NO_{2(g)} + 2^-OH_{(aq.)} \rightarrow NO^-_{2(aq.)} + NO^-_{3(aq.)} + H_2O_{(l)}$	(IV) Combination

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

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

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

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

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

Ans. **(4)**

Sol. A → (IV)

B → (I)

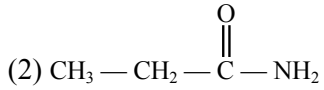
C → (II)

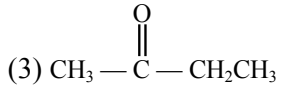
D → (III)

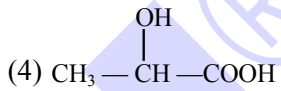
77. Consider the given reaction, identify the major product P.

$$CH_3-COOH \xrightarrow[(iv)\ H_2O/\bar{O}H,\Delta]{(i)\ LiAlH_4\quad (ii)\ PCC\quad (iii)\ HCN/\bar{O}H} \text{"P"}$$

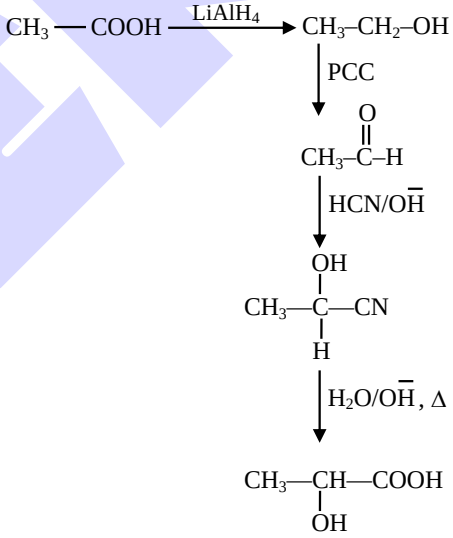
(1) $CH_3 - CH_2 - CH_2 - OH$

(2) 

(3) 

(4) 

Ans. **(4)**

Sol. 

78. The correct IUPAC name of $[PtBr_2(PMe_3)_2]$ is:

(1) bis(trimethylphosphine)dibromoplatinum(II)

(2) bis[bromo(trimethylphosphine)]platinum(II)

(3) dibromobis(trimethylphosphine)platinum(II)

(4) dibromodi(trimethylphosphine)platinum(II)

Ans. **(3)**

Sol. Dibromo bis(trimethylphosphine) platinum (II)

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

List-I Tetrahedral Complex	**List-II** Electronic configuration
(A) $TiCl_4$	(I) e^2, t_2^0
(B) $[FeO_4]^{2-}$	(II) e^4, t_2^3
(C) $[FeCl_4]^-$	(III) e^0, t_2^0
(D) $[CoCl_4]^{2-}$	(IV) e^2, t_2^3

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

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

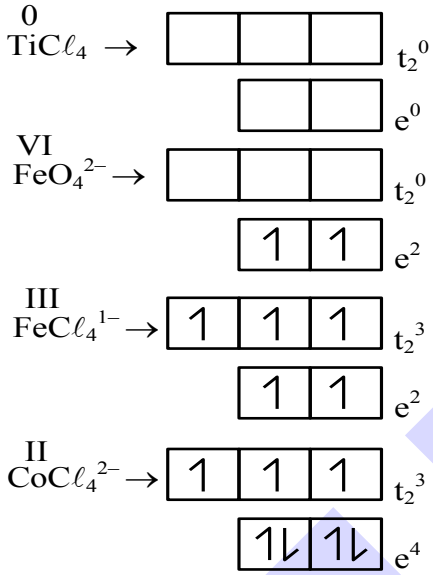
(2) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

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

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

Ans. **(4)**

Sol.



80. The ratio $\frac{K_P}{K_C}$ for the reaction:

$CO_{(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons CO_{2(g)}$ is:

(1) $(RT)^{1/2}$ (2) RT

(3) 1 (4) $\frac{1}{\sqrt{RT}}$

Ans. **(4)**

Sol. $CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g)$

$$\Delta n_g = 1 - \left(1 + \frac{1}{2}\right) = -\frac{1}{2}$$

$$\frac{K_P}{K_C} = (RT)^{\Delta n_g} = \frac{1}{\sqrt{RT}}$$

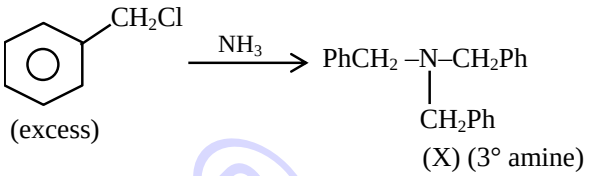
SECTION-B

81. An amine (X) is prepared by ammonolysis of benzyl chloride. On adding p-toluenesulphonyl chloride to it the solution remains clear. Molar mass of the amine (X) formed is_____ $g\ mol^{-1}$.

(Given molar mass in $gmol^{-1}$ C : 12, H : 1, O : 16, N : 14)

Ans. **(287)**

Sol.



Molar Mass of (X) is 287 $g\ mol^{-1}$

82. Consider the following reactions

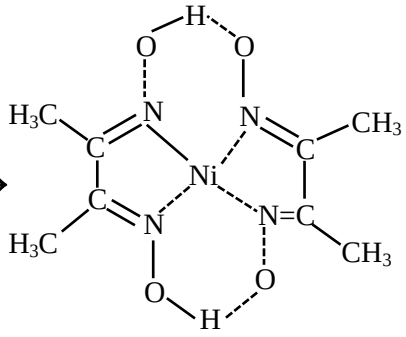
$$NiS + HNO_3 + HCl \rightarrow A + NO + S + H_2O$$

$$A + NH_4OH + H_3C - \underset{\underset{H_3C - C = N - OH}{|}}{C} = N - OH \longrightarrow B + NH_4Cl + H_2O$$

The number of protons that do not involve in hydrogen bonding in the product B is_____.

Ans. **(12)**

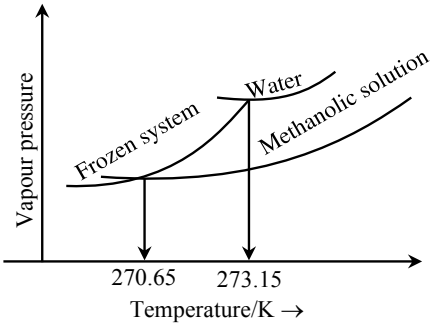
Sol. **B** →



$$3NiS + 2HNO_3 + 6HCl \longrightarrow 3NiCl_2 + 2NO + 3S + 4H_2O$$

$$NiCl_2 + 2NH_4OH + \underset{\underset{H_3C - C = N - OH}{|}}{H_3C - C = N - OH} \rightarrow NH_4Cl + H_2O + (B)$$

83. When 'x' × 10^{-2} mL methanol (molar mass = 32 g; density = 0.792 g/cm^3) is added to 100 mL water (density = 1 g/cm^3), the following diagram is obtained.



x =……(nearest integer)

[Given: Molal freezing point depression constant of water at 273.15 K is 1.86 K kg mol^{-1}]

Ans. **(543)**

Sol. $\Delta T_f = 273.15 - 270.65 = 2.5$ K

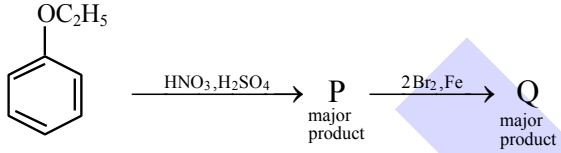
$\Delta T_f = K_f m \Rightarrow 2.5 = 1.86 \times \frac{n}{0.1}$

$\Rightarrow n = 0.1344$ moles

$\Rightarrow w = 0.1344 \times 32 = 4.3$ g

Volume = $\frac{4.3}{0.792} = 5.43$ ml $= 543 \times 10^{-2}$ ml

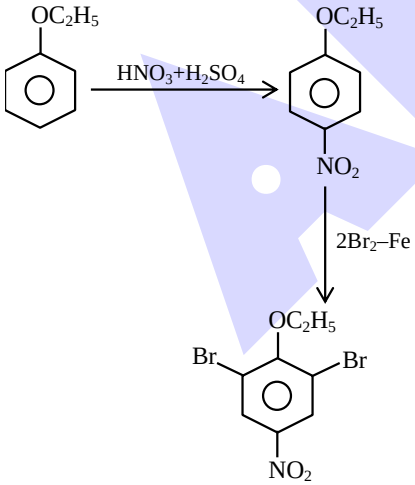
84.



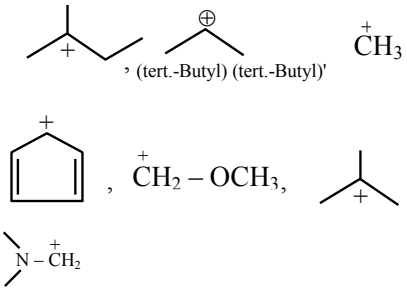
The ratio of number of oxygen atoms to bromine atoms in the product Q is_____ × 10^{-1}.

Ans. **(15)**

Sol.

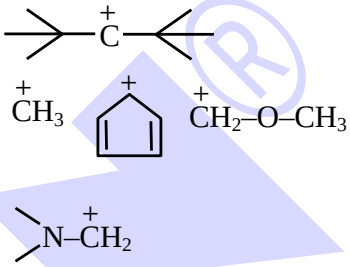


85. Number of carbocation from the following that are **not** stabilized by hyperconjugation is…….. .



Ans. **(5)**

Sol.



86. For the reaction at 298 K, 2A + B → C. ΔH = 400 kJ mol^{-1} and ΔS = 0.2 kJ mol^{-1} K^{-1}. The reaction will become spontaneous above_____ K.

Ans. **(2000)**

Sol. $\Delta G = 0$

$T = \frac{\Delta H}{\Delta S} = \frac{400}{0.2} = 2000$ K

87. Total number of species from the following with central atom utilising $2p^2$ hybrid orbitals for bonding is…… .

NH_3, SO_2, SiO_2, $BeCl_2$, C_2H_2, C_2H_4, BCl_3, HCHO, C_6H_6, BF_3, $C_2H_4Cl_2$

Ans. **(6)**

Sol. Central atom utilising sp^2 hybrid orbitals

SO_2, C_2H_4, BCl_3, HCHO, C_6H_6, BF_3

88. Consider the two different first order reactions given below

$A + B \rightarrow C$ (Reaction 1)

$P \rightarrow Q$ (Reaction 2)

The ratio of the half life of Reaction 1 : Reaction 2 is 5 : 2. If t_1 and t_2 represent the time taken to complete $\frac{2}{3}^{rd}$ and $\frac{4}{5}^{th}$ of Reaction 1 and Reaction 2, respectively, then the value of the ratio $t_1 : t_2$ is_____ $\times 10^{-1}$ (nearest integer).

[Given: $\log_{10}(3) = 0.477$ and $\log_{10}(5) = 0.699$]

Ans. **(17)**

Sol. $\frac{(t_{1/2})_I}{(t_{1/2})_{II}} = \frac{K_2}{K_1} = \frac{5}{2}$

$\therefore \; K_1 t_1 = \ell n \frac{1}{1-\frac{2}{3}} = \ell n 3$

$K_2 t_2 = \ell n \frac{1}{1-\frac{4}{5}} = \ell n 5$

$\Rightarrow \frac{K_1}{K_2} \times \frac{t_1}{t_2} = \frac{0.477}{0.699}$

$\Rightarrow \frac{t_1}{t_2} = \frac{0.477}{0.699} \times \frac{5}{2} = 1.7 = 17 \times 10^{-1}$

89. For hydrogen atom, energy of an electron in first excited state is – 3.4 eV, K.E. of the same electron of hydrogen atom is x eV. Value of x is_____ $\times 10^{-1}$ eV. (Nearest integer)

Ans. **(34)**

90. Among VO_2^+, MnO_4^- and $Cr_2O_7^{2-}$, the spin-only magnetic moment value of the species with least oxidising ability is…….BM (Nearest integer).

(Given atomic member V = 23, Mn = 25, Cr = 24)

Ans. **(0)**

Sol. For 3d transition series;

Oxidising power : $V^{+5} < Cr^{+6} < Mn^{+7}$

V^{+5} : [Ar] $4s^0\ 3d^0$

Number of unpaired electron = 0

$\boxed{\mu = 0}$

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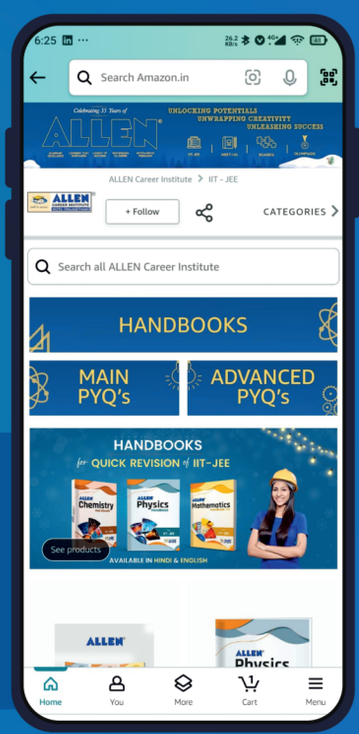

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