1. How many and what types of bonds are present in NH_4^+?
(a) Four covalent bonds
(b) Three covalent bonds and one ionic bond
(c) Four ionic bonds
(d) Three covalent bonds and one coordinate bond

2. Which of the following molecules contains covalent and coordinate bonds?
(a) CCl_4 (b) H_2SO_4 (c) NaCl (d) $Mg(OH)_2$

3. During a coordinate bond formation,
(a) One electron from an atom is transferred to other
(b) One electron each is lost from both the atoms
(c) A pair of electrons is contributed by one atom and shared by both the atoms
(d) A pair of electrons is transferred to the other atoms.

4. NH_3 and BF_3 combine readily because of the formation of :

(a) a covalent bond (b) a hydrogen bond
(c) a coordinate bond (d) an ionic bond

5. Which of the following does not contain coordinate bond ?

(a) N_2O_4 (b) NH_4^+
(c) CO_3^{2-} (d) H_3O^+

6. N_2O is isoelectronic with CO_2 and N_3^-, which is the structure of N_2O ?

(a) $\overset{+}{N}=N=\overset{-}{O}$ (b) N–O–N
(c)  (d) $N \equiv N \rightarrow \ddot{O}:$

7. Which of the following compounds shows maximum hydrogen bonding?
(a) HF (b) H_2O (c) NH_3 (d) CH_3OH

8. In which of the following substances will hydrogen bond be strongest?
(a) HCl (b) H_2O (c) HI (d) H_2O

9. The ice floats on water because
(a) Solids have lesser density than liquids
(b) It has open-cage like structure in which lesser molecules are packed per mL than water
(c) Of hydrogen bonding ice is lighter than water
(d) When ice is formed water molecules come closer and start floating.

10. Which of the following molecules shows intramolecular hydrogen bonding?
(a) o-Nitrophenol (b) *p*-Nitrophenol
(c) Benzoic acid (d) Ethanol

11. Though covalent in nature, methanoal is soluble in water, why?
(a) Methanol is transparent like water.
(b) Due to hydrogen bonding between methanol and water molecules.
(c) Due to van der 'waals' forces between methanol and water.
(d) Due to covalent attraction forces.

12. Which of the following observations can be explained on the basis of hydrogen bonding?
(i) H – F has higher boiling point than other halogen acids.

(ii) H_2O has highest boiling point among hydrides of group 16 elements.

(iii) NH_3 has lower boiling point than PH_3.

(a) (i), (ii) and (iii) (b) (i) and (iii)
(c) (ii) and (iii) (d) (i) and (ii)

13. Which of the following statements is true about hydrogen bonding?
(a) Cl and N have comparable electronegativities yet there is no H-bonding in HCl because size of Cl is large.
(b) Intermolecular H-bonding results in decease in m.p. and b.p.
(c) Ice has maximum density at $0\ ^0C$ due to H-bonding.
(d) $KHCl_2(HCl_2^-)$ exists but $KHF_2(HF_2^-)$ does not exist due to lack of H-bonding in HCl.

14. Hydrogen bond between two atoms is formed due to
(a) Displacement of electrons towards more electronegative atom resulting in fractional positive charge on hydrogen
(b) Displacement of electrons towards hydrogen atom resulting in a polar molecule.
(c) Formation of a bond between hydrogen atoms of one molecule and the other.
(d) Existence of an attractive force which binds hydrogen atoms together.

15. Which of the following statements is not true?
(a) Intermolecular hydrogen bonds are formed between two different molecules of compounds.
(b) Intramolecular hydrogen bonds are formed between two different molecules of the same compound.
(c) Intramolecular hydrogen bonds are formed within the same molecule.
(d) Hydrogen bonds have strong influence on the physical properties of a compound.

16. Hydrogen bonds are formed in many compounds e.g.,
$H_2O, HE\ NH_3$. The boiling point of such compounds depends to a large extent on the strength of hydrogen bond and the number of hydrogen bonds. The correct decreasing order of the boiling points of above compounds is
(a) $HE > H_2O > NH_3$ (b) $H_2O > HF > NH_3$
(c) $NH_3 > HF > H_2O$ (d) $NH_3 > H_2O > HF$

17. The correct order of the strength of H-bonds is
(a) H……F > H……O > H……N
(b) H……N > H……O > H……F
(c) H……O > H……N > H……F
(d) H……F > H……N > H……O

18. Boiling point of H_2O is higher than that of H_2S, because the former
(a) Is capable of forming H-bonds
(b) Has higher molecular mass
(c) Has relatively strong covalent bonds
(d) Is capable of forming co-ordinate bonds with H^+ ions

19. The hybrid state of I in IF_5 is
(a) sp^3d^2 (b) sp^3d^3 (c) sp^3d (d) sp^3

20. Pure phosphoric acid is very viscous because :
(a) it is a strong acid
(b) it is tribasic acid
(c) it is hygroscopic
(d) it has PO_4^{3-} groups which are bonded by many hydrogen bonds

21. Which of the following is least volatile ?
(a) HF (b) HCl
(c) HBr (d) HI

22. Which of the following molecule exhibits hydrogen-bonding ?

(a) CH_4 (b) H_2Se
(c) N_2H_4 (d) H_2S

23. Which compound have lowest boiling point.

(a) NH_3 (b) H_2O
(c) H_2S (d) HF

24. Hydrogen bonding would not affect the boiling point of :

(a) HI (b) NH_3
(c) CH_3OH (d) H_2O

25. Which of the following compound has maximum number of H-bonds per mole ?

(a) HF (b) PH_3
(c) H_2O (d) OF_2

26. Water (H_2O) is liquid while hydrogen sulphide (H_2S) is a gas because :

(a) water has higher molecular weight
(b) hydrogen sulphide is weak acid
(c) water molecular associate through hydrogen bonding
(d) sulphur has high electronegativity than oxygen

27. Which of the following compounds would have significant intermolecular hydrogen bonding ?

(a) HF, N_2O_4 (b) HF, CH_4, CH_3OH
(c) HF, CH_3OH (d) CH_3OH, CH_4

28. Which of the following has minimum melting point

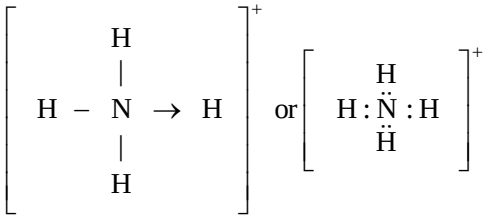
(a) CsF (b) HCl
(c) HF (d) LiF

29. Which of the following is least volatile ?

(a) HF (b) HCl
(c) HBr (d) HI

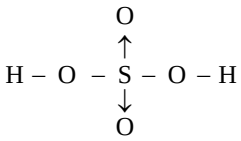
30. The hydrogen bond is strongest in
(a) O – H … S (b) S – H … F
(c) F – H … F (d) F – H … O

1. (d) :

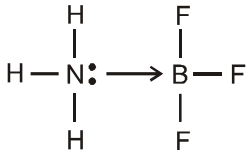


or

2. (b) H_2SO_4;

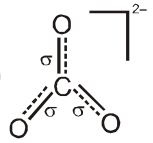


3. (c) : In a coordinate or dative bond, electrons required for sharing are contributed by one atom. The atom which contributes the electrons for sharing is called donor atoms and the atom which shares the electrons is called acceptor atom.



4. (c)

5. (c)



; it has only σ & π bonds. (;g dsoy σ vkSj π ca/k j[krk gS)

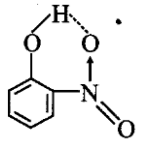
6. (d) $N \equiv N \rightarrow \ddot{O}:$

7. (a) : Greater the electronegativity and smaller the size of the atom, stronger is the H – bond.

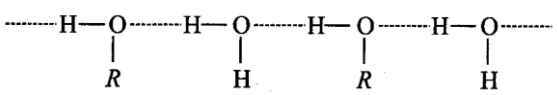
8. (b) : Only H_2O forms H-bolding while other substance HCl, HI and H_2S do not form H-bonding.

9. (b) : Density of ice is less than water due to an open-cage structure formed by hydrogen bonding.

10. (a) :



11. (b) :



In methanol, R is - CH_3 group

Hydrogen bonding between methanol and water.

12. (d) : Statement (iii) is not true since NH_3 has higher boiling point than PH_3 due to hydrogen bonding.

13. (a) : For hydrogen bonding the size of the atom should be small.

14. (a) : Hydrogen bonding occurs when H atom is linked to an electronegative atom like F, O or N. it is the force of attraction between small positive charge developed on H atom and small negative charge developed on electronegative atom due to displacement of electrons towards more electronegative atom.

15. (b) : Intramolecular hydrogen bonds are formed within the same molecule.

16. (b) : Strength of hydrogen bonding depends on the size and electroengativity of the atom. Smaller the size of the atom, greater is the electronegativity and hence stronger is the H-bonding. Thus the order of strength of H – bonding is H ….F>H…O > H…N. But each HF molecule is linked only to two other HF molecules while each H_2O molecule is linked to four other h_2O molecules through H-bonding.
Hence, the decreasing order of boiling points is $H_2O > HF > NH_3$

17. **(a)**
[strength of H-bond ∝ E.N. of Z atom]

18. **(a)**
In H_2O H-bond is present

19. **(a)**
IF_5 sp^3d^2 hybridization

20. (d) In pure phosphoric acid the PO_4^{3-} groups are bonded together through many hydrogen bonds.

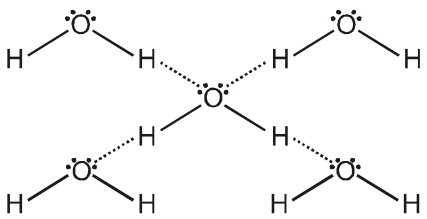
21. (a) HF is least volatile (i.e. high boiling point) due to strong intermolecular hydrogen bonding.

22. (c) In CH_4, H_2Se and H_2S the central atoms are not more electronegative ; hence do not form hydrogen bonds with itself and other molecule. In N_2H_4 the nitrogen is more electronegative and thus is able to form hydrogen bond with itself and other molecules like water.

23. (c) Inter molecular hydrogen bond is present in NH_3, H_2O and HF. H_2S does not form inter molecular hydrogen bonding because the electronnegativity of sulphur is low.

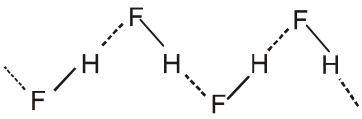
24. (a) HI does not form hydrogen bonding owing to less electronegativity value of iodine.

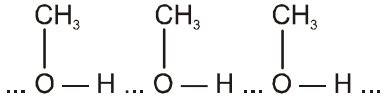
25. **(c)**



26. (c) Due to polar nature of H_2O there is association of water molecules giving a liquid state of abnormally high boiling point.

27. **(c)**





28. (b) HCl is the most covalent species.

29. (a) HF is least volatile (i.e. high boiling point) due to strong intermolecular hydrogen bonding.

30. (c)
The hydrogen bond strength depends on the electronegativity of the atom to which it is attached