JEE Mains 2019 Chapter wise Question Bank

Hydrogen - Questions

Q1

The isotopes of hydrogen are:
(1) Tritium and protium only
(2) Protium and deuterium only
(3) Protium, deuterium and tritium
(4) Deuterium and tritium only

9 Jan Morning

Q2

The temporary hardness of water is due to:

(1) Na_2SO_4 (2) NaCl

(3) $Ca(HCO_3)_2$ (4) $CaCl_2$

9 Jan Evening

Q3

The total number of isotopes of hydrogen and number of radioactive isotopes among them, respectively, are:

(1) 3 and 1   (2) 3 and 2

(3) 2 and 1   (4) 2 and 0

10 Jan Morning

Q4

The chemical nature of hydrogen peroxide is:

(1) Oxidising agent in acidic medium, but not in basic medium.

(2) Reducing agent in basic medium, but not in acidic medium.

(3) Oxidising and reducing agent in acidic medium, but not in basic medium.

(4) Oxidising and reducing agent in both acidic and basic medium.

10 Jan Morning

Q5

The correct statements among (a) to (d) regarding H_2 as a fuel are :
(a) It produces less pollutants than petrol.
(b) A cylinder of compressed dihydrogen weighs ~ 30 times more than a petrol tank producing the same amount of energy.
(c) Dihydrogen is stored in tanks of metal alloys like $NaNi_5$.
(d) On combustion, values of energy released per gram of liquid dihydrogen and LPG are 50 and 142 kJ, respectively.
(1) (b) and (d) only
(2) (a) and (c) only
(3) (b), (c) and (d) only
(4) (a), (b) and (c) only

11 Jan Morning

Q6

The hardness of a water sample (in terms of equivalents of $CaCO_3$) containing $10^{-3} M\, CaSO_4$ is:
(molar mass of $CaSO_4$=136 g mol^{-1})
(1) 10 ppm   (2) 50ppm
(3) 90 ppm   (4) 100ppm

12 Jan Morning

Q7

The volume strength of $1M\, H_2O_2$ is :
(Molar mass of $H_2O_2 = 34$ g mol^{-1})
(1) 5.6   (2) 16.8
(3) 11.35   (4) 22.4

12 Jan Evening

Q8

100 mL of a water sample contains 0.81 g of calcium bicarbonate and 0.73 g of magnesium bicarbonate. The hardness of this water sample expressed in terms of equivalents of $CaCO_3$ is:
(molar mass of calcium bicarbonate is 162 g mol^{-1} and magnesium bicarboante is 146 g mol^{-1})
(1) 5,000 ppm   (2) 1,000 ppm
(3) 100 ppm   (4) 10,000 ppm

8 April Morning

Q9

The strength of 11.2 volume solution of H_2O_2 is : [Given that molar mass of H = 1 g mol^{-1} and O = 16 g mol^{-1}]

(1) 13.6%   (2) 3.4%   (3) 34%   (4) 1.7%

Q3

The number of water molecules(s) not coordinated to copper ion directly in $CuSO_4 \cdot 5H_2O$, is:

(1) 2   (2) 3   (3) 1   (4) 4

Q4

The synonym for water gas when used in the production of methanol is :

(1) natural gas   (2) fuel gas

(3) laughing gas   (4) syn gas

Q5

The correct statements among (a) to (d) are :

(a) saline hydrides produce H_2 gas when reacted with H_2O.

(b) reaction of $LiAlH_4$ with BF_3 leads to B_2H_6.

(c) PH_3 and CH_4 are electron – rich and electron – precise hydrides, respectively,

(d) HF and CH_4 are called as molecular hydrides.

(1) (a), (b), (c) and (d)   (2) (c) and (d) only

(3) (a), (c) and (d) only   (4) (a), (b) and (c) only

Q6

The temporary hardness of a water sample is due to compound X. Boiling this sample converts X to compound Y. X and Y, respectively, are :

(1) $Mg(HCO_3)_2$ and $Mg(OH)_2$

(2) $Ca(HCO_3)_2$ and $Ca(OH)_2$

(3) $Mg(HCO_3)_2$ and $MgCO_3$

(4) $Ca(HCO_3)_2$ and CaO

JEE Mains 2019 Chapter wise Question Bank

Hydrogen - Answers

Q1

(3) Hydrogen has three isotopes:

Protium ($_1H^1$), deuterium ($_1H^2$) and tritium ($_1H^3$).

Q2

(3) Only bicarbonates cause temporary hardness, whereas chlorides and sulphates cause permanent hardness.
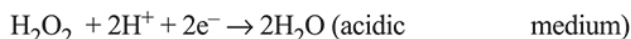
Q3

(1) There are three isotopes of H out of which only tritium is radioactive, which emits low energy β^- particles. Its half life is 12.33 years.
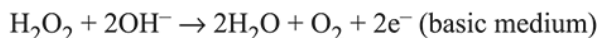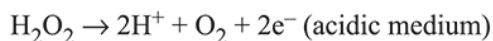
Q4

(4) H_2O_2 acts as oxidising agent as well as reducing agent in both acidic and basic medium.

H_2O_2 acts as oxidant:

$H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$ (acidic   medium)

$H_2O_2 + 2e^- \rightarrow 2OH^-$ (basic medium)

H_2O_2 acts as reductant:-

$H_2O_2 \rightarrow 2H^+ + O_2 + 2e^-$ (acidic medium)

$H_2O_2 + 2OH^- \rightarrow 2H_2O + O_2 + 2e^-$ (basic medium)

Q5

(4) option (a), (b) and (c) are correct.

Q6

(4) 10^{-3} M $CaSO_4$ ∫ 10^{-3} M $CaCO_3$

$\Rightarrow 10^{-3}$ M $CaCO_3$ means 10^{-3} moles of $CaCO_3$ are present in 1 L

Molar mass of $CaCO_3 = 40 + 12 + 48 = 100$ g/mol

$$10^{-3} \text{ mol} = \frac{W}{100\,\text{g/mol}}$$

$$W = 10^{-3} \times 100 \text{ g} = 100 \text{ mg}$$

i.e. 100 mg of $CaCO_3$ is present in 1 L solution.

Hardness of water = Number of milligram of $CaCO_3$ per litre of water.

∴ Hardness of water = 100 ppm

Q7

(3) Volume strength = $11.35 \times$ molarity = 11.35

Q8

(4) Moles of $Ca(HCO_3)_2 = \dfrac{0.81}{162} = 0.005$

Moles of $Mg(HCO_3)_2 = \dfrac{0.73}{146} = 0.005$

Hardness in terms of $CaCO_3$ in ppm

$= \dfrac{(0.005 + 0.005) \times 100}{100} \times 10^6 = 10^4$ ppm

Q9

(2) 11.2 V strength of H_2O_2 means, 11.2 L of O_2 is liberated at STP.

$$H_2O_2 \longrightarrow H_2O + \frac{1}{2}O_2$$
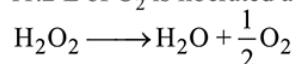
11.2 L of O_2 at STP = 0.5 mol

∴   No. of moles of H_2O_2 = 1 mol

i.e., 1 L of given H_2O_2 solution has 1 mole of H_2O_2 (i.e., 34 g)

Strength $= \dfrac{34}{1000} \times 100 = 3.4\%$

8 April Evening

Q3

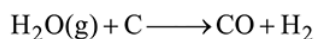(3) In $CuSO_4 \cdot 5H_2O$, four H_2O molecules are directly coordinated to the central metal ion while one H_2O molecule is hydrogen bonded.

9 April Morning

Q4

(4) When steam is passed over red hot coke, an equimolar mixture of CO and H_2 is obtained.

$$H_2O(g) + C \longrightarrow CO + H_2$$

Steam   Red hot

The gaseous mixture thus obtained is called water gas or syn gas (synthesis gas).
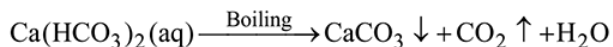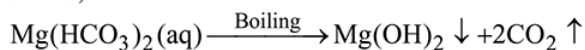
10 April Morning

Q5

(4) (a) Saline hydrides with water produces H_2 gas.

(b) $3LiAlH_4 + 4BF_3 \rightarrow 2B_2H_6 + 3LiF + 3AlF_3$

(c) PH_3 is electron rich whereas CH_4 is electron precise hydride.

(d) HF and CH_4 are molecular hydrides.

10 April Evening

Q6

(1) Temporary hardness is caused by bicarbonates of calcium and magnesium. On boiling following changes occurs,

$$Mg(HCO_3)_2(aq) \xrightarrow{\text{Boiling}} Mg(OH)_2 \downarrow + 2CO_2 \uparrow$$

$$Ca(HCO_3)_2(aq) \xrightarrow{\text{Boiling}} CaCO_3 \downarrow + CO_2 \uparrow + H_2O$$

12 April Evening