HYDROGEN & IT'S COMPOUND

1. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A : Hydrogen is the most abundant element in the Universe, but it is not the most abundant gas in the troposphere.

Reason R : Hydrogen is the lightest element. In the light of the above statements, choose the correct answer from the options given below :

(1) **A** is true but **R** is false

(2) Both **A** and **R** are true and **R** is the correct explanation of **A**

(3) **A** is false but **R** is true

(4) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

2. Statements about heavy water are given below.

A. Heavy water is used in exchange reactions for the study of reaction mechanisms.

B. Heavy water is prepared by exhaustive electrolysis of water

C. Heavy water has higher boiling point than ordinary water.

D. Viscosity of H_2O is greater than D_2O

(1) A, B and C only (2) A and B only

(3) A and D only (4) A and C only

3. Which of the following forms of hydrogen emits low energy β^- particles?

(1) Deuterium $^{2}_{1}H$ (2) Tritium $^{3}_{1}H$

(3) Protium $^{1}_{1}H$ (4) Proton H^+

4. Calgon is used for water treatment. Which of the following statement is NOT true about Calgon?

(1) Calgon contains the 2nd most abundant element by weight in the Earth's crust.

(2) It is polymeric compound and is water soluble.

(3) It is also known as Graham's salt

(4) It does not remove Ca^{2+} ion by precipitation.

5. Given below are two statements :

Statement I : H_2O_2 can act as both oxidising and reducing agent in basic medium.

Statement II : In the hydrogen economy, the energy is transmitted in the form of dihydrogen.

In the light of the above statements, choose the correct answer from the options given below :

(1) Both statement I and statement II are false

(2) Both statement I and statement II are true

(3) Statement I is true but statement II is false

(4) Statement I is false but statement II is true

6. The correct statements about H_2O_2 are :

(A) used in the treatment of effluents.

(B) used as both oxidising and reducing agents.

(C) the two hydroxyl groups lie in the same plane.

(D) miscible with water.

Choose the correct answer from the options given below :

(1) (A), (B), (C) and (D)

(2) (A), (B) and (D) only

(3) (B), (C) and (D) only

(4) (A), (C) and (D) only

7. The INCORRECT statement(s) about heavy water is (are)

(A) used as a moderator in nuclear reactor

(B) obtained as a by-product in fertilizer industry.

(C) used for the study of reaction mechanism

(D) has a higher dielectric constant than water

Choose the correct answer from the options given below :

(1) (B) only (2) (C) only

(3) (D) only (4) (B) and (D) only

8. The functional groups that are responsible for the ion-exchange property of cation and anion exchange resins, respectively, are :

(1) $-SO_3H$ and $-NH_2$

(2) $-SO_3H$ and –COOH

(3) $-NH_2$ and –COOH

(4) $-NH_2$ and $-SO_3H$

9. Given below are two statements : One is labelled as Assertion A and the other labelled as reason R

Assertion A : During the boiling of water having temporary hardness, $Mg(HCO_3)_2$ is converted to $MgCO_3$.

Reason R : The solubility product of $Mg(OH)_2$ is greater than that of $MgCO_3$.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Both A and R are true but R is not the correct explanation of A

(2) A is true but R is false

(3) Both A and R are true and R is the correct explanation of A

(4) A is false but R is true

10. In basic medium, H_2O_2 exhibits which of the following reactions ?

(A) $Mn^{2+} \rightarrow Mn^{4+}$

(B) $I_2 \rightarrow I^-$

(C) $PbS \rightarrow PbSO_4$

Choose the most appropriate answer from the options given below :

(1) (A), (C) only (2) (A) only

(3) (B) only (4) (A), (B) only

11. The single largest industrial application of dihydrogen is :

(1) Manufacture of metal hydrides

(2) Rocket fuel in space research

(3) In the synthesis of ammonia

(4) In the synthesis of nitric acid

12. Metallic sodium does not react normally with

(1) gaseous ammonia

(2) But-2-yne

(3) Ethyne

(4) tert-butyl alcohol

13. Isotope(s) of hydrogen which emits low energy β^- particles with $t_{½}$ value > 12 years is/are

(1) Protium

(2) Tritium

(3) Deuterium

(4) Deuterium and Tritium

14. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : Heavy water is used for the study of reaction mechanism.

Reason (R) : The rate of reaction for the cleavage of O - H bond is slower than that of O-D bond.

Choose the **most appropriate** answer from the options given below :

(1) Both **(A)** and **(R)** are true but **(R)** is not the true explanation of **(A)**.

(2) Both **(A)** and **(R)** are true and **(R)** is the true explanation of **(A)**.

(3) **(A)** is false but **(R)** is true.

(4) **(A)** is true but **(R)** is false.

15. Deuterium resembles hydrogen in properties but :

(1) reacts slower than hydrogen

(2) reacts vigorously than hydrogen

(3) reacts just as hydrogen

(4) emits β^+ particles

16. Which one of the following methods is most suitable for preparing deionized water?

(1) Synthetic resin method

(2) Clark's method

(3) Calgon's method

(4) Permutit method

17. Given below are two statements :

Statement-I : The process of producing syn-gas is called gasification of coal.

Statement-II : The composition of syn-gas is $CO + CO_2 + H_2$ (1 : 1 : 1)

In the light of the above statements, choose the **most appropriate** answer from the options given below :

(1) **Statement-I** is false but **Statement-II** is true

(2) **Statement-I** is true but **Statement-II** is false

(3) Both **Statement-I** and **Statement-II** are false

(4) Both **Statement-I** and **Statement-II** are true

18. Which one of the following statements is **incorrect ?**

(1) Atomic hydrogen is produced when H_2 molecules at a high temperature are irradiated with UV radiation.

(2) At around 2000 K, the dissociation of dihydrogen into its atoms is nearly 8.1%.

(3) Bond dissociation enthalpy of H_2 is highest among diatomic gaseous molecules which contain a single bond.

(4) Dihydrogen is produced on reacting zinc with HCl as well as $NaOH_{(aq)}$.

SOLUTION

1. Official Ans. by NTA (2)

Sol. Most abundant gas in the troposphere is nitrogen.

2. Official Ans. by NTA (1)

Sol. Heavy water is used in exchange reactions for study of reaction mechanisms

Heavy water is prepared by exhaustive electrolysis of water.

B.P. of D_2O = 374.4 K

B.P. of H_2O = 373 K

Viscosity of H_2O = 0.89 centipoise

Viscosity of D_2O = 1.107 centipoise

3. Official Ans. by NTA (2)

Sol. For tritium ($_1^3H$)

No. of neutron (n) = 2

No. of proton (p) = 1

$\frac{n}{p} = 2$

$\because \frac{n}{p}$ is high,

tritium will emit β particle.

4. Official Ans. by NTA (1)

Sol. → 2nd most abundant element is "Si" and it is not present in calgon

$Na_6P_6O_{18}$ = (Graham's salt)

(Sodium hexametaphosphate)

→ It exist in polymeric form as $(NaPO_3)_6$ and water soluble compound

→ It removes Ca^{2+} in soluble ion but not by precipitation

5. Official Ans. by NTA (2)

Sol. (a) H_2O_2 can acts as both oxidising and reducing agent in basic medium.

(i) $2Fe^{2+} + H_2O_2 \rightarrow 2Fe^{3+} + 2OH^-$

In this reaction, H_2O_2 acts as oxiding agent.

(ii) $2\overset{+7}{M}nO_4^- + 3H_2O_2 \rightarrow 2\overset{+4}{M}nO_2 + 3O_2 + 2H_2O + 2OH^-$

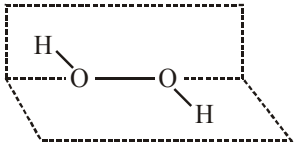
In this reaction, H_2O_2 acts as reducing agent

(b) The basic principle of hydrogen economy is the transportation and storage of energy in the form of liquids or gaseous dihydrogen.

Advantage of hydrogen economy is that energy is transmitted in the form of dihydrogen and not as electric power

6. Official Ans. by NTA (2)

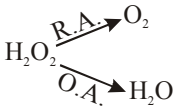
Sol.



Structure of H_2O_2

(Open book type) → Non planar

H_2O_2 is used in the treatment of effluents.



act as both O.A & R.A.

H_2O_2 is miscible in water due to hydrogen bonding.

7. Official Ans. by NTA (3)

Sol. The dielectric constant of H_2O is greater than heavy water.

8. Official Ans. by NTA (1)

Sol. Cation exchanger contains $-SO_3H$ or –COOH groups while anion exchanger contains basic groups like $-NH_2$.

9. Official Ans. by NTA (4)

Sol. For temporary hardness,

$Mg(HCO_3)_2 \xrightarrow{\text{heating}} Mg(OH)_2\downarrow + 2CO_2\uparrow$

Assertion is false.

$MgCO_3$ has high solubility product than $Mg(OH)_2$.

According to data of NCERT table 7.9 (Equilibrium chapter), the solubility product of magnesium carbonate is 3.5×10^{-8} and solubility product of $Mg(OH)_2$ is 1.8×10^{-11}.

Hence Reason is incorrect.

The question should be Bonus.

10. Official Ans. by NTA (4)

Sol. In basic medium, oxidising action of H_2O_2.

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

In basic medium, reducing action of H_2O_2

$I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

In acidic medium, oxidising action of H_2O_2.

$PbS(s) + 4H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(\ell)$

Hence correct option (4)

11. Official Ans. by NTA (3)

Sol. Informative, according to ncert uses of di hydrogen.

In fact NH_3 largest production in used to manufacture nitrogenous fertilisers.

12. Official Ans. by NTA (2)

Sol. Metallic sodium does not react with 2-butyne because 2-butyne does not have acidic hydrogen.

13. Official Ans. by NTA (2)

Sol. ${}_1^1H$ and ${}_1^2H$ are stable while ${}_1^3H$ is radioactive.

14. Official Ans. by NTA (4)

Sol. D_2O in used for the study of reaction mechanism.

Rate of reaction for the cleavage of O–H bond > O-D bond.

15. Official Ans. by NTA (1)

Sol. The bond dissociation energy of D_2 is greater than H_2 and therefore D_2 reacts slower than H_2.

16. Official Ans. by NTA (1)

Sol. Pure demineralised (de-ionized) water free from all soluble mineral salts is obtained by passing water successively through a cation exchange (in the H^+ form) and an anion exchange (in the OH^- form) resins.

17. Official Ans. by NTA (2)

Sol. The process of producing syn-gas from coal is called gasification of coal.

Syn-gas having composition of CO & H_2 in 1 : 1

18. Official Ans. by NTA (2)

Sol. Atomic hydrogen is produced at high temperature in an electric are or under ultraviolet radiations

The dissociation of dihydrogen at 2000 K is only 0.081%

H–H bond dissociation enthalpy is highest for a single bond for any diatomic molecule.

Dihydrogen can be produced on reacting Zn with dil. HCl as well as NaOH (aq.)