SECTION A

1. **(a)**
2. **(b)**
3. **(b)**
4. **(d)**
5. **(b)**
6. **(c)**
7. **(c)**
8. **(a)**
9. **(a)**
10. **(d)**
11. **(c)**
12. **(d)**
13. **(a)**
14. **(b)**
15. **(c)**
16. **(b)**

SECTION B

17. **(a)** (a) Due to high pressure inside the pressure cooker, higher is the boiling point and faster is the cooking.
(b) Negative deviation
Temperature increases.

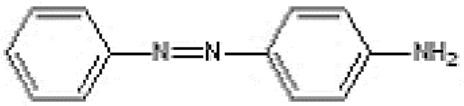
OR

(b) Same composition in liquid and in vapour phase and boil at a constant temperature.
Maximum Boiling Azeotrope $68\%HNO_3 + 32\%H_2O$ (Or any other correct example) (Percentage can be ignored)

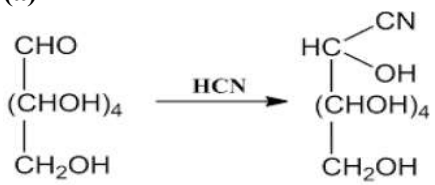
18. **(a)** $10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5I_2$
(b) $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

19. • Less reactive,
• The carbon atom of the carbonyl group of benzaldehyde is less electrophilic than carbon atom of the carbonyl group present in propanal. / The polarity of the carbonyl group is reduced in benzaldehyde due to resonance.

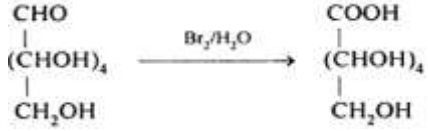
20. **(a)** $A = CH_3CH_2CN$; $B = CH_3CH_2CH_2NH_2$
(b) $A = C_6H_5\ N^+\ _2Cl^-$;
B=



21. **(a)**



(b)



SECTION C

22. T_b of glucose solution $= 100.20°C$
$\Delta T_b = T_b - T°b$
$= 100.20° - 100°C = 0.20°C$ or $0.20\ K$
$\Delta T_b = K_b \cdot m$
$m = \frac{0.20}{0.512} = 0.390\ mol/kg$

$\Delta T_f = K_f \cdot \text{m}$
$\Delta T_f = 1.86\ \text{K kg/mol} \times 0.390\ \text{mol/kg}$
$\Delta T_f = 0.725\ \text{K}$
Freezing point of solution
$= 273.15 - 0.725$
$= 272.425\ \text{K}$
Or $-0.725°\text{C}$

23. **(a) (i)** The limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte.

(ii) The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte.

(b) ' X ' is better, as X has more negative electrode potential than Fe/X has more oxidation potential than Fe .

24. $t_{1/2} = \frac{0.693}{k}$

$k_1 = \frac{0.693}{20} = 0.03465/3.465 \times 10^{-2}\ \text{min}^{-1}$

$k_2 = \frac{0.693}{5} = 0.1386/1.386 \times 10^{-1}\ \text{min}^{-1}$

$\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$

$\log\frac{0.1386}{0.03465} = \frac{Ea}{2.303 \times 8.314}\frac{[350 - 300]}{[350 \times 300]}$

$\log 4 = \frac{Ea}{19.15}\frac{[50]}{[350 \times 300]}$

$\text{Ea} = 24209\ \text{J mol}^{-1}$ or $24.209\ \text{kJ mol}^{-1}$

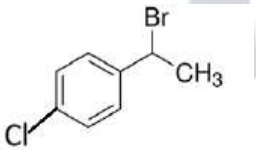
25. **(a)** Its high $\Delta_a H°$ and low $\Delta_{hyd} H°$.

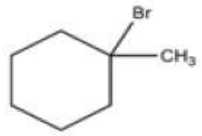
(b) Cr

$Cr^{3+}(d^4$ to $d^3)$/ stable half-filled t_{2g} level

(c) Fully-filled d-orbitals hence no d-d transition / due to the absence of unpaired electron.

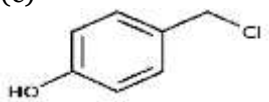
26.(a) (a)





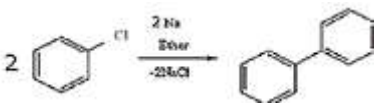
(b)

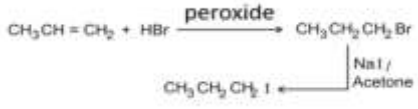
(c)



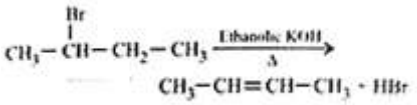
OR

(b) (a)





(b)



(c)

(or any other suitable method of conversion)

27. **(a)** $(CH_3)_2NH < CH_3CH_2NH_2 < CH_3CH_2OH$

(b) **(i)** aromatic halides do not undergo nucleophilic substitution with the anion formed by phthalimide.

(ii) 

/Due to resonance the lone pair on nitrogen is less available for donation/ Due to + R effect lone pair of electrons is not easily available on N of -NH_2 group/ Due to -R effect of carbonyl group, electron density on N atom of NH_2 group decreases.

28. **(a)**

Native protein	Denatured protein
Three-dimensional structure is intact.	Three-dimensional structure is destroyed.
Biologically active	Biologically inactive

(Or any other one correct difference)

(b) Lactose

(c) Vitamin K

SECTION D

29. **(a)** **(i)** Slowest step.

(ii) Series of elementary reactions / Reactions involving two or more steps.

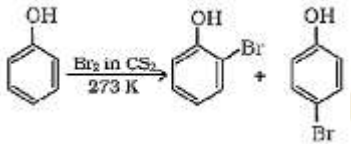
(b) Increases with increase in temperature.

OR

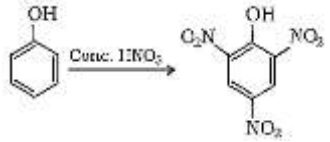
(b) Molecularity is defined only for elementary reactions whereas order is experimentally determined hence applicable for both / Because molecularity of each elementary reaction in complex reaction may be different and hence meaningless for overall complex reaction whereas order of a complex reaction is experimentally determined by the slowest step in its mechanism and is therefore applicable for both.

(c) 9 times

30. **(a)** **(i)**



/ 2-Bromophenol and 4-Bromophenol is formed.



(ii)

/ 2,4,6-Trinitrophenol / Picric acid is formed.

(b) Due to resonance, the lone pair of electrons on oxygen is not easily available for protonation.

(c) Phenol

Due to electron releasing effect (+I effect) of methyl group/phenoxide ion formed is less stable in cresol.

OR

(c) 2-Hydroxybenzaldehyde / 2-Hydroxybenzenecarbaldehyde.

SECTION E

31. (a) (a) The cell reaction is

$Sn(s) + 2H^+(aq) \rightarrow Sn^{2+}(aq) + H_2(g)$

$E_{Cell} = (E^o{}_c - E^o{}_a) - \frac{0.059}{2}\log\frac{[Sn^{2+}]}{[H^+].^2}$

$= [(0) - (-0 \cdot 14)] - \frac{0.059}{2}\log\frac{0.004}{(0.02)\cdot{}^2}$

$= 0.14 - 0.0295\log 10$

$= 0.1105\ V$

(b) (i) overpotential of O_2

(ii) Number of ions carrying current per unit volume decreases on dilution

OR

(b) (a) At anode:

$Pb + SO_4{}^{-2} \rightarrow PbSO_4 + 2e^-$

At cathode:

$PbO_2 + SO_4^{-2} + 4H^+ + 2e^- \rightarrow PbSO_4 + 2H_2O$

Overall reaction:

$Pb + PbO_2 + 2SO_4^{-2} + 4H^+ \rightarrow 2PbSO_4 + 2H_2O$

(b) $E_{cell} = E^\circ{}_{cell} = \frac{0.059}{n}\log\left[\frac{[Cr^{3+}]^2}{[Cr^2O7^{2-}][H+]^{14}}\right]$

$Ecell = 1.33 - \frac{\frac{0.059}{6}\log(10^{-2})^2}{(10^{-2})(1\times10^{-4})^{14}}$

$= 1.33 - \frac{0.059}{6}(54)\log 10$

$= 1.33 - 0.059 \times 9$

$= 1.33 - 0.531$

$= 0.799\ V$

32. (A)(a) The orbital splitting energies are not sufficiently large for forcing paring of electrons.

(b) In the presence of strong field ligand, d^7 is converted into more stable d^6 configuration / Strong field effect stabilises higher oxidation state.

(c) Co-ordination isomerism.

(d) $[Ni(H_2O)_6]^{2+}$ has unpaired electrons whereas $[Ni(CN)_4]^{2-}$ has no unpaired electron.

(e) Pentaamminecarbonatocobalt(III) chloride

OR

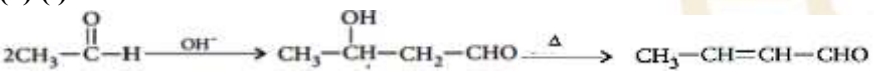
(B)(a) The higher stability of complexes involving chelating ligands as compare to complexes having non-chelating ligand.

Example: $[Co(en)_3]^{3+}$ (or any other correct example)

(b) d^2sp^3, diamagnetic

(c) $[Pt(NH_3)_2Cl_2]$

33. (a) (a) (i)

(ii) 

(b) $A = (CH_3)_2CH = CHCH_3$ / 2-Methylbut-2-ene

$B = CH_3CHO$/ Ethanal

$C = CH_3COCH_3$/ Acetone/ Propanone

OR

$A = C_3H_7COOC_4H_9$/ Butyl butanoate

$B = C_3H_7COOH$/ Butanoic acid

$C = C_4H_9OH$/ Butan-1-ol

$C_3H_7COOC_4H_9 +$ dil. $H_2SO_4 \rightarrow C_3H_7COOH + C_4H_9OH$

$C_4H_9OH +$ Conc.Sulphuric acid $+$ Heat $\rightarrow CH_3CH_2CH = CH_2$

$C_4H_9OH \xrightarrow{CrO_3/CH_3COOH} C_3H_7COOH$

SECTION A

34. **(b)**
35. **(c)**
36. **(c)**
37. **(a)**
38. **(b)**
39. **(a)**
40. **(c)**
41. **(b)**
42. **(c)**
43. **(d)**
44. **(d)**
45. **(c)**
46. **(d)**
47. **(a)**
48. **(a)**
49. **(d)**

SECTION B

50. $k = \frac{[R]_0 - [R]}{t}$

$t = \frac{0.10 - 0.075}{0.0030}$

$t = \frac{0.025}{0.0030}$

$t = 8.33$ s

OR

Rate $= \frac{-1\Delta[NH3]}{2\Delta t} = \frac{\Delta[N2]}{\Delta t} = \frac{+1\Delta[H2]}{3\Delta t}$

$\frac{-1\Delta[NH3]}{2\Delta t} = \frac{\Delta[N2]}{\Delta t} = \frac{+1\Delta[H2]}{3\Delta t} = k$

$\frac{\Delta[N2]}{\Delta t} = 2.5 \times 10^{-4}$ mol L^{-1} S^{-1}

$\frac{\Delta[H2]}{\Delta t}$

$= 3 \times 2.5 \times 10^{-4}$

$= 7.5 \times 10^{-4}$ mol L^{-1} S^{-1}

51. **(a)** The reaction that seems to be of higher order but under certain conditions is of first order.
(b) The time in which the concentration of a reactant is reduced to one half of its initial concentration / The time in which half of the reaction is completed.

52. **(a)** Due to the presence of unpaired electron in d sub shell/ due to d-d transition.
(b) Due to the presence of fully filled d - subshell in ground state and oxidized state.

53. **(a)** Tetraammineaquachloridocobalt (III) chloride
(b) Dichloridobis(ethane-1,2-diamine) chromium (III) chloride

54. **(a)**  , due to the formation of more stable tertiary carbocation.
(b) 2-Bromo-2-methylbutane < 2-Bromopentane < 1-Bromopentane.

SECTION C

55. $\frac{p_1^0 - p_1}{p_1^0} = \frac{w_2 \times M_1}{M_2 \times w_1}$

$\frac{24 - p_1}{24} = \frac{5 \times 18}{60 \times 95}$

$\frac{24 - p_1}{24} = \frac{3}{190}$

$24 - p_1 = \frac{3 \times 24}{190}$

$p_1 = 23.62$ mmHg /23.64 mmHg

(Deduct 1/2 mark for no or incorrect unit).

56. $\rho = \frac{RA}{l}$

$= \frac{5 \times 10^3 \times 0.8}{40}$

$= 100\Omega$ cm

$K = \frac{1}{\rho}$

$= \frac{1}{100}$

$= 10^{-2}$ S cm $- 1$

$\Lambda_m = \frac{\kappa \times 1000}{\mathbf{C}}$

$= \frac{10^{-2} \times 1000}{0.05}$

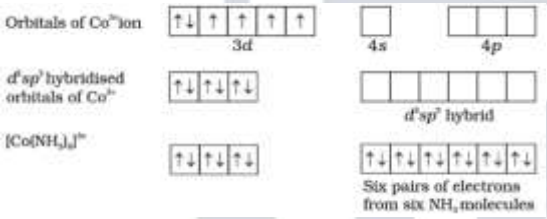
$= 2 \times 10^2$ S cm^2 mol^{-1}

57. **(a)** $5C_2O_4^{2-} + 2MnO_4^- + 16H^+ \longrightarrow 2Mn^{2+} + 8H_2O + 10CO_2$

(b) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

(c) $Cr_2O_7^{2-} + 8H^+ + 3H_2S \rightarrow 2Cr^{3+} + 3S + 7H_2O$

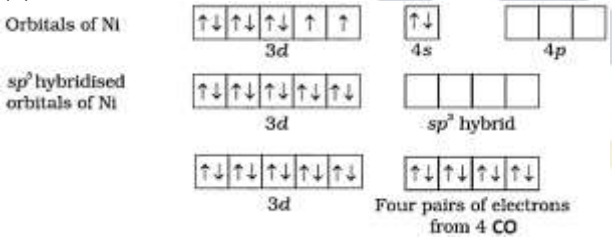
58. **(a)**



Hybridization: d^2sp^3

Magnetic character: Diamagnetic.

(b)



Hybridization: sp^3

Magnetic character: Diamagnetic.

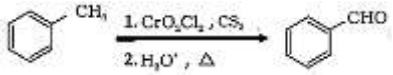
59. **(a)** **(i)** The stereoisomers related to each other as non-superimposable mirror images.

(ii) A mixture containing dextro and laevo enantiomers in equal proportions.

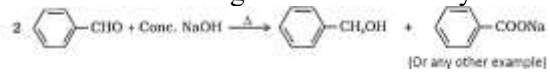
(b) C $-$ Cl bond acquires a partial double bond character due to resonance / the carbon atom of benzene attached to halogen is sp^2-hybridised / Explanation through resonating structures.

60. **(A)** **(a)** The carbonyl group of aldehydes and ketones is reduced to CH_2 group on treatment with hydrazine followed by heating with sodium or potassium hydroxide in high boiling solvent such as ethylene glycol

(b) Chromyl chloride oxidises methyl group of toluene to a chromium complex, which on hydrolysis gives corresponding benzaldehyde.



(c) Aldehydes which do not have α-hydrogen atom, undergo self-oxidation and reduction reaction on heating with concentrated alkali gives salt of carboxylic acid and alcohol



(Or any other example)

OR

(B) (a) $A = CH_3COCl$ (b) CH_3CHO

(c) $CH_3CH = NNH_2$

(b) $A = CH_3CHO$ (b) $CH_3CH(OH)CH_2CHO$ (c) $CH_3CH = CHCHO$

61. (a) The oxide linkage between two monosaccharides.

(b) Hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (-) and the product is named as invert sugar.

(c) Carbohydrates that yield two to ten monosaccharide units, on hydrolysis.

SECTION D

62. (a) When external pressure is larger than the osmotic pressure, then the movement of solvent is from solution to solvent side through semi permeable membrane. / The direction of osmosis can be reversed if a pressure larger than the osmotic pressure is applied to the solution side.

Cellulose acetate / Or any other suitable example.

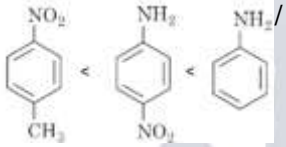
(b) (i) RBC swells up / Cells swell and may even burst due to endo-osmosis.

OR

(ii) 1 M KCl, $i = 2/KCl$ dissociates into ions, whereas urea does not dissociate.

(c) It depends upon the number of solute particles in the solution.

63. (a)



/ Award full marks if attempted because of printing error.

(b) Due to resonance in aniline the lone pair of electrons are less available while they are easily available in methyl amine.

(c) (i) $\mathbf{NH_3 < (CH_3)_3\,N < CH_3NH_2 < (CH_3)_2NH}$

OR

(ii) A mixture of primary, secondary and tertiary amines and also a quaternary ammonium salt is formed.

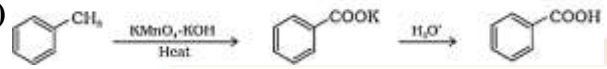
SECTION E

64. (a) But-2-enal

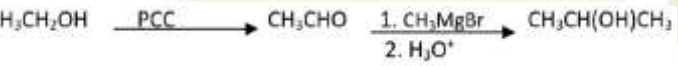
(b) On heating with $NaOH + I_2$, propanone gives yellow ppt. Of iodoform (CHI_3) whereas propanal does not.

(Or any other suitable chemical test)

(c) (i)



(ii)



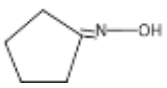
(iii)

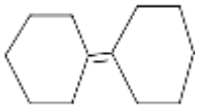
(Or any other correct method)

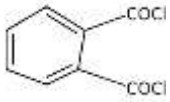
OR

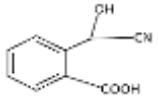
(B)

(a)



(b) 

(c) 

(d) 

(e) CH_3COCl/ Anhy. $AlCl_3$ or $(CH_3CO)_2O$/ Anhy. $AlCl_3$

65. (A) (a) $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$

$= -2.87 - 1.5$ V

$= -4.37$ V

$\Delta G^0 = -nFE^\circ C_{\text{ell}}$

$= -6 \times 96500 \times (-4.37)$

$= 2530.230$ kJ/mol

Reaction is non-spontaneous.

(b) Yes, the tarnish can be removed.

Aluminium has more negative standard electrode potential than silver so will reduce silver sulphide to silver, tarnish will be removed. /

$3Ag^+ + Al \longrightarrow 3Ag + Al^{3+}$

$E^\circ C_{\text{ell}} = E_{\text{cathode}} - E^\circ_{\text{anode}}$

$= -0.71 - (-1.66)$V

$= 0.95$ V

This indicates that the reaction is feasible and tarnish can be removed.

OR

(B)

(a) (i) Potential difference between two electrodes of a galvanic cell.

(ii) The galvanic cell in which combustion energy of fuels is directly converted into electrical energy.

(b) $n = 2$

$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$

$= -0.40 - (-0.76)$V

$= 0.36$ V

$E^\circ_{\text{celi}} - \frac{0.059}{2}\log\left[\frac{Zn^{2+}}{cd^{2+}}\right]$

$E_{\text{Cell}} = [0.36] - \frac{0.059}{2}\log\frac{0.1}{0.01}$

$= (0 \cdot 36 - 0 \cdot 0295)$

$= 0.3305$ V

(Deduct $1/2$ mark for no or incorrect unit)

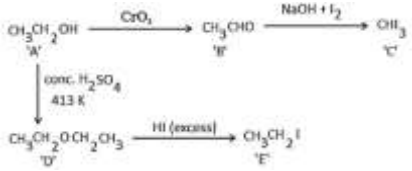
66. (A) $A = CH_3CH_2OH$/ Ethanol / Ethyl alcohol,

$B = CH_3CHO$/ Ethanal / Acetaldehyde,

$C = CHI_3$ / Iodoform / Triiodomethane,

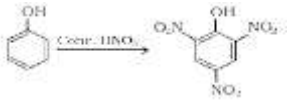
$D = CH_3CH_2OCHCH_3$ / Ethoxyethane / Diethyl ether,

$E = CH_3CH_2I$/ Ethyl iodide / Iodoethane.

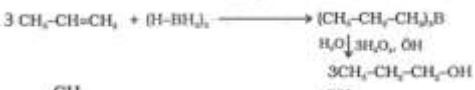


OR

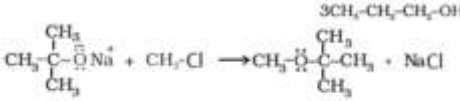
(B) (a) (i)



(ii)



(iii)



(b) On heating with $NaOH + I_2$, Butan-2-ol gives yellow ppt. Of iodoform (CHI_3) whereas Butan-1ol does not.
(Or any other suitable chemical test)

(c) Ethanol < Water < Phenol.

SECTION A

67. (b)
68. (a)
69. (c)
70. (a)
71. (b)
72. (d)
73. (a)
74. (b)
75. (d)
76. (d)
77. (b)
78. (c)
79. (c)
80. (a)
81. (d)
82. (a)

SECTION B

83. Order of the reaction =1 / First

Rate = k[A]

OR

Rate of the reaction will increase. Rate constant remains same.

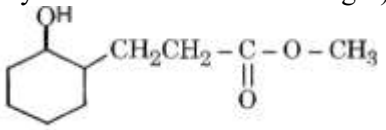
84. Structural formula: $K_2[PtCl_6]$

IUPAC Name: Potassium hexachloridoplatinate (IV)

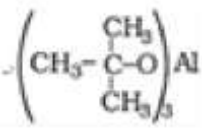
85. Galvanic cell which converts the energy of combustion of fuels directly into electrical energy.

Advantages
1. High efficiency
2.Pollution free
(or any other two correct advantages)

86. (a)



(b)



87. Amino-acids which cannot be synthesized in the body and must be obtained through diet.

In zwitter ionic form, amino-acids react both with acids and bases./ Due to the presence of both carboxylic group and amino group.

SECTION C

88. (a) (i) Greater stability of allylic carbocation due to resonance.

(ii) Being covalent in nature, only nitrogen is free to donate electron pair in AgCN .
(iii) Less sterically hindered carbon in Methyl chloride/ greater steric hinderance on tertiary carbon of t-butyl chloride.

OR

(b) (i) $A = CH_3CH_2CH_2Br$
$B = CH_3CH_2CH_2OH$
(ii) $A = CH_3CH = CHCH_3$
$B = CH_3CH_2CH(Br)CH_3$
(iii) $A = CH_3CH_2Cl$ $B = CH_3CH_3$

89. $2AI + 3Ni^{2+} \rightarrow 2Al^{3+} + 3Ni$
E° cell $= E^\circ_{Ni^{2+}/Ni} - E^\circ_{Al^{3+}/Al}$
; E° cell $= -0.25 - (-1.66) = 1.41$ V
$n = 6$

$$E_{cell} = E^\circ_{cell} \frac{-2.303RT}{nF} \log \frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$$

$$E_{cell} = 1.41 - \frac{0.059}{6} \log \frac{[0.001]^2}{[0.1]^3}$$

$$E_{cell} = 1.41 - \frac{0.059}{6} \log \frac{[10]^{-6}}{[10]^{-3}}$$

$$E_{cell} = 1.41 - \frac{0.059}{6} \log 10^{-3}$$

$E_{cell} = 1.41 - (-0.0295)$
$E_{cell} = 1.41 + 0.0295$
$E_{cell} = 1.439$ V/1.44 V
(Deduct 1/2 mark for no or incorrect unit)

90. **(a)** Change from Mn^{3+} to Mn^{2+} results in extra stable half filled d^5 configuration. Cr^{2+} is reducing as its configuration changes from d^4 to d^3 which is stable half filled $t_{2g}{}^3$ configuration.
(b) Due to poorer shielding offered by $5f$ electrons than $4f$.
(c) H, B, C and N atoms being small in size get trapped inside the crystal lattices of transition metals.

91. I = Normal molar mass/Abnormal molar mass
I = 40/25
=1.6
$\alpha = i - 1/n - 1$
$= \frac{1.6-1}{1}$

$= 0.6 \times 100$
=60%
(Any other suitable method)

92. **(a)** $C_6H_5NH_2 > C_6H_5NHCH_3 > C_2H_5NH_2 > (C_2H_5)_2NH$
(b) $(CH_3)_2NH < C_2H_5NH_2 < C_2H_5OH$
(c) $C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH_2$

93. A: $C_6H_5COCH_3$ Acetophenone
B: CHI_3 Triiodomethane
C: C_6H_5COOH Benzoic acid

94. **(a)**No
Sodium ethoxide is a strong nucleophile as well as a strong base so elimination reaction of tbutyl chloride predominates over substitution.
Chloroethane and Sod.tert-butoxide / C_2H_5Cl and $(CH_3)_3CONa$
(b)2-Ethoxy-2-methylpropane

SECTION D

95. **(a)** Chloroform and Acetone (or Any other correct example)
A − B interactions are stronger than A − A and B − B interaction.

(b) (i) For any solution the partial vapour pressure of each volatile component is directly proportional to its mole fraction.

OR

(b) (ii) $p = p^0 x; p = K_H x$

When $p^0 = K_H$

p$\alpha\chi$ for both.

(c) The enthalpy of mixing of the pure components in the ideal solution is Zero/ Δ_{mix} H = 0.

The Volume of mixing of the pure components in the ideal solution is Zero. / Δ_{mix} V = 0 (or any other two suitable characteristics)

96. (a) 2-Deoxyribose, Phosphoric acid, Nitrogenous base.

DNA	**RNA**
1.Double stranded helix	Single stranded helix

(or any other suitable structural difference)

(b)

Nucleotide	**Nucleoside**
1.Pentose sugar + Nitrogenous base + Phosphate	1.Pentose sugar + Nitrogenous base

(c) (i) To preserve genetic information and Protein synthesis

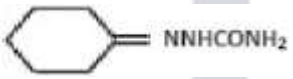
OR

(c) (ii) Phosphodiester linkage

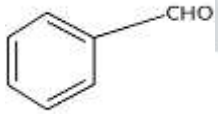
Uracil

SECTION E

97. (a) (i) (I)



(II) CH_3COCH_3



(III)

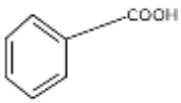
(ii) (I)Benzoic acid with Sodium bicarbonate gives brisk effervescence. No reaction with Ethyl benzoate

(ii)Propanal, when heated with ammoniacal solution of silver nitrate (Tollens' reagent) gives silver mirror. No reaction with propanone

(or any other suitable chemical test)

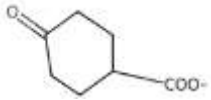
OR

(b) (i)(I)



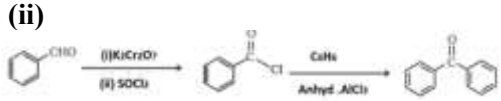
(II)1. $(BH_3)_2, 2 \cdot H_2O_2/OH^-, 3 \cdot PCC$

(III)



(b) (ii)

(I)

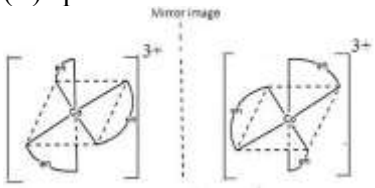


(II) $C_6H_5CHO \xrightarrow{CH_3CHO,\ dil\ NaOH,\Delta} C_6H_5CH=CHCHO \xrightarrow{H_2/Ni} C_6H_5CH_2CH_2CH_2OH$
(Or any other suitable method)

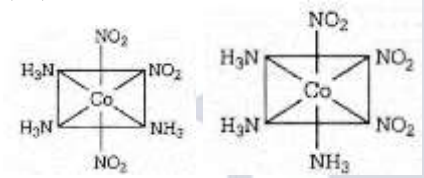
98. **(a) (i)** (I) CO being a strong field ligand, causes pairing of electrons therefore, there is no unpaired electron. Whereas $Cl^-$is a weak field ligand, does not cause pairing, therefore presence of unpaired electrons.
(II) CO can form both sigma (σ) and pi (π)bond with central metal atom/Metal to ligand bonding creates synergic effect between CO and the Metal.
(III) Mirror images are superimposable/ Presence of plane of symmetry.
(ii)
(I) $\Delta_0 > P$, causes pairing of electrons, therefore 1 unpaired electron
(II) $\Delta_0 < P$, No pairing of electrons therefore 5 unpaired electrons

OR

(b) (i)
(I)Coordination Isomerism / $[Cr(NH_3)_6][Co(CN)_6]$
(II)Optical Isomerism /



(III)Geometrical isomerism /



(ii) Weak field ligands produce weak field and leads to small splitting of d-orbitals whereas strong field ligands produce strong field leading to large splitting of d-orbitals.
Strong field ligands cause pairing of electrons/a smaller number of unpaired electrons hence produces low spin complexes and weak field ligands causes no pairing of electrons/a greater number of unpaired electrons hence produces high spin complexes.

99. **(a) (i)** $k = \frac{2.303}{t}\log\frac{[R]_o}{[R]}$

$$k = \frac{2.303}{60}\log\frac{1.2\times10^{-2}}{0.2\times10^{-2}}$$
$$= \frac{2.303}{60}\log 6$$
$$= \frac{2.303}{60}\times 0.778$$
$$k = 2.98\times10^{-2}\ min^{-1}/0.0298\ min^{-1}$$

(Deduct $1/2$ mark for incorrect or no unit.)
(ii) (I) Order is determined experimentally.
(II) If one of the reactants is taken in excess.

Of

(b) (i) $\log\frac{k_2}{k_1} = \frac{E_a}{2\cdot303R}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$

$$\log\frac{2k_1}{k_1} = \frac{E_a}{19\cdot15}\left[\frac{1}{298}-\frac{1}{308}\right]$$
$$0\cdot3 = \frac{E_a}{19\cdot15}\left[\frac{10}{298\times308}\right]$$
$$E_a = \frac{0.3\times19.15\times298\times308}{10}$$
$$E_a = 52729 Jmol^{-1} \text{ or } 52.729 kJmol^{-1}$$

(Deduct $1/2$ mark for incorrect or no unit.)
(ii) (1). Rate $= k[H_2O_2][I^-]$
(2) Overall order: 2/ Second

Molecularity:
2 / Bimolecular

SECTION A

100. **(d)**
101. **(d)**
102. **(c)**
103. **(b)**
104. **(d)**
105. **(b)**
106. **(c)**
107. **(b)**
108. **(c)**
109. **(a)**
110. **(b)**
111. **(d)**
112. **(a)**
113. **(d)**
114. **(b)**
115. **(a)**

SECTION B

116. $\Delta T_b = iK_bm$

$\Delta T_b = i\frac{K_b \times 1000 \times w_2}{M_2 \times w_1}$

$i = 3$

$\Delta T_b = \frac{3 \times 0.52 \times 3 \times 1000}{111 \times 260}$

$= 0.162$ K

OR

Given $n_X = n_Y$

$\chi_x = \chi_y = 0.5$

$P_T = p_X {}^0x_{x+}p_Y {}^0x_Y/p_{total} = x_1p_1^0 + x_2p_2^0$

$= 120 \times 0.5 + 160 \times 0.5$

$= 60 + 80$

$= 140$ mmHg

117. Conductivity decreases with decrease in concentration

Due to decrease in number of current carrying ions per unit volume.

Molar conductivity increases with decrease in concentration

Due to decrease in inter-ionic attraction or increase in dissociation or increase in number of ions.

118. **(a)** Rate $= k[HI]^0 = k$

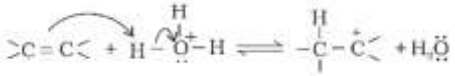
(b) Increases with increase in temperature

$k = Ae^{-Ea/RT}/\ln k = \ln A - Ea/RT$

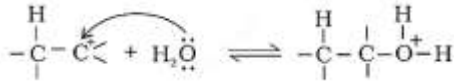
119. The mechanism of the reaction involves the following three steps

Step 1: Protonation of alkene to form carbocation by electrophilic attack of H_3O^+.

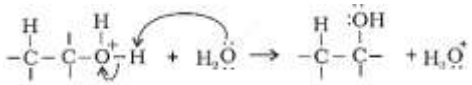
$H_2O + H^+ \rightarrow H_3O^+$



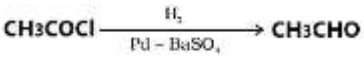
Step 2: Nucleophilic attack of water on carbocation.



Step 3: Deprotonation to form an alcohol.



120. **(a)** Acetyl chloride is hydrogenated over catalyst, palladium-barium sulphate to prepare acetaldehyde /



(b) Due to less steric hinderance and greater electrophilicity of carbonyl carbon in propanal than propanone. / Due to more steric hinderance and less electrophilicity of carbonyl carbon in propanone than propanal

SECTION C

121. **(a) (i)** The solution is non ideal, shows positive deviation from Raoult's law / A-B interactions are weaker than $A-A$ and $B-B$ interactions

(ii) Decrease in temperature

(iii) Ethanol and acetone

(or any other suitable example)

OR

(b) (i) Salt lowers the freezing point of water and prevents formation of ice and hence its easy to clean.

(ii)-Red blood cells swell up

-As the solution is hypotonic, water will flow into the cell/ As the solution is hypotonic, endosmosis occurs.

(iii) Desalination of sea water

122. Rate $= k[A]^x[B]^y$

Eq. 1 Rate $_1 = k(0.1)^x(0.1)^y = 5.0 \times 10^{-2}$

Eq. 2 Rate $_2 = k(0.2)^x(0.1)^y = 1.0 \times 10^{-1}$

Eq. 3 Rate $_3 = k(0.1)^x(0.2)^y = 5.0 \times 10^{-2}$

$$\frac{0.1}{0.5} = \frac{k \times 0.2^x \times 0.1^y}{k \times 0.1^x \times 0.1^y}$$

Hence $x = 1$

$$\frac{0.05}{0.05} = \frac{k \times 0.1^x \times 0.2^y}{k \times 0.1^x \times 0.1^y}$$

Hence $y = 0$

Rate $^y = k[A]^1[B]^0$

Overall order $= 1$

123. **(a)** The difference of energy between the two sets of d-orbitals t_2g and eg due to the presence of ligands in a definite geometry. / The energy required to split the degenerate d-orbitals into two sets of orbitals.

(i) $t^3{}_{2g}e^1{}_g$(ii) $t^4{}_{2g}e^0{}_g$

(b) Orbital splitting energy is not sufficiently large for causing pairing of electrons

124. **(a)** Due to resonance in chlorobenzene leading to partial double bond character of $C-Cl$ bond but there is no resonance in CH_3Cl/sp^2 hybridised carbon atom having shorter bond length between $C-Cl$ in chlorobenzene than sp^3 hybridized carbon in methyl chloride.

(b) Grignard reagent react with water to form corresponding hydrocarbon

(c) Due to the formation of planar carbocation, nucleophile may attack from either side of carbocation.

125. **(a) 4-methylphenol < Phenol < 3,5-dinitrophenol < 2,4,6-trinitrophenol**

(b)

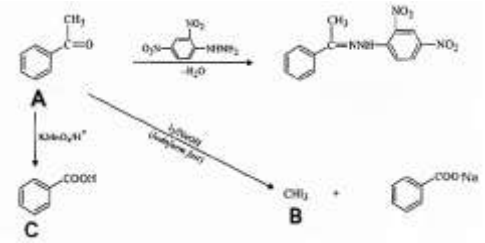
(i)

(ii)

126. A = Acetophenone $/C_6H_5COCH_3$

B = Iodoform $/CHI_3$,

C=Benzoic acid/C $_6H_5COOH$



127. **(a)** Peptide linkage

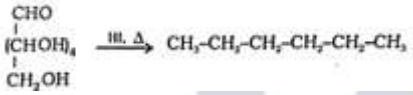
(b)

DNA	RNA
Double stranded	Single stranded
Sugar is deoxyribose	Sugar is ribose
Thymine base is present	Uracil base is present
It replicates	It does not replicate

(or any two suitable differences)

SECTION D

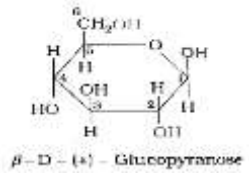
128. **(a)**



(b) (i) Cyclic structures of glucose differ only in configuration of - OH group at C_1. / Stereoisomers which differ in configuration of -OH group at C_1 or C_2

OR

(b) (ii)



(c) Hydrolysis of dextrorotatory sucrose brings a change in the sign of rotation or inverts the optical rotation from dextrose to leave. The product of hydrolysis is invert sugar.

129. **(a) (i)** $[Cr(H_2O)_4Cl_2]Cl$

(ii) 6

(b) Double salts dissociate into simple ions while complex compounds do not dissociate completely into ions when dissolved in water. (Or any other suitable difference)

(c) (i) $[Cr(NH_3)_3Cl_3] < [Cr(NH_3)_5Cl]Cl|_2 < [Cr(NH_3)_6]Cl_3$

OR

(c) (ii)

	Primary Valency		Secondary Valency
1.	Ionisable	1.	Non-ionisable

2.	Satisfied by negative ions	2.	Satisfied by negative ions or neutral molecules

(or any other two suitable differences)

SECTION E

130. **(a) (i)** (II) will remain as reduction reaction / (II)

(I) will be reversed to become an oxidation reaction

Due to low reduction potential of Cr

(ii) Cell representation $Mg(s)/Mg^{2+}(aq, 0.100M)||Ag^{+}(aq, 0.001M)/Ag(s)$

$n = 2$

$$Ecell = E^{\circ}\ cell\ - \frac{2.303RT}{nF}\log\frac{[Mg^{2+}]}{[Ag^{+}]^2}$$

$$= 3.17 - \frac{0.059}{2}\log\frac{0.100}{(0.001)^2}$$

$$= 3.17 - \frac{0.059}{2}\log 10^5$$

$$= 3.17 - 0.0295 \times 5$$

$$= 3.17 - 0.1475$$

$$= 3.0225\ V \text{ or } 3.02\ V$$

OR

(b) (i) Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte.

To determine -1. Limiting molar conductivity of an electrolyte.

2. Dissociation constant of a weak electrolyte

(or any other two suitable applications)

(ii) $\Lambda^{\circ}mNH_4OH = \Lambda^{\circ}mNH_4Cl + \Lambda^{\circ}mNaOH - \Lambda^{\circ}mNaCl$

$$= 129.8 + 217.4 - 108.9$$

$$= 238.3 Scm^2\ mol^{-1}$$

$$\alpha = \frac{\Lambda m^c}{\Lambda^{\circ}m}$$

$$= \frac{9.33}{238.3}$$

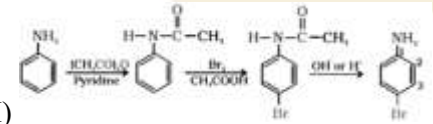
$$= 0.039/3.9\%$$

131. **(a) (i)** Amine ' X ' react with $C_6H_5SO_2Cl$ to give a compound, soluble in NaOH so amine ' X ' is primary amine, $CH_3CH_2NH_2$ /Ethanamine/Ethyl amine

(ii) $(CH_3)_2NH < CH_3NH_2 < (CH_3)_3\ N < NH_3 < C_6H_5NH_2$

(iii) In the strongly acidic medium, aniline is protonated to anilinium ion, which is metadirecting.

(iv)(I)



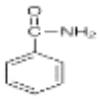
(II) $C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{(0.5^{\circ}C)} C_6H_5\ N_2 + Cl^- \xrightarrow{H_2O,283\ K} C_6H_5OH$

(b) (i)

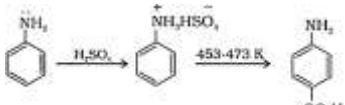
$$CH_3CH_2NH_2 + CHCl_3 + 3KOH(EtOH) \xrightarrow{\Delta} C_2H_5NC + 3KCl + 3H_2O$$

(ii) A =

B =



(iii)(I) $C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{(0-5^{\circ}C)} C_6H_5\ N_2^{+}Cl^- \xrightarrow{CH_3CH_2OH} C_6H_6$



(II)

132. (a) (i)

(I) $A - K_2MnO_4$ B- $KMnO_4$

(II) $MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

(ii) (I) Gets reduced to +3 common oxidation state.

(II) Due to poorer shielding offered by $5f$ electrons than $4f$.

(III) Due to completely filled d - subshell (d^{10}) in zinc whereas in Cu , due to high enthalpy of atomization and low enthalpy of hydration.

OR

(b) (i) (I) Lanthanoid contraction.

The steady decrease in atomic and ionic radii in lanthanoid series.

(II) Decrease in basic character from left to right in lanthanoid series. (any other correct consequence)

(ii) (I)They have the ability to exhibit variable oxidation states/ tendency to form complex compounds/ large surface area.

(II) Due to involvement of ($n - 1$) d and ns electrons which results in strong metallic bond and strong interatomic bonding.

(III) Sc has incompletely filled d orbital ($3d^1$) in its ground state whereas Zn has completely filled d orbital ($3d^{10}$) in ground state as well as in its oxidized state.

SECTION (A)

133. (b)
134. (d)
135. (a)
136. (c)
137. (a)
138. (c)
139. (b)
140. (a)
141. (c)
142. (b)
143. (c)
144. (b)
145. (b)
146. (a)
147. (d)
148. (a)

SECTION B

149. At a constant temperature, the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas present above the surface of liquid or solution/ the partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution

Because the solubility of oxygen increases with decrease in temperature/ Because of low solubility of O_2 in warm water.

150. (a) First order

(b) Slope= k/ 2.303

151. (a) (i) Dichloridobis(ethane-1,2-diamine)cobalt(IV) sulphate

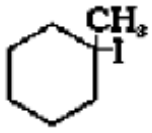
(ii) Potassium trioxalatoferrate(III) Br_2, H_2O

OR

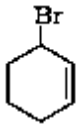
(b) (i) Double salts dissociate into simple ions while complex compounds do not dissociate completely into ions when dissolved in water. (Or any other suitable difference)

(ii) When a ligand binds through two donor atoms is called a didentate ligand while a unidentate ligand which has two different donor atoms and either of the two ligates in the complex is called ambidentate ligand.

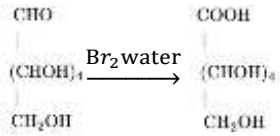
152. **(a)**



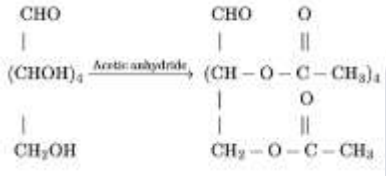
(b)



153. **(a)** Glucose gets oxidised to six carbon carboxylic acid (gluconic acid) on reaction with a mild oxidising agent like bromine water. This indicates the presence as an aldehydic group /



(b) Acetylation of glucose with acetic anhydride gives glucose pentaacetate which confirms the presence of five -OH groups /



SECTION C

154. $\Delta T_f = K_f m$

$m = \Delta T_f / K_f$

$m = 0.3/1.86$

$= 0.16$ m

$$m = \frac{x_2 \times 1000}{M_A}$$

$$x_2 = \frac{0.16 \times 18}{1000} = 2.88 \times 10^{-3}$$

$$\frac{p_1^0 - p_1}{p_1^0} = x_2$$

$$\frac{24.8 - p_1}{24.8} = 2.88 \times 10^{-3}$$

$$p_1^0 - p_1 = x_2 p_1^0$$

$= 2.88 \times 10^{-3} \times 24.8$ mmHg

$= 0.07$ mmHg

155. Rate $= k[A]^p[B]^q$

$5.0 \times 10^{-3} = k[0.01]^p[0.01]^q$ ..... Eq 1

$1.0 \times 10^{-2} = k[0.02]^p[0.01]^q$. .....Eq 2

$5.0 \times 10^{-3} = k[0.01]^p[0.02]^q$ ..... Eq 3

On Comparing (eq1) and (eq3)

$1 = (2)^q$

$q = 0$

On Comparing (eq1) and (eq2)

$(2)^1 = (2)^p$

$p = 1$

Order w · r · tA = 1

Order w.r.t B= 0

From eq 1

$5.0 \times 10^{-3} = k[0.01]^1[0.01]^0$

$k = 0.5\ min^{-1}$

156. **(a)** Because of the formation of NaOH/ Due to the formation of OH^- ions.

(b) Because the overall reaction does not involve any ion in solution whose concentration can change during its life time.

(c) Because the number of ions per unit volume that carry current in a solution decreases.

157. **(a)** $[FeF_6]^{3-}$ $-$ sp^3 d^2

$[Fe(CN)_6]^{4-} - d^2sp^3$

(b) $[FeF_6]^{3-}$-outer orbital complex

$[Fe(CN)_6]^{4-}$ - inner orbital complex

(c) $[FeF_6]^{3-}$ - paramagnetic

$[Fe(CN)_6]^{4-}$-diamagnetic

OR

(a) It becomes colourless/ colour slowly fades away

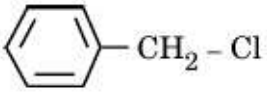
(b) $t_{2g}{}^3 e_g{}^2$

(c) sp^3, diamagnetic

158.

	S_N1	S_N2
1.	Unimolecular	Bimolecular
2.	It follows first order kinetics	It follows second order kinetics
3.	Retention of configuration	Inversion of configuration
4.	Racemisation occurs	No racemisation is seen
5.	Takes place through formation of carbocation	Takes place through formation of transition state
6.	Occurs in polar protic solvent	Occurs in polar aprotic solvent
7.	Rate is independent of the concentration of the nucleophile.	Rate is dependent on the concentration of the nucleophile.

(Any TWO)



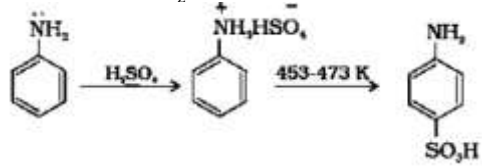
because of the stability of benzyl carbocation

159. $A = CH_3CH = CHCN$/ But-2-ene nitrile

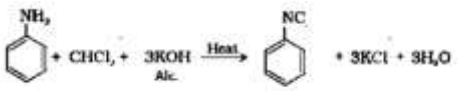
$B = CH_3CH = CHCHO$/ But-2-enal

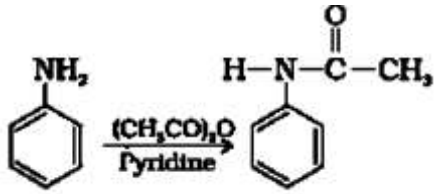
$$CH_3CH = CHCN \xrightarrow[2.\ H_2O]{1.\ \text{DIBAL-H}} CH_3CH = CHCHO$$

160. **(a)**



(b)

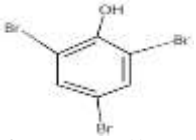




(c)

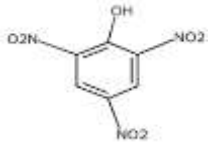
SECTION D

161. (a) (i)



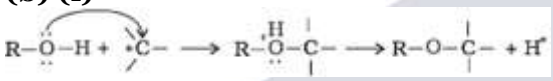
/ 2,4,6-Tribromophenol is formed

(ii)



/ 2,4,6-Trinitrophenol / Picric acid is formed.

(b) (i)



OR

(b)(ii) due to sp^2 hybridisation leading to shorter bond length / Due to resonance leading to partial double bond character of C-OH bond

(c) 2-Methylpropan-2-ol gives turbidity immediately whereas butan-1-ol does not react.

162. (a) (i) A linkage which joins amino acids through -CO-NH- bond

(ii) When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH , it loses its biological activity.

(b) Due to zwitter ion formation which can react with both acids and bases./ Due to the presence of both carboxylic group and amino group.

(c) (i) Fibrous protein: parallel polypeptide chain structure / insoluble in water Globular protein: spherical polypeptide chain structure/ soluble in water

(Any one difference)

OR

(c) (ii) α-helix and β-pleated sheet

SECTION E

163. (a) (i) $E_{Cell} = (E^o{}_c - E^o{}_a) - \frac{0.059}{2}\log\left[\frac{Zn^{2+}}{Pb^{2+}}\right]$

$= [(-0 \cdot 13) - (-0 \cdot 76)] - \frac{0.059}{2}\log\frac{0.1}{0.02}$

$= 0.63 - 0.0295\log 5$

$= 0.63 - 0.0295 \times 0.699$

$= 0.63 - 0.02$

$= 0.61$ V

(Deduct 1/2 mark for no or incorrect unit)

(ii) The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte.

5F

OR

(b) (i) $k = G^*/R$

$G^* = k \times R = 0.125 \times 10^{-3} \times 1000$

$= 0.125\ cm^{-1}$

(ii) $E^{2+}_{Mg^{2+}}/Mg = E^0 Mg^{2+}/Mg^- - \frac{0.059}{2}\log\frac{1}{[Mg^{2+}]}$

$= 2.36\ V - \frac{0.059}{2}\log\frac{1}{10^{-4}}$

$= 2.36 - 0.0295 \times 4\log 10$

$= 2.242\ V$

(iii) It decreases with increase in temperature

164. **(a) (i)** (I) Due to formation of chromate /$CrO_4{}^{2-}$ ion

(II) Due to completely filled d-orbitals in ground state as well as oxidised state.

(III) Because Mn^{2+} is more stable due to stable 3 d^5 configuration whereas Cr^{3+} is more stable due to stable $t_2\ g^3$ configuration.

(ii) (I) it changes to permanaganate ion / $MnO_4{}^-$ is formed /

$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

(II) Potassium manganate/ K_2MnO_4 is formed/

$2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

OR

(b) (i) • An alloy of lanthanoid / an alloy of lanthanoid and iron with traces of S, C, Ca and AI.

• used in making bullets/shells/ lighter flint

(ii) $CrO_4{}^{2-}/Cr_2O_7{}^{2-}$

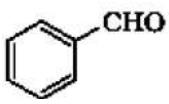
(iii) variable oxidation state of vanadium / large surface area /Complex formation

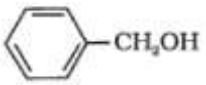
(iv) Because of large number of unpaired electrons in their atoms they have stronger interatomic interaction or strong metallic bonding

(v) by acidification of Na_2CrO_4/

$2Na_2CrO_4 + 2H^+ \rightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$

165. **(a) (i) A =** 

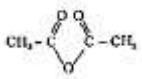
B = 

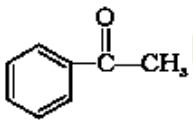
C = 

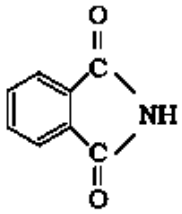
(ii) (I) Because carbon of carboxyl group is less electrophilic due to resonance with - OH group.

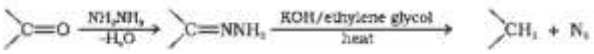
(II) Because ethanoate ion is more stable than ethoxide ion due to resonance.

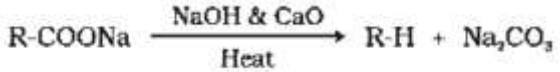
OR

(b) (i) (I)  / $(CH_3CO)_2O$

(II) 

(III) 

(ii) (I) 

(II) 

SECTION A

166. **(a)**

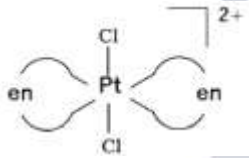
167. **(d)**
168. **(b)**
169. **(c)**
170. **(b)**
171. **(a)**
172. **(c)**
173. **(a)**
174. **(c)**
175. **(d)**
176. **(a)**
177. **(b)**
178. **(c)**
179. **(a)**
180. **(b)**
181. **(c)**

SECTION B

182. **When vapour pressure of the solution is higher than expected from the ideal behaviour.**
Example : ethanol and acetone/ carbon disulphide and acetone (or any other suitable example)
Minimum boiling azeotrope

183. When one of the reactant is present in excess
Hydrolysis of an ester/ sucrose (or any other suitable example)
For elementary reaction, which takes place in a single step.

184. **(a)** Dichloridobis(ethane-1,2-diamine)platinum(IV) ion



OR

(i) $[Co(NH_3)_5(CO_3)]Cl$
(ii) Pentaamminenitrito-O-cobalt(III) chloride

185. -Because C – X bond acquires a partial double bond character due to resonance/ sp^2 hybridized carbon of C-X bond leading to shorter bond length (Or any other suitable reason).
-Nitro group withdraws the electron density from the benzene ring and thus facilitates the attack of the nucleophile on haloarene / - NO_2 group being electron withdrawing stabilises the intermediate carbanion.

186. Because the hydrogen bonds are formed between specific pairs of bases 2-deoxyribose sugar, base and phosphoric acid

SECTION C

187. $\Delta T_f = i\, K_f\, m$

$$\Delta T_f = \frac{i \times K_f \times w_2 \times 1000}{M_2 \times w_1}$$

$$0.45 = \frac{i \times 5.12 \times 0.3 \times 1000}{60 \times 30}$$

$$i = 0.527$$

$$\alpha = \frac{i - 1}{1/n - 1}$$

$$\alpha = \frac{0.527 - 1}{1/2 - 1} \quad (n = 2)$$

$$\alpha = 0.946 \text{ or } 94.6\%$$

(Or any other suitable method)

188. **(a)** Lead storage battery

Anode: $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$

Cathode: $PbO_2[s] + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow PbSO_4[s] + 2H_2O(l)$

OR

(b) Because at cathode the reaction with higher value of E° is preferred and therefore, the reduction of H_2O to H_2 gas is preferred whereas at anode water should get oxidised in preference to $Cl^-(aq)$, however, on account of overpotential of oxygen, oxidation of Cl^- to Cl_2 gas is preferred.

$NaCl(aq) + H_2O(l) \rightarrow Na^+(aq) + OH^-(aq) + 1/2H_2(g) + 1/2Cl_2(g)$

189.

	$2N_2O_5(g)$	→	$2N_2O_4(g)$	+	$O_2(g)$
Start t = 0	Pi atm		0 atm		0 atm
At time t	(Pi − 2x)atm		2 x atm		x atm

$P_t = P_i - 2x + 2x + x = P_i + x$

$x = P_t - P_i$

$p_A = P_i - 2x$

$= P_i - 2(P_t - P_i)$

$= 3P_i - 2P_t$

$k = \frac{2.303}{t}\log\frac{p_l}{p_A}$

Where pi = 0.5 atm,

$p_A = 3p_i - 2p_t$

$= (3 \times 0.5) - (2 \times 0.625)$

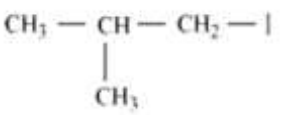
$= 0.25$ atm

$k = \frac{2.303}{100\ s}\log\frac{0.5\ atm}{0.25\ atm}$

$= \frac{2.303}{100\ s} \times 0.3010$

$= 6.93 \times 10^{-3}\ s^{-1}$

190. A =



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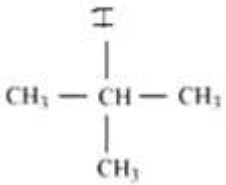

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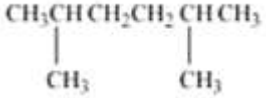
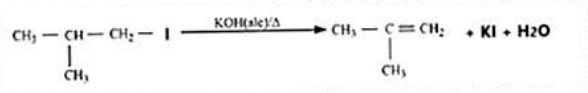
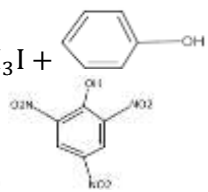


D=

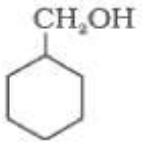


191. (a)

CH_3I +



(b)



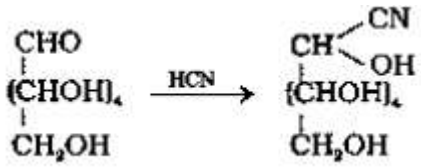
(c)

192. **(a)** Because the carboxyl group is deactivating and the catalyst aluminium chloride (Lewis acid) gets bonded to the carboxyl group.(forms salt)

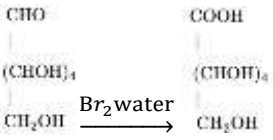
(b) Because carbonyl carbon of HCHO is more electrophilic than CH_3CHO / due to +1 effect of methyl group/ steric effect of methyl group, CH_3CHO is less reactive.

(c) Because of greater electronegativity of sp^2 hybridised carbon to which carboxyl carbon is attached.

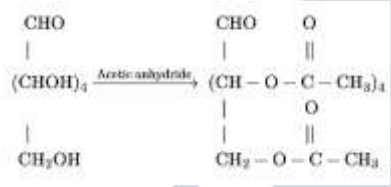
193.



(a)



(b)



(c)

SECTION D

194. **(a)** Due to presence of one unpaired electron in t_{2g} which gets excited to e_g / Due to excitation energy $t_{2\,g}{}^{1} \rightarrow e_g{}^{1}$, it gives colour. (d-d transition)

When heated, water is lost therefore crystal field splitting does not occur and it becomes colourless.

(b) The energy required to split the degenerate d-orbitals into two sets of orbitals (t_2 g and e_g). /The difference of energy between the two sets of d-orbitals t_2 g and eg due to the presence of ligands in a definite geometry.

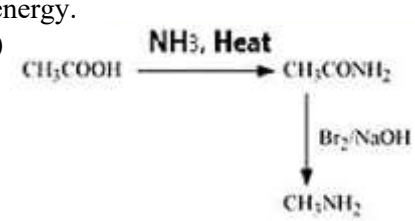
OR

(b) (ii) $\Delta_0 < P$, weak filed ligand

$\Delta_0 > P$, strong field ligand

(c) Because the orbital splitting energies are not sufficiently large for forcing pairing / Due to low crystal field splitting energy.

195. **(a) (i)**



(ii) $CH_3 - CH_2 - C \equiv N \xrightarrow{H_2/Pt} CH_3 - CH_2 - CH_2 - NH_2$

(or by any other method)

(b) Aniline undergoes resonance and as a result the electrons on the N -atom are less available for donation.

(c) (i) $(CH_3)_3\,N < CH_3NH_2 < (CH_3)_2NH$

OR

(c) (ii) $A = C_6H_5NH_2; B == C_6H_5\,N_2{}^{+}Cl$

SECTION E

196. **(a) (i)** (I) Because Mn^{2+} is more stable than Mn^{3+} due to extra stable half-filled d^5 configuration.

(II) Due to comparable energies of 5f, 6 d and 7 s orbitals

(III) Due to the involvement of greater number of electrons from $(n-1)d$ in addition to the ns electrons in the inter-atomic metallic bonding.

(ii)

$5SO_3^{2-} + 2MnO_4^- + 6H^+ \longrightarrow 2Mn^{2+} + 3H_2O + 5SO_4^{2-}$

$2MnO_4^- + H_2O + I^- \longrightarrow 2MnO_2 + 2OH^- + 1O_3^-$

or

(b) (i) Mn, Zn, Ni, Cu (any two)

(ii) K_2MnO_4, due to presence of one unpaired electron

(iii) Similar radii of 4 d and 5 d series elements/ similar properties/ difficulty in separation of lanthanoids (or any other relevant consequence)

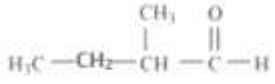
(iv) It is prepared by fusion of MnO_2 with an alkali metal hydroxide and an oxidising agent /

$2MnO_2 + 4KOH + O_2 \rightarrow 2\ K_2MnO_4 + 2H_2O$

(v) because of the ability of oxygen to form multiple bonds with metal

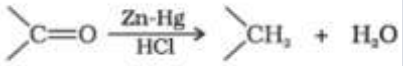
197. **(a) (i)**

(l) $(CH_3)_3C - CHO$

(II) 

(III) $CH_3 - CO - CH_2CH_2CH_3$

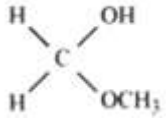
(ii)

(I) 

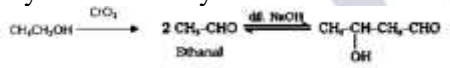
(II) 

OR

(b) (i)

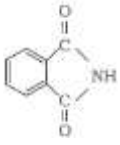


(ii) Because semicarbazide undergoes resonance involving only one of the two - NH_2 groups, which is attached directly to the carbonyl-carbon atom.

(iii) 

(iv)

(v)



198. **(b) (i)**

$= [(0) - (-0 \cdot 76)] - \frac{0.059}{2}\log\frac{0.1}{(0.01)\cdot^2}$

$= 0.76 - 0.0295\log 10^3$

$= 0.76 - 0.0885$

$= 0.6715$ V or 0.67 V

(Deduct ½ mark for no or incorrect unit)

(ii) The amounts of different substances liberated by the same quantity of electricity passing through the electrolytic solution are proportional to their chemical equivalent weights.

6F

OR

(b) (i) $\Lambda_m = \frac{K}{c} \times 1000$

$\Lambda_m = \frac{2.48 \times 10^{-2}}{0.2} \times 1000$

$= 124 \text{Scm}^2 \text{ mol}^{-1}$

$\Lambda_m^0 = \lambda^0_{K^+} + \lambda_{Cl^-}$

$= 73.5 + 76.5$

$= 150 \text{Scm}^2 \text{ mol}^{-1}$

$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$

$= \frac{124}{150}$

$= 0.827$

(ii) $E^0_{cell} = E^0_{cathode} - E^0 \text{ anode}$

$= 0.34 - (-2.37)$

$= 2.71 \text{ V}$

$\Delta_r G^0 = -nFE^0_{cell}$

$= -2 \times 96500 \times 2.71$

$= -523030 \text{Jmol}^{-1}$ or $-523.03 \text{kJmol}^{-1}$

(iii) Primary cell

Maintains constant potential throughout its usage/ longer lifespan

SECTION A

199. **(c)**
200. **(d)**
201. **(c)**
202. **(b)**
203. **(b)**
204. **(c)**
205. **(b)**
206. **(b)**
207. **(d)**
208. **(b)**
209. **(d)**
210. **(c)**
211. **(a)**
212. **(d)**
213. **(a)**
214. **(d)**

SECTION B

215. (a) Because overall reaction does not involve any ion in solution whose concentration can change during its life time.

(b) $\alpha = \frac{\Lambda_m}{\Lambda_m^0}$

$\alpha = \frac{50}{400} = 0.125$

216. P is the better choice for coating iron to prevent corrosion

Because it will oxidize first, protecting the iron from corrosion/ The more negative the E° value, the stronger the reducing agent./ P has a more negative $E^\circ(-2.37 \text{ V})$ as compared to iron (-0.44 V), which means P is a stronger reducing agent than iron.

217. **(a)** Rate $= k[A]^2[B]$

$= k[2A]^2[2B]$

= 8 times

(b) $molL^{-1}\ s^{-1}/molL^{-1}$ time $^{-1}$

218. **(a) (i)**

$$CH_3CN \xrightarrow[Na(Hg)/C_2H_3OH]{H_2/Ni} CH_3CH_2NH_2$$

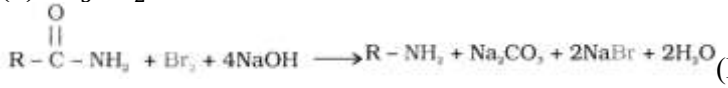
or LiAlH4

(ii)

OR

(b) (i) Add chloroform with alc. KOH to both the compounds and heat, ethanamine will give foul smell of isocyanide while dimethylamine does not. (Or any other suitable chemical test)

(ii) CH_3NH_2 / methanamine is formed /



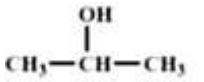
(R =CH_3)

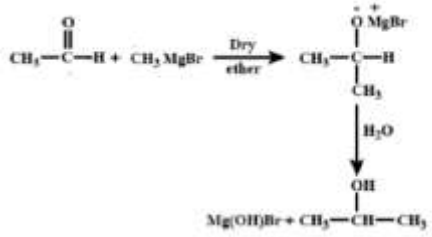
219. The hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. / Secondary and tertiary structures get destroyed and primary remains intact.

Fibrous protein- keratin/ Myosin

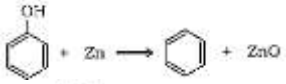
Globular protein- Insulin / Albumin

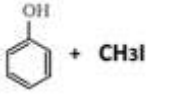
SECTION C

220. **(a)**  / Propan-2-ol is formed/



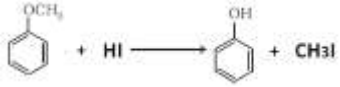
(b) Benzene () is formed /





(c)

/ Phenol and methyl iodide are formed /



221. $\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2-T_1}{T_1T_2}\right]$

$$\log\frac{0.08}{0.04} = \frac{Ea}{19.15}\frac{[310-300]}{[310\times300]}$$

$$\log 2 = \frac{Ea}{19.15}\frac{[10]}{[310\times300]}$$

$$Ea = \frac{0.3010\times19.15\times310\times300}{10}$$

$= 53606 Jmol^{-1} = 53.606\ kJ\ mol^{-1}$

(Deduct 1/2 mark for no or incorrect unit)

222. **(i)** Due to salt formation with aluminium chloride, the Lewis acid.

(ii) Due to more hydration and less steric hinderance.

(iii) Because it can form hydrogen bonds with water molecules, while aniline does not form due to bulky benzene molecule.

223. **(a) (i)** $[Co(NH_3)_6]Cl_3$

(ii) Hexaamminecobalt(III) chloride

(iii) d^2sp^3

OR

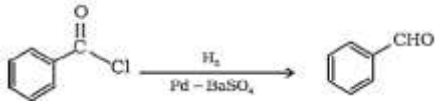
(b) (i) Diamminechloridonitrito-O-platinum(II)

(ii) $[Co(en)_3]^{3+}$ contains a didentate ligand showing chelate effect / Because of chelate formation.

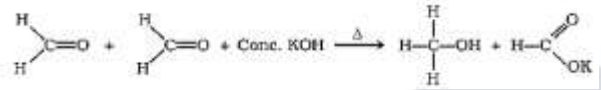
(iii) sp^3

224. **(a)** When an acid chloride is treated with $H_2, Pd - BaSO_4$ an aldehyde is formed.

OR



(b) When aldehyde with no α-hydrogen atom is treated with conc. KOH , it undergoes disproportionation to form alcohol and carboxylate ion.



OR

(c) When carboxylic acids having an α-hydrogen are halogenated with Cl_2/Br_2 in presence of red phosphorous, α-hhalogen acids are formed.

OR

(Or any other correct reaction)

225. E° cell $= E^\circ$ cathode $- E^\circ$ anode

$= 0.40 - (-0.76)V$

$= 1.16$ V

$\Delta G^0 = E^\circ$ cel

$-nFl$

$= -2 \times 96500 \times 1.16$

$=-223880$ J mol^{-1} or -223.880 kJ mol^{-1}

$$\log Kc = \frac{n\dot{E}^0_{cell}}{0.059}$$

$$= \frac{2 \times 1.16}{0.059}$$

$= 39.322$

226. The process of conversion of an enantiomer into a racemic mixture is known as racemisation.

• S_N1

• In S_N1 the carbocation formed is sp^2 hybridised and planar.

SECTION D

227. **(a)**

Glycosidic linkage	**Peptide linkage**
A glycosidic linkage is an oxide(-O-) linkage that joins two monosaccharides.	A peptide linkage is an amide (-CONH-) linkage that forms between two amino acids.

• Due to absence of free - CHO group.

(b) Carbohydrates that yield two to ten monosaccharide units, on hydrolysis. For example- maltose/ sucrose or any other correct example.

OR

(b) Because it exists in zwitter ionic form which reacts with both acids and bases.

(c) Amino acids which contain more carboxyl groups as compared to amino groups.

228. **(a)** Because in $[Cr(NH_3)_6]^{3+}$, there are 3 unpaired electrons in the d-orbitals of the chromium ion , while in $[Ni(CN)_4]^{2-}$, cyanide is a strong field ligand causing the d-electrons to pair up resulting in no unpaired electrons.

(b) The primary valences are normally ionisable while secondary valences are non-ionisable.

(c) The energy required to split the degenerate d-orbitals into two sets t_2g and eg. / The difference of energy between the two sets of d-orbitals t_2g and eg due to the presence of ligands in a definite geometry.

OR

(c) $t^4\ {}_2eg^0$

SECTION E

229. **(A) (a) (i)** They have the ability to exhibit variable oxidation states/ tendency to form complex compounds/provide large surface area.

(ii) Because Mn^{+2} is more stable in +2 due to stable 3 d^5 configuration.

(iii) Because it undergoes disproportionation reaction/ $2Cu^+ \rightarrow Cu^{2+} + Cu$

(b) Potassium permanganate is prepared by fusion of MnO_2 with an alkali metal hydroxide and an oxidising agent. This produces K_2MnO_4 which disproportionates in a neutral or acidic solution to give permanganate. /

$2MnO_2 + 4KOH + O_2 \rightarrow 2\ K_2MnO_4 + 2H_2O$

$3MnO_4{}^{2-} + 4H^+ \rightarrow 2MnO_4{}^- + MnO_2 + 2H_2O$

$MnO_2 \xrightarrow[\text{with air or } KNO_3]{\text{Fused with KOH, oxidised}} \underset{\text{maganate ion}}{MnO_4^{2-}}$

; $\underset{\text{manganate}}{MnO_4^{2-}} \xrightarrow[\text{alkaline solution}]{\text{Electrolytic oxtdation in}} \underset{\text{permanganate ion}}{MnO_4^-}$

(Balancing may be ignored)

OR

(B)(i) Dichromates are generally prepared from chromate, which in turn are obtained by the fusion of chromite ore $(FeCr_2O_4)$ with sodium or potassium carbonate in free access of air. /

$4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$

$2Na_2CrO_4 + 2H^+ \rightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$

(Balancing may be ignored)

(ii) The steady decrease in atomic radii in lanthanoid series. / steady decrease in ionic radii or atomic radii across the $4f$ series

Consequence: 4d and 5d elements have similar radii and similar properties.

(Or any other correct consequence)

(iii) Cr and Cu

230. **(A)**(a)(i)A: $CH_3CH_2CH_2CHO$, B: $CH_3COCH_2CH_3$

(ii)n-Butane is formed / Chemical equation

(iii) $CH_3 - CO - CH_2 - CH_2 - CH_3 \xrightarrow{NaOH/I_2} CHI_3 + CH_3CH_2CH_2COONa$

(b)(i)ethanal < ethanol < ethanoic acid

(ii)acetone < ethanal < methanol

OR

(B)(a) Aldehydes and ketones having at least one α-hydrogen undergo a reaction in the presence of dilute alkali to form β-hydroxy aldehydes (aldol) or β-hydroxy ketones (ketol), respectively.

$\underset{\text{Ethanal}}{2\ CH_3\text{-}CHO} \overset{\text{dil. NaOH}}{\rightleftharpoons} CH_3\text{-}\underset{\underset{OH}{|}}{CH}\text{-}CH_2\text{-}CHO$

(Or any other correct example)

• Due to the strong electron withdrawing effect of the carbonyl group and resonance stabilisation of the conjugate base.

(b)(i)Add $NaHCO_3$ to both the compounds, benzoic acid gives brisk effervescence while benzaldehyde does not.

(ii)Add NaOH and I_2 to both the compounds and heat, ethanal forms yellow precipitate of iodoform while propanal does not.

(or any other suitable chemical test)

231. (A)(a) $i = 2$

$$\Delta T_b = \frac{i \times Kb \times wB \times 1000}{M_B \times w_A}$$

$$= \frac{2 \times 0.52 \times 6 \times 1000}{120 \times 200}$$

$$= 0.26\ K$$

$$\Delta T_b = T_b - T_b^\circ$$

$$0.26 = Tb - 373.15$$

$$T_b = 373.41\ K$$

Or

$$0.26 = Tb - 100^\circ C$$

$$T_b = 100.26^\circ C$$

(ii)

• For a solution of volatile liquids, the partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution.

• $p = p^0 x_1; p = K_H x$

When $p^0 = K_H$

p α χ for both.

OR

(B)(a)

$$\Delta T_f = \frac{i \times Kf \times wB \times 1000}{M_B \times w_A}$$

$$2.94 = \frac{i \times 4.9 \times 5 \times 1000}{122 \times 35}$$

$$i = \frac{2.94 \times 122 \times 35}{4.9 \times 5 \times 1000}$$

$$i = 0.512$$

$$\alpha = \frac{i - 1}{\frac{1}{n} - 1}$$

$$= \frac{0.512 - 1}{\frac{1}{2} - 1}$$

$$= 0.976$$

$$\alpha(\%) = 97.6\%$$

(b) (i) The solutions which obey Raoult's law over the entire range of concentration.

(ii) Extra(excess) pressure which needs to be applied to a solution to stop the flow of solvent across a semipermeable membrane.