



INDIAN SCHOOL MUSCAT

CLASS: XI

CHEMISTRY



CHEMICAL BONDING AND MOLECULAR STRUCTURE

I. Choose the Best Answer

- Which of the following molecules has both covalent and ionic bond
(a) CH_3Cl (b) NH_4Cl (c) HCl (d) BeCl_2
- Identify correct statement regarding NH_3 and BF_3
(a) Both are Lewis acid (b) Both are iso structural
(c) Both are Lewis base (d) Have different values of dipole moment
- Identify the molecule having sideways overlapping of atomic orbitals
(a) CH_4 (b) CO_2 (c) NH_3 (d) H_2O
- Which of the following chemical species is most stable?
(a) O_2 (b) O^{2+} (c) O^{2-} (d) O_2^{2-}
- The shape of XeF_4 molecule according to VSEPR theory is
(a) Square planar (b) Square pyramid (c) Tetrahedral (d) Pyramidal

II. Fill in the Blanks

- The energy required to completely separate one mole of solid ionic compound into gaseous constituent ions is called _____ .
- Among alkali metal ions _____ ion has highest polarizing power.
- Isoelectronic molecules and ions have identical _____.
- A triple covalent bond consists of _____ sigma and _____ pi bonds.

5. Atomic orbitals are _____ centric and molecular orbitals are _____ centric.

III. Assertion and Reasoning Questions:

Directions: (Questions 1 to 4).

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion.

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion.

C. If Assertion is true statement but Reason is false.

D. If both Assertion and Reason are false statements.

1. Assertion (A): Among the two O – H bonds in H₂O molecule, the energy required to break the first O – H bond and the other O – H bond is the same.

Reason (R): This is because the electronic environment around the oxygen is the same even after breakage of one O – H bond.

2. Assertion (A): Though the central atom of both NH₃ and H₂O molecules are sp³ hybridized, yet H – N – H bond angle is greater than that of H – O – H.

Reason (R): This is because nitrogen atom has one lone pair and oxygen atom has two lone pairs.

3. Assertion (A): SF₆ molecule is unstable.

Reason (R): A stable molecule must have 8 electrons around the central atom. i.e. octet rule should be satisfied.

4. Assertion (A): Pi bond is never formed alone. It is formed along with a sigma bond

Reason (R): Pi bond is formed by sideways overlap of p- orbitals only.

5. Assertion (A): Ionic compounds tend to be non-volatile.

Reason (R): Ionic compounds are solid.

IV Descriptive Questions:

1. Why NH₃ and BF₃ have different shapes?

2. What are

a) expanded octet molecules?

b) odd electron molecules?

c) electron deficient molecules?

Give two examples for each.

3. Differentiate between

- a) Bond energy and Bond dissociation energy
- b) Covalent and Van der Waal's radius
- c) Sigma and pi bond
- d) Bonding molecular orbital and anti-bonding molecular orbital

4. Draw the resonating structures of O_3 , CO_3^{2-} , NO_3^- , SO_2 , C_6H_6 and calculate formal charges on each atom.

5. Assign reason for the following;

- (i) NH_3 is freely soluble in water while PH_3 is not.
- (ii) B_2 is paramagnetic while C_2 is not.

6. Give reasons:

- a) BF_3 is non-polar while NF_3 is polar.
- b) ClF_3 is T-shaped.
- c) Bonds in ozone are equivalent.

Bond angle in water is larger than bond angle in H_2S

7. (i) H_2^+ and H_2^- have same bond order. Which is more stable?

(ii) Differentiate between bonding and anti-bonding molecular orbitals

8. Define the term bond length.

Arrange the following in the increasing order of their bond lengths: Ethane, ethene, ethyne

9. Discuss the conditions for the combination of atomic orbitals to form molecular orbitals.

10. Discuss the shapes of the following molecules using VSEPR model $BeCl_2$, BCl_3 , CH_4 , PCl_5 ,

SF_6 , H_2O , ClF_3 , BrF_3 , XeF_4 , SF_4 , NH_4^+

11. Although Chlorine (EN = 3.2) is more electronegative than Nitrogen (EN = 3.0), yet chlorine does not form hydrogen bond while nitrogen does. Give reason.

12. a) Define lattice enthalpy. How is it related to the stability of ionic compound?

b) Write the favorable conditions for the formation of ionic bond.

13. Arrange the following in the order of property indicated for each set:

(i) O^2 , O^{2+} , O^{2-} , O_2^{2-} (increasing stability)

- (ii) LiCl, NaCl, KCl, RbCl (increasing covalent character)
- (iii) NO_2 , NO^{2+} , NO^{2-} (decreasing bond angle)
- (iv) H – F, H – Cl, H – Br, H – I (increasing bond dissociation enthalpy)

14. Explain intermolecular and intramolecular hydrogen bonding with examples.

15. Give reasons:

- a) p_x orbital does not overlap with p_y orbital.
- b) Oxygen is paramagnetic.
- c) Acetic acid forms dimer.
- d) Para nitro phenol has higher boiling point than ortho nitro phenol.
- e) Hydrogen bonding in HCl is insignificant.
- f) HF has a higher boiling point than HCl.
- g) Axial bonds are longer than equatorial bonds in PCl_5

16. (i) Explain the formation of following molecules on the basis of hybridization:

(BeCl_2 , BCl_3 , CH_4 , C_2H_4 , C_2H_2 , PCl_5 and SF_6)

(ii) On the basis of molecular orbital theory calculate the bond order and predict the magnetic property of N_2 , F_2 , O_2^- and O_2^+ .

(iii) What is meant by hybridization? Describe the shape of sp , sp^2 and sp^3 hybridized orbitals.

17. Draw the Lewis structure of the species as mentioned below:

- (i) In which the central atom has incomplete octet.
- (ii) In which the central atom has an expanded octet,
- (iii) An odd electron molecule is formed.

18. Give reasons for the following:

- (a) NH_3 has higher boiling point than PH_3 .
- (b) Ionic compounds do not conduct electricity in solid state.
- (c) LiCl is more covalent than KCl.
- (d) NH_3 is more polar than NF_3 .
- (e) H_2O has bent structure.

19. Which hybrid orbitals are used by the carbon atoms in the following molecules?

(a) $\text{CH}_3\text{-CH=CH}_2$ (b) $\text{CH}_3\text{-CH}_2\text{-OH}$ (c) CH_3CHO (d) CH_3COOH

20. (i) Explain the structure of PCl_5 according to hybridization. Why all P – Cl bonds lengths are not equivalent in PCl_5 ?

(ii) The dipole moment of HCl is 1.03 D, and the bond length is 127 pm. Calculate the percent ionic character of HCl molecule.

21. Using molecular orbital theory, explain why Be_2 molecule does not exist.

