CHEMICAL BONDING AND MOLECULAR STRUCTURE

CHEMISTRY

Single Correct Answer Type

1. The hybrid state of S in SO_3 is similar to that of
   a) C in C_2H_2 b) C in C_2H_4 c) C in CH_4 d) C in CO_2
2. The hydration energy of Mg^{2+} is larger than that of:
   a) Al^{3+} b) Na^{+} c) Be^{2+} d) None of these
3. Number of lone pair (s) in $XeOF_4$ is/are
   a) 0 b) 1 c) 2 d) 3
4. Van der Waals' forces between molecules depend upon:
   a) Number of electrons b) Charge on nucleus c) Radius of atoms d) All of these
5. XeF_6 is:
   a) Octahedral
   b) Pentagonal pyramidal
   c) Planar
   d) tetrahedral
6. The bond order in NO is 2.5 while that in NO^+ is 3. Which of the following statements is true for these two species?
   a) Bond length in NO^+ is greater than in NO
   b) Bond length in NO is greater than in NO^+
   c) Bond length in NO^+ is equal to than in NO
   d) Bond length is unpredictable
7. An atom with atomic number 20 is most likely to combine chemically with the atom whose atomic number is:
   a) 11 b) 16 c) 18 d) 10
8. Which has the largest distance between the carbon hydrogen atom?
   a) Ethane b) Ethene c) Ethyne d) Benzene
9. Length of hydrogen bond ranges from 2.5Å to:
   a) 3.0 Å b) 2.75 Å c) 2.6 Å d) 3.2 Å
10. If $H - X$ bond length is 2.00 Å and $H - X$ bond has dipole moment 5.12×10^{-30} C − m, the percentage of ionic character in the molecule will be
    a) 10% b) 16% c) 18% d) 20%
11. Which molecule is planar?
    a) NH_3 b) CH_4 c) C_2H_4 d) $SiCl_4$
12. From the molecular orbital theory, one can show that the bond order in F_2 molecule as
    a) 2 b) 1 c) 3 d) 4
13. Two ice cubes are pressed over each other until they unite to form one block. Which one of the following forces dominates for holding them together?
    a) Dipole-dipole interaction b) Van der Waals' forces
    c) Hydrogen bond formation d) Covalent attraction
14. Maximum number of covalent bonds between two like atoms can be:
    a) Three b) Two c) Four d) One
15. When sodium and chlorine react, energy is:
    a) Released and ionic bond is formed
    b) Released and covalent bond is formed
    c) Absorbed and covalent bond is formed

d) Absorbed and ionic bond is formed

16. The maximum possible number of hydrogen bonds is a H_2O molecule can participate is
a) 1 b) 2 c) 3 d) 4

17. The element having lowest ionisation energy among the following is:
a) $1s^2, 2s^2 2p^3$ b) $1s^2, 2s^2 2p^6, 3s^1$ c) $1s^2, 2s^2 2p^6$ d) $1s^2, 2s^2 2p^5$

18. Bond energies in NO, NO^+ and NO^- are such as
a) $NO^- > NO > NO^+$ b) $NO > NO^- > NO^+$ c) $NO^+ > NO > NO^-$ d) $NO^+ > NO^- > NO$

19. Two type FXF angles are present in which of the following molecules? (X=S, Xe, C)
a) SF_4 b) XeF_4 c) SF_6 d) CF_4

20. The bond angle between two hybrid orbitals is 105°. The percentage of s-character of hybrid orbital is between
a) $50-55\%$ b) $9-12\%$ c) $22-23\%$ d) $11-12\%$

21. Which is electron deficient compound?
a) C_2H_4 b) B_2H_6 c) C_2H_6 d) $NaBH_4$

22. CCl_4 is insoluble in water because:
a) CCl_4 is non-polar and water is polar
b) Water is non-polar and CCl_4 is polar
c) Water and CCl_4 both are polar
d) None of the above

23. Which of the following is not correct regarding the properties of ionic compounds?
a) Ionic compounds have high metling and boiling points
b) Their reaction velocity in aqueous medium is very high
c) Ionic compounds in their molten and aqueous solutions do not conduct electricity
d) They are highly soluble in polar solvents

24. The number of sigma and pi (π) bonds present in benzene respectively are
a) 12, 6 b) 6, 6 c) 6, 12 d) 12, 3

25. Which of the following is not tetrahedral?
a) BF_4^- b) NH_4^+ c) CO_3^{2-} d) SO_4^{2-}

26. In PCl_5 molecule, P is:
a) sp^3-hybridized b) dsp^2-hybridized c) ds^3p-hybridized d) sp^3d-hybridized

27. The bond angle and % of d-character in SF_6 are
a) 120°, 20% b) 90°, 33% c) 109°, 25% d) 90°, 25%

28. Linear combination of two hybridized orbitals, belonging to two atoms and each having one electron leads to:
a) Sigma-bond
b) Double bond
c) Coordinate covalent bond
d) Pi-bond

29. In allene structure, three carbon atoms are joined by:
a) Three σ-and three π-bonds
b) Two σ- and one π-bond
c) Two σ-and two π-bonds
d) Three π-bonds only

30. Geometry of SiO_4^{4-} anion is
a) Tetrahedral b) Trigonal c) Trihedral d) Pentagonal

31. The carbon atom in graphite is:
a) sp^2-hybridized b) sp^3-hybridized c) sp-hybridized d) None of these

32. Boron cannot form which one of the following anions?
a) BF_6^{3-} b) BH_4^- c) $B(OH)_4^-$ d) BO_2^-

33. If the ionic radii of K^+ and F^- are about 1.34 Å each, then the expected values of atomic radii of K and F

should be respectively:

a) 1.34 and 1.34 Å b) 2.31 and 0.64 Å c) 0.64 and 2.31 Å d) 2.31 and 1.34 Å

34. If Z-axis is the molecular axis, then π-molecular orbitals are formed by the overlap of

a) $s + p_z$ b) $p_x + p_y$ c) $p_z + p_z$ d) $p_x + p_x$

35. Which one is the weakest bond?

a) Hydrogen b) Ionic c) Covalent d) Metallic

36. The total number of valency electrons for PO_4^{3-} ion is:

a) 32 b) 16 c) 28 d) 30

37. The ratio of σ and π-bonds in benzene is:

a) 2 b) 6 c) 4 d) 8

38. The geometry of PF_5 molecule is:

a) Planar b) Square planar c) Trigonal bipyramidal d) Tetrahedral

39. Which one of the following linear structure?

(I)I_3^- (II)NO_2^-

(III)I_3^+ (IV)SO_2

(V)N_3^-

a) I, II and III b) I and V c) II, III and IV d) All of these

40. According to MO theory, which of the following lists ranks the nitrogen species in terms of increasing bond order?

a) $N_2^- < N_2^{2-} < N_2$ b) $N_2^- < N_2 < N_2^{2-}$ c) $N_2^{2-} < N_2^- < N_2$ d) $N_2 < N_2^{2-} < N_2^-$

41. The equilateral triangle shape has:

a) sp-hybridization b) sp^2-hybridization c) sp^3-hybridization d) sp^3d-hybridization

42. Which of the following has fractional bond order?

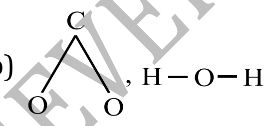
a) O_2^{2+} b) O_2^{2-} c) F_2^{2-} d) H_2^-

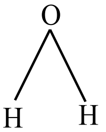
43. For which of the following hybridization the bond angle is maximum?

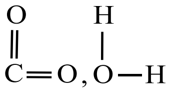
a) sp^2 b) sp c) sp^3 d) dsp^2

44. Experiment shows that H_2O has a dipole moment whereas, CO_2 has not. Point out the structures which best illustrate these facts:

a) $O{=}C{=}O, H{-}O{-}H$

b) 

c) $O{=}C{=}O$, 

d) 

45. In $TeCl_4$, the central atom tellurium involves

a) sp^3 hybridisation b) $sp^3\,d$ hybridization c) $sp^3\,d^2$ hybridisation d) dsp^2 hybridisation

46. Stability of hydrides generally increases with:

a) Increase in bond angle

b) Decrease in bond angle

c) Decrease in resonance

d) None of these

47. Which of the following is isoelectronic with CO_2?

a) NO_2 b) NO c) N_2O d) N_2O_4

48. Which can be described as a molecule with residual bonding capacity?

a) N_2 b) CH_4 c) NaCl d) $BeCl_2$

49. Lattice energy of an ionic compound depends upon

a) Charge on the ion and size of the ion b) Packing of ions only

c) Size of the ion only d) Charge on the ion only

50. Identify the correct statement from below, concerning the structure of $CH_2 = C = CH_2$

a) The molecule is planar

b) One of the three carbon atoms is in an-sp^3hybridised state

c) The molecule is non - planar with the two $-CH_2$ groups being in planes perpendicular to each

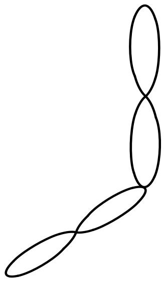
d) All the carbon atoms are sp-hybridized other

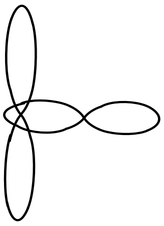
51. (i) $H - C - H$ angle in CH_4
(ii) $Cl - B - Cl$ angle in BCl_3
(iii) $F - I - F$ angle in IF_7 in a plane
(iv) $I - I - I$ angle in I_3^-
Increasing order of above bond angles is
a) (i) < (ii) < (iii) < (iv) b) (ii) < (i) < (iii) < (iv)
c) (iii) < (i) < (ii) < (iv) d) (iv) < (ii) < (i) < (iii)

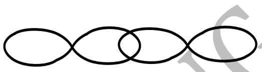
52. Among the following elements, the most electronegative is:
a) Oxygen b) Chlorine c) Nitrogen d) Fluorine

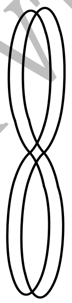
53. Metallic bonds do not play a role in:
a) Brass b) Copper c) Germanium d) Zinc

54. Which p-orbitals overlapping would give the strongest bond?

a) 

b) 

c) 

d) 

55. H_2O boils at higher temperature than H_2S because it is capable of forming:
a) Ionic bonds b) Covalent bonds c) Hydrogen bonds d) Metallic bonds

56. When two atomic orbitals combine, they form:
a) One molecular orbitals
b) Two molecular orbitals
c) Two bonding molecular orbitals
d) Two antibonding molecular orbitals

57. The correct increasing covalent nature is:
a) $NaCl < LiCl < BeCl_2$ b) $BeCl_2 < NaCl < LiCl$ c) $BeCl_2 < LiCl < NaCl$ d) $LiCl < NaCl < BeCl_2$

58. IP_1 and IP_2 of Mg are 178 and 348 kcal mol^{-1}. The energy required for the reaction,
$Mg \longrightarrow Mg^{2+} + 2e^-$ is:
a) +170 kcal b) +526 kcal c) -170 kcal d) -526 kcal

59. The electronic configuration
$$(\sigma 1s)^2(\overset{*}{\sigma}1s)^2(\sigma 2s)^2(\overset{*}{\sigma}2s)^2(\sigma 2p_x)^2$$
$$(\pi 2p_y)^2(\pi 2p_z)^2(\overset{*}{\pi}2p_y)^2(\overset{*}{\pi}2p_z)^1$$
can be assigned to
a) O_2 b) O_2^+ c) O_2^- d) O_2^{2-}

60. 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 structure
b) Isostructural with same hybridization for the central atom
c) Isostructural with different hybridization for the central atom
d) Similar is hybridization for the central atom with different structure

61. 6, 6
a) 6, 6 b) 6, 6 c) 6, 6 d) 6, 6

62. Greater the dipole moment:
a) Greater is the ionic nature

b) Lesser the polarity
c) Smaller the ionic nature
d) None of these

63. H—B—H bond angle in BH_4^- is:
a) 180°
b) 120°
c) 109°
d) 90°

64. Which of the following molecular orbitals has two nodal planes?
a) $\sigma 2p_x$
b) $\pi 2p_y$
c) $\pi^* 2p_y$
d) $\sigma^* 2p_x$

65. The common feature 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 ligands

66. Hydrogen bonding is maximum in
a) C_2H_5OH
b) CH_3OCH_3
c) $(CH_3)_2C=O$
d) CH_3CHO

67. The O—H bond distance in water molecule is:
a) 1.0Å
b) 1.33 Å
c) 0.96 Å
d) 1.45 Å

68. O_2^{2+} has a bond order of
a) 1
b) 2
c) 3
d) 4

69. Which among the following molecules/ ions is diamagnetic?
a) Super oxide ion
b) Oxygen
c) Carbon molecule
d) Unipositive ion of N_2molecule

70. The enolic form of acetone contains
a) 9 sigma bonds, 1 pi bond and two lone pairs
b) 8 sigma bonds, 2 pi bond and two lone pairs
c) 10 sigma bonds, 1 pi bond and one lone pairs
d) 9 sigma bonds, 2 pi bond and one lone pairs

71. Which of the following are isoelectronic and isostructural?

$NO_3^-, CO_3^{2-}, ClO_3^-, SO_3$

a) NO_3^-, CO_3^{2-}
b) SO_3, NO_3^-
c) ClO_3^-, CO_3^{2-}
d) CO_3^{2-}, SO_3

72. Which of the following is paramagnetic with bond order 0.5?
a) F_2
b) H_2^+
c) N_2
d) O_2^-

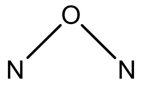
73. Water has high heat of vaporization due to:
a) Covalent bonding
b) H-bonding
c) Ionic bonding
d) None of these

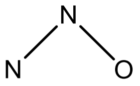
74. The C – H bond distance is the longest in
a) C_2H_6
b) C_2H_2
c) $C_2H_2Br_2$
d) C_2H_4

75. If the electronegativity difference between two atoms *A* and *B* is 2.0, then the percentage of covalent character in the molecule is
a) 54%
b) 46%
c) 23%
d) 72%

76. Structure of ICl_2^- is:
a) Trigonal
b) Octahedral
c) Square planar
d) Distorted trigonal pyramidal

77. Polar covalent compounds are soluble in:
a) Polar solvents
b) Non-polar solvents
c) Concentrated acids
d) All solvents

78. N_2O is isoelectronic to CO_2 and N_3^-. Which of the following is the structure of N_2O?
a) 

b) N − O − N
c) N − O − N
d) 

79. Which does not show hydrogen bonding?
a) C_2H_5OH
b) Liquid NH_3
c) H_2O
d) Liquid HBr

80. All bond angles are exactly equal to 109° 28` in
a) Methyl chloride
b) Iodoform
c) Chloroform
d) Carbon tetrachloride

81. Which among the following has highest ionic radius?
a) F^- b) B^{3+} c) O^{2-} d) Li^+

82. Zero dipole moment is possessed by
a) PCl_3 b) BF_3 c) ClF_3 d) NH_3

83. The number of electrons involved in the bond formation of N_2 molecule
a) 2 b) 4 c) 6 d) 10

84. Which one of the following orders is not in according with the property stated against it?
a) $F_2 > Cl_2 > Br_2 > I_2$: Electronegativity
b) $F_2 > Cl_2 > Br_2 > I_2$: Bond dissociation energy
c) $F_2 > Cl_2 > Br_2 > I_2$: Oxidising power
d) $HI > HBr > HCl > HF$: Acidic property in water.

85. What is the dominant intermolecular force or bond that must be overcome in converting liquid CH_3OH to a gas?
a) London dispersion force
b) Hydrogen bonding
c) Dipole-dipole interaction
d) Covalent bonds

86. The incorrect statements regarding bonding molecular orbitals because:
a) Bonding molecular orbitals possess less energy than combining atomic orbitals.
b) Bonding molecular orbitals have low electron density between the two nuclei.
c) Every electron in bonding molecular orbitals contributes to attraction between atoms.
d) They are formed when the lobes of the combining atomic orbitals have same sign.

87. A coordinate bond is a dative covalent bond. Which of the below is true?
a) Three atom form bond by sharing their electrons
b) Two atoms form bond by sharing their electrons
c) Two atoms form bond and one of them provides both electrons
d) Two atoms form bond by sharing electrons obtained from third atom.

88. The bond length between C – C bond in sp^2 hybridised molecule is
a) 1.2 Å b) 1.39 Å c) 1.33 Å d) 1.54 Å

89. The electronegativity values of C, H, O, N and S are 2.5, 2.1, 3.5, 3.0 and 2.5 respectively. Which of the following bonds is most polar?
a) C—H b) N—H c) S—H d) O—H

90. Which of the following has largest size?
a) Al b) Al^+ c) Al^{2+} d) Al^{3+}

91. In which of the following, the bond length between hybridised carbon atom and other carbon atom is minimum?
a) Propyne b) Propene c) Butane d) Propane

92. Which is expected to conduct electricity?
a) Diamond b) Molten sulphur c) Molten KCl d) Crystalline NaCl

93. Metals are good conductors of electricity because they contain
a) Ionic bonds
b) A network structure
c) Very few valence electrons
d) Free electrons

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

95. The attraction that non-polar molecules have for each other is primarily caused by:
a) Hydrogen bonding
b) Difference in electronegativities
c) High ionisation energy

d) Van der Waals' forces

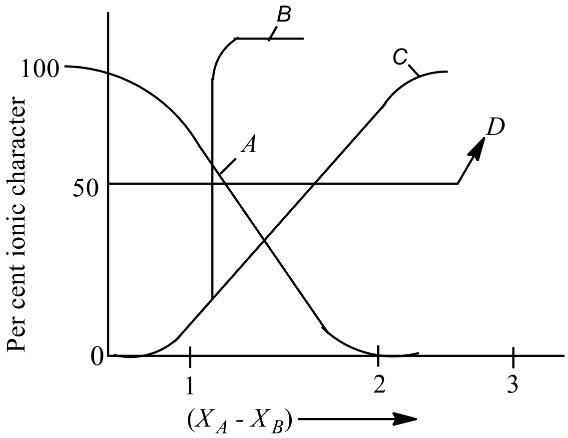
96. In HCHO carbon atom has hybridisation:

a) sp b) sp^2 c) sp^3 d) None of these

97. Which of the following species has four lone pairs of electrons in its outer shell?

a) I b) O^- c) Cl^- d) He

98. For AB bond if per cent ionic character is plotted against electronegativity difference $(X_A - X_B)$, the shape of the curve would look like



The correct curve is

a) A b) B c) C d) D

99. Chlorine atom, in its third excited state, reacts with fluorine to form a compound X. The formula and shape of X are

a) ClF_5, pentagonal

b) ClF_4, tetrahedral

c) ClF_4, pentagonal bipyramidal

d) ClF_7, pentagonal bipyramidal

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

$O(g) + e \longrightarrow O^-(g)$; $\Delta H = -142$ kJ/mol

$O^-(g) + e \longrightarrow O^{2-}(g)$; $\Delta H = 844$ kJ/mol

This is because:

a) O^- ion has comparatively larger size than oxygen atom

b) Oxygen has high electron affinity

c) O^- ion will lead to resist the addition of another electron

d) Oxygen is more electronegative

101. In which of the following molecules are all the bonds not equal?

a) AlF_3 b) NF_3 c) ClF_3 d) BF_3

102. Which of the following compound is covalent?

a) H_2 b) KCl c) Na_2S d) CaO

103. Which of the following molecular species has unpaired electron (s)?

a) N_2 b) F_2 c) O_2^- d) O_2^{2-}

104. The correct order of bond angles is:

a) $PF_3 < PCl_3 < PBr_3 < PI_3$

b) $PF_3 < PBr_3 < PCl_3 < PI_3$

c) $PI_3 < PBr_3 < PCl_3 < PF_3$

d) $PF_3 > PCl_3 < PBr_3 < PI_3$

105. If the bond length and dipole moment of a diatomic molecule are 1.25 A and 1.0 D respectively, what is the per cent ionic character of the bond?

a) 10.66 b) 12.33 c) 16.66 d) 19.33

106. The molecule which does not exhibit dipole moment is

a) NH_3 b) $CHCl_3$ c) H_2O d) CCl_4

107. N_2accept electron and convert into N_2^-, where this electron goes?
a) Antibonding π-molecular orbital
b) Bonding π-molecular orbital
c) σ-bonding molecular orbital
d) σ-antibonding molecular orbital

108. The correct order of radii is:
a) $N < Be < B$ b) $F^- < O^{2-} < N^{3-}$ c) $Na < Li < K$ d) $Fe^{3+} < Fe^{2+} < Fe^{4+}$

109. The bond order is maximum in:
a) H_2 b) H_2^+ c) He_2 d) He_2^+

110. Which of the following atoms has minimum covalent radius?
a) Si b) N c) C d) B

111. The screening effect of d-electrons is:
a) Equal to the p -electrons
b) Much more than p-electrons
c) Same as f-electrons
d) Less than p-electrons

112. Which of the following statement is wrong?
a) The stability of hydrides increase from NH_3 to BiH_3 in group 15 of the periodic table.
b) Nitrogen cannot form $d\pi - p\pi$ bond.
c) Single N—N bond is weaker than the single P—P bond.
d) N_2O_4 has two resonance structure

113. The molecule having permanent dipole moment is:
a) SF_4 b) XeF_4 c) SiF_4 d) BF_3

114. Unusually high boiling point of water is result of
a) Intermolecular hydrogen bonding b) Intramolecular hydrogen bonding
c) Both intra and inter molecular hydrogen bonding d) High specific heat

115. Which of the following is least ionic?
a) CaF_2 b) $CaBr_2$ c) CaI_2 d) $CaCl_2$

116. What bond order does O_2^{2-} have?
a) 1 b) 2 c) 3 d) 1/3

117. A compound contains X, Y and Z atoms. The oxidation states of X, Y and Z are +2, +2 and -2 respectively. The possible formula of the compound is
a) XYZ_2 b) $Y_2(XZ_3)_2$ c) $X_3(Y_4Z)_2$ d) $X_3(YZ_4)_3$

118. Which one of the following is a non-polar molecule?
a) CCl_4 b) $CHCl_3$ c) CH_2Cl_2 d) CH_3Cl

119. Which one of the following has the regular tetrahedral structure?
(Atomic numbers B = 5, S = 16, Ni = 28, Xe = 54)
a) XeF_4 b) SF_4 c) BF_4^- d) $[Ni(CN)_3]^{2-}$

120. If the dipole moment of toluene and nitro-benzene are 0.43 D and 3.93 D, then what is the expected dipole moment of p-nitro toluene?
a) 3.50 D b) 2.18 D c) 4.36 D d) 5.30 D

121. Which of the following is most stable?
a) Pb^{2+} b) Ge^{2+} c) Si^{2+} d) Sn^{2+}

122. In which of the following compound sp^2 hybridisation is absent?
a) $CH_2 = CH - CH = CH_2$ b) $CH \equiv C - CH_2 - CH_3$
c) $CH_2 - CH = CH_2$ d) $CH_2 = CH - CH_2 - CH_3$

123. Which one of the following pairs of species has the same bond order:
a) NO^+ and CN^+ b) CN^- and NO^+ c) CN^- and CN^+ d) O_2^- and CN^-

124. Which of the following characteristics regarding halogens is not correct?

a) Ionization energy decreases with increase in atomic number.
b) Electronegativity decreases with increase in atomic number.
c) Electron affinity decreases with increase in atomic number.
d) Enthalpy of fusion increases with increase in atomic number.

125. The number of S – S bonds in sulphur trioxide is

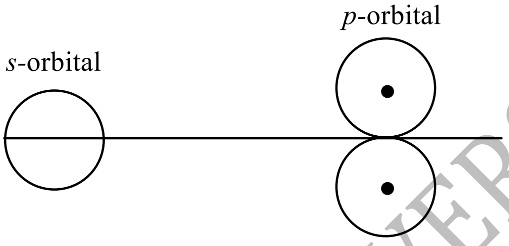
a) Three	b) Two	c) One	d) Zero

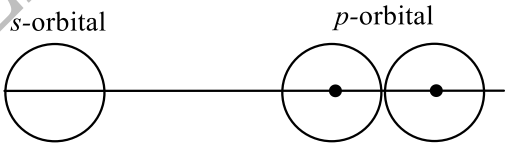
126. The low density of ice compared to water is due to
a) Induced dipole – induced dipole interactions
b) Dipole – induced dipole interaction
c) Hydrogen bonding interactions
d) Dipole –dipole interaction

127. Consider the following molecules or ions
(i)H_2O (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)

128. Which of the following compounds has dipole moment approximately equal to that of chlorobenzene?
a) *o*-dichlorobenzene
b) *m*-dichlorobenzene
c) *p*-dichlorobenzene
d) *p*-chloronitrobenzene

129. Which of the following overlaps leads to bonding?

a)


b)


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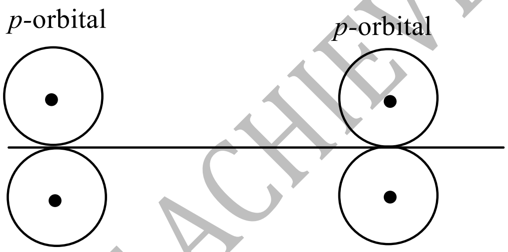
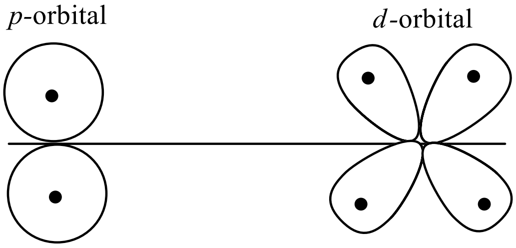


d)


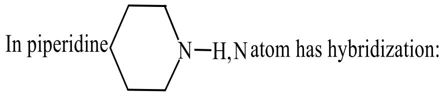
130. Which of the following is correct?
a) The number of electrons present in the valence shell of S in SF_6 is 12.
b) The rates of ionic reactions are very low.
c) According to VSEPR theory, $SnCI_2$ is a linear molecule.
d) The correct order of ability to form ionic compounds among Na^+, $Mg^{2+}$and Al^{3+} is $Al^{3+} > Mg^{2+} > Na^+$.

131. The number of sigma and pi bonds in peroxodisulphuric acid are respectively

a) 9 and 4	b) 11 and 4	c) 4 and 8	d) 4 and 9

132. Which is not a paramagnetic species?

a) O_2	b) O_2^+	c) O_2^-	d) O_2^{2-}

133.

In piperidine N—H, N atom has hybridization:

a) sp	b) sp^2	c) sp^3	d) dsp^2

134. Electron deficient species are known as:

a) Lewis acids b) Hydrophilic c) Nucleophiles d) Lewis bases

135. The molecule having three folds of axis of symmetry is:
a) NH_3 b) PCl_5 c) SO_2 d) CO_2

136. The structure of ICl_2^- is:
a) Trigonal
b) Octahedral
c) Square planar
d) Distorted trigonal bipyramid

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

138. Which of the following is not isostructural with $SiCl_4$?
a) PO_4^{3-} b) NH_4^+ c) SCl_4 d) SO_4^{2-}

139. A molecule which cannot exist theoretically is:
a) SF_4 b) OF_2 c) OF_4 d) O_2F_2

140. An atom X has three valence electrons and atom Y has six valence electrons. The compound formed between them will have the formula
a) X_2Y_6 b) XY_2 c) X_2Y_3 d) X_3Y_2

141. Which one is polar molecule among the following?
a) CH_4 b) CCl_4 c) CO_2 d) H_2O

142. Shape of molecules is decided by:
a) Sigma bond
b) π-bond
c) Both sigma and π-bonds
d) Neither sigma nor π-bonds

143. The shape of carbon dioxide is
a) Pyramidal b) Tetrahedral c) Planar d) linear

144. The correct ionic radii order is:
a) $N^{3-} > O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$
b) $N^{3-} > Na^+ > O^{2-} > F^- > Mg^{2+} > Al^{3+}$
c) $Na^+ > O^{2-} > N^{3-} > F^- > Mg^{2+} > Al^{3+}$
d) $O^{2-} > F^- > Na^+ > N^{3-} > Mg^{2+} > Al^{3+}$

145. Which is not linear?
a) CO_2 b) HCN c) C_2H_2 d) H_2O

146. Hybridisation of oxygen in diethyl ether is
a) Sp b) sp^2 c) sp^3 d) sp^3d

147. What is the effect of more electronegative atom on the strength of ionic bond?
a) Increases b) Decreases c) Remains the same d) None of these

148. Which of the following two are isostructural?
a) XeF_2, IF_2^- b) NH_3, BF_3 c) CO_3^{2-}, SO_3^{2-} d) PCl_5, ICl_5

149. NF_3 is:
a) Non-polar compound
b) Electrovalent compound
c) Having low value of dipole moment than NH_3
d) Having more dipole moment than NH_3

150. Molecular size of ICl and Br_2 is nearly same, but boiling point of ICl is about 40°C higher than Br_2. This might be due to:
a) I—Cl bond is stronger than Br—Br bond
b) Ionisation energy of I < ionisation energy of Br
c) ICl is polar where as Br_2 is non-polar
d) The size of I > size of Br

151. Which molecule is linear?
a) H_2S b) NO_2 c) ClO_2 d) CO_2

152. Which of the following shows minimum melting point?
a) Naphthalene b) Diamond c) NaCl d) Mn

153. Which of the following does not have a lone pair on the central atom?
a) NH_3 b) PH_3 c) BF_3 d) PCl_3

154. Molecular orbital theory was given by
a) Kossel b) Mosley c) Mulliken d) Werner

155. NH_3 has a net dipole moment, but boron trifluoride (BF_3) has zero dipole moment, because:
a) B is less electronegative than N
b) F is more electronegative than H
c) BF_3 is pyramidal while NH_3 is planar
d) NH_3 is pyramidal while BF_3 is trigonal planar

156. Proton plays an important role in…bonding.
a) Electrovalent b) Hydrogen c) Covalent d) Coordinate

157. Which represents a collection of isoelectronic species?
a) Be, Al^{3+}, Cl^- b) Ca^{2+}, Cs^+, Br c) Na^+, Ca^{2+}, Mg^{2+} d) N^{3-}, F^-, Na^+

158. An electrovalent compound does not exhibit space isomerism due to:
a) Presence of ions
b) High melting point
c) Strong electrostatic forces between constituent ions
d) Non-directional nature of electrovalent bond

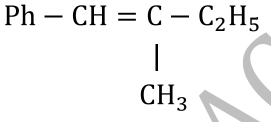
159. In which molecule Sulphur atom is not sp^3-hybridized?
a) SO_4^{2-} b) SF_4 c) SF_2 d) None of these

160. In which one of the following species, the central atom has the type of hybridization which is not the same as that present in other three?
a) SF_4 b) I_3^- c) $SbCl_5^{2-}$ d) PCl_5

161. The radii of F, F^-, O and O^{2-} are in the order of:
a) $O^{2-} > F^- > F > O$ b) $F^- > O^{2-} > F > O$ c) $O^{2-} > O > F^- > F$ d) $O^{2-} > F^- > O > F$

162. The correct order of decreasing second ionisation enthalpy of Ti (22), V (23), Cr (24) and Mn (25) is:
a) $V > Mn > Cr > Ti$ b) $Mn > Cr > Ti > V$ c) $Ti > V > Cr > Mn$ d) $Cr > Mn > V > Ti$

163. How many σ and π-bonds are present in given compound?



$$Ph-CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-C_2H_5$$

a) $19\ \sigma$ and $4\ \pi-$ bonds b) $22\ \sigma$ and $4\ \pi-$ bonds
c) $25\ \sigma$ and $4\ \pi-$ bonds d) $26\ \sigma$ and $4\ \pi-$ bonds

164. $C-Cl$ bond is stronger than C – I bond, because
a) $C-Cl$ bond is more ionic than C – I b) $C-Cl$ bond is polar covalent bond
c) $C-Cl$ bond is more covalent than C – I d) $C-Cl$ bond length is longer than C – I

165. The ICl molecule is:
a) Purely covalent
b) Purely electrovalent
c) Polar with negative end on chlorine
d) Polar with negative end on iodine

166. Which of the following silver salts is insoluble in water?
a) $AgClO_4$ b) Ag_2SO_4 c) AgF d) $AgNO_3$

167. Silicon has 4 electrons in the outermost orbit. In forming the bond:
a) It gains electrons b) It losses electrons c) It shares electrons d) None of these

168. The shape of gaseous $SnCl_2$ is

a) Tetrahedral b) Linear c) Angular d) T-shape

169. Chlorine atom tends to acquire the structure of:
a) He b) Ne c) Ar d) Kr

170. The $d-$ orbital involved in $sp^3\ d-$ hybridisation is
a) $d_{x^2-y^2}$ b) d_{xy} c) d_{z^2} d) d_{zx}

171. When O_2 is converted into O_2^+;
a) Both paramagnetic character and bond order increase
b) Bond order decreases
c) Paramagnetic character increases
d) Paramagnetic character decreases and the bond order increases

172. Intramolecular hydrogen bond is present in
a) Water b) *o*-nitrophenol c) *p*-nitrophenol d) methylamine

173. A pair of compounds which have odd electrons in the group $NO, CO, ClO_2, N_2O_s, SO_2$ and O_2 are
a) NO and ClO_2 b) COI and SO_2 c) $ClO_2$and CO d) $SO_2$and O_3

174. According to VSEPR theory the repulsion between different pair (lone or bond) of electrons obey the order
a) $lp\ \ bp\ \ lp\ \ lp\ \ bp\ \ bp$ b) $lp\ \ bp\ \ bp\ \ bp\ \ lp\ \ lp$
c) $lp\ \ lp\ \ \ lp\ \ bp\ \ bp\ \ bp$ d) $bp\ \ bp\ \ lp\ \ lp\ \ lp\ \ bp$

175. The bond between two identical non-metal atoms has a pair of electrons:
a) Unequally shared between the two
b) Equally shared between the two
c) Transferred fully from one atom to another
d) None of the above

176. The bond angle in AsH_3 is greater than that in
a) NH_3 b) H_2O c) BCl_3 d) None of these

177. The correct order of increasing electropositive character among Cu, Fe and Mg is:
a) $Cu \approx Fe < Mg$ b) $Fe < Cu < Mg$ c) $Fe < Mg < Cu$ d) $Cu < Fe < Mg$

178. H—O—H bond angle in H_2O is 104.5° and not 109°28′ because of:
a) High electronegativity of oxygen
b) Bond pair-bond pair repulsion
c) Lone pair-lone pair repulsion
d) Lone pair-bond pair repulsion

179. The bond order in O_2^+ is equal to bond order in:
a) N_2^+ b) CN^- c) CO d) NO^+

180. The electron affinity for inert gases is likely to be:
a) High b) Small c) Zero d) Positive

181. The true statements from the following are
1.PH_5 and $BiCl_5$ do not exist
2.$p\pi - d\pi$ bond is present in SO_2
3.Electrons travel at the speed of light
4.SeF_4 and CH_4 have same shape
5.I_3^+has bent geometry
a) 1,3 b) 1,2,5 c) 1,3,5 d) 1,2,4

182. 1,3-butadiene has:
a) 6σ and 2π-bonds b) 2σ and 2π-bonds c) 9σ and 2π-bonds d) 6σ and 2π-bonds

183. The bond between atoms of two elements of atomic number 37 and 53 is:
a) Covalent b) Ionic c) Coordinate d) Metallic

184. In methane the bond angle is
a) 180° b) 90° c) 109° d) 120°

185. One would expect the elemental form of Cs at room temperature to be:
a) A network solid b) A metallic solid c) Non-polar liquid d) An ionic liquid

186. Which of the following is false?

a) Glycerol has strong hydrogen bonding
b) Glycol is a poisonous alcohols
c) Waxes are esters of higher alcohols with higher acids
d) Alkyl halides have higher b.p. than corresponding alcohols

187. Ionic radii are:

a) $\propto \frac{1}{\text{effective nuclear charge}}$
b) $\propto \frac{1}{(\text{effective nuclear charge})^2}$
c) $\propto$ effective nuclear charge
d) $\propto$ (effective nuclear charge)^2

188. Which of the following statements is incorrect?

a) He_2 does not exist because its bond order is zero
b) O_2, O_2^- and O_2^+ are all paramagnetic
c) Any two atomic orbitals can combine to form two molecular orbitals
d) $\pi(2p_x)$ and $\pi(2p_y)$are degenerate molecular orbitals

189. Which of the following pairs will from the most stable ionic bond?

a) Na and Cl b) Mg and F c) Li and F d) Na and F

190. Among NaF, NaCl NaBr and NaI, the NaF has highest melting point because:

a) It has maximum ionic character
b) It has minimum ionic character
c) It has associated molecules
d) It has least molecular weight

191. The planar structure of BF_3 can be explained by the fact that BF_3 is

a) sp hybridized b) sp^2 hybridised c) sp^3 hybridised d) $sp^3\,d$ hybridized

192. The correct order of bond order value among the following is

(i) NO^- (ii) NO^+
(iii)NO (iv) NO^{2+}
(v) NO^{2-}

a) (i) < (iv) < (iii) < (ii) < (v) b) (iv) = (ii) < (i) < (v) < (iii)
c) (v) < (i) < (iv) = (iii) < (ii) d) (ii) < (iii) < (iv) < (i) < (v)

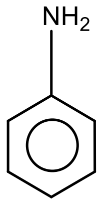
193. The bond between chlorine and bromine in $BrCl_3$ is:

a) Ionic
b) Non-polar
c) Polar with negative end on Br^-
d) Polar with negative end on Cl^-

194. Which of the following has regular tetrahedral shape?

a) $[Ni(CN)_4]^{2-}$ b) SF_4 c) $[BF_4]^-$ d) XeF_4

195. Which of the following will have large dipole moment?

a)


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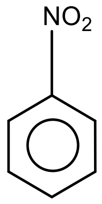

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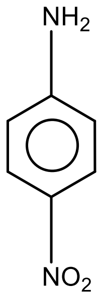

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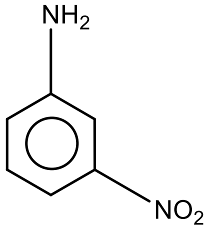


196. PCl_5 exists but NCl_5 does not because:

a) Nitrogen has no vacant $2d$-orbitals

b) NCl_5 is unstable
c) Nitrogen atom is much smaller than phosphorus
d) Nitrogen is highly mert

197. 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^-

198. The molecule having a pyramidal shape out of the following is
a) CO_2 b) BF_3 c) SF_4 d) NH_3

199. If Na^+ ion is larger than Mg^{2+} ion and $S^{2-}$is larger thanCl^- ion, which of the following will be stable soluble in water?
a) Sodium chloride b) Sodium sulphide c) Magnesium chloride d) Magnesium sulphide

200. An atom of an element A has three electrons in its outermost orbit and that of B has six electrons in its outermost orbit. The formula of the compound between these two will be
a) A_3B_6 b) A_2B_3 c) A_3B_2 d) A_2B

201. The energy of σ 2s-orbital is greater than σ∗ 1s orbital because:
a) σ 2s orbital is bigger than σ∗ 1s orbital
b) σ 2s orbital is a bonding orbital whereas, σ∗ 1s is an antibonding orbital
c) σ 2s orbital has a greater value of n than σ∗ 1s orbital
d) None of the above

202. The bond angle in ammonia molecule is
a) $90^\circ 3'$ b) $91^\circ 8'$ c) $106^\circ 45'$ d) $109^\circ 28'$

203. The compound in which the number of $d \quad p$ bonds are equal to those present in ClO_4^-
a) XeF_4 b) XeO_3 c) XeO_4 d) XeF_6

204. The correct order of bond angles (smallest first) in $H_2S, NH_3, BF_3$and SiH_4 is
a) $H_2S < SiH_4 < NH_3 < BF_3$ b) $NH_3 < H_2S < SiH_4 < BF_3$
c) $H_2S < NH_3 < SiH_4 < BF_3$ d) $H_2S < NH_3 < BF_3 < SiH_4$

205. A covalent molecule AB_3 has pyramidal structure. The number of lone pair and bond pair of electrons in the molecule are respectively.
a) 2 and 2 b) 0 and 4 c) 3 and 1 d) 1 and 3

206. Be in $BeCl_2$ undergoes
a) Diagonal hybridisation b) Trigonal hybridisation
c) Tetrahedral hybridisation d) No hybridisation

207. Which statement is wrong?
a) Hybridisation is the mixing of atomic orbitals prior to their combining into molecular orbitals
b) sp^2-hybrid orbitals are formed from two p-atomic orbitals and one s-atomic orbitals
c) dsp^2-hybrid orbitals are all at 90° to one another
d) d^2sp^2-hybrid orbitals are directed towards the corners of a regular tetrahedron

208. In the anion $HCOO^-$ the two carbon-oxygen bonds are found to be of equal length. What is the reason for it?
a) Electronic orbits of carbon atom are hybridised
b) The C=O bond is weaker than the C − O bond
c) The anion $HCOO^-$ has two resonating structures
d) The anion is obtained by removal of a proton from the acid molecule

209. Which of the following molecules has three fold axis of symmetry?
a) NH_3 b) C_2H_4 c) CO_2 d) SO_2

210. Oxygen and the oxide ion have the
a) Same proton number b) Same electronic configuration
c) Same electron number d) Same size

211. Valence bond theory of metallic bond was given by
a) Dalton b) Drudel c) Fajan d) Pauling

212. The correct order of second ionisation potential of carbon, nitrogen, oxygen and fluorine is:

a) C > N > O > F b) O > N > F > C c) O > F > N > C d) F > O > N > C

213. The molecule which has T – shaped structure is

a) PCl_3 b) ClF_3 c) NH_3 d) BCl_3

214. As a result of resonance:

a) Bond length decreases

b) Energy of the molecules decreases

c) Stability of the molecule increases

d) All are correct

215. The pair of species with the same bond order is:

a) NO, CO b) N_2, O_2 c) O_2^{2-}, B_2 d) O_2^+, NO^+

216. Which of the following molecules has pentagonal bipyramidal shape?

a) PF_5 b) SF_6I c) XeF_6 d) $[Fe(CN)_6]^{3-}$

217. The number of types of bonds between two carbon atoms in calcium carbide is

a) One sigma, two pi b) One sigma, one pi c) Two sigma, one pi d) Two sigma, two pi

218. The bond angle between H—O—H in ice is closest to:

a) 115˚ b) 109˚28′ c) 110˚ d) 90˚

219. If a molecule MX_3 has zero dipole moment the sigma bonding orbitals used by M (at. No. < 21) is:

a) Pure p b) sp-hybrid c) sp^2-hybrid d) sp^3-hybrid

220. Which combination of atoms can form a polar covalent bond?

a) H and H b) H and Br c) N and N d) Na and Br

221. The bond strength in O_2^+, O_2, O_2^- and O_2^{2-} follows the order:

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

222. The shape of XeF_4 molecule and hybridisation of xenon in it are

a) Tetrahedral and sp^3 b) Square planar and dsp^2

c) Square planar and sp^3d^2 d) Octahedral and sp^3d^2

223. In H_2^- ion, the bond order is:

a) Zero b) 1/2 c) -1/2 d) 1

224. H-bonding is not present in:

a) Glycerine b) Water c) H_2S d) HF

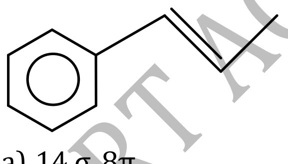
225. In which of the following gaseous molecules, the ionic character of the covalent bond is greatest?

a) HCl b) HBr c) HI d) HF

226. The angle between the overlapping of one s-orbital and one p-orbital is:

a) 180° b) 120° c) 109°28′ d) 120°60′

227. How many bonds are there in?



a) 14 σ, 8π b) 18 σ, 8π c) 19 σ, 4π d) 14 σ, 2π

228. Which is the correct statement about σ and π molecular orbitals? Statements are

(i) π-bonding orbitals are ungerade

(ii) π-antibonding orbitals are ungerade

(iii) σ-antibonding orbitals are gerade

a) (i) only b) (ii) and (iii) only c) (iii) only d) (ii) only

229. Among the following statement, the correct statement about PH_3 and NH_3 is:

a) NH_3 is a better electron donor because the lone pair of electron occupies spherical s-orbital and is less directional

b) PH_3 is a better electron donor because the lone pair of electron occupies sp^3-orbital and is more directional

c) NH_3 is a better electron donor because the lone pair of electron occupies sp^3-orbital and more directional

d) PH_3 is a better electron donor because the lone pair of electron occupies spherical s-orbital and is less directional

230. Which is expected to have linear structure?
a) SO_2 b) CO_2 c) CO_3^{2-} d) SO_4^{2-}

231. The bond angle in PH_3 is:
a) Much lesser than NH_3 b) Equal to that in NH_3 c) Much greater than in NH_3 d) Slightly more than in NH_3

232. Carnallite in solution in water shows the properties of
a) K^+, Mg^{2+}, Cl^- b) $K^+, Cl^-, SO_4^{2-}, Br^-$ c) K^+, Mg^{2+}, CO_3^{2-} d) K^+, Mg^{2+}, Cl^-, Br^-

233. A simple of a coordinate covalent bond is exhibited by
a) HCl b) NH_3 c) C_2H_2 d) H_2SO_4

234. In the series ethane, ethylene and acetylene, the C—H bond energy is:
a) The same in all the three compounds
b) Greatest in ethane
c) Greatest in ehtylene
d) Greatest in acetylene

235. In which molecule the van der Waals' force is likely to be the most important in determining the m.p. and b.p.?
a) Br_2 b) CO c) H_2S d) HCl

236. Identify the wrong statement in the following:
a) Atomic radius of the elements increases as one moves down the first group of the periodic table
b) Atomic radius of the elements decreases as one moves across from left to right in the 2nd period of the periodic table
c) Amongst isoelectronic species, smaller the positive charge on the cation, smaller is the ionic radius
d) Amongst isoelectronic species, greater the negative charge on the anion, larger is the ionic radius

237. (I)1, 2-dihydroxy benzene
(II) 1, 3-dihydroxy benzene
(III) 1, 4-dihydroxy benzene
(IV) Hydroxy benzene
The increasing order of boiling points of above mentioned alcohols is
a) $I < II < III < IV$ b) $I < II < IV < III$
c) $IV < I < II < III$ d) $IV < II < I < III$

238. Dipole moment is shown by
a) *cis* - 1, 2-dichloro ethane b) *trans*-1, 2-dichloro ethane
c) *trans*-1 2-dichloro-2 peptene d) Both (a) and (c)

239. Compounds formed by sp^3d^2-hybridization will have configuration:
a) Square planar
b) Octahedral
c) Trigonal bipyramidal
d) Pentagonal bipyramidal

240. In which molecular are all atoms coplanar?
a) PF_3 b) NH_3 c) BF_3 d) CH_4

241. The AsF_5 molecule is trigonal bipyramidal.The hybrid orbitals used by the As atoms for bonding are
a) $d_{x^2-y^2},\ d_{z^2}, s, P_x, P_y$ b) d_{xy}, s, P_x, P_z c) $s, P_x, P_y, P_z, d_{z^2}$ d) $d_{x^2-y^2}, s, P_x, P_y$

242. The bond order of N_2^+ is
a) 1.5 b) 3.0 c) 2.5 d) 2.0

243. CO_2 is isostructural with
a) C_2H_2 b) $SnCI_2$ c) NO_2 d) $MgCI_2$

244. The compound with the maximum dipole moment among the following is:
a) p-dichlorobenzene b) m-dichlorobenzene c) o-dichlorobenzene d) Carbon tetrachloride

245. Which of the following bonds require the largest amount of energy to dissociate the bond concerned?
a) H—H bond in H_2 b) C—H bond in CH_4 c) $N \equiv N$ bond in N_2 d) $O = O$ bond in O_2

246. The sequence that correctly describes the relative bond strength pertaining to oxygen molecule and its cation or anion is
a) $O_2^{2-} > O_2^- > O_2 > O_2^+$ b) $O_2 > O_2^+ > O_2^- > O_2^{2-}$
c) $O_2^+ > O_2 > O_2^{2-} > O_2^-$ d) $O_2^+ > O_2 > O_2^- > O_2^{2-}$

247. The type of hybridisation in XeF_4 is
a) dsp^2 b) sp^3d c) sp^3d^2 d) sp^3d^3

248. What bond order does Li_2 have?
a) 3 b) 1 c) 2 d) 0

249. Which have zero dipole moment?
a) 1,1-dichloroethene
b) *Cis*-1, 2-dichloroethene
c) *trans*-1, 2-dichlorothene
d) None of the above

250. Strongest bond is formed by the head on overlapping of:
a) 2*s* -and 2*p* -orbitals b) 2*p*- and 2*p*-orbitals c) 2*s*- and 2*s*- orbitals d) All of these

251. Hybridization state of I in ICl_2^+ is :
a) dsp^2 b) sp c) sp^2 d) sp^3

252. Arrange the following compound in order of increasing dipole moment:
Toluene (I) *m*-dichlorobenzene (II)
o-dichlorobenzene (III) *p*-dichlorobenzene (IV)
a) I < IV < II < III b) IV < I < II < III c) IV < I < III < II d) IV < II < I < III

253. Which has maximum covalent character?
a) $SiCl_4$ b) $MgCl_2$ c) NaCl d) $AlCl_3$

254. Which species does not exist?
a) $(SnCl_6)^{2-}$ b) $(GeCl_6)^{2-}$ c) $(CCl_6)^{2-}$ d) $(SiCl_6)^{2-}$

255. Among the following which has the highest cation to anion size ratio?
a) CsI b) CsF c) LiF d) NaF

256. The dipole moment of HBr is 1.6×10^{-30} cm and inter – atomic spacing is 1 Å. The % ionic character of HBr is
a) 7 b) 10 c) 15 d) 27

257. When an element of very low ionisation potential is allowed to react with an element of very high electron affinity, we get:
a) A weak ionic bond b) A strong ionic bond c) A polar covalent bond d) No bond

258. Ionization potential is lowest for:
a) Halogens b) Inert gases c) Alkaline earth metals d) Alkali metals

259. The orbitals of same energy level providing the most efficient overlapping are:
a) sp^3-sp^3 b) sp -sp c) sp^2-sp^2 d) All of these

260. The covalent compound HCl has the polar character because:
a) The electronegativity of hydrogen is greater than that of chlorine
b) The electronegativity of hydrogen is equal to than that of chlorine
c) The electronegativity of chlorine is greater than that of hydrogen
d) Hydrogen and chlorine are gases

261. Identify the non-polar molecule in the set of compounds given
HCl, HF, H_2, HBr
a) H_2 b) HCl c) HF, HBr d) HBr

262. Which one of the following compounds has sp^2 hybridisation?
a) CO_2 b) SO_2 c) N_2O d) CO

263. The increasing order of the ionic radii of the given isoelectronic species is:

a) $S^{2-}, Cl^-, Ca^{2+}, K^+$ b) $Ca^{2+}, K^+, Cl^-, S^{2-}$ c) $K^+, S^{2-}, Ca^{2+}, Cl^-$ d) $Cl^-, Ca^{2+}, K^+, S^{2-}$

264. Which cannot exist on the basis of M.O. theory?
a) C_2 b) He_2^+ c) H_2^+ d) He_2

265. Which of the following does not involve covalent bond?
a) PH_3 b) CsF c) HCl d) H_2S

266. $B_{10}C_2H_{12}$ is isoelectronic with
a) $B_{12}H_{12}^{2-}$ b) $B_{12}H_{12}$ c) $B_{12}H_{12}^+$ d) $B_{12}H_{12}^{2+}$

267. The electronegativity of A and B are 1.20 and 4.0 respectively. Therefore, ionic character in $A - B$ bond will be
a) 50% b) 43% c) 53.3% d) 72.23%

268. During the formation of a chemical bond
a) Electron-electron repulsion becomes more than the nucleus-electron repulsion attraction
b) Energy of the system does not change
c) Energy increases d) Energy decreases

269. The number of ions formed when a molecule of $K_4Fe(CN)_6$ dissociates is:
a) 4 b) 5 c) 6 d) 2

270. Pair of species having identical shapes for molecules is
a) CF_4, SF_4 b) BF_3, PCl_3 c) XeF_2, CO_2 d) PF_5, IF_7

271. An example of a polar covalent compound is
a) KCl b) NaCl c) CCl_4 d) HCl

272. Which is not an exception to octet rule?
a) BF_3 b) $SnCl_4$ c) BeI_2 d) ClO_2

273. The molecules having dipole moment are:
a) 2, 2-dimethylpropane
b) *Trans*-3-hexene
c) *Trans*-2-pentene
d) 2, 2, 3, 3-tetramethylbutane

274. Which of the following species has a bond order other than 3?
a) CO b) CN^- c) NO^+ d) O_2^+

275. Which of the following is planar?
a) XeF_2 b) XeO_3F c) XeO_2F_2 d) XeF_4

276. Among the following species, identify the pair having same bond order CN^-, O_2^-, NO^+, CN^+
a) CN^- and O_2^- b) O_2^- and NO^+ c) CN^- and NO^+ d) CN^- and CN^+

277. The bond angle and dipole moment of water respectively, are
a) 109.5°, 1.84 D b) 107.5°, 1.56 D c) 104.5°, 1.84 D d) 102.5°, 1.56 D

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

279. Which compound shows hydrogen bonding?
a) RCH_2NHCH_3 b) RCH_2CHO c) C_2H_6 d) HCl

280. Chlorine atom differs from chloride ion in the number of:
a) Protons
b) Neutrons
c) Electrons
d) Protons and electrons

281. What is the reason for unusual high b.p. of water?
a) Due to the presence of H^+ and OH^- ions in water b) Due to dipole – dipole interactions
c) Due to London forces d) Strong London Forces

282. The increasing order of the first ionization enthalpies of the elements B, P, S and F (lower first) is:
a) $F < S < P < B$ b) $P < S < B < F$ c) $B < P < S < F$ d) $B < S < P < F$

283. The IP_1, IP_2, IP_3, IP_4, and IP_5 of an element are 7.1, 14.3, 34.5, 46.8, 162.2 eV respectively. The element is

likely to be:

a) Na b) Si c) F d) Ca

284. Which of the following is paramagnetic?

a) B_2 b) C_2 c) N_2 d) F_2

285. Ionization potential of Na would be numerically the same as:

a) Electron affinity of Na^+

b) Electronegativity of Na^+

c) Electron affinity of He

d) Ionization potential of Mg

286. Which one of the following conversions involve change in both hybridisation and shape?

a) $CH_4 \longrightarrow C_2H_6$ b) $NH_3 \longrightarrow NH_4^+$ c) $BF_3 \longrightarrow BF_4^-$ d) $H_2O \longrightarrow H_3O^+$

287. According to MO theory,

a) O_2^+ is paramagnetic and bond order greater than O_2

b) O_2^+ is paramagnetic and bond order less than O_2

c) O_2^+ is diamagnetic and bond order is less than O_2

d) O_2^+ is diamagnetic and bond order is more than O_2

288. If the molecule of HCl were totally polar, the expected value of dipole moment is 6.12 D (dbye), but the experimental value of dipole moment was 1.03 D. Calculate the percentage ionic character

a) 17 b) 83 c) 50 d) Zero

289. The order of first electron affinity of O, S and Se is:

a) $O > S > Se$ b) $S > O > Se$ c) $Se > O > S$ d) $Se > S > O$

290. The nodal plane in the π-bond of ethane 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 contains the carbon-carbon σ-bond

291. The correct electronegativity order is:

a) C, N, Si, P b) N, Si, C, P c) Si, P, C, N d) P, Si, N, C

292. The pair of species having identical shapes for molecules of both species is

a) CF_4, SF_4 b) XeF_2, CO_2 c) BF_3, PCl_3 d) PF_5, IF_5

293. Amongst the following, the molecule that is linear is

a) SO_2 b) CO_2 c) ClO_2 d) NO_2

294. Using MO theory predict which of the following species has the shortest bond length?

a) O_2^{2+} b) O_2^+ c) O_2^- d) O_2^{2-}

295. The hybridisation of carbon atom in benzene is?

a) sp b) sp^2 c) sp^3 d) dsp^2

296. Bond angle between two hybrid orbitals is 105°. Hybrid character orbital is:

a) Between 20-21% b) Between 19-20% c) Between 21-22% d) Between 22-23%

297. 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) $[KHF]^+$ and F^-

298. *o*-hydroxy benzaldehyde, although contains enolic group but does not give test of group with $FeCl_3$ because:

a) It is steam volatile

b) Of intermolecular H-bonding

c) Of intramolecular H-bonding

d) All of the above

299. Iron is tougher than sodium because:

a) Iron atom is smaller

b) Iron atoms are more closely packed

c) Metallic bonds are stronger in iron

d) None of the above

300. Correct order of bond angles in NH_3, PCl_3 and BCl_3 is

a) $PCl_3 > NH_3 > BCl_3$ b) $NH_3 > BCl_3 > PCl_3$
c) $NH_3 > PCl_3 > BCl_3$ d) $BCl_3 > NH_3 > PCl_3$

301. The number of π - bonds present in propyne is

a) 4 b) 1 c) 3 d) 2

302. A bond with maximum covalent character between non-metallic elements is formed:

a) Between identical atoms
b) Between chemically similar atoms
c) Between atoms of widely different electro-negativities
d) Between atoms of the same size

303. The compound in which underlined carbon uses only its sp^3 hybrid orbitals for bond formation is

a) $CH_3\underline{C}OOH$ b) $CH_3\underline{C}ONH_2$ c) $CH_3\underline{C}H_2OH$ d) $CH_2\underline{C}H = CH_2$

304. Consider the following compounds

(i) chloroethene (ii) benzene
(iii) 1, 3-butadiene (iv) 1,3,5 – hexatriene

All the carbon atoms are sp^2 hybridised in

a) (i), (iii), (iv) only b) (i), (ii) only c) (ii), (ii), (iv) only d) (i), (ii), (iii) and (iv)

305. When ionic compounds get dissolved in water:

a) They involve heat changes
b) Inter-ionic attraction is reduced
c) Ions show dipole-ion attraction with water molecules
d) All are correct

306. Pick the odd one out (The one having zero dipole moment):

a) NH_3 b) H_2O c) BCl_3 d) SO_2

307. Which of the following shows minimum bond angle?

a) H_2O b) H_2Se c) H_2S d) H_2Te

308. Among the following isostructural compounds, identify the compound which has the highest lattice energy

a) LiF b) LiCl c) NaCl d) MgO

309. Which species is diamagnetic in nature?

a) He_2^+ b) H_2 c) H_2^+ d) H_2^-

310. Which of the following compounds would have the highest boiling point?

a) $CH_3CH_2CH_2CH_3$ b) CH_3NH_2 c) CH_3OH d) CH_2F_2

311. Hybridisation of central atom in NF_3 is

a) sp^3 b) sp c) sp^2 d) dsp^2

312. Which of the compounds has highest boiling point?

a) Acetone b) Diethyl ether c) Methanol d) Ethanol

313. The number and type of bonds between two carbon atoms in CaC_2 are:

a) One sigma (σ) and one pi (π)-bond
b) One sigma (σ) and two pi (π)-bonds
c) One sigma (σ) and one and a half pi (π)-bond
d) One sigma (σ) bond

314. Which of the following hydrogen bonds are strongest in vapour phase?

a) HF---HF b) HF---HCl c) HCL---HCl d) HF---Hi

315. The bond angle and hybridization in ether (CH_3OCH_3) is:

a) $106^\circ 51', sp^3$ b) $104^\circ 31', sp^3$ c) $110^\circ, sp^3$ d) None of these

316. Which has the highest bond energy?

a) Hydrogen bond b) Triple bond c) Double bond d) Single bond

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

a) H_2CO_3 b) SiF_4 c) BF_3 d) $HClO_2$

318. The incorrect statement among the following is:
a) The first ionization potential of Al is less than the first ionization potential of Mg
b) The second ionization potential of Mg is greater than the second ionization potential of Na
c) The first ionization potential of Na is less than the first ionization potential of Mg
d) The third ionization potential of Mg is greater than the third ionization potential of Al

319. The bond angle is smallest in
a) H_2O b) H_2S c) $BeCl_2$ d) N_2O

320. The number of electrons in the valence shell of sulphur in SF_6 is
a) 12 b) 10 c) 8 d) 11

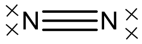
321. Acetic acid exists as dimer in benzene due to:
a) Condensation reaction
b) Hydrogen bonding
c) Presence of carboxyl group
d) Presence of hydrogen atom at α-carbon

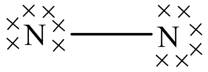
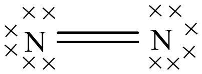
322. The correct order of hybridization of the central atom in the following species NH_3, $[PtCl_4]^{2-}$, PCl_5 and BCl_3 is:
a) dsp^2, dsp^3, sp^2, sp^3 b) sp^3, dsp^2, dsp^3, sp^2 c) dsp^2, sp^2, sp^3, dsp^3 d) dsp^2, sp^3, sp^2, dsp^3

323. Chemical bond formation takes place when?
a) Energy is absorbed
b) Forces of attraction overcome forces of repulsion
c) Forces of repulsion overcome forces of attraction
d) Forces of attraction are equal to forces of repulsion

324. NH_3 has higher boiling point than expected, because:
a) With water it forms NH_4OH
b) It has strong intermolecular hydrogen bonds
c) It has strong intermolecular covalent bonds
d) Its density decreases in freezing

325. Which of the following represents the Lewis structure of N_2 molecule?

a)

b)

c)

d)


326. Which of the following has a bond order of 1.75?
a) ClO_3^- b) ClO_4^- c) NO_3^- d) CO_3^{2-}

327. Higher is the bond order, greater is:
a) Bond dissociation energy
b) Covalent character
c) Bond length
d) Paramagnetism

328. Which has the highest ionisation potential?
a) Na b) Mg c) C d) F

329. Strongest bond is in:
a) NaCl b) CsCl c) Both (a) and (b) d) None of these

330. Which of the following is not 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) $O_2 > O_2^-$

331. The bond order in O_2^{2-} ion is
a) 3 b) 2 c) 3/2 d) 1

332. Which is likely to have the highest melting point?
a) He b) CsF c) NH_3 d) $CHCl_3$

333. Which of the following are not correct?
a) Lone pair of electrons present on central atom can give rise to dipole moment
b) Dipole moment is vector quantity

c) CO_2 molecule has dipole moment
d) Difference in electronegativities of combining atoms can lead to dipole moment

334. In the formation of N_2^+ from N_2, the electron is lost from:
a) a σ-orbital b) a π-orbital c) a σ^*-orbital d) a π^*-orbital

335. Bond angle of $109°28'$ is found in
a) NH_3 b) H_2O c) $\overset{\oplus}{C}H_5$ d) $\overset{\oplus}{N}H_4$

336. The half of the difference between the number of electrons in bonding molecular orbitals and antibonding molecular orbitals is known as:
a) Bond order b) Proton order c) Molecular order d) Electron order

337. Which of the following set contains species having same angle around the central atom?
a) SF_4, CH_4, NH_3 b) NF_3, BCl_3, NH_3 c) $BF_3, NF_3, AlCl_3$ d) BF_3, BCl_3, BBr_3

338. At ordinary temperature and pressure, among halogens, the chlorine is a gas, bromine is a liquid and iodine is a solid. This is because:
a) The specific heat is in the order $Cl_2 > Br_2 > I_2$
b) Intermolecular forces among molecules of chlorine are the weakest and those in iodine are the strongest
c) The order of density is $I_2 > Br_2 > Cl_2$
d) The order of stability is $Cl_2 > Br_2 > I_2$

339. Which of the following has lowest bond angle?
a) BeF_2 b) H_2O c) NH_3 d) CH_4

340. Which of the following has shortest carbon-carbon bond length?
a) C_6H_6 b) C_2H_6 c) C_2H_4 d) C_2H_2

341. Which one of the following constitutes a group of the isoelectronic species?
a) C_2^{2-}, O_2^-, CO, NO b) $NO^+, C_2^{2-}, CN^-, N_2$ c) $CN^-, N_2, O_2^{2-}, CO_3^{2-}$ d) N_2, O_2^-, NO^+, CO

342. 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

343. Methanol and ethanol are miscible in water due to:
a) Covalent character
b) Hydrogen bonding character
c) Oxygen bonding character
d) None of the above

344. The shape of ClF_3 is
a) Distorted T- shape b) Pyramidal c) Tetrahedral d) Trigonal planar

345. Which are true statements among the following?
(1) PH_5 and $BiCl_5$ does not exist
(2) $p\pi—d\pi$ bonds are present in SO_2
(3) Electrons travel with speed of light
(4) SeF_4 and CH_4 has same shape
(5) I_3^+ has bent geometry
a) 1, 3 b) 1, 2, 5 c) 1, 3, 5 d) 1, 2, 4

346. The actual geometry of NO_2^- is
a) Planar b) Linear c) V-shape d) Tetrahedral

347. Which has the lowest anion to cation size ratio?
a) LiF b) NaF c) CsI d) CsF

348. The energy change accompanying the process given below is,
$Na^+(g) + Cl^-(g) \longrightarrow NaCl(s)$:
a) Hydration energy b) Ionization energy c) Electron affinity d) Lattice energy

349. Which of the following has covalent bond?
a) Na_2S b) $AlCl_3$ c) NaH d) $MgCl_2$

350. The correct order in which the $O - O$ bond length increases in the following is
a) $O_2 < O_3 < H_2O_2$ b) $H_2O_2 < O_3 < O_2$ c) $O_3 < O_2 < H_2O_2$ d) $O_2 < H_2O_2 < O_3$

351. N_2 is less reactive than CN^- due to
a) Difference in spin quantum number b) Presence of more electrons in orbitals
c) Absence of dipole moment d) None of the above

352. According to molecular orbital theory for O_2^+:
a) Bond order is less than O_2 and O_2^+ is paramagnetic
b) Bond order is more than O_2 and $O_2^+$is paramagnetic
c) Bond order is less than O_2 and $O_2^+$is diamagnetic
d) Bond order is more than O_2 and O_2^+ is diamagnetic

353. As compared to covalent compounds, electrovalent compounds generally have:
a) Low melting points and low boiling points
b) High melting points and high boiling points
c) Low melting points and high boiling points
d) High melting points and low boiling points

354. Which is present in peroxides?
a) O_2 b) O^{2-} c) O_2^{2-} d) O_2^-

355. Two hybrid orbitals have a bond angle of 120°. The percentage of$s$ character in the hybrid orbital is nearly
a) 25% b) 33% c) 50% d) 66%

356. Which molecule is T-shaped?
a) BeF_2 b) BCl_3 c) NH_3 d) ClF_3

357. Which of the following is paramagnetic?
a) O_2 b) CN^- c) CO d) NO^+

358. Dipole moment is highest for:
a) $CHCl_3$ b) CH_4 c) CHF_3 d) CCl_4

359. Which will not conduct electricity?
a) Aqueous KOH solution b) Fused NaCl c) Graphite d) KCl in solid state

360. The ionization potential order for which set is correct?
a) $Li > K > Cs$ b) $B > Li > K$ c) $Cs > Li > B$ d) $Cs < Li < K$

361. The bond that determines the secondary structure of a protein is:
a) Coordinate bond b) Covalent bond c) Hydrogen bond d) Ionic bond

362. Molecular orbital theory was developed mainly by
a) Pauling b) Mulliken c) Thomson d) Pauling and Slater

363. Which species has lone pair on central atom?
a) CCl_4 b) CH_4 c) NH_4^+ d) H_2O

364. In which of the following molecules/ions are all the bonds not equal?
a) SF_4 b) SiF_4 c) XeF_4 d) BF_4^-

365. Super octet molecule is:
a) F_3Cl b) PCl_3 c) NH_3 d) None of these

366. The number of unpaired electrons in a paramagnetic diatomic molecule of an element with atomic number 16 is:
a) 4 b) 1 c) 2 d) 3

367. Which of the following statement is not correct?
a) Hybridisation is the mixing of atomic orbitals prior to their combining into molecular orbitals
b) sp^2hybrid orbitals are formed from two p-atomic orbitals and one s-orbital
c) d^2sp^3 hydride orbitals are directed towards the corners of a regular octahedron
d) dsp^3hybrid orbitals are all at 90° to one another

368. Which statement is correct?

a) Pi-bond always exists with sigma-bond
b) Pi-bond can exist independently
c) Sigma-bond is weaker than pi-bond
d) Pi-bond is less reactive than sigma-bond

369. Which of the following pair has same structure?
a) PCl_5 and SF_6 b) SO_2 and NH_3 c) PH_3 and BCl_3 d) NH_4^+ and SO_4^{2-}

370. Which of the following has dipole moment?
a) CO_2 b) *p*-dichlorobenzene c) NH_3 d) CH_4

371. Which one of the following is highest melting halide?
a) AgCl b) AgBr c) AgF d) AgI

372. The hybridisation state of central atom in PCl_5 is
a) sp^3d b) sp^3d^2 c) sp^3 d) d^2sp^3

373. The correct order of increasing bond angles in the following triatomic species is:
a) $NO_2^- < NO_2 < NO_2^+$ b) $NO_2^+ < NO_2 < NO_2^-$ c) $NO_2^+ < NO_2^- < NO_2$ d) $NO_2^- < NO_2^+ < NO_2$

374. $K^+, Cl^-, Ca^{2+}, S^{2-}$ ions are isoelectronic. The decreasing order of their size is:
a) $S^{2-} > Cl^- > K^+ > Ca^{2+}$
b) $Ca^{2+} > K^+ > Cl^- > S^{2-}$
c) $K^+ > Cl^- > Ca^{2+} > S^{2-}$
d) $Cl^- > S^{2-} > Ca^{2+} > K^+$

375. As the *s*-character of hybridization orbitals increases, the bond angle:
a) Increases b) Decreases c) Does not change d) Becomes zero

376. $AlCl_3$ is covalent while AlF_3 is ionic. This fact can be justified on the basis of
a) Valence bond theory b) Crystal structure c) Lattice energy d) Fajan rule

377. Which one of the following is a correct set with respect to molecule, hybridisation and shape?
a) $BeCl_2, sp^2$, linear b) $BeCl_2, sp^2$, triangular planar
c) BCl_3, sp^2, triangular planar d) BCl_3, sp^3, tetrahedral

378. 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

379. The correct order of decreasing polarity is
a) $HF > SO_2 > H_2O > NH_3$ b) $HF > H_2O > SO_2 > NH_3$
c) $HF > NH_3 > SO_2 > H_2O$ d) $H_2O > NH_3 > SO_2 > HF$

380. The process requiring the absorption of energy is:
a) $F - F^-$ b) $H \rightarrow H^-$ c) $Cl \rightarrow Cl^-$ d) $O \rightarrow O^{2-}$

381. In O_2^-, O_2 and O_2^{2-} molecular species, the total number of antibonding electrons respectively are
a) 7 , 6, 8 b) 1, 0, 2 c) 6, 6, 6 d) 8, 6, 8

382. sp^3 hybridisation is found in
a) CO_3^{2-} b) BF_3 c) NO_3^- d) NH_3

383. Among the following metals interatomic forces are probably weakest in:
a) Cu b) Ag c) Zn d) Hg

384. Which of the following phenomenon will occur when two atoms of an element with same spin of electron in orbitals approach each other?
a) Orbitals will overlap
b) Orbitals will not overlap
c) Bonding will take place
d) A diatomic molecule will be formed

385. If the bond has zero per cent ionic character, the bond is:
a) Pure covalent b) Partial covalent c) Partial ionic d) Coordinate covalent

386. Which bond angle θ would result in the maximum dipole moment for the triatomic molecule yxy?
a) $\theta = 90°$ b) $\theta = 120°$ c) $\theta = 150°$ d) $\theta = 180°$

387. The species having bond order different from that in CO is
a) NO^- b) NO^+ c) CN^- d) N_2

388. The species having octahedral shape is:
a) SF_6 b) BF_4^- c) PCl_5 d) BO_3^{3-}

389. The following compounds have been arranged in order of their increasing thermal stabilities. Identify the correct order:
K_2CO_3 (I) $MgCO_3$ (II)
$CaCO_3$ (III) $BeCO_3$ (IV)
a) I < II < III < IV b) IV < II < III < I c) IV < II < I < III d) II < IV < III < I

390. Which of the following will show least dipole moment?
a) Ethane b) Ether c) Ethanol d) Water

391. Which has the minimum bond energy?
a) H—Br b) H—I c) I—I d) H—H

392. The polarising ability of which one of the following is highest?
a) Small highly positive ion
b) Large positive ion
c) Small highly negative ion
d) Large negative ion

393. Which is expected to show paramagnetism?
a) ClO_2 b) SO_2 c) CO_2 d) SiO_2

394. Highest covalent character is found in which of the following?
a) CaF_2 b) $CaCl_2$ c) CaI_2 d) $CaBr_2$

395. The molecule which has zero moment is
a) CH_3Cl b) NF_3 c) BF_3 d) ClO_2

396. Hydrogen bond is strongest in
a) S——H-----O b) O——H-----S c) F——H-----F d) O——H-----N

397. The only molecule having dipole moment is
a) 2,2-dimethylpropane
b) *trans*-2-pentene
c) *trans*-3-hexene
d) 2,2,3,3-tetramethylbutane

398. Two lone pairs of electrons and two bond pairs are present in:
a) NH_3 b) BF_3 c) CO_3^{2-} d) NH_2^-

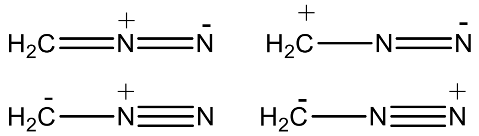
399. The lattice enthalpy and hydration enthalpy of four compounds are given below.

Compound	Lattice enthalpy (in kJ mol^{-1})	Hydration enthalpy (in kJ mol^{-1})
P	+780	-920
Q	+1012	-812
R	+828	-878
S	+632	-600

The pair of compounds which is soluble in water is
a) P and Q b) Q and R c) R and S d) P and R

400. The increase in bond order results in:
a) Decrease in bond length and increase in bond energy
b) Decrease in bond length and bond energy
c) Increase in bond length and bond energy
d) None of the above

401. The correct stability order of the following resonance structure is



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

402. Which is not characteristic of π-bond?
a) π-bond is formed when a sigma bond already formed
b) π-bond is formed from hybrid orbitals
c) π-bond may be formed by the overlapping of p-orbitals
d) π-bond results from lateral overlap of atomic orbitals

403. A molecule in which sp^2-hybrid orbitals are used by the central atom in forming covalent bond is:
a) He_2 b) SO_2 c) PCl_5 d) N_2

404. Which species has the highest bond order?
a) O_2 b) O_2^{2-} c) N_2 d) Both O_2 and O_2^{2-}

405. Molecular shapes of SF_4, CF_4, XeF_4 are
a) The same with 2, 0 and 1 lone pair of electron respectively
b) The same with 1, 1 and 1 lone pair of electrons respectively
c) Different with 0, 1 and 2 lone pair of electrons respectively
d) Different with 1, 0 and 2 lone pair of electrons respectively

406. The correct sequence of hybridisation of methane, ethene and acetylene is
a) sp, sp^2, sp^3 b) sp^2, sp^3, sp c) sp^3, sp^2, sp d) sp^3, sp, sp^2

407. The nature of the bond in diamond is
a) Ionic b) Covalent c) Metallic d) Coordinate covalent

408. The set representing the correct order of first ionization potential is:
a) $K > Na > Li$ b) $Be > Mg > Ca$ c) $B > C > N$ d) $Ge > Si > C$

409. Amongst the following, the molecule that is linear is
a) SO_2 b) BeH_2 c) ClO_2 d) NO_2

410. Which of the following species does not exist under normal conditions?
a) Be^{2+} b) Be_2 c) B_2 d) Li_2

411. How many σ and π – bonds are present in toluene?
a) $3\pi + 8\sigma$ b) $3\pi + 10\sigma$ c) $3\pi + 15\sigma$ d) $6\pi + 3\sigma$

412. Octet rule is not valid for the molecule:
a) CO_2 b) H_2O c) O_2 d) CO

413. CO_2 has the same geometry as:
(A) $HgCl_2$, (B) NO_2, (C) $SnCl_4$, (D) C_2H_2
a) A and C b) B and D c) A and D d) C and D

414. Concept of bond order in the molecular orbital theory depends on the number of electrons in the bonding and antibonding orbitals. The bond order:
a) Can have a −ve value
b) Has always an integral value
c) Is a non-zero quantity
d) Can assume any +ve value, including zero

415. The number of σ and π-bonds in pent-4-en-1-yne are respectively:
a) 3, 10 b) 9, 4 c) 4, 9 d) 10, 3

416. The Cl—C—Cl angle in 1, 1, 2, 2-tetrachloroethene and tetrachloromethane respectively will be about:
a) 109.5° and 900° b) 120° and 109.5° c) 90° and 109.5° d) 109.5° and 120°

417. Which set has strongest tendency to form anions?
a) Ga, In, Te b) Na, Mg, Al c) N, O, F d) V, Cr, Mn

418. From elementary molecular orbital theory we can give the electronic configuration of the singly positive nitrogen molecular ion N_2^+ as

a) $l\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p^4, \sigma 2p^1$
b) $\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p^2, \pi 2p^3$
c) $\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p^3, \pi 2p^2$
d) $\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p^2, \pi 2p^4$

419. NH_3 has much higher boiling point than PH_3 because

a) NH_3 has larger molecular weight
b) NH_3 undergoes umbrella inversion
c) NH_3 forms hydrogen bond
d) NH_3 contains ionic bonds whereas PH_3 contains covalent bonds

420. In a crystal, the atoms are located at the positions of:

a) Maximum potential energy
b) Minimum potential energy
c) Zero potential energy
d) Infinite potential energy

421. Which substance has the greatest ionic character?

a) Cl_2O
b) NCl_3
c) $PbCl_2$
d) $BaCl_2$

422. The conductivity of the metal decreases with increases in temperature because

a) The kinetic energy of the electron increases
b) The movement of electrons becomes haphazard
c) The kernels start vibrating
d) The metal becomes hot and starts emitting radiations

423. Which of the following when dissolved in water forms a solution, *i.e.*, non-conducting?

a) Chile salt petre
b) Potash alum
c) Green vitriol
d) Ethyl alcohol

424. Which bond is more polar?

a) Cl—Cl
b) N—F
c) C—F
d) O—F

425. The pairs of bases in DNA are held together by:

a) Hydrogen bonds
b) Ionic bonds
c) Phosphate groups
d) Deoxyribose groups

426. Which of the following has highest bond angle?

a) H_2O
b) H_2S
c) NH_3
d) PH_3

427. The compound in which carbon atom uses only sp^3 - hybrid orbitals for bond formation is

a) HCOOH
b) NH_2CONH_2
c) $(CH_3)_3COH$
d) CH_3CHO

428. For the type of interactions; (I) Covalent bond, (II) van der Waals' forces, (III) Hydrogen bonding, (IV) Dipole-dipole interaction, which represents the correct order of increasing stability?

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

429. If the ionization potential for hydrogen atom is 13.6 eV, then the ionization potential for He^+ ion should be:

a) 72.2 eV
b) 54.4 eV
c) 6.8 eV
d) 13.6 eV

430. The hydrogen bonding is strongest in:

a) O—H … S
b) S—H … O
c) F—H … F
d) F—H … O

431. The correct increasing order of polarising power is:

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) $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

432. Acetate ion contains:

a) One C, O single bond and one C, O double bond

b) Two C, O single bonds
c) Two C, O double bonds
d) None of the above

433. Which one is paramagnetic and has the bond order half (0.5)?
a) F_2 b) N_2 c) O_2 d) H_2^+

434. Which one is correct?
a) Dinitrogen is paramagnetic
b) Dihydrogen is paramagnetic
c) Dioxygen is paramagnetic
d) Dioxygen is diamagnetic

435. IP is influenced by:
a) Size of atom
b) Charge on nucleus
c) Electrons present in inner shells
d) All of the above

436. The hybridization 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

437. The bond between carbon atoms (1) and (2) in compound $N \equiv \underset{(1)}{C} - \underset{(2)}{CH} = CH_2$,
involves the hybrid orbitals;
a) sp^2, sp^3 b) sp, sp^2 c) sp, sp^3 d) sp, sp

438. Which of the following has lowest boiling point?
a) NaCl b) CuCl c) $CuCl_2$ d) CsCl

439. When metals react with non-metals, the metal atoms tend to
a) Share electrons b) Lose electrons c) Gain electrons d) None of the above

440. Which one has more tendency to form covalent compounds?
a) Ba b) Be c) Mg d) Ca

441. The order of melting point of *ortho, para, meta*-nitrophenol is
a) $o > m > p$ b) $p > m > o$ c) $m > p > o$ d) $p > o > m$

442. Number of non-bonding electron pair on Xe in XeF_6, XeF_4 and XeF_2 respectively will be
a) 6, 4, 2 b) 1, 2, 3 c) 3, 2, 1 d) 0, 3, 2

443. The hybridization of carbon in diamond, graphite and acetylene is:
a) sp^3, sp^2, sp b) sp^3, sp, sp^2 c) sp^2, sp^3, sp d) $sp, sp^3 sp^2$

444. The molecule, ion which is pyramidal in shape is
a) NO_3^- b) PCl_3 c) CO_3^{2-} d) SO_3

445. The number of lone pairs of 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

446. The electronic structure of the four elements A, B, C and D are, $(A) = 1s^2$; $(B) = 1s^2, 2s^2 2p^2$; $(C) = 1s^2, 2s^2 2p^5$; $(D) = 1s^2, 2s^2 2p^6$.
The tendency to form electrovalent bond is maximum in:
a) A b) B c) C d) D

447. $C - C$ bond order in benzene is
a) 1 b) 2 c) Between 1 and 2 d) None of these

448. For the formation of covalent bond, the difference in the value of electronegativities should be:
a) Equal to or less than 1.7
b) More than 1.7
c) 1.7 or more

d) None of the above

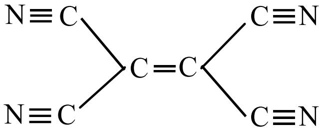
449. Which among the following elements has lowest value of ionisation energy?

a) Pb	b) Sn	c) Si	d) C

450. In coordinate bond, the acceptor atoms must essentially contain in its valency shell an orbitals:

a) With paired electron	b) With single electron	c) With no electron	d) With three electrons

451. How many σ-and π-bonds are there in the molecule of tetracyanoethylene?



a) Nine σ- and nine π	b) Five σ- and nine π	c) Nine σ- and seven π	d) Five σ- and eight π

452. Paramagnetism of oxygen is explained on the basis of its electronic configuration of

a) $(\overset{*}{\pi}2p_x)^1(\pi 2p_y)^1$	b) $(\overset{*}{\pi}2p_y)^1(\overset{*}{\pi}2p_z)^1$	c) $(\overset{*}{\sigma}2s)^1\ (\pi 2p_y)^1$	d) $(\overset{*}{\sigma}2s)^1\ (\pi 2p_y)^1$

453. The compound possessing most strongly ionic nature is:

a) $SrCl_2$	b) $BaCl_2$	c) $CaCl_2$	d) CsCl

454. The complex ion which has no '*d*' electrons in the central metal atom is:

a) $[MnO_4]^-$	b) $[Co(NH_3)_6]^{3+}$	c) $[Fe(CN)_6]^{3-}$	d) $[Cr(H_2O)_6]^{3+}$

455. Which of the following species is least stable?

a) O_2	b) O_2^+	c) O_2^-	d) O_2^{2-}

456. The dipole moment of HBr is 1.6×10^{-30}C-m and interatomic spacing is 1Å. The % ionic character of HBr is

a) 7	b) 10	c) 15	d) 27

457. Which group of atoms have nearly same atomic radius?

a) Na, K, Rb, Cs	b) Li, Be, B, C	c) Fe, Co, Ni, Cu	d) F, Cl, Br, I

458. Bond polarity of diatomic molecule is because of

a) Difference in electron affinity of the two atoms

b) Difference in electronegativities of the two atoms

c) Difference in ionisation potential

d) All of the above

459. The hybridization of P in PO_4^{3-} is same as in:

a) I in ICl_4^-	b) S in SO_3	c) N in NO_3^-	d) S in SO_4^{2-}

460. AB is an ionic solid. The ionic radii of A^+ and B^+ are respectively r_c and r_a. Lattice energy of AB is proportional to

a) $\frac{r_c}{r_a}$	b) $(r_c + r_a)$	c) $\frac{r_a}{r_c}$	d) $\frac{1}{(r_c + r_a)}$

461. Which contains a coordinate and covalent bond?

a) $BaCl_2$	b) NH_4Cl	c) HCl	d) H_2O

462. Covalent radius of Li is 123 pm. The crystal radius of Li will be:

a) > 123 pm	b) < 123 pm	c) $+ 123$ pm	d) $= \frac{123}{2}$ pm

463. Which of the following does not contain coordinate bond?

a) BH_4^-	b) NH_4^+	c) CO_3^{2-}	d) H_3O^+

464. The bond order of C_2^+ is:

a) 1	b) 2	c) 3/2	d) 1/2

465. With increasing bond order, stability of a bond

a) Increases	b) Decreases	c) Remains unaltered	d) None of these

466. Molecular orbitals theory was proposed by:

a) Werner	b) Kossel	c) Moseley	d) Mullikan

467. The isoelectronic pair is

a) Cl_2O, ICl_2^-	b) Cl_2^-, ClO_2	c) IF_2^+, I_3^-	d) ClO_2^-, ClF_2^+

468. The compound 1,2-butadiene has

a) sp, sp^2 and sp^3 hybridised carbon atoms
b) Only sp^2 hybridised carbon atoms
c) Only sp hybridised carbon atoms
d) Only sp and sp^2 hybridised carbon atoms

469. The correct order of ionic radii is:

a) $\mathrm{Fe} > \mathrm{Fe}^{2+} > \mathrm{Fe}^{3+}$
b) $\mathrm{O}^{2-} > \mathrm{O}^{-} > \mathrm{O}^{+}$
c) $\mathrm{I}^{-} > \mathrm{I} > \mathrm{I}^{+}$
d) All of these

470. The shape of sulphate ion is

a) Square planar
b) Trigonal
c) Trigonal planar
d) Tetrahedral

471. Molecular shape of SF_4, CF_4 and XeF_4 are:

a) The same with 2, 0 and 1 lone pair of electrons respectively
b) The same with 1, 1 and 1 lone pair of electrons respectively.
c) Different with 0, 1 and 2 lone pairs of electrons respectively.
d) Different with 1, 0 and 2 lone pairs of electrons respectively.

472. Which of the following is sp^3 hybridised?

a) NH_3
b) BH_3
c) PCl_5
d) $AlCl_3$

473. Sodium chloride is soluble in water but not in benzene because

a) $\Delta H_{\text{hdydration}} < \Delta H_{\text{lattice energy in water}}$ and $\Delta H_{\text{hdydration}} > \Delta H_{\text{lattice energy in benzene}}$
b) $\Delta H_{\text{hdydration}} > \Delta H_{\text{lattice energy in water}}$ and $\Delta H_{\text{hdydration}} < \Delta H_{\text{lattice energy in benzene}}$
c) $\Delta H_{\text{hdydration}} = \Delta H_{\text{lattice energy in water}}$ and $\Delta H_{\text{hdydration}} < \Delta H_{\text{lattice energy in benzene}}$
d) $\Delta H_{\text{Hdydration}} < \Delta H_{\text{lattice energy in water}}$ and $\Delta H_{\text{Hdydration}} = \Delta H_{\text{lattice energy in benzene}}$

474. The pair likely to form the strongest hydrogen bonding:

a) H_2O_2 and H_2O
b) HCOOH and CH_3COOH
c) CH_3COOH and CH_3COO
d) SiH_4 and $SiCl_4$

475. The number of sigma and pi bonds in 1- butane 3-yne are:

a) 5σ and 5π
b) 6σ and 4π
c) 7σ and 3π
d) 8σ and 2π

476. Which is soluble in water?

a) AgF
b) AgCl
c) AgBr
d) AgI

477. Which of the following compounds has the lowest melting point?

a) CaF_2
b) $CaCl_2$
c) $CaBr_2$
d) CaI_2

478. sp^3 hybridisation is not found in

a) H_2O
b) CH_4
c) BCl_3
d) NH_3

479. Amongst H_2O, H_2S, H_2Se and H_2Te, the one with highest boiling point is:

a) H_2O because of hydrogen bonding
b) H_2Te because of higher molecular weight
c) H_2S because of hydrogen bonding
d) H_2Se because of lower molecular weight

480. Which of the following is false?

a) Methane molecule is tetrahedral in shape
b) Nickel tetrachloride is square planar in shape
c) P_2O_5 is like two pyramids joined at their apices
d) Acetylene is non-linear

481. The pair of elements which on combination are most likely to form an ionic compound is:

a) Na and Ca
b) K and O_2
c) O_2 and Cl_2
d) Al and I_2

482. Among the following the maximum covalent character is shown by the compound.

a) $FeCl_2$
b) $SnCl_2$
c) $AlCl_3$
d) $MgCl_2$

483. Dipole-dipole attractive forces are strongest between the molecules of:

a) He
b) CH_4
c) CO_2
d) H_2O

484. The type of hybridization of sulphur atom present in SO_2 and SO_3 is respectively:

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

485. The electrons used in bonding atoms:

a) Belong to outermost shell
b) Belong to penultimate shell
c) Belong to outermost shell and sometimes penultimate shell
d) Belong to penultimate shell and sometimes to outermost shell

486. Given are O_2, O_2^+, O_2^{2+} and O_2^{2-} respectively. Find the correct increasing bond order
a) $O_2 < O_2^{2-} < O_2^{2+} < O_2^+$
b) $O_2^{2-} < O_2 < O_2^+ < O_2^{2+}$
c) $O_2^{2-} < O_2 < O_2^+ < O_2^{2-}$
d) $O_2^+ < O_2^{2-} < O_2 < O_2^{2+}$

487. In a homonuclear molecule which of the following set of orbitals is degenerate?
a) $\sigma 2s$ and $\sigma 1s$
b) $\pi\, 2p_x$ and $\overset{*}{\pi}\, 2p_y$
c) $\pi 2p_x$ and $\sigma 2p_z$
d) $\sigma 2p_z$ and $\overset{*}{\pi}\, 2p_x$

488. The electronegativity order of O, F, Cl and Br is:
a) $F > O > Cl > Br$
b) $F > Cl < Br > O$
c) $Br > Cl > F > O$
d) $F < Cl < Br < O$

489. Solid NaCl is a bad conductor of electricity because:
a) In solid NaCl there are no ions
b) Solid NaCl is covalent
c) In solid NaCl there is no velocity of ions
d) In solid NaCl there are no electrons

490. The number of lone pairs is same in PCl_3 and:
a) BCl_3
b) NCl_3
c) CCl_4
d) PCl_5

491. CaO and NaCl have the same crystal structure and approximately the same ionic radii. If U is the lattice energy of NaCl, the approximate lattice of CaO is
a) $\frac{U}{2}$
b) U
c) $2U$
d) $4U$

492. In the molecule $CH \equiv C - CH = CH_2$, the hybridisation of C – C bond is
a) $sp^2 - sp$
b) $sp^3 - sp^3$
c) $sp^2 - sp^2$
d) $sp^3 - sp$

493. Shape and hybridisation of IF_5 respectively are
a) Trigonal bipyramidal, sp^3d
b) Sea-saw, sp^3d
c) Square pyramidal, sp^3d^2
d) Pentagonal pyramidal, sp^3d^3

494. Which of the following set of properties belong toPCl_5?
a) sp^3, tetrahedral, 4 valence shell pairs of electrons
b) $sp^3\ d$, trigonal bipyramidal, 5 valence shell pairs of electrons
c) $sp^3\ d^2$, octahedral, 6 valence shell pairs of electrons
d) $sp^3\ d$, square planar, 4 valence shell pairs of electrons

495. In a polar molecule, the ionic charge is 4.8×10^{-10}esu. If the interionic distance is 1 Å unit, then the dipole moment is
a) 0.48 debye
b) 4.18 debye
c) 4.8 debye
d) 41.8 debye

496. The double bonds between the two carbon atoms in ethylene consists of:
a) Two sigma-bonds at right angles to each other
b) One sigma-bond and one pi-bond
c) Two pi-bonds at right angles to each other
d) Two pi-bonds at an angle of 60° to each other

497. The state of hybridisation of S in SF_4 is
a) sp^3 and has a lone pair of electron
b) sp^2 and has tetrahedral structure
c) sp^3d and has a trigonal bipyramidal structure
d) sp^3d^2 and has an octahedral structure

498. In OF_2, number of bond pair and lone pairs of electrons are respectively:
a) 2, 6
b) 2, 8
c) 2, 10
d) 2, 9

499. In which pair, the first atom or ion is not larger than the second?
a) N, F   b) Cl^-, Cl   c) O, S   d) Fe^{2+}, Fe^{3+}

500. The maximum number of hydrogen bonds that a molecule of water can have is
a) 1   b) 2   c) 3   d) 4

501. The isoelectronic species among the following are:
I—CH_3^+; II—NH_2^+; III—NH_4^+; IV—NH_3
a) I, II, III   b) II, III, IV   c) I, II, IV   d) II, I

502. Dipole moment is exhibited by:
a) 1, 4-dichlorobenzene
b) 1, 2-dichlorobenzene
c) *Trans*- 1, 2-dichloroethene
d) *Trans*-1, 2-dichloro-2-butene

503. In a multi-electron atom, the energy of a 2 p-orbital is:
a) Less than that of 2s-orbital
b) More than that of 2s-orbital
c) Equal to that of 2s-orbital
d) Double that of 2s-orbital

504. In which molecule the central atom does not use sp^3-hybrid orbitals in its bonding?
a) NH_2^- b) BeF_3^- c) SO_2Cl_2 d) SO_4^{2-}

505. RbO_2 is
a) Peroxide and paramagnetic   b) Peroxide and diamagnetic
c) Superoxide and paramagnetic   d) Superoxide and diamagnetic

506. Ionization energy of nitrogen is more than oxygen because:
a) Nucleus has more attraction for electrons
b) Half-filled p-orbitals are more stable
c) Nitrogen atom is small
d) More penetration effect

507. The high melting point and insolubility in organic solvents of sulphanilic acid are due to its---structure
a) Simple ionic   b) Cubic   c) Bipolar ionic   d) hexagonal

508. Which of the following does not have a coordinate bond?
a) SO_2 b) H_2SO_3 c) HNO_2 d) HNO_3

509. Which of the following sequence regarding ionisation potential of coinage metal is correct:
a) $Cu > Ag > Au$ b) $Cu < Ag < Au$ c) $Cu > Ag < Au$ d) $Ag > Cu < Au$

510. Which, molecule has zero dipole moment?
a) HBr   b) AgI   c) $PbSO_4$ d) H_2O

511. BCl_3 is a planar molecule, while NCl_3 is pyramidal, because
a) N – Cl bond is more covalent than B – Cl bond
b) Nitrogen atom is smaller than boron atom
c) B – Cl bond is more polar than N – Cl bond
d) BCl_3 has no lone pair of electrons but NCl_3 has a lone pair of electrons

512. Hybridisation of the underline atom changes in
a) $\underline{A}lH_3$ changes to AlH_4^- b) $H_2\underline{O}$ changes to H_3O^+
c) $\underline{N}H_3$ changes to NH_4^+ d) In all cases

513. Which molecule has hydrogen bonding
a) CH_4 b) CH_3COOH c) GeH_4 d) H_2Te

514. The energy released when a neutral gaseous atom takes up an electron is called:
a) Ionization energy   b) Solvation energy   c) Electronegativity   d) Electron affinity

515. In NO_3^- ion, number of bond pair and lone pair electrons are respectively:
a) 2, 2   b) 3, 1   c) 1, 3   d) 4, 8

516. Which has sp^2-hybridisation?

a) CO_2 b) SO_2 c) N_2O d) CO

517. A sp^3-hybrid orbital contains:
a) 1/4 s-character b) 1/2 s-character c) 2/3 s-character d) 3/4 s-character

518. In the formation of NO^+ from NO, the electron is removed from
a) a σorbital b) a π orbital c) aσ^* orbital d) a π^*orbital

519. The decreasing order of the second ionization energy of K, Ca and Ba is:
a) $K > Ca > Ba$ b) $Ca > Ba > K$ c) $Ba > K > Ca$ d) $K > Ba > Ca$

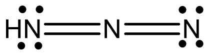
520. The value of n in the molecular formula $Be_nAI_2Si_6O_{18}$ is
a) 1 b) 2 c) 3 d) 4

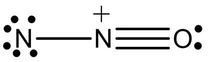
521. Compound X is anhydride of sulphuric acid. The number of σ bonds and the number of π - bonds present in X are, respectively.
a) 3, 3 b) 4, 2 c) 2, 4 d) 4, 3

522. OF_2 is:
a) Linear molecule and sp -hybridized
b) Tetrahedral molecule and sp^3-hybridized
c) Bent molecule and sp^3-hybridized
d) None of the above

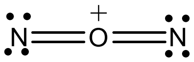
523. Which is not true in case of ionic bond?
a) It is linear bond
b) It is 100% ionic
c) It is formed between two atoms with large electronegativity difference
d) None of the above

524. Which of the following are possible resonating structure of N_2O?


I


II


III


IV

a) I and II b) I and III c) I, II and III d) All of these

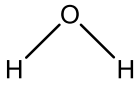
525. The number of σ and π – bonds in a molecule of acetonitrile are respectively
a) 2, 5 b) 3, 4 c) 4, 3 d) 5, 2

526. Strongest hydrogen bond is present in
a) O——H-----F b) S——H-----O c) O——H-----S d) F——H-----F

527. 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

528. The trigonal bipyramidal geometry results from the hybridisation
a) dsp^3 or sp^3d b) dsp^2 or sp^2d c) d^2sp^3 or sp^3d^2 d) d^3p^2 or $d^2\ p^3$

529. Which one of the following molecules has the smallest bond angle?
a) NH_3 b) PH_3 c) H_2O d) H_2Se

530. The  bond angle in H_2O is 104.5. This fact can be best explained with the help of
a) Valence shell electron pair repulsion (VSEPR) theory
b) Molecular orbital theory
c) Presence of hydrogen bond
d) Electronegativity difference between hydrogen and oxygen atoms

531. 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^-

532. Which of the following is non – linear molecule?

a) SO_3 b) CO_2 c) CS_2 d) $BeCl_2$

533. Which contains both covalent and ionic bonds?

a) CCl_4 b) KCN c) $CaCl_2$ d) H_2O

534. In the formation of NaCl by combination of Na and Cl:

a) Sodium and chlorine both lose electrons
b) Sodium and chlorine both gain electrons
c) Sodium loses but chlorine gains electrons
d) Sodium gains but chlorine loses electrons

535. Which of the following has linear structure?

a) CCl_4 b) C_2H_4 c) C_2H_2 d) SO_2

536. A molecule (X) has (i) four sigma bonds formed by the overlap of sp^2 and s - orbitals (ii) one sigma bond formed by sp^2 and sp^2 orbitals and (iii) one π bond formed by p_x and p_z orbitals. Which of the following is X?

a) C_2H_6 b) C_2H_3Cl c) $C_2H_2Cl_2$ d) C_2H_4

537. The lowest ionization energy would be associated with the electronic structure:

a) $1s^2, 2s^2 2p^6, 3s^1$ b) $1s^2, 2s^2 2p^5$ c) $1s^2, 2s^2 2p^6$ d) $1s^2, 2s^2 2p^6, 3s^2$

538. Which is correct in the following?

a) Radius of Cl atom is 0.99Å, while that of Cl^+ ion is 1.54 Å
b) Radius of Cl atom is 0.99 Å, while that of Na atom is 1.54 Å
c) The radius of Cl atom is 0.95 Å, while that of Cl^- ion is 0.81 Å
d) Radius of Na atom is 0.95 Å, while that of Na^+ ion is 1.54 Å

539. How many unpaired electrons are present in N_2^+?

a) 1 b) 2 c) 3 d) 4

540. Which one of the following compounds has the smallest bond angle in its molecule?

a) SO_2 b) OH_2 c) SH_2 d) NH_3

541. Which of the following is isostructural with CO_2?

a) N_2O b) NO_2 c) N_2O_5 d) NO

542. The electronic configuration of four elements L, P, Q and R are given in brackets
$L(1s^2, 2s^2, 2p^4), P(1s^2, 2s^2, 2p^6, 3s^1), Q(1s^2, 2s^2, 2p^6, 3s^2, 3p^5), R(1s^2, 2s^2, 2p^6, 3s^2)$ The formula of ionic compounds that can be formed between these elements are

a) L_2p, RL, PQ andR_2Q b) LP, RL, PQ and RQ c) P_2L, RL, PQ and RQ_2 d) LP, R_2L, P_2Q, and RQ

543. In which of the following ionisation processes, the bond order has increased and the magnetic behaviour has changed?

a) $C_2 \longrightarrow C_2^+$ b) $NO \longrightarrow NO^+$ c) $O_2 \longrightarrow O_2^+$ d) $N_2 \longrightarrow N_2^+$

544. The size of ionic species is correctly given in the order:

a) $Cl^{7+} > Si^{4+} > Mg^{2+} > Na^+$
b) $Na^+ > Mg^{2+} > Si^{4+} > Cl^{7+}$
c) $Na^+ > Mg^{2+} > Cl^{7+} > Si^{4+}$
d) $Cl^{7+} > Na^+ > Mg^{2+} > Si^{4+}$

545. Which of the following has the minimum bond length?

a) O_2 b) O_2^+ c) O_2^- d) O_2^{2-}

546. In acetylene molecule, between the carbon atoms there are

a) Three pi bonds b) One sigma and two pi bonds
c) Two sigma and one pi bonds d) Three sigma bonds

547. The ionic radii of N^{3-}, O^{2-} and F^- are respectively given by:

a) 1.36, 1.40, 1.71 b) 1.36, 1.71, 1.40 c) 1.71, 1.40, 1.36 d) 1.71, 1.36, 1.40

548. Bond order of 1.5 is shown by:

a) O_2^{2-} b) O_2 c) O_2^+ d) O_2^-

549. In which of the process, the bond order increases and magnetic behaviour changes?
a) $N_2 \rightarrow N_2^+$ b) $C_2 \rightarrow C_2^+$ c) $NO \rightarrow NO^+$ d) $O_2 \rightarrow O_2^+$

550. Which involves a bond forming process?
a) Stretching rubber
b) Dissolution of sugar in water
c) Rusting of iron
d) Emission of γ-rays by radioactive iron

551. Which is paramagnetic?
a) Cl_2O_6 b) Cl_2O_7 c) Cl_2O d) ClO_2

552. Which one of the following pairs of molecules will have permanent dipole moments for both members?
a) SiF_4 and NO_2 b) NO_2 and CO_2 c) NO_2 and O_3 d) SiF_4 and CO_2

553. The state of hybridization of boron and oxygen atom in boric acid (H_3BO_3) is respectively:
a) sp^3, sp^3 b) sp^2, sp^3 c) sp^3, sp^2 d) sp^2, sp^2

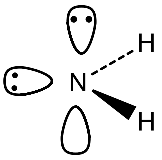
554. The correct order towards bond angle is
a) $sp^3 < sp^2 < sp$ b) $sp < sp^2 < sp^3$ c) $sp < sp^3 < sp^2$ d) $sp^2 < sp^3 < sp$

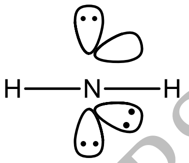
555. Which orbital is used by oxygen atom to form a sigma bond with other oxyen atom in O_2 molecule?
a) Pure p-orbital b) sp^2-hybrid orbital c) sp^3- hybrid orbital d) sp- hybrid orbital

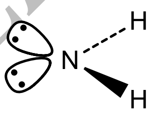
556. Which of the following is a linear molecule?
a) $BeCl_2$ b) H_2O c) SO_2 d) CH_4

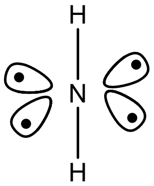
557. Which involves breaking of covalent bond?
a) Boiling H_2S b) Melting KCN c) Melting SiO_2 d) Boiling CF_4

558. For $\bar{N}H_2$, the best three-dimensional view is

a) 

b) 

c) 

d) 

559. For the four successive transition elements (Cr, Mn, Fe and Co), the stability of +2 oxidation state will be there in which of the following order?
a) Cr > Mn > Co > Fe
b) Mn > Fe > Cr > Co
c) Fe > Mn > Co > Cr
d) Co > Mn > Fe > Cr
(At. no. Cr = 24, Mn = 25, Fe = 26, Co = 27)

560. In PO_4^{3-}, the formal charge on each on each oxygen atom and the $P - O$ bond order respectively are
a) −0.75, 0.6 b) −0.75, 1.0 c) −0.75, 1.25 d) −3, 1.25

561. An element Xhas 3 electrons in p-orbitals and also belongs to III period. Its molecular formula should be:
a) X b) X_2 c) X_4 d) X_5

562. Elements having six electrons in its outermost orbit generally form:
a) Complex ion b) Negative ion c) Positive ion d) Zwitter ion

563. Oxygen is divalent, but sulphur exhibits variable valency of 2, 4 and 6, because:
a) Sulphur is less electronegative than oxygen
b) Sulphur is bigger atom than oxygen
c) Ionisation potential of sulphur is more than oxygen
d) Of the presence of d-orbitals in sulphur

564. Of the following sets which one does not contain isoelectronic species?
a) $BO_3^{3-}, CO_3^{2-}, NO_3^-$ b) $SO_3^{2-}, CO_3^{2-}, NO_3^-$ c) CN^-, N_2, C_2^{2-} d) $PO_4^{3-}, SO_4^{2-}, ClO_4^-$

565. In which of the following, unpaired electrons are present?
$KO_2, AlO_2^-, BaO_2, NO_2^+$

a) NO_2^+, BaO_2 b) KO_2, AlO_2^- c) Only KO_2 d) Only BaO_2

566. Which transition involves maximum amount of energy?
a) $M^-(g) \longrightarrow M(g) + e$
b) $M^-(g) \longrightarrow M^+(g) + 2e$
c) $M^+(g) \longrightarrow M^{2+}(g) + e$
d) $M^{2+}(g) \longrightarrow M^{3+}(g) + e$

567. What is the nature of the bond between B and O in $(C_2H_5)_2OBH_3$?
a) Covalent b) Coordinate covalent
c) Ionic bond d) Banana shaped bond

568. Which does not use sp^3-hybrid orbitals in its bonding?
a) BeF_3^- b) OH_3^+ c) NH_4^+ d) NF_3

569. Hybridisation of $C_2$and C_3 of
$H_3C-CH=C=CH-CH_3$ are
a) sp, sp^3 b) sp^2, sp c) sp^2, sp^2 d) sp, sp

570. Maximum covalence of an atom of an element is equal to:
a) Number of unpaired electrons in the s-and p-orbitals of valency shell
b) Number of unpaired electrons in the p-orbitals of valency shell
c) Total number of electrons in the s-and p-orbitals of valency shell
d) Total number of electrons in the p-orbitals of valency shell

571. Which main group elements have a different number of outermost electrons than their group number?
a) Alkali metals b) Noble gases c) Halogens d) None of these

572. The forces present in the crystals of naphthalene are:
a) Van der Waals' forces b) Electrostatic forces c) Hydrogen bonding d) None of these

573. Which does not show inert pair effect?
a) Al b) Sn c) Pb d) Thallium

574. The electronic theory of bonding was proposed by
a) Pauling b) Lewis c) Bronsted d) Mullikan

575. The correct order of decreasing first ionization potential is:
a) $C > B > Be > Li$ b) $C > Be > B > Li$ c) $B > C > Be > Li$ d) $Be > Li > B > C$

576. 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

577. Which of the following is more ionic?
a) NaCl b) KCl c) $MgCl_2$ d) $CaCl_2$

578. The species showing $p\pi$-$d\pi$ overlapping is:
a) NO_3^- b) PO_4^{3-} c) CO_3^{2-} d) NO_2^-

579. H_2O has a net dipole moment, while BeF_2 has zero dipole moment, because:
a) H_2O molecule as linear while BeF_2 is bent
b) BeF_2 molecule is linear, while H_2O is bent
c) Fluorine is more electronegative than oxygen
d) Be is more electronegative than oxygen

580. Among the following which is the strongest oxidising agent?
a) Cl_2 b) F_2 c) Br_2 d) I_2

581. Which of the following molecule in its valence shell has three bond pairs of electrons and one lone pair of electrons?
a) NH_3 b) H_2O c) BF_3 d) CO_2

582. Which of the following statements is correct?
a) All carbon to carbon bonds contain a σ - bond and one or more π - bonds
b) All carbon to hydrogen bonds are π - bonds
c) All oxygen to hydrogen bonds are hydrogen bonds
d) All carbon to hydrogen bonds are σ - bonds

583. Which of the following has sp^2 hybridisation?

a) C_2H_6 b) C_2H_4 c) $BeCl_2$ d) C_2H_2

584. The formation of energy bonds in solids are in accordance with

a) Heisenberg's uncertainty principle b) Bohr's theory

c) Ohm's law d) Rutherford's atomic model

585. Which of the following configuration is associated with biggest jump between 2nd and 3rd IE?

a) $1s^2, 2s^2 2p^2$ b) $1s^2, 2s^2 2p^6, 3s^1$ c) $1s^2, 2s^2 2p^6, 3s^2$ d) $1s^2, 2s^2 2p^1$

586. The predominent intermolecular forces in hydrogen fluoride is due to:

a) Dipole-induced dipole interaction

b) Dipole-dipole interaction

c) Hydrogen bond interaction

d) Dispersion interaction

587. Correct order of bond length is

a) $CO_3^{2-} > CO_2 > CO$ b) $CO_2 > CO > CO_3^{2-}$

c) $CO > CO_2 > CO_3^{2-}$ d) None of these

588. Which of the following molecules has pyramidal shape?

a) PCl_3 b) SO_3 c) CO_3^{2-} d) NO_3^-

589. The molecular electronic configuration of Be_2 is

a) $\sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 02s^2 \overset{*}{\sigma} 2p^2$ b) $KK\sigma 2S^2$ c) $\sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 02s^2 \overset{*}{\sigma} 2s^2$ d) None of the above

590. The maximum number of 90° angles between bond pair-bond pair of electrons is observed in

a) dsp^3 hybridisation b) $sp^3\ d$ hybridization

c) dsp^2 hybridisation d) $sp^3\ d^2$ hybridisation

591. In which of the following arrangement the order is not correct according to property indicated against it?

a) Increasing size : $Al^{3+} < Mg^{2+} < Na^+ < F^-$

b) Increasing IE_1 : $B < C < N < O$

c) Increasing EA_1 : $I < Br < F < Cl$

d) Increasing metallic radius : $Li < Na < K < Rb$

592. Most covalent halide of aluminium is:

a) $AlCl_3$ b) AlI_3 c) $AlBr_3$ d) AlF_3

593. The bond order of individual carbon-carbon bonds in benzene is:

a) One

b) Two

c) Between 1 and 2

d) One and two alternately

594. In pyrophosphoric acid, $H_4P_2O_7$, number of σ and $d\pi - p\pi$ bonds are respectively

a) 8 and 2 b) 6 and 2 c) 12 and zero d) 12 and 2

595. The percentage s– character of the hybrid orbitals in methane, ethene and ethyne are respectively

a) 25, 33, 50 b) 25, 50, 75 c) 50, 75, 100 d) 10, 20, 40

596. The types of bonds present in $CuSO_4 \cdot 5H_2O$ are only

a) Electrovalent and covalent

b) Electrovalent and co-ordinate

c) Electrovalent, covalent and co- ordinate covalent

d) Covalent and co-ordinate covalent

597. Which pair represents isostructural species?

a) CH_3^- amd CH_3^+ b) NH_4^+ and NH_3 c) SO_4^{2-} and BF_4^- d) NH_2^- and BeF_2

598. In which of the following species, all the three types of hybrid carbons are present?

a) $CH_2 = C = CH_2$ b) $CH_3 - CH = CH - CH_2^+$

c) $CH_3 - C \equiv C - CH_2^+$ d) $CH_3 - CH = CH - CH_2^-$

599. Which statement is not correct?

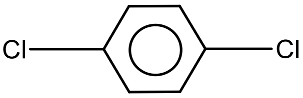
a) Double bond is shorter than a single bond.
b) Sigma bond is weaker than π-bond.
c) Double bond is stronger than a sigma bond.
d) Covalent bond is stronger than hydrogen bond.

600. The pair having similar geometry is:
a) BF_3, NH_3 b) BF_3, AlF_3 c) BeF_2, H_2O d) BCl_3, PCl_3

601. Which of the following is largest?
a) Cl^- b) S^{2-} c) Na^+ d) F^-

602. The AsF_5 molecule is trigonal bipyramidal. The hybrid orbitals used by the As atoms for bonding are
a) $d_{x^2-y^2}, d_{z^2}, s, p_x, p_y$ b) d_{xy}, s, p_x, p_y, p_z c) $s, p_x, p_y, p_z, d_{z^2}$ d) $d_{x^2-y^2}, s, p_x, p_y$

603. Consider the following halogen containing compounds
(A) $CHCl_3$ (B) CCl_4
(C) CH_2Cl_2 (D) CH_3Cl
(E)



The compounds with a net zero dipole moment are
a) B and E only b) C only c) C and D only d) A and D only

604. Alkali metals in each period have:
a) Largest size
b) Lowest *IE*
c) Highest *IE*
d) Highest electronegativity

605. In a regular octahedral molecule, MX_6 the number of $X-M-X$ bonds at 180° is
a) Three b) Two c) Six d) Four

606. Valency means:
a) Combining capacity of an element
b) Atomicity of an element
c) Oxidation number of an element
d) None of the above

607. Which does not form two or more chlorides?
a) Na b) Hg c) Cu d) Fe

608. Which has the largest first ionisation energy?
a) Li b) Na c) K d) Rb

609. Polarization of electrons in acrolein may be written as:
a) $\overset{\delta^-}{CH_2}=CH-\overset{\delta^+}{CH}=O$ b) $\overset{\delta^-}{CH_2}=CH-CH=\overset{\delta^+}{O}$ c) $\overset{\delta^-}{CH_2}=\overset{\delta^+}{CH}-CH=O$ d) $\overset{\delta^+}{CH_2}=CH-CH=\overset{\delta^-}{O}$

610. Which bond has the highest bond energy?
a) Coordinate bond b) Sigma bond c) Multiple bond d) Polar covalent bond

611. In which of the following molecules the van der Waals' forces is likely to be the most important in determining the melting and boiling point?
a) CO b) H_2S
c) Br_2 d) HCl

612. The higher values of specific heat of water in comparison to other liquids is due to:
a) High dielectric constant
b) Polarity
c) H-bonding
d) None of the above

613. Which contains both polar and non-polar covalent bonds?
a) NH_4Cl

b) HCN
c) H_2O_2
d) CH_4

614. How many – bonds are present in naphthalene?
a) 4 b) 5 c) 6 d) 7

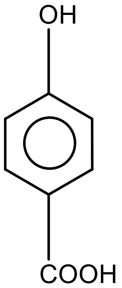
615. If the electron pair forming a bond between two atoms A and B is not in the centre, then the bond is
a) Polar bond b) Single bond c) π-bond d) Non-polar bond

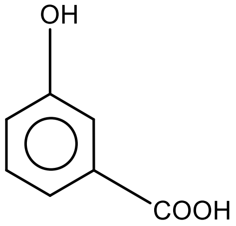
616. Which of the following species in non-linear?
a) ICl_2^- b) I_3^- c) N_3^- d) ClO_2^-

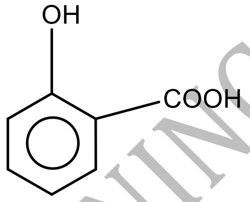
617. The bond order of CO molecule on the basis of molecular orbital theory is:
a) Zero b) 2 c) 3 d) 1

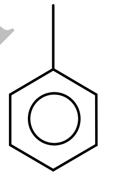
618. Which one is the strongest bond?
a) Cl—F b) F—F c) Br—F d) Br—Cl

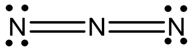
619. Which of the following compound has maximum volatility?

a)


b)


c)


d)


620. In the following electron-dot structure, calculate the formal charge from left to right nitrogen atom;


a) -1, -1, +1 b) -1, +1,-1 c) +1, -1, -1 d) +1, -1, +1

621. Hybridisation shown by carbon and oxygen of – OH group in phenol are respectively
a) sp^2, sp^2 b) sp^3, sp^3 c) sp, sp^2 d) sp^2, sp^3

622. The molecule which has pyramidal shape is:
a) PCl_3 b) SO_3 c) CO_3^{2-} d) NO_3^-

623. The correct increasing bond angles order is:
a) $BF_3 < NF_3 < PF_3 < ClF_3$
b) $ClF_3 < PF_3 < NF_3 < BF_3$
c) $BF_3 \approx NF_3 < PF_3 < ClF_3$
d) $BF_3 < NF_3 < PF_3 > ClF_3$

624. Van der Waals' forces are applied to:
a) Inert gases only
b) Rare gases only
c) Mixture of gases
d) Elementary gases only

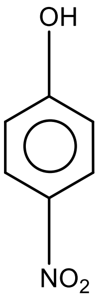
625. Which bond angle results in the minimum dipole moment for the triatomic molecule XY_2 shown below?
a) 90° b) 120° c) 150° d) 180°

626. Which shows the least dipole moment?
a) $CHCl_3$ b) CH_3CH_2OH c) CH_3COCH_3 d) CCl_4

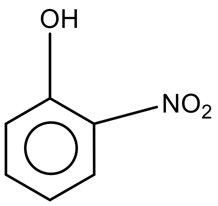
627. Which force is strongest?
a) Dipole-dipole forces
b) Ion-ion forces
c) Ion-dipole forces
d) Ion-induced dipole forces

628. Which molecule has linear structure?
a) CO_2 b) H_2O c) SO_2 d) H_2O_2

629. Out of the compounds below the vapour pressure of (B) at a particular temperature is



(A)



(B)

a) Higher than that of (A)
b) lower than that of (A)
c) Higher or lower than (A), depending on the size of the vessel
d) Same as that of (A)

630. Which ion has a higher polarizing power?
a) Mg^{2+}
b) Al^{3+}
c) Ca^{2+}
d) Na^{+}

631. Which of the following represent the given mode of hybridisation $sp^2 - sp^2 - sp - sp$ from left to right?
a) $H_2C = CH - C \equiv CN$
b) $HC \equiv C - CH_2 - C \equiv CH$
c) $H_2C = C = C = CH_2$
d) $HC = C - CH_2 - C = CH$

632. The solubility of KCl is relatively more in (where D is dielectric constant):
a) $C_6H_6(D = 0)$
b) $(CH_3)_2CO(D = 2)$
c) $CH_3OH(D = 32)$
d) $CCl_4(D = 0)$

633. Elements have electronegativities 1.2 and 3.0, bond formed between them would be
a) Ionic
b) Covalent
c) Co-ordinate
d) metallic

634. Among the following, the pair in which the two species are not isostructural, is
a) SiF_4 and SF_4
b) IO_3^- and XeO_3
c) BH_4^- and NH_4^+
d) PF_6^- and SF_6

635. Which has zero dipole moment?
a) ClF
b) PCl_3
c) SiF_4
d) $CFCl_3$

636. Which of the following molecules is covalent and shows expanded octet in its formation?
a) HF
b) NF_3
c) BF_3
d) ClF_3

637. Which one of the following is a correct set?
a) H_2O, sp^3, angular
b) $BCl_3\ sp^3$, angular
c) NH_4, dsp^2, square planar
d) CH_4, dsp^2, tetrahedral

638. Which property of halogens increases from F to I?
a) Electronegativity
b) First ionization energy
c) Bond length in the molecule
d) None of the above

639. The total number of bonds in acetylene molecule is:
a) One
b) Two
c) Three
d) Five

640. The number of antibonding electron pairs in O_2^{2-} molecular ion on the basis of molecular orbital theory is (Atomic number of O is 18.)
a) 5
b) 4
c) 3
d) 2

641. Variable valency is characteristic of:
a) Noble gases
b) Alkali metals
c) Transition metals
d) Non-metallic elements

642. In which molecule all atoms are coplanar?
a) CH_4
b) BF_3
c) PF_3
d) NH_3

643. During change of O_2 to 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

644. Bond energy of covalent O—H bond in water is:
a) Greater than bond energy of hydrogen bond
b) Equal to bond energy of hydrogen bond
c) Less than bond energy of hydrogen bond
d) None of the above

645. Which one of the following has a coordinate bond?
a) NH_4Cl b) $AlCl_3$ c) NaCl   d) Cl_2

646. Which carbon is more electronegative?
a) sp^3 hybridised carbon
b) sp – hybridised carbon
c) sp^2 hybridised carbon
d) Always same irrespective of its hybrid state

647. Among $NH_3, BeCl_2, CO_2$ and H_2O, the non-linear molecules are:
a) $BeCl_2$ and H_2O b) $BeCl_2$ and CO_2 c) NH_3 and H_2O d) NH_3 and CO_2

648. 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

649. Which molecule has the largest dipole moment?
a) HF   b) HCl   c) HBr   d) HI

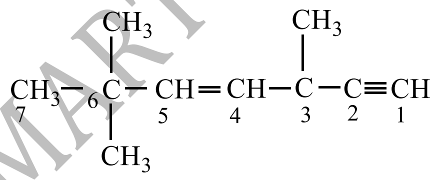
650. The intermolecular attractive forces vary in the order:
a) Water $<$ alcohol $<$ ether
b) Water $>$ alcohol $>$ ether
c) Alcohol $>$ water $<$ ether
d) Ether $>$ water $>$ alcohol

651. Which of the following species has a linear shape?
a) NO_2^+ b) O_3 c) NO_2^- d) SO_2

652. The electronic configuration of 4 elements K, L, M and N are,
$K = 1s^2,\ 2s^2 2p^1$ $L = 1s^2,\ 2s^2 2p^6$
$M = 1s^2,\ 2s^2 2p^4$ $N = 1s^2,\ 2s^2 2p^3$
The element that would form a diatomic molecule with double bond is:
a) K b) L c) M d) N

653. Which of the following will provide the most efficient overlap?
a) $s-s$ b) $s-p$ c) sp^2-sp^2 d) $sp-sp$

654. The state of hybridization of C_2, C_3, C_5 and C_6 of the hydrocarbon,



$$\underset{7}{CH_3}-\underset{6}{\overset{CH_3}{\underset{CH_3}{C}}}-\underset{5}{CH}=\underset{4}{CH}-\underset{3}{\overset{CH_3}{C}}-\underset{2}{C}\equiv\underset{1}{CH}$$

is in the following sequence:
a) sp, sp^2, sp^3 and sp^2 b) sp, sp^3, sp^2 and sp^3 c) sp^3, sp^2, sp^2 and sp d) sp, sp^2, sp^2 and sp^3

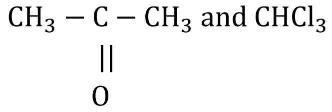
655. Four diatomic species are listed below in different sequences. Which of these represents the correct order of their increasing bond order?
a) $NO < C_2^{2-} < O_2^- < He_2^+$
b) $C_2^{2-} < He_2^+ < NO < O_2^-$
c) $He_2^+ < O_2^- < NO < C_2^{2-}$
d) $O_2^- < NO < C_2^{2-} < He_2^+$

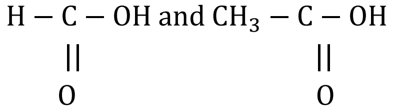
656. Which one species has the longest bond length?

a) NO^+　b) O_2^-　c) O_2^+　d) N_2^+

657. The pair of molecules forming strongest hydrogen bonds are

a) SiH_4 and SiF_6

b) 
$CH_3-\overset{\overset{\large O}{\|}}{C}-CH_3$ and $CHCl_3$

c) 
$H-\overset{\overset{\large O}{\|}}{C}-OH$ and $CH_3-\overset{\overset{\large O}{\|}}{C}-OH$

d) H_2O and H_2

658. Which one of the following has not triangular pyramidal shape?

a) NH_3　b) NCl_3　c) PF_3　d) BCl_3

659. A covalent bond is formed between the atoms by the overlapping of orbitals containing:

a) Single electron
b) Paired electron
c) Single electron with parallel spin
d) Single electron with opposite spin

660. Which of the following bonds required the largest amount of bond energy to dissociate the atom concerned?

a) $H-H$ bond in H_2　b) $O=O$ bond in O_2　c) $N\equiv N$ bond in N_2　d) $C-C$ bond in C_2H_6

661. The covalency of nitrogen in HNO_3 is:

a) Zero
b) 3
c) 4
d) 5

662. Which is distilled first?

a) Liquid H_2　b) Liquid CO_2　c) Liquid O_2　d) Liquid N_2

663. Which one of the following is a correct set?

a) H_2O, sp^3, angular　b) H_2O, sp^2, linear
c) NH_4^+, dsp^2, square planar　d) CH_4, dsp^2, tetrahedral

664. Which is correct order for electron gain enthalpy?

a) $S < O < Cl < F$　b) $O < S < F < Cl$　c) $Cl < F < S < O$　d) $F < Cl < O < S$

665. Which is a pyramidal structure?

a) Trimethylamine　b) Methanol　c) Acetylene　d) Water

666. Among the following mixtures, dipole – dipole as the major interaction, is present in

a) Benzene and ethanol　b) Acetonitrile and acetone
c) KCl and water　d) Benzene and carbon tetrachloride

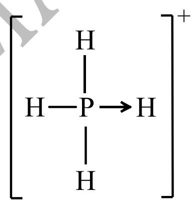
667. In dry ice there are … in between molecules.

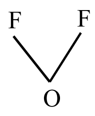
a) Ionic bond　b) Covalent bond　c) Hydrogen bond　d) None of these

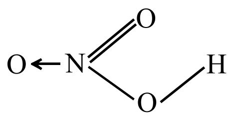
668. The dipole moment of o, p and m-dichlorobenzene will be in the order

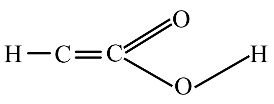
a) $o > p > m$　b) $p > o > m$　c) $m > o > p$　d) $o > m > p$

669. Which formulae does not correctly represents the bonding capacity of the atom involved?

a) 

b) 

c) 

d) 

670. Which has minimum ionic radius?

a) N^{3-}　b) K^+　c) Na^+　d) F^-

671. The bond order is maximum in

a) O_2　b) O_2^+　c) O_2^-　d) O_2^{2-}

672. PF_3 molecule is:

a) Square planar b) Trigonal bipyramidal c) Tetrahedral d) Trigonal pyramidal

673. Resonance is due to:
a) Delocalization of σ-electrons
b) Delocalization of π-electrons
c) Migration of H atoms
d) Migration of protons

674. Which property is commonly exhibited by a covalent compound?
a) High solubility in water
b) Low m.p.
c) High electrical conductivity
d) High b.p.

675. Which of the following is an electrovalent linkage?
a) CH_4 b) $SiCl_4$ c) $MgCl_2$ d) BF_3

676. The decreasing values of bond angles from NH_3 (106°) to SbH_3 (101°) down group-15 of the periodic table is due to:
a) Increasing bp - bp repulsion
b) Increasing p-orbital character in sp^3
c) Decreasing lp - bp repulsion
d) Decreasing electronegativity

677. The shape of ClO_3^- according to VSEPR model is:
a) Planar triangle b) Pyramidal c) Tetrahedral d) Square planar

678. Which metal has a greater tendency to form metal oxide?
a) Cr b) Fe c) Al d) Ca

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

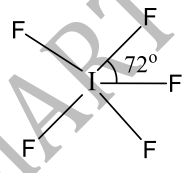
680. A p-block element in which last electron enters into s-orbitals of valence shell instead of p-orbital is:
a) As b) Ga c) No such element exist d) He

681. How many electron pairs are present in valence shell of oxygen in water molecule?
a) 4 b) 1 c) 2 d) 3

682. Number of electrons in a the valence orbit of nitrogen in an ammonia molecule is
a) 8 b) 5 c) 6 d) 7

683. The number of valency electrons in carbon atom is:
a) Zero b) 2 c) 6 d) 4

684. The structure of IF_5 can be best described as

a)


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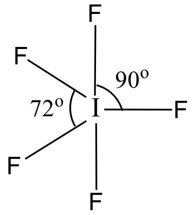
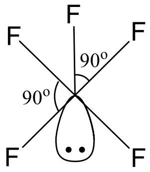


c)


d) None of these

685. The relationship between the dissociation energy and N_2 and N_2^+ is
a) dissociation energy of N_2 = dissociation energy of N_2^+
b) dissociation energy of N_2 can either be lower or higher than the dissociation energy of N_2^+
c) dissociation energy of N_2 > dissociation energy of N_2^+
d) dissociation energy of N_2^+ > dissociation energy of N_2

686. The bond angle in H_2S (for H—S—H)is:
a) Same as that of Cl—Be—Cl in $BeCl_2$
b) Greater than H—N—H bond angle in NH_3
c) Greater than H—Se—H and less than H—O—H

d) Same as Cl—Sn— Cl in $SnCl_2$

687. Which one among the following does not have the hydrogen bond?
a) Phenol b) Water c) Liquid NH_3 d) Liquid HCl

688. Which of the following molecules/ions does not contain unpaired electrons.
a) O_2^{2-} b) B_2 c) N_2^+ d) O_2

689. The $C-O-H$ bond angle in ethanol is nearly
a) 90 b) 104 c) 120 d) 180

690. Which one of the following does not have sp^2 hybridised carbon?
a) Acetone b) Acetic acid c) Acetonitrile d) Acetamide

691. Among the following elements Ca, Mg, P and Cl the order of increasing atomic radius is:
a) $Mg < Ca < Cl < P$ b) $Cl < P < Mg < Ca$ c) $P < Cl < Ca < Mg$ d) $Ca < Mg < P < Cl$

692. Which has a giant covalent structure?
a) PbO_2 b) SiO_2 c) NaCl d) $AlCl_3$

693. Bond angles of NH_3, PH_3, AsH_3 and SbH_3 is in the order
a) $PH_3 > AsH_3 > SbH_3 > NH_3$ b) $SbH_3 > AsH_3 > PH_3 > NH_3$
c) $SbH_3 > AsH_3 > NH_3 > PH_3$ d) $NH_3 > PH_3 > AsH_3 > SbH_3$

694. Amongst the elements with following electronic configurations, which one of them may have the highest ionization energy?
a) $Ne[3s^2 3p^1]$ b) $Ne[3s^2 3p^3]$ c) $Ne[3s^2 3p^2]$ d) $Ar[3d^{10} 4s^2 4p^3]$

695. Based on VSEPR theory, the number of 90 degree $F-Br-F$ angles in BrF_5 is
a) 0 b) 1 c) 2 d) 3

696. Which one of the following elements has lower value of ionisation energy?
a) Mg b) Rb c) Li d) Ca

697. The lattice energy order for lithium halide is:
a) $LiF > LiCl > LiBr > LiI$
b) $LiCl > LiF > LiBr > LiI$
c) $LiBr > LiCl > LiF > LiI$
d) $LiI > LiBr > LiCl > LiF$

698. Among the species: CO_2, CH_3COO^-, CO, CO_3^{2-}, HCHO which has the weakest $C-O$ bond?
a) CO b) CO_2 c) CO_3^{2-} d) CH_3COO^-

699. Peroxide ion
(i) has five completely filled antibonding molecular orbitals
(ii) is diamagnetic
(iii) has bond order one
(iv) is isoelectronic with neon
Which one of these is correct?
a) (ii) and (iii) b) (i),(ii) and (iv) c) (i),(ii) and (iii) d) (i) and (iv)

700. Which is the weakest among the following type of bond?
a) Ionic bond b) Covalent bond c) Metallic bond d) Hydrogen bond

701. In which of the following pairs of molecules/ions, the central atom has sp^2-hybridization?
a) NO_2 and NH_3 b) BF_3 and NO_2^- c) NH_2^- and H_2O d) BF_3 and NH_2^-

702. Bond length decreases with:
a) Decrease in size of the atom
b) Increase in the number of bonds between the atoms
c) Decrease in bond order
d) Decrease in the number of bonds between the atoms

703. Which of the following molecules/ ions does not contain unpaired electrons?
a) O_2^{2-} b) B_2 c) N_2^+ d) O_2

704. The structure of IF_7 is
a) Square pyramid b) Trigonal bipyramid

c) Octahedral d) Pentagonal bipyramid

705. The species C_2

a) Has one σ bond and one π bond b) Has both π bonds

c) Has both σ bonds d) Does not exist

706. In which of the following bond angle is maximum?

a) NH_3 b) NH_4^+ c) PCl_5 d) SCl_2

707. Oxidising power of chlorine in aqueous solution can be determined by the parameters indicated below

$\frac{1}{2}Cl_2(g) \xrightarrow{\frac{1}{2}\Delta_{diss}H^\circ} Cl(g) \xrightarrow{\Delta_{EA}H^\circ} Cl^-(g) \xrightarrow{\Delta_{hyd}H^\circ} Cl^-(aq)$

The energy involved in the conversion of $\frac{1}{2}Cl_2(g)$ to $Cl^-(aq)$(Using the data)

$\Delta_{diss^{H^\circ}Cl_2} = 240\ kJ\ mol^{-1}$

$\Delta_{EA^{H^\circ}Cl} = -349\ kJ\ mol^{-1}$

$\Delta_{hyd\ H^\circ}Cl = -381\ kJ\ mol^{-1}$ will be

a) $+152\ kJ\ mol^{-1}$ b) $-610\ kJ\ mol^{-1}$ c) $-850\ kJ\ mol^{-1}$ d) $+120\ kJ\ mol^{-1}$

708. The hybridisation of the *ipso* – carbon dichlorobenzene is

a) sp hybridized b) sp^2 hybridised c) $sp^2\ d$ hybridized d) sp^3 hybridised

709. Which of the following has maximum dipole moment?

a) NCl_3 b) NBr_3 c) NH_3 d) NI_3

710. The molecule having largest dipole moment among the following is

a) CHI_3 b) CH_4 c) $CHCl_3$ d) CCl_4

711. Which of the following diatomic molecules would be stabilized by the removal of an electron?

a) C_2 b) CN c) N_2 d) O_2

712. Which of the following possess maximum hydration energy?

a) $MgSO_4$ b) $RaSO_4$ c) $SrSO_4$ d) $BaSO_4$

713. In which of the following hydrogen bond is present?

a) H_2 b) Ice c) Sulphur d) Hydrocarbon

714. The correct order of decreasing polarisability of ion is:

a) Cl^-, Br^-, I^-, F^- b) F^-, I^-, Br^-, Cl^- c) I^-, Br^-, Cl^-, F^- d) F^-, Cl^-, Br^-, I^-

715. Which is highest melting point halide?

a) NaCl b) NaBr c) NaF d) NaI

716. Number of σ and π bonds in acetylene are

a) 3 and 2 b) 2 and 2 c) 2 and 3 d) 4 and 3

717. Which of the following halides is least stable and has doubtful existence?

a) CI_4 b) GeI_4 c) SnI_4 d) PbI_4

718. $C - C$ bond length is maximum in

a) Diamond b) Graphite c) Naphthalene d) Fullerene

719. The electronegativity difference between N and F is greater than that between N and H yet the dipole moment of NH_3 (1.5 D) is larger than that of NF_3 (0.2D). This is because:

a) In NH_3 as well as NF_3 the atomic dipole and bond dipole are in opposite directions.

b) In NH_3 the atomic dipole and bond dipole are in the opposite directions whereas in NF_3 these are in the same direction.

c) In NH_3 as well as in NF_3 the atomic dipole and bond dipole are in the same direction.

d) In NH_3 the atomic dipole and bond dipole are in the same direction whereas in NF_3 these are in opposite directions.

720. Resonance is not shown by:

a) C_6H_6 b) CO_2 c) CO_3^{2-} d) SiO_2

721. The molecular shapes of SF_4, CF_4 and XeF_4 are

a) Different with 1, 0 and 2 lone pairs of electrons on the central atom, respectively

b) Different with 0, 1 and 2 lone pairs of electrons on the central atom, respectively

c) The same with 1, 1 and 1 lone pairs of electrons on the central atoms, respectively
d) The same with 2, 0 and 1 lone pairs of electrons on the central atom, respectively

722. The shape of IF_7 molecule is
a) Pentagonal bipyramidal
b) Trigonal bipyramidal
c) Tetrahedral
d) Octahedral

723. Decreasing order of C – C bond length is
(I)C_2H_4 (II)C_2H_2
(III)C_6H_6 (IV)C_2H_6
a) $IV > III > I > II$
b) $I > II > IV > III$
c) $II > I > IV > III$
d) $IV > I > III > II$

724. In which of the following compounds, the bonds have the largest percentage of ionic character:
a) H_2O
b) HF
c) IBr
d) N_2O_4

725. Oxygen and sulphur both are the member of same group in Periodic Table but H_2O is liquid while H_2S is gas because
a) Molecular weight of water is more
b) Electronegativity of sulphur is more
c) H_2S is weak acid
d) Water molecules are having strong hydrogen bonds between them

726. The linear structure is possessed by:
a) $SnCl_2$
b) NCO^-
c) NO_2^+
d) CS_2

727. When the hybridization state of carbon atom changes from sp^3 to sp^2 and finally to sp, the angle between the hybridized orbitals:
a) Decreases gradually
b) Decreases considerably
c) Is not affected
d) Increases progressively

728. Which species has the maximum number of lone pair of electrons on the central atom?
a) $[ClO_3^-]$
b) XeF_4
c) SF_4
d) $[I_3^-]$

729. Which concept best explains that o-nitrophenol is more volatile than p-nitrophenol?
a) Resonance
b) Steric hinderance
c) Hydrogen bond
d) Hyperconjugation

730. How many bonded electron pairs are present in IF_7 molecule?
a) 6
b) 7
c) 5
d) 8

731. The comparatively high b.p. of HF is due to
a) High reactivity of fluorine
b) Small size of hydrogen atom
c) Formation of hydrogen bonds and consequent association
d) High IE of fluroine

732. Which one of the following species is diamagnetic in nature?
a) H_2^-
b) H_2^+
c) H_2
d) He_2^+

733. The unequal sharing of bonded pair of electrons between two atoms in a molecule gives rise to:
a) Ionic bond
b) Polar covalent bond
c) Non-polar covalent bond
d) None of the above

734. In which of the following process energy is liberated?
a) $Cl \longrightarrow Cl^+ + e$
b) $HCl \longrightarrow H^+ + Cl^-$
c) $Cl + e \longrightarrow Cl^-$
d) $O^- + e \longrightarrow O^{2-}$

735. Identify the least stable ion amongst the following:
a) Li^-
b) Be^-
c) B^-
d) C^-

736. The lowest bond energy exist in the following bonds for:
a) C—C b) N—N c) H—H d) O—O

737. Number of lone pair (s) in $XeOF_4$ is/are
a) 0 b) 1 c) 2 d) 3

738. Which one is electron deficient compound?
a) NH_3 b) ICl c) BCl_3 d) PCl_3

739. Which type of bond is present in H_2S molecule?
a) Ionic bond b) Covalent bond
c) Coordinate d) All of three

740. In compound X, all the bond angles are exactly 109°28′ , X is:
a) Chloromethane b) Iodoform c) Carbon tetrachloride d) Chloroform

741. The hybridisation of P in PCl_5 is
a) sp^2 b) sp^3d c) sp^3 d) dsp^2

742. Pauling's electronegativity values for elements are useful in predicting:
a) Polarity of bonds in molecules
b) Position of elements in electromotive series
c) Coordination number
d) Dipole moment of various molecules

743. The hybridization of carbon atoms in C—C single bond of $HC{\equiv}C{—}CH{=}CH_2$ is:
a) $sp^3{-}sp^3$ b) $sp^2{-}sp^3$ c) $sp{-}sp^2$ d) $sp^3{-}sp$

744. It is thought that atoms combine with each other such that the outermost orbit acquires a stable configuration of 8 electrons. If stability were attained with 6 electrons rather than with 8, what would be the formula of the stable fluoride ions?
a) F^{3+} b) F^+ c) F^- d) F^{2-}

745. The number of antibonding electrons pairs in O_2^{2-} on the basis of MO theory are:
a) 4 b) 3 c) 2 d) 5

746. Which has triangular planar shape?
a) CH_3^+ b) ClO_2^- c) H_3O^+ d) ClO_3^-

747. Specify the coordination geometry around and hybridization of N and B atoms in a 1:1 complex of BF_3 and NH_3:
a) N : tetrahedral, sp^3 ; B : tetrahedral, sp^3
b) N : pyramidal, sp^3 ; B : pyramidal, sp^3
c) N : pyramidal, sp^3 ; B : planar, sp^2
d) N : pyramidal, sp^3 ; B : tetrahedral, sp^3

748. Which of the following molecule has highest bond energy?
a) C − C b) N − N c) O − O d) F − F

749. The number of oxygen atoms bonded to one phosphorus atom in P_4O_6 is
a) 4 b) 3 c) 6 d) 5

750. Bond energies in NO,NO^+ and NO^- are such as
a) $NO^- > NO > NO^+$ b) $NO^+ > NO^- > NO$ c) $NO > NO^- > NO^+$ d) $NO^+ > NO > NO^-$

751. In XeF_6, oxidation state and state of hybridisation of Xe and shape of the molecule are, respectively
a) $+6, sp^3\,d^3$, distorted octahedral b) $+4, sp^3\,d^2$, square planar
c) $+6, sp^3$, pyramidal d) $+6, sp^3d^2$, square pyramidal

752. Which one of the following pairs of species have the same bond order?
a) CN^- and NO^+ b) CN^- and CN^+ c) O_2^- and CN^- d) NO^+ and CO

753. The bond length of species $O_2, O_2^+$and O_2^- are in the order of
a) $O_2^+ > O_2 > O_2^-$ b) $O_2^- > O_2 > O_2^+$ c) $O_2 > O_2^+ > O_2^-$ d) $O_2 > O_2^- > O_2^+$

754. Which hybridization results non-polar orbitals?
a) sp b) sp^2 c) sp^3 d) dsp^2

755. The d-orbital involed in sp^3d hybridization is

a) $d_{x^2-y^2}$ b) d_{xy} c) d_{z^2} d) d_{zx}

756. The element with strong electropositive nature is:
a) Cu b) Cs c) Cr d) Ba

757. Which statement is correct?
a) X^+ ion is larger than X^- ion
b) X^- ion is larger in size than X atom
c) X^+ and X^- have the same size
d) X^+ ion is larger in size than X atom

758. SF_2, SF_4 and SF_6 have the hybridisations at sulphur atom respectively, as
a) sp^2, sp^3, sp^2d^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

759. Solid CH_4 is:
a) Molecular solid b) Ionic solid c) Covalent solid d) Not exist

760. The bond angles of NH_3, NH_4^+ and NH_2^- are in the order
a) $NH_2^- > NH_3 > NH_4^+$ b) $NH_4^+ > NH_3 > NH_2^-$ c) $NH_3 > NH_2^- > NH_4^+$ d) $NH > NH_4^+ > NH_2^-$

761. sp^2-hybridization is shown by:
a) $BeCl_2$ b) BF_3 c) NH_3 d) XeF_2

762. $Cl - P - Cl$ bond angles in PCl_5 molecule are
a) 120 and 90 b) 60 and 90 c) 60 and 120 d) 120 and 30

763. Which one of the following pairs is isostructural (*i.e.*, having the same shape and hybridization)?
a) [NF_3 and BF_3] b) [BF_4^- and NH_4^+] c) [BCl_3 and $BrCl_3$] d) [NH_3 and NO_3^-]

764. Which one of the following sets of ions represents a collection of isoelectronic species?
a) $K^+, Cl^-, Ca^{2+}, Sc^{3+}$ b) $Ba^{2+}, Sr^{2+}, K^+, Ca^{2+}$ c) $N^{3-}, O^{2-}, F^-, S^{2-}$ d) $Li^+, Na^+, Mg^{2+}, Ca^{2+}$

765. Which molecule has zero dipole-moment?
a) HF b) HBr c) H_2O d) CO_2

766. Four diatomic species are listed below. Identify the correct order in which the bond order is increasing in them:
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) $He_2^+ < O_2^- < NO < C_2^{2-}$

767. Which one of the following compounds has bond angle as nearly 90°?
a) NH_3 b) H_2S c) H_2O d) CH_4

768. The hybrid state of sulphur in SO_3 molecule is
a) sp^3d b) sp^3 c) sp^3d^2 d) sp^2

769. In which of the following pair both molecules do not possess same type of hybridisation?
a) CH_4 and H_2O b) PCl_5 and SF_4 c) SF_6 and XeF_4 d) BCl_3 and NCl_3

770. Which is the most covalent?
a) $C - F$ b) $C - O$ c) $C - S$ d) $C - Br$

771. The shape of NO_3^- is planar. It is formed by the overlapping of oxygen orbitals with … orbitals of nitrogen.
a) sp^3-hybridized b) sp^2-hybridized c) Three p-orbitals d) None of these

772. Which of the ions has the largest ionic radius?
a) Be^{2+} b) Mg^{2+} c) Ca^{2+} d) Sr^{2+}

773. A σ-bonded molecule MX_3 is T-shaped. The number non-bonding pairs of electron is
a) 0
b) 2
c) 1
d) Can be predicted only if atomic number of M is known

774. Which of the following is not isoelectronic?
a) NO^- b) CN^- c) N_2 d) O_2^{2+}

775. In which set of molecules are all the species paramagnetic?

a) B_2, O_2, N_2 b) B_2, O_2, NO c) B_2, F_2, O_2 d) B_2, O_2, Li_2

776. Which of the following has strongest hydrogen bonding?
a) Ethylamine b) Ammonia c) Ethyl Alcohol d) Diethyl ether

777. The bonds present in N_2O_5 are:
a) Ionic
b) Covalent and coordinate
c) Covalent
d) Ionic and covalent

778. The angle between two covalent bonds is maximum in:
a) CH_4 b) H_2O c) CO_2 d) SO_3

779. 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

780. In the electronic structure of acetic acid there are:
a) 16 shared and 8 unshared valency electrons
b) 8 shared and 16 unshared valency electrons
c) 12 shared and 12 unshared valency electrons
d) 18 shared and 6 unshared valency electrons

781. Increasing order (lower first) of size of the various hybridised orbitals is:
a) sp, sp^2, sp^3 b) sp^3, sp^2, sp c) sp^2, sp^3, sp d) sp^2, sp, sp^3

782. Among the following, the compound that contains ionic, covalent and coordinate linkage is
a) NH_3 b) NH_4Cl c) NaCl d) CaO

783. How many bridging oxygen atoms are present in P_4O_{10}?
a) 6 b) 4 c) 2 d) 5

784. Consider the Born-Haber cycle for the formation of an ionic compound given below and identify the compound (Z) formed.

$$\begin{bmatrix} M(s) \xrightarrow{\Delta H_1} M(\mathrm{g}) \xrightarrow{\Delta H_2} M^+(\mathrm{g}) \\ \frac{1}{2}X_2(\mathrm{g}) \xrightarrow{\Delta H_3} X(\mathrm{g}) \xrightarrow{\Delta H_4} X^-(\mathrm{g}) \end{bmatrix} \xrightarrow{\Delta H_5} Z$$

a) M^+X^- b) $M^+X^-(s)$ c) MX d) $M^+X^-(\mathrm{g})$

785. The bond length is maximum in:
a) H_2S b) HF c) H_2O d) Ice

786. N_2 and O_2 are converted into monocations, N_2^+ and O_2^+ respectively. Which of the following is wrong?
a) In N_2^+, N − N bond weakens b) In O_2^+, the O − O bond order increases
c) In O_2^+, paramagnetism decreases d) N_2^+ become diamagnetic

787. The number of nodal planes present in $\overset{*}{\sigma}$ s-antibonding orbitals is
a) 1 b) 2 c) 0 d) 3

788. Which of the following has maximum number of lone pairs associated with Xe?
a) XeO_3 b) XeF_4 c) XeF_6 d) XeF_2

789. Which is most volatile compound?
a) HI b) HCl c) HBr d) HF

790. The calculated bond order in O_2^- ion is
a) 1 b) 1.5 c) 2 d) 2.5

791. A C ≡ C bond is:
a) Weaker than C=C bond
b) Weaker than C—C bond
c) Longer than C—C bond
d) Shorter than C=C bond

792. In which of the following pairs bond angle is 109°28′ ?
a) $[NH_4^+], [BF_4^-]$ b) $[NH_4^+], [BF_3]$ c) $[NH_3], [BF_4^-]$ d) $[NH_3], [BF_3]$

793. Which of the following molecules has three-fold axis of symmetry?

a) NH_3 b) C_2H_4 c) CO_2 d) SO_2

794. In which of the following arrangements the sequence is not strictly according to the property written against it?

a) $HF < HCl < HBr < HI$: increasing acid strength

b) $NH_3 < PH_3 < AsH_3 < SbH_3$: increasing basic strength

c) $B < C < O < N$: increasing first ionization enthalpy

d) $CO_2 < SiO_2 < SnO_2 < PbO_2$:increasing oxidising power

795. Which one of the following is paramagnetic?

a) N_2 b) NO c) CO d) O_3

796. Which of the following has largest ionic radius?

a) Na^+ b) K^+ c) Li^+ d) Cs^+

797. Lattice energy of a solid increases if

a) Size of ions is small b) Charges of ions are small

c) Ions are neutral d) None of the above

798. Which one is most polar?

a) CCl_4 b) $CHCl_3$ c) CH_3Cl d) CH_3OH

799. The high boiling point of water is due to:

a) Weak dissociation of water molecules

b) Hydrogen bonding among water molecules

c) Its high specific heat

d) Its high dielectric constant

800. The states of hybridisation of boron and oxygen atoms in boric acid (H_3BO_3) are respectively

a) sp^2 and sp^2 b) sp^2 and sp^3 c) sp^3 and sp^2 d) sp^3 and sp^3

801. In which pair of species, both species do have the similar geometry?

a) CO_2, SO_2 b) NH_3, BH_3 c) CO_3^{2-}, SO_3^{2-} d) SO_4^{2-}, ClO_4^-

802. Which of the following is largest ion?

a) Na^+ b) Mg^{2+} c) O^{2-} d) F^-

803. The electronic configuration of sodium and chlorine justifies:

a) Their physical state

b) Their reactivity

c) The formation of electrovalent compound NaCl

d) None of the above

804. sp^3 hybridisation is found in

a) $\overset{+}{C}H_3$ b) $:\overset{-}{C}H_3$ c) ClO_3^- d) SO_3

805. Glycerol is more viscous than ethanol due to

a) High molecular weight b) High boiling point

c) Many hydrogen bonds per molecule d) Fajan's rule

806. In the case of alkali metals, the covalent character decreases in the order:

a) $MI > MBr > MCl > MF$

b) $MCl > MI > MBr > MF$

c) $MF > MCl > MBr > MI$

d) $MF > MCl > MI > MBr$

807. Two nodal planes are present in

a) $\overset{*}{\pi}2p_x$ b) $\sigma 2p_z$ c) $\pi 2p_x$ d) $\pi 2p_y$

808. H – bond is not present in

a) Water b) Glycerol

c) Hydrogen fluoride d) Hydrogen sulphide

809. In which of the following pairs molecules have bond order three and are isoelectronic?

a) CN^-, CO b) CO, O_2^+ c) NO^+, CO^+ d) CN^-, O_2^+

810. Which of the following halides has maximum melting point?

a) NaF b) NaCl c) NaBr d) NaI

811. Which atomic orbital is always involved in sigma bonding only?

a) s b) p c) d d) f

812. Which of the following acts sometimes as a metal and sometimes as a non-metal?

a) Hg b) Cl c) K d) At

813. Amongst the following elements the configuration having the highest ionization energy is:

a) $[\mathrm{Ne}]3s^2 3p^1$ b) $[\mathrm{Ne}]3s^2 3p^3$ c) $[\mathrm{Ne}]3s^2 3p^2$ d) $[\mathrm{Ar}]3d^{10} 4s^2 4p^3$

814. Which of the following species exhibits the diamagnetic behaviour ?

a) O_2^{2-} b) O_2^+ c) O_2 d) NO

815. Which is a good solvent for ionic and polar covalent compounds?

a) H_2O b) CH_3COOH c) CCl_4 d) Liquid NH_3

816. The following salt shows maximum covalent character

a) $AlCl_3$ b) $MgCl_2$ c) CsCl d) $LaCl_3$

817. Each of the followings has non-zero dipole moment, except:

a) C_6H_6 b) CO c) SO_2 d) NH_3

818. Bonded electron pairs present in octahedral SF_6 molecule:

a) 3 b) 4 c) 6 d) 5

819. Resonance structures can be written for

a) O_3 b) NH_3 c) CH_4 d) H_2O

820. Born-Haber cycle may be used to calculate

a) Electronegativity b) Mass number c) Oxidation number d) Electron affinity

821. The electronic structure of four elements A, B, C, D are

$(A) 1s^2$ $(B) 1s^2, 2s^2, 2p^2$

$(C) 1s^2, 2s^2, 2p^5$ $(D) 1s^2, 2s^2, 2p^6$

The tendency to form electrovalent bond is largest in

a) A b) B c) C d) D

822. In which element shielding effect is not possible?

a) H b) Be c) B d) N

823. 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

824. Which of the following is isoelectronic with carbon atom?

a) Na^+ b) Al^{3+} c) O^{2-} d) N^+

825. Which of the following statement is correct?

a) Polarization of an anion is maximum by high charged cation

b) Small sized cation minimises the polarization

c) A small anion brings about a large degree of polarisation

d) A small anion undergoes a high degree of polarization

826. Among LiCl, $BeCl_2$, BCl_3 and CCl_4, the covalent bond character follows the order:

a) $LiCl > BeCl_2 > BCl_3 > CCl_4$

b) $LiCl < BeCl_2 < BCl_3 < CCl_4$

c) $LiCl > BeCl_2 > CCl_4 > BCl_3$

d) $LiCl < BeCl_2 < BCl_3 > CCl_4$

827. The value of bond order in nitrogen and oxygen molecule is:

a) 3, 2 b) 4, 2 c) 2, 3 d) 1, 2

828. Pauling received Nobel Prize for his work on:

a) Photosynthesis b) Atomic structure c) Chemical bonding d) Thermodynamics

829. With which of 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

830. The enhanced force of cohesion in metals is due to:

a) The covalent linkages between atoms
b) The electrovalent linkages between atoms
c) The lack of exchange of valency electrons
d) The exchange energy of mobile electrons

831. Among HX, the maximum dipole moment is of:
a) HF b) HCl c) HBr d) HI

832. Dative bond is present in:
a) SO_3 b) NH_3 c) $BaCl_2$ d) BF_3

833. In which of the following molecule, the central atom does not have sp^3-hybridization?
a) CH_4 b) SF_4 c) BF_4^- d) NH_4^+

834. Which has an odd electron and shows paramagnetic character?
a) NO b) SO_2 c) CO_2 d) H_2O

835. Which ion is not isoelectronic with O^{2-}?
a) N^{3-} b) Na^+ c) F^- d) Ti^+

836. Which species is paramagnetic?
a) O_2^- b) CH_3^- c) CO d) NO^+

837. Structure of ammonia is
a) Pyramidal b) Tetrahedral c) Trigonal d) Trigonal pyramidal

838. The example of the p-p-orbital overlapping is the formation of:
a) H_2 molecule
b) Cl_2 molecule
c) Hydrogen chloride
d) Hydrogen bromide molecule

839. In which of the following $p\pi$ - $d\pi$ bonding is observed?
a) NO_3^- b) SO_3^{2-} c) BO_3^{3-} d) CO_3^{2-}

840. The shape of ClO_4^- ion is:
a) Square planar b) Square pyramidal c) Tetrahedral d) Trigonal bipyramidal

841. The critical temperature of water is higher than that of O_2 because H_2O molecule has:
a) Fewer electrons than O_2
b) Two covalent bonds
c) V-shape
d) Dipole moment

842. Compound formed by sp^3d-hybridization will have structure:
a) Trigonal bipyramidal
b) T-shaped
c) Linear
d) Either of these depending on number of lone pair of electrons of central atom

843. Which has the lowest bond angle?
a) NH_3 b) BeF_2 c) H_3O^+ d) CH_4

844. Assuming that Hund's rule is violated, the bond order and magnetic nature of the diatomic molecule B_2 is
a) 1 and diamagnetic
b) 0 and diamagnetic
c) 1 and paramagnetic
d) 0 and paramagnetic

845. The energy of antibonding molecular orbitals is:
a) Greater than the bonding M.O.
b) Smaller than the bonding M.O.
c) Equal to that of bonding M.O.
d) None of the above

846. The set representing the correct order of ionic radius is:

a) $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$
b) $Li^+ > Na^+ > Mg^{2+} > Be^{2+}$
c) $Mg^{2+} > Be^{2+} > Li^+ > Na^+$
d) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$

847. Which of the following hydrogen bonds is the strongest?
a) O——H-----N   b) F——H-----F   c) O——H-----O   d) O——H-----F

848. H_2O is dipolar, whereas BeF_2 is not. It is because
a) The electronegativity of F is greater than that of O
b) H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule
c) H_2O is linear and BeF_2 is angular
d) H_2O is angular and BeF_2 is linear

849. Which of the following statements is most correct? Effective nuclear charge of an atom depends on:
a) The atomic number of the atom
b) The charge on the ion
c) The shielding effect
d) Both the actual nuclear charge and the shielding effect

850. The total number of valency electrons in PH_4^+ ion is:
a) 8   b) 9   c) 6   d) 14

851. Phosphoric acid is syrupy in nature due to
a) Strong covalent bonding   b) Hydrogen bonding
c) van der Waals' forces   d) None of the above

852. The correct order of bond angles is:
a) $H_2S < NH_3 < BF_3 < SiH_4$
b) $NH_3 < H_2S < SiH_4 < BF_3$
c) $H_2S < NH_3 < SiH_4 < BF_3$
d) $H_2S < SiH_4 < NH_3 < BF_3$

853. Metallic lusture is explained by
a) Diffusion of metal ions   b) Oscillation of loose electrons
c) Excitation of free protons   d) Existence of bcc lattice

854. Which of the following phenomenon will occur when two atoms of same spin will react?
a) Bonding will not occur
b) Orbital overlap will not occur
c) Both (a) and (b)
d) None of the above

855. The hybrid state of S in SO_3 is similar to that of
a) C in C_2H_2 b) C in C_2H_4 c) C in CH_4 d) C in CO_2

856. Among the following the pair in which the two species are not isostructural is
a) IO_3^- and XeO_3 b) PF_6^- and SF_6 c) BH_4^- and NH_4^+ d) SiF_4 and SF_4

857. Which of the following species contains three bond pairs and one lone pair around the central atom?
a) NH_2^- b) PCl_3 c) H_2O d) BF_3

858. Intramolecular hydrogen bonding is found in:
a) Salicyldehyde   b) Water   c) Acetaldehyde   d) Phenol

859. The type of bond formed between H^+ and NH_3 in NH_4^+ ion is:
a) Ionic   b) Covalent   c) Dative   d) Hydrogen

860. Which of the following statements is correct about N_2 molecule?
a) It has a bond order of 3   b) The number of unpaired electrons present in it is zero and hence, it is diamagnetic
c) The order of filling of MOs is $\pi(2p_x) = \pi(2p_y), \sigma(2p_z)$ d) All the above three statements are correct

861. Ice has an open structure compared to water due to which it floats on water and occupies a greater volume

of space. The open structure of ice is due to:
a) Solid state of ice b) Its low density c) Crystalline nature d) Hydrogen bonding

862. Which of the following has minimum melting point?
a) CsF b) HCl c) HF d) LiF

863. Geometry of ammonia molecule and the hybridisation of nitrogen involved in it are
a) sp^3 hyridisation and tetrahedral geometry
b) sp^3 hyridisation and distorted tetrahedral geometry
c) sp^2 hyridisation and triangular geometry
d) None of the above

864. The molecule having smallest bond angle is
a) H_2O b) H_2S c) NH_3 d) H_2Te

865. For a covalent solid, the units which occupy lattice points are:
a) Atoms b) Ions c) Molecules d) Electrons

866. Carbon suboxide (C_3O_2) has recently been shown as a component of the atmosphere of Venus. Which of the following formulation raepresents the correct ground state Lewis structure for carbon suboxide?
a) :O:C::C:C:O: b) :O::C::C:C::O: c) : Ö::C::C::C:: Ö: d) :O: C: C: C: O:

867. The ionization energy will be maximum for the process:
a) $Ba \longrightarrow Ba^{2+}$ b) $Be \longrightarrow Be^{2+}$ c) $Cs \longrightarrow Cs^{+}$ d) $Li \longrightarrow Li^{+}$

868. Born Haber cycle is used to determine:
a) Lattice energy b) Electron affinity c) Ionization energy d) Either of them

869. In which of the following molecules/ions BF_3, NO_2^-, NH_2^-, and H_2O the central atom is sp^2 hybridized?
a) BF_3 and NO_2^- b) NO_2^- and NH_2^- c) NH_2^- and H_2O d) NO_2^- and H_2O

870. $sp^3\,d$ hybridisation results in
a) A square planar molecule b) An octahedron molecule
c) A trigonal bipyramidal molecule d) A tetrahedron molecule

871. In the electronic structure of H_2SO_4, the total number of unshared electrons is
a) 20 b) 16 c) 12 d) 8

872. Which of the following element has higher ionisation energy?
a) Boron b) Carbon c) Oxygen d) Nitrogen

873. The bond length of HCl molecule is 1.275 Å and its dipole moment is 1.03 D. The ionic character of the molecule (in per cent) (charge of the electron$= 4.8 \times 10^{-10}$ esu) is
a) 100 b) 67.3 c) 33.66 d) 16.83

874. In a double bond connecting two atoms there is a sharing of:
a) 2 electrons b) 4 electrons c) 1 electron d) All electrons

875. Number of P – O bonds in $P_4O_{10}$is
a) 17 b) 16 c) 15 d) 6

876. Elements whose electronegativities are 1.2 and 3.0 form:
a) Ionic bond b) Covalent bond c) Coordinate bond d) Metallic bond

877. Which of the following is correct?
a) Decreases in bond length means increase in bond strength
b) Covalent radius of carbon is less than that of nitrogen
c) Single bonds are stronger than double bonds
d) Fe (III) chloride cannot exist in the dimeric form Fe_2Cl_6

878. Which of the following is a favourable factor for cation formation?
a) Low ionisation potential b) High electron affinity
c) High electronegativity d) Small atomic size

879. A number of ionic compounds, e.g., AgCl, CaF_2, $BaSO_4$ are insoluble in water. This is because:
a) Ionic compounds do not dissolve in water
b) Water has a high dielectric constant
c) Water is not a good ionizing solvent

d) These molecules have exceptionally high attractive forces in their lattice

880. Ionisation potential values of 'd' block elements as compared to ionisation potential values of 'f' block elements are:

a) Higher b) Lower c) Equal d) Either of these

881. When a metal atom combines with a non-metal atom, the non-metal atom will

a) Lose electrons and decrease in size
b) Lose electrons and increase in size
c) Gain electrons and decrease in size
d) Gain electrons and increase in size

882. The hydration of ionic compounds involves:

a) Evolution of heat
b) Weakening of attractive forces
c) Dissociation into ions
d) All of the above

883. Which of the following is diamagnetic?

a) H_2^+ b) O_2 c) Li_2 d) Fe_2^+

884. Molecular orbital electronic configuration for 'X' anion is

$$KK(\sigma 2s)^2(\overset{*}{\sigma}2s)^2(\pi 2p_x)^2(\pi 2p_y)^2(\sigma 2p_z)^2(\overset{*}{\pi}2p_x)^1.$$

The anion 'X' is

a) N_2^- b) O_2^- c) N_2^{2-} d) O_2^{2-}

885. According to Fajan's rule polarization is more when:

a) Small cation and large anion
b) Small cation and small anion
c) Large cation and large anion
d) Large cation and small anion

886. Organic compounds soluble in water contain:

a) C, H. Cl b) C, H c) C, H, O d) C, S

887. Atomic radii of fluorine and neon in angstrom unit are respectively given by:

a) 0.72, 1.60 b) 1.60, 1.60 c) 0.72, 0.72 d) 1.60, 0.72

888. The decreasing order of bond angle is

a) $NO_2 > NO_2^+ > NO_2^-$ b) $NO_2^- > NO_2 > NO_2^+$
c) $NO_2^+ > NO_2 > NO_2^-$ d) $NO_2^+ > NO_2^- > NO_2$

889. The correct order of dipole moment is:

a) $CH_4 < NF_3 < NH_3 < H_2O$
b) $NF_3 < CH_4 < NH_3 < H_2O$
c) $NH_3 < NF_3 < CH_4 < H_2O$
d) $H_2O < NH_3 < NF_3 < CH_4$

890. Which oxide of nitrogen is isoelectronic with CO_2?

a) NO_2 b) N_2O c) NO d) N_2O_2

891. Which of the following molecules does not possess a permanent electric dipole moment?

a) H_2S
b) SO_2
c) SO_3
d) CS_2

892. Among O, C, F, Cl, Br the correct order of increasing atomic radii is:

a) F < O < C < Cl < Br b) F < C < O < Br < Cl c) F < Cl < Br < O < C d) C < O < F < Cl < Br

893. In which of the following diatomic molecules /ions is the bond order of each molecule/ion = 2.5?

a) O_2^+, NO, CN^- b) CN^-, N_2^+, N_2 c) N_2^+, NO, O_2^+ d) O_2^+, CN^-, N_2^+

894. What type of hybridisation takes place in the N atom of NH_3 ?

a) sp^2 b) sp^3 c) dsp^2 d) sp

895. Identify the correct order of solubility of Na_2S, CuS and ZnS in aqueous medium:
a) $CuS > ZnS > Na_2S$ b) $ZnS > Na_2S > CuS$ c) $Na_2S > CuS > ZnS$ d) $Na_2S > ZnS > CuS$

896. In the following molecule, the two carbon atoms marked by asterisk (*) possess the following type of hybridized orbitals:

$$H_3C-\overset{*}{C}\equiv\overset{*}{C}-CH_3$$

a) sp^3-orbital b) sp^2-orbital c) sp-orbital d) s-orbital

897. Debye an unit of dipole moment is of the order of:
a) 10^{-10} esu cm b) 10^{-18} esu cm c) 10^{-6} esu cm d) 10^{-12} esu cm

898. Which of the following is a favourable factor for cation formation?
a) High electronegativity b) High electron affinity
c) Low ionisation potential d) Smaller atomic size

899. The paramagnetic molecule at ground state among the following is
a) H_2 b) O_2 c) N_2 d) CO

900. The bond in the formation of fluorine molecule will be
a) Due to $s-s$ overlapping b) Due to $s-p$overlapping
c) Due to $p-p$ overlapping d) Due to hybridisation

901. The diamagnetic molecules are:
a) B_2, C_2, N_2 b) O_2, N_2, F_2 c) C_2, N_2, F_2 d) B_2, O_2, N_2

902. The IP_1 is maximum for:
a) K b) Na c) Be d) He

903. In the transition of Cu to Cu^{2+}, there is a decrease in:
a) Atomic number
b) Atomic mass
c) Equivalent weight
d) Number of valency electrons

904. In the following, which bond will be responsible for maximum value of hydrogen bond?
a) $N-H$ b) $O-H$ c) $F-H$ d) $S-H$

905. The bond order of O_2^+ is the same as in
a) N_2^+ b) CN^- c) CO d) NO^+

906. Structure of XeF_5^+ ion is
a) Trigonal bipyramidal b) Square pyramidal c) Octahedral d) Pentagonal

907. The fHOMO in CO is
a) π- bonding b) π-antibonding c) σ-antibonding d) σ- bonding

908. Which of the following has sp^3-hybridization on central atom?
a) BF_2 b) BCl_3 c) SO_3 d) CCl_4

909. Which one has sp^3 hybridisation?
a) N_2O b) CO_2 c) SO_2 d) CO

910. Coordinate compounds are formed by:
a) Transfer of electrons
b) Sharing of electrons
c) Donation of electron pair
d) None of the above

911. In P_4O_{10} the
a) Second bond in $P=O$ is formed by $p\pi-d\pi$ back bonding
b) $P=O$ bond is formed by $p\pi-p\pi$ bonding
c) $P=O$ bond is formed by $d\pi-d\pi$ bonding
d) $P=O$ bond is formed by $d\pi-d\pi\ -3\sigma$ back bonding

912. Allene (C_3H_4) contains
a) One double bond, one triple bond and one single bond
b) One triple and two double bonds

c) Two triple and one double bond
d) Two double and four single bond

913. Which shows non-directional bonding?
a) BCl_3 b) CsCl c) NCl_3 d) $BeCl_3$

914. Which one of the following contains both ionic and covalent bonds?
a) C_6H_5Cl b) H_2O c) NaOH d) CO_2

915. $Na^+, Mg^{2+}, Al^{3+}, Si^{4+}$ are isoelectronics. Their ionic size follows the order:
a) $Na^+ < Mg^{2+} < Al^{3+} < Si^{4+}$
b) $Na^+ > Mg^{2+} < Al^{3+} < Si^{4+}$
c) $Na^+ < Mg^{2+} > Al^{3+} > Si^{4+}$
d) $Na^+ > Mg^{2+} > Al^{3+} > Si^{4+}$

916. Which of the following does not apply to metallic bond?
a) Overlapping valence orbitals
b) Mobile valence electrons
c) Delocalized electrons
d) Highly directed bonds

917. Van der Waals' forces are maximum in:
a) HBr b) LiBr c) LiCl d) AgBr

918. The internuclear distance in H_2 and Cl_2 molecules are 74 and 198 pm respectively. The bond length of H—Cl may be:
a) 272 pm b) 70 pm c) 136 pm d) 248 pm

919. The molecule having zero dipole moment is
a) CH_2Cl_2 b) BF_3 c) NF_3 d) ClF_3

920. For a stable molecule, the value of bond order must be
a) There is no relationship between stability and bond order
b) Zero
c) Positive
d) negative

921. Which compound among the following has more covalent character?
a) $AlCl_3$ b) AlI_3 c) MgI_2 d) NaI

922. Which among the following has the largest dipole moment?
a) NH_3 b) H_2O c) HI d) SO_3

923. The hybridization of phosphorus in $POCl_3$ is same as in:
a) P in PCl_3 b) S in SF_6 c) Cl in ClF_3 d) B in BCl_3

924. A square planar complex is formed by hybridisation of the following atomic orbitals
a) s, p_x, p_y, p_z b) s, p_x, p_y, p_z, d c) d, s, p_x, p_y d) s, p_x, p_y, p_z, d, d

925. Which of the following pairs are isostructural?
a) SO_3^{2-}, NO_3^- b) BF_3, NF_3 c) BrO_3^-, XeO_3 d) SF_4, XeF_4

926. Among HF, CH_4, CH_3OH and N_2O_4 intermolecular hydrogen bond is expected
a) In two b) In all c) In all leaving one d) None of these

927. Hydration of different ions in aqueous solution is an example of
a) Ion – induced dipole interaction
b) Dipole - dipole interaction
c) Dipole – induced dipole interaction
d) Ion – dipole interaction

928. Amongst LiCl, RbCl, $BeCl_2$ and $MgCl_2$, the compounds with the greatest and the least ionic character, respectively
a) LiCl and RbCl b) RbCl and $MgCl_2$ c) RbCl and $BeCl_2$ d) $MgCl_2$ and $BeCl_2$

929. The percentage of p – character in the orbitals forming P – P bonds in P_4 is
a) 25 b) 33 c) 50 d) 75

930. Atoms or group of atoms which are electrically charged are known as:

a) Anions
b) Cations
c) Ions
d) Atoms

931. Which among the following elements has lowest value of ionisation energy?

a) Mg
b) Ca
c) Ba
d) Sr

932. IP_2 for an element is invariably higher than IP_1 because:

a) The size of cation is smaller than its atom
b) It is difficult to remove 'e' from cation
c) Effective nuclear charge is more for cation
d) All of the above

933. In forming (i) $N_2 \longrightarrow N_2^+$ and (ii) $O_2 \longrightarrow O_2^+$; the electrons respectively are removed from

a) $\left(\overset{*}{\pi}\, 2\, p_y \text{ or } \overset{*}{\pi}\, 2\, p_x\right)$ and $\left(\overset{*}{\pi}\, 2\, p_y \text{ or } \overset{*}{\pi}\, 2\, p_x\right)$
b) $\left(\pi\, 2\, p_y \text{ or } \pi\, 2\, p_x\right)$ and $\left(\pi\, 2\, p_y \text{ or } \pi\, 2\, p_x\right)$
c) $\left(\pi\, 2\, p_y \text{ or } \pi\, 2\, p_x\right)$ and $\left(\overset{*}{\pi}\, 2\, p_y \text{ or } \overset{*}{\pi}\, 2\, p_x\right)$
d) $\left(\overset{*}{\pi}\, 2\, p_y \text{ or } \overset{*}{\pi}\, 2\, p_x\right)$ and $\left(\pi\, 2\, p_y \text{ or } \pi\, 2\, p_x\right)$

934. Which one pair of atoms or ions will have same configuration?

a) Li^+ and He^-
b) Cl^- and Ar
c) Na and K
d) F^+ and Ne

935. Which combination is best explained by the coordinate covalent bond?

a) $H^+ + H_2O$
b) $Cl + Cl$
c) $Mg + \frac{1}{2}O_2$
d) $H_2 + I_2$

936. The dipole moment of $CHCl_3$ is 1.05 debye while that of CCl_4 is zero, because CCl_4 is:

a) Linear
b) Symmetrical
c) Planar
d) Regular tetrahedral

937. Which shows the highest lattice energy?

a) RbF
b) CsF
c) NaF
d) KF

938. In a polar molecule, the ionic charge is 4.8×10^{-10} e.s.u. If the inter ionic distance is 1 Å unit, then the dipole moment is

a) 41.8 debye
b) 4.18 debye
c) 4.8 debye
d) 0.48 debye

939. The correct order regarding the electronegativity of hybrid orbitals of carbon is:

a) $sp < sp^2 > sp^3$
b) $sp < sp^2 < sp^3$
c) $sp > sp^2 < sp^3$
d) $sp > sp^2 > sp^3$

940. Which of the following groups all do not have $sp^3\,d$ hybridisation?

a) ClF_3, IF_3, XeF_3^+
b) ICl_2^-, ClF_2^-, I_3^-
c) ClF_3, BrF_3, IF_3
d) $PCl_3, AsCl_3, PF_5$

941. Which of the following compounds does not follow the octet rule for electron distribution?

a) H_2O
b) PH_3
c) PCl_3
d) PCl_5

942. Which of the following sets represents the collection of isoelectronic species?

a) $Na^+, Mg^{2+}, Al^{3+}, Cl^-$
b) $Na^+, Ca^{2+}, Sc^{3+}, F^-$
c) $K^+, Cl^-, Mg^{2+}, Sc^{3+}$
d) $K^+, Ca^{2+}, Sc^{3+}, Cl^-$

943. Which of the following has unchanged valency?

a) H
b) Na
c) Fe
d) O

944. The structure of XeF_4 is:

a) Planar
b) Tetrahedral
c) Square planar
d) Pyramidal

945. N_2 and O_2 are converted into N_2^+ and O_2^+ respectively.
Which of the following is not correct?

a) In N_2^+, the N – N bond weakens
b) In O_2^+, O – O bond order increases
c) In O_2^+, paramagnetism decreases
d) N_2^+ becomes diamagnetic

946. Which molecule has trigonal planar geometry?

a) IF_3
b) PCl_3
c) NH_3
d) BF_3

947. Malleability and ductility of metals can be accounted due to

a) The presence of electrostatic force
b) The crystalline structure in metal
c) The capacity of layers of metal ions to slide over the other
d) The interaction of electrons with metal ions in the lattice

948. Underlined carbon is sp^3 hybridised in
a) $CH_3\underline{C}H=CH_2$ b) $CH_3\underline{C}H_2NH_2$ c) $CH_3\underline{C}ONH_2$ d) $CH_3CH_2\underline{C}N$

949. Hydrogen fluoride is a liquid unlike other hydrogen halides because:
a) HF molecules associate due to hydrogen bonding
b) F_2 is highly reactive
c) HF is the weakest acid of all hydrogen halides
d) Fluorine atom is the smallest of all halogens

950. The number of sigma (σ)and pi (π) covalent bonds respectively in banzene nitrile are
a) 5, 13 b) 15, 3 c) 13, 5 d) 16, 2

951. In which one of the following cases, breaking of covalent bond takes place?
a) Boiling of H_2O b) Melting of KCN c) Boiling of CF_4 d) Melting of SiO_2

952. Which compound is soluble in water
a) CS_2 b) C_2H_5OH c) CCl_4 d) $CHCl_3$

953. A π-bond is formed by sideways overlapping of:
a) *s*-*s* orbitals b) *p*-*p* orbitals c) *s*-*p* orbitals d) *s*-*p*-*s* orbitals

954. Which statement is true?
a) Absolutely pure water does not contain any ion.
b) Some covalent compounds may also give ions in aqueous solution.
c) In aqueous solution only electrovalent compound give ions.
d) Very sparingly soluble substances do not dissociate in aqueous solution

955. Formation of π-bond:
a) Increases bond length
b) Decreases bond length
c) Distorts the geometry of molecule
d) Makes homoatomic molecules more reactive

956. In which reaction, the hybridisation on the central atom changes from sp^2 to sp^3?
a) $NH_3+H^+\longrightarrow NH_4^+$ b) $BF_3+F^-\longrightarrow BF_4^-$ c) $H_2O+H^+\longrightarrow H_3O^+$ d) $C_2H_2+2H_2\longrightarrow C_2H_6$

957. The low solubility of $BaSO_4$ in water is due to:
a) Low dissociation energy
b) Ionic bonds
c) High value of lattice energy
d) None of the above

958. The number of lone pairs of electron on Xe in $XeOF_4$ is:
a) 1 b) 2 c) 3 d) 4

959. Which compound does not contain double bond or triple bond?
a) C_2H_4 b) H_2O c) N_2 d) HCN

960. The compound showing maximum covalent character is:
a) BI_3 b) BCl_3 c) BF_3 d) BBr_3

961. Carbon atoms in $C_2(CN)_4$ are:
a) *sp*-hybridised
b) sp^2-hybridised
c) *sp*- and sp^2-hybridised
d) sp, sp^2 and sp^3-hybridised

962. Which statement is wrong?
a) 2nd ionisation energy shows jump in alkali metals
b) 2nd electron affinity for halogens is zero

c) Maximum electron affinity exists for F
d) Maximum ionization energy exists for He

963. Value of x in potash alum,
$K_2SO_4.AI_x(SO_4)_3.24H_2O$ is
a) 4 b) 1 c) 2 d) None of these

964. Among the following, the paramagnetic compound is
a) Na_2O_2 b) O_3 c) N_2O d) KO_2

965. HCl molecule in the vapour state is an example of:
a) Non-polar bond b) Ionic bond c) Polar covalent bond d) Pure covalent bond

966. The electrons in an incomplete outershell are known as:
a) Kernel electrons b) Valency electrons c) Shell electrons d) None of the above

967. According to bond order concept the correct order of stability of O_2, O_2^+, and O_2^- is
a) $O_2 > O_2^+ > O_2^-$ b) $O_2^- > O_2 > O_2^+$ c) $O_2 > O_2^- > O_2^+$ d) $O_2^+ > O_2 > O_2^-$

968. The element which exists in both hard and soft form is:
a) Fe b) Si c) C d) Al

969. Which of the following is not a correct statement?
a) Every AB_5 molecule does in fact have square pyramid structure.
b) Multiple bonds are always shorter than corresponding single bonds.
c) The electron-deficient molecules can act as Lewis acids.
d) The canonical structures have no real existence.

970. The bond strength increases:
a) With increasing bond order
b) With increasing extent of overlapping of orbitals
c) With decreasing difference between energies of overlapping orbitals
d) All of the above

971. The number of unpaired electrons in O_2 molecule is:
a) Zero b) 1 c) 2 d) 3

972. Which has higher bond energy and stronger bond?
a) F_2 b) Cl_2 c) Br_2 d) I_2

973. Which of the following statements regarding carbon monoxide is correct?
a) It involves sp-orbitals of carbon
b) It contains a lone pair only on carbon
c) It contains a lone pair only on oxygen
d) In carbonyl, oxygen end is attached to the metal atoms

974. Which of the following is having highest bond length?
a) NO^- b) NO^+ c) CN^- d) CN^+

975. Which of the following statement is correct for $CsBr_3$?
a) It is a covalent compound
b) It contains Cs^{3+} and Br^- ions
c) It contains $Cs^+$and Br_3^- ions
d) It contains Cs^+, Br^- and lattice Br_2 molecule

976. In 1 – butene number of σ - bonds is
a) 8 b) 10 c) 11 d) 12

977. Which does not have pyramidal geometry?
a) SO_3^{2-} b) NO_3^- c) NH_3 d) $C(C_6H_5)_3^-$

978. The nature of bonding in CCl_4 and CaH_2 :
a) Electrovalent in both CCl_4 and CaH_2
b) Covalent in CCl_4 and electrovalent in CaH_2
c) Electrovalent in CCl_4 and covalent in CaH_2
d) None of the above

979. Which of the following oxides is not expected to react with sodium hydroxide?

a) BeO b) B_2O_3 c) CaO d) SiO_2

CHEMICAL BONDING AND MOLECULAR STRUCTURE

CHEMISTRY

: ANSWER KEY :

1)	b	2)	b	3)	b	4)	d	177)	d	178)	c	179)	a	180)	c
5)	b	6)	b	7)	b	8)	a	181)	b	182)	c	183)	b	184)	c
9)	b	10)	b	11)	c	12)	b	185)	b	186)	d	187)	a	188)	c
13)	c	14)	a	15)	a	16)	d	189)	b	190)	a	191)	b	192)	c
17)	b	18)	c	19)	a	20)	c	193)	d	194)	c	195)	d	196)	a
21)	b	22)	a	23)	c	24)	d	197)	b	198)	d	199)	d	200)	b
25)	c	26)	d	27)	b	28)	a	201)	c	202)	c	203)	b	204)	c
29)	c	30)	a	31)	a	32)	a	205)	d	206)	a	207)	d	208)	c
33)	b	34)	d	35)	a	36)	a	209)	a	210)	a	211)	d	212)	c
37)	c	38)	c	39)	b	40)	c	213)	b	214)	d	215)	c	216)	c
41)	b	42)	d	43)	b	44)	c	217)	a	218)	b	219)	c	220)	b
45)	b	46)	a	47)	c	48)	d	221)	b	222)	c	223)	b	224)	c
49)	a	50)	c	51)	c	52)	d	225)	d	226)	a	227)	c	228)	a
53)	a	54)	c	55)	c	56)	b	229)	c	230)	b	231)	a	232)	a
57)	a	58)	b	59)	c	60)	a	233)	d	234)	d	235)	a	236)	c
61)	a	62)	a	63)	c	64)	c	237)	c	238)	d	239)	b	240)	c
65)	a	66)	a	67)	c	68)	c	241)	c	242)	c	243)	a	244)	c
69)	c	70)	a	71)	a	72)	b	245)	c	246)	d	247)	c	248)	b
73)	b	74)	a	75)	a	76)	d	249)	c	250)	b	251)	d	252)	b
77)	a	78)	c	79)	d	80)	d	253)	a	254)	c	255)	b	256)	b
81)	c	82)	b	83)	c	84)	b	257)	b	258)	d	259)	b	260)	c
85)	b	86)	b	87)	c	88)	b	261)	a	262)	b	263)	b	264)	d
89)	d	90)	a	91)	a	92)	c	265)	b	266)	a	267)	d	268)	d
93)	d	94)	d	95)	d	96)	b	269)	b	270)	c	271)	d	272)	b
97)	c	98)	c	99)	d	100)	c	273)	c	274)	d	275)	a	276)	c
101)	c	102)	a	103)	c	104)	d	277)	c	278)	d	279)	a	280)	c
105)	c	106)	d	107)	a	108)	b	281)	a	282)	d	283)	b	284)	a
109)	a	110)	b	111)	d	112)	a	285)	a	286)	c	287)	a	288)	a
113)	a	114)	a	115)	c	116)	a	289)	b	290)	a	291)	c	292)	b
117)	a	118)	a	119)	c	120)	c	293)	b	294)	a	295)	b	296)	d
121)	a	122)	b	123)	b	124)	c	297)	c	298)	c	299)	c	300)	d
125)	d	126)	c	127)	d	128)	b	301)	d	302)	a	303)	c	304)	d
129)	b	130)	a	131)	b	132)	d	305)	d	306)	c	307)	d	308)	d
133)	c	134)	a	135)	a	136)	d	309)	b	310)	c	311)	a	312)	d
137)	a	138)	c	139)	c	140)	c	313)	b	314)	a	315)	c	316)	b
141)	d	142)	a	143)	d	144)	a	317)	a	318)	b	319)	b	320)	a
145)	d	146)	c	147)	a	148)	a	321)	b	322)	b	323)	b	324)	b
149)	c	150)	c	151)	d	152)	a	325)	a	326)	b	327)	a	328)	d
153)	c	154)	c	155)	d	156)	d	329)	b	330)	d	331)	d	332)	b
157)	d	158)	d	159)	b	160)	c	333)	c	334)	b	335)	d	336)	a
161)	d	162)	d	163)	c	164)	a	337)	d	338)	b	339)	b	340)	d
165)	c	166)	b	167)	c	168)	c	341)	b	342)	d	343)	b	344)	a
169)	c	170)	d	171)	d	172)	b	345)	b	346)	c	347)	d	348)	d
173)	a	174)	c	175)	b	176)	d	349)	b	350)	a	351)	c	352)	b

353)	b	354)	c	355)	b	356)	d
357)	a	358)	c	359)	d	360)	b
361)	c	362)	b	363)	d	364)	a
365)	a	366)	c	367)	d	368)	a
369)	d	370)	c	371)	c	372)	a
373)	a	374)	a	375)	a	376)	d
377)	a	378)	d	379)	b	380)	d
381)	a	382)	d	383)	d	384)	b
385)	a	386)	a	387)	a	388)	a
389)	b	390)	a	391)	c	392)	a
393)	a	394)	c	395)	c	396)	c
397)	b	398)	d	399)	d	400)	a
401)	b	402)	b	403)	b	404)	c
405)	d	406)	c	407)	b	408)	b
409)	b	410)	b	411)	c	412)	b
413)	c	414)	d	415)	d	416)	b
417)	c	418)	a	419)	c	420)	b
421)	d	422)	c	423)	d	424)	c
425)	a	426)	c	427)	c	428)	b
429)	b	430)	c	431)	d	432)	a
433)	d	434)	c	435)	d	436)	b
437)	b	438)	c	439)	b	440)	b
441)	b	442)	c	443)	a	444)	b
445)	a	446)	c	447)	c	448)	a
449)	b	450)	c	451)	a	452)	b
453)	d	454)	a	455)	d	456)	b
457)	c	458)	b	459)	d	460)	d
461)	b	462)	a	463)	c	464)	c
465)	a	466)	d	467)	d	468)	a
469)	d	470)	d	471)	d	472)	a
473)	b	474)	b	475)	c	476)	a
477)	d	478)	c	479)	a	480)	d
481)	b	482)	c	483)	d	484)	b
485)	c	486)	b	487)	b	488)	a
489)	c	490)	b	491)	d	492)	a
493)	c	494)	b	495)	c	496)	b
497)	c	498)	b	499)	c	500)	d
501)	d	502)	b	503)	b	504)	b
505)	c	506)	b	507)	c	508)	c
509)	c	510)	b	511)	d	512)	a
513)	b	514)	d	515)	d	516)	b
517)	a	518)	d	519)	a	520)	c
521)	a	522)	c	523)	a	524)	b
525)	d	526)	a	527)	d	528)	a
529)	d	530)	a	531)	b	532)	a
533)	b	534)	c	535)	c	536)	d
537)	a	538)	b	539)	a	540)	c
541)	a	542)	c	543)	b	544)	a
545)	b	546)	b	547)	c	548)	d
549)	c	550)	c	551)	d	552)	c
553)	b	554)	a	555)	b	556)	a

557)	c	558)	a	559)	b	560)	c
561)	c	562)	b	563)	d	564)	b
565)	c	566)	d	567)	b	568)	a
569)	b	570)	c	571)	b	572)	a
573)	a	574)	b	575)	b	576)	b
577)	b	578)	b	579)	b	580)	b
581)	a	582)	d	583)	b	584)	b
585)	c	586)	c	587)	a	588)	a
589)	c	590)	d	591)	b	592)	b
593)	c	594)	d	595)	a	596)	c
597)	c	598)	c	599)	b	600)	b
601)	b	602)	c	603)	a	604)	b
605)	a	606)	a	607)	a	608)	a
609)	d	610)	c	611)	c	612)	c
613)	c	614)	b	615)	a	616)	d
617)	c	618)	c	619)	c	620)	b
621)	d	622)	a	623)	b	624)	c
625)	d	626)	d	627)	b	628)	a
629)	a	630)	b	631)	a	632)	c
633)	b	634)	a	635)	c	636)	d
637)	a	638)	c	639)	d	640)	b
641)	c	642)	b	643)	a	644)	a
645)	a	646)	b	647)	c	648)	d
649)	a	650)	b	651)	a	652)	c
653)	a	654)	b	655)	c	656)	b
657)	c	658)	d	659)	d	660)	c
661)	c	662)	a	663)	a	664)	b
665)	a	666)	b	667)	b	668)	d
669)	d	670)	c	671)	b	672)	d
673)	b	674)	b	675)	c	676)	d
677)	b	678)	d	679)	c	680)	d
681)	a	682)	a	683)	d	684)	c
685)	c	686)	c	687)	d	688)	a
689)	b	690)	c	691)	b	692)	b
693)	d	694)	b	695)	a	696)	b
697)	a	698)	c	699)	a	700)	d
701)	b	702)	b	703)	a	704)	d
705)	b	706)	b	707)	b	708)	b
709)	c	710)	c	711)	d	712)	a
713)	b	714)	c	715)	c	716)	a
717)	d	718)	a	719)	d	720)	d
721)	a	722)	a	723)	a	724)	b
725)	d	726)	d	727)	d	728)	d
729)	c	730)	b	731)	c	732)	c
733)	b	734)	c	735)	b	736)	d
737)	b	738)	c	739)	b	740)	c
741)	b	742)	a	743)	c	744)	b
745)	a	746)	a	747)	a	748)	b
749)	b	750)	d	751)	a	752)	a
753)	b	754)	c	755)	c	756)	b
757)	b	758)	c	759)	a	760)	b

761)	b	762)	a	763)	b	764)	a	873)	d	874)	b	875)	b	876)	a
765)	d	766)	d	767)	b	768)	d	877)	a	878)	a	879)	d	880)	a
769)	d	770)	c	771)	b	772)	d	881)	d	882)	d	883)	c	884)	a
773)	b	774)	a	775)	b	776)	c	885)	a	886)	c	887)	a	888)	c
777)	b	778)	c	779)	c	780)	a	889)	a	890)	b	891)	d	892)	a
781)	a	782)	b	783)	a	784)	b	893)	c	894)	b	895)	d	896)	c
785)	a	786)	d	787)	a	788)	d	897)	b	898)	c	899)	b	900)	c
789)	b	790)	b	791)	d	792)	a	901)	c	902)	d	903)	d	904)	c
793)	a	794)	b	795)	b	796)	d	905)	a	906)	b	907)	d	908)	d
797)	a	798)	d	799)	b	800)	b	909)	c	910)	c	911)	a	912)	d
801)	d	802)	c	803)	c	804)	b	913)	b	914)	c	915)	d	916)	d
805)	c	806)	a	807)	a	808)	d	917)	d	918)	c	919)	b	920)	c
809)	a	810)	a	811)	a	812)	d	921)	b	922)	b	923)	a	924)	c
813)	b	814)	a	815)	a	816)	a	925)	c	926)	a	927)	d	928)	c
817)	a	818)	c	819)	a	820)	d	929)	d	930)	c	931)	c	932)	d
821)	c	822)	a	823)	b	824)	d	933)	c	934)	b	935)	a	936)	d
825)	a	826)	b	827)	a	828)	c	937)	c	938)	c	939)	d	940)	d
829)	a	830)	d	831)	a	832)	a	941)	d	942)	d	943)	b	944)	c
833)	b	834)	a	835)	d	836)	a	945)	d	946)	d	947)	c	948)	b
837)	a	838)	b	839)	b	840)	c	949)	a	950)	c	951)	d	952)	b
841)	d	842)	d	843)	a	844)	a	953)	b	954)	b	955)	b	956)	b
845)	a	846)	a	847)	b	848)	d	957)	c	958)	a	959)	b	960)	c
849)	d	850)	a	851)	b	852)	c	961)	c	962)	c	963)	c	964)	d
853)	b	854)	c	855)	b	856)	d	965)	c	966)	b	967)	d	968)	c
857)	b	858)	a	859)	c	860)	d	969)	a	970)	d	971)	c	972)	b
861)	d	862)	b	863)	b	864)	d	973)	a	974)	a	975)	c	976)	c
865)	a	866)	c	867)	b	868)	d	977)	b	978)	b	979)	c		
869)	a	870)	c	871)	b	872)	d								

CHEMICAL BONDING AND MOLECULAR STRUCTURE

CHEMISTRY

: HINTS AND SOLUTIONS :

1 **(b)**

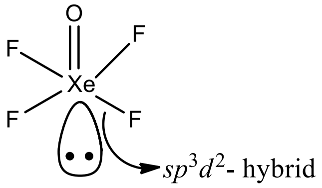
Molecule	Hybridization
SO_3	sp^2
C_2H_2	sp
C_2H_4	sp^2
CH_4	sp^3
CO_2	sp

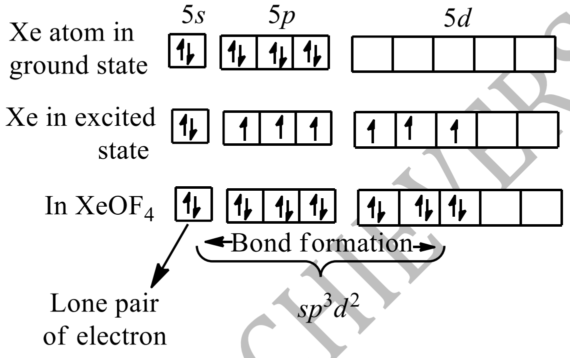
2 **(b)**

$Mg^{2+}$is smaller thanNa^+ and thus, smaller is cation more is hydration energy.

3 **(b)**

Number of lone pair in $XeOF_4$ is one (1). The structure of $XeOF_4$ is given as follows :





One π-bond so remaining six electron pairs form an octahedron with one position occupied by a lone pair.

4 **(d)**

These are the factors on which van der Waals' forces depend.

5 **(b)**

It has sp^3d^3-hybridization with one lone pair on Xe.

6 **(b)**

Bond order $\propto \frac{1}{\text{Bond length}}$

BO of NO<BO of NO^+

∴ Bond length of NO is greater than the bond length of NO^+.

7 **(b)**

Element with atomic number 20 is metal (Ca); it will combine with non-metal.

8 **(a)**

A decrease in s-character increases bond length.

10 **(b)**

Calculated dipole moment,

$$\mu_{\text{cal}} = 2.0 \times 10^{-10}\text{ m} \times 1.6 \times 10^{-19}\text{ C}$$
$$= 3.2 \times 10^{-29}\text{ C} - \text{m}.$$

Percentage of ionic character $= \frac{\mu_{\text{exp}}}{\mu_{\text{cal}}} \times 100$

$$= \frac{5.12 \times 10^{-29}}{3.2 \times 10^{-29}} \times 100 = 16\%$$

11 **(c)**

C_2H_4 involves sp^2-hybridization on carbon atoms.

12 **(b)**

According to molecular orbital theory.

$$F_2(18) = \sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2$$
$$\approx \pi 2p_y^2, \overset{*}{\pi}2p_x^2, \approx \overset{*}{\pi}2p_y^2$$

Bond order in $F_2 = \frac{N_b - N_a}{2} = \frac{10-8}{2} = 1$

15 **(a)**

Bond formation is always exothermic. Compounds of sodium are ionic.

16 **(d)**

In case of water, five water molecules are attached together through four hydrogen bonding

17 **(b)**

Removal of electron is easier in the order of shell $4 > 3 > 2 > 1$

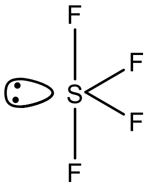
18 **(c)**

Bond order of NO^+, NO and NO^- are 3, 2.5 and 2 respectively.

Bond energy ∝ bond order.

19 **(a)**

FXF angles of two types are present in sp^3d hybrid orbitals. Since, SF_4 shows sp^3d hybridisation as follows, therefore, it exhibits two different FXF angles.



20 **(c)**

s-character ∝ bond angle

For 25% s character (as in sp^3hybrid orbital), bond angle is 109.5°, for 33.3% s character (as in

sp^2 hybrid orbital),bond angle is 120° and for 50% s character (as in sp hybrid orbital), bond angle is 180°.

Similarly, when the bond angle decreases below 1.9.5°,the$s$ −character will decrease accordingly

Decreasing in angle $= 120° - 109.5° = 10.5°$

$\therefore$ Decrease in s-character $= 33.3 - 25 = 8.3$

Actual decrease in bond angle $= 109.5° - 105° = 4.5°$

$\therefore$ Expected decrease in s-character

$$= \frac{8.3}{10.5} \times 4.5 = 3.56\%$$

Thus, the s-character should decrease by about 3.56%, ie, s-character $= 25 - 3.56 = 21.44\%$

21 **(b)**

B has only six electron in B_2H_6.

22 **(a)**

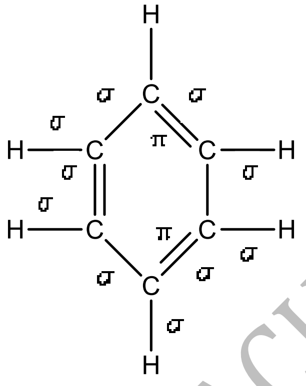
Like gets dissolved in like. It is theory.

23 **(c)**

Ionic compounds are good conductor of electricity in molten or in solution state. However, they are bad-conductor in solid state.

24 **(d)**

In benzene 12σ and 3π bonds are present. The structure of benzene is



25 **(c)**

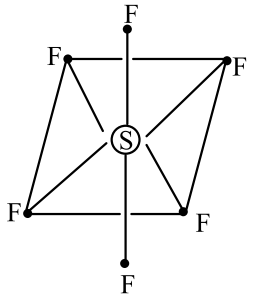
In CO_3^{2-} ion the C-atom undergoes sp^2-hybridisation. It has triangular planar structure. While BF_4^-, NH_4^+ and SO_4^{2-} have tetrahedral structure.

26 **(d)**

PCl_5 has trigonal bipyramid geometry.

27 **(b)**

SF_6 has octahedral geometry, sp^3d^2 hybridisation and bond angle is 90°



$$\% \text{ of } d\text{-character} = \frac{2\,(\text{no.of } d\text{−orbitals})}{6(\text{total hybridised orbitals})} \times 100$$

$$= 33\%$$

So, SF_6 are bond angle = 90°

and d-character = 33%.

28 **(a)**

Head on overlapping give rise to σ-bond formation.

29 **(c)**

Allene is $CH_2 = C = CH_2$.

30 **(a)**

Silicate ion (Sio_4^{4-}) is the basic structural unit of silicates. Silicates are metal derivatives of silicic acid.

31 **(a)**

Due to planar equilateral geometry of graphite.

32 **(a)**

Due to non-availability of d-orbitals, boron cannot expand its octet. Therefore, the maximum covalence of boron cannot exceed 4.

33 **(b)**

Cations are always shorter than their parent atom, anion are always larger.

35 **(a)**

H-bonding is weakest bonding.

36 **(a)**

5 of P + 24 of O + 3 of –ve charge = 32.

37 **(c)**

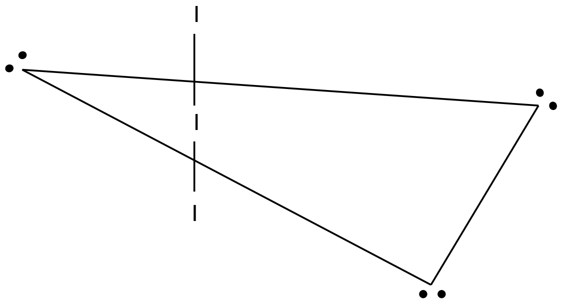
Benzene has 12σ- and 3π-bonds.

38 **(c)**

PF_5 involves sp^3d-hybridization.

39 **(b)**

I_3^- ion is made up of an I_2 molecule with an I^- bonded to it by means of a coordinate bond in which I_2 is lone pair acceptor (Lewis acid) and I^- the lone pair donor (Lewis base). There are two bond pairs and three lone pairs in the outer shell of central atom. To minimize the repulsive forces the three lone pairs occupy the equatorial position. The ion is therefore, linear in shape with a bond angle of exactly 180°.



$$\underset{\text{Lewis acid}}{I_2} + \underset{\text{Lewis base}}{I^-} \longrightarrow [I—I \leftarrow I]^-$$

Similarly, N_3^- ion is also linear in shape.

40 **(c)**
According to M.O. theory, bond order of N_2, N_2^- and N_2^{2-} are 3, 2.5 and 2 respectively.

41 **(b)**
e.g., BF_3.

42 **(d)**
Bond order for $H_2^- = +1/2$

43 **(b)**
sp-hybridization leads to bond angle of 180°.

44 **(c)**
$\mu\ H_2O \neq 0, \mu_{CO_2} = 0$

45 **(b)**
No, of hybrid orbital $= \frac{1}{2}$[No.of e^- in V-shell of atom + No.of monovalent atoms −charge on cation +charge on anion]

No. of hybrid orbital	2	3	4	5	6	7
Type of hybridisation	sp	sp^2	sp^3	sp^3d	sp^3d^2	sp^3d^3

Hybridisation in $TeCl_4$:
No. of hybrid orbital $= \frac{1}{2}[6 + 4 + 0 + 0] = 5$
Hence, $TeCl_4$ shows sp^3d hybridisation.

46 **(a)**
The stability and bond angle order for hybrids in a group is $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$.

47 **(c)**
Isoelectronic species are those species which have equal number of electrons. Hence, CO_2 is isoelectronic with N_2O.
Number of electron in CO_2 =22
Number of electron in N_2O =22

48 **(d)**
In $BeCl_2$, Be atom has incomplete octet.

49 **(a)**
Greater the charge, smaller the radius, greater the polarising power and thus greater the covalent nature. This leads to increase in lattice energy.

50 **(c)**
The structure, $CH_2 = C = CH_2$ is non-planar with two $-CH_2$ groups being in planes perpendicular to each other.

52 **(d)**
Electronegativity increases along the period and decreases down the group.

53 **(a)**
Brass in an alloy.

54 **(c)**
It is head on overlapping and thus, forms more stronger bond.

55 **(c)**
H-bonding in molecule gives rise to increase in its b.p.

56 **(b)**
One bonding molecular orbital and one antibonding.

57 **(a)**
Follow Fajans' rule.

58 **(b)**
Removal of two electrons (one by one) from an atom requires energy $= IP_1 + IP_2$.

59 **(c)**
The molecular orbital electronic configuration.
$(\sigma 1s)^2(\overset{*}{\sigma}1s)^2(\sigma 2s)^2(\overset{*}{\sigma}2s)^2(\sigma 2p_x)^2$
$(\pi 2p_y)^2(\pi 2p_z)^2(\overset{*}{\pi}2p_y)^2(\overset{*}{\pi}2p_z)^1$
Total electrons =17
Hence, this configuration belongs to O_2^- $(17e^-)$ ion.

60 **(a)**
$H_3O^+ : sp^3 ; NO_3^- : sp^2$

61 **(a)**
6, 6

62 **(a)**
More is the dipole moment more is ionic nature.
$\mu = \delta \times d$; higher is μ, more will be δ on the atom.

63 **(c)**
Due to sp^3-hybridization.

65 **(a)**
Each species has 14 electrons and bond order for each is three.

66 **(a)**
Among the given choices of compound having oxygen attached to hydrogen will have maximum hydrogen bonding.
∵ Among CH_3OCH_3, $(CH_3)_2C = O$, CH_3CHO and C_2H_5OH only C_2H_5OH has oxygen attached to hydrogen atom.
∴ C_2H_5OH shows maximum hydrogen bonding.

67 **(c)**

It is experimental value.

68 **(c)**

O_2^{2+} has 14 electrons. Its electronic configuration is as

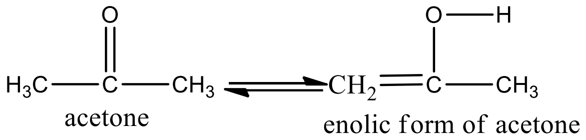
O_2^{+} : $\sigma 1s^2\, \overset{*}{\sigma}1s^2, \sigma 2s^2\, \overset{*}{\sigma}2s^2, \pi 2p_y^2\, \pi 2p_z^2 \sigma 2p_x^2$

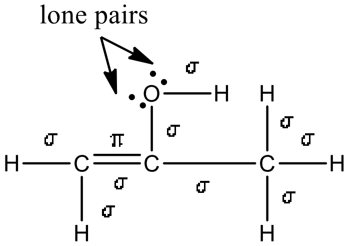
Bond order $= \frac{N_b - N_a}{2} = \frac{10-4}{2} = 3$

69 **(c)**

In diamagnetic molecule, all the electrons are paired

70 **(a)**





Hence, enolic form of acetone contains 9 sigma bonds, 1 pi bond and two lone pairs.

71 **(a)**

In NO_3^- ion, total number of electrons = 7+24+1=32 and in it central atom is sp^2 hybrid.

No. of hybrid orbitals $= \frac{V-8B}{2} + B = \frac{24-8\times3}{2} + 3$

($V \rightarrow$ total number of electrons in valence shell
$B \rightarrow$ probability of formation of bond)

In CO_3^{2-} ion, total number of electrons = 6+24+2=32 and in it central atom is sp^2 hybrid.

No. of hybrid orbital$= \frac{24-8\times3}{2} + 3 = 3$

Hence, NO_3^- and CO_3^{2-} ions are isoelectronic and isostructural.

72 **(b)**

$H_2^+ = \sigma 1s^2$ (According to molecular orbital theory)

$$\text{Bond order} = \frac{\text{bonding electrons} - \text{antibonding electrons}}{2}$$

$$= \frac{1}{2} = 0.5$$

H_2^+ is paramagnetic due to the presence of one unpaired electron.

73 **(b)**

H-bonding in molecules gives rise to increase in b.p.

74 **(a)**

Bond distance is in the order :

$C - C > C = C > C \equiv C$

$sp^3 > sp^2 > sp$

75 **(a)**

% ionic character $= 16(x_A - x_B) + 3.5(x_A - x_B)^2$

$= 16 \times 2 + 3.5 \times (2^2)$

$= 46$

$\therefore$ The % covalent character $= 100 - 46 = 54$

76 **(d)**

ICl_2^- has sp^3d-hybridized state ($i.e.$, trigonal bipyramidal shape but distorted due to the presence of lone pair of electron on I atom.)

77 **(a)**

Like gets dissolved in like.

78 **(c)**

N_2O is isoelectronic with CO_2 and N_3^-.

Hence, its structure is linear.

$$N - N - O$$

79 **(d)**

H atom attached on N, O, F develops hydrogen bonding molecule.

80 **(d)**

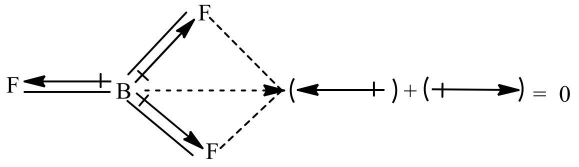
In CCl_4 all bonds of carbon being identical, the molecule is a regular tetrahedron

81 **(c)**

In O^{2-} effective nuclear charge is minimum due to more number of electrons and thus the size of O^{2-} is maximum.

82 **(b)**

The zero dipole moment of BF_3 molecule is due to its symmetrical (triangular planar) structure.



84 **(b)**

Bond dissociation energy order:

Cl_2	>	Br_2	>	F_2	>	I_2
242.6		192.8		158.8		151.1 in kJ mol^{-1}

85 **(b)**

CH_3OH shows H—bonding in liquid state.

86 **(b)**

They have high electron density.

87 **(c)**

A coordinate bond is a dative covalent bond in which two atoms form bond and one of them provides both electrons.

$$X\!: + Y \longrightarrow X\!:\!Y \text{ or } X \longrightarrow Y$$

88 **(b)**

$C - C$ bond length in sp^2hybrid molecule is= 1.39Å

89 **(d)**

More is electronegativity differences, more is ionic character.

90 **(a)**

Cation are always smaller than their parent atoms:

$Al^{3+} < Al^{2+} < Al^{+} < Al$.

91 **(a)**

We know that the $C - C$ bond length $= 1.54$ A, C =C bond length $= 1.34$ A and $C \equiv C$ bond length $= 1.20$ A. Since propyne has triple bond; therefore, it has minimum bond length.

92 **(c)**

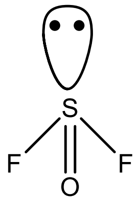
Ionic compounds conduct current in molten state.

93 **(d)**

Metals are good conductor of electricity because they contain free electrons.

94 **(d)**

OSF_2 has pyramidal shape



95 **(d)**

Non-polar species exert van der Waals' forces among themselves.

96 **(b)**

It has 3σ-and 1π-bond.

97 **(c)**

Cl^- has $1s^2, 2s^2 2p^6, 3s^2 3p^6$ configuration.

98 **(c)**

Per cent ionic character is given by % of ionic character.

$= 16(X_A - X_B) + 3.5(X_A - X_B)^2$

From the above relation, it is clear that as soon as $(X_A - X_B)$ increases, % ionic character will also increase.

Therefore, curve C shows a correct path.

99 **(d)**

$7Cl{=}1s^2, 2s^2, 2p^6, 3s^2, 3p_x^2, 3p_y^2, 3p_z^1$

$Cl{=}1s^2, 2s^2, 2p^6, 3s^1, 3p_x^1, 3p_y^1, 3p_z^1, 3d^1, 3d^1 3d^1$

(3rd excited state)

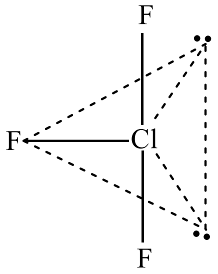
Chlorine atom, in its third excited state, reacts with fluorine to form ClF_7. Its shape is pentagonal bipyramidal.

100 **(c)**

Anion (O^-) repels the test electron because of same charge.

101 **(c)**

Cl in ClF_3 has sp^3d-hybridization



and possesses two axial Cl— F bonds and one equatorial bond. Two lone pairs are at equatorial position give rise to bent 'T' shape to ClF_3.

103 **(c)**

O_2^- has one unpaired electron in its antibonding molecular orbital.

104 **(d)**

$PCl_3 < PBr_3 < PI_3$, the bond angle order is explained in terms of increasing electronegativity of halogens, whereas, $PF_3 > PCl_3$, bond angle order is explained in terms of pπ - dπ bonding in PF_3.

105 **(c)**

μ experimental = Dipole moment $\times 10^{-18}$

μ theoretical = Bond length × 4.8 × 10^{-10} esu × cm

$$\text{Percentage ionic character} = \frac{\mu_{\text{experimental}}}{\mu_{\text{theoretical}}} \times 100$$

$$= \frac{1.0 \times 10^{-18} \times 100}{1.25 \times 4.8 \times 10^{-10} \times 10^{-8}}$$
$$= 16.66\%$$

106 **(d)**

CCl_4 does not exhibit dipole moment due to its symmetrical structure.

Cl
|
Cl – C – Cl
|
Cl

107 **(a)**

N_2 molecule has 14 electrons. The molecular orbital electronic configuration of the molecule is as

$N_2 : KK\ (\sigma 2s)^2 (\overset{*}{\sigma} 2s)^2 (\pi 2p_x)^2$

$= (\pi 2p_y)^2 (\pi 2p_z)^2$

N_2^- ion is formed when N_2 accept an electron hence it has15 electrons. The molecular orbital electronic configuration of the molecule is as

$N_2^- : KK\ (\sigma 2s)^2 (\overset{*}{\sigma} 2s)^2 (\pi 2p_x)^2 (\pi 2p_y)^2$

$(\sigma 2p_z)^2 (\overset{*}{\pi} 2p_x)^1$

Hence, this electron goes to antibonding π

molecular orbital.

108 **(b)**

The size of isoelectronic decreases with increase in atomic number.

109 **(a)**

The bond orders for H_2, H_2^+, He_2 and He_2^+ are 1.0, 0.5, 0.0 and 0.5 respectively.

110 **(b)**

N atom has smallest radius.

111 **(d)**

The order of screening effect for a given shell electrons is $s > p > d > f$.

112 **(a)**

The stability of hydrides decreases down the gp, $i.e.$, from NH_3 to BiH_3 which can be observed from their bond dissociation enthalpy. The correct order is

$$NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$$

Property	NH_3	PH_3	AsH_3	SbH_3	BiH_3
$\Delta_{diss}H^-(E-H)/\text{kJ mol}^{-1}$	389	322	297	255	–

113 **(a)**

SF_4 has sp^3d^2-hybridization and see-saw geometry.

114 **(a)**

Due to presence of intermolecular hydrogen bonding in H_2O, its molecules are associated with each other which results unusual high boiling point of water.

115 **(c)**

Larger is anion, more is covalent character.

116 **(a)**

Molecular orbital configuration of,

O_2^{2-}

$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p^2, \pi 2p_x^2, \pi 2p_y^2, \pi^* 2p$

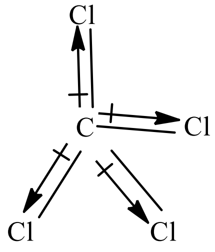
117 **(a)**

Valencies of *X*, *Y* and *Z* is +2, +2 and -2 respectively so, they will form a compound having of formula XYZ_2.

118 **(a)**

The molecule in which the bond dipoles of all the bonds are cancel out by each other, is called non – polar *e.g.*, CCl_4.

In CCl_4, there is a large difference between the electronegativities of C and Cl but all the four C – Cl bond dipoles cancel each other , hence it is a non-polar molecule.

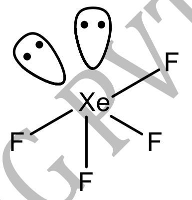


(non-polar)

119 **(c)**

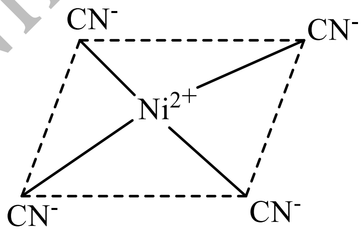
Tetrahedral structure is associated with sp^3 hybridised central atom without any lone pair. The structure of all the compounds given are as follows :

XeF_4



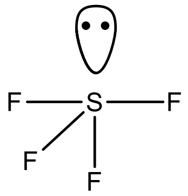
Distorted octahedral

$[Ni(CN)_4]^{2-}$



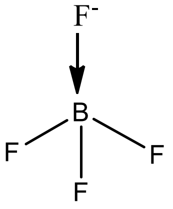
Square planar

SF_4



Distorted trigonal bipyramidal

BF_4^-

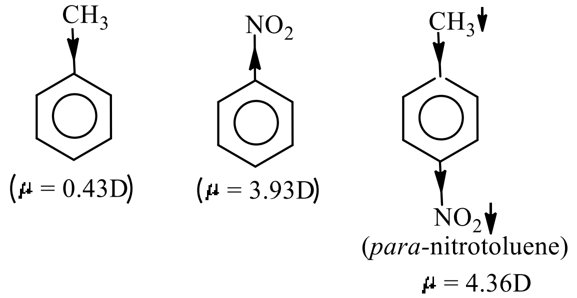


Tetrahedral

120 **(c)**

Methyl group has $+I$ effect and$-NO_2$ group has$-I$ effect. Therefore, in *p*-nitro toluene the dipole moments of $-CH_3$ and$-NO_2$ groups act in the same direction. So, the resultant dipole moment is additive.

i.e., 3.93+0.43=4.36 debye



121 **(a)**

The tendency to show lower ionic state increases down the group due to inert pair effect.

122 **(b)**

$CH \equiv C - CH_2 - CH_3$

$sp \quad sp \quad sp^3 \quad sp^3$

In butyne – 1, there is no carbon with sp^2 hybridisation.

123 **(b)**

$NO^+ : \sigma 1s^2, \sigma^x 1s^2, \sigma 2s^2, \sigma^x 2s^2, \sigma 2p_x^2 \begin{bmatrix} \pi 2p_y^2 \\ \pi 2\pi_z^2 \end{bmatrix}$

$\therefore B.O. = \frac{10-4}{2} = 3$

$CN^- : \sigma 1s^2, \sigma^x 1s^2, \sigma 2s^2, \sigma^x 2s^2, \sigma 2p_x^2 \begin{bmatrix} \pi 2p_y^2 \\ \pi 2p_z^2 \end{bmatrix}$

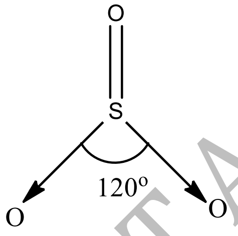
$\therefore B.O. = \frac{10-4}{2} = 3$

124 **(c)**

Electron affinity order for halogens is $Cl > F > Br > I$.

125 **(d)**

Sulphur trioxide has no $S-S$ linkage. It has triangular planar geometry.



127 **(d)**

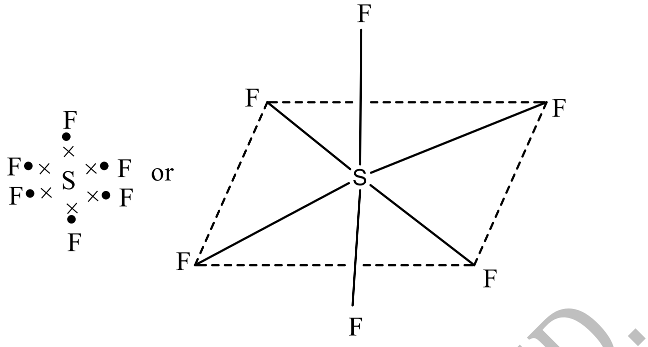
All molecules or ions *i.e.*, $H_2O, NH_4^+, SO_4^{2-}, ClO_4^-$, and NH_3 are involved in sp^3 hybridisation in their formation.

129 **(b)**

p-orbitals always show lateral overlapping.

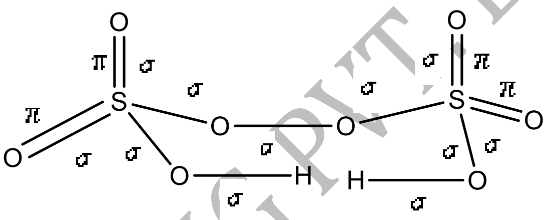
130 **(a)**

SF_6 does not obey octet rule as in it S-atom has 12 electrons in its valence shell.



131 **(b)**

The structure of peroxodisulphuric acid ($H_2S_2O_8$) is



Hence, it contains 11σ and 4π-bonds.

132 **(d)**

Paramagnetic species have unpaired electrons

133 **(c)**

N in it has three σ-bonds and one lone pair of electron.

134 **(a)**

Electron deficient species can accept lone pair of electron and thus, act as Lewis acid.

135 **(a)**

NH_3 has pyramidal shape and thus, possesses three folds axis of symmetry.

136 **(d)**

ICl_2^- has sp^3d-hybridization and has two bond pairs and three lone pairs of electrons.

137 **(a)**

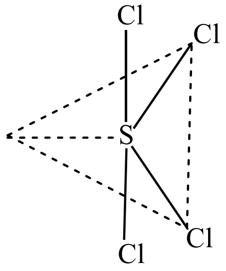
The dipole moment of a polar molecule depends upon its geometry. A symmetrical molecule is non-polar even though it contain polar bonds. Methane molecule (CH_4) has zero moment value of dipole moment due to its symmetrical structure.

In $CHCl_3$, the resultant of C – H and C – Cl dipole oppose the resultant of two C – Cl dipoles while in CH_2Cl_2, the resultant of C – H dipoles adds to resultant of two C – Cl. In case CH_3Cl, the resultant of two C – H dipole adds to the resultant of two C – Cl. In case CH_3Cl the resultant of two C – H dipoles add to the resultant of C – H and C – Cl dipoles.

Thus dipole moment of CH_3Cl is highest among the given compounds. The molecule (CCl_4) again becomes symmetrical and dipole moment reduces to zero.

138 **(c)**

S in SCl_4 is sp^3d-hybridized and possesses see-saw structure whereas $SiCl_4$ is tetrahedral.



139 **(c)**

Oxygen cannot expand its octet due to absence of d-orbitals in its valence shell.

142 **(a)**

Geometry is explained by taking an account of single bonds only. However, presence of double bond may distort bond angles, *e*.g., HCHO has sp^2-hybridization but angle H—C—H is 116° and angle H—C—O is 122° due to double bond. In BF_3 (sp^2-hybridization) each angle is of 120°.

143 **(d)**

The shape of carbon dioxide is linear because it has sp hybridisation and bond angle 180°.

$O = C = O$

144 **(a)**

Addition of electrons to an atom results an increase in its size.

145 **(d)**

H_2O is V shaped.

146 **(c)**

In diethyl ether oxygen undergoes sp^3 hybridisation forming four sp^3 hybrid orbitals.

147 **(a)**

As soon as the electronegativity increases, ionic bond strength increases

148 **(a)**

Both are linear.

149 **(c)**

Inspite of three polar bond, the lone pair of electron on N atom decreases the dipole moment of NF_3 than NH_3.

150 **(c)**

Polarity in a molecule gives rise to an increase in forces of attractions among molecules and thus, more becomes boiling point.

152 **(a)**

The melting point of naphthalene is minimum because it is non – polar covalent compound and has less melting point.

153 **(c)**

BF_3 is a electron deficient compound. So, it has no lone pair orbital over B atom.

154 **(c)**

Molecular orbital theory was given by Mulliken.

155 **(d)**

The trigonal geometry of BF_3 with three vectors (B → F) acting at 120° leads to zero dipole moment. In NH_3 three vectors (N ← H) act as 107° along with one lone pair giving dipole moment in molecule.

156 **(d)**

Proton (H^+) can only accept a lone pair from donor atom.

157 **(d)**

Each has 10 electrons

158 **(d)**

Isomerism is arised due to directional nature of covalent bonding.

159 **(b)**

SF_4 has sp^3d-hybridized sulphur atom.

160 **(c)**

$SbCl_5^{2-}$ has sp^3d^2–and rest all has sp^3d-hybridisation.

161 **(d)**

Size of anions is larger than their parent atoms. Also more is ENC lesser is size.

162 **(d)**

$${}_{22}Ti : 3s^2, 4s^2 \overset{IE_1}{\longrightarrow} 3d^2, 4s^1$$

$${}_{23}V : 3d^3, 4s^2 \overset{IE_1}{\longrightarrow} 3d^3, 4s^1$$

$${}_{24}Cr : 3d^5, 4s^1 \xrightarrow{IE_1} 3d^5 \xrightarrow[\text{hlaf-filled}]{IE_2 \text{ from}} \text{maximum}$$

$${}_{25}Mn : 3d^5, 4s^2 \overset{IE_1}{\longrightarrow} 3d^5, 4s^1$$

164 **(a)**

C – Cl bond is more ionic than C – I bond because of the greater difference in electronegativities of C and Cl as compared to that of carbon and iodine. Therefore, C – Cl bond is stronger than C – I bond.

165 **(c)**

Cl is more electronegative than I.

166 **(b)**

The solubility of a compound depends upon its hydration enthalpy. If hydration enthalpy exceeds the lattice enthalpy than it is soluble in water. For Ag_2SO_4, hydration enthalpy is lower than lattice enthalpy, so it is insoluble in water.

167 **(c)**

Silicon has the tendency to show covalent bonding because of higher IP values.

168 **(c)**

In $SnCl_2$, Sn has sp^2 hybridisation and hence, has angular shape

169 **(c)**

The inert gas just after chlorine is argon.

170 **(d)**

The d-orbital involved in sp^3d -hybridization is d_{zx}.

171 **(d)**

$$O_2 = \sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 2s^2 \overset{*}{\sigma} 2s^2 \sigma 2p_z^2 \pi 2p_x^2$$
$$= \pi 2p_y^2 \overset{*}{\pi} 2p_{x'} = \overset{*}{\pi} 2p_{y'}$$

In O_2^+, one electron is removed from Na

BO for $O_2 = 2$ and for O_2^+=2.5

Therefore, paramagnetism decreases, BO increases.

172 **(b)**

Intramolecular H-bonding is present in *ortho* nitrophenol.

174 **(c)**

According to valence shell electron pair repulsion (VSEPR) theory, the order of repulsive interactions between various electron is

$$lp - lp > lp - bp > bp - bp$$

175 **(b)**

In like atoms, electronegativity difference is zero.

176 **(d)**

BCl_3 has bond angle equal to 120° (trigonal planar). NH_3 and H_2O have sp^3 hybridisation but due to the presence of lone pair of electrons, they have bond angle less than $109.28'$ ($NH_3 - 107°$, $H_2O - 104.5°$), AsH_3 (sp^3 hybrid) has smaller bond angle than NH_3 due to less electronegativity of As than N.

177 **(d)**

E°_{op} order is Mg > Fe > Cu; more is E°_{op}, more is electropositive character.

178 **(c)**

O atom possesses two lone pair of electrons.

179 **(a)**

M.O. configuration of O_2^+ is:

$\sigma 1s^2 \sigma^* 1s^2, \sigma^* 2s^2 \sigma 2p^2, \pi 2p_y^2 \pi 2p_y^2 \pi^* 2p_x^1$

Bond order of $O_2^+ = \frac{1}{2}[6 - 1] = \frac{5}{2}$

M.O. configuration of N_2^+ is:

$\sigma 1s^2 \sigma^* 1s^2, \sigma 2s^2 \sigma^* 2s^2, \pi 2p_y^2 \pi 2p_y^2 \sigma 2p^1$

Bond order of $N_2^+ = \frac{1}{2}[5 - 0] = \frac{5}{2}$

180 **(c)**

No scope for addition in completely filled valence orbitals of inert gases.

181 **(b)**

SeF_4 has distorted tetrahedral geometry while, CH_4 has tetrahedral geometry

Speed of electron ≠ speed of light

182 **(c)**

Butadiene is $CH_2 = CH—CH = CH_2$.

183 **(b)**

37 is atomic number of Rb the electropositive element and 53 is atomic number of iodine (the electronegative element).

184 **(c)**

In methane bond angle is $109°28'$. Methane molecule is tetrahedral in structure.

185 **(b)**

Cs is metal and solid.

186 **(d)**

1. Glycerol has strong hydrogen bonding due to presence of 3 – OH groups in it. It is correct statement.

2. Alkyl halides have lower boiling point than alcohols because alcohols have stronger forces of attraction between the hydrogen bonds as compared to weaker van der Waals' forces between molecules of alkyl halide.

∴ Statement (d) is false.

187 **(a)**

Ionic radii= $\frac{n^2 a_0}{Z_{\text{eff}}}$

188 **(c)**

Only those atomic orbitals combine, that have nearly equal energy

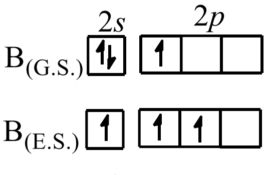
189 **(b)**

The stability of the ionic bond depends upon the lattice energy which is expected to be more between Mg and F due to +2 charge on Mg atom

190 **(a)**

Smaller is anion, lesser is its polarization.

191 **(b)**



sp^2- hybridisation

Boron has planar structure due to sp^2 hybridisation.

192 **(c)**

3. NO^-(16). According to MOT.

$$\sigma 1s^2,\ \overset{*}{\sigma}1s^2,\ \sigma 2s^2,\ \overset{*}{\sigma}2s^2,\ \sigma 2p_x^2,\ \begin{cases}\pi p_y^2\\ \pi 2p_z^2,\end{cases}\begin{cases}\overset{*}{\pi}2p_y^1\\ \overset{*}{\pi}2p_z^1,\end{cases}$$

$$\text{Bond order} = \frac{\text{bonding electrons} - \text{antibonding electrons}}{2}$$

$$= \frac{10-6}{2} = 2$$

4. NO^+(14).

$$\sigma 1s^2,\ \overset{*}{\sigma}1s^2,\ \sigma 2s^2,\ \overset{*}{\sigma}2s^2,\ \sigma 2p_x^2,\ \begin{cases}\pi 2p_y^2\\ \pi 2p_z^2,\end{cases}$$

Bond order $= = \frac{10-4}{2} = 3$

5. NO (15)

$$\sigma 1s^2,\ \overset{*}{\sigma}1s^2,\ \sigma 2s^2,\ \overset{*}{\sigma}2s^2,\ \sigma 2p_x^2,\ \begin{cases}\pi 2p_y^2\\ \pi 2p_z^2,\end{cases}\begin{cases}\overset{*}{\pi}2p_y^1\\ \overset{*}{\pi}2p_z^0\end{cases}$$

Bond order $= = \frac{10-5}{2} = 2.5$

(iv)NO^{2+}(13).

$$\sigma 1s^2,\ \overset{*}{\sigma}1s^2,\ \sigma 2s^2,\ \overset{*}{\sigma}2s^2,\ \sigma 2p_x^2,\ \begin{cases}\pi 2p_y^2\\ \pi 2p_z^2,\end{cases}$$

Bond order $= = \frac{9-4}{2} = 2.5$

6. NO^{2-}(17)

$$\sigma 1s^2,\ \overset{*}{\sigma}1s^2,\ \sigma 2s^2,\ \overset{*}{\sigma}2s^2,\ \sigma 2p_x^2,\ \begin{cases}\pi 2p_y^2\\ \pi 2p_z^2,\end{cases}\begin{cases}\overset{*}{\pi}2p_y^2\\ \overset{*}{\pi}2p_z^1\end{cases}$$

Bond order $= = \frac{10-7}{2} = 1.5$

The order of bond order is

$NO^{2-} < NO^- < NO^{2+} \approx NO < NO^+$

193 **(d)**

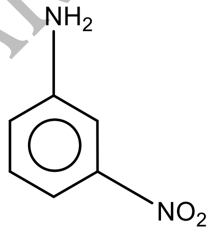
Cl is more electronegative than Br.

194 **(c)**

Boron in $[BF_4]^-$ has regular tetrahedral geometry because of sp^3-hybridization on boron atom.

195 **(d)**

Usually symmetrical molecules have less dipole moment in comparison to unsymmetrical molecules.

Hence,  (m-nitroaniline) has the highest dipole moment among the given.

196 **(a)**

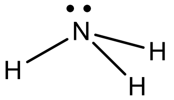
Thus, excitation of $2s$-electron in N is not possible.

197 **(b)**

PF_5 has sp^3d hybridization (trigonal bipyramid); BrF_5 has sp^3d^2 hybridization (square pyramidal)

198 **(d)**

In NH_3 sp^3 hybridisation is present but its shape becomes pyramidal due to the presence of one lone pair of electron.



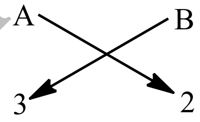
199 **(d)**

Higher the lattice energy lower the solubility. Out of the four combinations possible, the lattice energy of MgS (bi-bivalent ionic solid) is higher than those of $Na_2S, MgCl_2$ (uni-bivalent or biuni-valent ionic solids) and NaCl (uni-univalent ionic solids) and hence, MgS is the least soluble.

200 **(b)**

A three electrons in its outermost orbit, its valency is 3. B has six electrons in its outermost orbit, its valency is 2

Element



Valency

Formula of the compound $= A_2B_3$

201 **(c)**

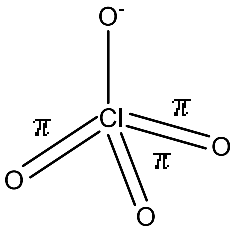
A reason for the given fact.

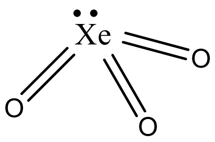
202 **(c)**

In NH_3, sp^3-hybridization is present but bond angle is 106°45′ because nitrogen has lone pair of electrons, according to VSEPR theory due to bp- and lp repulsion, bond angle decreases from 109°28′ to 106°45′

203 **(b)**

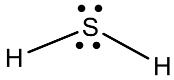
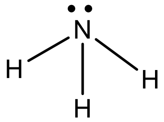
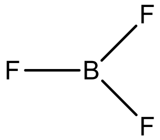
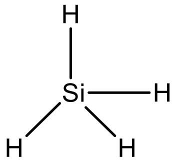
ClO_4^- and XeO_3 both contain $3d\pi - p\pi$ bonds





204 **(c)**

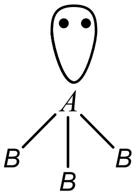
Species	Structure	lp	bp	VSEPR	Bond angle

H_2S		2	2	lp − lp	90°
NH_3		1	3	lp − bp bp − bp	107°
BF_3		0	3	lp − bp	120°
SiH_4		0	4	bp − bp bp − bp bp − bp	109°28′′

Thus, bond angle $H_2S < NH_3 < SiH_4 < BF_3$.

205 **(d)**

The pyramidal structure of covalent molecule AB_3 is as :



No. of lone pair = 1

No. of bond pair =3

207 **(d)**

d^2sp^3-leads to octahedral geometry.

209 **(a)**

A molecule is said to possess a three-fold axis of symmetry if on rotation around this axis through an angle of 360/3, *ie*, 120°,gives the same arrangement of atoms. Since NH_3 has a pyramidal geometry, therefore, it has a three fold axis of symmetry

210 **(a)**

Proton number does not change in ion formation, though number of electrons and size change during this.

211 **(d)**

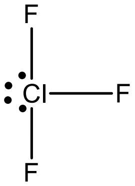
Valence bond theory (Resonance theory) of metallic bond was given by Pauling (1937). According to this theory, the metallic bonding is essentially covalent in origin and metallic structure exhibits resonance of electro-pair bonds between each atom and its nearest neighbours. In other words, there is a resonance of a large number of canonical forms.

212 **(c)**

Notice configuration of N^+, C^+, O^+ and F^+.

213 **(b)**

ClF_3 has sp^3d hybridisation. Out of five sp^3d hybrid orbitals two are completely filled by *lp* and three are half filled which overlap with three $2p_z$ half filled orbitals of three F-atoms. Due to the presence of two *lps* its geometry is bent *T*-shaped.



214 **(d)**

These are characteristics of resonance.

215 **(c)**

$$O_2^{2-}\ :\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2 \sigma^* 2s^2 \sigma 2p^2 \begin{bmatrix}\pi 2p_y^2 \\ \pi 2p_z^2\end{bmatrix} \begin{matrix}\pi^* 2p_y^2 \\ \pi^* 2p_z^2\end{matrix}$$

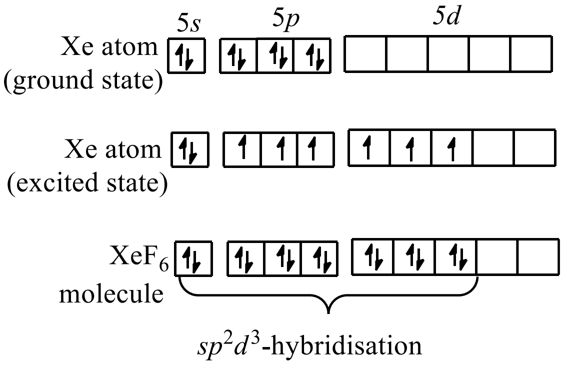
$$B.O. = \frac{10-8}{2} = 1$$

$$B_2 : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2 \begin{bmatrix}\pi 2p_y^1 \\ \pi 2p_z^1\end{bmatrix}$$

$$B.O. = \frac{6-4}{2} = 1$$

216 **(c)**

In the formation of XeF_6 molecule, three 5 *p* electrons are promoted to 5*d* orbitals. Now, one 5s, three 5p and three 5d-orbitals of Xe atom intermix together and form seven sp^3d^3 hybrid orbitals. One sp^3d^3 hybrid orbital contains one lone pair of electrons while other six are half-filled. The expected geometry is pentagonal bipyramidal.



Shape : Pentagonal bipyramidal

217 **(a)**

$CaC_2 \rightleftharpoons Ca^{2+} + C_2^{2-}$

Carbide ion

In carbide ion, two carbon atoms are joined by triple bond

(If is isoelectronic with N_2)

$-C \equiv C-$

with two π and one σ-bonds.

218 **(b)**

H_2O has sp^3-hybridization.

219 **(c)**

$e.g.$, BF_3, a non-polar molecule having sp^2-hybridization.

220 **(b)**

When there is less difference in electronegativities of two atoms (but electronegativities are not same) and large difference in their size, polar covalent bond forms.

H and Br : Small difference in electronegativities and large difference in size. Hence, form polar covalent bond.

Na and Br : large difference in electronegativities, hence electrovalent bond is formed.

221 **(b)**

The bond order for $O_2^{2-}, O_2^-, O_2, O_2^+$ are 1.0, 1.5, 2.0, 2.5 respectively. Higher is bond order, more is bond energy.

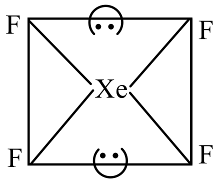
222 **(c)**

In XeF_4, the central atom, Xe, has eight electrons in its outermost shell. Out of these four are used for forming four σ-bonds with F and four remain as lone pairs.

$\therefore\ XeF_4 \implies 4\ \sigma$ bonds + 2 lone pairs

$\implies$ 6 bybridised orbitals, $i.e.$, sp^3d^2 hybridisation

Since, two lone pairs of electrons are present, the geometry of XeF_4 becomes square planar from octahedral.



223 **(b)**

Bond order $= \frac{1}{2}$ [no. of bonding electrons − no. of antibonding electrons]

224 **(c)**

H-bonding is noticed in molecules having H atom attached on N, O or F.

225 **(d)**

F is more electronegative.

226 **(a)**

s-orbitals always lead head on overlapping.

228 **(a)**

According to molecular orbital theory , π-bonding orbital are ungerade.

229 **(c)**

Basic character of hydrides is $NH_3 > PH_3$.

230 **(b)**

CO_2 has sp-hybridization.

231 **(a)**

Bond angles decrease on moving down the group for similar compounds, $i.e.$, $NH_3 > PH_3 > AsH_3 > SbH_3$.

232 **(a)**

Ionic compounds break into their constituent ions when dissolved in water.

Carnallite is double salt having composition, $KCl.MgCl_2.6H_2O$. It gives K^+, Cl^- and Mg^{2+} ions when dissolved in water.

234 **(d)**

An increase in s-character give rise to an increase in bond strength.

235 **(a)**

In rest all dipole-dipole forces also exist.

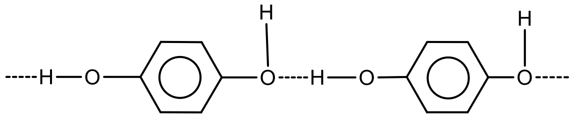
236 **(c)**

Among the isoelectronic species smaller is +ve charge, larger is ionic radius, e.g.,

Ionic radius : $Na^+ > Mg^{2+} > Al^{3+}$

237 **(c)**

1, 4-dihydroxy benzene shows the highest boiling point among given compounds because it forms strong intermolecular hydrogen bonds (It does not form intermolecular H-bonding.)



Intermolecular
H-bonding

Order of H-bonding in o, m and p-isomers of a compound is given below

Intermolecular H-bonding, $o < m < p$-isomers

intermolecular H-bonding

$o > m > p$ isomers.

Hydroxy benzene do not form a chain of H-bonding . Hence, intermolecular H-bond is stronger than intermolecular H-bonds, so the stability of 1, 4-dihydroxy benzene is highest. Hence its boiling point is highest. The increasing order of the boiling points of the given compound is

$IV < I < II < III$

238 **(d)**

Molecules in *trans*-1, 2-dichloroethene are symmetrical hence, no dipole moment.

239 **(b)**

sp^3d^2-hybridization leads to octahedral geometry.

240 **(c)**

In BF_3,boron is sp^2 hybridised, so its all atoms are coplanar

241 **(c)**

Since, the geometry of AsF_5 molecule is trigonal bipyramidal, it is sp^3d hybridised. Thus, s, p_x, p_y, p_z and d_{z^2} orbitals are utilised by As atom from bonding.

242 **(c)**

Molecular orbital configuration of N_2^+ is

$$N_2^+ = (\sigma 1s)^2(\overset{*}{\sigma}1s)^2(\sigma 2s)^2(\overset{*}{\sigma}2s)^2(\pi 2p_y)^2 = (\pi 2p_z)^2(\sigma 2p_x)^1$$

Bond order $= \frac{N_b - N_a}{2} = \frac{9-4}{2} = 2.5$

243 **(a)**

Structure of C_2H_2 is linear.

$H - C \equiv C - H$

Structure of CO_2 is also linear

$O = C = O$

So, both are isostructural species.

244 **(c)**

In o-dichlorobenzene, $\alpha = 60^\circ$

$\therefore \cos\alpha = +ve$

$$\mu = \sqrt{\mu_1^2 + \mu_2^2 + 2\mu_1\mu_2\cos\alpha}$$

245 **(c)**

Multiplicity of bonds gives higher bond energy.

246 **(d)**

Bond order of oxygen molecule = 2

Bond order of oxygen molecule ion = 2.5

Bond order of superoxide ion $(O_2^-) = 1.5$

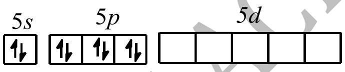
Bond order of peroxide ion $(O_2^{2-}) = 1$

Hence, the order of bond strength is as

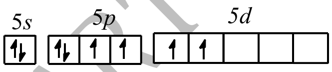
$O_2^+ > O_2 > O_2^- > O_2^{2-}$

247 **(c)**

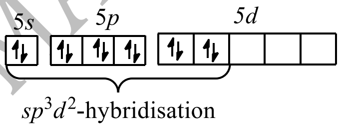
Electronic configuration of Xe in ground state



Electronic configuration of Xe in excited state



Electronic configuration of Xe in XeF_4



Note The expected geometry of XeF_4 is octahedral. On account of the fact that *lp-lp* repulsion > *lp-bp* repulsion, there is some distortion octahedral geometry with two lone pair of electrons. In other words, it has a square planar geometry.

248 **(b)**

$Li_2: KK(\sigma 2s)^2, BO = \frac{1}{2}(2-0) = 1$

Hence, structure of Li_2 is [Li – Li].

250 **(b)**

More directionally concentrated orbitals show more overlapping.

251 **(d)**

It is the hybridization of ICl_2^+.

252 **(b)**

$o-, m-, p$-derivatives has $\alpha = 60^\circ, 120^\circ$ and 180° and thus, resultant vector has zero dipole moment in p-derivative. Also dipole moment of m-dichlorobenzene is more than toluene.

253 **(a)**

Covalent character α charge of cation

254 **(c)**

Carbon cannot accept $6Cl^-$, since it has no vacant d-orbitals.

255 **(b)**

Cs^+ is largest cation and F^- is smallest anion.

256 **(b)**

Charge of $e^- = 1.6 \times 10^{-19}$

Dipole moment of HBr $= 1.6 \times 10^{-30}$

Inter-atomic spacing $= 1$ Å

$= 1 \times 10^{-10}$ m

Percentage of ionic character in HBr

$$= \frac{\text{Dipole moment of HBr} \times 100}{\text{inter spacing distance} \times q}$$

$$= \frac{1.6\times10^{-30}}{1.6\times10^{-19}\times10^{-10}} \times 100$$

$$= 10^{-30} \times 10^{29} \times 100$$

$$= 10^{-1} \times 100$$

$$= 0.1 \times 100$$

$$= 10\%$$

257 **(b)**

Lower IE, more EA and high lattice energy are required conditions for ionic bonding.

258 **(d)**

Ionisation potential increases along the period.

259 **(b)**

More is s-character, smaller is hybridized orbital, more becomes tendency for overlapping, more is bond energy, lesser is bond length.

260 **(c)**

Larger is the difference in electronegativities of two atom, more is polar character in bond.

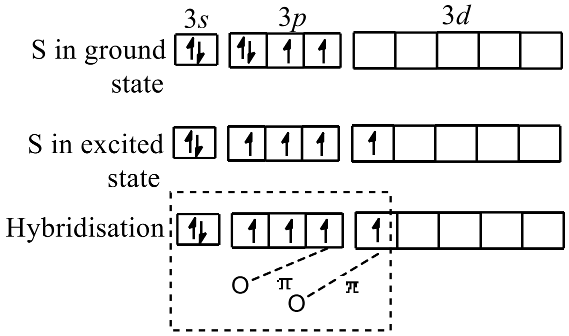
261 **(a)**

The molecules having no difference in electronegativity of bonded atoms are non-polar in nature. They are molecules having same atoms. $\therefore$ Among HCl, HF, HBr and H_2. H_2 is non-polar molecule.

262 **(b)**

In SO_2 molecule, S is sp^2-hybridised.

S (16) $= 1s^2, 2s^2, 2p^6, 3s^2, 3p^4$



sp^2-hybridisation

263 **(b)**

The size of isoelectronic species increases with decrease in effective nuclear charge.

264 **(d)**

Bond order for He_2 is zero.

265 **(b)**

CsF is ionic compound.

266 **(a)**

Isoelectronic species have same number of electrons

267 **(d)**

Ionic character$= 16(E_A - E_B) + 3.5(E_A - E_B)^2$

$= 16(4 - 1.2) + 3.5(4 - 1.2)^2$

$= 72.24\%$

268 **(d)**

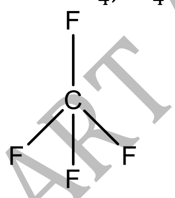
During the formation of chemical bond energy decreases

269 **(b)**

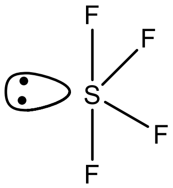
$K_4Fe(CN)_6 \longrightarrow 4K^+ + Fe(CN)_6^{4-}$.

270 **(c)**

7. CF_4, SF_4



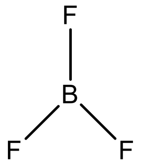
Tetrahedral
(sp^3 hybridisation)



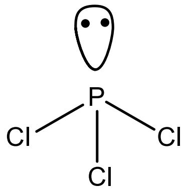
Sec-saw structure
(sp^3d hybridisation)

∴ Both have different structure.

8. BF_3, PCl_3



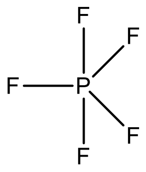
Trigonal planar
(sp^2d hybridisation)



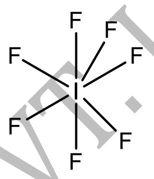
Pyramidal structure
(sp^3d hybridisation)

∴ Both have different structure.

9. XeF_2, CO_2



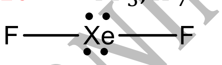
Trigonal bipyramidal



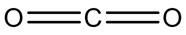
Pentagonal bipyramidal

∴ Both have different structure.

10. PF_5, IF_7



Linear



Linear

∵ Both have linear structure.

∴ They have same structure.

271 **(d)**

Covalent union between two unlike atoms gives rise to the formation of a polar covalent bond in which shared pair of electron shifted towards more electronegative atom. This gives rise to equal but opposite partial charges on two ends. HCl shows polar covalent bond.

272 **(b)**

Rest all either has incomplete (BF_3, BeF_2) octer or expanded octet (ClO_2).

274 **(d)**

CO, CN^- and NO^+ all the three species have 14 electrons.

According to MOT

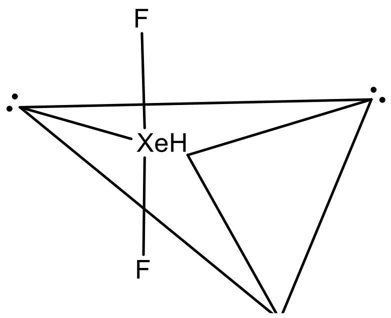
$\sigma 1s^2, \overset{*}{\sigma} 1s^2, \sigma 2s^2, \overset{*}{\sigma} 2s^2, \sigma 2p_x^2 (\pi 2p_y^2 = \pi 2p_z^2)$

Bond order $= \frac{10-4}{2} = 3$

Similarly bond order for $O_2^+ = 2.5$

275 **(a)**

XeF_2 molecule contains two bond pairs and three lone pairs in the outer-shell of central atom and thus its hybridisation is sp^3d^2 but to minimise the repulsive forces the three lone pairs occupy the equatorial position and the molecule becomes linear shape.



276 **(c)**

Species having the same number of electron, have same bond order.

Species	Number of electrons
CN^-	6+7+1=14
O_2^-	8+8+1=17
NO^+	7+8-1=14
CN^-	6+7-1=12

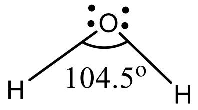
Since, CN^- and NO^+ have same number of electrons, they have same bond order, *i.e.*, 3.

CN^- or NO^+ = 14= $\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2 \approx \pi 2p_y^2,$

Bond order $= \frac{N_{b-}N_a}{2}$

$$= \frac{10-4}{2} = 3.$$

277 **(c)**



In water molecule the $H-O-H$ bond angle is 104.5° and dipole moment is 1.84 D.

The bond angle of H_2O is lower than 109.28″ due to the presence of two lone pair of electrons on the oxygen atom.

278 **(d)**

Follow text.

279 **(a)**

RCH_2NHCH_3 shows the hydrogen bonding, since H is attached to N atom.

280 **(c)**

Cl atom has 17 electrons, Cl^- ion has 18 electrons.

281 **(a)**

High boiling point. of water is due to dipole-dipole interaction.

282 **(d)**

Ionisation enthalpy increases along the period and decreases down the group.

283 **(b)**

The jump in IP values exist in IP_5 and thus, removal of fifth electron occurs from inner shell. Thus, element contains four electrons in its valency shell.

284 **(a)**

Paramagnetic species has unpaired electron.

$B_2 = 5+5 = 10\ \sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \pi 2p_x^1$
$= \pi 2p_y^1$

$C_2 = 6+6 = 12$
$= \sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \pi 2p_x^2$
$= \pi 2p_y^2$

$N_2 = 7+7 = 14 = \sigma 1s^2, \overset{*}{\sigma}1s^2 \sigma 2s^2, \overset{*}{\sigma}2s^{2,} \pi 2p_x^2$
$= \pi 2p_y^2, \sigma 2p_z^2$

$F_2 = 9+9 = 18$
$= \sigma 1s^{2,} \overset{*}{\sigma}1s^2, \sigma 2s^{2,} \overset{*}{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2$
$= \pi 2p_y^2, \overset{*}{\pi}2p_x^2 = \overset{*}{\pi}2p_y^2$

$\therefore$ B_2 is paramagnetic because it has unpaired electron.

285 **(a)**

$Na \longrightarrow Na^+ + e; IE$ of Na = +ve
$Na^+ + e \longrightarrow Na;\quad EA$ of Na^+ =-ve
Both are equal but opposite in nature.

286 **(c)**

(a) $CH_4 \longrightarrow CH_3 - CH_3$
$4bp + 0lp \quad 4bp \quad 4bp$
Hybridisation $sp^3 \quad sp^3 \quad sp^3$
Structure tetrahedral tetrahedral

(b) $NH_3 \longrightarrow NH_4^+$
$3bp + 1lp \quad 4bp$
Hybridisation $sp^3 \quad sp^3$
Structure pyramidal tetrahedral

(c) $BF_3 \longrightarrow BF_4^-$
$3bp \quad 4bp$
Hybridisation $sp^2 \quad sp^3$
Structure trigonal planar tetrahedral

(d) $H_2O \longrightarrow H_3O^+$
$2bp + 2lp \quad 3bp + 1lp$
Hybridisation $sp^3 \quad sp^3$
Structure angular pyramidal

Thus conversion of BF_3 into BF_4^- involves change in both hybridisation and shape.

287 **(a)**

In O_2 molecule, the total number of electrons = 16

Electronic distribution in molecular orbital of

$O_2 = \sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_x^2 \left(\pi 2p_y^2, \pi 2p_z^2\right), \left(\overset{*}{\pi}2p_y^1, \overset{*}{\pi}2p_z^1\right)$

Bond order in $O_2 = \frac{1}{2}[N_{b-} N_a] = \frac{1}{2}[10-6] = 2.0$

In $O_2^+ = \sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_x^2$

$(\pi 2p_y^2 = \pi 2p_z^2), (\overset{*}{\pi} 2p_y^1)$

Bond order in $O_2^+ = \frac{N_b - N_a}{2} = \frac{10-5}{2} = 2.5$

288 **(a)**

Percentage ionic character

$$= \frac{\text{experimental value of DM}}{\text{theoretical value of DM}} \times 100$$

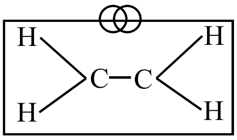
$$= \frac{1.03}{6.12} \times 100 = 17\%$$

289 **(b)**

Electron affinity decreases down the group, but 'O' has small atomic size and $2p$-orbital becomes very compact and already has 6 electrons, hence, there is a repulsive force among the already present and added electrons. Some of the energy evolved, due to addition of electron, is used to reduce the repulsion. Hence, the E.A. of O is less than S, so the order is $S > O > Se$.

290 **(a)**

A π-bond has a nodal plane passing through the two bonded nuclei, *i. e.*, molecular plane.



←Nodal plane, *i.e.*, molecular plane.

291 **(c)**

Electronegativity of elements increases along the period and decreases down the group.

292 **(b)**

In CO_2, C-atom is sp-hybridised, thus it has linear structure. In XeF_2, Xe is sp^3d hybridised with three lone-pairs of electrons on equatorial position. This minimises repulsion, hence it has also linear structure.

293 **(b)**

Structure of CO_2 is linear due to sp-hybridisation.

(sp)

$O = C = O$

294 **(a)**

Higher the bond order short the bond length O_2^{2+} has the shortest the bond length (BO=3)

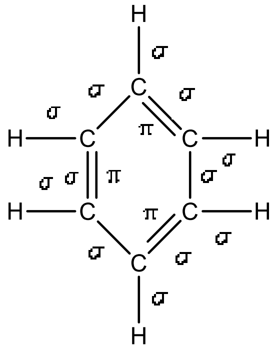
Bond order of remaining species are :

$O_2^+(2.5)$, $O_2^-(1.5)$ and $O_2^{2-}(1)$

295 **(b)**

11. The first bond between any two atoms is σ and rest are π bonds.

12. π bond is formed by sideways overlapping of unhybridised p-orbital.



Each carbon has 3σ and 1 π-bond.

∴ All carbon atoms of C_6H_6 are sp^2 hybridised.

296 **(d)**

Nearer to 25%, the angle is 109°28′ for sp^3-hybridization.

297 **(c)**

$KHF_2 \longrightarrow K^+ + HF_2^-$.

298 **(c)**

Intramolecular H—bonding in salicyl aldehyde prevents its test with $FeCl_3(aq)$.

299 **(c)**

Stronger is metallic bonding (Fe has d-subshell), more is hardness.

300 **(d)**

Compound	Bond angle
NH_3	107°
PCl_3	93°
BCl_3	120°

301 **(d)**

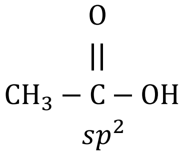
In propyne there are 2 π – bonds and six sigma bonds.

$CH_3C \equiv CH$

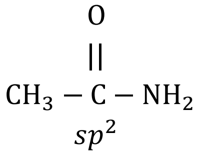
302 **(a)**

Like atoms results in covalent bonding leading to the formation of non-polar bond, *e.*g., H—H or H_2.

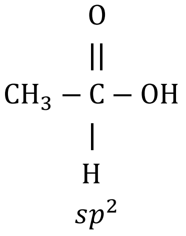
303 **(c)**



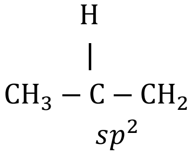
$CH_3 - \overset{\overset{O}{\|}}{C} - OH$ sp^2



$CH_3 - \overset{\overset{O}{\|}}{C} - NH_2$ sp^2

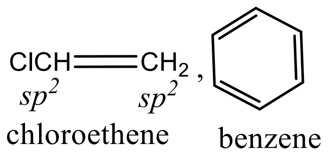


$CH_3 - \overset{\overset{O}{\|}}{\underset{\underset{H}{|}}{C}} - OH$ sp^2



$CH_3 - \overset{\overset{H}{|}}{C} - CH_2$ sp^2

304 **(d)**



all carbon atoms are sp^2 hybridised chloroethene

$CH_2 = CH - CH = CH_2$

$sp^2 \quad sp^2 \quad sp^2 \quad sp^2$

$CH_2 = CH - CH = CH - CH = CH_2$

$sp^2 \quad sp^2 \quad sp^2 \quad sp^2 \quad sp^2 \quad sp^2$

1, 3, 5-hexatriene

305 **(d)**

If the lattice energy < hydration energy, then only ionic compounds are soluble.

306 **(c)**

BCl_3 has equilateral triangular shape leading to vector sum of polar bonds to zero.

307 **(d)**

Hybride : H_2O H_2S H_2Se H_2Te

Bond angle : 104° 92° 91° 90°

In all of the given species central atom is sp^3 hybridised. They have angular shape due to the presence of two lone pair of electron. The bond angle decreases with decrease in electronegativity therefore H_2Te shows minimum bond angle.

308 **(d)**

Lattice energy $\propto$ charge of ions $\propto \frac{1}{\text{size of ions}}$

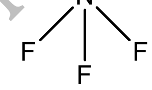
309 **(b)**

He_2^+, H_2^- have 3 electrons, one must be unpaired. H_2^+ has one unpaired electron. H_2 has two (paired) electrons.

310 **(c)**

Among the given, only CH_3OH and CH_3NH_2 are able to form H-bonds but H-bonding in CH_3OH due to high electronegativity of O-atom is strong. Hence, CH_3OH has the highest boiling point.

311 **(a)**



(σ-bps + lps = 3+1=4)

In NF_3 N-atoms is sp^3-hybride, but due to presence of a lone pair of electron, NF_3 has pyramidal structure.

312 **(d)**

The boiling point of ethanol is highest among these due to the presence of hydrogen bonding.

313 **(b)**

C_2^{2-} has $[C \equiv C]^{2-}$ structure.

314 **(a)**

A compound having maximum electronegative element will form strong hydrogen bond

315 **(c)**

The bond angle in CH_3OCH_3 is 110° inspite of sp^3-hybridization of O and two lone pair due to stearic hindrance.

316 **(b)**

Multiplicity in bonding give rise to an increase in bond energy.

317 **(a)**

Carbon in H_2CO_3 has sp^2-hybridization and also polar. BF_3 has sp^2 but non-polar. SlF_4 has sp^3-hybridization. $HClO_2$has sp^3-hybridisation.

318 **(b)**

The removal of second electron from Mg takes place from 3*s*-orbital whereas, the removal of second electron from Na takes place from 2*p*-orbital. More closer are shells to the nucleus, difficult is removal of electron.

319 **(b)**

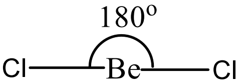
Bond angle depends on the structure of molecule. If two molecules have same structure, then bond angle is decided by the electronegativity of central atom. Electrongeativity of central atom $\propto$ bond angle.

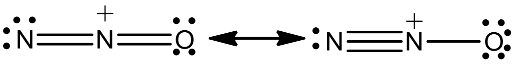
The bond angle of H_2S is less than H_2O because S is less electronegative than H_2O.

Hence, $H_2O > H_2S$

(104.5°) (92.2°)

Further the $BeCl_2$ has linear structure, hence its bond angle is 180°. The N_2O molecule also has linear structure with bond angle 180°.

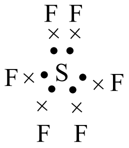




320 **(a)**

S has 6 electrons in its the valence shell and it shares 6 electrons with 6 fluorine atoms.

∴ In SF_6, S has 12 electrons in its valence shell



322 **(b)**

$NH_3, [PtCl_4]^{2-}, PCl_5$ and BCl_3 have $sp^3, dsp^2 sp^3 d$

and sp^2 hybridization respectively. Note that hybridization of P in PCl_5 is wrongly reported in problem.

323 **(b)**

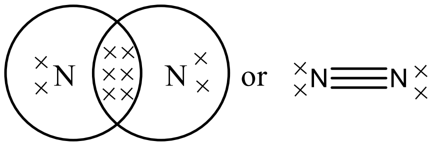
The bond formation process is exothermic and thus resultant acquires lower energy level.

324 **(b)**

Due to H-bonding in NH_3.

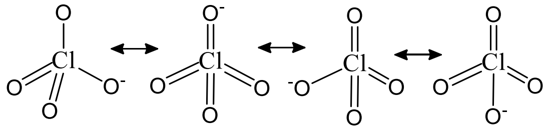
325 **(a)**

Lewis structure of N_2 molecule is



326 **(b)**

The resonating structure of ClO_4^- are as



$$\Rightarrow \text{Bond order} = \frac{\text{Total number of bonds between Cl and O}}{\text{Total number of resonating structure}}$$

$$= \frac{7}{4} = 1.75$$

327 **(a)**

Bond energy increases with increase in bond order.

328 **(d)**

Ionisation potential increases along the period.

329 **(b)**

CsCl is most ionic because of most electropositive nature of Cs.

330 **(d)**

$O_2 < O_2^-$

Bond order

$C_2 = 2$

$C_2^{2-} = 3$

$B_2 = 2$

$B_2^+ = 1.5$

$Li_2 = 1$

$Li_2^+ = 0.5$

$N_2 = 3$

$N_2^+ = 2.5$

$O_2 = 2$

$O_2^- = 1.5$

331 **(d)**

The molecular configuration of O_2^- is as

$$\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_y^2$$
$$\approx \pi 2p_z^2, \overset{*}{\pi}2p_x^2 \approx \overset{*}{\pi}2p_y^2$$

$$\text{Bond order} = \frac{N_{b-}N_a}{2}$$
$$= \frac{10-8}{2}$$

$\therefore$ Bond order = 1

332 **(b)**

It is an ionic compound. The most ionic compound is CsF.

333 **(c)**

CO_2 is linear molecule.

334 **(b)**

M.O. configuration of N_2 is:

$\sigma 1s^2 \sigma^* 1s^2, \sigma 2s^2 \sigma^* 2s^2, \pi 2p_y^2, \pi 2p_z^2, \sigma 2p_x^2$

M.O. configuration of N_2^+ is:

$\sigma 1s^2 \sigma^* 1s^2, \sigma 2s^2 \sigma^* 2s^2, \pi 2p_y^2, \pi 2p_z^2, \sigma 2p_x^1$

335 **(d)**

In NH_4^+ ion, N is sp^3 hybridised therefore, bond angle in NH_4^+ (tetrahedral shape) is 109°28′.

336 **(a)**

The definition of bond order.

338 **(b)**

The intermolecular forces increase with increases in mol. wt.

339 **(b)**

Bond angles of BeF_2, H_2O, NH_3 and CH_4 are 180°, 104°31′, 106°50′, 109°28′ respectively.

340 **(d)**

Bond length decreases with increase in *s*-character.

341 **(b)**

Isoelectronic species have same number of electrons, NO^+, C_2^{2-}, CN^- and N_2. All have 14 electrons.

342 **(d)**

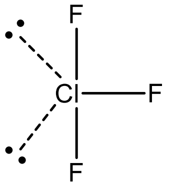
sp^3d^2 hybridised molecule have octahedral geometry.

343 **(b)**

$R—O—H \ldots H—O—H$

344 **(a)**

The shape of ClF_3 is distorted T-shape due to the presence of two lone pair of electrons.



345 **(b)**

These are facts.

346 **(c)**

NO_2^- has sp^2 hybridisation. Its expected geometry is trigonal planar but actual geometry is V-shape due to presence of lone pair of electrons.

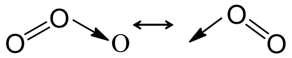
347 **(d)**

Cs^+ is biggest ion among these. F^- is smallest.

348 **(d)**
Formation of solid lattice from oppositely charged ionized gaseous atoms give rise to evolution of lattice energy.

349 **(b)**
We know that Al^{3+} cation is smaller than Na^+ (because of greater nuclear charge). According to Fajan's rule, small cation polarise anion upto greater extent. Hence, Al^{3+} polarise Cl^- ions upto greater extent, therefore, $AlCl_3$ has covalent bond between Al and Cl atoms.

350 **(a)**
H—O—O—H, O←O=O, O=O



Due to resonance, in O_3,the $O-O$ bond length will be in between $O=O$ and $O-O$

352 **(b)**
Bond order for $O_2=2$ and for $O_2^+=2.5$
Both are paramagnetic (O_2has 2 unpaired electron, O_2^+ has one unpaired electron).

354 **(c)**
$[O-O]^{2-}$

355 **(b)**
For sp^2hybridization, bond angle is 120°
In sp^2hybridization,
s character $=\frac{1}{3}\times 100=33\%$

356 **(d)**
ClF_3 has sp^3d-hybridization with two lone pair of electron on Cl.

357 **(a)**
13. $O_2=8+8=16$

$=\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, (\pi 2p_x^2=\pi 2p_y^2), (\overset{*}{\pi}2p_x^1=\overset{*}{p}2p_y^1)$
∵ It has 2 unpaired electrons.
∴ It is paramagnetic.
14. $CN^-=6+7+1=14$

$=\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, (\pi 2p_x^2=\pi 2p_y^2)$
∴ No unpaired electron and no paramagnetic.
15. $CO=6+8=14$

$=\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, (\pi 2p_x^2=\pi 2p_y^2)$
∴ No unpaired electron and no paramagnetic.
16. $NO^+=7+8-1=14$

$=\sigma 1s^2 \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, (\pi 2p_x^2=\pi 2p_y^2)$
∴ No unpaired electron and not paramagnetic.

358 **(c)**
C— F bond is more polar than C— Cl.

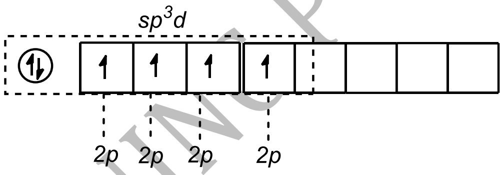
359 **(d)**
Ionic compounds conduct current only in fused state.

360 **(b)**
IP_1 of B > $IP_1$of Li ENC of boron is more than Li. Also IP_1 of Li > IP_1 of K because removal of electron in K occurs from $4s$.

361 **(c)**
It is a fact.

363 **(d)**
O has two lone pair of electrons.

364 **(a)**
In SF_4, S has sp^3d-hybridisation. Thus, it contains two axial and two equatorial bonds to give see-saw structure.



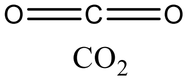
365 **(a)**
F_3Cl has 10 electrons on Cl atom. A superoctet molecule means for expanded octet on an atom.

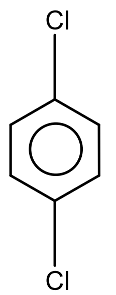
366 **(c)**
S_2 molecule is paramagnetic like O_2 having 2 unpaired electrons.

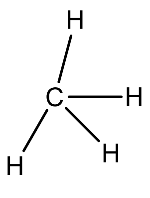
368 **(a)**
π-bonding occurs only after σ-bond is formed.

369 **(d)**
$NH_4^+$and SO_4^{2-}both show sp^3 hybridisation and tetrahedral geometry

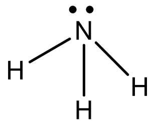
370 **(c)**
Dipole moment is a vector quantity. The dipole moment of symmetrical molecule is zero. Only the molecule which has distorted shape has dipole moment.


CO_2
(a)


p-dichlorobenzene
(b)


methane
(d)

∵ CO_2, p -dichlorobenzene and CH_4 have regular symmetrical shape.
∴ They don't have dipole moment.



(NH_3)

(c)

NH_3 has distorted structure due to presence of lone pair of electron.

∴ It has dipole moment.

371 **(c)**

According to Fajan's rule smaller anion is polarised to lesser extent than the larger anion.

∴ compound having smaller anion has more ionic character.

∴ Higher melting

Since, the size of F^- ion is smallest, it is polarised.

∴ AgF will have highest ionic character and hence highest melting point.

(∵ Ionic compounds have greater melting point than covalent compound)

372 **(a)**

Number of hybrid orbitals for neutral atom $= \frac{1}{2}$ [Number of valence electron in central atom + Number of monovalent atom]

Number of hybrid orbital $= \frac{5+5}{5} = 5$

Hence, hybridisation is sp^3d.

374 **(a)**

The size of isoelectronic decreases with increase in atomic number.

375 **(a)**

Bond angle for sp, sp^2 and sp^3-orbitals are 180°, 120° and 109°28′ respectively.

378 **(d)**

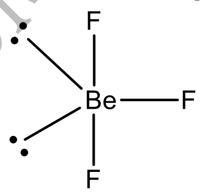
In BrF_3 molecule, Br is sp^3d hybrid, but geometry is T-shaped due to distortion of geometry from trigonal-bipyramidal to T-shaped by the involvement of lone pair-lone pair repulsion.

Here

$lp - lp$ repulsion $= 0$

$lp - bp$ repulsion $= 4$

$bp - bp$ repulsion $= 2$



379 **(b)**

As the distance between the atoms, increases, bond polarity increases

380 **(d)**

EA_1 for elements is exothermic and EA_2 is endothermic. Also EA_2 for O $>$ EA_1 for O.

381 **(a)**

$O_2^- = 8 + 8 + 1$

$= \sigma 1s^2, {}^{*}_{\sigma}1s^2, \sigma 2s^2, {}^{*}_{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2$

$= \pi 2p_y^2, {}^{*}_{\pi}2p_x^2 = {}^{*}_{\pi}2p_y^1$

∴ Total antibonding electrons $= 7$

$O_2 = 8 + 8 = 16$

$= \sigma 1s^2, {}^{*}_{\sigma}1s^2, \sigma 2s^2, {}^{*}_{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2 =$
$\pi 2p_y^2, \pi 2p_x^1 = {}^{*}_{\pi}2p_y^1$

∴ Total antibonding electrons $= 6$

$O_2^{2-} = 8 + 8 + 2 = 18$

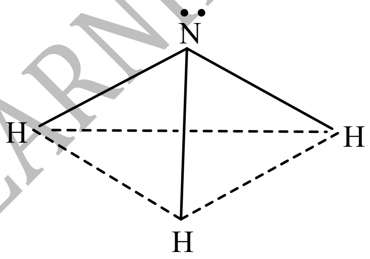
$= \sigma 1s^2, {}^{*}_{\sigma}1s^2, \sigma 2s^2, {}^{*}_{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2$

$= \pi 2p_y^2, {}^{*}_{\pi}2p_x^2 = {}^{*}_{\pi}2p_y^2$

∴ Total antibonding electrons $= 8$

382 **(d)**

In NH_3, N undergoes sp^3 hybridisation. Due to the presence of one lone-pair, it is pyramidal in shape.



383 **(d)**

Hg exists in liquid state.

384 **(b)**

According to valence bond theory, overlapping orbitals must possess half-filled nature as well as antispin electron.

385 **(a)**

Non-polar or pure covalent bond has zero per cent ionic character due to the absence of partial charges on either end.

386 **(a)**

The dipole moment of two dipoles inclines at an angle θ is given by the equation $\pi = \sqrt{x^2 + y^2 + 2xy\cos\theta}$, $\cos 90 = 0$,since, the angle increases from $90 - 180$, the value of $\cos\theta$ becomes more and more $-$ve and hence resultant decreases. Thus, dipole moment is maximum, when, $\theta = 90°$

387 **(a)**

$CO(14) = \sigma 1s^2, {}^{*}_{\sigma}1s^2, \sigma 2s^2, {}^{*}_{\sigma}2s^2, \pi 2p_y^2$

$= \pi 2p_z^2, \sigma 2p_x^2$

$BO = \frac{N_b - N_a}{2} = \frac{10-4}{2} = 3$

$NO^-(16) =$

$\sigma 1s^2, {}^{*}_{\sigma}1s^2, \sigma 2s^2, {}^{*}_{\sigma}2s^2, \sigma 2p_x^2, (\pi 2p_y^2 = \pi 2p_z^2),$
${}^{*}_{\pi}2p_y^1 = {}^{*}_{\pi}2p_z^1$

$\text{BO} = \frac{10-6}{2} = 2$

$\text{NO}^+(13)$; BO= 3

$\text{CN}^-(14)$; BO= 3

$\text{N}_2(14); BO = 3$

Hence, bond order of NO^- is different from that of CO.

388 **(a)**

S atom in SF_6 is sp^3d^2-hybridized state and shows octahedral shape.

389 **(b)**

The stability of carbonates increases with increasing electropositive character of metal.

391 **(c)**

Larger is the size of atom, lesser is the tendency for overlapping, lesser is bond energy.

392 **(a)**

The polarising ability is characteristic of cation, smaller the size of cation with large magnitude of positive charge, more will be its polarising ability. (∵ It can cause large distortions in anion cloud.)

393 **(a)**

ClO_2 has 33 electrons, *i.e.*, one unpaired.

394 **(c)**

Larger anion is polarized more (Fajans' rule).

395 **(c)**

The molecules having distorted geometry have dipole moment and those having regular geometry have zero dipole moment.

∵ NH_3, CH_3Cl and ClO_2 have distorted geometry.

∴ They have dipole moment.

∵ BF_3 has regular triangular planar geometry.

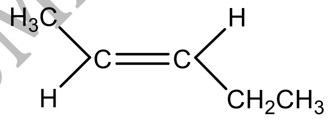
The dipole moment of BF_3 is zero.

396 **(c)**

When hydrogen forms hydrogen bonding with fluorine it will be strongest H-bonding because fluorine is strongest electronegative element.

397 **(b)**

Trans 2-pentene has dipole moment.



Because $+I$ effect of ethyl group is more than that of CH_3 group, hence the two dipoles do not cancel each other.

398 **(d)**

NH_2^- has sp^3-hybridization having two covalent bonds and two lone pair of N atom.

399 **(d)**

The solubility of a compound mainly depend upon its hydration energy. If the hydration energy of a compound is greater than from its lattice enthalpy, then its is soluble in water. Thus, for solubility

Hydration enthalpy > lattice enthalpy

For compounds *P* and *R* hydration enthalpy exceeds the lattice enthalpy, so they are soluble in water.

400 **(a)**

It is a fact derived from bond order.

401 **(b)**

I has maximum covalent bond and negative charge on electronegative nitrogen, most stable. III has more covalent bond than both II and IV, III is second most stable. Between II and IV, II is more stable since it has negative charge on nitrogen while IV has negative charge carbon.

402 **(b)**

Hybrid orbitals never form π-bond.

404 **(c)**

$$O_2(16) = \sigma 1s^2, {}^{*}_{\sigma}1s^2, \sigma 2s^2, {}^{*}_{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2 \approx \pi 2p_y^2, {}^{*}_{\pi}2p_x^1 \approx {}^{*}_{\pi}2p_y^1$$

$\text{BO} = \frac{10-6}{2} = 2$

$$O_2^{2-}(18) = \sigma 1s^2, {}^{*}_{\sigma}1s^2, \sigma 2s^2, {}^{*}_{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2 \approx \pi 2p_y^2, {}^{*}_{\pi}2p_x^2 \approx {}^{*}_{\pi}2p_y^2$$

$\text{BO} = \frac{10-8}{2} = 1$

$$N_2(14) = \sigma 1s^2, {}^{*}_{\sigma}1s^2, \sigma 2s^2, {}^{*}_{\sigma}2s^2, \pi 2p_x^2 \approx \pi 2p_y^2, \sigma 2p_z^2$$

$\text{BO} = \frac{10-4}{2} = 3$

Thus, bond order is highest for N_2.

405 **(d)**

Molecular shapes of SF_4, CF_4, XeF_4 are different with 1, 0 and 2 lone pair or electrons respectively.

406 **(c)**

The correct sequence of hybridisation of methane, ethene and ethyne is sp^3, sp^2 and sp.

407 **(b)**

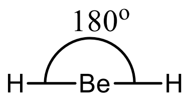
Diamond has a three-dimensional structure in which a large number of carbon atoms are arranged tetrahedrally by covalent bonds. It is an allotropic form of carbon.

408 **(b)**

The ionisation potential decreases down the group.

409 **(b)**

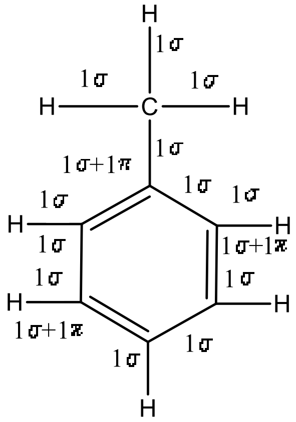
BeH_2 molecule is linear because it has *sp*-hybridisation. It has bond angle180° .



410 **(b)**

$Be_2(\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2)$ has bond order equal to zero.

411 **(c)**



15σ and 3π- bonds are present in toluene.

412 **(b)**

In H_2O, H-atom contains only two electrons.

413 **(c)**

Both $HgCl_2$ and C_2H_2 are linear like CO_2 because of *sp*-hybridization.

414 **(d)**

Follow concept of bond order in M.O. theory.

415 **(d)**

$HC \equiv C - HC = CH - CH_3$ 10σ, 3π

416 **(b)**

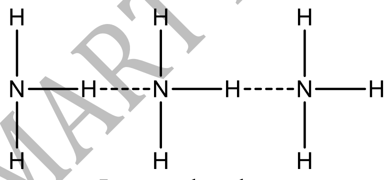
$CCl_2 = CCl_2$ has sp^3 -hybridization. CCl_4 has sp^3 -hybridization.

417 **(c)**

All are non-metals.

419 **(c)**

Boiling point of ammonia is much higher than phosphine. It is due to extensive hydrogen bonding found in ammonia.



Intermolecular
hydrogen bonding

420 **(b)**

Lower potential energy level imparts stability.

421 **(d)**

$$\text{Covalent character } \propto \frac{1}{\text{size of cation}}$$
$$\propto \text{size of anion}$$

(according to Fajan's rule)

Lower the covalent character, higher will be ionic character.

Cl_2O, contains O^{2-}, NCl_3 contains N^{3-}, $PbCl_2$ contains $Pb^{2+}$and $BaCl_2$ contains Ba^{2+}.

Hence, the order of covalent character is

$NCl_3 > Cl_2O > PbCl_2 > BaCl_2$

∴ $BaCl_2$ has the greatest ionic character.

422 **(c)**

Kernals start vibrating and hence, create hindrance in the flow of electrons

423 **(d)**

Chile salt petre ($NaNO_3$), potash alum ($K_2SO_4.Al_2(SO_4)_3.24H_2O$) and green vitriol ($FeSO_4.7H_2O$) are ionic compounds. They produce ions in their aqueous solutions, so they are conducting in nature. Ethyl alcohol, C_2H_5OH being covalent in nature, does not produce any ion in aqueous solution. Hence, it is non-conducting in nature.

424 **(c)**

Due to large electronegativity difference in C and F atoms.

425 **(a)**

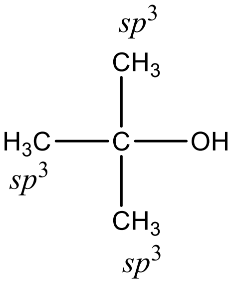
Proteins show H-bonding.

426 **(c)**

Bond angles decreases down the group.

∴ $H_2O > H_2S$. Also bond angle of $H_2O < NH_3$ due to lone pair effect.

427 **(c)**



In the above compound all bonds are σ bond and hence, carbon atom uses only sp^3- hybrid orbitals for bond formation.

428 **(b)**

It is the order of stability.

429 **(b)**

E_1 for $He^+ = E_1$ for $H \times Z^2$ (where Z=at. no. of He).

430 **(c)**

H—bonding order:

$\cdots H - F > \cdots H - O > \cdots H - N$

431 **(d)**

The charge-size ratio increases and thus polarizing power increases.

434 **(c)**

O_2 has two unpaired electrons.

435 **(d)**

These are the factors on which IP depends.

436 **(b)**

The hybridised states of N in NO_2^+, NO_3^- and NH_4^+ are sp, sp^2 and sp^3 respectively.

437 **(b)**

Carbon (1) has 2σ − and 2μ − bonds. Carbon (2) has 3σ and 1 π-bond.

438 **(c)**

According to Fajan's rule, as the size of cation decreases, its polarising power increases. Hence, Cu^{2+} polarise Cl^- ions more than Cu^+. Therefore, $CuCl_2$ has more covalent character and hence, its boiling point is less.

439 **(b)**

Metals are more electropositive and lose electrons, while non – metals have tendency to gain electron.

440 **(b)**

Be has smallest size and thus, Be cation possesses more polarizing power.

441 **(b)**

Due to intermolecular hydrogen bonding in *ortho*-isomer, it has least melting point. Due to effective intermolecular hydrogen bonding in *para* isomer, it has highest melting point among the isomers. So, the order is

$Para$ isomer $> meta > ortho$

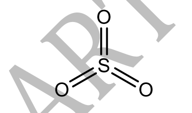
(114°C) (97°C) (54 °C)

443 **(a)**

Based on geometry of molecule.

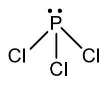
444 **(b)**

The structure of these molecules/species are as follows :



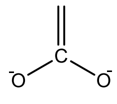
(σ-bps + lps = 3 + 0 = 3)

sp^2-hybridisation trigonal planar



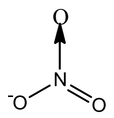
(σ-bps + lps = 3 + 1 = 4)

sp^2-hybridisation pyramidal



(σ-bps + lps = 3 + 0 = 3)

sp^2-hybridisation trigonal planar



(σ-bps + lps = 3 + 0 = 3)

sp^2-hybridisation trigonal planar

PCl_3 has sp^3-hybridisation but due to presence of a lone-pair, its shape is pyramidal instead of tetrahedral.

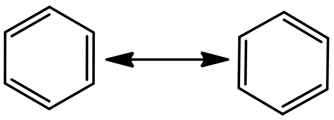
446 **(c)**

[C] forms anion readily by gaining one electron only.

447 **(c)**

Number of bonds between two atoms is called bond order.

Resonating structures of benzene are



∴ In benzene, the carbon – carbon bond is between the double and single bond due to the resonance, so its bond order is 1.5.

448 **(a)**

If difference in electronegativity in between two atoms is 1.7, the molecule possesses 50% covalent +50% ionic nature.

449 **(b)**

IP_1 of Pb $>$ IP_1 of Sn (an exception).

450 **(c)**

Only then it can accept lone pair in that shell.

451 **(a)**

Count σ-and π-bonds.

452 **(b)**

The molecular electronic configuration of O_2 is

$$O_2 = [KK, (\sigma 2s)^2, (\overset{*}{\sigma}2s)^2, (\sigma 2p_x)^2, \left(\pi 2p_y\right)^2$$

$$= (\pi 2p_z)^2, \left(\overset{*}{\pi}2p_y\right)^1 = (\pi 2p_z)^1]$$

453 **(d)**

Cs is more electropositive.

454 **(a)**

In MnO_4^-, the oxidation no. of Mn is +7, *i.e.*, all the 4*s* and 3*d* electrons are lost.

455 **(d)**

Stability ∝ bond order

456 **(b)**

Charge of $e^- = 1.6 \times 10^{-19}$C

Dipole moment of HBr $= 1.6 \times 10^{-30}$C-m

Interionic spacing $= 1$ Å $= 1 \times 10^{-10}$m

% of ionic character in

$$\text{HBr} = \frac{\text{Dipole moment of HBr} \times 100}{\text{Interspacing distance } \times q}$$

$$= \frac{1.6 \times 10^{-30} \times 100}{1.6 \times 10^{-19} \times 10^{-10}}$$

$$= 10^{-30} \times 10^{29} \times 100 = 0.1 \times 100 = 10\%$$

457 **(c)**

Due to shielding effect of $(n-1)d$-subshell.

459 **(d)**

P in PO_4^{3-}has sp^3-hybridization like S in SO_4^{2-}.

460 **(d)**

The lattice becomes stronger (*i.e.*, the lattice energy U becomes more negative). As r the interionic distance decreases. U is proportional to $\frac{1}{r}$

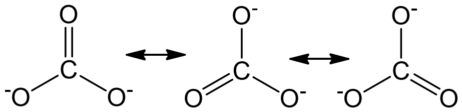
or $$U \propto \frac{1}{(r_c+r_a)}$$

462 **(a)**

Covalent radius are always smaller than crystal radius as the former involves overlapping region.

463 **(c)**

CO_3^{2-} has the following structure



It contains only covalent bonds

464 **(c)**

Molecular orbital configuration of,

$C_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2, \pi 2p_y^1$

466 **(d)**

Mullikan proposed M.O. theory.

467 **(d)**

$Cl_2O = 42$ electrons
$ICl_2^- = 88$ electrons
$Cl_2^- = 35$ electrons
$IF_2^+ = 70$ electrons
$I_3^- = 160$ electrons
$Cl_2O = 33$ electrons
$ClO_2^- = 34$ electrons
$ClF_2^+ = 34$ electrons

ClO_2^- and ClF_2^+ contain 34 electrons each hence they are isoelectronic.

468 **(a)**

1, 2-butandiene has the structure.

```
    H   H       H
    |   |       |
H − C − C = C = C − H
    | sp³ sp² sp sp²
    H
```

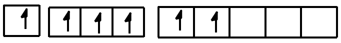
469 **(d)**

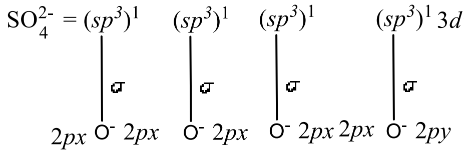
Anions are always larger in size than their parent atom. Cations are always smaller in size than their parent atom.

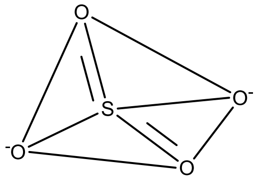
470 **(d)**

Sulphade ion (SO_4^{2-}) has tetrahedral geometry, as in S-atom undergoes sp^3 hybridisation.

S in II excited state =





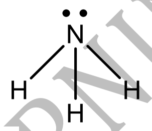


Tetrahedral shape of SO_4^{2-}

471 **(d)**

SF_4 has sp^3d-hybridization with one lone pair,
CF_4 has sp^3-hybridization with no lone pair and
XeF_4 has sp^3d^2-hybridization with two lone pairs.

472 **(a)**



(σ-*bps* + *lps* = 3+1=4)

Hence, hybridisation=sp^3

In NH_3 N-atoms is sp^3 hybridised, but due to presence of a lone pair of electron on N-atom. It is pyramidal in shape.

473 **(b)**

For a compound to be soluble, the hydration energy must be greater than the lattice energy. Since, NaCl is soluble in water but insoluble in benzene.

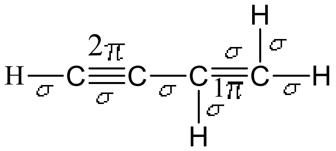
$$\Delta H_{\text{hydration}} > \Delta H_{\text{lattice energy in water}}$$

and $$\Delta H_{\text{hydration}} < \Delta H_{\text{lattice energy in benzene}}$$

474 **(b)**

Dimerization occurs in carboxylic acids which indicates strong H-bonding.

475 **(c)**



Thus, the number of σ and π bonds respectively are 7 and 3

476 **(a)**

Solubility order : AgF > AgCl > AgBr > AgI.

477 **(d)**

CaI_2 has maximum covalent character due to large size of anion and possesses lowest lattice energy.

Thus melting point is lowest.

478 **(c)**

Hybridisation=$\frac{1}{2}$ [no. of electron in valence shell + no. of monovalent atoms-charge on cation+ charge on anion]

17. H_2O

$H=\frac{1}{2}(6+2+0\text{-}0)=\frac{8}{2}=4$

$\therefore sp^3$hybridisation

18. CH_4

$H=\frac{1}{2}(4+4+0\text{-}0)$

$=\frac{8}{2}=4$

$\therefore sp^3$hybridisation

19. BCl_3

$H=\frac{1}{2}(3+3+0\text{-}0)$

$=\frac{6}{2}=3$

$\therefore sp^3$hybridisation

20. NH_3

$H=\frac{1}{2}(5+3+0\text{-}0)$

$=\frac{8}{2}=4$

$\therefore sp^3$hybridisation

$\therefore$ (c) is correct answer.

479 **(a)**

H_2O shows high b.p. (inspite of lowest mol. wt.) on account of strong H-bonding.

480 **(d)**

C_2H_2 is a linear molecule with sp-hybridization.

481 **(b)**

KO_2 is an ionic compound.

482 **(c)**

In all the given compounds, anion is same(Cl^-), hence polarising power is decided by size and charge of cation. Al^{3+} with maximum charge and smallest size has maximum polarising power hence, $AlCl_3$ is maximum covalent.

483 **(d)**

Dipole forces exist only in polar molecule.

484 **(b)**

Both possess sp^2-hybridization but different geometry.

485 **(c)**

In transition elements, penultimate shell electrons also participate in bonding.

486 **(b)**

Species	O_2	O_2^+	O_2^{2+}	O_2^{2-}
Bond Order	2	2.5	3	1

Hence, the increasing bond order is as follows :

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

487 **(b)**

$\pi 2p_x$ and $\pi 2p_y$ or $\overset{*}{\pi}_{2p_x}$ and $\overset{*}{\pi}_{2p_y}$ orbitals have nearly equal energy and thus, are called degenerate orbitals.

488 **(a)**

The most electronegative element is F and next to F is O.

489 **(c)**

Ions are held in NaCl by coulombic forces and thus, possess no velocity.

490 **(b)**

Both have one lone pair of electron.

491 **(d)**

Lattice energy,$U=\frac{q_1q_2}{r^2}$

Since, interionic distances in CaO and NaCl are similar, (larger cation has smaller anion and vice versa) r is almost the same. Therefore, lattice energy depends only on charge. Since, the magnitude of charge on Na^+ and Cl^- ions is same *ie*, unity and that on Ca^{2+} and O^{2-} ions is 2 each, therefore, the lattice energy of CaO is four times the lattice energy of NaCl, *ie*,4U

492 **(a)**

$$\overset{sp}{CH}\equiv\overset{sp}{C}-\overset{sp^2}{CH}=\overset{sp^2}{CH_2}$$

Hence, carbon atom bonded to each other by single

$(C-C)$ are sp and sp^2 hybrid.

493 **(c)**

In IF_5, halogens are member of VII group.

Summation of group number

$=42$

Bond pair $=\frac{42}{8}=5(\text{Residue })\ 2$

Lone pair $=\frac{2}{2}=1$

5 bond pair, 1 lone pair means the geometry is square pyramidal and sp^3d^2 hybridisation.

494 **(b)**

PCl_5 molecule has $sp^3\ d$ hybridiation.

Its geometry is trigonal bipyramidal and it has 5 valence shell pairs of electrons.

495 **(c)**

Given, ionic charge $= 4.8 \times 10^{-10}$ esu

and, ionic distance $= 1$ Å $= 10^{-8}$cm

We know that

Dipole moment =ionic charge×ionic distance

$= 4.8 \times 10^{-10} \times 10^{-8}$

$= 4.8 \times 10^{-18}$ esu cm^{-1}

$= 4.8$ debye

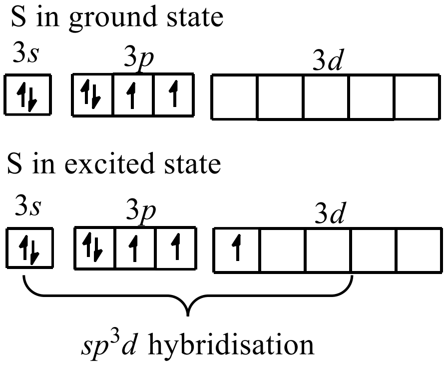
496 **(b)**

$CH_2 = CH_2$ has 1σ-and 1π-in between two sp^2-hybridized carbon.

497 **(c)**

S in SF_4 possesses trigonal bipyramidal structure with sp^3d hybridisation.

S in ground state



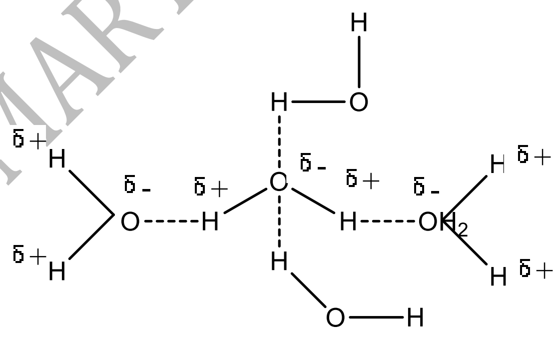
S in excited state

499 **(c)**

Atomic size decreases along the period and increases down the gp.

500 **(d)**

One water molecules is joined to four water molecules—two with H—atoms and other two with O—atoms. Thus, The maximum number of hydrogen bonds that a molecule of water can have is four as shown below :



501 **(d)**

CH_3^+ and NH_2^+ both have 8 electrons.

503 **(b)**

Energy level order $2p > 2s$.

504 **(b)**

Be in BeF_3^- is sp^2-hybridized

505 **(c)**

RbO_2 means Rb^+ and 0_2^-, 0_2^- is the superoxide ion.

$$0_2^-(17) = \sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2 \approx \pi 2p_y^2, \overset{*}{\pi}2p_x^2 \approx \overset{*}{\pi}2p_y^1$$

As it contains one unpaired electron, thus paramagnetic in nature.

506 **(b)**

A reason for the given fact.

507 **(c)**

Sulphanilic acids have dipolar structure to their melting point is high and insoluble in organic solvent

509 **(c)**

Atomic size of Ag and Au are closer to each other but nuclear charge is more on Au.

511 **(d)**

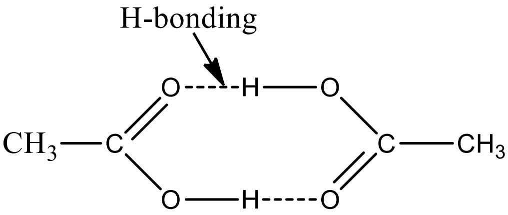
BCl_3 has trigonal planar structure due to 3 bond pairs in the valence shell of boron whereas NCl_3 has distorted tetrahearal structure due to one lone pair and three bond pair in the valence shell of nitrogen.

512 **(a)**

In AlH_3, Al is sp^2hybridised while in AlH_4^-, Al is sp^3 hybridised.

513 **(b)**

CH_3COOH dimerises in gaseous state due to H-bonding.



514 **(d)**

It is the definition of electron affinity.

516 **(b)**

SO_2 has sp^2-hybridization.

517 **(a)**

One of s-orbital +3 of p-orbital $= sp^3$

518 **(d)**

$NO(7 + 8 = 15)$

$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$

$\approx \pi 2p_y^2, \pi^* 2p_x^1$

$NO^+(7 + 8 - 1 = 14)$

$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 \approx \pi 2p_y^2$

Thus, in the formation of NO^+ from NO, the electron is removed from a π^*orbital

519 **(a)**

2nd IE_1 of alkali metals is abnormally higher.

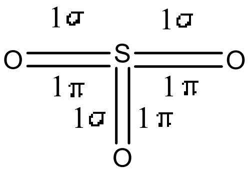
520 **(c)**

For $Be_nAl_2Si_6O_{18}$

$$2n + 6 + 24 - 36 = 0$$
$$n = 3$$

521 **(a)**

The structure of an hydride of H_2SO_4 is :



522 **(c)**

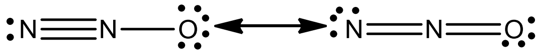
O atom possesses sp^3-hybridization with two lone pair of electron.

523 **(a)**

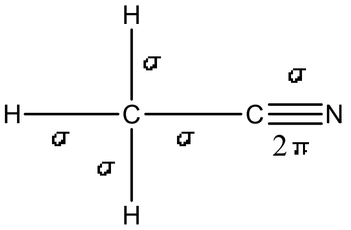
Ionic bonds are non-directional.

524 **(b)**

The molecule of N_2O is linear as would be expected for a triatomic molecule with 16 outer shell electrons. Its resonance structure is



525 **(d)**



Hence, number of σ and π-bond in acetonitrile are 5 and 2 respectively.

526 **(a)**

More the difference in electronegativity of atoms, stronger will be the hydrogen bond. ∵ Electronegativity difference between H and F is highest.

(∵F has highest electronegativity)

∵ $F - H - - - - - O$ hydrogen bond is strongest.

527 **(d)**

Cyanide ion is,

$-\bar{C}\equiv N \longrightarrow -\bar{N}\equiv C.$

528 **(a)**

21. dsp^3 or sp^3d hybridisation results in trigonal bipyramidal geometry according to VSEPR theory.

22. dsp^2 hybridisation has square planar geometry.

23. d^2sp^3or sp^3d^2 hybridisation has octahedral planar geometry.

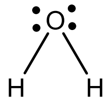
529 **(d)**

Bond angles of

$NH_3 = 107°, H_2Se = 91.0°, H_2O = 104.5°, H_2S = 92.2°$

So, the H_2Se molecule has smallest bond angle.

530 **(a)**



The bond angle in H_2O is 104.5° due to the presence of two lone pairs of electrons. This fact can be best explained with the help of valence shell electron pair repulsion (VSEPR) theory.

531 **(b)**

NO_2^-	sp^2
NO_3^-	sp^2
NH_2^-	sp^3
NH_4^+	sp^3
SCN^-	sp

533 **(b)**

$K^+[C \equiv N]^-$; K^+ and CN^- ionic, C and N forms covalent bonds.

534 **(c)**

NaCl exist as Na^+Cl^-.

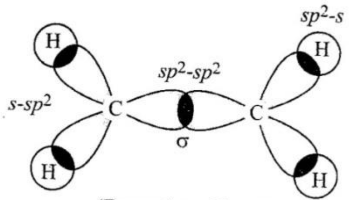
535 **(c)**

C_2H_2 has a linear structure because it has sp-hybridisation.

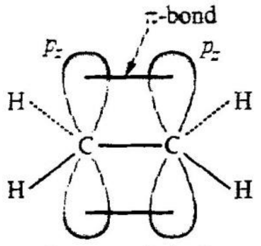
$H - C \equiv C - H$

536 **(d)**

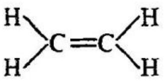
Structure of C_2H_4 is



(Formation of bond)



Formation of π-bond)



Geometry of the molecule)

So, the compound (X) is C_2H_4.

537 **(a)**

Ionization energy increases along the period and decreases down the group.

538 **(b)**

The atomic radius decreases along the period. Also cations are always smaller than their parent atom and anions are always larger than their parent atom.

539 **(a)**

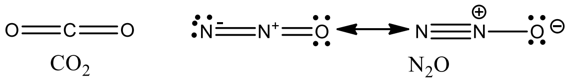
In N_2, all electrons are paired. Thus, N_2^+ has one electron unpaired.

540 **(c)**

Molecule	Hybridisation	Repulsion	Bond angle
SO_2	sp^2	*lp.bp, bp – bp*	119°
OH_2	sp^3	*lp – lp, bp – lp bp – bp*	104.5°
SH_2	sp^3	—do—	
NH_3	sp^3	*lp – bp, bp – bp*	90° 107°

541 **(a)**

CO_2 is isostructural with N_2O because both have linear structure.



542 **(c)**

Valencies of L, Q, P and R is-2,-1,+1, and +2 respectively. So, they will form

$P_2L, RL\ PQ$, and RQ_2

543 **(b)**

$NO \longrightarrow NO^+$

(NO^+) Total $e^- = 14$

$\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \pi 2p_x^{1+1} = \pi 2p_y^{1+1}\sigma 2p_z^2$

Diamagnetic

Bond order = $= \frac{10-4}{2} = 3$

(NO) Total $e^- = 15$

$\sigma 1s^2\ \overset{*}{\sigma}1s^2\sigma 2s^2\ \overset{*}{\sigma}2s^2, \sigma 2p_z^2\pi 2p_x^{1+1}\pi 2p_y^{1+1}, \overset{*}{\pi}2p_x^1$

$= \overset{*}{\pi}2p_y$

Paramagnetic

Bond order = $= \frac{10-5}{2} = 2.5$

Electron is taken away from non-bonding molecular orbital that's why bond order increases.

544 **(a)**

All are isoelectronic species; more is nuclear charge smaller is ionic size.

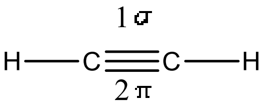
545 **(b)**

Bond order for O_2=2; O_2^+=2.5, O_2^-=1.5, O_2^{2-}=1

Thus bond length is $O_2^+ < O_2 < O_2^- < O_2^{2-}$

546 **(b)**

The structure of acetylene is



In acetylene, both the C-atoms are *sp* hybridised. Hence in acetylene molecule, there are one sigma and two pi bonds are present between carbon atoms.

547 **(c)**

Size of isoelectronics decreases with increasing atomic number.

548 **(d)**

O_2^- :

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p^2 \begin{bmatrix} \pi 2p_y^2 \\ \pi 2p_z^2 \end{bmatrix} \begin{bmatrix} \pi^* 2p_y^2 \\ \pi^* 2p_z^1 \end{bmatrix}$

$\therefore B.O. = \frac{10-7}{2} = 1.5$

549 **(c)**

NO has 15 electrons (paramagnetic) whereas NO^+ has 14 electrons (diamagnetic).

550 **(c)**

$2Fe + 3[O] \rightarrow Fe_2O_3$ (rust).

551 **(d)**

ClO_2 has 33 electron; one will be unpaired.

552 **(c)**

NO_2 and O_3 both are having irregular geometry.

554 **(a)**

s character ∝ bond angle

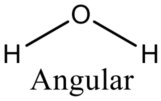
555 **(b)**

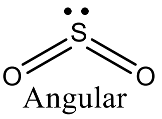
Since the two O atoms in O_2 are connected by a double bond (O = O), therefore,hybridization of O is sp^2

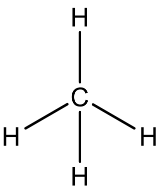
556 **(a)**

Cl − Be − Cl

In $BeCl_2$, Be is *sp*-hybridised, hence it has linear structure.


Angular


Angular

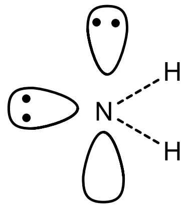

Tetrahedral

557 **(c)**

On fusion KCN, ionic bonding is disturbed; on boiling H_2S and CF_4 only kinetic energy of molecules increases.

558 **(a)**

Structure of $\overline{N}H_2$ is as follows



559 **(b)**

Mn^{2+} is most stable as it has half-filled d-orbitals.

560 **(c)**

The structure of PO_4^{3-} is $\left[\begin{array}{c} O \\ | \\ O - P - O \\ || \\ O \end{array}\right]^{3-}$

Here, there units negative charge is shared by four O atoms and five bond pairs are shared between four P—O bonds

$\therefore$ Formal charge $= \frac{3}{4} = -0.75$

BO of $P - O$ bond $= \frac{5}{4} = 1.25$

561 **(c)**

The element is P which exists as P_4.

562 **(b)**

Elements having six electrons in valency shell are electronegative elements, *e*.g., O.

563 **(d)**

In sulphur, the excitation of np-electrons to nd-subshell gives rise to increase in number of unpaired electrons.

564 **(b)**

Species	**Electron in central element**	**Electrons in other element**	**Charge gained**	**Total**
BO_3^{3-}	5	$3 \times 8 = 24$	+3	32
CO_3^{2-}	6	$3 \times 8 = 24$	+2	32
NO_3^-	7	$3 \times 8 = 24$	+1	32
SO_3^{2-}	16	$3 \times 8 = 24$	+2	42
CN^-	6	7	1	14
N_2	7	7	0	14
C_2^{2-}	6	6	+2	14
PO_4^{3-}	15	$4 \times 8 = 32$	+3	50
SO_4^{2-}	16	$4 \times 8 = 32$	+2	50
ClO_4^-	17	$4 \times 8 = 32$	+1	50

Thus, (b) $SO_3^{2-}, CO_3^{2-}, NO_3^-$ are not isoelectronic.

565 **(c)**

Unpaired electrons are present in KO_2, while others have paired electrons.

$NO_2^+ \longrightarrow$22 electrons

$BaO_2 \longrightarrow$72 electrons

$AlO_2^- \longrightarrow$30 electrons

$KO_2 \longrightarrow$35 electrons

566 **(d)**

$IP_3 > IP_2 > IP_1$

567 **(b)**

Coordinate bond is formed.

$(C_2H_5)_2O \longrightarrow BH_3$

$(C_2H_5)_2O$ gives one lone pair of electron to BH_3. So, it is called electron pair donar and BH_3 is called electron pair acceptor.

568 **(a)**

BeF_3^- involves sp^2-hybridization.

570 **(c)**

Maximum covalence in most of the atoms (except N, O, F) is given by the number of valency electrons. The paired s electrons are also get unpaired during excitation.

571 **(b)**

Noble gases are in zero group however they possess eight electrons in their valence shell.

572 **(a)**

Solid molecules possess stronger van der Waals' forces.

573 **(a)**

Inert pair effect is not noticed for elements having their outermost shell (n) if $n < 4$.

574 **(b)**

(a) **Pauling** gave scale of electronegativity.

(b) **Bronsted** gave concept of acid and base.

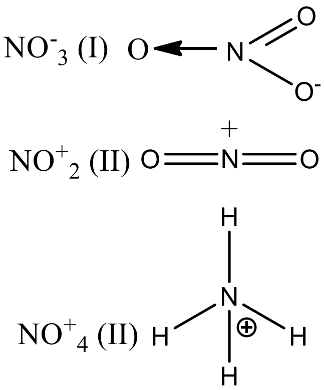
(c) **Mullikan** determined charge on electron.

(d) **Lewis** gave electronic theory of bonding.

575 **(b)**

Ionization potential increases along the period. Also Be has $1s^2, 2s^2, i.e.$, removal of electrons from $2s$ while in Boron it occurs from $2p$ and therefore, Be has high I.P.

576 **(b)**



	σ-bond	Lone pair	Unpaired electron	Total
I.	3	×	×	3 $(sp^2$
II.	2	×	×	2 (sp)
III.	4	×	×	$4(sp^3)$

577 **(b)**

Larger cation favours ionic bonding (Fajan's rule).

578 **(b)**

Only P has d-orbitals.

579 **(b)**

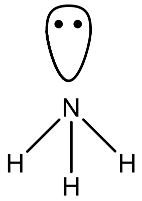
H_2O is sp^3-hybridized; BeF_2 is sp-hybridized.

580 **(b)**

Oxidising power: $F_2 > Cl_2 > Br_2 > I_2$.

581 **(a)**

NH_3 molecule in its valence shell has three bond pairs of electrons and one lone pair of electrons. The shape of NH_3 molecule is pyramidal due to the presence of one lone pair electron. It has sp^3 hybridisation.



582 **(d)**

All carbon to hydrogen bonds are σ-bonds

583 **(b)**

In C_2H_6, C is sp^3 hybridised.
In C_2H_4, C is sp^2 hybridised.
In $BeCl_2$, Be is sp hybridised.
In C_2H_2, C is sp hybridised

584 **(b)**

Energy bonds in solids are formed in accordance with Bohr's theory.

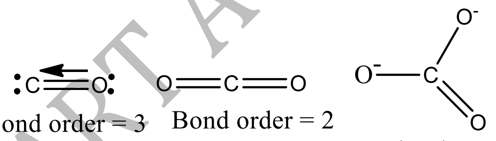
585 **(c)**

The jump in ionisation energy occurs when valence shell changes during removal of electron.

586 **(c)**

H atom attached on F is responsible for H-bonding..

587 **(a)**



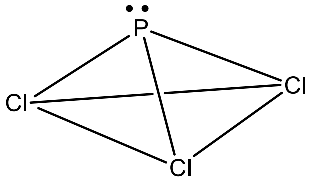
Bond order = 3 Bond order = 2 Bond order = 1.33 (due to resonance)

Bond length increases when bond order decrease, hence the correct order of bond length is

$CO_3^{2-} > CO_2 > CO$

588 **(a)**

In PCl_3 molecule, phosphorus is sp^3-hybridised but due to presence of lone-pair of electron. It has pyramidal structure.



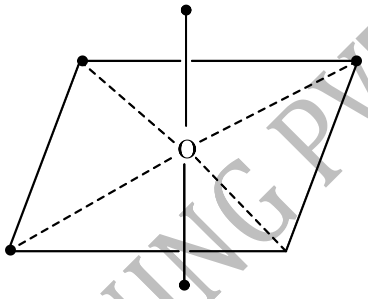
589 **(c)**

$Be_2 = (8\text{ electrons})$

$\sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 2s^2 \overset{*}{\sigma} 2S^2$

590 **(d)**

$sp^3 d^2$ hybridisation has octahedral structure such that four hybrid orbitals are at 90° w.r.t each other and others two at 90° with first four.



591 **(b)**

IE_1 of N $> IE_1$ of O due to half filled nature in N.

592 **(b)**

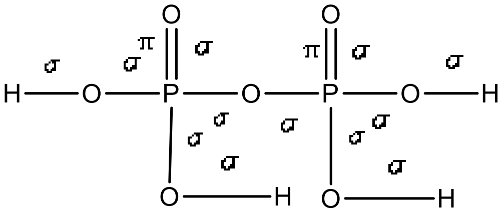
Larger anion is easily deformed (Follow Fajans' rule).

593 **(c)**

Due to resonance structure of C_6H_6.

594 **(d)**

Draw bond structure and then count bonds.



$\Rightarrow 12\sigma, 2d\pi - p\pi$ bonds.

595 **(a)**

In methane, ethene and ethyne, the hybridisations are respectively sp^3, sp^2 and sp. Hence, % s-character will be

$$sp^3 = \frac{1}{4} \times 100 = 25\%$$

$$sp^2 = \frac{1}{3} \times 100 = 33\%$$

$$sp = \frac{1}{2} \times 100 = 50\%$$

597 **(c)**

Both SO_4^{2-} and BF_4^- have sp^3-hybridization and are tetrahedral.

598 **(c)**

If there is four σ − bonds, hybridisation is sp^3, if three σ − bonds, hybridisation is sp^2 and if two

$\sigma -$ bonds, hybridisation is sp.

(a) $CH_2 = C = CH_2$
$sp^2 \quad sp \quad sp^2$

(b) $CH_3 - CH = CH - CH_2^+$
$sp^3 \quad sp^2 \quad sp^2 \quad sp^2$

(c) $CH_3 - C \equiv C - CH_2^+$
$sp^3 \quad sp \quad sp \quad sp^2$

(d) $CH_3 - CH = CH - CH_2^-$
$sp^3 \quad sp^2 \quad sp^2 \quad sp^3$

(e) $CH_2 = CH - CH = CH_2$
$sp^2 \quad sp^2 \quad sp^2 \quad sp^2$

Hence, in $CH_3 - C \equiv C - CH_2^+$, all the three types of hybrid carbons are present.

599 **(b)**

Sigma bond formation involves more overlapping and thus stronger.

600 **(b)**

Both have sp^2-hybridization geometry.

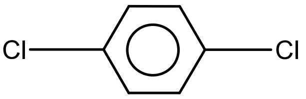
601 **(b)**

Anions are always larger than their parent atom. Also atomic radius increases down the group, decreases along the period.

602 **(c)**

AsF_5has sp^3d hybridization. In sp^3d hybridization, it is d_{z^2} orbitals which takes part

603 **(a)**



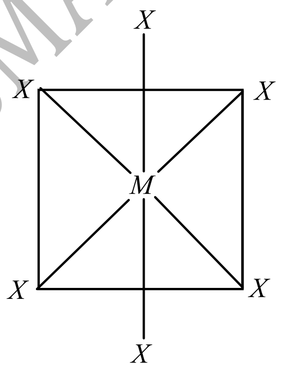
CCl_4 and compounds has zero dipole moment due to their symmetrical structure.

604 **(b)**

Ionisation energy increases along the period.

605 **(a)**

In octahedral structure MX_6, the six hybrid orbitals ($sp^3\ d^2$) are directed towards the corners of a regular octahedral with an angle of 90°. According to following structure of MX_6 the number of $X - M - X$ bonds at 180° must be three.



606 **(a)**

It is the definition of valency.

607 **(a)**

Only Na shows +1 oxidation state. Rest all have +1, +2(Hg), +1, +2 (Cu) and +2, +3 (Fe) oxidation states.

608 **(a)**

The ionisation energy of elements decreases down the group.

609 **(d)**

O is more electronegative than C.

610 **(c)**

Bond energy increases with multiplicity of bonds.

611 **(c)**

$Br_2$is a non-polar molecule and hence, its melting point and boiling point depend only upon van der Waals' forces of attraction while all the remaining molecules have dipole moments and hence, their melting points and boiling points depend upon dipole-dipole interactions

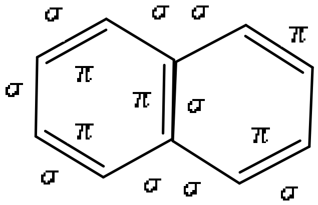
612 **(c)**

H-bonding in H_2O increases forces of attracting among molecules and develops abnormal properties.

614 **(b)**

In a double bond (=) one σ and one π-bond is present while in a single bond (−) only σ-bond is present.

The structure of the naphthalene is as

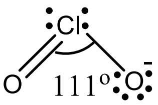


In naphthalene five double bonds are present, hence 5π bonds are present in naphthalene.

616 **(d)**

ICl_2^-, I_3^-, N_3^- are linear but

ClO_2^- is angular due to sp^3 hybridisation of Cl aton



So, ClO_2^- is non-linear.

617 **(c)**

Bond order $= \frac{1}{2}$ [bonding electrons – antibonding electrons]

618 **(c)**

The difference of electronegativity is more.

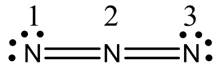
619 **(c)**

Ortho hydroxyl benzaldehyde has maximum volatility due to intra molecular H-bonding.

620 **(b)**

Formal charge = Number of electrons in valence shell –

$(\frac{1}{2}\times$numbers of electrons as bond pair+numbers of electrons as lone pair)



For N_1 and N_3

Formal charge $= 5 - \left(\frac{4}{2} + 4\right) = 5 - (6) = -1$

For $N_2 = 5 - \frac{1}{2} \times 8 - 0 = 5 - 4 = +1$

621 **(d)**

In phenol each C atom is sp^2 hybridised and O atom is sp^3 hybridised.

622 **(a)**

Due to sp^3-hybridization on carbon atoms.

623 **(b)**

Bond angles of ClF_3, PF_3, NF_3 and BF_3 are (180°, 90°), (101)°, (106°) and (120°) respectively.

624 **(c)**

Operates in each gaseous molecule.

625 **(d)**

Resultant of two opposite vectors produces zero dipole moment.

626 **(d)**

Because of its regular tetrahedral geometry, CCl_4 has least dipole moment

627 **(b)**

Coulombic forces are strongest among all.

628 **(a)**

CO_2 has linear structure. It has sp-hybridisation

$O = C = O$

629 **(a)**

In (A) *para*-nitro phenol intermolecular (between two molecules) H-bonding exists while in (B) *ortho* –nitrophenol, intramolecular H-bonding exists.

Because of the presence of intramolecular H-bonding, the boiling point of (B) is lower as compare to (A) and thus, (B) is more volatile *i.e.*, has higher vapour pressure as compare to (A).

630 **(b)**

Small cation has more polarizing power.

632 **(c)**

Polar solute are more soluble in polar solvents.

633 **(b)**

Since, the electronegativity (EN) different is 3.0 − 1.2 = 1.8, which is less than 1.9, therefore, bond is expected to be covalent

634 **(a)**

SiF_4 and SF_4 are not isostructural because SiF_4 is tetrahedral due to sp^3 hybridisation of Si while SF_4 is not tetrahedral but it is distorted tetrahedral because in it S is sp^3d hybridised and has a lone pair of electron.

635 **(c)**

SiF_4 has regular tetrahedral geometry.

636 **(d)**

Cl possesses 10 electrons in ClF_3.

637 **(a)**

Molecule	$bp + lp$	Hybridisation	Shape
H_2O	2 +2	sp^3	Angular
BCl_3	3 + 0	sp^2	Trigonal Planar
NH_4^+	4 + 0	sp^3	Tetrahedral
CH_4	4 + 0	sp^3	Tetrahedral

638 **(c)**

Electronegativity and ionisation energy decreases from F to I.

639 **(d)**

$CH \equiv CH$; 3 for triple bonds and two for C—H bond.

640 **(b)**

The electronic configuration of O_2^{2-} ion is

O_2^{2-}

$-\sigma 1s^2, \overset{*}{\sigma}1s^2\ \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2, \pi 2p_y^2, \overset{*}{\pi}2p_x^2,$

Hence, number of antibonding electron pair in O_2^{2-} molecular ion are four.

641 **(c)**

Due to the presence of d-subshell electrons.

642 **(b)**

Due to sp^2-hybridization.

643 **(a)**

M.O. configuration of O_2:

$$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma * 2s^2, \sigma 2p_x^2 \begin{bmatrix} \pi 2p_y^2 \\ \pi 2p_z^2 \end{bmatrix} \begin{bmatrix} \pi^* 2p_y^2 \\ \pi^* 2p_z^1 \end{bmatrix}$$

Molecular orbitals $\pi^* 2p_z$ gains electron when O_2^- is formed from O_2

644 **(a)**

H-bonding is weakest bonding.

646 **(b)**

Out of sp^3, sp, sp^2 hybridised carbon, sp hybridised carbon is more electronegative.

647 **(c)**

Both NH_3 and H_2O have sp^3-hybridization. CO_2 and $BeCl_2$ are linear (sp-hybridization).

648 **(d)**

Unpaired electrons give rise to paramagnetism.

649 **(a)**
HF has largest dipole moment because electronegativity difference of both is high so, it is highly polar

650 **(b)**
Due to H-bonding which is more in water than alcohol and not in ether.

652 **(c)**
$1s^2, 2s^2 2p^4$ leads a sharing of two electron pairs to form molecule, *e.g.*, O_2.

654 **(b)**
Count σ and π bonds.

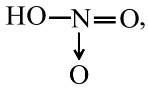
655 **(c)**
Bond order $C_2^- > NO > O_2^- > He_2^+$
$3 \quad 5/2 \quad 3/2 \quad 1/2$

656 **(b)**
Larger is bond order, lesser is bond length.

657 **(c)**
Strongest H-bonds are formed in between HCOOH and CH_3COOH. This is because H- bonding increases with electronegativity and decreases with size of atom

658 **(d)**
BCl_3 has sp^2-hybridization. Rest all have sp^3-hybridization having one lone pair of electron and thus, pyramidal in nature.

659 **(d)**
The overlapping orbitals must possess half-filled nature with anti-spin electron.

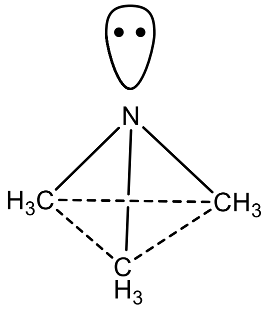
661 **(c)**
HNO_3 is  $HO{-}\underset{\underset{O}{\downarrow}}{N}{=}O$, assume one covalence for each coordinate bond.

662 **(a)**
B.p. of H_2 is minimum.

663 **(a)**
H_2O has sp^3-hybridisation and is angular in shape.

664 **(b)**
Electron gain enthalpy of Cl is maximum.

665 **(a)**
The structure of trimethyl amine is pyramidal.

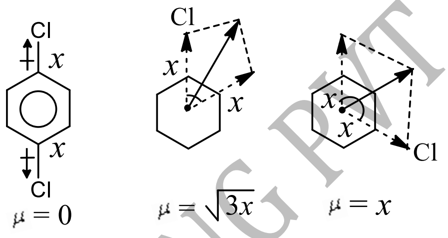


666 **(b)**

Molecules	Interaction
Benzene and ethanol	Dispersion force
Acetonitrile and acetone	Dipole-dipole
KCl and water	Ion-dipole
Benzene and carbon tetrachloride	Dispersion (London) force

667 **(b)**
Dry ice is CO_2 having C—O covalent bonds.

668 **(d)**



In p-dichlorobenzene, two $C - Cl$ dipole cancel each other
$\therefore \mu = 0$
In, o-dichlorobenzene, two $C - Cl$ dipoles (say x) are inclined at an angle of 60°.Therefore, according to parallelogram law of forces, the resultant
$= \sqrt{x^2 + x^2 + 2x \times \cos 60°}$
$= \sqrt{x^2 + x^2 + 2x^2 \times 1/2}$
$= \sqrt{3x^2} = \sqrt{3x}$
In m-dichlorobenzene, the two dipoles are inclined to each other at an angle of 120°, therefore, resultant
$= \sqrt{x^2 + x^2 + 2x \times \cos 120°}$
$= x^2 + x^2 + 2x^2 \times (-1/2)$
$= \sqrt{x^2} = x$
Thus ,the decreasing order of dipole moments:
$o > m > p$

669 **(d)**
One carbon has three bonds and other five where as each should have four bonds.

670 **(c)**
Cations are smaller in size than their parent atoms.

671 **(b)**
$O_2 (8 + 8 = 16)$
$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$
$\approx \pi 2p_y^2, \pi^* 2p_x^1 \approx \pi^* 2p_y^1$
Bond order $= \frac{10-6}{2} = 2$
$O_2^+ (8 + 8 - 1 = 15)$

Bond order= $\frac{10-5}{2} = 2.5$

$O_2^-(8 + 8 + 1 = 17)$,

Bond order = $\frac{10-7}{2} = 1.5$

$O_2^{2-}(8 + 8 + 2 = 18)$,

Bond order = $\frac{10-8}{2} = 1$

Thus, bond order is maximum for O_2^+

672 **(d)**

P atom has sp^3-hybridization with one position occupied by lone pair of electron.

673 **(b)**

A characteristic of resonance.

674 **(b)**

Covalent compounds have lower m.p. and b.p. than ionic one.

676 **(d)**

It is a reason for given fact.

677 **(b)**

ClO_3^- has sp^3-hybridization with one lone pair of electron.

678 **(d)**

Greater the stability of oxide, greater is the case of its formation. Generally ionic oxides are more stable than covalent oxides and among the given metals only Ca form ionic oxide. Hence, Ca has greater tendency to form oxide.

679 **(c)**

Higher the charge/size ratio, more is the polarising power.

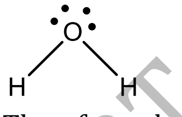
$K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

680 **(d)**

He has $1s^2$ configuration.

681 **(a)**

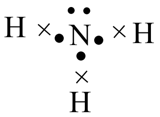
Water molecules has following structure



Therefore, there are 4 pairs of electrons (2 lone pairs and 2-bond pairs) in the valence shell of O-atom in water molecule.

682 **(a)**

Total electrons in valence shell of nitrogen and hydrogen.



∴ Total electrons in NH_3=5+1+1+1=8

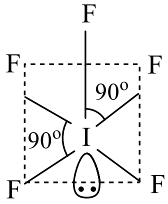
683 **(d)**

The electronic configuration of carbon is $1s^2, 2s^2 2p^2$.

684 **(c)**

Number of hybrid orbitals = no. of bp + no. of *lp* = 5 + 1 = 6

Thus, hybridization is sp^3d^2 but geometry, due to the presence of one pair, is square pyramidal, *ie*



685 **(c)**

(i)N_2 (14 electrons)

$= KK^*, \sigma 2s^2, \sigma 2s^2, \pi 2p_x^2 \approx \pi 2p_y^2, \sigma 2p_z^2$

Bond Order $= \frac{1}{2}(N_b - N_a)$

$= \frac{1}{2}(8 - 2) = 3$

(ii)N_2^+ (13 electrons)

$= KK^*, \sigma 2s^2, \overset{*}{\sigma} 2s^2, \pi 2p_x^2 \approx \pi 2p_y^2, \sigma 2p_z^1$

Bond Order $= \frac{1}{2}(7 - 2) = 2.5$

Since, bond dissociation energy ∝ bond order. Hence, bond dissociation energy of N_2 is greater than that of the bond dissociation energy of N_2^+ .

686 **(c)**

Bond angles in $BeCl_2, NH_3, H_2O$ and $SnCl_2$ are 180°, 107°, 104.5° and 119° respectively. Also H_2S, H_2O, H_2Se has sp^3-hybridization and bond angles of hydrides decreases down the group.

687 **(d)**

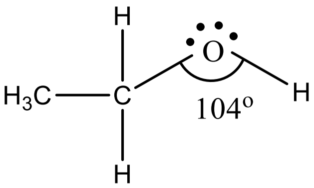
LiquidHCl does not from H-bonds

688 **(a)**

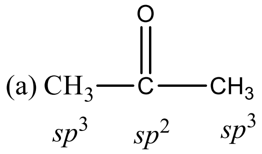
O_2 has two unpaired electrons but are paired in O_2^{2-}.

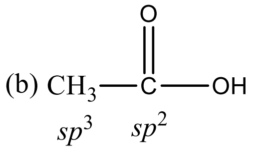
689 **(b)**

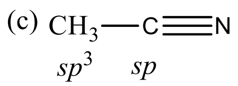
In ethanol the oxygen of – OH group is bonded to the sp^3 hybridised carbon by a sigma bond. The C – O – H bond angle in ethanol is less than the tetrahedral angle (109°, 28″) due to larger repulsions between the lone pair of repulsions between the lone pairs of oxygen. Hence, it is 104° in ethanol.

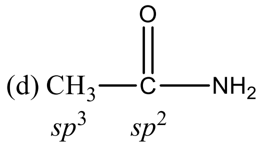


690 **(c)**









Acetonitrile does not contain sp^2 hybridised carbon.

691 **(b)**

The atomic radii decreases along the period and increases down the gp.

692 **(b)**

SiO_2possesses giant molecular structure due to tetra valence and catenation nature of Si.

693 **(d)**

According to VSEPR theory the bond angle decreases with increase in the size of the valence shell of the central atom because electronegativity decreases. *i.e.*, decreasing order of bond angles is

$$NH_3 > PH_3 > AsH_3 > SbH_3$$

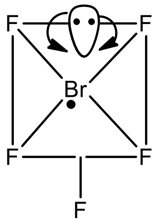
694 **(b)**

Half-filled orbitals are more stable.

695 **(a)**

In BrF_5 number of electrons = 6

(1 *lp* +5 *bp*)



So, the structure is supposed to be square pyramidal but will be distorted because of additional *lp-bp* interaction.

Additional *lp-bp* interaction reduced the all bond angle and do not let any angle to be 90°.

696 **(b)**

Ionisation energy decreases down the group and increases along the period.

697 **(a)**

Smaller is size of anion, lesser is its polarization, more is ionic nature, more is lattice energy.

698 **(c)**

Among the given species, the bond dissociation energy of C − O bond is minimum in case of CO_3^{2-} by which C − Obond become more weaker in CO_3^{2-} or the bond order of CO_3^{2-}(1.33) is minimum so, the bond become weaker

699 **(a)**

Peroxide ion in O_2^{2-}

$O_2^{2-}(18) = \sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2$

$\pi 2p_x^2 = \pi 2p_y^2, \overset{*}{\pi}2p_x^2 = \overset{*}{\pi}2p_y^2$

Bond order $= \frac{N_b - N_a}{2} = \frac{10-8}{2} = 1$

It contains four completely filled antibonding molecular orbitals. Since, all the electrons are paired, O_2^{2-} is diamagnetic.

Peroxide ion is isoelectronic with argon, not with neon.

701 **(b)**

$BF_3 : sp^2$ $NO_2^- : sp^2$ $NH_3 :$ sp^3 $NH_2^- : sp^3$ $H_2O : sp^3$

702 **(b)**

Multiplicity in bonds decreases bond length.

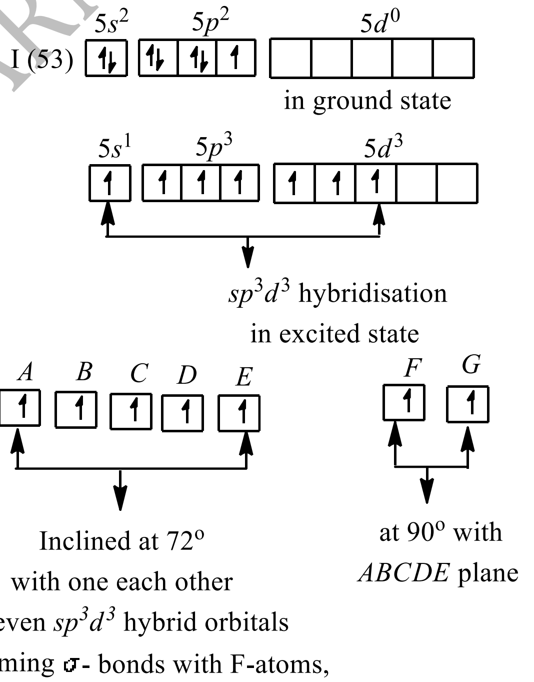
703 **(a)**

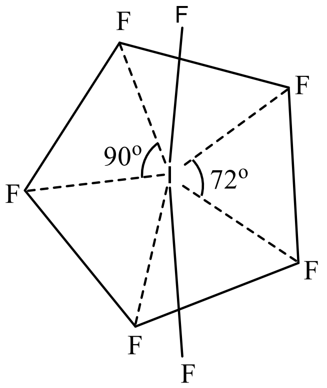
O_2^{2-} (Total number of electrons =18)

$\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2 \overset{*}{\pi}2p_x^2 = \overset{*}{\pi}2p_y^2$

704 **(d)**

IF_7





Pentagonal bipyramidal structure

705 **(b)**

In C_2, only 2π bonds are present

706 **(b)**

NH_4^+ has angle of 109°28′.

707 **(b)**

$$\frac{1}{2}Cl_2(g) \longrightarrow Cl^-(aq)$$

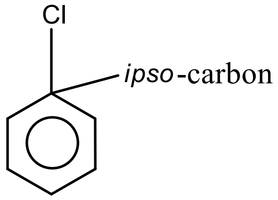
$$\Delta H = \frac{1}{2}\Delta H_{\text{diss}}(Cl_2) + \Delta H_{\text{EA}}\ Cl + \Delta H_{\text{hyd}}(Cl^-)$$

$$= \frac{240}{2} - 349 - 381$$

$$= -610 \text{ kJ mol}^{-1}$$

708 **(b)**

The position at which substituent is present, is called *ipso*-position.

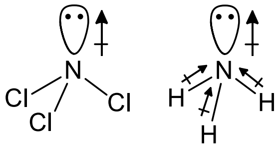


Chlorobenzene

The hybridisation of *ipso*-carbon in chlorobenzene is sp^2.

709 **(c)**

Electronegativity difference between N (3,0) and Cl (3.0) is zero and hence, N − Cl bonds are non-polar. As a result, the overall dipole moment of NCl_3 molecule and its direction is just the dipole moment of the lone pair of electrons



On the other hand, N − Br, (3.0 − 2.8), N − I(3.0 − 2.5) and N − H (3.0 − 2.1) are polar and hence, contribute towards the overall dipole moment of the respective moleculas. Since, the EN difference is higher in case of N − H bonds, therefore, NH_3has the higher dipole moment

710 **(c)**

$CHCl_3$ molecule has largest dipole moment among the given species.

711 **(d)**

In O_2, there are two electrons in antibonding orbitals. Removal of one electron from the O_2molecular gives O_2^+in which the number of antibonding electrons is one less and hence, BO increases. Thus, removal of the electron from O_2stabilized the molecule

712 **(a)**

Mg^{2+} is a smaller cation in these. Smaller is cation more is hydration energy.

713 **(b)**

Hydrogen bonding ∝ electronegativity

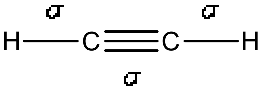
714 **(c)**

Larger is anion, more is its polarization.

715 **(c)**

NaF is more ionic; F is smallest anion among all and thus, least polarized.

716 **(a)**



and 2 π

Hence, In acetylene, there are 3 σ and 2 π bond.

717 **(d)**

+4 ionic state is not possible for head with iodide because I^- reduces Pb^{4+} to Pb^{2+}.

718 **(a)**

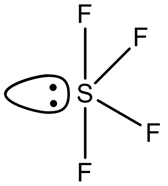
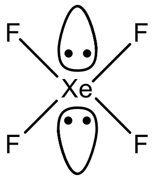
The C − C bond length in sp^3 hybridisation is greater than sp^2 hybridisation due to large size of *p*-orbitals.

In diamond sp^3 hybridisation is present while in graphite, naphthalene and fullerene sp^2 hybridisation is present therefore the C − C bond length is maximum in diamond.

720 **(d)**

SiO_2 structure is definite.

721 **(a)**

Molecule	**Structure**	**Hybridisation of central atom**	**Lone pair**
SF_4		sp^3d	One
CF_4	F | F − C − F | F	sp^3	Zero
XeF_4		sp^3d^2	Two

722 **(a)**

We know that the shape of IF_7 (molecule) is pentagonal bipyramidal because central atom I have sp^3d^3 hybridisation.

723 **(a)**

C − C bond length= 1.54 Å

C = C bond length= 1.34 Å

C ≡ C bond length= 1.20° Å

Thus, correct decreasing order C to C bond lengths is

$\text{IV} > III > I > II$

724 **(b)**

Due to larger difference in electronegativity.

725 **(d)**

Both O and S belong to same group but H_2O is a liquid whileH_2S is a gas. This can be explained on the basis of electronegativity. In water due to the high electronegativity of oxygen hydrogen bonds are formed. As a result the molecules of H_2O get associate together, hence water exists as a liquid at room temperature. On the other hand, the electronegativity of S is less and therefore, hydrogen bonding in H_2S is almost negligible. As a result of which molecules of H_2S are not associated and H_2S exsists as a gas at room temperature.

726 **(d)**

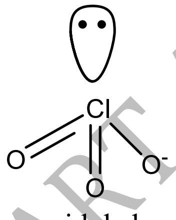
S = C = S.

727 **(d)**

The bond angles in sp^3, sp^2 and sp-hybridization are 109 °, 120 ° and 180 ° respectively.

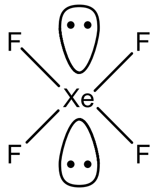
728 **(d)**

In ClO_3^- , Cl is central atom, it is sp^3 hybrid and on it one lone pair of electrons (free pair of electrons) is present.



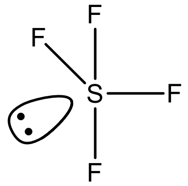
Pyramidal shape

In XeF_4, Xe is central atom it is sp^3d^2 hybrid and on it two lone pair of electrons are present.



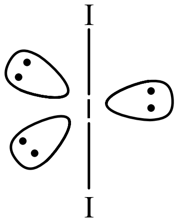
Square planar

In SF_4, S is central atom and sp^3d-hybridised and on it one lone pair of electrons is present.



Irregular tetrahedral

In I_3^-, I is central atom and it is sp^3d hybridised and on it three lone pair of electrons are present.



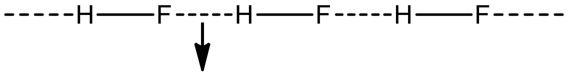
Linear shape

730 **(b)**

Seven atoms of fluorine are covalently bonded with iodine.

731 **(c)**

Intermolecular hydrogen bonding is found in $(HF)_n$ due to higher electronegativity of fluorine atoms.



Hydrogen bonding

Hydrogen bonding is helpfull in the association of HF molecule, so HF is found in liquid form.

732 **(c)**

A species is said to be diamagnetic if it has all electrons paired

Species	Electrons	MO electronic configuration	Magnetic behaviour
H_2^-	3	$\sigma 1s^2 \overset{*}{\sigma} 1s^1$	Paramagnetic
H_2^+	1	$\sigma 1s^1$	Paramagnetic
H_2	2	$\sigma 1s^2$	Diamagnetic
He_2^+	3	$\sigma 1s^2 \overset{*}{\sigma} 1s^1$	Paramagnetic

733 **(b)**

This give rise to polarity in bonds.

734 **(c)**

First electron affinity is energy releasing process.

735 **(b)**

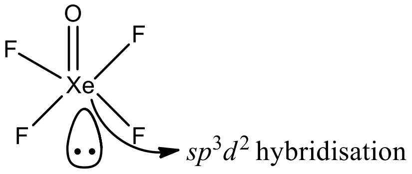
Li^- : $1s^2, 2s^2$; Be^- : $1s^2, 2s^2, 2p^1$; in Li, addition of electron has taken place in 2s orbital; in Be^- , addition of electron has taken place in $2p$ orbital loosing its $2s$ completely filled configuration. EA_1 for Be is more positive than EA_1 for Li. Thus Be^- is least stable.

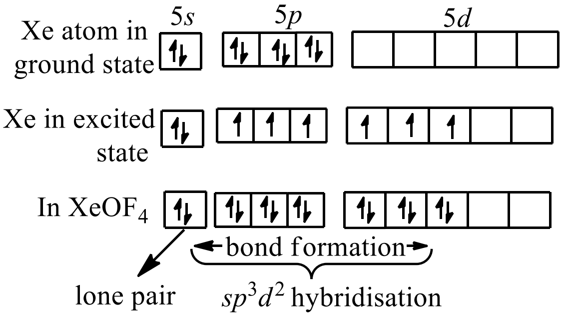
736 **(d)**

Bond energy for C—C, N—N, H—H and O—O are : H—H > C—C > N—N > O—O.

737 **(b)**

The number of lone pair in $XeOF_4$ is one (1). The structure of $XeOF_4$ is given as follows



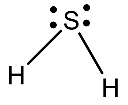


738 **(c)**

BCl_3 has six electrons in outer shell of boron atom.

739 **(b)**

H_2S contain only covalent bonds, as the electronegativity difference between H and S is only (2.6 – 2.1 = 0.5).

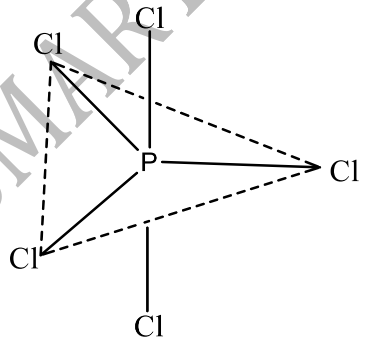


740 **(c)**

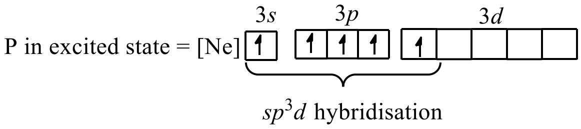
CCl_4 has sp^3-hybridization giving regular tetrahedron geometry. In others the geometry is little distorted inspite of sp^3-hybridization due to different atoms on the vertices of tetrahedron.

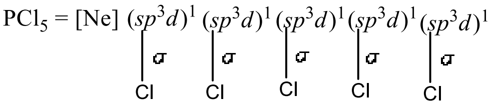
741 **(b)**

P undergoes sp^3d hybridisation in PCl_5 and it has trigonal bipyramidal structure



Trigonal bipyramidal shape of PCl_5





742 **(a)**

Electronegativity difference in two atoms involved in bonding is a measure of polarity in molecule.

743 **(c)**

≡ C— has 2σ-and 2π- (thus, sp-hybridization); −CH= has 3σ- and 1π- (thus, sp^2-hybridization). Remember hybridized orbitals do not form π-bonds.

744 **(b)**

F has 7 electrons in its valence shell. Thus, to attain stability, it should have lost one electron.

745 **(a)**

In O_2^{2-}, 8 electrons are present in antibonding orbitals

$$\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_x^2 \begin{bmatrix} \pi 2p_y^2 \\ \pi 2p_z^2 \end{bmatrix}, \begin{bmatrix} \pi^* p_y^2 \\ \pi^* 2p_z^2 \end{bmatrix}$$

746 **(a)**

CH_3^+ possesses sp^2-hybridization.

747 **(a)**

No doubt NH_3 and BF_3 have sp^3 (pyramidal) and sp^2 (coplanar) hybridization respectively having one lone pair of electron on N atom which is responsible for pyramidal shape of NH_3 inspite of sp^3 hybridization. However, as soon as it is coordinated to BF_3, both attain tetrahedral geometry and acquire sp^3-hybridization.

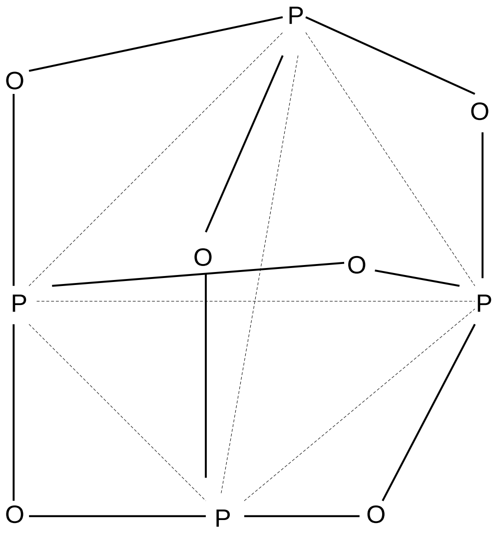
748 **(b)**

Nitrogen molecule has highest bond energy due to presence of triple bond

749 **(b)**

P_4O_6 has following structure.

Thus, every P-atom is linked to 3 oxygen atoms.

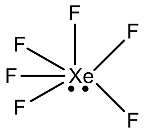


750 **(d)**

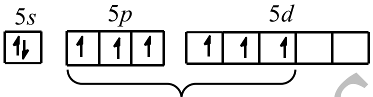
Bond energy ∝ Bond order

751 **(a)**

In XeF_6, the oxidation state of Xe is $+6$. The shape of XeF_6 should be pentagonal bipyramid due to sp^3d^3 hybridisation but due to the presence of one lone pair at one *trans* position its shape becomes distorted octahedral.



distorted octahedral shape



xenon atom in third excited state

752 **(a)**

CN^- and NO^+ both have same number of electrons and same bond order (3).

753 **(b)**

Bond length $\propto \frac{1}{\text{bond order}}$

754 **(c)**

sp^3-hybridization leads to tetrahedral geometry.

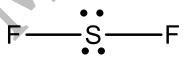
756 **(b)**

Alkali metals are most electropositive elements.

757 **(b)**

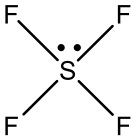
Anions are always larger than parent atom; cations are always lesser than parent atom.

758 **(c)**



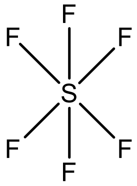
Total number = 4⟶ sp^3hybridisation

SF_4 :



Total number = 5⟶ $sp^3\,d$ hybridisation

SF_6 :



Total number = 6⟶ $sp^3\,d^2$ hybridisation

759 **(a)**

Van der Waals' forces increases in CH_4 to give solid CH_4.

760 **(b)**

As the number of lone pairs of electrons increases, bond angle decreases. Thus, the order of bond angle is

$NH_4^+ > NH_3 > NH_2^-$

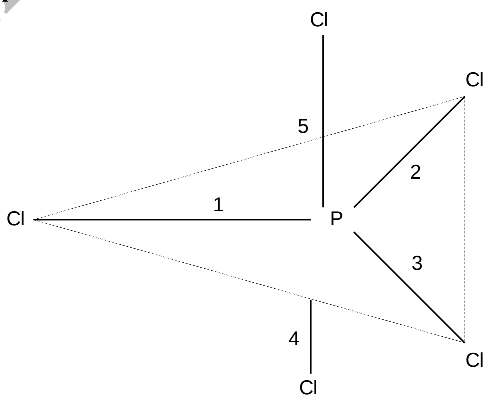
(no lp) (1 lp) (2lp)

761 **(b)**

$BeCl_2 - sp, BF_3 - sp^2; NH_3 - sp^3; XeF_2 - sp^3d$

762 **(a)**

Cl − P − Cl bond angles in PCl_5 molecule are 120° and 90°. PCl_5, having sp^3d hybridised P atom (trigonal bipyramidal geometry) has two types of bonds; axial and equatorial. The two types of bond have different bond lengths 1, 2, 3 and 4 equatorial bonds and 4, 5 axial bonds.



763 **(b)**

Both BF_4^- and NH_4^+ have sp^3-hybridisation and therefore possess tetrahedral geometry.

NF_3 : sp^3
BF_3 : sp^2
BF_4^- : sp^3
NH_4^+ : sp^3
BCl_3 : sp^2
$BrCl_3$: sp^3d
NH_3 : sp^3
NO_3^- : sp^2

764 **(a)**

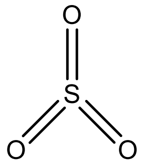
Each possesses 18 electrons.

766 **(d)**

$$He_2^+(B.O. = 0.5) < O_2^-(B.O. = 1.5) < NO(B.O. = 2.5) < C_2^{2-}(B.O. = 3.0)$$

768 **(d)**

In SO_3 molecules, S-atom remains sp^2 hybrid, hence, it has trigonal planar structure



769 **(d)**

$BCl_3 = 3\sigma$ bonds$+0lp$ of $e^- = 3 \Longrightarrow$ sp^2hybridisation

$NCl_3 = 3\sigma$ bonds$+1lp$ of $e^- = 4 \Longrightarrow$ sp^3hybridisation

771 **(b)**

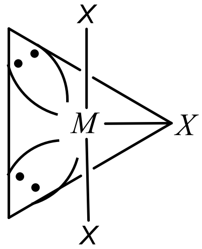
N is sp^2-hybridized in NO_3^-.

772 **(d)**

The ionic radius increases down the group.

773 **(b)**

The formula of MX_3 shows the presence of 3σ bonds. Since, it has T-shape geometry, it must contain 2 lone pairs as



774 **(a)**

Except NO^- (16 electrons), rest all have 14 electrons.

776 **(c)**

Ethyl alcohol forms stronger H-bonds than ethylamine or ammonia due to greater electronegativity of oxygen than nitrogen atom. Diethyl ether, however, does not form H-bonds since , it does not have a H-atom attached to O-atom.

778 **(c)**

Carbon in CO_2 has sp-hybridization.

779 **(c)**

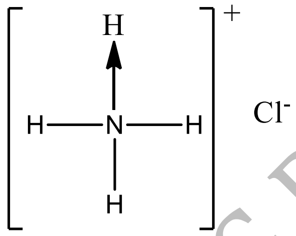
In both CH_4 and CCl_4, sp^3hybridisation is present and both have tetrahedral geometry.

781 **(a)**

As the s-character increases in hybrid orbitals, bond energy increases, size of the hybridized orbital decreases. s-characters in sp, sp^2 and sp^3 are $1/2, 1/3, 1/4$ respectively.

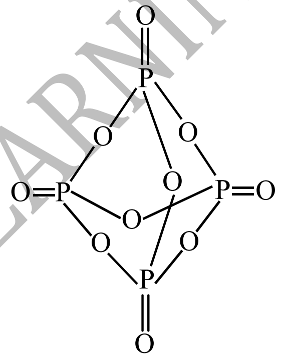
782 **(b)**

NH_4Cl contains ionic, covalent and coordinate linkage.



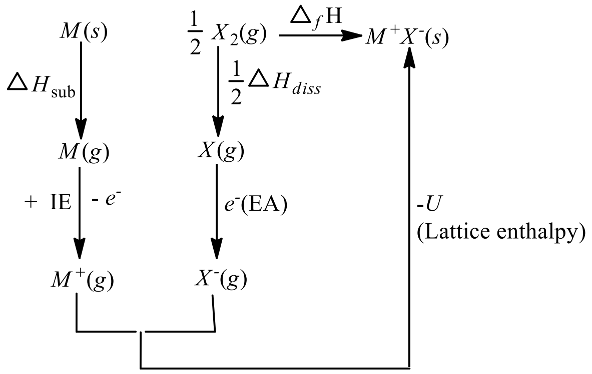
783 **(a)**

P_4O_{10} is



784 **(b)**

The Born-Haber cycle takes place as follows



Hence, Z is $M^+ X^- (s)$

785 **(a)**

S atom is larger in size than O and F.

786 **(d)**

$N_2(7+7=14) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2$
$\approx \pi 2p_y^2, \sigma 2p_z^2$

Bond order $= \frac{10-4}{2} = 3$

$N_2^+(7+7-1=13)$
$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2$
$= \pi 2p_y^2, \sigma 2p_\pi^1$(paramagnetic)

Bond order $= \frac{9-4}{2} = 2.5$

Since, N_2^+has less bond, then N − Nbond gets weak

$O_2(8+8=16)$

$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$

$\approx \pi 2p_y^2, \pi^* 2p_x^1 \approx \pi^* 2p_y^1$

Bond order $= \frac{10-6}{2} = 2$

$O_2^+(8+8-1=15)$

$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$

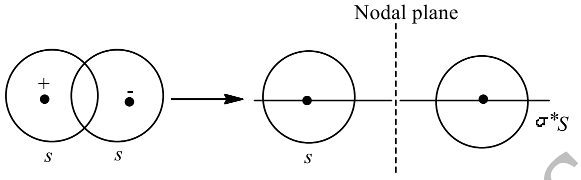
$\approx \pi 2p_y^2, \pi^* 2p_x^1$

Bond order $= \frac{10-5}{2} = 2.5$

Thus, in the formation of $O_2^+$from O_2, paramagnetism decreases but the bond order increases

787 **(a)**

In an antibonding molecular orbital, most of the electron density is located away from the space between the nuclei, as a result of which there is a nodal plane (*i.e.*, a plane at which the electron density is zero) between the nuclei.



788 **(d)**

	Species	Hybridisation of Xe	Lone pair on Xe	Bonding pairs
(a)	XeO_3	sp^3	1	3
(b)	XeF_4	sp^3d^2	2	4
(c)	XeF_6	sp^3d^3	1	6
(d)	XeF_2	sp^3d	3 (Max.)	2

789 **(b)**

Boiling point of HF is highest due to H-bonding. For other halogen acids boiling point increase in the order $HCl < HBR < HI$. Therefore, most volatile (with Lower b.pt.) is HCl.

790 **(b)**

The MO electronic configuration of

$O_2^-\ (8+8+1=17)$

$= \sigma 1s^2,\ {}^*_{\sigma}1s^2, \sigma 2s^2,\ {}^*_{\sigma}2s^2, \sigma 2p_z^2, \pi 2p_x^2$

$\approx \pi 2p_{y,}^2\ {}^*_{\pi}2p_{x,}^2 \approx\ {}^*_{\pi}2p_y^1$

Bond order $= \frac{N_{b-N_a}}{2}$

$$= \frac{10-7}{2} = 1.5$$

791 **(d)**

Multiplicity in bonds decreases bond lengths.

792 **(a)**

Both NH_4^+ and BF_4^- have sp^3-hybridization.

793 **(a)**

NH_3 molecule has three fold axis of symmetry because it has sp^3 hybridisation but due to presence of one lone pair of electron it has pyramidal structure.

794 **(b)**

Basic character of hydrides decreases down the gp.

795 **(b)**

NO is paramagnetic in nature

796 **(d)**

Cation radius increases down the group.

797 **(a)**

According to Born-lande equation

$$U = \frac{Z^+Z^-e^2\text{An}}{r_{\text{node}}}\left(\frac{1}{n}-1\right)$$

Where , U is lattice energy

r_{node} is interionic distance

$\because \quad U \propto \frac{1}{\text{interionic disance}}$

∴ Ions should be of small size to have high lattice energy.

798 **(d)**

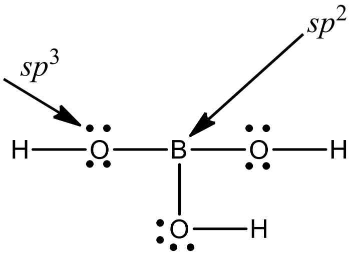
Dipole moment of CH_3OH is maximum in these.

799 **(b)**

Intermolecular H-bonding gives rise to an increase in b.p.

800 **(b)**

H_3BO_3 has structure



Boron has three bonds thus sp^2 hybrdised. Each oxygen has two bonds and tw

801 **(d)**

Species having same hybridisation show similar geometry.

SO_4^{2-}:Hybridisation of S ⟶ sp^3

ClO_4^-:Hybridisation of Cl ⟶ sp^3

802 **(c)**

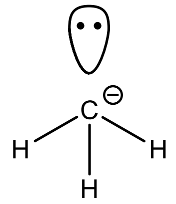
Anions are larger in size than their parent atom.

803 **(c)**

Na^+ and Cl^- are formed.

804 **(b)**

: $-CH_3$ has sp^3 hybridisation.



805 **(c)**

Glycerol and ethanol both have intermolecular hydrogen bonding but in glycerol ($CH_2OH.CHOH.CH_2OH$) hydrogen bonds per molecule is more than ethanol (C_2H_5OH). It increases attraction between the molecules and hence, glycerol is more viscous than ethanol.

806 **(a)**

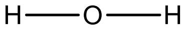
Larger anion is more polarised.

807 **(a)**

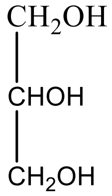
In $\overset{*}{\pi}_{2P_x}$ orbital, two nodal planes are present.

808 **(d)**

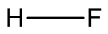
Hydrogen bond is formed between molecules of compounds having O, F and N with H.



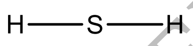
(a)



glycerol
(b)



hydrogen fluoride
(c)



hydrogen sulphide
(d)

∵ H_2S does not have O, F or N.

∴ It does not form hydrogen bond.

810 **(a)**

NaF has maximum melting point, melting point decreases with increases in size of halide ion and their bond energy get lower

811 **(a)**

s-orbitals never go for lateral overlapping because of non-directional nature.

812 **(d)**

The metallic character is found in iodine as well as in astatine (At). Note that metallic character increases down the group.

813 **(b)**

Ionization energy increases along the period and decreases down the group. Also (b) has $[\text{Ne}]3s^2, 3p^3$, *i.e.*, half filled configuration, being more stable and thus, have high ionization energy.

814 **(a)**

The correct option is O_2^{2-}. This species has 18 electrons, which are filled in such a way that all molecular orbitals are fully filled, so diamagnetic.

$\sigma 1s^2\ \overset{*}{\sigma}1s^2, \sigma 2s^2\ \overset{*}{\sigma}2s^2 \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \overset{*}{\pi}2p_x^2 = \overset{*}{\pi}2p_y^2$

815 **(a)**

Water is an universal solvent.

816 **(a)**

According to Fajan's rule, as the charge on cation increase its size decreases. As a result its tendency to polarise anion increases. This brings more and more covalent character to electrovalent compounds.

∵ Among $AlCl_3, LaCl_3, MgCl_2$ and CsCl size of Al^{3+} is smallest.

∴ Al^{3+} polarises anion to highest extent.

∴ $AlCl_3$ has maximum covalent character.

817 **(a)**

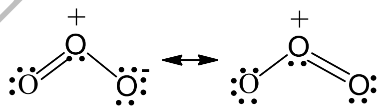
C_6H_6 has regular hexagonal geometry.

818 **(c)**

SF_6 has six S—F bonds.

819 **(a)**

Resonating structure can be written only for such molecules in which multiple bonds are presents, *eg*, O_3



820 **(d)**

According to Born-Haber cycle the enthalpy of formation (ΔH_f) of an ionic compound may be given as

$$\Delta H_f = S + \frac{1}{2}D + I + E + U$$

Where, I = ionisation energy
S = sublimation energy
E = electron affinity
D = dissociation energy
U = lattice energy of compound

Born-Haber cycle is used to determine the lattice energy of the compound. It also may be used to calculate electron affinity of an element.

821 **(c)**

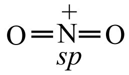
Element C has electronic structure $1s^2, 2s^2, 2p^5$,it requires only one electron to complete its octet and it will form anion so it will form electrovalent bond

822 **(a)**

H atom has $1s^1$ configuration. Shielding effect is property of penultimate shell electrons.

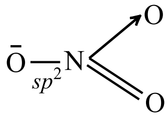
823 **(b)**

NO_2^+ : The species is linear with sp-hybridisation.

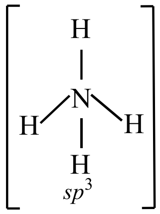


$\overset{+}{\underset{sp}{O=N=O}}$

NO_3^- : The species is trigonal planar with sp^2-hybridisation.



NH_4^+ : The species is tetrahedral with sp^3-hybridisation.



824 **(d)**

Both C and N^+ have six electrons.

825 **(a)**

According to Fajans' rule, polarization of anion is influenced by charge of cation, size of cation. More is the charge on cation, more is polarization of anion.

826 **(b)**

Smaller cation causes more polarization of anion.

827 **(a)**

Bond order $= \frac{1}{2}$ [no. of bonding electrons-no. of antibonding electron]

828 **(c)**

Pauling work on chemical bonding.

829 **(a)**

All have linear structure

$O=C=O, Cl-Hg-Cl, H-C\equiv C-H$

830 **(d)**

A characteristic of metallic bonding.

831 **(a)**

Due to larger differences in electronegativity.

833 **(b)**

SF_4 has sp^3d –hybridization. Rest all have sp^3-hybridization.

834 **(a)**

NO has 15 electrons.

835 **(d)**

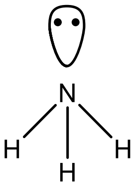
Ti^+ has 21 electrons in it. Rest all have 10 electrons.

836 **(a)**

O_2^- has one unpaired electron.

837 **(a)**

Structure of ammonia is pyramidal (Distorted from tetrahedral to pyramidal due to repulsion between lone pair and bond pair of electrons).



838 **(b)**

Cl_2 involves $3p-3p$ overlapping.

839 **(b)**

Only Sulphur has d-orbitals.

840 **(c)**

ClO_4^- has sp^3-hybridization on Cl atom.

841 **(d)**

Due to dipole moment intermolecular forces of attraction becomes stronger and thus, liquefaction becomes easier.

842 **(d)**

sp^3d-hybridisation leads to trigonal bipyramidal geometry if no lone pair is present, *e*.g., PCl_5; in ClF_3 geometry is T-shaped due to the presence of two lone pair of electron. In XeF_2, geometry is linear due to the presence of three lone pair of electrons.

843 **(a)**

Due to the presence of lone pair on N atom.

844 **(a)**

B_2: Total electrons = 10

Configuration : $\sigma 1s^2 \overset{*}{\sigma}1s^2 \sigma 2s^2 \overset{*}{\sigma}2s^2 \pi 2p_x^1 = \pi 2p_y^1$

If Hund's rule is violated, then

$\sigma 1s^2 \overset{*}{\sigma}1s^2 \sigma 2s^2 \overset{*}{\sigma} 2s^2 \ \pi 2p_x^2 = \pi 2p_y^0$

So, diamagnetic

Bond order $= \frac{6-4}{2} = 1$

845 **(a)**

Bonding molecular orbitals possess lower energy levels than antibonding orbitals.

846 **(a)**

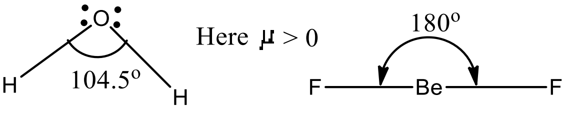
Be^{2+} is smallest and Na^+ has largest radius.

847 **(b)**

Hydrogen bond is strongest in HF due to higher electronegativity of F.

848 **(d)**

The structure of H_2O is angular V-shape and has sp^3- hybridisation and bond angle is 105°. Its dipole moment value is positive or more than zero.



But in BeF_2 , structure is linear due to sp-hybridisation ($\mu = 0$). Thus, due to $\mu > 0$, H_2O is dipolar and due to $\mu = 0$, BeF_2 is non-polar.

849 **(d)**

These are factors on which effective nuclear charge depends.

850 **(a)**

5(on P) + 4(on H)−1= 8.

851 **(b)**

Phosphoric acid has 3 – OH groups, which are involved in hydrogen bonding .

The type of hydrogen bonding, found , is intermolecular. Due to this, it is syrupy.

852 **(c)**

The bond angles are

H_2S	NH_3	SiH_4	BF_3
92.6°	107°	$109^\circ 28'$	120°

853 **(b)**

The metals have low ionization energy. In a piece of metal many free electrons are found which move form one atom to other. The presence of mobile electrons or oscillation of loose electrons are responsible for metallic lusture.

854 **(c)**

Same spin electrons in two atoms do not take part in bonding.

855 **(b)**

Molecule	Hybridisation
SO_3	sp^2
C_2H_2	sp
C_2H_4	sp^2
CH_4	sp^3
CO_2	sp

Hence, the hybrid state of S in SO_3 is similar to that of C in C_2H_4.

856 **(d)**

IO_3^-, XeO_3, (sp^3 hybridisation) pyramidal

PF_6^- , SF_6 (sp^3d^2) octahedral

BH_4^- , NH_4^+, SiF_4 (sp^3) tetrahedral

CO_3^{2-} (sp^2) trigonal planar

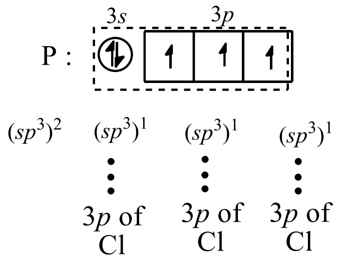
NO_3^- (sp^2) trigonal planar

SF_4 (sp^3d) $see-saw$

Hence, SiF_4 and SF_4 are not isostructural (same structure).

857 **(b)**

PCl_3 has sp^3-hybridisation and possesses one lone pair on P-atom and three bond pair of electron



859 **(c)**

N atom in NH_3 provides electron pair to H^+ to form coordinate or dative bond ($H_3N \rightarrow H$).

861 **(d)**

Due to H-bonding, $V_{\text{ice}} > V_{\text{water}}$.

862 **(b)**

The covalent compounds have low melting point due to weaker forces of attraction among them as compared to strong forces of attraction in ionic compounds.

∵ HCl is covalent compound among CsF, HCl HF and Li

(CsF, HF and LiF are ionic compounds)

∴ HCl has minimum boiling point.

863 **(b)**

(i) Hybridisation $=\frac{1}{2}$ (no. of e^- in valence shell of central atom + no. of monovalent atoms + charge on anion – charge on cation)

(ii) Shape or geometry of molecule depends on lone pair and bond pair of electrons present in it.

Hybridisation of

N in $NH_3 = \frac{1}{2}(5+3+0-0) = 4$

∴ sp^3 hybridisation.

∵ It has 3 bond pair and 1 lone pair of electrons, so it has distorted tetrahedron shape.

864 **(d)**

24. The bond angle decreases with decrease in electronegativity. It results in decrease in repulsion between bond pair-bond pair electrons and bond angle becomes smaller.

25. Between NH^3 and H_2O, H_2O has smaller bond angle due to presence of two lone pair of electrons causing more repulsion among electrons as compared of NH^3 which has only one lone pair of electron.

Hydrides

NH^3 H_2O H_2S H_2Se H_2Te

Bond angles
107° 105° 92° 91° 90°

H_2 Te has smallest bond angle.

865 **(a)**
In ionic solids, ions exist at lattice points. In covalent solids atoms lie at lattice points.

866 **(c)**
In structure (c), all the atoms have complete octet. Thus, it is the correct representation of carbon suboxide

867 **(b)**
Smaller is atom, more is energy needed to remove electron, *i.e.*, ionisation energy. Also removal of two electrons needs more energy.

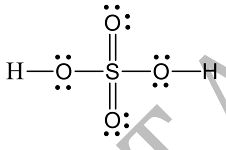
868 **(d)**
Born-Haber cycle inter-relates the various energy terms involved in ionic bonding.

869 **(a)**
$BF_3(sp^2)$, $NO_2^-(sp^2)$, $NH_2^-(sp^3)$and $H_2O(sp^3)$.

870 **(c)**

sp^3 hybridisation	Tetrahedron molecule
dsp^2 hybridisation	Square planar molecule
sp^3d hybridisation	Trigonal bipyramidal molecule
sp^3d^2 or d^2sp^3 hybridisation	Octahedron molecule

871 **(b)**



Total number of unshared electrons = 4 × 4 = 16

872 **(d)**
Ionisation energy order is $B < C < O < N$.

873 **(d)**
Given,
observed dipole moment = 1.03 D
Bond length of HCl molecule, $d = 1.275$ Å
$= 1.275 \times 10^{-8}$ cm
Charge of electron, $e^- = 4.8 \times 10^{-10}$ esu
Percentage ionic character = ?
Theoretical value of dipole moment $= e \times d$
$= 4.8 \times 10^{-10} \times 1.275 \times 10^{-8}$ esu.cm
$= 6.12 \times 10^{-18}$ esu.cm
$= 6.12$ D
Percentage ionic character
$$= \frac{\text{observed dipole moment}}{\text{theoretical value of dipole moment}} \times 100$$
$$= \frac{1.03}{6.12} \times 100 = 16.83\%$$

874 **(b)**
Double bond involves the sharing of two electron pairs or four electrons.

875 **(b)**
There are 16 $P - O$ bonds in P_4O_{10}.

876 **(a)**
Difference of electronegativity > 1.7 produces ionic compound.

877 **(a)**
It is a concept.

878 **(a)**
Low ionisation potential indicates that element can easily lose electron to form cation.

879 **(d)**
Ionic compounds having lattice energy higher than hydration energy are insoluble in water.

880 **(a)**
Removal of electron is easier in f-block elements due to more shielding.

881 **(d)**
Metals and non-metals combine to complete their octet. Since, non-metals have lack of electrons, in order to complete their octet, they gain electrons, consequently, the size of non-metal atom will increase.
$$\underset{(Na^+)}{\text{Metal}} + \underset{(Cl)}{\text{Non} - \text{metal}} \longrightarrow \underset{NaCl}{\text{Electrovalent bond}}$$

882 **(d)**
These are characteristics of hydration.

883 **(c)**
Molecules or ion having no unpaired electrons are diamagnetic, *e.g.*,
$Li_2 = 6e^- = \sigma 1s^2, \overset{*}{\sigma} 1s^2, \sigma 2s^2$

884 **(a)**
Given electronic configuration of anion X is
$\sigma 1s^2, \overset{*}{\sigma} 1s^2, \sigma 2s^2, \overset{*}{\sigma} 2s^2, \pi 2p_x^2$
$= \pi 2p_y^2, \sigma 2p_z^2, \overset{*}{\pi} 2p_x^1$
∴ Total number of electrons of anion $X = 15$
Hence, the anion X is N_2^-.

885 **(a)**
Small cation causes more polarization in anion. Also larger anions are easily polarized by a cation. More is polarization of anion, more is covalent character.

886 **(c)**

Hydrogen bonding is responsible for their solubility.

887 **(a)**

Ne has van der Waals radius larger than covalent radius of fluorine.

888 **(c)**

As the number of unpaired electrons (lone pair of electrons) increases, bond angle decreases. Thus, the decreasing order of bond angle is

Species : $NO_2^+ > NO_2 > NO_2^-$

Bond angle: 180° 135° 115°

889 **(a)**

Dipole moment of $CH_4 = 0$.

890 **(b)**

Each has 22 electrons.

891 **(d)**

CS_2 is linear having zero dipole moment.

892 **(a)**

Atomic radius decreases along the period, increases down the group.

894 **(b)**

In NH_3, the N atom contains a one lone pair of electrons and three bond pairs in its valence shell. So, it shows sp^3 hybridisation. Due to presence of one lone pair of electron, its shape deviates from tetrahedral because lone pair shows more repulsion than bond pairs.

As

$lp - lp > lp - bp > bp - bp$

So, its shape is pyramidal and angle 107°.

895 **(d)**

The K_{sp} value of CuS is less than ZnS and thus, ZnS is more soluble. Also sodium salts are highly soluble in water.

896 **(c)**

Both carbon atoms have 2σ-and 2π-bonds.

897 **(b)**

1debye $= 10^{-18}$esu.

898 **(c)**

Low ionisation energy indicates that electron can be easily lost and cation formation is easier.

899 **(b)**

The paramagnetic species has unpaired electron in it.

(a)$H_2 = 1 + 1 = \sigma 1s^2$

(b)$N_2 = 7 + 7 = 14 =$

$\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

(c)$CO = 6 + 8 = 14 =$

$\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

(d)$O_2 = 8 + 8 = 16 =$

$\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2, (\pi 2p_x^2 = \pi 2p_y^2), (\overset{*}{\pi}2p_x^1 = \overset{*}{\pi}2p_y^1)$

$\because O_2$ molecule has unpaired electrons.

$\therefore O_2$ molecule is paramagnetic.

901 **(c)**

C_2, N_2 and F_2 has no unpaired electron in their molecular orbital configuration.

902 **(d)**

IP of inert gases is maximum.

903 **(d)**

Cu loses two electron to form Cu^{2+}.

905 **(a)**

$O_2^+ \ (15\ e^-)$

$= KK^* \ (\sigma 2s)^2 (\overset{*}{\sigma}2s)^2 (\sigma 2p_x)^2, (\pi 2p_y)^2$

$= (\pi 2p_z)^2 (\overset{*}{\pi}2p_y)^1 = (\overset{*}{\pi}2p_z)^0$

Hence, bond order $= \frac{1}{2}(10 - 5) = 2.5$

$N_2^+ \ (13\ e^-) = KK^* \ (\sigma 2s)^2 (\overset{*}{\sigma}2s)^2 (\pi 2p_y)^2$

$= (\pi 2p_z)^2, (\sigma 2p_x)^1$

Hence, Bond order $= \frac{1}{2}(9 - 4) = 2.5$

906 **(b)**

In XeF_5^+, Xe atom has only seven electrons , *i.e.*, $5s^2\ 5p^5$. Here two $5p$ electrons are promoted to $5d$-sublevel. Then $5s$, three $5p$ and two $5d$ orbitals hybridize to give six sp^3d^2 hybrid orbitals in an octahedral geometry. Out of these five orbitals are singly occupied which form sigma bonds with five F atoms. The sixth hybrid orbital is occupied by a lone pair in *trans* position giving a square pyramid structure.

907 **(d)**

HOMO, means highest occupied molecular orbital and in CO (14 electron ion),σ bonding molecular orbital in HOMO

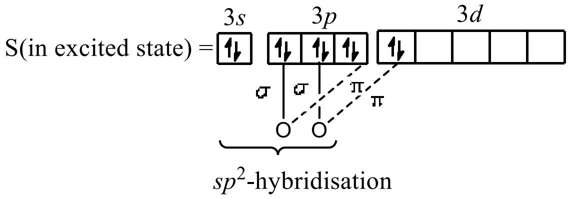
$CO = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2$

$= \pi 2p_y^2, \sigma 2p_z^2$

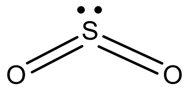
909 **(c)**

Sulphur is sp^2hybridised in SO_2.

$S = 1s^2, 2s^2 2p^6, 3s^2 3p^4 3d^0$



Due to sp^2-hybridisation and presence of one lone pair of electrons SO_2 has angular geometry.



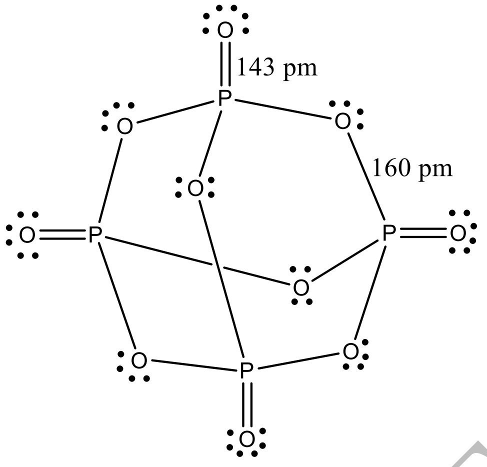
Among N_2O, CO_2 and CO, all have sp-hybridisation.

910 **(c)**

Coordinate bonding involves sharing of an electron pair provided by a donor to acceptor atom.

911 **(a)**

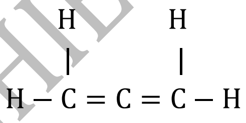
In the structure of P_4O_{10}, each phosphorus atom is covalently linked with three oxygen atoms and each oxygen atom is bonded to two phosphorus atoms. Each phosphorus atom is also linked with an additional oxygen atom with the help of a coordinate linkage by lone pair of electron present on P atom.



912 **(d)**

$H_2C = C = CH_2$ or

Allene (C_3H_4)



$$\begin{matrix} & H & & H & \\ & | & & | & \\ H - & C & = C = & C & - H \end{matrix}$$

It has 2 double and 4 single bonds

913 **(b)**

CsCl is ionic.

914 **(c)**

In NaOH, Na^+ and OH^- ions are bonded together by ionic bond while in OH^- ion oxygen and hydrogen atoms are bonded together by covalent bond $Na^+ [O - H]^-$.

915 **(d)**

Effective nuclear charge increases in this order.

917 **(d)**

AgBr has higher lattice energy.

918 **(c)**

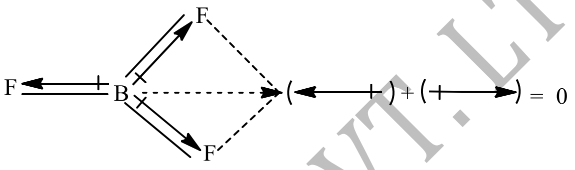
$$r_H = \frac{74}{2} = 37\text{pm}, \; r_{Cl} = \frac{198}{2} = 99\text{pm}.$$

B.L. of HCl $\approx r_H + r_{Cl}$

919 **(b)**

A symmetrical molecule have zero dipole moment. The dipole moment of BF_3 molecule is zero due to its symmetrical (triangular planar) structure.

The three fluoride atoms lie at the corners of an equilateral triangle with boron at the centre. Thus, the vectorial addition of the dipole moments of the three bonds gives a net sum of zero.



920 **(c)**

Bond order ∝ Stability

Hence, for a stable molecule the value of bond order must be positive. When bond order is zero the molecule will not exist.

921 **(b)**

Follow Fajans' rule.

922 **(b)**

It is a fact.

923 **(a)**

In PCl_3 and $POCl_3$, P atom is sp^3-hybridized.

924 **(c)**

Square planar geometry has dsp^2-hybridisation.

925 **(c)**

Both BrO_3^- and XeO_3 have sp^3-hybridisation and one lone pair of electron.

926 **(a)**

HF and CH_3OH shows intermolecular hydrogen bonding.

927 **(d)**

During hydration of ions in aqueous solution, there exists an attractive force between ions and water molecules, which are polar in nature and acts as dipole. So, hydrogen of ions in aqueous solution is an example ion-dipole interaction.

928 **(c)**

According to Fajan's rule, largest cation and smallest ions form ionic bond

929 **(d)**

Phosphorus atom is sp^3 hybridised in P_4 usually. Therefore, p-character 75%

930 **(c)**

Na^+ is cation; Cl^-, PO_4^{3-} are anion.

931 **(c)**

Ionisation energy decreases down the group.

932 **(d)**

The characteristics to be observed during removal of II electron.

933 **(c)**

1.$(N_2 \longrightarrow (\sigma 1s)^2\ (\overset{*}{_\sigma}1s)^2\ (\sigma 2s)^2(\overset{*}{_\sigma}2s)^2$

$(\sigma 2p_z)^2\ (\pi 2p_x)^2(\pi 2p_y)^2$

$N_2^+ \longrightarrow (\sigma 1s)^2\ (\overset{*}{_\sigma}1s)^2\ (\sigma 2s)^2(\overset{*}{_\sigma}2s)^2$

$(\sigma 2p_z)^2\ (\pi 2p_x)^2(\pi 2p_y)^1$

1.$O_2 \longrightarrow (\sigma 1s)^2\ (\overset{*}{_\sigma}1s)^2\ (\sigma 2s)^2(\overset{*}{_\sigma}2s)^2\ (\sigma 2p_z)^2$

$(\sigma 2p_x)^2(\sigma 2p_y)^2\ (\overset{*}{_\pi}\ 2p_x)^1\ \left(\overset{*}{_\pi}\ 2p_y\right)^1$

$O_2^+ \longrightarrow (\sigma 1s)^2\ (\overset{*}{_\sigma}1s)^2\ (\sigma 2s)^2\ (\overset{*}{_\sigma}2s)^2\ (2p_z)^2$

$(\pi 2p_x)^2(\pi 2p_y)^2\ (\overset{*}{_\pi}\ 2p_x)^1$

Since , $\pi 2p_x$ and $\pi 2p_y$ are nearly same in energy,

the electrons can be removed from ($\pi 2p_y$ or $\pi 2p_x$)

and $(\overset{*}{_{\pi 2p_y}}$ or $\overset{*}{_{\pi 2p_x}})$ respectively.

934 **(b)**

Both possess $1s^2, 2s^2 2p^6, 3s^2 3p^6$ configuration.

936 **(d)**

The resultant dipole in regular tetrahedron is zero.

937 **(c)**

Smaller the size of cation, more is ionic character, more is attraction among ions.

938 **(c)**

Given ionic charge $= 4.8 \times 10^{-10}$ e.s.u. and ionic distance $= 1\text{Å} = 10^{-8}$ cm. We know that dipole moment = Ionic charge × ionic distance

$= (4.8 \times 10^{-10}) \times 10^{-8}$

$= 4.8 \times 10^{-18}$ e. s. u. per cm

$= 4.8$ debye.

939 **(d)**

As the s-character increases in hybridised orbitals, its electronegativity increases.

	sp	sp^2	sp^3
s-character	50%	33.3%	25%

940 **(d)**

PCl_3 and $AsCl_3$ have sp^3 hybridisation and PF_5 has sp^3d hybridisation. Hence, in group of PCl_3 , $AsCl_3$ and PF_5 all do not have sp^3d hybridisation.

942 **(d)**

Each has 18 electrons.

943 **(b)**

Alkali metals are always univalent.

944 **(c)**

XeF_4 has sp^3d^2-hybridized Xe atom having two lone pair of electrons and thus, octahedral geometry changes to square planar due to lone pair effect.

945 **(d)**

$PCl_5 = sp^3d$ (Trigonal pyramidal)
$IF_7 = sp^3d^3$(Pentagonal bipyramidal)
$H_3O^+ = sp^3$ (Pyramidal)
$ClO_2 = sp^2$ (Angular) bond length are shorter than single bond due to resonance.
$NH_4^+ = sp^3$(Tetrahedral)

946 **(d)**

B in BF_3 has sp^2-hybridization.

947 **(c)**

In metallic bonds, the valence shell electrons are delocalised and shared between many atoms. These delocalised electrons allow the metal atoms to slide past one another without being subjected strong repulsive forces. The malleability and ductility of metals is due to this sliding capacity of the delocalised electrons.

948 **(b)**

$CH_3 - CH_2 - NH_2$
$sp^3 \quad sp^3$
$CH_3 - CH = CH_2$
$sp^3 \quad sp^2 \quad sp^2$

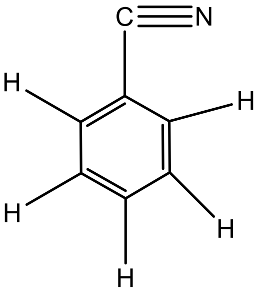
$$\begin{array}{c} O \\ || \\ CH_3 - C - NH_2 \end{array}$$

$sp^3 \quad sp^3$
$CH_3 - CH_2 - C \equiv N$
$sp^3 \quad sp^2 \quad sp$

949 **(a)**

A reason for given fact.

950 **(c)**



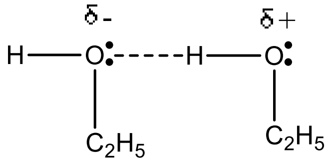
Benzene nitrile contains 13σ and 5π bonds.

951 **(d)**

During melting of SiO_2, the gient network structure held by covalent bonds breaks to give individual molecules ofSiO_2. In contrast, during boiling of H_2O only change of state occurs from liquid to gaseous; during melting of KCN, electrostatic attraction between K^+ and CN^- ions is overcome ; during boiling of CF_4, van der Waals' forces of attraction breaks

952 **(b)**

Ethyl alcohol C_2H_5OH is soluble in water due to H-bonding.



Hydrogen bonding

953 **(b)**

Only p-orbitals give rise to σ-bond (head on overlapping) and π-bond (lateral overlapping).

954 **(b)**

HCl and $AlCl_3$ are covalent but give ions in solution.

955 **(b)**

As a result of more overlapping. Note that π-bonds are formed after σ-has already formed.

956 **(b)**

(a) $NH_3 \quad + \quad H^+ \longrightarrow NH_4^+$

$(3bp + 1lp)$ $\quad (4bp \Rightarrow sp^3$ hybridisation)

$\Rightarrow sp^3$ hybridisation)

(b) $BF_3 + \quad F^- \longrightarrow BF_4^-$

$(3bp + sp^2$ hybridisation)

$(4bp \Rightarrow sp^3$ hybridisation)

(c) $H_2O + H^+ \longrightarrow H_3O^+$

$(2bp + 2lp$ $\quad (3bp + 1lp$

$\Rightarrow sp^3$ hybridisation) $\Rightarrow sp^3$ hybridisation)

(d) $CH \equiv CH + 2H_2 \longrightarrow CH_3 - CH_3$

$sp \quad sp \qquad\qquad sp^3 \quad sp^3$

Hence, reaction given in option (b) involves the change of hybridisation from sp^2 to sp^3.

957 **(c)**

Lattice energy of $BaSO_4$ is appreciable high and predominates over hydration energy.

958 **(a)**

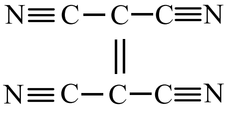
Xe in $XeOF_4$ has sp^3d^2-hybridization having one lone pair on Xe atom.

960 **(c)**

Due to back bonding in BF_3.

961 **(c)**

$C_2(CN)_4$ is



C = C is sp^3-hybridization and C ≡ N is sp-hybridized.

962 **(c)**

Electron affinity order for halogens is $Cl > F > Br > I$.

963 **(c)**

Potash alum is a double salt.

Potash alum, $K_2SO_4.Al_x(SO_4)_3.24H_2O$ (given)

Ions	Al	SO_4
Valency	+3	-2

Therefore, $Al_3(SO_4)_3$ is compound of Al^{3+} and SO_4^{2-}.

On comparing, x=2

Hence, formula of potash alum is

$$= K_2SO_4.Al_2(SO_4)_3.24H_2O$$

964 **(d)**

For KO_2, O_2^- has unpaired electron so, it is paramagnetic.

$O_2^-(17)$

$\sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_x^2, (\sigma 2p_y^2 = \sigma 2p_z^2), \overset{*}{\pi}2p_y^2 = \overset{*}{\pi}2p_z^1$

965 **(c)**

HCl exists as $H^{\delta+} — Cl^{\delta-}$ due to difference in electronegativity of H and Cl.

966 **(b)**

Outer shell electrons are referred as valence electrons.

967 **(d)**

Bond order ∝ stability

Species	Bond order
O_2^+	2.5
O_2	2.0
O_2^-	1.5

Hence, the order of stability is

$O_2^+ > O_2 > O_2^-$

968 **(c)**

Diamond is hard, graphite is soft.

969 **(a)**

IF_5 is square pyramid (sp^3d^2-hybridisation in I); PCl_5 is trigonal bipyramid (sp^3d-hybridisation in P).

970 **(d)**

Characteristics of bond order concept.

971 **(c)**

M.θ. configuration of O_2 is

$\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p^2, \pi 2p_x^2, \pi 2p_y^2, \pi^*2p_x^1,$

.

972 **(b)**

Bond energy of Cl_2 is highest among all halogen molecules. B.E. of F_2, Cl_2, Br_2, I_2 are 37, 58, 46 and 36 kcal mol^{-1} respectively.

974 **(a)**

Bond length $\propto \frac{1}{\text{Bond order}}$

$NO^- = 16e^-$

$= \sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_x^2, \pi 2p_y^2$

$= \pi 2p_z^2, \overset{*}{\pi}2p_y^1 = \overset{*}{\pi}2p_z^1$

$BO = \frac{N_{b-}N_a}{2}$

$= \frac{10-6}{2} = 2$

Similarly BO of NO^+ will be calculated as

$NO^+ = 14e^-$

$BO = \frac{10-4}{2} = 3$

$CN^- = 14e^-, BO = 3$

$CN^+ = 13e^-, BO = \frac{9-4}{2} = 2.5$

Bond order is least for NO^- . So, its bond length is highest.

975 **(c)**

$CsBr_3 \longrightarrow Cs^+ + Br_3^-$

976 **(c)**

H H H H
| | | |
H − C = C − C − C − H
| |
H H

Number of σ bonds in 1-butene are 11.

977 **(b)**

NO_3^- has sp^2-hybridization and possesses coplanar or equilateral triangular geometry.

978 **(b)**

CCl_4 involves two non-metals C and Cl and thus, bonding is covalent. CaH_2 is an ionic compound as it involves alkaline earth metal.

979 **(c)**

CaO is basic oxide.