CHEMISTRY

BOOKS - CHHAYA CHEMISTRY (BENGALI ENGLISH)

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Numerical Examples

1. Calculate the percentage of ionic character of HF. Given that the dipole moment of HF is 1.91 D and its bonding length is 0.92Å.

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2. The percentage of ionic character of LiH is 76.81% and the bond length is 1.596Å. Wha is the value of dipole moment of LiH molecule?

$[1D = 3.335 \times 10^{-30} C \cdot m]$

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3. Calculate the fractional charge on each atom of HBr. The dipole moment of HBr is 0.78D and its bond length is 1.41Å. [electronic charge, $e = 4.8 \times 10^{-10}$ esu, $1D = 10^{-10} esu \cdot cm$].

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4. Dipole moment of NaCl is 8.5 D. interatomic distance between Na^+ and Cl^- is 2.36 Å. Calculate the percentage of ionic character of NaCl molecule.

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Warm Up Exercise

1. What are valence electrons?

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2. What do you mean by octet rule and duplet rule? State the significance of octet rule.

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3. How will you predict the common valency of an element rom its lewis symboll? Give examples?

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4. Give the lewis symbols of (i) Br

(ii) N

(iii) O^{2-}

(iv) S^{2-}

(v) N^{3-}

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5. What do you understand by the term ionic bond? Mention the factors favouring its formation.

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6. How is crytalline NaCl formed from constituent elements?

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7. The elements belonging to which group(s) of the periodic table combine to form electrovalent compounds and why?

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8. What do you mean by lattice energy of lattice enthalpy?

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9. How will you determine the lattice energy of an ionic compound using Born-Haber cycle? Illustrate with example.

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10. Which elements exhibit variable electrovalency and why?

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11. State the importance of lattice enthalpy.

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12. What do you mean by coodination number (C.N.)?

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13. Explain why the melting and boiling points of ionic compounds are much higher .

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14. Why the ionic compounds do not exhibit isomerism?

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15. Which type of ionic compounds exhibit isomorphism?

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16. What is solvation energy of solvation enthalpy?

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17. What is the condition for dissolution of an ionic compound in a particular solvent?

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18. The ionic compounds are soluble in polar solvents but isoluble in non-polar solvents-why?

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19. Why do ionic compounds conduct electricity only in solution or molten state and not in solid state?

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20. If r_+/r_- in equal to 0.53, what is the C.N. of the cation?

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21. What do you mean by covalent bond and covalency?

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22. Explain the formation of three molecules containing a single, a double and a triple bond respectively.

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23. Give the factors favouring formation of covalant bond.

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24. Draw lewis dot structure of H_3PO_4 and CO_3^{2-}.

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25. Calculate formal change on N-atom in HNO_3 molecule.

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26. Elements of which part of the periodic table exhibit greater tendency to form covalent bonds and why?

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27. Molecules of covalent compounds exhibit isomerism- why?

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28. In which of the given molecules the central atom does not obey the octet rule?

$CiF_3, SF_2, OsF_8, BCl_3, NH_3, NO_2$

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29. What do you understand by polarisation of an anion and when does it take place?

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30. The melting point of $MgBr_2$ is $700^\circ C$ while that of $AlBr_3$ is only $97^\circ C$. Give reason.

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31. Why is CuCl more covalent than NaCl?

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32. Arrange in the increasing order according to the given properties and explain the order: (i) $MgCl_2, AlCl_3, NaCl, SiCl_4$ (melting point), (ii) $LiBr, NaBr, KBr$ (melting point), (iii) $MgCO_3, CaCO_3, BeCO_3$ (thermal stability), (iv) $HgI_2, HgCl_2$ (intensity of colour).

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33. (i) Explain why AgCl is white in colour whereas AgI is yellow. (ii) if the degree of polarisation of the anion is (e.g. PbI_2 is yellow) but if it is lower, then the compound is either white or colourless (e.g., $PbCl_2$ is white)- why?

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34. LiCl is soluble in organic solvents while the chlorides of other alkali metals are not explain.

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35. Give reasons: (i) $PbCl_4$ exists but PbI_4 does not, (ii) $SnCl_2$ is solid at room temperature while $SnCl_4$ is liquid. (iii) FeI_3 cannot be prepared.

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36. What is coodinate covalent bond or coodinate bond?

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37. Explain the formation of a coordinate bond with example.

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38. Mention the conditions for coordinate bond formation.

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39. Why is a coordinate bond referred to as a semipolar bond?

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40. Aluminium chloride exists as a dimer-explain.

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41. Give examples of two compounds in which there exists electrovalency, covalency and coordinate covalency.

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42. Explain why BF_3 forms addition compound with NH_3

.

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43. $AlCl_3$ forms a dimer but BCl_3 cannot-explain.

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44. What do you understand by (i) bond length, (ii) bond dissociation enthalpy and (iii) bond angle?

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45. Arrange the following compounds in increasing order of carbon-carbon bond strength and explain the order.

$CH_2 = CH_2, CH_3 - CH_3, CH \equiv CH$

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46. In water, the first and second O-H bond disociation enthalies are 502 and 427 kJ mol^{-1} respectively. Determine the value of bond enthalpy of O-H bond.

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47. Arrange the given compounds in order of their increasing bond length: HCl, HI, HBr, HF. Explain the order.

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48. Why does the value of bond angle increase with increase in electronegativity of the central atom in AB_2 type of molecule?

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49. In which of the following molecules/ions all the bonds are not equal ?

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50. Bond angles in $PBr_3(101.5^\circ), (PBl_3(100^\circ)$ and $PF_3(97^\circ)$ decrease with increase in electronegativities of the surrounding atoms, however, bond angles in BF_3, BCl_3 and BBr_3 do not change with change in electronegativities of the surrounding atoms. explain with reason.

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51. Bond angle in H_2O is greater than that of H_2S- explain.

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52. Arrange the following in order of increasing radii.

F, Cl, Br

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53. Arrange the following molecules/ions in order of decreasing H-N-H bond angle and explain the order.

NH_3, NH_4^+, NH_2^-.

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54. Write down the main postulates of valence bond theory.

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55. What do you understand by the term atomic orbital?

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56. Explain why covalent bonds possess directional property.

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57. What do you meann by a σ and π-bond?

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58. Why are the π-bonds weaker and more reactive than the σ-bonds?

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59. Arrange (s-s), (s-p) and (p-p) σ-bonds in order of decreasing bond strength and explain the order.

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60. Explain why the formation of a π-bond is not possible between a p_y and a_x-orbital.

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61. Which symmetry element is present in a π-bond?

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62. What is meant by hybridisation of atomic orbitals?

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63. What will be the spatial distribution of (i) sp^3,

(ii) sp^2

and (iii) sp hybrid orbitals?

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64. Is hybridisation possible in an isolated atom?

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65. The state of hybridisation of the central atom of which of the following is sp^3d^2?

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66. Name the type of hybridisation of the central atom which leads to eaach of the following geometries: (i) square planar

(ii) Planar triangular (iii) tetrahedral

(iv) linear

(v) octahedral

(vi) trigonal bipyramidal.

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67. Identify the state of hybridisation of each carbon in:

(i) $CH_2 = CH - CH = CH_2$

(ii) $CH_2 = C = CH_2$

(iii) $CH_3 - C \equiv CH$ ltBrgt (iv) $CH_2 = CH - CHO$

(v) $HC \equiv C - CHO$

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68. The four C-H bonds in methane are equivalent though carbon was different orbitals in bond formation. Explain.

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69. Arrange ehthane, ethylene and acetylene in order of their decreasing C-H bond length. Explain the order.

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70. Total number of lone pair of electrons in I_3^- ion is -

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71. Why are the P-Cl bonds in PCl_5 not of same length?

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72. Which of the molecules or ions are iso-structural and why?

$BF_3, NH_4^+, CO_3^{2-}, BF_4^-, NO_3^-, CH_3^+, CCl_4$

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73. All the C-O bond lengths in CO_3^{2-} are equal-explain.

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74. Give reasons for the extra stability of benzene.

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75. Write the canonical structures for sulphite ion and phosphate ion.

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76. All the C-O bond lengths in CO_3^{2-} are equal-explain.

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77. Define electronegativity of an element.

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78. Explain Pauling's scale of electronegativity.

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79. Which is the most electronegative element according to the pauling's scale of electronegativity?

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80. Which one among the following pairs is more electronegative and why?

(i) C_{sp} or C_{sp^3}, (ii) carbon in CHI_3 or carbon in $CHCl_3$, (iii) Na or Cl (iv) carbon in C_2H_4 or C_2H_2.

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81. What do you mean by dipole moment of a molecule?

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82. Mention the SI units of dipole moment.

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83. Some molecules are non-polar even though they contain polar bond-explain with suitable example.

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84. How will you distinguish between the two geometrical isomers of 1.2-dichloroethene from their boiling points?

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85. Explai why the following molecules are non-polarr:

(i) CCl_4, (ii) CS_2, (iii) BF_3, (iv) 1,3,5-trinitrobenzene,

(v) trans-2,3-dichlorobut-2-ene.

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86. Predict the dipole moment off (i) a molecule of the type AB_4 having square planar geometry, (ii) a molecule of the type, AB_3 having trigonal bipyramidal geometry,

(iii) a molecule of the type, AB_6 having octahedral geometry, (iv) a molecule of the type, AB_7 having pentagonal bipyramidal geometry.

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87. Explain why the dipole moment values of hydrogen halides decrease from H-F to H-I.

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88. Explain why the dipole moment of CD_3F (1.858 D) is higher than that of CH_3F (1.847 D).

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89. What is hybrogen bond? Is it stronger than a covalent bond?

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90. How many types of hybrogen bonds are there? Illustrate each type with suitable examples.

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91. Write down the conditions for hybrogen bond formation.

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92. σ-Nitrophenol boils at alower temperature than P-nitrophenol. Give reason.

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93. NH_3 molecules remain associated through intermolecular hydrogen bonding but there is not such association among HCl molecules even though electronegativities of N and Cl are the same explain

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94. At normal temperature o-hydroxybenzaldehyde is a liquid but p-hydroxybenzaldehyde is a solid. Give reason.

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95. In which of the following compounds interamolecular hydrogen bonding is possible:

(i) CH_3COOH

(ii) $CH_3COOH = C(OH)CH_3.$

(iii) $CH_3CONH_2,$

(iv) $HOCH_2CH_2OH,$

(v) $PbCOC(OH)_2COPh$

(vi) $(CH_3)_2NH$

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96. Explain why sucrose $(C_{12}H_{22}O_{11})$, being a covalent compound, is quite soluble in water.

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97. Hydrogen bonds are usually longer than covalent bonds. Give an example where covalent and hydrogen bonds are equal in length. Explain.

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98. Give an example where chlorine forms H-bond.

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99. Arrange the following species in order of increasing stability and give reasons: Li_2, Li_2^+, Li_2^-.

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100. Inert gases are monoatomic. Explain in terms of MO theory.

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101. B_2 is paramagnetic but C_2 is not. Explain.

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102. A homonuclear diatomic molecule contains 8 electrons Predict whether the molecule will exist or not.

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103. Compare the stabilities of O_2^- and N_2^+ ions and comment on their magnetic nature.

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104. Predict the similarties between F_2 molecule and O_2^{2-} ion on the basis of MO theory.

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105. Taking z-axis as internuclear axis, eplain why $2p_x$ or $2p_y$-orbital does not combine with 2s-orbital to form molecular orbitals.

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106. If the electronic configuration of atom is $1s^2$, comment on the stability of A_2 molecule and A_2^+ ion.

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Questions Answer Zone For Board Examination

1. name the energy which is released during formation of an ionic crystal?

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2. Out of NaCl and MgO, which one has higher lattice energy?

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3. Elements belonging to which groups of the periodic table combine with each other to form electrovalent compounds?

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4. If A^+ and B^{2+} ions are isoelectronic, then which of the following informations regarding their size is correct:

(1) $A^+ > B^{2+}$

(2) $A^+ > B^{2+}$

(3) $A^+ = B^{2+}$

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5. Arrange the following isoelectronic ions in increasing order of their ionic radi: X^+, Y^{2+}, A^- and B^{2-}.

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6. Designate the following changes as exothermic or endothermic: (1) $A(g) \rightarrow A^{+}(g) + e^{-}$

(2) $B(g) + e \rightarrow B^{-}(g)$

(3) $X(s) \rightarrow X(g)$

(4) $A^{+}(g) + B^{-}(g) \rightarrow AB$

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7. What is the coordination number of A^{+} and B^{-} ions if the geometry of the ionic crystal (AB) is cubic?

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8. Out of NaF, KCl and MgO, which of the two compounds exhibit isomorphism?

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9. What is the geometry of the ionic crystal if the valeu of r_+/r_- (radius ratio of the monovalent cation and anion) is in the range 0.225-0.414?

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10. Out of Sn^{2+} and Sn^{4+}, which one is more stable?

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11. The values of dielectric constants of the solvents, A and B are x and y respectively. If $\frac{1}{x} < \frac{1}{y}$, then in which

solvent an ionic compound is more soluble?

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12. For the salt CaF_2, $\Delta H^0_{\text{lattice}} > \Delta H^0_{\text{hyd}}$. Predict whether this salt is soluble in water or not.

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13. Which out of NaCl and $CHCl_3$ reacts with $AgNO_3$ solution to give a precipitate of $AgCl$?

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14. Which of the following are hypervalent compounds?

CO_2, ClF_3, SO_3, IF_5

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15. How many types of bonds are present in $LiAlH_4$?

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16. Give examples of an anion and a cation which are isostructural with BF_3 and CH_4 respectively.

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17. Arrange in order of decresing size: sp, sp^2, sp^3

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18. Give the hybridisation of P and PCl_5. Why are axial bonds longer as compared to equatorial bonds?

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19. mention the change in hybridisation (if any) of the Al-atom in the reaction: $AlCl_3 + Cl^- \rightarrow AlCl_4^-$.

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20. Is there any change in hybridisation of B and N-atoms as a result of the following reaction?

$BF_3 + NH_3 \rightarrow F_3B \cdot NH_3$

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21. Although the O-atoms in water and diethyl ether are sp^3-hybridised, the H-O-H and Et-O-Et bond angles are different- why?

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22. Draw the resonance structures of N_2O obeying the octet rule.

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23. Which of the following hybrid orbitals possess two types of angles?

(1) sp^3,

(2) sp^2,

(3) sp,

(4) sp^3d,

(5) sp^3d^2,

(6) sp^3d^3

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24. Which of the following are isostructural? (1) BF_3,

(2) SO_4^{2-},

(3) NO_3^-

(4) NH_4^+

(5) CO_3^{2-}

(6) PO_4^{3-}.

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25. Give an example of an anion which is isostructural with BF_3.

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26. Out of SF_6 and SCl_2, S has highe electronegativity in which of the compounds and why?

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27. Arrange in the order of increasing ionic character:

$C-H, F-H, Br-H, Na-I, K-F$ and $Li-Cl$

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28. What is the shape of a molecule, AB_2 if it has a definite dipole moment?

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29. The dipole moment of HF is 2.0 D. calculate its value in coulomb-metre (C.m).

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30. N_2O is polar even though it is linear-why?

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31. Arrange halobenzenes $(C_6H_5 - X, X = F, Cl. Br. I)$ in the order of their increasing polarity.

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32. The dipole moment of a molecule, $\mu = e \times d$. What is the value of d in case of CCl_4?

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33. Arrange the following in the order of decreasing strengths: $N - H \ldots N, O - H \ldots O, F - H \ldots F$.

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34. Arrange the following interactions in the order of their increasing strengths, covalent bond, H-bonding, dipole-dipole interaction, van der Waals forces.

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35. Which of the following species has same number of unpaired electrons?

(1) Cr^{3+}

(2) Mn^{2+}

(3) Fe^{3+}

(4) Cu^{2+}

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36. What is the change in bond order, if an electron is addd to a bonding MO?

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37. According to MO theory which of the following combination between the orbitals are not possible?

(1) $2p_z, 2p_z$

(2) $2s, 2p_y$

(3) $1s, 2s$

(4) $2p_x, 2p_x$

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38. Out of O and O_2, which one has a greater ionisation enthalpy and why?

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39. Sodium chloride is a solid having high melting point but carbon tetrachloride is a liquid-why?

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40. Sodium chloride is soluble in water but insoluble in benzene or hexane. Explain in the observation.

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41. Nitrogen produces only NCl_3 but phosphorus produces both PCl_3 and PCl_5. Give reasons.

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42. Aqueous solution of hydrogen chloride is strongly acidic but the solution of hydrogen chloride in benzene is not at all acidic -why?

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43. MgO has higher lattice enegy than NaF. Why?

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44. $SnCl_4$ is a covalent compound whereas $SnCl_2$ is an ionic compound-why?

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45. The ionic radius of Na^+ is less than the atomic radius of Na but the ionic radius of Cl^- is greater than the atomic radius of Cl-why?

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46. Arrange $Al^{3+}, Na^+ \& Mg^{2+}$ ions in the decreasing order of their ionic radii and explain the order.

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47. Arrange O^{2-}, N^{3-} and F^- ions in the decreasing order of their ionic radii and explain the order.

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48. Explain the following order of thermal stability of the carbonates of the alkaline earth metals:

$BaCO_3 > SrCO_3 > CaCO_3 > MgCO_3$

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49. NaCl is non-volatile but HCl is volatile-explainwith reason.

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50. What type of bond is formed between two elements, A and B if both of them are highly electronegative or they have huge difference in their electronegativities. Give examples.

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51. Out of AlF_3 and $AlCl_3$, which one is more covalent in nature and why?

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52. Which of the following oxides are amphoteric .

(1) BeO

(2) SnO

(3) ZnO

(4) Al_2O_3

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53. Which one between p and sp-orbital has more directional characteristics and why?

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54. In a certain polar solvent, PCl_5 undergoes ioonisation as follows: $2PCl_5 \Leftrightarrow PCl_4^+ + PCl_6^-$, predict geometrical shapes of all the species involved.

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55. $MgCl_2$ is linear but $SnCl_2$ is angular-explain.

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56. Arrange the following in the increasing order of their polarities and explain with reason: $B-Cl, Ba-Cl, Br-Cl, Cl-Cl$

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57. Identify the three isomeric chlorotoluenes having dipole moments: 1.35D, 1.9D and 1.78D.

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58. Which has the least dipole moment-1 -butene, cis-2-butene, trans-2-butene and 2-methylpropene?

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59. What do you mean by hydrogen bond donor and hydrogen bond acceptor? Define protic and aprotic solvents. Give examples.

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60. The boiling point of water $(100^{\circ}C)$ is much higher than that of $HF(19.5^{\circ}C)$, even though they have similar molecular masses. Explain.

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61. Explain the following observation: (1) Glycerol $[HOCH_2CH(OH)CH_2OH]$ is a highly viscous liquid. (2) when 30 mL of water is added to 30 mL of ethanol, volume of the mixture becomes less than 60 mL.

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62. Arrange water, methanol and dimethyl ether in increasing order of their viscosity and give reasons in favour of that order.

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63. At equilibrium acetyl acetone $(CH_3COCH_2COCH_3)$ exists mainly $(\approx 80\%)$ is enol form -explain.

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64. State the useful rule related to the solubility of a compound. Unlike ethane, ethanol dissolves in water. Explain and discus in terms of energy change.

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65. Inert gases do not generally participate in chemical reaction-explain with reason.

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66. The bond dissociation enthalpy of N_2 is higher than that of N_2^+ but the bond dissociation enthalpy of O_2^+ is higher than that of O_2. Explain.

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67. Arrange the following species in order of their increasing bond lengths and explain: C_2, C_2^- and C_2^{2-}.

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68. Explain the following order of bond dissociation enthalpies: $F-F < Cl-Cl < O=O < N \equiv N$

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69. Determine the shapes of the given molecules or ions:

(1) $POCl_3$

(2) CH_3^-

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70. The molecule of any compound composed of two dissimilar elements is always polar-justify the statement.

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71. Explain the following observations:

(1) H_2^+ ion is more stable than H_2^- ion even though the bond orders of both the ions are the same.

(2) When a magnet is dipped in a jar containing liquid oxygen, some oxygen molecules cling to it.

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72. It is correct to say that bond order always increases with loss of electron? Explain your answe.

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Solved Wbchse Scanner

1. Identify polar and non-polar molecules from the following: $Cl_2, CHCl_3, NH_3, BCl_3$ Or, the dipole moment of NF_3 molecule is less than that of NH_3 molecule. Explain.

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2. Define coordination number.

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3. HF_2^- ion exists but HBr_2^- ion does not. Explain.

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4. X is the central atom of XO_2 molecule. If dipole moment of the molecule is zero, indicate the hybridisation state of X.

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5. Arrange the following compounds in increasing order of boiling point: HF, H_2O, NH_3

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6. Arrange the following molecules in increasing order of number of lone pair of electrons. H_2O, PCl_3, H_2O, BF_3

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7. Mention the state of hybridisation of the central atom of the following molecules/ ions, CO_3^{2-}, PH_4^+, ClO_3^-, CS_2 or, write the resonating structures of ClO_4^- ion.

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8. Mention the nature of bonding of the following molecules/ions, CaH_2, BH_4^-, Na_2O_2, SiH_4

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9. Dimethyl ether and ethanol have same molecular weight, but their volatilities are different-explain.

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10. Between N_2O and NO_2 molecules, which one is more polar explain?

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11. Arrange the following ions in the increasing order of their ionic radii, F^-, Mg^{2+}, Al^{3+}, O^{2-}.

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12. Arrange the following molecules in increasing order of their dipole moments: NH_3, NF_3, CBr_4.

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13. how many (σ) and (π) bonds are present in buta-1,3-diyne?

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14. What are the different types of bonds present in ammonium bromide molecule?

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15. Draw the resonating structures of sulphate ion.

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16. (i) Define coordination number.

(ii) Carbon dioxide and sulphur dioxide are both

triatomic. The first one is non-polar but the second but is polar. Comment on their structures from this fact.

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17. (i) Which of H_2O or H_2S molecules has a greater bond angle? Explain.

(ii) Between o-nitrophenol and p-nitrophenol, which one has a greater boiling point? Explain.

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18. Which of the following is not paramagnetic-

A. N_2^+

B. Li_2

C. O_2

D. H_2^+

Answer: B

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19. Which bond among the following is least ionic-

A. $P - F$

B. $S - F$

C. $Cl - F$

D. $F - F$

Answer: D

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20. (i) When hydrogen combines with oxygen, a polar covalent produce is formed-explain.

(ii) What types of bonds are present in KHF_2?

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21. (i) Why H_2 is a stable molecule, but He_2 is not?

(ii) Write cannonicals of ClO_4^- ion.

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22. In which of the following conversions there are changes of hybridisation and shape-

A. $CH_4 \rightarrow C_2H_6$

B. $NH_3 \rightarrow NH_4^{\oplus}$

C. $BF_3 \rightarrow BF_4^{\Theta}$

D. $H_2O \rightarrow H_3O^{\oplus}$

Answer: C

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23. The correct bond order of nitrogen and its different ions is-

A. $N_2^{2-} < N_2^- < N_2$

B. $N_2 < N_2^{2-} < N_2^-$

C. $N_2^- < N_2^{2-} < N_2$

D. $N_2^- < N_2 < N_2^{2-}$

Answer: A

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24. Which one of the following compounds is not polar-

A. N_2O

B. H_2O

C. NF_3

D. BF_3

Answer: D

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25. (i) Why are the bond angles of NH_3 and H_2O less than the normal values of the regular tetrahedron bond angles inspite of being sp^3 hybridised?

(ii) Find out the bond order of H_2^+ ion.

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26. (i) What are the types of hybridisation of NH_4^+, CO_3^{2-}, H_2S and SF_6?

(ii) C-O bond is polar but CO_2 does ot have a dipole moment. Why?

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27. (i) Although KHF_2 is a stable compound, $KHBr_2$ does not exist. Explain why?

(ii) Arrange the following compounds with ascending order of boiling point: HF, H_2O, NH_3.

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28. All the carbon-oxygen bonds in CO_3^{2-} radical are equivalent-explain.

Watch Video Solution

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29. The bond order of He^{2+} ion is-

A. 0

B. 0.5

C. 1

D. 1.5

Answer: A

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30. Which is not paramagnetic of the following?

A. N_2^+

B. CO

C. O_2^-

D. NO

Answer: B

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31. (i) Arrange the following compounds according to their increase of melting point: $NaCl$, $MgCl_2$, $AlCl_3$

(ii) Between NH_3 and NF_3 which one is more polar and why?

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32. (i) why does the PCl_5 exist but NCl_5 does not?

(ii) why does $BaSO_4$ not soluble in water?

View Text Solution

33. Which has the smallest bond-length-

A. O_2^+

B. O_2^-

C. O_2^{2-}

D. O_2

Answer: A

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34. What is the hybridisation state of central I atom is I_3^- ?

A. sp^3

B. dsp^2

C. sp^3d^2

D. sp^3d

Answer: D

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35. (i) Calculate the bond order of $[He - H]^+$ from molecular orbital theory.

(ii) what will be the order of viscosity of the following?

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36. (i) Both $Br_2(g)$ and $NO_2(g)$ are reddish brown gaseous substances. How will you chemically distinguish betweenthem?

(ii) What will be the order of covalant character of the following compounds?

A. LiF

B. LiCl

C. LiBr

D. LiI

Answer:

Watch Video Solution

37. The state of hybridisation of the central atom of which of the following is sp^3d^2-

A. SF_4

B. PCl_5

C. SF_6

D. SO_4^{2-}

Answer: C

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38. Which of the following is the correct order of repulsive interaction of lone pair (lp) and bond pair (bp) off electrons-

A. $lp - lp > lp - bp > bp - bp$

B. $lp - bp > lp - lp > bp - bp$

C. $bp - bp > lp - lp > lp - bp$

D. $lp - lp > bp - bp > lp - bp$

Answer: A

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39. Show by drawing its molecular orbital diagram why O_2 is paramagnetic.

Watch Video Solution

40. (i) Draw the canonicals of CO_3^{2-}

(ii) Why is boiling point of H_2O greater than that of H_2S ?

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Solved Ncert Exercise

1. Write lewis dot symbols for atoms of the following elements: Mg, Na, B, O, N, Br.

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2. Write Lewis symbols for the followint atoms and ions: S and S^{2-}: Al and Al^{3+}, H and H^{-}

View Text Solution

3. Define ortet rule. Write its significance and limitations.

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4. Draw the lewis structures for the following molecules and ions: H_2S, $SiCl_4$, BeF_2, CO_3^{2-}, HCOOH.

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5. Although geometries of NH_3 and H_2O molecules are distorted tetrahedral, bond angle in water is less than that of ammonia. Discuss.

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6. How do you express the bond strength in terms of bond order?

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7. Define the bond length.

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8. Explain the important aspects of resonance with reference to the CO_3^{2-} ion.

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9. H_3PO_3 can be represented by structures 1 & 2. can these two structures be taken as the canonical forms of the resonance hybrid representing H_3PO_3 ? If not give

reasons for the same.

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10. Write the resonance structures for SO_3, NO_2, NO_3^-.

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11. Use Lewis symbols to show electron transfer between the following atoms to form cations and anions:

(1) K and S

(2) Ca and O

(3) Al and N.

Watch Video Solution

12. Although both $CO_2 \& H_2O$ are triatomic molecules, the shape of H_2O molecule is bent while that of CO_2 is linear. Explain this on the basis of dipole moment.

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13. Write the significance/applications of dipole moment.

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14. Define electronegativity. How does it differ from electron gain enthalpy?

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15. Explain with the help of suitable example polar covalent bond.

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16. Arrange in order of increasing ionic character in the molecules: LiF, K_2O, N_2, SO_2 and CIF_3.

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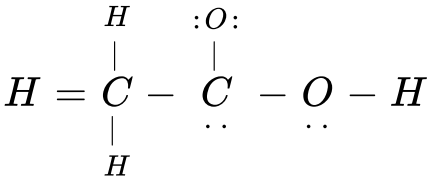
17. Skeletal structure of CH_3COOH as shown below is correct, but some of the bonds are shown incorrectly.

Write the correct lewis structure for acetic acid.



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18. Apart from tetrahedral geometry, another possible geometry for CH_4 is square planar with the four H atoms at the cornerrs of the square and the C atom at its centre. Explain why CH_4 is not square planar?

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19. Explain why BeH_2 molecule has a zero dipole moment although be Be-H bonds are polar.

View Text Solution

20. Which has higher dipole moment & why: NH_3, NF_3 ?

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21. Describe the change in hybridisation (if any) of the Al in the following reaction. $AlCl_3 + Cl^- \rightarrow AlCl_4^-$

View Text Solution

22. Is there any change in the hybridisation of B and N atoms as a result of the following reaction?

$BF_3 + NH_3 \rightarrow F_3B \cdot NH_3$

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23. Draw diagram showing the formation of a double bond and a triple bond between carbon atoms in C_2H_4 and C_2H_2 molecules.

Watch Video Solution

24. What is the total number of sigma and pi bonds in the following molecules?

(1) C_2H_2 ltBrgt (2) C_2H_4

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25. Considering x-axis as the internuclear axis which out of the following will not form a sigma bond and why ?

Watch Video Solution

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

(1) $CH_3 - CH_3 : (2) CH_3 - CH = CH_2,$

(3) $CH_3 - CH_2 - OH$

(4) $CH_3 - CHO$

(5) $CH_3, COOH$

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27. What do you understand by bond pairs and lone pairs of electrons? Illustrate by giving one example of each type.

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28. Compare the relative stability of the following species and indicate their magnetic properties: O_2, O_2^+, O_2^- (superoxide), O_2^{2-} (peroxide)

Watch Video Solution

29. Write the significance of a plus and a minus sign shown in representing the orbitals.

View Text Solution

30. Describe the hybridisation in case of PCl_5. Why are the axiial bonds longer as compared to equatorial bonds?

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31. Define hydrogen bond. It is weakerr or stronger than the van der waals forces?

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32. What is meant by the term bond order? Calculate the bond order of : N_2, O_2, O_2^+ and O_2^-.

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Higher Order Thinking Skill Hots Questions

1. The ionic bond between sodium and chloride ion is stronger than that between potassium and chloride ion. Explain.

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2. Silicon tetrachloride readily undergoes hydrolysis but carbon tetrachloride does not undergo hydrdolysis undergo normal conditions. Explain.

View Text Solution

3. Covalent bonds have definite orientations but electrovalent bonds have no definite orientation-explain.

View Text Solution

4. The second ionisation enthalpy of Mg is sufficiently high while the second electron affinity or electron gain enthalpy of oxygen is low (actually this value is positive), yet Mg^{2+} and O^{2-} ions form ionic compound, MgO. Explain with reasons.

View Text Solution

5. Both sodium and hydrogen are electropositive elements. Sodium reacts with chlorine to form an electrovalent compound but hydrogen reacts with chlorine to form a covalent compound-explain.

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6. The melting point of CaI_2 is much lower $(575^\circ C)$ than that of CaF_2 $(1392^\circ C)$-explain with reason.

View Text Solution

7. The B-F bond in BF_3 is shorter in length that the B-F bond in BF_4^- - explainwith reasons.

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Watch Video Solution

8. Why the bond dissociation enthalpy of F_2 is less than that of Cl_2.

Watch Video Solution

9. Acetylene dissolves in acetone but not in water Explain the observation.

Watch Video Solution

10. Arrange nitrogen dioxide molecule (NO_2), nitronium ion $\left(NO_2^+\right)$ and nitriteion $\left(NO_2^-\right)$ in incrasing order of

bond angle and explain the order.

Watch Video Solution

11. H_2O is liquid while H_2S is a gas, though oxygen and sulphur, both belong to the same group of the periodic table.

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12. Why does PCl_5 form $PCl_3 \& Cl_2$ on strong heating?

Watch Video Solution

13. Arrange methanol, water and dimethyl ether in order of increasing boiling points and explain the order.

Watch Video Solution

14. Explain why diamond melts at a very high temperatuer even though it is composed of covalently linked carbon atoms.

View Text Solution

15. Which out of 1-butyne and I-butene has large dipole moment and why?

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16. Hydrogen bonding between Ha nd F atom is stronger than that between H and O atoms. However, H_2O is more viscus and its bp is greater than that of HF. Explain.

View Text Solution

17. Why is the viscosity and boiling point of concentrated H_2SO_4 very high?

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18. In SF_4 molecule, the lone pair of electrons occupies an equatorial position, rather than axial position, in the overal trigonal bipyramidal arrangement. Wy?

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19. Explains the shape of I_3^- ion.

Watch Video Solution

20. Give the structure of $(CH_3)_3N$ and $\left[(CH_3)_3Si\right]_3N$. Are they isostructural ?

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21. Indicate the type of bonds present in NH_4NO_3 and state the mode of hybridisation of two N-atoms.

Watch Video Solution

22. ClF_3 exists, but FCl_3 does not.

Watch Video Solution

23. $BaSO_4$ is insoluble in water, even though it is an ionic compound. Why?

Watch Video Solution

24. The dipole moment of $CH_3Cl(\mu = 1.87D)$ is greater than that of $CH_3F(\mu = 1.81D)$ evenn though the C-F bond is more polar than the C-Cl bond.

Watch Video Solution

25. Show by calculation that the dipole moment of methane is zero.

Watch Video Solution

26. Boiling pont of hydrogen fluride is maximum among all the halogen acid-explain.

Watch Video Solution

27. Both CO_2 and N_2O are linear. However N_2O is polar while CO_2 is non-polar-explain.

Watch Video Solution

28. Explain why all the three nitrogen-oxygen bonds in NO_3^- ion are equal in length.

Watch Video Solution

29. Although H_2, Li_2 and B_2 molecules have the same bond order (i.e., 1), yet they are not equally stable. Explain

this observation and arrange them in order of decreasing stability.

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Entrance Question Bank

1. The sp^3d^2-hybridisation of central atom of a molecule would lead to -

A. square planar geometry

B. tetrahedral geometry

C. trigonal bipyramidal geometry

D. octahedral geometry

Answer: D

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2. Which of the following is paramagnetic-

A. N_2

B. NO

C. CO

D. O_3

Answer: B

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3. In the electron-dot structure, calculate the formal charge from left to right nitrogen atom, $\dot{\underset{\cdot\cdot}{N}} = N = \dot{\underset{\cdot\cdot}{N}}$-

A. $-1, \ -1, \ +1$

B. $-1, \ +1, \ -1$

C. $+1, \ -1, \ -1$

D. $+1, \ -1, \ +1$

Answer: B

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4. Which of the following compound has maximum volatility-

A. 

B. 

C. 

D. 

Answer: C

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5. The number of unpaired electrons in Fe^{3+} (Z=26) are

A. 0

B. 1

C. 2

D. 3

Answer: C

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6. Which of the following statement is correct for 2 - butene-

A. $C_1 - C_2$ bond is a $sp^3 - sp^3\sigma$-bond

B. $C_2 - C_3$ bond is a $sp^3 - sp^2\sigma$-bond

C. $C_1 - C_2$ bond is a $sp^3 - sp^2\sigma$-bond

D. $C_1 - C_2$ bond is a $sp^2 - sp^2\sigma$-bond

Answer: C

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7. Paramagnetic behaviour of B_2 is due to the presence of

-

A. 2 unpaired electrons in $\pi_b MO$

B. 2 unpaired electrons in $\pi^* MO$

C. 2 unpaired electrons in $\sigma^* MO$

D. 2 unpaired electrons in $\sigma_b MO$

Answer: A

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8. The state of hybridisation of the central atom and the number of lone pairs over the central atom in $POCl_3$ are

A. sp, 0

B. sp^2, 0

C. sp^3, 0

D. dsp^2, 1

Answer: C

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9. CO is practically non-polar since-

A. The σ-electron derift from C to O is almost nullified by the π-electron drift from O to C

B. The σ-electron drift from O to C is almost nullified by the π-electron drift from C to O

C. The bond moment is low

D. there is a triple bond between C and O

Answer: A

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10. The increasing order of O-N-O bond angle in the species NO_2, NO_2^+ and NO_2^- is-

A. $NO_2^+ < NO_2 < NO_2^-$

B. $NO_2 < NO_2^- < NO_2^+$

C. $NO_2^+ < NO_2^- < NO_2$

D. $NO_2 < NO_2^+ < NO_2^-$

Answer:

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11. The ground state electronic configuration of CO molecule is-

A. $1\sigma^2 2\sigma^2 1\pi^2 3\sigma^2$

B. $1\sigma^2 2\sigma^2 3\sigma^2 1\pi^2 2\pi^2$

C. $1\sigma^2 2\sigma^2 1\pi^2 3\sigma^2 2\pi^2$

D. $1\sigma^2 1\pi^4 2\sigma^2 3\sigma^2$

Answer: D

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12. In diborane, the number of electrons that account for bonding in the bridges is-

A. six

B. two

C. eight

D. four

Answer: D

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13. In O_2 and H_2O_2, the O-O bond lengths are 1.21 Å and 1.48Å respectively. In ozone, the average O-O bond length is-

A. 1.28 Å

B. 1.18Å

C. 1.44 Å

D. 1.52 Å

Answer: A

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14. In $SOCl_2$, the Cl-S-Cl and Cl-S-O bond angles are-

A. $130^\circ, 115^\circ$

B. $106^\circ, 96^\circ$

C. $107^\circ, 108^\circ$

D. $96^\circ, 106^\circ$

Answer: D

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15. The structure of XeF_6 is experimentally determined to be distorted octahedron. Its structure according to VSEPR theory is-

A. octahedron

B. trigonal bipyramid

C. pentagonal bipyramid

D. tetragonal bipyramid

Answer: C

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16. In case of heteronuclear diatomics of the type AB, where A is more electronegative than B, bonding molecular orbital resembles the character of A more than that of B. The statement

A. is false

B. is true

C. cannot be evaluated since data is not sufficient

D. is true only for certain systems

Answer: B

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17. The bond angle in $NF_3(102.3^\circ)$ is smaller than $NH_3(107.2^\circ)$. This is because of

A. large size of F compared to H

B. large size of N compared to F

C. opposite polarity of N in the two molecules

D. small size of H compared to N

Answer: C

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18. The compound that will have a permanent dipole moment among the following is-

A. I

B. II

C. III

D. IV

Answer: A

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19. Among the following structures the one which is not resonating structure of others is-

A. I

B. II

C. III

D. IV

Answer: D

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20. Correct order of decreasing length of the bond as indicated by the arrow in the following structures is-

A. $I > II > III$

B. $II > I > III$

C. $III > II > I$

D. $I > III > III$

Answer: C

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21. The correct order of decreasing H-C-H angle in the following molecules is-

A. $I > II > III$

B. $II > I > III$

C. $III > II > I$

D. $I > III > II$

Answer: B

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22. In the given compound, the number of 'sp' hybridised carbon is $-CH_2 = C = CH - \underset{\underset{CN}{|}}{C}H - C \equiv CH$

A. 2

B. 3

C. 4

D. 5

Answer: C

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23. The number of lone pairs of electrons on the central atoms of H_2O, $SnCl_2$, PCl_3 and XeF_2 respectively are-

A. 2,1,1,3

B. 2,2,1,3

C. 3,1,1,2

D. 2,1,2,3

Answer: A

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24. The number of σ and π-bonds present between the two carbon atoms in calcium carbide are respectively-

A. $1\sigma - 1\pi$-bond

B. $1\sigma - 2\pi$-bond

C. $2\sigma - 1\pi$-bond

D. $1\sigma, 1\frac{1}{2}\pi$-bond

Answer: B

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25. Which of the following molecules have shape like CO_2

-

A. $HgCl_2$

B. $SnCl_2$

C. C_2H_2

D. NO_2

Answer: A and C

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26. The ground state magnetic property of B_2 and C_2 molecules will be-

A. B_2 paramagnetic and C_2 diamagnetic

B. B_2 and diamagnetic C_2 paramagnetic

C. both are diamagnetic

D. both are paramagnetic

Answer: A

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27. The shape of XeF_5^- is-

A. square pyramidial

B. triangular bipyramidal

C. planar

D. pentagonal bipyramidal

Answer: D

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28. Which statements are correct for the peroxide ion-

A. it has five completely filled anti-bonding molecular orbitals

B. it is diamagnetic

C. it has bond order one

D. It is isoelectronic with neon

Answer: A

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29. Which of the following has the strongest H-bond-

A. $F - O - - - - S$

B. $S - H - - - - O$

C. $F - H - - - - F$

D. $F - H - - - - O$

Answer: C

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30. B cannot form which of the following anions-

A. BF_6^{3-}

B. BF_4^-

C. $B(OH)_4^-$

D. BO_2^-

Answer: A

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31. Which of the following statement is wrong-

A. nitrogen cannot form $d\pi - p\pi$ bond

B. single N-N bond is weaker than the single P-P bond

C. N_2O_4 has two resonance structures

D. The stability of hybrides increases from NH_3 to BiH_3 due to increase in size of the central atom

Answer: D

View Text Solution

32. The structure of IF_7 is-

A. square pyramid

B. trigonal bypyramid

C. octahedral

D. pentagonal bipyramid

Answer: D

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33. The hybridisation of orbitals of N-atom in NO_3^-, NO_2^+ and NH_4^+ are respectively-

A. sp, sp^2, sp^3

B. sp^2, sp, sp^3

C. sp, sp^3, sp^2

D. sp^2, sp^3, sp

Answer: B

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34. Among the following , the maximum covalent character is shown by-

A. $FeCl_2$

B. $SnCl_2$

C. $AlCl_3$

D. $MgFl_2$

Answer: C

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35. Iron exhibits +2 and +3 oxidation states. Which of the following statements about iron is incorrect-

A. Ferrous compounds are relatively more ionic than ferric compounds

B. Ferrous compounds are less volatile than the corresponding ferric compounds

C. ferrous compounds are more easily hydrolysed then the corresponding ferric compounds

D. ferrous oxide is more basic in nature than ferric oxide

Answer: C

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36. ortho-nitrophenol is less soluble is water than p- and m-nitrophenols because-

A. o-nitrophenol shows intramolecular H-bonding

B. o-nitrophenol shows intermolecular H-bonding

C. Melting point of o-Nitrophenol is less than those of m-and p-isomers

D. o-nitrophenol is more volatile than those of m- and p-isomers

Answer: A

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37. The molecule having the smallest bond angle is-

A. $AlCl_3$

B. $SbCl_3$

C. PCl_3

D. NCl_3

Answer: B

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38. In which of the following pairs the two species are not isostructural-

A. PCl_4^+ and $SiCl_4$

B. PF_5 and BrF_5

C. AlF_6^{3-} and SF_6

D. CO_3^{2-} and NO_3^-

Answer: B

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39. Stability of the species Li_2, Li_2^- and Li_2^+ increases in the order of-

A. $Li_2 < Li_2^+ < Li_2^-$

B. $Li_2^- < Li_2^+ < Li_2$

C. $Li_2 < Li_2^- < Li_2^+$

D. $Li_2^- < Li_2 < Li_2^+$

Answer: B

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40. In which of the following pairs of molecules/ions, botht hes pecies are not likely to exist-

A. H_2^+, He_2^{2-}

B. H_2^-, He_2^{2-}

C. H_2^{2+}, He_2

D. H_2^-, Fe_2^{2+}

Answer: C

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41. Which one of the following molecules is expected to exhibit diamagnetic behaviour-

A. C_2

B. N_2

C. O_2

D. S_2

Answer: A::B

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42. The correct statement for the molecule, CsI_3, is-

A. it contains Cs^+, I^- and lattice I_2 molecule

B. it is a covalent molecule

C. it contains Cs^+ and I_3^- ions.

D. it contains Cs^{3+} and I^- ions.

Answer: C

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43. For which of the following molecules significant $\mu \neq 0$

-

A. III and IV

B. only I

C. I and II

D. only III

Answer: A

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44. Which of the following alkaline earth metal sulphates has its hydration enthalpy greater than its lattice enthalpy-

A. $BaSO_4$

B. $SrSO_4$

C. $CaSO_4$

D. $BeSO_4$

Answer: B

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45. In which of the following molecule or ion the hybridisation state ofo the N-atom is sp-

A. NO_2^+

B. NO_2^-

C. NO_3^-

D. NO_2

Answer: A

View Text Solution

46. Which one of the following is not paramagnetic-

A. O_2

B. B_2

C. NO

D. CO

Answer: D

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47. Total number of lone pair of electrons I_3^- ion is-

A. 9

B. 13

C. 3

D. 6

Answer: A

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48. Which of the following compounds contain(s) not covalent bond(s)-KCl, PH_3, O_2, B_2H_6, H_2SO_4

A. KCl

B. KCl, B_2H_6

C. KCl, B_2H_6, PH_3

D. KCl, H_2SO_4

Answer: A

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49. According to molecule orbital theory, which of the following will not be a viable molecule-

A. H_2^-

B. H_2^{2-}

C. He_2^{2+}

D. He_2^{+}

Answer: B

View Text Solution

50. In which of the following pairs of molecules/ions, the central atoms have sp^2 hybridisation-

A. NO_2^- and NH_3

B. BF_3 and NO_2^-

C. NH_2^- and H_2O

D. BF_3 and NH_2^-

Answer: B

Watch Video Solution

51. Considering the state of hybridisation of C-atoms, find out the molecule among the following which is linear-

A. $CH_3 - CH_2 - CH_3 - CH_3$

B. $CH_3 - CH = CH - CH_3$

C. $CH_3 - C \equiv C - CH_3$

D. $CH_2 = CH - CH_2 - C \equiv CH$

Answer: C

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52. Which of the following structures is the most preferred and hence of lowest energy for SO_3-

A. 

B. 

C. 

D. 

Answer: D

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53. The correct order of increasing bond length of C-H, C-O, C-C and C=C is-

A. $C-H<C=C<C-O<C-C$

B. $C-C<C=C<C-O<C-H$

C. $C-O<C-H<C-C<C=C$

D. $C-H<C-O<C-C<C=C$

Answer: A

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54. Which of the two ions from the list given below that have the geometry that is explained by the same

hybridisation or orbitals, $NO_2^-, NO_3^-, NH_2^-, NH_4^+, SCN^-$ -

A. NO_2^- and NO_3^-

B. NH_4^+ and NO_3^-

C. SCN^- and NH_2^-

D. NO_2^- and NH_2^-

Answer: A

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55. Which has the minimum bond length-

A. O_2^+

B. O_2^-

C. O_2^{2-}

D. O_2

Answer: A

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56. Four diatomic species are listed below, identify the correct order in which the bond order is increasing-

A. $NO < O_2^- < C_2^{2-} He_2^+$

B. $O_2^- < NO < C_2^{2-} < He_2^+$

C. $C_2^{2-} < He_2^+ < O_2^- < NO$

D. $He_2^+ < O_2^- < NO < C_2^{2-}$

Answer: D

View Text Solution

57. During change of O_2 tto O_2^- ion, the electron adds on which one of the following orbitals-

A. π^*-orbital

B. π-orbital

C. σ^*-orbital

D. σ-orbital

Answer: A

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58. The pair of species with the same bond order is-

A. O_2^{2-}, B_2

B. O_2^+, NO^+

C. NO, CO

D. N_2, O_2

Answer: A

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59. Which of the following species contains three bond pairs and one lone pair around the central atom-

A. H_2O

B. BF_3

C. NH_2^-

D. PCl_3

Answer: D

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60. Bond order of 1.5 is shown by-

A. O_2^+

B. O_2^-

C. O_2^{2-}

D. O_2

Answer: B

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61. Which of the following pairs is isostructural?

A. BCl_3 and $BrCl_3$

B. NH_3 and NO_3^-

C. NF_3 and BF_3

D. BF_4^- and NH_4^+

Answer: D

Watch Video Solution

62. Which contains no π-bond-

A. SO_2

B. NO_2

C. CO_2

D. H_2O

Answer: D

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63. Which of the following lathanoid ions is diamagnetic (At. Nos. Ce=58, Sm=62, Eu=63, Yb=70)-

A. Eu^{2+}

B. Yb^{2+}

C. Ce^{2+}

D. Sm^{2+}

Answer: B

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64. Which of the following is paramagnetic-

A. CN^-

B. NO^+

C. CO

D. CO_2^-

Answer: D

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65. Which of the following is a polar molecule-

A. SiF_4

B. XeF_4

C. BF_3

D. SF_4

Answer: D

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66. XeF_2 is isostructural with-

A. $SbCl_3$

B. $BaCl_2$

C. TeF_2

D. ICl_2^-

Answer: D

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67. Which spceis has plane triangular shape-

A. N_3

B. NO_3^-

C. NO_2

D. CO_2

Answer: B

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68. Which has the maximum dipole moment-

A. CO_2

B. CH_4

C. NH_3

D. NF_3

Answer: C

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69. The formation of the oxide ion $O^{2-}(g)$, form oxygen atom requires first an exothermic and then an endothermic step as shown below,

$O(g) + e^- \rightarrow O^-(g), \Delta H_f^0 = -141kJ \cdot mol^{-1}$

$O^-(g) + e^- \rightarrow O^{2-}(g), \Delta H_f^0 = +780kJ \cdot mol^{-1}$

ltbr. Thus, process of formations of O^{2-} in gas phase is unfavourable even through O^{2-} is isoelectronic with neon. it is due to the fact that-

A. electron repulsion outweighs the stability gained by achieving noble gas configuration

B. O^{-} ion has comparatively smaller size than O-atom

C. oxygen is more electronegative

D. addition of electron in O result in larger size of the ion

Answer: A

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70. In which of the following pairs, both the species are not isostructural-

A. $SiCl_4$, PCl_4^+

B. diamond, SiC

C. NH_3, PH_3

D. XeF_4, XeO_4

Answer: D

View Text Solution

71. Decreasing order of stability is-

A. $O_2^+ > O_2 > O_2^- > O_2^{2-}$

B. $O_2^{2-} > O_2^- > O_2 > O_2^+$

C. $O_2 > O_2^+ > O_2^{2-} > O_2^-$

D. $O_2^- > O_2^{2-} > O_2^+ > O_2$

Answer: A

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72. Which one of the following compounds shows the presence of interamolecular hydrogen bond-

A. HCN

B. cellulose

C. conc. Acetic acid

D. H_2O_2

Answer: B

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73. Which of the following pairs of ions are isoelectronic and isostructural-

A. ClO_3^- , SO_3^{2-}

B. CO_3^{2-} , NO_3^-

C. ClO_3^- , CO_3^{2-}

D. SO_3^{2-} , CO_3^{2-}

Answer: B

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74. Among the following which one is a wrong statement-

A. $p_{\pi\_d\_(\pi)}$ bonds are present in SO_2

B. SeF_4 and CH_4 have same shape

C. I_3^+ has bent geometry

D. PH_3 and $BiCl_5$ do not exist

Answer: B

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75. The hybridisations of atomic orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are-

A. sp^2, sp^3 and sp

B. sp, sp^2 and sp^3

C. sp^2, sp and sp^3

D. sp, sp^3 and sp^2

Answer: B

View Text Solution

76. Consider the molecules CH_4, NH_3 and H_2O. Which of the given statements is false-

A. the H-C-H bond angle in CH_4, the H-N-H bond angle in NH_3 & the H-O-H bond angle in H_2O are all greater than 90°

B. the H-O-H bond angle in H_2O is larger than the H-C-H bond angle in CH_4

C. the H-O-H bond angle in H_2O is smaller than the H-N-H bond angle in NH_3

D. the H-C-H bond angle in CH_4 is larger than the H-N-H bond angle in NH_3

Answer: B

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77. Predict the correct order among the following-

A. lone pair-lone pairr $>$ lone pair-bond pair $>$ bond pair-bond pair

B. lone pair-lone pair $>$ bond pair-bond pair $>$ lone pair-lone pair

C. bond pair-bond pair $>$ lone pair-bond pair $>$ lone pair-lone pair

D. lone pair-bond pair $>$ bond pair-bond pair $>$ lone pair-lone pair

Answer: A

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78. The charge forming electron pair in the carbonion $CH_3C \equiv C$ exists in-

A. sp-orbital

B. 2p-orbital

C. sp^3-orbital

D. sp^2-orbital

Answer: A

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79. Match the compound given in column-I with the hybridisation and shape given in column-II and mark the

correct option

A. a-iv,b-i,c-ii,d-iii

B. a-i,b-iii,c-iv,d-ii

C. a-i,b-ii,c-iv,d-iii

D. a-iv,b-iii,c-i,d-ii

Answer: B

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80. Which of the following pairs of species have the same bond order-

A. O_2, NO^+

B. CN^-, CO

C. N_2, O_2^+

D. CO, NO

Answer: B

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81. The species, having bond angles of 120° is-

A. ClF_3

B. NCl_3

C. BCl_3

D. PH_3

Answer: C

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82. Match the interhalonge compounds of column-I with the geometry in column-II and assign the correct code:

A. a-iii,b-i,c-iv,d-ii

B. a-v,b-iv,c-iii,d-ii

C. a-iv,b-iii,c-ii,d-i

D. a-iii,b-iv,c-i,d-ii

Answer: A

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83. Consider the following species, $CN^+, CN^- NO$ and CN which one of these will have the highest bond order-

A. CN

B. NO

C. CN^+

D. CN^-

Answer: D

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84. In the structure of ClF_3, the number of lone pairs of electrons on central atom Cl is-

A. three

B. one

C. four

D. two

Answer: D

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85. Descreaing order of bond angle is-

A. $BeCl_2 > NO_2 > SO_2$

B. $BeCl_2 > SO_2 > NO_2$

C. $SO_2 > BeCl_2 > NO_2$

D. $SO_2 > NO_2 > BeCl_2$

Answer: A

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86. The dipole moment is minimum in -

A. NH_3

B. NF_3

C. SO_2

D. BF_3

Answer: D

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87. In BF_3, the B-F bond length is 1.30Å, when BF_3 is allowed to be treated with mMe_(3)N , itf or $msanadduct$, Me_(3)N to BF_(3)`, the bond length of B-F in the adduct is

A. greaterthan 1.30 Å

B. smaller than 1.30Å

C. equal to 1.30Å

D. none of these

Answer: A

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88. Total number of antibonding electrons present in O_2 will be-

A. 6

B. 8

C. 4

D. 2

Answer: A

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89. Which of the following represents the correct bond order-

A. $O_2^+ < O_2^- < O_2^{2-}$

B. $O_2^{2-} > O_2^{2-} > O_2^+$

C. $O_2^{2-} > O_2^+ > O_2^-$

D. $O_2^+ > O_2^- > O_2^{2-}$

Answer: D

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90. In O_3 molecule, the formal charge on the central O-atom is-

A. 0

B. -1

C. -2

D. $+1$

Answer: D

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91. Four diatomic species are listed below in different sequences. Which of these represents the correct order of their increasing bond order-

A. $C_2^{2-} < He_2^+ < NO < O_2^-$

B. $He_2^+ < O_2^{2-} < NO < C_2^{2-}$

C. $O_2^- < NO < C_2^{2-} < He_2^+$

D. $NO < C_2^{2-} < O_2^- < He_2^+$

Answer: B

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92. Which of the following molecules has more than one lone pair-

A. SO_2

B. XeF_2

C. SiF_4

D. CH_4

Answer: B

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93. The AsF_3 molecule is trigonal bipyramidal. The hybrid orbitals used by the As atoms for bonding are-

A. $3_{x^2-y^2}, d_{z^2}, s, p_x, p_y$

B. d_{xy}, s, p_x, p_y, p_z

C. $d_{x^2-y^2}, s, p_x, p_y$

D. s, p_x, p_y, p_z, d_z^2

Answer: D

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94. H_2O is polar, whereas BeF_2 is not because-

A. electronegativity of F is greater than that of O

B. H_2O involves H-bonding, whereas, BeF_2 is a discrete molecule

C. H_2O is angular and BeF_2 is linear

D. H_2O is linear and BeF_2 is angular

Answer: C

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95. Which of the following have same hybridisation but are not isostructural-

A. ClF_3 and I_3^-

B. BrF_3 and NH_3

C. CH_4 and NH_4^+

D. XeO_3 and NH_3

Answer: A

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96. Which of the following pairs have different hybridisation and same shape-

[I] NO_3^- and CO_3^{2-}

[II] SO_2 and NO_2^-

[III] XeF_2 and CO_2

[IV] H_2O and NH_3

A. I and IV

B. II and IV

C. III

D. none of these

Answer: C

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97. Which of the following is correct regarding bond angles-

I. $SO_2 < H_2O$

II. $H_2S < SO_2$

III. $SO_2 < H_2S$

IV. $SbH_3 < NO_2^+$

A. Iiand IV

B. I, II and IV

C. I and III

D. none of these

Answer: A

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98. Which pair of molecules does ot have identical structure-

A. I_3^- , BeF_2

B. O_3, SO_2

C. BF_3, ICl_3

D. BrF_4^- , XeF_4

Answer: C

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99. Which of the following order is correct-

A. $AlCl_3 < MgCl_2 < NaCl$, polarising power

B. $CO > CO_2 > HCO_2^- > CO_3^{2-}$: bond length

C. $BeCl_2 < NF_3 < NH_3$: dipole moment

D. $H_2S > NH_3 > SiH_4 > BF_3$: bond angle

Answer: C

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100. Which of the following has maximum % of s-character-

A. N_2H_2

B. N_2H_4

C. NH_3

D. NH_2^-

Answer: A

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101. Which of the following pairs does not have same bond order-

A. N_2 and CN^-

B. O_2^+ and NO

C. F_2^- and O_2^+

D. B_2^{2-} and CN^+

Answer: C

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Single Correct Type

1. The compound with no dipole moment is-

A. methyl chloride

B. carbon tetrachloride

C. methylene chloride

D. chloroform

Answer: B

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2. Which of the following does not have a H-bond-

A. phenol

B. liq. NH_3

C. water

D. liq. HCl

Answer: D

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3. The molecule having one unpaired electron is-

A. NO

B. CO

C. CN^-

D. O_2

Answer: A

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4. The bond between two identical non-metal atoms ahs a pair of electron-

A. unequally shared between the two

B. transferred fully from one atom to another

C. with idential spins

D. equally shared betwee them

Answer: D

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5. Hydrogen bond is the strongest in-

A. O-H----S

B. S-H----O

C. F-H----F

D. F-H----O

Answer: C

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6. The ion that is isoelectronic with CO is-

A. CN^-

B. O_2^+

C. O_2^-

D. N_2^+

Answer: A

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7. Which of the following resonating structures is not correct for carbon dioxide-

A. $: \overset{\cdot\cdot}{O} = C = \overset{\cdot\cdot}{O} :$

B. $: \overset{\cdot\cdot}{\underset{\cdot\cdot}{\overset{-}{O}}} - C = O^{+} :$

C. $: \overset{\cdot\cdot}{\underset{\cdot\cdot}{\overset{+}{O}}} - C = O^{-} :$

D. $: {}^{+}O \equiv C - \overset{\cdot\cdot}{\underset{\cdot\cdot}{O}}^{-} :$

Answer: C

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8. Percentage of ionic character is maximum in-

A. $H - F$

B. $H - Cl$

C. $H - Br$

D. $H - I$

Answer: A

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9. Which of the following molecules constants both polar and non-polar bonds-

A. NH_4Cl

B. HCN

C. H_2O_2

D. CH_4

Answer: C

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10. Which of the following statements is correct for $CsBr_3$ –

A. it is covalent compound

B. It contains Cs^{3+} and Br^- ion.

C. It contains Cs^+ and Br_3^- ions

D. It contains Cs^+, Br^- and lattice Br_2 molecules.

Answer: C

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11. KF combines with HF to form KHF_2. The compound contains the species-

A. K^+, F^- and H^+

B. K^+, F^- and HF

C. K^+ and $[HF_2]^-$

D. it contains Cs^+, Br^- and lattice Br_2 molecule

Answer: C

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12. The correct order of increasing C-O bond length of CO, CO_3^{2-}, CO_2 is-

A. $CO_3^{2-} < CO_2 < CO$

B. $CO_2 < CO_3^{2-} < CO$

C. $CO < CO_3^{2-} < CO_2$

D. $CO < CO_2 < CO_3^{2-}$.

Answer: D

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13. The geometry of H_2S and its dipole moment is-

A. angular and non-zero

B. angular and zero

C. linear and non-zero

D. linear and zero

Answer: A

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14. The species in which the central atom uses sp^2 hybrid orbitals in its bonding is-

A. PH_3

B. NH_3

C. CH_3^+

D. SbH_3

Answer: C

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15. The molecular that has a pyramidal shape-

A. PCl_3

B. SO_3

C. CO_3^{2-}

D. NO_3^-

Answer: A

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16. Among the following compounds, the one that is non-polar and has the central atom with sp^2 hybridisation is-

A. H_2CO_3

B. SiF_4

C. BF_3

D. $HClO_2$

Answer: C

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17. The hybridisation of atomic orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ are-

A. sp, sp^3 and sp^2 respectively

B. sp, sp^2 and sp^3 respectively

C. sp^2, sp and sp^3 respectively

D. sp^2, sp^3 and sp respectively.

Answer: B

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18. Which has the largest bond angle-

A. H_2Se

B. H_2S

C. H_2O is angular and BeF_2 is linear

D. SO_2

Answer: C

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19. Which of the following contains maximum number of lone pairs of electrons on the central atom-

A. ClO_3^-

B. XeF_4

C. I_3^-

D. SF_4

Answer: C

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20. The percentage of p-character in the orbitals forming p-p bonds in $P_4$is-

A. 25

B. 33

C. 50

D. 75

Answer: D

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21. The hybridisation involved in the molecules of OSF_4 and $XeOF_4$ respectively are-

A. sp^3d and sp^3d^2

B. sp^3d^2 and sp^3d

C. sp^3d and sp^3d

D. sp^3d^2 and sp^3d^2

Answer: A

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22. Which of the following molecules is paramagnetic-

A. C_2

B. N_2

C. O_2

D. F_2

Answer: C

Watch Video Solution

23. In which of the following species, the bond length is expected to be the largest-

A. O_2^{2-}

B. O_2^-

C. O_2

D. O_2^+

Answer: A

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24. Among the following, the paramagnetic compound is-

A. Na_2O_2

B. O_3

C. N_2O

D. KO_2

Answer: D

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25. Species having bond order different from that in CO is-

A. NO^-

B. NO^+

C. CN^-

D. N_2

Answer: A

Watch Video Solution

26. The increasing bond length of O-O bond in $O_2, O_2[AsF_6]$ and KO_2 is-

A. $O_2[AsF_6] < KO_2 < O_2$

B. $O_2[AsF_6] < O_2 < KO_2$

C. $KO_2 < O_2[AsF_6] < O_2$

D. $KO_2 < O_2 < O_2[AsF_6]$.

Answer: B

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27. Which of the following pairs have identical bond order:-

A. CN^- and O_2^-

B. CN^- and NO^+

C. CN^- and O_2^+

D. NO^+ and O_2^+

Answer: B

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28. The number and type of bonds between two carbon atoms in calcium carbide (CaC_2) are -

A. one σ and one π bonds

B. one σ and two π-bonds

C. one σ and one and a half π-bonds

D. one σ bond

Answer: B

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29. The common features among the species CN^-, CO and NO^+ are-

A. bond order three and isoelectronic

B. bond order three and weak field ligands

C. bond order two and π-acceptors

D. isoelectronic and weak field ligards

Answer: A

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30. The hybridisation of central iodine atom in I_3^+ and I_3^- are respectively-

A. sp^3, sp^3d

B. sp^3d, sp^3

C. sp^3d, sp^3d

D. sp^3, sp^3d

Answer: A

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31. The no. of unpared electrons in a paramagentic diatomic molecule of an element with atomic number 16 is-

A. 4

B. 1

C. 2

D. 3

Answer: C

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32. In the formation of N_2^+, the electron is lost from :

A. σ-orbital

B. π-orbital

C. σ^*-orbital

D. π^*-orbital

Answer: A

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33. In $\left[Ag(CN)_2\right]^-$ the number of π-bonds is-

A. 2

B. 3

C. 4

D. 6

Answer: C

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34. Which is wrong combination

A. $p_x - p_x$

B. $p_x - p_y$

C. $p_y - p_y$

D. $p_z - p_z$

Answer: B

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35. In which of the following molecules all the bonds are not equal-

A. AlF_3

B. NF_3

C. ClF_3

D. BF_3

Answer: C

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36. The correct order in which the O-O bond length increases in the following is-

A. $O_2 < H_2O_2 < O_3$

B. $O_3 < H_2O < O_2$

C. $H_2O_2 < O_2 < O_3$

D. $O_2 < O_3 < H_2O_2$

Answer: D

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37. Among the following compounds, the one that is polar and has the central atom with sp^2 hybridisation is-

A. H_2CO_3

B. SiF_4

C. BF_3

D. $BClO_2$

Answer: A

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38. The number of lone pairs on Xe in XeF_2, XeF_4 and XeF_6 respectively are-

A. 3,2,1

B. 2,4,6

C. 1,2,3

D. 6,4,2

Answer: A

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39. The molecule with the highest dipole moment is-

A. CH_2Cl_2

B. CH_3Cl

C. $CHCl_3$

D. CCl_4

Answer: B

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40. Among the following, the compound having both electrovalent and covalent bond is -

A. H_2S

B. AlF_3

C. $NaOH$

D. HNO_3

Answer: C

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41. which is not a moneran

A. $s - s$

B. p-p

C. $s - p$

D. both (a) and (b)

Answer: B

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42. Among the halides of Al, the one with maximum solubility in water is-

A. AlF_3

B. $AlCl_3$

C. $AlBr_3$

D. AH_3

Answer: A

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43. Among the four element $P\left(1s^2 2s^2\right), Q\left(1s^2 2s^2 2p^2\right), R\left(1s^2 2s^2 2p^5\right)$ and $S\left(1s^2 2s^2 2p^6\right)$, which has the maximum tendency to form covalent bond-

A. P

B. Q

C. R

D. S

Answer: C

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44. Which of the following oxide of nitrogen is ionic-

A. NO

B. N_2O_5

C. N_2O_4

D. N_2O_3

Answer: B

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45. Which of the followng ions forms the largest hydrated ion in solution-

A. Fe^{3+}

B. Fe^{2+}

C. Cs^{+}

D. Al^{3+}

Answer: D

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46. Covalent radius of lithium atom is 123 pm, the crystal radius of Li will be-

A. > 123 pm

B. < 123 pm

C. $+123$pm

D. $\frac{123}{2}$pm

Answer: A

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47. Which hybridisation results in non-planar orbitals-

A. sp

B. sp^2

C. sp^3-orbital

D. dsp^2

Answer: C

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48. Electrnegativity value of four different elements P, Q, R and S are 0.7, 1.1, 1.6 and 1.7 respectively. The bond which has most ionic character is-

A. P-S

B. Q-S

C. Q-R

D. R-S

Answer: A

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49. The total number of electrons that takes part in forming bonds in N_2 is-

A. 2

B. 4

C. 6

D. 10

Answer: C

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50. Among the given pairs CO_2 resembles-

A. $HgCl_2, C_2H_2$

B. C_2H_2, NO_2

C. $HgCl_2, SnCl_4$

D. N_2O, NO_2

Answer: A

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51. The solubility of anhydrous $AlCl_3$ and hydrous $AlCl_3$ in diethyl ether are S_1 and S_2 respectively. Then -

A. $S_1 = S_2$

B. $S_1 > S_2$

C. $S_1 < S_2$

D. none of these

Answer: B

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52. The ONO angle is maximum in-

A. NO_3^-

B. NO_2^-

C. NO_2

D. NO_2^+

Answer: D

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53. In a regular octahedral molecule, MX_6 the number of X-M-X bonds with 180° is-

A. 3

B. 2

C. 6

D. 4

Answer: A

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54. A σ-bonded molecule MX_3 is T-shaped. The number of non-bonding pairs of electrons is-

A. 0

B. 2

C. 1

D. 3

Answer: B

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55. How many types of F-S-F bonds are present in SF_4

A. 2

B. 5

C. 4

D. 3

Answer: A

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56. Which of the following pairs are isostructural-

A. $\left[CO_3^{2-}, SO_3^{2-}\right]$

B. $\left[XeF_2, IF_2^-\right]$

C. $\left[NH_2^-, BeF_2\right]$

D. $[SO_4^{2-}, BF_4^-]$

Answer: B::D

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57. Which of the following statements are not correct-

A. the shape of PCl_5 is trigonal pyramidal

B. the geometrical arrangements of electron pairs around Cl in ClO_2^- is square planar.

C. the geometrical arrangement of electron pairs arround I in IF_4^- is octahedral

D. The geometrical arrangement of electron pairs around I in ICl_3 is trigonal planar.

Answer: B::D

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58. Dipole moment is possed by-

A. 1,4-dichlorobenzene

B. trans-1,2-dichloroethene

C. cis-1,2-dichloroethene

D. trans-2,3-dichloropent-2-ene.

Answer: C::D

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59. CO_2 is isostructural with-

A. $HgCl_2$

B. $SnCl_2$

C. C_2H_2

D. NO_2

Answer: A::C

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60. Linear structure is exhibited by-

A. $SnCl_2$

B. NCO^-

C. NO_2^+

D. CS_2

Answer: B::C::D

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61. Which of the following statements about carbonate $\left(CO_3^{2-}\right)$ ion are incorrect-

A. the C-O bond order is 1.33

B. the formal charge on each oxygen atom is 0.67 units

C. it has two C-O single bonds, one C=O double bond

D. the hybridisation of central atom is sp^3

Answer: C::D

View Text Solution

62. Paramagnetic species are-

A. O_2^+

B. O_2^-

C. N_2^+

D. N_2^-

Answer: A::B::C::D

View Text Solution

63. Molecules having distorted tetrahedral geometry are-

A. H_2O

B. NH_2

C. BF_4^-

D. XeF_2

Answer: A::B::C::D

View Text Solution

64. Which of the combinations are correct-$HgCl_2$-linear

A. ClF_3-V-shaped

B. ClF_3-T-shaped

C. ICl_4^- -saqure planar

D.

Answer: A::C::D

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65. In the following case(s), hybridisation of the underlined atom is affected, when-

A. $\underline{P}Cl_5$ (solid) dissociated into PCl_4^+ and PCl_6^+

B. LiH reacts with $\underline{Al}H_3$ forming AlH_4^-

C. $\underline{N}H_3$ is protonated

D. $H_3\underline{P}O_2$ is heated forming PH_3 and H_3PO_3

Answer: A::B

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66. Which of the following molecule have a bond angle smaller than tetrahedral angle-

A. NH_4^+

B. SiH_4

C. NH_3

D. H_2O

Answer: C::D

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67. Identify the species that are non-polar-

A. CH_3^+

B. NH_4^+

C. BF_4^+

D. C_2H_2

Answer: B::C

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68. Nitrogen oxide(s) that contain(s) N-N bond(s) is/are-

A. N_2O

B. N_2O_3

C. N_2O_4

D. N_2O_5

Answer: A::B::C::D

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69. Molecules with the shape of a see-saw are-

A. $XeOF_4$

B. SF_4

C. $XeOF_2$

D. XeO_2F_2

Answer: B::D

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70. The molecules in which the central atom is sp^3d^2 hybridised are-

A. XeF_4

B. XeF_6

C. SF_6

D. I_3^-

Answer: A::C

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71. In which of the following cases, hybridisation of the central atom does not change

A. $NH_3 \rightarrow NH_4^+$

B. $BCl_3 \rightarrow BCl_4^-$

C. $SO_2Cl_2 \rightarrow H_2SO_4$

D. $BF_3 \rightarrow BF_3 \cdot NH_3$

Answer: A::C

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72. Which type of chemical bonds are present in N_2O_5-

A. H-bond

B. coordinate bond

C. covalent bond

D. ionic bond

Answer: B::C

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73. Which species among the following have shape similar to that of sulphate ion-

A. XeF_4

B. SF_4

C. XeO_4

D. SiF_4

Answer: C::D

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74. The following bond(s) is/are present in $CuSO_4 \cdot 5H_2O$-

A. covalent bond

B. coordinate covalent bond

C. ionic bond

D. hydrogen bond

Answer: A::B::C::D

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75. Which of the following species are hypervalent-

A. ClO_4^-

B. BF_3

C. SO_4^{2-}

D. CO_3^{2-}

Answer: A::C

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76. Which of the following are planar molecules-

A. $F_2C = C = CF_2$

B. $F_2B - C \equiv C - BF_2$

C. $(SiH_3)_3N$

D. $H_2N - NH_2$

Answer: B::C

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77. Which of the following species are stabilised by addition of electron-

A. C_2

B. CN

C. N_2

D. F_2

Answer: A::B

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78. Which are correct cannonical forms of azide ions-

A. $: \overset{\cdot\cdot}{\overset{-}{N}} = \overset{+}{N} = \overset{\cdot\cdot}{N}^{-} :$

B. $: \overset{\Theta}{\overset{\cdot\cdot}{N}} = N \equiv N :$

C. $: N \equiv \overset{+}{N} - \underset{\cdot\cdot}{\overset{\cdot\cdot}{N}}^{2-} :$

D. 

Answer: A::C

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79. Which of the following species does not exist-

A. F_3^-

B. I_3^-

C. PH_5

D. PF_5

Answer: A::C::D

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80. Which of the following pairs from ionic compound-

A. H, Ca

B. C, Cl

C. Na, O

D. Ca, C

Answer: A::C::D

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81. Which of the following species are capable of forming a coordinate bond with BF_3 -

A. NH_4^+

B. NH_3

C. F^-

D. Ca^{2+}

Answer: B::C

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82. In which of the following the hybrid orbitals of the central atom have the same s-character-

A. CH_4

B. $Ni(CO)_4$

C. XeO_3

D. $\left[Ni(CN)_4\right]^{2-}$

Answer: A::B::D

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83. PCl_5 is highly reactive and in solid state it splits into ions. The shape of these ions are-

A. square pyramidal

B. tetrahedral

C. octahedral

D. trigonal bipyramidal

Answer: B::C

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84. The d-orbitals involved in sp^3d^2 hybridisation are (z-axis is the internuclear axis)-

A. $d_{x^2-y^2}$

B. d_{xy}

C. d_{z^2}

D. d_{yz}

Answer: A::C

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Very Short Type Questions

1. What will be the nature of the compound formed between the metallic elements of group-I to II and non-metals of group VI or VII of the periodic table?

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2. In terms of ionisation enthalpy and electron gain enthalpy.

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3. Write the Lewis symbols of magnesium and aluminium.

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4. Write the structure of an anion which is isostructural with BF_3 and a cation which is isostructural with CH_4.

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5. Give an example of a compound in which electrovalent, covlent and coordinate covalent bonds are present.

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6. Which one of $CHCl_3$ and CCl_4 is regular tetrahedral in shape?

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7. how many σ and π-bonds are present in $CH_2 = CH - CH = CH_2$?

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8. What is the hybrid state of the central atom in each of following? BF_4^-, NO_3^-, PF_5, CO_2.

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9. Predict the shapes using VSEPR theory, IF_7, ClF_3, SF_6, $BeCl_2$.

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10. How many resonance structures can be written for SO_4^{2-} ?

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11. Arrange the halogen hyddracids in order of their decreasing boiling points.

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12. Find out the non-polar molecule among CH_3Cl, SF_6, SO_2, C_2H_4 and  .

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13. Which one is less viscous between HF and H_2O ?

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14. Which one out of O_2 and O_2^- exhibits highest paramagnetism?

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15. How will you distinguish B_2 from the following species having same bond order: Li_2, O_2^{2-} and F_2?

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16. Is there any change in bond order if electron is added to bonding molecular orbital?

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17. The bond order of He_2^+ ion is- $\frac{1}{2}, 1, \frac{3}{2}, O.$

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Fill In The Blanks

1. A____covalent bond is formed between two atoms having different electgronegativities.

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2. Pi bonds are___than sigma bonds.

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3. In different resonating structures, the___arrangement remains the same.

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4. When atomic orbitals overlap head-on, the bond formed is ____whereas when they overlap laterally, the bond formed is-____.

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5. $AlCl_3$ is ____compound while PCl_5 is____ compound in terms of octet rule.

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6. The C.G.S unit of dipole momoent is ___whereas its SI unit is___.

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7. In general, larger is the bond length, ___is the bond energy.

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8. The energy of H-bond is____

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9. The hybrid state of S in SO_3 molecule is____.

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10. The shape of the molecule containing 3 bond pairs and one lone pairs around the central atom is____

A. Trigonal pyramidal

B. Trigonal planar

C. Tetrahedral

D. None

Answer: A

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11. The bond order of CO molecule is _____ whereas that of CO^+ ion is___.

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12. In ice, each O atom is surrounded by____ H-atoms out of which, ___ are bonded by covalent bonds, while the rest are bonded by____ bonds.

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13. The shape of sulphur hexafluoride molecule is___whereas that of sulphur tetrafluoride is____.

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14. There are___π bonds in a nitrogen molecule.

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15. The strongest hydrogen bond is formed between ___ and hydrogen atom.

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16. Hydrogen bond is _____than a covalent bond.

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17. The dipole moment of methyl alcohol is ____than that of CH_3SH.

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18. d^2sp^3 hybridisation represents_____configuration.

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19. Amongst the three isomers of nitrophenol, the one that is least soluble in water is____.

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20. Amongst N_2O, SO_2, I_2^+ and I_3^- the linear species are ____ and _____.

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Short Type Questions

1. Explain why covalent compounds exhibit isomerism.

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2. Explain the formation of BF_4^- ion from BF_3.

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3. $PbCl_2$ is white while PbI_2 is golden yellow-why?

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4. Write down the Lewis dot structure of nitrite ion (NO_2^-).

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5. What should be the electron affinity and electronegativity of the atoms involved in covalent bond formation?

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6. Indicate the nature of bonds in $NaBH_4$.

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7. Metallic Na reats violently with water, but Na^+ ion not react with water-why?

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8. NaCl is non-volatile but HCl is volatile-explainwith reason.

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9. Which of the ionic bonds formed between Na^+ and Cl^- and between K^+ and Cl^- will be stronger and why?

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10. The lattice energy of MgO is greater than NaF-why?

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11. Unlike CaF_2, $CaCl_2$ is soluble in water-why?

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12. BF_3 does not obey octet rule, yet it exists -explain.

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13. Ionic compounds having cations and anions with higher charge are insoluble in water-explain why?

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14. Explain why the reaction between NaCl nd $AgNO_3$ is fast but the reaction between H_2 and Cl_2 is slow.

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15. Define coordination number with suitable example.

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16. What type of bond will be formed between two elements with similar electronegativities? Give example.

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17. Explain the given order of solubility of silver halides in water: $AgF > AgCl > AgBr > AgI$.

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18. Give the states of hybridisation of central atoms of $PCl_4^+ \& XeOF_4$?

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19. Arrange the following in increasing order of bond angle around the central atom and explain: $BeF_2, BF_3, NH_3, H_2O, CH_4$.

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20. Explain why the axial bonds in PCl_5 are longer than the equatorial bonds.

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21. CO_2 is non-polar but COS is polar, even though both of them are linear. Explain.

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22. Tropone (cycloheptatrienone, ) is highly poalr ($\mu = 4.17D$) in nature-why?

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23. Explain whether the compounds 1,3,5-tribromobenzene and 2,4,6-trichlorobenzene will be polar or not.

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24. The boiling point of cis-1,2-dichloethene is higher than that of tis trans-isomer-why?

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25. Ethanol boils at a higher temperature than diemthyl ether, even though they have same molecular formula-

explain.

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26. Which of the following have zero dipole moment and why?

$CO_2, CHCl_3, CCl_4, H_2O, p(CH_3C_6H_4CH_3), BF_3, NH_3$

.

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27. H_2O is a liquid but H_2S is a gas-why?

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28. PH_3 is less soluble in water compound to NH_3-why?

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29. What is the effect of the following ionisation process on the bond orders of C_2 and O_2 – (i) $C_2 \rightarrow C_2^+ + e$ (ii) $O_2 \rightarrow O_2^+ + e$

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Numberical Problems

1. Calculate the bond order of Cl-O bond in ClO_4^-.

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2. Calculate the number of sigma and pi-electrons present in 0.1 mol of vinyl cyanide.

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3. Why the dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.

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4. The dipole moment of HCl is 1.03 D and the distance between H and Cl atoms in the molecule is 1.275 Å. Calculate the percentage of ionic character of HCl.

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5. Calculate the ratio of partial positive charge on H-atom in HCl to that in HI. μ (HCl)=1.03D, bond length=1.27Å, μ (HI)=0.38D and bond length=1.61Å.

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6. Dipole moment of LiH is $1.94 \times 10^{-29} C \cdot m$ and the interatomic distance between Li and H in the molecule is $1.59 \times 10^{-10} cm$. Calculate the percentage of ionc character in LiH.

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7. Calculate the percentage of s-character between hybrid orbitals having a bond angle of 105° [$\cos 105^\circ = 0.2588$].

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Practice Set

1. The bond angle in $NF_3(102.^\circ)$ is smaller than $NH_3(107.^\circ)$. This is because-

A. large size of F compared to H

B. large size of N compare to F

C. opposite polarity of N in the two molecules

D. small size of H compared to N

Answer:

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2. Which of the following pairs is isostructural-

A. BCl_3 and $BrCl_3$

B. NH_3 and NO_3^-

C. NF_3 and BF_3

D. BF_4^- and NH_4^+

Answer:

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3. Which combination of atomic orbitals is not allowed according to MO theory-

A. $p_x - p_x$

B. $p_x - p_y$

C. $p_y - p_y$

D. $p_z - p_z$

Answer:

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4. The geometry of H_2S and its dipole moment is-

A. angular and non-zero

B. angular and zero

C. liner and non-zero

D. linear and zero

Answer:

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5. Inerrt gases do not generally participate in the chemical reaction-explain with reason.

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6. (a) Dimethyl ether and ethanol have same molecular weight but their volatilities are different-explain. (b) find out the bond order of H_2^+ ion.

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7. Electronegativity of Br is less than that of F, yet BF_3 is weaker lewis acid than BBr_3 — explain.

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8. (a) MgO has a higher lattice energy than NaF-why?

(b) What is the geometry of the ionic crystal if the value of r_+ / r_- is in the range of 0.225-0.414?

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9. (a0 Which one between p^- and sp^- orbitals has more directional properties and why? (b) does PCl_5 form PCl_5 and Cl_2 on strong heating?

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10. In a certain polar solvent, PCl_5 undergoes ioonisation as follows: $2PCl_5 \Leftrightarrow PCl_4^+ + PCl_6^-$, predict geometrical shapes of all the species involved.

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