



Hydrogen

- 1. Hydrogen peroxide oxidises $[Fe(CN)_6]^{4-}$ to $[Fe(CN)_6]^{3-}$ in acidic medium but reduces $[Fe(CN)_6]^{3-}$ to $[Fe(CN)_6]^{4-}$ in alkaline medium. The other products formed are, respectively
 - (a) $(H_2O + O_2)$ and H_2O
 - (b) $(H_2O + O_2)$ and $(H_2O + OH^-)$
 - (c) H_2O and $(H_2O + O_2)$

3.

(d)
$$H_2O$$
 and $(H_2O + OH^-)$

- 2. Which one of the following statements about water is false?
 - (a) Water is oxidized to oxygen during photosynthesis.
 - (b) Water can act both as an acid and as a base.
 - (c) There is extensive intramolecular hydrogen bonding in the condensed phase.
 - (d) Ice formed by heavy water sinks in normal water. (2016)
 - Identify the incorrect statement regarding heavy water.(a) It reacts with SO₃ to form deuterated sulphuric acid (D₂SO₄).
 - (b) It is used as a coolant in nuclear reactors.
 - (c) It reacts with CaC_2 to produce C_2D_2 and $Ca(OD)_2$.
 - (d) It reacts with Al_4C_3 to produce CD_4 and $Al(OD)_3$.

(Online 2016)

(2018)

- 4. Identify the reaction which does not liberate hydrogen.
 - (a) Reaction of lithium hydride with B_2H_6 .
 - (b) Electrolysis of acidified water using Pt electrodes.
 - (c) Reaction of zinc with aqueous alkali.
 - (d) Allowing a solution of sodium in liquid ammonia to stand.

(Online 2016)

The molecular formula of a commercial resin used for exchanging ions in water softening is C₈H₇SO₃Na (Mol. wt. 206). What would be the maximum uptake of Ca²⁺ ions by the resin when expressed in mole per gram resin?

(a)
$$\frac{7}{85>}$$
 (b) $\frac{6}{967}$ (c) $\frac{6}{658}$ (d) $\frac{6}{75;}$ (2015)

6. From the following statements regarding H_2O_2 , choose the incorrect statement.

- (a) It has to be stored in plastic or wax lined glass bottles in dark.
- (b) It has to be kept away from dust .
- (c) It can act only as an oxidizing agent.
- (d) It decomposes on exposure to light.

(2015)

- 7. Permanent hardness in water cannot be cured by
 - (a) boiling
 - (b) ion exchange method
 - (c) Calgon's method
 - (d) treatment with washing soda. (Online 2015)
- 8. Which physical property of dihydrogen is wrong?(a) Colourless gas (b) Odourless gas
 - (c) Tasteless gas (d) Non-inflammable gas

(Online 2015)

- **9.** Very pure hydrogen (99.9%) can be made by which of the following processes?
 - (a) Mixing natural hydrocarbons of high molecular weight.
 - (b) Electrolysis of water.
 - (c) Reaction of salt like hydrides with water.
 - (d) Reaction of methane with steam. (2012)
- 10. In context with the industrial preparation of hydrogen from water gas (CO + H_2), which of the following is the correct statement?
 - (a) CO is oxidised to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali.
 - (b) CO and H_2 are fractionally separated using differences in their densities.
 - (c) CO is removed by absorption in aqueous Cu_2Cl_2 solution.
 - (d) H_2 is removed through occlusion with Pd.

(2008)

- 11. Which one of the following processes will produce hard water?
 - (a) Saturation of water with $CaCO_3$
 - (b) Saturation of water with MgCO₃
 - (c) Saturation of water with CaSO₄
 - (d) Addition of Na_2SO_4 to water (2003)

| | ANSWER KEY | | | | | | | | | | | | | | | | | | | | |
|----|------------|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|-----|-----|-----|-----|
| 1. | (c) | 2. | (c) | 3. | (b) | 4. | (a) | 5. | (b) | 6. | (c) | 7. | (a) | 8. | (d) | 9. | (b) | 10. | (a) | 11. | (c) |

Explanations

1. (c) : Oxidising action of H_2O_2 in acidic medium : $2[Fe(CN)_6]^{4-} + H_2O_2 + 2H^+ \longrightarrow 2[Fe(CN)_6]^{3-} + 2H_2O$ Reducing action of H_2O_2 in alkaline medium : $2[Fe(CN)_6]^{3-} + 2OH^- + H_2O_2 \longrightarrow 2[Fe(CN)_6]^{4-} + 2H_2O + O_2$

2. (c): In the condensed phase, there is extensive intermolecular hydrogen bonding in water molecules but not intramolecular hydrogen bonding.

3. (b): Heavy water is used as moderator in nuclear reactors to control the speed of neutrons.

4. (a): $2\text{LiH} + B_2H_6 \xrightarrow{\text{Ether}} 2\text{LiBH}_4$

5. (b): $2C_8H_7SO_3Na^+ + Ca^{2+} \longrightarrow (C_8H_7SO_3)_2Ca^{2+} + 2Na^+$ $2 \mod 1 \mod (2 \times 206 = 412 \text{ g})$ 1 mol of $Ca^{2+} \equiv 412 \text{ g}$ of resin

Maximum uptake of Ca²⁺ ions by the resin = $\frac{6 \text{ y} \{x\}}{967 \text{ s}} = \frac{6}{967} \text{ y} \{x\}$

6. (c) : H₂O₂ acts as an oxidising as well as a reducing agent.
7. (a) : Only temporary hardness which is due to HCO₃⁻ (bicarbonate) ions is removed by boiling.

8. (d) : Dihydrogen is an inflammable gas.

9. (b) : Dihydrogen of high purity is usually prepared by the electrolysis of water using platinum electrodes in presence of small amount of acid or alkali.

$$2H_2O_{(l)} \xrightarrow{\text{electrolysis}} 2H_{2(g)} + O_{2(g)}$$

Dihydrogen is collected at cathode.

10. (a) : Carbon monoxide is oxidised to carbon dioxide by passing the gases and steam over an iron oxide or cobalt oxide or chromium oxide catalyst at 673 K resulting in the production of more H_2 .

$$CO + H_2O \xrightarrow{Fe_2O_3, CoO}{673 \text{ K}} CO_2 + H_2$$
$$CO_2 \xrightarrow{\text{NaOH}}{\text{alkali}} Na_2CO_3$$

 CO_2 is absorbed in alkali (NaOH). The entire reaction is called water gas shift reaction.

11. (c) : Permanent hardness is introduced when water passes over rocks containing the sulphates or chlorides of both of calcium and magnesium.