PREVIOUS HSE QUESTIONS FROM THE CHAPTER "CHEMICAL BONDING AND MOLECULAR STRUCTURE"

1. Draw the potential energy curve for the formation of a hydrogen molecule on the basis of inter-nuclear distance between the hydrogen atoms. (2)
2. (i) What is meant by dipolemoment ? (1)
   (ii) Dipolemoment of BF_3 is zero, but that of NH_3 is not zero. Why ? (2)
3. (i) A molecule of the type AB_2E_2 has 2 bond pairs of electrons and 2 lone pairs of electrons. The most stable structure of this molecule is _____ .
   (A) Tetrahedral (B) Bent (C) Square planar (D) Square pyramid (1)
   (ii) Write the important postulates of VSEPR theory. (3)
4. (i) Write the molecular orbital configuration of O_2 molecule. Account for its paramagnetic character. (2)
   (ii) Calculate the bond order of O_2 molecule. (2) [December 2021]
5. Fill in the blanks :

Molecule	Structure	Bond Angle
BF_3	.....	120^0
$BeCl_2$	Linear	.....

   (2)
6. (i) What is bond order according to M.O. theory ? (1)
   (ii) He_2 molecule does not exist, why ? (2)
7. (i) Write any two postulates of VSEPR theory. (2)
   (ii) Hydrogen bonds are of two types, which are they ? Write one example for each. (2)
8. (i) Hybridisation of Carbon in CH_4 is
   (A) sp^2 (B) sp (C) sp^3 (D) sp^3d (1)
   (ii) Write any two characteristics of hybridisation. (1)
   (iii) O_2 molecule is paramagnetic, explain using M.O. theory. (2) [September 2021]
9. (a) Define Bond angle. (1)
   (b) NH_3 and NF_3 molecules have a pyramidal shape with a lone pairs of electrons on nitrogen atom. But the dipole moment of NH_3 is 4.9×10^{-30} Cm and that of NF_3 is 0.8×10^{-30} Cm. Give reason. (2)
10. (a) The bond angle in water is lower than the tetrahedral angle. Why? (1)
    (b) Give 1 example of a molecule in which the central atom is in sp hybridisation. Predict its geometry. (1)
    (c) Write the MO configuration of N_2 molecule and calculate its bond order. (2) [Dec 2020]
11. (a) Give two examples of compounds having expanded octet. (1)
    (b) Draw the Lewis dot symbols of (i) Cl_2 (ii) NF_3 (2)
12. (a) Predict the hybridisation of phosphorous atom in PCl_5 molecule. (1)
    (b) Account for the high reactivity of PCl_5 molecule. (1)
    (c) Draw the MO energy level diagram of O_2 molecule. (2) [March 2020]
13. The dipole moment of BeF_2 is zero, while that of H_2O is 1.85 D. Account for this the on basis of their molecular structure. (2)
14. (a) A molecule of the type AB_4E has 4 bond pairs of electrons and 1 lone pair ofelectron. Predict the most stable structure of this compound. (1)
    (b) Hydrogen fluoride is a liquid, while hydrogen chloride is a gas. Why ? (1)
15. Draw the molecular orbital diagram for F_2 molecule. Account for its magnetic character. (3) [July 2019]
16. Represent the Lewis structure of Ozone (O_3) molecule and assign the formal charge on each atom. (2)
17. Among NaCl, $BeCl_2$ and $AlCl_3$, which one is more covalent? Justify the answer. (2)

18. Write the molecular orbital electronic configuration of N_2 and O_2 molecules. Compare the stability and magnetic behaviour of these molecules on the basis of M. O. theory. (3) [March 2019]
19. If Z-axis is the internuclear axis, name the type of covalent bond formed by the overlapping of two p_y-orbitals. (1)
20. Write any two limitations of octet rule. (2)
21. The diatomic species Ne_2, does not exist, but Ne_2^- can exist. Explain on the basis of molecular orbital theory. (4) [August 2018]
22. Predict the shape of XeF_4 molecule, according to VSEPR theory. (1)
23. By using the concept of hybridization, explain the structure of H_2O molecule. (2)
24. Write the molecular orbital electronic configurations of N2 and O2 and calculate their bond orders. Give a comparison of their stability and magnetic behaviour. (4) [March 2018]
25. a) The hybridization of C in ethene is .....
    i) sp ii) sp^2 iii) sp^3 iv) sp^3d (1)
    b) Explain sp^3d^2 hybridization with an example. (3)
    c) Calculate the bond order of Lithium molecule. (At. no. of Li is 3) (1) [July 2017]
26. The geometry of the molecule is decided by the type of hybridisation.
    a) Discuss the shape of PCl_5 molecule using hybridisation. (2)
    b) Give the reason for the high reactivity of PCl_5. (2)
    c) Isoelectronic species have the same bond order. Among the following choose the pair having same bond order.
    CN^-, O_2^-, NO^+, CN^+ (1) [March 2017]
27. VSEPR theory is used to predict the shape and bond angle of molecules.
    a) Write the postulates of VSEPR theory. (2)
    b) Explain the shape and bond angle of NH_3 molecule using VSEPR theory. (2)
    c) PCl_5 molecule is unsymmetric. Why? (2) [September 2016]
28. a) The electronic configuration of a molecule can give information about bond order.
    i) Write the molecular orbital configuration of F_2 molecule.
    ii) Find its bond order. (2)
    b) Give any two factors influencing the formation of an ionic bond. (2)
    c) Give the shape of the following species. i) NH_4^+ ii) $HgCl_2$ (1) [March 2016]
29. a) The net dipole moment of a polyatomic molecule depends on the spatial arrangement of various bonds in the molecule. The dipole rnoment of BF_3 is zero while that of NF_3 is not zero. Justify. (2)
    b) The type of hybridization indicates the geometry of a molecule. In water molecule, the oxygen atom is sp^3 hybridized. But water molecule has no tetrahedral geometry. Explain (2)
30. The formation of molecular orbitals can be described bv the linear combination of atomic orbitals.
    a) Which one of the following correctly represents the formation of bonding molecular orbital from the atomic orbitals having wave functions ψ_A and ψ_B?
    i) $\psi_A \times \psi_B$ ii) ψ_A / ψ_B iii) $\psi_A + \psi_B$ iv) $\psi_A - \psi_B$ (1)
    b) Write the electronic configuration of oxygen molecule on the basis of Molecular Orbital Theory. Justify the presence of double bond in it and account for its paramagnetic character. (2) [October 2015]
31. Molecular orbital theory was developed by F. Hund and R.S. Mullikken.

a) One-half of the difference between the number of electrons in the bonding and antibonding molecular orbitals is called …….. (1)

b) i) Write the molecular electronic configuration of the N_2 molecule. (1)

ii) Predict the stability and magnetic property of N_2 with reasons. (3)

32. In order to explain the geometrical shapes of molecules, the concept of hybridisation was introduced.

a) The geometry of SF_6 molecule is ……..

i) Tetrahedral ii) Planar iii) Octahedral iv) Trigonal bipyramidal (1)

b) i) Define the term hybridisation. (1)

ii) Explain sp^3 hybridisation taking methane (CH_4) as an example. (3) [March 2015]

33. a) Molecular orbitals are formed by the linear combination of atomic orbitals (LCAO). Give the salient features of molecular orbital theory. (3)

b) Explain sp^3d hybridisation with a suitable example. (2)

34. a) The shape of the molecules is based on the VSEPR theory. Give the salient features of this theory. (3)

b) Draw the potential energy curve for the formation of a hydrogen molecule on the basis of tinter nuclear distance of the hydrogen atoms. (2) [August 2014]

35. a) He_2 cannot exist as stable molecule. Justify this statement on the basis of bond order. (1)

b) State Fajan's rule regarding the partial covalent character of an ionic bond. (1)

c) Which has higher boiling point – o-nitrophenol or p-nitrophenol? Give reason. (3) [March 2014]

36. a) Only valence electrons of atoms take part in chemical combination. Draw the Lewis representation of NF_3. (1)

b) Define dipole moment. The dipole moment of BF_3 is zero. Why?(2)

c) Based on bond order compare the relative stability of O_2 and O_2^{2-}. (2) [September 2013]

37. The Valence Shell Electron Pair Repulsion (VSEPR) theory helps in predicting the shapes of covalent molecules.

a) Arrange the bond pair electron and lone pair electron in the decreasing order of the repulsive interactions among them. (1)

b) A molecule of the type AB_3E_2 has three bond pairs and two lone pairs of electrons. Predict the most stable arrangement of electron pairs in this molecule. (1)

c) The bond order value is an important property of a molecule. How is bond order related to bond length? (1)

d) Write the electronic configuration of an oxygen molecule and justify its magnetic character. (2) [March 2013]

38. a) The ionic bonds have partial covalent character and the covalent bonds also show some ionic character.

i) Explain the covalent character of Lithium chloride using Fajan's rule (1)

ii) NF_3 and NH_3 show dipole moment. But the dipole moment of NF_3 is less than that of NH_3. Why? (1)

iii) The covalent bond can be explained by Molecular Orbital Theory (MOT). Using MO diagram explain the paramagnetic nature of oxygen molecule. (3) [September 2012]

39. Valence Bond Theory (VBT) and Molecular Orbital Theory (MOT) are the two important theories of chemical bonding.

a) Out of the following which is the hybridisation of phosphorus in PCl_5? (sp^3, sp^2, dsp^2, sp^3d) (1)

b) Explain the geometry of PCl_5 molecule and account for its high reactivity. (2)

c) Write the molecular orbital configuration of the C_2 molecule and calculate its bond order. (2)
[March 2012]

40. a) Hydrogen bonding plays an important role in determining the physical properties of substances.
    i) Illustrate hydrogen bonding using an example. (1½)
    ii) Compare the boiling points of o-nitro phenol and p-nitro phenol based on hydrogen bonding. (1½)
    b) Describe the hybridisation and structure of PCl_5 molecule. (2) [September 2011]
41. The attractive force which holds atoms together in a molecule is called a chemical bond.
    a) Explain the formation of a H_2 molecule on the basis of the valence bond theory (VBT). (2½)
    b) Using the molecular orbital theory (MOT), explain why Ne_2 molecule does not exist? (1½)
    c) Calculate the bond order of dinitrogen (N_2). (1) [March 2011]
42. VSEPR theory is used to predict the shape of covalent molecules.
    a) State the main postulates of VSEPR theory. (3)
    b) Based on VSEPR theory predicts the shape of H_2O and NH_3. (2) [October 2010]
43. The stability and magnetic properties of a molecule can be explained using the molecular orbital theory proposed by F. Hund and R.S. Mulliken.
    a) Define bond order according to the M.O theory.
    b) Draw the energy level diagram for the formation of O_2 molecule.
    c) Calculate the bond order and predict the magnetic character of O_2 molecule. [March 2010]
44. a) What do you understand by bond pair electrons and lone pair electrons? (2)
    b) Explain the bond pair electrons and lone pair electrons H_2O and NH_3 molecules with suitable drawings. (3) [March 2009]
45. Water is a liquid while H_2S is a gas.
    a) Suggest the reason for the above fact. (1)
    b) Explain the phenomenon. (2) [February 2008]

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