Question No. 27 a) 3 or 4 marks

1) What is packing efficiency in a crystal? Calculate the packing efficiency per unit cell in a simple cubic lattice (SCC) or primitive cubic cell (PCC).

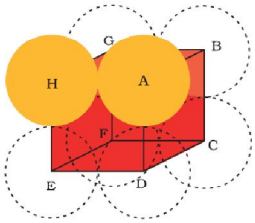
Ans: Packing efficiency is a percentage of total space filled by the particles in a crystal.

Edge length of a cube = a, radius of a particle = r

Particles touch each other along the edge a = 2r,

Volume of the unit cell = $a^3 = 8r^3$

Simple cubic unit cell contains only 1 particle



Volume occupied by particle is = $1x \frac{4}{3} \pi r^3$

$$\text{Packing efficiency} = \frac{\text{volume occupied by the particle}}{\text{volume of the unit cell}} \times 100\%$$

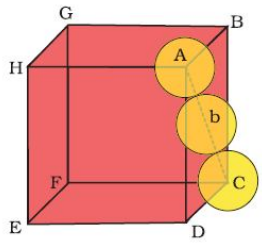
$$= \frac{\frac{4}{3}\pi r^3}{8r^3} \times 100\% \quad = 52.4\%$$

OR

2) Calculate the packing efficiency in face centred cubic (FCC) or CCP or hcp arrangement.

Ans: If r is the radius of the particle, then $b = 4r = \sqrt{2}\, a$ or $a = 2\sqrt{2}\, r$

Volume of the unit cell is $a^3 = (2\sqrt{2}r)^3$



Volume of one particle $= \frac{4}{3}\pi r^3$

Each unit cell has 4 particles.

Total volume of four particles is equal to $4 \times \frac{4}{3}\pi r^3$

$$\text{Packing efficiency} = \frac{\text{volume occupied by the particles}}{\text{Total volume of the unit cell}} \times 100\%$$

$$= \frac{4 \times \frac{4}{3}\pi r^3}{(2\sqrt{2}r)^3} \times 100\% \quad = 74\ \%$$

OR

3) Calculate the packing efficiency in body centred cubic (bcc) lattice.

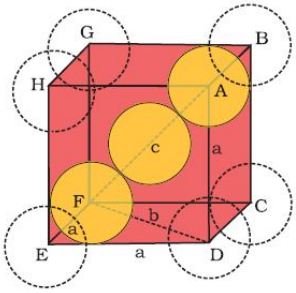
Ans: Edge length of a cube = a, radius of a particle = r,

body diagonal = c. then c = 4r.

$c^2 = 3a^2$

$(4r)^2 = 3a^2$ or $a = 4r/\sqrt{3}$

$\therefore$ Volume of the unit cell = $a^3 = (4r/\sqrt{3})^3$



Volume of one particle $= \frac{4}{3}\pi r^3$

Volume occupied by the particles $= 2 \times \frac{4}{3}\pi r^3$

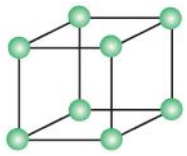
$$\text{Packing Efficiency} = \frac{\text{volume occupied by the particles}}{\text{volume of the unit cell}} \times 100\%$$

$$= \frac{2 \times \frac{4}{3}\pi r^3}{(4r/\sqrt{3})^3} \times 100\% \quad = 68\%.$$

Question No. 27 b) 2 marks

1) Calculate the number of particles present in per unit cell in SCC.

Ans: In SCC, the particles present at only eight corners and each particle is shared by eight other unit cells.



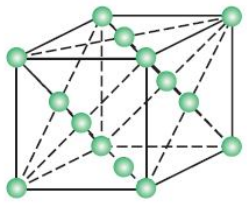
Therefore, the total number of particles present in a unit cell is

$= 8 \times \frac{1}{8} = 1$ particle.

OR

2) Calculate the number of particles present in per unit cell in FCC.

Ans: In FCC, the particle present at centre of each face is shared by two other unit cells where as each particle at corner is shared by eight other unit cells.



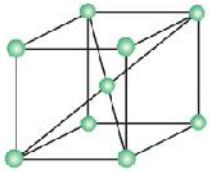
Therefore, the total number of particles present in a unit cell is

$= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} \quad = 1 + 3 = 4$ particles.

OR

3) Calculate the number of particles present in per unit cell in BCC.

Ans: In BCC, the particle present at body centre is shared only unit cell where as each particle at corner is shared by eight other unit cells.



Therefore, the total number of particles present in a unit cell is

$= 8 \times \frac{1}{8} + 1 \times 1 \quad = 1 + 1 = 2$ particles

OR

4) An element having atomic mass 107.9g/mol has fcc unit cell. The edge length of unit cell is 408.6pm. Calculate the density of the unit cell. (Given $N_A = 6.022 \times 10^{23} mol^{-1}$).

Ans: Given, z = 4, a = 408.8 pm = 408.8×10^{-12} m, M = 107.9g/mol = 107.9×10^{-3},
$N_A = 6.022 \times 10^{23}$ per mol, d = ?

$$\text{Density (d)} = \frac{z.M}{N_A.a^3} = \frac{4 \times 107.9 \times 10^{-3}}{6.022 \times 10^{23} \times (408.8 \times 10^{-12})^3} = 1.05 \times 10^{-2} \text{ kgm}^{-3}$$

OR

5) Sodium metal crystallizes in a BCC structure. Its unit cell edge length is 420pm. Calculate its density. (atomic mass of sodium = 23u, NA = 6.022×10^{23} mol^{-1}).

Ans: Given, z = 2, a = 420 pm = 288×10^{-12} m, M = 23u = 23×10^{-3},
$N_A = 6.022 \times 10^{23}$ per mol, d = ?

$$\text{Density (d)} = \frac{z.M}{N_A.a^3} = \frac{2 \times 23 \times 10^{-3}}{6.022 \times 10^{23} \times (420 \times 10^{-12})^3} = 3.73 \text{ kgm}^{-3}$$

OR

6) An element has a body centred cubic structure with a cell edge of 288 pm. The density of the element is 7.2 g/cm³. How many atoms are present in 208 g of the element?

Ans: Given, z = 2, a = 288 pm = 288×10^{-10} cm, d = 7.2 g/cm³,
$N_A = 6.022 \times 10^{23}$ per mol

i.e $d = \frac{z.M}{N_A.a^3}$

$$\therefore M = \frac{d.N_A.a^3}{z} = \frac{7.2 \times 6.022 \times 10^{23} \times (288 \times 10^{-10})^3}{2} = 51.79 \text{ g/mol}$$

51.79 g of element contains 6.022×10^{23} atoms.

208 g of the element contains $= \frac{6.022 \times 10^{23} \times 208}{51.79}$ atoms $= 24.19 \times 10^{23}$ atoms.

Question No. 11) 2 marks

1) A cubic unit cell consists of three elements A, B & C. Atoms of A are present at the corners, atoms of B at the body centre and atoms of C at the centre of each face. What is the formula of the compound?

Ans: No. of atoms A per unit cell = $8 \times \frac{1}{8} = 1$

No. of atoms B per unit cell = $1 \times 1 = 1$

No. of atoms C per unit cell = $6 \times \frac{1}{2} = 3$

A:B:C =1:1:3

Therefore, the formula of the compound is **ABC_3**

OR

2) A compound id formed by two elements X and Y. Atoms of the element Y (as anions) make ccp and those of the element X (as cations) occupy all the octahedral voids. What is the formula of the compound?

Ans: Let the no. of atoms of Y involved in ccp be 'x'

Therefore, no. of octahedral voids = x

Given that all the octahedral voids are occupied by atoms of X.

Therefore, no. of atoms of X = x

Thus, ratio of X : Y = x : x = 1 : 1

Hence the formula of the compound is **XY.**

OR

3) Write any four differences between crystalline and amorphous solids.

Ans:

	Crystalline solids		**Amorphous solids**
1.	These have regular arrangement of constituent particles.	1.	These have no regular arrangement of constituent particles.
2.	These have definite shape and definite volume.	2.	These don't have definite shape and definite volume.
3.	These have sharp melting points.	3.	Melting points over a range of temperature.
4.	Anisotropic in nature.	4.	Isotropic in nature.
5.	These are true solids.	5.	These are not true solids.

OR

4) Write any two differences between Schoktty defect and Frenkel defect.

Ans:

	Schoktty defect		**Frenkel defect**
1.	Equal number of cations and anions are missing from their lattice.	1.	An ion occupies interstitial site.
2.	Decrease in density of solids.	2.	No change in density of solids.

Unit –2 Solutions

Question No. 28) 3 Marks:

1) The vapour pressure of pure benzene at certain temperature is 0.850bar. A 0.5g of non-volatile solute is dissolved in 39g of benzene (molar mass of benzene is 78 g/mol). Then the vapour pressure of the solution is 0.845bar. Calculate the molar mass of the solute.

Solution: Given, $p^0 = 0.850bar$, $p = 0.845bar$, Then, $p^0 - p = 0.850 - 0.845 = 0.005bar$

$w_1 = 39g$, $M_1 = 78g/mol$

$w_2 = 0.5g$, $M_2 = ?$

$$M_2 = \frac{w_2 M_1}{w_1} \times \frac{p^0}{p^0 - p}$$

$$M_2 = \frac{0.5 \times 78 \times 0.850}{39 \times 0.005} = 170g/mol$$

OR

2) The boiling point of benzene is 353.23K when 1.80g of a non-volatile, non-ionising solute was dissolved in 90g of benzene, the boiling point is raised to 354.11K. Calculate the molar mass of the solute. (Given K_b for benzene = 2.53Kkg/mol)

Solution: Given, $w_1 = 90g$, $w_2 = 1.80g$, $K_b = 2.53Kkg/mol$

$\Delta T_f = T - T_0 = 354.11 - 353.23 = 0.88K$ $M_2 = ?$

$$\therefore M_2 = \frac{K_b \times w_2 \times 1000}{w_1 \times \Delta T_b} = \frac{2.53 \times 1.80 \times 1000}{90 \times 0.88} = 57.5g/mol$$

OR

3) A 0.643g of a solute is dissolved in 50ml of benzene (density is 0.879g/ml) decreases the freezing point from 278.66K to 278.18K. If K_f for benzene is 5.12Kkg/mol. Calculate the molar mass of the solute.

Solution: Given, $w_2 = 0.643g$, $K_f = 5.12\ Kkg/mol$

$\Delta T_f = T_0 - T = 278.66 - 278.18 = 0.48K$

Volume 'v' = 50ml, $d = 0.879g/ml$

$w_1 = v \times d = 50 \times 0.879 = 43.95g$ $M_2 = ?$

$$\therefore M_2 = \frac{K_f \times w_2 \times 1000}{w_1 \times \Delta T_f} = \frac{5.12 \times 0.643 \times 1000}{43.95 \times 0.48} = 156.1g/mol$$

OR

4) A 200cm³ of an aqueous solution of a protein contains 1.26g of protein. The osmotic pressure of the solution at 300K is found to be 2.57 x 10⁻³bar. Calculate the molar mass of the protein (Ideal gas constant R = 0.083 litre bar/K/mol).

Solution: Given, $V = 200cm^3 = 0.2L.$ $w = 1.26g$, $T = 300K$

$\pi = 2.57 \times 10^{-3}bar$, $R = 0.083$ litre bar/K/mol $M = ?$

$$\pi = \frac{wRT}{MV}$$

$$M = \frac{wRT}{\pi V} = \frac{1.26 \times 0.083 \times 300}{2.57 \times 10^{-3} \times 0.2} = 61.039g/mol$$

Unit – 4 Chemical kinetics

Question No. 30 a) 3 Marks:

1) Derive an integrated rate equation for the velocity constant or rate constant of a zero order reaction.

Ans: Consider a zero order reaction $R \longrightarrow P$

$$\text{Rate} = -\frac{d[R]}{dt} = k[R]^0$$

$$-\frac{d[R]}{dt} = k \times 1$$

$$d[R] = -k\,dt$$

Integrating both sides, we get $[R] = -kt + I$ -- (1) where I is integration constant

At, $t = 0$, $[R] = [R]_0$, eqn (1) becomes $[R]_0 = I$ --- (2)

where $[R]_0$ is the initial concentration of the reactant.

Substitute (2) in (1)

$$\boxed{[R] = -kt + [R]_0}$$

OR

2) Derive an integrated rate equation for the velocity constant or rate constant of a first order reaction.

Ans: Consider a first order reaction $R \longrightarrow P$

$$\text{Rate} = -\frac{d[R]}{dt} = k[R]$$

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

Integrating the equation, we get $\ln[R] = -kt + I$ --- (1)

When $t = 0$, $R = [R]_0$, eqn (1) becomes $\ln[R]_0 = I$ --- (2)

Substitute (2) in (1)

$$\ln[R] = -kt + \ln[R]_0$$

$$k = \frac{1}{t} \ln \frac{[R]_0}{[R]}$$

$$\boxed{k = \frac{2.303}{t} \log_{10} \frac{[R]_0}{[R]}}$$

OR

3) Rate constant of a first order reaction is 0.0693 min^{-1}. Calculate the percentage of the reactant remaining at the end of 60 minutes.

Ans: Given $k = 0.0693\ min^{-1}$, $t = 60$ minutes, $[R]_0 = 100\%$, $R = ?$

$$k = \frac{2.303}{t} \log_{10} \frac{[R]_0}{[R]}$$

$$0.0693 = \frac{2.303}{60} \log_{10} \frac{100}{[R]}$$

$$R = 1.56\%$$

OR

4) The rate of a reaction increases by 4 times when the temperature of the reaction is raised from 340 K to 360 K. Calculate the energy of activation of the reaction. Given R = 8.314 J/K/mol.

Ans: Given $\log(k_2/k_1) = 4$, $T_1 = 340$, $T_2 = 360$, $Ea = ?$

$$\log \frac{k_2}{k_1} = \frac{Ea}{2.303R} \left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

$$\log 4 = \frac{Ea}{2.303 \times 8.314} \left(\frac{360 - 340}{340 \times 360}\right)$$

$$\log 4 = \frac{Ea}{2.303 \times 8.314} \left(\frac{360 - 340}{340 \times 360}\right)$$

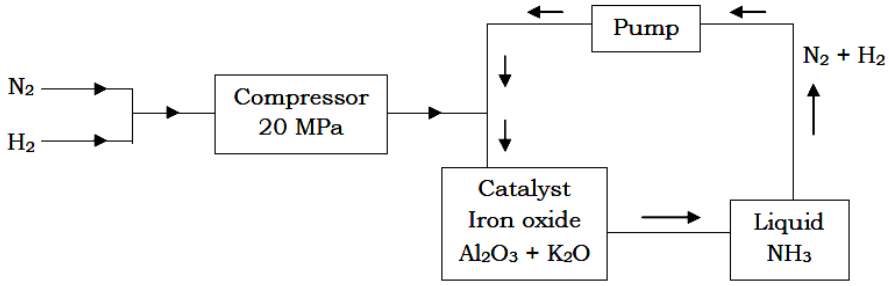
$$Ea = 70554J \text{ or } 70.554\ kJ$$

Unit –7 p – block elements

Question No. 20) or 21) or 22) 3 Marks:

1) For the manufacture of ammonia by Haber's process,
i) Draw the flow chart
ii) Write the chemical equation for the reaction involved
iii) Name the catalyst and promoter used in the reaction.

Ans: i) Haber's Process flow chart



ii) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, $\Delta H_f = -92$ kJ/mol

iii) Catalyst - Iron oxide and promoter- Molybdenum

OR

2) Write the chemical equations are involved in the manufacture of nitric acid by Ostwald's process.

Ans: Step I: Conversion of ammonia into nitrogen oxide:

$$\underset{\text{Ammonia}}{4NH_3(g)} + \underset{\text{Oxygen}}{5O_2(g)} \xrightarrow[500K,\ 9\ bar]{Pt/Rh\ gauze\ catalyst} \underset{\text{Nitrogen oxide}}{4NO(g)} + 6H_2O(g)$$

Step II: Conversion of nitrogen oxide into nitrogen dioxide:

$$\underset{\text{Nitrogen oxide}}{2NO\ (g)} + O_2\ (g) \longrightarrow \underset{\text{Nitrogen dioxide}}{2NO_2\ (g)}$$

Step III: Conversion of nitrogen dioxide into nitric acid:

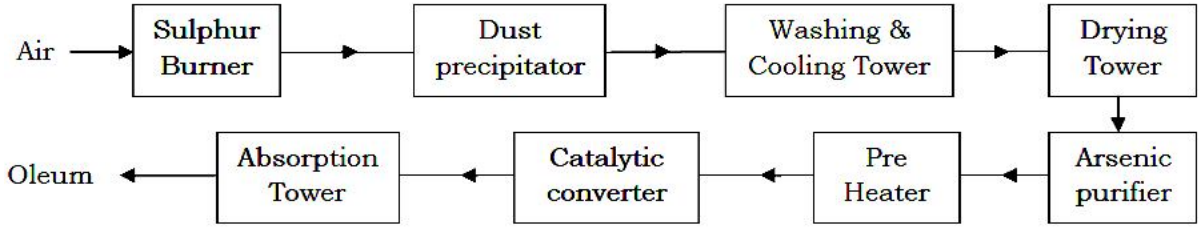
$$\underset{\text{Nitrogen dioxide}}{3NO_2\ (g)} + H_2O\ (l) \longrightarrow \underset{\text{Nitric acid}}{2HNO_3\ (aq)} + NO\ (g)$$

NO thus formed is recycled and the aqueous HNO_3 can be concentrated by distillation.

OR

3) Write the flow chart and chemical equations are involved in the manufacture of sulphuric acid by Contact process.

Ans: Flow chart:



Sulphuric acid is manufactured by the Contact process which involves three steps:

Step I: Conversion of sulphur into sulphur dioxide:

$$\underset{\text{Sulphur}}{S} + \underset{\text{Oxygen}}{O_2\ (g)} \longrightarrow \underset{\text{Sulphur dioxide}}{SO_2\ (g)}$$

Step II: Conversion of sulphur dioxide into sulphur trioxide:

$$\underset{\text{Sulphur dioxide}}{2SO_2\ (g)} + O_2\ (g) \xrightarrow{V_2O_5} \underset{\text{Sulphur trioxide}}{2SO_3\ (g)} \quad \Delta H_f = -196.6\ \text{kJ/mol}$$

Step III: Conversion of sulphur trioxide into Oleum :

$$\underset{\text{Sulphur trioxide}}{SO_3} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Oleum}}{H_2S_2O_7}$$

Step IV: Conversion of Oleum into Sulphuric acid :

$$\underset{\text{Oleum}}{H_2S_2O_7} + \underset{\text{Water}}{H_2O} \longrightarrow \underset{\text{Sulphuric acid}}{2H_2SO_4}$$

The sulphuric acid obtained by Contact process is 96-98% pure.

OR

4) How is chlorine prepared using $KMnO_4$? (2 Marks)

Ans: Action of conc. HCl on $KMnO_4$

$$2KMnO_4 + 16HCl \longrightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$$

Unit –8 d & f – block elements

Question No. 24) 3 Marks:

1) Write the chemical equations are involved in the manufacture potassium permanganate ($KMnO_4$).

Ans: Step I: Conversion of manganese dioxide into potassium manganate:

$$\underset{\text{Manganese dioxide}}{2MnO_2} + \underset{\text{Potassium hydroxide}}{4KOH} + \underset{\text{Oxygen}}{O_2} \xrightarrow{KNO_3} \underset{\text{Potassium manganate}}{2K_2MnO_4} + 2H_2O$$

Step II: Conversion of potassium manganate into potassium permanganate:

$$\underset{\text{Potassium Manganate}}{3K_2MnO_4} + \underset{\text{Acid}}{4H^+} \longrightarrow \underset{\text{Potassium permanganate}}{2KMnO_4} + MnO_2 + 2H_2O$$

OR

2) Write the chemical equations are involved in the manufacture of potassium dichromate ($K_2Cr_2O_7$) from chromite ore.

Ans. The manufacture of potassium dichromate involves the following steps.

Step I: Conversion of chromite ore into sodium chromate:

$$\underset{\text{Chromite ore}}{4FeO.Cr_2O_3} + \underset{\text{Sodium carbonate}}{8Na_2CO_3} + \underset{\text{Oxygen}}{7O_2} \xrightarrow{900^oC} \underset{\text{Sodium chromate}}{8Na_2CrO_4} + \underset{\text{Iron oxide}}{2Fe_2O_3} + 8CO_2\uparrow$$

Step-II:Conversion of sodium chromate into sodium dichromate:

$$\underset{\text{Sodium chromate}}{2Na_2CrO_4} + \underset{\text{Sulpuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Sodium dichromate}}{Na_2Cr_2O_7} + \underset{\text{Sodium sulphate}}{Na_2SO_4} + H_2O$$

The solution is concentrated and cooled, when less soluble sodium sulphate crystallized out. On filteration sodium dichromate separate in the form of filterate.

Step III:Conversion of sodium dichromate into potassium dichromate:

$$\underset{\text{Sodium dichromate}}{Na_2Cr_2O_7} + \underset{\text{Potassium chloride}}{2KCl} \longrightarrow \underset{\text{Potassium dichromate}}{K_2Cr_2O_7} + 2NaCl$$

The solution mixture is cooled. The less soluble potassium dichromate crystallizes out leaving behind sodium chloride solution.

Unit –9 Coordination compounds

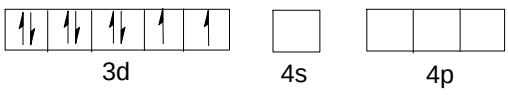
Question No. 25) or 26) 3 Marks:

1) Using VBT account for the hybridisation, geometry and magnetic property of $[Ni(CN)_4]^{-2}$

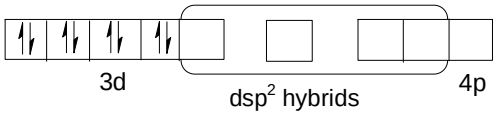
Ans:

Electronic configuration of Ni^{+2}: $[Ar]3d^8$

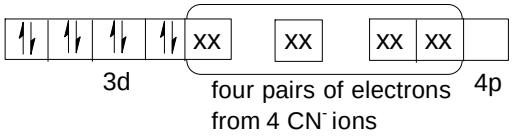
Orbitals of Ni^{+2} ion is



dsp^2 hybridised orbitals of Ni^{+2}



$[Ni(CN)_4]^{-2}$



Hybridization: dsp^2

Geometry: Square planar

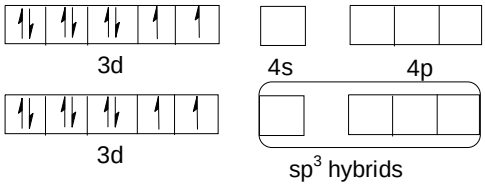
Magnetic property: Diamagnetic

OR

2) Using VBT account for the hybridisation, geometry and magnetic property of $[Ni(Cl)_4]^{-2}$.

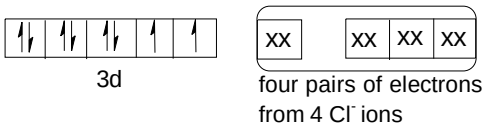
Ans:

Electronic configuration of Ni^{+2}: $[Ar]3d^8$
Orbitals of Ni^{+2} ion is



sp^3 hybridised orbitals of Ni^{+2}

$[Ni(Cl)_4]^{-2}$



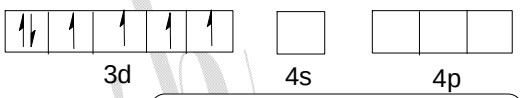
Hybridization: sp^3
Geometry: Tetrahedral
Magnetic property: Paramagnetic

OR

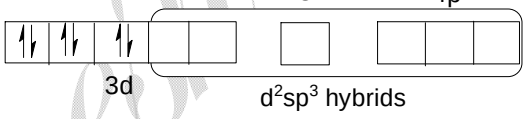
3) Using VBT account for the hybridisation, geometry and magnetic property of $[Co(NH_3)_6]^{+3}$

Ans:

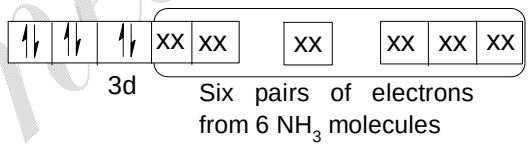
Electronic configuration of Co^{+3}: $[Ar]3d^6$
Orbitals of Co^{+3} ion is



d^2sp^3 hybridised orbitals of Co^{+3}



$[Co(NH_3)_6]^{+3}$



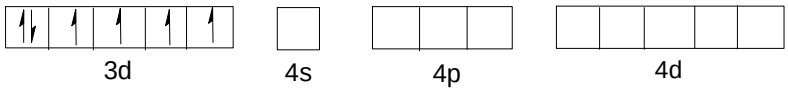
Hybridization: d^2sp^3
Geometry: Octahedral
Magnetic property: Diamagnetic

OR

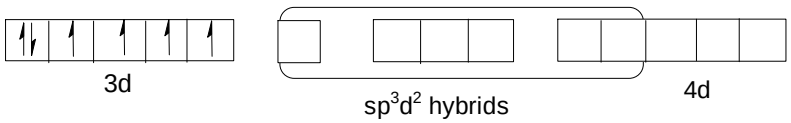
4) Using VBT account for the hybridisation, geometry and magnetic property of $[CoF_6]^{+3}$.

Ans:

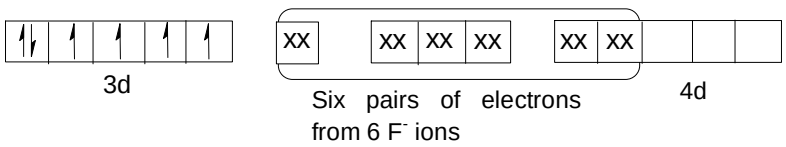
E.C. of Co^{+3}: $[Ar]3d^6$
Orbitals of Co^{+3} ion is



sp^3d^2 hybridised orbitals of Co^{+3}



$[CoF_6]^{+3}$



Hybridization: sp^3d^2
Geometry: Octahedral
Magnetic property: Paramagnetic

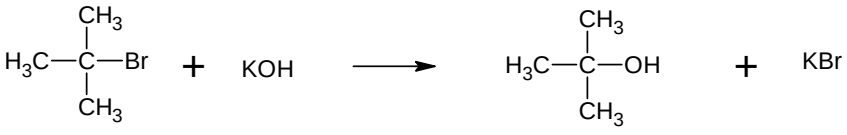
Unit – 10 Haloalkanes and Haloarenes

Question No. 32 a) 3 Marks:

1) What is S_N1 mechanism? Explain S_N1 mechanism by taking hydrolysis of tertiary butyl bromide as an example.

Ans : It is unimolecular nucleophilic substitution reaction.

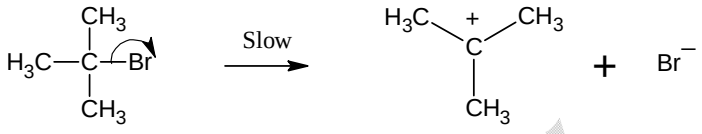
When tertiary butyl bromide is heated with aqueous potassium hydroxide, tertiary butyl alcohol is formed.



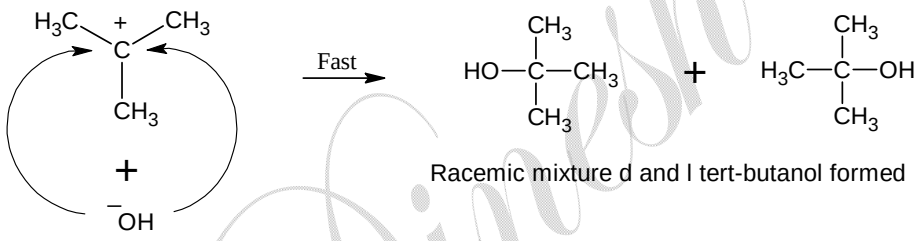
t-Butyl bromride — t-Butyl alcohol

Mechanism : The mechanism involves two steps.

Step 1 : Formation of carbocation.



Step 2 : Attack of nucleophile (OH^-).



Racemic mixture d and l tert-butanol formed

OR

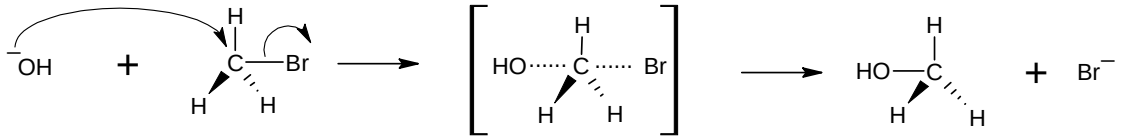
2) What is S_N2 mechanism? Explain S_N2 mechanism by taking an example of hydrolysis of methyl bromide.

Ans : It is bimolecular nucleophilic substitution reaction.

When methyl bromide is heated with aqueous potassium hydroxide, methyl alcohol is formed.

$$CH_3 - Br + KOH \xrightarrow{\Delta} CH_3 - OH + KBr$$

Mechanism : The mechanism involves only one step



Transistion state

In this mechanism the nucleophile OH^- attacks the carbon atom to form a new C – OH bond. Here, there exists a transition state in which C – OH bond is partially formed and C – Br bond is partially broken. Finally the C – OH bond becomes stronger and C – Br bond gets weakened, releases Br^- to give end product methyl alcohol.

Unit – 11 Alcohols, Phenols and Ethers

Question No. 33 a) 3 Marks:

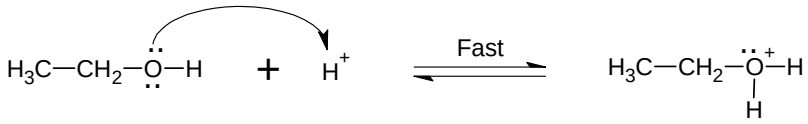
1) Explain the mechanism of acid catalysed dehydration of ethanol into ethene.

Ans: Ethyl alcohol is treated with Conc. H_2SO_4 at 443 K, it undergoes dehydration to give ethene.

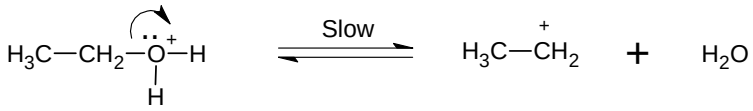
$$\underset{\text{Ethanol}}{CH_3\text{-}CH_2\text{-}OH} + \text{Conc. } H_2SO_4 \xrightarrow{443\ K} \underset{\text{Ethene}}{CH_2{=}CH_2} + H_2O$$

Mechanism:

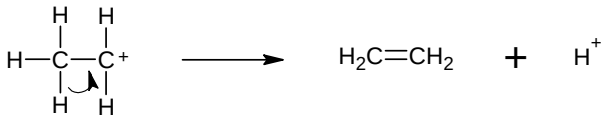
Step-1: Formation of protonated alcohol.



Step-2: Formation of carbocation.



Step-3: Loss of proton.



OR

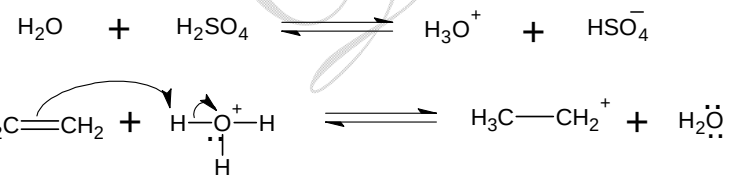
2) Explain the mechanism of acid catalysed hydration of ethene to form ethanol.

Ans: When ethene is treated with water in the presence of Conc. H_2SO_4 to form ethyl alcohol.

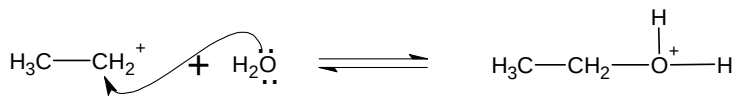
$$\underset{\text{Ethene}}{CH_2{=}CH_2} + H_2O \xrightarrow{\text{Conc. } H_2SO_4} \underset{\text{Ethyl alcohol}}{CH_3\text{-}CH_2\text{-}OH}$$

Mechanism: It involves three steps.

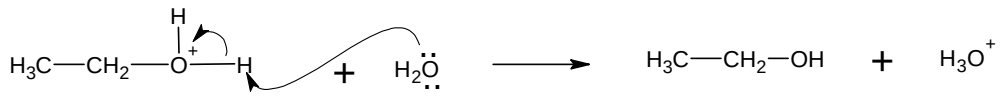
Step-1: Formation of carbocation.



Step-2: Attack of nucleophile.



Step-3: Loss of proton to form alcohol.

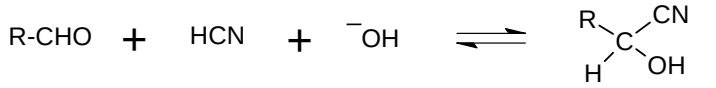


Unit – 12 Aldehydes, ketones and carboxylic acids

Question No. 34 a) 3 Marks:

1) Explain the mechanism of addition of HCN to aldehyde.

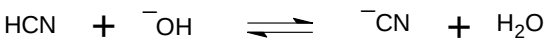
Ans: Aldehyde reacts with hydrogen cyanide in base to give aldehyde cyanohydrin.



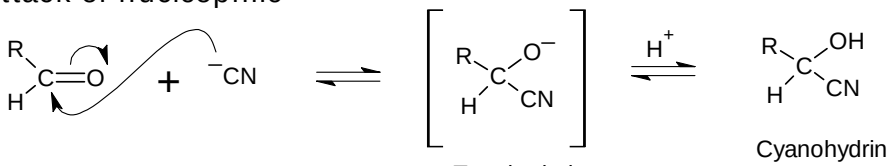
Cyanohydrin

Mechanism:

Step-1: Formation of nucleophile



Step-2: Attack of nucleophile



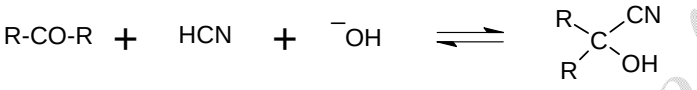
Tetrahedral intermediate

Cyanohydrin

OR

2) Explain the mechanism of addition of HCN to ketone.

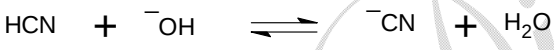
Ans: Ketone reacts with hydrogen cyanide in base to give ketone cyanohydrin.



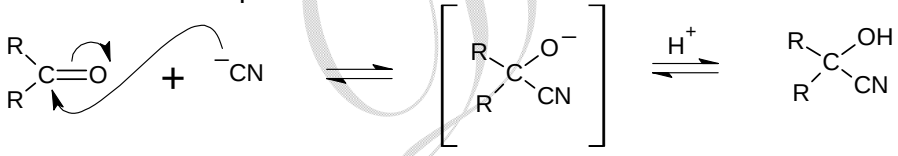
Cyanohydrin

Mechanism:

Step-1: Formation of nucleophile



Step-2: Attack of nucleophile



Tetrahedral intermediate

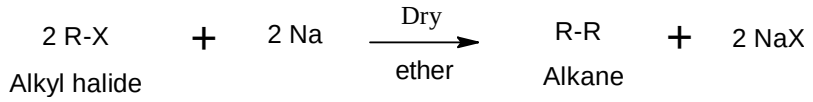
2 Marks Questions: PART –B OR PART-D:

1) Write general equation for Wurtz reaction.

OR

How do you convert alkyl halide to alkane?

Ans: Alkyl halide reacts with sodium metal in dry ether to form alkane.



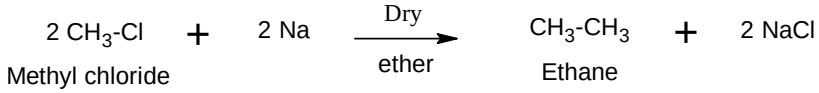
OR

Explain wurtz reaction with an example.

OR

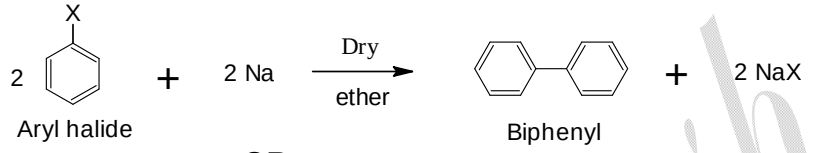
Write the chemical equation when methyl chloride reacts with sodium in dry ether.

Ans: Methyl chloride reacts with sodium metal in dry ether to form ethane



2) Write the general equation for Fittig reaction.

Ans: Aryl halide reacts with sodium metal in dry ether to form biphenyl.



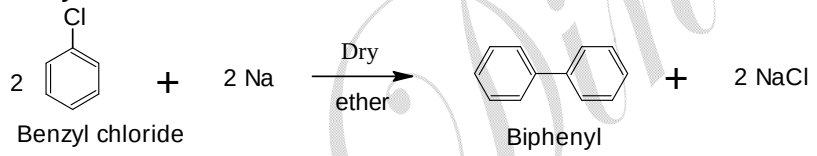
OR

Explain Fittig reaction with an example.

OR

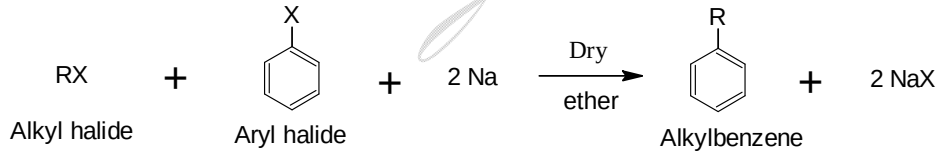
Write the chemical equation when benzyl chloride reacts with sodium in dry ether.

Ans: Benzyl chloride or chlorobenzene reacts with sodium metal in dry ether to form biphenyl.



3) Write the general equation for Wurtz-Fittig reaction.

Ans: Alkyl halide and aryl halide reacts with sodium metal in dry ether to form alkyl benzene.



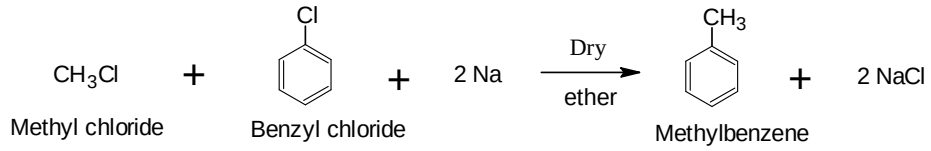
OR

Explain Wurtz-Fittig reaction with an example.

OR

Write the chemical equation when methyl chloride and benzyl chloride reacts with sodium in dry ether.

Ans: Methyl chloride and benzyl chloride reacts with sodium metal in dry ether to form methylbenzene or toluene.

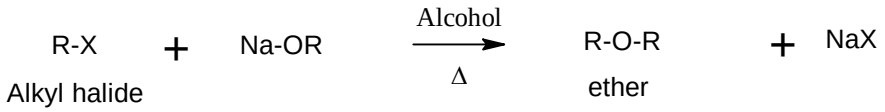


4) Write general equation for Willamson's ether synthesis.

OR

How do you convert alkyl halide to ether?

Ans: When alkyl halide reacts with sodium alkoxide in alcohol to form ether.



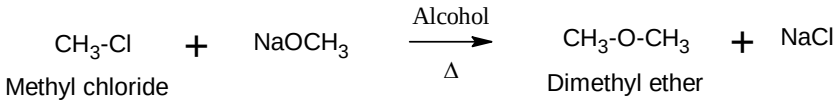
OR

Explain Willamson's ether synthesis with an example.

OR

Write the chemical equation when methyl chloride reacts with sodium methoxide in alcohol.

Ans: When methyl chloride reacts with sodium methoxide in alcohol to form dimethyl ether.

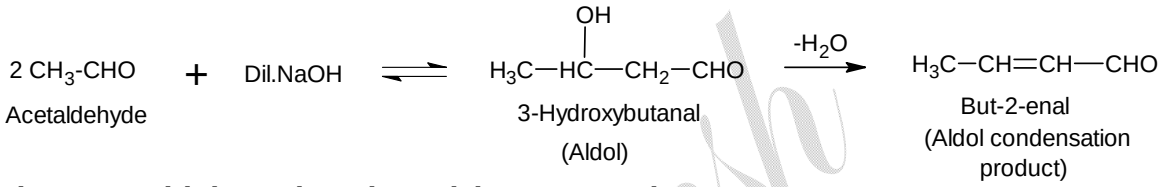


5) Explain aldol condesation with an example.

OR

Write the chemical equation when acetaldehyde reacts with dil. NaOH or KOH solution.

Ans: Aectaldehyde reacts with dilute NaOH to form 3–Hydroxybutanal.

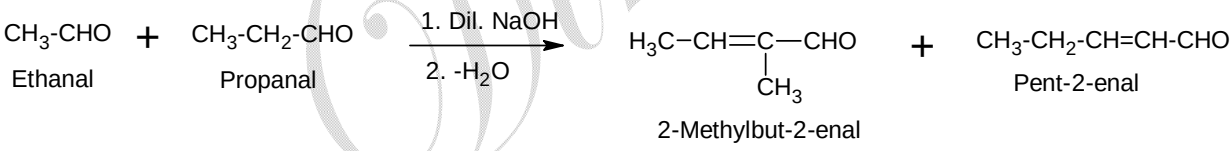


6) Explain cross aldol condesation with an example.

OR

Write the chemical equation when acetaldehyde and propanal react with dil. NaOH or KOH solution.

Ans: Aectaldehyde and propanal reacts with dilute NaOH to form 2-Methylbut-2-enal and Pent-2-enal.

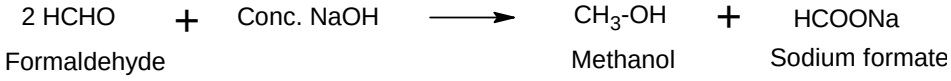


7) Explain Cannizzaro's reaction with an example.

OR

Write the chemical equation when formaldehyde reacts with Conc. NaOH or KOH solution.

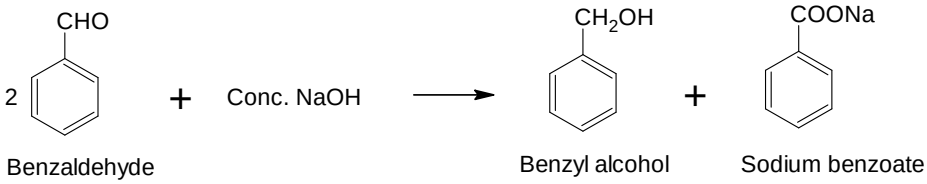
Ans: Formaldehyde reacts with Conc. NaOH to form methanol and sodium formate.



OR

Write the chemical equation when benzaldehyde reacts with Conc. NaOH or KOH solution.

Ans: Benzaldehyde reacts with Conc. NaOH to form benzyl alcohol and sodium benzoate.



8) Explain Kolbe's reaction with an example.

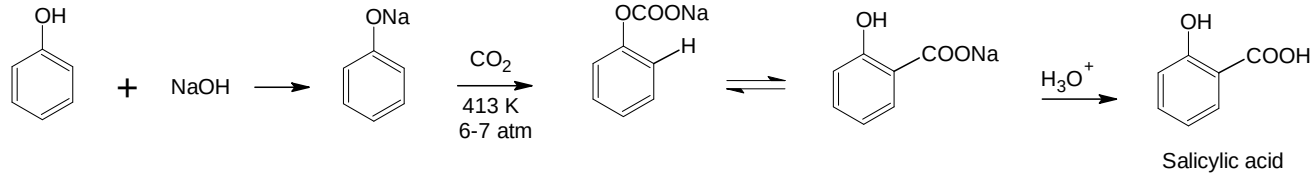
OR

Write the chemical equation when phenol reacts with CO_2 in the presence of NaOH solution.

OR

How do you convert phenol to salicylic acid?

Ans: Phenol reacts with NaOH to form sodium phenate. This on treated with carbon dioxide at 413 K and 6-7 atm and followed by hydrolysis to give salicylic acid.



Salicylic acid

9) Explain Reimer-Tiemann reaction with an example.

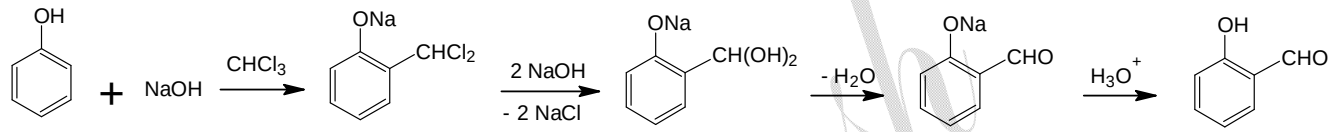
OR

Write the chemical equation when phenol reacts with chloroform in the presence of NaOH solution.

OR

How do you convert phenol to salicyaldehyde?

Ans: Phenol reacts with $CHCl_3$ and NaOH, followed by hydrolysis to give salicyaldehyde.



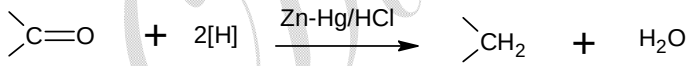
Salicyaldehyde

10) Explain Clemmensen reduction with an example.

OR

Write the chemical equation when aldehyde or ketone on reduction with Zn-Hg/HCl.

Ans: Aldehyde or ketone is reduction with zinc-mercury amalgam in HCl to give alkane. This reaction is called Clemmensen reduction.

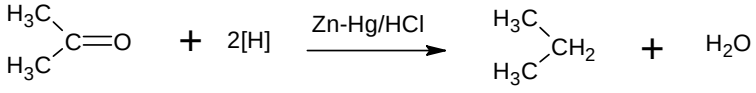


Alkane

OR

How do you convert propanone to propane?

Ans: Propanone on reduction with zinc-mercury amalgam in HCl to give propane.



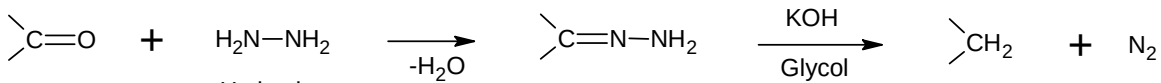
Propanone Propane

11) Explain Wolff-Kishner reduction with an example.

OR

Write the chemical equation when aldehyde or ketone on reduction with hydrazine.

Ans: Aldehyde or ketone is reduction with hydrazine followed by base hydrolysis to give alkane. This reaction is called Wolff-Kishner reduction.



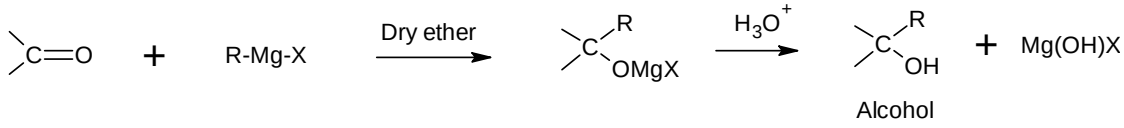
Hydrazine Alkane

12) Explain Grignard reaction with an example.

OR

Write the chemical equation when aldehyde or ketone reacts with Grignard reagent.

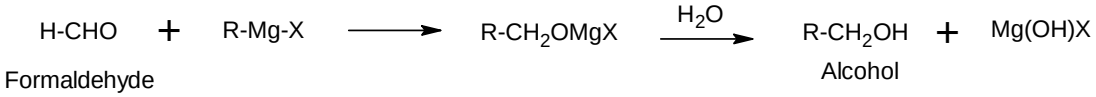
Ans: Aldehyde or ketone reacts with R-Mg-X in dry ether and followed by hydrolysis to give corresponding alcohol.



OR

Write the chemical equation when formaldehyde reacts with Grignard reagent.

Ans: Formaldehyde is treated with Grignard reagent followed by hydrolysis to give alcohol.



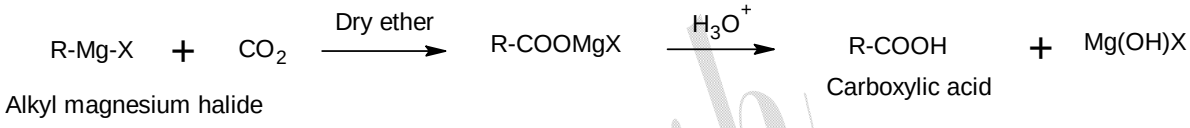
OR

Write the chemical equation when alkyl magnesium halide reacts with carbon dioxide.

OR

How are carboxylic acid prepared from Grignard reagent?

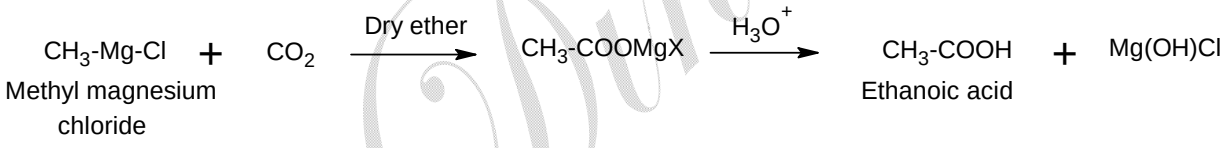
Ans: Alkyl magnesium halide is treated with carbon dioxide in dry ether and followed by hydrolysis to give carboxylic acid.



OR

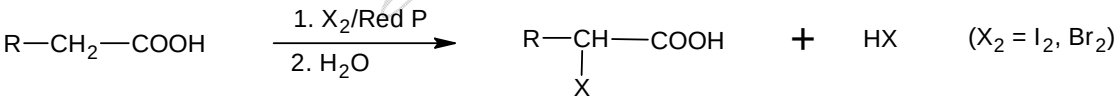
Write the chemical equation when methyl magnesium chloride reacts with carbon dioxide.

Ans: Methyl magnesium chloride is treated with carbon dioxide in dry ether and followed by hydrolysis to give ethanoic acid.



13) Explain HVZ (Hell-Volhard-Zelinsky) reaction.

Ans: Carboxylic acid on heating with halogen gas in the presence of red phosphorus and followed by hydrolysis to give α–halocarboxlic acid.



14) Explain Hoffmann bromamide degradation reaction.

OR

How do you prepare primary amine from amide.

Ans: Amide reacts with bromine in the presence of NaOH to form primary amine.

OR

Write the chemical equation when acetamide reacts with Br_2 in NaOH solution.

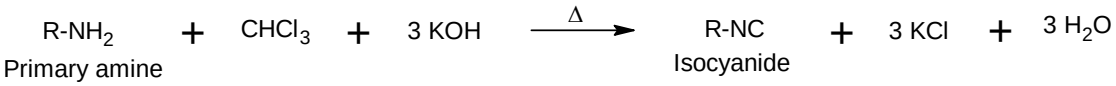
OR

How do you convert acetamide to methyl amine?

Ans: Acetamide reacts with bromine in the presence of NaOH to form methyl amine.

15) Explain Carbylamine reaction.

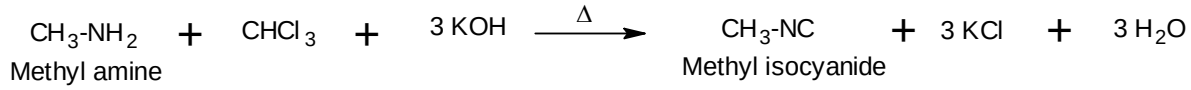
Ans: Primary amine reacts with $CHCl_3$ & KOH to give isocyanide.



OR

How do you prepare methyl isocyanide from methyl amine.

Ans: Methyl amine reacts with $CHCl_3$ & KOH to give methyl isocyanide.



16) Explain Gabriel Phthalimide synthesis with an example.

OR

How do you prepare primary amine from Phthalimide.

Ans: Phthalimide is treated with alcoholic KOH to give potassium phthalimide. This on treated with alkyl halide and followed by treated with aqueous NaOH solution to give primary amine.