Model Answer Set- II

Std. – 12th

Sub:- Chemistry

General Instructions:

1. Sections A: Q. No. 1 contains **10** multiple choice questions carrying **one mark** each
Q. No. 2 contains **8** very short answer type questions carrying **one mark** each
2. **Section B:** Q. No. 3 to Q. No. 14 are **12** short answer-I type questions **carrying two marks** each. Attempt any **eight** questions.
3. Section C: Q. No. 15 to Q. No. 26 are **12** short answer-II type questions carrying **three marks** each. Attempt any **eight** questions.
4. Section D: Q. No 27 to Q. No. 31 are **5** long answer type questions carrying **four mark** Attempt any **three** questions.

SECTION A

Q.1. Select and write correct answer: 10.

1 (a) 3

2 **(a)** $_{n}\left[NH-(CH_2)_5-CO \right]$

3 (c) Metamers

4 d) 2-chloropropane

5 d) $C_6H_4(NH_2)_2$

6 a) One litre of 1M [Co $(NH_3)_6$] $C\ell_3$

7 b) O_2, gas is produced at anode

8 d) $-\frac{2.303R(273+t)}{2}$

9 $a)\ \frac{M_2\Delta T_b\times W_1}{1000\times W_2}$

10 $d)\ H_3O^+, OH^-$

Q.2 Answer the following: 8.

1 Each 8 ions of $C\ell^-$ at corners contribute $\frac{1}{8}$ th of a sphere.
∴ Total $C\ell^-$ ions = $\frac{1}{8}\times 8=1$
Similarly: Total number of Cs^+ ions =1 (since it is at body centre)

2 Carbohydrates are
Polyhydroxy aldehydes or ketones
Compounds which give polyhydroxy aldehydes or ketones on hydrolysis.

3 $Zn(NH_3)_4^{+2}$
$Zn \xrightarrow{-2e^-} Zn^{2+} + 4NH_3 \rightarrow [Zn(NH_3)_4]^{2+}$
Z = atomic number of Zn = 30
X = number of electrons lost due to formation of ion = 2
Y = number of electrons donated by ligands = 8 EAN of Zn =Z-X+Y = 30-2+8=36
(ii) $[Fe(CN)_6]^{-4}$
Z = atomic number of Iron = 26
X = number of electrons lost due to formation of Fe^{2+} = 2
Y = number of electrons donated by six CN-ligands = 12
EAN of Fe in $[Fe(CN)_6]^{-4}$=Z-X+Y=26-2+12=36

4 i) An antiseptic.
ii) For unsaturation test in laboratory
iii) In volumetric analysis of reducing agents.
iv) For detecting halides in qualitative analysis.
v) Powerful oxidizing agent in laboratory and industry.

5 4-Methoxy -2- hexanone
4-methoxy- hex-2-one

6 Step -1 : $NO_{(g)} + C\ell_{2(g)} \rightarrow NOC\ell_{2(g)}$
Step -2 : $NOC\ell_{2(g)} + NO_{(g)} \rightarrow 2NOC\ell_{(g)}$
Overall : $2NO_{(g)} + C\ell_{2(g)} \rightarrow 2NOC\ell_{(g)}$
Reaction intermediate = $NOC\ell_{(g)}$
Molecularity of first step = 2
Molecularity of second step = 2
Molecularity of overall reaction = 3

7 By dissolving a non volatile solute in it.

8 Standard state of substance is the in which the substance is the most stable at pressure 1 bar and at temperature 298k.
e.g. $H_{2(g)}, CO_{2(g)}\ Hg_{(l)}, C_2H_5OH_l, H_2O_{(l)}, Na_{(s)}, C_{(graphite)}), CaCO_{3(s)}$

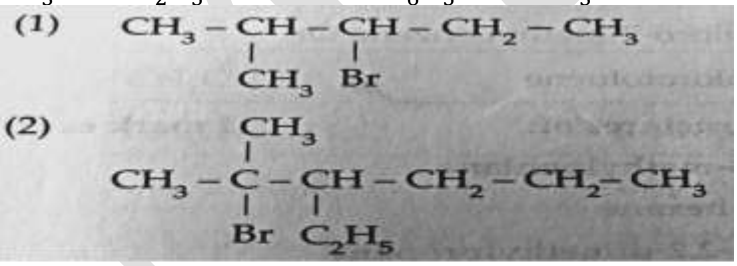
SECTION B

Attempt any Eight : 16.

Q.3. Physical properties of HCℓ
(I) Hydrogen chloride is a colourless and pungent smelling gas.
(ii) It can be easily liquefied to a colouress liquid (b.p.189 K) which freezes to a crystalline solid (m.p.159 K)
(iii) If is highly soluble in water.

Q.4. Ethers are classified into two types
(1) **Symmetrical ether (Simple ether)**
In this type of ethers two alkyl or aryl groups bonded to the oxygen atom are the same.
G.F. R-O-R or Ar-O- Ar
e.g. CH_3-O-CH_3
(2) **Unsymmetrical ether (Mixed ether)**
In this type of ether two alkyl or aryl groups bonded to oxygen atom are different.
G.F. R-O-R or Ar-O-R
CH_3 – O - C_2H_5 C_6H_5 – O - CH_3

Q.5.



(1) $CH_3-\underset{CH_3}{\underset{|}{CH}}-\underset{Br}{\underset{|}{CH}}-CH_2-CH_3$

(2) $CH_3-\overset{CH_3}{\overset{|}{\underset{Br}{\underset{|}{C}}}}-\underset{C_2H_5}{\underset{|}{CH}}-CH_2-CH_2-CH_3$

Q.6. Stability of a complex is governed by (a) charge to size ratio of the metal ion and (b) nature of the ligand.
(i) Charge to size ratio of the metal ion: Higher the ratio greater is the stability. For the divalent metal ion complexes their stability shows the trend: $Cu^{2+} > Ni^{2+} > Co^{2+} > Fe^{2+} > Mn^{+2} > Cd^{2+}$. The above stability order is called Irving-William order. In the above list both Cu and Cd have the charge +2, however, the ionic radius of Cu^{2+} is 69 pm and that of Cu^{2+} is 97 pm. The charge to size ratio of Cu^{2} is greater than that of Cd^{2+}. Therefore the Cu^{2+} forms stable complexes than Cd^{2+}.
(ii) Nature of the ligand: A second factor that governs stability of the complexes is related to how easily the ligand can donate its lone pair of electrons to the central metal ion that is, the basicity of the ligand. The ligands those are stronger bases tend to form more stable

complexes.

Q.7. Step I : $C\ell_{(g)} + O_{3(g)} \rightarrow C\ell O_{(g)} + O_{2(g)}$
Step II : $C\ell O_{(G)} + O_{(g)} \rightarrow C\ell_{(g)} + O_{2(g)}$
Overall : $O_{3(g)} + O_{(g)} \rightarrow 2O_{2(g)}$
Reaction intermediate in this reaction is $C\ell O_{(g)}$, which is formed in step – I and consumed in step – II
Since both the steps involve two reaction each, both the steps are bi-molecular.

Q.8. (a) NaCℓ gives two particles on dissolution.
NaCℓ $\rightarrow Na^{+} + C\ell^{-}$
0.1m 0.1m 0.1m
Total particles in solution = 0.2mol
(b) $AI_2(SO_4) \rightarrow 2AI^{+3} + 3SO^{-2}$
0.05m 0.1m 0.15m
Total particle in solution
=0.1m+0.15m=0.25mol
$Al_2(SO_4)_3$ solution contains more number of particles than NaCl solution. Hence, $Al_2(SO_4)_3$ solution has maximum ΔT_f. Therefore, the freezing point depression of 0.05 m $Al_2(SO_4)_3$ solution will be higher than 0.1 m NaCl solution.

Q.9. The hardness of water is due to presence of Ca^{2+} ions. The Ca^{2+} ions can be removed by adding more Ca^{2+} ions in the form of lime Ca$(OH)_2$, to the hard water. The OH^{-} ions of lime react with HCO_3^{-} ions present in the hard water to form CO_3^{2-}ions.
$OH^{-}_{(aq)} + HCO^{-}_{3(aq)} \rightarrow CO^{2-}_{3(aq)} + H_2O_{(\ell)}$
Solubility product of $CaCO_3$, is very low (K_{sp}= 4.5 ×10^{-9}). Addition of lime makes IP >>K_{sp} which results in the precipitation of $CaCO_3$ and thereby removal of hardness.

Q.10. (i) On dissolution, entropy increases, i.e., ΔS is positive. ΔH is positive, but if TΔS > ΔH, then according to the equation, ΔG = ΔH – T ΔS, ΔG will be-ve. Hence, the process is spontaneous.
(ii) A real crystal has some disorder due to presence of defects whereas ideal crystal has no disorder. Hence, a real crystal has more entropy than ideal crystal.

Q.11. The reducing agent is an element which has low standard reducing potential. This is because the element having low standard reduction potential easily undergoes oxidation and causes the reduction of the other element with which it forms the galvanic cell.
E°_{red}value of $Mg_{(g)}$ is greater than $K_{(s)}$
∴ $K_{(s)}$ is the better reducing agent than $Mg_{(s)}$
E°_{red}value of $Co^{2+}_{(aq)}$ is greater than In (s)
∴ In(s) is the better reducing agent than Co^{2+}

Q.12. Examples:
MnO_2 acts as a catalyst for decomposition of $KClO_3$.
In manufacture of ammonia by Haber's process Mo/Fe is used in Fischer Tropsch process Mo/Fe is used as a catalyst.
Co-Th alloy is used in Fischer Tropsch process

Q.13. Data : ΔH=ΣΔ$H_{(rectants\ bonds)}$-ΣΔ$H_{(reactant\ bonds)}$
=[4ΔH(C − H) + ΔH(O = O)] − [2ΔH(C − H] + ΔH(C-O)+2(O-H)
=2ΔH(C-H)+ ΔA(O=O)]- ΔH(C-O)-2(O-H)
=2(414)+499-745-2(464)=-346kJ
ΔH = -346kJ

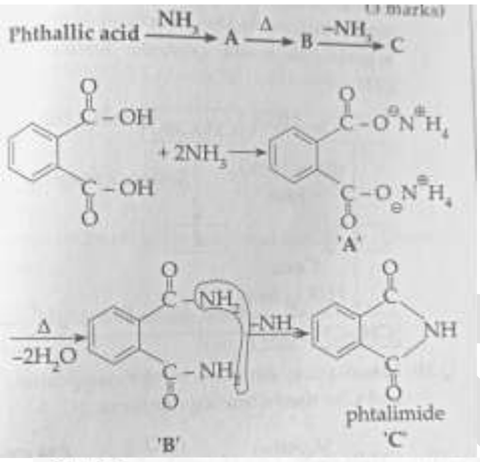
Q.14. At the freezing point of a pure liquid the attractive forces among molecules are large. This makes it difficult to change the phase from liquid to solid.
Now in solution, the solvent molecules are separated from each other due to solute molecules. This decreases the attractive forces between solvent molecules.
Consequently, the temperature of the solution is lowered below the freezing point of pure solvent to cause the phase change.

SECTION C

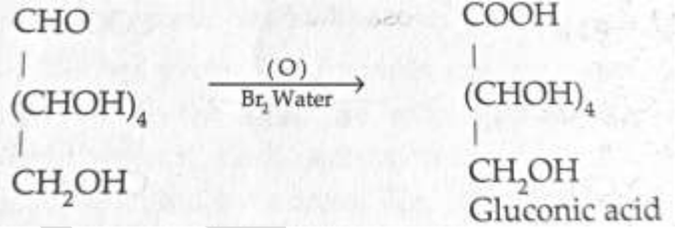
24.

Attempt Any Eight

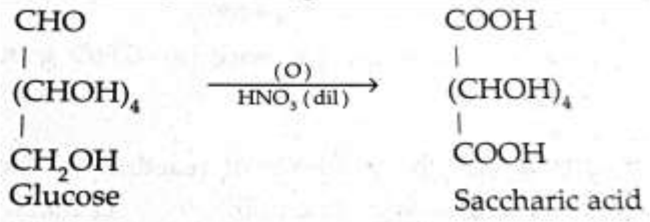
Q.15.



Q.16.



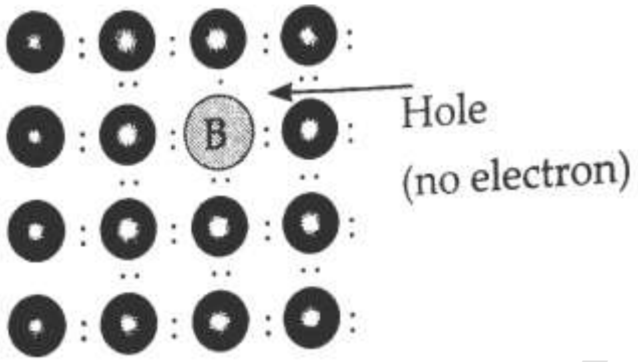
a)
(i) Br_2 Water (bromine water) is a mild oxidizing agent.
(ii) It oxidizes glucose to gluconic acid.



b)
(i) dil Nitric acid is a strong oxidizing agent.
(ii) It oxidizes glucose to saccharic acid.

Q.17. p-type semiconductor is an extrinsic semiconductor obtained by doping intrinsic semiconductor with electron deficient impurity.

It is produced by doping a pure semiconductor material (Si or Ge) with an impurity of group 13 elements having less number of valence electrons than that of the pure semiconductor.
Example Doping of Silicon with Boron The B atoms occupy normal positions of some of the Si atoms in the lattice.

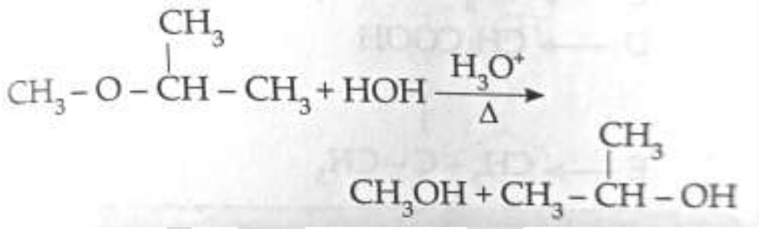


The Boron atom has only three valence electrons hence it does hot have enough electrons to form bonds with its four Si neighboring atoms.
B atom forms bonds with three Si atoms and the missing fourth electron creates an electron vacancy, called a hole, which behaves as a positive charge moving in the direction opposite to the electrons in the partially filled valence bond under the influence of an applied potential.

Q.18.

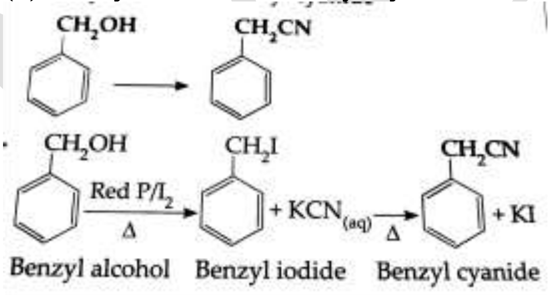
(1) $CH_3 - CH_2 - O - C_2H_5 + HOH \xrightarrow{H_3O^+} 2C_2H_5OH$

(2) $C_6H_5 - O - CH_3 + HOH \xrightarrow{H_3O^+} C_6H_5OH + CH_3OH$



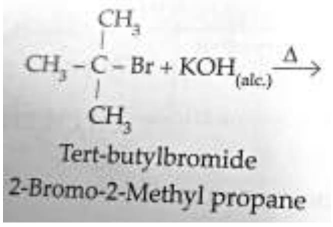
(3)

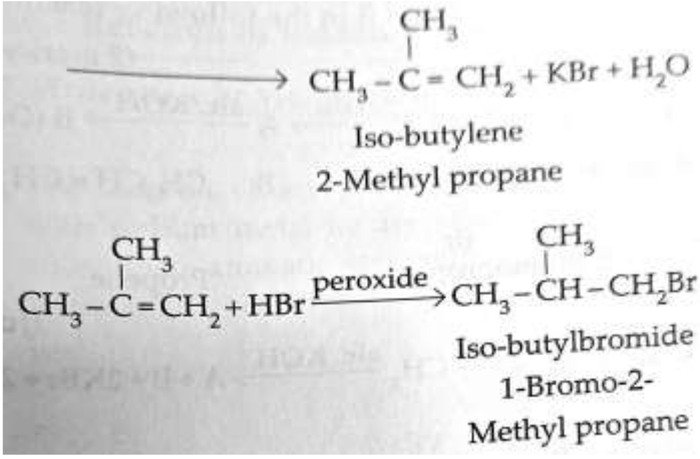
Q.19. (1) Benzyl alcohol to benzyl cyanide



(2) tert-Butyl bromide to isobutyl bromide

(a)





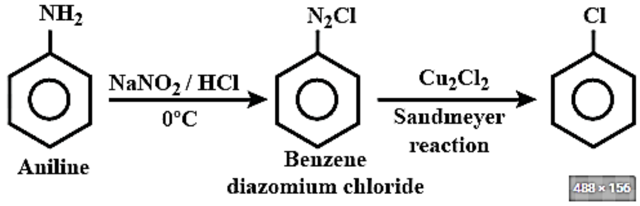
$$\longrightarrow \underset{\text{Iso-butylene}\ \text{2-Methyl propane}}{CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2} + KBr + H_2O$$

Iso-butylene
2-Methyl propane

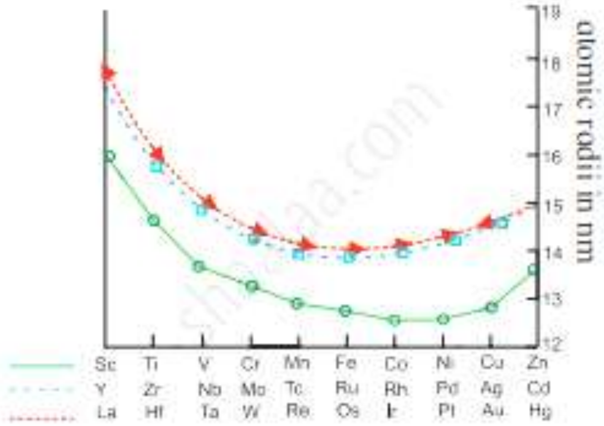
$$CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2+HBr \xrightarrow{\text{peroxide}} CH_3-\overset{\overset{CH_3}{|}}{CH}-CH_2Br$$

Iso-butylbromide
1-Bromo-2-
Methyl propane

(3) Aniline to chlorobenzene



Q.20. Atomic radii of the elements of the transition series decrease gradually from left to right. As we move across a transition series from left to right the nuclear charge increases by one unit at a time. The last filled electron enters a penultimate (n-1) d subshell. However, d orbitals in an atom are less penetrating or more diffused and, therefore d electrons offer smaller screening effect. The result is that effective nuclear charge also increases as the atomic number increases along a transition series. Hence the atomic radii decreases gradually across a transition series from left to right.

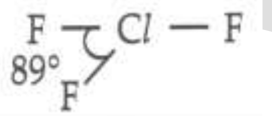
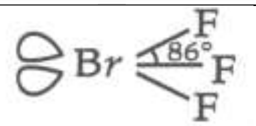
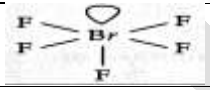


Element (M)	Atomic number (Z) Density (g/cm^3)		Atomic/ions radius (pm)			Ionisation enthalpy (kJ/mol)
			M	$M^{2\oplus}$	$M^{2\oplus}$	
Sc	21	3.43	164	-	73	631
Ti	22	4.1	147	-	67	656
V	23	6.07	135	79	64	650
Cr	24	7.19	129	82	62	653
Mn	25	7.19	129	82	62	717

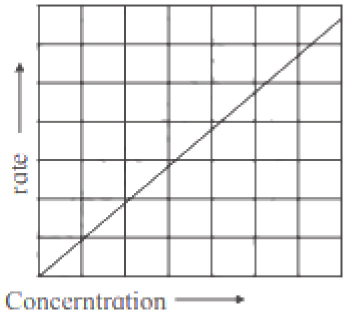
Fe	26	7.8	126	77	65	762
Co	27	8.7	125	74	61	758
Ni	28	8.9	125	70	60	736
Cu	29	8.9	128	73	-	745
Zn	30	7.1	137	75	-	906

Q.21. Ethylamine > diethylamine > triethylamine.
(the reason is that ethyl group has greater +I effect than methyl group)
Ethylamine > n-propaylamine > n-butylamine
n-butyl alcohol > n-butylamine > N-butane.

Q.22.

Formula	Name	Structure	Shape
Icl	Iodine monochloride		Linear
ClF_3	Bromine trifluoride		Bent T-shaped
BrF_3	Bromine trifluoride		Bent T-shaped
BrF_5	Bromine pentafluoride		Square Pyramidal

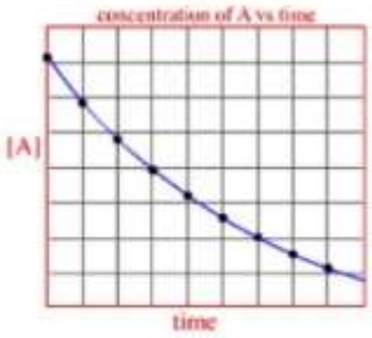
Q.23. (i) A graph of rate of a reaction and concentration:
The differential rate law for the first order reaction A→products is:



Initial concentration

Rate = $\underset{y}{\underset{\updownarrow}{-\frac{d[A]}{dt}}} = \underset{m}{\underset{\updownarrow}{k}}\underset{x}{\underset{\updownarrow}{[A]_t}} + \underset{c}{\underset{\updownarrow}{o}}$

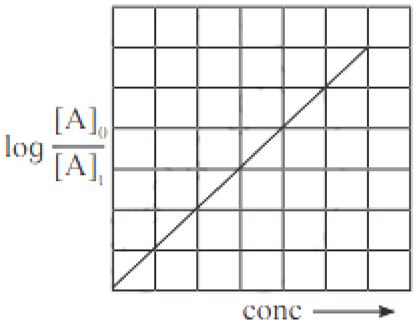
The equation is of the from y=mx + c.A plot of rate versus $[A]_t$is a straight line passing through origin.
The slope of the line =k.
(ii) A graph of concentration against time :
When the concentration of reactant is plotted against time t, a curve is obtained. The variation of concentration with time is given by –



$[A]_t = [A]_\circ . e^{-kt}$

(iii) A graph of log $\frac{[A]_\circ}{[A]_t}$ against time:

The integrated rate law is –K = $\frac{2.303}{t}\log\frac{[A]_\circ}{[A]_t}$

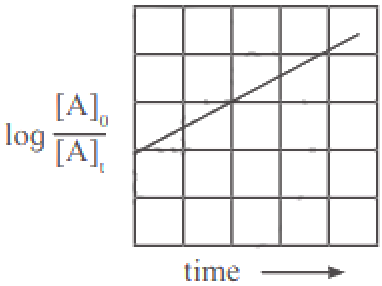


$$\text{Thus}\quad \underset{\underset{y}{\updownarrow}}{\log\frac{[A]_\circ}{[A]_t}} = \underset{\underset{m}{\updownarrow}}{\frac{t}{2.303}}\,\underset{\underset{x}{\updownarrow}}{t}$$

The equation is of the form y=mx. A plot of log $\frac{[A]_\circ}{[A]_t}$ versus time (t) is a straight line passing through origin. The slope of the line = $\frac{k}{2.303}$

A graph of log [$[A]_\circ$ against time (t) :

The integrated rate law is : K = $\frac{2.303}{t}\log\frac{[A]_\circ}{[A]_t}$



$$\frac{kt}{2.303} = \log[A]_\circ - \log[A]_t$$

$$\text{i.e. Thus}\quad \underset{\underset{y}{\updownarrow}}{\log[A]_t} = \underset{\underset{m}{\updownarrow}}{\frac{t}{2.303}}\,\underset{\underset{x}{\updownarrow}}{t} + \underset{\underset{c}{\updownarrow}}{\log[A]_\circ}$$

The equation is of the form y=mx+c. A plot of log $[A]_t$ versus time (t) is a straight line, with intercept on y-axis

Slope of line = $-\frac{-k}{2.303}$

Intercept of line = log $[A]_\circ$.

Q.24 Bufferr action of an acidic buffer:

(I) Consider acidic buffer formed by mixing acetic acid and sodium acetate solutions. CH_3COOH is a weak electrolyte, it dissociates feebly. While CH_3COONa is a strong electrolyte which dissociates almost completely in water.

$CH_3COOH_{(aq)} \rightleftharpoons CH_3COO^-_{(aq)} + H^+_{(aq)}$

$CH_3COONa_{(aq)} \rightarrow CH_3COO^-_{(aq)} + Na^+_{(aq)}$

(ii) When a small quantity of strong acid, HCl is added, the added H+ ions will be consumed by the conjugate base CH,COO present in large concentration and produce undissipated acetic acid.

$CH_3COO^-_{(aq)} \quad + Na^+_{(aq)} \rightleftharpoons CH_3COONa_{(aq)}$

(large concentration) (added acid)

The added acid cannot change the [H] and pH of the buffer remains unchanged.

(iii) When a small quantity of strong base like NaOH is added, the added OH ions of base are neutralized by acetic acid of buffer forming unionized water molecule and pH does not change.

$OH^- + CH_3COOH \rightleftharpoons CH_3COO^- + H_2O$

The added base cannot change the $[OH^-]$ and pH of the buffer remains unchanged.

Q.25 $F_{2(g)} + C\ell F_{(g)} \rightarrow C\ell F_{3(I)}$ ΔH°= -139.2kJ

$\boldsymbol{C\ell F}_{3(I)} + 2O_{2(g)} \rightarrow C\ell_2O_{(g)} + 3OF_{2(g)}$ ΔH°= +533.4kJ

$F_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow OF_{2(g)}$ ΔH°= +24.7kJ

ΔH°= ?

Multiply equation (1) by 2 and equation (3) by (-2) and add to equation (2).

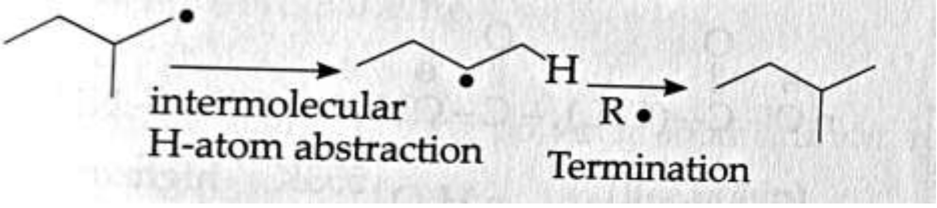
$2F_{2(g)} + 2C\ell F_{(g)} \rightarrow 2C\ell F_{3(I)}$ ΔH°= -278.4kJ

$-2F_{(g)} - O_{2(g)} \rightarrow 2OF_{2(g)}$ ΔH°= -49.4kJ

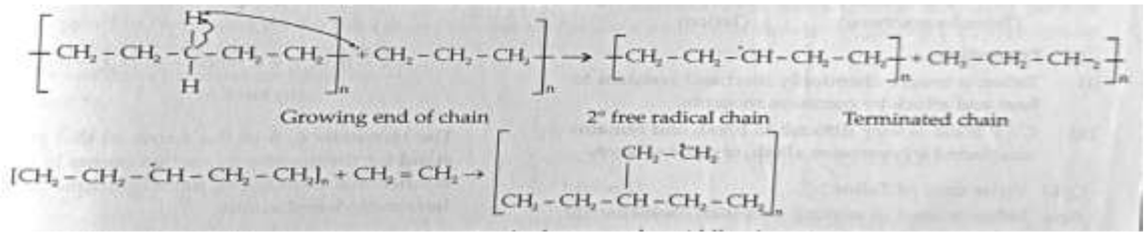
$2C\ell F_{3(I)} + O_{2(g)} \rightarrow \ell O_{(g)} + 3OF_{2(g)}$ ΔH°= +533.4kJ

$2C\ell F_{3(I)} + 2O_{2(g)} \rightarrow C\ell_2O_{(g)} + 3OF_{2(g)}$ ΔH°= +205.6kJ

Q.26 Polythene is obtained by free radical polymerization mechanism. At the high temperature at which this polymerization occurs, the growing free radicals not only add to the double-bond of the monomer but also abstract hydrogen atom from chain already formed. This abstraction of H-atom generates a new free radical centre from which a chain can now grow.



A detailed structural mechanism of the LDP mechanism is



SECTION D

12

Q.27 i) Reference electrode: It is defined as an electrode whose potential is arbitrarily taken as zero or is exactly known.

ii) Standard Hydrogen electrode: An electrode in which pure and dry hydrogen gas is bubbled at 1 atm pressure around a platinised platinum plate immersed in 1M H+ ion solution is called standard hydrogen electrode.

Solution: Data: E^0anode =-0.126 V, E^0cathode = 0.242 V

E^0cell

At LHE: $Pb_{(s)} \rightarrow Pb^{2+}_{(aq)} + 2e^-$ (Oxidation at anode)

At RHE :$Hg_2C\ell_{2(g)} + 2e^- \rightarrow 2Hg_{(I)} + 2C\ell^-$(Reduction at cathode)

$Pb_{(s)} + Hg_2C\ell_{2(g)} \rightarrow Pb^{2+}_{(aq)} + 2Hg_{(I)} + 2C\ell^-_{(aq)}$

Left hand electrode an is anode because E° of Pb is less.

Right hand electrode is an cathode because E° is higher.

∴ The right hand electrode is a calomel electrode. i.e E^0cal

E^0cell = E^0cathode -E^0anode

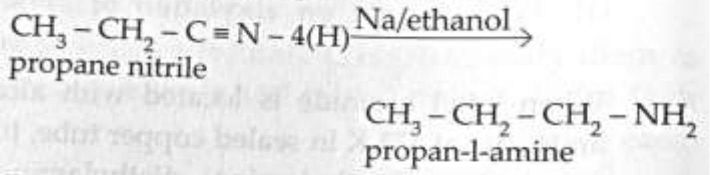
E^0Cal - E^0Pb

= 0.242 − (−0.126)

E^0Cell = 0.368 V

Anode is left and electrode Pb^{2+}/Pb, Cathode is right and calomel electrode.

Q.28. When propane nitrile is reduced by sodium and ethanol, it gives propan -1-amine



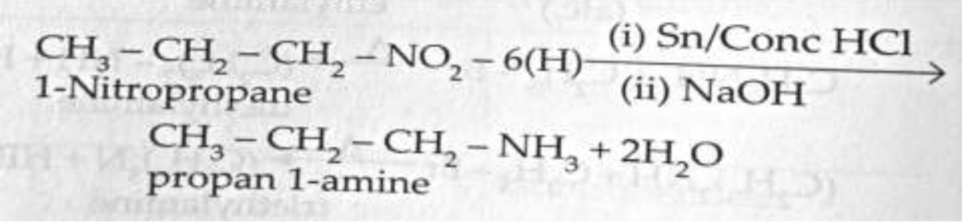
$CH_3-CH_2-C\equiv N-4(H)\xrightarrow{Na/ethanol}CH_3-CH_2-CH_2-NH_2$

propane nitrile

propan-l-amine

From-1-nitropropane:

When 1- nitropropane is reduced in the presence of tin and cone, Hydrochloric acid, propan-1-amine is obtained.



$CH_3-CH_2-CH_2-NO_2-6(H)\xrightarrow[\text{(ii) NaOH}]{\text{(i) Sn/Conc HCl}}CH_3-CH_2-CH_2-NH_3+2H_2O$

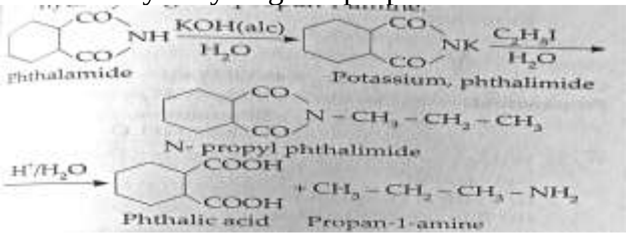
1-Nitropropane

propan 1-amine

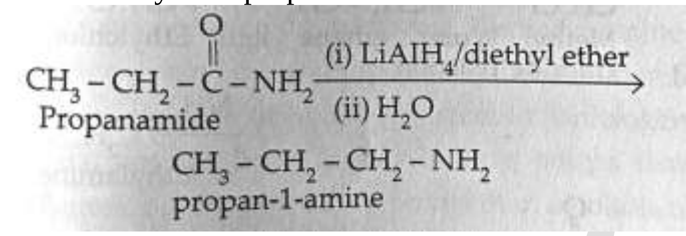
(3)

From phthalamide:

Phthalamide is reacted with alcoholic KOH to form potassium phthalamide. When potassium phthalamide is treated with n-propyl iodide, N-propyl thalimide is obtained which on hydrolysis gives propan-l-amine.

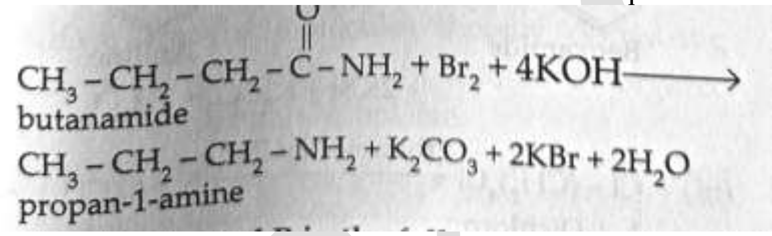


(4) From propanamide: When propanamide is reduced in the pressure of Lithium aluminum hydride propan-1-amine is obtained.



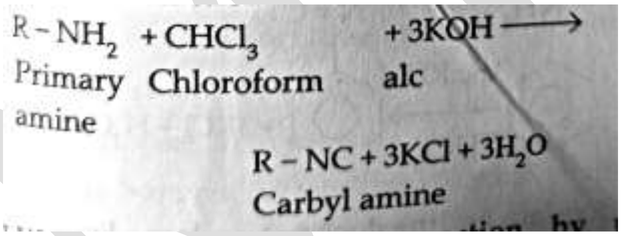
$$\underset{\text{Propanamide}}{CH_3-CH_2-\overset{O}{\overset{\|}{C}}-NH_2} \xrightarrow[\text{(ii) } H_2O]{\text{(i) } LiAlH_4\text{/diethyl ether}} \underset{\text{propan-1-amine}}{CH_3-CH_2-CH_2-NH_2}$$

From butanamide:
When butanamide is reacted with bromine and aqueous KOH, propan-1-amine is obtained.



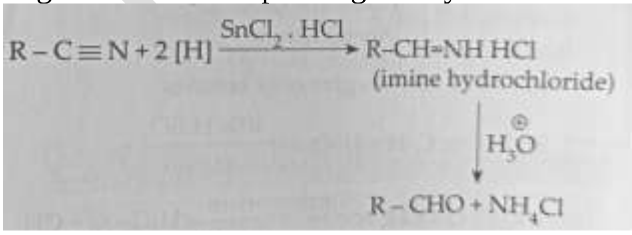
$$\underset{\text{butanamide}}{CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-NH_2} + Br_2 + 4KOH \longrightarrow \underset{\text{propan-1-amine}}{CH_3-CH_2-CH_2-NH_2} + K_2CO_3 + 2KBr + 2H_2O$$

Aliphatic as well as aromatic primary amines on heating with chloroform and alcoholic potassium hydroxide solution form isocyanides or carbylamines which are foul smelling substances. This reaction is known as Carbylamine reaction or Isocyanide test. Secondary and Tertiary amines do not show this reaction. It is a test for primary amines.
General Reaction:



$$\underset{\text{Primary amine}}{R-NH_2} + \underset{\text{Chloroform}}{CHCl_3} + \underset{\text{alc}}{3KOH} \longrightarrow \underset{\text{Carbyl amine}}{R-NC} + 3KCl + 3H_2O$$

Q.29. Nitriles are reduced to imine hydrochloride by $SnCI_2 + HCI$, followed by acid hydrolysis to give called corresponding aldehydes. This reaction is called Stephen reaction.

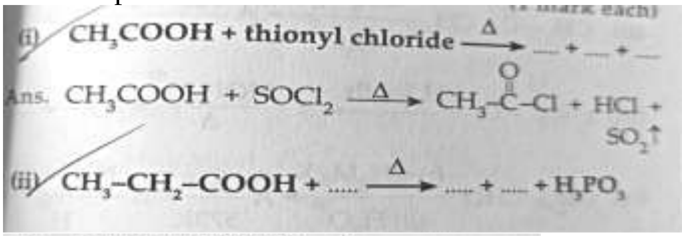


$$R-C\equiv N + 2[H] \xrightarrow{SnCl_2\text{ . }HCl} \underset{\text{(imine hydrochloride)}}{R-CH=NH\,HCl} \xrightarrow{H_3\overset{\oplus}{O}} R-CHO + NH_4Cl$$

(i) Nanoparticles are used in manufacturing of scratch proof eyeglasses, transport, sunscreen, crack resistant paints etc.
(ii) It is used in electronic devices like Magnetoresistive Random Access Memory (MRAM).
(iii) It is used in water purification techniques.

(iv) SNanomaterials used in self cleaning materials. e.g. lotus plant having nanostructures which repel water which carries dirt as it rolls off.

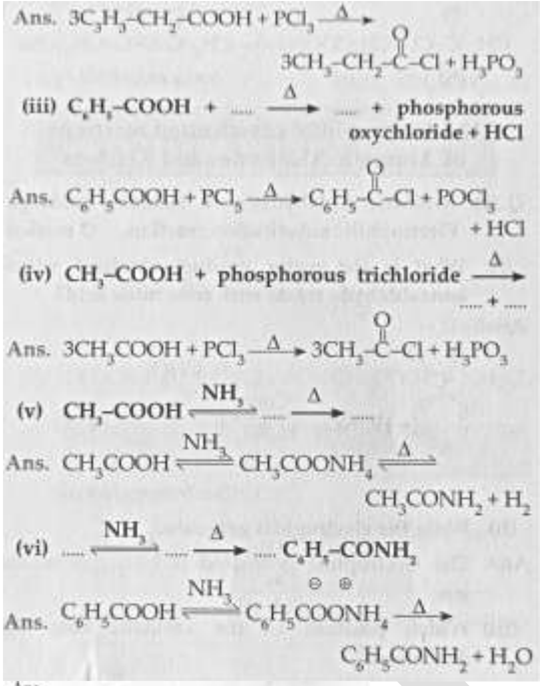
Q.30.



(i) CH_3COOH + thionyl chloride $\xrightarrow{\Delta}$ ..... + ... + ...

Ans. $CH_3COOH + SOCl_2 \xrightarrow{\Delta} CH_3-\overset{O}{\overset{\|}{C}}-Cl + HCl + SO_2\uparrow$

(ii) CH_3-CH_2-COOH + ... $\xrightarrow{\Delta}$ ..... + ... + H_3PO_3



Ans. $3C_2H_5-CH_2-COOH + PCl_3 \xrightarrow{\Delta} 3CH_3-CH_2-\overset{O}{\overset{\|}{C}}-Cl + H_3PO_3$

(iii) C_6H_5-COOH + ... $\xrightarrow{\Delta}$ ..... + phosphorous oxychloride + HCl

Ans. $C_6H_5COOH + PCl_5 \xrightarrow{\Delta} C_6H_5-\overset{O}{\overset{\|}{C}}-Cl + POCl_3 + HCl$

(iv) CH_3-COOH + phosphorous trichloride $\xrightarrow{\Delta}$ ..... + ...

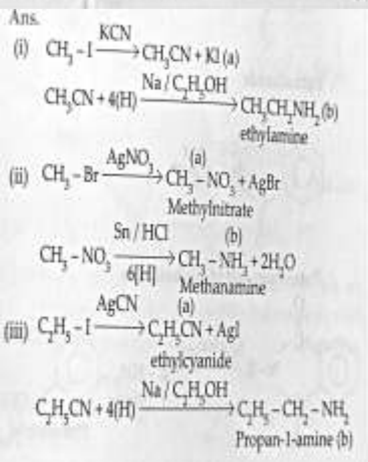
Ans. $3CH_3COOH + PCl_3 \xrightarrow{\Delta} 3CH_3-\overset{O}{\overset{\|}{C}}-Cl + H_3PO_3$

(v) $CH_3-COOH \xrightarrow{NH_3}$ ..... $\xrightarrow{\Delta}$ .....

Ans. $CH_3COOH \overset{NH_3}{\rightleftharpoons} CH_3COONH_4 \overset{\Delta}{\rightleftharpoons} CH_3CONH_2 + H_2$

(vi) ..... $\xrightarrow{NH_3}$ ..... $\xrightarrow{\Delta}$ ..... $C_6H_5-CONH_2$

Ans. $C_6H_5COOH \overset{NH_3}{\rightleftharpoons} C_6H_5CO\overset{\ominus}{O}\overset{\oplus}{N}H_4 \xrightarrow{\Delta} C_6H_5CONH_2 + H_2O$



Ans.

(i) $CH_3-I \xrightarrow{KCN} CH_3CN + KI$ (a)

$CH_3CN + 4(H) \xrightarrow{Na/C_2H_5OH} CH_3CH_2NH_2$ (b)
ethylamine

(ii) $CH_3-Br \xrightarrow{AgNO_3} CH_3-NO_3 + AgBr$ (a)
Methylnitrate

$CH_3-NO_3 \xrightarrow[6[H]]{Sn/HCl} CH_3-NH_2 + 2H_2O$ (b)
Methanamine

(iii) $C_2H_5-I \xrightarrow{AgCN} C_2H_5CN + AgI$ (a)
ethylcyanide

$C_2H_5CN + 4(H) \xrightarrow{Na/C_2H_5OH} C_2H_5-CH_2-NH_2$
Propan-1-amine (b)

Q.31. Stereoisomers: Stereoisomers have the same links among constituent atoms however the arrangements of atoms in space are different.

There are two Kinds of stereoisomers in coordination compounds:

(i) Geometrical isomers or stereoisomers: These are non superimposable mirror image isomers. These are possible in heteroleptic complexes. In these isomers, there are cis and trans types of arrangements of ligands.

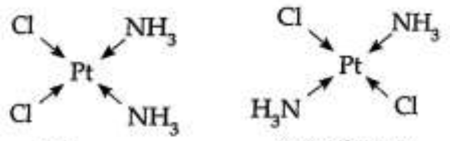
Cis-isomers Identical ligands occupy adjacent positions.

Trans-isomer: Identical ligands occupy the opposite positions.

Cis and trans isomers have different properties. Cis trans isomerism is observed in square planar and octahedral complexes.

Cis and trans isomers in square planar complexes: The square planar complexes of MAB, and MABC type exist as cis and trans isomers, where A, B and C are monodentate ligands, M is metal. For example:

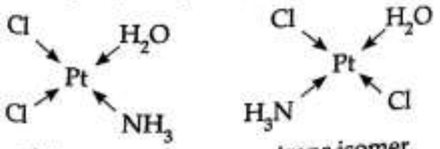
(1) $Pt(NH_3)_2Cl_2$, (MA_2B_2 type)



cis isomer trans isomer

Here the cis isomer is more soluble in water than the trans isomer. The cis isomer named cisplatin is an anticancer drug while the trans isomer is physiologically inactive. The cis isomer is polar with non-zero dipole moment. The trans isomer has zero dipole moment as a result of the two opposite PtCl and two Pt-NH, bond moments, which cancel each other.

(2) $[Pt(NH_3)(H_2O)Cl_2]$ (MA_2BC type)

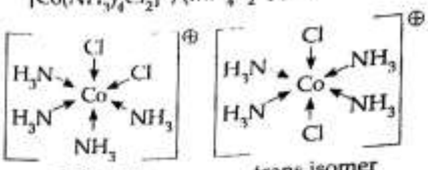


cis isomer trans isomer

Four coordinate tetrahedral complexes do not show cis and trans isomers.

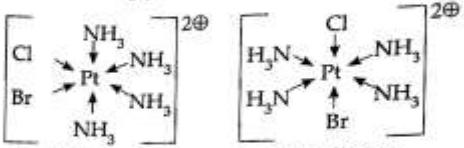
(b) Cis and trans isomers in octahedral complexes: The octahedral complexes of the type MA,B,, MA,BC and M(AA),B, exist as cis and trans isomers. (AA) is a bidentate ligand.

$[Co(NH_3)_4Cl_2]^{\oplus}$, ($MA_4B_2$ type)



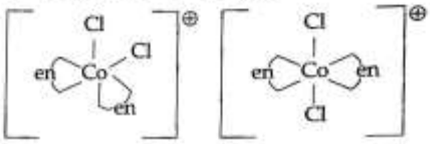
cis isomer trans isomer

$[Pt(NH_3)_4ClBr]^{2\oplus}$, ($MA_4BC$ type)



cis isomer trans isomer

$[Co(en)_2Cl_2]^{\oplus}$, ($M(AA)_2B_2$ type)

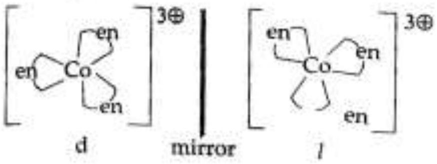


cis isomer trans isomer

ii) Optical isomers (Enantiomers): The complex molecules or ions that are non superimposable mirror images of each other are enantiomers. The no superimposable mirror images are chiral. Enantiomers have identical properties however differ in their response to the plane polarized light. The enantiomer that rotates the plane of plane-polarized light to right (clockwise) is called the dextro (d) isomer, while the other that

rotates the plane to left (anticlockwise) is called levo isomer.
Optical isomers in octahedral complexes

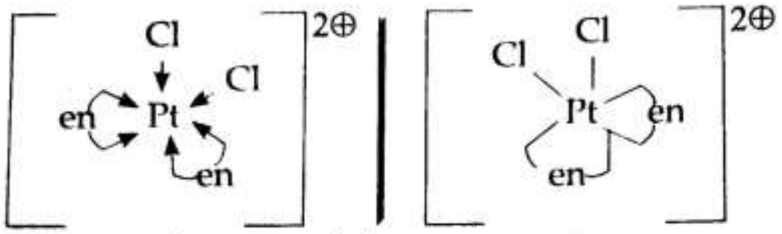
$[Co(en)_3]^{3\oplus}$



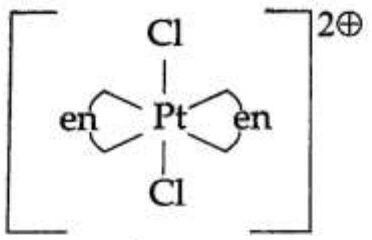
(b) Octahedral complexes existing as both geometrical and optical isomers

$[PtCl_2(en)_2]^{2\oplus}$

In this type of complex, only the cis isomer exists as pair of enantiomers



cis isomer



trans isomer

Square planar complexes do not show enantiomers since they have mirror plane and axis of symmetry.