Hydrogen & s-Block Elements

Level - 0	DTS-0

1. Because of low IE_1 and high electropositive character, they are themselves strong reducing agent.

2. Highly reactive elements as their IE_1 values are low.

3. In unipositive ions all electrons are paired.

4. Removal of IInd electron from Na^+ takes place from inert gas configuration.

5. H_2O : Electron rich covalent hydride

B_2H_6 : Electron precise covalent hydride

NaH : Ionic hydride

6. Ammonia soda process or Solvay process.

7. **(i)** $Na + H_2O \longrightarrow NaOH + \frac{1}{2}H_2$

(ii) $2\,Na + O_2 \longrightarrow Na_2O_2$

(iii) $Na_2O_2 + H_2O \longrightarrow 2\,NaOH + \frac{1}{2}O_2$

8. Due to the formation of HCl on hydrolysis $BeCl_2 + H_2O \longrightarrow Be(OH)_2 + 2HCl$

9. Due to greater nuclear charge and small size, there is greater inter particle forces & thus pack more tightly in solid lattice.

10. $MgCl_2 \cdot 6H_2O$ undergoes partial hydrolysis by its own water molecules of crystallization when heated. Which upon strong heating gives MgO.

$MgCl_2 \cdot 6H_2O \xrightarrow{\Delta} MgO + 2HCl + 5H_2O$

11. Auto protolysis of water means that two molecules of water reacts with each other through protons transfer i.e. one acts as the acid while the other acts as the base. The molecule which accepts a proton is converted into H_3O^+ while that which loses a proton is converted into OH^- ion.

$$\underset{\text{Acid}}{H_2O} + \underset{\text{Base}}{H_2O} \rightleftharpoons \underset{\text{Acid}}{H_3O^+}(aq) + \underset{\text{Base}}{OH^-}(aq)$$

12. HNO_3 is a strong oxidizing agent. It oxidizes the H_2 produced.

13. **(i)** Be^{2+} and O^{2-} being smaller in size has higher lattice energy and lattice energy is greater than hydration energy in BeO where as in $BaSO_4$ lattice energy is less due to bigger sulphate ion and is soluble.

(ii) In $BaSO_4$ lattice energy is greater than hydration energy while in BaO lattice energy is smaller than hydration energy.

14. Refer text.

15. **(a)** $BaCl_2 > SrCl_2 > CaCl_2 > MgCl_2 > BeCl_2$

(b) **(i)** $Ba(OH)_2 > Sr(OH)_2 > Ca(OH)_2 > Be(OH)_2$

(ii) $MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

16. Interaction of H^+ and OH^- ions of H_2O with anions and cations of the salt respectively to give the original acid and the original base is called hydrolysis e.g.

$Na_2CO_3 + 2H_2O \longrightarrow 2NaOH + H_2CO_3$

Hydration, on the other hand, means addition of H_2O to ions or molecules to form hydrated ions or hydrated salts for e.g.

$NaCl + H_2O \longrightarrow Na^+(aq) + Cl^-(aq)$; $CuSO_4 + 5H_2O \longrightarrow CuSO_4.5H_2O$

17. Advantages of using as fuel.

(i) Abundantly available. **(ii)** Pollution free as the product is water.

(iii) High calorific fuel. **(iv)** Excellent reducing agent.

(v) Time required for regeneration of H_2 fuel is short.

18. **(i)** At high pressure (200 atm) and in presence of catalyst Fe, Mo.

(ii) Very active metals like Na, K, Ca etc can react with H_2O at room temperature.

(iii) Metals which are more electropositive than hydrogen.

19. Oxidising agent : $H_2O_2 + 2H^+ + 2e^- \longrightarrow 2H_2O$(acidic medium)

$H_2O_2 + 2e^- \longrightarrow 2OH$(basic medium)

Reducing agent : $H_2O_2 \longrightarrow 2H^+ + O_2 + 2e^-$

20. **(i)** $Na_2CO_3 \xrightarrow{\Delta}$ No change (stable to heat) ; $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

(ii) $MgCl_2 \cdot 6H_2O \xrightarrow{\Delta} MgO + 2HCl + 5H_2O$; $CaCl_2 \cdot 6H_2O \xrightarrow{\Delta} 6H_2O$

(iii) $Ca(NO_3)_2 \xrightarrow{\Delta} CaO + 2NO_2 + \frac{1}{2}O_2$; $NaNO_3 \xrightarrow{\Delta} NaNO_2 + \frac{1}{2}O_2$

21. **(a)** More electropositive elements than hydrogen (eg, Zn, Fe, Mg) react with dilute mineral acids (dil, HCl and H_2SO_4) to liberate dihydrogen gas.

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

(b) Metals like Be, Zn, Sn, Al etc react with boiling alkali solution liberating dihydrogen.

$Be + NaOH \xrightarrow{Heat} Na_2BeO_2 + H_2$; $Zn + NaOH \xrightarrow{Heat} Na_2ZnO_2 + H_2$

(c) $2Na + 2H_2O(cold) \longrightarrow 2NaOH + H_2$

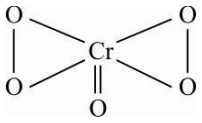
$Zn + H_2O(boiling) \xrightarrow{Heat} ZnO + H_2$

$3Fe + H_2O(steam) \longrightarrow Fe_3O_4 + 4H_2$

22. **(a)** $\{H_2O_2 \longrightarrow H_2O + [O]\} \times 4$

$K_2Cr_2O_7 + H_2SO_4 + 4[O] \longrightarrow K_2SO_4 + 2CrO_5 + H_2O$

$K_2Cr_2O_7 + H_2SO_4 + 4H_2O_2 \longrightarrow K_2SO_4 + \underset{\text{blue}}{2CrO_5} + 5H_2O$



Chromium pentoxide

(b) The bleaching action of H_2O_2 is due to the nascent oxygen which it liberate on decomposition

$H_2O_2 \longrightarrow H_2O + [O]$

The nascent oxygen combines with colouring matter which in turn gets oxidizing. Thus the bleaching of H_2O_2 is due to the oxidation of colouring matter by nascent oxygen.

23. **(i)** $CaO(s) + H_2O(\ell) \longrightarrow Ca(OH)_2(aq)$

(ii) $Na_2O(s) + H_2O(\ell) \longrightarrow 2NaOH(aq)$

(iii) $3Fe(s) + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$

(iv) $CuO(s) + H_2(g) \xrightarrow{heat} Cu + H_2O$

(v) $CO(g) + H_2O(g) \xrightarrow[Co\ (catalysis)]{700K,\ 200atm} CH_3OH(\ell)$

24. **(a)** It reduces acidified $KMnO_4$ solution. The pink colour of $KMnO_4$ is discharged.

(b) $\underset{(Black)}{PbS} + 4H_2O_2 \longrightarrow \underset{(White)}{PbSO_4} + 4H_2O$

(c) It reduces alkaline potassium ferrocyanide to potassium ferricyanide.

(d) It oxidizes acidified ferrous sulphates to ferric sulphate.

(e) It oxides sulphurous acid to sulphuric acid

25. **(i)** $Cr(OH)_3$ is converted into yellow coloured CrO_4^{2-}

(ii) Hydrazine is oxidised to N_2 and H_2O

(iii) $H_2O_2 + Ba(OH)_2 \longrightarrow BaO_2 + 2H_2O$

(iv) $NaOCl + H_2O_2 \longrightarrow NaCl + H_2O + O_2$