

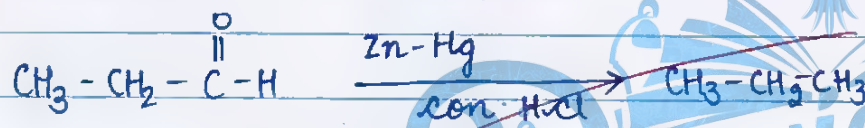
CASE STUDY

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CHEMISTRY

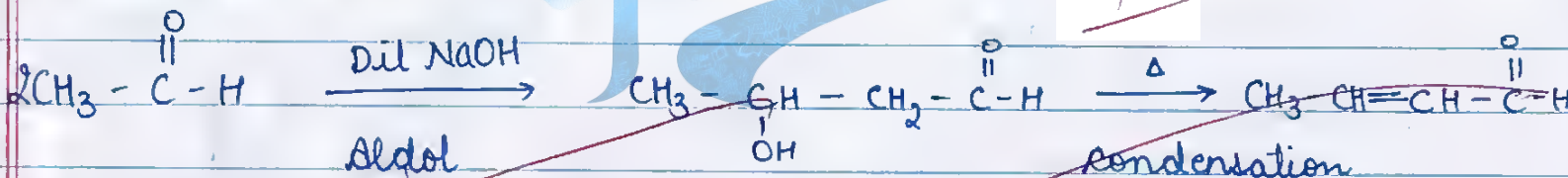
Section A

Ans 1: (i) Propanal to propane



i.e reduction of propanal to propane using Clemmenson reduction

(ii) Ethanal to But-2-enal



i.e Aldol condensation to form but-2-enal

Ans 2: $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$

given $\frac{\Delta[\text{NH}_3]}{\Delta t} = 3.6 \times 10^{-4} \text{ mol l}^{-1} \text{ s}^{-1}$

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$$(i) \text{ rate of reaction} = -\frac{\Delta[N_2]}{\Delta t} = -\frac{\Delta[H_2]}{3\Delta t} = \frac{\Delta[NH_3]}{2\Delta t}$$

$$\therefore \text{rate} = \frac{\Delta[NH_3]}{2\Delta t} = \frac{3.6 \times 10^{-7} \text{ mol L}^{-1} \text{ s}^{-1}}{2} = \underline{1.8 \times 10^{-7} \text{ mol L}^{-1} \text{ s}^{-1}}$$

$$(ii) -\frac{\Delta[H_2]}{3\Delta t} = \frac{\Delta[NH_3]}{2\Delta t}$$

$$\Rightarrow \text{Rate of disappearance of } H_2 = -\frac{\Delta[H_2]}{\Delta t} = \frac{3}{2} [3.6 \times 10^{-7}]$$

$$= \underline{5.4 \times 10^{-7} \text{ mol L}^{-1} \text{ s}^{-1}}$$

Ans 3: (i) Kohlrausch's law of independent migration of ions states that the limiting and molar conductivity of an electrolyte is given by the sum of the individual molar conductivities of the cation and anion.

$$\text{i.e. } \Lambda_m^{\circ}(MX) = \Lambda_m^{\circ}(M^{+}) + \Lambda_m^{\circ}(X^{-})$$

This law is valid for both strong and weak electrolyte.

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(ii) $\alpha = \frac{\Delta_m}{\Lambda_m^\circ} \Rightarrow$ given $\Delta_m = 488 \text{ cm}^2 \text{ mol}^{-1}$ or $\Lambda_m^\circ = 400 \text{ S cm}^2 \text{ mol}^{-1}$

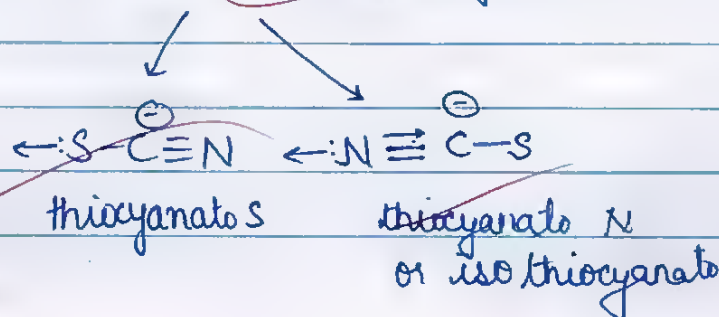
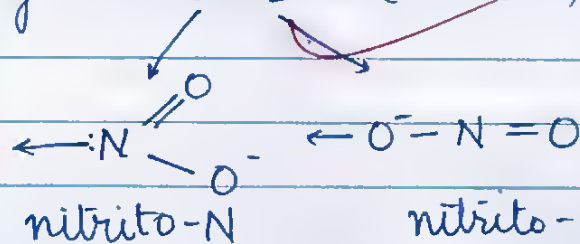
$\therefore \alpha = \frac{48}{400} = 12 \times 10^{-2}$

section B

Ans 4: (b) (i) $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})_2]\text{Cl}_2$

~~Tetraammineaqua chlorido Cobalt (III) chloride~~

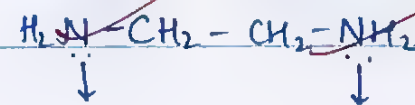
(ii) An ambidentate ligand has 2 ligating atoms out of which at a time only one bonds with the central metal atom
Eg: NO_2^- (Nitrite) SCN^- (thiocyanate)



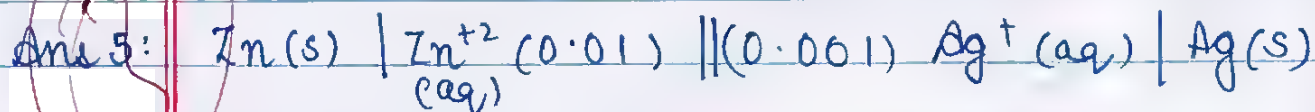
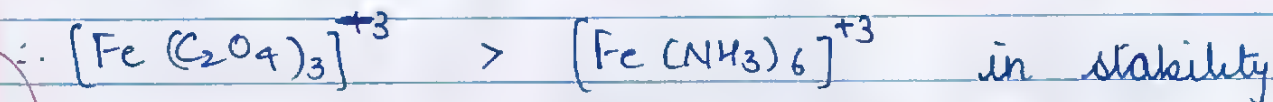
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Whereas a bidentate ligand has 2 ligating sites with which it simultaneously bonds to central metal atom

Eg: oxalate and ethane 1,2 diamine



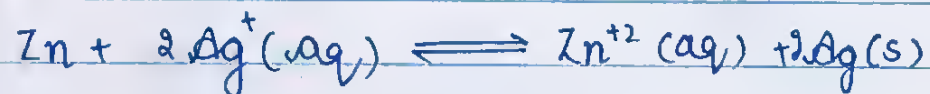
(III) Although ammonia is a strong field ligand but out of $[Fe(NH_3)_6]^{+3}$ and $[Fe(C_2O_4)_3]^{-3}$; $[Fe(C_2O_4)_3]^{-3}$ is more stable because oxalate is a bidentate ligand and therefore forms a chelating complex which provides it more stability as compared to the unidentated complex of similar structure



Q. 20.20

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overall equation of the cell



using Nernst equation, (At 298K)

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{0.0591}{n} \log_{10} Q$$

Here $E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cathode}} - E^{\circ}_{\text{anode}} = E^{\circ}_{\text{Ag}^+/\text{Ag}} - E^{\circ}_{\text{Zn}^{2+}/\text{Zn}}$

$$\therefore E^{\circ}_{\text{cell}} = 0.8 - [-0.76] = 1.56 \text{ V}$$

$$n = 2 e^-$$

$$Q = \frac{[\text{Zn}^{2+}]}{[\text{Ag}^+]^2}$$

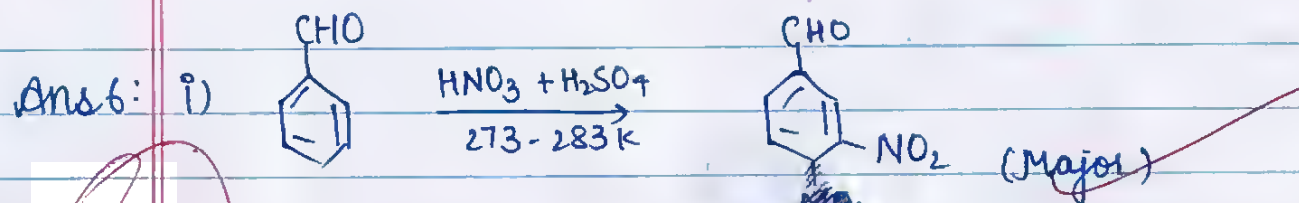
$$\therefore E_{\text{cell}} = 1.56 - \frac{0.0591}{2} \log_{10} \left(\frac{10^{-2}}{(10^{-3})^2} \right) = 1.56 - \frac{0.0591}{2} \log_{10} 10^4$$

$$= 1.56 - \frac{0.0591}{2} \times 4 = 1.56 - 0.1182 = 1.4418 \text{ V}$$

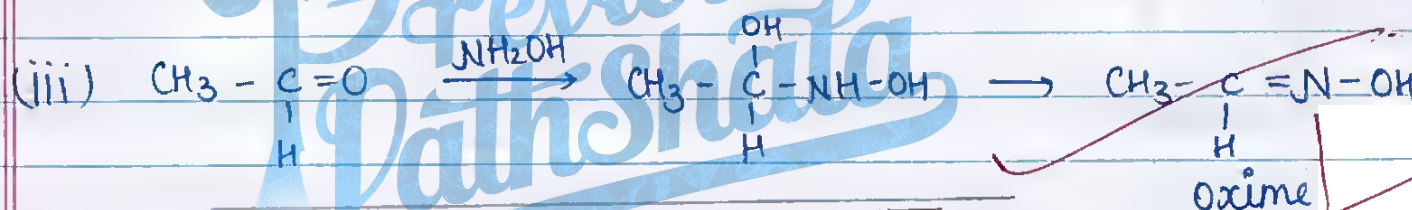
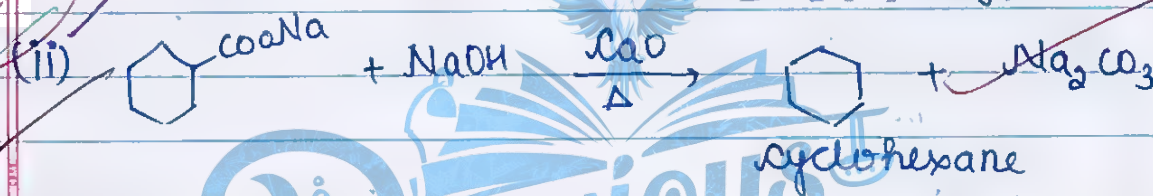
$$E_{\text{cell}} = 1.4418 \text{ V}$$

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mp - nitro benzaldehyde

Ans 7: order of rxn = 1st

Given; for 75% completion / decomposition

i.e. $\frac{[A]_t}{[A]_0} = \frac{1}{4}$ $t = 30 \text{ mins}$

$$K = \frac{2.303}{t} \log_{10} \left(\frac{A_0}{A_t} \right)$$

$$K = \frac{2.303 \times \log_{10} 4}{30 \text{ mins}}$$

$$t_{1/2} = \frac{0.693}{K} \quad \text{or} \quad \frac{\ln 2}{K}$$

$$\left[t_{1/2} = \frac{2.303 \times \log_{10} \left(\frac{A_0}{A_t} \right)}{K} \quad \text{on} \quad A_0/A_t = 2 \right]$$

$$\therefore t_{1/2} = \frac{0.693 \times 30 \text{ mins}}{2.303 \times 2 \log_{10} 2}$$

$$[\log_{10} 4 = 2 \log_{10} 2]$$

$$= \frac{0.693 \times 30 \text{ mins}}{2 \times 0.693} = \boxed{15 \text{ mins}}$$

Ques 8.

Lyophilic

Lyophobic

- (1) Liquid loving sols
- (2) Stable and difficult to coagulate
- (3) Prepared by mixing dispersed phase with dispersion medium
- (4) If dispersion medium is separated for eg by evaporation, sol can be reconstituted by remixing the medium
 $\therefore$ called Reversible sols

- (1) Liquid repelling sols
- (2) unstable and coagulate on adding small amount of electrolyte
- (3) cannot be prepared by mixing with dispersion med.
- (4) After separation of sol particles from medium, sol will not be reformed by mixing it ~~be~~ with medium
 $\therefore$ called irreversible sols

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Lyophilic

(5.) They are highly solvated

(6.) Eg Gum, starch, rubber, clay aqueous sols

Lyophobic

(5.) Not solvated in great amounts

(6.) Eg metals and their sulphides in water

Ans 9: (i) The negative value of $E^\circ_{\text{Mn}^{+2}/\text{Mn}}$ suggests that +2 oxidation state is relatively more stable for Manganese.

$\text{Mn}^{+2} : d^5$

1	1	1	1	1
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d^5 configuration is more stable due to half filled d orbitals. (leading to its high exchange energy also.)

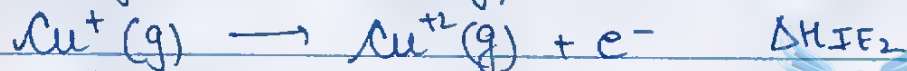
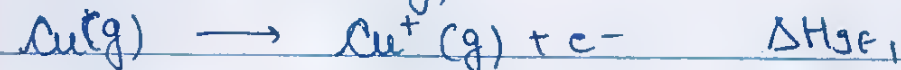
(ii) The irregularities arise due to :-

- (a) variation in Ionisation energy of these elements
- (b) variation in Ionic size across a series
- (c) Difference in Hydration enthalpies

CHAPTER 11

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(iii) The electrode potential values involve:-

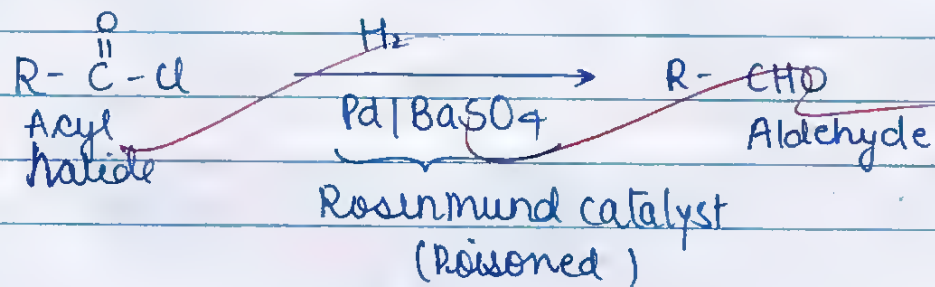


For Copper, The second ionisation enthalpy is very high and thus Hydration enthalpy does not compensate for the stabilisation of $\text{Cu}^{2+} \text{ aq}$

$\therefore \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)}$ has a +ve E°

Ques 10: (a) i) Rosenmund reaction

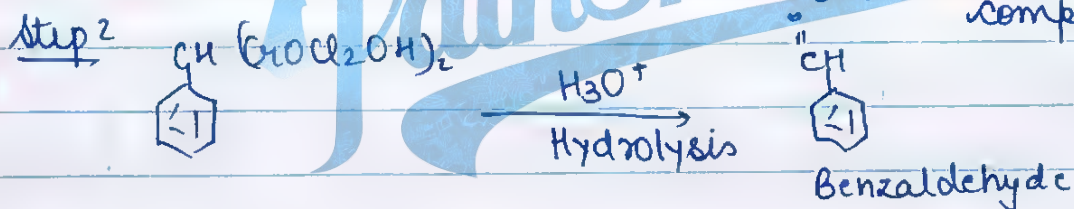
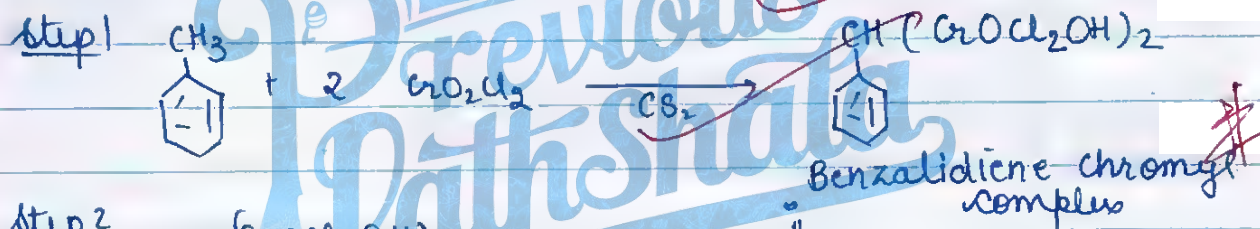
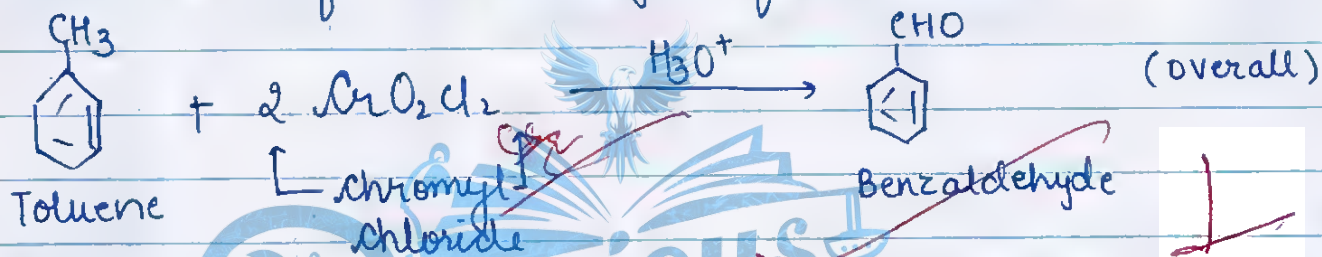
Method for preparation of aldehydes by reducing acyl halides



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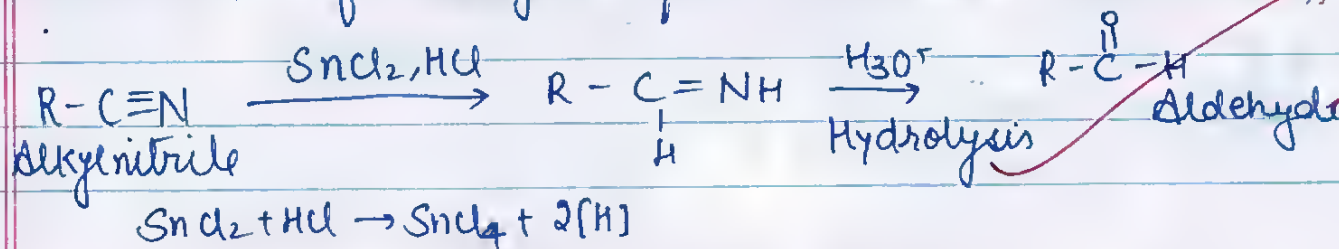
ii) Etard reaction

Formation of Benzaldehyde from Toluene



(iii) Stephen reaction

Formation of Aldehydes from Nitriles (Reduction)



CASE STUDY

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Ans II:

(i) Transition metals due to presence of variable number of oxidation states can act as catalysts for various reactions by accepting or donating their d -orbital electrons.

For Eg: In the reaction: $2I^- + S_2O_8^{2-} \rightarrow I_2 + 2SO_4^{2-}$
 Fe^{+3} acts as a catalyst in its $+3$ or $+2$ states



(ii) According to IUPAC, transition elements are defined as the elements which contain unpaired electrons either in their ground or excited state.

Zn, Cd, Hg have $(n)d^{10}ns^2$ configuration in ground state and $(n+1)d^{10}$ in excited state. Therefore do not contain

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any unpaired electrons. Thus are not transition elements



In Hf, before the filling of 5d orbitals; 4f orbitals are filled (called lanthanoid series). The f orbitals have poor screening or shielding effect; therefore they do not shield the outer electrons effectively which leads to increase in effective nuclear charge.

This increased Z_{eff} results in the contraction of the shells due to which the 5d series has a smaller radii ^{to} than 4d series. Similar

$\therefore$ Radii of Zr $\approx$ Hf

P.T.O

the compound formed with 1° amine is soluble in NaOH due to the presence of Acidic H whereas compound formed with 2° amine is insoluble in NaOH due to absence of any Acidic H

(iv) (a)

