

Hydrogen & Its Compounds

1. Preparation of H₂

- Q 1. Which of the following element is present in largest number of compounds?
 (A) Hydrogen (B) Carbon
 (C) Silicon (D) Nitrogen
- Q 2. The ionization energy of Hydrogen lie in the range of ionization energy of
 (A) Halogen (B) Alkali Metal
 (C) Noble Gas (D) None of these
- Q 3. Electronegativity of Hydrogen lie in the range electronegativity of
 (A) Halogen (B) Alkali Metal
 (C) Noble Gas (D) None of these
- Q 4. Hydrogen resembles halogen in many respects for which several factors are responsible. Of the following factors, which one is most important in this respect? **[NCERT Exemplar]**
 (A) its tendency to lose electrons to form a cation
 (B) its tendency to gain electron to attain a stable noble gas configuration
 (C) its low negative electron gain enthalpy
 (D) its small size
- Q 5. H⁺ ion always get associated with other atoms and molecules. This is because **[AIIMS 2015]**
 (A) I.E. of hydrogen resembles with that of IA metal
 (B) its reactivity is similar to halogens
 (C) it resembles both alkali metal & Halogen
 (D) loss of an electron from Hydrogen atom results in a nucleus of very small size as compared to other atom
- Q 6. Hydrogen is
 (A) Electropositive (B) electronegative
 (C) Both electropositive and electronegative
 (D) Neither electropositive nor electronegative
- Q 7. Why does Hydrogen exist in diatomic form rather than in monoatomic form under normal condition? **[NCERT]**
- Q 8. Which of the following can not be used for the preparation of hydrogen gas in the laboratory?
 1. Zinc/conc. H₂SO₄
 2. Zn/dil. HNO₃
 3. Pure Zinc/dil. H₂SO₄
 (A) 1 & 2 (B) 1, 2 & 3
- (C) 3 only (D) 1 & 3
- Q 9. In the laboratory preparation of hydrogen, pure zinc is not used because
 (A) Pure zinc becomes passive due to the formation of oxide layer.
 (B) Pure zinc becomes passive due to the formation of sulphate layer over the metal
 (C) Pure zinc reacts slowly with the acid
 (D) Pure zinc reacts with acid vigorously and violently
- Q 10. With which metal dil H₂SO₄ react and produce dihydrogen?
 (A) Ag (B) Cu (C) Fe (D) Pt
- Q 11. Very Pure Hydrogen (99.9 %) can be made by which of the following process? **[AIEEE 2012]**
 (A) Reaction of methane gas with steam
 (B) Mixing Natural hydrocarbon of high molecular weight
 (C) Electrolysis of Water
 (D) Reaction of Salts like Hydrides with Water
- Q 12. Commercial hydrogen is obtained from
 (A) Coal gas (B) water gas
 (C) air (D) producer gas
- Q 13. In context of Industrial preparation of Hydrogen from Water Gas (CO + H₂), which of the following is correct statement? **[AIEEE 2008]**
 (A) CO & H₂, are fractionally separated using differences in their densities.
 (B) CO is removed by absorption in aqueous Cu₂Cl₂ solution
 (C) H₂ is removed through occlusion with Pd
 (D) CO is oxidized to CO₂ with steam in the presence of a catalyst followed by absorption of CO₂ in alkali.
- Q 14. Which of the following reactions increases production of dihydrogen from synthesis gas? **[NCERT Exemplar]**
 (A) $CH_4 + H_2O \xrightarrow{1270K/Ni} CO + 3H_2$
 (B) $C + H_2O \xrightarrow{1270K} CO + H_2$
 (C) $CO + H_2O \xrightarrow{673K/Catalyst} CO_2 + H_2$
 (D) $C_2H_6 + 2H_2O \xrightarrow{1270K/Ni} 2CO + 5H_2$

- Q 15. Which of the following reaction is an example of use of water gas in the synthesis of other compounds? [NCERT Exemplar]
 (A) $CH_4 + H_2O \xrightarrow{1270K/Ni} CO + 3H_2$
 (B) $CO + H_2O \xrightarrow{673K/Catalyst} CO_2 + H_2$
 (C) $CO + 2H_2 \xrightarrow{Co-catalyst} CH_3OH$
 (D) $C_2H_6 + 2H_2O \xrightarrow{1270K/Ni} 2CO + 5H_2$
- Q 16. How the production of dihydrogen obtained from 'coal gasification' can be increased? [NCERT]
- Q 17. Complete the following reactions: [NCERT]
 (i) $H_2(g) + MnO_3(s) \xrightarrow{\Delta}$
 (ii) $CO(g) + H_2(g) \xrightarrow{\Delta/Catalyst}$
 (iii) $C_3H_8(g) + 3H_2O(g) \xrightarrow{\Delta/Catalyst}$
 (iv) $Zn(s) + NaOH(aq) \xrightarrow{\Delta}$
- Q 18. Electrolysis of pure H_2O does not give $H_2(g)$ because
 (A) It does not have H^+ concentration
 (B) Pure H_2O is non – conductor of electricity
 (C) It gives mixture of H_2 & O_2 , can't be separated easily
 (D) None of these
- Q 4. In water, of in aqueous solution of HCl or H_2SO_4 , proton exists as
 (A) H_3O^+ (B) $H(H_2O)_4^+$
 (C) $H(H_2O)_n^+$ (D) All correct
- Q 5. Hydrogen gas will not reduce
 (A) Heated CuO (B) heated Fe_2O_3
 (C) Heated SnO_2 (D) heated Al_2O_3
- Q 6. Hydrogen can act as O.A. in its reaction with
 (A) Br_2 (B) Ca (C) N_2 (D) S
- Q 7. Which of the solution is preferred to produce pure H_2 ?
 (A) $NaOH$ Solution (B) KOH Solution
 (C) $Ba(OH)_2$ solution (D) $Be(OH)_2$ solution
- Q 8. H_2 gas is not used in
 (A) Hydrogenation of vegetable oil
 (B) As rocket Fuel
 (C) As a reducing agent
 (D) As torpedoes fuel
- Q 9. Which of the following statement about H_2 is Incorrect? [NEET 2016 – II]
 (A) Hydrogen never acts as cation in ionic salts
 (B) Hydronium ion, H_3O^+ exist freely in solution
 (C) Dihydrogen does not act as reducing agent
 (D) Hydrogen has three isotopes of which tritium is the most common
- Q 10. Under what condition of temp. & pressure the formation of atomic hydrogen from molecular hydrogen will be favoured most ?
 (A) High temp and high pressure
 (B) Low temp. & low pressure
 (C) High temp. & Low pressure
 (D) Low pressure & high temperature
- Q 11. The reactivity order of atomic H and Nascent H is
 (A) Atomic H > Nascent H
 (B) Atomic H < Nascent H
 (C) Atomic H = Nascent H
 (D) None of these
- Q 12. Conversion of atomic hydrogen to molecular hydrogen is
 (A) An exothermic process
 (B) an endothermic process
 (C) A nuclear change
 (D) photochemical change
- Q 13. Spin isomerism is shown by [AIIMS 2007]
 (A) DichloroBenzene (B) Hydrogen Molecule
 (C) Dibasic Acid (D) n – butane
- Q 14. Which of the following statements is not correct?

2. Type of Hydrogen

- Q 1. **Assertion (A):** Some metals like Palladium & platinum, can be used as storage media for H_2 .
Reason (R): Palladium & Platinum can absorb large volume of H_2 gas. [NCERT Exemplar]
 (A) Both A & R are correct and R is correct explanation of A
 (B) Both A & R are correct but R is not correct explanation of A
 (C) A is correct but R is not correct
 (D) A and R are both False
- Q 2. The absorption of hydrogen on Palladium is commonly known as [IIT 1980]
- Q 3. Which compound act as hydrolyth?
 (A) NH_3 (B) H_2O
 (C) CaH_2 (D) H_2SO_4

- (A) The ratio of ortho to para hydrogen varies with temperature
 (B) The ratio of ortho to para hydrogen at 300 K and above is 3:1
 (C) Pure para hydrogen can be obtained by cooling ordinary hydrogen to about 20 K
 (D) Pure ortho hydrogen can be obtained by heating ordinary hydrogen above 300 K
- Q 15. Consider the following statements about ortho and para hydrogen
- (1) In ortho hydrogen, the spins of the proton are in the same direction.
 - (2) Ortho hydrogen is more stable than para hydrogen at the ambient condition.
 - (3) At ordinary temperature, ordinary hydrogen is a mixture of 75% para & 25% ortho forms.
 - (4) The two forms have similar chemical properties, but differ in physical properties like specific heat and thermal conductivity.
- Which of the statements are correct?
- (A) 1, 2 and 3 (B) 2, 3 and 4
 (C) 1, 3 and 4 (D) 1, 2 and 4
- 3. Isotopes of Hydrogen, Hydrides**
- Q 1. The number of isotopes of Hydrogen atom which is/are radioactive?
 (A) 1 (B) 2 (C) 3 (D) 0
- Q 2. What do you understand by [NCERT]
 (i) Hydrogen Economy (ii) Hydrogenation
 (iii) Syngas (iv) Water gas shift reaction
 (v) Fuel cell
- Q 3. The pH of D₂O and H₂O at 298 K is
 (A) 7.35 & 7.0 (B) 7.0 & 7.0
 (C) 7.0 & 6.85 (D) 6.85 & 7.25
- Q 4. Of the two solvents H₂O and D₂O, Sodium chloride dissolves
 (A) Equally in both (B) more in D₂O
 (C) more in H₂O (D) Only in H₂O
- Q 5. Heavy water is so called because
 (A) It is highly dense and viscous liquid
 (B) It is an oxide of heavier isotope of hydrogen
 (C) It is as heavy as mercury
 (D) Its formula is D₂O
- Q 6. Hydrides of metals are named like
 (A) Alkane (B) Alkene
 (C) Alkyne (D) None is correct
- Q 7. Which hydride is also called **alanate**?
 (A) Li⁺[AlH₄]⁻ (B) Na⁺[BH₄]⁻
 (C) CaH₂ (D) AlH₃
- Q 8. Which of the following element from lattice hydrides?
 (A) Alkali Metal (B) Non-metal
 (C) Transition Metal (D) Alkaline earth Metal
- Q 9. H₂O is a
 (A) Covalent Hydrides (B) Lattice hydrides
 (C) Ionic Hydrides (D) Polar Hydrides
- Q 10. Which of the following hydrides are non-stoichiometric?
 (A) Covalent Hydrides (B) Lattice hydrides
 (C) Ionic Hydrides (D) Polar Hydrides
- Q 11. Elements of which of the following group(s) of P.T. do not form hydrides? [NCERT Exmaplar]
 (A) groups 7, 8, 9 (B) group 13
 (C) groups 15, 16, 17 (D) group 14
- Q 12. Only one of element of ----- forms Hydrides? [NCERT Exmaplar]
 (A) Group 6 (B) Group 7
 (C) Group 8 (D) Group 9
- Q 13. Which of the following is an electron precise hydrides? [AIIMS 2013]
 (A) B₂H₆ (B) NH₃
 (C) H₂O (D) CH₄
- Q 14. What do you understand by non-stoichiometric hydrides? Do you expect alkali metal form this type of hydrides? [NCERT]
- Q 15. Saline Hydrides reacts with water violently producing fire. Can CO₂, a well known fire extinguisher, be used in this case? [NCERT]
- Q 16. Arrange the following in increasing order [NCERT]
 (i) CaH₂, BeH₂ & TiH₂ of electrical conductance
 (ii) LiH, NaH & CsH in Ionic Character
 (iii) H-H, D-D & F-F bond dissociation enthalpy
 (iv) NaH, MgH₂ & H₂O in reducing property

4. Water

- Q 1. In H_2O , no. of Hydrogen Bonding with each H_2O molecule is
(A) 3 (B) 4 (C) 6 (D) 2
- Q 2. The density of $\text{H}_2\text{O}(\text{l})$ is greater than density of ice is due to
(A) Hexagonal Cage like Structure in Ice
(B) Hexagonal Cage like Structure in $\text{H}_2\text{O}(\text{l})$
(C) Tetrahedral Cage like Structure in ICE
(D) tetrahedral Cage like Structure in $\text{H}_2\text{O}(\text{l})$
- Q 3. Temporary hardness of H_2O is due to
(A) bicarbonates of Ca & Mg
(B) Chlorides of Ca & Mg
(C) Sulphates of Ca & Mg
(D) All of these
- Q 4. Temporary hardness can be removed by
(A) Heating (B) $\text{Ca}(\text{OH})_2$
(C) NaOH (D) All of these
- Q 5. If both temporary & permanent hardness are present in water, then hardness is removed by
(A) $\text{Ca}(\text{OH})_2$ (B) Calogen
(C) NaOH (D) Na_2CO_3
- Q 6. **Assertion (A):** Permanent hardness of water is removed by treatment with washing soda.
Reason (R): Washing soda reacts with soluble Magnesium & Calcium Sulphate to form insoluble carbonates. **[NCERT Exemplar]**
(A) Both A & R are correct and R is correct explanation of A
(B) Both A & R are correct but R is not correct explanation of A
(C) A is correct but R is not correct
(D) A and R are both False
- Q 7. Calogen is
(A) Sodium Hexametaphosphate
(B) Sodium Hexaorthophosphate
(C) Sodium Hexapyrophosphate
(D) None of these
- Q 8. Deionised water is obtained by passing hard water through
(A) Zeolite (B) Cation exchanger
(C) Anion exchanger
(D) Both cation and anion exchanger one after the other
- Q 9. When hard water is passed through ion exchange resin with formula $\text{R}-\text{NH}_3^+ \text{OH}^-$ it becomes free from
(A) Ca^{2+} (B) all cations
(C) all anions (D) All types of ions
- Q 10. Which ions must be removed from hard water in order to make it soft?
(A) Ca^{2+} and SO_4^{2-} (B) Ca^{2+} and Mg^{2+}
(C) SO_4^{2-} and Cl^- (D) HCO_3^- and SO_4^{2-}
- Q 11. The reagent which is commonly used to determine Hardness of water titrimetrically is **[AIIMS 2003]**
(A) Oxalic Acid (B) Sodium salt of EDTA
(C) Sodium Citrate (D) Sodium thiosulphate
- Q 12. In Zeolite method of removal of hardness, which ion is removed by zeolite?
(A) Ca^{2+} Ion (B) SO_4^{2-} ion
(C) HCO_3^- ion (D) All of these
- Q 13. The hardness of water sample containing 0.002 mole of MgSO_4 dissolved in 1 litre of water is expressed as **[AIIMS 2016]**
(A) 20 ppm (B) 200 ppm
(C) 220 ppm (D) 120 ppm
- Q 14. The maximum tolerable limit of degree of hardness in water required for our daily needs is approximately
(A) 10 -15 ppm (B) 100 to 150 ppm
(C) 10^3 ppm (D) 700 to 800 ppm
- Q 15. Is distilled water is useful for drinking purpose? If not, how can it be made useful? **[NCERT]**
- Q 16. Which of the following hydrates scumble into powder when H_2O is removed?
(A) Cationic Hydrates (B) Anionic Hydrates
(C) Lattice Hydrates (D) None of these
- Q 17. When $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is heated
(A) All 5 H_2O molecules are removed simultaneously
(B) Initially only 1 H_2O molecules is removed
(C) Initially only 4 H_2O molecules is removed
(D) None of these
- Q 18. Which of the statement about water is Incorrect? **[JEE Main 2016]**
(A) There is extensive Intramolecular Hydrogen bonding in the condensed phase.
(B) Ice formed by heavy water sinks in Normal water
(C) H_2O is oxidized to O_2 during photosynthesis
(D) water can act as both as acid as well as base

5. Hydrogen Peroxide

- Q 1. HCl is added to the following oxides. Which one would give H_2O_2 ?
 (A) MnO_2 (B) PbO_2
 (C) BaO_2 (D) NO_2
- Q 2. **Assertion (A):** Anhydrous BaO_2 is used for preparing H_2O_2 .
Reason (R): Hydrated BaO_2 is not available.
 [AIIMS 2015]
 (A) Both A & R are correct and R is correct explanation of A
 (B) Both A & R are correct but R is not correct explanation of A
 (C) A is correct but R is not correct
 (D) A and R are both False
- Q 3. Phosphoric acid is preferred to sulphuric acid in the preparation of H_2O_2 from barium peroxide because
 (A) sulphuric acid reacts with explosion
 (B) phosphoric acid is available at low cost than sulphuric acid
 (C) phosphoric acid acts as a preservative by retarding decomposition of H_2O_2
 (D) all of the above statements
- Q 4. The Hydrolysis of one mole of peroxodisulphuric acid produces
 (A) 2 moles of sulphuric acid
 (B) 2 moles of peroxomonosulphuric acid
 (C) 1 mole of Sulphuric acid and 1 mole of peroxomonosulphuric acid
 (D) 1 mole of H_2SO_4 , 1 mole of peroxomonosulphuric acid & 1 mole of H_2O_2
- Q 5. The industrial preparation of H_2O_2 by oxidation of 2 – butyl anthraquinol is not used for large scale preparation of H_2O_2 because
 (A) H_2O_2 decomposes easily
 (B) H_2O_2 decompose in organic impurities
 (C) H_2O_2 is unstable
 (D) H_2O_2 undergoes oxidation as well as reduction
- Q 6. K_a of H_2O_2 is of the order of
 (A) 10^{-2} (B) 10^{-14}
 (C) 10^{-16} (D) 10^{-10}
- Q 7. In which of the following equations, H_2O_2 acts as reducing agent in the acidic medium?
 (A) $H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$
 (B) $H_2O_2 + 2OH^- \rightarrow 2H_2O + O_2 + 2e^-$
 (C) $H_2O_2 \rightarrow 2H^+ + O_2 + 2e^-$
 (D) $H_2O_2 + OH^- + 2e^- \rightarrow 3OH^-$
- Q 8. Which of the following equation depict the oxidising nature of H_2O_2 ? [NCERT Exemplar]
 (A) $2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$
 (B) $2Fe^{3+} + 2H^+ + H_2O_2 \rightarrow 2Fe^{2+} + 2H_2O + O_2$
 (C) $2I^- + 2H^+ + H_2O_2 \rightarrow I_2 + 2H_2O$
 (D) $KIO_4 + H_2O_2 \rightarrow KIO_3 + H_2O + O_2$
- Q 9. Which of the following equation depict the reducing nature of H_2O_2 ? [NCERT Exemplar]
 (A) $2[Fe(CN)_6]^{4-} + 2H^+ + H_2O_2 \rightarrow 2[Fe(CN)_6]^{3-} + 2H_2O$
 (B) $I_2 + 2OH^- + H_2O_2 \rightarrow 2I^- + 2H_2O + O_2$
 (C) $Mn^{2+} + H_2O_2 \rightarrow Mn^{4+} + 4H_2O$
 (D) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$
- Q 10. Which of the following statement is not correct?
 (A) H_2O_2 oxidise Fe(2) to Fe(3)
 (B) H_2O_2 can be obtained by electrolysis of dil. H_2SO_4
 (C) H_2O_2 reduce Mn(2) to Mn(3)
 (D) H_2O_2 is a weak base.
- Q 11. Which of the following suppress the decomposition of H_2O_2 ?
 (A) MnO_2 (B) Finely divided metals
 (C) Acetanilide (D) Dust particles
- Q 12. H_2O_2 on reacting with ethane gives
 (A) Ethylene (B) Ethanal
 (C) Ethane (D) Ethanol
- Q 13. The action of H_2O_2 on $K_2Cr_2O_7 + H_2SO_4$ produces blue colour due to formation of ?
 (A) CrO_5 (B) Cr_2O_3
 (C) $Cr_2(SO_4)_3$ (D) None of these
- Q 14. The structure of H_2O_2 is [CBSE PMT 1999]
 (A) Planar (B) Non – Planar
 (C) Spherical (D) Linear
- Q 15. In gaseous Hydrogen peroxide, the dihedral angle between H –atoms is X° but in solid state it is Y° . The values of X and Y are
 (A) 94.8, 94.8 (B) 111.5, 90.2
 (C) 90.2, 90.2 (D) 111.5, 111.5
- Q 16. The hybridization of O atom in H_2O_2 is
 (A) sp^3d (B) sp
 (C) sp^2 (D) sp^3

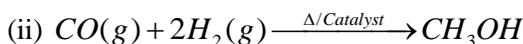
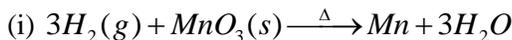
- Q 17. Which of the following process is not used for concentrating H_2O_2 ?
- (A) Distillation under reduced pressure
 - (B) Evaporation in a vacuum desiccators
 - (C) fractional crystallisation
 - (D) sublimation
- Q 18. From the following statements regarding H_2O_2 , choose the INCORRECT Statement:
[JEE Main 2015]
- (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 only act as an oxidising agent
 - (D) it decomposes on exposure to light
- Q 19. Old lead paintings regain their original colour by washing with hydrogen peroxide solution. It is because
- (A) Hydrogen peroxide oxidize the dye
 - (B) Hydrogen peroxide reduce the oxidized coloured compounds
 - (C) Hydrogen peroxide oxidize black coloured PbS to white PbSO_4
 - (D) Hydrogen Peroxide dissolves the blackened layer by virtue of its acidic nature.
- Q 20. Which chemical is used as the fuel in torpedoes?
- (A) H_2O_2
 - (B) PbO_2
 - (C) N_2H_4
 - (D) B_2H_6

Answer Key

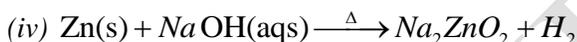
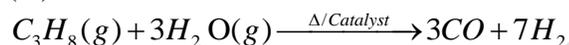
1. Preparation of H₂

- (1). A (2). A (3). D
 (4). B (5). D (6). C
 (7). Due to Noble gas configuration of Each H atom in Dihydrogen
 (8). B (9). C (10). C
 (11). D (12). B (13). D
 (14). C (15). D
 (16).
 By use of catalyst Fe(CrO₄) [Iron chromate] in the production increases the production of H₂
 Also, removal of CO₂ gas increases the extent of forward reaction.

(17).



(iii)



(18). B

2. Type of Hydrogen

- (1). A (2). Occlusion (3). C
 (4). D (5). D (6). B
 (7). C (8). D (9). C, D
 (10). C (11). A (12). A
 (13). B (14). D (15). D

3. Isotopes of Hydrogen, Hydrides

(1). A

(2).

(i) Hydrogen Economy – Storage and transportation of energy in the form of liquid and gaseous hydrogen or in the form of hydrolyth, which is a clean source of energy.

(ii) Hydrogenation – addition of Hydrogen atoms On unsaturated molecules to form less unsaturated or saturated molecule

(iii) Syngas – the mixture of CO & H₂ is called syn gas. It can be produced by action of steam on hydrocarbon or Coke at high Temperature.

(iv) Water gas shift reaction – The amount of hydrogen in syn gas can be increased by action of CO and steam in presence of Iron chromate as Catalyst.

(v) Fuel cell – Cell in which combustion of fuel is used to generate electricity.

- (3). A (4). C (5). B
 (6). D (7). A (8). C
 (9). A (10). B (11). A
 (12). A (13). D

(14). Hydrides without fixed formula, formed by d & f block metals. IA metal form ionic hydrides of definite molecular formula.

(15). No, saline hydrides reacts with H₂O to form H₂ which is a highly exothermic reaction. CO₂ gas can't be used to extinguish this fire because CO₂ is absorbed in hydroxide formed in the reaction.

(16).

(i) TiH₂ < BeH₂ < CaH₂

(ii) LiH < NaH < CsH

(iii) F–F < H–H < D–D

(iv) H₂O < MgH₂ < NaH

4. Water

- (1). B (2). A (3). D
 (4). D (5). C (6). A
 (7). A (8). D (9). C
 (10). B (11). B (12). A
 (13). B (14). B

(15). No, by mixing useful minerals in distilled water.

(16). C (17). C (18). A

5. Hydrogen Peroxide

- (1). C (2). D (3). C
 (4). C (5). B (6). A
 (7). C (8). B (9). B
 (10). D (11). D (12). A
 (13). A (14). B (15). B
 (16). D (17). D (18). C
 (19). C (20). A