



## CHEMISTRY

### BOOKS - CENGAGE CHEMISTRY (ENGLISH)

## HYDROGEN, WATER AND HYDROGEN PEROXIDE

#### Illustration

1. Comment on the reactions of dihydrogen with (a) chlorine, (b) sodium and (c) copper (II) oxide.



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2. a. Would you expect the hydrides of  $N$ ,  $O$  and  $F$  to have lower boiling points than the hydrides of their subsequent group members? Give reason.

b. Can phosphorous with outer electronic configuration  $3s^2 3p^3$  form  $PH_5$ ?

c. How many hydrogen-bonded water molecules(s) are associated with  $CuSO_4 \cdot 5H_2O$ ?



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

b. Concentrated  $H_2SO_4$  cannot be used for drying  $H_2$ .

Why?

c. The electrolysis of water manufactures  $H_2$  gas is always carried out in presence of acid ( $H_2SO_4$ ) or alkali ( $KOH$ ), yet no  $SO_4^{2-}$  or  $K^{\oplus}$  are discharged. Why?

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4. a. A solution of ferric chloride acidified with  $HCl$  is unaffected when hydrogen is bubbled through it, but gets reduced when zinc is added to acidified solution. Explain.

b. When sodium hydride in fused state is electrolysed, hydrogen is discharged at the anode. Explain.

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5. In the laboratory, for the preparation of dihydrogen gas from granular zinc, conc  $H_2SO_4$ , and  $HNO_3$  cannot be used. Why? Which is the most suitable acid?

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6. A sample of hard water contains 1 mg  $CaCl_2$  and 1 mg  $MgCl_2$  per litre. Calculate the hardness of water in terms of  $CaCO_3$  present in per  $10^6$  parts of water.

- A. 2.5ppm
- B. 1.95ppm
- C. 2.15ppm
- D. 195ppm

**Answer: B**

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7. A water sample is found to contain 96 ppm of  $SO_4^{2-}$  and 122 ppm of  $HCO_3^-$  with  $Ca^{2+}$  ion as the only cation.

(a). Calculate the ppm of  $Ca^{2+}$  in water.

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8. Hardness of water is 200 ppm. The normality and molarity of  $CaCO_3$  in the water is

(a).  $2 \times 10^{-6} (N, 2 \times 10^{-6} M)$

(b).  $4 \times 10^{-2}N, 2 \times 10^{-2}M$

(c).  $4 \times 10^{-3}N, 2 \times 10^{-3}M$

(d).  $4 \times 10^{-1}N, 2 \times 10^{-1}M$

A.  $2 \times 10^{-6}N, 2 \times 10^{-6}M$

B.  $4 \times 10^{-2}N, 2 \times 10^{-2}M$

C.  $4 \times 10^{-3}N, 2 \times 10^{-3}M$

D.  $4 \times 10^{-1}N, 2 \times 10^{-1}M$

**Answer: C**



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9. A sample of hard water contains 122 ppm of  $HCO_3^{\ominus}$  ions. What is the minimum weight of CaO required to

remove ions completely from 1 kg of such water sample?

(a). 56 mg

(b). 112 mg

(c). 168 mg

(d). 224 mg

A.  $56\text{mg}$

B.  $112\text{mg}$

C.  $168\text{mg}$

D.  $244\text{mg}$

**Answer: A**



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10.  $25\text{mL}$  sample of distilled water, tap water and boiled water required, respectively,  $1\text{mL}$ ,  $13\text{mL}$  and  $5\text{mL}$  of soap solution to form permanent lather. The ratio of permanent to temporary hardness in the tap water is

A. 3 : 2

B. 2 : 3

C. 1 : 2

D. 2 : 1

**Answer: C**



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11.  $0.0093\text{g}$  of  $\text{Na}_2\text{H}_2\text{EDTA}\cdot 2\text{H}_2\text{O}$  is dissolved in  $250\text{mL}$  of aqueous solution. A sample of hard water containing  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions is titrated with the above  $\text{EDTA}$  solution using a buffer of  $\text{NH}_4\text{OH} + \text{NH}_4\text{Cl}$  using eriochrome black- $T$  as indicator.  $10\text{mL}$  of the above  $\text{EDTA}$  solution requires  $10\text{mL}$  of hard water at equivalent point. another sample of hard water is titrated with  $10\text{mL}$  of above  $\text{EDTA}$  solution using  $\text{KOH}$  solution ( $\text{pH} = 12$ ). using murexide indicator, it requires  $40\text{mL}$  of hard water at equivalence point.

a. Calculate the amount of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  present in  $1\text{L}$  of hard water.

b. Calculate the hardness due to  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$  ions and the total hardness of water in  $\text{ppm}$  of  $\text{CaCO}_3$ . (Given

$$\text{mol}^{-1}, MW(\text{CaCO}_3) = 100\text{g mol}^{-1})$$



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**12.** A 50 mL sample of hard water containing  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions is titrated with 50 mL 0.005 M EDTA solution at  $\text{pH} = 10$ , using eriochrome black-T indicator to reach equivalence point.

In an equal another amount of hard water sample,  $\text{Mg}^{2+}$  ions are precipitated as  $\text{Mg}(\text{OH})_2$  by adding suitable amount of NaOH. The solution after precipitation of  $\text{Mg}(\text{OH})_2$ , is stirred and then titrated with EDTA solution using calcon as indicator, and it requires 10 " mL of " above EDTA solution to reach equivalence point.

(a). Calculate the strength of  $Ca^{2+}$  and  $Mg^{2+}$  ions present in hard water.

(b). Calculate the hardness due to  $Ca^{2+}$  ions in ppm of  $CaCO_3$ .

(c). Calculate the hardness due to  $Mg^{2+}$  ions in ppm of  $CaCO_3$ .

(d) Calculate the total hardness of water in ppm of  $CaCO_3$ .

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**13.** 100 mL sample of hard water is titrated with 500 mL of 0.001 M EDTA solution at  $pH = 10$ , using eriochrome black-T indicator to reach equivalence point. An equal amount of hard water sample is boiled for 30

min. After filtration and cooling, the same sample is titrated with 200 mL of 0.011 M EDTA solution at  $pH = 10$  using Mg-EDTA complex solution and erichrome black-T indicator to reach equivalence point.

(i). Calculate the total hardness of water sample (temporary + permanent) in ppm of  $CaCO_3$ .

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14. Can sodium bicarbonate make water hard?

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15. a. Water extinguishes most fires, but it does not extinguish petrol fires. Explain.

b. Soft water lathers with soap, but not hard water. Why?

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16. a. A small amount of acid or alkali is added before electrolysis of water. Why?

b. What happens when:

i. Hydrolith is treated with water.

ii. Heavy water reacts with aluminium carbide.

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17. How many types of heavy water are possible? Write down formulae of all possible heavy water molecules.

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18. Calculate (a) normality (b) molarity (c) strength in  $gL^{-1}$  and (d) percentage strength of 10 volume strength of  $H_2O$

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19. Calculate the number of moles and weight of  $O_2$  produced on heating 1.12 L of 10 volume strength of  $H_2O_2$  at STP.

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20. 10 ml of  $H_2O_2$  liberates 12.7g of iodine from an acidic  $KI$  solution. Calculate (a) normality, (b) molarity, (c) volume strength. (d) Strength and (c) percentage strength of  $H_2O_2$ .

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21. A solution of  $K_2Cr_2O_7$  containing  $4.9gL^{-1}$  is used to titrate  $H_2O_2$  solution containing  $3.4gL^{-1}$  in acidic medium. What volume of  $K_2Cr_2O_7$  will be required to react with 20mL of  $H_2O_2$  solution ? Also calculate the strength of  $H_2O_2$  in terms of available oxygen.

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22. When 25 mL of an aqueous solution of  $H_2O_2$  is titrated with an excess of KI solution in dilute  $H_2SO_4$ , the liberated  $I_2$  required 20 mL of 0.3 N  $Na_2S_2O_3$  solution for complete reaction. Calculate the volume strength of  $H_2O_2$  solution.

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23. Calculate the volume strength of  $H_2O_2$  solution if 50 mL of  $H_2O_2$  solution is diluted with 50 mL of  $H_2O$ . 20 mL of this diluted solution required 40 mL of  $M/60 K_2Cr_2O_7$  solution in presence of  $H_2O_2$  for complete reaction.

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24. 100 mL of ozone ( $O_3$ ) at STP were passed through 100 mL of 10 volume  $H_2O_2$  solution. What is the volume strength of  $H_2O_2$  after the reaction?



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25. 5.1 g sample of  $H_2O_2$  solution containing  $x\%$   $H_2O_2$  by weight requires  $x$  mL of  $K_2Cr_2O_7$  solution for complete oxidation under acidic condition. What is the molarity of  $K_2Cr_2O_7$  solution?



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26. 200 mL of acidified 3 N  $H_2O_2$  is reacted with  $KMnO_4$  solution till there is a light tinge of purple colour. Calculate the volume of  $O_2$  produced at STP.

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27. a. When  $H_2O_2$  is added to blood, rapid evolution of a gas occurs. Why?

b. Hydrogen peroxide acts both as an oxidising and as a reducing agent in alkaline solution towards certain first row transition metal ions. Illustrate both these properties of  $H_2O_2$  using chemical equations.

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**28.** What happens when:

- a. Chromium hydroxide is treated with hydrogen peroxide in the presence of sodium hydroxide.
- b. Hydrogen peroxide is added to ferrous ammonium sulphate solution.
- c. hydrogen peroxide is added to acidified potassium permanganate.
- d. An alkaline solution of potassium ferricyanide is reacted with  $H_2O_2$ .



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**29.** There are three samples of  $H_2O_2$  labelled as  $10vol$ ,  $15vol$ ,  $20vol$ . Half liter of each sample are mixed

and then diluted with equal volume of water. Calculate the volume strength of resultant solution.

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## Solved Examples

1.  $5.0\text{cm}^3$  of  $H_2O_2$  liberates 0.508 g of iodine from an acidified KI solution. The strength of  $H_2O_2$  solution in terms of volume strength at STP is

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2. To a 25 mL  $H_2O_2$  solution excess of an acidified solution of

potassium iodide was added. The iodine liberated required 20 mL of 0.3 N sodium thiosulphate solution. Calculate the volume strength of  $H_2O_2$  solution.

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3. Element (A) burns in nitrogen to give an ionic compound, (B) reacts with water to give (C) and (D). A solution of (C) becomes milky on bubbling carbon dioxide. Identify (A),(B),(C) and (D)

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4. Calculate the volume of 10 volume  $H_2O_2$  solution that will react with 200 mL of 2N  $KMnO_4$  in acidic medium.



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5. An aqueous compound of an inorganic compound ( $X$ )

shows the following reactions:

a. it decolourises and acidified  $KMnO_4$  solution accompanied by the evolution of oxygen.

b. it liberates  $I_2$  from an acidified  $KI$  solution.

c. It gives a brown precipitate with alkaline  $KMnO_4$  solution with evolution of oxygen.

d. It removes black stains from old oil paintings. Identify ( $X$ ) and give chemical equations for the reaction at steps (a) to (d).



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6. 3.4g sample of  $H_2O_2$  solution containing  $x\%$   $H_2O_2$  by weight requires  $x$  mL of a  $KMnO_4$  solution for complete oxidation under acidic condition. The normality of  $KMnO_4$  solution is

A. 1N

B. 2N

C. 3N

D. 0.5N

**Answer: B**



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7. If  $100\text{mL}$  of acidified  $2\text{NH}_2\text{O}_2$  is allowed to react with  $\text{KMnO}_4$  solution till there is light tinge of purple colour, the volume of oxygen produced at  $\text{STP}$  is :

A.  $2.24\text{L}$

B.  $1.12\text{L}$

C.  $3.36\text{L}$

D.  $4.48\text{L}$

**Answer: A**



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8. Calcium burns in nitrogen to produce a white powder which dissolves in sufficient water to produce a gas (A) and alkaline solution. The solution on exposure to air produce a thin solid layer of (B) on the surface. Identity the compound (A) and (B)

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### Ex 3 1

1. If water contains  $10\text{ppm}$  of  $MgCl_2$  and  $8\text{ppm}$  of  $CaSO_4$  calculate the  $\text{ppm}$  of  $CaCO_3$

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2. 100 mL of tap water was titrated with  $\frac{M}{50}$  HCl with methyl orange as indicator if 30 mL of HCl were required, calculate the hardness of  $CaCO_3$  per  $10^6$  parts of water. The hardness is temporary.



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3. In the determination of hardness of a sample of water, the following results were obtained:

Volume of sample  $H_2O = 100mL$

volume of  $N/50Na_2CO_3$  added to it =  $20mL$

volume of  $N/50H_2SO_4$  used to back titrate the

unreacted  $Na_2CO_3 = 10mL$

Calculate the hardness of water in  $gL^{-1}$



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4. An exhausted zeolite bed was revived by 250 L of NaCl solution containing  $50\text{gL}^{-1}$  of NaCl solution. How many litres of hard water of hardness 250 ppm can be softened on the zeolite bed?



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### Ex 3 2

1. What is understood by 'Water gas shift reaction' ?  
Discuss its use for the preparation of hydrogen.



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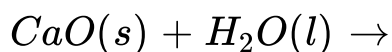
2. Hydrogen forms compounds with elements having atomic numbers 9, 11, 12 and 17. Mention their chemical formulae and compare their chemical behaviour.

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3. What are metallic/interstitial hydrides ? How do they differ from molecular hydrides ?

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4. Complete the following reactions :





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5. Explain, why hydrogen peroxide is stored in coloured/plastic bottles.



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6. Describe the industrial applications of hydrogen which depend on the heat liberated when its atoms are made to combine on the surface of a metal,



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7. How would you prepare

dihydrogen from water by using a reducing agent ?

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8. Complete the following equations :



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9. Discuss the importance of heavy water in nuclear reactors.

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10. How is heavy water prepared from ordinary water ?

Discuss its important physical and chemical properties.

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11. Explain, why water has high boiling and melting points as compared to  $H_2S$ .

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12. Distinguish clearly between hard and soft water

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**13.** Explain the correct context in which the following terms are used:

Diprotium

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**14.** Is it correct to say that hydrogen can behave as a metal? If it is correct, mention the conditions under which such behaviour is possible.

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**15.** What is importance of the heavier isotopes of hydrogen?





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**16.** Does hydrogen show allotropy? How many allotropes of dihydrogen are known and what is their importance?



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**17.** What is understood by 'hydrogen gap'?



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**18.** Hydrogen forms three types of bonds in its compounds. Giving suitable examples, explain each type of bonding.



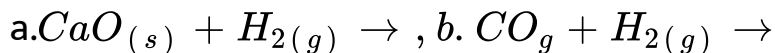
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19. Elements with atomic numbers 17 and 20 form compounds with hydrogen. Write the formula of these two compounds and compare their chemical behaviour in water.



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20. Complete the following reactions.



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**21.** Describe some unusual properties of water.

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

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**23.** What is meant by hydrogenation?

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**24.** What are the advantages in using hydrogen as a fuel?



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25. Why are ionic hydrides frequently used to remove traces of water from organic compounds?



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26. Although  $D_2O$  resembles  $H_2O$  chemically, yet it is a toxic substance. Explain



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27. Why do lakes freeze from top towards bottom ?



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28. Why is ice less dense than water and what kind of attractive forces must be overcome to melt ice ?



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29. A white solid is either  $Na_2O$  or  $Na_2O_2$ . A piece of red litmus paper turns white when it is dipped into a freshly made aqueous solution

of the white solid.

a. Identify the substance and explain the balanced equation.

b. Explain what would happen to the red litmus if the

white solid

were the other compound.

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**30.** Explain the following.

- a. Hydrated barium peroxide is used in the preparation of  $H_2O_2$  instead of anhydrous barium peroxide.
- b. Phosphoric acid is preferred to sulphuric acid in the preparation of  $H_2O_2$  from barium peroxide..

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**31.** An element has the minimum and maximum oxidation states as  $-X$  and  $+X$  respectively. It does not have the

possibility of undergoing disproportionation in any of its compounds. What is the value of  $X$ ?

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**32.** Give reason for the following

- a. The process  $\frac{1}{2}H_{2(g)} + e^{\ominus} \rightarrow H_{(g)}^{\ominus}$  is endothermic, yet ionic hydrides are known.
- b. A mixture of hydrazine and  $H_2O_2$  with  $Cu(II)$  catalyst is used as a rocket propellant.
- c. It is possible to remove completely the temporary hardness caused due to  $Mg(HCO_3)_2$  by boiling.

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**33.** The degree of hardness of a given sample of hard water is  $40\text{ppm}$ . If the entire hardness is due to  $\text{MgSO}_4$ , how much of  $\text{MgSO}_4$  is present per  $\text{kg}$  of water?

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**34.**  $34\text{ g}$  of  $\text{H}_2\text{O}_2$  is present in  $1120\text{ mL}$  of " solution. This solution is called

A.  $10\text{vol}$

B.  $20\text{vol}$

C.  $34\text{vol}$

D.  $32\text{vol}$



**Answer: A**

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35. A 5.0 mL solution of  $H_2O_2$  liberates 1.27 g of iodine from an acidified KI solution. The percentage strength of  $H_2O_2$  is

A. 11.2

B. 5.6

C. 1.7

D. 3.4

**Answer: D**

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36. 100 mL of ozone ( $O_3$ ) at STP were passed through 100 mL of 10 volume  $H_2O_2$  solution. What is the volume strength of  $H_2O_2$  after the reaction?

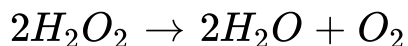
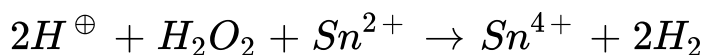
- A. 9.5
- B. 9.0
- C. 4.75
- D. 4.5

**Answer: A**



## Exercises Linked Comprehension

1.  $H_2O_2$  is reduced rapidly by  $Sn^{2+}$ .  $H_2O_2$  is decomposed slowly at room temperature to yield  $O_2$  and  $H_2O$ . 136g of 10% by mass of  $H_2O_2$  in water is treated with 100mL of 3M  $Sn^{2+}$  and then a mixture is allowed to stand until no further reaction occurs. The reactions involved are:



The equivalent of  $H_2O_2$  reacted with  $Sn^{2+}$  is

A. 0.2

B. 0.3

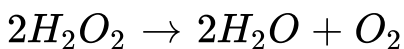
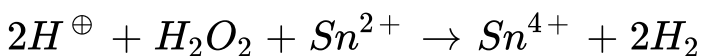
C. 0.4

D. 0.6

Answer: D

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2.  $H_2O_2$  is reduced rapidly by  $Sn^{2+}$ .  $H_2O_2$  is decomposed slowly at room temperature to yield  $O_2$  and  $H_2O$ . 136g of 10% by mass of  $H_2O_2$  in water is treated with 100mL of 3M  $Sn^{2+}$  and then a mixture is allowed to stand until no further reaction occurs. The reactions involved are:



The equivalent of  $H_2O_2$  reacted with  $Sn^{2+}$  is

A. 0.1

B. 0.2

C. 0.3

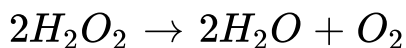
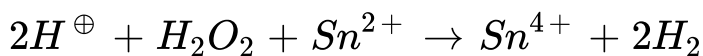
D. 0.4

**Answer: B**



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3.  $H_2O_2$  is reduced rapidly by  $Sn^{2+}$ .  $H_2O_2$  is decomposed slowly at room temperature to yield  $O_2$  and  $H_2O$ . 136g of 10% by mass of  $H_2O_2$  in water is treated with 100mL of 3M  $Sn^{2+}$  and then a mixture is allowed to stand until no further reaction occurs. The reactions involved are:



The volume strength of  $H_2O_2$  left after reacting with  $Sn^{2+}$

A. 1.12V

B. 11.2V

C. 2.24V

D. 22.4V

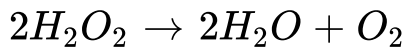
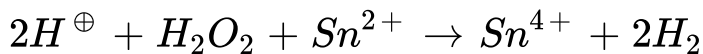
**Answer: B**



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4.  $H_2O_2$  is reduced rapidly by  $Sn^{2+}$ .  $H_2O_2$  is decomposed slowly at room temperature to yield  $O_2$  and  $H_2O$ . 136g of 10% by mass of  $H_2O_2$  in water is treated

with  $100\text{mL}$  of  $3\text{M Sn}^{2+}$  and then a mixture is allowed to stand until no further reaction occurs. The reactions involved are:



Calculate the volume of  $\text{O}_2$  produced at  $27^\circ\text{C}$  and  $1\text{ atm}$  after  $\text{H}_2\text{O}_2$  is reacted with  $\text{Sn}^{(2+)}$  and the mixture is allowed to stand.

A.  $2.46\text{L}$

B.  $4.92\text{L}$

C.  $1.23\text{L}$

D.  $7.38\text{L}$

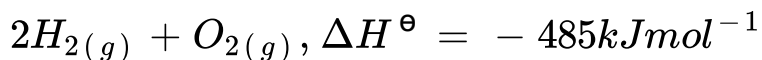
**Answer: C**



5. Hydrogen accounts for approximately 75 % of the mass of the universe. Hydrogen serves as the nuclear fuel of our Sun and other stars, and these are mainly composed of hydrogen. On the earth, though hydrogen is rarely found in the uncombined state. Since the earth's gravity is too weak to hold such light molecules, nearly all the  $H_2$  originally present in the earth's atmosphere has been lost to space. In the earth's crust and oceans, hydrogen is found in water, petroleum, proteins, carbohydrates and other compounds and it is the ninth most abundant element on a mass basis. Hydrogen has three isotopes : hydrogen or protium ( $H$ ), deuterium or heavy hydrogen (D or  $^2H$ ), tritium ( $T$  or  $^3H$ ). The physical properties of the



three isotopes are different due to the difference in their masses, i.e. isotope effect. The chemical properties of the three isotopes are similar as they have the same electronic configuration. Reaction between hydrogen and oxygen is highly exothermic, and gas mixtures that contain as little as 4% by volume hydrogen in oxygen (or in air) are highly flammable and potentially explosive.



As hydrogen is environmentally clean it is an enormously attractive fuel. 'Hydrogen economy' is an emerging field in which it is thought that our energy needs can be met by gaseous, liquid and solid hydrogen. As hydrogen is not a naturally occurring substance such as coal, oil or natural gas, energy must be expended to produce hydrogen before it can be used.

If an isotope of hydrogen has one neutron in its atom, its atomic number and atomic mass will respectively be

A. 1, 2

B. 1, 3

C. 1, 1

D. 2, 1

**Answer: A**

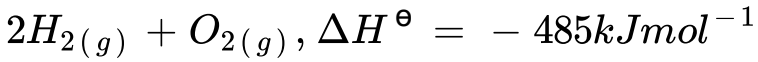


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**6.** Hydrogen accounts for approximately 75 % of the mass of the universe. Hydrogen serves as the nuclear fuel of our Sun and other stars, and these are mainly composed of

hydrogen. On the earth, though hydrogen is rarely found in the uncombined state. Since the earth's gravity is too weak to hold such light molecules, nearly all the  $H_2$  originally present in the earth's atmosphere has been lost to space. In the earth's crust and oceans, hydrogen is found in water, petroleum, proteins, carbohydrates and other compounds and it is the ninth most abundant element on a mass basis. Hydrogen has three isotopes : hydrogen or protium ( $H$ ), deuterium or heavy hydrogen ( $D$  or  $^2H$ ), tritium ( $T$  or  $^3H$ ). The physical properties of the three isotopes are different due to the difference in their masses, i.e. isotope effect. The chemical properties of the three isotopes are similar as they have the same electronic configuration. Reaction between hydrogen and oxygen is highly exothermic, and gas mixtures that contain as little as 4% by volume hydrogen in oxygen (or

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As hydrogen is environmentally clean it is an enormously attractive fuel. 'Hydrogen economy' is an emerging field in which it is thought that our energy needs can be met by gaseous, liquid and solid hydrogen. As hydrogen is not a naturally occurring substance such as coal, oil or natural gas, energy must be expended to produce hydrogen before it can be used.

Which of the following fuel produces least environmental pollution?

A. Hydrogen

B. Coal

C. Wood

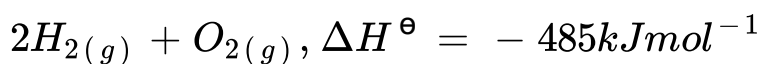
D. Gasoline

**Answer: A**

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naturally occurring substance such as coal, oil or natural gas, energy must be expended to produce hydrogen before it can be used.

Which of the following is radioactive in nature?

- A. Hydrogen only
- B. Deuterium only
- C. Tritium only
- D. Deuterium and tritium

**Answer: C**

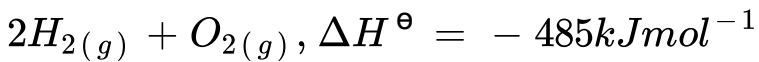


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Hydrogen,  $H_2$  is very less abundant in the atmosphere due to

A. inflammable nature of  $H_2$

B. weak earth's gravity which is not able to hold light

$H_2$  molecules

C. diatomic nature of hydrogen

D. very rapid reaction between hydrogen and atmosphere oxygen

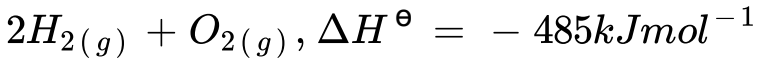
**Answer: B**

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Liquid  $H_2$  has been used as rocket fuel as

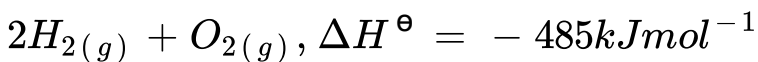
- A. its reaction with oxygen is highly exothermic
- B. it occupies small space
- C. it has high thrust
- D. all of the above

**Answer: D**

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**10.** Hydrogen accounts for approximately 75% of the mass of the universe. Hydrogen serves as the nuclear fuel of our Sun and other stars, and these are mainly composed of hydrogen. On the earth, though hydrogen is rarely found in the uncombined state. Since the earth's gravity is too weak to hold such light molecules, nearly all the  $H_2$  originally present in the earth's atmosphere has been lost to space. In the earth's crust and oceans, hydrogen is found in water, petroleum, proteins, carbohydrates and other compounds and it is the ninth most abundant element on a mass basis. Hydrogen has

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gas, energy must be exploded to produce hydrogen before it can be used.

Which of the following is the lightest gas?

A. hydrogen

B. oxygen

C. nitrogen

D. helium

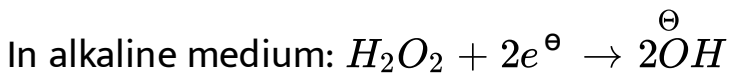
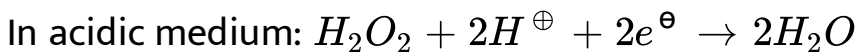
**Answer: A**



**Watch Video Solution**

**11.** Hydrogen peroxide is a powerful oxidising agent, both in the acidic

and alkaline medium.



Hydrogen peroxide acts as a reducing agent towards powerful oxidising agents.

In acidic medium:  $H_2O_2 \rightarrow 2H^{\oplus} + O_2 + 2e^{\ominus}$  In alkaline medium, however, its reducing nature is more effective.



$H_2O_2$  behaves as a bleaching agent due to

- A. oxidation of  $KMnO_4$
- B. reduction of  $KMnO_4$
- C. both oxidation and reduction
- D. none of the above of  $KMnO_4$



**Answer: B**

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**12.** Hydrogen peroxide is a powerful oxidising agent, both in the acidic and alkaline medium.

In acidic medium:  $H_2O_2 + 2H^{\oplus} + 2e^{\ominus} \rightarrow 2H_2O$

In alkaline medium:  $H_2O_2 + 2e^{\ominus} \rightarrow 2OH^{\ominus}$

Hydrogen peroxide acts as a reducing agent towards powerful oxidising agents.

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$H_2O_2 \rightarrow 2H^{\oplus} + O_2 + 2e^{\ominus}$

$H_2O_2$  behaves as a bleaching agent due to

A. oxidising nature

B. reducing nature

C. acidic nature

D. unstable nature

**Answer: A**



**Watch Video Solution**

**13.** Hydrogen peroxide is a powerful oxidising agent, both in the acidic and alkaline medium.

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In the reaction,  $H_2O_2 + O_3 \rightarrow H_2O + 2O_2$ ,  $H_2O_2$  behaves as

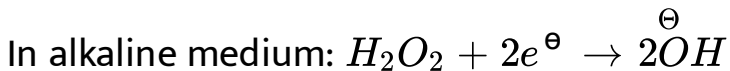
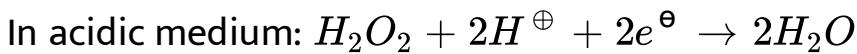
- A. an oxidising agent
- B. reducing agent
- C. acid
- D. base

**Answer: B**



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**14.** Hydrogen peroxide is a powerful oxidising agent, both in the acidic and alkaline medium.

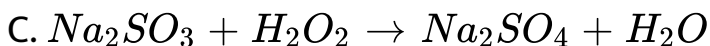
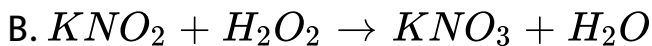
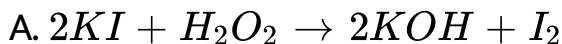


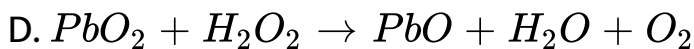
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In which of the following reactions,  $H_2O_2$  act as a reducing agent?

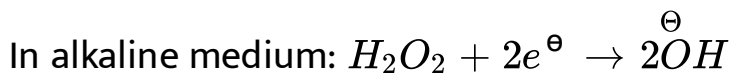
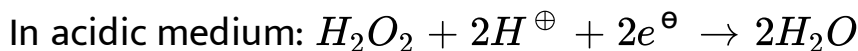




**Answer: D**

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**15.** Hydrogen peroxide is a powerful oxidising agent, both in the acidic and alkaline medium.

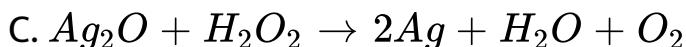
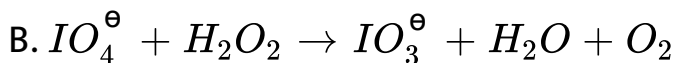
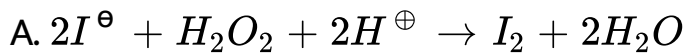


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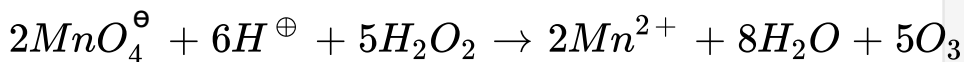
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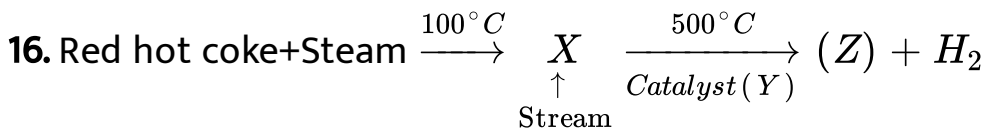
D.



**Answer: A**



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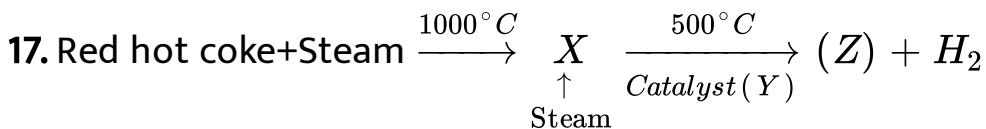


the above sequence refers to

- A. Lane's process
- B. Bosch's process
- C. Ostwald's process
- D. Haber's process

**Answer: B**

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'X' is

A. water gas

B. producer gas

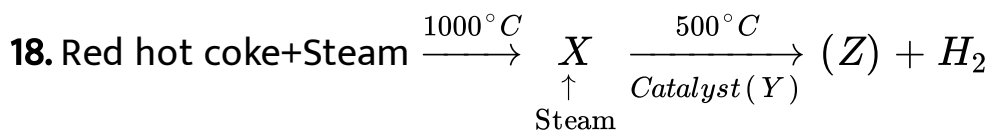
C. coal gas

D. oil gas

**Answer: A**



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'Z' is

A.  $CO$

B.  $CO_2$

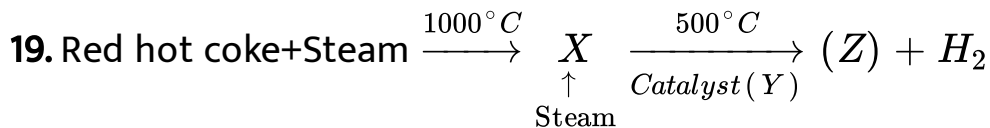


C.  $O_2$

D.  $H_2O$

**Answer: B**

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Catalyst 'Y' is

A.  $V_2O_5$

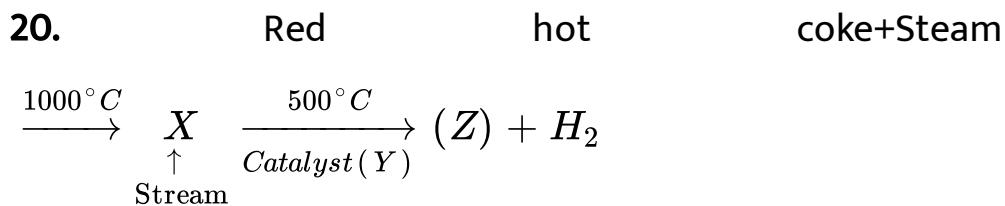
B.  $Cr_2O_3$

C.  $Fe_2O_3$

D.  $Fe_2O_3 + Cr_2O_3$

Answer: D

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'Z' is removed by passing the gaseous mixture through

A. acidic solution

B. alkaline solution

C. water under high pressure of  $25\text{atm}$

D. an organic solvent

Answer: C





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## Exercises Multiple Correct

1. Which of the following is//are basic hydride?

A.  $HCl$

B.  $NH_3$

C.  $H_2S$

D.  $PH_3$

**Answer: B::D**



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2. In which of the following properties hydrogen does not show similarity with alkali metals?

- A. atomicity
- B. ionisation enthalpy
- C. reducing nature
- D. electropositive nature

**Answer: C::D**

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3. In the reaction of sodium hydride and water:

- A. sodium is reduced

B. hydrogen is oxidised

C. hydrogen is reduced

D. No element is oxidised or reduced

**Answer: B::C**



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**4. Which of the following elements are oxidised when they react with dihydrogen?**

A. Calcium

B. Sulphur

C. Lithium

D. Carbon

**Answer: A::C**

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5. What is true about saline hydrides?

- A. They are binary compounds of hydrogen and metallic elements
- B. They are crystalline solids.
- C. They are generally very soft.
- D. Their common examples are  $SiH_4$ ,  $CH_4$ , etc.

**Answer: A::D**



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6. Among the hydrides given below which are reasonable good acids?



**Answer: B::C**



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7. Which is false about ice?

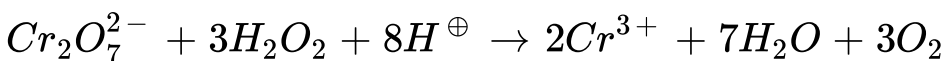
- A. It has open cage-like structure.
- B. it has more density than water.
- C. Each  $O$  atom is surrounded by four  $H$  atoms
- D. Each  $O$  atom has four  $H$ -bonds around it.

**Answer: B::D**



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8. Which of the following statements about the following reaction is / are not correct?





- A.  $H_2O_2$  is oxidised to  $O_2$
- B.  $H_2O_2$  is reduced to  $H_2O$
- C. The oxidation number of chromium atom changes by 3.
- D. Hydrogen ions are oxidised to  $H_2O$

**Answer: B::D**

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9. Which of the following statements is/are correct about 6.8 % strength of  $H_2O_2$ ?

A. its normality is  $4N$

B. its molarity is  $2M$

C. Its volume strength is  $22.4V$

D. Volume strength  $11.2 \times M$

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

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10.  $xg$  of  $H_2O_2$  requires  $100mL$  of  $M/5KMnO_4$  in a titration in a solution having  $pOH = 1.0$  Which of the following is / are correct?

A. The value of  $x$  is  $1.7g$

B. The value of  $x$  is  $0.34g$

C.  $MnO_4^\ominus$  change to  $MnO_4^{2\ominus}$

D.  $H_2O_2$  change to  $O_2$

**Answer: B::C::D**

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11.  $20\text{mL}$  of  $H_2O_2$  is reacted completely with acidified  $K_2Cr_2O_7$  solution.  $40\text{mL}$  of  $K_2Cr_2O_7$  solution is required to oxidise the  $H_2O_2$  completely. Also,  $2.0\text{mL}$  of the same  $K_2Cr_2O_7$  solution is required to oxidise  $5.0\text{mL}$  of a  $1.0\text{M}$   $H_2C_2O_4$  solution to reach equivalence point.

Which of the following statements is / are correct?

A. The  $H_2O_2$  solution is  $5\text{M}$

B. The volume strength of  $H_2O_2$  is  $56V$

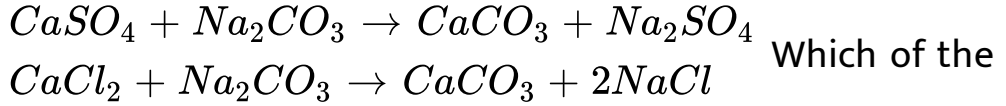
C. The volume strength of  $H_2O_2$  is  $112V$

D. If  $40mL$  more  $5M/8H_2O$  is further added to the  $10mL$  of the above  $H_2O_2$  solution, the volume strength of the resulting solution is changed to  $16.8V$

**Answer: A::B::D**

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**12.** Permanent hardness is due to  $Cl^\ominus$  and  $SO_4^{2-}$  of  $Mg^{2+}$  and  $Ca^{2+}$  and is removed by adding  $Na_2CO_3$ .



Which of the

following statements is / are correct?

A. If hardness is  $100\text{ppmCaCO}_3$  the amount of

$Na_2CO_3$  required to soften  $10L$  of hard water is

$10.6g$

B. If hardness is  $100\text{ppmCaCO}_3$ , the amount of

$Na_2CO_3$  required to soften  $10L$  of hard water is

$1.06g$ .

C. If hardness is  $420\text{ppmMgCO}_3$ , the amount of

$Na_2CO_3$  required to soften  $10L$  of hard water is  $53g$

D. If hardness is  $420\text{ppmMgCO}_3$  is the amount of

$Na_2CO_3$  required to soften  $10L$  of hard water is

5.3g

Answer: A::D

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13. The hardness of water due to  $HCO_3$  is  $122 \pm$  . Select the correct statement(s).

A. The hardness of water in terms of  $CaCO_3$  is  $200ppm$

B. The hardness of water in terms of  $CaCO_3$  is  $100ppm$

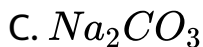
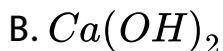
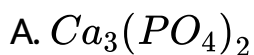
C. The hardness of water in terms of  $CaCO_3$  is  $22ppm$

D. The hardness of water in terms of  $CaCO_3$  is  $95\text{ppm}$

**Answer: B::D**

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



**Answer: B::C**



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15. In which of the following hydrides, hydrogen exists in negative oxidation state?



Answer: B::C



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16. The oxidation states of the most electronegative elements in the products of the reaction between  $BaO_2$  and  $H_2SO_4$  are

A.  $-1$

B.  $+1$

C.  $-2$

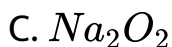
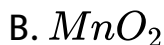
D.  $0$

**Answer: A:C**



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



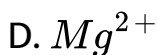
**Answer: C::D**



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18. When zeolite which is hydrated sodium aluminium silicate is treated with hard water, the sodium ions are

exchanged with which of the following ion (S)?



**Answer: C::D**



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



B. *Sn*

C. *Al*

D. *Mg*

**Answer: A::B::C**



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## Exercises Single Correct

1. Which of the following process uses water gas shift reaction?

A. Merck's process

B. Lane's process

C. Permutit process

D. Bosch's process

**Answer: D**

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2. Ethylene and  $H_2O_2$  react to give

A.  $CO_2$ ,  $H_2O$

B.  $CO$ ,  $H_2O$

C. Ethylene oxide

D. Ethylene glycol

**Answer: D**



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3. In which of the following compound does hydrogen exhibit a negative oxidation state:

A.  $LiH$

B.  $H_2O$

C.  $HCl$

D. none of these

**Answer: A**



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4. The number of electrons in deuterium is

A. 2

B. 3

C. 1

D. 0

**Answer: C**



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5. Which of the following represents the heavy water?

A. water at  $277k$

B. water containing large contamination of lead salts

C. deuterium oxide

D. protium oxide

**Answer: C**



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**6.**  $H_2O_2$  cannot act as

A. oxidising agent

B. dehydrating agent

C. reducing agent

D. acid



**Answer: B**

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7. Hardness of water is due to dissolved impurities of

- A. calcium and magnesium salt
- B. barium and magnesium salts
- C. calcium and strontium salts
- D. sodium and potassium salts

**Answer: A**

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8.  $H_2O_2$  is reduced by

A.  $O_3$

B. acidic  $KMnO_4$  solution

C. lead sulphide suspension in water

D. none of these

**Answer: C**



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9. When water is dropped over sodium peroxide, the colourless gas produced is

A. dinitrogen

B. dioxygen

C. dihydrogen

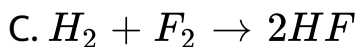
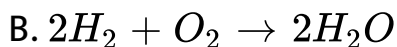
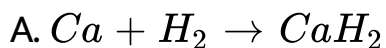
D. hydrogen peroxide

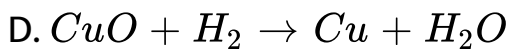
**Answer: B**



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**10.** In which of the following reaction dihydrogen acts as an oxidising agent?





**Answer: A**



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11. Which of the following metal does not produce dihydrogen gas with dilute hydrochloric acid?

A. *Mg*

B. *Zn*

C. *Ag*

D. *Ba*

**Answer: C**



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12. Which oxide cannot be reduced by  $H_2$ ?

A.  $Al_2O_3$

B.  $CuO$

C.  $ZnO$

D. All of these

**Answer: A**



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13. Ortho- and para-hydrogen differ in

- A. atomic number
- B. mass number
- C. electron spin in two atoms
- D. nuclear spin in two atoms

**Answer: D**



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**14.** Nascent hydrogen consists of

- A. hydrogen ions in the excited state
- B. hydrogen molecules with excess energy
- C. solvated protons

D. hydrogen atoms with excess energy

**Answer: D**

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**15. 30** – volume hydrogen peroxide means

A. 30 % of  $H_2O_2$  by volume

B. 30g of  $H_2O_2$  solution contains 1g of  $H_2O$

C.  $1cm^3$  of solution liberates  $30cm^3$  of dioxygen gas at

STP

D.  $1cm^3$  of solution liberate  $30cm^3$  of dioxygen gas at

STP

**Answer: C**

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**16.** The compound which gives  $H_2O_2$  on treatment with dilute acid is

A.  $PbO_2$

B.  $MnO_2$

C.  $TiO_2$

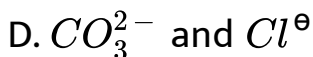
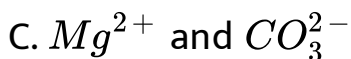
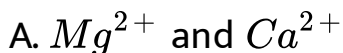
D.  $KO_2$

**Answer: D**

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17. When a sample of hard water is passed through the layer of sodium zeolite resulting which of the following ions will not be present in the resulting sample of water obtained?



**Answer: A**



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18. Hydrolysis of one mole of peroxodisulphuric acid produces acid produces

A. two moles of sulphuric acid and hydrogen peroxide

B. two moles of peroxomonosulphuric acid

C. one mole of sulphuric acid, one mole of peroxomonosulphuric acid and one mole of hydrogen peroxide

D. one mole of sulphuric acid and one mole of peroxomonosulphate acid

**Answer: A**



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19. Barium peroxide reacts with phosphoric acid to produce barium phosphate alongwith

A. water

B. hydrogen peroxide

C. dioxygen

D. phosphine

**Answer: B**



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20. One part of heavy water is present in  $X$  parts of ordinary water. Here  $X$  is

A. 10

B. 60

C. 6000

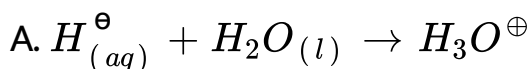
D. 60000

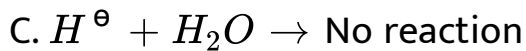
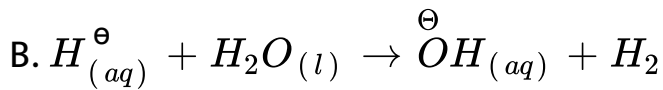
**Answer: C**



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21. The hydride ion  $H^-$  is stronger base than its hydroxide ion  $OH^-$ . Which of the following reactions will occur if sodium hydride (NaH) is dissolved in water ?





D. none of the above

**Answer: B**

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22. The volume strength of  $0.92NH_2O_2$  solution is

A. 4.8

B. 5.2

C. 8.8

D. 8.4

**Answer: D**

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23. Which one of the following pairs of substances on reaction will not evolve  $H_2$  gas ?

A. Iron and aqueous  $H_2SO_4$

B. Copper and  $HCl_{(aq)}$

C. Sodium and ethanol

D. Iron and steam

**Answer: C**

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24.  $H_2$  molecule has two electrons and two nuclei. In which form of hydrogen the spin of electrons and also the spin of nuclei are in opposite directions.

A. orthohydrogen

B. parahydrogen

C. metahydrogen

D.  $\beta$ -hydrogen

**Answer: B**



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25. What is false about Lane's process?

- A. method is used for manufacture of dihydrogen
- B. it involves the oxidation of iron by steam
- C. it involves the reducing of  $H_2O_{(g)}$  by iron
- D. it involves the oxidation of water gas

**Answer: D**



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**26.** Which of the following hydrides are generally non-stoichiometric in nature?

- A. ionic hydrogen
- B. molecular hydrides



C. interstitial hydrides

D. all of these

**Answer: C**



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27. Dihydrogen gas may be prepared by heating caustic soda on

A. *Cu*

B. *Zn*

C. *Na*

D. *Ag*

**Answer: B**

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**28.** The volume of 10 volume of  $H_2O_2$  required to liberate  $500\text{mL}$  of  $O_2$  at 'STP is

A.  $25\text{mL}$

B.  $50\text{mL}$

C.  $100\text{mL}$

D.  $125\text{mL}$

**Answer: B**

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29. Pure  $H_2O_2$  is

A. semi-solid

B. liquid

C. solid

D. gas

**Answer: B**



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30. Hydrogen can react with the following even in dark:

A.  $I_2$

B.  $Cl_2$

C.  $F_2$

D.  $Br_2$

**Answer: C**



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**31.** When zeolite which is hydrated sodium aluminium silicate is treated with hard water, the sodium ions are exchanged with which of the following ion (S)?

A.  $H^{\oplus}$  ions

B.  $Ca^{2+}$  ions

C.  $SO_4^{2-}$  ions

D.  $OH^\ominus$  ions

**Answer: B**

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32. 34 g of  $H_2O_2$  is present in 1120 mL of solution. This solution is called

A. 10vol solution

B. 20vol solution

C. 34vol solution

D. 32vol solution

**Answer: A**

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**33.** A 5.0 mL solution of  $H_2O_2$  liberates 1.27 g of iodine from an acidified KI solution. The percentage strength of  $H_2O_2$  is

A. 11.2

B. 5.6

C. 1.7

D. 3.4

**Answer: D**

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34. A 5.0 mL solution of  $H_2O_2$  liberates 1.27 g of iodine from an acidified KI solution. The percentage strength of  $H_2O_2$  is

- A. 11.2
- B. 5.6
- C. 1.7
- D. 3.4

**Answer: A**



35. 100 mL of ozone ( $O_3$ ) at STP were passed through 100 mL of 10 volume  $H_2O_2$  solution. What is the volume strength of  $H_2O_2$  after the reaction?

- A. 9.5
- B. 9.0
- C. 4.75
- D. 4.5

**Answer: A**



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36.  $25\text{mL}$  sample of distilled water, tap water and boiled water required, respectively,  $1\text{mL}$ ,  $13\text{mL}$  and  $5\text{mL}$  of soap solution to form permanent lather. The ratio of permanent to temporary hardness in the tap water is

A. 3 : 2

B. 2 : 3

C. 1 : 2

D. 2 : 1

**Answer: D**



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37. 3.4g sample of  $H_2O_2$  solution containing  $x\%$   $H_2O_2$  by weight requires  $x$  mL of a  $KMnO_4$  solution for complete oxidation under acidic condition. The normality of  $KMnO_4$  solution is

- A. 1N
- B. 2N
- C. 3N
- D. 0.5N

**Answer: B**

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38. If  $100\text{mL}$  of acidified  $2\text{NH}_2\text{O}_2$  is allowed to react with  $\text{KMnO}_4$  solution till there is light tinge of purple colour, the volume of oxygen produced at  $\text{STP}$  is :

A.  $2.24\text{L}$

B.  $1.12\text{L}$

C.  $3.36\text{L}$

D.  $4.48\text{L}$

**Answer: A**



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39.  $100\text{mL}$  of  $\text{H}_2\text{O}_2$  is oxidised by  $100\text{mL}$  of  $0.01\text{MKMnO}_4$  in acidic medium ( $\text{MnO}_4^\ominus$  reduced to  $\text{Mn}^{2+}$ ).  $100\text{mL}$  of the same  $\text{H}_2\text{O}_2$  is oxidised by  $V\text{mL}$  of  $0.01\text{MKMnO}_4$  in basic medium. Hence  $V$  is

A.  $\frac{100}{3}\text{mL}$

B.  $\frac{500}{3}\text{mL}$

C.  $\frac{300}{5}\text{mL}$

D. None

**Answer: B**



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40.  $10\text{mL}$  of  $\text{H}_2\text{O}_2$  solution (volume strength =  $x$ ) requires  $10\text{mL}$  of  $N/0.56\text{MnO}_4^\ominus$  solution in acidic medium. Hence  $x$  is

A. 0.56

B. 5.6

C. 0.1

D. 10

**Answer: D**



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**41.** The normality and volume strength of a solution made by mixing  $1.0L$  each of  $5.6$  volume and  $11.2$  volume  $H_2O_2$  solution are:

- A.  $1N$ ,  $5.6vol$
- B.  $1.5N$ ,  $5.6vol$
- C.  $1.5N$ ,  $8.4vol$
- D.  $1N$ ,  $8.4vol$

**Answer: C**

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42.  $100\text{mL}$  of  $\text{H}_2\text{O}_2$  is oxidised by  $100\text{mL}$  of  $0.01\text{MKMnO}_4$  in acidic medium ( $\text{MnO}_4^\ominus$  reduced to  $\text{Mn}^{2+}$ ).  $100\text{mL}$  of the same  $\text{H}_2\text{O}_2$  is oxidised by  $V\text{mL}$  of  $0.01\text{MKMnO}_4$  in basic medium. Hence  $V$  is

A. 500

B. 100

C.  $\frac{100}{3}$

D.  $\frac{500}{3}$

**Answer: D**



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43. The purity of  $H_2O_2$  in a given sample is 85%. Calculate the weight of impure sample of  $H_2O_2$  which requires 10 mL of  $M/5 KMnO_4$  solution in a titration in acidic medium

A. 2g

B. 0.2g

C. 0.17g

D. 0.15g

**Answer: B**



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44. 10L of hard water required 0.56g of lime ( $CaO$ ) for removing hardness. Hence, temporary hardness in ppm (part per million  $10^6$ ) of  $CaCO_3$  is:

A. 100

B. 200

C. 10

D. 20

**Answer: B**



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45. Hydrogen has the tendency to gain one electron to acquire helium configuration, in this respect, it resembles:

- A. alkali metals
- B. carbon
- C. alkaline earth metals
- D. halogens

**Answer: D**



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46. Heavy water is qualified as heavy liquid as it is.

- A. a heavy liquid

B. an oxide of heavier isotope of oxygen

C. an oxide of deuterium

D. denser than water

**Answer: C**



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**47. Which of the following is used as rocket fuel?**

A. Liquid  $O_2$

B. liquid  $NH_3$

C. Liquid  $N_2$

D. Liquid  $H_2$

**Answer: D**



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**48.** On burning hydrogen in air the colour of flame is

A. green

B. light bluish

C. yellow

D. none of these

**Answer: B**



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49. Number of  $H -$  bonds formed by a water molecule is:

A. 2

B. 8

C. 1

D. 4

**Answer: D**

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50. Surface water contains.

A. suspended impurities

B. organic impurities

C. salt

D. salt and organic compound

**Answer: A**



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**51.** Which is false about  $H_2O_2$ ?

A. acts both as an oxidising and reducing agent.

B. Two  $-OH$  bonds lie in the same plane.

C. Pale blue liquid.

D. Can be oxidised by  $O_3$

**Answer: B**



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52. When electric current is passed through an ionic hydride in molten state:

- A. hydrogen is liberated at anode
- B. hydrogen is liberated at cathode
- C. hydride ion migrates towards cathode
- D. hydride ion remains in solution

**Answer: A**



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53. Among  $CaH_2$ ,  $NH_3$ ,  $NaH$  and  $B_2H_6$  which are covalent hydrides?

A.  $NH_3$  and  $B_2H_6$

B.  $NaH$  and  $CaH$

C.  $NaH$  and  $NH_3$

D.  $CaH_2$  and  $B_2H_6$

**Answer: A**



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54. The oxygen atoms in  $H_2O_2$  undergo \_\_\_ hybridisation.



A. (a)  $sp^3$

B. (b)  $sp^2$

C. (c)  $sp$

D. (d)  $sp^3d^2$

**Answer: A**



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**55.** Which of the following is correct for hydrogen?

A. it can form bonds in +1 as well as -1 oxidation state.

B. it is collected at cathode

C. it has a very high ionisation potential

D. all of the above

**Answer: C**



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**56.** Which of the following is not a water softener?

A. calgon

B. permutit

C.  $Na_2SO_4$

D.  $Na_2CO_3$

**Answer: C**



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57. Calgon is an industrial name given to

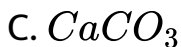
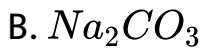
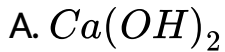
- A. normal sodium phosphate
- B. sodium meta-aluminate
- C. sodium hexametaphosphate
- D. hydrated sodium aluminium silicate

**Answer: B**



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58. Both temporary and permanent hardness is removed on boiling with



**Answer: A**



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59. The exhausted permutit is generally regenerated by percolating through it a solution of

- A. sodium chloride
- B. calcium chloride
- C. magnesium chloride
- D. barium chloride

**Answer: B**



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**60.** Heavy water is

- A.  $H_2O$
- B.  $D_2O$
- C. water at  $4^\circ C$

D. water obtained by repeated distillation

**Answer: A**

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**61.** An orange coloured solution acidified with  $H_2SO_4$  and treated with a substance 'X' gives a blue coloured solution of  $CrO_5$ . The substance 'X' is

A.  $H_2O_2$

B.  $H_2O$

C.  $dilHCl$

D. *ConcHCl*

**Answer: D**

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62. The shape of water molecule is same as that of

A.  $C_2H_2$

B.  $CO_2$

C.  $NH_3$

D.  $Cl_2O$

**Answer: A**

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63. Hydrogen can be placed in group 17 of the periodic table because

A. hydrogen forms hydrides like  $NaH$

B. hydrogen has isotopes  $D$  and  $T$

C. it is light

D. hydrogen combines with halogens

**Answer: D**



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64. Given colourless liquid will be determined whether it is water or not?

A. by smelling

B. by tasting

C. by phenolphthalein

D. by adding a pinch of anhydrous  $CuSO_4$

**Answer: C**



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65. Heavy water is used in atomic reactor as

A. coolant

B. moderator

C. both coolant and moderator

D. neither coolant nor moderator

**Answer: C**



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**66.** Hydrogen peroxide was first time prepared by

A. gay-lussac

B. priestely

C. thenard

D. bernard

**Answer: C**

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67. Consider  $LiH$ ,  $MgH_2$  and  $CuH$ :

A. all are ionic hydrides

B.  $LiH$ ,  $MgH_2$  are ionic, whereas  $CuH$  is covalent

C. all are covalent

D.  $LiH$  is ionic,  $MgH_2$  is covalent  $CuH$  is metallic

**Answer: D**

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68. Water softening by Clarke's process uses

A. calcium bicarbonate

B. calcium hydroxide

C. potash alum

D. sodium bicarbonate

**Answer: B**



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69.  $H_2O_2$  is a

A. monobasic acid

B. dibasic acid

C. neutral

D. weak alkali

**Answer: B**



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**70.** Which one of the following compounds is a peroxide ?

A.  $KO_2$

B.  $BaO_2$

C.  $MnO_2$

D.  $NO_2$

**Answer: B**

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71. Hard water is not fit for washing clothes because

A. (a) it contains  $Na_2SO_4$  and  $KCl$

B. (b) it gives precipitate

C. (c) it contains impurities

D. (d) it is acidic in nature

**Answer: B**

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## Exercises Assertion Reasoning

1. Assertion (*A*): Ferrocyanide ion oxidises  $H_2O_2$  to  $H_2O$ .

Reason (*R*) : Oxidation product of  $H_2O_2$  is  $O_2$ .

- A. If both (A) and (R) are correct and (R) is the correct explanation of (A).
- B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).
- C. If (A) is correct, but (R) is incorrect.
- D. If (A) is incorrect, but (R) is correct.

**Answer: D**



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2. Assertion (A): In a reaction of  $H_2O_2$  and  $Na_2CO_3$ , hydrogen peroxide acts as acid.

Reason (R) :  $H_2O_2$  cannot act as acid.

- A. If both (A) and (R) are correct and (R) is the correct explanation of (A).
- B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).
- C. If (A) is correct, but (R) is incorrect.
- D. If (A) is incorrect, but (R) is correct.



Answer: C

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3. Assertion (*A*): The colour of old lead painting can be restored by washing with dilute solution of  $H_2O_2$ .

Reason (*R*) : Black lead sulphide is oxidised by  $H_2O_2$  to white lead sulphate.

A. If both (*A*) and (*R*) are correct and (*R*) is the correct explanation of (*A*).

B. If both (*A*) and (*R*) are correct but (*R*) is not the correct explanation of (*A*).

C. If (*A*) is correct, but (*R*) is incorrect.

D. If (A) is incorrect, but (R) is correct.

**Answer: A**

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4. Assertion (*A*): A small piece of zinc dissolves in dilute nitric acid but no hydrogen is evolved.

Reason (*R*) :  $HNO_3$  is an oxidising acid and oxidises hydrogen evolved to water.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

**Answer: A**

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5. Assertion (A): Hydrogen oxidises lithium to  $Li$ .

Reason (R) : Hydrogen cannot act as oxidising agent.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

**Answer: A**

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6. Assertion (A): Pink coloured solution of potassium permanganate turns green on passing  $O_3$  through it.

Reason (R) :  $K_2MnO_4$  is oxidised by  $O_3$  to  $KMnO_4$ .

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

- B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).
- C. If (A) is correct, but (R) is incorrect.
- D. If (A) is incorrect, but (R) is correct.

**Answer: D**

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7. Assertion (*A*): Electrolysis of hard water produces  $O_2$  and  $D_2$ .

Reason (*R*): Ordinary hydrogen is called protium.

- A. If both (A) and (R) are correct and (R) is the correct explanation of (A).
- B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).
- C. If (A) is correct, but (R) is incorrect.
- D. If (A) is incorrect, but (R) is correct.

**Answer: A**

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**8.** Assertion (A): Colour of  $KMnO_4$  disappears when dihydrogen gas is bubbled through it.

Reason (R) :Dihydrogen gas is highly inflammable.

- A. If both (A) and (R) are correct and (R) is the correct explanation of (A).
- B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).
- C. If (A) is correct, but (R) is incorrect.
- D. If (A) is incorrect, but (R) is correct.

**Answer: B**

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9. Assertion (A): Concentration of  $H_2O_2$  is expressed in volume.

Reason (R): Volume strength = Normality  $\times$  5.6.

- A. If both (A) and (R) are correct and (R) is the correct explanation of (A).
- B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).
- C. If (A) is correct, but (R) is incorrect.
- D. If (A) is incorrect, but (R) is correct.

**Answer: B**

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**10.** Assertion (A): Hardness of water is determined by titrating it with disodium salt of *EDTA*.



Reason (*R*) :The indicator used in the titration is Eriochrome Black–*T* at  $pH = 10$ .

- A. If both (A) and (R) are correct and (R) is the correct explanation of (A).
- B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).
- C. If (A) is correct, but (R) is incorrect.
- D. If (A) is incorrect, but (R) is correct.

**Answer: A**



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11. Assertion (*A*): Temporary hardness in water is due to the presence of chlorides of magnesium.

Reason (*R*): Temporary hardness is removed by Clark's method.

A. If both (*A*) and (*R*) are correct and (*R*) is the correct explanation of (*A*).

B. If both (*A*) and (*R*) are correct but (*R*) is not the correct explanation of (*A*).

C. If (*A*) is correct, but (*R*) is incorrect.

D. If (*A*) is incorrect, but (*R*) is correct.

**Answer: D**



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12. Assertion (*A*): When blood is added to a solution of  $H_2O_2$ , the solution bubbles furiously.

Reason (*R*) : Catalase (an enzyme) present in blood decomposes  $H_2O_2$  and produces bubbles of  $O_2$ .

A. If both (*A*) and (*R*) are correct and (*R*) is the correct explanation of (*A*).

B. If both (*A*) and (*R*) are correct but (*R*) is not the correct explanation of (*A*).

C. If (*A*) is correct, but (*R*) is incorrect.

D. If (*A*) is incorrect, but (*R*) is correct.

**Answer: A**

**13.** Assertion (*A*): Alkali metals form ionic hydrides.

Reason (*R*) : Alkali metals lose their valence electron which is accepted by hydrogen to form hydride ion.

- A. If both (*A*) and (*R*) are correct and (*R*) is the correct explanation of (*A*).
- B. If both (*A*) and (*R*) are correct but (*R*) is not the correct explanation of (*A*).
- C. If (*A*) is correct, but (*R*) is incorrect.
- D. If (*A*) is incorrect, but (*R*) is correct.

**Answer: A**

**14.** Assertion ( $A$ ): The process of adsorption of hydrogen on palladium is known as occlusion.

Reason ( $R$ ) : The adsorbed hydrogen is more active than ordinary hydrogen.

- A. If both ( $A$ ) and ( $R$ ) are correct and ( $R$ ) is the correct explanation of ( $A$ ).
- B. If both ( $A$ ) and ( $R$ ) are correct but ( $R$ ) is not the correct explanation of ( $A$ ).
- C. If ( $A$ ) is correct, but ( $R$ ) is incorrect.
- D. If ( $A$ ) is incorrect, but ( $R$ ) is correct.

**Answer: B**



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**15.** Assertion (A):  $H_2O$  is a linear molecule.

Reason (R) : Oxygen is  $sp^3$  hybridised.

- A. If both (A) and (R) are correct and (R) is the correct explanation of (A).
- B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).
- C. If (A) is correct, but (R) is incorrect.
- D. If (A) is incorrect, but (R) is correct.

**Answer: D**

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**16.** Assertion (*A*):  $NaCl$  is less soluble in heavy water than in ordinary water.

Reason (*R*) : Dielectric constant of ordinary water is more than that of heavy water.

A. If both (*A*) and (*R*) are correct and (*R*) is the correct explanation of (*A*).

B. If both (*A*) and (*R*) are correct but (*R*) is not the correct explanation of (*A*).

C. If (*A*) is correct, but (*R*) is incorrect.

D. If (A) is incorrect, but (R) is correct.

**Answer: A**

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17. Assertion (*A*): Dihydrogen is prepared in the laboratory by the action of conc  $H_2SO_4$  on granular zinc.

Reason (*R*) : Pure hydrogen can be obtained by the action of water on sodium hydride.

A. If both (A) and (R) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).



C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

**Answer: D**

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## Exercises Interger

1. What is the molarity of  $H_2O_2$  of the 11.2V (volume strength)?

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2. A bottle of  $H_2O_2$  is labelled as  $10\text{vol}H_2O_2$ .  $112\text{mL}$  of this solution of  $H_2O_2$  is titrated against  $0.04\text{M}$  acidified solution of  $KMnO_4$ . Calculate the volume of  $KMnO_4$  in terms of litre.

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3. What is the oxidation state of oxygen of  $H_2O_2$  in the final products when it reacts with  $ClO_3^-$ ?

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4. What is the oxidation state of oxygen of  $H_2O_2$  in the final products when it reacts with  $As_2O_3$ ?



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5. Washing soda ( $Na_2CO_3 \cdot 10H_2O$ ) is widely used in softening of hard water. If 1L of hard water requires 0.0143g of washing soda, what is hardness of water in terms of *ppm* of  $CaCO_3$ ?



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6. What is the sum of protons, electrons and neutrons in the heaviest isotope of hydrogen?



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7. What is the sum of protons, electrons and neutrons in the lightest isotope of hydrogen?

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8. How many moles of ammonia are produced when one mole of calcium nitride reacts with water?

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9. How many moles of phosphine are produced when one of the calcium phosphides reacts with water?

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10. What is the molarity of a commercial sample of 33.6 volume hydrogen peroxide solution?

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## Exercises Fill In The Blanks

1. The principal cause of hardness of water is the presence of \_\_\_\_ and \_\_\_\_ ions.

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2. In reaction of hydrogen peroxide and sodium carbonate,  $H_2O_2$  acts as \_\_\_\_.



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3. In the reaction of  $F_2$  and  $H_2O$ , water act as \_\_\_\_.



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4. Sodium zeolite is \_\_\_\_.



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5. The trade name of sodium hexametaphosphate is \_\_\_\_.



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6. The electrolysis of molten hydrolith produces \_\_\_\_ gas at anode.

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7. Bleaching action of hydrogen peroxide is due to \_\_\_\_.

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8.  $O - O - H$  bond angle in  $H_2O_2$  is approximately \_\_\_\_.

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9. Bleaching powder and hydrogen peroxide react to give \_\_\_\_\_.

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10. Dropping of water over calcium carbide produces \_\_\_\_\_ gas.

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## Exercises True False

1. A sample of water which does not produce lather with soap readily



is called heavy water.

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2. 1 litre of 30 volume-hydrogen peroxide contains  $91.07gH_2O_2$ .

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3. Deuterium is an isotope of hydrogen.

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4. Water is an ionic hydride.





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5.  $H_2O_2$  cannot act as reducing agent. True or False



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6. Zinc dissolves in concentrated  $NaOH$  solution to produce dihydrogen as well as dioxygen gas.



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7. Protium oxide is the name given to  $D_2O$ .



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8. Ammonia and phosphine are saline hydrides.

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9. Oxygen atoms and hydrogen atoms in  $H_2O_2$  are collinear.

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10.  $D_2O$  is more polar than  $H_2O$ .

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1. When zeolite which is hydrated sodium aluminium silicate is treated with hard water, the sodium ions are exchanged with which of the following ion (S)?

A.  $H^{\oplus}$  ions

B.  $Ca^{2+}$  ions

C.  $SO_4^{2-}$  ions

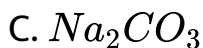
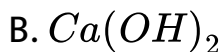
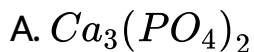
D.  $Mg^{2+}$

**Answer: B::D**



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2. The reagent(s) used for softening the temporary hardness of water is (are):



**Answer: B::C::D**



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3. Hydrogen peroxide in its reaction with  $KIO_4$  and  $NH_4OH$  respectively, is acting as a

A. reducing agent, oxidising agent

B. reducing agent, reducing agent

C. oxidising agent, oxidising agent

D. oxidising agent, reducing agent

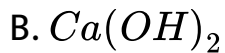
**Answer: A**



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## Exercises Archive Single Correct

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

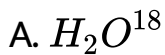


**Answer: B**

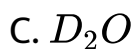


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**2. Heavy water is**



B. water obtained by repeated distillation



D. water at  $4^{\circ}C$

**Answer: C**

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3. The compound which gives  $H_2O_2$  on treatment with dilute acid is

A.  $PbO_2$

B.  $Na_2O_2$

C.  $MnO_2$

D.  $TiO_2$

**Answer: B**

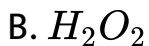
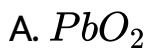




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4. The species that does not contain peroxide bond is

//are :



**Answer: A**



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5. Hydrolysis of one mole of peroxodisulphuric acid produces

A. 2 mol of sulphuric acid

B. 2 mol of peroxomonosulphuric acid

C. 1 mol of  $H_2SO_4$  and 1 mol of peroxomonosulphuric acid

D. 2 mol of  $H_2O_2$  and 1 mol  $H_2O_2$

**Answer: D**



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

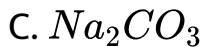
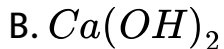
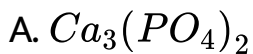
- A. form soluble complexes with anionic species
- B. precipitate anionic species
- C. form soluble complexes with cationic species
- D. precipitate cationic species.

**Answer: C**



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7. The reagent(s) used for softening the temporary hardness of water is (are):

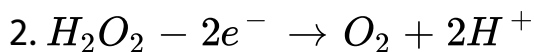
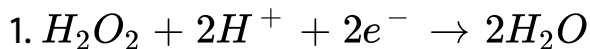


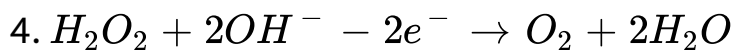
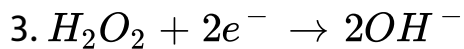
**Answer: B**



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8. In which of the following reactions  $H_2O_2$  acts as a reducing agent?





A. *B* and *C*

B. *A* and *C*

C. *B* and *D*

D. *A* and *B*

**Answer: C**

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**9.** From the following statements regarding  $H_2O_2$ , choose the incorrect statement :

- A. it can act only as an oxidizing agent
- B. it decomposes on exposure to light
- C. it has to be stored in plastic or wax lined glass bottles in dark
- D. it has to be kept away from dust

**Answer: A**



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## Exercises Archive Fill In The Blanks

1. The adsorption of hydrogen by palladium is commonly known as \_\_\_\_\_.



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2. Hydrogen gas is liberated the action of aluminium with concentrated solution of\_\_\_\_\_.



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## Subjective Archive Subjective

1.  $H_2O_2$  is a better oxidising agents than water.



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2. The mixture of hydrazine and hydrogen peroxides with a copper (*II*) catalyst is used as a rocket propellant.

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3. a. When  $H_2O_2$  is added to blood, rapid evolution of a gas occurs. Why?

b. Hydrogen peroxide acts both as an oxidising and as a reducing agent in alkaline solution towards certain first row transition metal ions. Illustration both these properties of  $H_2O_2$  using chemical equations.

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