.

TEXTBOOK QUESTIONS SOLVED

Question 1. Justify the position of hydrogen in the periodic table on the basis of its electronic configuration.
Answer: Hydrogen has been placed at the top of the alkali metal in group, but it is not a member of the group.
Its position is not justified properly because of its electronic configuration as ($1s^1$). It can be placed with alkali metals because it also has similar configuration (ns^1) as alkali metals.
However, it can also be placed along with halogen in group 17 since just like halogen it can acquire inert gas configuration by accepting one electron.

Question 2. Write the names of isotopes of hydrogen. What is the mass ratio of these isotopes?
Answer:

$$\text{Protium} - {}_1^1\text{H}$$

$$\text{Deuterium} - {}_1^2\text{H} \quad \text{or} \quad \text{D}$$

$$\text{Tritium} - {}_1^3\text{H} \quad \text{or} \quad \text{T}$$

$$\text{Mass ratio of Protium : Deuterium : Tritium} = 1 : 2 : 3$$

Question 3. Why does hydrogen occur in a diatomic form rather than in a monoatomic form under normal conditions?
Answer: In diatomic form, the K-shell of hydrogen is complete ($1s^2$) and so it is quite stable.

Question 4. How can the production of dihydrogen obtained from 'Coal gasification' be increased?
Answer: The production of dihydrogen in coal gasification can be increased by reacting CO(y) present in syngas with steam in the presence of iron chromate catalysts.

$$CO(g) + H_2O(g) \xrightarrow[673K]{FeCrO_4 \text{ (catalyst)}} CO_2(g) + H_2(g)$$

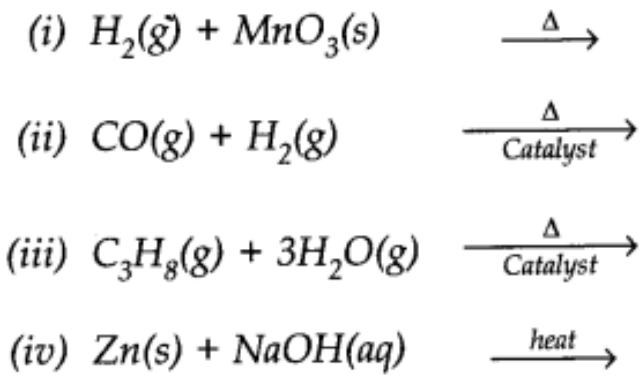
With the removal of $C0_2$ the reaction shifts in the forward direction and thus, the production of dihydrogen will be increased.

Question 5. Describe the bulk preparation of dihydrogen by electrolytic method. What is the role of an electrolyte in this process?
Answer: In bulk, hydrogen can be produced by electrolysis of acidified water using Pt electrodes.

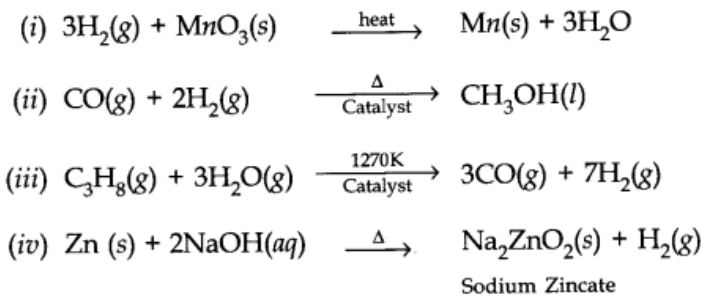
$$2H_2O(l) \xrightarrow[\text{traces of acid or base}]{\text{Electrolysis}} 2H_2(g) + O_2(g)$$

Electrolyte is added to increase the dissociation of water.

Question 6. Complete the following reactions.



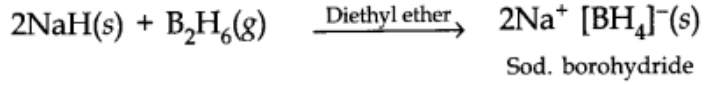
Answer:



Question 7. Discuss the consequences of high enthalpy of H-H bond, in terms of chemical reactivity of dihydrogen.
Answer: This is due to its small atomic size and also small bond length (74 pm) of H-H bond.

Question 8. What do you understand by (i) Electron-deficient (ii) Electron-precise (iii) Electron-rich compounds of hydrogen? Provide justification with suitable examples.
Answer:
(i) Electron deficient hydrides: Compounds in which central atom has incomplete octet, are called electron deficient hydrides. For example, BeH_2, BH_3 are electron deficient hydrides.
(ii) Electron precise hydrides: Those compounds in which exact number of electrons are present in central atom or the central atom contains complete octet are called precise hydrides e.g., CH_4, SiH_4, GeH_4 etc. are precise hydrides.
(iii) Electron rich hydrides: Those compounds in which central atom has one or more lone pair of excess electrons are called electron rich hydrides, e.g.,NH_3, H_2O.

Question 9. What characteristics do you expect from an electron-deficient hydride with respect to its structure and chemical reaction?
Answer: It is expected to be a Lewis acid. They are likely to accept electrons to become stable. They can form coordinate bond with electron rich compound.



Question 10. Do you expect the carbon hydride of type $C_n H_{2n+2}$ to act as 'Lewis' acid or base? Justify your answer.
Answer: Carbon hydrides of the type $C_n H_{2n+2}$ are electron precise hydrides. Because they have atom with exact number of electrons to form covalent bonds. Thus, they do not behave as Lewis acid or base. Since they have no tendency to accept or lose electrons.

Question 11. What do you understand by the term 'non-stoichiometric hydrides'? Do you expect this type of hydrides to be formed by alkali metals? Justify your answer.

Answer: Those hydrides which do not have fix composition are called non-stoichiometric hydrides, and the composition varies with temperature and pressure. This type of hydrides are formed by d and /block elements. They cannot be formed by alkali metals because alkali metal hydrides form ionic hydrides.

Question 12. How do you expect the metallic hydrides to be useful for hydrogen storage? Explain.
Answer: In metallic hydrides, hydrogen is adsorbed as H-atoms. Due to the adsorption of H atoms the metal Lattice expands and become unstable. Thus, when metallic hydride is heated, it decomposes to form hydrogen and finely divided metal. The hydrogen evolved can be used as fuel.

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