The s block elements-solutions

SUBJECTIVE PROBLEMS:

Sol 1.

(i) Potassium carbonate cannot be manufactured by Solvay process, since; unlike sodium hydrogen carbonate, potassium hydrogen carbonate is rather too soluble in water to be precipitated like $NaHCO_3$.

(ii) H_2O_2 is a better oxidizing agent than H_2O because oxidation number of oxygen in H_2O_2 is – 1 and that in water it is -2. So H_2O easily reduces to -2 oxidation number.

(iii) MgO is used for the lining of steel making furnace because it acts as basic flux and facilitates the removal of acidic impurities of Si, P and S from steel through slag formation.

(iv) The anhydrous magnesium chloride is fused with NaCl to provide conductivity to the electrolyte and to lower the fusion temperature of anhydrous $MgCl_2$.

NOTE: NaCl prevents hydrolysis of $MgCl_2$

(v) The oxidation state of oxygen in H_2O_2 (i.e. -1) can be changed to 0 or -2 i. e oxygen in H_2O_2 exists in an intermediate oxidation state with respect to O_2 and O^{2-}. Hence it acts both as an oxidizing and reducing agent.

(vi) **NOTE**: Smaller the size of cation, higher gill be hydration tendency because hydration energy of cation is inversely proportional to size of cation: The size of alkaline earth metal ions are smaller than the size of alkali metal ions. So in crystalline form the salts of alkaline earth metals have more water molecules than those, of alkali metals.

(vii) $BeCl_2$ is hydrolyses due to high polarizing power and presence of vacant p-orbitals in Be-atom.

(Be = $1s^2$, $2s^2 2p_x^1\ 2p_y^0\ 2p_z^0$)

Sol 2.

Bleaching powder, $Ca(OCl)_2$, can be prepared by passing chlorine through $Ca(OH)_2$ solution.

$3Ca(OH)_2 + 2Cl_2 \xrightarrow[35°C]{below} Ca(OCl)_2.\ CaCl_2.Ca(OH)_2.2H_2O$

Slaked lime Bleaching Powder

Sol 3.

(i) $2Ca_3(PO_4)_2 + 6SiO_2 + 10C \xrightarrow[furnace]{electric} 6CaSiO_3 + 10CO + P_4$

This is the **electro thermal process** to extract phosphorus from phosphorite or bone ash $[Ca_3(PO_4)_2]$.

(ii) Ferricyanide is oxidized to Ferro cyanide on treatment with alkali

$2K_3[Fe(CN)_6] + H_2O_2 + 2KOH \rightarrow 2K_4[Fe(CN)_6] + 2H_2O + O_2$

(iii) $NaCl + NH_4OH + CO_2 \rightarrow NH_4Cl + NaHCO_3$

(iv) $2K_3[Fe(CN)_6] + H_2O_2 + 2KOH \rightarrow 2K_4[Fe(CN)_6] + 2H_2O + O_2$

(v) $CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$

Calcium bicarbonate

NOTE: Suspension of lime stone is $CaCO_3$.

Sol 4.

In sea water Mg exists as $MgCl_2$.

On treating sea water wit slaked lime $Mg(OH)_2$ is obtained.

$MgCl_2$ + $Ca(OH)_2$ → $Mg(OH)_2\downarrow + CaCl_2$

In sea water slaked lime

On reacting $Mg(OH)_2$ with HCl, $MgCl_2$ is obtained.

$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + H_2O$

From $MgCl_2$, Mg is obtained by reduction of $MgCl_2$ with $CaCl_2$.

$MgCl_2 + CaC_2 \rightarrow Mg + CaCl_2 + 2C$

Sol 5.

$Ca_5(PO_4)_3F + 5h_2SO_4 + 10H_2O \xrightarrow{\Delta} 3H_3PO_4 + 5CaSO_4.2H_2O + HF$

Sol 6.

H_2O_2	$+ H_2SO_4$	+	2KI	→	K_2SO_4	+	I_2	$+2H_2O$
34 gm			Acidified				254 gm	
3			KI sol				0.508	
							gm	

5 cm^3
or ml

i. e. 254 gm of I_2 is released by 34 gm H_2O_2

∴ 0.508 gm of I_2 will be released by

= 34/254 * 0.508 = 0.608

5 ml of H_2O_2 sol. Contains 0.068 gm of H_2O_2

∴ 1 ml of H_2O_2 contains 0.068/5 gm H_2O_2

NOTE: The strength of H_2O_2 is generally calculate in terms of **volume strength.** According to which 10 volume of H_2O_2 means that 1 ml of H_2O_2 sol gives 10 ml of O_2 at STP.

$2H_2O_2 \rightarrow 2H_2O +$ O_2

2*34 gm 32 gm or

22,400 ml at STP

i.e., 68 gm of H_2O_2 gives 22, 400 ml of O_2 at STP or 1 ml of H_2O_2 sol

Or 0.068/5 gm of H_2O_2 sol gives 4.48 ml of O_2 i.e. strength of H_2O_2 sol is **4.48 volumes**

Sol 7.

LiF has more ionic character while Lil has more covalent character. The latter is due to the greater polarizability of larger iodide ion than the fluoride ion.

Sol 8.

$[Ca_3(PO_4)_2.CaF_2] + 6H_3PO_4 \rightarrow 4\ Ca(H_2PO_4)_2 + HF$

(Triple super phosphate)

Sol 9.

Meq. Of H_2O_2 = Meq. Of $Na_2S_2O_3$

$W/17 * 1000 = 20 * 0.3$ $\therefore w = 0.102$ g

$H_2O_2 \rightarrow H_2O + 1/2\ O_2$

$\therefore$ Volume of $O_2 = 11200 * 0.102/34 = 33.6$ mL

$\therefore$ Volume strength $= 33.6/25 = 1.344$

Sol 10.

$$2KMnO_4 + 3H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5\ [O]$$
$$[H_2O_2 + [O] \rightarrow H_2O + O_2] * 5$$
$$2KMnO_4 + 5H_2O_2 + 3H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$$

Sol 11.

$3M + N_2 \rightarrow M_3N_2$

'A' 'B'

$M_3N_2 + 6H_2O \rightarrow 3M(OH)_2 + 2NH_3$

'B' 'C' 'D'

$M(OH)_2 + CO_2 \rightarrow MCO_3 + H_2O$

'C' 'D'

M may be either Ca or Ba

NOTE: It is not magnesium because $Mg(OH)_2$ has very low solubility in water.

If we consider Ba as M then A is **Ba,** B is **Ba_3N_2,** C is **$Ba(OH)_2$,** D is **$BaCO_3$.**

Sol 12.

$SrSO_4 > CaSO_4 > MgSO_4 > BeSO_4$ (Based upon size of cation or ionic character)

Sol 13.

$3Ca(OH)_2 + 2Cl_2 \rightarrow Ca(OCl)_2 + Ca(OH)_2.CaCl_2.2H_2O$

Bleaching powder

(A mixture of $Ca(OCl)_2$ and basic chloride)

Sol 14.

When H_2O_2 acts as oxidizing agent, following reaction takes place:

$H_2O_2 + 2e^- \rightarrow 2OH^-$

While regarding its action as reducing agent, the following reaction takes place:

$H_2O_2 + 2OH^- \rightarrow O_2 + 2H_2O + 2e^-$