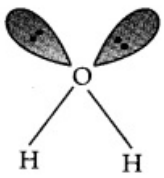
Question 13. How does the atomic hydrogen or oxy-hydrogen torch function for cutting and welding purposes ? Explain.
Answer: When hydrogen is burnt in oxygen the reaction is highly exothermic, it produces very high temperature nearly 4000°C which is used for cutting and welding purposes.

Question 14. Among NH_3 H_2O and HE, which would you expect to have highest magnitude of hydrogen bonding and why?
Answer: HF is expected to have highest magnitude of hydrogen bonding since, 'F' is most electronegative. Therefore, HF is the most polar.

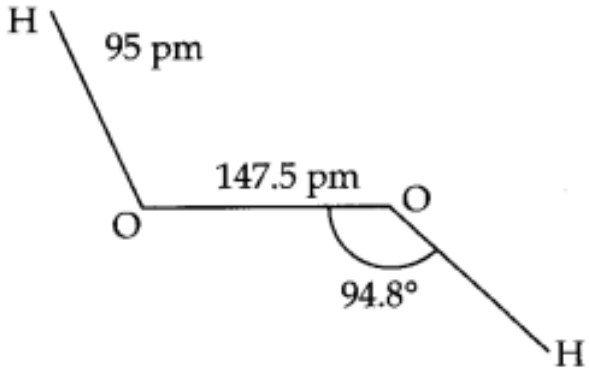
Question 15. Saline hydrides are known to react with water violently producing fire. Can CO_2, a well known fire extinguisher, be used in this case? Explain.
Answer: No. Because if saline hydrides react with water the reaction will be highly exothermic thus the hydrogen evolved in this case can catch fire. $C0_2$ cannot be used as fire extinguisher because $C0_2$ will get absorbed in alkali metal hydroxides.

Question 16. Arrange the following:
(i) CaH_2, BeH_2 and TiH_2 in order of increasing electrical conductance.
(ii) LiH, NaH and CsH in order of increasing ionic character.
(iii) H-H, D—D and F—F in order of increasing bond dissociation enthalpy.
(iv) NaH, MgH_2 and H_2O in order of increasing reducing property.
Answer: (i) $BeH_2 < TiH_2 < CaH_2$
(ii) LiH < NaH < CsH
(iii) F—F < H—H < D—D
(iv) $H_2O < MgH_2 <$ NaH

Question 17. Compare the structures of H_2O and H_2O_2
Answer: In water, O is sp^3 hybridized. Due to stronger lone pair-lone pair repulsions than bond pair-bond pair repulsions, the HOH bond angle decreases from 109.5° to 104.5°. Thus water molecule has a bent structure.



H_2O_2 has a non-planar structure. The O—H bonds are in different planes. Thus, the structure of H_2O_2 is like an open book.



Question 18. What do you understand by the term 'auto-protolysis' of water? what is its significance?
Answer: Auto-protolysis means self-ionisation of water. It may be represented as

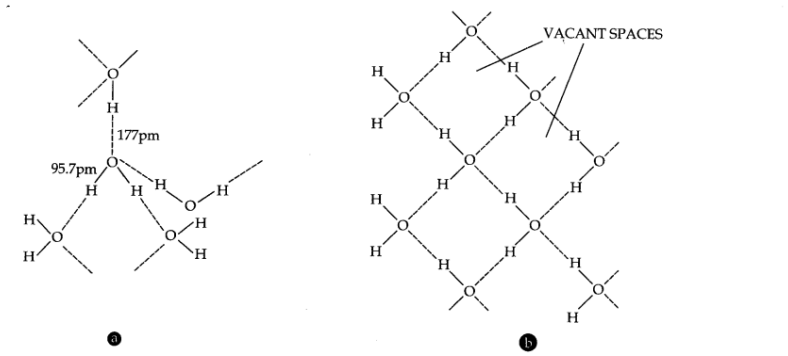
$$\underset{\text{Acid 1}}{H_2O(l)} + \underset{\text{Base 2}}{H_2O(l)} \rightleftharpoons \underset{\text{Acid 2}}{H_3O^+(aq)} + \underset{\text{Base 1}}{OH^-(aq)}$$

Due to auto-protalysis water is amphoteric in nature, i.e., it can act as an acid as well as base.

Question 19. Consider the reaction of water with F_2 and suggest, in terms of oxidation and reduction, which species are oxidised/reduced ?
Answer: $2F_2(ag) + 2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4F(aq)$
In this reaction water acts as a reducing agent and itself gets oxidised to O_2 while F_2 acts as an oxidising agent and hence itself reduced to F^- ions.

Question 20. Complete the following chemical reactions.
(i) $PbS(s) + H_2O_2\ (aq) \rightarrow$
(ii) $MnO_4^-\ (aq) + H_2O_2\ (aq) \rightarrow$
(iii) $CaO(s) + H_2O(g) \rightarrow$
(iv) $AlCl_3(g) + H_2O(l) \rightarrow$
(v) $Ca_3N_2(S) + H_2O(l) \rightarrow$
Classify the above into (a) hydrolysis, (b) redox and (c) hydration reactions.
Answer:
(i) $PbS(s) + 4H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$
(ii) $2MnO_4^-\ (aq) + H_2O_2(aq) + 6H^+(aq) \rightarrow 2Mn\ (aq) + 8H_2O(l) + 5O_2(g)$
(iii) $CaO(s) + H_2O(g) \rightarrow Ca(OH)_2(aq)$
(iv) $AlCl_3(aq) + 3H_2O(l) \rightarrow Al(OH)_3(S) + 3HCl\ (aq)$
(v) $Ca_3N_2(s) + H_2O(l) \rightarrow 3Ca(OH)_2(aq) + 2NH_3(aq)$
(a) Hydrolysis reactions, (iii) (iv) and (v)
(b) Redox reactions (i) and (ii)

Question 21. Describe the structure of common form of ice.



(a) Structure of water in the liquid state
(b) Tetrahedral arrangement of oxygen atoms in ice.

Answer: Ice crystallizes in the normal hexagonal form. However, at very low temperatures it condenses in cubic form. In the normal hexagonal ice each oxygen atom is tetrahedrally surrounded by four other hydrogen atoms.

Question 22. What causes the temporary and permanent hardness of water?
Answer: Temporary hardness of water is due to the presence of bicarbonates of calcium and magnesium in water i.e., $Ca(HCO_3)_2$ and $Mg(HCO_3)$ in water. Permanent hardness of water is due to the presence of soluble chlorides and sulphates of calcium and magnesium i.e., $CaCl_2$, $CaS0_4$, $MgCl_2$ and $MgSO_4$.

Question 23. Discuss the principle and method of softening of hard water by synthetic ion-exchange resins.
Answer: Cation exchange resins have large organic molecule with $S0_3H$ group which are insoluble in water. Ion exchange resin (RSO_3H) is changed to RNa on treatment with NaCl. The resin exchange Na+ ions with Ca^{2+} and Mg^{2+} ions present in hard water and make it soft.

$2RNa(s) + M_2+(aq) \rightarrow R_2M(s) + 2Na^+(aq)$

where, M = Mg, Ca.
The resins can be regenerated by adding aqueous NaCl solution.

Question 24. Write chemical reaction to show the amphoteric nature of water.
Answer: Water is amphoteric in nature because it acts as an acid

$$\underset{\text{Base 1}}{H_2O(l)} + \underset{\text{Acid 2}}{H_2S(aq)} \longrightarrow \underset{\text{Acid 1}}{H_3O^+(aq)} + \underset{\text{Base 2}}{HS^-(aq)}$$

$$\underset{\text{Acid 1}}{H_2O(l)} + \underset{\text{Base 2}}{NH_3(aq)} \longrightarrow \underset{\text{Acid 2}}{NH_4^+(aq)} + \underset{\text{Base 1}}{OH^-(aq)}$$

********** END **********