



CHEMISTRY

BOOKS - MAXIMUM PUBLICATION

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Example

1. The octet rule is not valid for

A. CO_2

B. H_2O

C. O_3

D. CO

Answer: D



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2. The stability of an ionic crystal depends principally on

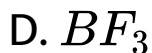
- A. High electron gain enthalpy of the anion forming species
- B. The lattice enthalpy of the crystal
- C. Low ionization enthalpy of the cation forming species
- D. Low heat of sublimation of cation forming solid

Answer: B



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3. Which of the following molecules has highest dipole moment?



Answer: A



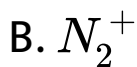
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4. The d- orbital involved in sp^3d hybridization is _____



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5. Which of the following is paramagnetic and has a bond order of 1/2?



Answer: D



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6. Dipole moment μ electric charge 'e' and bond length 'd' are related by the equation.



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7. In which of the following carbon atom is sp^2 hybridised?

A. CO_2

B. C_2H_6

C. C_6H_6

D. HCN

Answer: C



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8. AgF is ionic where as AgCl is covalent. This can be explained by



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9. The shape of covalent molecule CIF_3 is ____

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10. The $C - O$ bond order in CO_3^{2-} is

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11. The order of repulsion of electron pairs as written by students is given below:

lone pair-lone pair repulsion > lone pair -bond pair repulsion > bond pair -bond pair repulsion.

Name the theory behind this



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12. The order of repulsion of electron pairs as written by students is given below:

lone pair-lone pair repulsion > lone pair -bond pair repulsion > bond pair -bond pair repulsion.

Name the theory behind this



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13. During a small group discussion in the calss room a student argued that in acetylene both the carbon atoms are in sp_3 hybridised state.

What is your opinion?



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14.

What is the bond angle between carbon atoms in acetylene?



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15. what is the hybridisation of CH_4



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16. Classify the following compounds according to their hybridisation BF_3



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17. Classify the following compounds according to their hybridisation C_2H_4



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18. Explain the given compound according to its hybridisation BF_3



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19. what is the hybridisation of C_2H_2



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20. A student arranged the halide ions in the increasing order of polarisability as: F I^- I^- Cl I^- Br. Is this the correct order? If not write it in correct order



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21. A student arranged the halide ions in the increasing order of polarisability as: F I^- I^- Cl I^-

It Br. Justify



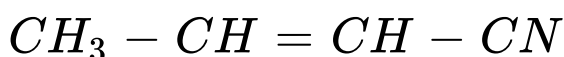
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22. Give any two differences between sigma and pi bonds



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23. Write the type of hybridisation of each carbon in the compound





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24. In ethane there are 6 covalent bonds. Five are strong σ bonds and the remaining one is a weak π bond'

Do you agree with this?



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25. In ethene there are 6 covalent bonds. Five are strong σ bonds and the remaining one is a

week π bond.

How is σ bond different from π bond in the mode of formation?



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26. Choose the correct molecules from the given clues: H_2O , SF_6 , BF_3 ,

a) Clue-1 The central atom is in sp^2 hybridised state and the molecule has trigonal planar in shape.

Clue-2 The bond angle is 120°



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27. Choose the correct molecules from the given clues: H_2O , SF_6 , BF_3 ,

Clue-1 The number of electron pairs in this molecule is 6

Clue-2 It has octahedral geometry.



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28. Choose the correct molecules from the given clues: H_2O , SF_6 , BF_3 ,

Clue-1 The bond angle is reduced from $109^{\circ}28'$ to 104.5°

Clue-2 It has a bent shape



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29. Give theoretical explanation for the following statements

a) H_2S is acidic while H_2O is neutral.



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30. Give theoretical explanation for the following statement

Hydrogen chloride gas dissolves in water.



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31. Ionisation enthalpy is one of the factors favoring the formation of ionic bonds.

a) Will you agree with the statement?



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32. Ionisation enthalpy is one of the factors favoring the formation of ionic bonds.

Explain how?



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33. Ionisation enthalpy is one of the factors favoring the formation of ionic bonds.

Write another factor favouring the formation of ionic bonds.



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34. The dipole moment of BF_3 is zero eventhough the B-F bonds are polar, Justify.



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35. Give the hybridisation involved in the following compound NH_3



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36. Give the hybridisation involved in the following compounds C_2H_4



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37. Give the hybridisation involved in the following compound SF_6



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38. Give the hybridisation involved in the following compound PCl_5



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39. o-nitro phenol has a lower boiling point than its para isomer. Why?



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40. How many σ and π bonds are there in the following molecule. ethane



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41. How many σ and π bonds are there in the following molecule. acetylene?



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42. BF_3 and NH_3 are tetra atomic molecules.

But the shape of BF_3 is different from that of NH_3 . Explain this using hybridisation.



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43. Covalent bond is formed by the overlapping of atomic orbitals.

a) What is meant by orbital overlapping?



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44. Covalent bond is formed by the overlapping of atomic orbitals.

What are the 3 types of overlapping ?



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45. Which among the following will exist He_2 or He_2^+ ? Explain.



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46. H_2S is a gas at ordinary condition, while H_2O is liquid. Account for the above statement.



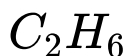
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47. State the hybridisation in the following molecule.



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48. State the hybridisation in the following molecule.



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49. Bond order is a term commonly used in MO theory.

How is it calculated ?



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50. Bond order is a term commonly used in MO theory.

How is it related to bond length and bond energy?



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51. Explain the hybridisation and geometry of ethyne.



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52. What is the difference between bonding molecular orbital and antibonding molecular orbital?



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53. How the magnetic nature of a molecule is related to its electronic structure?



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54. Molecular Orbital Theory (MOT) is an advanced theory of chemical bonding .

Write the salient features of MOT.



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55. Molecular Orbital Theory (MOT) is an advanced theory of chemical bonding .

What is meant by LCAO> Illustrate using hydrogen molecule.



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56. Molecular Orbital Theory (MOT) is an advanced theory of chemical bonding .

What are the condition for the combination of atomic orbitals?



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57. Consider a reaction



What is the change in hybridisation state of phosphorus ?



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58. Consider a reaction



b) Explain why does PCl_5 decomposes easily?



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59. Write the number of bond pairs of electrons and lone pairs of electrons in electron dot structure of ammonia molecule.

A. 3 bond pairs 1 lone pair

B. 2 bond pairs 3 lone pair

C. 3 bond pairs 3 lone pair

D. 1 bond pair 3 lone pairs

Answer:



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60. The structure of o-nitrophenol and p-nitrophenol are shown in the figure. The former is a steam volatile liquid whereas the

letter is a solid. Justify your answer giving reason.



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61. Hydrogen bonding is present in NH_3 and H_2O

What is hydrogen bond?



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62. Hydrogen bonding is present in NH_3 and H_2O

What are different types of hydrogen bonds?



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63. Hydrogen bonding is present in NH_3 and H_2O

Explain the effect of hydrogen bonding.



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64. Classify the following compounds according to their shape

BeF₂, BeCl₂, CH₄, BF₃, PCl₅, SF₆, SbCl₅, NH₄, SiF₄, AlCl₃



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65. Benzene is an example of a compound exhibiting resonance .

What you mean by resonance?



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66. Benzene is an example of a compound exhibiting resonance .

Explain the resonance of ozone.



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67. In the formation of methane, carbon undergoes sp^3 hybridisation.

a)What do you mean by sp^3 hybridisation?



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68. In the formation of methane, carbon undergoes sp^3 hybridisation.

Give the % s- character and p- character of an sp^3 hybrid orbital.



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69. In the formation of methane, carbon undergoes sp^3 hybridisation.

What is the bond angle in methane ?



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70. In the formation of methane, carbon undergoes sp^3 hybridisation. What is the geometry of methane molecule?



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71. Dipole moment is used to predict the shape of molecules.

a) Justify the statement based on the shapes of CO_2 and H_2O .



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72. Dipole moment is used to predict the shape of molecules.

b) Which is having high dipole moment ? NH_3 or NF_3 ? Why?



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73. Depending upon the type of overlapping, covalent bonds are of two types.

Name them and give any two difference between them.



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74. Depending upon the type of overlapping, covalent bonds are of two types.

Find the total number of these two types of bonds in propane and 2-butene



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Exercise

1. Explain the formation of a chemical bond



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2. Write the favourable conditions for the formation of ionic bond



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3. Although geometries of NH_3 and H_2O molecules are distorted tetrahedral, bond

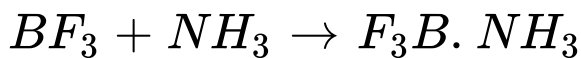
angle in water is less than that in ammonia.

Discuss.



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4. Is there any changes in the hybridisation of B and N atoms as a result of the following reaction



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5. Define hydrogen bond. Is it weaker or stronger than the van der Waals' forces?



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6. What do you understand by bond pair electrons and lone pair electron



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7. Explain the bond pair electron and lone pair electrons H_2O and NH_3 molecules with suitable drawings.



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8. The stability and magnetic properties of a molecule can be well explained using the molecular orbital theory developed by F. Hund and R.S. Mulliken

a) Define bond order according to the M.O. theory.



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9. The stability and magnetic properties of a molecule can be well explained using the molecular orbital theory developed by F. Hund and R.S. Mulliken

b) Draw the energy level diagram for the formation of the O_2 molecule.



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10. Calculate the bond order and predict the magnetic property of the O_2 molecule.



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11. VSEPR theory is used to predict the shape of covalent molecules .

a) State the main postulates of VSEPR theory



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12. VSEPR theory is used to predict the shape of covalent molecules .

b) Based on VSEPR theory predict the shape of H_2O and NH_3 .



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13. 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)



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14. The attractive force which holds atoms together in a molecule is called a chemical bond

b) Using the molecular orbital theory (MOT), explain why a Ne_2 molecule does not exist.



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15. The attractive force which holds atoms together in a molecule is called a chemical

bond

c) Calculate the bond order of dinitrogen(N_2)



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16. Hydrogen bonding plays an important role in determining the physical properties of substances

Illustrate hydrogen bonding using an example



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17. Hydrogen bonding plays an important role in determining the physical properties of substances

ii) Compare the boiling points of o-nitrophenol and p-Nitrophenol based on hydrogen bonding



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18. Describe the hybridization and structure of PCl_5 molecule.





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19. 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 hybridization of phosphorus in PCl_5 ?

$(sp^2, sp^3, dsp^2, sp^3d)$



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

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



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

Write the molecular orbital electronic configuration of the C_2 molecule and calculate its bond order.



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22. The ionic bonds have partial covalent character and the covalent bonds also show some ionic character

Explain the covalent character of Lithium chloride using Fajan's rule



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23. The ionic bonds have partial covalent character and the covalent bonds also show some ionic character

ii) NF_3 and NH_3 show dipole moment. But the dipole moment of NF_3 is \leq that of NH_3 . Why?



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24. The covalent bond can be explained by Molecular Orbital Theory (MOT). Using

molecular orbital diagram explain the paramagnetic nature of oxygen molecule.



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

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



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

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



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

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



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28. The Valence Shell Electron Pair Repulsion (VSEPR) theory helps in predicting the shapes

of covalent molecules

Write the electronic configuration of an oxygen molecule and justify its magnetic nature.



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29. Only valence electrons of atoms take part in chemical combination. Draw the Lewis representation of NF_3



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30. Define dipole moment. The dipole moment of BF_3 is zero. Why?



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31. Based on bond order compare the relative stability of O_2 and O_2^{2-}



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32. He_2 cannot exist as stable molecule. Justify this statement on the basis of bond order



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33. State Fajan's rule regarding the partial covalent character of an ionic bond.



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34. Which has higher boiling point, o-nitrophenol or p-nitrophenol? Give the reason



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



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36. Explain sp^3d hybridization with a suitable example.



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37. The shapes of the molecules is based on the VSEPR theory. Give the salient features of this theory



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38. Draw the potential energy curve for the formation of a hydrogen molecule on the basis of the internuclear distance of the hydrogen atoms.



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39. Molecular orbital theory was developed by F. Hund and R. S. Mulliken

a) One- half of the difference between the

number of electrons in the bonding and antibonding molecular orbitals is called _____



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40. Molecular orbital theory was developed by F. Hund and R. S. Mulliken

b) Predict stability and magnetic property of N_2 with reasons.



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41. In order to explain the geometrical shapes of molecules, the concept of hybridization was introduced

a) The geometry of SF_6 molecule is ___

A. tetrahedral

B. planner

C. octahedral

D. triagonal bipyramidal

Answer:



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42. Define the term , hybridization.



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43. Explain sp^3 hybridization taking methane (CH_4) as an example



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44. The net dipole moment of a polyatomic molecule depends on the spatial arrangement of various bonds in the molecule.

The dipole moment of BF_3 is zero while that of NF_3 is not zero. Justify



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45. 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 .



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46. The formation of molecular orbitals can be described by 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 & ψ_B ?

A. $\psi_A \times \psi_B$

B. $\frac{\psi_A}{\psi_B}$

C. $\psi_A + \psi_B$

D. $\psi_A - \psi_B$

Answer:



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47. The formation of molecular orbitals can be described by the linear combination of atomic orbitals

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.



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48. The electronic configuration of a molecule can give information about bond order.

i) Write the molecular orbital configuration of F_2 molecule.



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49. The electronic configuration of a molecule can give information about bond order.

ii) Find its bond order



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50. Give any two factors influencing the formation of an ionic bond.



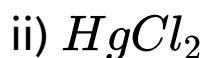
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51. Give the shape of the following species



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52. Give the shape of the following species



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53. VSEPR theory is used to predict the shape and bond angle of molecules.

a) Write the postulates of VSEPR theory.



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54. VSEPR theory is used to predict the shape and bond angle of molecules.

b) Explain the shape and bond angle of NH_3 molecule using VSEPR theory.



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55. VSEPR theory is used to predict the shape and bond angle of molecules.

c) PCl_5 molecule is unsymmetric . Why?



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56. The geometry of the molecule is decided by type of hybridization.

a) Discuss the shape of PCl_5 molecule using hybridization.



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57. The geometry of the molecule is decided by type of hybridization.

Give the reason for the high reactivity of PCl_5

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58. The geometry of the molecule is decided by type of hybridization.

Isoelectronic species have the same bond

order.

Among the following, choose the pair having same bond order.



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