FINAL JEE–MAIN EXAMINATION – JANUARY, 2024

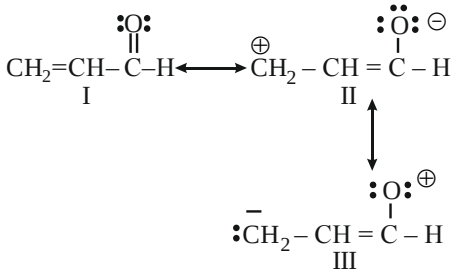
(Held On Saturday 27th January, 2024) **TIME : 3 : 00 PM to 6 : 00 PM**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

61. The order of relative stability of the contributing structure is:



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

(1) I > II > III

(2) II > I > III

(3) I = II = III

(4) III > II > I

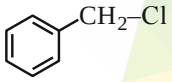
Ans. **(1)**

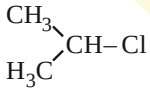
Sol. I > II > III, since neutral resonating structures are more stable than charged resonating structure. II > III, since stability of structure with –ve charge on more electronegative atom is higher.

62. Which among the following halide/s will not show S_N1 reaction:

(A) $H_2C = CH - CH_2Cl$

(B) $CH_3 - CH = CH - Cl$

(C) 

(D) 

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

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

Ans. **(4)**

Sol. Since $CH_3 - CH = \overset{+}{C}H$ is very unstable, CH_3–CH = CH – Cl cannot give S_{N1} reaction.

63. Which of the following statements is not correct about rusting of iron?

(1) Coating of iron surface by tin prevents rusting, even if the tin coating is peeling off.
(2) When pH lies above 9 or 10, rusting of iron does not take place.
(3) Dissolved acidic oxides SO_2, NO_2 in water act as catalyst in the process of rusting.
(4) Rusting of iron is envisaged as setting up of electrochemical cell on the surface of iron object.

Ans. **(1)**

Sol. As tin coating is peeled off, then iron is exposed to atmosphere.

64. Given below are two statements:

Statement (I) : In the Lanthanoids, the formation of Ce^{+4} is favoured by its noble gas configuration.

Statement (II) : Ce^{+4} is a strong oxidant reverting to the common +3 state.

In the light of the above statements, choose the most appropriate 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) Statement I is true but Statement II is false
(4) Both Statement I and Statement II are false

Ans. **(2)**

Sol. Statement (1) is true, Ce^{+4} has noble gas electronic configuration.

Statement (2) is also true due to high reduction potential for Ce^{4+}/Ce^{3+} (+1.74V), and stability of Ce^{3+}, Ce^{4+} acts as strong oxidizing agent.

65. Choose the correct option having all the elements with d^{10} electronic configuration from the following:

(1) ^{27}Co, ^{28}Ni, ^{26}Fe, ^{24}Cr
(2) ^{29}Cu, ^{30}Zn, ^{48}Cd, ^{47}Ag
(3) ^{46}Pd, ^{28}Ni, ^{26}Fe, ^{24}Cr
(4) ^{28}Ni, ^{24}Cr, ^{26}Fe, ^{29}Cu

Ans. **(2)**

Sol. $[Cr] = [Ar]4s^1 3d^5$
$[Cd] = [Kr]5s^2 4d^{10}$
$[Cu] = [Ar]4s^1 3d^{10}$
$[Ag] = [Kr]5s^1 4d^{10}$
$[Zn] = [Ar]4s^2 3d^{10}$

66. Phenolic group can be identified by a positive:
(1) Phthalein dye test
(2) Lucas test
(3) Tollen's test
(4) Carbylamine test

Ans. **(1)**

Sol. Carbylamine Test-Identification of primary amines
Lucas Test - Differentiation between 1°, 2° and 3° alcohols
Tollen's Test - Identification of Aldehydes
Phthalein Dye Test - Identification of phenols

67. The molecular formula of second homologue in the homologous series of mono carboxylic acids is _____.
(1) $C_3H_6O_2$
(2) $C_2H_4O_2$
(3) CH_2O
(4) $C_2H_2O_2$

Ans. **(2)**

Sol. $HCOOH, \underset{\uparrow}{CH_3COOH}$
Second homologue

68. The technique used for purification of steam volatile water immiscible substance is:
(1) Fractional distillation
(2) Fractional distillation under reduced pressure
(3) Distillation
(4) Steam distillation

Ans. **(4)**

Sol. Steam distillation is used for those liquids which are insoluble in water, containing non-volatile impurities and are steam volatile.

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

$$Ph{-}CH{=}CH_2 \xrightarrow[\text{(iii) HBr}]{\text{(i) } BH_3,\ \text{(ii) } H_2O_2,\ \ominus OH} A$$
(iv) Mg, ether, then $HCHO/H_3O^+$

(1) $Ph-CH_2-CH_2-CH_3$
(2) $Ph-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_3$
(3) $Ph-\underset{\displaystyle CH_2OH}{\overset{|}{CH}}-CH_3$
(4) $Ph-CH_2-CH_2-CH_2-OH$

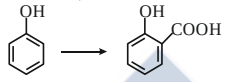
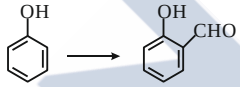
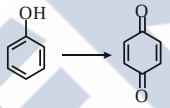
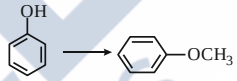
Ans. **(4)**

Sol. $PhCH=CH_2 \xrightarrow{B_2H_6/H_2O_2,OH^-} PhCH_2CH_2OH$

$PhCH_2CH_2OH + HBr \longrightarrow PhCH_2CH_2Br + H_2O\ (SN^{NGP})$

$PhCH_2CH_2Br \xrightarrow[\text{(II) } H_3O^+]{\text{(I) } H-\overset{\displaystyle O}{\overset{\|}{C}}-H} PhCH_2CH_2CH_2OH$; $PhCH_2CH_2Br \xrightarrow{Mg/\text{dry ether}} PhCH_2CH_2MgBr$

70. Match List-I with List-II.

List – I (Reaction)	**List – II (Reagent(s))**
(A) 	(I) $Na_2Cr_2O_7, H_2SO_4$
(B) 	(II) (i) NaOH (ii) CH_3Cl
(C) 	(III) (i) NaOH, $CHCl_3$ (ii) NaOH (iii) HCl
(D) 	(IV) (i) NaOH (ii) CO_2 (iii) HCl

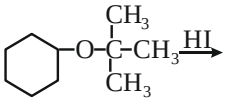
Choose the correct answer from the options given below:
(1) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)
(2) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
(3) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
(4) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

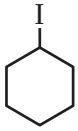
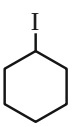
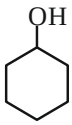
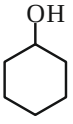
Ans. **(4)**

Sol. (A) → Kolbe Schmidt Reaction
(B) → Reimer Tiemann Reaction
(C) → Oxidation of phenol to p-benzoquinone
(D) → $PhOH + NaOH \rightarrow H_2O + PhO^-$

$PhO^- + CH_3-Cl \longrightarrow PhOCH_3 + Cl^-$

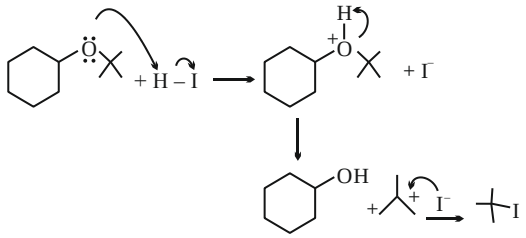
71. Major product formed in the following reaction is a mixture of:

$$\text{  } \xrightarrow{HI} \text{Major product}$$

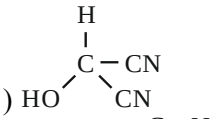
(1)  and $(CH_3)_3CI$
(2)  and $(CH_3)_3COH$
(3)  and $(CH_3)_3COH$
(4)  and $CH_3-\underset{\displaystyle CH_3}{\overset{CH_3}{\overset{|}{\underset{|}{C}}}}-I$

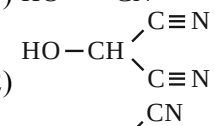
Ans. **(4)**

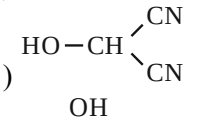
Sol.

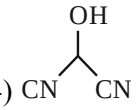


72. Bond line formula of $HOCH(CN)_2$ is:

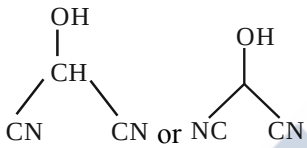
(1) 

(2) 

(3) 

(4) 

Ans. **(4)**

Sol. $CH(OH)(CN)_2$ is 

73. Given below are two statements:

Statement (I) : Oxygen being the first member of group 16 exhibits only –2 oxidation state.

Statement (II) : Down the group 16 stability of +4 oxidation state decreases and +6 oxidation state increases.

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) Both Statement I and Statement II are correct

(3) Both Statement I and Statement II are incorrect

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

Ans. **(3)**

Sol. Statement-I: Oxygen can have oxidation state from –2 to +2, so statement I is incorrect

Statement- II: On moving down the group stability of +4 oxidation state increases whereas stability of +6 oxidation state decreases down the group, according to inert pair effect.

So both statements are wrong.

74. Identify from the following species in which d^2sp^3 hybridization is shown by central atom:

(1) $[Co(NH_3)_6]^{3+}$

(2) BrF_5

(3) $[Pt(Cl)_4]^{2-}$

(4) SF_6

Ans. **(1)**

Sol. $[Co(NH_3)_6]^{+3}$ – d^2sp^3 hybridization

BrF_5 – sp^3d^2 hybridization

$[PtCl_4]^{-2}$ – dsp^2 hybridization

SF_6 – sp^3d^2 hybridization

75. Identify B formed in the reaction.

$$Cl-(CH_2)_4-Cl \xrightarrow{\text{excess } NH_3} A \xrightarrow{NaOH} B + H_2O + NaCl$$

(1) 

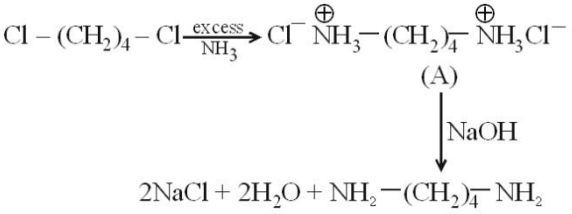
(2) $H_2N-(CH_2)_4-NH_2$

(3) $Cl\overset{+}{N}H_3-(CH_2)_4-\overset{+}{N}H_3Cl^-$

(4) 

Ans. **(2)**

Sol.



76. The quantity which changes with temperature is:

(1) Molarity

(2) Mass percentage

(3) Molality

(4) Mole fraction

Ans. **(1)**

Sol. $$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution}}$$

Since volume depends on temperature, molarity will change upon change in temperature.

77. Which structure of protein remains intact after coagulation of egg white on boiling?
(1) Primary
(2) Tertiary
(3) Secondary
(4) Quaternary

Ans. **(1)**

Sol. Boiling an egg causes denaturation of its protein resulting in loss of its quarternary, tertiary and secondary structures.

78. Which of the following cannot function as an oxidising agent?
(1) N^{3-}
(2) SO_4^{2-}
(3) BrO_3^-
(4) MnO_4^-

Ans. **(1)**

Sol. In N^{3-} ion 'N' is present in its lowest possible oxidation state, hence it cannot be reduced further because of which it cannot act as an oxidizing agent.

79. The incorrect statement regarding conformations of ethane is:
(1) Ethane has infinite number of conformations
(2) The dihedral angle in staggered conformation is 60°
(3) Eclipsed conformation is the most stable conformation.
(4) The conformations of ethane are inter-convertible to one-another.

Ans. **(3)**

Sol. Eclipsed conformation is the least stable conformation of ethane.

80. Identity the incorrect pair from the following:
(1) Photography - AgBr
(2) Polythene preparation – $TiCl_4$, $Al(CH_3)_3$
(3) Haber process - Iron
(4) Wacker process – $PtCl_2$

Ans. **(4)**

Sol. The catalyst used in Wacker's process is $PdCl_2$

SECTION-B

81. Total number of ions from the following with noble gas configuration is _____.

Sr^{2+} (Z = 38), Cs^+ (Z = 55), La^{2+} (Z = 57) Pb^{2+} (Z = 82), Yb^{2+} (Z = 70) and Fe^{2+} (Z = 26)

Ans. **(3)**

Sol. Noble gas configuration = $ns^2\ np^6$
$[Sr^{2+}] = [Kr]$
$[Cs^+] = [Xe]$
$[Yb^{2+}] = [Kr]\ 4d^{10}\ 4f^{14}\ 5s^2\ 5p^6$
$[La^{2+}] = [Xe]\ 5d^1$
$[Pb^{2+}] = [Xe]\ 4f^{14}\ 5d^{10}\ 6s^2$
$[Fe^{2+}] = [Ar]\ 3d^6$

82. The number of non-polar molecules from the following is _____

HF, H_2O, SO_2, H_2, CO_2, CH_4, NH_3, HCl, $CHCl_3$, BF_3

Ans. **(4)**

Sol. The non-polar molecules are CO_2, H_2, CH_4 and BF_3

83. Time required for completion of 99.9% of a First order reaction is _____ times of half life ($t_{1/2}$) of the reaction.

Ans. **(10)**

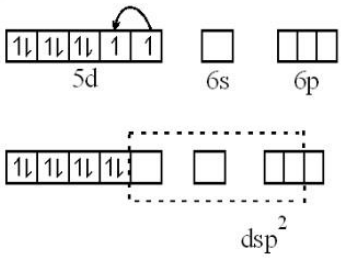
Sol.

$$\frac{t_{99.9\%}}{t_{1/2}} = \frac{\frac{2.303}{k}\left(\frac{a}{a-x}\right)}{\frac{2.303}{k}\log 2} = \frac{\log\left(\frac{100}{100-99.9}\right)}{\log 2} = \frac{\log 10^3}{\log 2} = \frac{3}{0.3} = 10$$

84. The Spin only magnetic moment value of square planar complex $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ is _____ B.M. (Nearest integer)
(Given atomic number for Pt = 78)

Ans. **(0)**

Sol. Pt^{2+} (d^8)



$Pt^{2+} \rightarrow dsp^2$ hybridization and have no unpaired e^-s.
$\therefore$ Magnetic moment = 0

85. For a certain thermochemical reaction $M \rightarrow N$ at T = 400 K, $\Delta H^\ominus = 77.2$ kJ mol^{-1}, $\Delta S = 122$ JK^{-1}, log equilibrium constant (logK) is –_____ $\times 10^{-1}$.

Ans. **(37)**

Sol.
$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$
$$= 77.2\times10^3 - 400\times122 = 28400\,J$$
$$\Delta G^\circ = -2.303\,RT\log K$$
$$\Rightarrow 28400 = -2.303\times8.314\times400\log K$$
$$\Rightarrow \log K = -3.708 = -37.08\times10^{-1}$$

86. Volume of 3 M NaOH (formula weight 40 g mol^{-1}) which can be prepared from 84 g of NaOH is _____ $\times 10^{-1}$ dm^3.

Ans. **(7)**

Sol. $M = \frac{n_{NaOH}}{V_{sol}(\text{in L})} \Rightarrow 3 = \frac{(84/40)}{V} \Rightarrow V = 0.7L = 7 \times 10^{-1} L$

87. 1 mole of PbS is oxidised by "X" moles of O_3 to get "Y" moles of O_2. X + Y = _____

Ans. **(8)**

Sol. $PbS + 4O_3 \rightarrow PbSO_4 + 4O_2$

$x = 4, y = 4$

88. The hydrogen electrode is dipped in a solution of pH = 3 at 25°C. The potential of the electrode will be –_____ $\times 10^{-2}$ V.

$\left(\frac{2.303RT}{F} = 0.059\,V\right)$

Ans. **(18)**

Sol. $2H^+_{(aq.)} + 2e^- \rightarrow H_2(g)$

$$E_{cell} = E^0_{cell} - \frac{0.059}{2}\log\frac{P_{H_2}}{\left[H^+\right]^2}$$

$= 0 - 0.059 \times 3 = -0.177$ volts. $= -17.7 \times 10^{-2}$ V.

89. 9.3 g of aniline is subjected to reaction with excess of acetic anhydride to prepare acetanilide. The mass of acetanilide produced if the reaction is 100% completed is _____ $\times 10^{-1}$ g.

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

Ans. **(135)**

Sol. $C_6H_5NH_2 + CH_3 - \overset{O}{\overset{||}{C}} - O - \overset{O}{\overset{||}{C}} - CH_3 \rightarrow$

$(\text{Aniline MM} = 93)$

$$C_6H_5NH - \overset{O}{\overset{||}{C}} - CH_3 + CH_3COOH$$

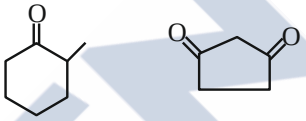
$(\text{Acetanilide MM} = 135)$

$n_{Acetanilide} = n_{Aniline}$

$\Rightarrow \frac{m}{135} = \frac{9.3}{93}$

$\Rightarrow m = 13.5\,g$

90. Total number of compounds with Chiral carbon atoms from following is _____.



$CH_3 - CH_2 - CH(NO_2) - COOH$

$CH_3 - CH_2 - CHBr - CH_2 - CH_3$

$CH_3 - CH(I) - CH_2 - NO_2$

$CH_3 - CH_2 - CH(OH) - CH_2OH$

$CH_3 - \underset{\underset{I}{|}}{CH} - CH(I) - C_2H_5$

Ans. **(5)**

Sol. Chiral carbons are marked by.