HINTS & SOLUTIONS

s-Block Elements

[Set-1]

SECTION-A

1. (i): NaCl is used as a source of sodium ions in biological fluids ((Na^+) = 140 m moles/L)

2. (i): Li^+ ions has the highest charge to radius ratio and is the most heavily hydrated, the extent of hydration decreases in the order

   $Li^+ > N^+ > K^+ > Rb^+ > Cs^+$

3. (iv): Low solubility of CsI is due to low hydration enthalphy of Cs^+ and I^- ions. The hydration enthalphy of CsI is less than its lattice enthalpy.

4. (iv): $2MO_2 + 2H_2O \longrightarrow 2MOH + H_2O_2 + O_2$

   The solution becomes basic.

5. (iii): Sodium carbonate is a salt of weak acid and strong base and hence its aqueous solution is basic. LiF has a high lattice enthalpy due to small size of its ions.

   Sodium dissolves in liquid NH_3 to give blue colour solution due to ammoniated electron.

   Na_2SO_4 is a salt of strong acid and strong base, No hydrolysis only hydration.

6. (i): $6Li + N_2 \longrightarrow 2Li_3N$

   Li_3N has a high lattice enthalpy due to small size of Li^+ ion.

7. (i): $BeCO_3$ is unstable and decompose very readily to give CO_2 and BeO. To prevent this we store the $BeCO_3$ in an atmosphere of CO_2.

   $BeCO_3 \xrightarrow{heat} BeO + CO_2$

8. (ii): Na_2CO_3 is the most stable carbonate out of the four given due to stabilization of large cation by large anion.

9. (ii) This is due to hydration enthalpy of Be^{2+} ion which compensates for high lattice enthalpy. Hence $BeSO_4$ is soluble in water.

10. (i) $BeCl_2$ is a the most covalent due to small size, high charge and high polarizing power of Be^{2+}.

11. (i) $BeO + C + Cl_2 \xrightarrow{850-1050K} BeCl_2 + CO$

    (ii) $Na_2O_2 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O_2$

OR

(i) $2Na + 2NH_3 \rightarrow 2NaNH_2 + H_2$

A bronze coloured solution is obtained due to formation of metal cluster with the liberation of H_2 gas.

(ii) $BeO + 2NaOH + H_2O \longrightarrow \underset{\text{sodium beryllate}}{Na_2[Be(OH)_4]}$

BeO being amphoteric dissolved in excess of NaOH.

12. (i) As we move down the group, the ionic size increases, charge density decreases and the extent of hydration also decreases, therefore, Cs^+ ion is least hydrated and Li^+ is most heavily hydrated. So, the ionic mobility in aqueous medium increases down the group.

$Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$

$\rightarrow$ increasing ionic mobility

(ii) Be is the least metallic element in group -2 and it forms an amphoteric oxide which reacts with an acid as well as base

$\underset{\text{(base)}}{BeO} + 2HCl \longrightarrow BeCl_2 + H_2O$

$\underset{\text{(acid)}}{BeO} + 2NaOH + H_2O \longrightarrow Na_2[Be(OH)_4]$

13. (i) Chlorides of group 2 metals are hygroscopic in nature means they exist in the hydrated form. This is due to the their high charge to radius ratio as compared to group 1 metals. The tendency to form hydrates decreases down the group

$MgCl_2.8H_2O$, $CaCl_2.6H_2O$, $BaCl_2.2H_2O$

(ii) This is due to the stabilisationof large anions (O_2^{2-} and O_2^-) by large cations.

(iii) Be and Mg do not show colour to the flame. This is due to their small size and high ionization enthalpy, the electrons are strongely bound to the nucleus and do not get excited easily by flame.

14. (i) Aqueous solution of $BeCl_2$ is acidic in nature because $BeCl_2$ is a salt of weak base $Be(OH)_2$ and strong acid HCl.

$BeCl_2 + 2H_2O \longrightarrow Be(OH)_2 + 2H^+ + 2Cl$

(ii) BeO is insoluble in water due to high lattice enthalpy of BeO. This is because of small size of Be^{2+} ion, that the ions are very tightly held.

(iii) Molten sodium hydride liberates H_2 at anode due to the oxidation of the hydride ion

$NaH \rightarrow Na^+ + H^-$

$2H^- \rightarrow H_2 + 2e^-$ at anode

$2Na^+ + 2e^- \rightarrow 2Na$ at cathode

OR

(i) Na, K and Rb are used in photoelectric effect due to their large size and low ionisation enthalpy. As a result, they easily lose electron when irradiated with a light.

(ii) This is due to the formation of sodium oxide or sodium hydroxide layer on the metal

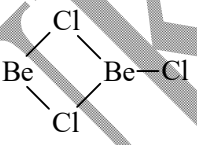
$4Na + O_2 \rightarrow 2Na_2O$

(iii) Due to small size, high charge to radius ratio and availability of empty atomic orbitals, Be^{2+} easily accepts lone pair of electron from F^-.

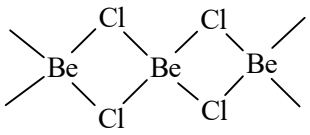
$BeF_2 + 2F^- \rightarrow [BeF_4]^{2-}$

$MgF_2 + 2F^- \rightarrow$ No reaction

15. (i) **Vapour state,** $BeCl_2$ exists as dimer with chloro bridge



Solid state, $BeCl_2$ has a polymeric structure with bridged Cl atom, Be $\rightarrow sp^3$ hybridised.



(ii) The equations involved in the preparation of sodium carbonate by Solvay's process are

$$2NH_3 + H_2O + CO_2 \longrightarrow (NH_4)_2CO_3$$

$$(NH_4)_2CO_3 + H_2O + CO_2 \longrightarrow 2NH_4HCO_3$$

$$NH_4HCO_3 + NaCl \longrightarrow NH_4Cl + \underset{\text{(crystals)}}{NaHCO_3}$$

$$2NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + H_2O + CO_2$$

Potassium carbonate cannot be prepared by Solvay process because potassium hydrogen carbonate is too soluble to be precipitated by the addition of ammonium hydrogen carbonate to a saturated solution of potassium chloride

OR

(i) (a) All alkali metals show colour when subjected to flame. This is because the heat from the flame excites the outermost orbital electron to a higher energy level. When the excited electron comes back to the ground states, there is emission of radiation in the visible region and the colour is obtained.

(b) Lithrium is hard because of its small size.

(ii) (a) $Be(OH)_2 + 2HCl + 2H_2O \longrightarrow [Be(H_2O)_4]Cl_2$

(b) $4LiNO_3 \xrightarrow{\text{heat}} 2Li_2O + 4NO_2 + O_2$

(c) $BaO_2 + H_2O \longrightarrow BaO + H_2O_2$

