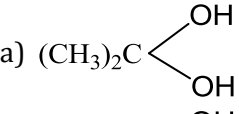
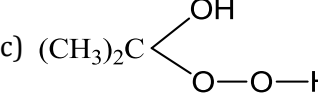


9. HYDROGEN

Single Correct Answer Type

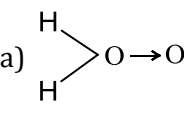
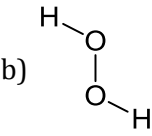
- Consider the following statements
Ortho and *para* forms of hydrogens are
I. different due to difference in their nuclear spins
II. different due to difference in their electrons spins
III. have same physical properties
Select true and false statements
I II III
a) T T F b) F T F
c) T F F d) T F T
- $\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$
This represents
a) Oxidation of H_2O_2 b) Reduction of H_2O_2
c) Disproportionation of H_2O_2 d) Acidic nature of H_2O_2
- H_2O_2 is used as but not as
a) Oxidant, reductant b) Bleaching agent c) Antiseptic d) Catalyst
- Which of the following easily reacts with water producing hydrogen?
a) PH_3 b) B_2H_6 c) CH_4 d) H_2S
- Molar ratio of H_2O_2 oxidised by one mole of MnO_4^- in basic and acidic medium is
a) 1:1 b) 1:2 c) 3:5 d) 5:3
- Hydrogen
a) Is placed in I A since it forms monovalent cation H^+
b) Is placed in VII A (halogen family) since it forms monovalent anion H^-
c) Is placed in IV A (carbon family) since both have a half-filled shell of electrons
d) Follows all of the above facts
- Perhydrol is
a) 30% solution of H_2O_2 b) "100 volume" H_2O_2
c) Both (a) and (b) are correct d) None of the above is correct
- Select the correct statement(s)
a) H_2O_2 reduces MnO_4^- to Mn^{2+} in acidic medium
b) H_2O_2 reduces MnO_4^- to MnO_2 in basic medium
c) H_2O_2 can be used to bleach blackened oil paintings
d) All the above are correct statements
- H_2 can be obtained from
a) Water gas ($\text{CO} + \text{H}_2$) by liquefaction of CO at low temperature under pressure
b) Water gas by oxidation of CO into CO_2 (by steam) which can be easily removed by dissolving in H_2O
c) Electrolysis of water
d) All the above methods
- The set of elements which could form stable, covalent hydrogen bonded hydrides are
a) Nitrogen, oxygen and fluorine b) Lithium, sodium and potassium
c) Sulphur, selenium and tellurium d) Chlorine, bromine and iodine
- The volume of oxygen liberated at NTP from 15 mL of 20 volume H_2O_2 is
a) 250 mL b) 300 mL c) 150 mL d) 200 mL
- The hardness of water is estimated by
a) EDTA method b) Titrimetric method c) Conductivity method d) Distillation method
- Which is radioactive isotope of hydrogen?
a) ${}^1_1\text{H}$ b) ${}^2_1\text{H}$ c) ${}^3_1\text{H}$ d) All of those

14. Which is not the correct statement?
 a) *s*-block elements, except Be and Mg, form ionic hydride
 b) BeH₂, MgH₂, CuH₂, ZnH₂, CaH₂ and HgH₂ are intermediate hydride
 c) *p*-block elements form covalent hydride
 d) *d*- and *f*-block elements form ionic hydride
15. Heavy water is
 a) Water at 4°C
 b) Water containing heavy ions
 c) D₂O
 d) Water containing sulphate of Ca
16. D₂O has maximum density at
 a) 4°C
 b) 11.6°C
 c) 0°C
 d) 0 K
17. The most stable is
 a) NaH
 b) RbH
 c) KH
 d) LiH
18. Water gas is a mixture of
 a) CO and H₂O
 b) CO and N₂
 c) CO and H₂
 d) CO and CH₄
19. Dil. H₂SO₄ and oxide react to produce hydrogen peroxide. The oxide is
 a) MnO₂
 b) PbO₂
 c) TiO₂
 d) Na₂O₂
20. Ag₂O + H₂O₂ → 2Ag + H₂O + O₂
 In an above reaction H₂O₂ acts as/an
 a) Oxidizing agent
 b) Reducing agent
 c) Bleaching agent
 d) None of these
21. Which is true statement about D₂O and H₂O?
 a) D₂O has lower dielectric constant than H₂O
 b) NaCl is more soluble in D₂O than H₂O
 c) Both (a) and (b) are correct
 d) None of the above is correct
22. In the following reaction,
 Cr₂O₇²⁻ + H⁺ + H₂O₂ →
 a) CrO₅ is formed
 b) Cr³⁺ is formed
 c) CrO₄²⁻ is formed
 d) No effect of H₂O₂
23. How does H₂O₂ differ from O₃ in its chemical action?
 a) In oxidizing PbS to PbSO₄
 b) In liberating I₂ from KI
 c) In decolorizing acidified KMnO₄
 d) In oxidizing K₄[Fe(CN)₆] to K₃[Fe(CN)₆]
24. H₂O₂ exists as in alkaline medium
 a) HO₂⁻
 b) HO₂[⊕]
 c) O₂²⁻
 d) H₂O[⊕]
25. Select the incorrect statement
 a) H⁺ can exist as H₃O₄⁺ in water
 b) H₂ is thermally stable
 c) Ionisation of CH₃COOH is slower than that of CH₃COOD
 d) Kinetic isotopic effect is observed when there is retardation in the rate water H₂O is replaced by D₂O
26. H₂ is adsorbed on palladium surface. It is a case of
 a) Occlusion
 b) Diffusion
 c) Effusion
 d) Electroosmosis
27. Hard water is not fit for washing clothes because
 a) It contains impurities
 b) It is acidic in nature
 c) It gives precipitate with soap
 d) It contains Na₂SO₄ and KCl
28. Electrolysis of aqueous NaCl and NaH differs in
 a) formation of basic solution at the cathode by NaCl only
 b) Formation of basic solution at the cathode by NaH only
 c) Formation of H₂ gas at cathode and anode both by NaH only
 d) Formation of H₂ gas at cathode and anode both by NaCl only
29. Water gas is produced by
 a) Passing steam over red hot coke
 b) Passing steam and air over red hot coke
 c) Burning coke in excess of air
 d) Burning coke in limited supply of air
30. Electron deficient hydride is/are
 a) BH₃
 b) AlH₃
 c) BeH₂
 d) All of these

31. H_2O_2 is manufactured these days by
- The action of H_2SO_4 on BaO_2
 - The action of H_2SO_4 on Na_2O_2
 - Electrolysis of 50% on Na_2O_2
 - Burning hydrogen in excess oxygen
32. H_2O_2 can also be obtained by the partial oxidation of 2-propanol
 $(\text{CH}_3)_2\text{CHOH} + \text{O}_2 \rightarrow (\text{CH}_3)_2\text{CO} + \text{H}_2\text{O}_2$
 Intermediate in this reaction is
- 
 $(\text{CH}_3)_2\text{C} \begin{array}{l} \text{OH} \\ \text{OH} \end{array}$
 - $(\text{CH}_3)_3\text{C}^+$
 - 
 $(\text{CH}_3)_2\text{C} \begin{array}{l} \text{OH} \\ \text{O}-\text{O}-\text{H} \end{array}$
 - None of these
33. Consider the following reactions
 I: $\text{AlH}_3 + \text{H}^- \rightarrow \text{AlH}_4^-$
 II: $\text{H}_2\text{O} + \text{H}^- \rightarrow \text{H}_2 + \text{OH}^-$
 Select the correct statements based on these reactions
- H^- is a Lewis acid in I and Lewis base in II
 - H^- is a Lewis base in I and Bronsted base in II
 - H^- is a Lewis acid in I and Bronsted acid in II
 - H^- is a Lewis base in I and II
34. H, D and T (isotopes of hydrogen) have nuclear spin quantum number respectively as
- $\frac{1}{2}, 1, \frac{1}{2}$
 - $\frac{1}{2}, \frac{1}{2}, 1$
 - $\frac{1}{2}, 1, \frac{3}{2}$
 - $\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$
35. Bond angles $\text{H}-\text{O}-\text{H}$ and $\text{H}-\text{O}-\text{O}-$ in water and hydrogen peroxide respectively are
- 104.5° in both
 - 94.8° in both
 - $104.5^\circ, 94.8^\circ$
 - 94.8° and 104.5°
36. In the following reaction using $^{18}\text{H}_2\text{O}_2$,
- $$2\text{MnO}_4^- + 5\text{H}_2\text{O}_2 + 6\text{H}^+ \longrightarrow 2\text{Mn}^{2+} + 8\text{H}_2\text{O} + 5\text{O}_2$$
- ^{18}O goes with
- H_2O
 - O_2
 - Both (a) and (b)
 - None of these
37. H_2 reacts much faster with Cl_2 than D_2 , because
- Rate of diffusion of H_2 is greater than D_2
 - H_2 has lower energy of activation than D_2
 - Both (a) and (b) are correct
 - None of the statements is correct
38. Out of LiH, MgH_2 and CuH
- All are ionic hydrides
 - LiH, MgH_2 are ionic and CuH covalent hydride
 - All are covalent hydride
 - LiH is ionic MgH_2 and CuH are intermediate hydrides
39. Hydrogen peroxide is prepared in the laboratory by
- Passing CO_2 into BaO_2
 - Adding MnO_2 to dil. H_2SO_4
 - Adding Na_2O_2 to cold water
 - Adding PbO_2 into KMnO_4
40. H_2O_2 is a reducing agent in the reaction
- $\text{Ag}_2\text{O} + \text{H}_2\text{O}_2 \rightarrow 2\text{Ag} + \text{H}_2\text{O} + \text{O}_2$
 - $2\text{KI} + \text{H}_2\text{O}_2 \rightarrow 2\text{KOH} + \text{I}_2$
 - $\text{H}_2\text{O}_2 + \text{SO}_2 \rightarrow \text{H}_2\text{SO}_4$
 - $\text{PbS} + 4\text{H}_2\text{O}_2 \rightarrow \text{PbSO}_4 + 4\text{H}_2\text{O}$
41. Industrial source of H_2O_2 is
- By oxidation of 2-ethyl anthraquinol in a cyclic process
 - By partial oxidation of 2-propanol
 - By both (a) and (b)
 - None of the above
42. H_2O_2 is the hydride of
- O_2
 - H_2O
 - Both (a) and (b)
 - None of these
43. Spin isomerism is shown by

- a) Dichloro benzene b) Hydrogen c) Dibasic acid d) *n*-butane
44. The correct decreasing order of basic strength is
 a) $\text{AsH}_3 > \text{SbH}_3 > \text{PH}_3 > \text{NH}_3$ b) $\text{SbH}_3 > \text{AsH}_3 > \text{PH}_3 > \text{NH}_3$
 c) $\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3$ d) $\text{PH}_3 > \text{AsH}_3 > \text{SbH}_3 > \text{NH}_3$
45. Which cannot be oxidized by H_2O_2 ?
 a) Na_2SO_3 b) PbS c) KI d) O_3
46. Which among the following is a hydride?
 a) Rongalite b) Nitrolim c) Hydrolith d) Minium
47. In alkaline H_2O_2
 a) Mn^{2+} changes to MnO_2 b) Cr^{3+} changes to CrO_4^{2-}
 c) Both (a) and (b) are correct d) None of the above is correct
48. H_2 gas is liberated at cathode and anode both by electrolysis of the following aqueous solution except in
 a) NaH b) HCOONa c) NaCl d) LiH
49. Ionic hydride reacts with water to give
 a) Hydride ions b) Acidic solution c) Protons d) Basic solutions
50. Choose the correct statement(s)
 a) H_2 is more rapidly adsorbed on to surface than D_2
 b) H_2 reacts over 13 times faster with Cl_2 than D_2 because H_2 has a lower energy of activation
 c) Both (a) and (b) are true
 d) None of the above is true
51. The hydride ion H^- is stronger base than its hydroxide ion OH^- . Which of the following reactions will occur if sodium hydride (NaH) is dissolved in water?
 a) $2\text{H}^+(\text{aq}) \rightarrow \text{H}_2 + 2e^-$ b) $\text{H}^+(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{OH}^- + \text{H}_2$
 c) $\text{H}^- + \text{H}_2\text{O}(\text{l}) \rightarrow \text{No reaction}$ d) None of the above
52. Select the incorrect statement
 a) *Ortho* and *para* hydrogen are different due to difference in their nuclear spins
 b) *Ortho* and *para* hydrogen are different due to difference in their electron spins
 c) *Para* hydrogen has a lower internal energy than that of *ortho* hydrogen
 d) *Para* hydrogen is more stable at lower temperature
53. Which is a source of nascent hydrogen?
 I. $\text{Zn} + \text{dil. HCl}$,
 II. $\text{CH}_3\text{OH} + \text{Na}$
 III. Electrolysis of H_2O
 IV. Silent electric discharge
 a) I, II b) II, III c) I, II, III, IV d) IV
54. Which statement is not correct for hydrogen?
 a) It has a very high ionization potential
 b) It is always collected at cathode
 c) It can form bonds in +1 as well as -1 oxidation state
 d) It has same electronegativity as halogens
55. Cl_2 undergoes
 a) Oxidation in water b) Reduction in water
 c) Disproportionation in water d) No reaction in water
56. Which is true about different forms of hydrogen?
 a) *Ortho* hydrogen has same spins of two nuclei clockwise or anticlockwise
 b) *Para* hydrogen has different spins of two nuclei
 c) At absolute zero, there is 100% *para* form and at
 d) All the above are correct
57. Select the correct statement(s)
 a) Hydride ion is larger than any of the halide ions except iodide

- b) Hydrides ions are reducing agents
 c) Boranes are electron deficient hydrides
 d) All of the above are correct statements
58. Oxidation state of hydrogen is zero in
 a) CaH_2 b) NaH c) PdH_2 d) NH_3
59. (A) FeCl_3 solution + $\text{Zn} \rightarrow$ product X
 (B) FeCl_3 solution + H_2 gas \rightarrow product Y
 FeCl_3 solution gives blue colour with $\text{K}_4[\text{Fe}(\text{CN})_6]$ hence
 a) X also gives blue colour with $\text{K}_4[\text{Fe}(\text{CN})_6]$
 b) Y also gives blue colour with $\text{K}_4[\text{Fe}(\text{CN})_6]$
 c) Both X and Y give blue colour with $\text{K}_4[\text{Fe}(\text{CN})_6]$
 d) None gives colour with $\text{K}_4[\text{Fe}(\text{CN})_6]$
60. $\text{Na}[\text{Cr}(\text{OH})_4]$ on reaction with H_2O_2 changes to
 a) Na_2CrO_4 b) $\text{Na}_2\text{Cr}_2\text{O}_7$ c) $\text{Cr}(\text{OH})_3$ d) CrO_5
61. Hydrogen peroxide is reduced by
 a) Ozone b) barium peroxide
 c) Acidic solution of KMnO_4 d) Lead sulphide suspension
62. Hydrogen can be fused to form helium at
 a) High temperature and high pressure b) High temperature and low pressure
 c) Low temperature and high pressure d) Low temperature and low pressure
63. Fuel used for rocket propulsion is a mixture of
 a) Hydrazine and hydrogen peroxide b) Hydrazine and TNT
 c) Hydroxyl amine and TNT d) Hydroxyl amine and hydrogen peroxide
64. Which of the following statements about H_2O_2 differ from O_3 in its chemical action?
 a) H_2O_2 is used to clean oil paintings
 b) H_2O_2 acts as oxidising as well as reducing agent
 c) Two hydroxyl groups in H_2O_2 lie in the same plane
 d) It retains same structure in liquid and solid form
65. D_2O (heavy water) and H_2O differ in following except in
 a) Freezing point b) Density
 c) Ionic product of water d) Its reaction with sodium
66. The fuel gas obtained by blowing steam over incandescent coal is known as
 a) Coal gas b) Water gas c) Producer gas d) Natural gas
67. Which of the following is heavy water?
 a) H_2O^{18} b) H_2O^{16} c) H_2O_3 d) D_2O
68. Triple point of water is
 a) 273.16 K b) 373.15 K c) 203.12 K d) 193.16 K
69. Hydrogen is produced by the reaction
 a) $\text{Na}_2\text{O}_2 + 2\text{HCl}$ b) $\text{Mg} + \text{H}_2\text{O}$ c) $\text{BaO}_2 + \text{HCl}$ d) $\text{H}_2\text{S}_4\text{O}_8 + \text{H}_2\text{O}$
70. Permanent hardness of water can be removed by adding
 a) NaHCO_3 b) Na_2CO_3 c) CaOCl_2 d) Cl_2
71. Zn gives H_2 gas with H_2SO_4 and HCl but not with HNO_3 because
 a) Zn acts as an oxidizing agent when reacts with HNO_3
 b) HNO_3 is weaker acid than H_2SO_4 and HCl
 c) In electrochemical series Zn is above hydrogen
 d) NO_3^- is reduced in preference to hydronium ion
72. On burning hydrogen in air, the colour of flame is
 a) Green b) Light bluish c) Yellow d) None of these
73. H^- is a
 a) Lewis base b) Lowry-Bronsted base c) Both (a) and (b) d) None of these

74. There are three isotopes of hydrogen and three naturally occurring isotopes of oxygen (^{16}O , ^{17}O and ^{18}O). How many kinds of water are possible?
 a) 18 b) 16 c) 8 d) 9
75. 10 mL of H_2O_2 solution on treatment with KI and titration of liberated I_2 , required 10 mL of 1 N hypo. Thus, H_2O_2 is
 a) 1N b) 5.6 volume c) 17 gL^{-1} d) All are correct
76. Which is true statement about H_2O ?
 a) Hardness can be removed by passing through ion exchange resin
 b) Its presence can be detected by anhydrous CuSO_4
 c) It is amphiprotic
 d) All the above are correct statements
77. Which is accepted structure of H_2O_2 in gas phase?
 a)  b)  c) Both (a) and (b) d) None of these
78. Hydride ion is a
 a) Strong conjugate acid of H_2 b) Strong conjugate base of H_2
 c) Strong conjugate acid of H^+ d) Strong conjugate base of H^-
79. Mass of one atom is 6.66×10^{-23} g. Its percentage in an hydride is 95.24. Thus, hydride is
 a) MH b) MH_2 c) MH_3 d) MH_4
80. Which is hydrolysis reaction?
 a) $\text{O}^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow 2\text{OH}^-(\text{aq})$ b) $\text{O}_2^{2-}(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow \text{O}_2(\text{g}) + 4\text{OH}^-(\text{aq})$
 c) $4\text{O}_2^-(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 3\text{O}_2(\text{g}) + 4\text{OH}^-(\text{aq})$ d) All of the above
81. Pure water can be obtained from sea water by
 a) Centrifugation b) Plasmolysis c) Reverse osmosis d) Sedimentation
82. H_2 , D_2 and T_2 do not differ in
 a) Freezing point b) Boiling point c) Critical temperature d) Bond energy
83. In the following compounds H is covalent bonded in case of
 a) BaH_2 b) CaH_2 c) SiH_4 d) NaH
84. Consider the following statements
 I: Rate of transfer of D^+ from D_2O is slower than that of H^- from H_2O
 II: K_a for $\text{CH}_3\text{COOH} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}^+$ is smaller than that of K_a for $\text{CH}_3\text{COOD} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{D}^+$
 III: Tritium is a radioactive isotope
 Select the correct statements
 a) I, II b) II, III c) I, III d) I, II, III
85. Select the correct statement
 a) Ammonia is more soluble in aqueous ammonium chloride than in pure water
 b) Solid ammonium fluoride and ice are miscible in all proportions
 c) Both (a) and (b) are correct
 d) One of the above statements is correct
86. Metallic hydrides
 a) Are also called interstitial hydrides
 b) Are non-stoichiometric, being deficient in hydrogen
 c) Are poor conductors of electricity, exhibit less paramagnetism and have hydrogen as atom and not as molecule
 d) Have all the properties given above
87. Out of the following metals which will give H_2 on reaction with NaOH
 I: Zn, II: Mg, III: Al, IV: Be
 a) I, II, III, IV b) I, III, IV c) II, IV d) I, III

88. Which of the following disproportionates when treated with water?
 a) SO_3 b) F_2 c) N_2 d) Cl_2
89. Abundance of H_2 in the earth's atmosphere is very small. This is because
 a) The earth's gravitation field is too small to hold so light an element
 b) H_2 exists in *ortho* and *para* form
 c) H_2 is diatomic gas
 d) H_2 is not the metal
90. Adsorbed hydrogen by palladium is known as
 a) Nascent b) Atomic c) Heavy d) Occluded
91. Steam is passed over red hot carbon and the gaseous products cooled and passed first through a solution of alkali, then through ammoniacal cuprous chloride and then through water. What is finally collected?
 a) CO_2 b) A mixture of hydrocarbons
 c) $\text{CO} + \text{H}_2$ d) H_2
92. SiH_4 is an example of which of the following type of hydrides?
 a) Ionic b) Interstitial c) Metallic d) Covalent
93. The acid, not suitable for the preparation of hydrogen by the action of metals, is
 a) HCl b) CH_3COOH c) HNO_3 d) H_2SO_4

Multiple Correct Answers Type

94. Hydrides of metals are named like
 a) Alkane b) Alkene c) Alkyne d) None is correct
95. In water, or in aqueous solutions of HCl or H_2SO_4 proton exists as
 a) H_3O^+ b) $\text{H}(\text{H}_2\text{O})_4^+$ c) $\text{H}(\text{H}_2\text{O})_n^+$ d) $[\text{H}_3\text{O}^+][\text{OH}]$
96. Some of the following properties are similar for metals and their metallic hydrides
 a) Hardness b) Metallic lusture
 c) Electrical conductivity d) Magnetic property
97. Hydrogen and halogen resemble in the
 a) Formation of H^+ and X^+ b) Formation of H^- and X^-
 c) Formation of H_2 and X_2 d) Following octet rule in H^- and X^-
98. "10 volume" H_2O_2 means
 a) 1 mL H_2O_2 gives 10 mL O_2 at NTP b) 1 g H_2O_2 gives 10 mL O_2 at NTP
 c) 1 mol H_2O_2 gives 10 mL O_2 at NTP d) 10 mL gives 1 mol H_2 and 1 mol O_2 at NTP
99. Which of the following statements about H_2O_2 are true?
 a) H_2O_2 is used to clean oil paintings
 b) H_2O_2 acts as oxidizing as well as reducing agent
 c) Two hydroxyl groups in H_2O_2 lie in the same plane
 d) It retains same structure in liquid and solid form
100. Out of the following metals which will give H_2 on reaction with NaOH
 I: Zn, II: Mg, III: Al, IV: Be
 a) I, II, III, IV b) I, III, IV c) II, IV d) I, III
101. H^+ , D^+ and T^+ differ in all except in
 a) Number of electrons b) Number of neutrons
 c) Ionic mass d) Electronic configuration
102. Which is a source of nascent hydrogen?
 a) $\text{Zn} + \text{dil. HCl}$, b) $\text{CH}_3\text{OH} + \text{Na}$
 c) Electrolysis of H_2O d) Silent electric discharge
103. Density of H_2O is maximum at
 a) 0°C b) 100°C c) -273°C d) 4°C
104. H_2O_2 is "5.6 volume", then

- a) It is 1.7% weight by volume
c) It is 1 M
- b) It is 1 N
d) It is 5.6 M
105. H_2O_2 can be obtained when following reacts with H_2SO_4 except with
a) PbO_2
b) BaO_2
c) Na_2O_2
d) SrO_2
106. H_2 can be obtained from
a) Water gas ($CO + H_2$) by liquefaction of CO at temperature under pressure
b) Water gas by oxidation of CO into CO_2 (by steam) which can be easily removed by dissolving in H_2O
c) Electrolysis of water or $NaOH$
d) Reaction of $NaOH$ on Zn
107. Which is/are radioactive isotope(s) of hydrogen?
a) 1_1H
b) 2_1H
c) 3_1H
d) 4_1H
108. H_2 gas can be prepared by
a) Dissolving NaH or Na in H_2O
c) Reaction of Cu with dilute H_2SO_4
b) Reaction of Al with $NaOH$ solution
d) Electrolysis of H_2O in the presence of KOH
109. How does H_2O_2 differ from O_3 in its chemical action?
a) In oxidizing PbS to $PbSO_4$
c) In decolourising acidified $KMnO_4$
b) In liberating I_2 from KI
d) In oxidizing $K_4[Fe(CN)_6]$ to $K_3[Fe(CN)_6]$
110. Select the correct statements:
a) Boiling point of H_2O , NH_3 , HF are maximum in their respective group due to intermolecular H-bonding
b) Boiling point of CH_4 out of CH_4 , SiH_4 , GeH_4 and SnH_4 is least due to lack of H-bonding
c) Benzoic acid forms dimer by H-bonding
d) H_2O exists as $H_9O_4^+$ in acidic medium
111. Temporary hardness and permanent hardness can be removed respectively by addition of
a) CaO , $CaCO_3$
b) CaO , Na_2CO_3
c) Na_2CO_3 , CaO
d) $NaHCO_3$, $CaCl_2$
112. Industrially H_2O_2 is obtained from
a) 2-ethyl anthraquinol by oxidation and then reduction in a cyclic process
b) H_2SO_5
c) $H_2S_2O_8$
d) BaO_2
113. Which is/are true statement(s)?
a) The layer of ice on the surface of river in the winter acts as a thermal insulator between the water below and the air above
b) The fish and other marine organisms are enable to survive long periods of freezing weather due to the fact that ice is lighter than water
c) When ice is formed volume decreases
d) Density of ice is maximum at $0^\circ C$
114. Select the correct statement(s) about lime light
a) Oxy-hydrogen flame
b) Used in welding
c) Temperature of lime light is sufficient to melt even platinum
d) Produced in an endothermic reaction
115. Which is hydrolysis reaction?
a) $O^{2-}(aq) + H_2O(l) \rightarrow 2OH^-(aq)$
c) $4O_2^-(aq) + 2H_2O(l) \rightarrow 3O_2(g) + 4OH^-(aq)$
b) $O_2^{2-}(aq) + 2H_2O(l) \rightarrow O_2(g) + 4OH^-(aq)$
d) $Fe^{3+} + 3H_2O \rightarrow Fe(OH)_3 + 3H^+$
116. Decomposition of H_2O_2 can be prevented by addition of
a) Ferrous sulphate
b) Oxalic acid
c) Ozone
d) Glycerol

Assertion - Reasoning Type

This section contain(s) 0 questions numbered 117 to 116. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is

correct.

- a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1
- b) Statement 1 is True, Statement 2 is True; 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

117

Statement 1: Temporary hardness can be removed by boiling.

Statement 2: On boiling the soluble bicarbonates change to carbonates which being insoluble get precipitated.

118

Statement 1: NaCl is less soluble in heavy water than in ordinary water.

Statement 2: Dielectric constant of ordinary water is more than that of heavy water.

119

Statement 1: Saline hydrides are nonvolatiles non conducting and crystalline solids.

Statement 2: Saline hydrides are compounds of hydrogen with most of the p block elements

120

Statement 1: Water has high boiling point.

Statement 2: Water shows hydrogen bonding.

121

Statement 1: Hard water is more suitable than soft water.

Statement 2: Hard water can be used in steam boilers.

122

Statement 1: Hydrogen shows resemblance with alkali metals as well as halogens.

Statement 2: Hydrogen exists in atomic form only at high temperature.

123

Statement 1: Hydrogen has only two isotopes namely protium and deuterium .

Statement 2: Protium is radio active in nature.

Matrix-Match Type

This section contains 0 question(s). Each question contains Statements given in 2 columns which have to be matched. Statements (A, B, C, D) in **columns I** have to be matched with Statements (p, q, r, s) in **columns II**.

124. Match the hydrides in Column I with their properties in Column II

Column-I	Column- II
(A) NaH	(p) Conducts electricity in fused state
(B) BeH ₂	(q) Electron deficient
(C) CaH ₂	(r) Liberates H ₂ at anode on electrolysis of molten salt
(D) OH ₂	(s) Negative oxidation state of hydrogen atom
	(t) Concept of hybridization is applicable

CODES :

	A	B	C	D
a)	A,c,d	b,d,e	a,c,d	e
b)	b,d,e	a,c,d	a,c,d	e
c)	a,c,d	a,c, d	b,d,e	e
d)	b,d,e	e	a,c,d	a,c,d

125. Match order of different properties in Column I with the related property in Column II

Column-I	Column- II
(A) $HCl < HBr < HI < HF$	(p) Boiling point order
(B) $H_2S < H_2Se < H_2Te$	(q) Melting point order
(C) $PH_3 < AsH_3 < SbH_3 < NH_3$	(r) Bond polarity order
(D) $HF < HCl < HBr < HI$	(s) Acidic strength

CODES :

	A	B	C	D
a)	A,d	b,c,	a,b,c,	d
b)	a,b	b,c,d	a,b,c,d	d
c)	a,b	a,b,c,d	d	b,c,d
d)	a,b,c,d	b,c,d	d	a,b

126. Match List I with List II. Choose the correct matching codes from the choices given.

Column-I	Column- II
(A) BeH ₂	(1) Complex
(B) AsH ₃	(2) Lewis acid
(C) B ₂ H ₆	(3) Interstitial

(D) LaH_3

(4) Covalent

(E) LiAlH_4

(5) Intermediate

(6) Ionic

CODES :

	A	B	C	D	E
a)	6	2	4	5	1
b)	6	2	4	3	1
c)	6	4	2	3	1
d)	6	4	2	3	1
e)	5	4	2	3	1

Linked Comprehension Type

This section contain(s) 11 paragraph(s) and based upon each paragraph, multiple choice questions have to be answered. Each question has atleast 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 127 to -127

Read the following experiments and answer the questions at the end of it. "Research scholar *A* added zinc pieces into aqueous FeCl_3 solution and performed some experiments with resultant solution." Research scholar *B* passed H_2 gas into aqueous FeCl_3 solution and performed some experiments with resultant solution"

127. Yellow coloured FeCl_3 solution changed to light green (appeared as colourless) in the experiment of

a) *A*

b) *B*

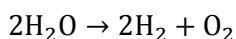
c) Both (a) and (b)

d) None of these

Paragraph for Question Nos. 128 to - 128

Depletion of resources of fossil fuels will at some future time make hydrogen, either for use directly by combustion and electrochemically in fuel cells or indirectly *via* hydrogenation of coal, the major alternative to nuclear energy; hence, arises the current interest in the so-called **hydrogen economy**

A thermochemical cycle for hydrogen production involves at least one element that can exist in two different oxidation states



Read the above passage and answer the following questions

128. Production of H_2 from H_2O requires a net input of energy that would come from

a) Nuclear source

b) Solar source

c) Both (a) and (b)

d) None of these

Paragraph for Question Nos. 129 to - 129

H^+ , H^- and H exist short-lived or long-lived

Answer the following questions

129. Which is the correct order of ionization energy?

- a) $H < H^+ < H^-$ b) $H^+ < H < H^-$ c) $H^- < H$ d) $H^- < H < H^+$

Paragraph for Question Nos. 130 to - 130

Oxygen forms three types of oxides O^{2-} , O_2^{2-} and O_2^-

Answer the following questions

130. Which of the following are Bronsted-Lowry bases in aqueous solution?

- a) O^{2-} , O_2^{2-} , O_2^- b) O^{2-} , O_2^{2-} c) O_2^- , O_2^{2-} d) O^{2-} , O_2^-

Paragraph for Question Nos. 131 to - 131

$Na[Cr(OH)_4]$, (A) green solution changes to yellow coloured solution when boiled with H_2O_2

131. Yellow coloured solution is due to the formation of

- a) $Na_2Cr_2O_7$ by oxidation of A b) $Na_2Cr_2O_7$ by reduction of A
c) Na_2CrO_4 by oxidation of A d) Na_2CrO_4 by reduction of A

Paragraph for Question Nos. 132 to - 132

Two liquids A and B are made of same atoms, with following properties

	A	B
Magnetic property	diamagnetic	diamagnetic
KI/ H^+ /starch	blue	no colour
Molar mass difference wrt B	16 units	—

Answer the following questions

132. A and B are respectively

- a) H_2O_2 , H_2O b) KO_2 , K_2O c) H_2O , H_2O_2 d) K_2O , KO_2

Paragraph for Question Nos. 133 to - 133

H_2O has dual behaviour, as oxidant as well as reductant. Following species are used to illustrate this behaviour

Cl_2 , F_2 , K, Br_2

Answer the following questions

133. Which of the following is oxidized by water?

- a) Cl_2 b) F_2 c) Br_2 d) K

Integer Answer Type

134. 68 g H_2O_2 will make equivalent(s)

135. CrO_5 has peroxy linkage(s). x is

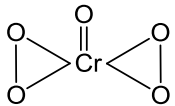
136. H_2 is formed by electrolysis of aqueous brine solution. In an experiment 0.112 mL of H_2 gas is formed at

- NTP. What is the pH after electrolysis of brine solution?
137. 5.0 mL of H_2O_2 solution liberates 1.016 g of I_2 from an acidified KI solution. Thus, volume strength (at STP) is approximately.....
138. Two moles of MnO_4^- reduces x mole(s) of H_2O_2 in basic medium. x is
139. How many of the following undergo disproportionation when dissolved in water?
 $\text{Cl}_2, \text{F}_2, \text{Na}_2\text{O}_2, \text{KO}_2, \text{K}_2\text{O}$
140. Number of neutrons in the heaviest isotopes of hydrogen is.....
141. Number of peroxy linkage (s) in $\text{H}_2\text{S}_2\text{O}_8$ is
142. 5.6 g of a unsaturated hydrocarbon occupies 2.24 L at NTP. It also required 4.48 L of H_2 gas for its reduction. How many π bonds does it have?
143. How many of the following make alkaline solution in water?
 $\text{O}^{2-}, \text{O}_2^{2-}, \text{O}_2^-$
144. $^{14}_7\text{N}$ undergoes nuclear reaction
 $^{14}_7\text{N} \xrightarrow{(n,\text{T})}$
 What is atomic number of the atom formed?
145. How many types of water can be formed out of $^1_1\text{H}, ^2_1\text{H}, ^3_1\text{H}$ and $^{16}_8\text{O}$?
146. Ionic product, $[\text{H}^+][\text{HO}_2^-]$ of H_2O_2 was found to be 1×10^{-12} at a given temperature. Thus, pH of H_2O_2 is
147. How many moles of H_2O_2 are oxidized by 2 moles of KMnO_4 in acidic medium?
148. H_2O_2 is "33.6" volume. Thus, its normality is
149. How many of the following are oxidant?
 $\text{H}_2\text{O}, \text{H}_2\text{O}_2, \text{KO}_2, \text{Na}_2\text{O}_2, \text{Na}_2\text{O}, \text{O}_3$

: ANSWER KEY :

1)	c	2)	c	3)	d	4)	b
5)	c	6)	d	7)	b	8)	d
9)	d	10)	a	11)	b	12)	a
13)	c	14)	d	15)	c	16)	b
17)	d	18)	c	19)	d	20)	b
21)	a	22)	a	23)	c	24)	a
25)	c	26)	a	27)	c	28)	c
29)	a	30)	d	31)	c	32)	c
33)	b	34)	a	35)	c	36)	b
37)	b	38)	d	39)	a	40)	a
41)	b	42)	a	43)	b	44)	c
45)	d	46)	c	47)	d	48)	a
49)	d	50)	c	51)	b	52)	b
53)	a	54)	b	55)	c	56)	d
57)	d	58)	c	59)	b	60)	a
61)	d	62)	a	63)	c	64)	c
65)	d	66)	b	67)	d	68)	a
69)	b	70)	b	71)	d	72)	b
73)	c	74)	a	75)	c	76)	d
77)	b	78)	b	79)	b	80)	a
81)	c	82)	d	83)	c	84)	d
85)	c	86)	d	87)	b	88)	d
89)	a	90)	d	91)	d	92)	d
93)	c	1)	a	2)	a,b,c	3)	c
	4)	b,c					
5)	a	6)	a,b,d	7)	b	8)	
	a,d						
9)	a,b	10)	d	11)	a,b	12)	a
13)	a,b,c,d	14)	c	15)	a,b,d	16)	c
17)	a,c,d	18)	b	19)	a	20)	
	a,b						
21)	a,b,c	22)	a,d	23)	d	1)	a
	2)	a	3)	c	4)	a	
5)	d	6)	b	7)	d	1)	a
	2)	b	3)	e	1)	a	
	2)	c	3)	c	4)	a	
5)	c	6)	a	7)	d	1)	4
	2)	2	3)	9	4)	9	
5)	3	6)	4	7)	2	8)	1
9)	2	10)	3	11)	6	12)	6
13)	6	14)	5	15)	6	16)	4

: HINTS AND SOLUTIONS :

- 11 **(b)**
 "20 volume" means
 1 mL H_2O_2 gives = 20 mL O_2 at NTP
 Thus, 15 mL H_2O_2 gives = 300 mL O_2 at NTP
- 22 **(a)**
 $\text{Cr}_2\text{O}_7^{2-} + \text{H}^+ \rightarrow \text{CrO}_3$
 Conc
 $\text{CrO}_3 + \text{H}_2\text{O}_2 \rightarrow \text{CrO}_5$
- 
- 23 **(c)**
 O_3 does not decolourise KMnO_4
- 39 **(a)**
 $\text{BaO}_2 + \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{BaCO}_3 + \text{H}_2\text{O}_2$
- 48 **(a)**
- | Salt | Ionization | At cathode |
|---|------------|--|
| At anode | | |
| (a) $\text{NaH} \rightleftharpoons \text{Na}^+ + \text{H}^-$ | | $\text{Na}^+ + e^- \rightarrow \text{Na}$ |
| $\text{H}^+ + e^- \rightarrow \frac{1}{2}\text{H}_2 + e^-$ | | |
| | | $\text{Na} + \text{H}_2\text{O} \rightarrow$ |
| $\text{NaOH} + \frac{1}{2}\text{H}_2$ | | |
| (b) $\text{HCOONa} \rightleftharpoons \text{HCOO}^- + \text{Na}^+$ | | Same |
| $\text{HCOO}^- \rightarrow \frac{1}{2}\text{H}_2 + \text{CO}_2 + e^-$ | | |
| (c) $\text{NaCl} \rightleftharpoons \text{Na}^+ + \text{Cl}^-$ | | Same |
| $\text{Cl}^- \rightarrow \frac{1}{2}\text{Cl}_2 + e^-$ | | |
| (d) $\text{LiH} \rightleftharpoons \text{Li}^+ + \text{H}^-$ | | $\text{Li} + e^- \rightarrow \text{Li}$ |
| $\text{H}^- \rightarrow \frac{1}{2}\text{H}_2 + e^-$ | | |
| | | $\text{Li} + \text{H}_2\text{O} \rightarrow \text{LiOH} +$ |
| $\frac{1}{2}\text{H}_2$ | | |
- 58 **(c)**
 H_2 is adsorbed in Pd-surface. Thus, it is in molecular state with oxidation number of H = 0
- 59 **(b)**
 FeCl_3 solution is acidic due to hydrolysis when Zn is added, nascent hydrogen is formed which reduces FeCl_3 to FeCl_2 and thus no reaction with $\text{K}_4[\text{Fe}(\text{CN})_6]$
- $$\text{FeCl}_3 + \text{K}_4[\text{Fe}(\text{CN})_6] \longrightarrow \text{KFe}[\text{Fe}(\text{CN})_6] + 3\text{KCl}$$
- blue
- $\downarrow \text{H}(\text{Zn} + \text{HCl})$
- $$\text{FeCl}_2 + \text{K}_4[\text{Fe}(\text{CN})_6] \longrightarrow \text{No colour}$$
- $$\text{FeCl}_3 + 3\text{H}_2\text{O} \rightarrow \text{Fe}(\text{OH})_3 + 3\text{HCl}$$
- $$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + 2\text{H}$$
- H_2 gas is not sufficient in reducing FeCl_3 to FeCl_2
- 60 **(a)**
 $\text{Na}[\text{Cr}(\text{OH})_4] + \text{H}_2\text{O}_2 \rightarrow \text{Na}_2\text{CrO}_4$
 yellow
- 69 **(b)**
 $\text{Mg} + \text{H}_2\text{O} \xrightarrow{\Delta} \text{Mg}(\text{OH})_2 + \text{H}_2$, other are for H_2O_2
- 79 **(b)**
 Mass of one atom = 6.66×10^{-23} g
 Mass of N_0 atoms = $6.66 \times 10^{-23} \times 6.02 \times 10^{23}$ g
 = 40 g
 Thus, atomic weight of the element = 40
- | Element | % | % at wt. | Ratio |
|---------|-------|----------|-------|
| M | 95.24 | 2.381 | 1 |
| H | 4.76 | 4.76 | 2 |
- Thus, hydride is MH_2
- 117 **(a)**
 Temporary hardness is due to presence of bicarbonates of Ca and Mg.
- $$\text{M}(\text{HCO}_3)_2 \rightleftharpoons \text{MCO}_3 \downarrow + \text{CO}_2 + \text{H}_2\text{O}$$
- $(\text{M} = \text{Ca}, \text{Mg})$
- 118 **(a)**
 NaCl is less soluble in heavy water than in ordinary water because dielectric constant of ordinary water (*i.e.*, 81) is more than that of heavy water (*i.e.*, 80).
- 119 **(c)**
 Saline or ionic hydrides are compounds of hydrogen with most of the s-block metals hydrogen forms molecular or covalent hydrides.
- 120 **(a)**
 The high boiling point of H_2O is due to H-bonding which holds the water the water molecules together rather than leaving them free.
- 121 **(d)**
 Hard water is unsuitable for laundry washing and dyeing. By using hard water over a period of time, the inner surface of the boiler gets crusted with so called boiler scale. It reduces the efficiency of boiler and also damages it.
- 122 **(b)**

Hydrogen can gain an electron form H^- ion with the stable noble gas configuration of helium. It can also lose its electron to give H^+ ion. Hydrogen therefore has resemblance to the halogens as well as to the alkali metals which gain or lose an electron respectively to form univalent negative and positive ions with noble gas configuration.

123 (d)

Hydrogen has three isotopes namely protium (${}_1H^1$) deuterium(${}_1H^2$ or D) and tritium (${}_1H^3$ or T). Tritium is radioactive and emits low energy β particles.

126 (e)

Complex compounds which do not give all their constituent ions when dissolved in water, individual identity of ions are lost, *e.g.*, $-[Cu(NH_3)_4]SO_4$, $LiAlH_4$.

Lewis acid electrons deficient species which gain electrons while forming a bond with Lewis bases. *E.g.*, B_2H_6 .

Interstitial metal hydrides *f* –block hydrides are non-stoichiometric *e.g.*, LaH_n etc, where chemical composition is variable *e.g.*, $-LaH_{2.87}$, $X_bH_{2.5}$ etc.

Intermediate hydride polymeric in nature *e.g.*, BeH_2 .

Covalent hydride bond forms by sharing of electron. *e.g.*, AsH_3 .