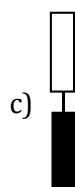
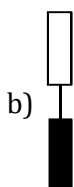
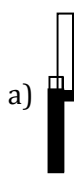


4. CHEMICAL BONDING AND MOLECULAR STRUCTURE

Single Correct Answer Type

1. Which represents metallic character in an element?



d) None of these

2. The enolic form of acetone contain

a) 10 σ bonds, 1 π bond and 1 lone pair

b) 8 σ bonds, 2 π bonds and 2 lone pairs

c) 9 σ bonds, 1 π bond and 2 lone pairs

d) 9 σ bonds, 2 π bonds and 1 lone pair

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

a) Bond order three and isoelectronic

b) Bond order three and weak field ligands

c) Bond order two and π -acceptors

d) Isoelectronic and weak field ligands

4. The high density of water compared to ice is due to

a) Hydrogen bonding interactions

b) Dipole-dipole interactions

c) Dipole-induced dipole interactions

d) Induced dipole induced dipole interactions

5. Among the following species, identify the isostructural pairs

NF_3 , NO_3^- , BF_3 , H_3O^+ , HN_3

a) $[NF_3, NO_3^-]$ and $[BF_3, H_3O^+]$

b) $[NF_3, HN_3]$ and $[NO_3^-, BF_3]$

c) $[NF_3, H_3O^+]$ and $[NO_3^-, BF_3]$

d) $[NF_3, H_3O^+]$ and $[HN_3, BF_3]$

6. Which combination will give the strongest ionic bond?

a) K^+ and Cl^-

b) K^+ and O^{2-}

c) Ca^{2+} and Cl^-

d) Ca^{2+} and O^{2-}

7. Ratio of σ and π bonds is maximum in

a) Naphthalene

b) Tetracyano methane

c) Enolic form of urea

d) equal

8. In which pair or pairs is the strongest bond found in the first species?

I: O_2^{2-} , O_2 ; II: N_2 , N_2^+ III: NO^+ , NO^-

a) I only

b) II only

c) I and III only

d) II and III only

9. (C – Cl) bond in $CH_2 = CH - Cl$ (vinyl chloride) is stabilized in the same way as in

a) Benzyl chloride

b) Benzoyl chloride

c) Chlorobenzene

d) Allyl chloride

10. Select the correct statement about resonance

a) The larger the number of the contributing structures, the greater the stability of the molecule

b) Greater number of the covalent bonds add to the stability of the molecule

c) The positive charge should reside, as far as possible, on the less electronegative element

d) All the above are correct statements

11. Which of the following have identical bond order?

I. CN^- II. O_2^-

III. NO^+ IV. CN^+

a) I, III

b) II, IV

c) I, II, III

d) I, IV

12. The geometry of the atoms in the species PCl_4^+ is best described as

a) Tetrahedral

b) *see-saw*

c) Square

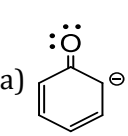
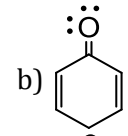
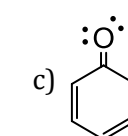
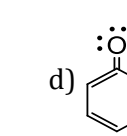
d) Trigonalbipyramidal

13. In a Lewis dot structure, the electrons which complete an octet but are not located between two atoms are referred to as

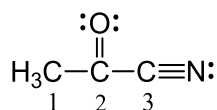
a) Bonding pairs

b) Delta minus electrons

c) Excess electrons

- d) Lone pairs
14. Which one of the following compounds has the electron-pair geometry as the trigonalbipyramidal with three equatorial positions occupied by lone pairs of electrons?
- a) AlCl_3
 b) XeF_2
 c) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
 d) $\text{CH}_3 - \text{Mg} - \text{Br}$
15. Correct Lewis structure is
- a) $[\text{:}\ddot{\text{O}}-\text{C}=\ddot{\text{N}}:]^-$ b) $[\text{C}\equiv\text{C:}]^{2-}$ c) $[\text{:}\ddot{\text{Cl}}-\ddot{\text{O}}:]^-$ d) $:\ddot{\text{N}}=\ddot{\text{O}}:$
16. A molecule in which the central atom forms three single bonds and has one lone pair is said to be have a shape
- a) Bent b) Linear c) Planar d) Pyramidal
17. The correct order of increasing C – O bond length of CO , CO_3^{2-} , CO_2 is
- a) $\text{CO}_3^{2-} < \text{CO}_2 < \text{CO}$ b) $\text{CO}_2 < \text{CO}_3^{2-} < \text{CO}$ c) $\text{CO} < \text{CO}_3^{2-} < \text{CO}_2$ d) $\text{CO} < \text{CO}_2 < \text{CO}_3^{2-}$
18. The percentage of *p*-character in the orbitals forming P – P bonds in P_4 is
- a) 25 b) 33 c) 50 d) 75
19. Select the correct statement
- a) Both lattice energy and hydration energies decrease with ionic size
 b) Lattice energy can be calculated using Born-Haber cycle
 c) If the anion is large compared to the cation, the lattice energy will remain almost constant within a particular group
 d) All of the above are correct statements
20. The paramagnetism of oxygen is best explained by
- a) MO theory b) Valence bond theory c) VSEPR theory d) Lewis dot structure
21. When a chemical bond is formed, there is decrease in
- a) Kinetic energy b) Potential energy c) Repulsive force d) Attractive force
22. 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
23. The formal charge of the O atoms in the ion $[\text{:}\ddot{\text{O}}=\text{N}=\ddot{\text{O}}:]^+$ is
- a) -2 b) -1 c) 0 d) +1
24. Which of the following can provide an electron pair for the formation of a coordinate covalent bond?
- a) H^+ b) H^- c) H_2 d) He^{2+}
25. Which of these molecules have non-bonding electron pairs on the central atom?
 I. SF_4 ; II. ICl_3 ; III. SO_2
- a) II only b) I and II only c) I and III only d) I, II and III
26. A molecule of the type AX_5 has square pyramidal geometry. Hence, number of lone pairs on A is
- a) 4 b) 3 c) 2 d) 1
27. Coordinate covalent bond is absent in
- a) $[\text{Fe}(\text{CN})_6]^{4-}$ b) Adduct of NH_3 and BH_3
 c) H_3O^+ d) PCl_3
28. Which is not the resonance structure of phenoxide ion?
- a)  b)  c)  d) 
29. 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
30. Among KO_2 , AlO_2^- , BaO_2 and NO_2^+ , unpaired electron is present in
 a) KO_2 only b) NO_2^+ and BaO_2 c) KO_2 and AlO_2^- d) BaO_2 only
31. What hybrid orbitals are employed by carbon atoms 1, 2 and 3, respectively as labelled in the compound shown?



- a) sp^3, sp, sp b) sp^3, sp^2, sp c) sp^3, sp, sp^2 d) sp^3, sp^2, sp^2
32. Which of the following are isoelectronic and isostructural?
 $\text{NO}_3^-, \text{CO}_3^{2-}, \text{ClO}_3^-, \text{SO}_3$
 a) $\text{NO}_3^-, \text{CO}_3^{2-}$ b) $\text{SO}_3, \text{NO}_3^-$ c) $\text{ClO}_3^-, \text{CO}_3^{2-}$ d) $\text{CO}_3^{2-}, \text{SO}_3$
33. When N_2^+ is formed from N_2 bond-order..... and when O_2^+ is formed from O_2 bond-order.....
 a) Increases b) Decreases c) Increases, decreases d) Decreases, increases
34. Elements in period 3 or below don't always "obey" the octet rule because they
 a) Can only use p orbitals for bonding b) Can use s and p orbitals for bonding
 c) Can use s, p and d orbitals for bonding d) Cannot use d orbitals for bonding
35. Match Column I (complex ions) with Column II (number of unpaired electrons) and select the correct answer

	Column I		Column II
A	$[\text{CrF}_6]^{4-}$	1.	One
B	$[\text{MnF}_6]^{4-}$	2.	Two
C	$[\text{Cr}(\text{CN})_6]^{4-}$	3.	Three
D	$[\text{Mn}(\text{CN})_6]^{4-}$	4.	Four
		5.	Five

- A B C D
- a) 4 1 2 5 b) 2 5 3 1
 c) 4 5 2 1 d) 2 1 3 5
36. Hybridisation on carbon in carbanion $\overset{\ominus}{\text{C}}\text{H}_3$ is
 a) sp^3 b) sp^3d^2 c) sp^2 d) sp^3d
37. One of the following is least volatile
 a) HCN b) HF c) H_2O d) CS_2
38. Mg_2C_3 reacts with water forming propyne. C_3^{4-} has
 a) Two sigma and two pi bonds b) Three sigma and one pi bonds
 c) Two sigma and one pi bonds d) Two sigma and three pi bonds
39. Which of the following are isoelectronic and isostructural?
 $\text{NO}_3^-, \text{CO}_3^{2-}, \text{ClO}_3^-, \text{SO}_3$
 a) $\text{NO}_3^-, \text{CO}_3^{2-}$ b) $\text{SO}_3, \text{NO}_3^-$ c) $\text{ClO}_3^-, \text{CO}_3^{2-}$ d) $\text{CO}_3^{2-}, \text{SO}_3$
40. Which of the following will have the molecular shape of a trigonal bipyramid?
 a) PF_3Cl_2 b) IF_5 c) BrF_5 d) SbF_2^{2-}
41. Which structure appears wrong?
 a) $\text{H}-\overset{+}{\text{N}}-\overset{+}{\text{N}}=\text{N}^{2-}$ b) $\begin{array}{c} \text{F} \\ | \\ \text{F} \end{array} \text{B}=\overset{\ominus}{\text{F}} \overset{\oplus}{\text{F}}$ c) H^+F^- d) $\overset{\ominus}{\text{C}}\text{H}_2-\text{CH}=\overset{\oplus}{\text{Cl}}$
42. Which are non-polar molecules?
 I: NCl_3 ; II: SO_3 ; III: PCl_5

- a) I only b) II only c) I and II only d) II and III only
43. C – H bond distance is the longest in
 a) C₂H₂ b) C₂H₄ c) C₂H₆ d) C₂H₂Br₂
44. Number of bond pairs (*X*) and lone pairs (*Y*) around the central atom in the I₃⁻ ion are
 X Y
 a) 2 2 b) 2 3
 c) 3 2 d) 4 3
45. Which property could describe a covalent compound?
 a) It conducts electricity when melted b) It is a gas at room temperature
 c) It is composed of a non-metal and metal d) It is solid with a very high melting point
46. Which of the following ions has the maximum polarizing power?
 a) Na⁺ b) Ca²⁺ c) Mg²⁺ d) Al³⁺
47. True structure is predicted by
 a) Valence-bond approach b) Sidgwick approach
 c) Hybrid formation d) None of these
48. N₂ and O₂ are converted into monoanion N₂⁻ and O₂⁻ respectively. Which of the following statement is wrong?
 a) In N₂, the N – N bond weakens b) In O₂⁻, O – O bond length increases
 c) In O₂⁻, bond-order decreases d) N₂⁻ become diamagnetic
49. Central O atom in O₃ is hybridized
 a) *sp* b) *sp*² c) *sp*³ d) *dsp*²
50. The table shown below gives the bond dissociation energies (*E*_{diss}) for single covalent bonds of carbon (C) atoms with element 'A', 'B', 'C' and 'D'. Which element has the smallest atom?

Bond	<i>E</i> _{diss} (kJ mol ⁻¹)
C – A	240
C – B	328
C – C	276
C – D	485

- a) A b) B c) C d) D
51. Select the correct statement
 a) BF₃ and NH₃ have same dipole moment
 b) Dipole moment of NH₃ is smaller than that of BF₃
 c) BF₃ molecule has a planar structure, while the NH₃ molecule is tetrahedral
 d) The nitrogen atom has unshared pair of electrons while the boron atom has a free (vacant) valence orbital
52. The species having pyramidal shape is
 a) SO₃ b) BrF₃ c) SiO₃²⁻ d) OSF₂
53. Which concept best explains that the *o*-nitrophenol is more volatile than *p*-nitrophenol?
 a) Steric hindrance b) Hyperconjugation c) H-bonding d) Resonance
54. Hybridization of the underlined atom is affected when
 a) CH₃COOH is decarboxylated b) CH₃CH₂OH is dehydrated
 c) CH₃CH₃ is chlorinated d) C₆H₆ is nitrated
55. Which of the following molecules is expected to exhibit diamagnetic behaviour?
 a) C₂ b) N₂ c) O₂ d) S₂
56. Hybridization of the nitrogen atom and electron geometry around nitrogen atom in pyridine is



- a) *sp*³, pyramidal b) *sp*², planar trigonal c) *sp*², linear d) *sp*³, tetrahedral
57. The structure and hybridization of silicon and carbon in Si(CH₃)₄ is
 a) Bent, *sp* b) Trigonal, *sp*² c) Octahedral, *sp*³*d* d) Tetrahedral, *sp*³

58. Select the correct statement
- Cations with 18-electron shell have greater polarizing power than the cations with 8-electron shell
 - Inner electrons have poor shielding effect on the nucleus and thus electronegativity of the 18-electron shell is increased
 - CuCl is covalent and NaCl is ionic
 - All the above are correct statements
59. The species having pyramidal shape is
- SO₃
 - BrF₃
 - SiO₃²⁻
 - OSF₂
60. Number of lone pair (s) in XeOF₄ is/are
- 0
 - 1
 - 2
 - 3
61. Consider the following compounds
I. K₄[Fe(CN)₆], II. NH₄Cl, III. H₂SO₄
Ionic, covalent and coordinate bonds are present in
- I, II and III
 - I and III
 - II and III
 - I and II
62. Following consists of discrete polar molecules at room temperatures
- CS₂
 - RaCl₂
 - HCN
 - F₂
63. Energy gaps between the highest filled band and the lowest empty bands in element A, B, C and D are 0, 70, 530 and 110 kJmol⁻¹. Thus
- Element A is metal
 - Element C is insulator
 - Element B and D can be semiconductors
 - All are correct conclusions about element A, B, C and D
64. The correct stability order of the following resonance structure is
- $$\begin{array}{cc} \text{H}_2\text{C}=\overset{+}{\text{N}}=\overset{-}{\text{N}} & \text{H}_2\text{C}-\overset{+}{\text{N}}=\overset{-}{\text{N}} \\ \text{H}_2\overset{-}{\text{C}}-\overset{+}{\text{N}}=\overset{-}{\text{N}} & \text{H}_2\overset{-}{\text{C}}-\overset{+}{\text{N}}=\overset{-}{\text{N}} \end{array}$$
- (I) > (II) > (IV) > (III)
 - (I) > (III) > (II) > (IV)
 - (II) > (I) > (III) > (IV)
 - (III) > (I) > (IV) > (II)
65. Stability of the species Li₂, Li₂⁻ and Li₂⁺ increases in the order of
- Li₂ < Li₂⁺ < Li₂⁻
 - Li₂⁻ < Li₂⁺ < Li₂
 - Li₂ < Li₂⁻ < Li₂⁺
 - Li₂⁻ < Li₂ < Li₂⁺
66. Which of the following molecules or ions is not linear?
- BeCl₂
 - I₃⁻
 - CS₂
 - ICl₂⁺
67. O₂ molecule is paramagnetic due to presence of
- Two unpaired electrons in antibonding MO
 - One unpaired electron in antibonding MO
 - Two unpaired electrons in bonding MO
 - One unpaired electron in bonding MO
68. An ionic compound A⁺B⁻ is most likely to be formed from A and B when
- Ionization energy of A is low
 - Electron affinity of B is low
 - Electronegativity of B is low
 - Ionization energy of B is low
69. A set of inner d-complex is
- [Fe(CN)₆]⁴⁻, [Ni(CN)₄]²⁻, [Pt(en)₂]²⁺
 - [Fe(H₂O)₆]³⁺, [CoF₆]³⁻, [Cr(CN)₆]³⁻
 - Both (a) and (b)
 - None of the above
70. Polarizing action of Cd²⁺ on anion is stronger than that of Ca²⁺ because
- The charges of the ions are same
 - Their radii are same (Ca²⁺ = 0.104 nm; Cd²⁺ = 0.099 nm)
 - The Ca²⁺ ion has a noble-gas electron configuration, and the Cd²⁺ ion, an 18-electron configuration of its outer shell

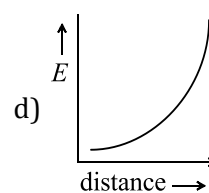
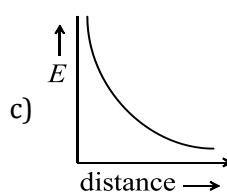
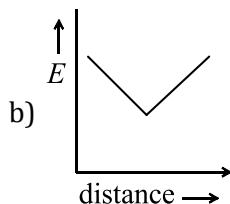
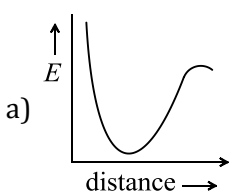
d) All the above are correct

71. Compound X is highly volatile and insoluble in water. Bonding in X is
 a) Ionic b) Covalent c) Polar covalent d) Coordinate
72. In vinyl acetylene $\text{CH} \equiv \text{C} - \text{CH} = \text{CH}_2$, type of overlapping in $(\text{C}_2\sigma\text{C}_3)$ bond is
 a) sp^2-sp b) $sp-sp^2$ c) sp^3-sp^3 d) sp^3-sp^2
73. Match Column I with Column II and select the correct answer

Column I (species)	Column II (O – N – O angle)
A. NO_2^+	1. 180°
B. NO_2	2. 132°
C. NO_2^-	3. 120°
D. NO_3^-	4. 115°
	5. 109°

A B C D

- a) 5 4 3 2 b) 5 2 4 3
 c) 1 2 4 2 d) 1 4 3 2
74. Select the incorrect statement
 a) Double bond is shorter than a single bond
 b) σ -bond is weaker than a π -bond
 c) Double bond is stronger than a single bond
 d) Covalent bond is stronger than a hydrogen bond
75. Which of the following has the highest percentage of ionic character in its bonding?
 a) LiI b) MgCl_2 c) CsF d) CsI
76. Which of the following is non-polar but contains polar bonds?
 a) HCl b) CO_2 c) NH_3 d) NO_2
77. $\text{Mg}^{2+}\text{O}^{2-}$ is formed since
 a) IE of Mg is low b) EA of O is low c) IE of Mg is high d) IE of O is low
78. The structure of 1, 3-butadiene is $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$ and the distance between the central carbon atom is 1.46 \AA (instead of 1.54 \AA). This is due to the
 Existence of on-octet resonance structures involving double bonding between the central carbon atoms
 a) $\overset{\oplus}{\text{C}}\text{H}_2 - \text{CH} = \text{CH} - \overset{\ominus}{\text{C}}\text{H}_2$
 b) Decrease in bond length when terminal double bonds exist
 c) sp^2-sp^2 overlapping
 d) $p-p$ overlapping
79. Among the following, the paramagnetic compound is
 a) Na_2O_2 b) O_3 c) N_2O d) KO_2
80. Which plot best represents the potential energy (E) of two hydrogen atoms as they approach one another to form a hydrogen molecule?



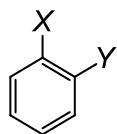
81. Among the following ions the $p\pi-d\pi$ overlap could be present in
 a) NO_2^- b) NO_3^- c) PO_4^{3-} d) CO_3^{2-}
82. In I_3^- , Lewis base is
 a) I_2 b) I^- c) I_2^+ d) I_2^-
83. The expected spin-only magnetic moments (BM) for $[\text{Fe}(\text{CN})_6]^{4-}$ and $[\text{FeF}_6]^{3-}$ respectively are

- a) 1.73 and 1.73 b) 1.73 and 5.92 c) 0 and 1.73 d) 0 and 5.92
84. The hybridization of atomic orbitals of N in NO_2^+ , NO_3^- and NH_4^+ are respectively
a) sp, sp^2, sp^3 b) sp, sp^3, sp^2 c) sp^2, sp, sp^3 d) sp^2, sp^3, sp
85. ZnCO_3 is thermally more stable than MgCO_3 , because
a) $\text{Mg}(\text{OH})_2$ exhibits only basic properties while $\text{Zn}(\text{OH})_2$ is amphoteric
b) Polarizing action of Zn^{2+} with 18-electron configuration on the anion is larger than that of Mg^{2+} with a noble-gas electron configuration and of same size and charge
c) Both (a) and (b) are correct
d) None of the above
86. A diatomic molecule has a dipole moment of 1.2 D. If the bond distance is 1.0 Å, fraction of an electronic charge on each atom is
a) 0.25 b) 0.33 c) 0.66 d) 0.90
87. The maximum covalency is equal to the number of
a) Paired p -electrons b) Unpaired s -electrons
c) Unpaired s - and p -electrons d) s - and p - electrons in the valence shell
88. One of the following ions has a trigonal planar shape
a) SO_3^{2-} b) PO_4^{3-} c) CN^- d) CO_3^{2-}
89. In carbon-hydrogen-oxygen compounds
a) All O –to – H bonds are π bonds b) All C –to – H bonds are σ bonds
c) All C –to – C bonds are σ and π bonds d) All C –to – C bonds are π bonds
90. 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
91. Which statement is not correct about NO_2 ?
a) It is paramagnetic b) It forms dimer and paramagnetism is lost
c) It has one coordinate bonds d) It has nitrogen oxygen triple bond
92. Which of the following compounds has both ionic and covalent bonding?
a) NaBr b) $\text{Ba}(\text{CN})_2$ c) PCl_5 d) $\text{CH}_3\text{CH}_2\text{OH}$
93. Which of the following has zero dipole moment?
a) CO b) SO_2 c) SO_3 d) H_2O
94. What is the geometry of nitrogen atom in NH_3 , $\text{N}(\text{CH}_3)_3$ and $\text{N}[\text{Si}(\text{CH}_3)_3]_3$?
I. Trigonal planar II. Trigonal pyramidal
III. Square planar
a) I, I, I b) II, II, III c) II, I, II d) II, II, I
95. Select the correct statements
a) The delocalized electrons in the π -orbitals of graphite cause this allotropic form to conduct electricity
b) Pauling assigns “metallic valence” equal to their group number to the elements of IA to VIA
c) Diatomic lithium molecules Li_2 are stable towards dissociation
d) All are correct statements
96. Which pair of substances will have the most similar geometry?
a) $\text{SO}_3, \text{SO}_3^{2-}$ b) $\text{SO}_3, \text{SO}_4^{2-}$ c) $\text{SO}_3, \text{CO}_3^{2-}$ d) $\text{SO}_4^{2-}, \text{CO}_3^{2-}$
97. In which case, hybridisation of the central atom is affected when
a) NH_3 changes to NH_4^+ b) AlH_3 changes to AlH_4^- c) In both cases d) In none case
98. The carbon dioxide molecule is linear. The electronegativities of C and O are 2.5 and 3.5 respectively. Based on these values and on consideration of molecular geometry, the C – O bond is..... and the molecule is.....
a) Polar; polar b) Non-polar; non-polar c) Polar; non-polar d) Non-polar; polar
99. The species having bond order different from that in CO is
a) NO^- b) NO^+ c) CN^- d) N_2
100. The molecules that will have dipole moments are
a) 1, 2-dichloro benzene b) *cis*-3-hexene c) *trans*-2-pentene d) All of these

101. The As–Cl bond distance in AsCl_3 is 2.20 \AA . If radius of chlorine atom is 0.99 \AA then radius of As atom is
 a) 0.24 \AA b) 3.19 \AA c) 1.21 \AA d) 2.09 \AA
102. Which species has the same shape as the NO_3^- ion?
 a) SO_3 b) SO_3^{2-} c) ClF_3 d) ClO_3^-
103. Which of the following has $-\text{O}-\text{O}-$ linkage?
 a) $\text{H}_2\text{S}_2\text{O}_6$ b) $\text{H}_2\text{S}_2\text{O}_8$ c) $\text{H}_2\text{S}_2\text{O}_3$ d) $\text{H}_2\text{S}_4\text{O}_6$
104. The hydrogen bond is not present in
 a) Phenol b) Liquid HCl c) Water d) Liquid NH_3
105. Which of the following statements is correct for CsBr_3 ?
 a) It is covalent compound b) It contains Cs^{3+} and Br^-
 c) It contains Cs^+ and Br_3^- d) It contains Cs^+ , Br^- and lattice Br_2 molecule
106. The ground state electronic configuration of valence shell electrons in nitrogen molecule (N_2) is written as $KK(\sigma^* 2s)^2(\sigma 2s)^2(\pi 2p)^4(\sigma 2p)^2$. Hence, the bond order in nitrogen molecule is
 a) 0 b) 1 c) 2 d) 3
107. Which of the following is an electron-deficient compound?
 a) NaBH_4 b) CO_2 c) B_2H_6 d) Al_2Cl_6
108. Consider the following species
 I: $\text{S}_4\text{O}_6^{2-}$; II: S_3O_9 ; III: $\text{S}_2\text{O}_5^{2-}$; IV: $\text{P}_3\text{O}_9^{3-}$
 Which of the above species have same number of $X-O-X$ linkage ($X = P$ or S)?
 a) II, III b) I, III c) II, IV d) I, IV
109. The nitrogen atoms in NH_3 , NH_2^- and NH_4^+ are all surrounded by eight electrons. When these species are arranged in increasing of $\text{H}-\text{N}-\text{H}$ bond angle, correct order is
 a) $\text{NH}_3, \text{NH}_2^-, \text{NH}_4^+$ b) $\text{NH}_4^+, \text{NH}_2^-, \text{NH}_3$ c) $\text{NH}_3, \text{NH}_4^+, \text{NH}_2^-$ d) $\text{NH}_2^-, \text{NH}_3, \text{NH}_4^+$
110. Solubility of NaCl , Na_2SO_4 and Na_3PO_4 in water in increasing order is
 a) $\text{NaCl} < \text{Na}_2\text{SO}_4 < \text{Na}_3\text{PO}_4$ b) $\text{Na}_3\text{PO}_4 < \text{Na}_2\text{SO}_4 < \text{NaCl}$
 c) $\text{NaCl} < \text{Na}_3\text{PO}_4 < \text{Na}_2\text{SO}_4$ d) $\text{Na}_2\text{SO}_4 < \text{NaCl} < \text{Na}_3\text{PO}_4$
111. The shape of IF_7 molecule is
 a) Pentagonal bipyramidal b) Trigonal pyramidal
 c) Tetrahedral d) Square planar
112. Which set contains no ionic species?
 a) $\text{NH}_4\text{Cl}, \text{OF}_2, \text{H}_2\text{S}$ b) $\text{CO}_2, \text{CCl}_4, \text{Cl}_2$ c) $\text{BF}_3, \text{AlF}_3, \text{TlF}_3$ d) $\text{I}_2, \text{CaO}, \text{CH}_3\text{Cl}$
113. Which species has the maximum number of lone pair of electrons on the central atom?
 a) $[\text{ClO}_3^-]$ b) XeF_4 c) SF_4 d) $[\text{I}_3^-]$
114. The hybridization scheme for the central atom includes a d -orbital contribution in
 a) I_3^- b) PCl_3 c) NO_3^- d) H_2Se
115. (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) $\text{I} < \text{II} < \text{III} < \text{IV}$ b) $\text{I} < \text{II} < \text{IV} < \text{III}$
 c) $\text{IV} < \text{I} < \text{II} < \text{III}$ d) $\text{IV} < \text{II} < \text{I} < \text{III}$
116. Which one of the following has the highest boiling point?
 a) AsH_3 b) SbH_3 c) PH_3 d) NH_3
117. Which set of properties would identify a white solid unknown as a molecular compound?
 I. contains a metal
 II. has a definite crystal structure
 III. dissolves in water, but not in organic liquids
 IV. melts at 80°C
 V. does not conduct electricity in fused state

- a) I, II, III b) I, III, V c) II, III, IV d) II, IV, V
118. All the following molecules are polar except one
 a) BCl_3 b) CH_2Cl_2 c) NH_3 d) FNO
119. Number of water molecules directly attached to one water molecule is
 a) 1 b) 2 c) 3 d) 4
120. For the dot structure shown the most likely elements are $X = \dots$ and $Y = \dots$
- $$\begin{array}{c} \text{:}\ddot{\text{Y}}\text{:} \\ | \\ \text{:}\ddot{\text{Y}}\text{---}\text{X}\text{---}\ddot{\text{Y}}\text{:} \\ | \\ \text{:}\ddot{\text{Y}}\text{:} \end{array}$$
- a) Carbon, hydrogen b) Carbon, oxygen c) Fluorine, carbon d) Carbon, fluorine
121. Specify the coordination geometry around the 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
122. PCl_5 has a shape of trigonal bipyramid whereas IF_5 has the shape of a square pyramid. It is due to
 a) Presence of unshared electron pair on I which is oriented so as to minimize repulsion while P in PCl_5 has no unshared pair
 b) Octet of P is complete while that of I is incomplete
 c) P and I are of different group
 d) F and Cl have different extent of repulsion
123. The angle between the bonding orbitals of a molecule AX_3 with zero dipole moment is
 a) 120° b) 109° c) 104° d) 180°
124. Covalency of carbon in the CO molecule is three because
 a) An unexcited carbon atom has two unpaired electrons
 b) The carbon atom can be an acceptor of an electron pair
 c) The carbon atom has four valence electrons
 d) Maximum covalency of carbon is three
125. In ammonia, $\text{H} - \text{N} - \text{H}$ bond angle is
 a) 170° b) 104.5° c) 109.5° d) 120°
126. Select the correct statement about carbonium ion CH_5^+ .
 a) This cation shares eight electrons among five bonds
 b) There is no empty orbital
 c) It is not electro deficient
 d) All the above are correct statements
127. Allyl cyanide has
 a) 9 sigma bonds and 4 pi bonds b) 9 sigma bonds, 3 pi bonds and 1 lone pair
 c) 8 sigma bonds and 5 pi bonds d) 8 sigma bonds, 3 pi bonds
128. Bond order of O_2 , O_2^+ , O_2^- and O_2^{2-} is in order
 a) $\text{O}_2^- < \text{O}_2^{2-} < \text{O}_2 < \text{O}_2^+$ b) $\text{O}_2^{2-} < \text{O}_2^- < \text{O}_2 < \text{O}_2^+$ c) $\text{O}_2^+ < \text{O}_2 < \text{O}_2^- < \text{O}_2^{2+}$ d) $\text{O}_2 < \text{O}_2^+ < \text{O}_2^- < \text{O}_2^{2-}$
129. Which of the following bonds is the weakest?
 a) Coordinate bond b) Hydrogen bond c) Van der Waal' forces d) Covalent bond
130. The correct order of dipole moments of HF, H_2S and H_2O is
 a) $\text{HF} < \text{H}_2\text{S} < \text{H}_2\text{O}$ b) $\text{HF} < \text{H}_2\text{S} > \text{H}_2\text{O}$ c) $\text{HF} > \text{H}_2\text{S} > \text{H}_2\text{O}$ d) $\text{HF} > \text{H}_2\text{O} < \text{H}_2\text{S}$
131. On heating one end of a piece of a metal the other end becomes hot because of
 a) Resistance of the metal b) Mobility of atoms in the metal
 c) Energized electrons moving to the other end d) Minor perturbation in the energy atom
132. In which of the following pairs of molecules/ions both the species are not likely to exist?
 a) H_2^+ , He_2^{2-} b) H_2^- , He_2^{2-} c) H_2^{2+} , He_2 d) H_2^- , He_2^{2+}
133. Electron pairs occupy localised orbitals. Their orbitals are oriented in such a way that the repulsion

- between electron clouds becomes
- a) Zero b) Minimum c) Maximum d) Infinite
134. A substance in which large energy gap separates the valence and conduction band is a/an
a) Metal b) Metalloid c) Semiconductor d) Insulator
135. Among the following the molecule with the highest dipole moment is
a) CH_3Cl b) CH_2Cl_2 c) CHCl_3 d) CCl_4
136. The correct order of increasing bond length of
 $\text{C}-\text{H}$ (I), $\text{C}-\text{O}$ (II), $\text{C}-\text{C}$ (III) and $\text{C}=\text{C}$ (IV) is
a) $\text{I}<\text{II}<\text{III}, \text{IV}$ b) $\text{I}<\text{IV}<\text{II}<\text{III}$ c) $\text{IV}<\text{III}<\text{II}<\text{I}$ d) $\text{III}<\text{IV}<\text{II}<\text{I}$
137. Which of the following has the smallest bond length?
a) NO^+ b) NO c) NO^- d) Equal
138. According to VSEPR theory, a molecule with three charge clouds including one lone pair would have a shape
a) Bent b) Linear c) Tetrahedral d) Trigonal planar
139. HCN and HNC molecular have equal number of
a) Lone pair and σ bonds b) σ bonds and π bonds
c) π bonds and lone pair d) Lone pairs, σ bonds and π bonds
140. The cyanide ion CN^- and the nitrogen molecule N_2 are isoelectronic. However, in contrast to CN^- , N_2 is chemically inert due to
a) Unsymmetrical electron distribution b) Low bond energy
c) Absence of bond polarity d) Presence of greater number of electrons in bonding
141. Solubility of KCl is maximum in
a) $\text{CH}_3\text{CH}_2\text{OH}$ b) CH_3OCH_3 c) H_2O d) CH_3COOH
142. Select the correct statement
a) LiF and MgO are isostructural and also isodimensional, but a crystal of MgO is much harder than one of LiF
b) The thermal stability of the isomorphous sulphates of Ca^{2+} , Sr^{2+} and Ba^{2+} w. r. t. decomposition into metal oxide and sulphur trioxide increases in the order $\text{CaSO}_4, \text{SrSO}_4, \text{BaSO}_4$
c) Both (a) & (b) are correct
d) None of the above
143. Solutions of alkali metals in liquid ammonia at -33°C conduct electricity without chemical reaction at the electrodes. Hence, conductivity should
a) Increase as temperature is lowered
b) Decrease as temperature is lowered
c) Remain constant on changing the temperature
d) There is always interaction of alkali metal with liquid ammonia
144. In which of the following sets do all the three compounds have bonds that are mainly ionic?
a) $\text{NaCl}, \text{NCl}_3, \text{CCl}_4$ b) $\text{CsBr}, \text{BaBr}_2, \text{SrO}$ c) $\text{CsF}, \text{BF}_3, \text{NH}_3$ d) $\text{Al}_2\text{O}_3, \text{CaO}, \text{SO}_2$
145. Which species has the maximum number of lone pair of electrons on the central atom?
a) $[\text{ClO}_3^-]$ b) XeF_4 c) SF_4 d) $[\text{I}_3^-]$
146. Which of the following does not obey 18-electron rule?
a) $\text{Cr}(\text{CO})_6$ b) $\text{Fe}(\text{CO})_5$ c) $\text{V}(\text{CO})_6$ d) $\text{Mn}_2(\text{CO})_{10}$
147. *Ortho*-isomers have dipole moments. In which cases dipole moments are maximum and minimum?



Maximum

Minimum

X Y X Y

a)	Cl	Cl	CH ₃	CH ₃
b)	OH	CH ₃	Cl	Cl
c)	OH	NO ₂	CH ₃	CH ₃
d)	OH	NO ₂	Cl	Cl

148. Select the correct statement about carbenium ion CH_3^+ .
- It is planar with empty p -orbital
 - There are three sigma (C – H) bonds
 - It is electron deficient with six electrons in outer-shell
 - All the above are correct statements
149. AsF_5 molecule is trigonal bipyramidal. The hybrid orbitals used by As atoms for bonding are
- $d_{x^2-y^2}, d_{z^2}, s, p_x, p_y$
 - d_{xy}, s, p_x, p_y, p_z
 - s, p_x, p_y, p_z, d_{xy}
 - $d_{x^2-y^2}, s, p_x, p_y, p_z$
150. Octet rule is not followed in
- $\text{CCl}_4, \text{N}_2\text{O}_4$ and N_2O_5
 - $\text{BF}_3, \text{BeCl}_2$ and NO_2
 - $\text{NaCl}, \text{MgCl}_2, \text{MgO}$
 - $\text{PCl}_3, \text{NH}_3, \text{H}_2\text{O}$
151. Metallic bonding is explained by
- Band model
 - Electron-sea model
 - Both (a) and (b)
 - None of the these
152. Which of the following species contain at least one atom that violates the octet rule?
- $\text{O} - \text{Cl} - \text{O}$
 - $\text{F} - \text{Xe} - \text{F}$
 - Both (a) and (b)
 - None of these
153. Which of the following molecule does not possess a permanent dipole moment?
- H_2S
 - SO_2
 - CS_2
 - SO_3
154. Which pair is not correct order of lattice energy?
- $\text{KCl} > \text{MgO}$
 - $\text{AlN} > \text{MgO}$
 - $\text{CaO} > \text{BaO}$
 - $\text{MgCO}_3 > \text{CaCO}_3$
155. Geometrical configuration of BF_3 and NF_3 molecules is
- The same because of same covalency of the central atom
 - Different because BF_3 is polar and NF_3 is non-polar
 - Different because BF_3 is non-polar and NF_3 is polar
 - None is correct
156. Which of the following species/ molecules has a planar geometry?
- $\text{Ni}(\text{CO})_4$
 - SF_4
 - CoCl_4^{2-}
 - XeF_4
157. Which of the following is most polar bond?
- $\text{Cl} - \text{Cl}$
 - $\text{N} - \text{F}$
 - $\text{C} - \text{F}$
 - $\text{O} - \text{F}$
158. Which has a maximum repulsive interaction?
- $bp-bp$
 - $lp-lp$
 - $lp-bp$
 - Equal
159. Which one of the following molecules will form a linear polymeric structure due to hydrogen bonding?
- NH_3
 - H_2O
 - HCl
 - HF
160. Molecular shapes of SF_4, CF_4 and XeF_4 are
- The same, with 2, 0 and 1 lone pair of electrons respectively
 - The same, with 1, 1 and 1 lone pair of electrons respectively
 - Different with 0, 1 and 2 lone pair of electrons respectively
 - Different with 1, 0 and 2 lone pair of electrons respectively
161. MgSO_4 is soluble while BaSO_4 is insoluble in H_2O . This is because
- Lattice energy of BaSO_4 is greater than MgSO_4
 - BaSO_4 is more covalent than MgSO_4
 - Hydration energy of Mg^{2+} is greater than Ba^{2+}
 - Lattice energy of MgSO_4 is greater than BaSO_4
162. Delocalized molecular orbitals are found in
- H_2
 - HS^-
 - CH_4
 - CO_3^{2-}
163. When the number of electron pairs on the central atom is six, then geometry of the molecule is
- Octahedral
 - Trigonalbipyramidal
 - Equilateral triangle
 - Linear

164. Ionization energies (IE) and electron affinities (EA) of F and Cl are given below

Element	IE	EA
F	17.4 eV	3.45 eV
Cl	13.0 eV	3.61 eV

Compound formed between F and Cl is predominantly

- a) F^+Cl^- b) Cl^+F^- c) $F - Cl$ d) 

165. 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

166. The shape of XeO_2F_2 molecule is

- a) Trigonalbipyramidal b) Square planar c) Tetrahedral d) See-saw

167. Select the correct statement about valence-bond approach

- a) Each bond is formed by maximum overlap for its maximum stability
 b) It represents localized electron model of bonding
 c) Most of the electrons retain the same orbital locations as in a separated atoms
 d) All the above are correct statements

168. Which of the following molecules are expected to exhibit intermolecular H-bonding?

- I. Acetic acid II. *o*-nitrophenol
 III. *m*-nitrophenol IV. *o*-boric acid

Select the correct alternate

- a) I, II, III b) I, II, IV c) I, III, IV d) II, III, IV

169. H-bonding is maximum in

- a) Ethanol b) Methoxy methane
 c) Chloroethane d) N, N-diethyl amino ethane

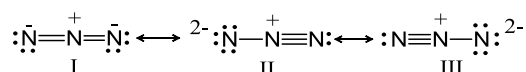
170. Which of the following molecules does not have a dipole moment?

- a) IBr b) $CHCl_3$ c) CH_2Cl_2 d) BF_3

171. Which has maximum number of lone-pairs of electrons on the central atom?

- a) XeF_2 b) H_3O^+ c) XeF_4 d) XeF_6

172. Azide ion (N_3^-) exhibits an N – N bond order of 2 and may be represented by resonance structures I, II and III given below



Select the correct statement

- a) Structures I and II make greater contributions than III
 b) Structures II and III make greater contributions than I
 c) Structures I and III make greater contributions than II
 d) All three structures make equal contributions

173. The number of anti-bonding electron pairs in O_2^{2-} molecular ion on the basis of molecular orbital theory is (atomic number of O is 8)

- a) 5 b) 2 c) 4 d) 6

174. If there are five electron pairs in outer shell, then structure and bond angle as predicted by Sidgwick-Powell theory is

- a) Octahedron, 90° b) Trigonalbipyramidal, 120° and 90°
 c) Pentagonal bipyramidal, 72° and 90° d) Tetrahedron, $109^\circ 28'$

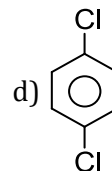
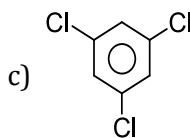
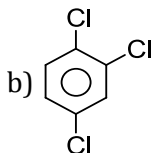
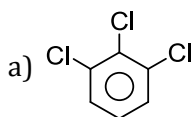
175. Which property is not due to H-bonding?

- a) High boiling point of water b) High viscosity of glycerol
 c) Solubility of ammonia in water d) Polar nature of halogen acid

176. Number of unpaired electrons in $[V(H_2O)_6]^{3+}$ is

- a) 2 b) 3 c) 4 d) 5

177. Considering the state of hybridization of carbon atoms, find out the molecules among the following which



192. Arrange the following compounds in increasing dipole moment: toluene (I), *m*-chlorobenzene (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
193. Which substance has a dipole moment?
- a) CCl₄ b) CH₂Cl₂ c) C₂Cl₂ d) C₂Cl₄
194. Assuming that Hund's rule is violated, the bond order and magnetic nature of the diatomic molecule B₂ is
- a) 1 and diamagnetic
b) 0 and diamagnetic
c) 1 and paramagnetic
d) 0 and paramagnetic
195. Consider the following pairs,
- I. HNO₃ and NO₃⁻
- II. and
- Which has the greater resonance stabilization?
- a) (a) NO₃⁻ in I and in II b) HNO₃ in I and HCHO in II
- c) NO₃⁻ in I and HCHO in II d) (d) HNO₃ in I and in II
196. In which of the following molecules would you expect the nitrogen-to-nitrogen bond to be the shortest?
- a) N₂H₄ b) N₂ c) N₂O₄ d) N₂O
197. In allene(C₃H₄), the type(s) of hybridization of the carbon atoms, is (are)
- a) *sp* and *sp*³ b) *sp* and *sp*² c) Only *sp*³ d) *sp*² and *sp*³
198. Which of the following has maximum bond energy?
- a) O₂⁻ b) O₂⁺ c) O₂ d) O₂²⁻
199. Some ether is added to an aqueous solution mixture of LiCl, NaCl and AlCl₃. Which will be extracted into ether?
- a) LiCl, NaCl b) LiCl, AlCl₃ c) NaCl, AlCl₃ d) LiCl, NaCl, AlCl₃
200. The compound NH₃ – BF₃ can be easily separated into its compounds because
- a) BF₃ is highly reactive b) NH₃ is highly reactive
c) BF₃ and NH₃ are unstable d) BF₃ and NH₃ have their independent existence
201. The bond angle in H₂O is 105° and in H₂S it is 90°. It is due to
- a) The larger size of S atom as compared to O atom which minimizes repulsion and allows the bonds in H₂S to be purely *p*-type
b) Liquid state of H₂O as compared to gaseous state of SO₂
c) Both (a) & (b) are correct
d) None of the above is correct
202. In terms of polar character, which one of the following order is correct?
- a) NH₃ < H₂O < HF < H₂S b) H₂S < NH₃ < H₂O < HF
c) H₂O < NH₃ < H₂S < HF d) HF < H₂O < NH₃ < H₂S

Multiple Correct Answers Type

203. Which of the following pairs contain same number of electrons but their shapes are different?
- a) BF₃, BCl₃ b) CH₄, NH₃ c) NH₃, H₂O d) BeCl₂, BeF₂

204. In BrF_3 molecule, the lone pairs occupy equatorial position to minimize
- Lone pair-bond pair repulsion only
 - Bond pair-bond pair repulsion only
 - Lone pair-lone pair repulsion and lone pair-bond pair repulsion
 - Lone-pair-lone pair repulsion only
205. The isotone(s) of $^{76}_{32}\text{Ge}$ is/are :
- $^{77}_{32}\text{Ge}$
 - $^{77}_{33}\text{As}$
 - $^{77}_{34}\text{Se}$
 - $^{78}_{34}\text{Se}$
206. Which is/are correct statements?
- A solute will dissolve in water if hydration energy is greater than lattice energy
 - If the anion is large compared to the cation, the lattice energy will remain almost constant
 - Solubility of II A hydroxide is in order
 $\text{Be}(\text{OH})_2 < \text{Mg}(\text{OH})_2 < \text{Ca}(\text{OH})_2 < \text{Sr}(\text{OH})_2$
 - AgF is water soluble
207. Resonance occurs due to the :
- Delocalization of a lone pair of electrons
 - Delocalization of sigma-electrons
 - Delocalization of pi-electrons
 - Migration of protons
208. Select the correct statement(s) about C_3^{4-} ion
- It reacts with H_2O forming C_3H_6
 - It react with H_2O forming C_3H_4
 - It has two sigma and two pi bonds
 - It has three sigma and one pi bonds
209. Which of the following statements is/are correct?
- Hybridization is the mixing of atomic orbitals prior to their combining into molecular orbitals
 - sp^2 -hybrid orbitals are at 120° to one another
 - dsp^3 -hybrid orbitals are directed towards the corners of a regular tetrahedron
 - sp^3d^2 -hybrid orbitals are directed towards the corners of a regular octahedron
210. In which of the following hybridization of underlined atom(s) is/are affected?
- PCl_5 solid dissociates into PCl_4^+ and PCl_6^-
 - NH_3 is protonated to give NH_4^+
 - NH_4NO_3 is heated to give N_2O
 - LiH reacts with AlH_3 forming LiAlH_4
211. Which are the species in which sulphur undergoes sp^3 hybridisation?
- SF_4
 - SCl_2
 - SO_4^{2-}
 - H_2S
212. Correct order of thermal stability is/are
- $\text{Li}_3\text{N} > \text{Na}_3\text{N} > \text{K}_3\text{N}$
 - $\text{BeCl}_2 > \text{MgCl}_2 > \text{CaCl}_2$
 - $\text{K}_2\text{CO}_3 > \text{Na}_2\text{CO}_3 > \text{Li}_2\text{CO}_3$
 - $\text{BeCO}_3 > \text{MgCO}_3 < \text{CaCO}_3$
213. H_2O is dipolar, whereas BeF_2 is not. It is because
- The electronegativity of F is greater than that of O
 - H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule
 - H_2O is linear and BeF_2 is angular
 - H_2O is angular and BeF_2 is linear
214. In which molecule is the van derWaals force likely to be most important in determining m.p. and b.p.?
- ICl
 - Br_2
 - H_2S
 - CO
215. Which is/are the correct increasing order of the property indicated?
- $\text{BaO} < \text{SrO} < \text{CaO} < \text{MgO} < \text{BeO}$ (lattice energy)
 - $\text{LiF} < \text{LiCl} < \text{LiBr} < \text{LiI}$ (melting point)
 - $\text{AlF}_3 < \text{AlCl}_3 < \text{AlBr}_3 < \text{AlI}_3$ (covalent nature)
 - $\text{NaF} < \text{MgO} < \text{AlN} < \text{SiC}$ (lattice energy)
216. Which combination of the compounds with their magnetic moments are correct?
- $[\text{Mn}(\text{H}_2\text{O})_6]\text{Cl}_3 \mu = 4.90 \text{ BM}$
 - $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_3 \mu = 5.92 \text{ BM}$
 - $\text{Ni}(\text{CO})_4 \mu = 0.00 \text{ BM}$
 - $[\text{Ni}(\text{CN})_4]^{2-} \mu = 0.00 \text{ BM}$
217. Ionic radii of :
- $\text{Ti}^{4+} < \text{Mn}^{7+}$
 - $^{35}\text{Cl}^+ < ^{37}\text{Cl}^-$
 - $\text{K}^+ > \text{Cl}^-$
 - $\text{P}^{3+} > \text{P}^{5+}$
218. Which of the following do not have lone pair?

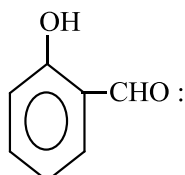
219. Which of the following have a dipole moment?
 a) SiF₄ b) XeF₄ c) SF₄ d) BF₃
 a) 2,2,3,3-tetramethylbutane b) *Trans*-2-pentene c) *Cis*-1,2-dichloroethene d) *Trans*-1,2-dichloroethene
220. Which of the following have identical bond-order?
 a) CN⁻ b) O₂⁻ c) NO⁺ d) CN⁺
221. The linear structure is assumed by :
 a) SnCl₂ b) NCO c) CS₂ d) NO₂⁺
222. Which molecule(s) has/have V-shape?
 a) H₂O b) SnCl₂ c) H₂S d) None of these
223. The planar shape of N(SiH₃)₃ is explained by the
 a) Type of hybrid orbitals of nitrogen
 b) Additional *dπ-pπ* overlap along the N – Si bond
 c) Higher electronegativity of nitrogen
 d) Higher electronegativity of silicon
224. Which of the following is/are coloured and paramagnetic?
 a) Cu⁺ b) NO₂ c) [Fe(H₂O)₆]²⁺ d) [Al(OH)₄]⁻
225. Which form two or more chlorides?
 a) Na b) Hg c) Cu d) Fe
226. Species having same bond order are
 a) NO b) NO⁺ c) NO²⁺ d) NO⁻
227. Which one of the following arrangement does not give the correct picture of the trends indicated against it?
 a) F₂ > Cl₂ > Br₂ > I₂ : Electron gain enthalpy
 b) F₂ > Cl₂ > Br₂ > I₂ : Bond dissociation energy
 c) F₂ > Cl₂ > Br₂ > I₂ : Electronegativity
 d) F₂ > Cl₂ > Br₂ > I₂ : Oxidizing power
228. The type of bond(s) present in ammonium chloride is/are :
 a) Ionic b) Covalent c) Coordinate d) None of these
229. Which phosphorus (P) has
 a) P – P – P bond angle of 60° b) 4 lone pairs of electrons
 c) 4P – P single bonds d) 6P – P single bonds
230. Which has/have magnetic moment?
 a) [Fe(H₂O)₆]²⁺ b) [Ni(CN)₄]²⁻ c) [Fe(CN)₆]³⁻ d) O₂
231. The molecule(s) which show H-bonding is/are :
 a) *o*-nitrophenol b) Water c) HCl d) Ethyl acetoacetate
232. Pick out the isoelectronic structures from the following :
 (I)CH₃⁺ (II) H₃O⁺ (III)NH₃ (IV)CH₃⁻
 a) I and II b) III and IV c) I and III d) II, III and IV
233. Ionization energy is influenced by :
 a) Size of atom
 b) Charge on the nucleus
 c) Electrons present in inner shells
 d) None of the above
234. CO₂ is isostructural with :
 a) HgCl₂ b) SnCl₂ c) C₂H₂ d) NO₂
235. Which statement(s) is/are correct?
 a) A pi-bond is weaker than sigma-bond
 b) A sigma-bond is weaker than pi-bond
 c) A (=) bond stronger than single bond

- d) A covalent bond is stronger than H-bond
236. Which have linear structure?
 a) BeF_2 b) $\text{Ag}[\text{CN}]_2^-$ c) CO_2 d) XeF_2
237. Electrovalency is favoured by :
 a) Low IE values b) High EA values c) High lattice energy d) None of these
238. Which of the following statements is/are correct?
 a) CH_3^+ shows sp^2 -hybridization whereas CH_3^- shows sp^3 -hybridization
 b) NH_4^+ has a regular tetrahedral geometry
 c) sp^2 -hybridized orbitals have equal s - and p -character
 d) Hybridized orbitals always form σ -bonds
239. Which possess fractional bond order?
 a) O_2^+ b) O_2^- c) H_2^+ d) N_2
240. The octet rule is not obeyed in :
 a) CO_2 b) BCl_3 c) PCl_5 d) SiF_4
241. Consider the following compounds
 I. $\text{B}_3\text{O}_3^{3-}$ II. $\text{B}_3\text{N}_3\text{H}_6$ III. $\text{C}_5\text{H}_5^\ominus$
 Planar and aromatic character is in
 a) All b) I and II only c) II and III only d) I and III only
242. Resonance structures of a molecule should have :
 a) Identical arrangement of atoms
 b) Nearly the same energy content
 c) The same number of paired electrons
 d) Identical bonding
243. In which of the following driving force is to complete the octet of B atom permanently?
 a) $2\text{BH}_3 \rightleftharpoons \text{B}_2\text{H}_6$
 b) $\text{B}_2\text{H}_6 + 2 \text{THF} \rightarrow 2 \text{THF} \cdot \text{B}(\text{H})_2$
 c) $\text{NH}_3 + \text{BH}_3 \rightarrow [\text{NH}_3 \rightarrow \text{BH}_3]$
 d) $\text{CH}_3\text{CHO} + \text{BH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{OH}$
244. Intermolecular H-bonding in HF makes it :
 a) High b.p. liquid
 b) Capable of forming two series of salt
 c) Dibasic
 d) Capable of forming acid salt
245. In the following case (s), hybridization of the underlined atom is affected
 a) $\underline{\text{P}}\text{Cl}_5$ (solid) dissociates into PCl_4^+ and PCl_6^-
 b) LiH reacts with $\underline{\text{Al}}\text{H}_3$ forming LiAlH_4
 c) $\underline{\text{N}}\text{H}_3$ is protonated
 d) $\text{H}_3\underline{\text{P}}\text{O}_2$ is heated forming PH_3 and H_3PO_3
246. PbCl_4 exists but PbBr_4 and PbI_4 do not because of
 a) Br^- and I^- ions are bigger in size
 b) Chlorine is a gas
 c) Br_2 and I_2 are more electronegative
 d) Inability of bromine and iodine to oxidize Pb^{2+} to Pb^{4+}
247. Among the following the pair in which the two species are isostructural are
 a) SiF_4 and SF_4 b) IO_3^- and XeO_3 c) BH_4^- and NH_4^+ d) PF_6^- and SF_6
248. The species that does not contain peroxide bond is /are :
 a) PbO_2 b) H_2O_2 c) MnO_2 d) BaO_2
249. Which of the following statements is/are correct regarding ionic compounds?
 a) They are good conductors at room temperature
 b) They are generally soluble in polar solvents

- c) They consist of ions
 d) They generally have high melting and boiling points
250. In which of the following pairs, molecules/ ions have similar shape?
 a) CO_2 and H_2O b) BF_3 and H_2O c) CCl_4 and PtCl_4 d) NH_3 and BF_3
251. Which statement(s) is/are correct?
 a) PF_3 has higher bond angle than PCl_3
 b) Dipole moment of NH_3 is more than NF_3
 c) I^+ is smaller than I^- ion
 d) I^- is smaller than I^+ ion
252. The correct structural representation of diborane is:



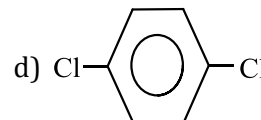
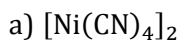
253. In which central atom(s) has/have one lone pair of electron?
 a) Cl_2 b) NH_3 c) PCl_3 d) XeF_6
254. Which among the following is/are linear?
 a) BeF_2 b) $\text{Ag}(\text{CN})_2^-$ c) CO_2 d) XeF_2
255. Which combination(s) given below is/are correct?
 a) HgCl_2 -linear
 b) ClF_3 -T-shaped
 c) ICl_4^- -square planar
 d) XeF_6 -pentagonal bipyramid
256. *A, B, C* are three substances. *A* does not conduct electricity in the solid or liquid state. *B* conducts electricity both in the fused and solution states, while *C* conducts electricity only in the solution state. Which of the following statement(s) is/are true regarding *A, B* and *C*?
 a) *A* has polar covalent linkage
 b) *A* has non-polar covalent linkage
 c) *B* is ionic in nature
 d) *C* has polar covalent linkage
257. Which of the following compounds possesses zero dipole moment?
 a) Water b) Benzene c) Carbon tetrachloride d) Boron trifluoride
258. The correct order of the O – O bond length in O_2 , H_2O_2 and O_3 is
 a) $\text{H}_2\text{O}_2 > \text{O}_3 > \text{O}_2$ b) $\text{O}_2 > \text{O}_3 > \text{H}_2\text{O}_2$ c) $\text{O}_2 > \text{H}_2\text{O}_2 > \text{O}_3$ d) $\text{O}_3 > \text{H}_2\text{O}_2 > \text{O}_2$
259. Which of the following is/are electron deficient compounds?
 a) NaBH_4 b) B_2H_6 c) AlCl_3 d) C_3^{4-}
260. Which of the following are diamagnetic?
 a) Li_2 b) N_2^+ c) O_2^{2-} d) C_2
261. The Molecule,



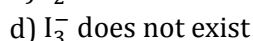
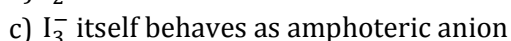
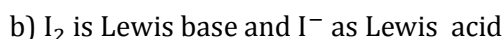
- a) Has intermolecular H-bonding
 b) Has intermolecular H-bonding
 c) Reduces Tollen's reagent
 d) Is steam-volatile
262. Which combinations of the compounds and their geometry are correct?
 a) HgCl_2 –linear b) ClF_3 –V-shaped c) ClF_3 –T-shaped d) ICl_4^- – square planar
263. Which of the following force(s) is/are weak?

- a) Covalent forces b) Van der Waal's forces c) Coulombic forces d) London forces
264. IE_2 for an element are invariably higher than IE_1 because :
- a) The size of cation is smaller than its atom
 b) It is difficult to remove 'e' from cation
 c) IE is endothermic
 d) All of the above

265. Which has/have zero value of dipole moment?



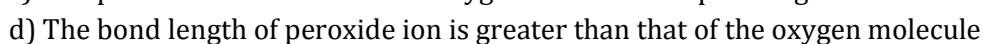
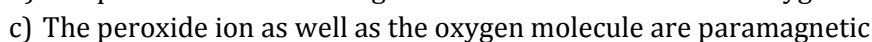
266. In I_3^-



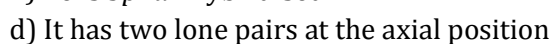
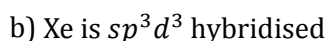
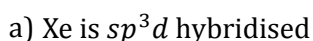
267. The compound which contains both ionic and covalent bond is/are :



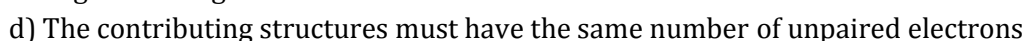
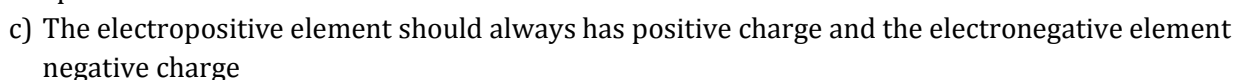
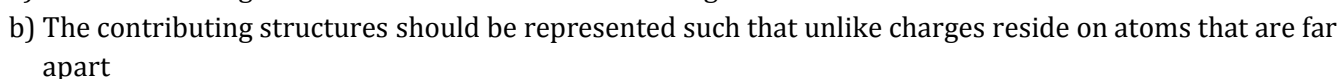
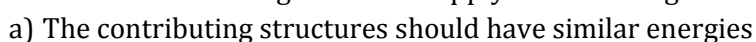
268. Which of the following statements is/are correct?



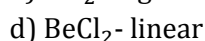
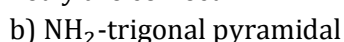
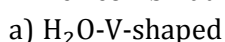
269. Select the incorrect statements about $[\text{XeF}_5]^-$



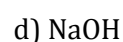
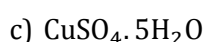
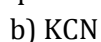
270. Which of the following conditions apply to resonating structures?



271. Which combinations of the compounds and their geometry are correct

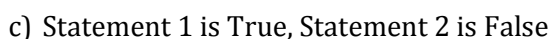
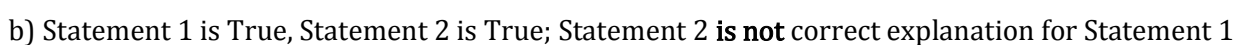


272. Which of the following compounds contain both ionic and covalent bonds?



Assertion - Reasoning Type

This section contain(s) 0 questions numbered 273 to 272. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.



Statement 1: Alkanes are insoluble in water

Statement 2: Organic compounds do not form hydrogen bonding with water

274

Statement 1: The first ionisation energy of Be is greater than that of B.

Statement 2: $2p$ -orbital is lower in energy than $2s$ -orbital.

275

Statement 1: Ionisation enthalpy is always positive.

Statement 2: Energy is always required when electrons are removed.

276

Statement 1: Molecular nitrogen is less reactive than molecular oxygen.

Statement 2: The bond length of N_2 is shorter than that of oxygen.

277

Statement 1: N and P show a maximum covalency of five.

Statement 2: P can expand the outer shell of electrons beyond an octet by involving d -orbitals present in its valence shell.

278

Statement 1: NaCl is more ionic than NaI.

Statement 2: Chlorine is more electronegative than iodine.

279

Statement 1: The dipole moment of NF_3 is more than NF_3 .

Statement 2: The presence of lone pair of electron on N shows an additive contribution in dipole moment of NH_3 whereas it shows a negative contribution towards dipole moment of NF_3 .

280

Statement 1: The bond angle in BF_3 is smaller than that in BF_4 .

Statement 2: BF_3 has sp^2 -hybridisation, whereas BF_4^- has sp^3 -hybridisation.

281

Statement 1: Bond energy has order like $C - C \leq C < C \equiv C$

Statement 2: Bond energy increases with increase in bond order

282

Statement 1: The bond angle in H_2O is greater than H_2S .

Statement 2: H-bonding does not occur in H_2S due to low electronegativity of S.

283

Statement 1: MO configuration of CO is $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma 2p_x^2, \pi 2p_y^2, \pi 2p_z^2, \sigma^* 2s^2$

Statement 2: The bond energy level $\sigma^* 2s^2$ possesses higher energy because then only bond length order for CO (more) and CO^+ (less) can be explained.

284

Statement 1: All molecules with polar bond have dipole moment.

Statement 2: Dipole moment is a vector quantity.

285

Statement 1: The lattice energy of silver halides is $\text{AgF} > \text{AgCl} > \text{AgBr} > \text{AgI}$.

Statement 2: AgF is water soluble.

286

Statement 1: Magnesium combines with fluorine to form MgF_2

Statement 2: Oppositely charged ions are attracted to each other by electrovalent bond

287

Statement 1: Solubility of NaCl in D_2O is less than, H_2O

Statement 2: Higher viscosity of D_2O is responsible for low solubility of NaCl.

288

Statement 1: The ionisation energy of ${}_1\text{H}^2$ is more than ionisation energy of ${}_1\text{H}^1$.

Statement 2: This is due to isotopic effect.

289

Statement 1: IF_7 is super octet molecule.

Statement 2: Central atom of I in IF_7 has 14 electrons.

290

Statement 1: The first ionisation energy of N is greater than O.

Statement 2: N atom has half filled p -orbitals.

291

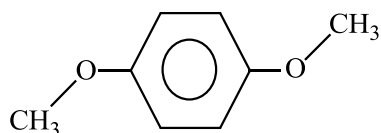
Statement 1: SeCl_4 does not have a tetrahedral structure.

Statement 2: Se in SeCl_4 has two lone pairs.

292

Statement 1: p -dimethoxy benzene is polar molecule.

Statement 2: The two methoxy groups at para positions are located as



293

Statement 1: LiCl is predominantly a covalent compound.

Statement 2: Electronegativity difference between Li and Cl is too small.

294

Statement 1: In NH_3 , N is sp^3 hybridised, but angle is found to be 104° .

Statement 2: The decrease in bond angle is due to repulsion between the lone pairs on nitrogen and bond pair between N and H.

295

Statement 1: IE_1 for He is maximum and EA_1 for Cl is more than EA_1 of F.

Statement 2: He possesses paired electrons in 1s sub-shell, closest to nucleus, whereas electron density in F is maximum which exerts more electro-electron repulsion.

296

Statement 1: E_{A2} for halogens is endothermic.

Statement 2: Halogens have $ns^2 np^5$ configuration and can accommodate only one electron.

297

Statement 1: In the aqueous HF solution, H_3O^+ and F^- are more likely to be found.

Statement 2: Hydrogen bonding in HF is stronger than that in H_2O .

298

Statement 1: CO_2 molecules are linear

Statement 2: The value of dipole moment of CO_2 is zero

299

Statement 1: F atom has less electron affinity than Cl atom.

Statement 2: Additional electrons are repelled more effectively by 3p-electrons in Cl atom than by 2p-electrons in F atom.

300

Statement 1: SF_4 has lone pair of electron at equatorial position in preference to apical position in the overall trigonal bipyramidal geometry.

Statement 2: If lone pair is at equatorial position then only repulsion is minimum.

301

Statement 1: Solubility of NaOH in water increases with rise in temperature, although it is exothermic dissolution.

Statement 2: Changes showing exothermic nature occurs in backward direction if temperature is raised.

302

Statement 1: The dipole moment of NH_3 is less than NF_3 .

Statement 2: The lone pair present on N shows additive nature of N – H vector whereas it is subtractive to N—F vector.

303

Statement 1: The molecule *cis*-1-chloropropene is more polar than *trans*-1-chloropropene.

Statement 2: The magnitude of resultant vector in *trans*-1-chloro-propene is non-zero.

304

Statement 1: F – F bond has low bond dissociation energy

Statement 2: The fluorine has low reactivity

305

Statement 1: BF_3 molecule is planar with an angle of 120° .

Statement 2: BF_3 has bond pair-lone pair electron ratio 1 : 3.

306

Statement 1: The bond energy of P—Cl bond in PCl_3 and PCl_5 are different.

Statement 2: In PCl_3 , $sp^3 - p$ overlapping whereas in PCl_5 , $sp^3d - p$ overlapping is noticed.

307

Statement 1: FeCl_2 is more covalent than FeCl_3 because electronegativity of $\text{Fe}^{3+} > \text{Fe}^{2+}$.

Statement 2: Higher is the charge on cation, more is deformation of anion, more is covalent character.

308

Statement 1: NH_3 and CH_3^- both have pyramidal shape.

Statement 2: N in NH_3 and C in CH_3^- both have sp^3 -hybridisation with one lone pair of electron on each.

309

Statement 1: If difference of electronegativity between two atoms is zero the resultant molecule will be non-polar covalent.

Statement 2: The shared pair of electron lies just in the middle of two atoms.

310

Statement 1: All F – S – F angle in SF_4 is greater than 90° but less than bond 180° .

Statement 2: The lone pair-bond pair repulsion is weaker the bond pair-bond pair repulsion.

311

Statement 1: PCl_5 conducts current in solid state.

Statement 2: PCl_5 exists as $[\text{PCl}_4]^+$ and $[\text{PCl}_6]^-$ ions.

312

Statement 1: P—Cl bond in PCl_3 and PCl_5 had different bond energy.

Statement 2: P in PCl_3 and PCl_5 is sp^3 -hybridised.

313

Statement 1: Oxygen does not possess *d*- orbitals in their valency shell

Statement 2: The covalency of oxygen is two

Matrix-Match Type

This section contain(s) 0 question(s). Each question contains Statements given in 2 columns which have to be matched. Statements (A, B, C, D) in **columns I** have to be matched with Statements (p, q, r, s) in **columns II**.

314. Match the species in Column I with corresponding character(s) in Column II

Column-I	Column- II
(A) CO_2	(1) Zero dipole moment
(B) CH_4	(2) Expansion of octet
(C) ClF_2^\oplus	(3) sp^3 hybridisation
(D) PCl_5	(4) sp^3d hybridisation
(E) ClF_2^\ominus	(5) Linear

CODES :

	A	B	C	D	E
a)	1,3	3	2,4	3,5	1,5
b)	1,5	1,3	3	2,4	1,5
c)	2,4	3,5	1,3	3	1,5
d)	3,5	3	1,5	1,3	1,5

315. Match the compounds (in Column I) with the structures (in Column II)

Column-I	Column- II
(A) $(\text{CH}_3)_3\text{B}$	(1) Square planar
(B) NH_4Cl	(2) Trigonalbipyramid
(C) $[\text{Cl}_4]^-$	(3) Tetrahedral
(D) PCl_5	(4) Trigonal

CODES :

	A	B	C	D
a)	3	2	4	1
b)	2	1	3	4
c)	1	4	2	3
d)	4	3	1	2

316. Match the type of species (in Column I) with the compound (in Column II)

	Column-I	Column- II
(A)	Ionic species	(1) HCl
(B)	Non-polar covalent	(2) LiCH ₃
(C)	Polar covalent species having sigma bond only	(3) KCH ₃
		(4) NO

CODES :

	A	B	C	D
a)	4	1	3	4
b)	3	2	1	
c)	2	4	3	1
d)	1	3	4	2

317. Match List I with List II and choose the correct matching codes from the choices given.

	Column-I	Column- II
(A)	PCl ₅	(1) Linear
(B)	IF ₇	(2) Pyramidal
(C)	H ₃ O ⁺	(3) Trigonal bipyramidal
(D)	ClO ₂	(4) Tetrahedral
(E)	NH ₄ ⁺	(5) Pentagonal bipyramidal
		(6) Angular

CODES :

	A	B	C	D	E
a)	3	5	2	1	4
b)	3	5	4	1	4

c)	3	5	6	1	4
d)	3	5	2	6	4
e)	3	5	2	4	4

318. Match the compounds (in Column I) with the type of hybridization on the central atom/ion (in Column II)

	Column-I	Column-II
(A)	BCl_3	(1) sp^3
(B)	NH_3	(2) sp^3d^2
(C)	$[\text{Cu}(\text{NH}_3)_4]^{2+}$	(3) sp^2
(D)	$[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$	(4) dsp^2

CODES :

	A	B	C	D
a)	1	2	3	4
b)	2	4	1	3
c)	3	1	4	2
d)	4	3	2	1

319. Match the items under Column I with items under Column II

	Column-I	Column-II
(A)	PCl_5	(1) V-shaped
(B)	F_2O	(2) Triangular planar
(C)	BCl_3	(3) Trigonalbipyramidal
(D)	NH_3	(4) Trigonal pyramidal
		(5) Tetrahedral

CODES :

	A	B	C	D
a)	2	3	4	1
b)	3	1	2	4
c)	4	2	1	2
d)	1	4	3	2

320. Match List I with List II and select the correct answer:

Column-I	Column-II
----------	-----------

- | | |
|-----------------------|-------------------|
| (A) ICI^- | (1) Linear |
| (B) BrF_2^+ | (2) Pyramidal |
| (C) ClF_4^- | (3) Tetrahedral |
| (D) AlCl_4^- | (4) Square planar |
| | (5) Angular |

CODES :

	A	B	C	D
a)	1	2	4	5
b)	4	5	2	3
c)	1	5	4	3
d)	5	1	3	4

321. Match the species (in Column I) with the bond order (in Column II)

	Column-I	Column- II
(A) N_2		(1) 1.0
(B) O_2		(2) 2.0
(C) F_2		(3) 2.5
(D) O_2^+		(4) 3.0

CODES :

	A	B	C	D
a)	4	2	1	3
b)	2	3	4	1
c)	3	1	2	4
d)	1	4	3	2

322. Match the species in Column I with their properties in Column II

	Column-I	Column- II
(A) NH_3		(1) Lewis acid
(B) $\ominus\text{NH}_2$		(2) Lewis base
(C) $\oplus\text{NH}_4$		(3) Distorted geometry
(D) BH_4^-		(4) sp^3 hybridised central atom
		(5) Has two types of H

CODES :

	A	B	C	D
a)	2,3,4	2,3,4	3,5	4,5
b)	4,5	3,5	2,3,4	2
c)	3,5	5	4,5	2,3,4
d)	5	4,5	2,3,4	3,5

323. Match List I with List II. Select the correct answer using the codes given below the list.

	Column-I	Column- II
(A)	NH_4	(p) sp^3d^3
(B)	PCl_5	(q) sp^3d
(C)	SF_6	(r) sp^3
(D)	IF_7	(s) sp^3d^2

CODES :

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

324. Match Column I (hybrid bond orbitals) with Column II (species) and select the correct answer

	Column-I	Column- II
(A)	sp^3	(1) ICl_4^-
(B)	dsp^2	(2) TeCl_4
(C)	sp^3d	(3) MnO_4^-
(D)	sp^3d^2	(4) $\text{Ni}(\text{CN})_4^{2-}$

CODES :

	A	B	C	D
a)	3	4	2	1
b)	4	2	1	3
c)	2	1	3	4
d)	1	3	4	2

325. Match each the diatomic molecules in Column I with its property/properties in Column II

Column-I	Column- II
(A) B_2	(1) Paramagnetic
(B) N_2	(2) Undergoes oxidation
(C) O_2^-	(3) Undergoes reduction
(D) O_2	(4) Bond order ≥ 2
	(5) Mixing of 's' and 'p' orbitals

CODES :

	A	B	C	D
a)	2,3,4,5	1,2,3,5	1,3,4,5	3,5
b)	1,2,3,5	2,3,4,5	1,2,3,5	1,3,4,5
c)	1,3,4,5	3,5	2,3,4,5	1,2,3,5
d)	3,5	1,3,4,5	4,5	2,3,4,5

326. Match List I and List II and pick out correct matching codes from the given choices.

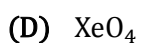
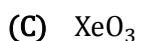
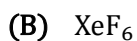
Column-I	Column- II
(A) ClF_3	(1) Square planar
(B) PCl_5	(2) Tetrahedral
(C) IF_5	(3) Trigonal bipyramidal
(D) CCl_4	(4) Square pyramidal
(E) XeF_4	(5) T- shaped

CODES :

	A	B	C	D	E
a)	5	4	3	2	1
b)	5	3	4	2	1
c)	5	3	4	1	1
d)	4	3	5	2	1
e)	5	4	1	5	1

327. Match the compounds (in Column I) with the structure (in Column II)

Column-I	Column- II
(A) XeF_4	(1) Distorted octahedral



(2) Tetrahedral

(3) Square planar

(4) Pyramidal

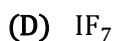
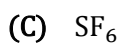
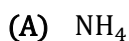
CODES :

	A	B	C	D
a)	3	1	4	2
b)	1	2	3	4
c)	2	4	1	3
d)	4	3	2	1

328. Match List I with List II. Select the correct answer using the codes given below the list.

Column-I

Column- II



(p) sp^3d^3

(q) sp^3d

(r) sp^3

(s) sp^3d^2

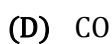
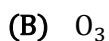
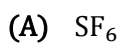
CODES :

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

329. Match the species in Column I with their properties in Column II

Column-I

Column- II



(1) π bonds are also present

(2) σ bonds are only present

(3) Hypervalent

(4) Hypovalent

(5) Linear

CODES :

A	B	C	D
----------	----------	----------	----------

- a) 1,5 2,3 1,2,5 2,4,5
 b) 1,2,5 2,4,5 1,5 2,3
 c) 2,3 1,5 2,4,5 1,2,5
 d) 2,4,5 1,2,5 2,3 1,5

330. Match the compounds in the list I with that in List II.

Column-I	Column- II
(A) XeO ₃	(p) Planar triangular
(B) XeOF ₄	(q) T- shape
(C) BO ₃ ³⁻	(r) Trigonal pyramid
(D) ClF ₃	(s) Square pyramid
(E) I ₃ ⁻ (aq)	(t) Linear
	(u) Bent

CODES :

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

Linked Comprehension Type

This section contain(s) 30 paragraph(s) and based upon each paragraph, multiple choice questions have to be answered. Each question has atleast 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 331 to -331

When does ions C⁺ and A⁻ of an ionic molecule, C⁺A⁻ whose both the ions are symmetrical come closer or each other of the ions gets distorted or polarized by the other ion. But the produced by C⁺ cation in A⁻ anion is appreciable while that produced by A⁻ anion in C⁺ cation is negligible. The ability of a cation to polarise a nearby anion is called its polarizing power or polarizing ability. In the polarization process the electrons of the anion are withdrawn by the cation towards itself

331. Bond polarity of diatomic molecule is because of
- Difference in ionization potential
 - Difference in electron affinities of the two atoms
 - Difference in electronegativities of the two atoms
 - All of the above

Paragraph for Question Nos. 332 to - 332

According to the concept of resonance, whenever a single Lewis structure can't describe a molecule accurately, then a number of structure called resonating structure, with similar energy. Same relative position of all nuclei and with same number of paired and unpaired electrons

The molecule as such has a single definite structure which is the resonance hybrid of the resonating structure and can't as such be depicted by a single Lewis structure. As a result of resonance, the bond order may change in many molecules or ions, and is given by formula

Total number of bonds between two atoms

$$\text{Bond order} = \frac{\text{in all the structure}}{\text{Total number of resonating structures}}$$

332. Which of the following molecule contains one pair of non bonding electrons?

a) H₂O

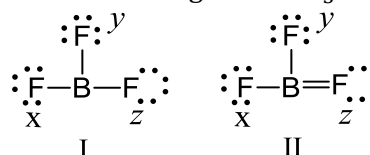
b) HF

c) NH₃

d) CH₄

Paragraph for Question Nos. 333 to - 333

Boron-containing compounds often have a boron atom with only three bonds (and no lone pairs) two structure have been assigned to BF₃



333. Select the correct statements

- a) Octet of F is complete in I and II but octet of B is incomplete in I but complete in II
- b) Octets of F and B are complete in I and II
- c) Octets of F and B are incomplete in I and II
- d) Octet of F is complete in I and II but octet of B is complete in I but incomplete in II

Paragraph for Question Nos. 334 to - 334

Consider the following molecules and answer the questions given

I: H₂O;

II: CO₂;

III: NH₃

IV: CCl₄;

V: ClF

334. In which compound are the bonds most polar?

a) H₂O

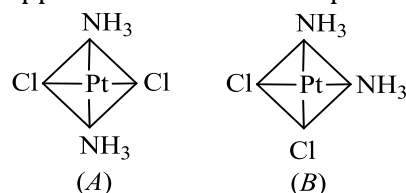
b) CO₂

c) CCl₄

d) ClF

Paragraph for Question Nos. 335 to - 335

The platinum-chlorine distance has been found to be 2.32 Å in several crystalline compounds. This value applies to both of the compounds shown in the figure



Based on the above structures, answer the following questions

335. Cl – Cl distance in structure (A) is
a) 2.32 Å b) 4.64 Å c) 1.16 Å d) 9.28 Å

Paragraph for Question Nos. 336 to - 336

By the following method you can predict the geometrical shape of species with only one central atom, without first drawing the Lewis structure

1. Total number of electron pairs = (number of valence electrons \pm electrons (for ionic charge))/2
 2. Number of bond electron pairs = number of atoms – 1
 3. Number of electron pairs around central atom = total number of electron pairs – 3 [number terminal atoms (except H)]
 4. Number lone pair = (number of central electron pairs – number bond pairs – number bond pairs)
- Read the above method and answer the following questions

336. If *A* is the central element of the molecule containing *A* and *X* element and *E* the number of electron pairs round it then VSEPR notation AX_3E will be for the molecules
a) PCl_5, ICl_4^- b) NH_3, H_2O c) NH_3, ClO_3^- d) ICl_4^-, ClO_3^-

Paragraph for Question Nos. 337 to - 337

Read the following short write-up and answer the questions at the end of it

In certain polar solvents PCl_5 undergoes an ionization reaction in which Cl^- ion leaves one PCl_5 molecule and attaches itself to another

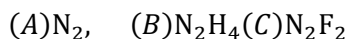


337. Select the incorrect statement (s)
a) Dissociation is a redox reaction
b) Hybridization changes from sp^3d to sp^3d^2 (PCl_6^-) and sp^3 (PCl_4^+)
c) Structure changes from trigonalbipyramidal to tetrahedral (PCl_4^+) and octahedral (PCl_6^-)
d) None of the above is incorrect

Paragraph for Question Nos. 338 to - 338

Read the following short write-up and answer the questions at the end of it

“ Each of the following compounds has a nitrogen-nitrogen bond”



Molecules may be polar or non-polar, that is dependent on the electronegativity difference between two atoms. Their bond-lengths (between N-atoms) have been 1.45Å, 1.10 Å and 1.22 Å but not in correct order

338. Compounds have been matched with their bond-length (between N-atoms). Which is not the correct matching?
a) A – 1.10 Å b) B – 1.45 Å c) C – 1.22 Å d) None of these

Paragraph for Question Nos. 339 to - 339

Read the following short-write up and answer the questions at the end of it

“Methyl isocyanate is used to make certain pesticides. In December 1984, water leaked into a tank containing

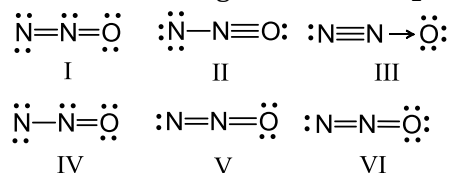
this substance at a chemical plant, producing a toxic cloud that killed thousands of people in Bhopal

339. Which is not the resonance structure of methyl isocyanate?



Paragraph for Question Nos. 340 to - 340

Assume following structure of N_2O and answer the questions



340. Which is the most favourable structure?



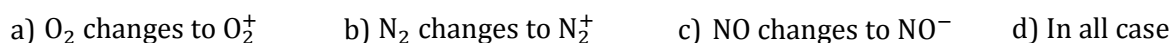
Paragraph for Question Nos. 341 to - 341

We consider dissociation energy of different species

Species	Dissociation energy (kJ mol ⁻¹)
O_2^+	642.9
O_2	493.6
O_2^-	395.0
N_2^+	840.7
N_2^-	765.0
N_2	941.7
NO^+	1046.9
NO	626.9
NO^-	487.8

Answer the following questions

341. In which cases bond-order increases?



Paragraph for Question Nos. 342 to - 342

Dipole moment of a bond is a vector and physical quantity to calculate the percentage ionic character in a covalent bond. It is expressed as :

$$\text{Dipole moment } (\mu) = \delta \times d$$

Where, δ is dipole moment and d is the bond length.

It is usually expressed in terms of CGS unit known as Debye (D) $1\text{D} = 10^{-18}$ esu.cm. In SI unit it is expressed in Coulomb meter Resultant dipole moment (μ_R) of two bond moments (μ_1 and μ_2) acting at an angle θ , is given by :

$$\mu_R = \sqrt{\mu_1^2 + \mu_2^2 + 2\mu_1\mu_2 \cos \theta}$$

If $\mu_1 = \mu_2$, also if $\cos\theta = 1$, *i. e.*, $\theta = 180^\circ$ then $\mu = 0$. (molecule is nonpolar)

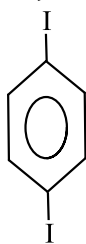
If $\mu \neq 0$ molecule is polar.

Dipole moment plays an important role in deciding the stability order of alkanes, *i. e.*, a more stable alkane has less dipole moment. The dipole moment of a molecule can predict the geometrical and position isomers as well as orientations in benzene nucleus and polarity of molecule.

342. Dipole moment of HCl molecule is found to be 0.816 D. Assuming HCl bond length to be equal to 1 Å, the % ionic character of HCl molecule is :
- a) 10% b) 17% c) 27% d) 37%

Integer Answer Type

343. Number of electron pairs in SF₆ at the corners of octahedron are
344. Number of shell in which valence electrons of iodine lies
345. In a very ideal imaginary condition, a sample of ice was taken, and its osmotic pressure was found to be 0.274 atm at 300 K (density 1g/mL). Thus, number of water units attached to one water unit is.....
346. Based on VSEPR theory, number of 90 degree F—Br—F in BrF₅ is
347. What is formal charge on F in BF₃?
348. Maximum number of atoms which can be attached on N-atom is ...
349. Number of unpaired electron(s) in O₂⁻ is/are.....
350. Bond order of BN is
351. Formal charge on sulphur in SO₂ is.....
352. Ratio of bond pair-lone pair electrons in XeOF₂ is
353. In a compound of Xe, F and O Xe = 60.4% (131.3), F = 17.5% (19.0)
Thus, number of oxygen atom.....
354. Bond order of NO⁺ is
355. Assuming C₆H₆ ring a regular hexagon and C—I bond lies on the line through the centre of hexagon. If the distance between adjacent carbon is 1.40 Å, the I—I distance in Å is....



356. What is the ratio of σ and π bonds in benzene?
357. Based on VSEPR theory, the number of 90° F — Br — F angles in BrF₅ is.....
358. AX₄ forms square planar type structure. Distance between A and X atoms is 4 units then distance between two X atom in *trans* position is....
359. Total number of orbitals involved in the formation of hybrid orbitals in ClF₂⁺ is.....
360. The dipole moment of AB is 1.6×10^{-30} cm. If intermolecular distance is 2.0×10^{-10} m, the % ionic character of AB is
361. How many of the following have incomplete duplet or octet on central atom?
BeCl₂, BH₃, NH₄⁺, H⁺, H⁻, CH₃⁺, CH₃⁻, CH₂
362. Steric number of CH₄ is.....
363. Number of electron pairs in XeF₄ at the corners of square are
364. Bond order for CO is ...
365. In O₃, central oxygen involved in the formation of hybrid orbitals in ClF₂⁻ is....
366. How many maximum number of H atom are in the same plane in B₂H₆?
367. Difference of σ and π bonds in C(CN)₄ is.....

368. Superoxide ion has electrons in antibonding molecular orbitals
369. Total number of orbitals involved in the formation of hybrid orbitals in ClF_2^- is.....
370. Number of hybrid orbitals in XeF_4 is.....
371. Bond-order in NO^+ is.....
372. A slightly polar molecule AB has dipole moment of 0.24 D. If bond-length is 1 Å, ionic character is....%
373. Steric number of H_2O is.....
374. Number of unpaired electrons in $\text{O}_2[\text{AsF}_4]$ is
375. Lone pairs in I_3^- are.....
376. How many of the following cases hybridization state of underlined atom changes?
- $\bar{\text{N}}\text{H}_2 + \underline{\text{S}}\text{O}_3 \rightarrow [\text{NH}_2\underline{\text{S}}\text{O}_3]^-$
- $\underline{\text{C}}\text{H}_3\underline{\text{C}}\text{OOH} \rightarrow \text{CH}_4 + \text{CO}_2$
- $2\underline{\text{P}}\text{Cl}_5 \rightarrow \overset{\oplus}{\text{P}}\text{Cl}_4 + \text{PCl}_6^-$
- $\text{CH}_3\underline{\text{C}}\text{H}_2\text{OH} \rightarrow \text{CH}_2 = \text{CH}_2 + \text{H}_2\text{O}$
- $\underline{\text{A}}\text{H}_3 + \text{H}^- \rightarrow \text{AlH}_4^-$
- $2\underline{\text{O}} = \underline{\text{O}} \rightarrow \text{O} \rightarrow 3\underline{\text{O}}_2$
- $(\text{CH}_3)_3\underline{\text{C}}\text{Cl} \rightarrow (\text{CH}_3)_3\overset{\oplus}{\text{C}} + \text{Cl}^-$
377. Out of CH_2Cl_2 , CH_4 , CCl_4 , H_2O , CHCl_3 , *d*-dichlorobenzene, *o*-cresol, *p*-xylene, SCl_2 , BF_3 , IBr and CH_2O , non-zero value of dipole moment is of....

4.CHEMICAL BONDING AND MOLECULAR STRUCTURE

: ANSWER KEY :

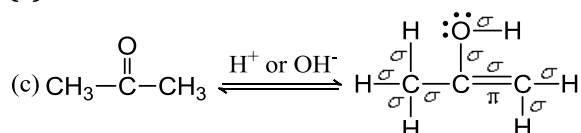
1)	a	2)	c	3)	a	4)	a	189)	a	190)	a	191)	a	192)	b
5)	c	6)	d	7)	c	8)	d	193)	b	194)	a	195)	a	196)	b
9)	c	10)	d	11)	a	12)	a	197)	b	198)	b	199)	b	200)	d
13)	d	14)	b	15)	c	16)	d	201)	a	202)	b	1)	b,c	2)	c
17)	d	18)	d	19)	d	20)	a	3)	b,d	4)	a,b,c,d				
21)	b	22)	a	23)	c	24)	b	5)	a,c	6)	b	7)	a,b,d	8)	
25)	d	26)	d	27)	d	28)	c		a,c,d						
29)	a	30)	a	31)	b	32)	a	9)	b,c,d	10)	a,b,c,d	11)	d	12)	b
33)	d	34)	c	35)	c	36)	a	13)	a,c,d	14)	a,b,c,d	15)	d	16)	
37)	c	38)	a	39)	a	40)	a		a,d						
41)	a	42)	d	43)	c	44)	b	17)	b,c	18)	a,c	19)	b,c,d	20)	
45)	b	46)	d	47)	c	48)	d		a,b,c						
49)	b	50)	d	51)	d	52)	d	21)	a,b	22)	b,c	23)	b,c,d	24)	
53)	c	54)	b	55)	b	56)	b		a,c						
57)	d	58)	d	59)	d	60)	b	25)	a,b	26)	a,b,c	27)	a,b,d	28)	
61)	a	62)	b	63)	d	64)	b		a,c,d						
65)	b	66)	d	67)	a	68)	a	29)	a,b,d	30)	b,d	31)	a,b,c	32)	
69)	a	70)	c	71)	b	72)	a		a,c						
73)	c	74)	b	75)	c	76)	a	33)	a,c,d	34)	a,b,c	35)	a,b,c	36)	
77)	a	78)	a	79)	d	80)	a		a,b,d						
81)	c	82)	b	83)	d	84)	a	37)	a,b,c	38)	b,c	39)	a	40)	
85)	b	86)	a	87)	d	88)	d		a,b						
89)	b	90)	d	91)	d	92)	b	41)	b,c	42)	a,b,c,d	43)	a,b	44)	a
93)	c	94)	d	95)	d	96)	c	45)	b,c,d	46)	a,c	47)	b,c,d	48)	b
97)	b	98)	c	99)	a	100)	d	49)	a,b,c	50)	c	51)	b,c,d	52)	
101)	c	102)	a	103)	b	104)	b		a,b,c,d						
105)	c	106)	d	107)	c	108)	c	53)	a,b,c	54)	b,c,d	55)	b,c,d	56)	a
109)	d	110)	b	111)	a	112)	b	57)	b,c	58)	a,c,d	59)	b,d	60)	
113)	d	114)	a	115)	c	116)	b		a,c,d						
117)	d	118)	a	119)	d	120)	d	61)	b,d	62)	a,b	63)	a,c,d	64)	a
121)	a	122)	a	123)	a	124)	b	65)	b,c,d	66)	a,b	67)	b,c,d	68)	
125)	a	126)	d	127)	b	128)	b		a,b,c,d						
129)	c	130)	c	131)	c	132)	c	69)	a,b,d	70)	a,b,c,d	1)	a	2)	a
133)	b	134)	d	135)	a	136)	b		3)	a	4)	b			
137)	a	138)	a	139)	d	140)	c	5)	b	6)	b	7)	b	8)	b
141)	c	142)	c	143)	a	144)	b	9)	a	10)	d	11)	c	12)	b
145)	d	146)	c	147)	d	148)	d	13)	d	14)	a	15)	c	16)	c
149)	c	150)	b	151)	c	152)	c	17)	c	18)	c	19)	c	20)	a
153)	c	154)	a	155)	c	156)	a	21)	c	22)	a	23)	c	24)	b
157)	c	158)	b	159)	d	160)	d	25)	b	26)	a	27)	a	28)	c
161)	c	162)	d	163)	a	164)	b	29)	d	30)	b	31)	b	32)	c
165)	a	166)	d	167)	d	168)	c	33)	d	34)	c	35)	b	36)	c
169)	a	170)	d	171)	a	172)	b	37)	c	38)	d	39)	b	40)	a
173)	c	174)	b	175)	d	176)	a	41)	b	1)	b	2)	d	3)	b
177)	c	178)	d	179)	a	180)	c		4)	d					
181)	a	182)	c	183)	c	184)	c	5)	c	6)	b	7)	c	8)	a
185)	a	186)	a	187)	c	188)	a	9)	a	10)	a	11)	a	12)	b

13)	b	14)	a	15)	a	16)	c
17)	d	1)	c	2)	c	3)	a
	4)	a					
5)	b	6)	c	7)	d	8)	d
9)	c	10)	b	11)	a	12)	b
1)	6	2)	5	3)	4	4)	0
5)	0	6)	4	7)	1	8)	2
9)	0	10)	2	11)	3	12)	3
13)	7	14)	4	15)	8	16)	8
17)	4	18)	5	19)	5	20)	4
21)	4	22)	3	23)	3	24)	4
25)	0	26)	7	27)	5	28)	6
29)	3	30)	5	31)	4	32)	1
33)	3	34)	5	35)	7		

: HINTS AND SOLUTIONS :

1 (a)
Partially filled bonds or overlapping bonds represent metal

2 (c)



9σ-bond $\left\{ \begin{array}{l} 1 \text{ (C - O)}\sigma \text{ bond} \\ 1 \text{ (O - H)}\sigma \text{ bond} \\ 5 \text{ (C - H)}\sigma \text{ bonds} \\ 2 \text{ (C - C)}\sigma \text{ bonds} \end{array} \right.$

1 π bond [1 (C - C)π bond]

Two lone pairs on O-atom

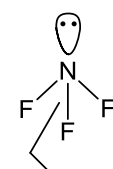
3 (a)

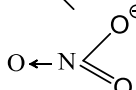
	Electrons	Bond order	Ligand
CN ⁻	14	3	Strong
CO	14	3	Strong
NO ⁺	14	3	weak

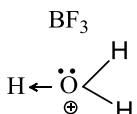
4 (a)

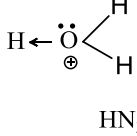
Due to H-bonding in water molecules, water has high density

5 (c)

(c) NF₃  one lone pair, sp³
three (N-F) bonds (pyramidal)

 no lone pair, sp²
(triangular planar)

 BF₃ no lone pair, sp²
triangular planar

 HN₃ one lone pair, sp³,
pyramidal

H-N≡N: each N atom is sp-hybridised

Thus, NF₃ and H₃O⁺ are identical and BF₃ and NO₂⁻ are identical

6 (d)

Force of attraction between cation and anion is

$$F = \frac{kz_1z_2e^2}{r^2}$$

Where, *k* is dielectric constant of the medium. *z*₁ and *z*₂ are charges on cation and anion, and *r* the internuclear distance

Size of Cl⁻ > O²⁻

K⁺ > Ca²⁺

Charge on Ca²⁺ > K⁺

O²⁻ > Cl⁻

7 (c)

C

8 (d)

Bond order

I. O₂²⁻ 1

O₂ 2 Stronger

II. N₂ 3 Stronger

N₂⁺ 2.5

III. NO⁺ 3 Stronger

NO⁻ 2

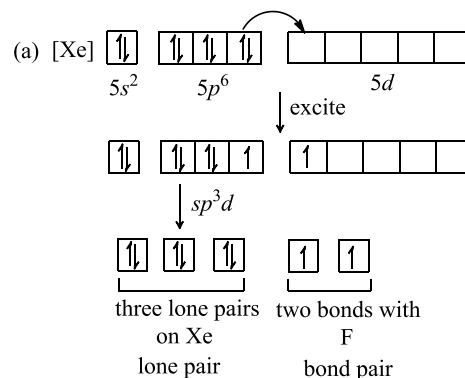
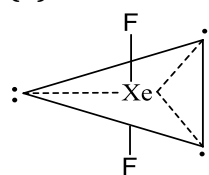
Larger the bond order, greater the bond energy

11 (a)

Species	Electrons	Bond order
I. CN ⁻	14	3.0
II. O ₂ ⁻	17	1.5
III. NO ⁺	14	3.0
IV. CN ⁺	12	2.0

I and II have same bond-order

14 (b)



(a) XeF₂ 3 2

(b) XeF₄ 2 4

(c) H₃O⁺ 1 3

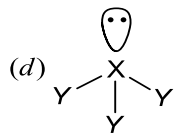
(d) XeF₆ 1 6

15 (c)

In (c), octet of Cl and O is completed as for Lewis structure

In (a), (b) and (d), octets of C, N and O as expected are not complete

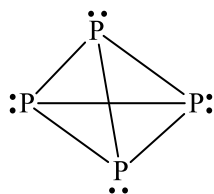
16 (d)



Due to *lp* – *bp* repulsion, tetrahedral geometry is distorted to pyramidal geometry

18 (d)

P-atom is *sp*³-hybridised. Thus, *p*-character in P₄ is 75%

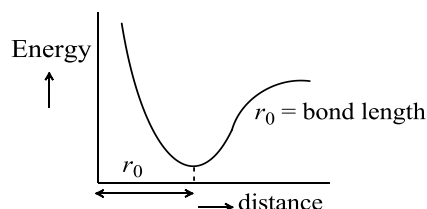


20 (a)

M.O. theory explains filling of electrons in bonding and antibonding M.O. If there are unpaired electrons in these orbitals then paramagnetic

21 (b)

When a chemical bond is formed, potential energy decreases



22 (a)

In O₂ molecule, the total number of electrons = 16

Electronic distribution in molecular orbital of O₂ = σ1s², σ*1s², σ2s², σ*2s², σ2p_x² (π2p_y², π2p_z²), (π*2p_y¹, π*2p_z¹)

Bond order in O₂ = $\frac{1}{2} [N_b - N_a] = \frac{1}{2} [10 - 6] = 2.0$

In O₂⁺ = σ1s², σ*1s², σ2s², σ*2s², σ2p_x² (π2p_y² = π2p_z²), (π*2p_y¹)

Bond order in O₂⁺ = $\frac{N_b - N_a}{2} = \frac{10 - 5}{2} = 2.5$

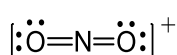
23 (c)

Formal charge = $v - \frac{s}{2} - u$

Where, *v* = valence electrons

s = shared electrons (forming bonds)

u = unshared electrons



On oxygen atom $\begin{cases} v = 6 \\ s = 4 \\ u = 4 \end{cases}$

Thus, formal charge = $6 - \frac{4}{2} - 4 = 6 - 2 - 4 = 0$

24 (b)

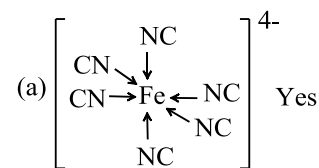
H⁺: no electro

H⁻ : one lone pair H[•]:

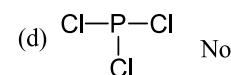
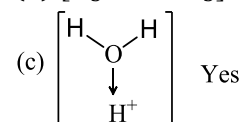
H₂: no lone pair

He²⁺: no lone pair

27 (d)

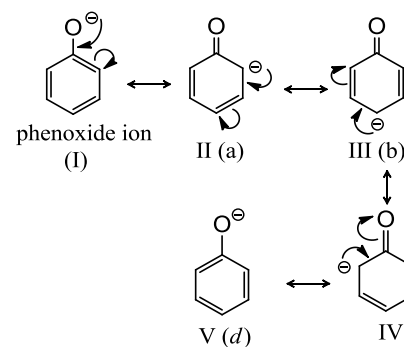


(b) [H₃N → BH₃] Yes



28 (c)

These is delocalization of π-electrons in phenoxide ion, giving various resonating structures



29 (a)

B₂(10)

σ 1s² σ*1s² σ2s² σ*2s² π2p_y²

N_B = 6

N_A = 4

BO diamagnetic = $\frac{6 - 4}{2} = 1$

30 (a)

KO₂ ⇌ K⁺ + O₂⁻ (one unpaired electron)

NO₂⁺ (no unpaired electron)

BaO₂ ⇌ Ba²⁺ + O₂²⁻ (no unpaired electron)

AlO₂⁻ (no unpaired electron)

32 (a)

	Electrons	Structure
--	-----------	-----------

NO_3^-	$7 + 24 + 1 = 32$	Triangular
CO_3^{2-}	$6 + 24 + 2 = 32$	Triangular
ClO_3^-	$17 + 24 + 1 = 42$	Pyramidal
SO_3	$16 + 24 = 40$	Triangular

33 (d)

Electrons Bond order

N_2	14	3.0
N_2^+	13	2.5 decreases
O_2	16	2.0
O_2^+	15	2.5 increases

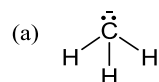
34 (c)

Third period and further periods involve s, p and d -orbitals for bonding. Thus, octet rule is generally violated

35 (c)

Complex ions	Z (atomic number of metal)	ON	Ligand	Unpaired electron
A. CrF_6^{4-}	24	+2	Weak	4
B. MnF_6^{4-}	25	+2	Weak	5
C. $[\text{Cr}(\text{CN})_6]^{4-}$	24	+2	Strong	2
D. $[\text{Mn}(\text{CN})_6]^{4-}$	25	+2	Strong	1

36 (a)



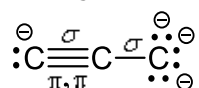
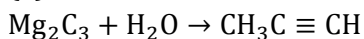
Three (C – H) bonds and one lone pair = four hybrid orbitals

Thus, sp^3

37 (c)

There is maximum association by intermolecular H-bonding in H_2O thus high boiling point and least volatile

38 (a)



Two σ and two π bonds

39 (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 = $\frac{V - 8B}{2} + B = \frac{24 - 8 \times 3}{2} + 3$

($V \rightarrow$ total number of electrons in valence shell

$B \rightarrow$ probability of formation of bond)

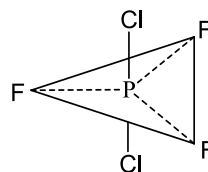
In CO_3^{2-} ion, total number of electrons = $6 + 24 + 2 = 32$ and in it central atom is sp^2 hybrid.

No. of hybrid orbital = $\frac{24 - 8 \times 3}{2} + 3 = 3$

Hence, NO_3^- and CO_3^{2-} ions are isoelectronic and isostructural.

40 (a)

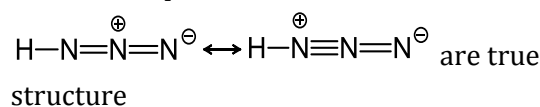
PF_3Cl_2 : sp^3d hybridisation on P



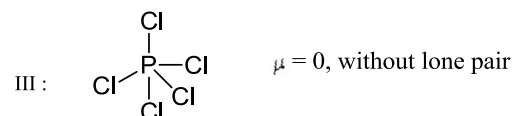
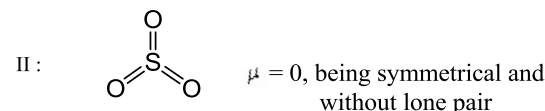
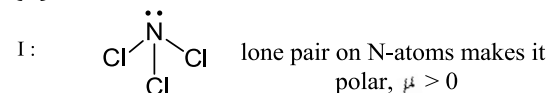
Three hybrid orbitals are at 120° and other two are at 90° with one each other. Thus, trigonal bipyramidal structure

41 (a)

N has incomplete octet



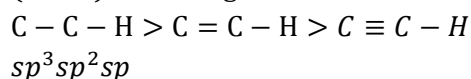
42 (d)



Thus, II and III are non-polar

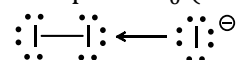
43 (c)

(C – H) bond length is in order



44 (b)

I_3^- is formed when I^- (Lewis base) donated one lone pair to I_0 (Lewis acid)



Thus, lone pair on central atom = Three and bond pair = Two

Thus, $X = 2$

$Y = 3$

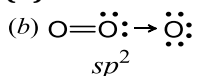
46 (d)

Smaller the cationic size, larger the charge, larger the polarizing power

Size $\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+ < \text{Ca}^{2+}$

and charge $+3 > +2 > +1$

49 (b)



Central O-atom has one σ bond one coordinate bond and one lone pair

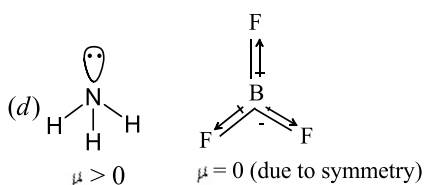
Thus, sp^2 hybridised

50 (d)

Smaller the size of the atom, greater the force of attraction hence greater the dissociation energy.

Thus, element D with smallest size forms strongest (C – D) bond

51 (d)



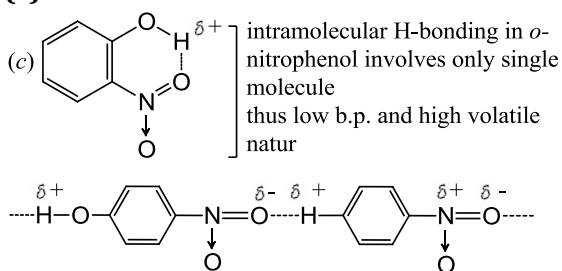
(a) Incorrect

(b) $\mu_{\text{NH}_3} > \mu_{\text{BF}_3}$ thus incorrect

(c) Due to lone pair of N, NH_3 has pyramidal geometry thus incorrect

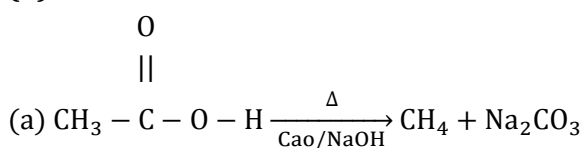
(d) Correct

53 (c)



Intermolecular H-bonding in *p*-nitrophenol involves larger number of molecules thus high boiling point thus low volatile nature

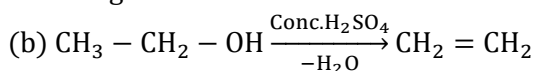
54 (b)



$\uparrow\uparrow$

sp^3sp^3

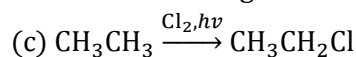
No change



$\uparrow\uparrow$

sp^3sp^2

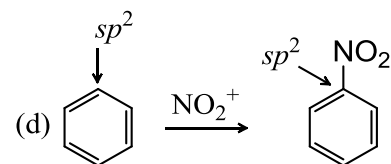
Thus there is change



$\uparrow\uparrow$

sp^3sp^3

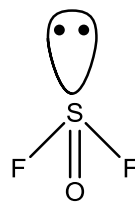
No change



No change

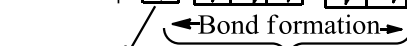
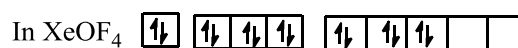
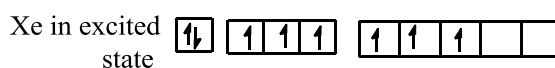
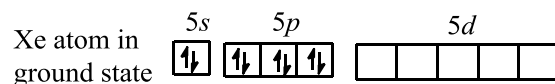
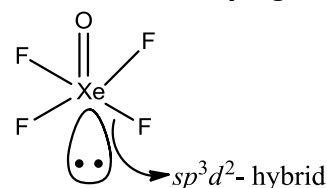
59 (d)

OSF_2 has pyramidal shape



60 (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.

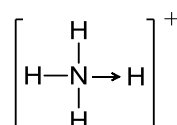
61 (a)

I: $\text{K}_4[\text{Fe}(\text{CN})_6] \rightarrow 4\text{K}^+ + [\text{Fe}(\text{CN})_6]^{4-}$ ionic bond
 $[\text{Fe}(\text{CN})_6]^{4-}$ has coordinate bonds with Fe^{2+} and CN^-

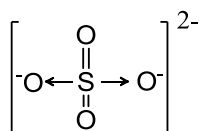
CN^- has covalent bonding $\text{N} \equiv \text{C}^\ominus$

II: $\text{NH}_4\text{Cl} \rightarrow \text{NH}_4^+ + \text{Cl}^-$ ionic bond

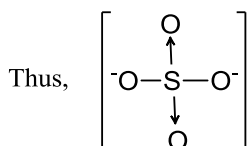
NH_4^+ has covalent and coordinate bond



III: $H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-}$ ionic bond
 SO_4^{2-} has covalent and coordinate bond



or



62 (b)

- (a) CS_2 non-polar
- (b) $RaCl_2$ ionic
- (c) HCN weak acid
- (d) F_2 non-polar

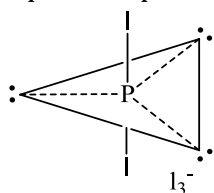
64 (b)

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.

66 (d)

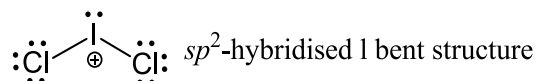
- (d) (a) $Cl-Be-Cl$ sp -linear
 - (b) $I_2 \leftarrow I^-$
- Lewis acid Lewis base

There are three lone-pairs and two bond-pairs in the outer-shell of central atom. To minimize repulsive forces, three lone pairs occupy the equatorial position



Thus, linear bond angle 180°

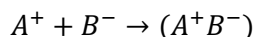
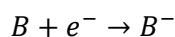
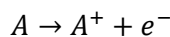
- sp -linear
↓
- (c) $S=C=S$
- (d) ICl_2



67 (a)

O_2 (16)
 $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_x)^2 (\pi 2p_y)^2 (\pi 2p_z)^2$
 Anti bonding M.O. has two unpaired electrons, hence, O_2 is paramagnetic

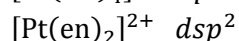
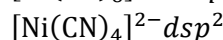
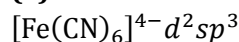
68 (a)



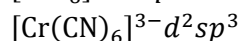
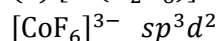
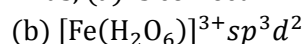
A^+ is formed when ionization energy of A is low

B^- is formed when electron affinity of B is high

69 (a)

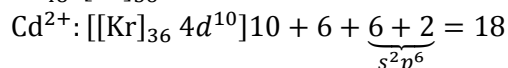
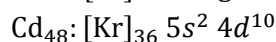
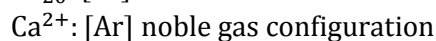
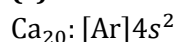


Thus, (a) is correct

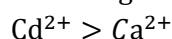


Thus, (b) is not correct

70 (c)



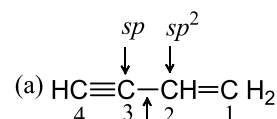
Electrons configuration of outer shell decreases screening effect, hence polarization of



71 (b)

Compounds which are insoluble in water have covalent bonds. Due to their low boiling points, there are highly volatile

72 (a)



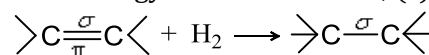
When $(C=C)$ bond and $(C \equiv C)$ bond are present, numbering is done from $(C=C)$ side. Thus, $(C_2 \sigma C_3)$ is formed by $(sp^2 - sp)$ overlapping

74 (b)

Only σ single bond one σ , one π one σ , two π triple

I double bond II bond III
 Both length $I > II > III$ Thus, (a) is correct

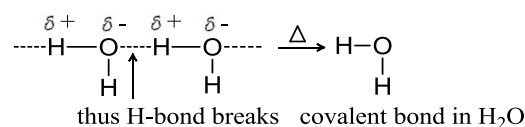
Both energy $I < II < III$ Thus, (c) is correct



π bond reacts than π bond is weaker than σ bond.

Thus, (b) is incorrect

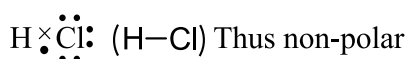
H_2O molecules are associated by H-bonding and thus making it liquid



Thus, (d) is correct

- 75 (c)
 Smaller the size of cation
 Larger the size of anion,
 Larger the charge,
 Larger the polarizing power and thus smaller the ionic character
 $\text{Li}^+ < \text{Mg}^{2+} < \text{Cs}^+$ size
 $+1 < +2$ charge
 $\text{F}^- < \text{Cl}^- < \text{I}^-$ size
 Thus, (c) has maximum ionic character

- 76 (a)
 H – Cl is formed by sharing of electron pair between H and Cl



Since, Cl is more electronegative than H, hence bonding pair is pulled by Cl making it polar



- 77 (a)
 $\text{Mg} \rightarrow \text{Mg}^{2+} + 2e^-$
 Mg^{2+} is formed by low (IE) of Mg
 $\text{O} + 2e^- \rightarrow \text{O}^{2-}$
 O^{2-} is formed by high (EA) of O

- 78 (a)
 (a) $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2 \leftrightarrow \overset{+}{\text{C}}\text{H}_2-\text{CH}=\text{CH}-\overset{-}{\text{C}}\text{H}_2$
 Due to resonance all (C – C) bond lengths are 1.46 Å (which is less than C – C bond and larger than C = C bond)

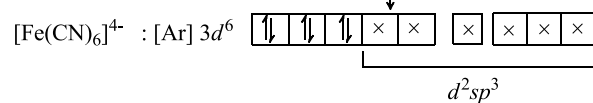
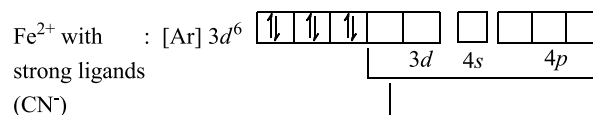
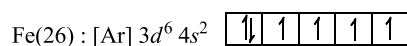
- 79 (d)
 For KO_2 , O_2^- has unpaired electron so, it is paramagnetic.
 $\text{O}_2^- (17)$
 $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2, (\sigma 2p_y^2 = \sigma 2p_z^2), \pi^* 2p_y^2 = \pi^* 2p_z^2$

- 80 (a)
 As two H atoms approach each, there is stable bond formation where P.E. is minimum as shown in (a)

- 81 (c)
 N and C (second period elements) lack *d*-orbitals. Hence, $p\pi - d\pi$ overlap would be present in PO_4^{3-}

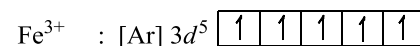
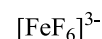
- 82 (b)
 $\text{I}^- + \text{I}_2 \rightarrow \text{I}_3^-$
 I^- is electron-pair donor thus is a Lewis-base
 I_2 is electron-pair acceptor thus it is a Lewis-acid
 $[\text{I}^- \rightarrow \text{I}_2]$

- 83 (d)

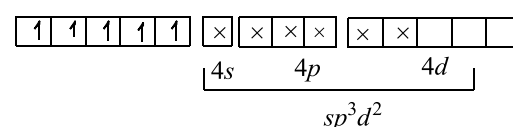
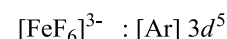


N (unpaired electron) = zero

Thus, magnetic moment = $\sqrt{N(N+2)}\text{BM} = 0$



Fe^{3+} with weak ligand (F^-) -no change-



N (unpaired electrons) = 5

Magnetic moment = $\sqrt{N(N+2)}\text{BM}$

$$= \sqrt{35}\text{BM} = 5.92 \text{ BM}$$

- 86 (a)

$$\mu = e \times l$$

$$e = \frac{\mu}{l} = \frac{1.2 \text{ D}}{1.0 \text{ \AA}} = \frac{1.2 \times 10^{-18} \text{ esu cm}}{1.0 \times 10^{-8} \text{ cm}}$$

$$= 1.2 \times 10^{-10} \text{ esu}$$

$$\text{Charge on electron} = 4.8 \times 10^{-10} \text{ esu}$$

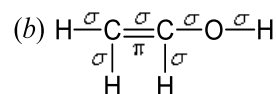
$$\text{Thus, fraction of charge} = \frac{1.2 \times 10^{-10}}{4.8 \times 10^{-10}} = 0.25$$

- 87 (d)

Covalency is in covalent compound and is equal to number of valence shell electron in *s*- and *p*-orbitals

Group	Examples	Valence electrons		Maximum covalency
		<i>s</i>	<i>p</i>	
13	B	2	1	3
14	Si	2	2	4
15	P	2	3	5
16	S	2	4	6
17	Cl	2	5	7

- 89 (b)



C – H bonds are always σ

- 90 (d)

A molecule is stabilized if

(a) bond order increases

(b) electron is removed from antibonding M.O. of

higher energy

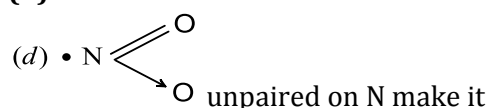
Electrons Bond order

C_2	12	2.0
C_2^+	11	1.5
CN	13	2.5
CN^+	12	2.0
N_2	14	3.0
N_2^+	13	2.5
O_2	16	2.0
O_2^+	15	2.5 (two electrons in anti

bonding M.O.)

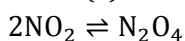
Thus, O_2^+ is stabilised

91 (d)



paramagnetic

Thus, (a) is correct



In N_2O_4 formation, unpaired electron is used.

Thus, paramagnetism is lost

Thus, (b) is correct

It is one coordinate bond. Thus, (c) is correct

There is no triple bond. Thus (d) is incorrect

92 (b)

(a) $NaBr \rightleftharpoons Na^+ + Br^-$ only ionic

(b) $Ba(CN)_2 \rightleftharpoons Ba^{2+} + 2CN^-$

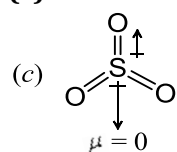
Ba^{2+} and CN^- are joined by ionic bond

CN^- has covalent bond $C \equiv N$

(c) PCl_5 only covalent

(d) CH_3CH_2OH only covalent

93 (c)



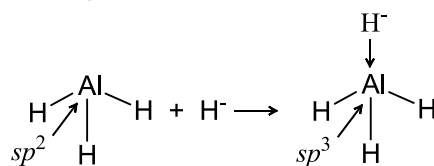
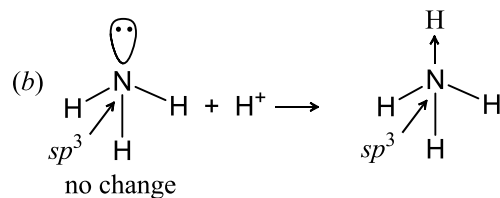
There is no lone pair on SO_3 and also molecule is symmetrical, hence dipole moment is zero

94 (d)

NH_3 } Trigonal pyramidal due to
 $N(CH_3)_3$ } $lp - bp$ repulsion (instead of tetrahedral)

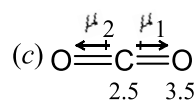
In $N[(Si(CH_3)_3)_3]$ structure is triangular planar as lone pair on N-atom is transferred to the empty d -orbitals of silicon ($p\pi - d\pi$ overlapping and its Lewis base character is lost. Thus, II, II, I

97 (b)



Thus, hybridization of Al is affected when AlH_3 changes to AlH_4^- hybridisation of Al changes from sp^2 to sp^3

98 (c)

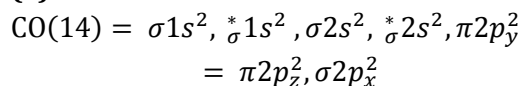


Based on (electronegativity) difference (C - O) bond is polar. But dipole moment of one (C - O) side is compensated by that of other (C - O) side

$$\mu_{\text{Total}} = \vec{\mu}_1 + \vec{\mu}_2$$

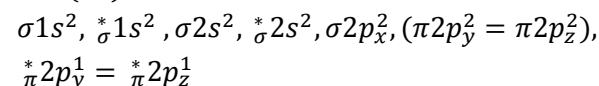
$$= \vec{\mu}_1 + \vec{\mu}_2 = 0$$

99 (a)



$$BO = \frac{N_b - N_a}{2} = \frac{10 - 4}{2} = 3$$

$NO^-(16) =$



$$BO = \frac{10 - 6}{2} = 2$$

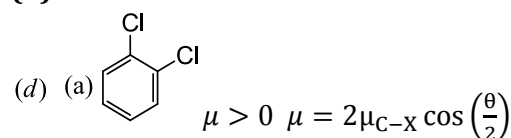
$NO^+(13); BO = 3$

$CN^-(14); BO = 3$

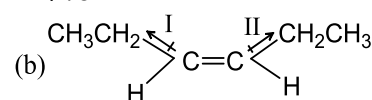
$N_2(14); BO = 3$

Hence, bond order of NO^- is different from that of CO.

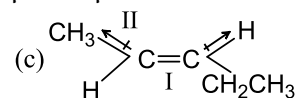
100 (d)



= +ve



$\mu > 0 \quad \mu = I + II$

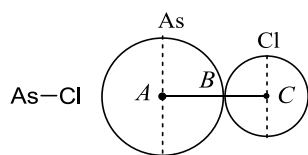
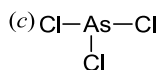


$\mu > 0 \quad \mu = I + II$

= +ve

(I > II)

101 (c)



$$AB + BC = AC$$

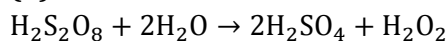
$$r_{\text{As}} + r_{\text{Cl}} = AC = 2.20$$

$$r_{\text{As}} + 0.99 = 2.20$$

$$r_{\text{As}} = 2.20 - 0.99 = 1.21 \text{ \AA}$$

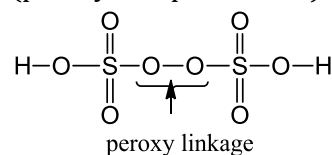
Oxygen has complete octet

103 (b)



H_2O_2 (with ($\text{O}^- - \text{O}^-$) linkage) is formed when $\text{H}_2\text{S}_2\text{O}_8$

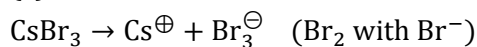
(peroxydisulphuric acid) is hydrolysed



104 (b)

Electronegativity of Cl is too low to form H-bonding

105 (c)



106 (d)

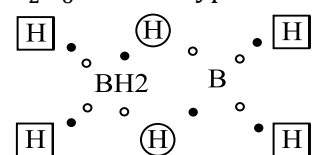
$$\text{Bond order} = \frac{N_B - N_A}{2} = \frac{10 - 4}{2} = 3$$

N_B = Electrons in bonding molecular orbital

N_A = Electrons in antibonding molecular orbital

107 (c)

B_2H_6 has two types of bonding

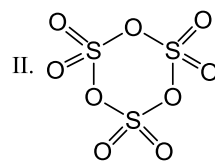
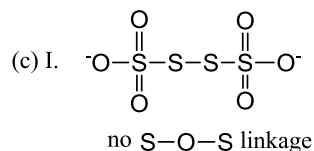


1. Formed by two electrons between B and H

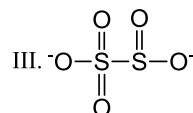
2. Formed by one electron between B and H

B-atom is thus electron-deficient

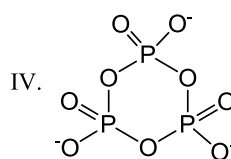
108 (c)



Three (S-O-S) linkages



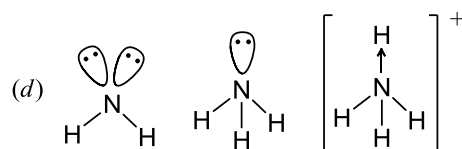
No (S-O-S) linkage



Three, (P-O-P) linkage

Thus, II and IV have X-O-X (X = S, P)

109 (d)



Repulsion $lp - lp$ $lp - bp$

$lp - bp > bp - bp > bp - bp$

$bp - bp$

Due to repulsion, bond angle decreases

Bond angle $\text{NH}_2^- < \text{NH}_3 < \text{NH}_4^+$

110 (b)

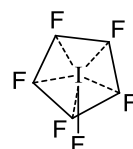
Na^+ is identical

$\text{Cl}^- \text{SO}_4^{2-} \text{PO}_4^{3-}$

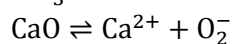
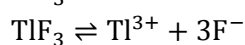
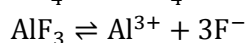
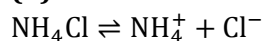
$\text{NaCl} > \text{Na}_2\text{SO}_4 > \text{Na}_3\text{PO}_4$ polar nature

111 (a)

IF_7 has pentagonal bipyramidal structure



112 (b)



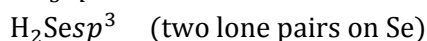
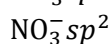
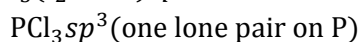
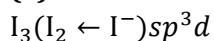
in (a) NH_4Cl is ionic

(b) all are covalent

(c) AlF_3 and TlF_3 are ionic

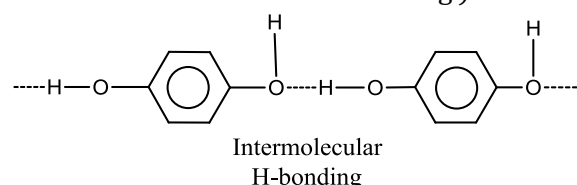
(d) CaO is ionic

114 (a)



115 (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.)



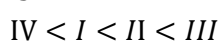
Order of H-bonding in *o*, *m* and *p*-isomers of a compound is given below

Intermolecular H-bonding, *o* < *m* < *p*-isomers

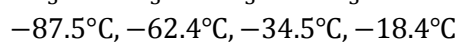
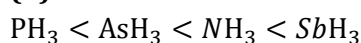
intermolecular H-bonding

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



116 (b)



There is association by H-bonding in NH_3 but molar mass of $SbH_3 \gg NH_3$ makes it highest boiling point liquid

117 (d)

Compound is covalent. Thus,

I: Incorrect

II: Correct

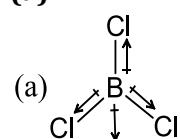
III. Incorrect, covalent compound does not dissolve in H_2O

IV: Correct

V: Correct

Thus, II, IV and V

118 (a)

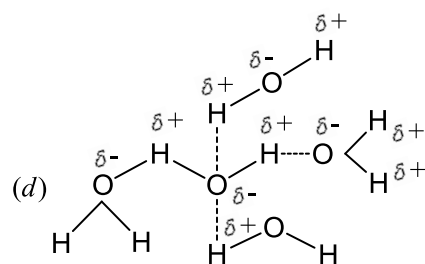


Resultant of two (B - Cl) is compensated by third

B - Cl. Thus $\mu = 0$

Thus, non-polar

119 (d)



Each water molecule is attached to four water molecules

120 (d)

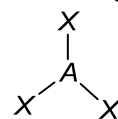
Atom *X* has complete octet and *Y* has three lone-pair and one (*X* - *Y*) bond. Thus,

X is C and *Y* is F

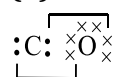
123 (a)

AX_3 has zero dipole moment. Thus, it has no lone pair. Thus, *A* is sp^2 -hybridised. Hence

Bond angle = 120°



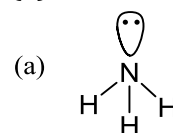
124 (b)



Oxygen can donate one electro pair to carbon

$$C \equiv O$$

125 (a)



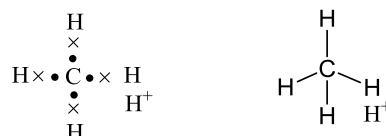
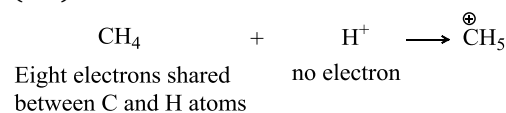
There is lone pair-bond pair repulsion

N-atom is sp^3 -hybridised. But due to this

repulsion, geometry is distorted to pyramidal and bond angle is 107°

126 (d)

Carbonium ion is formed when CH_4 adds proton (H^+)

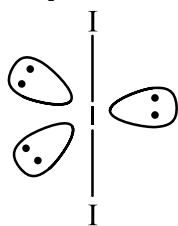


Eight electrons shared, thus (a) is correct

There is no empty orbital, thus (b) is correct octet complete, thus (c) is correct

127 (b)

are present.

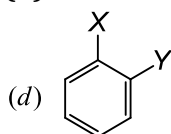


Linear shape

146 (c)

1. $\text{Cr}(\text{CO})_6$: $24 + 12 = 36$
2. $\text{Fe}(\text{CO})_5$: $26 + 10 = 36$
3. $\text{V}(\text{CO})_6$: $23 + 12 = 35$ (electron deficient)

147 (d)



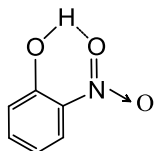
$$\text{Resultant } \mu = 2\mu' \cos\left(\frac{\theta}{2}\right)$$

μ' is the vector moment of the groups X and Y at ortho position

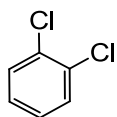
$$\pi \propto \cos\left(\frac{\theta}{2}\right)$$

$$\mu \propto \frac{1}{\theta}$$

Repulsion increases θ , hence μ decreases
attraction decreases θ , hence μ increases



By intramolecular H-bonding in *o*-nitrophenol, θ decreases, hence μ increases



Due to dipole-dipole repulsion of large Cl groups (steric effect) θ increases, hence μ decreases

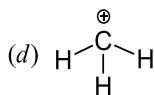
Thus, μ is maximum when $X = \text{NO}_2$

$Y = \text{OH}$

And μ is minimum when $X = \text{Cl}$

$Y = \text{Cl}$

148 (d)

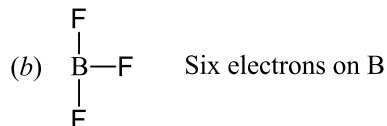


(a) planar, one empty *p*-orbital of carbon is present – correct

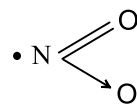
(b) thus (C – H) σ bonds – correct

(c) octet of carbon is incomplete – correct

150 (b)



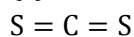
Six electrons on B



Seven electrons on N

Thus, B, Be and N are electron-deficients

153 (c)



Non-polar

154 (a)

Smaller size of cation

Larger the size of anion

Larger the charge on cation and anion, larger the polarizing power and thus larger the covalent nature and such compounds have larger lattice energy

(a) $\text{K}^+ > \text{Mg}^{2+}$ size

+1 + 2 charge

$\text{Cl}^- > \text{O}^{2-}$ size

-1 < 2- charge

Thus, MgO is less ionic than KCl thus lattice energy of MgO is larger than that of KCl

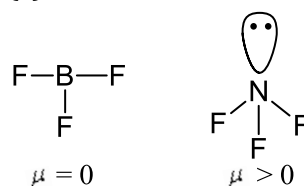
Thus, given order is incorrect

(b) $\text{AlN} > \text{MgO}$ correct

(c) $\text{CaO} > \text{BaO}$ correct

(d) $\text{MgCO}_3 > \text{CaCO}_3$ correct

155 (c)



Resultant dipole Due to lone pair

Moment is zero, on N, NF_3 is polar

Thus non-polar

156 (a)

$\text{Ni}(\text{CO})_4$: dsp^2 square planar

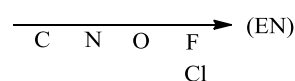
SF_4 : sp^3d (one lone pair on S)

$[\text{CoCl}_4]^{2-}$: sp^3 tetrahedral

XeF_4 : sp^3d^2 square planar but two lone pairs

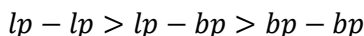
157 (c)

Bond is most polar if electronegativity (EN) difference is maximum



158 (b)

Repulsion is in order



161 (c)

High solubility of $MgSO_4$ is due to high enthalpy of hydration of the smaller Mg^{2+} ion which overcomes the lattice energy factor

163 (a)

It is a case of sp^3d^2 or d^2sp^3 hybridisation with octahedral geometry

164 (b)

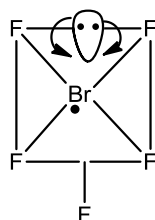
IE of Cl < IE of F thus Cl^+ is formed

EA of Cl > EA of F. It is due to screening effect. F^- is predominantly formed due to greater electronegativity of F. thus, Cl^+F^-

165 (a)

In BrF_5 number of electrons = 6

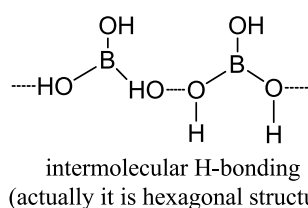
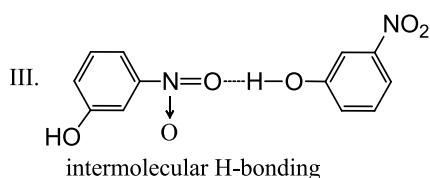
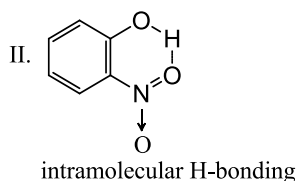
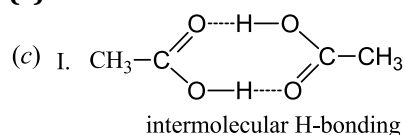
(1 lp + 5 bp)



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° .

168 (c)

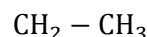
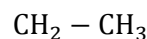
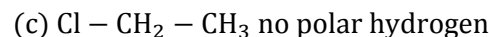
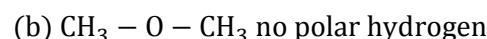
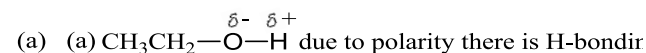


Thus, I, III and IV have intermolecular H-bonding.

(actually it is hexagonal structure)

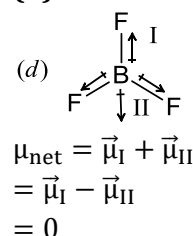
Thus, I, III and IV have intermolecular. H-bonding

169 (a)

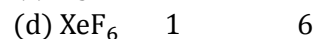
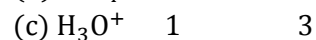
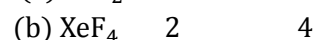
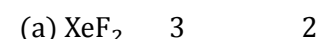
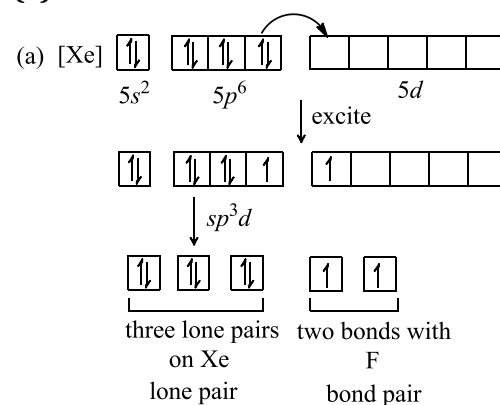


Thus, there is H-bonding in ethanol only

170 (d)



171 (a)

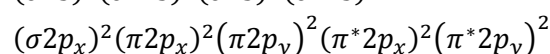
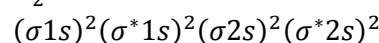


172 (b)

Based on formal charges, II and III make greater contributions than I

173 (c)

$O_2^{2-} = 18$ electrons



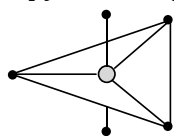
Underlined orbitals are antibonding M.O

Total = 4

174 (b)

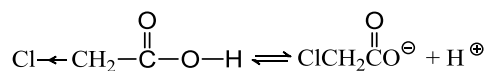
Three bond pairs are inclined at 120° with one each other, and the other two bond pairs are at 90° with first three, thus structure is: Trigonal

bipyramidal (as in PCl_5)

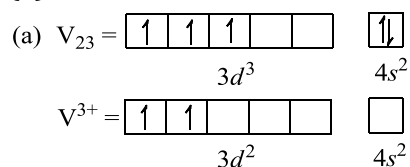


175 (d)

- (a) High boiling point of H_2O is due to intermolecular H-bonding
 (b) Glycerol molecules are associated by H-bonding making it viscous
 (c) NH_3 molecules are joined to H_2O molecules by H-bonding, making it water soluble
 (d) Cl-atom withdraws electron by induction, hence acid is ionized making it polar



176 (a)

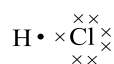


H_2O is a weak ligand hence no pairing of electrons

177 (c)

- sp^3 – tetrahedral 109.5°
 sp^2 – triangular 120°
 sp – linear 180°
 $\text{CH}_3 - \text{C} \equiv \text{C} - \text{CH}_3$

179 (a)

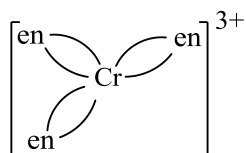


Valence electron in H = 1
 Valence electrons in Cl = 7

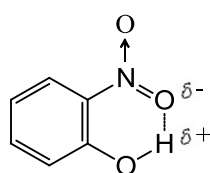
180 (c)

Chelation is associated with ring formation. It can happen when

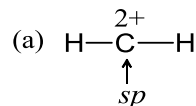
- (a) ligand is bidentate as en $\begin{pmatrix} \text{CH}_2\text{NH}_2 \\ | \\ \text{CH}_2\text{NH}_2 \end{pmatrix}$



- (b) intramolecular H-bonding is formed



181 (a)



CH_2 with incomplete octet of carbon is shortlived and has sp -hybridisation on carbon.

Linear

182 (c)

For $\text{Be}_n\text{Al}_2\text{Si}_6\text{O}_{18}$

$$2n + 6 + 24 - 36 = 0$$

$$n = 3$$

183 (c)

Element	Valence electron	Probable group
A	1	Group 1 (alkali metal)
B	3	Group 13 (boron family)
C	5	Group 15 (nitrogen family)

A can lose electron easily, thus is involved in ionic bond. B with three valence electrons (as Al) can form ionic compound with element of the type C with five electrons (as N). B and C together will not form ionic compound.

184 (c)

Species	Electrons	Bond order	Unpaired electron
O – F	17	1.5	1

paramagnetic

F_2 18 1.0 0 diamagnetic

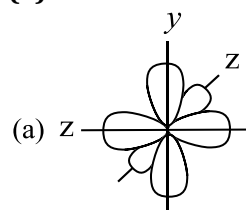
There is one unpaired electron in (O – F), hence paramagnetic, thus (a) is correct

Bond order of O – F > F – F

Thus, bond energy of O – F > F – F

Thus, (b) is correct

185 (a)

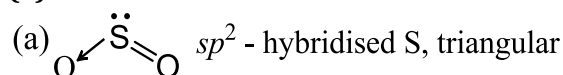


p_y and p_z overlap laterally forming π bonds

186 (a)

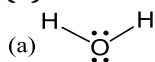
$s - s > s - p > p - p$

188 (a)



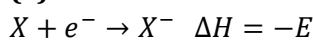
HCN , CO_2 and NO are linear

189 (a)



Bent geometry two (O – H) bonds and two lone-pairs

190 (a)

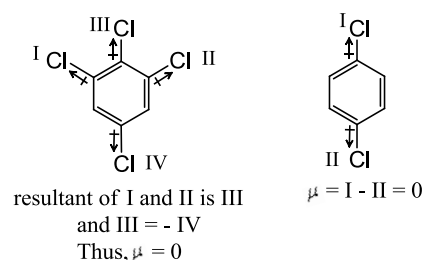
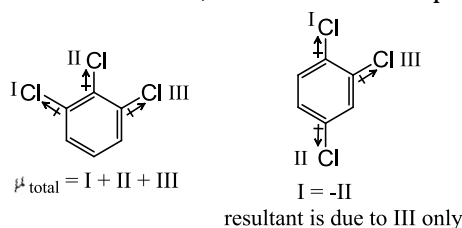


Where E is electron affinity

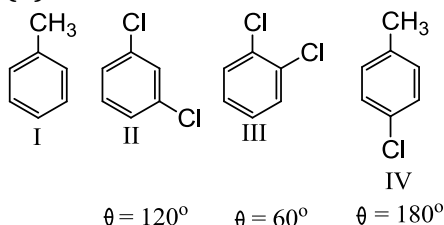
X^- is formed when size is small and X has high electron affinity

191 (a)

Resultant moment is in one direction in 1,2,3-trichlorobenzene, thus maximum dipole moment



192 (b)



$$\mu = 2\mu_{C-X} \cos\left(\frac{\theta}{2}\right)$$

$$\mu \propto \cos\left(\frac{\theta}{2}\right)$$

$$\mu \propto \frac{1}{\theta} \text{ (since as } \theta \text{ increases, } \cos \theta \text{ decreases)}$$

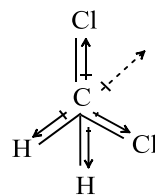
$$\text{Thus, } \mu_{IV} = 0 \left(\cos \frac{180^\circ}{2} = \cos 90^\circ = 0 \right)$$

and order being

$$\mu_{IV} < \underbrace{\mu_I}_{\text{single}} < \underbrace{\mu_{II} < \mu_{III}}_{\text{vector summation}} \quad (\text{C-CH}_3)$$

193 (b)

CH_2Cl_2 is similar to CH_4 (tetrahedral) but it has three different bond angles, HCH, HCCl, ClCCl which are close to but not equal to 109.5° . Since, electroegativity of $\text{Cl} > \text{C} > \text{H}$, the bond moments do not cancel and the molecule has a dipole moment



194 (a)

B_2 : Total electrons = 10

Configuration : $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^1 = \pi 2p_y^1$

If Hund's rule is violated, then

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2 = \pi 2p_y^0$

So, diamagnetic

$$\text{Bond order} = \frac{6-4}{2} = 1$$

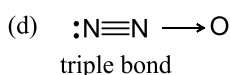
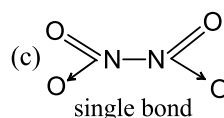
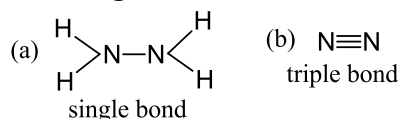
195 (a)

Greater the resonating structure, greater the stability NO_3^- (with negative charge) has greater delocalization of π electrons thus more resonating structures similarly HCOO^-

196 (b)

Bond order $N \equiv N > N = N > N - N$

Bond length $\xrightarrow{\text{minimum maximum}}$



Bond length is in order

(b) < (d) < (a) < (c)

In (d), resonance increases bond length

In (c), dimer formation is due to unpaired electrons. Hence, dipole-dipole repulsion increases bond length than single-bond

198 (b)

Greater the bond order, greater the bond energy

Bond order

(a) O_2^- 1.5

(b) O_2^+ 2.5

(c) O_2 2.0

(d) O_2^{2-} 1.0

199 (b)

Ether is a non-polar solvent (covalent) like dissolves likes (covalent) like dissolves likes (covalent)

Smaller the size of cation larger the charge, larger the polarizing power and thus larger the covalent nature of the compound with that cation (Cl^-)

being common)

Size of $\text{Li}^+ < \text{Na}^+$

Thus, LiCl is predominantly covalent

LiCl and AlCl_3 thus will be extracted into ether

200 (d)

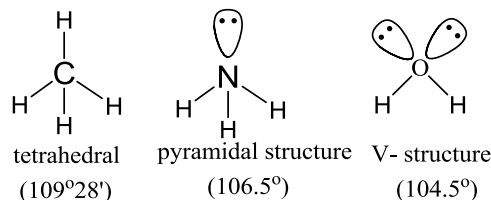
BF_3 and NH_3 are joined by coordinate bond in which NH_3 is a Lewis base and BF_3 is a Lewis acid. They have therefore independent existence and thus separated

202 (b)

Greater the electronegativity, greater the polar character. Electronegativity of $\text{F} > \text{O} > \text{N} > \text{S}$
Thus, $\text{H}_2\text{S} < \text{NH}_3 < \text{H}_2\text{O} < \text{HF}$

203 (b,c)

The central atom in each of three molecules CH_4 , NH_3 and H_2O undergoes sp^3 hybridisation. In CH_4 no lone pair is present. In NH_3 one lone pair is present while in water two lone pairs are present



226 (a,c)

(i) NO → Total valence electrons = 11

MO- configuration

=

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

$$\text{Bond order} = \frac{1}{2}(8 - 3) = 2.5$$

(ii) NO^+ → Total valence electrons = 10

MO-configuration

$$= (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_x)^2 (\pi 2p_y)^2 (\pi 2p_z)^2$$

$$\text{Bond order} = \frac{1}{2}(8 - 2) = 3.0$$

(iii) NO^{2+} → Total valence electrons = 9

MO-configuration

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

$$\text{Bond order} = \frac{1}{2}(7 - 2) = 2.5$$

(iv) NO^- → Total valence electrons = 12

MO-configuration

=

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

$$\text{Bond order} = \frac{1}{2}(8 - 4) = 2.0$$

229 (a,b,d)

The four P atoms in P_4 molecule are situated at the corners of tetrahedron. There are six $p-p$ single bonds with $p-p-p$ bond angle of 60° . Each P has a lone pair of electrons

260 (a,c,d)

From the molecular orbital theory, the number of unpaired electrons is zero. Hence, they are diamagnetic

271 (a,b,d)

Geometry of a molecule can be predicted if the state of hybridization at central atom is known
(i) H_2O → Number of σ -bonds at O-atom = 2

Number of lone pair of electrons at O atom = 2

$$\text{Total} = 2 + 2 = 4$$

Hybridisation is sp^3

Thus, the shape is angular of V-shaped

(ii) NH_3 → Number of σ -bonds at N atom = 3

Number of lone pair of electrons at N atom = 1

$$\text{Total} = 3 + 1 = 4$$

Hybridisation is sp^3

Shape is trigonal pyramidal (not tetrahedral)

(iii) BCl_3 → Number of σ -bonds at B atom = 3

Number of lone pair of electrons at B atom = 0

$$\text{Total} = 3$$

Hybridisation is sp^2

BCl_3 is trigonal planar

(iv) BeCl_2 → Number of σ -bonds at Be atom = 2

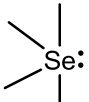
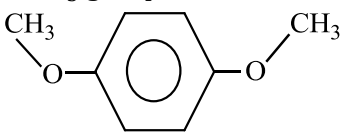
Number of lone pair of electrons at Be atom = 0

$$\text{Total} = 2 + 0 = 2$$

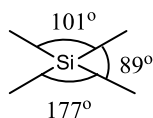
Hybridisation = sp

BeCl_2 is linear and bond angle is 180°

273 (a)

- A substance is said to be insoluble in water if it does not form hydrogen bonding with water. Alkanes, alkenes and ethers are insoluble in water
- 274 (a)
Energy level of 2s is lesser than 2p-orbital.
- 275 (a)
Ionisation enthalpy is the energy required to remove an electron from an isolated gaseous atom in its ground state. It is always positive.
- 277 (b)
N shows maximum covalence of +3 along with one coordinate bond whereas P shows maximum covalence of +5 due to given explanation.
- 278 (b)
NaCl is more ionic than NaI because Cl^- is less polarised in comparison to I^- .
- 279 (b)
The dipole moment of NH_3 is more than NF_3 because of the given explanation.
- 280 (b)
In sp^2 -hybridisation bond angle is 120° . In sp^3 it is $109^\circ 28'$.
- 281 (a)
With increase in bond order, bond length decreases and hence, bond energy increases.
- 282 (d)
The bond angle in H_2S is smaller because S atom has bigger size than O. Also H_2S does not show H-bonding.
- 283 (c)
Explanation is correct reason for statement.
- 284 (b)
Molecules having polar bonds may (e.g., ClF_3 polar) or may not (e.g., BF_3) have dipole moment. The resultant vector of bond moment decides the net dipole moment in molecule.
- 285 (d)
In spite of higher lattice energy AgF is soluble because F^- is extensively hydrated and heat of hydration predominates over lattice energy.
- 286 (a)
Electrovalent bond is not possible between similar atoms. This type of bonding requires two atoms of different nature, one atom should have the tendency to lose electrons *ie*, electropositive
- 287 (c)
Explanation is correct reason for statement.
- 289 (c)
Explanation is correct reason for statement.
- 290 (c)
Removal of electron from N atom requires more energy due to half filled p-orbital in N atom.
- 291 (c)
 SeCl_4 has see-saw geometry *ie*, distorted trigonal pyramidal geometry. In SeCl_4 , Se is sp^3d hybridised.
- 
- 292 (a)
p-dimethoxy benzene is polar due to orientation of CH_3 group as, The resultant vector is not zero.
- 
- 293 (c)
 LiCl is polar compound. In a period, we go from left to write the electronegativity increases. Li is a LA group element Cl is VIIA group element. So, the electronegativity difference is so large.
- 294 (a)
 $lp - lp > lp - bp > bp - bp$.
- In NH_3 the three N - H bond pairs are pushed close because of the lone pair-bond pair repulsion and HNH bond angle gets reduced from $109^\circ 28'$ to 107° .
- 295 (c)
Explanation is correct reason for statement.
- 296 (b)
Halogens can have only EA_1 value because they can accommodate only one electron ($ns^2 np^5$ to $ns^2 np^6$): No scope for further addition, thus EA_2 for halogens is zero.
- 297 (b)
Aqueous HF mainly exists as H_3O^+ and F^- because HF is more acidic than H_2O .
- 298 (a)
The values of dipole moments provide valuable information about the structure of molecules
- 299 (a)
Electron affinity of F < Electron affinity of Cl. Due to more 2p-test electron repulsion in F atom.

- 300 (c)
Explanation is correct reason for statement.
- 301 (d)
Assertion is an experimental fact observed against Le Chatelier principle.
- 302 (b)
That is why $\mu_{\text{NH}_3} > \mu_{\text{NF}_3}$.
- 303 (b)
Both *cis*- and *trans*-forms are polar. *Trans* is more polar due to higher value of dipole moment due to additive nature of CH_3 and Cl vectors.
- 304 (c)
Fluorine is highly reactive because $\text{F}-\text{F}$ bond has low bond dissociation energy
- 305 (d)
 BF_3 is planar due to sp^2 -hybridisation. Also in BF_3 , three bond pair on boron atom and 9 lone pairs of electrons on F atoms.
- 306 (c)
Explanation is correct reason for statement.
- 307 (b)
This is Fajans' rule. FeCl_3 is more covalent.
- 308 (c)
Explanation is correct reason for statement.
- 309 (c)
Explanation is correct reason for statement.
- 310 (d)
 SF_4 has see-saw shape. It has non planar structure. In this structure bond angles are different between different $\text{S}-\text{F}$ atoms.
According to VSEPR theory - $lp-lp > lp-bp > bp-bp$.



- 311 (b)
Solid ionic compounds conduct current only in fused state. PCl_5 in solid state exists as $[\text{PCl}_6]^- [\text{PCl}_4]^+$.
- 312 (a)
P in PCl_3 is sp^3 -hybridised; $\text{P}-\text{Cl}$ bond is sp^3-p bond.
P in PCl_5 is $sp^3 d$ -hybridised; $\text{P}-\text{Cl}$ bond is $sp^3 d-p$ bond.
- 313 (b)
The elements having vacant *d*-orbitals in their valency shell show variable covalency by increasing the number of unpaired electrons

under excited conditions

- 317 (d)
 $\text{PCl}_5 = sp^3 d$ (Trigonal pyramidal)
 $\text{IF}_7 = sp^3 d^3$ (Pentagonal bipyramidal)
 $\text{H}_3\text{O}^+ = sp^3$ (Pyramidal)
 $\text{ClO}_2 = sp^2$ (Angular) bond length are shorter than single bond due to resonance.
 $\text{NH}_4^+ = sp^3$ (Tetrahedral)
- 320 (c)
 $\text{ICl}_2^- \Rightarrow 2bp + 3lp$ (thus, $sp^3 d$ hybridization)=linear geometry
 $\text{BrF}_2^+ \Rightarrow 2bp + 2lp$ (thus, sp^3 hybridisation)=angular geometry
 $\text{ClF}_4^- \Rightarrow 4bp + 2lp$ (thus, $sp^3 d^2$ hybridisation) = square planar geometry
 $\text{AlCl}_4^- \Rightarrow 4bp + 0lp$ (thus sp^3 hybridisation) = tetrahedral geometry
- 323 (a)
Ethane CH_3-CH_3 $2sp^2$ hybrid carbon
Ethylene $\text{CH}_2=\text{CH}_2$ $2sp^2$ hybrid carbon
Acetylene $\text{CH}\equiv\text{CH}$ $2sp$ hybrid carbon

326 (b)

List I (Compound)	List II (Structure)
4. ClF_3	1. T-Shaped
5. PCl_5	2. Trigonal bipyramidal
6. IF_5	3. Square pyramidal
7. CCl_4	4. Tetrahedral
8. XeF_4	5. Square planar

328 (a)

Molecule /ion	Type of hybridisation
A. NH_4^+	r. sp^3
B. PCl_5	q. $sp^3 d$
C. SF_6	s. $sp^3 d^2$
D. IF_7	p. $sp^3 d^3$

330 (d)

XeO_3 (sp^3 hybridisation)
= contain a lone pair

= trigonal pyramidal 342 (b)

shape

XeOF₄ (*sp*³ *d* hybridisation) = one lone pair
= pyramidal shape

BO₃³⁻ (*sp*² hybridisation) = planar triangular

ClF₃ (*sp*³ *d*² hybridisation)

= two lone pair

= T shaped

I₃⁻ (*sp*³ *d* hybridisation) = 3 lone pair = linear

331 (c)

Polarity character is due to the difference in electronegativity of two atoms of molecule

332 (c)

In NH₃ nitrogen has one lone pair of electron

$$\mu_m = \vec{\delta} \times d$$

$$0.816 \times 10^{-18} = \delta \times 10^{-8}$$

$$\therefore \delta = 0.816 \times 10^{-10} \text{ esu}$$

$$\therefore \% \text{ ionic character} = \frac{0.816 \times 10^{-10}}{4.803 \times 10^{-10}} \times 100 = 16.9\%$$