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HYDROGEN

EXERCISE– 1 : BASIC OBJECTIVE QUESTIONS

1. In what respect electronic configuration of hydrogen and halogens are similar ?

(a) Hydrogen and halogens have one electron in their outermost shell.

(b) Hydrogen and halogens have one electron less than the noble gas configuration.

(c) Hydrogen and halogens can lose one electrons to form positive ions.

(d) Hydrogen and halogens show noble gas configuration.

2. Which of the following properties of hydrogen is incorrect ?

(a) Like halogens, hydrogen exists as a diatomic gas

(b) Like halogens hydrogen exhibits-1 oxidation state in its compounds with metals.

(c) Like halogens, hydrogen is liberated at cathode

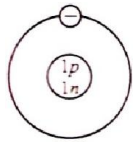
(d) The ionization energy of hydrogen is quite close to halogens.

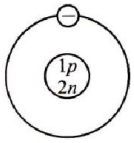
3. Which of the following is not an isotope of hydrogen?

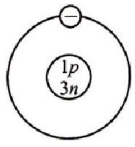
(a) Protium (b) Ortho-para hydrogen

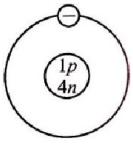
(c) Deuterium (d) Tritium

4. Which of the following is an atom of tritium ?

(a) 

(b) 

(c) 

(d) 

5. Which of the following metals will react with NaOH and KOH to liberate hydrogen gas ?

(a) Zn, A*l*, Fe and Mg

(b) A*l*, Fe, Mg and Sn

(c) Zn, Sn and A*l*

(d) Fe, Mg and A*l*

6. Which of the following is laboratory preparation of dihydrogen ?

(a) $3Fe + 4H_2O$ (steam) $\rightarrow Fe_3O_4 + 4H_2$

(b) $2Na + 2H_2O \rightarrow 2NaOH + H_2$

(c) $CaH_2 + 2H_2O \rightarrow Ca(OH)_2 + 2H_2$

(d) $Zn + H_2SO_4$ (dil.) $\rightarrow ZnSO_4 + H_2$

7. Which of the following metals does not liberate hydrogen from acids ?

(a) Fe (b) Cu

(c) Mg (d) Zn

8. A metal which does not react with cold water but reacts with steam to liberate H_2 gas is

(a) Na (b) Mg

(c) Au (d) Fe

9. Which of the following metals directly combine with hydrogen gas to give a hydride ?

(a) Au (b) Ni

(c) Ca (d) Cu

10. Which of the following is not a property of hydrogen?

(a) It is a colourless, odourless gas

(b) It is highly combustible.

(c) It is highly poisonous gas

(d) It is lighter than air.

11. Which property of hydrogen is shown by the following reactions ?

(i) $Fe_3O_4 + 4H_2 \rightarrow 3Fe + 4H_2O$

(ii) $CO + H_2 \xrightarrow[Cr_2O_3]{ZnO} CH_3OH$

(a) Reducing character

(b) Oxidising character

(c) Combustibility

(d) High reactivity

12. If a mole of hydrogen molecule is heated to a high temperature then following reaction which of the take place ?

(a) $H_{2(g)} + 436\ kJ\ mol^{-1} \rightarrow H_{(g)} + H_{(g)}$

(b) $2H_{2(g)} + 820\ kJ\ mol^{-1} \rightarrow 2H_{2(g)}$

(c) $H_{2(g)} + H_{2(g)} + 436\ kJ\ mol^{-1} \rightarrow H^{+}_{(aq)} + H^{-}_{(aq)}$

(d) $H_{2(g)} + 200\ kJ\ mol^{-1} \rightarrow H_{(g)} + H_{(g)}$

13. Match the column I with column II and mark the appropriate choice.

Column I		Column II	
(A)	NaH	(i)	Interstitial hydride
(B)	CH_4	(ii)	Molecular hydride
(C)	$VH_{0.56}$	(iii)	Ionic hydride
(D)	B_2H_6	(iv)	Electron-deficient hydride

(a) (A)→ (iii), (B)→ (iv), (C)→ (ii),(D)→ (i)

(b) (A)→ (ii), (B)→ (iv), (C)→ (iii),(D)→ (i)

(c) (A)→ (i), (B)→ (ii), (C)→ (iv),(D)→ (iii)

(d) (A)→ (iii), (B)→ (ii), (C)→ (i),(D)→ (iv)

14. What is the trend of boiling points of hydrides of N, O and F ?

(a) Due to lower molecular masses, NH_3, H_2O and HF have lower boiling points than those of the subsequent group member hydrides.

(b) Due to higher electronegativity of N, O and F; NH_3, H_2O and HF show hydrogen bonding and hence higher boiling points than the hydrides of their subsequent group members.

(c) There is no regular trend in the boiling points of hydrides.

(d) Due to higher oxidation states of N, O and F, the boiling points of NH_3, H_2O and HF are higher than the hydrides of their subsequent group members.

15. Phosphorus cannot form PH_5 with its outer electronic configuration as $3s^2$, $3p^3$ because

(a) phosphorus cannot show + 5 oxidation state

(b) PH_5 is not a stable compound.

(c) $\Delta_a H$ value of dihydrogen and Δ_{eg} H value of hydrogen do not favour higher oxidation state of phosphorus.

(d) phosphorus is not very reactive hence does not form PH_5.

16. Which of the following hydrides is electron deficient?

(a) NaH (b) CaH_2

(c) CH_4 (d) B_2H_6

17. On moving from left to right in a period what is the order of acidic character of hydrides ?

(a) $NH_3 < H_2O < HF$

(b) $HF < H_2O < NH_3$

(c) $H_2O < HF < NH_3$

(d) $H_2O < NH_3 < HF$

18. Non-stoichiometric hydrides are produced by

(a) palladium, vanadium (b) manganese, lithium

(c) nigrogen, fluorine (d) carbon, nickel

19. Which of the statements given below are true for the water molecule structure ?

(i) Oxygen undergoes sp^3 hybridisation.

(ii) Due to presence of two lone pairs of electrons on oxygen the H–O–H bonds angle is 118.4°.

(iii) Due to angular geometry the net dipole moment of water is not zero, $\mu = 1{,}84$ D.

(a) (i) and (ii) (b) (ii) and (iii)

(c) (i) and (iii) (d) only (ii)

20. The density of water is less in its solid state because

(a) in solid state (ice), water molecules are arranged in highly order open cage like structure.

(b) more extensive hydrogen bonding is present in solid state ice

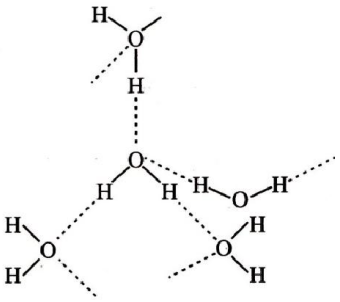
(c) the water molecules are closest in solid state of water.

(d) water in rigid crystalline, closely packed structure in its solid state.

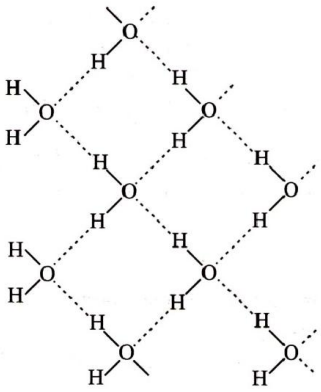
21. Choose the correct statement about the given figures.

(I)

(II)



(III)



(a) (II) represents solid state while (III) represents liquid state.

(b) (II) represents liquid state while (III) represents solid state.

(c) (I) represents solid state while (III) represents liquid state.

(d) (I) represents liquid state while (III) represents solid state.

22. Given below two reactions of water with sodium and carbon dioxide. What is the nature of water in these reactions ?

(i) $2Na + 2H_2O \rightarrow 2NaOH + H_2$

(ii) $6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$

(a) In (ii) water acts as an oxidizing agent while in (i) it acts as a reducing agent.

(b) In (i) water acts as an oxidizing agent while in (ii) it acts as a reducing agent.

(c) In both, (i) and (ii) hydrogen acts as a reducing agent.

(d) In both, (i) and (ii) hydrogen acts as an oxidizing agent.

23. Match the reaction of column I with their types given in column II and mark the appropriate choice.

Column I		Column II	
(A)	$H_2O + NH_3 \rightleftharpoons NH_4^+ + OH^-$	(i)	Self ionisation of H_2O
(B)	$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3 + 3HCl$	(ii)	Decomposition
(C)	$H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$	(iii)	Acidic nature of H_2O
(D)	$2H_2O \rightarrow 2H_2 + O_2$	(iv)	Hydrolysis

(a) (A) → (ii), (B) → (i), (C) → (iii), (A) → (iv)

(b) (A) → (iii), (B) → (ii), (C) → (iv), (A) → (i)

(c) (A) → (i), (B) → (ii), (C) → (iv), (A) → (iii)

(d) (A) → (iii), (B) → (iv), (C) → (i), (A) → (ii)

24. The temporary hardness of water due to calcium bicarbonate can be removed by adding

(a) $CaCO_3$ (b) $CaCl_2$

(c) HCl (d) $Ca(OH)_2$

25. A water sample is said to contain permanent hardness if water contains

(a) sulphates & chlorides of calcium and magnesium

(b) carbonates of calcium and magnesium

(c) bicarbonates of calcium and magnesium

(d) sulphates & chlorides of sodium and pottassium

26. In a permutit, the calcium and magnesium ions of hard water are exchanged by

(a) CO_3^{2-} and HCO_3^- ions of permutit

(b) Na^+ ions of permutit

(c) Al^{3+} ions of permutit

(d) Si^{4+} ions of permutit

27. Which of the following represents calgon ?

(a) $Na_2Al_2Si_2O_8$ (b) $Mg_3(PO_4)_2$

(c) $Na_2[Na_4(PO_3)_6]$ (d) $Na_2[Mg_2(PO_3)_6]$

28. Which of the following is not a disadvantage of using hard water ?

(a) In production of steam in boilers

(b) Formation of scales in cooking utensils

(c) In cooking, bathing and washing

(d) In ion exchangers

29. Liquid water is denser than ice due to

(a) higher surface tension (b) hydrogen bonding

(c) van der Waals forces (d) covalent bonding

30. The process used for the removal of hardness of water is

(a) Baeyer (b) Calgon

(c) Hoope (d) Serpeck

31. Presence of water can be detected by

(a) adding a drop to anhydrous copper sulphate which changes its colour from white to blue

(b) by boiling & testing for the presence of H_2& O_2

(c) by seeing its colour and transparency

(d) by checking the production of lather when mixed with soap.

32. Study the following reactions and mark the correct properties shown by water.

(i) $SO_3 + H_2O \rightarrow H_2SO_4$

(ii) $Cl_2O_7 + H_2O \rightarrow 2HClO_4$

(iii) $CaO + H_2O \rightarrow Ca(OH)_2$

(iv) $Na_2O + H_2O \rightarrow 2NaOH$

(a) All oxides react with water to give hydroxides

(b) Acidic oxides are formed by metals and basic oxides by non-metals.

(c) Non-metal oxides combine with water to form acids while metallic oxides combine with water to form alkalies.

(d) Acidic oxides are stronger than basic oxides since they form strong acids.

33. In which of the following reactions H_2O acts as a Bronsted acid ?

(a) $H_2O_{(l)} + NH_{3(aq)} \rightleftharpoons OH^-_{(aq)} + NH^+_{4(aq)}$

(b) $H_2O_{(l)} + H_2S_{(aq)} \rightleftharpoons H_3O^+_{(aq)} + HS^-_{(aq)}$

(c) $H_2O_{(l)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + OH^-_{(aq)}$

(d) $H^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons H_2O_{(l)}$

34. How many hydrogen bonded water molecules are associated with $CuSO_4.5H_2O$?

(a) Five (b) One

(c) Four (d) Three

35. During hydrate formation from aqueous solution, water can be associated in different forms. Indicate the wrong combination.

(i) Coordinated water – $[Cr(H_2O)_6]^{3+}\ 3Cl^-$

(ii) Interstitial water – $BaCl_2.2H_2O$

(iii) Hydrogen bonded water– $[Cu(H_2O)_4]^{2+}\ SO_4^{2-}.\ H_2O$

(a) (i) (b) (ii)

(c) (iii) (d) None of these

36. Which of the following reactions shows reduction of water ?

(a) $2H_2O + 2Na \rightarrow 2NaOH + H_2$

(b) $6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$

(c) $2F_2 + 2H_2O \rightarrow 4H^+ + 4F^- + O_2$

(d) $P_4O_{10} + 6H_2O \rightarrow 4H_3PO_2$

37. The formula for permutit or zeolite which is used as softner in ion-exchange method is

(a) $NaAlSiO_4$ (b) $NaAlO_2$

(c) $Ca_3(PO_4)_2$ (d) Na_2SO_4

38. Match the column I with column II and mark the appropriate choice.

Column I		Column II	
(A)	Syngas	(i)	$Na_6P_6O_{18}$
(B)	Calgon	(ii)	$NaAlSiO_4$
(C)	Permutit	(iii)	$CO + H_2$
(D)	Producer gas	(iv)	$CO + N_2$

(a) (A) → (i), (B) → (ii), (C) → (iii), (A) → (iv)

(b) (A) → (iii), (B) → (i), (C) → (ii), (A) → (iv)

(c) (A) → (iii), (B) → (ii), (C) → (iv), (A) → (i)

(d) (A) → (iii), (B) → (ii), (C) → (i), (A) → (iv)

39. Fluorine decomposes cold water to give

(a) $4H^+ + 4F^-$ and O_2 (b) HF and H_2

(c) HF only (d) H_2F_2 and HFO_4

40. Water plays a key role in the biosphere. It is due to certain properties of H_2O as compared to other liquids. These are except.

(a) higher specific heat

(b) lesser thermal conductivity

(c) high dielectric constant

(d) high surface tension.

41. Which is not a property of water ?

(a) It is a colourless and tasteless liquid

(b) There is no hydrogen bonding in solid state of water.

(c) It is an excellent solvent for transportation of ions in plants and animals.

(d) Frozen water is lighter than liquid water.

42. The maximum number of hydrogen bonds formed by a water molecule in ice is

(a) 4 (b) 1

(c) 2 (d) 3

43. Match the column I with column II and mark the appropriate choice.

Column I		Column II	
(A)	Clark's method	(i)	$Na_6P_6O_{18}$
(B)	Calgon's method	(ii)	$NaAlSiO_4$
(C)	Ion- exchange method	(iii)	RSO_3H
(D)	Synthetic resins method	(iv)	$Ca(OH)_2$

(a) (A) → (i), (B) → (iii), (C) → (iv), (A) → (ii)

(b) (A) → (ii), (B) → (iii), (C) → (iv), (A) → (i)

(c) (A) → (iii), (B) → (ii), (C) → (i), (A) → (iv)

(d) (A) → (iv), (B) → (i), (C) → (ii), (A) → (iii)

44. Which of the following act as a stabilizer for the storage of H_2O_2 ?

(a) Alakli (b) Dust

(c) Urea (d) None of these

45. Which of the following is not a process of preparation of hydrogen peroxide ?

(a) Auto-oxidation of 2-ethylanthraquinol

(b) By passing oxygen through boiling water

(c) By oxidation of isopropyl alcohol

(d) By reaction of barium peroxide with dil. H_2SO_4.

46. Which of the following represents the chemical equation involved in the preparation of H_2O_2 from barium peroxide ?

(a) $BaO_2.8H_2O + H_2SO_4 \rightarrow BaSO_4 + H_2O_2 + 8H_2O$

(b) $CH_3CHOHCH_3 + O_2 \rightarrow CH_3COCH_3 + H_2O_2$

(c) $BaO_2 + CO_2 + H_2O \rightarrow BaCO_3 + H_2O_2$

(d) $Ba_3(PO_4)_2 + 3H_2SO_4 \rightarrow 3BaSO_4 + 2H_3PO_4$

47. Which of the following reactions shows reducing nature of H_2O_2 ?

(a) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

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

(c) $2HCHO + H_2O_2 \rightarrow 2HCOOH + H_2O$

(d) $Na_2SO_3 + H_2O_2 \rightarrow Na_2SO_2 + H_2O$

48. What will be the strength of 20 vol of H_2O_2 in terms of gram per litre ?

(a) 60.71 g L^{-1} (b) 5.6g L^{-1}

(c) 30.62 g L^{-1} (d) 17g L^{-1}

49. Statues and paintings coated with white lead turn black on long exposure to atmosphere. The original colour can be restored by treating them with H_2O_2. The reason behind this

(a) blackened statues get coated with PbS which on reaction with H_2O_2 is oxidized to white $PbSO_2$.

(b) H_2O_2 dissolves the coating of white lead and exposes the inner surface.

(c) white lead reacts with H_2O_2 to form white $PbSO_4$

(d) Blackened statues get coated with lead sulphate which reacts with H_2O_2 to give PbS.

50. Which of the following reagents cannot be used for the preparation of hydrogen peroxide ?

(a) Sodium peroxide (b) 2-Ethylanthraquinol

(c) Sodium thiosulphate (d) Barium peroxide

51. Which of the following easily catalyse the decomposition of H_2O_2 when stored ?

(i) Rough surface (ii) Sunlight

(iii) Dust particles (iv) Metals

(a) (i) and (ii) (b) (i), (ii) and (iii)

(c) (ii) and (iii) (d) All of these

52. H_2O_2acts as a bleaching agent because of

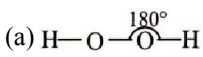
(a) reducing nature of H_2O_2

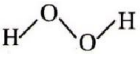
(b) oxidizing nature of H_2O_2

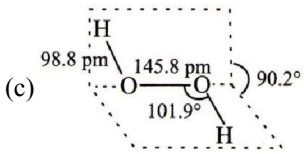
(c) acidic nature of H_2O_2

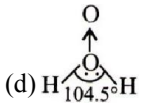
(d) basic nature of H_2O_2

53. Which of the following is a true structure of H_2O_2 in solid phase ?

(a) 

(b) 

(c) 

(d) 

54. What is heavy water ?

(a) H_2O^{18} (b) D_2O

(c) H_2O^{17} (d) H_2O

55. Which compound is formed when calcium carbide reacts with heavy water ?

(a) C_2D_2 (b) CaD_2

(c) CD_2 (d) Ca_2D_2

56. Heavy water is used as

(a) drinking water (b) detergent

(c) washing water (d) a moderator

57. Heavy water (D_2O) freezes at

(a) –3.8°C (b) 3.8°C

(c) 0°C (d) 38°C

58. Which of the following reactions is not used in preparation or deuterium compounds using heavy water ?

(a) $CaC_2 + 2D_2O \rightarrow C_2D_2 + Ca(OD)_2$

(b) $SO_3 + D_2O \rightarrow D_2SO_4$

(c) $2AIN + 3D_2O \rightarrow Al_2O_3 + 2ND$

(d) $Al_4C_3 + 12D_2O \rightarrow 3CD_4 + 4Al(OD)_3$

59. Some of the major uses of heavy water are given below. Which one is not correct ?

(a) It is used as a moderator in nuclear reactors.

(b) It is used as a tracer compound for studying reaction mechanism.

(c) High concentration of heavy water accelerates the growth of plants

(d) It is used in preparing deuterium.

EXERCISE– 2 : PREVIOUS YEAR JEE MAINS QUESTION

1. Which one of the following statements about water is FALSE?**(2016)**
(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 oxidized to oxygen during photosynthesis.

2. The molecular formula of a commercial resin used for exchanging ions in water softening is $C_8H_7SO_3Na$ (Mol. wt. 206). What would be the maximum uptake of Ca^{2+} ions by the resin when expressed in mole per gram resin?**(2015)**
(a) $\frac{2}{309}$ (b) $\frac{1}{412}$
(c) $\frac{1}{103}$ (d) $\frac{1}{206}$

3. Very pure hydrogen (99.9%) can be made by which of the following processes ? **(2012)**
(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.

4. In context with the industrial preparation of hydrogen from water gas (CO + H_2), which of the following is the correct statement ? **(2008)**
(a) CO is oxidized to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali.
(b) CO and H_2 are fractionally separated using differences in their densities.
(c) CO is removed by absorption in aqueous Cu_2Cl_2 solution.
(d) H_2 is removed through occlusion with Pd.

5. Which one of the following processes will produce hard water ?**(2007)**
(a) Saturation of water with $CaCO_3$.
(b) Saturation of water with $CaSO_4$.
(c) Saturation of water with $MgCO_3$.
(d) Addition of Na_2SO_4 to water.

JEE MAINS ONLINE QUESTION

1. Hydrogen peroxide acts both as an oxidising and as a reducing agent depending upon the nature of the reacting species. In which of the following cases H_2O_2 acts as a reducing agent in acid medium?
Online 2014 SET (3)
(a) KI (b) $Cr_2O_7^{2-}$
(c) SO_3^{2-} (d) MnO_4^-

2. Which physical property of dihydrogen is wrong ?
Online 2015 SET (1)
(a) Odourless gas (b) Tasteless gas
(c) Colourless gas
(d) Non-inflammable gas

3. Identify the incorrect statement regarding heavy water :**Online 2016 SET (1)**
(a) It reacts with Al_4C_3 to produce CD_4 and $Al(OD)_3$.
(b) It is used as a coolant in nuclear reactors.
(c) It reacts with CaC_2 to produce C_2D_2 and $Ca(OD)_2$.
(d) It reacts with SO_3 to form deuterated sulphuric acid (D_2SO_4).

4. Identify the reaction which does not liberate hydrogen :**Online 2016 SET (2)**
(a) Reaction of zinc with aqueous alkali.
(b) Electrolysis of acidified water using Pt electrodes
(c) Allowing a solution of sodium in liquid ammonia to stand.
(d) Reaction of lithium hydride with

5. In which of the following reactions, hydrogen peroxide acts as an oxidizing agent ?
Online 2017 SET (1)
(a) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$
(b) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$
(c) $+3H_2O_2 \rightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$
(d) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

6. The strength of 11.2 volume solution of H_2O_2 is : [Given that molar mass of H = 1 g mol^{-1} and O = 16 g mol^{-1}] **Online 2019 SET (2)**
(a) 3.4% (b) 1.7%
(c) 13.6% (d) 34%

EXERCISE– 3 : ADVANCED OBJECTIVE QUESTIONS

1. All questions marked **"S"** are single choice questions
2. All questions marked **"C"** are comprehension based questions
3. All questions marked **"A"** are assertion–reason type questions
   (A) If both assertion and reason are correct and reason is the correct explanation of assertion.
   (B) If both assertion and reason are true but reason is not the correct explanation of assertion.
   (C) If assertion is true but reason is false.
   (D) If reason is true but assertion is false.

1. (S) In which of the following properties hydrogen does not show similarity with alkali metals ?
(a) Electropositive character
(b) Reducing nature
(c) Electronic configuration (ns^1)
(d) Diatomic nature of molecule

2. (S) The isotopes of hydrogen have different physical properties due to difference in mass. They have almost same chemical properties with a difference in their rates of reactions which is mainly due to
(a) their different enthalpy of bond dissociation
(b) different electronic configurations
(c) different atomic masses
(d) different physical properties.

3. (S) A deuterium is
(a) an electron with a positive charge
(b) a nucleus having two protons
(c) a nucleus containing a neutron & two protons
(d) a nucleus containing a neutron & a proton

4. (S) Pure nascent hydrogen is best obtained by
(a) Na and C_2H_5OH (b) A*l* and NaOH
(c) Zn and dil. H_2SO_4 (d) All of these

5. (S) The process of production of syngas from sewage, saw- dust, scrap wood, etc. is quite common these days. The production of syngas from coal is called
(a) carbonisation (b) water gas shift
(c) coal gasification (d) synthesis gas shift.

6. (S) Syngas is a mixture of
(a) $CO_2 + H_2$ (b) $CO + H_2$
(c) $CO + CO_2$ (d) $CO + O_2$

7. (S) The production of dihydrogen obtained from coal gasification can be increased by reacting carbon monoxide of syngas mixture with steam in presence of a catalyst iron chromate. What is this process called ?
(a) Hydrogen reaction
(b) Water-gas shift reaction
(c) Coal-gas shift reaction
(d) Syn gasification

8. (S) Which of the following reactions of hydrogen with non-metals represents Haber's process ?
(a) $2H_2 + O_2 \xrightarrow{\text{heat}} 2H_2O;\ \Delta H = -285.9\,kJ\,mol^{-1}$
(b) $3H_2 + N_2 \xrightarrow[200\,atm]{673\,K,\,Fe} 2NH_3;\ \Delta H = -92.6\,kJ\,mol^{-1}$
(c) $H_2 + Cl_2 \xrightarrow{hv} 2HCl$
(d) $2H_2 + C \xrightarrow{1100^\circ C} CH_4$

9. (S) A metal (M) produces a gas (N) on reaction with alkalies like NaOH and KOH. Same gas is produced when the metals reacts with dilute sulphuric acid. Gas (N) reacts with another toxic gas (P) to form methanol at high temperature and pressure. (N) also reacts with metals like (Q) to form electrovalent hydrides. M, N, P and Q respectively are
(a) Zn, H_2, CO, Na
(b) Na, H_2, C*l*$_2$, Ca
(c) A*l*, H_2, H_2S, B
(d) Mg, H_2, NO_2, A*l*

10. (S) Alkenes combine with carbon monoxide and hydrogen in presence of octacarbonyldicobalt as catalyst under high temperature and pressure to form
(a) aldehydes which can further reduced to alcohols by hydrogen
(b) alkanes which are formed by addition of hydrogen.
(c) alcohols formed by reaction of CO & hydrogen
(d) ketones which can be further reduced to aldehydes by hydrogen.

11. (S) Hydrogen burns in air with a
(a) light bluish flame (b) yellow flame
(c) crimson red flame (d) green flame.

12. (S) Dihydrogen forms three types of hydrides. (i) hydrides are formed by alkali metals and alkaline earth metals. (ii) hydrides are formed by non-metals and (iii) hydrides are formed by d and *f*-block elements at elevated temperature. Complex metal hydrides such as (iv) and (v) are powerful reducing agents.

	(i)	(ii)	(iii)	(iv)	(v)
(a)	Covalent	Molecular	Saline	NaH	LiH
(b)	Molecular	Covalent	Ionic	$LiAlH_4$	CaH_2
(c)	Ionic	Covalent	Interstitial	$LiAlH_4$	$NaBH_4$
(d)	Covalent	Saline	Interstitial	$LiAlH_4$	$NaBH_4$

13. (S) Which of the following statements regarding hydridies is not correct ?

(a) Inoic hydrides are crystalline, non-volatitle and non-conducting in solid state.

(b) Electron-deficient hydrides act as Lewis acids or electron acceptors.

(c) Elements of group-13 form electron-deficient hydrides.

(d) Elements of group 15-17 form electron-precise hydrides.

14. (S) Form group 6 only one metal forms hydride. This metal is

(a) Mo (b) W

(c) Cr (d) Co

15. (S) Which of the following statements is correct regarding hydrogen ?

(a) Hydrogen shows +1 and -1 oxidation states.

(b) Hydrogen is never liberated at anode

(c) Hydrogen has same ionization enthalpy as that of alkali metal

(d) Hydrogen has same electronegativity as of halogens.

16. (S) Carbon hydride of the type, C_nH_{2n+2} do not act as Lewis acid or Lewis base. They behave as normal covalent hydrides because

(a) carbon hydrides are electron-rich hydrides

(b) carbon hydrides are electron-deficient hydrides

(c) carbon hydrides are electron-precise hydrides

(d) carbon hydrides are non-stoichiometric hydrides

17. (S) Among NH_3, H_2O, HF and H_2S which would have highest magnitude of hydrogen bonding ?

(a) HF due to maximum polarity

(b) H_2O due to lone pairs of electrons.

(c) NH_3 due to small size of nitrogen

(d) H_2S due to higher electron affinity of sulphur.

18. (S) Given below are the elements and the type of hydrides formed by them. Mark the incorrect match

(a) Phosphorus-Molecular hydride

(b) Potassium-Ionic hydride

(c) Vanadium-Interstitial hydride

(d) Nitrogen-Electron-deficient covalent hydride

19. (S) The H–O–H angle in water molecule is about

(a) 90° (b) 180°

(c) 102° (d) 105°

20. (S) What is the reaction given below called ?

$$H_2O_{(l)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + OH^-_{(aq)}$$

(a) Hydrolysis of water

(b) Hydration of water

(c) Disproportional of water

(d) Auto-protolysis of water

21. (S) Which gas is produced when calcium nitride (Ca_3N_2) is hydrolysed by water ?

(a) N_2 (b) NH_3

(c) H_2 (d) O_2

22. (S) What is meant by demineralised water ?

(a) Water free from cations and anions

(b) Water free from minerals dissolved in it

(c) Water free from impurities

(d) Water free from Na^+ and K^+ ions.

23. (S) Polyphosphates like sodium hexametaphosphate (calgon) are used as water softening agents because they

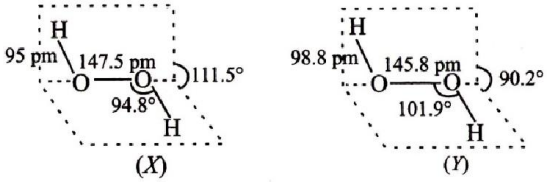
(a) forms soluble complexes with anionic species

(b) precipitate anionic species

(c) form soluble complexes with cationic species

(d) precipitate cationic species.

24. (S) Two structure of H_2O_2 and drawn below. Identify the phases X and Y of H_2O_2.



(a) (X) is the structure of H_2O_2 in gas phase and (Y) in solid phase

(b) (X) is the structure of H_2O_2 in solid phase and (Y) in gas phase

(c) (X) & (Y) are structures of H_2O_2 in gas phase

(d) (X) & (Y) are structures of H_2O_2 in solid phase

25. (S) Which of the following cannot be used as a test for H_2O_2 ?

(a) A paper dipped in PbS (black) turns white when brought in contact with H_2O_2.

(b) It liberates iodine from KI solution which gives blue colour with starch solution

(c) It gives blue colour with $K_4[Fe(CN)_6]$.

(d) It decolourises acidified $KMnO_4$ solution.

26. (S) Last traces of water is removed from H_2O_2 by

(a) electrolysis (b) crystallisation

(c) condensation (d) evaporation

27. (S) Which of the following statements regarding hydrogen peroxide is false ?

(a) It is a strong oxidizing agent

(b) It is decomposed by MnO_2

(c) It behave as a reducing agent

(d) It is more stable in basic solution.

28. (S) When CO_2 is bubbled through a solution of barium peroxide in water

(a) carbonic acid is formed

(b) H_2O_2 is formed

(c) H_2O is formed

(d) Barium hydroxide is formed.

29. (S) What will be the mass of oxygen liberated by decomposition of 200 mL hydrogen peroxide solution with a strength of 34 per litre ?

(a) 25.5 g (b) 3.0 g

(c) 3.2 g (d) 4.2 g

30. (S) The boiling point of heavy water is

(a) 100° C (b) 101.4° C

(c) 99° C (d) 110° C

31. (S) Heavy water is obtained by

(a) boiling water

(b) heating H_2O_2

(c) prolonged electrolysis ofH_2O

(d) All these.

32. (S) Water gas is mixed with steam and the mixture is passed over heated Fe_2O_3 in presence of Cr_2O_3. The mixture when passed in water dissolves CO_2 and dihydrogen left undissolved is collected. This method of preparation of hydrogen gas is known as

(a) Bosch process (b) Lane process

(c) Kellner (d) Hall process

33. (S) The order of reactivity of halogens towards hydrogen is

(a) $F_2>Cl_2>Br_2>I_2$ (b) $I_2>Br_2>Cl_2>F_2$

(c) $Cl_2>Br_2>I_2> F_2$ (d) $Br_2>Cl_2>F_2>I_2$

34.(S) In complex hydrides, hydride ions act as ligand and are coordinated to metal ions. These hydrides are good reducing agents. Which of the following hydrides is not complex hydride ?

(a) $LiAlH_4$ (b) $NaBH_4$

(c) $(AlH_3)_n$ (d) $LiBH_4$

35.(S) Hydrolysis of $SiCl_4$ gives

(a) $Si(OH)_4$ (b) $SiOCl_2$

(c) SiO_2 (d) H_2SiO_4

36.(S) A commercial sample of hydrogen peroxide is labeled as 10 volume. Its percentage strength is nearly

(a) 3% (b) 1%

(c) 90% (d) 10%

37.(S) What happens when an alkaline solution of potassium ferricyanide is reacted with H_2O_2 ?

(a) Potassium ferricyanide is oxidized to potassium ferrocyanide and H_2O_2 is oxidized

(b) Potassium ferricyanide becomes colourless and H_2O_2 is oxidised to O_2.

(c) Potassium ferricyanide is reduced to ferric hydroxide and H_2O_2 is oxidised to H_2O.

(d) Potassium ferricyanide is reduced to potassium ferrocyanide and H_2O_2 is oxidized to O_2

38.(S) Strength of 10 volume hydrogen peroxide solution means

(a) 30.35 g L^{-1} (b) 17 g L^{-1}

(c) 34 g L^{-1} (d) 68 g L^{-1}

39.(S) Peroxodisulphate, on hydrolysis yields

(a) water (b) dihydrogen

(c) hydrogen peroxide (d) deuterium

40.(S) Given below are the two reactions of H_2O_2. Mark the correct statement which follows.

(i) $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow$

$K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

(ii) $2Cr(OH)_3 + 4NaOH + 3H_2O_2 \rightarrow$

$2Na_2CrO_4 + 8H_2O$

(a) (i) Shows oxidizing nature of H_2O_2 and (ii) shows reducing nature of H_2O_2.

(b) In (i) H_2O_2 acts as a reducing agent and in (ii) it acts as an oxidizing agent.

(c) In both (i) & (ii), H_2O_2 acts as an oxidising agent.

(d) In both (i) & (ii), H_2O_2 acts as a reducing agent.

41.(S) Mark the following statements as true or false.

(i) Ordinary hydrogen is a mixture of 75% ortho and 25% para forms.

(ii) All the four atoms of molecule of H_2O_2 lie in the same plane.

(iii) Hydrogen peroxide is neutral like water.

(iv) H_2O_2 can be prepared from BaO_2 but not from MnO_2 and PbO_2.

(a) (i) and (iv) – true, (ii) and (iii) – false

(b) (i) and (ii) – true, (iii) and (iv) – false

(c) (iii) and (iv) – true, (i) and (ii) – false

(d) (i) and (iii) – true, (ii) and (iv) – false

EXERCISE–4 : PREVIOUS YEAR JEE ADVANCEDQUESTION

ONLY ONE OPTION CORRECT TYPE

1. The volume strength of 1.5 N H_2O_2 solution is **(1991)**

(a) 4.8 (b) 8.4

(c) 3.0 (d) 8.0

2. The oxide that gives hydrogen peroxide on treatment with a dilute acid is **(1985)**

(a) PbO_2 (b) Na_2O_2

(c) MnO_2 (d) TiO_2

3. Heavy water is **(1985)**

(a) $H_2{}^{18}O$

(b) water obtained by repeated distillation

(c) D_2O

(d) water at 4ºC

4. The temporary hardness of water due to calcium bicarbonate can be removed by adding **(1979)**

(a) $CaCO_3$ (b) $Ca(OH)_2$

(c) $CaCl_2$ (d) HCl

ONLY ONE OPTION CORRECT TYPE

5. The reagent(s) used for softening the temporary hardness of water is (are)**(2010)**

(a) $Ca_3(PO_4)_2$ (b) $Ca(OH)_2$

(c) Na_2CO_3 (d) NaOCl

6. The species that do not contain peroxide ions are **(1998)**

(a) PbO_2 (b) H_2O_2

(c) $Sr(O_2)_2$ (d) BaO_2

7. When zeolite, which is hydrated sodium aluminium silicate, is treated with hard water the sodium ions are exchanged with**(1990)**

(a) H^+ ions (b) Ca^{++} ions

(c) SO_4^{--} ions (d) Mg^{++} ions

ANSWER KEY

EXERCISE– 1 : BASIC OBJECTIVE QUESTIONS

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

EXERCISE– 2 : PREVIOUS YEARS JEE MAINS QUESTIONS

1.(b)	**2.** (b)	**3.**(b)	**4.** (a)	**5.** (c)

JEE Mains Online

1.(d)	**2.** (d)	**3.**(b)	**4.** (d)	**5.** (d)	**6.** (a)

EXERCISE– 3 : ADVANCED OBJECTIVE QUESTIONS

1. (d)	**2.** (a)	**3.** (d)	**4.** (d)	**5.** (c)	**6.** (b)	**7.** (b)	**8.** (b)	**9.** (a)	**10.** (a)
11. (a)	**12.** (c)	**13.** (d)	**14.** (c)	**15.** (a)	**16.** (c)	**17.** (a)	**18.** (d)	**19.** (d)	**20.** (d)
21. (b)	**22.** (a)	**23.** (c)	**24.** (a)	**25.** (c)	**26.** (b)	**27.** (d)	**28.** (b)	**29.** (c)	**30.** (b)
31. (c)	**32.** (a)	**33.** (a)	**34.** (c)	**35.** (c)	**36.** (d)	**37.** (d)	**38.** (a)	**39.** (c)	**40.** (b)
41. (a)									

EXERCISE– 4 : PREVIOUS YEAR JEE ADVANCED QUESTIONS

1.(b)	**2.** (b)	**3.** (c)	**4.** (b)	**5.** (b,c)	**6.** (a,c)	**7.** (b,d)