

CHAPTER 4

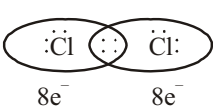
CHEMICAL BONDING AND MOLECULAR STRUCTURE

FACT/DEFINITION TYPE QUESTIONS

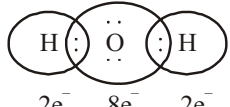
- The attractive force which holds various constituents (atoms, ions etc.) together in different chemical species is called a
 - chemical bond
 - chemical compound
 - ionic bond
 - covalent bond
- The evolution of various theories of valence and the interpretation of the nature of chemical bonds have closely been related to the developments in the understanding of
 - structure of atom
 - electronic configuration of elements
 - periodic table
 - All of the above
- Who provide explanation of valence based on inertness of noble gases ?
 - Lewis
 - Kössel-Lewis
 - Langmuir
 - Sidgwick & Powell
- In the formation of a molecule which of the following take part in chemical combination?
 - cation
 - anion
 - valence electron
 - inner shell electron
- Which of the following do(es) not represent correct Lewis symbols?

:C:	:Ö:	:Ñe:	:Be:	:B:
I	II	III	IV	V

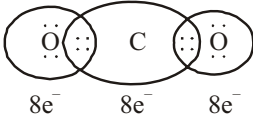
 - I, IV & V
 - II, III & IV
 - II only
 - II & III
- The bond formed as a result of the electrostatic attraction between the positive and negative ions is termed as ...
 - Chemical bond
 - Electrovalent bond
 - Co-ordinate bond
 - Covalent bond
- Cation and anion combines in a crystal to form following type of compound
 - ionic
 - metallic
 - covalent
 - dipole-dipole
- Electrovalence of calcium and chlorine respectively is
 - + 2, - 1
 - + 1, - 1
 - + 1, - 2
 - + 2, - 2
- When a metal atom combines with non-metal atom, the non-metal atom will
 - lose electrons and decrease in size
 - lose electrons and increase in size
 - gain electrons and decrease in size
 - gain electrons and increase in size
- Who introduced the term covalent bond ?
 - Lewis
 - Langmuir
 - Nyholm and Gillespie
 - Heitler and London
- Which of the following is/are not the condition(s) for Lewis dot structure?
 - Each bond is formed as a result of sharing of an electron pair between the atoms.
 - From the two combining atoms only one atom contribute electron(s) to the shared pair.
 - The combining atoms attain the outer shell noble gas configurations as a result of the sharing of electrons.
 - (i) and (iii)
 - (ii) and (iii)
 - (ii) only
 - (iii) only
- Which of the following does not represent the correct Lewis dot structure?



(A)



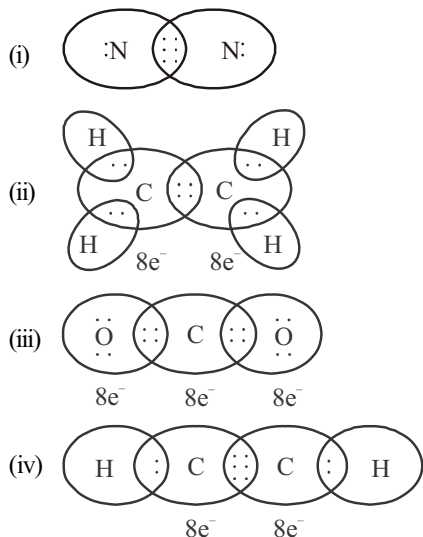
(B)



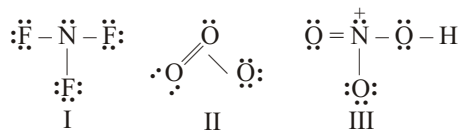
(C)

 - A
 - B
 - C
 - A and C

13. Which of the following statements are correct based on given Lewis dot structure ?

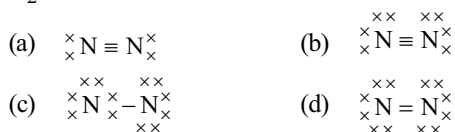


- (a) (i) and (iv) represents formation of triple bond
 (b) Only (iii) represents formation of double bond
 (c) Only (ii) represents formation of single bond
 (d) (ii) and (iii) both represents formation of single bond.
14. Which of the following Lewis representation of the molecules NF_3 , O_3 and HNO_3 is correct ?



Choose the correct option(s).

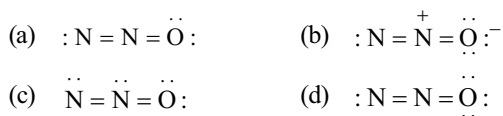
- (a) Only I (b) Only II
 (c) Only III (d) I, II and III
15. In N_2 molecule, the number of electrons shared by each nitrogen atom is
 (a) 1 (b) 2
 (c) 3 (d) 5
16. Which of the following represents the Lewis structure of N_2 molecule?



17. Which of the following shows the Lewis dot formula for CO_2 ?



18. Which of the following is the correct electron dot structure of N_2O molecule?



19. What is X, Y and Z in the following expression of formal charge.

$$\text{Formal charge (F.C) on an atom in a Lewis structure} = X - Y - \frac{1}{2}(Z)$$

- (a) X = Total number of non bonding electrons
 Y = Total number of bonding electrons
 Z = Total number of valence electrons in the free atom
 (b) X = Total number of valence electrons in the free atom
 Y = Total number of bonding electrons
 Z = Total number of non bonding electrons
 (c) X = Total number of valence electrons in the free atom
 Y = Total number of non bonding electrons
 Z = Total number of bonding electrons
 (d) X = Total number of electrons in the free atom
 Y = Total number of non bonding electrons
 Z = Total number of valence electrons

20. The lowest energy structure is the one with the formal charges on the atoms.

- (a) smallest (b) highest
 (c) zero (d) negative

21. In PO_4^{3-} ion, the formal charge on each oxygen atom and P—O bond order respectively are

- (a) -0.75, 0.6 (b) -0.75, 1.0
 (c) -0.75, 1.25 (d) -3, 1.25

22. In the cyanide ion, the formal negative charge is on

- (a) C (b) N
 (c) Both C and N
 (d) Resonate between C and N

23. What are the exceptions of the octet rule ?

- (a) The incomplete octet of central atom
 (b) An odd number of electrons on central atom.
 (c) Expanded octet of the central atom
 (d) All of these

24. In which of the following molecules octet rule is not followed?

- (a) NH_3 (b) CH_4
 (c) CO_2 (d) NO

25. In which of the following compounds octet is complete and incomplete for all atoms :

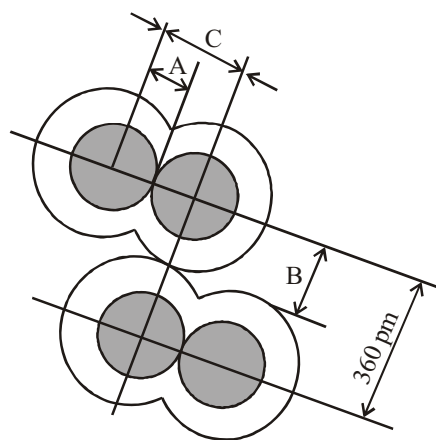
	Al_2Cl_6	$\text{Al}_2(\text{CH}_3)_6$	AlF_3	Dimer of BeCl_2	Dimer of BeH_2
(a)	IC	IC	IC	C	C
(b)	C	IC	IC	C	IC
(c)	C	IC	C	IC	IC
(d)	IC	C	IC	IC	IC

(Note : C for complete octet and IC for incomplete octet.)

26. Which of the following molecule(s) obey the octet rule?

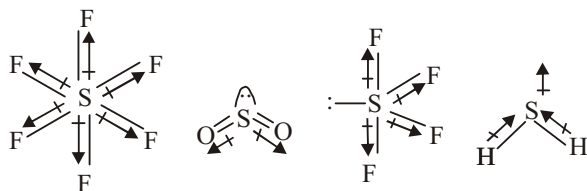
- (i) $[\text{BF}_4]^-$, (ii) $[\text{AlCl}_4]^-$, (iii) SO_2 , (iv) CCl_4
 (a) (i), (ii), (iii), (iv) (b) (ii), (iii), (iv)
 (c) (i), (iii), (iv) (d) (i), (ii), (iii)

27. Among the following the electron deficient compound is
 (a) BCl_3 (b) CCl_4
 (c) PCl_5 (d) BeCl_2
28. Which of the following is the electron deficient molecule?
 (a) C_2H_6 (b) B_2H_6
 (c) SiH_4 (d) PH_3
29. Which of the following compounds does not follow the octet rule for electron distribution?
 (a) PCl_5 (b) PCl_3
 (c) H_2O (d) PH_3
30. A pair of compound which have odd electrons in the group NO , CO , ClO_2 , N_2O_5 , SO_2 and O_3 are
 (a) NO and ClO_2 (b) CO and SO_2
 (c) ClO_2 and CO (d) SO_2 and O_3
31. Which of the following statements is incorrect ?
 (a) The formation of ionic compounds depend upon the ease of formation of the positive and negative ions from the respective neutral atoms.
 (b) Formation of ionic compounds depend upon arrangement of the positive and negative ions in the solid.
 (c) Formation of positive ion involves addition of electron(s) while that of negative ion involves removal of electron(s).
 (d) None of these
32. Complete the following statement by choosing the appropriate option.
 Ionic bonds will be formed more easily between elements with comparatively A and elements with comparatively high negative value of B .
 (a) A = low electronegativity
 B = ionization enthalpy
 (b) A = low ionization enthalpy
 B = electron gain enthalpy
 (c) A = high ionization enthalpy
 B = electron gain enthalpy
 (d) A = high electronegativity
 B = ionization enthalpy
33. In ionic solids how crystal structure get stabilized
 (a) By the energy released in the formation of crystal lattice.
 (b) By achieving octet of electrons around the ionic species in gaseous state.
 (c) By electron gain enthalpy and the ionization enthalpy.
 (d) None of these
34. Energy required to completely separate one mole of a solid ionic compound into gaseous constituent ions is called.....
 (a) Ionisation enthalpy
 (b) Electron gain enthalpy
 (c) Bond dissociation enthalpy
 (d) Lattice enthalpy
35. The effect of more electronegative atom on the strength of ionic bond
 (a) increases (b) decreases
 (c) remains the same (d) decreases slowly
36. Which of the following combination will form an electrovalent bond ?
 (a) P and Cl (b) NH_3 and BF_3
 (c) H and Ca (d) H and S
37. Among the following which compound will show the highest lattice energy ?
 (a) KF (b) NaF
 (c) CsF (d) RbF
38. Which of the following bond will have highest ionic character?
 (a) H-I (b) H-F
 (c) H-Cl (d) H-Br
39. Which of the following pairs will form the most stable ionic bond ?
 (a) Na and Cl (b) Mg and F
 (c) Li and F (d) Na and F
40. Which of the following methods is used for measuring bond length ?
 (a) X-ray diffraction
 (b) Electron-diffraction
 (c) Spectroscopic techniques
 (d) All of these
41. is measured as the radius of an atom's core which is in contact with the core of an adjacent atom in a bonded situation.
 (a) van der Waal's radius
 (b) Bond length
 (c) Covalent radius
 (d) Ionic radius
42. Following figure represent a chlorine molecule. Identify A B and C in the given figure.



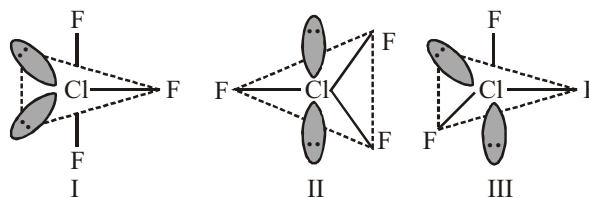
- (a) A = Bond length, B = van der Waal's radius
 C = Covalent radius
 (b) A = Covalent radius, B = Bond length
 C = Ionic radius
 (c) A = Ionic radius, B = van der Waal's radius
 C = Covalent radius
 (d) A = Covalent radius, B = van der Waal's radius
 C = Bond length

60. The correct order of dipole moments of HF, H_2S and H_2O is
 (a) $\text{HF} < \text{H}_2\text{S} < \text{H}_2\text{O}$ (b) $\text{HF} < \text{H}_2\text{S} > \text{H}_2\text{O}$
 (c) $\text{HF} > \text{H}_2\text{S} > \text{H}_2\text{O}$ (d) $\text{HF} > \text{H}_2\text{O} < \text{H}_2\text{S}$
61. The most polar bond is
 (a) C–F (b) C–O
 (c) C–Br (d) C–S
62. Which of the following possess dipole moment SF_6 (a), SO_2 (b), H_2S (c), SF_4 (d)?
 (a) b and c (b) a and c
 (c) b, c and d (d) a and b



63. According to Fajan's rule, covalent bond is favoured by
 (a) Large cation and small anion
 (b) Large cation and large anion
 (c) Small cation and large anion
 (d) Small cation and small anion
64. Arrange the following in increasing order of covalent character (i) NaCl, (ii) RbCl, (iii) MgCl_2 , (iv) AlCl_3 ?
 (a) (i), (ii), (iii), (iv) (b) (iv), (ii), (i), (iii)
 (c) (ii), (i), (iii), (iv) (d) (iii), (i), (ii), (iv)
65. The correct sequence of increasing covalent character is represented by
 (a) $\text{LiCl} < \text{NaCl} < \text{BeCl}_2$ (b) $\text{BeCl}_2 < \text{LiCl} < \text{NaCl}$
 (c) $\text{NaCl} < \text{LiCl} < \text{BeCl}_2$ (d) $\text{BeCl}_2 < \text{NaCl} < \text{LiCl}$
66. Which of the following salt shows maximum covalent character?
 (a) AlCl_3 (b) MgCl_2
 (c) CsCl (d) LaCl_3
67. Polarizability of halide ions increases in the order
 (a) F^- , I^- , Br^- , Cl^- (b) Cl^- , Br^- , I^- , F^-
 (c) I^- , Br^- , Cl^- , F^- (d) F^- , Cl^- , Br^- , I^-
68. The covalent bond length is the shortest in which one of the following bonds?
 (a) C—O (b) C—C
 (c) $\text{C}\equiv\text{N}$ (d) O—H
69. Hydrogen chloride molecule contains
 (a) polar covalent bond (b) double bond
 (c) co-ordinate bond (d) electrovalent bond
70. Sodium chloride is an ionic compound whereas hydrogen chloride is mainly covalent because
 (a) sodium is less reactive
 (b) hydrogen is non-metal
 (c) hydrogen chloride is a gas
 (d) electronegativity difference in the case of hydrogen and chlorine is less than 2.1.

71. According to VSEPR theory the geometry of a covalent molecules depends upon
 (a) the number of bond pairs of electrons
 (b) the number of lone pairs of electrons
 (c) the number of electron pairs present in the outer shell of the central atom
 (d) All the above
72. The geometry of ClO_3^- ion according to Valence Shell Electron Pair Repulsion (VSEPR) theory will be
 (a) planar triangular (b) pyramidal
 (c) tetrahedral (d) square planar
73. In BrF_3 molecule, the lone pairs occupy equatorial positions to minimize
 (a) lone pair - bond pair repulsion only
 (b) bond pair - bond pair repulsion only
 (c) lone pair - lone pair repulsion and lone pair - bond pair repulsion
 (d) lone pair - lone pair repulsion only
74. Which of the correct increasing order of lone pair of electrons on the central atom?
 (a) $\text{IF}_7 < \text{IF}_5 < \text{ClF}_3 < \text{XeF}_2$
 (b) $\text{IF}_7 < \text{XeF}_2 < \text{ClF}_2 < \text{IF}_5$
 (c) $\text{IF}_7 < \text{ClF}_3 < \text{XeF}_2 < \text{IF}_5$
 (d) $\text{IF}_7 < \text{XeF}_2 < \text{IF}_5 < \text{ClF}_3$
75. The number of lone pair and bond pair of electrons on the sulphur atom in sulphur dioxide molecule are respectively
 (a) 1 and 3 (b) 4 and 1
 (c) 3 and 1 (d) 1 and 4
76. A molecule has two lone pairs and two bond pairs around the central atom. The molecule shape is expected to be
 (a) V-shaped (b) triangular
 (c) linear (d) tetrahedral
77. Using VSEPR theory, predict the species which has square pyramidal shape
 (a) SnCl_2 (b) CCl_4
 (c) SO_3 (d) BrF_5
78. Among the following molecules : SO_2 , SF_4 , ClF_3 , BrF_5 and XeF_4 , which of the following shapes does not describe any of the molecules mentioned?
 (a) Bent (b) Trigonal bipyramidal
 (c) See-saw (d) T-shape
79. Which of the following structure is most stable ?



Choose the correct option.

- (a) Only I
 (b) Only II
 (c) Only III
 (d) All three have same stability

80. A σ -bonded molecule MX_3 is T-shaped. The number of non-bonding pairs of electron is
 (a) 0 (b) 2 (c) 1 (d) can be predicted only if atomic number of M is known.
81. Shape of methane molecule is
 (a) tetrahedral (b) pyramidal (c) octahedral (d) square planar
82. The shape of stannous chloride molecule is
 (a) see-saw (b) square planar (c) trigonal pyramidal (d) bent
83. Look at the following potential energy curve which of the following correctly represents the most stable state of hydrogen molecule.
-
- (a) A (b) B (c) C (d) D
84. Which of the following statements is false?
 (a) H_2 molecule has one sigma bond
 (b) HCl molecule has one sigma bond
 (c) Water molecule has two sigma bonds and two lone pairs
 (d) Acetylene molecule has three pi bonds and three sigma bonds
85. The number of sigma (σ) and pi (π) bonds present in 1,3,5,7 octatetraene respectively are
 (a) 14 and 3 (b) 17 and 4 (c) 16 and 5 (d) 15 and 4
86. Allyl cyanide molecule contains
 (a) 9 sigma bonds, 4 pi bonds and no lone pair
 (b) 9 sigma bonds, 3 pi bonds and one lone pair
 (c) 8 sigma bonds, 5 pi bonds and one lone pair
 (d) 8 sigma bonds, 3 pi bonds and two lone pairs
87. The molecule not having π -bond is
 (a) Cl_2 (b) O_2 (c) N_2 (d) CO_2
88. In hexa-1, 3-diene-5-yne the number of C — C δ , C — C π and C — H σ bonds, respectively are
 (a) 5, 4 and 6 (b) 6, 3 and 5 (c) 5, 3 and 6 (d) 6, 4 and 5
89. The angle between the overlapping of one s-orbital and one p-orbital is
 (a) 180° (b) 120° (c) $109^\circ 28'$ (d) $120^\circ 60'$
90. The enolic form of a acetone contains
 (a) 9 sigma bonds, 1 pi bond and 2 lone pairs
 (b) 8 sigma bonds, 2 pi bonds and 2 lone pairs
 (c) 10 sigma bonds, 1 pi bond and 1 lone pair
 (d) 9 sigma bonds, 2 pi bonds and 1 lone pair
91. Linear combination of two hybridized orbitals belonging to two atoms and each having one electron leads to a
 (a) sigma bond (b) double bond (c) co-ordinate covalent bond (d) pi bond.
92. Which of the following statements is not correct?
 (a) Double bond is shorter than a single bond
 (b) Sigma bond is weaker than a π (pi) bond
 (c) Double bond is stronger than a single bond
 (d) Covalent bond is stronger than hydrogen bond
93. Which of the following represents zero overlap of atomic orbitals.
-
- (a) (b) (c)
- (d) All of these
94. As the s-character of hybridised orbital increases, the bond angle
 (a) increase (b) decrease (c) becomes zero (d) does not change
95. Which of the following is/are not essential condition(s) for hybridisation?
 (i) The orbitals present in the valence shell of the atom are hybridised.
 (ii) The orbitals undergoing hybridisation should have almost equal energy.
 (iii) Promotion of electron is essential prior to hybridisation
 (iv) Only half filled orbitals participate in hybridisation.
 (a) (i) only (b) (iii) only (c) (iv) only (d) (iii) and (iv)

96. The nature of hybridisation in the ammonia molecule is
 (a) sp^2 (b) dp^2
 (c) sp (d) sp^3
97. The shape of sulphate ion is
 (a) square planar (b) trigonal
 (c) trigonal planar (d) tetrahedral
98. The strength of bonds formed by s-s and p-p, s-p overlap in the order of
 (a) $s-p > s-s > p-p$ (b) $p-p > s-s > s-p$
 (c) $s-s > p-p > s-p$ (d) $s-s > s-p > p-p$
99. Which of the following will have $sp^3 d^3$ hybridisation?
 (a) BrF_5 (b) PCl_5
 (c) XeF_6 (d) SF_6
100. The shape of CO_2 molecule is
 (a) linear (b) tetrahedral
 (c) planar (d) pyramidal
101. The hybridisation state of carbon in fullerene is
 (a) sp (b) sp^2
 (c) sp^3 (d) $sp^3 d$
102. Which of the following statements is true for an ion having sp^3 hybridisation?
 (a) all bonds are ionic
 (b) H-bonds are situated at the corners of a square
 (c) all bonds are co-ordinate covalent
 (d) H-atoms are situated at the corners of tetrahedron
103. Which of the following molecule does not have a linear arrangement of atoms?
 (a) H_2S (b) C_2H_2
 (c) BeH_2 (d) CO_2
104. In which one of the following molecules the central atom said to adopt sp^2 hybridization?
 (a) BeF_2 (b) BF_3
 (c) C_2H_2 (d) NH_3
105. Considering the state of hybridization of carbon atoms, find out the molecule among the following which is linear?
 (a) $CH_3-CH=CH-CH_3$
 (b) $CH_3-C \equiv C-CH_3$
 (c) $CH_2=CH-CH_2-C \equiv CH$
 (d) $CH_3-CH_2-CH_2-CH_3$
106. Equilateral shape has
 (a) sp hybridisation (b) sp^2 hybridisation
 (c) sp^3 hybridisation (d) None of these
107. In an octahedral structure, the pair of d orbitals involved in d^2sp^3 hybridization is
 (a) $d_{x^2-y^2}, d_{z^2}$ (b) $d_{xz}, d_{x^2-y^2}$
 (c) d_{z^2}, d_{xz} (d) d_{xy}, d_{yz}
108. The trigonal bipyramidal geometry is obtained from the hybridisation
 (a) dsp^3 or $sp^3 d$ (b) dsp^2 or $sp^2 d$
 (c) d^2sp^3 or $sp^3 d^2$ (d) None of these
109. In which of the following species is the underlined carbon having sp^3 - hybridisation?
 (a) $CH_3-\underline{C}OOH$ (b) $CH_3\underline{C}H_2OH$
 (c) $CH_3\underline{C}OCH_3$ (d) $CH_2=C\underline{H}-CH_3$
110. A sp^3 -hybrid orbital contains
 (a) 25% s-character (b) 75% s-character
 (c) 50% s-character (d) 25% p-character
111. The types of hybridisation of the five carbon atoms from left to right in the molecule
 $CH_3-CH=C=CH-CH_3$ are
 (a) $sp^3, sp^2, sp^2, sp^2, sp^3$ (b) $sp^3, sp, sp^2, sp^2, sp^3$
 (c) $sp^3, sp^2, sp, sp^2, sp^3$ (d) $sp^3, sp^2, sp^2, sp, sp^3$
112. Pick out the incorrect statement from the following
 (a) sp hybrid orbitals are equivalent and are at an angle of 180° with each other
 (b) sp^2 hybrid orbitals are equivalent and bond angle between any two of them is 120°
 (c) $sp^3 d^2$ hybrid orbitals are equivalent and are oriented towards corners of a regular octahedron
 (d) $sp^3 d^3$ hybrid orbitals are not equivalent
113. All carbon atoms are sp^2 hybridised in
 (a) 1, 3-butadiene (b) $CH_2=C=CH_2$
 (c) cyclohexane (d) 2-butene
114. Which one of the following is not correct in respect of hybridization of orbitals?
 (a) The orbitals present in the valence shell only are hybridized
 (b) The orbitals undergoing hybridization have almost equal energy
 (c) Promotion of electron is not essential condition for hybridization
 (d) Pure atomic orbitals are more effective in forming stable bonds than hybrid orbitals
115. Molecular orbital theory was given by
 (a) Kossel (b) Mosley
 (c) Mulliken (d) Werner
116. Atomic orbital is monocentric while a molecular orbital is polycentric. What is the meaning of above statements?
 (a) Electron density in atomic orbital is given by the electron distribution around a nucleus in an atom. While in molecular orbital it is given by the electron distribution around group of nuclei in a molecule.
 (b) While an electron in an atomic orbital is influenced by one nucleus, in a molecular orbital it is influenced by two or more nuclei depending upon the number of atoms in the molecule.
 (c) The electron in an atomic orbital is present in one nucleus while in molecular orbital electrons are present on more than one nuclei depending upon the number of atoms in the molecule.
 (d) All of these
117. With increasing bond order, stability of bond
 (a) Remain unaltered (b) Decreases
 (c) Increases (d) None of these

118. The given increasing order of energies of various molecular orbitals is not true for which of the following molecule?
 $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$
 (a) B_2 (b) C_2
 (c) N_2 (d) O_2
119. Which of the following corresponds unstable molecule? Here N_b is number of bonding electrons and N_a is number of antibonding electrons.
 (a) $N_b > N_a$ (b) $N_b < N_a$
 (c) $N_a = N_b$ (d) Both (b) and (c)
120. If N_x is the number of bonding orbitals of an atom and N_y is the number of antibonding orbitals, then the molecule/atom will be stable if
 (a) $N_x > N_y$ (b) $N_x = N_y$
 (c) $N_x < N_y$ (d) $N_x \leq N_y$
121. In the molecular orbital diagram for O_2^+ ion, the highest occupied orbital is
 (a) σ MO orbital (b) π MO orbital
 (c) π^* MO orbital (d) σ^* MO orbital
122. The theory capable of explaining paramagnetic behaviour of oxygen is
 (a) resonance theory
 (b) V.S.E.P.R. theory
 (c) molecular orbital theory
 (d) valence bond energy
123. In an anti-bonding molecular orbital, electron density is minimum
 (a) around one atom of the molecule
 (b) between the two nuclei of the molecule
 (c) at the region away from the nuclei of the molecule
 (d) at no place
124. When two atomic orbitals combine, they form
 (a) one molecular orbital (b) two molecular orbital
 (c) three molecular orbital (d) four molecular orbital
125. Paramagnetism is exhibited by molecules
 (a) not attracted into a magnetic field
 (b) containing only paired electrons
 (c) carrying a positive charge
 (d) containing unpaired electrons
126. The difference in energy between the molecular orbital formed and the combining atomic orbitals is called
 (a) bond energy (b) activation energy
 (c) stabilization energy (d) destabilization energy
127. The bond order in N_2^+ is
 (a) 1.5 (b) 3.0
 (c) 2.5 (d) 2.0
128. Which molecule has the highest bond order?
 (a) N_2 (b) Li_2
 (c) He_2 (d) O_2
129. Which one of the following molecules is expected to exhibit diamagnetic behaviour?
 (a) C_2 (b) N_2
 (c) O_2 (d) S_2
130. The correct statement with regard to H_2^+ and H_2^- is
 (a) both H_2^+ and H_2^- are equally stable
 (b) both H_2^+ and H_2^- do not exist
 (c) H_2^- is more stable than H_2^+
 (d) H_2^+ is more stable than H_2^-
131. Mark the incorrect statement in the following
 (a) the bond order in the species O_2 , O_2^+ and O_2^- decreases as $O_2^+ > O_2 > O_2^-$
 (b) the bond energy in a diatomic molecule always increases when an electron is lost
 (c) electrons in antibonding M.O. contribute to repulsion between two atoms.
 (d) with increase in bond order, bond length decreases and bond strength increases.
132. According to molecular orbital theory which of the following statement about the magnetic character and bond order is correct regarding O_2^+
 (a) Paramagnetic and Bond order $< O_2$
 (b) Paramagnetic and Bond order $> O_2$
 (c) Diamagnetic and Bond order $< O_2$
 (d) Diamagnetic and Bond order $> O_2$
133. Bond order is a concept in the molecular orbital theory. It depends on the number of electrons in the bonding and antibonding orbitals. Which of the following statements is true about it? The bond order
 (a) can have a negative quantity
 (b) has always an integral value
 (c) can assume any positive or integral or fractional value including zero
 (d) is a non-zero quantity
134. Which of the following does not exist on the basis of molecular orbital theory?
 (a) H_2^+ (b) He_2^+
 (c) He_2 (d) Li_2
135. The paramagnetic property of the oxygen molecule is due to the presence of unpaired electrons present in
 (a) $(\sigma 2p_x)^1$ and $(\sigma^* 2p_x)^1$
 (b) $(\sigma 2p_x)^1$ and $(\pi 2p_y)^1$
 (c) $(\pi^* 2p_y)^1$ and $(\pi^* 2p_z)^1$
 (d) $(\pi^* 2p_x)^1$ and $(\pi^* 2p_z)^1$
136. In which of the following state of compound the magnitude of H-bonding will be maximum and in which case it will be minimum?
 (a) Maximum = Solid, Minimum = Liquid
 (b) Maximum = Liquid, Minimum = Gas
 (c) Maximum = Solid, Minimum = Gas
 (d) Maximum = Gas, Minimum = Solid

137. Which of the following are correctly classified ?

Intermolecular H-bonding	Intramolecular H-bonding
(a) HF	H ₂ O
(b) CH ₃ OH	HF
(c) H ₂ O	<i>o</i> -nitrophenol
(d) HF	<i>p</i> -nitrophenol

138. Intramolecular hydrogen bond exists in

- (a) *ortho* nitrophenol (b) ethyl alcohol
(c) water (d) diethyl ether

139. The boiling point of *p*-nitrophenol is higher than that of *o*-nitrophenol because

- (a) NO₂ group at *p*-position behave in a different way from that at *o*-position.
(b) intramolecular hydrogen bonding exists in *p*-nitrophenol
(c) there is intermolecular hydrogen bonding in *p*-nitrophenol
(d) *p*-nitrophenol has a higher molecular weight than *o*-nitrophenol.

140. Which one of the following is the correct order of interactions ?

- (a) Covalent < hydrogen bonding < vander Waals < dipole-dipole
(b) vander Waals < hydrogen bonding < dipole < covalent
(c) vander Waals < dipole-dipole < hydrogen bonding < covalent
(d) Dipole-dipole < vander Waals < hydrogen bonding < covalent.

141. Strongest hydrogen bond is shown by

- (a) water (b) ammonia
(c) hydrogen fluoride (d) hydrogen sulphide

142. The low density of ice compared to water is due to

- (a) induced dipole-induced dipole interactions
(b) dipole-induced dipole interactions
(c) hydrogen bonding interactions
(d) dipole-dipole interactions

143. Methanol and ethanol are miscible in water due to

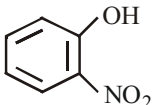
- (a) covalent character
(b) hydrogen bonding character
(c) oxygen bonding character
(d) None of these

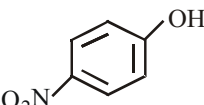
144. The hydrogen bond is shortest in

- (a) S—H---S (b) N—H---O
(c) S—H---O (d) F—H---F

145. Hydrogen bonding is maximum in

- (a) C₂H₅OH (b) CH₃OCH₃
(c) (CH₃)₂C=O (d) CH₃CHO

146. The vapour pressure of  is higher than

 due to

- (a) dipole moment (b) dipole-dipole interaction
(c) H-bonding (d) lattice structure

147. The reason for exceptionally high boiling point of water is

- (a) its high specific heat
(b) its high dielectric constant
(c) low ionization of water molecule
(d) hydrogen bonding in the molecules of water

148. Acetic acid exists as dimer in benzene due to

- (a) condensation reaction
(b) hydrogen bonding
(c) presence of carboxyl group
(d) presence of hydrogen atom at α -carbon

149. Hydrogen bonding is formed in compounds containing hydrogen and

- (a) highly electronegative atoms
(b) highly electropositive atoms
(c) metal atoms with *d*-orbitals occupied
(d) metalloids