15

Hydrogen

TOPIC 1
Preparation and Properties of Hydrogen

01 Tritium, a radioactive isotope of hydrogen, emits which of the following particles? **[NEET 2021]**

(a) Beta (β^-) (b) Alpha (α)
(c) Gamma (γ) (d) Neutron (n)

Ans. *(a)*

Tritium (^3_1H) is an isotope of hydrogen. It is a radioactive isotope and decays by emitting beta-particle (β^-) to form $^3_2He^+$.

$$\underset{\text{Tritium}}{^3_1H} \longrightarrow {}^3_2He^+ + \underset{\beta\text{-particle }(\beta^-)}{e^-} + 18.6\ \text{keV}$$

02 Which of the following statements about hydrogen is incorrect? **[NEET 2016, Phase I]**

(a) Hydrogen never acts as cation in ionic salts
(b) Hydronium ion, H_3O^+ exists freely in solution
(c) Dihydrogen does not act as a reducing agent
(d) Hydrogen has three isotopes of which tritium is the most common

Ans. *(c,d)*

- For ionic salts, hydrogen never behaves as cation, but behaves as anion (H^-).
- H_3O^+ exists freely in solution.
- Dihydrogen acts as a reducing agent.
- Hydrogen has three isotopes.
- Protium (^1_1H)
- Deuterium (^2_1H)
- Tritium (^3_1H)

Protium is the most common isotopes of hydrogen with an abundance of 99.98%.

03 "Metals are usually not found as nitrates in their ores". **[CBSE AIPMT 2015]**

Out of the following two (I and II) reasons which is/are true for the above observation?

I. Metal nitrates are highly unstable.
II. Metal nitrates are highly soluble in water.

(a) I and II are true
(b) I and II are false
(c) I is false but II is true
(d) I is true but II is false

Ans. *(c)*

Metals are usually not found as nitrates in their ores, because metal nitrates are highly soluble in water.

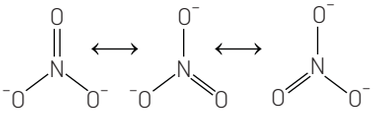
For example, KNO_3 (salt peter) would be classified as completely soluble.

Thus, KNO_3 could be expected to dissociate completely in aqueous solution to give K^+ and NO_3^- ions.

$$KNO_3 \rightleftharpoons K^+(aq) + NO_3^-(aq)$$

The nitrate anion has three equivalent oxygen surrounding a central nitrogen atom.

This tends to spread the single negative charge and make it easier for water (using hydrogen bonds) to separate the ions in solution.



TOPIC 2
Hydrides and Water

04 Match the following and identify the correct option. **[NEET (Sep.) 2020]**

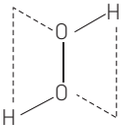
A.	$CO(g) + H_2(g)$	(i)	$Mg(HCO_3)_2$ + $Ca(HCO_3)_2$
B.	Temporary hardness of water	(ii)	An electron deficient hydride
C.	B_2H_6	(iii)	Synthesis gas
D.	H_2O_2	(iv)	Non-planar structure

	A	B	C	D		A	B	C	D
(a)	(iii)	(ii)	(i)	(iv)	(b)	(iii)	(iv)	(ii)	(i)
(c)	(i)	(ii)	(ii)	(iv)	(d)	(iii)	(i)	(ii)	(iv)

Ans. *(d)*

So, correct combinations are:
(a)–(iii), (b)–(i), (c)–(ii), (d)–(iv)

(a) Water gas ($CO + H_2$) is also known as synthesis gas (iii).
(b) Temporary hardness of water is due to the presence of HCO_3^- radicals of Mg^{2+} and/or Ca^{2+} ion(s) (i).
(c) Boron atoms of B_2H_6 are sp^3-hybridised but due to the presence of two B—H—B bonds (3C—$2e^-$), B_2H_6 becomes as an electron deficient hydride (ii).
(d) H_2O_2 has a book-shaped non-planar structure (iv).



Non-planar structure

TOPIC 3

Heavy Water and H_2O_2

05 The method used to remove temporary hardness of water is

[NEET (National) 2019]

(a) Clark's method
(b) ion-exchange method
(c) synthetic resins method
(d) Calgon's method.

Ans. *(a)*

Temporary hardness in water is due to presence of magnesium and calcium hydrogen carbonates.

Temporary hardness in water can be removed by Clark's method. In this method calculated amount of lime is added to hard water. It precipitates out calcium carbonate and magnesium hydroxide which can be filtered off.

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

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

Besides this, temporary hardness can also be removed by boiling. All the other given methods are used to remove permanent hardness of water.

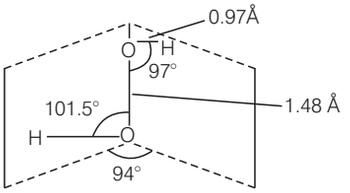
06 The structure of H_2O_2 is

[CBSE AIPMT 1999]

(a) planar
(b) non-planar
(c) spherical
(d) linear

Ans. *(b)*

H_2O_2 shows non-planar structure. It has a half opened book like structure in which the two O—H groups lie on the two pages of the book.



O—O single bond distance is 1.48 Å.