

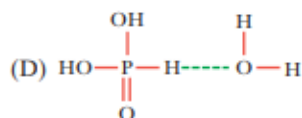
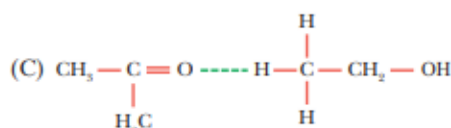
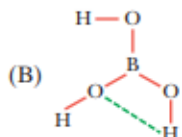
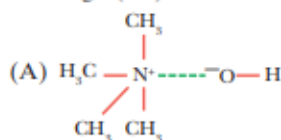
Hydrogen and the Hydrides

SINGLE CORRECT CHOICE TYPE QUESTIONS

- Hydrogen atom is almost _____ times larger than H^+ ion.
(A) 50
(B) 500
(C) 5000
(D) 50000
- The ionization energy order for H , H^+ , H^- is
(A) $H < H^+ < H^-$
(B) $H^- > H > H^+$
(C) $H^- < H$
(D) $H^+ > H > H^-$
- The most common way by which the hydrogen atom may attain stability is
(A) forming covalent bond.
(B) forming H^+ .
(C) forming H^- .
(D) Both (B) and (C).
- The most abundant element in the Universe is
(A) hydrogen.
(B) oxygen.
(C) nitrogen.
(D) helium.
- Which of the following is/are the properties of H_2 ?
(A) H_2 is the lightest gas known.
(B) H_2 is not very reactive under normal conditions.
(C) The bond energy of the $H-H$ bond is very high.
(D) None is incorrect.
- Which of the following statements is incorrect regarding the use of H_2 as fuel?
(A) It produces a lot of heat during burning.
(B) Burning H_2 causes pollution.
(C) Burning H_2 involves the risk of an explosion.
(D) Burning of hydrogen produces water.
- Proton and deuteron are differentiated by their
(A) number of protons.
(B) number of neutrons.
(C) number of electrons.
(D) charges.
- If the oxidation state of central atom in BH_3 is +3, then the oxidation states of the central atom in SiH_4 and CH_4 are, respectively,
(A) +4, -4
(B) +4, +4
(C) -4, +4
(D) -4, -4
- Choose the correct lattice energy order.
(A) $LiH < NaH < KH$
(B) $MgH_2 > CaH_2 < SrH_2$
(C) $LiH < NaH > KH$
(D) $MgH_2 > CaH_2 > SrH_2$
- At what temperature will water act as acid if K_w value of water at different temperature is as follows:
(A) $K_w = 10^{-14}$ (at $25^\circ C$)
(B) $K_w = 10^{-10}$ (at $80^\circ C$)
(C) $K_w = 10^{-16}$ (at $4^\circ C$)
(D) None of these.
- Choose the correct statement.
(A) HCl is the most volatile among all halogen acids.
(B) HCl is less easily liquefiable as compared to NH_3 .
(C) Water has higher boiling point than that of HF .
(D) All are correct.
- Choose the correct statement regarding maleic acid and fumaric acid.
(A) pK_{a1} of maleic acid is greater than pK_{a1} of fumaric acid.
(B) Both maleic acid and its first conjugate base have intramolecular hydrogen bonding.
(C) Fumaric acid cannot form hydrogen bonding.
(D) K_{a2} of fumaric acid is less than that of maleic acid.

MULTIPLE CORRECT CHOICE TYPE QUESTIONS

1. Which of the following representation of hydrogen bonding is(are) **incorrect**?



2. Hydrogen atom may attain stability by
 (A) forming an electron pair (covalent) bond with another atom.
 (B) losing an electron to form H^+ .
 (C) gaining an electron to form H^- .
 (D) None of these.

3. Which of the following properties of hydrogen atom are similar to those of halogens?

- (A) Formation of H^+ like X^+ .
 (B) Formation of H^- like X^- .
 (C) Formation of H_2 like X_2 .
 (D) None of these.

4. Which of the following processes can be used for preparation of H_2 gas?

- (A) Dissolving LiH in water.
 (B) Reaction of Al with NaOH solution.
 (C) Reaction of Zn with dilute H_2SO_4 .
 (D) Electrolysis of H_2O in the presence of KOH.

5. Which of the following properties of metallic hydrides are similar to those of their parent metal?

- (A) Hardness
 (B) Metallic lustre
 (C) Electrical conductivity
 (D) Magnetic property

6. Which of the following statements is correct regarding the conversion of metal into metallic hydride?

- (A) The density of metallic hydride is less than that of parent metal.
 (B) The crystal lattice expands through the inclusion of hydride.
 (C) A solid piece of a metal turns into powdered hydride.
 (D) None of these.

COMPREHENSION TYPE QUESTIONS

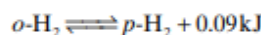
Passage 1: For Questions 1–3

H_2 , D_2 , T_2 are isotopes of each other.

1. The isotope effect arises due to
 (A) difference in number of electrons.
 (B) difference in number of protons.
 (C) difference in mass.
 (D) difference in properties.
2. Which of the following pairs shows maximum isotope effect?
 (A) 1_1H and 2_1D
 (B) $^{16}_8O$ and $^{18}_8O$
 (C) $^{35}_{17}Cl$ and $^{37}_{17}Cl$
 (D) $^{12}_6C$ and $^{14}_6C$
3. Which of the following properties has incorrect order?
 (A) $H_2 < D_2 < T_2$: Boiling point order
 (B) $H_2 < D_2 < T_2$: Freezing point order
 (C) $H_2 < D_2 < T_2$: Latent heat of vapourization
 (D) $T_2O > H_2O > D_2O$: Equilibrium constant for dissociation

Passage 2: For Questions 4–6

Ortho hydrogen ($o\text{-}H_2$) and *para* hydrogen ($p\text{-}H_2$) have different energy contents and are related by the equilibrium relation.



4. Which of the following statements is correct?
 (A) The percentage of $o\text{-}H_2$ decreases with increase in temperature.
 (B) The percentage of $p\text{-}H_2$ increases with decrease in temperature.
 (C) At absolute zero Kelvin, the percentage of $o\text{-}H_2$ is maximum.
 (D) At room temperature, D_2 cannot show $o\text{-}D_2 \rightleftharpoons p\text{-}D_2$ equilibrium.
5. $o\text{-}H_2$ and $p\text{-}H_2$ differ in which of the following properties?
 (A) Spin of nucleus.
 (B) Nuclear magnetic moment.
 (C) Boiling point.
 (D) All of these.
6. Choose the incorrect statement.
 (A) *Ortho* hydrogen has protons of parallel spin.
 (B) *Ortho* hydrogen is adsorbed more readily than *para* hydrogen by metal surface.
 (C) Both (A) and (B) are correct.
 (D) Neither (A) nor (B) is correct.

Passage 3: For Questions 7–9

Water on cooling to 0°C becomes ice. The main reason for this conversion is the hydrogen bonding.

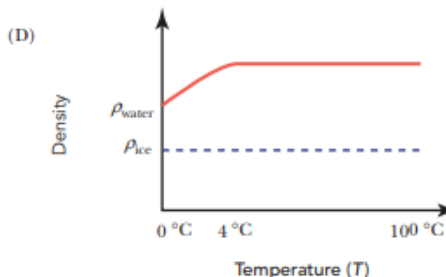
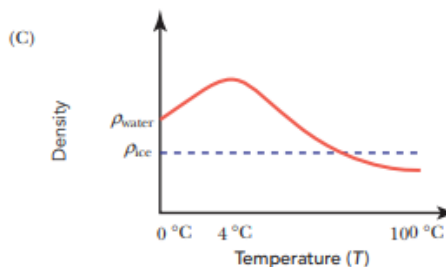
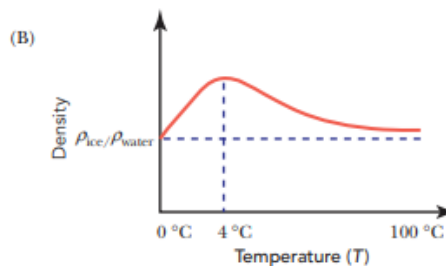
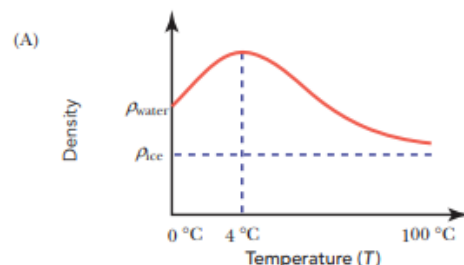
7. Which of the following statements is correct?

- (A) In ice, the hydrogen bonded H atoms are at equal distance from the other two covalently bonded H atoms around each O atom due to resonance.
- (B) In ice, the hydrogen bonded H atoms are at longer distance as compared to the other two covalently bonded H atoms around each O atom.
- (C) In ice, the hydrogen bonded H atoms are at shorter distance as compared to the other two covalently bonded H atoms around each O atom.
- (D) None of these.

8. Two ice cubes when pressed against each other join together. This kind of joining phenomenon occurs

- (A) just during pressing.
- (B) after pressing when the pressure is released.
- (C) during the whole process of pressing and releasing pressure.
- (D) Cannot be predicted.

9. Which of the following curves is the correct representation of the density vs. temperature plot for water?



ASSERTION-REASONING TYPE QUESTIONS

In the following set of questions, a Statement I is given and a corresponding Statement II is given below it. Mark the correct answer as:

- (A) If both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.
- (B) If both Statement I and Statement II are true but Statement II is not the correct explanation for Statement I.
- (C) If Statement I is true but Statement II is false.
- (D) If Statement I is false but Statement II is true.

1. **Statement I:** H^- is a stronger reducing agent as compared to H atom.

Statement II: The electronic configuration of H and H^- is $1s^1$ and $1s^2$ respectively.

2. **Statement I:** Free protons (H^+) do not exist under normal conditions.

Statement II: H^+ ion is extremely small in size and has a very high polarizing power.

3. **Statement I:** The abundance of H_2 in the earth's atmosphere is very small.

Statement II: The Earth's gravitational field is too small to hold a light element such as hydrogen.

4. **Statement I:** H^- and He are stable to an equal extent.

Statement II: H^- and He both have $1s^2$ electronic configuration.

5. **Statement I:** Hydride shift and methyl shift occur in a similar manner during a carbocation rearrangement.

Statement II: The structure of hydrogen resembles that of the Group 14 elements.

6. **Statement I:** D_2 is more rapidly adsorbed chemically on the metal surface than H_2 .

Statement II: Van der Waal's forces of attraction are more in D_2 than in H_2 .

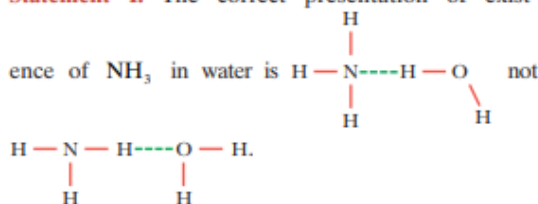
7. **Statement I:** Ti is prepared in an atmosphere of Argon not H_2 .

Statement II: Ti dissolves H_2 and becomes brittle.

8. **Statement I:** Trimethyl ammonium hydroxide (compound A) is a weaker base compared to tetramethyl ammonium hydroxide (compound B).

Statement II: The release of OH^- from (compound B) is faster than that from (compound A) due to presence of hydrogen bonding in (compound A) and absence of such bonding in (compound B).

9. **Statement I:** The correct presentation of existence of NH_3 in water is



Statement II: The polarity of $O-H$ bond is more than that of the $N-H$ bond.

10. **Statement I:** The heat of vapourization of HF is higher than that of H_2O .

Statement II: The hydrogen bond strength in HF is higher than that in H_2O .

11. **Statement I:** Boric acid is slippery in nature.

Statement II: Boric acid is monobasic in water.

12. **Statement I:** CsCl (solid) can absorb HCl vapour while NaCl (solid) cannot do so.

Statement II: Absorbing HCl vapour, CsCl forms $Cs^+[HCl_2]^-$ through hydrogen bond.

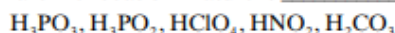
13. **Statement I:** Glycerol is more viscous than ethanol.

Statement II: Intermolecular hydrogen bonding is present in glycerol molecule.

INTEGER ANSWER TYPE QUESTIONS

The answer to each of the following questions is a non-negative integer.

- The total number of neutrons present in D_2O^{18} molecule is _____.
- The mass number of the element obtained when tritium undergoes β -decay is _____.
- The number of compounds among the following, which are monobasic in nature is _____.



4. The number of protons that can be accepted by hydrazine is _____.

5. The number of moieties available for H-bonding in one molecule of H_2SO_4 is _____.

MATRIX-MATCH TYPE QUESTIONS

In each of the following questions, statements are given in two columns, which have to be matched. The statements in Column I are labelled as (A), (B), (C) and (D), while those in Column II are labelled as (P), (Q), (R), (S) and (T). Any given statement in Column I can have correct matching with one or more statements in Column II.

1. Match the metal hydrides with their properties.

Column I	Column II
(A) LiH	(P) Conducts electricity when melted.
(B) BeH_2	(Q) The concept of hybridization is applicable.
(C) CH_4	(R) Liberates hydrogen at the anode on electrolysis in molten condition.
(D) CaH_2	(S) Produces hydrogen when dissolved in water.
	(T) Negative oxidation state of hydrogen atom.

2. Match the compounds with type of hydrogen bond.

Column I	Column II
(A) Maleic acid	(P) Intermolecular hydrogen bond is present
(B) $NaHCO_3(s)$	(Q) Intramolecular hydrogen bond is present.
(C) N_2H_4 (liquid)	(R) Hydrogen bonding through ion-dipole interaction is present.
(D) o-fluorophenol	(S) Hydrogen bonding through dipole-dipole interaction is present.

3. Match the order of compounds with the property.

Column I	Column II	Column I	Column II
(A) $\text{HCl} < \text{HBr} < \text{HI} < \text{HF}$	(P) The boiling point order.	(C) $\text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$	(R) The bond polarity order.
(B) $\text{PH}_3 < \text{AsH}_3 < \text{SbH}_3 < \text{NH}_3$	(Q) The melting point order.		(S) The acidic strength order.

ANSWERS

Single Correct Choice Type Questions

- | | | | |
|--------|--------|--------|---------|
| 1. (D) | 4. (A) | 7. (B) | 10. (D) |
| 2. (C) | 5. (D) | 8. (A) | 11. (D) |
| 3. (A) | 6. (B) | 9. (D) | 12. (B) |

Multiple Correct Choice Type Questions

- | | | |
|-----------------------|-----------------------|------------------|
| 1. (A), (B), (C), (D) | 2. (A), (B), (C) | 3. (B), (C) |
| 4. (A), (B), (C), (D) | 5. (A), (B), (C), (D) | 6. (A), (B), (C) |

Comprehension Type Questions

- | | | | | |
|--------|--------|--------|--------|--------|
| 1. (C) | 3. (D) | 5. (D) | 7. (B) | 9. (A) |
| 2. (A) | 4. (B) | 6. (D) | 8. (B) | |

Assertion–Reasoning Type Questions

- | | | | | |
|--------|--------|--------|---------|---------|
| 1. (B) | 4. (D) | 7. (A) | 10. (D) | 13. (B) |
| 2. (A) | 5. (A) | 8. (A) | 11. (B) | |
| 3. (A) | 6. (D) | 9. (A) | 12. (A) | |

Integer Answer Type Questions

- | | | | | |
|-------|------|------|------|-------|
| 1. 12 | 2. 3 | 3. 3 | 4. 2 | 5. 10 |
|-------|------|------|------|-------|

Matrix–Match Type Questions

- | | | |
|---|-------------------------------|---------------------------------|
| 1. (A) \rightarrow (P), (R), (S), (T) | 2. (A) \rightarrow (Q), (S) | 3. (A) \rightarrow (P) |
| (B) \rightarrow (Q), (T) | (B) \rightarrow (P), (R) | (B) \rightarrow (Q), (R) |
| (C) \rightarrow Q | (C) \rightarrow (P), (S) | (C) \rightarrow (P), (Q), (S) |
| (D) \rightarrow (P), (R), (S), (T) | (D) \rightarrow (Q), (S) | |