SOLVED EXAMPLES

- **Ex.1** Discuss the consequences of high enthalpy of H–H in terms of chemical reactivity.
- **Sol.** Due to high bond enthalpy of H–H bon, dihydrogen molecule (H_2) is quite unreactive at room temperature. However, at high temperature or in presence of catalysts, it combines with many metals and non-metals to form respectively hydrides.
- Ex.2 How does the atomic hydrogen or oxy-hydrogen torch function for cutting and welding purposes ? Explain.
- Sol. Atomic hydrogen is produced when molecular hydrogen is passed through an electric arc struck between tungsten electrodes (3773–4273 K).

 $H_2(g) \xrightarrow{\text{electric arc}} H(g) + H(g) : \Delta H = 436.0 \text{ kJ mol}^{-1}$

The life span of atomic hydrogen is about 0.3 sec and therefore, it immediately gets converted into the molecular hydrogen (H_2) liberating a large amount of energy which is used for cutting and welding purposes in the form of atomic hydrogen torch.

- Ex. 3 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.
- **Sol.** These are hydrides which have low hydrogen content. In these hydrides the ratio of the metal to hydrogen atoms is fractional and they are called non-stoichiometric hydrides. Furthermore, even this fractional ratio of atoms is not fixed but varies with the temperature and the pressure conditions. This type of hydrides are formed by d-and f-block elements. In these hydrides, the hydrogen atoms occupy holes in the metal lattice. Usually some holes always remain unoccupied and hence these metals form non-stoichiometric hydrides.

Alkali metals are highly reducing as they transfer their lone electron to the H atom, thereby, forming H⁻ ions. In other words, alkali metals hydrides are ionic in nature. SInce such hydrides are formed by complete transfer of an electron, therefore, the ratio of metal to hydrogen is always fixed. Therefore, alkali metals form only stoichiometric hydrides. They do not form non-stoichiometric hydrides at all.

- Ex.4 What do you understand by (i) electron-deficient, (ii) electron-precise, and (iii) electron rich compounds of hydrogen ? Provide justification with suitable examples.
- Sol. (i) Hydrides of elements of group-13 such as BH_3 , AIH_3 , etc., do not have sufficient number of electrons to form normal covalent bond and hence are called electron-deficient hydrides. To make up this deficiency, they generally exist in polymeric forms such as B_2H_6 , B_4H_{10} , $(AIH_3)_n$, etc.
 - (ii) Hydrides of elements of group-14 like CH_4 , SiH_4 , GeH_4 , etc. have exact number of electrons to form covalent bonds and hence are called electron-precise hydrides. All these hydrides have tetrahedral shapes.
 - (iii) Hydrides of elements of group 15, 16 and 17, like NH₃, PH₃, H₂O, H₂S, HF, HCl, etc. have more electrons than required to form normal covalent bonds and hence are called electron-rich hydrides. The excess electron in these hydrides are present as lone pairs of electrons.
- **Ex.5** Which of the following is correct for hydrogen ?
 - (1) It is always collected at cathode.
 - (2) Its ionization energy is very low incomparision with alkali metals.
 - (3) It can form bonds in +1 as well as in -1 oxidation states.
 - (4) Its oxide is not stable.

Sol. $2Na + H_2 \longrightarrow 2NaH^{+1-1}$; $N_2 + 3H_2 \longrightarrow 2NH_3^{-3+1}$

Ans.(3)



Ans. (4)

Ex. 6	Metal which does not	react with cold water	but evolves H ₂ with steam is :	
	(1) Na	(2) K	(3) Pt	(4) Fe

Sol. $4H_2O(g) + 3Fe(s) \xrightarrow{1000 \text{ K}} Fe_3O_4 + 4H_2 \uparrow$

- Ex. 7 Saline hydride are known to react with water violently producing fire, Can, CO₂, a well known fire extinguisher, be used in this case ? Explain.
- **Sol.** Saline hydride (Such as NaH, CaH₂, etc), react with water violently to form the corresponding metal hydrox ides with the evolution of dihydrogen. The dihydrogen gas so liberated undergoes spontaneous combustion causing fire. This is because of exothermic nature of combustion reactions.

 $NaH(s) + H_2O(\bullet) \longrightarrow NaOH(aq) + H_2(g)$

$$CaH_2(s) + 2H_2O(\bullet) \longrightarrow Ca(OH)_2(aq) + 2H_2(g)$$

The fire so produced cannot be extinguished by CO_2 because it reacts with the hot metal hydride and forms formate ions

 $\mathrm{NaH} + \mathrm{CO}_2 \longrightarrow \mathrm{HCOONa}$

However, send (because of its stable nature) is more effective fire extinguisher in such a case.

Ex.8 How can the production of dihydrogen, obtained from coal gasification, be increased ?

Sol. Coal gasification is the process of producing 'syngas' from coal and steam

$$C(s) + H_2O(g) \xrightarrow{1270K} \begin{array}{c} C(g) + H_2O(g) \\ \hline Ni \end{array} \xrightarrow{PQ(g)} \begin{array}{c} + H_2(g) \\ \hline syngas \end{array}$$

The production of hydrogen can be increased by the reaction carbon monooxide of syngas with steam in presence of iron chromate as catalyst at 673 K when it is oxidised to CO₂.

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

The CO_2 thus produced is removed by scrubbing with a solution of sodium arsenite.

Ex.9 Among NH₃, H₂O and HF which would you expect to have highest magnitude of hydrogen bonding and why?

Sol. Strength of H-hydrogen depends upon the atomic size and electronegativity of the other atom to which H-atom is covalently bonded. Smaller size and higher electronegativity favour H-bonding. Now among N,F, O atoms, atomic size of F is lowest and its electronegativity is highest. Hence H-F will have highest magnitude of H-bonding.

Ex. 10 What do you understand by the term 'auto-protolysis' of water. What is its significance ?

Sol. Auto-protolysis refers to self ionization of water. It may be represented as :

$$H_2O(\bullet) + H_2O(\bullet) \Longrightarrow H_3O^+(aq) + OH^-(aq)$$

 $Acid_1$ $Base_2$ $Acid_2$ $Base_1$

Due to auto-protolysis, water acts as amphoteric substance i.e., it reacts with both acids and bases. It acts as a base towards acids stronger than itself and as an acid towards bases stronger than itself. For example,

$$\begin{array}{ll} H_2O(\bullet) + NH_3(aq) &\longrightarrow NH_4^+(aq) + OH^-(aq) \\ Acid_1 & Base_2 & Acid_2 & Base_1 \\ H_2O(\bullet) + H_2S(aq) &\longrightarrow H_3O^+(aq) + HS^-(aq) \\ Base_1 & Acid_2 & Acid_1 & Base_2 \end{array}$$



Ex. 11 Match list-I with list-II and select the correct answer :

- Column-I
- (A) Heavy water
- (B) Temporary hard water
- (C) Soft water
- (D) Permanent hard water Ans. (A - r); (B - p); (C - q); (D - s)

Column-II

- (p) Bicarbonates of Mg and Ca in water
- (q) Distilled water
- (r) Deuterium oxide
- (s) Sulphates and chlorides of Mg and Ca in water.
- Sol. (A) Chemically heavy water is D_2O_2 , i.e. deuterium oxide.
 - (B) Temporary hardness of water is due to the presence of bicarbonates of calcium and magnesium and can be removed by simple boiling.

$$Ca(HCO_3)_2 \xrightarrow{\Delta} CaCO_3 \downarrow + H_2O + CO_2$$

- (C) Water which produces lather with soap solution readily, is called soft water e.g., distilled water, rain water and demineralised water. It contains no foreign ions.
- (D) Permanent hardness of water is due to the presence of sulphates and chlorides of calcium and magnesium and can be removed by chemical methods.

$$CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 \downarrow + 2NaCl_3$$

- Ex. 12 Is demineralised or distilled water useful for drinking purpose ? If not, how can it be made useful ?
- Sol. Demineralised or distilled water is not useful for drinking purpose because it does not contain even useful minerals. Therefore, to make it useful for drinking purposes, useful minerals in proper amounts should be added to demineralised or distilled water.
- Ex. 13 Consider the reaction of water with F₂ and suggest in terms of oxidation and reduction which species are oxidised/ reduced ?
- Sol. $2F_2(g) + 2H_2O(\bullet) \longrightarrow O_2(g) + 4H^+(aq) + 4F^-(aq)$ (oxidant) (reductant) or $3F_2(g) + 3H_2O(\bullet) \longrightarrow O_3(g) + 6H^-(aq) + 6F^-(aq)$ (oxidant) (reducant)

In these reactions, water acts as a reducing agent and gets oxidised to either O_2 or O_3 on the other hand, F_2 acts as an oxidising agent and gets reduced to F^- ion.

- **Ex. 14** Describe the usefulness of water in biosphere and biological systems.
- Sol. Water is essential for all forms of life. It constitutes about 65-70% of the body mass of animals and plants, In comparison to other liquids, water has high specific heat, thermal conductivity, surface tension, dipole moment and dielectric constant, etc. These properties allow water to play a key role in biosphere. The high heat of vaporisation and high heat capacity are responsible for moderation of the climate and body temperature of living beings. It is an excellent solvent for transportation of minerals and other nutrients for plant and animal metabolism. Water is also required for photosynthesis in plants which releases O_2 into the atmosphere.
- Ex. 15 What properties of water make it useful as a solvent ? What type of compounds can it (i) dissolve (ii) hydrolyse ?
 Sol. Water has high dielectric constant (79.39) and high dipole moment (1.84 D). Because of these properties, water dissolves most of the inorganic (ionic) compounds and many covalent compounds. That is why water is called a universal solvent. Ionic compounds dissolve in water due to ion dipole interaction but, covalent compounds such as alcohol, amines, urea, glucose, sugar, et., dissolve in water due to H–bonding.

Water can hydrolyse many metallic or non-metallic oxides, hydrides, carbides, nitrides, phosphides and other salts. Some of the important hydrolytic reactions are given below.

 $\begin{array}{l} \text{CaO}(s) + \text{H}_2\text{O}(\bullet) & \longrightarrow & \text{Ca(OH)}_2(\text{aq}) \\ \text{CaH}_2(s) + 2\text{H}_2\text{O}(\bullet) & \longrightarrow & \text{Ca(OH)}_2(\text{aq}) + 2\text{H}_2(\text{g}) \\ \text{Ca}_3\text{N}_2(s) + 6\text{H}_2\text{O}(s) & \longrightarrow & 3\text{Ca(OH)}_2(\text{aq}) + 2\text{NH}_3(\text{g}) \text{ (ammonia)} \end{array}$



(4) S_2 and S_4

Ans. (3)

- **Ex. 16** What is the difference between hydrolysis and hydration ?
- Sol. Hydrolysis refers to the reaction of salt or more precisely ions of the salt to form acidic or basic solution. For example,

$$Na_{2}CO_{3} + 2H_{2}O \rightleftharpoons 2Na^{+} + 2OH^{-} + H_{2}CO_{3}$$
$$NH_{4}Cl + H_{2}O \rightleftharpoons H^{+} + Cl^{-} + NH_{4}OH$$

Hydration, refers to the addition of H₂O to ions or molecules to form hydrated ions or hydrated salts. For example,

 $NaCl(s) + H_2O \longrightarrow Na_4^+(aa)_2 + Cl_4^-(aa)_3 + Cl_4^-(aa)_4 + Cl$

- **Ex. 17** Consider the following statements.
 - S1 : Water at 4°C having maximum density is known as heavy water.
 S2 : Heavy water is formed by the combination of hydrogen and oxygen.
 S3 : D₂O has higher density than H₂O.
 S4 : D₂O is obtained by exhaustive electrolysis of water.
 Which of the statements are correct ?
 - (1) S_1 and S_2 (2) S_2 and S_3 (3) S_3 and S_4
- Sol. S_3 : Heavy water is oxide of deuterium. Its density is 1.106 gm⁻³ and that of H₂O is 1.00 gm⁻³. S_4 : Correct statement.
- **Ex. 18** How can saline hydrides remove traces or water from organic compounds ?
- Sol. Saline hydrides (i.e. NaH, CaH_2 , etc.) react with water forming their corresponding metal hydroxides with the liberation of H_2 gas. Thus traces of water present in organic solvents can be easily removed by distilling them over saline hydrides when H_2 escapes into the atmosphere, metal hydroxide is left in the flask while dry organic solvent distills over.

Alternatively, organic compounds containing traces of water can be dried by placing them in a desicator containing saline hydrides at the bottom for a few hours or preferably overnight.

- **Ex.19** Do you expect different products in solution when aluminium (III) chloride and potassium chloride are treated separately with (i) normal water (ii) acidified water, and (iii) alkaline water ?
- Sol. KCI is the salt of a strong acid and a strong base. It does not undergo hydrolysis in normal water. It just dissociates to give $K^+(aq)$ and $Cl^-(aq)$ ions giving neutral solution.

 $KCl(s) \xrightarrow{water} K^+(aq) + Cl^-(aq)$

 $AlCl_3$, on the other hand, is a salt of a weak base $Al(OH)_3$ and a strong acid HCl. Therefore, in normal water, it undergoes hydrolysis, as follows giving acidic solution.

 $AlCl_3(s) + 3H_2O(\bullet) \longrightarrow Al(OH)_3(s) + H^+(aq) + Cl^-(aq)$

In acidic water, both KCl and AlCl, undergo ionisation.

KCl acidified water $K^+(aq) + Cl^-(aq)$

AlCl₃(s) acidified water $Al^{3+}(aq) + 3Cl^{-}(aq)$

In alkaline water, AlCl, reacts to form soluble tetrahydroxoaluminate (III) complex or metaaluminate ion, i.e. AlO₂

 $AlCl_{3}(s) + 4OH^{-}(aq) \longrightarrow [Al(OH)_{4}^{-}](aq) + 3Cl^{-}(aq)$

tetrahydroxoaluminate AlO₂⁻(aq) + 2H₂O(\bullet) Meltaaluminate ion

KCl does not react and only undergoes ionisation as K⁺ and Cl⁻ ions.



Ex. 20 What do you expect the nature of hydrides if formed by elements of atomic numbers 15,19,23 and 44 with dry dihydrogen? Compare their behaviour towards water.

Sol. (i) Element with Z = 15 is a non-metal (i.e., P) and hence forms covalent hydride (i.e., PH₃).

(ii) Element with Z = 19 is a alkali metal (i.e., K) and hence forms saline or ionic hydride (i.e., K^+H^-)

(iii) Element with atomic number Z = 23 is a transition metal (i.e., V) belonging to group 3. Hence it forms interstitial hydride (i.e. $VH_{1,6}$)

(iv) Element with Z = 44 is a transition metal (i.e. Ru) belonging to group 8. It does not form any hydride. Only ionic hydrides react with water evolving H₂ gas.

 $2KH(s) + 2H_2O(s) \longrightarrow 2KOH(aq) - 2H_2(g)$

Ex. 21 Assertion : H_2O_2 is not stored in glass bottles.

Reason : Alkali metal oxides present in glass catalyse the decomposition of H₂O₂.

- (1) If both Assertion and Reason are true and Reason is a correct explanation of Assertion.
- (2) If both Assertion and Reason are true and Reason is not a correct explanation of Assertion.
- (3) If Assertion is true but Reason is false.
- (4) If Assertion is false but Reason is true.
- **Sol.** Assertion and reason both are correct statements and the reason is the correct explanation of the assertion.

$$2H_2O_2 \xrightarrow{} Alkali metal oxide \rightarrow 2H_2O+O_2.$$

Ans. (1)



E	xercise # 1 Sin	gle Correct Choice	Type Questions]
ι.	Hydrogen is : (A) electropositive. (C) both electropositive as well as electronegative.	(B) electronegative.(D) neither electropositi	ive nor electronegative.
2.	 Dihydrogen has : (A) two isotopes and no isomers. (C) three isotopes and two optical isomers. 	(B) three isotopes and t(D) two isotopes and two	wo nuclear isomers. o geometrical isomers.
3.	 A deuterium atom : (A) has the same atomic mass as the hydrogen atom (B) has the same electronic configuration as the hyd (C) has the same composition of the nucleus as the i (D) contains one proton more than a hydrogen atom 	rogen atom. hydrogen atom.	
4.	Hydrogen is evolved by the action of cold dil. HNO ₃ (A) Fe (B) Mn	on : (C) Cu	(D)Al
5.	Hydrogen from HCl can be prepared by : (A) Cu (B) P	(C) Mg	(D) Hg
5.	 Nascent hydrogen consists of : (A) Hydrogen atoms with excess of energy (C) Hydrogen ions in excited state 	(B) Hydrogen molecule(D) solvated protons	s with excess energy
7.	 Hydrogen molecule differs from chlorine molecule ir (A) hydrogen molecule is non-polar but chlorine mole (B) hydrogen molecule is polar while chlorine molecule (C) hydrogen molecule can form intermolecular hyd (D) hydrogen molecule cannot participate in co-ordi 	the following respect : ecule is polar. ule is non-polar. rogen bonds but chlorine r nate bond formation but c	nolecule does not. hlorine molecule can.
8.	 Which one of the following properties shows that hy (A) It shows metallic character like alkali metals. (B) It is diatomic like alkali metals. (C) Its ionization energy is of the same order as that a (D) When hydrogen halides and alkali metal halides a cathode. 	drogen resembles alkali n of alkali metals. re electrolysed, hydrogen	netals ? and alkali metals are liberated
).	Hydrogen has three isotopes, the number of possible (A) 3 (B) 6	diatomic molecules will b (C)9	be : (D) 12
0.	The first ionization energy for in KJ mol ⁻¹ H, Li, F, Na Which of these values corresponds to that of hydro	has one of the following v gen ?	alues 1681, 520, 1312, 495.
1.	(A) 1081 (B) 1312 Reaction between following pairs will produce hydro (A) Cu + HCl (B) Fe + $H_2O(g)$	(C) 520 ogen except : (C) Mg + H_2O (hot)	(D) Na + Alcohol
12.	 Which of the following statements is most applicable (A) It can act as a reducing agent only (B) It can act as an oxidising agent only (C) It can act as both as oxidising and reducing agent (D) It can act neither as an oxidising nor as a reducing 	e to hydrogen ? nts ng agent	



13.	In all its properties, hydrogen resembles : (A) alkali metals only. (C) both alkali metals and halogens.	(B) halogens only.(D) neither alkali metals n	or halogens.
14.	The colour of hydrogen is : (A) black (B) yellow	(C) orange	(D) colourless
15.	Which one is not an isotope of hydrogen ? (A) Tritium (B) Deuterium	(C) Ortho hydrogen	(D) None of these
16.	Hydrogen combines with other elements by :(A) losing an electron(C) sharing an electron	(B) gaining an electron(D) losing, gaining and sh	naring of an electron
17.	 Which of the following explanations justifies for thalogens ? (A) The ionization energy of hydrogen is too high for (B) Hydrogen atom does not contain any neutron. (C) Hydrogen is much lighter than alkali metals or h (D) Hydrogen can form compounds with almost all of the following set of	not placing hydrogen in eith or group of alkali metals and alogens. other elements.	her the group of alkali metals or too low for halogen group.
18.	Hydrogen accepts an electron to form inert gas cont (A) halogen (B) alkali metals	iguration. In this it resemble (C) chalcogens	(D) alkaline earth metals
19.	 Which of the following statements concerning proti (A) They are isotopes of each other. (C) They exist in the nature in the ratio 1 : 2 : 3. 	um, deuterium and tritium is (B) They have similar elec (D) Their atomic masses a	not true ? ctronic configurations. are in the ratio 1 : 2 : 3.
20.	Deuterium or heavy hydrogen is prepared : (A) from ordinary hydrogen in a nuclear reactor. (C) by electrolysis of acidulated water.	(B) from ordinary hydrog(D) by reaction of electropo	en by fractionation. sitive elements with ordinary water.
21.	The oxidation states exhibited by hydrogen in its va (A) -1 only. (B) Zero only.	$\frac{1}{(C)} + 1, -1 \text{ and zero.}$	(D) + 1 only.
22.	When same amount of zinc is treated separately w solution the ratio of volumes of hydrogen evolved i (A) 1:1 (B) 1:2	ith excess of sulphuric acid s : (C) 2 : 1	and excess of sodium hydroxide (D)9:4
23.	Hydrogen acts as an oxidising agent in the reaction (A) bromine (B) calcium	with : (C) nitrogen	(D) sulphur
24.	The metal which displaces hydrogen from a boiling (A) Mg (B) Fe	caustic soda solution is : (C) As	(D) Zn
25.	Hydrogen does not combine with : (A) Sb (B) Na	(C) He	(D) Bi
26.	Which of the following groups represents the saline (A) NaH, KaH, CaH_2 (B) NaH, SiH_4 , CaH_2	e hydrides ? (C) NH ₃ , BH ₃ , AlH ₃	(D) None of these
27.	Which of the following is a interstitial hydride ? (A) $TiH_{1.5-1.8}$ (B) B_2H_6	(C) LiH	(D) H ₂ S
28.	In which of the following compounds does hydroge (A) PH ₃ (B) NH ₃	n have an oxidation state of (C) HCl	-1? (D) CaH ₂
29.	Which of the following metals adsorbs hydrogen ? (A) Zn (B) Pd	(C) Al	(D) K



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30.	Which of the following (A) CsH, AlH_3	represents a pair of covale (B) KH, NaH	nt hydrides ? (C) H ₂ S, HF	(D) VH _{0.56} , NH ₃
31.	The adsorption of hydro (A) dehydrogenation	gen by metals is called : (B) hydrogenation	(C) occlusion	(D) adsorption
32.	The hydride ion H^- is a sodium hydride (NaH) is (A) $H^-(aq) + H_2O \longrightarrow$ (C) $H^-(aq) + H_2O(l) \longrightarrow$	stronger base than its hydr s dissolved in water? $H_3O^{-}(aq)$ \rightarrow No reaction	roxide ion OH ⁻ . Which or (B) H ⁻ (aq) + H ₂ O(l) - (D) None of these.	f the following reactions will occur if $\longrightarrow OH^{-}(aq) + H_{2}(g)$
33.	When electric current is (A) hydrogen is liberate (C) no reaction takes pla	passed through an ionic h d at the anode. ace.	ydride in the molten state (B) hydrogen is liber (D) hydride ion migra	e : ated at the cathode. ates towards cathode.
34.	Temporary hardness of (A) MgSO ₄	water is due to the presenc (B) $Mg(HCO_3)_2$	e of : (C) CaCl ₂	(D) CaCO ₃
35.	Temporary hardness ma (A) Ca(OH) ₂	y be removed from water b (B) CaCO ₃	y adding : (C) CaSO ₄	(D) HC1
36.	Permanent hardness of v (A) MgSO ₄	water is due to the presenc (B) CaSO ₄	e of : (C) NaHCO ₃	(D) $Ca(HCO_3)_2$
37.	A variety of water which (A) heavy water.	n contains soluble salts of (B) soft water.	Ca and Mg is known as : (C) hard water.	(D) conductivity water.
38.	Heavy water (D ₂ O) freez (A) 0°C	tes at : (B) 3.8°C	(C)-3.8°C	(D) 38°C
39.	Heavy water is used in r (A) source of a particles (C) transporting heat of	nuclear reactors as : the reactor.	(B) slowing down the(D) heating purposes	e speed of high energy neutrons.
40.	Heavy water is : (A) $H_2^{18}O$ (C) D_2O		(B) water obtained by(D) water at 4°C.	v repeated distillation.
41.	Select the correct statem (A) It is less denser than (C) It has a heavy or ba	ent for heavy water. common water. d taste.	(B) It is an oxide of de(D) It has a heavier is	euterium. otope of oxygen.
42.	Permutit is a technical na (A) aluminates of Ca and (C) silicates of Ca and N	ame given to : 1 Na. a.	(B) hydrated silicates(D) silicates of Ca and	of Al and Na. d Mg.
43.	Which of the following (A) Passing it through a (C) Passing it through c	will cause softening of hard nion exchange resin. ation exchange resin.	d water ? (B) Passing it through (D) Passing it through	h sand. 1 alumina.
44.	Heavy water is manufac (A) combination of hydr (B) electrolysis of water (C) repeated electrolysis (D) none of the above.	tured by : rogen and heavier isotope of containing heavy hydrogo s of 3% aqueous solution of	of oxygen. en dissolved in it. f NaOH.	



45.	Deionized water is obtained by passing hard water th (A) zeolite. (C) anion exchanger.	 (B) cation exchanger. (D) both cation and anion exchanger one after the other.
46.	Hard water when passed through ion exchange resin (A) $Cl^{-}ions$ (B) $SO_4^{2-}ions$	containing, RCOOH groups, becomes free from : (C) H_3O^+ ions (D) Ca^{2+} ions
47.	One of the following is an incorrect statement, point (A) Permanent hardness can be removed by boiling v (B) Hardness of water effects soap consumption (C) Temporary hardness is due to bicarbonates of Ca (D) Permanent hardness is due to the soluble SO ₄ ²⁻ , C	it out. vater a and Mg Cl ⁻ , NO ₃ ⁻ of Ca and Mg
48.	Water is said to be permanently hard when it contain (A) Chloride and sulphates of Mg and Ca. (C) Carbonates of Na and K.	 s: (B) Bicarbonates of Na and K. (D) Phosphate of Na and K.
49.	 Which of the following is not true ? (A) Ordinary water is electrolysed more rapidly than I (B) D₂O freezes at lower temperature than H₂O. (C) Reaction between H₂ and Cl₂ is much faster than H (D) Bond dissociation energy for D₂ is greater than H 	$D_2O.$ D_2 and $Cl_2.$ $I_2.$
50.	Water can be tested by : (A) smell (C) hydrated CuSO ₄	(B) taste(D) anhydrous CoCl(blue) which changes to pink.
51.	 An ionic compound is dissolved simultaneously in h (A) larger in heavy water. (C) smaller in heavy water. 	 eavy water and soft water. Its solubility is : (B) same in both. (D) smaller in simple water.
52.	 Heavy water is a compound of : (A) hydrogen and heavier isotope of oxygen. (B) heavier isotope of hydrogen and heavier isotope (C) oxygen and heavier isotope of hydrogen. (D) none of the above. 	of oxygen.
53.	An oxide which gives H_2O_2 on treatment with dilute a (A) PbO_2 (B) Na_2O_2	acid is : (C) MnO_2 (D) TiO_2 .
54.	Now a day on industrial scale, H_2O_2 is generally prep (A) the action of H_2SO_4 on barium oxide. (C) by the electrolysis of H_2SO_4 .	(B) the action of H_2SO_4 on sodium peroxide. (D) by burning hydrogen in an excess of O_2 .
55.	When H_2O_2 is oxidised by a suitable oxidant, one of (A) O^{2-} (B) HO^{2-}	the products is : (C) OH^- (D) O_2
56.	The dihedral angle in gaseous H_2O_2 is : (A) 180° (B) 90°	(C) 111.5° (D) 109°–28′
57.	In acidic medium, H_2O_2 acts as a reducing agent in its (A) FeSO ₄ (B) KMnO ₄	s reaction with : (C) K_2MnO_4 (D) $K_4[Fe(CN)_6]$
58.	In basic medium, H_2O_2 acts as an oxidising agent in it (A) $Cr_2(SO_4)_3$ (B) Ag_2O	ts reactions with : (C) K_3 [Fe(CN) ₆] (D) K_2 Cr ₂ O ₇



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59.	The decomposition of H ₂ (A) alkali metal oxides	D ₂ can be checked by the ac (B) benzene	ldition of : (C) acetanilide	(D) MnO ₂
60.	Bleaching action of H_2O_2 (A) oxidising nature	is due to its : (B) reducing nature	(C) acidic nature	(D) thermal instability
61.	What would happen when (A) Colour of FeSO ₄ disap (C) An electron is added to	a a small quantity of H_2O_2 is ppears. To Fe^{2+} .	 s added to a solution of FeS (B) H₂ is evolved. (D) An electron is lost by 	50 ₄ ? Fe ²⁺ .
62.	Which of the following co (A) HgS	ompounds turns white on tro (B) PbS	eatment with H_2O_2 ? (C) NiS	(D) CuS
63.	A dilute solution of H_2O_2 (A) 10%	is labelled as 20 volume. Its (B) 6.070%	s percentage strength is : (C) 30%	(D) 3%
64.	The normality of 30 volum (A) 3.57	the H_2O_2 solution is : (B) 7.53	(C) 5.36	(D) 5.73
65.	The reaction $Ag_2O + H_2O$ (A) basic medium. (C) neutral medium.	$_2 \longrightarrow 2Ag + H_2O + O_2 t$	akes place in : (B) acidic medium. (D) both in acidic and bas	ic medium.
66.	In which of the following (A) $H_2O_2 + 2H^+ + 2e^-$ (C) $H_2O_2 \longrightarrow 2H^+ + O_2$	equations, H_2O_2 acts as a re $\rightarrow 2H_2O_2^+ 2e^-$	educing agent in the acidic r (B) $H_2O_2 + 2OH^- \longrightarrow$ (D) $H_2O_2 + OH^- + 2e^- \longrightarrow$	medium ? $2H_2O + O_2 + 2e^- \rightarrow 3OH^-$
67.	Moist hydrogen peroxide (A) it can catch fire. (C) it is oxidised by H_2SO_2	can not be dried over conc	 H₂SO₄ because : (B) it is reduced by H₂SO (D) none of these 	4.
68.	Hydrogen peroxide is use (A) an oxidant only. (C) an acid only.	d as :	(B) a reductant only.(D) an oxidant, a reductar	nt and an acid.
69.	On an industrial scale, H ₂ (A) 2-Ethylanthraquinol. (C) 1-Ethylanthraquinol.	O ₂ is prepared by auto-oxid	ation of : (B) 2-Ethylanthraquinone (D) 1-Ethylanthraquinone	•
70.	H ₂ O ₂ is used as : (A) antiseptic	(B) bleaching agent	(C) propellent	(D) all



Ex	xercise # 2	Part # I 🔰 [Mu	Itiple Correct Choice	Type Questions]
1.	In which of the following (A) Atomicity	properties hydrogen does (B) Ionisation energy	not resemble with halogen (C) Reducing nature	? (D) Electropositive nature.
2.	Which of the following el (A) Ca	ements are oxidised when (B) S ₈	they react with dihydrogen (C) Li	? (D) C
3.	Among the hydrides given (A) NH ₃	h below which are reason (B) HF	ably good acids ? (C) HN ₃	(D) NaH.
4.	 What is true about saline (A) They are binary comp (B) They are crystalline so (C) They are generally ver (D) Their common example 	hydrides ? ounds of hydrogen and m olids. ry soft. es are, SiH ₄ , CH ₄ etc.	etallic elements.	
5.	Which of the following is. (A) HCl	/are basic hydride ? (B) NH ₃	(C) H ₂ S	(D) PH ₃
6.	Water can act as : (A) an acid	(B) as a base	(C) as a reductant	(D) as an oxidant
7.	Which of the following with $(A) Zn + H_2SO_4$ (dil.)	ll not liberate dihydrogen (B) Zn + NaOH (aq)	? (C) $Cu + H_2SO_4$ (conc.)	(D) $F_2 + H_2O$
8.	Which of the following states $(A) H_2O_2$ reduces MnO_4^- (B) H_2O_2 oxidises Fe^{2+} io (C) H_2O_2 oxidises Mn^{2+} to (D) H_2O_2 liberates I_2 from	atements are correct ? both in acidic and basic m ns both in acidic and basic o Mn ⁴⁺ ions in basic medi a acidified KI solution and	nedia. e media. um. I reduces I ₂ to I [–] ions in basi	c medium.
9.	 Which is/are true about h (A) All physical constant (B) rate of chemical reaction (C) It is obtained as a byp (D) It is used in exchange 	eavy wa <mark>ter?</mark> of heavy water are higher ons are slower than those roduct in some fertilizer in reactions for the study of	than the corresponding value of ordinary water. Industries. The reaction mechanism.	ues of ordinary water.
10.	Non-stoichiometric hydrid (A) palladium	les are produced by : (B) vanadium	(C) manganese	(D) nickel
11.	 Which of the following st (A) The elements of f-bloc (B) Ionic hydrides are for (C) The density of ionic h (D) Covalent hydrides are 	atements is/are correct ? k like Ce, Eu, Yb on heat med by transfer of electro ydrides is higher than tho mainly formed by s-block	ing with H ₂ under pressure for ns from the metals to the hy se of the metals from which c elements.	orm hydrides. drogen atoms. they are formed.
12.	 Which of the following is/ (A) They are bad conducts (B) Covalent hydrides are (C) Covalent hydrides like (D) HF forms strong H-box 	fare characteristic(s) of mo or of electricity. usually volatile compour BH_3 , AlH ₃ etc act as Lew nd in liquid as well as in s	blecular hydrides ? nds having low melting and l vis acids. solid state.	boiling points.

HYDROGEN AND ITS COMPOUNDS

13.	Which of the following ca (A) Kl+HCl	nnot be oxidised by H_2O_2 ? (B) O_3	(C) PbS	(D) Na_2SO_3
14.	When hydrogen peroxide isThis is due to :(A) chromium sulphate.(C) perchromic acid.	s treated with a cold acidifie	 d K₂Cr₂O₇ solution containing (B) potassium chromate. (D) chromium trioxide. 	ng ether, a blue colour is obtained.
15.	The property of hydrogen (A) its electropositive chan (C) its reducing character	which distinguishes it from racter	alkali metals is : (B) its affinity for non met (D) its non-metallic charac	al .ter
16. 17	The isotopes of hydrogen (A) tritium	which is radioactive is : (B) deuterium	(C) para hydrogen	(D) nascent hydrogen
17.	(A) heated cupric oxide.(C) heated stannic oxide.		(B) heated ferric oxide.(D) heated aluminium oxid	e.
18.	Of which group elements to (A) 5	form interstitial hydrides with (B) 7	ith hydrogen ? (C) 8	(D) 9
19.	Which of the following is (A) B_2H_6	an electron rich hydride ? (B) GeH ₄	(C) H ₂ O	(D) SiH ₄
20.	A sample of H_2O_2 is labell (A) 30.35	ed as 10 volume. Its strengt (B) 60.7	h in gram/litre is : (C) 15.17	(D) 45.42
21.22.	Hydrogen peroxide canno (A) it is highly volatile in r (C) it decomposes at its bo Aqueous solution of hydro	t be concentrated by simple nature. biling point. bgen peroxide is :	 distillation easily because (B) it is not miscible with v (D) it has a very high boili 	: vater. ing point
	(A) alkaline	(B) neutral	(C) strongly acidic	(D) weakly acidic
23.	Which of the following is (A) Ordinary water.	used as a moderator in nuc (B) Heavy water.	lear reactors ? (C) Hard water.	(D) Hydrogen peroxide.
24.	Chemical (A) is used for generate caustic soda. Whe of (A) ?	water softening to remove en CO ₂ is bubbled through a	e temporary hardness. (A) solution of (A), it turns clou	reacts with sodium carbonate to ady. What is the chemical formula
	(A) CaCO ₃	(B) CaO	(C) Ca(OH) ₂	(D) $Ca(HCO_3)_2$
25.	Which of the following sta (A) Hydrogen has same ion (B) H^- has same electrone (C) H^- has oxidation numb (D) H^- will not be liberated	atements is correct ? nization potential as alkali i gativity as halogens. her of –1. l at anode.	netals.	
26.	The high density of water (A) Hydrogen bonding int (C) Dipole induced dipole	as compared to ice is due to teractions. interactions.	o : (B) Dipole dipole interacti (D) Induced dipole induce	ons. ed dipole interactions.
27.	Which of these contains o (A) Tritium	nly an electron and a proto (B) Hydrogen	on? (C) Deuterium	(D) Helium



28.	Metal hydride on treatmen (A) H_2O_2	nt with water gives : (B) H ₂ O	(C) acid	(D) hydrogen
29.	Which of the following is	the true structure of H_2O_2 :		
	(A) H-O-O-H	(B) O-O H	(C) H>0=0	(D) H > 0 ← 0
30.	Hydrogen resembles in m (A) halogen	any of its properties : (B) alkali metals	(C) both (A) and (B)	(D) none of these
31.	The structure of H_2O_2 is : (A) planar	(B) non-planar	(C) spherical	(D) linear
32.	Free hydrogen is found in (A) Water gas	: (B) Marsh gas	(C) Water	(D) Acids
33.	When a substance A reac When another substance D gas B on reaction with d smokeless flame of bunser (A) Na, H_2 , NaOH, Zn (C) Ca, H_2 , Ca(OH) ₂ , Sn	ts with water, it produces a D reacts with this solution of ilute sulphuric acid at roor n burner : A, B, C and D res	a combustible gas B and a C, it produces the same gas n temperature. A imparts a spectively are : (B) K, H ₂ , KOH, Al (D) CaC_2 , C_2H_2 , $Ca(OH)_2$, D	solution of substance C in water. B on warming but D can produce deep golden yellow colour to a Fe
34.	Which of the following pa (A) Fe and H_2SO_4 (aqueou (C) Sodium and ethyl alco	airs of substances on reactions). hol.	 on will not evolve H₂ gas? (B) Copper and HCl (aque (D) Iron and steam. 	cous).
35.	The boiling point of water (A) there is covalent bond (B) water molecules is line (C) water molecules asso (D) water molecules is not	is exceptionally high becau between H and O. ear ciate due to hydrogen bond linear	use : ling	
36.	In which of the following (A) $PbO_2(s) + H_2O_2(aq) \rightarrow$ (B) $Na_2SO_3(aq) + H_2O_2(aq)$ (C) $2KI(aq) + H_2O_2(aq) \rightarrow$ (D) $KNO_2(aq) + H_2O_2(aq)$	reactions, H_2O_2 acts as a re $PbO(s) + H_2O(1) + O_2(g)$ $) \rightarrow Na_2SO_4(aq) + H_2O(1)$ $\cdot 2KOH(aq) + I_2(s)$ $\rightarrow KNO_3(aq) + H_2O(1)$	educing agent	
37.	Which of the following hy (A) NaH	vdrides is electron deficient (B) CaH ₂	? (C) CH ₄	$(\mathbf{D}) \mathbf{B}_2 \mathbf{H}_6$
38.	Which is distilled first ? (A) Liquid CO ₂	(B) Liquid N ₂	(C) Liquid O ₂	(D) Liquid H ₂
39.	Action of water or dilute r (A) monohydrogen	nineral acids on metal can g (B) tritium	ive : (C) dihydrogen	(D) trihydrogen
40.	The low density of ice con (A) induced dipole induce (C) hydrogen bonding int	npared to water is due to : ed dipole interactions ceractions	(B) dipole induced dipole(D) dipole dipole interaction	interaction



41.	 H₂O₂ acts as an oxidising (A) neutral medium (C) alkaline medium 	agent in :	(B) acidic medium(D) acidic and alkaline me	dium
72.	Which of the following as (A) SiF_4	cid is formed when SiF_4 read (B) H_2SiF_4	cts with water : (C) H_2SO_4	(D) H_2SiF_6
43.	Commericial 11.2 volume (A) 1.0	H_2O_2 solution has a molarity (B) 0.5	y of: (C) 11.2	(D) 1.12
44.	Which pair does not sho (A) Ortho hydrogen and (C) Deuterium and tritium	w hydrogen isotopes? para hydrogen	(B) Protium and deuterium (D) Tritium and protium	n
45.	Ka of H_2O_2 is of the order (A) 10^{-16}	of: (B) 10 ⁻¹⁴	(C) 10 ⁻¹²	(D) 10 ⁻¹⁰
46.	What is false about H_2O_2 (A) acts as both oxidising (C) pale blue liquid.	? g and reducing agent.	 (B) two OH bonds lie in the control of the	he same plane.
47.	Which of the following is (A) NO_2	a true peroxide ? (B) MnO ₂	(C) BaO ₂	(D) SO ₂
48.	Water gas is : (A) $CO + N_2$	(B) $\operatorname{CO} + \operatorname{CO}_2 + \operatorname{CH}_4$	(C) $CO_2 + H_2$	(D) $CO + H_2$
49.	Which of the following h (A) Stibine (SbH ₃)	as the highest proton affinit (B) Arsine (AsH ₃)	ty ? (C) Phosphine (PH ₃)	(D) Ammonia (NH ₃)
50.	The bond angle and dipol (A) 109.5°, 1.84 D	e moment of water respecti (B) 107.5°, 1.56 D	vely are : (C) 104.5°, 1.84 D	(D) 1025°, 1.56 D
51.	The hardness of water sam (A) 20 ppm	ple containing 0.002 mole of (B) 200 ppm	magnesium sulphate dissolv (C) 2000 ppm	ed in a litre of water is expressed as (D) 120 ppm
52.	When hydrogen peroxide (A) CrO ₃	is added to acidified potassi (B) Cr_2O_3	ium dichromate, a blue colo (C) CrO ₅	ur is produced due to formation of (D) $\operatorname{CrO}_4^{2-}$
53.	Which of the following is (A) $NH_3 < PH_3 < AsH_3$	the correct order of increase (B) $ArH_3 < PH_3 < NH_3$	sing enthalpy of vaporisation (C) $PH_3 < AsH_3 < NH_3$	on ? (D) NH ₃ < AsH ₃ < PH ₃
54.	In alkaline medium, H_2O_2 (A) Fe ⁴⁺ , and Mn ⁴⁺	preacts with Fe^{3+} and Mn^{2+} r (B) Fe^{2+} and Mn^{2+}	espectively to give : (C) Fe ²⁺ and Mn ⁴⁺	(D) Fe^{4+} and Mn^{2+}
55.	Hydrogen gas is not liber (A) Mg	ated when the following me (B) Sn	tal is added to dil. HCl : (C) Ag	(D) Zn



56.	In transforming 0.01	mole of PbS to $PbSO_4$, the	volume of '10 volume H_2O_2	₂ required will be :
	(A) 11.2 ml	(B) 22.4 ml	(C) 33.6 ml	(D) 44.8 ml
57.	Usually high boiling	point of water is result of	:	
	(A) intermolecular h	ydrogen bonding.		
	(B) intramolecular h	ydrogen bonding.		
	(C) both intra and in	termolecular hydrogen bor	nding.	
	(D) high specific hea	t.		
58.	S1 : Water is an cov	alent hydride.		
	S2 : In the reaction of	$f H_2O_2$ and Na_2CO_3 , H_2O_2	acts as acid.	
	S3 : Auto-oxidation	of 2-ethylanthraquinol by	air produces hydrogenpero	oxide.
	(A) F F F	(B) F T F	(C) T T T	(D) F T T
59.	S : In acidic medium	n H.O. reduces KMnO. to	colourless Mn ²⁺ .	
	S_{1} : Oxygen atoms at	nd hydrogen atoms in H_2O	, are co-planer.	
	$S_1 : D_2O$ is more pola	r than H ₂ O.	2	
	$(\mathbf{A}) \mathbf{T} \mathbf{T} \mathbf{F}$	(B) F T F	(C) T F T	(D) F T T
60	S • Tritium the isot	one of hydrogen is radio-a	ctive in nature	
00.	S: Dibydrogen of h	igh degree of nurity is pren	ared by the electrolysis of y	water containing small amount of acid or
	b_2 binyarogen of m	ight degree of purity is prep	area by the electronysis of	water containing sman amount of acte of
	S. : Water gas shift r	eaction involves the reduc	tion of H ₂ O by H ₂ .	
	(A) T T F	(B) F T F	$(\mathbf{C}) \mathbf{T} \mathbf{F} \mathbf{F}^2$	(D) T T T
61.	S ₁ : The electrolysis	of molten hydrolith libera	tes hydrogen gas at cathod	le.
	S_2 : Use of hydrogen water.	n peroxide as fuel, it prod	uces pollution free atmosp	here because it's combustion product is
	$S_3: D_2O$ has higher e	enthalpy of vaporization th	an that of H_2O at 373 K.	
	(A) T T F	(B) F T F	(C) T F F	(D) F T T
62.	S_1 : D ₂ O is prepared	by the prolonged electroly	sis of ordinary water.	
	S_2 : Water which doe	es not produce lather with	soap solution easily is calle	ed hard water.
	S_3 : The Ca ²⁺ and M ₂	g ²⁺ ions of hard water reac	t with calgon to form corre	sponding precipitates.
	(A) T T F	(B) F T F	(C) T F F	(D) F T T
_				
2	Part # II	> [Assertion &	Reason Type Questi	onsj
	Fach question has 5	choices (A) (B) (C) (D) α	and (F) out of which only o	ne is correct
	(A) Statement-1 is tr	e. Statement-2 is true and S	Statement-2 is correct explain	nation for Statement-1
	(B) Statement-1 is tru	e, Statement-2 is true and St	atement-2 is not correct expl	lanation for Statement-1
	(C) Statement-1 is tru	ie, Statement-2 is false	1	
	(D) Statement-1 is fa	lse, Statement-2 is true		
	(E) Both Statement a	re false		



- 1. Statement-1 : H_2 gas is liberated at anode because. Statement-2 : Sodium hydride contains H^- ion.
- Statement-1 : Ionic hydrides like hydrolith liberates hydrogen gas on reaction with water.
 Statement-2 : The resultant solution acts as strong base.
- 3. Statement-1 : Reaction between protium and chloride is much faster than between deuterium and chlorine. Statement-2 : Enthalpy of dissociation of D_2 is less than H_2 .
- Statement-1 : NH₃ is an electron precise hydride.
 Statement-2 : NH₃ has one lone pair of electrons on N atom.
- 5. Statement-1 : The water gas shift reaction can be used to increase the amount of H_2 in the 'syn gas' mixture. Statement-2 : In this reaction water is reduced to H_2 by CO.
- 6. Statement-1 : D_2O has higher boiling point than H_2O . Statement-2 : Viscosity of $H_2O(\bullet)$ is less than that of $D_2O(\bullet)$.
- Statement-1 : Calgon is used in manufacture of soft water being used for laundry purpose.
 Statement-2 : Ca²⁺ and Mg²⁺ ions present in hard water are rendered ineffective by calgon forming their soluble complexes.
- 8. Statement-1 : H_2O_2 decomposes carbonates and bicarbonates to evolve CO_2 gas. Statement-2 : H_2CO_3 is stronger acid than H_2O_2 .
- 9. Statement-1 : H_2O_2 is used as a bleaching agent for delicate materials like silk, wool, etc. Statement-2 : The bleaching action of H_2O_2 is due to reduction.
- 10. Statement-1 : The decomposition of H_2O_2 is a disproportionation reaction. Statement-2 : $2H_2O_2 \longrightarrow 2H_2O + O_2$.
- Statement-1 : Heavy water is widely used as a moderator in nuclear reactors.
 Statement-2 : It slows down the fast moving neutrons and thus helps in controlling the nuclear reactions.
- Statement-1 : Demineralised water does not contain any ions.
 Statement-2 : Permutit process for water softening gives demineralised water.







	In context with the industria statement ?	al preparation of hydro	ogen from water gas $(CO + H_2)$, which of the following is the correct [AIEEE 2008]
	(1) CO is oxidised to CO_2	with steam in the pres	ence of a catalyst followed by	absorption of CO_2 in alkali.
	(2) CO and H, are fraction	ally separated using d	lifferences in their densities.	
	(3) CO is removed by abso	orption in aqueous Cu	Cl, solution.	
	(4) H_2 is removed through	occlusion with Pd.		
•	In which of the following $(a) H_2O_2 + 2H^+ + 2e^- \longrightarrow$	reactions H_2O_2 acts as $2H_2O$	s a reducing agent?	[JEE MAIN 2014]
	(b) $H_2O_2 - 2e^- \longrightarrow O_2 +$	2H ⁺		
	(c) $H_2O_2 + 2e^- \longrightarrow 2OH^-$	-		
	(d) $H_{2}O_{2} + 2OH^{-} - 2e^{-}$	$\rightarrow O2 + 2H_{2}O$		
	(1) (a), (c)	(2) (b), (d) (2^{2})	(3)(a),(b)	(4)(c),(d)
	The intermolecular interat	ion that is dependent	on the inverse cube of distance	e between the molecules is :
				[JEE MAIN 2015]
	(1) London force	(2) hydrogen bond	(3) ion-ion interaction	(4) ion-dipole interaction
	From the following statem	ents regarding H ₂ O ₂ ,	choose the incorrect statemer	nt? [JEE MAIN 2015
	(1) It has to be stored in pl	astic or wax lined gla	ss bottles in dark	
	(2) It has to be kept away t	form dust		
	(3) It can act only as an ox	idizing agent		
	(4) It decomposes on expo	sure to light		
	Which one of the followin	g statements about w	ater is FALSE?	LIFF MAIN 2016
•	(1) Water can act both as	an acid and as a base		
	(2) There is extensive intr	amolecular hydrogen	bonding in the condensed pl	nase.
	(3) Ice formed by heavy w	ater sinks in normal v	vater.	
	(4) Water is oxidized to or	xygen during photosy	nthesis.	
	The concentration of fluor 1000 ppb, 40 ppb, 100 ppm of :	ide, lead, nitrate and and 0.2 ppm, respect	iron in a water sample from a ively. This water is unsuitable f	n underground lake was found to be or drinking due to high concentration [JEE MAIN 2016]
	(1) Lead	(2) Nitrate	(3) Iron	(4) Fluoride
	(*) Louis			()) 1 1001100







		AOCK TES	ST •	
	SECTION - I : S	FRAIGHT O	BJECTIVE TYP	Ε
1.	Hydrogen is :(A) electropositive.(C) both electropositive as well as electror	(B) e egative. (D) r	lectronegative. wither electropositive	e nor electronegative.
2.	Reaction between following pairs will prov (A) $Cu + HCl$ (B) $Fe + H_2O(g)$	uce hydrogen ex) (C) N	cept : $Mg + H_2O$ (hot)	(D) Na + Alcohol
3.	The colour of hydrogen is : (A) black (B) yellow	(C) c	orange	(D) colourless
4.	 Which of the following explanations just halogens ? (A) The ionization energy of hydrogen is t (B) Hydrogen atom does not contain any i (C) Hydrogen is much lighter than alkali m (D) Hydrogen can form compounds with a 	fies for not plac oo high for group neutron. etals or halogens most all other ele	ing hydrogen in eith o of alkali metals and ements.	er the group of alkali metals or too low for halogen group.
5. 6.	Hydrogen accepts an electron to form iner(A) halogen(B) alkali metalsWhich of the following is a interstitial hydr(A) $TiH_{1.5-1.8}$ (B) B_2H_6	gas configuration (C) of (c) L	n. In this it resemble chalcogens iH	s : (D) alkaline earth metals (D) H ₂ S
7.	Hydrogen does not combine with : (A) Sb (B) Na	(C) H	Ie	(D) Bi
8.	The hydride ion H ⁻ is a stronger base than sodium hydride (NaH) is dissolved in wate (A) H ⁻ (aq) + H ₂ O \longrightarrow H ₃ O ⁻ (aq) (C) H ⁻ (aq) + H ₂ O(1) \longrightarrow No reaction	its hydroxide io r? (B) F (D) P	n OH ⁻ . Which of the I ⁻ (aq) + H ₂ O(l)	following reactions will occur if → OH ⁻ (aq) + H ₂ (g)
9.	Which of the following will cause softenin (A) Passing it through anion exchange resi (C) Passing it through cation exchange res	g of hard water ? n. (B) I in. (D) I	Passing it through sar Passing it through alu	nd. mina.
10.	Permutit is a technical name given to : (A) aluminates of Ca and Na. (C) silicates of Ca and Na.	(B) h (D) s	ydrated silicates of A ilicates of Ca and Mg	l and Na.
11.	When H_2O_2 is oxidised by a suitable oxida (A) O^{2-} (B) HO^{2-}	nt, one of the pro (C) C	oducts is : DH⁻	(D) O ₂
12.	The dihedral angle in gaseous H_2O_2 is : (A) 180° (B) 90°	(C) 1	11.5°	(D) 109°–28′
13.	What would happen when a small quantity (A) Colour of $FeSO_4$ disappears. (C) An electron is added to Fe^{2+} .	of H_2O_2 is addee (B) H (D) A	to a solution of FeS I_2 is evolved. An electron is lost by	O_4 ? F e^{2+} .



14.	The reaction $Ag_2O + H_2O$	$D_2 \longrightarrow 2Ag + H_2O + O_2$	takes place in :	
	(A) basic medium.		(B) acidic medium.	
	(C) neutral medium.		(D) both in acidic and ba	sic medium.
15.	In which of the following	g equations, H_2O_2 acts as a r	educing agent in the acidic	medium ?
	(A) $H_2O_2 + 2H^+ + 2e^-$	$\rightarrow 2H_2O$	(B) $H_2O_2 + 2OH^- \longrightarrow$	$-2H_2O + O_2 + 2e^-$
	$(\mathbf{C}) \operatorname{H}_2\operatorname{O}_2 \longrightarrow 2\operatorname{H}^+ + \operatorname{O}_2$	$D_2 + 2e^-$	(D) $H_2O_2 + OH^- + 2e^-$	→ 3OH ⁻
16.	H_2O_2 is used as :			
	(A) antiseptic	(B) bleaching agent	(C) propellent	(D) all
	SECTI	ON - II : MULTIPLE	CORRECT ANSWEI	RTYPE
17.	Among the hydrides give	en below which are reasona	ably good acids ?	
	(A) NH_3	(B) HF	(C) HN_3	(D) NaH.
10	NT / 11 / 1 1			
18.	Non-stoichiometric hydri	ides are produced by :		
	(A) palladium	(B) vanadium	(C) manganese	(D) nickel
10	W/h: -h -f4h - f-11	· · · · · · · · · · · · · · · · · · ·		
17.	which of the following s	ialements is/are correct?		

(A) The elements of f-block like Ce, Eu, Yb on heating with H₂ under pressure form hydrides.

- (B) Ionic hydrides are formed by transfer of electrons from the metals to the hydrogen atoms.
- (C) The density of ionic hydrides is higher than those of the metals from which they are formed.
- (D) Covalent hydrides are mainly formed by s-block elements.

SECTION - III : ASSERTION AND REASON TYPE

Each question has 5 choices (A), (B), (C), (D) and (E) out of which only one is correct.

(A) Statement-1 is true, Statement-2 is true and Statement-2 is correct explanation for Statement-1

- (B) Statement-1 is true, Statement-2 is true and Statement-2 is not correct explanation for Statement-1
- (C) Statement-1 is true, Statement-2 is false
- (D) Statement-1 is false, Statement-2 is true
- (E) Both Statements are false
- Statement-1 : H₂ gas is liberated at anode because.
 Statement-2 : Sodium hydride contains H⁻ ion.
- 21. Statement-1 : Ionic hydrides like hydrolith liberates hydrogen gas on reaction with water. Statement-2 : The resultant solution acts as strong base.
- Statement-1 : Calgon is used in manufacture of soft water being used for laundry purpose.
 Statement-2 : Ca²⁺ and Mg²⁺ ions present in hard water are rendered ineffective by calgon forming their soluble complexes.



23. Statement-1 : D_2O has higher boiling point than H_2O . Statement-2 : Viscosity of $H_2O(\bullet)$ is less than that of $D_2O(\bullet)$.

SECTION - IV : COMPREHENSION TYPE

Read the following comprehensions carefully and answer the questions.

Comprehension #1

Binary compounds of hydrogen with other elements are called hydrides. These hydrides can be classified into different classes depending upon their nature and type of bonding.

- Which of the following hydrides are generally non-stochiometric in nature ?
 (A) Ionic hydride
 (B) Molecular hydrides
 (C) Interstitial hydride
 (D) Covalent hydrides
- 25. Among the hydrides given below which is reasonably electron precise hydride ?
 (A) NH₃
 (B) SiH₄
 (C) NaH
 (D) H₂S
- **26.** Which of the following statements is false ?

(A) Saline hydrides are formed by the transference of electron from the metal atom to hydrogen atom.

(B) Along any given row of periodic table, generally the covalent hydrides become increasingly acidic in nature from left to right.

(C) Metallic hydrides are good conductors of electricity and also have high thermal conductivity.

(D) None of these.

SECTION - V: MATRIX - MATCH TYPE

27. Match the processes/reactions listed in coloumn–I with the resultant product(s) listed in coloumn – II

Column-1	Column-1
(A) Prolonged electrolysis of water (H_2O)	(p) H ₂ O ₂
(B) Electrolysis of $50\% H_2 SO_4$	$(\mathbf{q}) \mathbf{H}_2$
(C) Water gas shift reaction	$(\mathbf{r}) \overline{\mathrm{CO}}_2$
D Auto-oxidation of 2–Ethylanthraquinol	$(s) D_2 O$
	(t) CŌ

SECTION - VI : SUBJECTIVE TYPE

28. Complete the following chemical equations.

$$(i) \dots + H_2O \longrightarrow CaCO_3 + NH_3$$

(ii) $Al_4C_3 + H_2O \longrightarrow \dots + \dots$

(iii) + H_2O_2 + $H^+ \longrightarrow CrO_5$ +

- 29. Give two important uses of interstitial hydrides.
- 30. Give two advantages of using hydrogen as a fuel as compared to gasoline.



ANSWER KEY

EXERCISE - 1

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

 14. D
 15. C
 16. D
 17. A
 18. A
 19. C
 20. B
 21. C
 22. A
 23. B
 24. D
 25. C
 26. A

 27. A
 28. D
 29. B
 30. C
 31. C
 32. B
 33. A
 34. B
 35. A
 36. B
 37. C
 38. B
 39. B

 40. C
 41. B
 42. B
 43. C
 44. C
 45. D
 46. D
 47. A
 48. A
 49. B
 50. D
 51. C
 52. C

 53. B
 54. C
 55. D
 56. C
 57. B
 58. A
 59. C
 60. A
 61. D
 62. B
 63. B
 64. C
 65. A

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 67. C
 68. D
 69. A
 70. D
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EXERCISE - 2 : PART # I

2. A, C **3.** B,C **4.** A, B 5. B,D 6. A, B, C, D 7. C, D 1. C,D 8. A, B, C, D 9. A, B, C, D 10. A, B, D 11. A, B, C 12. A, B, C, D 13. B 14. C 15. D 16. A 17. D 18. A 19 C 20. A 21. C 22. D 23 B 24 C 25 C 26 A 27 B 28 D 29 B 30 C 31 B 32 A 33 A 34 B 35 C 36 A 37 D 38 D 39 C 40 D 41 D 42 B 43.A **44.** A **46.** B **47.** C **50.** C 52. C 53. C 54. C 55. C 56. D 57. A 45. C **48.** D **49.** D 51.B 58. C 59. C 60. A 61. D 62. A

PART # I

1. A 2. B 3. C 4. D 5. A 6. B 7. A 8. D 9. C 10. A 11. A 12. D

EXERCISE - 3 : PART # I

=, -, -, -, -, -, -, -, -, -, -, -, -, -,

PART # II

Comprehension #1: 1. A 2. B 3. D Comprehension #2: 1. C 2. B 3. D

EXERCISE - 4 : PART # I

1. 1 **2.** 2 **3.** 2 **4.** 3 **5.** 2 **6.** 2

1. $A \rightarrow (s, t), B \rightarrow (r), C \rightarrow (p), D \rightarrow (q)$

PART # I

1. A, B, D 2. B

MOCK TEST

1. C2. A3. D4. A5. A6. A7. C8. B9. C10. B11. D12. C13. D14. A15. C16. D17. B18. B,C19.A, B, D20. A, B, C21. A22. B23. A24. B25. C26. B27. D28. $A \rightarrow (s), B \rightarrow (p), C \rightarrow (q, r), D \rightarrow (p)$