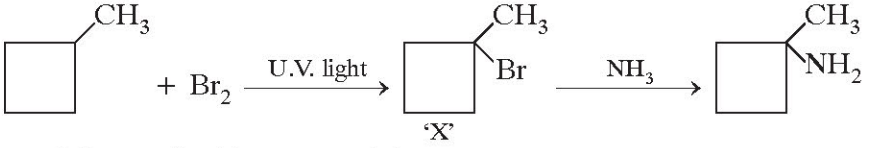
Answers to RCH/Set-2

1. (*a*) $\because$ $C_6H_5NH_2 + AlCl_3 \longrightarrow C_6H_5\overset{H}{\underset{H}{N}}\rightarrow AlCl_3$ but it forms $C_6H_5N \rightleftharpoons C$ with $CHCl_3$ and KOH.

2. (*b*) 

$\because$ 3° free radical is more stable.

3. (*c*) $\because$ Mn^{2+} has 5, Fe^{2+} has 4 and Co^{2+} has 3 unpaired electrons.

$\mu_B = \sqrt{35} = 5.92$ BM, $\mu_B = \sqrt{24} = 4.90$ BM, $\mu_B = \sqrt{15} = 3.87$ BM

4. (*a*) Boiling points decrease with increase in branching. Tertiary butyl chloride has lowest due to minimum surface area, minimum van der Waals' forces of attraction. 1-chloro butane has highest due to more van der Waals' forces of attraction.

5. (*a*) $M_{A_3B_3}$ type complex show facial-meridional isomerism.

6. (*c*) $\because$ $\frac{1}{8} = \left(\frac{1}{2}\right)^3$ has been decomposed, $3t_{1/2} = 3 \times T = 3T$

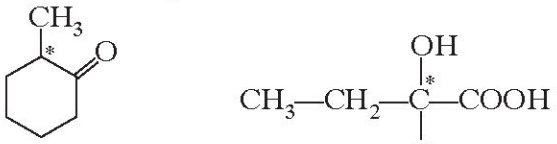
7. (*d*) $\because$ Cr^{2+} and Fe^{2+} have 4 unpaired electrons, Ti^{3+} and Cu^{2+} have one unpaired electron.

8. (*a*) Primary structure of protein remains intact whereas secondary and tertiary structures are ruptured.

9. (*b*) $Cl{-}(CH_2)_4{-}Cl + \underset{\text{(Excess)}}{2NH_3} \longrightarrow \underset{\text{'A'}}{Cl^-H_3\overset{+}{N}{-}(CH_2)_4{-}\overset{+}{N}H_3Cl^-}$

$$\text{'A'} \xrightarrow{NaOH} H_2N(CH_2)_4NH_2 + NaCl + H_2O$$

10. (*d*) I and IV are chiral due to presence of chiral 'C' atom as shown below:

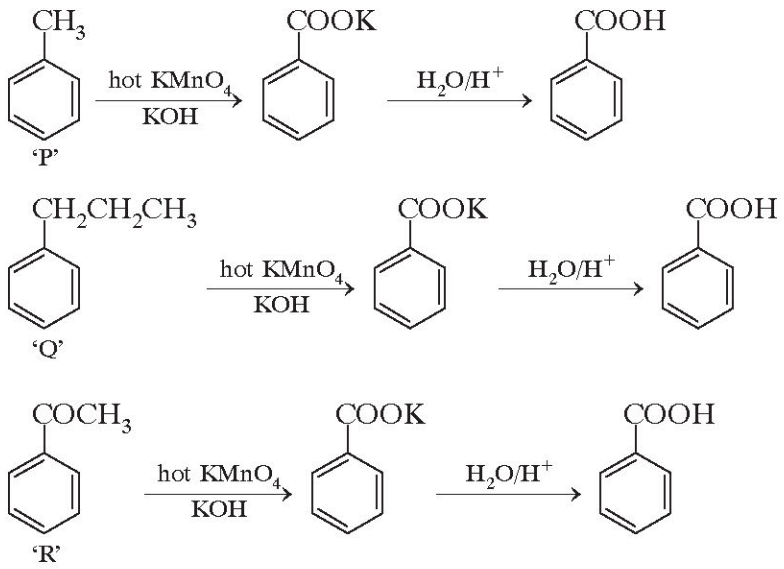


I IV

11. (*a*) $\because$ $t_{1/2}$ of first order reaction is independent of initial conc.$[P]_0$.

3° halides undergo S_N1 reaction.

12. (*d*) All 'P', 'Q' and 'R'



13. (*a*) Both A and R are true and R is the correct explanation of A.

14. (*b*) Both A and R are true but R is not the correct explanation of A.

15. (*b*) Both A and R are true but R is not the correct explanation of A.

16. (*c*) A is true but R is false.

$\because$ E_a remains the same

17. When there is dissociation of solute into ions, in dilute solutions, the number of particles increases. As the value of colligative property depends on the number of particles of solute, the experimentally observed value of colligative property will be higher than the true value, therefore, the experimentally determined (observed) molar mass is lower than true value in case of electrolytes.

For KCl (electrolyte), the experimentally determined molar mass is lower than the value when water is solvent.

Glucose (non-electrolyte) does not show a large deviation from the true value.

Or

$$\Delta T_f = 0°C - (-2°C) = 2°$$

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

$$2 = 1.86 \times \frac{W_B}{62} \times \frac{1000}{1000}$$

$$W_B = \frac{2 \times 62}{1.86} = \frac{124}{1.86} = 66.67 \text{ g}$$

18.

	'P'	'Q'
(*i*) Field strength of the ligands	Weak field ligand	Strong field ligand
(*ii*) Electronic configuration of metal 'M' in complex	$t_{2g}^3\ e_g^1$	$t_{2g}^4\ e_g^0$
(*iii*) Type of complex	High spin	Low spin

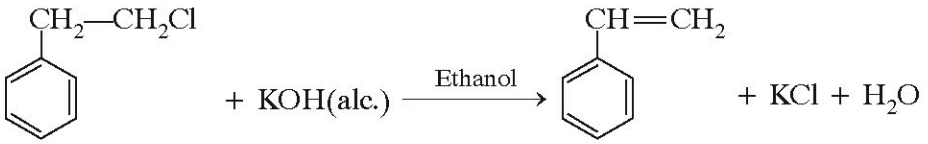
19. (*a*) $Cr(s)|Cr^{3+}(aq)\ ||\ Fe^{2+}(aq)|Fe(s)$ [$\because$ current flows cathode to anode]

(*b*) $2Cr(s) + 3Fe^{2+}(aq) \longrightarrow 2Cr^{3+}(aq) + 3Fe(s)$ (Net cell reaction)

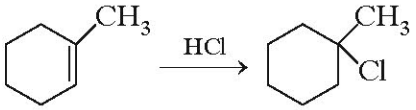
At anode: $Cr(s) \longrightarrow Cr^{3+} + 3e^-$

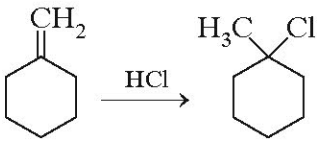
At cathode: $Fe^{2+}(aq) + 2e^- \longrightarrow Fe(s)$

$$E^\circ_{cell} = E^\circ_{Fe^{2+}/Fe} - E^\circ_{Cr^{3+}/Cr}$$
$$= -0.40 - (-0.76\ V) = +0.36\ V$$

20. (*a*) 

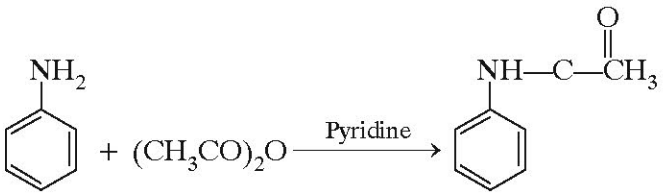
(*b*) It is due to double bond character (C⋯⋯Cl) in haloarenes and vinylic halides which is difficult to break as compared to C—Cl bond in haloalkanes.

(*c*) 



21. (*a*) Glucose reacts with $(CH_3CO)_2O$ to form glucose pentaacetate. It shows glucose has five —OH group.

(*b*) Glucose forms silver mirror with Tollen's reagent and gives brick red ppt. with Fehling's solution. It shows glucose is reducing sugar.

22. (*a*) 

'A' (Aniline or Benzenamine) N-phenyl ethanamide

(*b*) The given statement is not correct. Compound 'A' is aniline. The presence of lone pair of electrons on 'N' atom makes it Lewis base. So, the pH of the solution is more than 7.

(*c*) (*i*) By introducing electron releasing groups like —CH_3 and —OCH_3.

(*ii*) By introducing electron withdrawing groups like —NO_2 and —COOH.

23. $\text{Rate} = k[A]^x[B]^y$

$2.10 \times 10^{-4} = k[0.12]^x\,[0.26]^y$ ...(*i*)

$1.89 \times 10^{-3} = k[0.36]^x\,[0.26]^y$ ...(*ii*)

Dividing (*i*) by (*ii*), we get

$$\frac{1}{9} = \frac{1}{3^x} \Rightarrow 3^x = 3^2 \Rightarrow x = 2$$

$3.78 \times 10^{-3} = k[0.72]^2\,[0.13]^y$ ...(*iii*)

$1.89 \times 10^{-3} = k[0.36]^2\,[0.26]^y$ ...(*iv*)

Dividing (*iii*) by (*iv*), we get

$$2 = 2^2 \times \left(\frac{1}{2}\right)^y$$

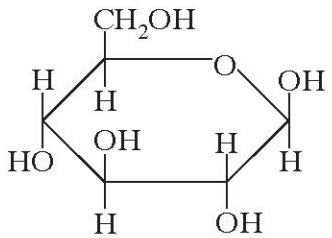
$$\frac{1}{2} = \left(\frac{1}{2}\right)^y \Rightarrow y = 1$$

$\text{Rate} = k[A]^2\,[B]^1$ is rate expression or rate law

24. (*a*) Cellulose forms cell walls of plants and bacteria. β-D-glucose is the basic unit of cellulose.

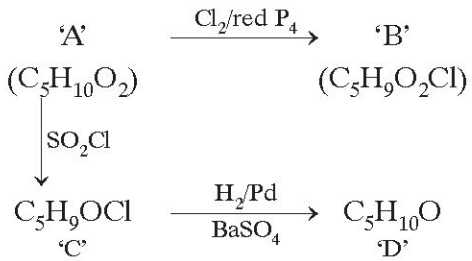
(*b*) C–1 of one unit of glucose is linked to C–4 of another unit of glucose. These units are linked to each other by glycosidic linkage.

(*c*)



β-D(+) Glucose

25.



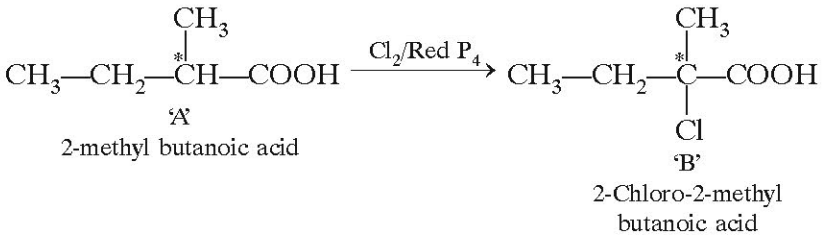
$$\underset{\text{'D'}}{C_5H_{10}O} \xrightarrow[\text{Regent}]{\text{Tollen's}} \text{'A'} + \underset{\text{Silver mirror}}{Ag\downarrow}$$

$$\text{'C'}(C_5H_9OCl) \xrightarrow[(ii)\ H^+]{(i)\ NaOH} \text{'A'}$$

Since 'D' ($C_5H_{10}O$) gives a positive Tollen's regent test, its an aldehyde. 'D' is also obtained by 'C' by controlled hydrogenation (Rosenmund reduction) so 'C' is acid halide which is obtained from 'A' by reaction with $SOCl_2$, therefore 'A' is an acid.

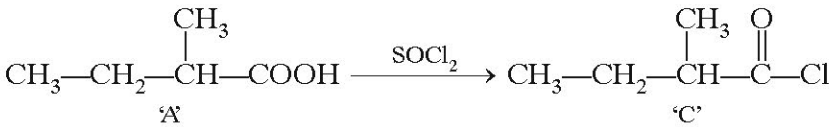
'A', when reacted with halogen in red phosphorus produces 'B', so 'B' is α-halo carboxylic acid and 'A' is an acid with α-hydrogen.

Since 'A' is an optically active compound with 5-carbons, therefore, 'A' is 2-methyl butanoic acid.

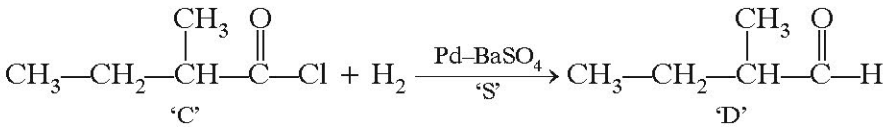


'A' — 2-methyl butanoic acid

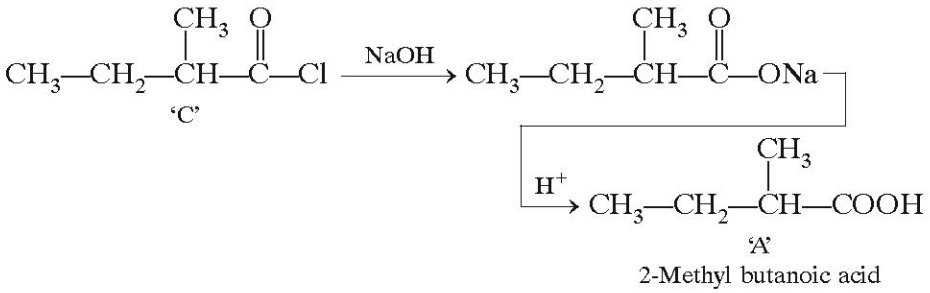
'B' — 2-Chloro-2-methyl butanoic acid



'A' → 'C' — 2-Methyl butanoyl chloride

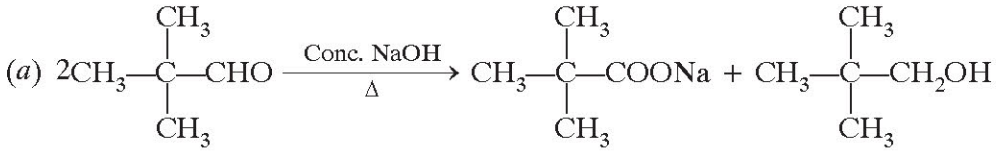


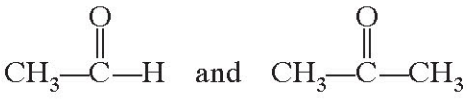
'C' → 'D' — 2-Methyl butanal



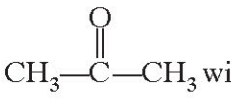
'C' → 'A' — 2-Methyl butanoic acid

Or

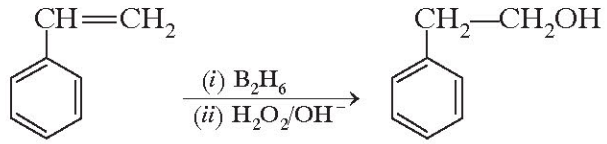
(*a*) 

(*b*) (*i*) 

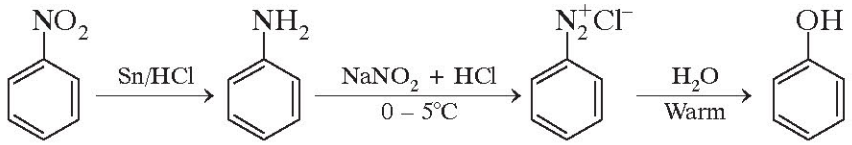
Ethanal Propan-2-one

(*ii*) 

will act as electrophile in the above reaction.

26. (*a*) (*i*) 

Styrene (Phenyl ethene) 2-Phenyl ethanol

(*ii*) 

Nitrobenzene Aniline Benzene diazonium chloride Phenol

(*b*) 1-Butanol is more soluble than 1-pentanol because alkyl group is longer in 1-pentanol which is hydrophobic.

27. (*a*) At anode: $2OH^- \longrightarrow O_2 + 2H^+ + 4e^-$ or $2H_2O \longrightarrow O_2 + 4H^+ + 4e^-$

(*b*) $\log K_C = \dfrac{nE^\circ}{0.0591}$ [when $E_{cell} = 0$]

$$Mg(s) \longrightarrow Mg^{2+}(aq) + 2e^-$$
$$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$$
$$\overline{Mg(s) + Cu^{2+}(aq) \longrightarrow Mg^{2+}(aq) + Cu(s)}$$

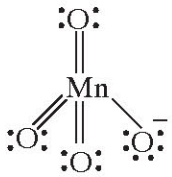
$$E^\circ_{cell} = E^\circ_{Cu^{2+}/Cu} - E^\circ_{Mg^{2+}/Mg}$$
$$= +0.34\ V - (-2.37\ V) = 2.71\ V$$
$$\log K_C = \frac{2 \times 2.71\ V}{0.0591} = 91.70$$

28. (*a*) $2MnO_4^- + 10I^- + 16H^+ \longrightarrow 2Mn^{2+} + 5I_2 + 8H_2O$ (Acidic medium)

$MnO_4^- + I^- + H_2O \longrightarrow MnO_2 + IO_3^- + 2OH^-$ (Basic medium)

(*b*) In acidic medium, I^- ions get oxidised to I_2 and MnO_4^- gets reducted to Mn^{2+}. In basic medium I^- gets oxidised to IO_3^- and MnO_4^- gets reduced to MnO_2.

(*c*)



29. (*a*) $[Zn^{2+}] = 0.1 \times \frac{95}{100} = 0.095$ M

$Zn^{2+} + 2e^- \longrightarrow Zn(s)$

$$E_{Zn^{2+}/Zn} = E^{\ominus}_{Zn^{2+}/Zn} - \frac{0.0591}{2} \log \frac{1}{[Zn^{2+}]}$$

$$= -0.76\ V - \frac{0.0591}{2} \log \frac{1}{0.095}$$

$$= -0.76\ V - \frac{0.0591}{2} [\log 1000 - \log 95]$$

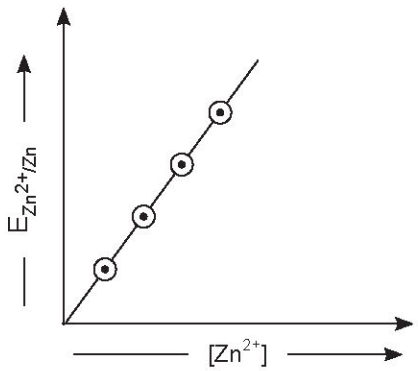
$$= -0.76\ V - \frac{0.0591\ V}{2} [3.000 - 1.9777]$$

$$= -0.76\ V - \frac{0.0591\ V}{2} \times 1.0223$$

$$= -0.76\ V - \frac{0.0604}{2} V$$

$$= -0.76\ V - 0.0302\ V = -0.7902\ V$$

(*b*)



$E_{Zn^{2+}/Zn}$ will increase with the increase in $[Zn^{2+}]$ as well as log $[Zn^{2+}]$.

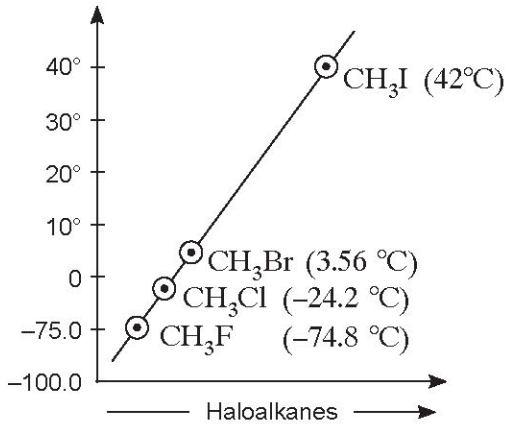
Or

Slope $= \frac{0.0591}{2}$

(*c*) When the cell is in equilibrium, $E_{cell} = 0$

Since, $\Delta G^\circ = -nE^\circ F$, Therefore, $\Delta_r G^\circ = 0$, at equilibrium

30. (*a*)



Boiling point increases with increase in molar mass because surface area increases, van der Waals' forces of attraction increases, hence, boiling point also increases.

(*b*) (*iv*) C_6H_5I is most reactive, because C—I bond is weaker due to longer bond length.

(*c*) (*iv*) *o*-Chlorobenzene is more polar due to higher dipole moment, therefore, it has stronger dipole-dipole interactions.

Or

(*c*) (*iv*) C—Br has lowest bond enthalpy due to longer bond length and lesser bond dissociation enthalpy.

31. (*a*) (*i*) Reactivity decreases because ionisation enthalpy increases due to decrease in atomic size and increase in effective nuclear charge.

(*ii*) $E^\circ_{Cu^{2+}/Cu} = +0.34$ V, its reduction potential is higher than $E^\circ_{H^+/H_2} = 0$, therefore, 'Cu' cannot displace H_2 from dil. acids.

(*b*) (*i*) It is because $EDTA^{4-}$ is hexadetate ligand, it has more chelate effect than ethyline diamine which is bidentate ligand.

(*ii*) In d^4 if $\Delta_0 < P$, $t_{2g}^3 e_g^1$, there are four unpaired electrons, due to which it is high spin complex.

(*iii*) It is because after removal of H_2O, splitting of *d*-orbitals does not take place in absence of ligands, no absorption of light so it becomes colourless.

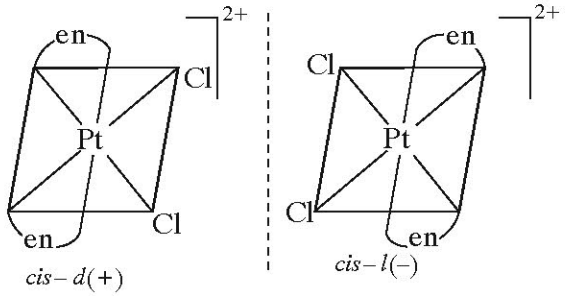
Or

(*a*) (*i*) It is because oxygen can form double bonds with Os but fluorine cannot form double bond.

(*ii*) It is due to low $\Delta_a H°$ of Mn and Zn.

(*b*) (*i*) Dichloridobis (ethane 1,2-diamine) platinum (IV)

(*ii*)



(*iii*) It will undergo d^2sp^3 hybridisation. All electrons will be paired due to presence of 'en', therefore, it is diamagnetic.

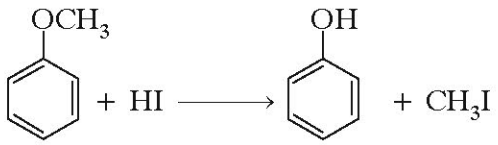
32. (*a*) (*i*) Three products will be formed.

(*ii*) I. $CH_3—CH_2—\underset{\underset{O}{\|}}{C}—OH$

II. $CH_3—\overset{\overset{O}{\|}}{C}—OH$

III. $CH_3—CH_2—CH_2—\overset{\overset{O}{\|}}{C}—OH$

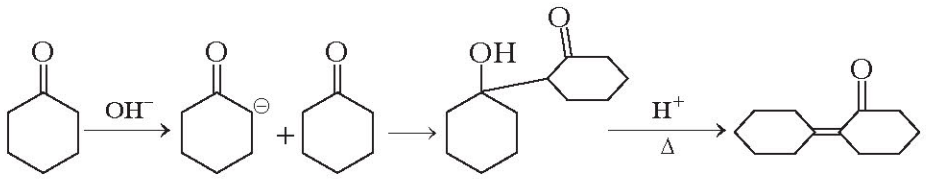
(*b*) (*i*) $CH_3—\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}—OCH_3 + HI \longrightarrow CH_3—\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}—I + CH_3OH$

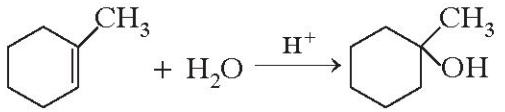
(*ii*) 

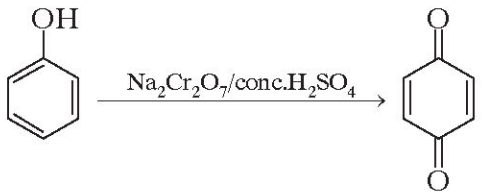
(*iii*) $C_6H_5CH_2OC_6H_5 + HI \longrightarrow C_6H_5CH_2I + C_6H_5OH$

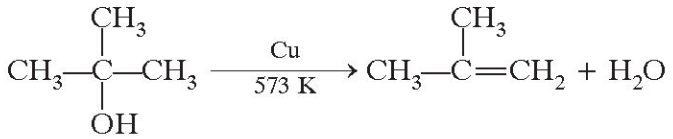
Or

(*a*) (*i*) 4-nitro benzaldehyde will react faster because —NO_2 group is electron withdrawing.

(*ii*) 

(*b*) (*i*) 

(*ii*) 

(*iii*) 

33. (*a*) 'B' will have least amount of solute because maximum amount of solvent has changed into vapours. It means it has higher vapour pressure than 'A' and 'C'.

(*b*) (*i*)
$$\Delta T_b = K_b \times \frac{1}{M_1}$$
$$0.4 = K_b \times \frac{1}{M_1} \quad \ldots(i)$$
$$0.8 = K_b \times \frac{1}{M_2} \quad \ldots(ii)$$

From (*i*) and (*ii*), $\frac{M_2}{M_1} = \frac{1}{2}$

$\Rightarrow$ $\frac{M_1}{M_2} = \frac{2}{1}$

$\therefore$ P : Q = 2 : 1

(*ii*) M_1 for 'P' is 200

$\therefore$ M_2 for 'Q' $= \frac{1}{2} \times M_1 = \frac{1}{2} \times 200 = 100$

Or

(*a*) (*i*) $\alpha = \frac{i-1}{n-1} \Rightarrow 0.2 = \frac{i-1}{2-1} \Rightarrow i = 1.2$ (in H_2O)

$$\alpha = \frac{1-i}{1-\frac{1}{n}} \Rightarrow 0.5 = \frac{1-i}{1-\frac{1}{2}} \text{ (in benzene)}$$

$\Rightarrow$ $1 - i = 0.25 \Rightarrow i = 0.75$ (in benzene)

(*ii*) It is because urea is non-electrolyte and a covalent compound. Its van't Hoff factor is 1.

(*b*) (*i*) Ethanol and water, when mixed result in endothermic process. Volume will increase on mixing. ΔH = +ve, ΔV = +ve

(*ii*) $\pi_1 = i_1 CRT$

$\pi_2 = i_2 CRT$

$$\frac{\pi_1}{\pi_2} = \frac{i_1}{i_2} = \frac{2}{1/2} = \frac{4}{1} \Rightarrow \pi_1 = 4\,\pi_2$$

(*iii*) $(\Delta T_f)_{\text{glucose solution}} = 2\ K_f$

$(\Delta T_f)_{\text{sucrose solution}} = 3\ K_f$

Melting point of solution = Melting point of solvent – ΔT_f

Since, ΔT_f is less in case of 2 m glucose solution, therefore, its melting point will be higher.