CHEMISTRY

BOOKS - CHHAYA CHEMISTRY (BENGALI ENGLISH)

HYDROGEN

Numerical Examples

1. Calculate the degree of hardness of a sample of hard water which is found to contain 72 mg of $MgSO_4$ per kg of water.

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2. Estimate the hardness of a sample of water 1L of which contains 0.001 mol of dissolved $\mathrm{MgCl_2}$

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3. 1 L of river water contains 6 mg Mg^{2+} and 20 mg Ca^{2+} ions as chloride salts. Determine the degree of hardness of that sample of river water.

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4. The degree of hardness of a sample of water is 40 ppm. If the hardness is only due to the presence of $\mathrm{MgSO_4}$,

then determine the amount of $MgSO_4$ in 1 kg of that water.

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5. 10 mL of 0.01 (N) HCl is required for titrating 100 mL of a sample of cold water using methyl orange as indicator. Determine the temporary hardness of that sample of water.

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6. Determine the weight of CaO required to remove the hardness of a sample of 10^5 L water, 1 L of which contains 1.62g of $Ca(HCO_3)_2$.

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7. Determine the strength of '10 volume H_2O_2' solution in

(1) gram per litre,

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8. Determine the strength of '10 volume H_2O_2' solution in

(2) normality and

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9. Determine the strength of '10 volume H_2O_2' solution in

(3)percentage strength.

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10. Determine the volume strength of 1.5 (N) H_2O_2.

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11. Determine the volume strength of a 6.07% H_2O_2 solution.

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12. The strengths of three H_2O_2 solutions are 10,15 and 20 volume respectively. 0.5L of each of these solutions are mixed and equal amount of water is added to it. Determine the volume strength of the mixed solution.

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13. 20 mL of a H_2O_2 solution after acidification required 20 mL of N/10 $KMnO_4$ solution for complete oxidation. Calculate the percentage and volume strength of H_2O_2 solution.

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Warm Up Exercise

1. Name the isotopes of hydrogen and state their mass ratio.

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2. What is the source of solar energy?

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3. Which isotope of hydrogen is most abundant and which one is radioactive?

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4. The chemical properties of the isotopes are identical but they chemical different rates of chemical reactions- why?

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5. How can tritium be synthesised artificially? How can it be stored ? State one important use of tritium.

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6. State one important use of deuterium.

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7. How can dihydrogen be prepared in the laboratory?

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8. Although Fe is placed above hydrogen in the electrochemical series, dihydrogen in not obtained by its reaction with nitric acid. Explain with reasons.

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9. Why commercial variety of zinc is used instead of pure zinc in the laboratory preparation of dihydrogen?

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10. Concentrated sulphuric acid cannot be used in the laboratory perparation of dihydrogen-why?

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11. Name a metal and a non-metal which on reaction with alkali liberates dihydrogen and write the corresponding chemical reactions.

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12. Give an example and formula of a compound which on electrolysis liberates dihydrogen at anode.

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13. Name two metals which can replace hydrogen from acid.

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14. How can one prepare H_2 gas from water by using a reducing agent?

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15. Write the industrial preparation of dihydrogen from water.

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16. Explain why dihydrogen is relatively inert at room temperature.

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17. Give example of two reaction one in which H_2 acts as on oxidising agent & other in which it acts as a reducing agent.

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18. What do you mean by hardening of oils?

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19. Show that the reactivity of halogens towards dihydrogen decreases on going from fluorine to iodine.

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20. Name two compounds, in one of which hydrogen is in + 1 and in the other in - 1 axidation state.

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21. Explain why the chemical properties of ortho and para-hydrogen are the same but their physical properties are different.

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22. What is nascent hydrogen?

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23. Show that nascent hydrogen is more active than ordinary molecular hydrogen and explain the cause of its hyperactivity.

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24. What do you mean by atomic hydrogen?

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25. Both dihydrogen and carbon monoxide burn in air with blue flame. How will you distinguish between them?

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26. Mention two advantages of using dihydrogen as a fuel with respect to gasoline.

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27. Mention four important uses of dihydrogen.

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28. What do you mean by hydrides? Give examples along with their general formula.

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29. Why ionic or salt-like hydrides on electrolysis liberates dihydrogen at anode?

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30. What characteristics do you expect from an electrondeficient and an electron-rich hydride with respect to their structures?

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31. Why the boiling point of HF is higher than that of other hydrogen halides?

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32. Which type of hydrides can be used as hydrogen storage media?

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33. How can you separate H_2 or D_2 from He?

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34. Why ionic or salt-like hydrides are used to dry organic solvents?

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35. Although the oxygen atom in water is sp^3 hybridised, the value of H-O-H bond angle is 104.5° -why?

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36. Explain why a molecule of water is polar in nature.

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37. Explain why the freezing point, boiling point, heat of fusion and heat of vaporisation of water are higher as compared to the hydrides of the other members of same group (16).

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38. Explain why ice floats on water.

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39. At which temperature the density of water is maximum and why?

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40. Many electrovalent or ionic compounds and same non-electrolytes such as organic compounds get readily dissolved in water-why?

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41. Water is very stable compound - why ?

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42. Explain why water is called 'universal solvent?

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43. Explain why water is called an 'amphiprotic solvent'. Establish this giving chemical equations.

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44. What do you understand by'self-ionisation' or 'autoprotolysis' of water?

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45. Give examples of two reactions one in which water acts as an oxidising agent and the other in which it acts as a reducing agent.

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46. Which type of compounds undergo hydrolysis? Give examples.

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47. What happens when steam is passed over red hot coke? Give suitable equation.

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48. Water plays a significant role in controling the atmospheric and body temperature-explain.

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49. How does water stabilise an ion?

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50. Why water is liquid at ordinary temperature?

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51. How will you prove that a colourless liquid is water?

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52. Indicate whether water undergoes oxidation or reduction during photosynthesis. Give the reaction involved.

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53. Cobalt chloride is blue in anhydrous state . In contact with water vapours it turns

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54. What is heavy water? Why it is called so? State the major source of heavy water.

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55. All physical constants of heavy water are higher than the corresponding values of ordinary water-why?

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56. What amount of water should be electrolysed to get 1L of 99% pure D_2O?

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57. Why concentration of D_2O increases when electrolysis of water is carried out for a long period of time?

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58. Explain why the reactions of D_2 O occur at a rate slower that the corresponding reactions of H_2O.

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59. How would you prepare deuterium peroxide (D_2O_2) ?

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60. How will you prepare deuteroammonia (ND_3) from N_2 ?

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61. Write down two important uses of heavy water.

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62. How will you prove that hypophoshporus acid (H_3PO_2) is a monobasic acid?

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63. Sodium chloride is less soluble in heavy water than ordinary water-why?

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64. Why is heavy water (D_2O) injurious to human beings, animals and plants?

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65. Some H_2SO_4 has been added to distilled water. Explain whether this acidic water will behave as hard water or not?

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66. Explain why lather is not formed when soap is used in hard water.

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67. It is better to use detergent than soap in hard water - explain why.

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68. What do you understand by the term softening of hard water?

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69. What is calgon? Which ions are rendered ineffective by calgon thereby eliminating the hardness of water?

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70. Temporary hardness caused by $Mg(HCO_3)_2$ cannot be removed completely by boiling - why?

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71. What are the inorganic cation exchangers which are known as permutits (synthetic) or zeolites (naturally occuring)? How does they remove cations from hard water?

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72. What do you understand by deionised or demineralised water?

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73. In the preparation of deionised water how do organic cation or anion exchange resins work?

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74. How can the exhausted inorganic and organic ionexchangers be regenerated?

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75. Explain why the water obtained after passing hard water through cation exchange resins is acidic.

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76. A sugar solution prepared in distilled water is passed successively through cation and anion exchange resins. What will be the taste of the collected water and why?

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77. Why is hard water not used for cooling purpose in industry?

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78. The hardness of water of a tube well is 300 ppm. What do you mean by this statement?

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79. Will the water obtained by passing hard water through anion exchange resin, form lather with soap? Why ?

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80. A sample of water contains $MgSO_4$ and urea. How can they be eliminated easily?

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81. How can hydrogen peroxide be prepared in the laboratory? What is the limitation of this process?

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82. Explain why in the laboratory preparation of H_2O_2 : the reaction is carried out at low temperature,

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83. Explain why in the laboratory preparation of H_2O_2 : dilute H_2SO_4 is used instead of concentrated H_2SO_4 ,

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84. Explain why in the laboratory preparation of H_2O_2 :

A thin paste of hydrated barium peroxide is used instead of anhydrous barium peroxide

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85. Explain why in the laboratory preparation of H_2O_2 :

At the end of the reaction, the mixture should contain a small amount of surplus acid,

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86. Explain why in the laboratory preparation of H_2O_2 :

HCL or HNO_3 is not used,

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87. Explain why in the laboratory preparation of H_2O_2 :

The paste of BaO_2 is poured into dilute H_2SO_4 instead of pouring dilute H_2SO_4 into the paste,

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88. Explain why in the laboratory preparation of H_2O_2 :

It is better to use syrupy phosphoric acid instead of dilute sulphuric acid.

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89. Explain why in the laboratory preparation of H_2O_2 : MnO_2 or PbO_2 cannot be used instead of BaO_2 for preparing H_2O_2 - why ?

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90. What is Merck's perhydrol? How can it be prepared ?

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91. How can H_2O_2 be manufactured by using 50% H_2SO_4 solution?

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92. What is Marshall's acid?

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93. How can H_2O_2 solution be prepared by electrolysing an equimolar mixture of sulphuric acid and ammonium sulphate?

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94. Explain why a solution of H_2O_2 cannot be concentrated by distillation at atmospheric pressure. How will you get pure H_2O_2 from its dilute solution?

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95. Which organic compound is used for manufacturing H_2O_2 conveniently and economically by reducing atmospheric oxygen?

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96. Discuss the structure of H_2O_2 molecule.Explain why the shape of H_2O_2 molecule in the solid phase differs from that in the gas phase.

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97. Explain why the dissociation of H_2O_2 is a disproportionation reaction.

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98. Mention some of the factors which accelerate the decomposition of H_2O_2.

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99. Name two compounds which can decelerate the decomposition of H_2O_2.

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100. H_2O_2 reacts with NaOH to give two types of salts - why? Write down the reactions.

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101. Explain why H_2O_2 cannot liberate CO_2 by reducing carbonate or bicarbonate salts.

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102. H_2O_2 exhibits both oxidising and reducing properties. Explain why.

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103. What do you mean by the 'antichlor' property of H_2O_2?

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104. Give the mechanism of the bleaching action of H_2O_2 .

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105. What are perhydrates? Give examples.

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106. How is H_2O_2 preserved in the laboratory?

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107. It is better to preserve H_2O_2 in a polythene bottle than in a glass bottle - why?

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108. Explain why H_2O_2 is used to restore the original colour of oil-paintings.

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109. How will you identify a colourless liquid as H_2O_2 or H_2O?

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110. What happens when H_2O_2 is added to acidified KI solution followed by addition of starch?

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111. What is perhydrol?

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112. What is Fenton's reagent? Mention its use.

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113. Give the name and structure of the compound used as brightener in washing powder.

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114. Mention the role of H_2O_2 in pollution control.

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115. What do you understand by the expression '30 volume H_2O_2 solution?

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116. What do you mean by 20% H_2O_2 solution?

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117. Calculate the volume strength of 1% H_2O_2 solution.

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118. Determine the volume strength of 1(N) H_2O_2.

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119. Calculate the percentage strength of '6.588 volume H_2O_2 '.

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Question Answer Zone For Board Examination Very Short Answer Type

1. Explain why concentrated HCL is not used in the laboratory preparation of H_2 gas.

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2. Write down the name and formula of a compound which on electrolysis produces dihydrogen at anode.

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3. What is syngas?

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4. Which isotope of hydrogen is used as a tracer in organic reactions?

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5. Explain why dihydrogen is not suitable for balloons.

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6. Which bond between two at atoms has the highest bond dissociation enthalpy?

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7. Explain why H_2 is more reactive than D_2.

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8. What change is expected to take place when vegetable oils are hydrogenated?

Watch Video Solution

9. Which isotope of hydrogen is used in nuclear reactors?

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10. Why are ionic hydrides used as solid fuels?

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11. The densities of ionic hydrides are greater than that of the metal from which they are formed- why ?

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12. Give examples of two interstitial hydrides.

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13. Which gaseous compound on treatment with dihydrogen produces methanol?

Watch Video Solution

14. Give the chemical reaction that occurs when hydrogen is used as a rocket fuel.

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15. A sample of water containing KCL does not behave as hard water, but a sample of water containing $CaCl_2$ behaves as hard water-why?

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16. What is EDTA, a compound used to determine the hardness of water?

Watch Video Solution

17. Can distilled water be called deionised water?

Watch Video Solution

18. What is the difference between the water softened by the permutit process and the water softened by the organic ion exchangers?

Watch Video Solution

19. What will be the hardness of a sample of water, 10^6 g of which contains $\frac{1}{6}$ mol $Al_2(SO_4)_3$?

Watch Video Solution

20. What is calgon?

Watch Video Solution

21. Give the chemical formula of permutit.

Watch Video Solution

22. What is the main source of heavy water?

Watch Video Solution

23. Can sea animals survive in distilled water?

Watch Video Solution

24. Although D_2O resembles H_2O chemically, yet it is a toxic substance - why?

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25. Which compound is used to colour hair golden?

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26. What is the trade name of hydrogen peroxide used as an antiseptic?

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27. What is the strength in normality of a '11.2 volume' H_2O_2 solution?

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28. Name a compound which suppresses the decomposition of H_2O_2

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29. H_2O_2 molecule has an open-book like structure. What is the angle between the two pages of the book in the gas phase?

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30. Name an organic compound without peroxo bond which is used to manufacture H_2O_2 .

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Short Answer Type

1. Why do most of the reactions of H_2 occur at much higher temperature?

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2. What characteristics do you expect from electrondeficient hydrides with respect to their structure and chemical reactivity?

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3. Explain why it is harmful to bathe in heavy water and use it for drinking purposes.

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4. Explain why the thermal stability of H_2O_2 is very low.

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5. How the presence of H^- ions confirmed in ionic hydrides?

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6. How do you separate 2 allotropic forms of hydrogen?

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7. Mention the difference in chemical characteristics of the two hydrides obtained when hydrogen combines with two elements having atomic number 17 and 20.

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8. Two samples of hard water contain same cations, Ca^{2+} & Mg^{2+}. One is marked as temporary and the other as permanent. In which respect do they differ?

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9. Tube-well water, if left for sometime, assumes a brownish turbidity-explain.

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10. Write the reactions for:

preparation of H_2O_2 from two sodium salts and

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11. Write the reactions for:

preparation of D_2O_2 from potassium persulphate.

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12. Between deionised water and distilled water which one is more pure and why?

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13. Rain water is soft, but after passing over hills and mountains it gets converted into hard water-why?

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14. Why is Na_2O_2 used for purifying air in submarines and in crowded places?

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15. Comment on the reactions of dihydrogen with Chlorine

Watch Video Solution

16. Comment on the reactions of dihydrogen with sodium

Watch Video Solution

17. Comment on the reactions of dihydrogen with copper (II) oxide.

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18. An ionic alkali metal hydride has covalent character to some extent and it does not react with oxygen and

chlorine. This hydride is used in the synthesis of another hydride. Write the formula of the hydride and what happens when it reacts with Al_2Cl_6.

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19. Sodium reacts with dihydrogen to form a crystalline ionic solid. It is non-volatile and a non-conductor of electricity. It also reacts vigorously with water to liberate H_2 gas. Write the formula of the ionic solid and give reaction between this solid & water. What happens when the ionic solid in its molten state is electrolysed?

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20. Why is sea water not used in boilers?

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21. The values of melting point, enthalpy of vaporisation and viscosity of H_2O and D_2O are given below:

	H_2O	D_2O
(i)Melting point(K)	373.0	374.4
(ii) Enthalpy of vaporisation $\left(kJ \cdot \text{mol}^{-1}, 373K\right)$	40.66	41.61
(iii) Viscosity (centipoise)	0.8903	1.107

From the given data,determine which liquid has greater magnitude of intermolecular forces of attraction.

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22. How will you prepare heavy water from ordinary water? Explain its principle.

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23. Can phosphorus form PH_5 with its outer electronic configuration of $3s^2 3p^3$?

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24. How will you prepare dihydrogen from HNO_3 ?

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25. Do you think the hydrides of N, O and F will have lower boiling points than hydrides of their corresponding group members? State reasons.

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26. KF reacts with HF to form the compound, KF-2HF. Discuss the probable structure of the compound.

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27. Calculate the amount of energy liberated due to combustion of 4g dihydrogen.

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28. Under what conditions, water reacts with calcium cyanamide and what are the products formed due to this reaction?

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29. Discuss the industrial preparation of H_2O_2 from 2ethylanthraquinol. State advantages of this process.

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30. Why H_2O_2 is a better oxidant than water?

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Solved Wbchse Scanner

1. Why during preparation of H_2O_2 a paste of hydrated barium peroxide is added to ice-cold H_2SO_4 but the reverse process is not done?

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2. How is heavy water produced?

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3. Hydrogen can be placed in Group 17 instead of Group 1 of periodic table. Give reason.

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4. What is heavy water? Why is it so called?

Watch Video Solution

5. What happens when H_2O_2 is mixed with cold acidic potassium dichromate solution.

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6. A water sample contains 1 millimole of Mg^{2+} ion per litre. Calculate the hardness of the water sample in ppm unit.

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7. BaO_2 is a peroxide but MnO_2 is not a peroxide explain.

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8. What is calgon?

Watch Video Solution

9. What is heavy water?

Watch Video Solution

10. With balanced chemical equation, give an example of reducing property of H_2O_2.

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Solved Ncert Exercise

1. Justify the position of hydrogen in the periodic table on the basis of its electronic configuration.

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2. Write the names of isotopes of hydrogen. What is the mass ratio of these isotopes ?

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3. Why does hydrogen occur in a diatomic form rather than in a monoatomic form under normal conditions?

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4. How can the production of dihydrogen, obtained from 'coal gasification, the increased?

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5. Describe the bulk preparation of H_2 by electrolytic method. What is the role of electrolyte in this process?

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6. Complete the following reactions:

$$H_2(g) + M_mO_o(s) \xrightarrow{\Delta}$$

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7. Complete the following reactions:

CO(g)+ $H_2(g)$ $\underset{\text{catalyst}}{\overset{\Delta}{\longrightarrow}}$

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8. Complete the following reactions:

$C_3H_8(g) + 3H_2O(g)$ $\underset{\text{catalyst}}{\overset{\Delta}{\longrightarrow}}$

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9. Complete the following reactions:

Zn(s) + NaOH(aq) $\xrightarrow{\text{heat}}$

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10. Discuss the consequences of high enthalpy of H-H bond in terms of chemical reactivity of dihydrogen.

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11. What do you understand by (1) electron-deficient, (2) electron-precise and (3) electron-rich compounds of hydrogen? Provide justification with suitable examples.

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12. What characteristics do you expect from an electrondeficient hydride with respect to its structure and chemical reactions?

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13. Do you expect the carbon hydrides of the type (C_nH_{2n+2}) to act as 'Lewis' acid or base? Justify your answer.

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14. What do you understand by the term "non-stoichiometric hydrides"? Do you expect this type of the

hydrides to be formed by alkali metals? Justify your answer.

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15. How do you expect the metallic hydrides to be useful for hydrogen storage? Explain.

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16. How does the atomic hydrogen or oxy-hydrogen torch function for cutting welding purposes?

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17. Among NH_3, H_2O and HF, which would you expect to have highest magnitude of hydrogen bonding & why?

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18. Saline hydrides are known to react with water violently producing fire, Can CO_2 , a well known fire extinguisher, be used in this case? Explain.

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19. Arrange the following:

CaH_2, BeH_2 and$\mathrm{TiH_2}$ in order of increasing electrical conductance.

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20. Arrange the following:

LiH, NaH and CsH in order of increasing ionic character.

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21. Arrange the following:

H-H, D-D and F-F in order of increasing bond dissociation enthalpy.

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22. Arrange the following:

NaH,MgH_2 and H_2O in order of increasing reducing property.

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23. Compare the structures of H_2O and H_2O_2.

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

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25. Consider the reaction of water with F_2 and suggest, in terms of oxidation and reduction, which species are oxidised/reduced?

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26. Complete the chemical reactions.

PbS(s) + H_2O_2(aq) $\rightarrow$

MnO_4(aq) + H_2O_2(aq) $\rightarrow$

CaO(s) + H_2O_2 $\rightarrow$

$AlCl_3(g) + H_2O(l) \rightarrow$

$Ca_3N_2(s) + H_2O(l) \rightarrow$

Classify the above into [a] hydrolysis,[b] redox and [c] hydration reactions.

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27. Describe the structure of the common form of ice.

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28. What causes the temporary and permanent hardness of water?

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29. Discuss the principle and method of softening of hard water by synthetic ion-exchange resins.

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30. Write chemical reactions to show the amphoteric nature of water.

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31. Write chemical reactions to justify that hydrogen peroxide can function as an oxidising as well as reducing agent.

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32. What is meant by 'demineralised' water and how can it be obtained?

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33. Is demineralised or distilled water useful for drinking purposes? If not, how can it be made useful?

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34. Describe the usefulness of water in biosphere and biological systems.

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35. What properties of water make it useful as a solvent? What types of compound can it (1) dissolve, and (2) hydrolyse?

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36. Knowing the properties of H_2O and D_2O do you think that D_2O can be used for drinking purposes?

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37. What is the difference between the terms 'hydrolysis' and 'hydration'?

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38. How can saline hydrides remove traces of water from organic compounds?

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

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40. Do you expect different products in solution when aluminium (III) chloride and potassium chloride treated separately with

normal water

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41. Do you expect different products in solution when aluminium (III) chloride and potassium chloride treated separately with

acidified water and

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42. Do you expect different products in solution when aluminium (III) chloride and potassium chloride treated separately with

alkaline water? Write equations wherever necessary.

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43. How does H_2O_2 behave as a bleaching agent?

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44. What do you understand by the terms:

hydrogen economy

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45. What do you understand by the terms:

hydrogenation

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46. What do you understand by the terms:

'syngas'

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47. What do you understand by the terms:

water-gas shift reaction

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48. What do you understand by the terms:

fuel-cell?

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Higher Order Thinking Skill Hots Questions

1. What is 'hydrogenite'? Mention its use.

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2. What is denoted by $[H_9O_4]^+$ ion ? Explain.

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3. Pure para-hydrogen is available but not pure orthohydrogen. Explain.

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4. How many hydrogen bonded water molecule(s) are associated in $\mathrm{CuSO}_4 \cdot 5H_2O$?

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5. Write down the reaction between H_2O_2 and hydrazine (NH_2NH_2) in the presence of Cu(II) catalyst. Mention

the use of this reaction.

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Entrance Question Bank

1. The normality of '30 volume' of H_2O_2 is-

A. 2.678(N)

B. 5.336(N)

C. 8.034(N)

D. 6.685(N)

Answer:

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2. When H_2O_2 is shaken with an acidified solution of $K_2Cr_2O_7$ is presence of ether, layer turns blue due to the formation of-

A. Cr_2O_3

B. CrO_4^{2-}

C. $Cr_2(SO_4)_3$

D. CrO_5

Answer:

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3. Commercial sample of H_2O_2 is labeled as 10V. Its % strength is nearly-

A. 3

B. 6

C. 9

D. 12

Answer:

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4. In aqueous alkaline solution, two electron reduction of HO_2^- gives-

A. $HO^{\ominus}$

B. H_2O

C. O_2

D. O_2^-

Answer:

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5. Which statement is not correct for ortho- and para-hydrogen-

A. they have different boiling points

B. ortho-form is more stable than para-form

C. they differ in their nuclear spin

D. they ratio of ortho to para-hydrogen changes with change in temperature

Answer:

Watch Video Solution

6. At room temperature, the reaction between water and fluorine produces-

A. HF and H_2O_2

B. HF, O_2 and F_2O_2

C. $F^{\ominus}$, O_2 and $H^{\oplus}$

D. HOF and HF

Answer:

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7. Very pure hydrogen (99.9%) can be made by which of the following processes-

A. mixing natural hydrocarbons of high molecular weight

B. electrolysis of water

C. reaction of salt-like hydrides with water

D. reaction of methane with steam

Answer:

Watch Video Solution

8. In which of the following reactions, H_2O_2 acts as a reducing agent-

(1)$H_2O_2 + 2H^+ + 2e \rightarrow 2H_2O$

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

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

(4) $H_2O_2 + 2H^- - 2e \rightarrow O_2 + 2H_2O$

A. 2,4

B. 1,2

C. 3,4

D. 1,3

Answer:

Watch Video Solution

9. From the following statement regarding H_2O_2, choose the incorrect statement-

A. it has to be stored in plastic or wax lined glass bottles in dark

B. it has to be kept away from dust.

C. it can act only as an oxidizing agent.

D. it decomposes on exposure to light

Answer:

Watch Video Solution

10. Which one of following statement about water is false-

A. water can act both as an acid and as a base

B. there is extensive intramolecular hydrogen bonding in the condensed phase

C. ice formed by heavy water sinks in normal water

D. water is oxidised to oxygen during photosynthesis

Answer:

Watch Video Solution

11. Hydrogen peroxide oxidises $\left[\mathrm{Fe(CN)_6}\right]^{4-} \rightarrow \left[\mathrm{Fe(CN)_6}\right]^{3-}$ in acidic medium but reduces $\left[\mathrm{Fe(CN)_6}\right]^{3-}$ to $\left[\mathrm{Fe(CN)_6}\right]^{4-}$ in alkaline medium. The other products formed are, respectively-

A. H_2O and $(H_2O + O_2)$

B. H_2O and $\left(H_2O + OH^-\right)$

C. $(H_2O + O_2)$ and H_2O

D. $(H_2O + O_2)$ and $\left(H_2O + OH^-\right)$

Answer:

Watch Video Solution

12. Which of the following is electron-deficient-

A. $(BH_3)_2$

B. PH_3

C. $(CH_3)_2$

D. $(\mathrm{SiH_3})_2$

Answer:

Watch Video Solution

13. The reaction of aqueous $\mathrm{KMnO_4}$ with H_2O_2 in acidic conditions gives-

A. Mn^{4+} and O_2

B. Mn^{2+} and O_2

C. Mn^{2+} and O_3

D. Mn^{4+} and MnO_2

Answer:

Watch Video Solution

14. $H_2O_2 + O_3 \rightarrow H_2O_2 + 2O_2$

(II) $H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$

Role of hydrogen peroxide in the above reactions is respectively-

A. oxidising in (I) and reducing in (II)

B. reducing in (I) and oxidising in (II)

C. reducing in (I) and (II)

D. oxidising in (I) and (II)

Answer:

Watch Video Solution

15. Which of the following statement is false

A. hydrogen has three isotopes of which tritium is the most common

B. hydrogen never acts as cation in ionic salts

C. hydronium ion, $H_3O^{\oplus}$ exists freely in solution

D. dihydrogen does not act as a reducing agent

Answer:

Watch Video Solution

16. In ice, oxygen atom is surrounded-

A. tetrahedrally by 4 hydrogen atoms

B. octahedrally by 2 oxygen and 4 hydrogen atoms

C. tetrahedrally by 2 hydrogen 2 oxygen atoms

D. octahedrally by 6 hydrogen atoms.

Answer:

Watch Video Solution

17. Predict the product of reaction of I_2 with H_2O_2 in basic medium-

A. I^-

B. I_2O_3

C. IO_3^-

D. I_3^-

Answer: A

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18. Strength of H_2O_2 is 15.18 g $\cdot$ L^{-1}. They it equal to -

A. 1 volume

B. 10 volume

C. 5 volume

D. 7 volume

Answer:

Watch Video Solution

19. Which of the following reaction increases the production of dihydrogen from synthesis gas-

A. $CH_4(g) + H_2O(g) \xrightarrow[Ni]{1270K} CO(g) + H_2(g)$

B. $C(g) + H_2O(g) \xrightarrow{1270K} CO(g) + H_2(g)$

C. $CO(g) + H_2O(g) \xrightarrow[\text{Catalyst}]{673K} CO_2(g) + H_2(g)$

D. $C_2H_6(g) + 2H_2O(g) \xrightarrow[Ni]{1270K} 2CO + 5H_2$

Answer:

Watch Video Solution

20. Which of the following reactions produces hydrogen-

A. Mg + H_2O

B. $H_2S_2O_8 + H_2O$

C. $BaO_2 +$ HCl

D. $Na_2O_2 +$ 2 HCl

Answer:

Watch Video Solution

21. H_2O_2 can be obtained when following reacts with H_2SO_4 except with-

A. $\mathrm{BaO_2}$

B. $\mathrm{PbO_2}$

C. Na_2O_2

D. $\mathrm{SrO_2}$

Answer:

Watch Video Solution

Mcq Hotspot Single Correct Type

1. At absolute zero-

A. only para-hydrogen exists

B. only ortho-hydrogen exists

C. both ortho-and para-hydrogen exist.

D. neither para-nor ortho-hydrogen exists

Answer: A

Watch Video Solution

2. In which of the following reaction dihydrogen acts as an oxidising agent-

A. $F_2 + H_2 \rightarrow$ 2HF

B. $Cl_2 + H_2 \rightarrow$ 2HCl

C. $N_2 + 3H_2 \rightarrow 2NH_3$

D. $2Na + H_2 \rightarrow 2NaH$

Answer: D

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3. Which of the following halogens has least affinity towards hydrogen-

A. I_2

B. Cl_2

C. Br_2

D. F_2

Answer: A

Watch Video Solution

4. Which of the following compounds on electrolysis produces hydrogen-

A. dil. H_2SO_4

B. dil. Solution of NaOH

C. $Ba(OH)_2$ solution

D. KOH solution

Answer: C

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5. Thermal stability of Gr.-15 hydrides follows the order-

A. $AsH_3 > PH_3 > NH_3 > SbH_3 > BiH_3$

B. $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

C. $NH_3 > AsH_3 > PH_3 > SbH_3 > BiH_3$

D. $BiH_3 > SbH_3 > AsH_3 > PH_3 > NH_3$

Answer: B

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6. The correct order of vaporisation enthalpy of the following hydride is-

A. $NH_3 < PH_3 < AsH_3$

B. $AsH_3 < PH_3 < NH_3$

C. $PH_3 < AsH_3 < NH_3$

D. $NH_3 < AsH_3 < PH_3$

Answer: C

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7. Interstitial hydrides are formed by-

A. s-block elements

B. p-block elements

C. d-block elements

D. intert gas elements

Answer: C

Watch Video Solution

8. The correct descending order of thermal stability of alkali metals hydrides is -

A. LiH $>$ NaH $>$ KH $>$ RbH $>$ CsH

B. CsH $>$ RbH $>$ KH $>$ NaH $>$ LiH

C. NaH $>$ KH $>$ LiH $>$ CsH $>$ RbH

D. CsH $>$ LiH $>$ KH $>$ NaH $>$ RbH

Answer: A

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9. Solubility of NaCl in the solvents H_2O and D_2O is -

A. equal in both

B. more in D_2O

C. more in H_2O

D. only in H_2O

Answer: C

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10. Degree of hardness of 1L sample water containing 0.002 mol $MgSO_4$ is -

A. 20 ppm

B. 200ppm

C. 2000ppm

D. 120 ppm

Answer: B

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11. Which of the following reacts with water to produce electron-precise hydrides-

A. Ca_3P_2

B. Al_4C_3

C. Mg_3N_2

D. none of these

Answer: B

Watch Video Solution

12. Which of following couples reacts with water to produce same gaseouse product-

A. K and KO_2

B. Ca and CaH_2

C. Na and Na_2O_2

D. Ba and BaO_2

Answer: B

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13. Which of the following compounds contain free hydrogen-

A. water

B. marsh gas

C. water gas

D. acid

Answer: C

Watch Video Solution

14. Which of the followings reacts with metallic sodium to produce hydrogen-

A. CH_4

B. C_2H_6

C. C_2H_4

D. C_2H_2

Answer: D

Watch Video Solution

15. Semi-water gas is-

A. CO + $H_2 + N_2$

B. $H_2 + CH_4$

C. CO + $H_2 + O_2$

D. CO + H_2

Answer: A

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16. Which of the following metals does not react with cold water but liberates H_2 gas with steam water-

A. Na

B. K

C. Ca

D. Fe

Answer: D

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17. Volume of '10 volume' H_2O_2 required to convert 0.01 mol PbS into $PbSO_4$ is -

A. 11.2 mL

B. 22.4 mL

C. 33.6 mL

D. 44.8 mL

Answer: D

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18. On dilution of H_2O_2 the value of dielectric constant-

A. increases

B. remains same

C. decreases

D. none of these

Answer: A

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19. By which of the following water gets oxidised to oxygen-

A. ClO_2

B. $KMnO_4$

C. H_2O_2

D. F_2

Answer: D

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20. Which of the following does not get oxidised by H_2O_2 -

A. Na_2SO_3

B. PbS

C. KI

D. O_3

Answer: D

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21. Temperature at which the density of D_2O is maximum is-

A. $9^\circ C$

B. $11.5^\circ C$

C. $15.9^\circ C$

D. $20^\circ C$

Answer: B

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22. Which of the followings undergoes disproportionation reaction with water-

A. SO_3

B. F_2

C. Cl_2

D. N_2

Answer: C

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23. The non-inflammable hydride is -

A. NH_3

B. PH_3

C. AsH_3

D. SbH_3

Answer: A

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24. Triple point of water is -

A. 203K

B. 193K

C. 273K

D. 373K

Answer: C

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25. The process by which hydrogen is prepared by the reaction of silicon, iron alloy and NaOH is-

A. Wood process

B. Haber's process

C. Silicol process

D. Bosch process

Answer: C

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26. An element reacts with hydrogen to form a compound A, which of reaction with water liberates hydrogen again. The element is -

A. Cl

B. Ca

C. Se

D. N_2

Answer: B

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27. Only one element of which of the following groups forms metal hydride-

A. Gr-6

B. Gr-7

C. Gr-8

D. Gr-9

Answer: A

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28. Acidic solution of which of the following turns orange in presence of H_2O_2-

A. BaO_2

B. Na_2O_2

C. TiO_2

D. PbO_2

Answer: C

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29. In the following reaction the isotopic oxygens-

2Mn

$$O_4^- + 3H_2O_2^{18} \rightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$$

A. both get converted into O_2

B. both get converted into OH^-

C. both get converted into MnO_2

D. one of them gets converted to O_2, another to MnO_2

Answer: A

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30. X on electrolysis produces Y which on vaccume distillation produces H_2O_2. The numbers of peroxo linkage present in X and Y are-

A. 1,1

B. 1,2

C. 0,1

D. 0,0

Answer: C

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31. The compound which on electrolysis in its molten or liquid state liberates hydrogen at anode is -

A. NaOH

B. CaH_2

C. HCl

D. H_2O

Answer: B

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32. Which of the following couples exhibit the maximum isotope effect-

A. ${}_{1}^{1}H, {}_{1}^{2}D$

B. ${}_{8}^{16}O, {}_{8}^{18}O$

C. ${}_{17}^{35}Cl, {}_{17}^{37}Cl$

D. ${}_{6}^{12}C, {}_{6}^{14}C$

Answer: A

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33. Which of the following emits by tritium-

A. Neutron

B. γ-ray

C. β-particle

D. α-particle

Answer: C

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34. Oxidation of benzene by H_2O_2 in presence of ferrous sulphate produces-

A. phenol

B. cyclohexane

C. anisole

D. benzaldehyde

Answer: A

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35. The oxidation state of Cr in the product obtained by the reduction of $K_2Cr_2O_7$ by atomic hydrogen is-

A. $+6$

B. $+2$

C. 0

D. $+3$

Answer: D

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36. Which of the following does not get reduced by H_2 in its aquous solution-

A. Cu^{2+}

B. Fe^{3+}

C. Zn^{2+}

D. Ag^{+}

Answer: C

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37. Which of the following compounds has similar odour as that of H_2O_2 -

A. caustic soda

B. chloroform

C. alcohol

D. nitric acid

Answer: D

Watch Video Solution

38. Which of the following compounds reacts with atomic hydrogen to from formaldehyde-

A. CO

B. CO_2

C. CH_4

D. C_2H_2

Answer: A

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39. Which of the following isotopes of hydrogen is the most reactive-

A. ${}_{1}^{1}H$

B. ${}_{1}^{2}H$

C. ${}_{1}^{3}H$

D. all the isotopes are equally reactive

Answer: A

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40. When equal amounts of Zn is allowed to react seperately with excess H_2SO_4 and excess NaOH,then ratio of the volumes of hydrogen produced for the first and the second case respectively is -

A. $1:2$

B. $2:1$

C. $4:9$

D. $1:1$

Answer: D

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41. Which of the following hydrides of s-block elements have polymeric structure-

A. LiH

B. BeH_2

C. NaH

D. MgH_2

Answer: B::D

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42. Which of the following statement are true-

A. if Z = 15, the element forms covalent hydride

B. if Z=23, the element forms ionic hydride

C. if Z=19,the element forms ionic hydride

D. if Z=44, the element forms metalic hydride

Answer: A::C

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43. Which of the following hydrides are polynuclear hydrides-

A. NaH

B. C_3H_8

C. N_2H_4

D. HF

Answer: B::C

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44. Which of the following statements are correct-

A. metalic hydrides are hydrogen deficient

B. metalic hydrides are conductors of heat and electricity

C. ionic hydrides in their solid state do not conduct electricity

D. ionic hydrides on electrolysis in their molten state produce H_2 at cathode.

Answer: A::B::C

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45. Which of the following ions get exchanged with Na^+ ion of zeolite when zeolite is added to the hard water-

A. H^+ ion

B. Ca^{2+} ion

C. SO_4^{2-}

D. Mg^{2+} ion

Answer: B::D

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46. Which of the following reactions are deuterolysis-

A. $2Na + 2D_2O \rightarrow 2NaOD + D_2$

B. $AlCl_3 + 3D_2O \rightarrow Al(OD)_3 + 3DCl$

C. $Ca + 2D_2O \rightarrow Ca(OD)_2 + D_2$

D. $Fe_2(SO_4)_3 + 6D_2O \rightarrow 2Fe(OD)_3 + 3D_2SO_4$

Answer: B::D

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47. Which of the following reactions are redox reactions -

A. $H_2O + SO_2 \rightarrow H_2SO_3$

B. CaO + $H_2O \rightarrow \mathrm{Ca(OH)_2}$

C. 2Na + $2H_2O \rightarrow 2\mathrm{NaOH} + H_2$

D. $2F_2 + 2H_2O \rightarrow O_2 + 4HF$

Answer: C::D

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48. In which of the following reactions H_2O_2 acts as a reductant-

A. $C_6H_6H_2O_2 \rightarrow C_6H_5OH + H_2O$

B. PbS + $4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

C. NaOBr + $H_2O_2 \rightarrow NaBr + H_2O + O_2$

D.

$$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$$

Answer: C::D

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49. Which of the following properties are same for a metal and its hydride-

A. hardness

B. metallic lustre

C. electrical conductance

D. magnetic property

Answer: A::B::C::D

View Text Solution

50. The correct orders are-

A. $H_2 < D_2 < T_2$: boiling point

B. $H_2 < D_2 < T_2$: freezing point

C. $H_2 < D_2 < T_2$: latent heat of vaporisation

D. $T_2O < H_2O < D_2O$: dissociation constant

Answer: A::B::C

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51. Which of the following react with zinc to produce hydrogen gas-

A. dil.HCl

B. hot NaOH solution

C. cold water

D. conc. H_2SO_4

Answer: A::B::C

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52. Which of the following properties have greater magnitude in D_2O then of in H_2O-

A. Viscosity

B. Surface tension

C. dielectric constant

D. latent heat of vaporisation

Answer: A::D

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53. Which of the following metal hydrides get reduced by hydrogen -

A. CuO

B. Pb_3O_4

C. Na_2O_2

D. MgO

Answer: A::B

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54. Multimolecular covalent hydrides of s-block are-

A. LiH

B. BeH_2

C. NaH

D. MgH_2

Answer: B::D

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55. The oxidation numbers of the most electronegative element in the product obtained due to the reaction between BaO_2 and dil. H_2SO_4 are-

A. -1

B. -2

C. 0

D. $+1$

Answer: A::B

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56. Which of the following compounds decreases the rate of decomposition of H_2O_2 -

A. $CO(NH_2)_2$

B. $PbNHCOCH_3$

C. MnO_2

D. $(COOH_2)$

Answer: A::B

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57. Which of the following produce H_2O_2 on hydrolysis-

A. pernitric acid

B. perchloric acid

C. perdisulphuric acid

D. Caro's acid

Answer: A::C::D

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58. Choose the correct statements-

A. concentration of 20 volume H_2O_2 solution is 60.7g.

L^{-1}

B. volume strength of 2(N)H_2O_2 solution is 15

C. volume strength of 2(N)H_2O_2 solution is 11.2

D. concentration of 20 volume H_2O_2 solution is 50.7g

$\cdot L^{-1}$

Answer: A::C

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59. Choose the correct alternative-

A. mixture of HCl and HClO is formed when chlorine reacts with cold water

B. arrange colour of $K_2Cr_2O_7$ solution turns blue when, it reacts with H_2O_2

C. under low pressure isopropyl alcohol reacts with small amount of H_2O_2 to produce formaldehyde

D. hydrolith produce black coloured product when it reacts with $\mathrm{PbSO_4}$

Answer: A::B::D

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60. Which of the following alternatives are not true-

A. correct order of reactivity of H_2 towards the halogens is : $Cl_2 > Br_2 > I_2 > F_2$

B. concentration of H_2O_2 used in rocket is 90%

C. H_2 gets more readily absorbed on the surface of pt-metal than D_2

D. conversion of atomic hydrogen into molecular hydrogen is an exothermic process

Answer: A::B::C

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Exercise Very Short Type Questions

1. Which is the lightest gas know?

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2. Which isotope of hydrogen is radioactive?

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3. Give examples of an ionic, a covalent and a metalic hydride.

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4. What is hydrolith?

Watch Video Solution

5. Name the two nuclear spin isomers of dihydrogen.

Watch Video Solution

6. Give example of an electron-deficient hydride in which three centre-two electron bonds are present.

Watch Video Solution

7. Which gaseous compound on treatment with dihydrogen produces methanol?

Watch Video Solution

8. How will you prove that a colourless liquid is water?

Watch Video Solution

9. What is the unit for expressing the degree of hardness of water?

Watch Video Solution

10. Write the names of two chemical substances which are used for removing dissolved oxygen from water meant for boiler.

Watch Video Solution

11. Why is heavy water used in atomic reactors?

Watch Video Solution

12. Name a solid and a liquid absorbent of water.

Watch Video Solution

13. Which chemical is commercially known as'perhydrol'?

Watch Video Solution

14. What is called'hyperol or artizone'?

Watch Video Solution

15. What is the volume strength of a molar solution of H_2O_2?

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16. Which organic reagent is used for the manufacture of H_2O_2 ?

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17. 10 volume of H_2O_2 = x(N)H_2O_2. What is the value of x?

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18. What are the ways in which water molecules are bonded to the anhydrous salt to form hydrates?

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Fill In The Blanks

1. The radioactive isotope of hydrogen is _____

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2. When NaH is electrolysed, _____ is obtained at the anode.

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3. Syngas is the mixture of hydrogen and _____

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4. para-hydrogen is _____ stable than ortho-hydrogen.

Watch Video Solution

5. The oxygen atom in the water molecule is _____ hybridised.

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6. H_2O undergoes electrolysis _____ than D_2O.

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7. Heavy water is used as a _____ in nuclear reactors.

Watch Video Solution

8. Temporary hardness is also known as _____ hardness.

Watch Video Solution

9. Rainwater is _____ water but sea water is _____ water.

Watch Video Solution

10. The reaction between $\mathrm{CaC_2}$ and D_2O forms _____.

Watch Video Solution

11. D_2O_2 can be prepared by electolysing _____by D_2O.

Watch Video Solution

12. H_2O_2 is slightly _____ acid than water.

Watch Video Solution

13. Decomposition of H_2O_2 is suppressed by _____.

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14. Boiling point of H_2O_2 is _____ than water.

Watch Video Solution

15. The mixture of _____ & H_2O_2 is known as Fenton's reagent.

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16. Volume strength of 1.5(N) H_2O_2 is ____.

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Short Type Questions

1. How can dihydrogen be obtained from nitric acid?

Watch Video Solution

2. Concentrated H_2SO_4 cannot be used for drying H_2 gas__ why?

Watch Video Solution

3. What do you mean by occlusion of hydrogen?

Watch Video Solution

4. What is atomic hydrogen torch? Explain its principle.

Watch Video Solution

5. What are non-stoichiometric hydrides ? Give examples.

Watch Video Solution

6. What do you understand by the term 'hydrogen economy'?

Watch Video Solution

7. What is syngas? What is syngas-shift reaction?

Watch Video Solution

8. Mention two reactions in which H_2 acts as a reducing agent and an oxidising agent respectively.

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9. Explain the meaning of the term 'hydride gap'.

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10. What type of hydrides can be formed by each of the following elements: Li, Zr, P , Hf, N, Ca ?

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11. What are the different types of bonds formed by hydrogen in its compounds.

Watch Video Solution

12. Describe any one industrial preparation of dihydrogen.

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13. Explain why ice floats on water.

Watch Video Solution

14. A fishy smell is obtained when F_2 is passed through water- why?

Watch Video Solution

15. Give example of a reaction in which H_2O acts oxidising agent.

Watch Video Solution

16. How can the hardness of water be expressed?

Watch Video Solution

17. Hard water cannot be used in boilers -why?

Watch Video Solution

18. It is necessary to use calculated amount of lime for the removal of temporary hardness of water by Clark's method-why?

Watch Video Solution

19. Explain why water is called'universal solvent'.

Watch Video Solution

20. What is heavy water? Why is it so called? How can it be prepared?

Watch Video Solution

21. Which one will readily undergo electrolysis? H_2O, D_2O .

Watch Video Solution

22. Explain the structure of the common form of ice.

Watch Video Solution

23. Describe some unusual properties of water.

Watch Video Solution

24. H_2O_2 has both oxidising and reducing properties-why?

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25. The boiling point of H_2O_2 is higher than that of H_2O - why?

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26. Water and hydrogen peroxide are kept in two separate bottles. How will you identify them?

Watch Video Solution

27. How does H_2O_2 display its bleaching property?

Watch Video Solution

28. In the preparation of H_2O_2, MnO_2 or PbO_2 cannot be used instead of BaO_2 - why?

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29. Why is H_2O_2 used to restore the original colour of oilpaintings?

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30. Explain why a solution of H_2O_2 cannot be stored in an ordinary glass bottle in the laboratory rack.

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31. What do you mean by 'x volume' H_2O_2solution?

Watch Video Solution

32. Explain why in the laboratory preparation of H_2O_2 :

It is better to use syrupy phosphoric acid instead of dilute sulphuric acid.

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33. How can H_2O_2 be preserved in the laboratory?

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34. What are the limitations of the process used for the laboratory preparation of hydrogen peroxide?

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Numerical Problems

1. 1L of a sample of hard water contains 1 mg $CaCl_2$ and 1 mg $MgCl_2$. Estimate the degree of hardness of this sample of water.

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2. Determine the strength of '30 volume' H_2O_2 in normality.

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3. Determine the volume (in litre) of O_2 obtained at STP when 0.1 litre of 2(M)H_2O_2 solution is decomposed.

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4. When 100 ml of a tube-well water is titrated using methyl orange as indicator, it requires 15 ml of 0.01 (N) HCl. Estimate the hardness. Of that sample of water.

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5. Calculate the amount of H_2O_2 present is 600 mL of 10 volume H_2O_2 solution.

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6. An excess of acidic KI solution is added to 25 mL of a H_2O_2 solution when iodine is liberated. 20 mL of 0.1 (N) sodium thio-sulphate solution is required to titrate the liberated iodine. Calculate the percentage strength, volume strength and strength in normality of the H_2O_2 solution.

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Practice Set 9

1. What is calgon?

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2. What is syngas?

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3. A sample of water containing KCL does not behave as hard water, but a sample of water containing $CaCl_2$ and $MgCl_2$ behaves as hard water - why ?

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4. Do you expect different product in solution when aluminium (III) choride and potassium chloride are treated separately with (1) normal water, (2) acidified water and (3) alkaline water? Write equation wherver necessary.

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5. Why does dihydrogen occur in diatomic form than in monoatomic form under normal condition.?

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