Answer Book – જવાબવહી

મુખ્ય જવાબવહી	પુરવણી	કુલ
1	+	=

H.S.C. વિજ્ઞાન પ્રવાહ 24-M-24

વિષય અને કોડ નંબર	રસાયણવિજ્ઞાન	052
પરીક્ષાની તારીખ	18/03/2024	
જવાબની ભાષા	ENGLISH	

પરીક્ષાર્થી માટે અગત્યની સૂચના

પરીક્ષાર્થીએ જવાબ લખવાનું શરૂ કરતાં પહેલાં પાન નં. 2 પરની સૂચનાઓ અવશ્ય વાંચવી.

મધ્યસ્થ મૂલ્યાંકન [illegible] યોગ માટે

G.S. H.S.E.B. 313 C.E.C.-2024

1

વિભાગ	પરીક્ષકે આપેલ ગુણ	પરીક્ષકની સહી	પરીક્ષકનો નિમણૂક નંબર	સમીક્ષકે આપેલ ગુણ	કો-ઓર્ડિનેટરે આપેલ ગુણ	બોર્ડની કચેરીના ઉપયોગ માટે
A						
B						
C						
કુલ ગુણ અપૂર્ણાંકમાં						
કુલ ગુણ પૂર્ણાંકમાં						
કુલ ગુણ શબ્દોમાં						

વેરીફાયરની સહી	સમીક્ષકની સહી	કો-ઓર્ડિનેટરની સહી
વેરીફાયરનો નિમણૂક નંબર	**સમીક્ષકનો નિમણૂક નંબર**	**કો-ઓર્ડિનેટરનો નિમણૂક નંબર**

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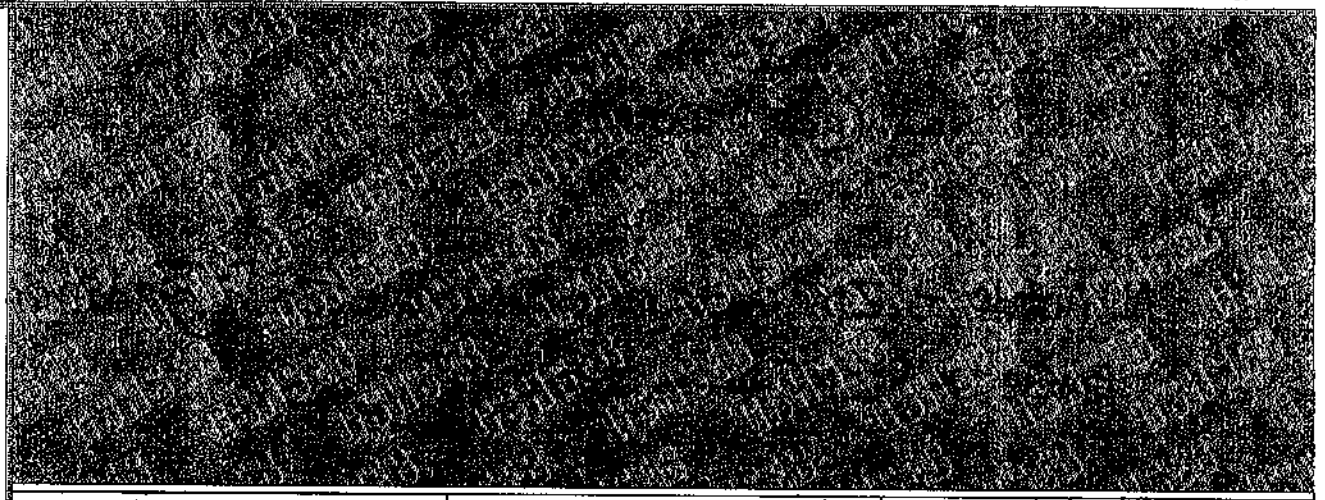
ગુણાંકન

પ્રશ્ન ક્રમાંક



વિભાગ-A		વિભાગ-B		વિભાગ-C	
પ્રશ્ન ક્રમાંક	ગુણ	પ્રશ્ન ક્રમાંક	ગુણ	પ્રશ્ન ક્રમાંક	ગુણ
1		13		22	
2		14		23	
3		15		24	
4		16		25	
5		17		26	
6		18		27	
7		19		મેળવેલ કુલ ગુણ	16
8		20		પરીક્ષકની સહી	
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10		મેળવેલ કુલ ગુણ	18		
11		પરીક્ષકની સહી		વેરીફાયરની સહી	
12					
મેળવેલ કુલ ગુણ	16	વિભાગ : A + B + C =			50
પરીક્ષકની સહી		પેજ નં. 3 ઉપરના પ્રશ્નના ક્રમવાર મેળવેલ ગુણ મૂકીને મહત્તમ ગુણ ગણતરીમાં લઈ વિભાગવાર દર્શાવવાના રહેશે અને ઉત્તરવહીના મુખ્ય પેજ ઉપર વિભાગવાર ગુણ લખવાના રહેશે.			

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Sec-A
(2-marks)

Q.1

At Anode :- Zinc gets converted into Zn^{2+} (oxidation)

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

At Cathode :- MnO_2 gets reduced to $MnO(OH)$.

Cathode :- $MnO_2 + NH_4^+ + e^- \longrightarrow MnO(OH) + NH_3$

Overall reac^n :- $Zn + 2MnO_2 + 2NH_4^+ \longrightarrow Zn^{2+} + 2MnO(OH) + 2NH_3$

$\Rightarrow$ Here product ammonia formed reacts with Zn^{2+} and make complex $[Zn(NH_3)_4]^{2+}$.

Q.2

$[N_2O_5]_i = 1.24 \times 10^{-2}\ M\ (mol\ L^{-1})$

$t = 60\ min = 60 \times 60\ s$

$[N_2O_5]_f = 0.2 \times 10^{-2}\ mol\ L^{-1}$ $\quad k = ?$

According to first order integrated eq^n

$\therefore k = \frac{2.303}{t} \log_{10} \frac{[R_0]}{[R]}$

$\therefore k = \frac{2.303}{60 \times 60} \log_{10} \frac{1.24 \times 10^{-2}}{0.2 \times 10^{-2}}$

$\therefore k = \frac{2.303 \times 0.7925}{60 \times 60} = 5.069 \times 10^{-4}\ s^{-1}$

$= 3.042 \times 10^{-2}\ min^{-1}$

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Q.4

=> The interstitial compounds are those compounds in which small atoms like, B, C, N or H gets placed into lattice structure of metal.

=> Interstial compounds are shown by d-block / transition elements

=> for eg:- TiC, Fe_3N, $VH_{0.56}$ etc.

=> Here above formula do not show oxidation number of metals.

* Two characteristics of interstial compounds are as follow:-

- They retain metal conductivity and have high boiling point.
- Some borides reach hardness of diamond, hence they are very hard compounds.

Q.5

Main Postulates of Werner's Theory of coordination compounds:-

- The central atom of coordination compound possess two types of valencies (i) Primary Valency (ii) Secondary Valency.
- Primary valency is ionisable and easily ionised by negative ions.
- Secondary Valency is not ionisable, it is due to neutral atoms and negative ions, and secondary valency is equal to coordination number which is fixed for metal.
- Every coordination compound have different type of structure in space depending on its central atom and ligand called coordination polyhedron.

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Q.6

(i) $K_3[Cr(C_2O_4)_3]$

IUPAC : Potassium trioxalato chromate(III)

(ii) $[CoCl_2(en)_2]Cl$

IUPAC : dichlorido bis-(ethane-1,2-diamine) cobalt(III) chloride

Q.7

⇒ The reaction in which alkyl chloride or alkyl bromide is treated with sodium iodide in dry acetone to form alkyl iodide, this reaction is called Finkelstein reaction.

⇒ General chemical eqn :-

$$R-X + Na^+I^- \xrightarrow{\text{dry acetone}} R-I + NaX \quad (X = Cl, Br)$$

To convert ethyl chloride to ethyl iodide for example

$$CH_3CH_2-Cl \xrightarrow[\text{dry acetone}]{NaI} CH_3CH_2-I + NaCl$$

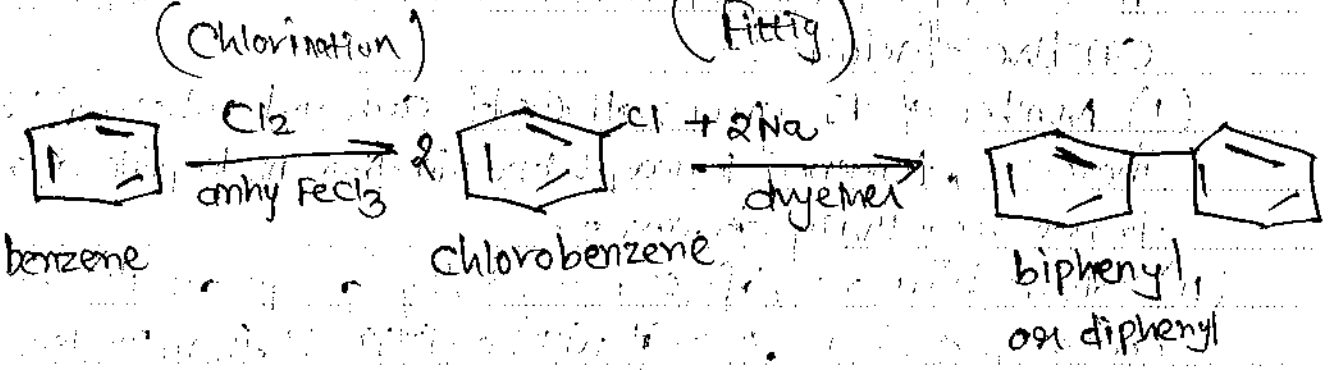
chloroethane → iodoethane

⇒ Here dry acetone is used to precipitate sodium salt, so that reaction will be in forward direction according to Le Chatelier's Principle.

P.T.O.

Q.8

Conversion : Benzene to Diphenyl



Q.9

⇒ Industrially, phenol is prepared from cumene ie Isopropyl benzen

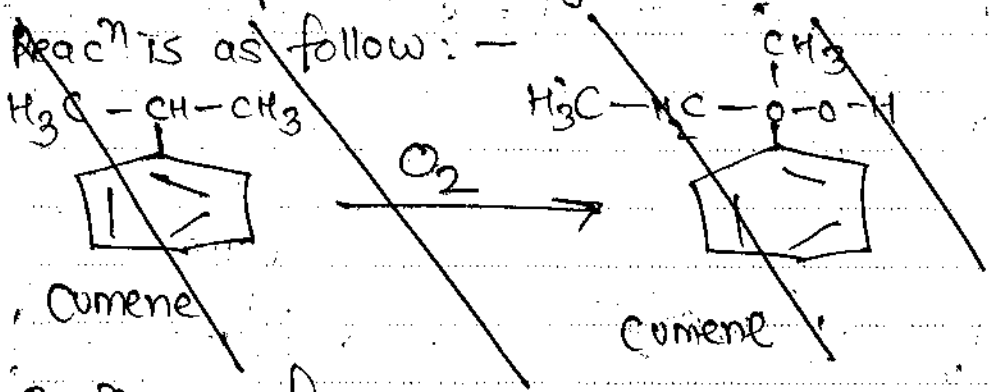
⇒ First, oxidation of cumene takes place.

⇒ Hence cumenehypoperoxide is formed.

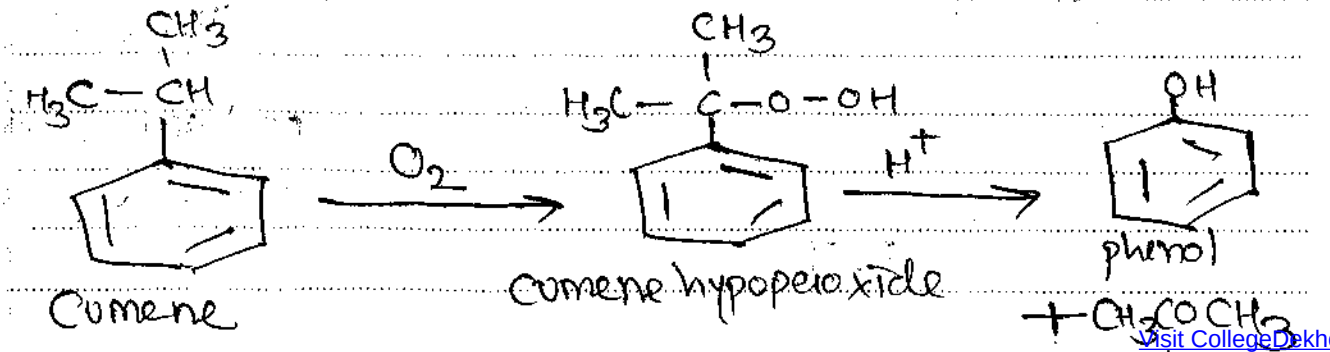
⇒ On treating cumene hypoperoxide with dilute acid we get phenol.

⇒ And as by product, we get acetone which is in large quantity

Reacⁿ is as follow :—



Reacⁿ is as follow



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Q10

⇒ Reactivity of Nucleophilic Addition Reaction depends on two factors :-

(i) Number of +I groups attached to carbonyl carbon, if +I groups increases, tendency to accept lone pair from nucleophile decreases hence reactivity decreases.

(ii) Steric hindrance, if too many bulky groups are attached to carbonyl carbon, then it will be difficult from nucleophile to attack

⇒ So in general reactivity towards nucleophilic addition reaction of aldehydes are more than ketone.

⇒ Methanal is most reactive, while benzophenone reacts least.

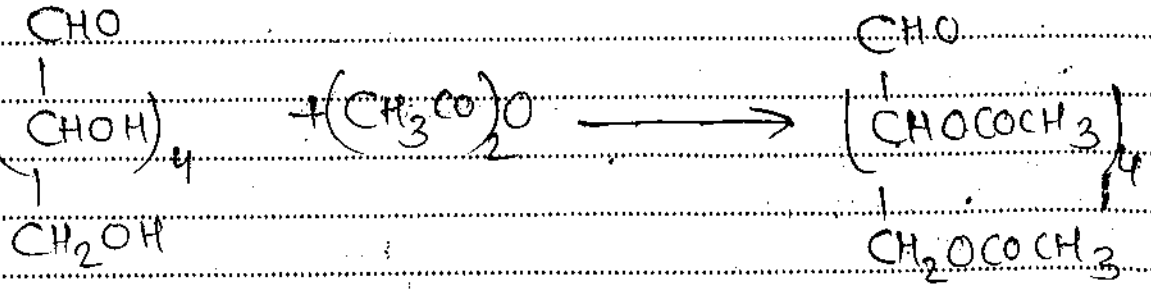
Q11

⇒ When glucose reacts with acetic anhydride, it forms pentaacetate.

⇒ This means glucose have five —OH group in it.

⇒ All —OH groups are attached to different carbon

⇒ Reaction is as follow



pentaacetate of glucose

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Sec-B
(3 marks)

Q.14 Nernst eqn for $Pt_{(s)} | H_{2(g)} | H^+_{(0.03M)} || Br^-_{(0.01M)} | Br_{2(l)} | Pt_{(s)}$

Reaction proceeds as

$$H_{2(g)} + Br^{\circ}_{2(l)} \longrightarrow 2Br^-_{(aq)} + 2H^+_{(aq)}$$

So ~~Acc~~ Oxidn at H_2 takes place while redn of Br_2 take place

So $E^{\circ}_{cell} = E^{\circ}_{cathode} - E^{\circ}_{anode}$

$= E^{\circ}_{Br_2/Br^-} - E^{\circ}_{H^+/H_2}$

$= 1.09 - 0.0$

$= 1.09V$

Nernst Eqn

$$E_{cell} = E^{\circ}_{cell} - \frac{0.059}{2} \log_{10} \frac{1}{[H^+]^2[Br^-]^2} \qquad n = 1 \text{ not } 2$$

$$= 1.09 - \frac{0.059}{2} \log \frac{1}{(0.01)^2 (0.03)^2}$$

$$= 1.09 - \frac{0.059 \times 7.053}{2}$$

$$= 1.09 - 0.208$$

$$= 0.882V$$

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Q.15

$T_1 = 500K \quad k_1 = 0.02\,s^{-1}$

$T_2 = 700K \quad k_2 = 0.07\,s^{-1}$

$Ea = ?$

$A = ?$

According to Arrhenius theory

$$\log_{10}\frac{k_2}{k_1} = \frac{Ea}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\log\frac{0.07}{0.02} = \frac{Ea}{2.303\times8.314}\left[\frac{1}{500} - \frac{1}{700}\right]$$

$$0.544 = \frac{Ea}{2.303\times8.314}\left[\frac{200}{700\times500}\right]$$

$$\therefore Ea = 18228.08\ J\,mol^{-1}$$

$$= 18.228\ kJ\,mol^{-1}$$

Now using Arrhenius eqn at $T_1 = 500K$

$$\therefore k_1 = A e^{-Ea/RT}$$

$$\therefore \ln k_1 = \ln A - \frac{Ea}{RT}$$

$$\therefore \log_{10} k_1 = \log_{10} A - \frac{Ea}{2.303RT}$$

$$\therefore \log_{10} A = \frac{18.228\times10^3}{2.303\times8.314\times500} + \log_{10} 0.02$$

$$= 1.904 - 1.698$$

$$= 0.205$$

$$A = 1.603$$

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Q16

⇒ Potassium dichromate is orange crystaline compound having formula $K_2Cr_2O_7$.

⇒ First iron chromite ore is treated with sodium carbonate in free excess of air.

So, $4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \longrightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$

⇒ Now this yellow sodium chromate is treated dilute acid so that it gets converted into orange sodium dichromate

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

(yellow) (orange)

⇒ Since sodium chromate is more soluble, hence it will be replacement for potassium dichromate, when formed is treated with KCl

So $Na_2Cr_2O_7 + 2KCl \longrightarrow K_2Cr_2O_7 + 2NaCl$

⇒ Hence potassium dichromate is prepared.

⇒ Now when pH of dichromate solution increase it gets converted to chromate.

⇒ Similarly when pH of chromate sol^n decrease it gets converted to dichromate

⇒ Hence they are interconvertible

$K_2Cr_2O_7 + 2OH^- \longrightarrow 2K_2CrO_4$

$+2K^+$

$\therefore 2K_2CrO_4 + 2H^+ \longrightarrow K_2Cr_2O_7 + H_2O + 2K^+$

$K_2Cr_2O_7 + 2OH^- + 2K^+ \longrightarrow 2K_2CrO_4 + H_2O$

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Q.17

(a) — C_4H_9Br is primary halide

So it can be 1-bromobutane $CH_3CH_2CH_2CH_2-Br$ or

$H_3C-\underset{\underset{CH_3}{|}}{CH}-CH_2-Br$ Isobutylbromide

Now further given when treated with sodium metal it gives C_8H_{18}, diff from n-butylbromide, so (A) will be Isobutylbromide $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-Br$

So Reacⁿ are as follow

$$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-Br \xrightarrow[-KBr,\ -H_2O]{\text{alc. KOH}} CH_3-\underset{\underset{CH_3}{|}}{C}=CH_2$$

(A) (B)

$$CH_3-\underset{\underset{CH_3}{|}}{C}=CH_2 + HBr \longrightarrow CH_3\underset{\underset{Br}{|}}{C}-CH_3$$

(C) is isomer of (A)

$$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-Br + CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-Br + 2Na \longrightarrow CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_3$$

(D) 2,5-dimethyl hexane

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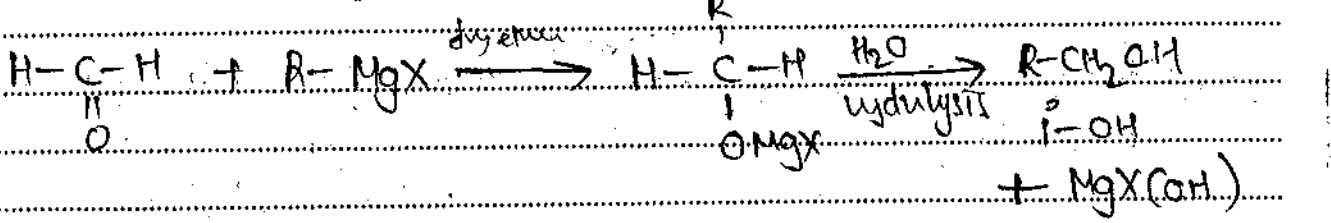
Q.18

for

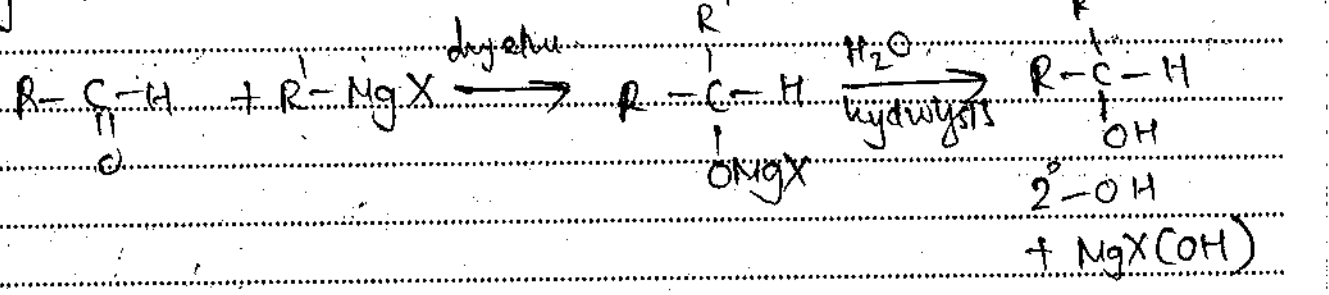
⇒ ~~Ben~~ primary alcohol,

- When methanal reacts with grignard reagent, after wet hydrolysis reactant will give primary alcohol = 1°-OH,



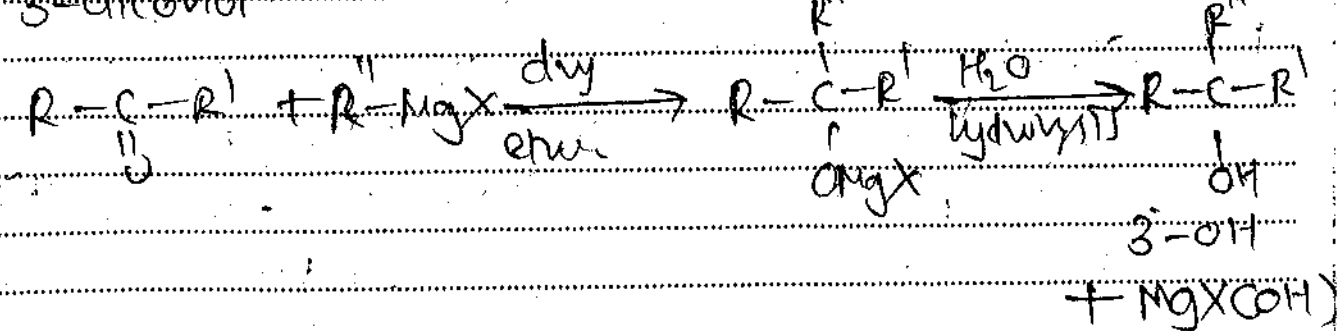
⇒ For 2°-alcohol

⇒ Any Aldehyde on treating with grignard reagent and then hydrolysis gives 2°-alcohol



⇒ for 3°-alcohol

Ketone with grignard reagent & then hydrolysis gives 3°-alcohol



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Q10

⇒ When two different aldehydes or ketone having α-hydrogen is treated in dilute alkali, then reaction is called cross aldol condensation

* Cross Aldol for ethanal and propanal

(i) $CH_3CHO + CH_3CHO \xrightarrow{dil\ NaOH}$ $CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-CHO$

ethanal

3-hydroxylbutanal

$\xrightarrow[-H_2O]{\Delta}$

$CH_3-CH=CH-CHO$

but-2-enal

(ii) $CH_3CH_2CHO + \overset{CH_3}{\underset{|}{C}}H_2CHO \xrightarrow{dil\ NaOH}$ $CH_3CH_2\underset{\underset{OH}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-CHO$

propanal propanal

3-hydroxy-2-methyl pentanal

$\xrightarrow[-H_2O]{\Delta}$

$CH_3CH_2CH=\underset{\underset{CH_3}{|}}{C}-CHO$

2-methyl pent-2-enal

(iii) $CH_3CHO + \overset{CH_3}{\underset{|}{C}}H_2CHO \xrightarrow{dil\ NaOH}$ $CH_3\underset{\underset{OH}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH_2}-CHO$

3-hydroxyl-2-methylbutanal

$\xrightarrow[-H_2O]{\Delta}$

$CH_3CH=\underset{\underset{CH_3}{|}}{C}H-CHO$

2-methyl but-2-enal

(continue ⇒)

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(iv) $CH_3CH_2CHO + CH_3CHO \xrightarrow{dil\ NaOH}$ $CH_3CH_2CH(OH)-CH_2-CHO$

3-methyl pentanal

$\xrightarrow[\Delta]{-H_2O}$ $CH_3CH_2-CH=CH-CHO$

pent-2-enal

Q20

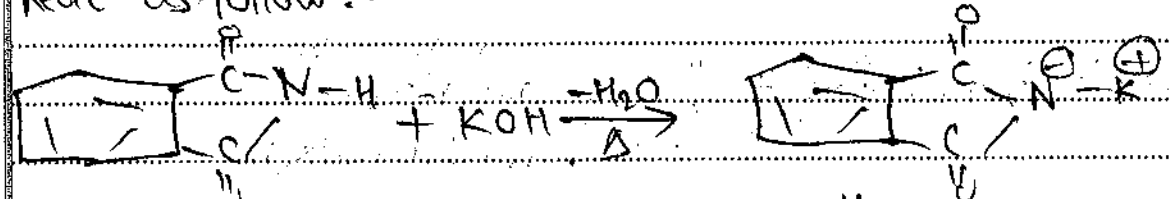
=> When phthalimide is treated with alkali lik KOH, it forms potassium salt of phthalimide

=> Now treating this salt with alkyl halide, we get N-alkyl phthalide

=> And lastly treating with dilute acid, we get primary amine as main product (dilute NaOH)

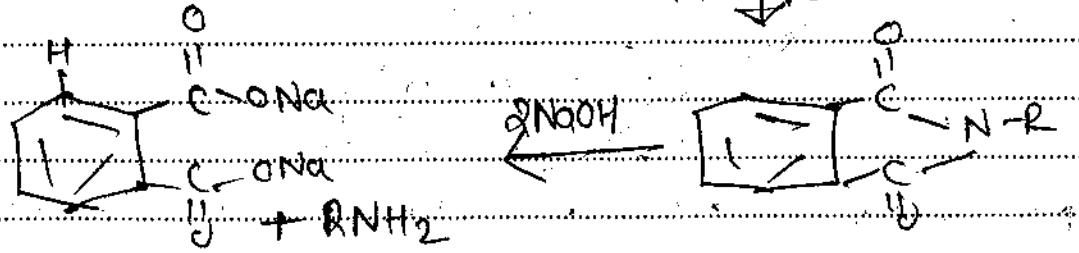
=> No primary aryl amine can be produced from gabriel phthalimide synthesis process as, phenyl ring does not attack salt of phthalimide.

So Reacⁿ as follow :—

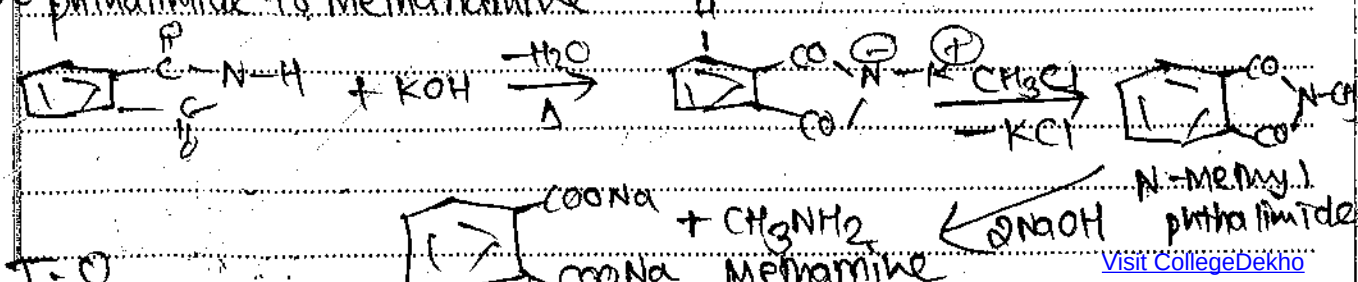


salt

$-KX$ $R-X$



for phthalimide to methanamine



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Sec-C
(4-Marks)

Q-2?

$w_2 = 4g$ $m_2 = 122\ gm/mol$

$w_1 = 50g$ $\Delta T_f = 1.62K$ $k_f = 4.9\ K\ kg\ mol^{-1}$

let according to formola

$$\Delta T_f = K_f m$$

$$= \frac{K_f \times w_2 \times 1000}{m_2 \times w_1}$$

$$\therefore m_2 = \frac{K_f \times w_2 \times 1000}{w_1 \times \Delta T_f}$$

$$= \frac{4.9 \times 4 \times 1000}{50 \times 1.62} = 241.9\ gm/mol$$

So i (vant hoff factor) $= \frac{\text{normal molar mass}}{\text{abnormal molar mass}}$

$$= \frac{122}{241.9}$$

$$\boxed{i = 0.504}$$

Now benzoic acid goes into association and forms dimer

So $2C_6H_5COOH \rightleftharpoons (C_6H_5COOH)_2$

initial mols	1	0
after	$1-\alpha$	$\alpha/2$

continued

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So No. of Mols after dissociation / No of before dissociation = i

$\therefore i = \frac{1-\alpha+\alpha/2}{1}$

$\therefore i = 1-\alpha/2$

$\therefore \alpha/2 = 1-0.504$

$\therefore \alpha = 0.992$

$\therefore \alpha\% = 99.2\%$

Q.24

⇒ When rate of reaction is proportional to first power of conc. of reactants, it is called first order reaction

$\therefore -\frac{d[R]}{dt} \propto [R]^1$

$\therefore -\frac{d[R]}{dt} = k[R]$ k = rate constant

$\therefore +\frac{d[R]}{[R]} = -k\,dt$

∴ Integrating on both side

$\therefore \int \frac{d[R]}{[R]} = -\int k\,dt$

$\therefore \ln[R] = -kt + I$

I = constant of integration

Continue ⇒

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at $t=0$ $[R]=[R_0]$ = initial conc^n

$\therefore \ln[R]_0 = I$

$\therefore$ so $\ln[R] = -kt + \ln[R_0]$ ——— (1)

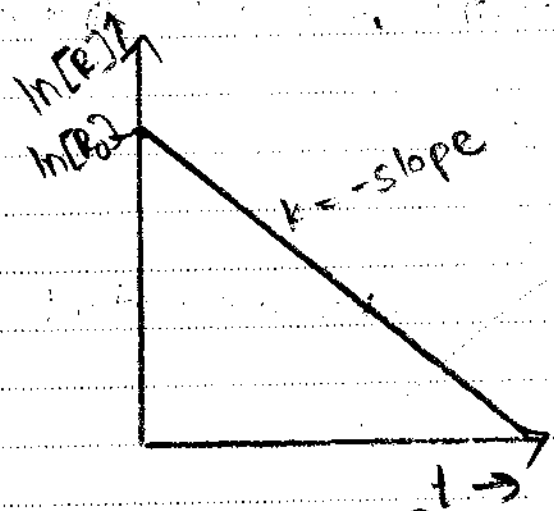
so $kt = \ln[R_0] - \ln\frac{[R_0]}{[R]}$

$\therefore kt = 2.303 \log_{10}\frac{[R_0]}{[R]}$

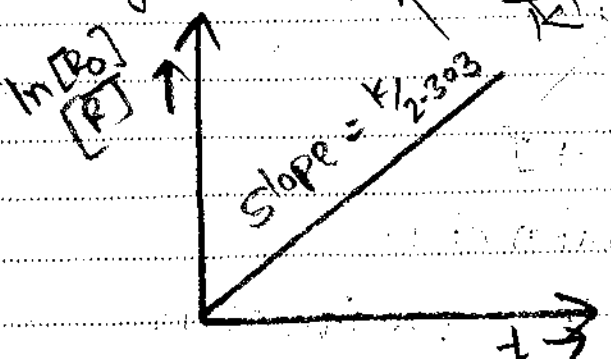
$\therefore k = \frac{2.303}{t}\log_{10}\frac{[R_0]}{[R]}$ ——— (2)

Hence formula for rate constant derived

from eq^n (1) we can draw graph $\ln[R] \rightarrow t$
whose slope $= -k$ intercept $\ln[R_0]$



Similarly from eq^n (2) graph of $\log\frac{[R_0]}{[R]} \rightarrow t$, shows straight with slope $= \frac{k}{2.303}$ slope $= k/2.303$



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• Unit of k for ~~fast or~~ first order is s^{-1}.

⇒ Now time required to complete half of original amount is called half life $t_{1/2}$

So from eqⁿ (2) $t = t_{1/2}$ and $[R] = \frac{[R_0]}{2}$

$$\therefore k = \frac{2.303}{t_{1/2}} \log_{10} \frac{2[R_0]}{[R_0]}$$

$$\therefore t_{1/2} = \frac{2.303 \times 0.301}{K}$$

$$= \frac{0.693}{K} \quad \text{——— (3)}$$

Hence from eqⁿ (3) it is clear half life of first order does not depend on initial conc^{n} of reactant.

Q.25

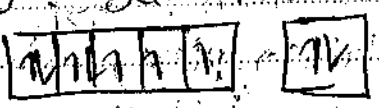
⇒ First we discuss of coordination compound $[CoF_6]^{3-}$

IUPAC : hexafluoridecobaltate (III) ion

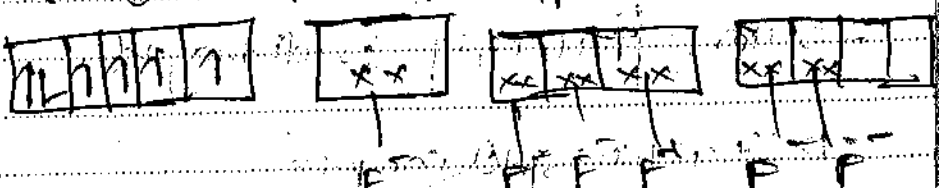
Oxidation : +3

No

Ground state ē confin : $_{24}Co$: $3d^7$ $4s^2$



ē config of Co^{3+} : $3d^6$ $4s^0$ $4p^0$ $4d^0$



Hence hybridisation : sp^3d^2

Continue ⇒

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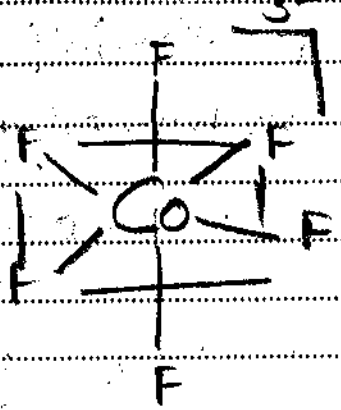
⇒ $[CoF_6]^{3-}$ makes octahedral complex, since F^- is weak ligand pairing does not take place



⇒ So No. of unpaired e⁻ : 4

Magnetic moment $= \sqrt{n(n+2)}$

$= \sqrt{4 \times 6}$

$= 4.89$ BM

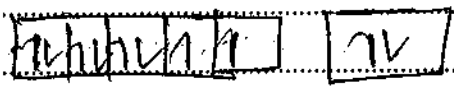
Hence $[CoF_6]^{3-}$ is paramagnetic ⇒ High spin complex

Now in case $[Ni(CN)_4]^{2-}$,

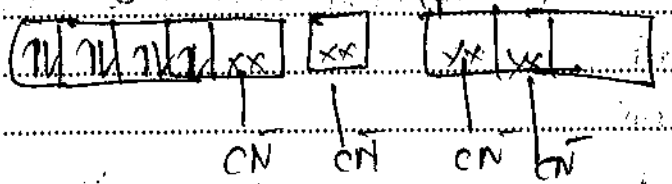
IUPAC : tetracyano nickelate (II) ion

Oxidation No : +2

Ground state e⁻ config : $_{28}Ni$: $3d^8$ $4s^2$



e⁻ config of Ni^{2+} : $3d^8$ $4s^0$ $4p^0$



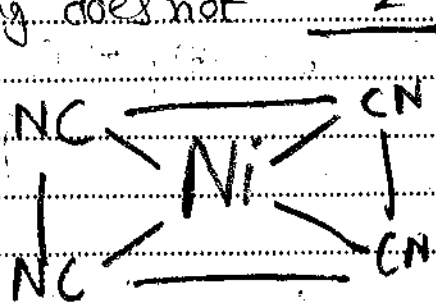
Hence hybridisation : dsp^2

Inner orbital complex, having square plana structure

→ Dᵉ to strong field ligand, no pairing does not takes place

⇒ Here $[Ni(CN_4)]^{2-}$ is diamagnetic

⇒ It is low spin complex



P.T.O

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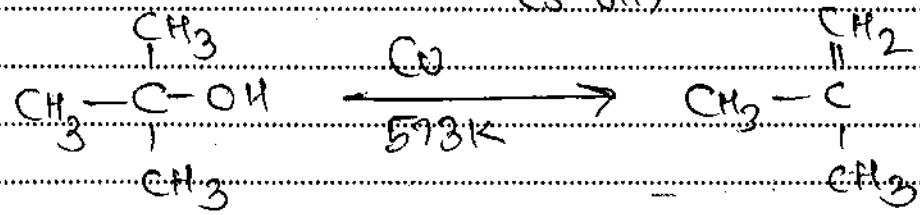
Q.26

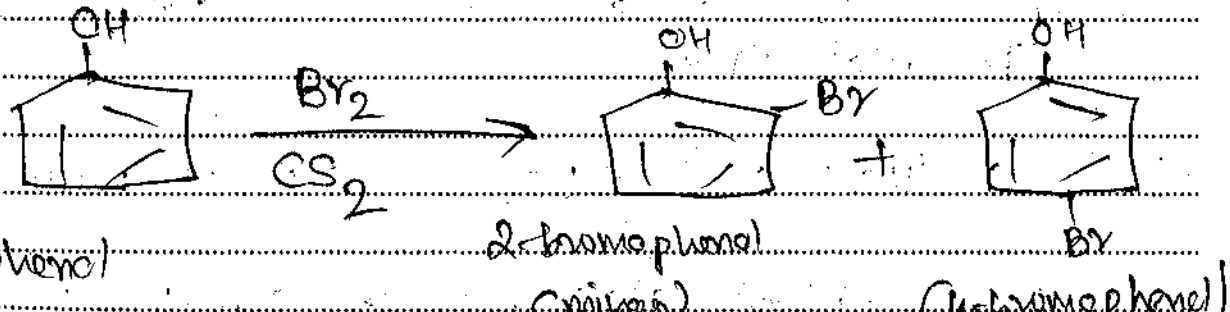
(i) When tertiary alcohol heated at 573K in presence of Copper
→ It get reduced to alkene, because elimination is preferred over oxidn.

So for eg tertbutyl alcohol (3°-OH) converts into 2-methyl prop-1-ene



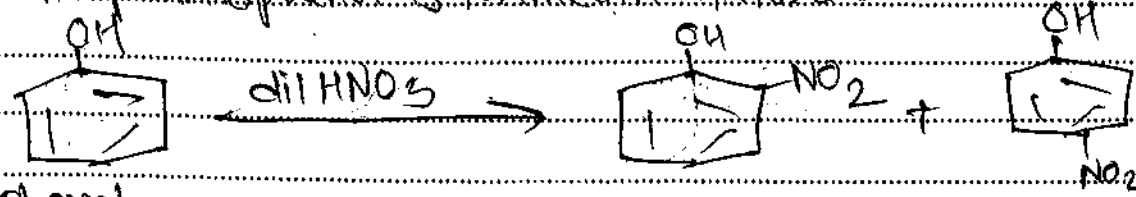
2-methyl propan-2-ol 2-methyl prop-1-ene.

(ii) Bromine in CS_2 with phenol (only ortho and para)
→ mono bromo derivative of phenol will formed, in which p-bromophenol is major product



phenol 2-bromophenol (minor) (4-bromophenol) (major)

(iii) Dilute HNO_3 with phenol
→ When dilute HNO_3 treated with phenol, o-nitrophenol and p-nitrophenol is formed in mixture.



phenol 2-nitrophenol (minor) 4-nitrophenol (major)

continue ⇒

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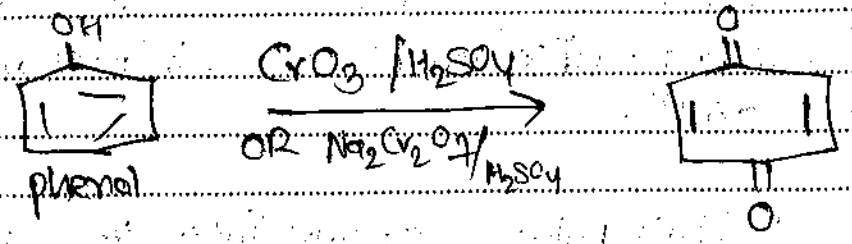
(iv) Oxidⁿ of phenol with chromic acid, will give conjugated diketone known as benzoquinone or benzene-2,5-diene-1,4-dione



phenol

benzene-2,5-diene-1,4-dione

Q. 27

(i) Fehling's Test :-

- When aliphatic aldehyde is treated with fehling A and fehling B in equimolar mixture red-brown ppt is formed
- This confirms the presence of -CHO group.
- Here fehling A is sol^n of copper sulphate
- And fehling B is sol^n of sodium potassium tartarate (Rochelle's salt)

$$R-CHO + 2Cu^{2+} + 5OH^- \longrightarrow R-COO^- + 3H_2O + Cu_2O$$

red brown ppt

- Only aliphatic aldehydes can give this reaction
- Here product is a carboxylate ion : fehling's reagent also used as oxidising agent for aldehyde to carboxylic acid.

Continue ⇒

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(ii) Hell-Volhard-Zelinsky reaction

- When carboxylic acid having α-hydrogen treated with Red-P and X_2, halogen X is substituted at position of α-hydrogen
- These reaction is known Hell-Volhard Zelinsky Reaction

$$R-CH_2-COOH \xrightarrow[(ii)\ H_2O]{(i)\ Red\ P-X_2} R-\underset{\displaystyle X}{\underset{|}{C}}H-COOH$$

for example

$$CH_3CH_2COOH \xrightarrow[(ii)\ H_2O]{(i)\ Red\ P/X_2} CH_3\underset{\displaystyle X}{\underset{|}{C}}H-COOH$$

propanoic acid

α-halo propionic acid

2-chloropropanoic acid

where (X = Cl, Br)

example

P.T.O.

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