Chemistry Study Materials for Class 11 (NCERT Based Notes of Chapter 09)

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Hydrogen

HYDROGEN PEROXIDE (H_2O_2)

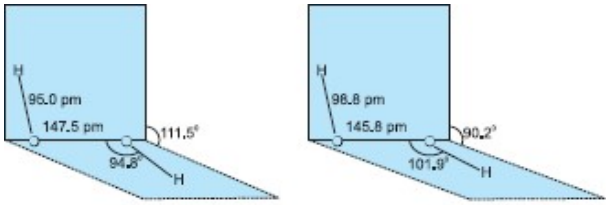
Preparation

It can be prepared by the following methods:

i. It is prepared by acidifying barium peroxide and removing excess water by evaporation under reduced pressure. $BaO_2.8H_2O(s) + H_2SO_4(aq) \rightarrow BaSO_4(s) + H_2O_2(aq) + 8H_2O(l)$

ii. Industrially it is prepared by the auto-oxidation of 2-alklylanthraquinols. 2 ethylanthraquinol ___ H_2O_2 + oxidised product

Structure



(a) Gas phase (b) Solid phase

Hydrogen peroxide has a non-planar structure as follows:

Chemical properties

H_2O_2 acts as an oxidising as well as reducing agent in both acidic and alkaline media.

1. Oxidising action in acidic medium

$2Fe^{2+} + 2H^+ + H_2O_2 \rightarrow 2Fe^{3+} + 2H_2O$ PbS +

$4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

2. Reducing action in acidic medium

   $2MnO^{-} + 6H^{+} + 5H_2O \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$

   $HOCl + H_2O_2 \rightarrow H_3O^{+} + Cl^{-} + O_2$

3. Oxidising action in basic medium

   $2Fe^{2+} + H_2O_2 \rightarrow 2Fe^{3+} + 2OH^{-}$ $Mn^{2+} + H_2O_2 \rightarrow Mn^{4+} + 2OH^{-}$

4. Reducing action in basic medium

5. $I_2 + H_2O_2 + 2OH^{-} \rightarrow 2I^{-} + 2H_2O + O_2$

   $2MnO^{-} + 3H_2O \rightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^{-}$

Storage - H_2O_2 decomposes slowly on exposure to light.

$2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$

In the presence of metal surfaces or traces of alkali (present in glass containers), the above reaction is catalysed. It is, therefore, stored in wax-lined glass or plastic vessels in dark. Urea can be added as a stabiliser. It is kept away from dust because dust can induce explosive decomposition of the compound.

Bleaching action of H_2O_2

H_2O_2 is used as a good bleaching agent. This is because H_2O_2 decomposes to form nascent hydrogen which is responsible for its bleaching action.

$$H_2O_2 \longrightarrow H_2O + [O]$$

Uses

1. In daily life it is used as hair bleach and as a mild disinfectant. As an antiseptic it is sold in the market as perhydrol.
2. It is used to manufacture chemicals like sodium perborate and per-carbonate, which are used in high quality detergents.
3. It is used in the synthesis of hydroquinone, tartaric acid and certain food products and pharmaceuticals.
4. It is employed in the industries as a bleaching agent for textiles, paper pulp, leather, oils, fats etc.
5. It is also used in Environmental (Green) Chemistry.

HEAVY WATER (D_2O)

D_2O is called heavy water. It is used as a moderator in nuclear reactors and in exchange reactions for the study of reaction mechanisms. It can be prepared by exhaustive electrolysis of water or as a by-product in some fertilizer industries. It is used for the preparation of other deuterium compounds.

e.g. $CaC_2 + 2D_2O \rightarrow C_2D_2 + Ca(OD)_2$

HYDROGEN ECONOMY

The basic principle of hydrogen economy is the transportation and storage of energy in the form of liquid or gaseous dihydrogen. Advantage of hydrogen economy is that energy is transmitted in the form of dihydrogen and not as electric power. Dihydrogen is also used in fuel cells for generation of electric power.

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