CHEMICAL BONDING

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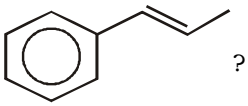
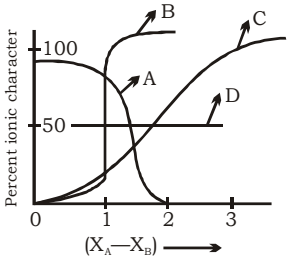
Multiple Choice Questions

1. It is believed that atoms combine with each other such that outermost shell acquires stable configuration of 8 electrons. If stability were attained with 6 electrons rather than 8, what would be the formula of the stable fluoride ion?
   (a) F^- (b) F^+
   (c) F^{2+} (d) F^{3+}
2. In which of the following compounds does the central atom obey the octet rule?
   (a) XeF_4 (b) $XeOF_2$
   (c) SCl_2 (d) $AlCl_3$
3. Based on lattice energy and other considerations, which one of the following alkali metal chlorides is expected to have the highest melting point?
   (a) LiCl (b) NaCl
   (c) KCl (d) RbCl
4. 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
5. In which of the following, the central atom has two lone pairs of electrons?
   (a) SF_4 (b) BrF_5
   (c) SO_2 (d) XeF_4
6. 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
7. Which of the following has a regular geomctry?
   (a) $CHCl_3$ (b) PCl_3
   (c) XeF_6 (d) SF_4
8. Predict the correct order of repulsions among the following:
   (a) bond pair-bond pair > lone pair-bond pair > lone pair - lone pair
   (b) lone pair - bond pair > bond pair - bond pair > lone pair - lone pair
   (c) lone pair - bond pair > lone pair - bond pair > bond pair - bond pair
   (d) lone pair - lone pair > bond pair - bond pair > lone pair - bond pair
9. The strength of the covalent bond in H_2, F_2 and HF is in the order
   (a) $H-H > F-F > H-F$ (b) $H-F > F-F > H-H$
   (c) $H-F > H-H > F-F$ (d) $F-F > H-F > H-H$
10. The number and type of bonds between two carbon atoms in calcium carbide are
    (a) one sigma, one pi (b) one sigma, two pi
    (c) two sigma, one pi (d) two sigma, two pi
11. How many bonds are there in  ?
    (a) $14\sigma, 8\pi$ (b) $18\sigma, 8\pi$
    (c) $19\sigma, 4\pi$ (d) $14\sigma, 2\pi$
12. In $[Ag(CN)_2]^-$, the number of π bonds is
    (a) 2 (b) 3
    (c) 4 (d) 6
13. Which of the following species contains equal number of σ and $\pi-$ bonds?
    (a) $(CN)_2$ (b) $CH_2(CN)_2$
    (c) HCO_3^- (d) XeO_4
14. The covalent bond length is the shortest in which one of the following bonds?
    (a) $C-O$ (b) $C-C$
    (c) $C \equiv N$ (d) $O-H$
15. The values of electronegativity of atoms A and B are 1.2 and 4.0 respectively. The % ionic character of the A - B bond is
    (a) 50% (b) 72.24%
    (c) 55.3% (d) 43%
16. For AB bond if percent ionic character is ploted against electronegativity difference $(X_A - X_B)$, the shape of the curve would look like



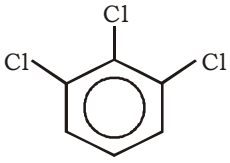
    (a) (A) (b) (B)
    (c) (C) (d) (D)
17. Arrange the following compounds in order of increasing dipole moment
    Toluene (I), *m*-dichlorobenzene (II), *o*-dichloro-benzene (III), *p*-dichlorobenzene (IV)
    (a) I < IV < II < III (b) IV < I < II < III
    (c) IV < I < III < II (d) IV < II < I < III

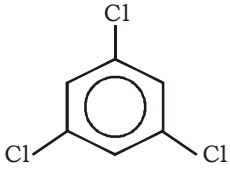
18. Among the following, the molecule with highest dipole moment is
(a) CCl_4 (b) NH_3
(c) H_2O (d) $CHCl_3$

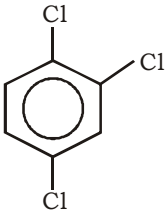
19. Which one of the following arrangements of molecules is correct on the basis of their dipole moments?
(a) $BF_3 > NH_3 > NH_3$ (b) $NF_3 > BF_3 > NH_3$
(c) $NH_3 > BF_3 > NH_3$ (d) $NH_3 > NH_3 > BF_3$

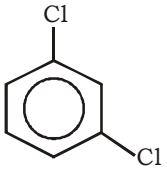
20. Among the following, the molecule with highest dipole moment is
(a) CH_3Cl (b) CH_2Cl_2
(c) $CHCl_3$ (d) CCl_4

21. Which of the following has maximum dipole moment?

(a) 

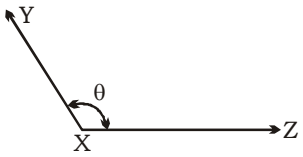
(b) 

(c) 

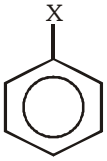
(d) 

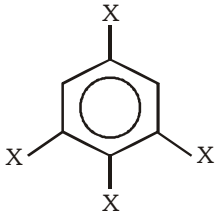
22. Which of the following are non-polar molecules?
I. NCl_3 II. SO_3 III. PCl_5
(a) I only (b) II only
(c) I and II only (d) II and III only

23. Which bond angle θ would result in the maximum dipole moment for the triatomic molecule, XY_2 shown below?



(a) 90^0 (b) 120^0
(c) 150^0 (d) 180^0

24. The dipole moment of 

is 1.5 D. The dipole moment of 

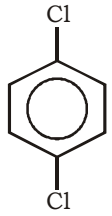
is:
(a) 1.5 D (b) 2.25 D
(c) 1 D (d) 3 D

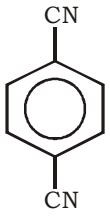
25. The correct order of increasing polarising power of the cations in $AlCl_3$, $MgCl_2$ and NaCl is
(a) $AlCl_3 < MgCl_2 < NaCl$ (b) $MgCl_2 < NaCl < AlCl_3$
(c) $NaCl < MgCl_2 < AlCl_3$ (d) $NaCl < AlCl_3 < MgCl_2$

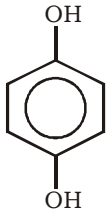
26. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, K^+, Ca^{2+}, Mg^{2+}, Ba^{2+}?
(a) $Ca^{2+} < Mg^{2+} < Be^{2+} < K^+$
(b) $Mg^{2+} < Be^{2+} < K^+ < Ca^{2+}$
(c) $Be^{2+} < K^+ < Ca^{2+} < Mg^{2+}$
(d) $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

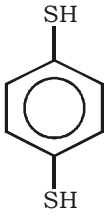
27. Which of the following is a polar molecule?
(a) BF_3 (b) SF_4
(c) SiF_4 (d) XeF_4

28. For which of the following molecules, significant $\mu \neq 0$?

(1) 

(2) 

(3) 

(4) 

(a) (3) and (4) (b) Only (1)
(c) (1) and (2) (d) Only (3)

29. Some ether is added to an aqueous solution of a mixture of LiCl, NaCl and $AlCl_3$. Which will be extracted into ether?
(a) LiCl, NaCl (b) LiCl, $AlCl_3$
(c) NaCl, $AlCl_3$ (d) LiCl, NaCl, $AlCl_3$

30. Among the following species, identify the isostructural pairs
NF_3, NO_3^-, BF_3, H_3^+O, HN_3
(a) $[NF_3, NO_3^-]$ and $[BF_3, H_3^+O]$
(b) $[NF_3, HN_3]$ and $[NO_3^-, BF_3]$
(c) $[NF_3, H_3^+O]$ and $[NO_3^-, BF_3]$
(d) $[NF_3, H_3^+O]$ and $[HN_3, BF_3]$

31. Which of the following pairs of ions are isoelectronic and isostructural?
(a) SO_3^{2-}, NO_3^- (b) ClO_3^-, SO_3^{2-}

(c) CO_3^{2-}, SO_3^{2-} (d) ClO_3^-, CO_3^{2-}

32. The type of hybrid orbitals used by chlorine atom in ClO_3^- is

(a) sp^3 (b) sp^2

(c) sp (d) none of these

33. Which one of the following compounds has sp^2 hybridisation?

(a) CO_2 (b) SO_2

(c) N_2O (d) CO

34. 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^3 respectively

35. The correct order of hybridisation of the central atom in the following species NH_3, $[PtCl_4]^{2-}$, PCl_5 and BCl_3 is:

(a) dsp^2, dsp^3, sp^2 and sp^3 (b) sp^3, dsp^2, dsp^3 and sp^2

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

36. The shapes of SF_4 and XeF_2 respectively are

(a) trigonal bipyramidal and trigonal bipyramidal
(b) see-saw and linear
(c) T-shape and linear
(d) square planar and trigonal bipyramidal

37. The pair having similar geometry is

(a) PCl_3, NH_4^+ (b) $BeCl_2$, H_2O

(c) CH_4, CCl_4 (d) IF_5, PF_5

38. The maximum number of 90^0 angles between bond pair-bond pair of electrons is observed in

(a) dsp^3 hybridisation (b) sp^3 d hybridisation

(c) dsp^2 hybridisation (d) sp^3d^2 hybridisation

39. Which of the following contains maximum number of lone pairs on the central atom?

(a) ClO_3^- (b) XeF_4

(c) SF_4 (d) I_3^-

40. Consider the following molecules or ions:

(i) CH_2Cl_2 (ii) NH_4^+

(iii) SO_4^{2-} (iv) ClO_4^-

(v) NH_3

sp^3 hybridisation is involved in the formation of

(a) (i), (ii), (v) only (b) (i), (ii) only

(c) (ii) only (d) (i), (ii), (iii), (iv) and (v)

41. The hybridization of oxygen atom in H_2O_2 is

(a) sp^3d (b) sp

(c) sp^2 (d) sp^3

42. SF_2, SF_4 and SF_6 have the hybridisation at sulphur atom respectively as

(a) sp^2, sp^3, sp^3d^2 (b) sp^3, sp^3, sp^3d^2

(c) sp^3, sp^3d, sp^3d^2 (d) sp^3, spd^2, d^2sp^3

43. The bond angle and % of d-character in SF_6 are

(a) 120^0, 20% (b) 90^0, 33%

(c) 109^0, 25% (d) 90^0, 25%

44. The percentage of p-character of the hybrid orbitals in graphite and diamond are respectively

(a) 33 and 25 (b) 50 and 75

(c) 67 and 75 (d) 33 and 75

45. The *d*-orbital involved in the hybridization in PCl_3 molecule is:

(a) $3d_{x^2-y^2}$ (b) $3d_{z^2}$

(c) 3dxy (d) $4d_{x^2-y^2}$

46. In which one of the following species the central atom has the type of hybridisation which is not the same as that present in the other three?

(a) PCl_5 (b) SF_4

(c) I_3^- (d) $SbCl_5^{2-}$

47. Some of the properties of the two species, NO_3^- and H_3O^+ are described below. Which one of them is correct?

(a) Dissimilar in hybridization for the central atom with different structures
(b) Isostructural with same hybridization for the central atom
(c) Isostructural with different hybridization for the central atom
(d) Similar in hybridizationfor the central atom with different structures

48. Which one of the following conversions involves change in both hybridisation and shape?

(a) $CH_4 \rightarrow C_2H_6$ (b) $NH_3 \rightarrow NH_4^+$

(c) $BF_3 \rightarrow BF_4^-$ (d) $H_2O \rightarrow H_3O^+$

49. Which of the two ions from the list given below that have the geometry that is explained by the same hybridization of orbitals, $NO_2^-, NO_3^-, NH_2^-, NH_4^+, SCN^-$?

(a) NO_2^- and NH_2^- (b) NO_2^- and NO_3^-

(c) NH_4^+ and NO_3^- (d) SCN^- and NH_2^-

50. The correct sequence of decrease in the bond angles of the following hydrides is

(a) $NH_3 > PH_3 > AsH_3 > SbH_3$
(b) $NH_3 > AsH_3 > PH_3 > SbH_3$
(c) $SbH_3 > AsH_3 > PH_3 > NH_3$
(d) $PH_3 > NH_3 > AsH_3 > SbH_3$

51. The nodal plane in the π – bond of ethene is located in

(a) the molecular plane
(b) a plane parallel to the molecular plane
(c) a plane perpendicular to the molecular plane which bisects the carbon-carbon σ – bond at right angle
(d) a plane perpendicular to the molecular plane which contain the carbon-carbon σ – bond

52. Shape of O_2F_2 is similar to that of

(a) C_2F_2 (b) H_2O_2

(c) H_2F_2 (d) C_2H_2

53. The ONO bond angle is maximum in

(a) NO_3^- (b) NO_2^-

(c) NO_2 (d) NO_2^+

54. In I_3^-, Lewis base is

(a) I_2 (b) I_2^-

(c) I_2^+ (d) I^-

55. In which of the following molecules are all the bonds not equal?
(a) AlF_3 (b) NF_3
(c) ClF_3 (d) BF_3

56. Which of the following species has a linear shape?
(a) NO_2^+ (b) O_3

(c) NO_2^- (d) SO_2

57. If I_2 is dissolved in aqueous KI, the intense yellow species, I_3^-, is formed. The structure of I_3^- ion is
(a) Square pyramidal (b) Trigonal bipyramidal
(c) Octahedral (d) Pentagonal bipyramid

58. In which pair of species, both species have similar geometry?
(a) CO_2, SO_2 (b) NH_3, BH_3

(c) CO_3^{2-}, SO_3^{2-} (d) SO_4^{2-} ad ClO_4^-

59. The incorrectly matched pair among the following is:

Molecule	**Shape**
(a) BrF_5	Trigonal bipyramidal
(b) SF_4	See saw
(c) CiF_3	T-shape
(d) NH_4^+	Tetrahedral
(e) NH_3	Trigonal pyrasidal

60. Two types of FXF angles are present in which of the following molecule?
(a) SF_4 (b) XeF_4
(c) SF_6 (d) CF_4

61. Out of N_2O, SO_2, I_3^+, I_3^-, H_2O, NO_2^- and N_3^-, the linear species are
(a) NO_2^-, I_3^+, H_2O (b) N_2O, I_3^+, N_3^-

(c) N_2O, I_3^-, N_3^- (d) N^{3-}, I_3^+, SO_2

62. Which of the following species is non-linear?
(a) ICl_2^- (b) I_3^-

(c) N_3^- (d) ClO_2^-

63. The species having pyramidal shape is:
(a) SO_3 (b) BrF_3
(c) SiO_3^{2-} (d) OSF_2

64. The correct order of increasing bond angles in the following species is:
(a) $ClO_2^- < Cl_2O < ClO_2$ (b) $Cl_2O < ClO_2 < ClO_2^-$

(c) $ClO_2 < Cl_2O < ClO_2^-$ (d) $Cl_2O < ClO_2^- < ClO_2$

65. Among the molecules SO_2, SF_4, ClF_3, BrF_5 and XeF_4 which of the following shape does not describe any of these molecules?
(a) Bent (b) Trigonal bipyramidal
(c) See-saw (d) T-shape

66. XeF_2 is isostructural with:
(a) TeF_2 (b) ICl_2^-
(c) $SbCl_3$ (d) $BaCl_2$

67. The species in which the N atom is in a state of sp hybridisation is:
(a) NO_2^+ (b) NO_2^-

(c) NO_3^- (d) NO_2

68. Consider the molecules CH_4, NH_3 and H_2O. Which of the given statements is false?
(a) The H - O - H bond angle in H_2O is smaller than H - N - H bond angle in NH_3
(b) The H - C - H bond angle in CH_4 is larger than the H - N - H bond angle in NH_3
(c) The H - C - H bond angle in CH_4, the H - N - H bond angle in NH_3 and H - O - H bond angle in H_2O are all greater than 90^0
(d) The H - O - H bond angle in H_2O is larger than H - C - H bond angle in CH_4

69. Which one of the following contains ionic, covalent and coordinate bonds?
(a) NaOH (b) NaCl
(c) NaCN (d) NaNC

70. Which has $p_\pi - d_\pi$ bonding?

(a) NO_3^- (b) SO_3^{2-}

(c) BO_3^{3-} (d) CO_3^{2-}

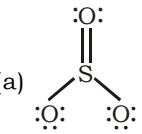
71. The corect stability order of the following resonance structures is

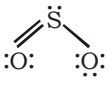
(I) $H_2C = \overset{+}{N}—N^-$ (II) $H_2\overset{+}{C} = N—N^-$

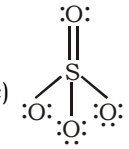
(III) $H_2\bar{C}—\overset{+}{N}\equiv N$ (IV) $H_2\bar{C}—N=\overset{+}{N}$

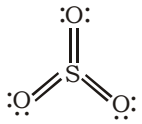
(a) I > II > IV > III (b) I > III > II > IV
(c) II > I > III > IV (d) III > I > IV > II

72. Which of the following structures is the most preferred and hence of lowest energy for SO_3?

(a) 

(b) 

(c) 

(d) 

73. Consider the statements:

I. Bond length in N_2^+ is 0.002 Å greater than in N_2

II. Bond length in NO^+ is 0.09 Å less than in NO

III. O_2^{2-} has shorter bond length than O_2

Which of the following statements are true?
(a) I and II (b) II and III
(c) I, II and III (d) I and III

74. 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) $CO < CO_2 < CO_3^{2-}$

75. In which of the following ionization processes, the

bond order has increased and the magnetic behaviour has changed?

(a) $N_2 \longrightarrow N_2^+$ (b) $C_2 \longrightarrow C_2^+$

(c) $NO \longrightarrow NO^+$ (d) $O_2 \longrightarrow O_2^+$

76. The species having bond order different from that in CO is

(a) NO^- (b) NO^+

(c) CN^- (d) N_2

77. The correct order of bond order values among the following:

A. NO^- B. NO^+

C. NO D. NO^{2+}

E. NO^{2-} is

(a) A < D < C < B < E (b) D = B < A < E < C

(c) E < A < D = C < B (d) B < C < D < A < E

78. Which one of the following pairs consists of only paramagnetic species?

(a) $[O_2, NO]$ (b) $[O_2^+, O_2^{2-}]$

(c) [CO, NO] (d) $[NO, NO^+]$

79. The magnetic moment of KO_2 at room temperature is ..... B.M.

(a) 1.41 (b) 1.73

(c) 2.23 (d) 2.64

80. Which of the following options represents the correct bond order?

(a) $O_2^- > O_2 < O_2^+$ (b) $O_2^- < O_2 > O_2^+$

(c) $O_2^- > O_2 > O_2^+$ (d) $O_2^- < O_2 < O_2^+$

81. Decreasing order of stability of O_2, O_2^-, O_2^+ and O_2^{2-} is

(a) $O_2^{2-} > O_2^- > O_2 > O_2^+$ (b) $O_2 > O_2^+ > O_2^{2-} > O_2^-$

(c) $O_2^- > O_2^{2-} > O_2^+ > O_2$ (d) $O_2^+ > O_2 > O_2^- > O_2^{2-}$

82. Four diatomic species are listed below in different sequences. Which of these presents the correct order of their increasing bond order?

(a) $O_2^- < NO < C_2^{2-} < He_2^+$ (b) $NO < C_2^{2-} < O_2^- < He_2^+$

(c) $C_2^{2-} < He_2^+ < NO < O_2^-$ (d) $He_2^+ < O_2^- < NO < C_2^{2-}$

83. Which one of the following pairs of species have the same bond order?

(a) O_2^- and CN^- (b) NO^+, CN^+

(c) CN^- and NO^+ (d) CN^- and CN^+

84. 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

85. In the change of NO^+ to NO, the electron is added to the

(a) σ orbital (b) π orbital

(c) σ^* orbital (d) π^* orbital

86. 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 – acceptor

(d) Isoelectronic and weak field ligands

87. Which is correct statement about σ – and π – molecular orbitals? Statements are:

(1) π – bonding orbitals are ungerade

(2) π – antibonding orbitals are ungerade

(3) σ – antibonding orbitals are gerade

(a) 1 only (b) 2 and 3 only

(c) 3 only (d) 2 only

88. Assuming the Hund's rule is violated, the bond order and magnetic nature of diatomic molecule B_2 is:

(a) 1 and diamagnetic (b) 0 and diamagnetic

(c) 1 and paramagnetic (d) 0 and paramagnetic

89. Peroxide ion.....

(i) has five completely filled antibonding molecular orbitals

(ii) is diamagnetic

(iii) has bond order one

(iv) is isoelectronic with neon

Which of these are correct?

(a) (iii) and (iv) (b) (i), (ii) and (iv)

(c) (ii) and (iii) (d) (i) and (iv)

90. The pairs of species oxygen and their magnetic behaviours are noted below. Which of the following presents the correct description?

(a) O_2^-, O_2^{2-} - Both diamagnetic

(b) O^+, O_2^{2-} - Both paramagnetic

(c) O_2^+, O_2 - Both paramagnetic

(d) O, O_2^{2-} - Both paramagnetic

91. Which of the following is correct with respect to bond length of the species?

(a) $C_2 > C_2^{2-}$ (b) $B_2^+ > B_2$

(c) $Li_2^+ > Li_2$ (d) $O_2 > O_2^-$

92. Which of the following species has lowest first ionization potential?

(a) O (b) O_2

(c) O_2^+ (d) O_2^-

93. Arrange the following ions in the order of decreasing X - O bond length where X is the central atom

(a) $ClO_4^-, SO_4^{2-}, PO_4^{3-}, SiO_4^{4-}$ (b) $SiO_4^{4-}, PO_4^{3-}, SO_4^{2-}, ClO_4^-$

(c) $SiO_4^{4-}, PO_4^{3-}, ClO_4^-, SO_4^{2-}$ (d) $SiO_4^{2-}, SO_4^{2-}, PO_4^{3-}, ClO_4^-$

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

(a) $O_3 < H_2O_2 < O_2$ (b) $O_2 < O_3 < H_2O_2$

(c) $O_2 < H_2O_2 < O_3$ (d) $H_2O_2 < O_2 < O_3$

95. In which of the following pairs of molecules/ions, both the species are not likely to exist?

(a) H_2^-, H_2^{2+} (b) H_2^+, He_2^{2-}

(c) H_2^-, He_2^{2-} (d) H_2^{2+}, He_2

96. 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) $Li_2 < Li_2^- < Li_2^+$

97. Which of the following is paramagnetic?

(a) CO (b) O_2^-

(c) CN^- (d) NO^+

98. Assuming $2s-2p$ mixing is not operative, the paramagnetic species among the following is:

(a) Be_2 (b) B_2

(c) C_2 (d) N_2

99. The maximum number of hydrogen bonds that a water molecule can form is

(a) 1 (b) 2

(c) 3 (d) 4

100. Which of the following hydrogen halide is most volatile?

(a) HF (b) HCl

(c) HBr (d) HI

101. How many hydrogen bonded water molecule(s) are associated with $CuSO_4.5H_2O$?

(a) 1 (b) 2

(c) 3 (d) 4

102. Ortho-Nitrophenol is less soluble in water than p- and *m*-Nitrophenols because

(a) Melting point of *o*-Nitrophenol is lower than those of *m*-and*p*-isomers

(b) *o*-Nitrophenol is more volatile in steam than *m*- and *p*-isomers

(c) *o*-Nitrophenol shows Intramolecular H - bonding

(d) *o*-Nitrophenol shows Inermolecular H-bonding.

103. The hydrogen bond is shortest in

(a) S—H------S (b) N—H------O

(c) S—H------O (d) F—H------F

104. Which of the following statement is correct?

(a) Melting point and boiling point of HI are greater than those of HF

(b) Boiling point of HI is greater than that of HF but melting point of HI is greater than that of HF

(c) Boiling point of HI is greater than that of HF but melting point of HI is less than that of HF

(d) Melting point and boiling point of HI are less than that of HF

105. The variation of boiling points of hydrogen halides is in the order HF > HI > HBr > HCl. What explains the higher boiling point of hydrogen fluoride?

(a) There is strong hydrogen bonding between HF molecules

(b) The bond energy of HF molecules is greater than in other hydrogen halides

(c) The effect of nuclear shielding is much reduced in fluorine which polarises the HF molecule

(d) The electronegativity of fluorine is much higher than for other elements in the group.

106. Which one of the following compounds shows the presence of intramolecular hydrogen bond?

(a) H_2O_2 (b) HCN

(c) Cellulose

(d) Concentrated acetic acid

107. Among KO_2, AlO_2^-, BaO_2 and NO_2^+, unpaired electron is present in

(a) NO_2^+ and BaO_2 (b) KO_2 and AlO_2^-

(c) KO_2 only (d) BaO_2 only

108. Hybridisation of Al in $AlCl_3$ (monomeric form above 800^0C) and Al_2Cl_6 (dimeric form below 400^0C) respectively are

(a) sp^2, sp^3 (b) sp^2, sp^2

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

109. Which one of the following statements about carbon monoxide is correct?

(a) It has two lone pairs of electrons on oxygen atom

(b) Carbon atom in it is *sp* hybridized

(c) In forming metal carbonyls, oxygen is attached to the metal atom

(d) It has large value of dipole moment

110. In which of the following molecule would you expect the nitrogen to nitrogen bond to be longest?

(a) N_2O (b) N_2O_4

(c) N_2H_4 (d) N_2

111. The bond dissociation energy of $B-F$ in BF_3 is 646 kJ mol^{-1} whereas that of $C-F$ in CF_4 is 515 kJ mol^{-1}. The correct reason for higher $B-F$ bond dissociation energy as compared to that of $C-F$ is

(a) smaller size of B-atom as compared to that of C-atom

(b) stronger σ-bond between B and F in BF_3 as compared to that between C and F in CF_4

(c) significant $p\pi-p\pi$ interaction between B and F in BF_3 whereas there is no possibility of such interaction between C and F in CF_4

(d) lower degree of $p\pi-p\pi$ interaction between B and F in BF_3 than that between C and F in CF_4

112. Which one of the following statements about water is false?

(a) Water is oxidized to oxygen during photosynthesis

(b) Water can act both as an acid and as a base

(c) There is extensive intramolecular hydrogen bonding in the condensed phase

(d) Ice formed by heavy water sinks in normal water

113. Among the following, which one is wrong statement?

(a) PH_5 and $BiCl_5$ do not exist

(b) $p\pi-d\pi$ bonds are present in SO_2

(c) SeF_4 and CH_4 have same shape

(d) I_3^+ has bent geometry

114. Which of the following statements are not correct?

(a) NaCl(s) being an ionic compound, is a good conductor of elecricity

(b) In canonical structures there is a difference in the arrangement of atoms

(c) Hybrid orbitals form stronger bonds than p-orbitals

(d) VSEPR theory cannot explain the square planar geometry of XeF_4

115. Paramagnetic species are

(a) O_2^+ (b) O_2^-

(c) N_2^+ (d) N_2^-

116. Which of the following statements about CO_3^{2-} ion are correct?
(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 and one $C=O$ double bond
(d) The hybridization of central atom is sp^3

117. Dipole moment is possessed by (one or more)
(a) 1, 4-Dichlorobenzene
(b) *cis* 1, 2-Dichloroethene
(c) *rans*-1, 2-Dichloroethene
(d) *trans*-2, 3-Dichloro-2-pentene

118. Which of the following species have the same shape and same bond order?
(i) CO_2 (ii) N_3^-
(iii) O_3 (d) NO_2^-
(a) (i) and (ii) (b) (iii) and (iv)
(c) (i) and (iii) (d) (ii) and (iv)

119. CO_2 is isostructural with
(a) $HgCl_2$ (b) $SnCl_2$
(c) C_2H_2 (d) NO_2

120. The linear structure is assumed by
(a) $SnCl_2$ (b) NCO^-
(c) NO_2^+ (d) CS_2

121. Which one of the following molecule(s) is(are) expected to exhibit diamagnetic behaviour?
(a) S_2 (b) C_2
(c) N_2 (d) O_2

122. The correct statement(s) about O_3 is(are):
(a) $O-O$ bond lengths are equal
(b) Thermal decomposition of O_3 is endothermic
(c) O_3 is diamagnetic in nature
(d) O_3 has a bent structure

123. Hydrogen bonding plays a central role in the following phenomena:
(a) Ice floats in water
(b) Higher Lewis basicity of primary amines than tertiary amines in aqueous solution
(c) Formic acid is more acidic than acetic acid
(d) Dimerisation of acetic acid in benzene

124. The compound(s) with two lone pairs of electrons on the central atom is(are)
(a) BrF_5 (b) ClF_3
(c) XeF_4 (d) SF_4

125. According to molecular orbital theory
(a) C_2^{2-} is expected to be diamagnetic
(b) O_2^{2+} is expected to have a longer bond length than O_2
(c) N_2^+ and N_2^- have the same bond order
(d) He_2^+ has the same energy as two isolated He atoms

126. Which of the following pairs of ions is isoelectronic and isostructural?
(a) CO_3^{2-}, NO_3^- (b) ClO_3^-, CO_3^{2-}
(c) SO_3^{2-}, NO_3^- (d) ClO_3^-, SO_3^{2-}

Based on the given Passage/Comprehension

Comprehension-1

The study of dipole moment of a molecule is useful to explain the shape of a molecule and also to predict a number of other properties of the molecule. The net dipole moment of a polyatomic molecule is the resultant of the different bond moments present in the molecule. The values are generally expressed in Debye or in the S.I. units in terms of Coulomb meter (C m)

127. 1 Debye is equivalent to
(a) 3.33×10^{-30} Cm (b) 1.602×10^{-27} Cm
(c) 10^{-20} Cm (d) 3.33×10^{-12} Cm

128. Which out of the following will have maximum dipole moment?
(a) NF_3 (b) NCl_3
(c) NBr_3 (d) NH_3

129. A covalent molecule, X - Y, is found to have a dipole moment of 1.5×10^{-29}C m and a bond length of 150pm. The per cent ionic character of the bond will be:
(a) 50% (b) 62.5%
(c) 75% (d) 90%

Comprehension-2

Molecular orbitals are formed by the overlap of atomic orbitals. Two atomic orbitals combine to form two molecular orbitals, called Bonding Molecular Orbial (BMO) and Anti-Bonding Molecular Orbital (ABMO). Different atomic orbitals of one atom combine with those atomic orbitals of the second atom which have comparable energies and proper orientation. Further, if the overlapping is head on, the molecular orbital is called 'sigma' and if the overlap is lateral, the molecular orbital is called 'pi'. The molecular orbitals are filled with electrons following the same rules as followed for filling of atomic orbitals. However, the order of filling is not the same for all molecules or their ions. Bond order is one of the most important parameter to compare a number of their characteristics.

130. Which one of the following statements is correct?
(a) BMO is lowered by the same amount of energy by which ABMO is raised.
(b) BMO is lowered by greater amount of energy than the amount by which ABMO is raised.
(c) BMO is lowered by less amount of energy than the amount by which AbMO is raised.
(d) Any one of the above is possible.

131. Which one of the following has maximum number of nodal planes?
(a) σ^*_{1s} (b) $\sigma^*_{2p_z}$
(c) π_{2p_x} (d) $\pi^*_{2p_y}$

132. H_2, Li_2, B_2 each has bond order equal to 1. The order of their stability is
(a) $H_2 = Li_2 = B_2$ (b) $H_2 > Li_2 > B_2$
(c) $H_2 > B_2 > Li_2$ (d) $B_2 > Li_2 > H_2$

133. In which of the following pair, both the molecular orbitals are gerade or ungerade?
(a) σ_{2s}, π_{2p_x} (b) σ^*_{2s}, $\pi^*_{2p_x}$

(c) $\sigma^*_{2s}, \pi_{2p_x}$ (d) π_{2p_x}, π_{2p_x}

Comprehension-3

Molecular orbitals are formed by the overlap of atomic orbitals. Two atomic orbitals combine to form two molecular orbitals called bonding molecular orbital (BMO) and antibonding molecular orbital (ABMO). Energy of antibonding orbital is raised above the parent atomic orbitals that have combined and the energy of the bonding orbital is lowered than the parent atomic orbitals. Energies of various molecular orbitals for elements hydrogento nitrogen increase in the order:

$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x \approx \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x \approx \pi^* 2p_y) < \sigma^* 2p_z$

and for oxygen and fluorine, order of energy of molecular orbitals is given below:

$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x \approx \pi 2p_y) < (\pi^* 2p_x \approx \pi 2p_y) < \sigma^* 2p_z$

Different atomic orbitals of one atom combine with those atomic orbitals of the second atom which have comparable energies and proper orientation. Further, if the overlapping is head on, the molecular orbital is called 'sigma', (σ) and if the overlap is lateral, the molecular orbital is called 'pi', (π). The molecular orbitals are filled with electrons according to the same rules as followed for filling of atomic orbitals. However, the order for filling is not the same for all molecules or their ions. Bond order is one of the most important parameters to compare the strength of bonds.

134. Which of the following statements is correct?
   (a) In the formation of dioxygen from oxygen atoms, 10 molecular orbitals will be formed.
   (b) All the molecular orbitals in the dioxygen will be completely filled.
   (c) Total number of bonding molecular orbitals will not be same as total number of antibonding orbitals in dioxygen.
   (d) Number of filled bonding orbitals will be same as number of filled antibonding orbitals.

135. Which of the following molecular orbitals has maximum number of nodal planes?
   (a) σ^*1s (b) σ^*2p_z
   (c) $\pi 2p_x$ (d) π^*2p_y

136. Which of the following pair is expected to have the same bond order?
   (a) O_2, N_2 (b) O_2^+, N_2^-
   (c) O_2^-, N_2^+ (d) O_2^-, N_2^-

137. In which of the following molecules, $\sigma, 2p_z$ molecular orbital is filled after $\pi 2p_x$ and $\pi 2p_y$ molecular orbitals?
   (a) O_2 (b) Ne_2
   (c) N_2 (d) F_2

Matching Type Questions

Match the entries of column I with appropriate entries of column II and choose the correct option out of the four option (a), (b), (c), (d) given at the end of each question.

138.

Column I (Molecule/ion)	**Column II (Shape)**
(A) $SnCl_2$	(p) Linear
(B) CO_3^{2-}	(q) V-shape (bent)
(C) $HgCl_2$	(r) Trigonal pyramidal
(D) H_3O^+	(s) Triangular planar

(a) A-p, B-q, C-s, D-r (b) A-s, B-r, C-p, D-q
(c) A-q, B-s, C-p, D-r (d) A-r, B-s, C-p, D-q

139.

Column I (Ion)	**Column II (Shape)**
(A) ICl_2^-	(p) V - shape
(B) NH_2^-	(q) Linear
(C) NH_4^+	(r) Tetrahedral
(D) $[PtCl_4]^{2-}$	(s) Square planar

(a) A-r, B-s, C-q, D-p (b) A-q, B-p, C-r, D-s
(c) A-p, B-q, C-r, D-s (d) A-s, B-p, C-q, D-r

140.

Column I	**Column II**
(A) sp^2	(p) ICl_4^-
(B) dsp^2	(q) $TeCl_4$
(C) sp^3d	(r) $SnCl_2$
(D) sp^3d^2	(s) $[Ni(CN)_4]^{2-}$

(a) A-r, B-s, C-q, D-p (b) A-r, B-p, C-q, D-s
(c) A-p, B-r, c-q, D-s (d) A-q, B-s, C-r, D-p

141.

Column I (Molecule/Ion)	**Column II (Bond order)**
(A) NO	(p) 1.5
(B) CO	(q) 2
(C) BN	(r) 2.5
(D) CN^-	(s) 3

(a) A-r, B-s, C-q, D-p (b) A-s, B-s, C-p, D-q
(c) A-r, B-r, C-p, D-s (d) A-r, B-s, C-q, D-s

142. **Match List I and List II and pick out correct matiching codes from the given choices**

List I (Compound)	**List II (Structure)**
(A) ClF_3	(p) square planar
(B) PCl_5	(q) tetrahedral
(C) IF_5	(r) trigonal bipyramidal
(D) CCl_4	(s) square pyramidal
(E) XeF_4	(t) T-shaped

(a) A-t, B-s, C-r, D-q, E-p (b) A-t, B-r, C-s, D-q, E-p
(c) A-s, B-r, C-t, D-q, E-p (d) A-r, B-s, C-p, D-t, E-q

143. **Match the compounds in the List I with that in List II**

List I	**List II**
(A) XeO_3	(p) Planar triangular
(B) $XeOF_4$	(q) T-shape
(C) BO_3^{3-}	(r) Trigonal pyramid
(D) ClF_3	(s) Square pyramid
(E) I_3^-(aq)	(t) Linear
	(u) Bent

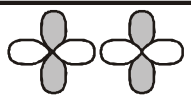
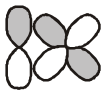
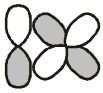
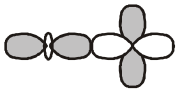
(a) A-p, B-s, C-r, D-q, E-t (b) A-q, B-s, C-p, D-r, E-u
(c) A-r, B-s, C-p, D-q, E-u (d) A-r, B-s, C-p, D-q, E-t

144. **Match List I (Molecules) with List-II (Boiling points) and select the correct answer**

List I	List II
(A) NH_3	(p) 290 K
(B) PH_3	(q) 211 K
(C) AsH_3	(r) 186 K
(D) SbH_3	(s) 264 K
(E) BiH_3	(t) 240 K

(a) A-p, B-q, C-t, D-s, E-p (b) A-t, B-r, C-q, D-s, E-p
(c) A-p, B-s, C-t, D-q, E-r (d) A-p, B-q, C-r, D-s, E-t

145. **Match the orbital overlap figures shown in List-I with the description gives in List-II and select the correct answer using the code given belwo the lists:**

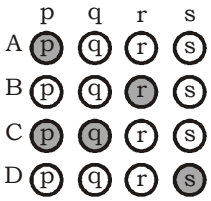
	List I		List II
P.		1.	*p* - *d* π antibonding
Q.		2.	*d* - *d* σ bonding
R.		3.	*p* - *d* π bonding
S.		4.	*d* - *d* σ antibonding

Code:

P	Q	R	S		P	Q	R	S
(a) 2	1	3	4	(b) 4	3	2	1	
(c) 2	3	1	4	(d) 4	1	3	2	

Matrix-Match Type Questions

Match the entries of column I with appropriate entries of column II. Each entry in column I may have one or more than one correct otpion from column II. If the correct matches are A-p, s; B-r; C-p, q; D-s, then the correctly bubbled 4 × 4 matrix should be as follows:



146.

Column I (Compound)	Column II (Type of bonds present)
(A) CaC_2	(p) Ionic
(B) $SnCl_2$	(q) Covalent
(C) $[CrCl_2(H_2O)_4]Cl.2H_2O$	(r) Coordinate
(D) $CuSO_4.5H_2O$	(s) Hydrogen bond

147.

ColumnI (Molecular orbital)	Column II (Nodal planes present /Symmetry)
(A) σ_{2s}	(p) 0
(B) $\sigma^*_{2p_z}$	(q) 1
(C) $\pi^*_{2p_x}$	(r) 2
(D) $\pi^*_{2p_y}$	(s) gerade

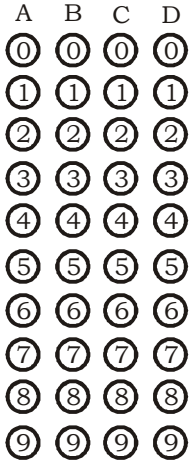
(Take Z-axis as the internuclear axis)

148.

ColumnI	Column II
(A) B_2	(p) Paramagnetic
(B) N_2	(q) Underoges oxidation
(C) O_2^-	(r) Undergoes reduction
(D) O_2	(s) Bond order ≥ 2
	(t) Mixing of *s* and *p*-orbitals

Integer Type Questions

Directions: The answer to each of the following questions is a single digit integer, ranging from 0 to 9. If the correct answer to the question numbers A, B, C and D (say) are 4, 0, 9 and 2 respectively, then the correct darkening of bubbles should be as shown on the side:



149. In Al_2Cl_6, each Al atom is linked to how many Cl-atoms?
150. Number of lone pair(s) present in the structure of HNO_3 is
151. Total number of lone pairs and bond pairs of electrons present around xenon in XeF_4 is
152. Total number of molecular orbitals containing electrons present in O_2^+ ion is
153. The number of 90^0 bond angles present in the molecule of SF_4 is
154. Total number of σ – bonds present in the molecule of propyne is
155. Total number of coordinate bonds present in a molecule of $CuSO_4.5H_2O$ is
156. Number of H_2O molecules attached to each H_2O molecule through hydrogen bonding is
157. The number of water molecule(s) directly bonded to the metal centre in $CuSO_4.5H_2O$ is
158. Based on VSEPR theory, the number of 90 degree F - B - F angles in BrF_5 is
159. A list of species having the formula XZ_4 is given below:
XeF_4, SF_4, SiF_4, BF_4^-, BrF_4^-, $[Cu(NH_3)_4]^{2+}$, $[FeCl_4]^{2-}$, $[CoCl_4]^{2-}$ and $[PtCl_4]^{2-}$
Defining shape on the basis of the location of X and Z atoms, the total number of species having a square planar shape is
160. The total number of electron pairs in N_2O_3 is
161. Among the following molecules/ions $BeCl_2$, N_3^-, N_2O, NO_2^+, O_3, SCl_2, ICl_2^-, I_3^- and XeF_2, the total number of linear molecule(s)/ion(s) where the hybridization of the central atom does not have contribution from the *d*-orbital(s) is (Atomic number: S = 16, Cl = 37, I = 53 and Xe = 5)

Assertion-Reason Type Questions

TYPE I

Directions: Each questions given below contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). It has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct. Choose the correct choice as under:

(a) Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statemetn-1.
(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(c) Statement-1 is True, Statement-2 is False.
(d) Statement-1 is False, Statement-2 is True.

162. **Statement-1:** LiCl is covalent whereas NaCl is ionic.
Statement-2: Greater the size of the cation, greater is its polarising power.

163. **Statement-1:** H_2 molecule is more stable than HeH molecule.
Statement-2: The antibonding electron in the molecule destabilises it.

164. **Statement-1:** NO_3^- and CO_3^{2-} ion both are triangular planar.
Statement-2: Hybridization of central atom in both is sp^2.

165. **Statement-1:** BF_3 molecule is planar while NF_3 is pyramidal.
Statement-2: N atom is smaller than B.

166. **Statement-1:** *o*-Nitrophenol has a higher boiling point than *p*-Nitro-phenol.
Statement-2: Intramolecular hydrogen bonding occurs in *p*-Nitro-phenol

167. **Statement-1:** The boiling point of NH_3 lies between that of SbH_3 and BiH_3
Statement-2: PH_3 has much lower boiling point than NH_3 but it increases from PH_3 to AsH_3 to SbH_3 to BiH_3 due to increase in van der Waals forces.

TYPE II

Directions: In each of the following questions, a statement of Assertion (A) is given followed by a corresponding statement of Reason (R) just below it. Of the statemetns, mark the correct answer as

(a) If both assertion and reason are true, and reason is the true explanation of the assertion.
(b) If both assertion and reason are true, but reason is not the true explanation of the assertion.
(c) If assertion is true, but reason is false.
(d) If both assertion and reason are false

168. **Assertion:** Nitrogen shows a valency of 3 as well as 5.
Reason: Lewis symbol of nitrogen is $:\dot{\underset{\cdot}{N}}\cdot$

169. **Assertion:** Ionic compounds tend to benon-volatile.
Reason: Ionic compounds are sold.

170. **Assertion:** Water is specially effective in screening the electrostatic interactions between the dissolved ions.
Reason: The electrostatic forces between two charged ions are inversely proportional to the dielectric constant of the solvent.

171. **Assertion:** SF_6 is not a stable molecule.
Reason: A stable molecule must have 8 electrons around the central atom, *i.e.,* octet rule should be satisfied.

172. **Assertion:** The bond angle of PBr_3 is greater than that of PH_3 but bond angle of NBr_3 is less than that of NH_3
Reason: Electronegativity of phosphorus atom is less than that of nitrogen.

173. **Assertion:** H-S-H bond angle of H_2S is closer to 90^0 but H-O-H bond angle in H_2O is 104.5^0.
Reason: $lp-lp$ repulson is stronger in H_2S than in H_2O.

174. **Assertion:** When two hydrogen atoms approach each other to form a covalent bond, between them, potential energ of the system continusily decrease.
Reason: When two atoms approach each other to form a covalent bond between them, potential energy of the system continuously decreases.

175. **Assertion:** Pi bond is never formed alone. It is formed along with a sigma bond.
Reason: Pi bond is formed by sideway overlap of p-orbitals only.

176. **Assertion:** The atoms in a covalent molecule are said to share electrons, yet some covalent molecules are polar.
Reason: In a polar covalent molecule, the shared electrons spend more time than average near one of the atoms.

177. **Assertion:** Boiling points of cis-isomers are higher than trans-isomers.
Reason: Dipole moments of cis-isomers are higher than trans-isomers.

178. **Assertion:** NO_3^- is planar while NH_3 is pyramidal.
Reason: N in NO_3^- has sp^2 and in NH_3 has sp^3 hybridization.

179. **Assertion:** $SeCl_4$does not have a tetrahedral structure.
Reason: Se in $SeCl_4$ has two lone pairs.

180. **Assertion:** N_3^- is a weaker base than NH_2^-.
Reason: The lone pair of electrons on N atom in N_3^- is in the sp^2-orbital while in NH_2^-, it is in an sp^3-orbital.

181. **Assertion:** BF_3 molecule is planar but NF_3 is pyramidal.
Reason: N atom is smaller than B.

182. **Assertion:** The resonance hybrid is more stable than any of the contributing structure.
Reason: The contributing structures contain the same number of unpaired electrons and have the real existence.

183. **Assertion:** Both $\pi(2p_x)$ and $\pi^*(2p_x)$ moleclar orbitals have one nodal plane each.
Reason: All molecular orbitals formed by sideway overlaping of $2p$ orbitals have one nodal plane.

184. **Assertion:** H_2, Li_2 and B_2 each has a bond order of 1 and hence are equally stable.
Reason: Stability of molecule/molecular ion depends only on bond order.

185. **Assertion:** Bond order can assume any value including zero.
Reason: Higher the bond order, shorter is the bond length and greater is the bond energy.

186. **Assertion:** B_2 molecule is diamagnetic.
Reason: The highest occupied molecular orbital is of σ-type.

187. **Assertion:** Molecular nitrogen is less reactive than molecular oxygen.
Reason: The bond length of N_2 is shorter than that of oxygen.

188. **Assertion:** H_2 molecule is more stable than HeH molecule.
Reason: The antibonding electronin the molecule destabilises it.

189. **Assertion:** The HF_2^- ion exists in the solid state and also in the liquid state but not in aqueous solution.
Reason: The magnitude of hydrogen bonds in between HF - HF molecules is weaker than that in between HF and H_2O molecules.

190. **Assertion:** Both *o*-hydroxy benzaldehyde and *p*-hydroxy benzaldehyde have same molecular weight and show H-bonding.
Reason: Melting point of *p*-hydroxy benzaldehyde is more.

191. **Assertion:** H_2O is the only hydride of group-16 which is liquid at ordinary temperature.
Reason: In ice, each oxygen atom is surrounded by two covalent bonds and two hydrogen bonds.

NCERT Exemplar Problems

1. Isostructural species are those which have the same shape and hybridisation. Among the given species, identify the isostructural pairs.
(a) [NF_3 and BF_3] (b) [BF_4^- and NH_4^+]
(c) [BCl_3 and $BrCl_3$] (d) [NH_3 and NO_3^-]

2. Polarity in a molecule and hence the dipole moment depends primarily on electronegativity of the constituent atoms and shape of a molecule. Which of the following has the highest dipole moment?
(a) CO_2 (b) HI
(c) H_2O (d) SO_2

3. The types of hybrid orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are expected to be
(a) sp, sp^3 and sp^2 (b) sp, sp^2 and sp^3
(c) sp^2, sp and sp^3 (d) sp^2, sp^3 and sp

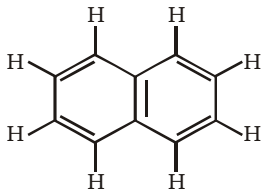
4. Hydrogen bonds are formed in many compounds *e.g.,* H_2O, HF, NH_3. The boiling point of such compounds depends to a large extent on the strength of hydrogen bond and the number of hydrogen bonds. The correct decreasing order of the boiling points of above compounds is
(a) HF > H_2O > NH_3 (b) H_2O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

5. In PO_4^{3-} ion, the formal charge on the oxygen atom of P - O bond is
(a) +1 (b) -1
(c) -0.75 (d) +0.75

6. In NO_3^- ion, the number of bond pairs and lone pairs of electrons on nitrogen atom are
(a) 2, 2 (b) 3,1
(c) 1, 3 (d) 4, 0

7. Which of the following species has tetrahedral geometry?
(a) BH_4^- (b) NH_2^-
(c) CO_3^{2-} (d) H_3O^+

8. Number of π bonds and σ bonds in the following structure is



(a) 6, 19 (b) 4, 20
(c) 5, 19 (d) 5, 20

9. Which molecule/ion out of the following does not contain unpaired electrons?
(a) N_2^+ (b) O_2
(c) O_2^{2-} (d) B_2

10. In which of the following molecule/ion all the bonds are not equal?
(a) XeF_4 (b) BF_4^-
(c) C_2H_4 (d) SiF_4

11. In which of the following substances will hydrogen bond be strongest?
(a) HCl (b) H_2O
(c) HI (d) H_2S

12. If the electronic configuration of an element is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$, the four electrons involed in chemical bond formation will be
(a) $3p^6$ (b) $3p^6, 4s^2$
(c) $3p^6, 3d^2$ (d) $3d^2, 4s^2$

13. Which of the following angle corresponds to sp^2 hybridisation?
(a) 90^0 (b) 120^0
(c) 180^0 (d) 109^0

14. Which of the following order of energies of molecular orbitals of N_2 is correct?
(a) $(\pi 2p_y) < (\sigma 2p_z) < (\pi^* 2p_x) \approx (\pi^* 2p_y)$
(b) $(\pi 2p_y) > (\sigma 2p_z) > (\pi^* 2p_x) \approx (\pi^* 2p_y)$
(c) $(\pi 2p_y) < (\sigma 2p_z) > (\pi^* 2p_x) \approx (\pi^* 2p_y)$
(d) $(\pi 2p_y) > (\sigma 2p_z) < (\pi^* 2p_x) \approx (\pi^* 2p_y)$

15. Which of the following statements is not correct from the view point of molecular orbital theory?
(a) Be_2 is not a stable molecule.
(b) He_2 is not stable but He_2^+ is expected to exist.
(c) Bond strength of N_2 is maximum amongst the homonuclear diatomic molecules belonging to the second period.
(d) The order of energies of molecular orbitals in N_2 molecular is $\sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

ANSWER

1-(b) 2-(c) 3-(b) 4-(d) 5-(d) 6-(a) 7-(a)
8-(c) 9-(c) 10-(b) 11-(c) 12-(c) 13-(d) 14-(d)
15-(b) 16-(c) 17-(b) 18-(c) 19-(d) 20-(a) 21-(a)
22-(c) 23-(a) 24-(a) 25-(c) 26-(d) 27-(b) 28-(a)
29-(b) 30-(c) 31-(b) 32-(a) 33-(b) 34-(b) 35-(b)
36-(b) 37-(c) 38-(d) 39-(d) 40-(d) 41-(d) 42-(c)
43-(b) 44-(c) 45-(b) 46-(d) 47-(a) 48-(c) 49-(b)
50-(a) 51-(a) 52-(b) 53-(d) 54-(d) 55-(c) 56-(a)
57-(b) 58-(d) 59-(a) 60-(a) 61-(c) 62-(d) 63-(d)
64-(a) 65-(b) 66-(b) 67-(a) 68-(d) 69-(d) 70-(b)
71-(b) 72-(d) 73-(a) 74-(d) 75-(c) 76-(a) 77-(c)
78-(a) 79-(b) 80-(d) 81-(d) 82-(d) 83-(c) 84-(a)
85-(d) 86-(a) 87-(a) 88-(a) 89-(c) 90-(c) 91-(d)
92-(d) 93-(b) 94-(b) 95-(d) 96-(c) 97-(b) 98-(c)
99-(d) 100-(b) 101-(a) 102-(c) 103-(d) 104-(b) 105-(a)
106-(c) 107-(c) 108-(a) 109-(b) 110-(b) 111-(c) 112-(c)
113-(c)

114-(a,b,d) 115-(a,b,c,d) 116-(a,b)
117-(b,d) 118-(a,b) 119-(a,c)
120-(b,c,d) 121-(b,c) 122-(a,c,d)
123-(a,b,d) 124-(b,c) 125-(a,c)

126-(a,d) 127-(a) 128-(d) 129-(b) 130-(c) 131-(d) 132-(c)
133-(c) 134-(a) 135-(d) 136-(b) 137-(c) 138-(c) 139-(b)
140-(a) 141-(d) 142-(b) 143-(d) 144-(b) 145-(c)

146-(A-p,q; B-q; C-p,q,r; D-p,q,r,s)
147-(A-p,s; B-q; C-qs, D-r,s)
148-(a-p,r,t; B-s,t; C-p,q; D-p,q,s)

149-(4) 150-(7) 151-(6) 152-(8) 153-(0) 154-(6) 155-(4)
156-(4) 157-(4) 158-(0) 159-(4) 160-(8) 161-(4) 162-(c)
163-(b) 164-(a) 165-(b) 166-(d) 167-(d) 168-(a) 169-(b)
170-(b) 171-(d) 172-(b) 173-(b) 174-(c) 175-(c) 176-(c)
177-(a) 178-(a) 179-(c) 180-(a) 181-(b) 182-(c) 183-(d)
184-(d) 185-(b) 186-(d) 187-(a) 188-(b) 189-(a) 190-(b)
191-(b)

NCERT Exemplar Problems

1-(b) 2-(c) 3-(b) 4-(b) 5-(b) 6-(d) 7-(a)
8-(c) 9-(c) 10-(c) 11-(b) 12-(d) 13-(b) 14-(a)
15-(d)