Chapter 8. Hydrogen

Question-1

Classify the following hydrides into covalent, ionic and interstitial hydrides.

Solution:

NH_3, ZrH_2, CaH_2, NaH, B_2H_6

Covalent = NH_3 B_2H_6

Ionic = NaH, CaH_2

Interstitial = ZrH_2.

Question-2

How is H_2O_2 manufactured?

Solution:

Industrially H_2O_2 is prepared by the auto oxidation of 2 hydroxy anthraquinols. It involves a cycle of reactions. The net reaction is to catalyst union of H_2 and O_2 to yield H_2O_2

$$2 - \text{ethylanthraquinol} \underset{H_2/Pd}{\overset{O_2 \text{ air}}{\rightleftharpoons}} (\text{oxidizied product}) + H_2O_2$$

It is concentrated by careful distillation under low pressure.

Question-3

What is the use of Zeolite / per mutit?

Solution:

Zeolite or permutit is a sodium aluminium silicate. Na Al $SiO_4.3H_2O$. When hard water, which contains Ca^{2+} / Mg^{2+} ions, is passed through Zeolite / permutit, Na^+ ion in the silicate gets exchanged for Ca^+ / Mg^{2+} in hard water. Thus hard water is softened.

Question-4

What is meant by 100-volume of Hydrogen peroxide?

Solution:

Each milliliter of 100-volume H_2O_2 will liberate 100 volumes of oxygen at STP. It may be 30% solution H_2O_2.

Question-5

Give examples for electron deficient, electron-precise and electron rich molecular hydrides.

Solution:

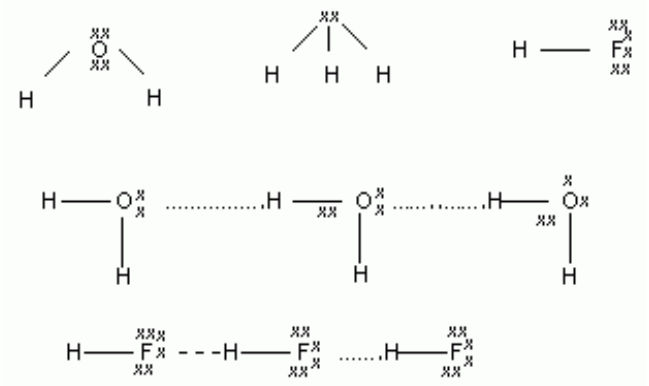
Electron deficient: B_2H_6 (has less number of electrons to write Lewis structure)
Electron – precise: CH_4
Electron – rich: NH_3 and H_2O (N and O have lone pairs of electrons).

Question-6

Why HF, H_2O and NH_3 have higher boiling points, and aggregation?

Solution:

Fluorine, oxygen and nitrogen are electronegative elements: They have lone pairs of electron in HF, H_2O and NH_3, electron rich hydride.



Question-7

Solution:

$2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

$KMnO_4$ is converted into $MnSO_4$: Oxidation number of Mn is changed from +7 to +2 by H_2O_2. That is H_2O_2 acts as a reducing agent, giving electrons to manganese. H_2O_2 is changed to O_2 by $KMnO_4$. Oxidation number of oxygen in H_2O_2 is changed from −1 to 0 in oxygen molecule. Hence $KMNO_4$ removes electron from oxygen of H_2O_2 . Hence H_2O_2 is oxidized by $KMNO_4$ to H_2O.

$2PbS(s) + H_2O_2 \rightarrow PbSO_4(s) + 4H_2O\ (l)$

S^{2-} in PbS is oxidized to SO_4; oxidation number of S in Pbs (-2) changed to (+6) in $PbSO_4$. Electrons are removed from Pbs by H_2O_2 to convert PbS to $PbSO_4$. Hence H_2O_2 is an oxidizing agent.

H_2O_2 is converted into H_2O : Oxidation number (-1) in H_2O_2 is changed into (-2) in H_2O. Hence H_2O_2 is reduced by PbS.

Question-8

How is H_2O_2 concentrated?

Solution:

Aqueous H_2O_2 solutions spontaneously decompose to give H_2O and O_2. Hence 1% H_2O_2, formed during preparation cannot be concentrated by distillation under atmospheric pressure. Hence H_2O_2 solution is concentrated to 30% by distillation under reduced pressure. This further concentrated to 85% by careful distillation under low pressure. The remaining water is frozen out to give pure H_2O_2.

Question-9

What is nascent hydrogen? How is its reactivity?

Solution:

The hydrogen at the time of its production (new born) is much more reactive and is called nascent hydrogen. It is in a atomic state at the moment of its formation.

E.g. H_2 molecule does not reduce $KMnO_4$. But, Zn and HCl reduces $KMnO_4$. Decolourise $KMnO_4$.

$Zn + H_2SO_4 \rightarrow ZnSO_4 + 2(H)$; $- 2KMnO_4 + 3H_2SO_4 + 10H \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O$

Question-10

What is the reaction involved using H_2O_2 for renovating old painting?

Solution:

Old paintings rendered black PbS by the atmospheric H_2S. Black PbS in painting is oxidized by H_2O_2 to white $PbSO_4$

$H_2O_2 \rightarrow H_2O + (O)$

$PbS + 4(O) \rightarrow PbSO_4$