1. 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

2. The order of reactivity of halogens towards hydrogen is.
(a) $F_2 > Cl_2 > Br_2 > I_2$
(b) $I_2 > Br_2 > CI_2 > F_2$
(c) $Cl_2 > Br_2 > I_2 > F_2$
(d) $Br_2 > Cl_2 > F_2 > l_2$

3. The maximum number of hydrogen bonds formed by a water molecule in ice is
(a) 4 (b) 1 (c) 2 (d) 3

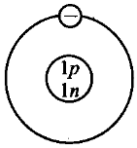
4. Which compound is formed when calcium carbide reacts with heavy water?
(a) C_2D_2 (b) CaD_2 (c) CD_2 (d) Ca_2D_2

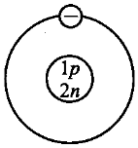
5. The boiling point of heavy water is.
(a) 100^0C (b) 101.4^0C (c) 99^0C (d) 110^0C

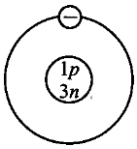
6. Which of the following compounds is used for water softening?
(a) $Ca_3(PO_4)_2$ (b) Na_3PO_4
(c) $Na_6P_6O_{18}$ (d) Na_2HPO_4

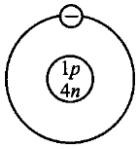
7. Only one element of _____ forms hydride.
(a) Group 6 (b) Group 7
(c) Group 8 (d) Group 9

8. 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 electron to form positive ions
(d) Hydrogen and halogens show noble gas configuration.

9. Which of the following is an atom of tritium ?
(a) 

(b) 

(c) 

(d) 

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

11. 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

12. Which of the following reactions of hydrogen with non-metals represents Haber's process?

(a) $2H_2 + O_2 \xrightarrow{heat} 2H_2O; \Delta H = -285.9 KJ\,mol^{-1}$

(b) $3H_2 + N_2 \underset{200atm}{\xrightarrow{673K, Fe}} 2NH_3; \Delta H = -92.6 KJ\,mol^{-1}$

(c) $H_2 + Cl_2 \xrightarrow{hv} 2HCl$

(d) $2H_2 + C \xrightarrow{1100^0 C} CH_4$

13. Which of the following statements regarding hydrides is not correct?

(a) Ionic hydrides are crystalline non-volatile 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 group15-17 form electron-precise hydrides.

14. 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.

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

(a) Suphates and chlorides of calcium and magnesium
(b) Carbonates of calcium and magnesium
(c) Bicarbonates of calcium and magnesium
(d) Sulphates and chlorides of sodium and potassium.

16. 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

17. 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) $Na_2[Mg_2(PO_3)_6]$

18. 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) $H_2O_{(i)} + H_2O_{(I)} \rightleftharpoons H_3O^+_{(aq)} + OH^-_{(aq)}$

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

19. 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

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

(a) Form soluble complexes with anionic species
(b) Precipitate anionic species

(c) Form soluble complexes with cationic species
(d) Precipitate cationic species.

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

(a) $BaO_2.8H_2O + H_2SO_4 + H_2O_2 + 8H_2O$

(b) $CH_3CHOCH_3 + O_2 \rightarrow CH_3COCH_3 + H_2O_2$

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

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

22. 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) $Na_2SO_3 + H_2O_2 \rightarrow Na_2SO_4 + H_2O$

23. The oxide that gives H_2O_2 on treatment with dilute H_2SO_4 is

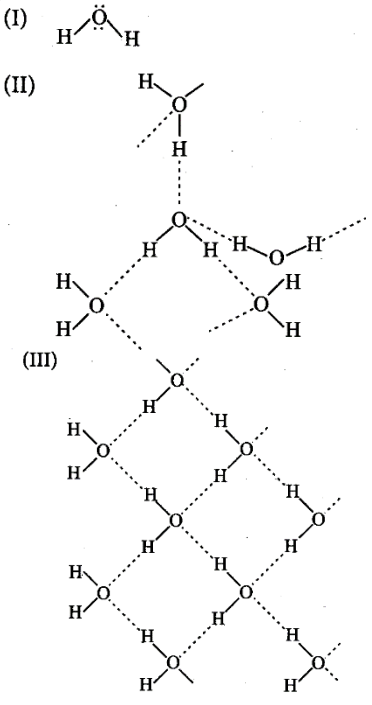
(a) PbO_2 (b) $BaO_2, 8H_2O$

(c) MnO_2 (d) TiO_2

24. 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	$LiAlH_4$	$NaBH_4$

25. Choose the correct statement about the given figure.



(a) (II) represents solid state while (III) represents liquid state.
(b) (II) represents liquid state while (III) represents
(c) (I) represents solid state while (III) represents liquid state.

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

26. Match the reactions 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 ionization 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), (D) → (iv)
(b) (A) → (iii), (B) → (ii), (C) → (iv), (D) → (i)
(c) (A) → (i), (B) → (ii), (C) → (iv), (D) → (iii)
(d) (A) → (iii), (B) → (iv), (C) → (i), (D) → (ii)

27. 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 oxidised to O_2

28. Mark the following statements as true of false.

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

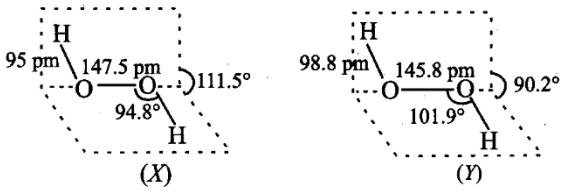
(ii) All the four atoms of molecule of H_2O_2 lie in the same plane.

(iii) Hydrogen peroxide is neutral like water.

(iv) Hydrogen peroxide 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

29. Two structures of H_2O_2 are 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 structure of H_2O_2 in solid phase and (Y) in gas phase

(c) (X) and (Y) are structures of H_2O_2 in solid phase.

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

30. 10 mL of H_2O_2 solution on treatment with KI and titration of liberated I_2, required 10 mL of 1N hypo. Thus H_2O_2 is -
(a) 1 N (b) 5.6 volume (c) 17 g L^{-1} (d) All are correct

1. (d) : Na reacts with cold water, Mg reacts with hot water, Fe reacts with steam and Au does not react with water.

$$3Fe + \underset{(Steam)}{4H_2O} \rightarrow Fe_3O_4 + 4H_2$$

2. (a) : With halogens, hydrogen reacts to give halides.

$$H_2 + Cl_2 \rightarrow 2HCl$$

$$H_2 + l_2 \rightarrow 2HI$$

The order of reactivity of halogens is

$$F_2 > Cl_2 > Br_2 > I_2.$$

3. (a) : In liquid state, water molecules form two hydrogen bonds while in solid state (ice), it contains four H – bonds due to spatial arrangement of molecules to form an open cage like structure.

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

5. (b) : Heavy water has higher molecular mass than ordinary water Hence, its boiling point is little higher than water.

6. (c) : Sodium hexametaphosphate $(Na_6P_6O_{18})$ commercially called calgon' is used for water softening.

7. (a) : From group 6, only one element i.e., chromium forms.

8. (b) : $H - 1s^1; He - 1s^2$

$x - ns^2np^5; Ne - 1s^2 2s^2 2p^6$

Both have one electron less than the nearest noble gas configuration.

9. (b) : Tritium is ^3_1H having one proton and two neutrons.
It has no. of protons = 1, no of electrons=1, no. of neutrons = 2.

10. (d) : In laboratory, hydrogen gas is prepared by action of dilute H_2SO_4 on granulated zinc.

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

11. (b) : The production of dihydrogen can be increased by reacting carbon monoxide of syngas with steam. This is called water-gas shift reaction.

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

12. (b) : Formation of NH_3 by reaction of hydrogen and nitrogen is known as Haber's process.

13. (d) : Elements of group 15-17 form electron rich hydrides. Group 14 elements form electron-precise hydrides.

14. (d) : Nitrogen forms electron-rich covalent or molecular hydrides.

15. (a) : Permanent hardness of water is due to sulphates and chlorides of calcium and magnesium.

16. $Na_2Al_2Si_2O_8.xH_2O + Ca^{2+}(or\,Mg^{2+}) \rightarrow$

$CaAl_2Si_2O_8.xH_2O + 2Na^+$

17. (c) : The complex salt of metaphosphoric acid, sodium hexametaphosphate $(NaPO_3)_6$ is known as calgon. It is represented as $Na_2[Na_4(PO_3)_6]$

18. (a) : H_2O acts as a Bronsted acid and gives proton to react with a base.

$\underset{\text{Acid}}{H_2O} + \underset{\text{base}}{NH_3} \rightleftharpoons OH^- + NH_4^+$

In $\underset{\text{base}}{H_2O} + \underset{\text{acid}}{H_2S} \rightarrow H_3O^+ + HS^-$

H_2O acts as a base with H_2S

19. (a) : $2F_2 + 2H_2O \rightarrow 4H^+ + 4F^- + O_2$

20. (c) : Polyphosphates like sodium hexametaphosphate (calgon) form soluble complexes with cations like Ca^{2+} and Mg^{2+} present in hard water.

$Na_6P_6O_{18} \rightarrow 2Na^+ + Na_6P_6O_{18}^{2-}$

$M^{2+} + Na_4P_6O_{18} \rightarrow [Na_2MP_6O_{18}]^{2-} + 2Na^+$

21. (a) : $BaO_2.8H_2O_{(s)} + H_2SO_{4(aq)} \rightarrow BaSO_{4(s)} + H_2O_{2(aq)} + 8H_2O_{(l)}$

22. (b) : In the reaction Ag_2O is reduced to Ag hence H_2O_2 acts as a reducing agent.

$Ag_2O + H_2O_2 \rightarrow 2Ag + H_2O + O_2$

23. (b) :

$BaO_2, 8H_2O_{(s)} + H_2So_{4(aq)} \rightarrow BaSO_{4(s)} + H_2O_{(aq)} + 8H_2O_{(l)}$

24. (c) : Ionic Covalent Interstitial $LiAlH_4$ $NaBH_4$

25. (b) : In liquid state water molecules are hydrogen bonded while in solid water molecules are arranged in tetrahedral manner with open cage structure.

26. (d) : (A) $\rightarrow$ (iii),(B) $\rightarrow$ (iv), (C) $\rightarrow$ (i), (D) $\rightarrow$ (ii)

27. (d) :

$2k_3[Fe(CN)_6] + 2KOH \rightarrow 2K_4[Fe(CN)_6] + H_2O$ $+[O]H_2O_2 + [O] \rightarrow H_2O + O_2$

$2k_3[Fe(CN)_6] + 2KOH + H_2O_2 \rightarrow 2k_4[Fe(CN)_6] + 2H_2O + O_2$

28. (a) : All four atoms of H_2O_2 do not lie in same plane. Hydrogen peroxide is slightly acidic in nature.

29. (a) : There is a slight difference in bond lengths of O – H, O – O – and O – O – H angle in structures of H_2O_2 in gas phase and in solid phase.

30. **(d)**

$H_2O_2 + 2I^- \rightarrow I_2$

$I_2 + 2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2I^-$

$H_2O_2 \equiv I_2 \equiv 2S_2O_3^{2-}$

$N_1V_1 = N_2V_2$

H_2O_2 hypo

$N_1(H_2O_2) = \frac{10 \times 1}{10} = 1N$

Conc. = N × E = 17 g/litre

Volume strength = 5.6 × normality

= 5.6 × 1

= 5.6 volume