

# S Block Elements

# UNIT-IV

## Comparative study of s-Block Elements:-

IA 1	IIA 2
H	
Li	Be
Na	Mg
K	Ca
Rb	Sr
Cs	Ba
Fr	Ra

IA → Alkali Metal  
(They react with  $H_2O$  to form Hydroxides which are strong alkalies)

IIA → Alkaline earth metal  
(Because their oxides are alkaline in nature and existed in the earth)

### Electronic Configuration

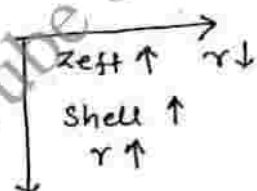
SE

A →  $ns$

IIA →  $ns^2$

where  $n$  = No. of period

### Atomic and Ionic Radii

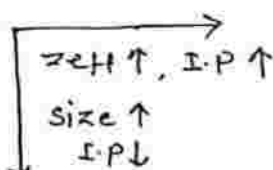


IIA Elements are smaller in size than IA Elements.

But their ionic radii are smaller than atomic radii b/cz After Removal  $e^-$   $Z_{eff} \uparrow$  significantly.

### Ionisation potential :-

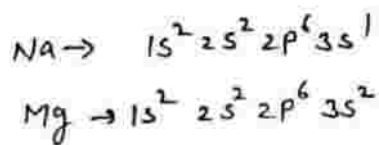
Cs have Lowest IP in Periodic table hence used in photocell



(ii) IIA Elements have higher value of I.P b/cz of stable E.C.

A → strong Electropositive Nature:- due to Low value of IP, they lose  $e^-$  easily.

$I^{\text{st}} \quad I.P$   
 $Na < Mg$   
 $Bud \quad II^{\text{nd}} \quad I.P$   
 $Na > Mg$



Q.1. 2014 Alkali metals are extremely reactive and strong reducing agents. Give Reason.

Ans. Alkali metals have very low value of I.E. they have tendency to loose  $e^-$  readily. that's why they are extremely reactive and kept in kerosene oil. They have high value of SOP (standard oxidation potential) so strong reducing Agent.

	Li	Na	K	Rb	Cs
SOP (V)	3.04	2.71	2.92	2.99	3.02

4. Density, melting point and Boiling point: →

(i) size of alkali metals are highest in their period so they doesn't have close packing in crystal. all alkali metals have BCC str. so they have (CN 8, PF 68%)

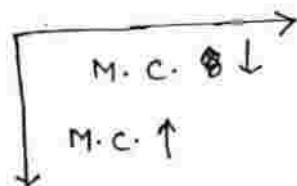
Low value of Density. which ↑ on moving down the group.

Alkali metals have weak force of attraction so they are soft and have Low M.P & B.P.

While alkaline earth metal are heavy and hard, high value of M.P & B.P due to small size and high charge density.

Metallic property :-

All S-Block Elements are Metal



Flame Test :-→

All the alkali metals give characteristic colour in bunsen flame. The reason is that when an alkali metal is heated in a bunsen flame, ~~they~~ the electrons get excited to higher energy level. When these  $e^-$ 's return to their ground level, energy is released in form of radiation of visible region of spectrum.

Li	Na	K	Rb	Cs
crimson Red	golden yellow	violet (lilac)	reddish violet	Blue

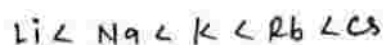
Among II group members, Be and Mg do not impart any colour to the flame b/coz their valence  $e^-$ 's are so tightly held by their nuclei that they require much greater amount of energy for their excitation and hence energy released during return journey lies beyond visible region (U.V. Region)

Be	Mg	Ca	Sr	Ba	Ra
Colourless	Colourless	Brick Red	crimson Red	Apple green	crimson Red.



### Chemical properties: →

The alkali metals exhibit high chemical reactivity which is due to their low I.E. and low heat of Atomisation. Reactivity ↑ on going down the gp.



#### (i) Action of Air (Reaction with Atmospheric oxygen)

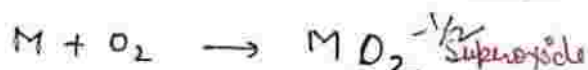
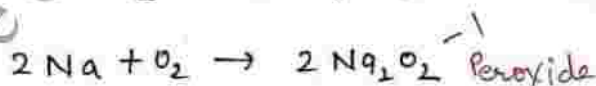
All the alkali metals tarnish rapidly on exposure to air due to formation of oxides at the surface.

The oxides may further react with moisture and atmospheric  $CO_2$  to form a layer of carbonates at the surface. therefore they are always

kept in kerosene or paraffin oil to protect them

from the action of air.

Lithium forms oxide, sodium forms mixt. of oxide and ~~superoxide~~ peroxide, rest form super oxide.



(M = K, Rb, Cs)

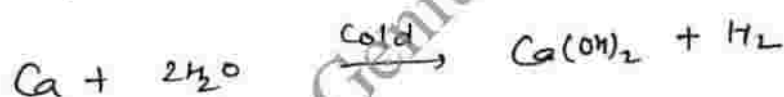
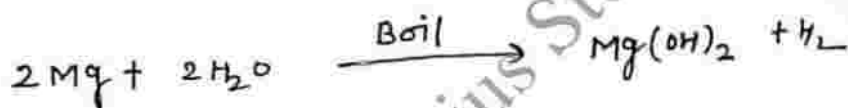
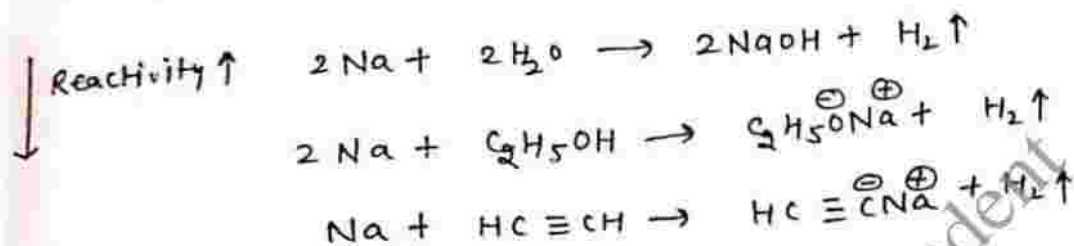
Reason: → The formation and stability of these oxides can be explained on the basis of their lattice energy.  $Li^+$  ion being a small ion has a strong field around it and can stabilise only small anion  $O^{2-}$  where  $Na^+$  ion being a large cation stabilise a large anion.





(ii) Reaction with water! →

due to low value of I.E



(iii) Solubility in liquid NH<sub>3</sub>! →

All the alkali metals

dissolve in liquid NH<sub>3</sub> giving deep Blue solution.

The colour deepens with ↑ in conc. of the sol.

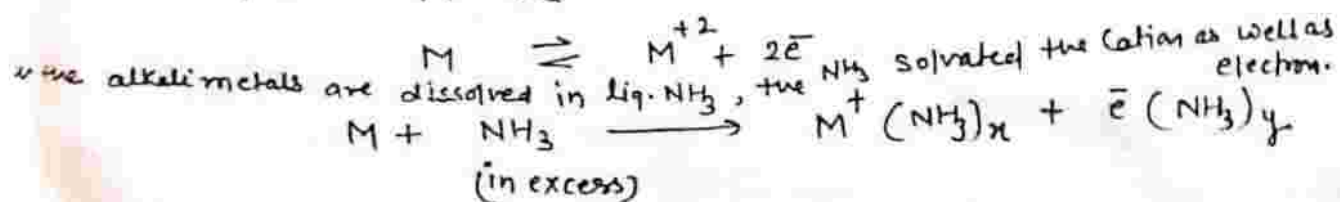
The concentrated solutions are Bronze in colour and Posses metallic lusture. The solutions are good

conductor of electricity and are Paramagnetic

in Nature. The paramagnetic character ↓ with

↑ in concentration. The dissolution of the metal is

accompanied by ionisation.  $\text{M} \rightleftharpoons \text{M}^+ + \text{e}^-$



The  $\bar{e}$  released by metals caused polarisation of the charges of the electrons of the

it is the ammoniated  $\bar{e}$  which is responsible for the Blue colour of solution. The electrical conductivity is due to ammoniated  $\bar{e}$  as well as ammoniated cation. The dilute solution are paramagnetic in nature. The  $\downarrow$  in Paramagnetic character with  $\uparrow$  in conc. suggests that in concentrated sol. ammoniated  $\bar{e}$  associated to form  $\bar{e}$  pairs.

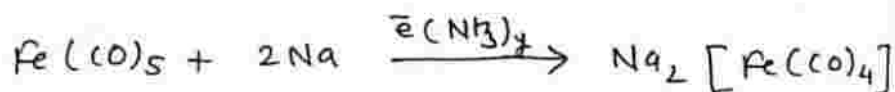
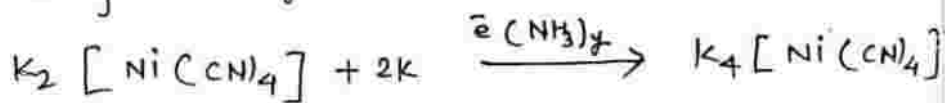


The value of  $x$  and  $y$  depends upon extent of solvation

The alkali metal solution in liq.  $\text{NH}_3$  are stable and decompose only slowly liberating Hydrogen the presence of transition metal (Fe, Pt, Zn)



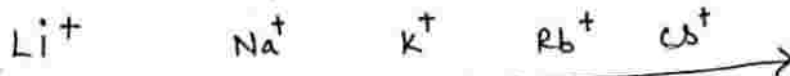
Due to presence of ammoniated  $\bar{e}$ , these solution behave as strong reducing Agent.



## SOLVATION TENDENCY

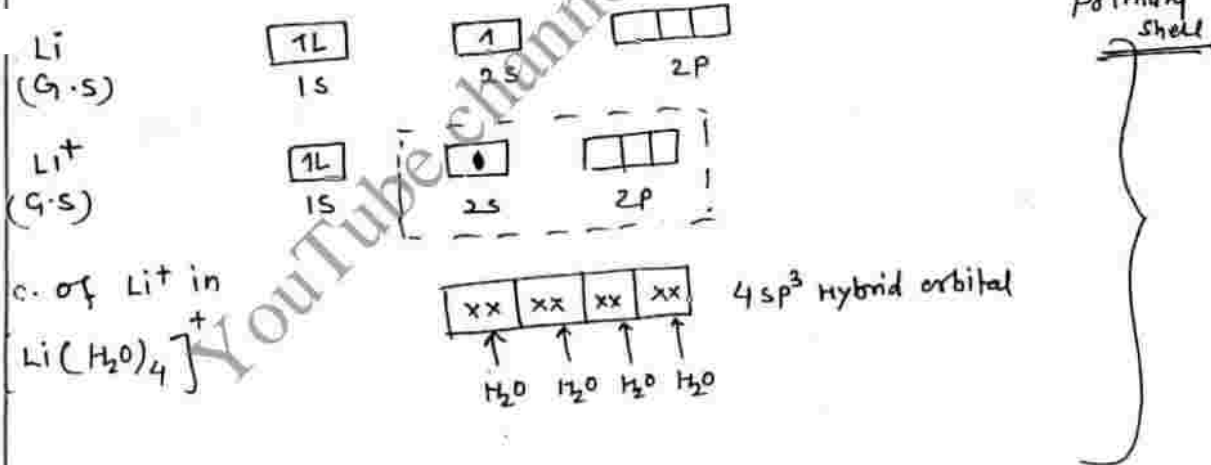
simple salts of alkali metals are soluble in water and give ions. The alkali metal ions are extensively

hydrated. The smaller the size of the ion, the greater is the degree of hydration.  $\text{Li}^+$  is hydrated max. while  $\text{Cs}^+$  is hydrated minimum.

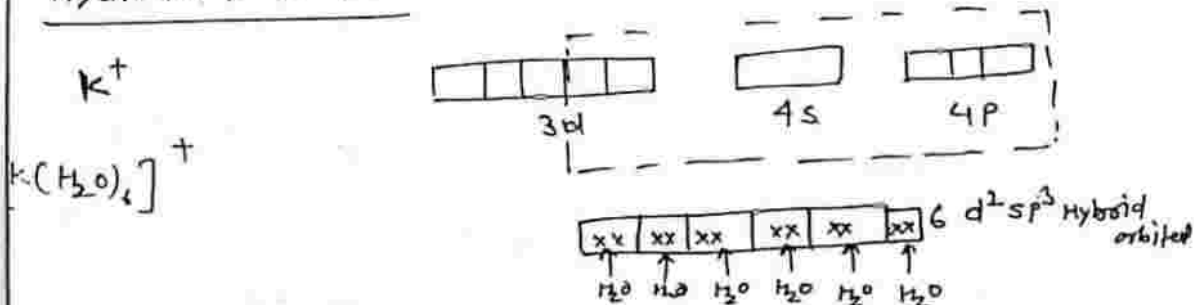


- (i) Ionic radii  $\uparrow$
- (ii) Hydrated radii  $\downarrow$
- (iii) Ionic mobility  $\uparrow$
- (iv) Conductivity  $\uparrow$

$\text{Li}^+$  ion forms coordinate bond with 4 water molecules in tetrahedral shape.

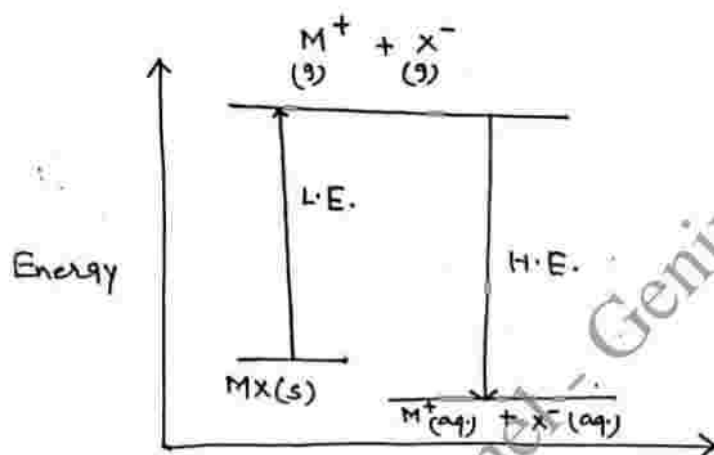


Hydration of  $\text{K}^+$  ion

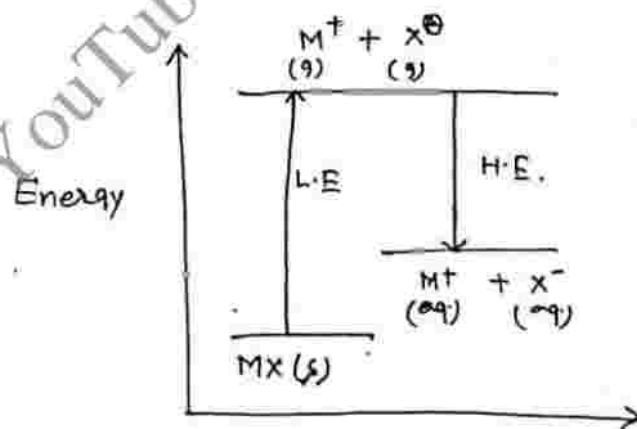




After this primary layer, a secondary layer of water molecule forms in which molecule doesn't form Bond But they are Bonded with weak ion - dipole force of Attraction. and this Attraction force is inversely proportional to radius. i.e. smaller ion have strong force. that's why  $\text{Li}^+$  is maximum Hydrated.



since  $\text{H.E.} > \text{L.E.}$   
 $\therefore$  Soluble in water



since  $\text{L.E.} > \text{H.E.}$   
 salt is insoluble in water.

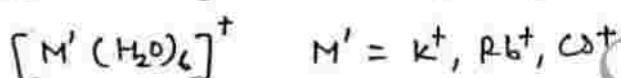
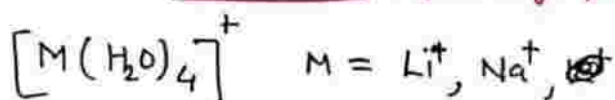
# 2015 COMPLEXATION - TENDENCY

S-BLOCK Elements have very less tendency to form complexes with ligands. B/c -

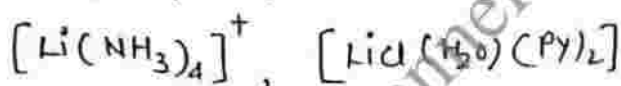
- (i) they do not have vacant orbitals.
- (ii) large size
- (iii) small charge.

The common unidentate ligand with which the alkali metal ions form somewhat stable complexes are  $H_2O$ ,  $NH_3$ ,

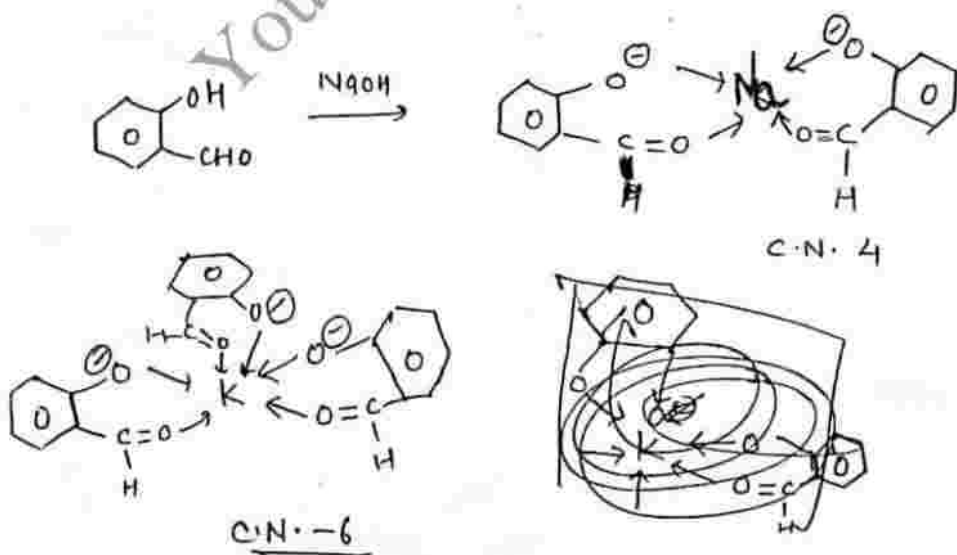
$Py$ ,  $Ph_3PO$ ; Triphenyl phosphine oxide



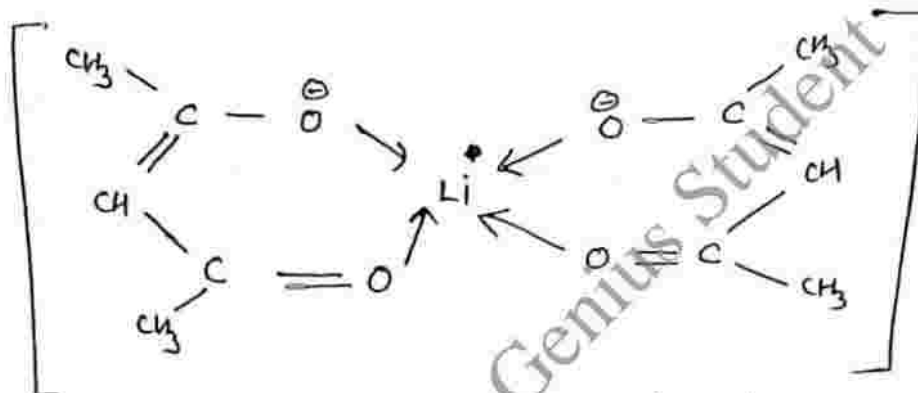
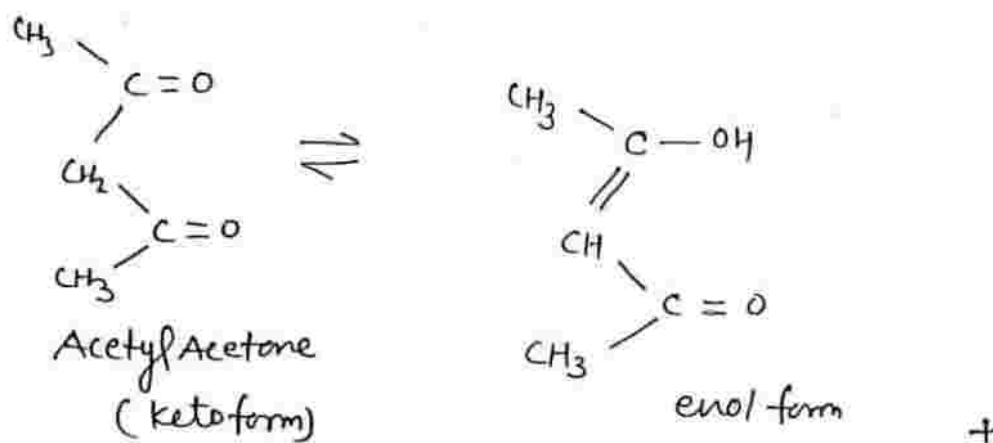
Some examples of lithium metal



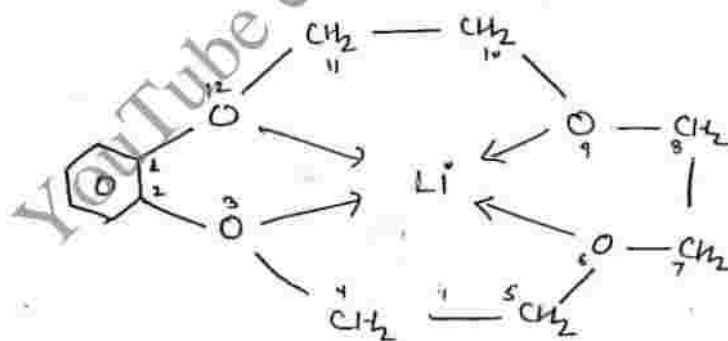
However alkali metals form reasonably stable complexes with some of the bidentate ligand and polydentate ligand such as salicylaldehyde,  $\beta$ -diketones, nitrophenols etc.



# Complex formation B/w $\text{Li}^+$ and $\beta$ -diketone



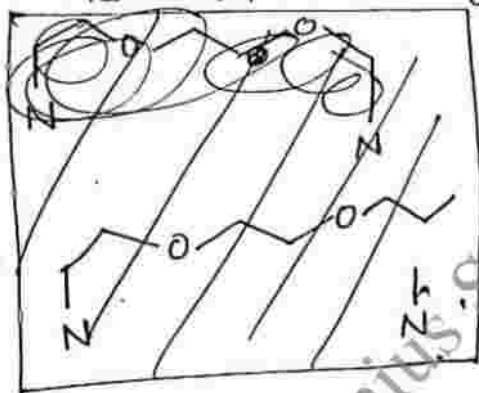
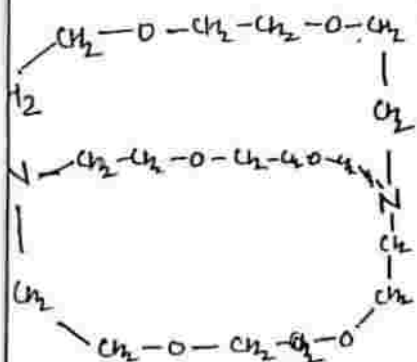
Polydentate ligand such as crown ethers and cryptanes are the most important ligand which form highly stable complexes with alkali metal ions.



2011 Lithium Benzo-12 crown-4 complex.  
 ↑ total No. of atoms      ↓ No. of oxygen atoms.

These ligands are also highly selective in complex formation. The cause of selectivity ~~of~~ lies in the size of the hole available in a polydentate ligand. Only the alkali metal ion which exactly fits into the holes form stable complexes.

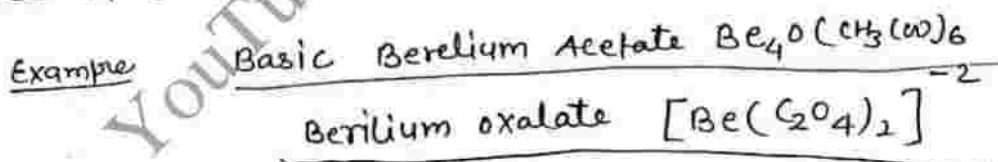
For example the hole in (Cryptate-22,2) is just of the right size for the  $K^+$  ion to fit in whereas  $Li^+$  and  $Na^+$  are too small while  $Rb^+$  and  $Cs^+$  are too big.



$K^+$  ion to fit in whereas  $Li^+$  and  $Na^+$  are too small while  $Rb^+$  and  $Cs^+$  are too big.

thus  $K^+$  complex of cryptate-222 is most stable.

Alkaline earth Metals are also doesn't have greater tendency to form complex But due to small size of Be it can form complexes (Tetrahedral)



Important complex of Ca is  $[Ca(EDTA)]^{-2}$

Important complex of Mg is chlorophyll



## 25/4 Functions of s-Block elements in Bio systems:-

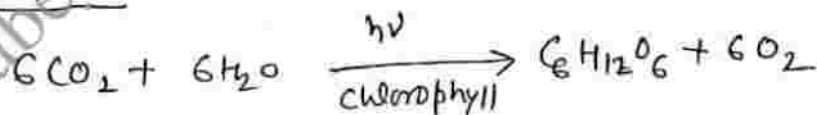
### 1. Transport of ions across the cell membrane

For the functioning of nerve and muscle cell, an electrical potential across the cell membrane is essential. This is maintained by the different ratio of  $\text{Na}^+$  and  $\text{K}^+$  inside and outside the cell.  $\text{Na}^+$  are actively expelled from cells, whereas  $\text{K}^+$  are not. This ion transport is sometimes called a sodium pump, and it involves both the active expulsion of  $\text{Na}^+$  and the active take-up of  $\text{K}^+$ . Thus the mechanism of ion transport involves polyether complex formation.

### 2. Energy transfer:->

In the living beings energy is stored in the form of ATP which forms complex with  $\text{Mg}^{+2}$  ion.

### 3. Photo synthesis:->



Chlorophyll is the pigment responsible for the green colour of the plants which is complex of  $\text{Mg}^{+2}$  ion.

### 4. Role of $\text{Ca}^{+2}$

$\text{Ca}^{+2}$  ion is present in bones as apatite  $\text{Ca}_5(\text{PO}_4)_3\text{OH}$ , fluoroapatite in teeth enamels  $[3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2]$ .

It is also important for blood clotting and contraction of muscles.