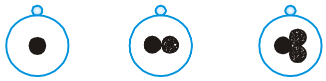
HINTS & SOLUTIONS

EXERCISE - 1
Single Choice

1. In electronegativity of hydrogen is in between metals and non metals so it behaves as both electro +ve and electro – ve. It can lose electron to form H^+ ion and it can also gain electron to form H^- ion.

2. Hydrogen has three isotopes and two isomers.



	Protium	Deuterium	Tritium
O Electron-	1	1	1
● Proton-	1	1	1
◎ Neutron-	Nil	1	2

(Isotopes of hydrogen)

Orthohydrogen Parahydrogen
(Isomers of hydrogen)

Ortho hydrogen-two protons in hydrogen molecule when spins in the same direction the form is termed as orthohydrogen, and when proton spins are in opposite direction the form is known as para hydrogen.

4. **(A)** $4Fe + 10HNO_3 \longrightarrow 4Fe(NO_3)_2 + NH_4NO_3 + 3H_2O$
very dil.
$4Fe + 10HNO_3 \longrightarrow 4Fe(NO_3)_2 + N_2O + 5H_2O$
dil.
(B) $Mn + 2HNO_3 \longrightarrow Mn(NO_3)_2 + H_2$
dil.
(C) $3Cu + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$
dil.
(D) $2Al + 8HNO_3 \longrightarrow 2Al(NO_3)_3 + 2NO + 4H_2O$

6. Hydrogen at the moment of formation is known as nascent hydrogen. It is believed that part of energy liberated in the reaction producing hydrogen become associated with hydrogen molecules and thus make them hyperactive.

8. Hydrogen and alkali metals are electropositive their electronegativity is very less i.e. H – 2.1, Li 1.0, Na 0.9, k = 0.8, Rb = 0.8

9. The number of possible diatomic molecules of three isotopes of hydrogen are six i.e.

1. H – H	4. D – D	H – Protium
2. H – D	5. D – T	D – Deuterium
3. H – T	6. T – T	T – Tritium

11. **(A)** $Cu + HCl \longrightarrow$ No reaction
(B) $3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2\uparrow$
steam magnetic oxide
(C) $Mg + 2H_2O \longrightarrow Mg(OH)_2 + H_2$
(D) $Na + C_2H_5OH \longrightarrow C_2H_5ONa + H$

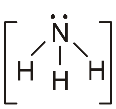
12. Hydrogen can act both as oxidising and reducing agent. It acts as oxidising agent when reacts with metal and form metal hydrides which are electrovalent compounds.
$2Na + H_2 \longrightarrow 2Na^+H^{\ominus}$ ∴
$Ca + H_2 \longrightarrow CaH_2$
Hydrogen also acts as reducing agent when its reacts with oxides
$PbO + H_2 \longrightarrow Pb + H_2O$
$CuO + H_2 \longrightarrow Cu + H_2O$
$Fe_3O_4 + H_2 \longrightarrow 3Fe + 4H_2O$

13. All properties of hydrogen do not resemble with that of alkali metals and halogens.

15. Ortho hydrogen is not the isotope of hydrogen but it is isomer of hydrogen.

16. Hydrogen can combine with other elements by losing, gaining and sharing of electrons
(i) Losing of electron : $H_2 + F_2 \longrightarrow 2H^+F^-$
(ii) Gaining of electrons : $2Na + H_2 \longrightarrow 2Na^+H^-$
(iii) Sharing of electrons :

$$N_2 + 3H_2 \xrightarrow[\text{500°C, High pressure}]{\text{Fe+MO}} 2NH_3$$



$$C + 2H_2 \xrightarrow{1200°C} CH_4$$

17. Ionisation energy of hydrogen is (1312 kJ mol^{-1}) which is too high than that of alkali metals and low than that of halogens.

18. Hydrogen accepts electron to form anion and get inert gas configuration like halogens.
$H + e^- \longrightarrow H^+$ (hydride ion)
$X + e^- \longrightarrow X^-$
halogen halide ion

21. Oxidation number fo hydrogen in hydrogen molecule and hydrogen atom is zero. Oxidation number of hydrogen in all compound containing hydrogen is + 1. except hydrides.
oxidation no. of hydrogen in hydrides is – 1.

22. $\underset{\text{1 mole}}{Zn} + \underset{\text{excess}}{H_2SO_4} \longrightarrow \underset{\text{1 mole}}{ZnSO_4} + H_2$

$\underset{\text{1 mole}}{Zn} + \underset{\text{excess}}{2NaOH} \longrightarrow \underset{\text{1 mole}}{Na_2ZnO_2} + H_2$

Ration of volume of hydrogen in both cases is 1 : 1.

23. In the reaction with calcium hydrogen acts as an oxidising agent.

$Ca + H_2 \longrightarrow CaH_2 \quad (Ca^{2+}\, 2H^-)$

24. $Zn + NaOH \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2\uparrow$

25. Hydrogen does not combine with helium.

26. Saline hydride means salt like hydride. Alkali metals and alkaline earth metals and some highly + ve members of lanthanide series can transfer electron easily to hydrogen atoms. Ex. NaH, KH, CaH_2 | (Si, B, and Al do not form salt like hydride).

27. Ti $H_{1.5-1.8}$ is a interstitial hydride.

28. In CaH_2 H has oxidation state (–1) [+ 2 + 2x = 0, x = – 1]

29. Transition elements like Ni, Pt, Pd adsorb hydrogen.

30. H_2S and HF are covalent hydrides H–S–H (bent), H – F.

32. $H^-_{(aq)} + H - OH_{(l)} \longrightarrow H_{2(g)} + \overset{\ominus}{O}H_{(aq)}$

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

33. Hydrogen is liberated at anode $2H^- \longrightarrow H_{2(g)} + 2e^-$

34. Temporary hardness of water is due to the presence of $Ca(HCO_3)_2$ and $Mg(HCO_3)_2$ in water

35. $Ca(OH)_2$ reacts with $Ca(HCO_3)_2$ to precipitate $CaCO_3$

$Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3\downarrow + 2H_2O$

$Mg(HCO_3)_2 + 2Ca(OH)_2 \longrightarrow 2CaCO_3\downarrow Mg(OH)_2\downarrow + 2H_2O$

37. Hard water contains soluble salts $CaCl_2$ $MgCl_2$, $CaSO_4$ $MgSO_4$ $Ca(HCO_3)_2Mg(HCO_3)_2$

38. Freezing point of heavy water is 3.8°C.

39. Slowing down the speed of high energy neutrons.

41. Heavy water contains heavy hydrogen (^2_1H), formula of heavy water is $^2_1H_2O$.

42. Hydrated silicates of Al and Na is called permutit $Na_2Al_2Si_2O_8 . xH_2O$

43. Cation exchange resin exchanges Ca^{2+}, Mg^{2+} ions from water, and water becomes soft.

44. Repeated electrolysis of 3% aqueous solution of NaOH.

45. Hard water passed through cation exchange resin which releases H^+ and then passed through anion exchanges resin which releases OH^-

$2RH_{(s)} + M^{2+}_{(aq)} \rightleftharpoons MR_{2(s)} + 2H^+_{(aq)}$. ... **(i)**

$[M^{2+} = Ca^{2+}/Mg^{2+}]$

$RNH_{2(s)} + H_2O_{(l)} \rightleftharpoons RNH^+_3 + OH^-_{(s)}$

$RNH^+_3 . OH^-_{(s)} + X^-_{(aq)} \rightleftharpoons RNH_3X^- + OH^-$ ... **(ii)**

$[X^- = Cl^-, HCO^-_3, SO^{2-}_4 \text{ etc.}]$

OH^- neutralise the H^+ released in the cation exchange in (eq i)

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

46. Hard water when passed through resin containing R–COOH groups it becomes free from Ca^+ ions.

49. Freezing point of D_2O and H_2O are 276.8 K and 273 K respectively.

50. Anhydrous CoCl (Blue) changes pink with water.

51. Ionic compounds are more soluble in soft water than heavy water. Soft water has high dielectric constant (78.39), while that of heavy water in 78.06. Due to higher polar character of solf water it is an excellent solvent for ionic compounds. Distillations ionic compounds takes place because of ion-dipole interactions solubility of covalent compounds is due to the formation of hydrogen bonds with water molecules.

52. Heavy water is composed of heavy hydrogen (Deuterium) and oxygen the formula of heavy water is $^2_1H_2O$ (D_2O).

53. $Na_2O_2 + 2HCl \longrightarrow 2NaCl + H_2O_2$

$Na_2O_2 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O_2$

55. H_2O_2 when oxidised in acidic or basic medium it produces O_2

$2MnO_4^- + 6H^+ + 5H_2O_2 \longrightarrow 2\,Mn^{2+} + 8H_2O + 5O_2$ (acidic medium)

$2MnO^-_4 + 3H_2O_2 \longrightarrow 2MnO_2 + 3O_2 + 2H_2O$ (basic medium)

56. Gaseous H_2O_2 has dihedral angle equal to 111.5°.

57. H_2O_2 acts as reducing agent and reduces $KMnO_4$ solution in acidic medium.

$2KMnO_4 + 6H^+ + 5H_2O_2 \longrightarrow 2K^+ + 2Mn^2 + 8H_2O + 5O_2$

58. In basic medium H_2O_2 oxidises $Cr_2(SO_4)_3$

$\underset{\text{Cr – Oxi. No. = + 3}}{2Cr^{3+}} + 10H^- + 3H_2O_2 \longrightarrow \underset{\text{Cr – Oxi. No. = + 6}}{2CrO^{2-}_4} + 8H_2O$

60. H_2O_2 slowly decomposes to give nascent oxygen, which decolourises the coloured substances

$H_2O_2 \longrightarrow H_2O + \underset{\text{nascent oxygen}}{[O]}$

Coloured substances + $\underset{\text{nascent oxygen}}{[O]}$ $\longrightarrow$ Colourless substance.

61. Fe^{2+} ion oxidises to Fe^{3+} ion by H_2O_2

$2Fe^{2+} + H_2O_2 + 2H^+ \longrightarrow 2Fe^{3+} + 2H_2O$

62. PbS reacts with H_2O_2 to give white $PbSO_4$

$\underset{\text{Black}}{PbS} + 4H_2O_2 \longrightarrow \underset{\text{White}}{PbSO_4} + 4H_2O$

63. 10 V means 3.035% H_2O_2, hence 20 V means 6.070% H_2O_2

64. 30 vol = 3.035 × 3 = 9.105% H_2O_2

100 ml sol contain 9.105 gms H_2O_2

Hence 1000 ml solution contain 91.05 gms H_2O_2

Strength of H_2O_2 = 91.05 gms /lit, basicity of H_2O_2 = 2

Equivalent wt of $H_2O_2 = \left(\frac{34}{2}\right) = 17$

Normality $= \frac{\text{Strength}}{\text{Eq. wt.}} = \frac{91.05}{17} = 5.3558 = 5.36$ **Ans.**

66. H_2O_2 acts as reducing aget in acidic medium

$H_2O_2 \longrightarrow 2H^+ + O_2 + 2e^-$

67. H_2O_2 can not be dried over conc. H_2SO_4 because it oxidises by H_2SO_4

$H_2SO_4 \longrightarrow H_2O + SO_2 + O$

$H_2O_2 + O \longrightarrow H_2O + O_2$

$H_2SO_4 + H_2O_2 \longrightarrow 2H_2O + SO_2 + O_2$

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68. Hydrogen peroxide can be used as an oxidant, reductant and an acid. It oxidise Fe^{2+} into Fe^{3+} slowly in acidic medium but in basic medium it oxides very fast.

$2Fe^{2+} + 2H^+_{(aq)} + H_2O_2 \longrightarrow 2Fe^{3+}_{(aq)} + 2H_2O_{(l)}$

(acidic medium) (SRP = + 1.77 V)

$2Fe^{2+} + H_2O_2 \longrightarrow 2Fe^{3+} + 2OH^-$

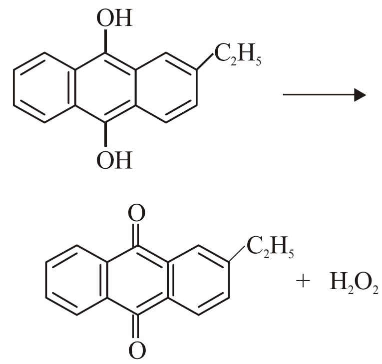
(basic medium) (SRP = + 0.87 V)

Hydrogen peroxide is also acidic in nature.

$H_2O_2 \rightleftharpoons H^+ + HO_2^-$ $Ka = 1.5 \times 10^{-12}$

$Na_2CO_3 + H_2O_2 \longrightarrow Na_2O_2 + H_2O + CO_2$

69. On industrial scale H_2O_2 is prepared by auto oxidation of 2-ethylanthraquinol.



2-ethyl anthru quinone

70. H_2O_2 can be used as antiseptic, bleaching agent and propellent.

EXERCISE - 2

Part # I : Multiple Choice

1. **(a)** Hydrogen has both oxidising and reducing property while halogen have oxidising property.

(b) Hydrogen has both the + ve and – ve nature while halogen have – ve nature only.

2. Metals react with hydrogen to form hydrides and thus oxidised

$Ca + H_2 \longrightarrow CaH_2$

$2Li + H_2 \longrightarrow 2LIH$

3. Hydrides of 3rd gp and 17th gp are good acids. Also HN_3 is a good hydride.

$B_2H_6 + 2NH_3 \longrightarrow 2[BH_3.NH_3]$.

7. 1. $Zn_{(s)} + H_2SO_{4(l)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}$.

2. $Zn_{(s)} + 2NaOH \longrightarrow Na_2ZnO_{2(aq)} + H_{2(g)}$

3. $Cu_{(s)} + 2H_2SO_4(conc.) \longrightarrow CuSO_{4aq)} + 2H_2O_{(l)} + SO_{2(g)}$

4. $2F_{2(g)} + 2H_2O_{(l)} \longrightarrow 4HF + O_2$

8. **(A)** $2MnO^-_4 + 6H^+ 5H_2O \longrightarrow 2Mn^{2+} + 8H_2O + 5O_2$

(reduction in acidic medium)

$2MnO_4 + 3H_2O_2 \longrightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$

(reduction in basic medium)

(B) $2Fe^{2+}_{(aq)} + 2H^+_{(aq)} + H_2O_2 \longrightarrow 2Fe^{3+}_{(aq)} + 2H_2O_{(l)}$

(oxidation in acidic medium)

$2Fe^{2+} + H_2O_2 \longrightarrow 2Fe^{3+} + 2OH^-$

(C) $Mn^{2+} + H_2O_2 \longrightarrow Mn^{4+} + 2OH^-$

(oxidation in basic medium)

(D) $2H_2O_2 + 2KI \longrightarrow 2KOH {}^{+}I_2 + 2H_2O$

(oxidation in acidic medium)

$I_2 + H_2O + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$

(reduction in basic medium)

14. A solution of $K_2Cr_2O_7$ in H_2SO_4 is oxidised to blue chromic acid by H_2O_2 and dissolve in ether to give blue coloured solution.

$$K_2Cr_2O_7 + H_2SO_4 \longrightarrow K_2SO_4 + H_2Cr_2O_7$$
$$H_2Cr_2O_7 + 4H_2O_2 \longrightarrow 2CrO_5 + 5H_2O$$

$$K_2Cr_2O_7 + H_2SO_4 + 4H_2O_2 \longrightarrow K_2SO_4 + 2CrO_5 + 5H_2O$$

Perchromic acid (blue)

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15. Hydrogen is non-metal while alkali metals have metallic character.

16. Tritium is radioactive.

17. Lattice energy of Al_2O_3 is very high so it require more energy to reduce, and giving high energy to hydrogen is explosive.

18. 5^{th} gp elements V, Nb, Ta forms interstitial hydrides with hydrogen 7, 8, 9 gps of periodic table do not form hydrides but they absorb hydrogen, and it is called absorption. This inability of 7, 8, 9 gps of periodic table is referred to as hydride gap of d-block.

19. H_2O is an electron rich hydride it contain unbonded two lone pairs of electrons.

20. 10 V = 3.035%
$\because$ 100 ml sol of H_2O_2 contain 3.035 gm
$\therefore$ 1000 ml sol of H_2O_2 contain 3.035 × 10 = 30.35 gm/lit.

21. H_2O_2 can not be concentrated by simple distillation because it decompose at its boiling point. It is concentrated under reduced pressure.

22. Aqueous solution of hydrogen peroxide is weakly acidic

$$H_2O_{2(aq)} \rightleftharpoons H^{\oplus} + HO_2^{\ominus} \quad K_a = 1.5 \times 10^{-12} \quad \text{at } 25°C$$

30% solution of H_2O_2 has pH = 4.

23. Heavy water is used as moderator in nuclear reactors.

24. Lime water $[Ca(OH)_2]$ is used to remove the temporary hardness of water. $Ca(OH)_2$ reacts with bicarbonates of Ca and Mg to form insoluble carbonate.

$$Ca(HCO_3)_{2(aq)} + Ca(OH)_2 \longrightarrow 2CaCO_3\downarrow + 2H_2O$$

$$Mg(HCO_3)_2 + Ca(OH)_2 \longrightarrow CaCO_3\downarrow + MgCO_3\downarrow + 2H_2O$$

26. Due to hydrogen bonding interactions water molecules are associated together so water has high density than ice.

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

32. Water gas is the mixture of $[CO + H_2]$

33. $2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$
(A) **(C)** **(B)**

$Zn_{(s)} + 2NaOH_{(aq)} \rightarrow Na_2ZnO_2 + H_2$ **(B)**
(D)

$Zn_{(s)} + H_2SO_{4(aq)} \xrightarrow{\text{Room temperature}} ZnSO_{4(aq)} + H_2$**(B)**,
(D)

$Na \xrightarrow{\text{Burn on nonluminous flame}}$ Golden yellow flame.

34. Copper does not reacts with dil HCl.

36. Oxidation No. of Pb in PbO_2 in + 4 while that is in PbO is + 2 hence PbO_2 reduced to PbO by H_2O_2

39. $2Na + 2H_2O \rightarrow 2NaOH + H_2$, $Mg + H_2O \rightarrow MgO + H_2$, $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

40. Due to dipole-dipole interaction ice has cage like structure with a number of vacant spaces in the crystal latice so the density of ice is lower than water.

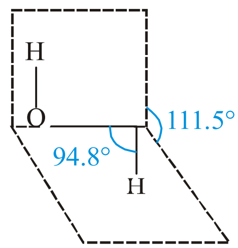
43. 10 Vol. H_2O_2 = 3.035 gm H_2O_2

$$\therefore 11.2 \text{ Vol } H_2O_2 = \frac{3.035 \times 11.2}{10} = 33.99 \text{ g},$$

$$\text{molarity} = \frac{\text{strength}}{\text{mole wt}} = \frac{33.99}{34} = 1\text{ M}$$

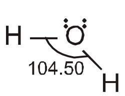
44. Ortho and para hydrogens are isomers of hydrogen.

46. Both ^{-}OH bonds in H_2O_2 do not lie in the same plane.



48. Water gas contains CO and H_2 in the ratio about. 4 : 5

49. High electron density on small N atom repel lone pair, making it more available for protonation. From P to Bi size of atom increases and so lone pair becomes less available for protonation.

50. 

51. $M_{MgSO_4} = 120$, $120 \text{ gms } MgSO_4 = 100 \text{ gms } CaCO_3$

$0.24 \text{ gms } MgSO_4 = \frac{100}{120} \times .24$

$= \frac{2}{10} = .2 \text{ gms}$

Again $\because$ 10^3 parts water $= .2$ gm $MgSO_4$

$\therefore$ $10^6 = \frac{.2}{10^3} \times 10^6 = .2 \times 1000$

$= 200$ ppm.

52. $K_2Cr_2O_7 + H_2SO_4 + 4H_2O_2 \rightarrow 2CrO_5 + K_2SO_4 + 5H_2O$
Blue

53. Enthalpy of vaporisation

	PH_3	<	AsH_3	<	NH_3
b.b(k)	185.5		210.6		238.5

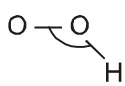
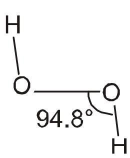
54. $2Fe[(CN)_6]^{3-}_{(s)} + H_2O_{2(l)} + 2OH^-_{(aq)} \rightarrow 2Fe[(CN)_6]^{4-}_{(aq)} + 2H_2O_{(l)} + O_{2(g)}$ $(Fe^{3+} \rightarrow Fe^{2+})$ and

$Mn^{2+} + H_2O_2 \rightarrow Mn^{4+} + 2OH^-$

55. Silver does not reacts with dil or conc HCl.

57. $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$
.01 mole 34×4 303 gms
2.39 gms 136 gms
2.39 gms PbS require 136 gms of H_2O_2
We know 10 V $H_2O_2 = 3.035$ gms of H_2O_2
Hence 3.035 gms $H_2O_2 = 1$ ml of 10 vol

$136 \text{ gms } H_2O_2 = \frac{1}{3.035} \times 136$ ml $= 44.8$ ml. Ans.

59. S_2 :  angle is 94.8° in gas phase. 

60. S_1 : Tritium liberate β-radiations

$^3_1T \rightarrow ^3_2He + ^0_{-1}e$

61. S_1 : $CaH_2(melt) \longrightarrow Ca^{2+}(melt) + 2H^-(melt)$.

At anode $\longrightarrow 2H^- \longrightarrow H_2 + 2e^-$

At cathode $\longrightarrow Ca^{2+} + 2e^- \longrightarrow Ca$

S_3 : $D_2O = 41.61 \text{ kJ mol}^{-1}$

$H_2O = 40.66 \text{ kJ mol}^{-1}$

62. S_3 : Form soluble complex which do not cause hindrance in the formation of lather.

Part # II : Assertion & Reason

1. NaH is crystalline hydride, it liberate H_2 at anode when electric current is passed through molten NaH

at anode $2H^- \rightarrow H_2 + 2e^-$

at cathode $2Na^+ + 2e^- \rightarrow 2Na$

3. D_2 - 443.35 kJ mol⁻ and H_2 - 435.88 kJ mol^{-1}.

4. $\dot{\ddot{N}}H$ is electron rich hydride. NH_3 contain one lone pair of electron on nitrogen.

5. $H_2 + CO_{(g)} + H_2O_{(g)} \xrightarrow[\text{Catalyst}]{673k} CO_{2(g)} + 2H_{2(g)}$

7. $2CaSO_4 + Na_2[Na_4(PO_3)_6] \rightarrow Na_2[Ca_2(PO_3)_6] + 2Na_2SO_4$

$2MgSO_4 + Na_2[Na_4(PO_3)_6] \rightarrow [Mg_2(PO_3)_6] + 2Na_2SO_4$

Complex salts

9. The bleaching action of H_2O_2 is due to oxidation

(i) $H_2O_2 \rightarrow H_2O + [O]$

(ii) coloured substance + [O] → colourless substance.

12. Demineralised water is free from Ca^{2+} and Mg^{2+} ions. Permutit exchange sodium ions with Ca^{2+} and mg^{2+} ions, to give soft water.

$Na_2Al_2Si_2O_8.xH_2O + M^2 \longrightarrow MAl_2Si_2O_8.xH_2O + 2Na$ $[M^{2+} = Ca^{2+}/Mg^{2+}]$

EXERCISE - 3

Part # I : Matrix Match Type

2. $H_2(g) + CO(g) + H_2O(g) \xrightarrow[673 K]{FeCrO_4} 2H_2(g) + CO_2(g)$

Part # II : Comprehension

Comprehension # 1 :

Sol (1 to 2)

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

$CO + H_2 + H_2O \xrightarrow[673 K]{FeCrO_4} H_2 + CO_2$
(B) (A) (A) (C)

3. Interstitial hydrides are non-stochiometric hydrides and thus deficient in hydrogen. Transition and innertransition elements at elevated temp. absorb hydrogen into the interstices of their lattices to yield metal like hydrides.

EXERCISE - 4

Part # I : AIEEE/JEE-MAIN

1. $[CO + H_2]_{(g)} + H_2O_{(g)} \xrightarrow[\text{Catalyst}]{673k} CO_{2(g)} + 2H_{2(g)}$,

$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$

2. A reducing agent loses electrons during redox reaction Hence (b, d) is correct.

3. hydrogen bond is dipole-dipole intraction

4. It acts as oxidizing as well as reducing agent.

5. Intra molecular H bond is not present

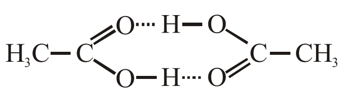
6. Nitrate

Part # II : IIT-JEE ADVANCED

1. Ice is less dense than water due to open crystal structure because of H-bonding.

The basicity of 1° amines is more than 3° amines as after they donate lone pair to H^+, they can form H– bonding with H_2O molecules and get easily stabilized by solvation. Where as in tertiary amines, the stabilization by solvation is very less.

The dimerisation of acetic acid in benzene is due to H-bonding.



Hence ans is : A, B, D

2. $Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$

MOCK TEST

1. In electronegativity of hydrogen is in between metals and non metals so it behaves as both electro +ve and electro – ve. It can lose electron to form H^+ ion and it can also gain electron to form H^- ion.

2. **(A)** $Cu + HCl \longrightarrow$ No reaction

(B) $3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2\uparrow$
steam — magnetic oxide

(C) $Mg + 2H_2O \longrightarrow Mg(OH)_2 + H_2$

(D) $Na + C_2H_5OH \longrightarrow C_2H_5ONa + H$

4. Ionisation energy of hydrogen is (1312 kJ mol^{-1}) which is too high than that of alkali metals and low than that of halogens.

5. Hydrogen accepts electron to form anion and get inert gas configuration like halogens.

$H + e^- \longrightarrow H^+$ (hydride ion)

$X + e^- \longrightarrow X^-$

halogen — halide ion

6. Ti $H_{1.5-1.8}$ is a interstitial hydride.

7. Hydrogen does not combine with helium.

8. $H^-_{(aq)} + H - OH_{(l)} \longrightarrow H_{2(g)} + \overset{\ominus}{O}H_{(aq)}$

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

9. Cation exchange resin exchanges Ca^{2+}, Mg^{2+} ions from water, and water becomes soft.

10. Hydrated silicates of Al and Na is called permutit $Na_2Al_2Si_2O_8 . xH_2O$

11. H_2O_2 when oxidised in acidic or basic medium it produces O_2

$2MnO_4^- + 6H^+ + 5H_2O_2 \longrightarrow 2Mn^{2+} + 8H_2O + 5O_2$ (acidic medium)

$2MnO^-_4 + 3H_2O_2 \longrightarrow 2MnO_2 + 3O_2 + 2H_2O$ (basic medium)

12. Gaseous H_2O_2 has dihedral angle equal to 111.5°.

13. Fe^{2+} ion oxidises to Fe^{3+} ion by H_2O_2

$2Fe^{2+} + H_2O_2 + 2H^+ \longrightarrow 2Fe^{3+} + 2H_2O$

15. H_2O_2 acts as reducing aget in acidic medium

$H_2O_2 \longrightarrow 2H^+ + O_2 + 2e^-$

16. H_2O_2 can be used as antiseptic, bleaching agent and propellent.

20. NaH is crystalline hydride, it liberate H_2 at anode when electric current is passed through molten NaH

at anode $2H^- \rightarrow H_2 + 2e^-$

at cathode $2Na^+ + 2e^- \rightarrow 2Na$

22. $2CaSO_4 + Na_2[Na_4(PO_3)_6] \rightarrow Na_2[Ca_2(PO_3)_6] + 2Na_2SO_4$

$2MgSO_4 + Na_2[Na_4(PO_3)_6] \rightarrow [Mg_2(PO_3)_6] + 2Na_2SO_4$
Complex salts

27. $H_2(g) + CO(g) + H_2O(g) \xrightarrow[673\ K]{FeCrO_4} 2H_2(g) + CO_2(g)$

28. **(i)** $CaNCN + 3H_2O \longrightarrow CaCO_3 + 2NH_3$

(ii) $Al_4C_3 + 12H_2O \longrightarrow 4Al(OH)_3 + 3CH_4$

(iii) $Cr_2O_7^{2-} + 2H^+ + 4H_2O_2 \longrightarrow 2CrO_5 + 5H_2O$

29. **(i)** Storage of H_2

(ii) Catalytic agents for hydrogenation.

30. **(i)** High enthalpy of combustion

(ii) No pollutant as product of combustion.