JEE MAIN-2021

Chemistry

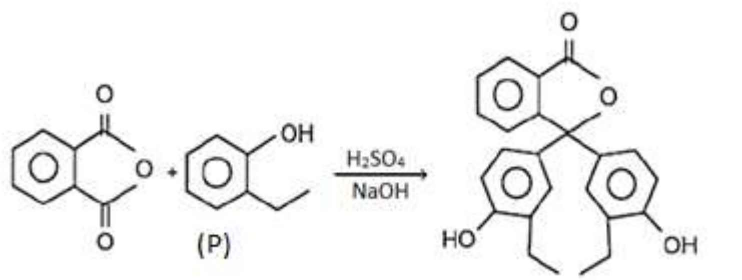
Section A

61. Sol. (4)

In acidic medium, the NH_2 group of aniline gets protonated which leads to formation of anilinium ion. Anilinium ion directs the incoming group to meta position. Thus, meta product is formed in addition to ortho and para.

62. Sol. (2)

P on reacting with the given reagent in the presence of H_2SO_4 gives a derivative of phenolphthalein which gives a pink colour in basic solutions.



Pink colour
(derivative of phenolphthalein)

63. Sol. (1)

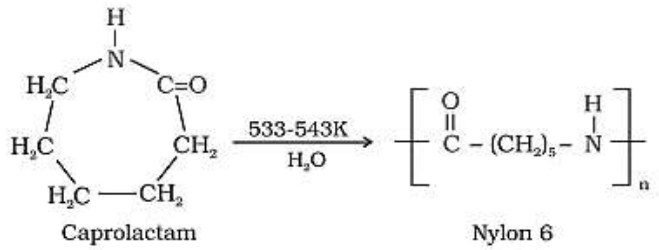
The $\alpha-$helix structure of protein is a result of the $H-$ bonding between the $-CO-$ and the $-NH-$ group of various peptide bonds.

64. Sol. (1)

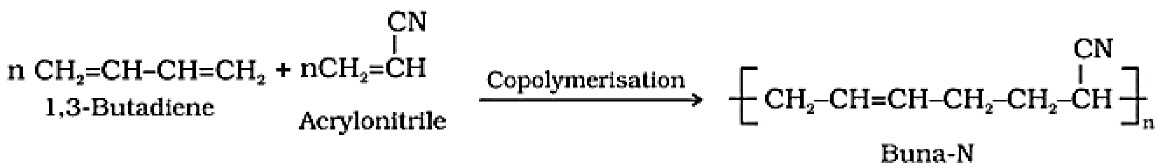
CH_4 (methane) gas is evolved due to anaerobic degradation of vegetation. CH_4 (methane) gas is a greenhouse gas and it causes global warming and cancer.

65. Sol. (3)

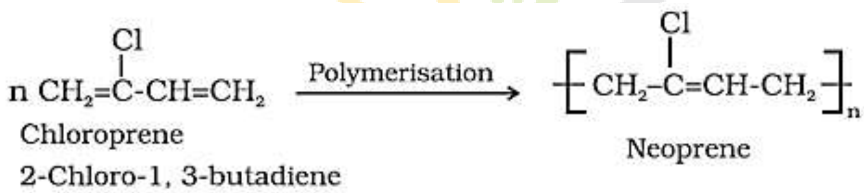
(i) Caprolactum is the monomer of Nylon 6.



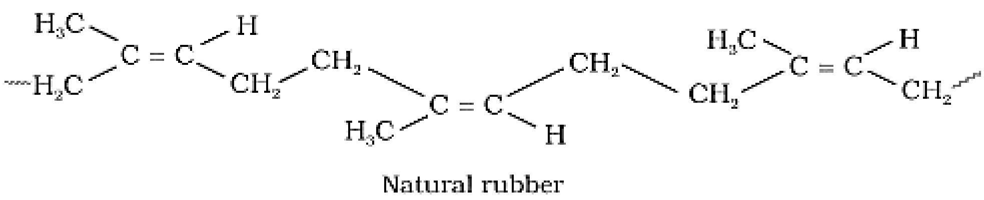
(ii) Acrylonitrile is one of the monomers of Buna N.



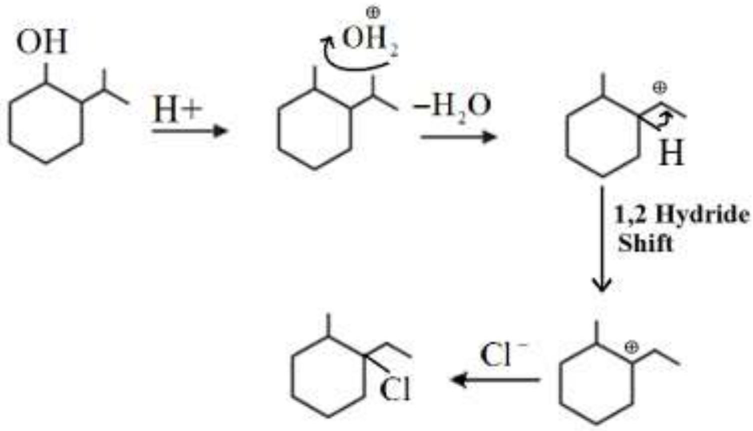
(iii) $2-$ chlorobuta $-1,3-$ diene is the monomer of neoprene.



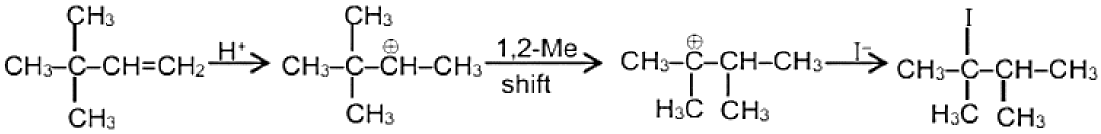
(iv) $2-$ Methylbuta $-1,3-$ diene is the monomer of natural rubber.



66. Sol. (1)

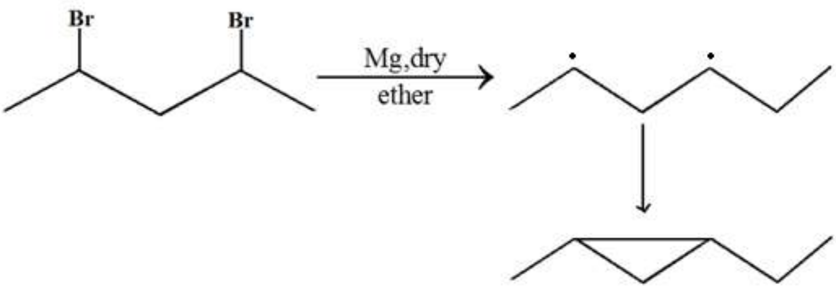


67. Sol. (3)

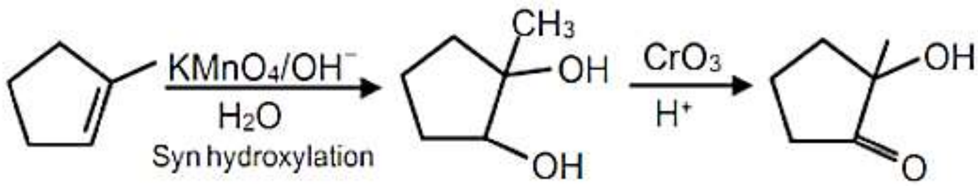


68. Sol. (2)

The reaction is an example of internal Wurtz reaction.



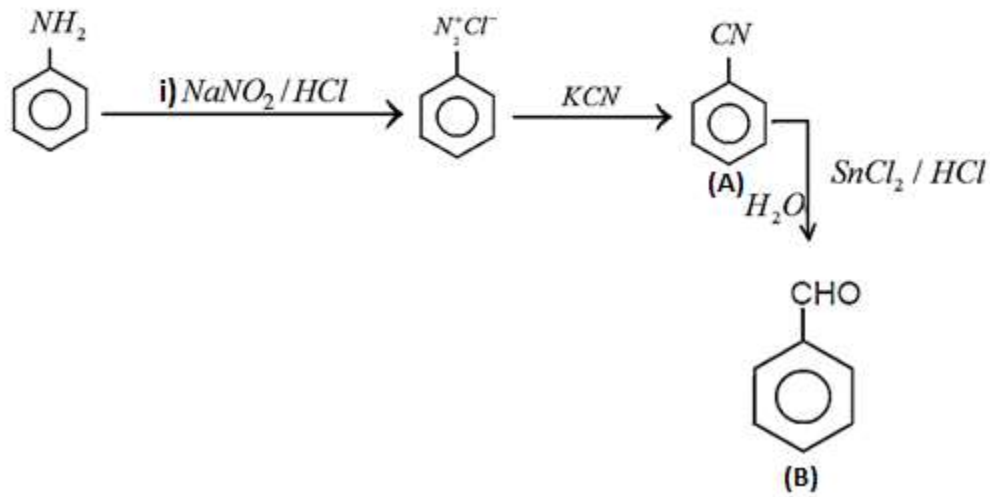
69. Sol. (1)



70. Sol. (2)

Molybdenum oxide helps in controlled oxidation of alkane to aldehyde and doesn't let the aldehyde get oxidized further to carboxylic acid.

71. Sol. (3)



72. Sol. (1)

$TiCl_4$ is tetrahedral and $SiCl_4$ is also tetrahedral. SO_4^{2-} and CrO_4^{2-} is also tetrahedral.

NH_3 is trigonal pyramidal and NO_3^- is trigonal planar.

ClF_3 is $T-$shape while BCl_3 is trigonal planar.

73. Sol. (1)

Sphalerite is ZnS

Malachite is $CuCO_3.Cu(OH)_2$

Calamine is $CuCO_3$

Siderite is $FeCO_3$

Cyanide of group 1 element is used to concentrate sulphide ores, hence sphalerite is the correct option.

74. Sol. (3)

$$Na_2B_4O_7.10H_2O \rightarrow Na_2B_4O_7 \rightarrow 2NaBO_2 + B_2O_3$$

Oxidising flame [Non – luminous flame]:

$$CuSO_4 \rightarrow CuO + SO_3$$

$$CuO + B_2O_3 \rightarrow \underset{\text{Blue bead}}{\overset{+2}{Cu}(BO_2)_2}$$

Reducing flame [luminous flame]:

$$Cu(BO_2)_2 + C \rightarrow 2\overset{+1}{Cu}BO_2 + CO + B_2O_3$$

$$2CuBO_2 + C \rightarrow 2\overset{0}{Cu}(S) + B_2O_3 + CO(g)$$

75. Sol. (2)

(i) $\underbrace{\overset{0}{I}_2 + \overset{+1}{H}_2\overset{-1}{O}_2 + 2OH^- \rightarrow \overset{0}{O}_2 + 2I^-}_{\text{reduction}} + 2H^+$

Since iodine is getting reduced, H_2O_2 is acting as reducing agent in case (i)

(ii) $\overset{+1}{H}_2\overset{-1}{O}_2 + \underbrace{HO\overset{+1}{Cl} \rightarrow Cl^-}_{\text{reduction}} + H_3O^+ + \overset{0}{O}_2$

Since Chlorine is getting reduced, H_2O_2 is acting as reducing agent.

76. Sol. (2)

Copper has a positive value of $E^0_{M^{2+}/M}$ as it lies below hydrogen in the electrochemical series.

77. Sol. (1)

$$Al_2O_3.xH_2O \xrightarrow{NaOH} \underset{\text{Soluble}}{\overset{(X)}{Na[Al(OH)_4]}}$$

$$Na[Al(OH)_4] \xrightarrow{Co_2(g)(y)} Al(OH)_3$$

$$Al(OH)_3 \xrightarrow{\Delta} \frac{Al_2O_3.xH_2O}{Z}$$

78. Sol. (1)

$$\frac{x}{m} = RP^{\frac{1}{n}}$$

$$\ln \frac{x}{m} = \ln k + \frac{1}{n} \ln p$$

When compared to equation of line, $y = mx + c$ with $y = \frac{\ln x}{m}$ and $x = \ln p$ then,

$$m = \frac{1}{n}$$

$$\frac{x}{m} \propto p \text{ (at law } p)$$

$$\therefore \frac{1}{n} = 1 \quad \Rightarrow \quad n = 1$$

79. Sol. (1)

Gun metal is made of Copper, zinc and tin in ratio of $87:3:10$.

80. Sol. (1)

On moving from left to right in period, the value of the ionization energy increases.

Phosphorus has the highest ionization potential as it has a half-filled outermost p — subshell which is extra stable.

Aluminium has the least ionization potential as it has only one electron in the outermost p subshell and the $3p$ electron of aluminium is further from the nucleus compared to the $3s$ electrons of magnesium. Also, removal of electron from $3s$ of magnesium will disrupt the stability of completely filled s orbital.

$Mg(12): 1s^2 2s^2 2p^6 3s^2$

$Al(13): 1s^2 2s^2 2p^6 3s^2 3p^1$

$Si(14): 1s^2 2s^2 2p^6 3s^2 3p^2$

$P(15): 1s^2 2s^2 2p^6 3s^2 3p^3$

$S(16): 1s^2 2s^2 2p^6 3s^2 3p^4$

Section B

81. Sol. 5

	$Cl_2(g)$ $\rightleftharpoons$	$2Cl(g)$	Total Moles
Moles at eq.	x	x	$2x$
Mole fraction	$\frac{x}{2x}=\frac{1}{2}$	$\frac{x}{2x}=\frac{1}{2}$	
Partial Pressure	$\frac{1}{2}\times P_T$	$\frac{1}{2}\times P_T$	

$$
\begin{array}{lll}
Cl_2(g) & \rightleftharpoons \; 2Cl(g) & \\
x & x & \text{moles at eq} \\
\frac{x}{2x}=\frac{1}{2} & \frac{x}{2x}=\frac{1}{2} & \text{mole fraction} \\
\frac{1}{2}\times P_T & \frac{1}{2}\times P_T & \text{partial pressure}
\end{array}
$$

$P_T = 1 atm$

$$K_p = \frac{[Cl]^2}{[Cl_2]} = \frac{\left(\frac{1}{2}\right)^2}{\left(\frac{1}{2}\right)} = \frac{1}{2} = 0.5$$

$K_p = 0.5 = 5 \times 10^{-1}$

$y = 5$

82. Sol. 4

$$\underbrace{\overbrace{S_8 + OH^- \rightarrow S^{2-}}^{\text{}} + S_2O_3^{2-}}_{} + H_2O$$

Oxidation: $S_8 \rightarrow S_2O_3^{2-}$; reduction: $S_8 \rightarrow S^{2-}$

$$S_8 + OH^- \rightarrow S^{2-} + S_2O_3^{2-} + H_2O$$

Reduction half reaction

$16e^- + \overset{0}{S_8} \rightarrow 8S^{2-}$ (1)

Oxidation half reaction

$12H_2O + S_8 \rightarrow 4S_2O_3^{2-} + 24H^+ + 16e^-$ (2)

Add (1) and (2)

$2S_8 + 12H_2O \rightarrow 8S^{2-} + 4S_2O_3^{2-} + 24H^+$

For basic medium add OH^- both sides to cancel H^+

$2S_8 + 12H_2O + 24OH^- \rightarrow 8S^{2-} + 4S_2O_3^{2-} + 24H^+ + 24OH^-$

$2S_8 + 12H_2O + 24OH^- \rightarrow 8S^{2-} + 4S_2O_3^{2-} + 24H_2O$

$2S_8 + 24OH^- \rightarrow 8S^{2-} + 4S_2O_3^{2-} + 12H_2O$

$S_8 + 12OH^- \rightarrow 4S^{2-} + 2S_2O_3^{2-} + 6H_2O$

83. Sol. 1535.3 seconds

For 40% completion

$$t = \frac{2.303}{K}\log\frac{100}{100-40}$$

$$t = \frac{2.303}{3.3\times10^{-4}}\log\frac{100}{60} = \frac{2.303}{3.3\times10^{-4}}\times0.22 = 1535.3 \text{ sec}$$

84. Sol. 1380

$$\Delta G^0 = -RT\ln K_{eq} = -R\times300\times\ln100 = -R\times300\times2\times\ln10$$
$$\Delta G^0 = -R\times300\times2\times2.3 = -1380R$$

85. Sol. 1

Formation constant of $\left[Cu\left(NH_3\right)_4\right]^{2+}$

$$Cu^{2+} + 4NH_3 \rightleftharpoons \left[Cu\left(NH_3\right)_4\right]^{2+} \qquad K_f$$

$$K_f = K_1\times K_2\times K_3\times K_4 = 10^4\times1.58\times10^3\times5\times10^2\times10 = 0.79\times10^{12}$$

Therefore, dissociation constant $\frac{1}{K_f} = \frac{1}{0.79\times10^{12}} = 1.2\times10^{-12} \simeq 1\times10^{-12}$

86. Sol. 7.5

$$\Delta T_f = i\times K_f\times m$$

Molar mass of $ClCH_2COOH = 94.5 \text{ g mol}^{-1}$

$$\Delta T_f = i \times 1.86 \times \frac{9.45 \times 1000}{94.5 \times 500}$$

$$0.5 = i \times 1.86 \times \frac{9.45 \times 1000}{94.5 \times 500}$$

$$i = 1.075$$

For $ClCH_2COOH \rightarrow ClCH_2COO^- + H^+$

1	$-$	$-$	
$1-\alpha$	α	α	$1+\alpha$

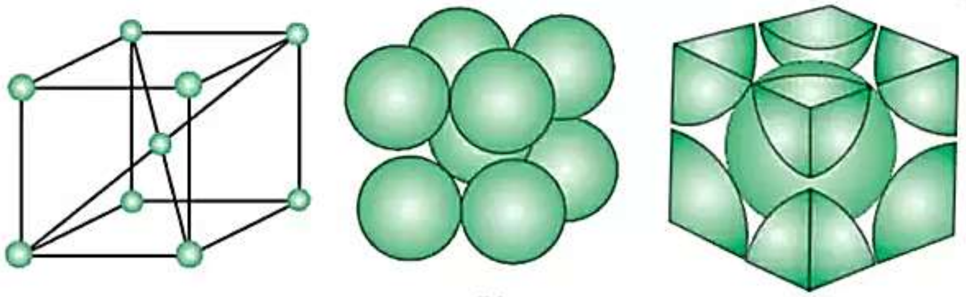
$$i = 1 + \alpha$$

$$1.075 = 1 + \alpha$$

$$\alpha = 1.075 - 1 = 0.075$$

$$\alpha = 7.5\%$$

87. Sol. 8



(a) (b) (c)

A body centre unit cell has 8 atoms at the corners of the unit cell and one atom at the body centre of the unit cell making the coordination number 8.

88. Sol. 2

$Be(OH)_2$ and BeO are amphoteric in nature while $Ba(OH)_2$ and $Sr(OH)_2$ are basic in nature.

89. Sol. $\mathbf{0.2}$

Molarity $M = \frac{\text{mass}}{\text{Molar mass}} \times \frac{1}{\text{Volume in ml}} \times 1000$

$$M = \frac{4.5}{90} \times \frac{1}{250} \times 1000 = 0.2$$

90. Sol. 2

$$\lambda = \frac{h}{\sqrt{2m(qv)}}$$

$$\frac{\lambda_{H^+}}{\lambda_{Li^{3+}}} = \sqrt{\frac{3 \times m_{Li^{3+}}}{1 \times m_{H^+}}} = \sqrt{\frac{8.33 \times 3}{1}} = 5$$

$$\therefore \frac{\lambda_{Li^{3+}}}{\lambda_{H^+}} = \frac{1}{5} = 0.2 = 2 \times 10^{-1}$$

$$\therefore x = 2$$