Hydrogen

Short Answer Type Questions

1. How can production of hydrogen from water gas be increased by using water gas shift reaction?
2. What are metallic/interstitial hydrides? How do they differ from molecular hydrides?
3. Name the classes of hydrides to which H_2O, B_2H_6 and NaH belong.
4. If same mass of liquid water and a piece of ice is taken, then why is the density of ice less than that of liquid water?
5. Complete the following equations:

   (i) $PbS\,(s) + H_2O_2(aq) \longrightarrow$ (ii) $CO\,(g) + 2H_2\,(g) \xrightarrow[Catalyst]{Cobalt}$

6. Give reasons:
   - (i) Lakes freeze from top towards bottom.
   - (ii) Ice floats on water.

7. What do you understand by the term 'auto protolysis of water' ? What is its significance?
8. Discuss briefly de-mineralisation of water by ion exchange resin.
9. Molecular hydrides are classified as electron deficient, electron precise and electron rich compounds. Explain each type with two examples.
10. How is heavy water prepared? Compare its physical properties with those of ordinary water.
11. Write one chemical reaction for the preparation of D_2O_2.
12. Calculate the strength of 5 volume H_2O_2 solution.
13. (i) Draw the gas phase and solid phase structure of H_2O_2.
    (ii) H_2O_2 is a better oxidising agent than water. Explain.
14. Melting point, enthalpy of vapourisation and viscosity data of H_2O and D_2O is given below :

	H_2O	D_2O
Melting point / K	373.0	374.4
Enthalpy of vapourisation at (373 K)/ kJ mol^{-1}	40.66	41.61
Viscosity/centipoise	0.8903	1.107

On the basis of this data explain in which of these liquids intermolecular forces are stronger?

15. Dihydrogen reacts with dioxygen (O_2) to form water. Write the name and formula of the product when the isotope of hydrogen which has one proton and one neutron in its nucleus is treated with oxygen. Will the reactivity of both the isotopes be the same towards oxygen? Justify your answer.
16. Explain why HCl is a gas and HF is a liquid.
17. When the first element of the periodic table is treated with dioxygen, it gives a compound whose solid state floats on its liquid state. This compound has an ability to act as an acid as well as a base. What products will be formed when this compound undergoes autoionisation?
18. Rohan heard that instructions were given to the laboratory attendant to store a particular chemical i.e., keep it in the dark room, add some urea in it, and keep it away from dust. This chemical acts as an oxidising as well as a reducing agent in both acidic and alkaline media. This chemical is important for use in the pollution control treatment of domestic and industrial effluents.
    - (i) Write the name of this compound.
    - (ii) Explain why such precautions are taken for storing this chemical.
19. Give reasons why hydrogen resembles alkali metals?
20. Hydrogen generally forms covalent compounds. Give reason.
21. Why is the Ionisation enthalpy of hydrogen higher than that of sodium?
22. Basic principle of hydrogen economy is transportation and storage of energy in the form

of liquid or gaseous hydrogen. Which property of hydrogen may be useful for this purpose? Support your answer with the chemical equation if required.

23. What is the importance of heavy water?
24. Write the Lewis structure of hydrogen peroxide.
25. An acidic solution of hydrogen peroxide behaves as an oxidising as well as reducing agent. Illustrate it with the help of a chemical equation.
26. With the help of suitable examples, explain the property of H_2O_2 that is responsible for its bleaching action?
27. Why is water molecule polar?
28. Why does water show high boiling point as compared to hydrogen sulphide? Give reasons for your answer.
29. Why can dilute solutions of hydrogen peroxide not be concentrated by heating. How can a concentrated solution of hydrogen peroxide be obtained?
30. Why is hydrogen peroxide stored in wax lined bottles?
31. Why does hard water not form lather with soap?
32. Phosphoric acid is preferred over sulphuric acid in preparing hydrogen peroxide from peroxides. Why?
33. How will you account for 104.5° bond angle in water?
34. Write redox reaction between fluorine and water.
35. Write two reactions to explain amphoteric nature of water.

Long Answer Type Questions

1. Atomic hydrogen combines with almost all elements but molecular hydrogen does not. Explain.
2. How can D_2O be prepared from water? Mention the physical properties in which D_2O differs from H2O. Give at least three reactions of D2O showing the exchange of hydrogen with deuterium.
3. How will you concentrate H_2O_2? Show differences between structures of H_2O_2 and H_2O by drawing their spatial structures. Also mention three important uses of H_2O_2.
4. (i) Give a method for the manufacture of hydrogen peroxide and explain the reactions involved therein.
   (ii) Illustrate oxidising, reducing and acidic properties of hydrogen peroxide with equations.
5. What mass of hydrogen peroxide will be present in 2 litres of a 5 molar solution? Calculate the mass of oxygen which will be liberated by the
   decomposition of 200 mL of this solution.
6. A colourless liquid 'A' contains H and O elements only. It decomposes slowly on exposure to light. It is stabilised by mixing urea to store in the presence of light.
   - (i) Suggest possible structure of A.
   - (ii) Write chemical equations for its decomposition reaction in light.

7. An ionic hydride of an alkali metal has significant covalent character and is almost unreactive towards oxygen and chlorine. This is used in the synthesis of other useful hydrides. Write the formula of this hydride. Write its reaction with Al_2Cl_6.
8. Sodium forms a crystalline ionic solid with dihydrogen. The solid is nonvolatile and non-conducting in nature. It reacts violently with water to produce dihydrogen gas. Write the formula of this compound and its reaction with water. What will happen on electrolysis of the melt of this solid.