JEE–MAIN EXAMINATION – APRIL 2025

(HELD ON MONDAY 07th APRIL 2025) **TIME : 3:00 PM TO 6:00 PM**

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

51. Given below are two statements :

Statement (I) : On hydrolysis, oligo peptides give rise to fewer number of α-amino acids while proteins give rise to a large number of β-amino acids.

Statement (II) : Natural proteins are denatured by acids which convert the water soluble form of fibrous proteins to their water insoluble form.

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 correct

(2) **Statement I** is incorrect but **Statement II** is correct

(3) Both **statement I** and **statement II** are incorrect

(4) **Statement I** is correct but **Statement II** is incorrect

Ans. (3)

Sol. (i) Protein does not gives β-amino acid on hydrolysis

(ii) Fibrous protein are not water soluble

So both statement's are wrong

52. Mixture of 1 g each of chlorobenzene, aniline and benzoic acid is dissolved in 50 mL ethyl acetate and placed in a separating funnel, 5 M NaOH (30 mL) was added in the same funnel. The funnel was shaken vigorously and then kept aside. The ethyl acetate layer in the funnel contains :

(1) benzoic acid

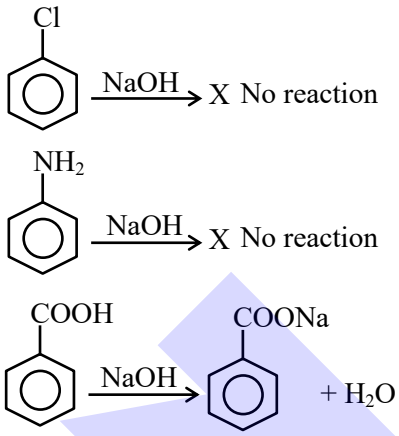
(2) benzoic acid and aniline

(3) benzoic acid and chlorobenzene

(4) chlorobenzene and aniline

Ans. (4)

Sol.



Organic layer in funnel are mixture of chloro benzene and aniline

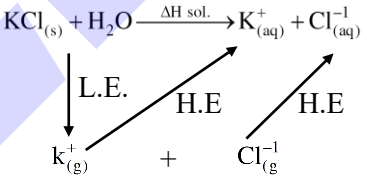
53. The hydration energies of K^+ and Cl^- are –x and –y kJ/mol respectively. If lattice energy of KCl is –z kJ/mol, then the heat of solution of KCl is :

(1) +x – y – z (2) x + y + z

(3) z – (x + y) (4) –z – (x + y)

Ans. (3)

Sol.



$$\Delta H_{Soln.} = L.E. + (H.E)_{K^+_{(g)}} + (HE)_{Cl^{-1}_{(g)}}$$

$$= Z - x - y$$

$$= z - (x + y)$$

54. $A(g) \rightarrow B(g) + C(g)$ is a first order reaction.

Time	T	∞
$\mathbf{P_{system}}$	P_t	P_∞

The reaction was started with reactant A only. Which of the following expression is correct for rate constant k ?

(1) $k = \frac{1}{t}\ln\frac{2(p_\infty - P_t)}{P_t}$ (2) $k = \frac{1}{t}\ln\frac{p_\infty}{P_t}$

(3) $k = \frac{1}{t}\ln\frac{p_\infty}{2(p_\infty - P_t)}$ (4) $k = \frac{1}{t}\ln\frac{p_\infty}{(p_\infty - P_t)}$

Ans. (3)

Sol.

	$A_{(g)}$	$\rightarrow$	$B_{(g)}$	+	$C_{(g)}$
$t=0$	P^o		0		0
$t=t$	P^o-x		x		x
$t=\infty$	0		P^o		P^o

$$P_t = P^o + x \Rightarrow x = P_t - P^o = P_t - \frac{P_\infty}{2}$$

$$P_\infty = 2P^o \Rightarrow P^o = \frac{P\infty}{2}$$

$$k = \frac{1}{t}\ell n \frac{P^o}{P^o - x}$$

$$k = \frac{1}{t}\ell n \frac{P_\infty}{2(P_\infty - P_t)}$$

55. "P" is an optically active compound with molecular formula $C_6H_{12}O$. When "P" is treated with 2,4-dinitrophenylhydrazine, it gives a positive test. However, in presence of Tollens reagent, "P" gives a negative test. Predict the structure of "P".

(1) $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-CH_2-CH_3$

(2) $CH_3-\overset{\overset{O}{\|}}{C}-\underset{\underset{CH_2-CH_3}{|}}{CH}-CH_3$

(3) $H-\overset{\overset{O}{\|}}{C}-CH_2-\underset{\underset{CH_2-CH_3}{|}}{CH}-CH_3$

(4) $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_3$

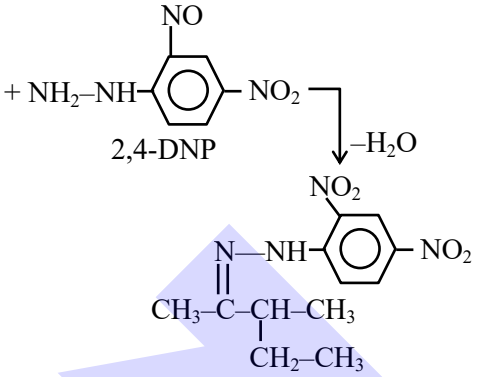
Ans. (2)

Sol.

$P \rightarrow CH_3-\overset{\overset{O}{\|}}{C}-\overset{*}{\underset{\underset{CH_2-CH_3}{|}}{CH}}-CH_3$

Chiral

Does not give Tollen's test



Gives test with 2,4-DNP

56. Choose the incorrect trend in the atomic radii (r) of the elements :

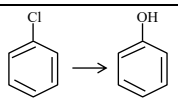
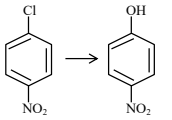
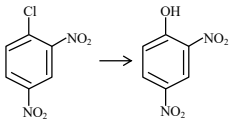
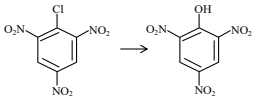
(1) $r_{Br} < r_K$ (2) $r_{Mg} < r_{Al}$

(3) $r_{Rb} < r_{Cs}$ (4) $r_{At} < r_{Cs}$

Ans. (2)

Sol. In a period from left to right atomic size decreases.

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

List-I Conversion		**List-II Reagents, Conditions used**	
(A)		(I)	Warm, H_2O
(B)		(II)	(a) NaOH, 368 K ; (b) H_3O^+
(C)		(III)	(a) NaOH, 443 K; (b) H_3O^+
(D)		(IV)	(a) NaOH, 623 K, 300 atm ; (b) H_3O^+

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

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

Ans. **(3)**

Sol. Aromatic halide give nucleophilic substitution reaction at high temperature or in presence of –I/–M group rate of reaction high even at low temperature.

A-IV

B-III

C-II

D-I

58. The correct statement amongst the following is :

(1) The term 'standard state' implies that the temperature is 0°C

(2) The standard state of pure gas is the pure gas at a pressure of 1 bar and temperature 273 K

(3) $\Delta_f H^{\theta}_{298}$ is zero for O(g)

(4) $\Delta_f H^{\theta}_{500}$ is zero for O_2(g)

Ans. **(4)**

Sol. For standard state $\Rightarrow$ pressure = 1 bar and temperature is specified only

$$\Rightarrow \left(\Delta H_f^{\circ}\right)_{O_{2,(g)}} = 0$$

59. Liquid A and B form an ideal solution. The vapour pressure of pure liquids A and B are 350 and 750 mm Hg respectively at the same temperature. If x_A and x_B are the mole fraction of A and B in solution while y_A and y_B are the mole fraction of A and B in vapour phase then :

(1) $\frac{x_A}{x_B} < \frac{y_A}{y_B}$ (2) $\frac{x_A}{x_B} = \frac{y_A}{y_B}$

(3) $\frac{x_A}{x_B} > \frac{y_A}{y_B}$ (4) $(x_A - y_A) < (x_B - y_B)$

Ans. **(3)**

Sol. $P_A^{\circ} < P_B^{\circ}$

$$\frac{P_A^{\circ}}{P_B^{\circ}} < 1$$

$$\frac{y_A}{y_B} = \frac{P_A^{\circ}}{P_B^{\circ}} \frac{x_A}{x_B}$$

$$\frac{\frac{y_A}{y_B}}{\frac{x_A}{x_B}} < 1$$

$$\frac{y_A}{y_B} < \frac{x_A}{x_B}$$

60. 'X' is the number of acidic oxides among VO_2, V_2O_3,CrO_3, V_2O_5 and Mn_2O_7. The primary valency of cobalt in $[Co(H_2NCH_2CH_2NH_2)_3]_2\ (SO_4)_3$ is Y. The value of X + Y is :

(1) 5 (2) 4

(3) 2 (4) 3

Ans. **(1)**

Sol. CrO_3 = Acidic

Mn_2O_7 = Acidic

$\therefore\ x = 2$

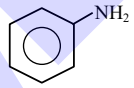
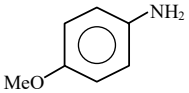
$$[\overset{III}{Co}(H_2NCH_2CH_2NH_2)_3]_2\ (SO_4)_3 \rightleftharpoons$$

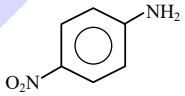
$$2[\overset{III}{Co}(H_2NCH_2CH_2NH_2)_3]^{3+} + 3SO_4^{2-}$$

$\therefore$ Primary valency = 3

$\therefore\ x + y = 5$

61. The descending order of basicity of following amines is :

(A)  (B) 

(C)  (D) CH_3NH_2

(E) $(CH_3)_2NH$

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

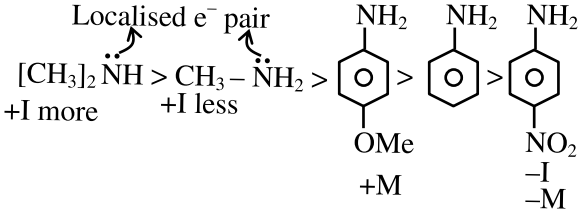
(1) B > E > D > A > C (2) E > D > B > A > C

(3) E > D > A > B > C (4) E > A > D > C > B

Ans. **(2)**

Sol. [2]

E > D > B > A > C



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

List-I Complex		List-II Primary valency and Secondary valency	
(A)	$[Co(en)_2Cl_2]Cl$	(I)	3 6
(B)	$[Pt(NH_3)_2Cl(NO_2)]$	(II)	3 4
(C)	$Hg[Co(SCN)_4]$	(III)	2 6
(D)	$[Mg(EDTA)]^{2-}$	(IV)	2 4

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

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

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

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

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

Ans. **(2)**

Sol. Primary valency = Oxidation state

Secondary valency = Co-ordination number

	Complex	Primary valency	Secondary
(A)	$[Co(en)_2Cl_2]Cl$	3	6
(B)	$[Pt(NH_3)_2Cl(NO_2)]$	2	4
(C)	$Hg[Co(SCN)_4]$	3	4
(D)	$[Mg(EDTA)]^{2-}$	2	6

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

List-I		List-II	
(A)	Solution of chloroform and acetone	(I)	Minimum boiling azeotrope
(B)	Solution of ethanol and water	(II)	Dimerizes
(C)	Solution of benzene and toluene	(III)	Maximum boiling azeotrope
(D)	Solution of acetic acid in benzene	(IV)	$\Delta V_{mix} = 0$

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

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

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

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

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

Ans. **(1)**

Sol. (A) Solution of chloroform and acetone shows –ve deviation, so maximum boiling azeotrope.

(B) Solution of ethanol & water shows +ve deviation. So minimum boiling azeotrope.

(C) Solution of benzene and toluene form ideal solution. $\Delta V_{mix} = 0$.

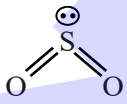
(D) Acetic acid in benzene form dimer.

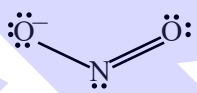
64. In SO_2, NO_2^- and N_3^- the hybridizations at the central atom are respectively :

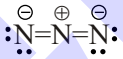
(1) sp^2, sp^2 and sp (2) sp^2, sp and sp

(3) sp^2, sp^2 and sp^2 (4) sp, sp^2 and sp

Ans. **(1)**

Sol. SO_2  sp^2

NO_2^-  sp^2

N_3^-  sp

65. The number of unpaired electrons responsible for the paramagnetic nature of the following complex species are respectively :

$[Fe(CN)_6]^{3-}$, $[FeF_6]^{3-}$, $[CoF_6]^{3-}$, $[Mn(CN)_6]^{3-}$

(1) 1, 5, 4, 2 (2) 1, 5, 5, 2

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

Ans. **(1)**

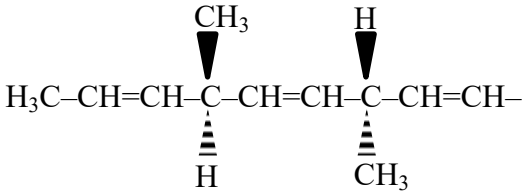
Sol. $[Fe(CN)_6]^{3-}$ Fe^{3+} $3d^5$ $t_{2g}^{2,2,1}$ $e_g^{0,0}$ unpaired $e^- = 1$

$[FeF_6]^{3-}$ Fe^{3+} $3d^5$ $t_{2g}^{1,1,1}$ $e_g^{1,1}$ unpaired $e^- = 5$

$[CoF_6]^{3-}$ Co^{3+} $3d^6$ $t_{2g}^{2,1,1}$ e_g^{1}, unpaired $e^- = 4$

$[Mn(CN)_6]^{3-}$ Mn^{3+} $3d^4$ $t_{2g}^{2,1,1}$ $e_g^{0,0}$ unpaired $e^- = 2$

66. The number of optically active products obtained from the complete ozonolysis of the given compound is :

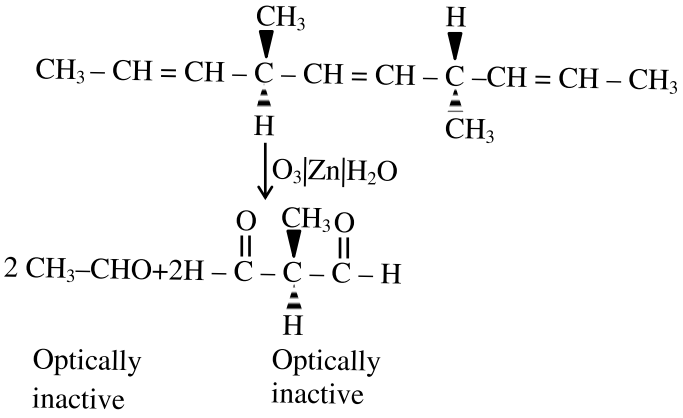


(1) 2 (2) 0

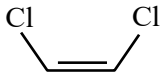
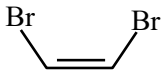
(3) 1 (4) 4

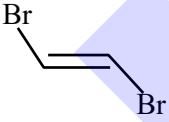
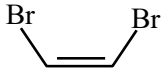
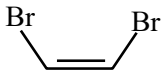
Ans. **(2)**

Sol.



67. Given below are two statements :

Statement (I) :  is more polar than 

Statement (II) : Boiling point of  is lower than  but it is more polar than 

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

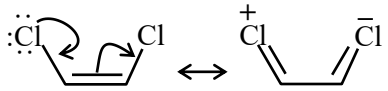
(1) **Statement I** is correct but **statement II** is incorrect

(2) **Statement I** is incorrect but **statement II** is correct

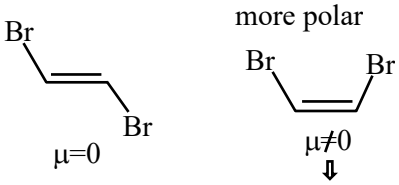
(3) Both **statement I** and **statement II** are incorrect

(4) Both **statement I** and **statement II** are correct

Ans. **(1)**

Sol. S-I 

Due to vacant –d orbital more polar

S-II 

⇩

Boiling point higher

68. The extra stability of half-filled subshell is due to

(A) Symmetrical distribution of electrons

(B) Smaller coulombic repulsion energy

(C) The presence of electrons with the same spin in non-degenerate orbitals

(D) Larger exchange energy

(E) Relatively smaller shielding of electrons by one another

Identify the **correct** statements

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

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

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

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

Ans. **(2)**

Sol. Extra stability of half filled is due to :

(i) Symmetrical distribution of electrons

(ii) Large exchange energy

(iii) Smaller coulombic repulsion

(iv) Smaller shielding of electrons by one another

69. The correct statements from the following are :

(A) Tl^{3+} is a powerful oxidising agent

(B) Al^{3+} does not get reduced easily

(C) Both Al^{3+} and Tl^{3+} are very stable in solution

(D) Tl^{+} is more stable than Tl^{3+}

(E) Al^{3+} and Tl^{+} are highly stable

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

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

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

(3) (B), (D) and (E) only

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

Ans. **(2)**

Sol. (i) True, $T\ell^{+}$ is more stable than $T\ell^{3+}$, due to inert pair effect. So $T\ell^{3+}$ is a powerful oxidising agent.

(ii) True, $E^{\circ}_{Al^{3+}/Al} = -1.66V$. So it is difficult to reduce $A\ell^{3+}$. So $A\ell^{3+}$ is highly stable.

(iii) False, as $T\ell^{3+}$ is unstable

(iv) True , $T\ell^{+}$ is more stable than $T\ell^{3+}$

(v) True , $A\ell^{3+}$ and $T\ell^{+}$ are highly stable

70. Given below are two statements :

1 M aqueous solution of each of $Cu(NO_3)_2$, $AgNO_3$, $Hg_2(NO_3)_2$; $Mg(NO_3)_2$ are electrolysed using inert electrodes,

Given : $E^{\theta}_{Ag^{+}/Ag} = 0.80V$, $E^{\theta}_{Hg_2^{2+}/Hg} = 0.79V$,

$E^{\theta}_{Cu^{2+}/Cu} = 0.24V$ and $E^{\theta}_{Mg^{2+}/Mg} = -2.37V$

Statement (I) : With increasing voltage, the sequence of deposition of metals on the cathode will be Ag, Hg and Cu

Statement (II) : Magnesium will not be deposited at cathode instead oxygen gas will be evolved at the cathode.

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

(1) Both **statement I** and **statement II** are incorrect

(2) **Statement I** is correct but **statement II** is incorrect

(3) Both **statement I** and **statement II** are correct

(4) **Statement I** is incorrect but **statement II** is correct

Ans. (2)

Sol. **Statement-II** $\Rightarrow$ At cathode, instead of Mg, $H_2O_{(\ell)}$ will reduce & evolve H_2 gas.

SECTION-B

71. Only litre buffer solution was prepared by adding 0.10 mol each of NH_3 and NH_4Cl in deionised water. The change in pH on addition of 0.05 mol of HCl to the above solution is ____ $\times 10^{-2}$, (Nearest integer)
(Given : pK_b of $NH_3 = 4.745$ and $\log_{10}3 = 0.477$)

Ans. (48)

Sol. $pOH = pK_b + \log\frac{[NH_4^{+}]}{[NH_3]}$

pOH = 4.745

on adding 0.05 mole HCl

NH_3	+ $H^{\oplus}$	$\rightarrow$ $NH_4^{\oplus}$
0.1	0.05	0.1
0.05	0	0.15

$pOH' = 4.745 + \log 3$

$pOH' - pOH = 0.477$

$14 - pH' - 14 + pH = 0.477$

$\Delta pH = 0.477$

$= 47.7 \times 10^{-2} \approx 48 \times 10^{-2}$

72. In Dumas' method 292 mg of an organic compound released 50 mL of nitrogen gas (N_2) at 300 K temperature and 715 mm Hg pressure. The percentage composition of 'N' in the organic compound is _____ % (Nearest integer)
(Aqueous tension at 300 K = 15 mm Hg)

Ans. (18)

Sol. Organic compound $\xrightarrow{\text{DUMA'S}}$ N_2
292 mg

V = 50 ml
P = 715 mm Hg
T = 300 k
Aq. tension = 15 mm Hg

$P_{N_2} = 715 - 15 = 700\,mmHg$

$P_{N_2} = \frac{700}{760}atm$

$n_{N_2} = \frac{P_{N_2}.V}{RT}$

$n_{N_2} = \frac{700}{760} \times \frac{50}{1000} \times \frac{1}{0.0821 \times 300}$

$n_N = 2 \times n_{N_2}$

Mass of N = $2 \times n_N \times 14$

$\%\ N = \frac{\text{mass of N}}{\text{mass of organic compound}} \times 100$

$\%\ N = \frac{700}{760} \times \frac{50}{1000} \times \frac{2 \times 14}{0.0821 \times 300} \times \frac{1000}{292} \times 100$

%N = 18%

73. Butane reacts with oxygen to produce carbon dioxide and water following the equation given below

$$C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l)$$

If 174.0 kg of butane is mixed with 320.0 kg of O_2, the volume of water formed in litres is _____ .(Nearest integer)

[Given : (a) Molar mass of C, H, O are 12, 1, 16 g mol^{-1} respectively, (b) Density of water = 1 g mL^{-1}]

Ans. (138)

Sol. $C_4H_{10} + \frac{13}{2}O_2 \rightarrow 4CO_2 + 5H_2O$

$3\times10^3 \quad 10\times10^3$

Moles of H_2O formed = $n_{H_2O} = 5\times\frac{2}{13}\times10\times10^3$

Then $w_{H_2O} = \frac{10^5}{13}\times18$

$= 1.3846 \times 10^5$ g

Volume of H_2O will be = 138.46 litre.

Ans. 138

74. The number of paramagnetic metal complex species among $[Co(NH_3)_6]^{3+}$, $[Co(C_2O_4)_3]^{3-}$, $[MnCl_6]^{3-}$, $[Mn(CN)_6]^{3-}$, $[CoF_6]^{3-}$, $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ with same number of unpaired electrons is ____.

Ans. (2)

Sol. $[Co(NH_3)_6]^{3+}$ Co^{3+} $3d^6$ $t_{2g}^{2,2,2}$ $e_g^{0,0}$

Diamagnetic (unpaired electron = 0)

$[Co(C_2O_4)_3]^{3-}$ Co^{3+} $3d^6$ $t_{2g}^{2,2,2}$ $e_g^{0,0}$

Diamagnetic (unpaired electron = 0)

$[MnCl_6]^{3-}$ Mn^{3+} $3d^4$ $t_{2g}^{1,1,1}$ $e_g^{1,0}$

Paramagnetic (unpaired electron = 4)

$[Mn(CN)_6]^{3-}$ Mn^{3+} $3d^4$ $t_{2g}^{2,1,1}$ $e_g^{0,0}$

Paramagnetic (unpaired electron = 2)

$[CoF_6]^{3-}$ Co^{3+} $3d^6$ $t_{2g}^{2,1,1}$ $e_g^{1,1}$

Paramagnetic (unpaired electron = 4)

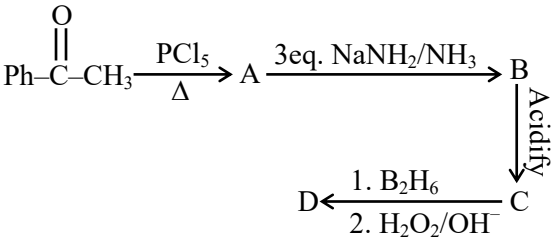
$[Fe(CN)_6]^{3-}$ Fe^{3+} $3d^5$ $t_{2g}^{2,2,1}$ $e_g^{0,0}$

Paramagnetic (unpaired electron = 1)

$[FeF_6]^{3-}$ Fe^{3+} $3d^5$ $t_{2g}^{1,1,1}$ $e_g^{1,1}$

Paramagnetic (unpaired electron = 5)

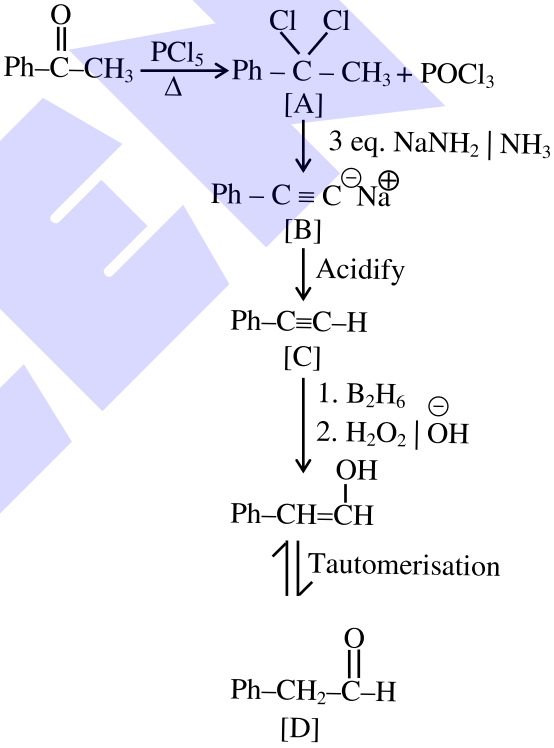
75. Identify the structure of the final product (D) in the following sequence of the reactions :



Total number of sp^2 hybridised carbon atoms in product D is.

Ans. (7)

Sol.



⇒ Number of sp^2 C–atoms in product D = 7

NTA Ans. = 7 ALLEN Ans.=7

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