Chemical Bonding (Part-A)

JEE (Main) Exercises

Single Correct Answer Type

1. Compare bond angles for the following molecules:

(a) \( x > y \)
(b) \( y > x \)
(c) \( x = y \)
(d) None of these

2. Compare bond lengths for the following molecules:

(a) \( x > y \)
(b) \( y > x \)
(c) \( x = y \)
(d) None of these

3. Compare bond lengths for the following molecules:

(a) \( x > y \)
(b) \( y > x \)
(c) \( x = y \)
(d) None of these

4. Compare \( x \) and \( y \) bond lengths for the above given molecules:

(a) \( x > y \)
(b) \( y > x \)
(c) \( x = y \)
(d) None of these

5. Compare \( x \) and \( y \) bond lengths for the above given molecules:

(a) \( x > y \)
(b) \( y > x \)
(c) \( x = y \)
(d) None of these

6. Compare \( x \) and \( y \) bond lengths for the above given molecule:

(a) \( x > y \)
(b) \( y > x \)
(c) \( x = y \)
(d) None of these

7. Which of the following silicate is called pyroxene?
(a) Orthosilicate
(b) Pyrosilicate
(c) 2D silicate
(d) Single-chain silicate

8. Which of the following silicate is called amphibole?
(a) Single-chain silicate
(b) Double-chain silicate
(c) 2D silicate
(d) Cyclic silicate
9. Which of the following silicate is called disilicate? 
(a) Orthosilicate  (b) Pyrosilicate 
(c) Single-chain silicate  (d) None of these

10. Select the correct diagram for the \( \pi^* 2p_y \) orbital:
(a) \[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]
(b) \[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]
(c) \[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]
(d) None of these

11. Select the correct diagram for the \( \sigma 2p_x \) orbital:
(a) \[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]
(b) \[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]
(c) \[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]
(d) None of these

12. Nature of \( \text{O}_2 \) molecule is:
(a) Paramagnetic  (b) Diamagnetic 
(c) Both (a) and (b)  (d) None of these

13. Which of the following has the highest boiling point? 
(a) \( \text{Ne} \)  (b) \( \text{He} \) 
(c) \( \text{CH}_4 \)  (d) \( \text{Xe} \)

14. The cationic part of solid \( \text{XeF}_6 \) is having the “____” shape:
(a) Linear  (b) Angular 
(c) Square pyramidal  (d) Tetrahedral

15. Compare \( x \) and \( y \) bond angles in the following molecule:
\[
\begin{array}{c}
\text{O} \\
\text{C} \\
\text{F}
\end{array}
\]
(a) \( x > y \)  (b) \( y > x \) 
(c) \( x = y \)  (d) None of these

16. A metal oxide is acidic when:
(a) \( \sqrt{\varphi} < 2.1 \)  (b) \( \sqrt{\varphi} = 2.1 \) to 3.2 
(c) \( \sqrt{\varphi} > 3.2 \)  (d) None of these

17. Find out the similarities between \( \text{I}_2\text{Cl}_5 \) and \( \text{Al}_2\text{Cl}_6 \):
(a) Both have 3C = 4\(^-\) bond 
(b) Both have \( sp^3 \)-hybridization for the central atom 
(c) Both are nonplanar 
(d) All are correct

18. Which of the following set has the same bond order? 
(a) \( \text{N}_2, \text{O}_2^-, \text{NO}^+, \text{CN}^- \)  (b) \( \text{N}_2^+, \text{O}_2, \text{NO}^-, \text{NO}_2^- \) 
(c) \( \text{NO}, \text{N}_2, \text{O}_2, \text{NO}^2+ \)  (d) All are correct

19. In the hydrolysis of \( \text{ICl} \), the products are:
(a) \( \text{HI} + \text{HCl} \)  (b) \( \text{H}_2 + \text{HOCl} \) 
(c) \( \text{HCl} + \text{HOI} \)  (d) \( \text{HOCl} + \text{HOI} \)

20. Which of the following geometry is not possible when the central atom is having \( sp^3d \)-hybridization? 
(a) TBP  (b) Trigonal planar 
(c) Linear  (d) T-shaped

21. Select the correct statement:
(a) If molecule has any polar bond, then it is always polar 
(b) Solubility of noble gases increases in water down the group when their size increases because London dispersion force increases 
(c) First ionization energy of \( \text{Al} \) is greater than that of gallium 
(d) \( \text{XeF}_6 \) has distorted octahedral geometry

22. Which is the correct order for different forces? 
(a) \( E_D \) (Dipole–induced dipole interaction) > \( E_K \) (Dipole–dipole interaction) > \( E_L \) (London force) 
(b) \( E_K \) (Dipole–dipole interaction) > \( E_D \) (Dipole–induced dipole interaction) > \( E_L \) (London force) 
(c) \( E_D \) (Dipole–induced dipole interaction) > \( E_K \) (Dipole–dipole interaction) > \( E_L \) (London force) 
(d) All forces are equally strong

23. Which of the following compounds are the common product/s obtained in the hydrolysis of \( \text{XeF}_6 \) and \( \text{XeF}_4 \)? 
(a) \( \text{XeO}_2 \text{F}_2 \)  (b) \( \text{HF} \) 
(c) \( \text{XeO}_3 \)  (d) Both (b) and (c)

24. Which of the following statement is incorrect for \( \text{CO} \) molecule? 
(a) Intramolecular Lewis acid–base interaction is present 
(b) Charge separation is present 
(c) \( \sigma \)-bonds, \( \pi \)-bonds, and back-bond all are present together 
(d) Direction of dipole moment is from C to O

25. Find the incorrect match:
(a) \( \text{Al}_2\text{Cl}_6 \) : 3C–4\(^-\) bond is present 
(b) \( \text{Al}_2(\text{CH}_3)_6 \) : All carbon atoms are \( sp^3 \)-hybridized 
(c) \( \text{I}_2\text{Cl}_6 \) : Nonplanar 
(d) \( \text{Al}_2\text{Br}_6 \) : Nonpolar
26. Which the following interaction form nonbonding molecular orbital when z-axis is the bonding axis?
(a) $d_{x} + d_{y}$
(b) $d_{x} + d_{x}$
(c) $d_{x} - d_{y}$
(d) All form N.B.M.O.

27. Which of the following molecule/species is polar?
(a) O$_2$
(b) NO$_2^+$
(c) Para-dichlorobenzene
(d) None of these

28. Which of the following is most covalent?
(a) CuCl
(b) NaCl
(c) AgCl
(d) AuCl

29. When NF$_3$ undergoes hydrolysis at room temperature, then the product will be:
(a) HNO$_2$
(b) N$_2$O$_3$
(c) NO + NO$_2$
(d) None of these

30. Select the incorrect order:
(a) Thermal stability : LiNO$_3$ < NaNO$_3$ < KNO$_3$
(b) Solubility : LiNO$_3$ < NaNO$_3$ < KNO$_3$
(c) Thermal stability : Be(OH)$_2$ < Ca(OH)$_2$ < Sr(OH)$_2$
(d) Solubility : Be(OH)$_2$ < Ca(OH)$_2$ < Sr(OH)$_2$

31. Which of the following does not contain three electron bond?
(a) ClO$_2$
(b) CO$_2$
(c) O$_2^-$
(d) NO

32. Which of the following ions is diamagnetic?
(a) N$_2^+$
(b) O$_2^-$
(c) Be$_2^+$
(d) NO$^+$

33. Which of the following is not an electron-deficient compound?
(a) BeEt$_2$
(b) AlMe$_3$
(c) B$_2$H$_6$
(d) Si(CH$_3$)$_4$

34. The BCl$_3$ is a planar molecule, whereas NCl$_3$ is a pyramidal because:
(a) N — Cl bond is more covalent bond than B — Cl bond
(b) B — Cl bond is more polar than N — Cl bond
(c) Nitrogen atom is similar to boron atom
(d) BCl$_3$ has no lone pair but NCl$_3$ has a lone pair or electrons

35. Which of the following molecule has the largest bond angle?
(a) BF$_3$
(b) NH$_3$
(c) CO$_2$
(d) SF$_6$

36. Which compound possesses the greatest lattice energy?
(a) LiBr
(b) LiCl
(c) LiF
(d) LiF

37. 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

38. Which of the following molecular species has unpaired electron(s)?
(a) N$_2$
(b) F$_2$
(c) O$_2$
(d) O$_2^-$

39. Covalent compounds have low melting points because:
(a) Covalent molecules have definite shape
(b) Covalent bond is weaker than ionic bond
(c) Covalent bond is less exothermic
(d) Covalent molecules are held by weak van der Waals forces of attraction

40. Which of the following has a zero dipole moment?
(a) ClF
(b) PCl$_3$
(c) SiF$_4$
(d) CFCl$_3$

41. The bond order of O$_2^-$ is:
(a) 1
(b) 1.5
(c) 2.5
(d) 3

42. In which of the following species is the underline carbon having $sp^3$-hybridization?
(a) CH$_3$ — COOH
(b) CH$_3$ — CH$_2$ — OH
(c) CH$_3$ — CO — CH$_3$
(d) CH$_2$ = CH — CH$_3$

43. A square planar complex is formed by hybridization of which atomic orbitals?
(a) s, p$_x$, p$_y$, d$_z$
(b) s, p$_x$, p$_y$, d$_{z^2}$
(c) s, p$_x$, p$_y$, d$_{xy}$
(d) s, p$_x$, p$_y$, d$_{xy}$

44. Which of the following compound has the smallest bond angle?
(a) SH$_2$
(b) NH$_3$
(c) SO$_2$
(d) OH$_2$

45. Which of the following statement is not correct for sigma and pi-bonds formed between two carbon atoms?
(a) A sigma bond is stronger than a pi-bond
(b) Bond energies of sigma and pi-bonds are of the same order
(c) Free rotation of atoms about a sigma bond is allowed but not in case of a pi-bond
(d) A sigma bond determines the direction between carbon atoms, but a pi-bond has no primary effect in this regard

46. Number of covalent bonds in MgH₂ is:
(a) Zero (b) 1 (c) 2 (d) 4

47. Only iodine forms heptafluoride IF₇, but chlorine and bromine give pentfluorides. The reason for this is:
(a) Low electron affinity of iodine
(b) Unusual pentagonal pyramidal structure of IF₇
(c) That the larger iodine atom can accommodate more number of smaller fluorine atom around it
(d) Low chemical reactivity of IF₇

48. Based on lattice energy and other considerations which one of the following alkali metal chloride has the highest melting point?
(a) KCl (b) RbCl (c) LiCl (d) NaCl

49. Which of the following cannot exist on the basis of M.O. theory?
(a) C₂ (b) He₂⁺ (c) H₂⁺ (d) He₂

50. Which of the following has fractional bond order?
(a) O₂²⁻ (b) O₂²⁺ (c) F₂⁻ (d) H₂⁺

51. The correct order of a dipole moment is:
(a) CH₄ < NF₃ < NH₃ < H₂O
(b) NF₃ < CH₄ < NH₃ < H₂O
(c) NH₃ < NF₃ < CH₄ < H₂O
(d) H₂O < NH₃ < NF₃ < CH₄

52. In water molecule, oxygen is:
(a) sp-hybridized (b) sp³-hybridized (c) sp²-hybridized (d) None of these

53. According to Fajan’s rule, ionic character increases for:
(a) Large cation and small anion
(b) Small cation and small charge on cation
(c) Small cation and large charge on cation
(d) Large cation and no charge on cation

54. Which one of the following order is not in accordance with the property stated against it?
(a) F > Cl > Br > I: Electronegativity
(b) F₂ > Cl₂ > Br₂ > I₂: Bond dissociation energy
(c) F₂ > Cl₂ > Br₂ > I₂: Oxidizing power
(d) HI > HBr > HCl > HF: Acidic property in water

55. The species having octahedral shape is:
(a) SF₆ (b) BF₃ (c) PCl₃ (d) BO₂⁻

56. Which one of the following sets of ions represent a collection of isoelectronic species?
(a) K⁺, Cl⁻, Ca²⁺, Sc³⁺
(b) Ba²⁺, Sr²⁺, K⁺, Ca²⁺
(c) N³⁻, O²⁻, F⁻, S²⁻
(d) Li⁺, Na⁺, Mg²⁺, Ca²⁺

57. Which of the following molecules/ions are all the bonds not equal?
(a) SF₄ (b) SiF₄ (c) XeF₄ (d) BF₃

58. The decreasing values of bond angles from NH₃ (107°) to SbH₃ (91°) down the group-15 of the periodic table is due to:
(a) Increasing s-p repulsion
(b) Increasing p-orbital character in sp³
(c) Decreasing s-p repulsion
(d) Increasing electronegativity

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

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

61. In compound X, all the bond angles are exactly 109°28'. X is:
(a) Chloroform (b) Iodoform (c) Carbon tetrachloride (d) Chloroform

62. The correct order of bond angle is:
(a) PF₃ > PCl₃ > PBr₃ > PI₃
(b) PF₃ > PBr₃ > PCl₃ > PI₃
(c) PI₃ > PBr₃ > PCl₃ > PF₃
(d) PF₃ > PCl₃ > PBr₃ > PI₃

63. Which compound among the following has more covalent character?
(a) AlCl₃ (b) All₃
64. The compound with the maximum dipole moment among the following is:
   (a) \( p\)-Dichlorobenzene   (b) \( m\)-Dichlorobenzene
   (c) \( o\)-Dichlorobenzene   (d) Carbon tetrachloride

65. Pauling’s electronegativity values of elements are useful in predicting:
   (a) Polarity of bonds in molecules
   (b) Position of elements in periodic table
   (c) Coordination number
   (d) Dipole moment of various molecules

66. The structure of \( \text{ICl}_2 \) is:
   (a) Trigonal   (b) Octahedral
   (c) Square planar   (d) None of these

67. In \( \text{H}_3^+ \) ion, the bond order is:
   (a) Zero   (b) \( \frac{1}{2} \)
   (c) \(-\frac{1}{2}\)   (d) 1

68. The shape of \( \text{ClO}_4^- \) according to VSEPR model is:
   (a) Planar triangle   (b) Pyramidal
   (c) Tetrahedral   (d) Square planar

69. The state of hybridization for the transition state of hydrolysis mechanism of \( \text{BCl}_3 \) and \( \text{SF}_4 \) are respectively:
   (a) \( sp^2 \), \( sp^3d \)   (b) \( sp^3 \), \( sp^3 \)
   (c) \( sp^3 \), \( sp^3d \)   (d) \( sp^3d \), \( sp^3d \)

70. Which of the following molecular species has unpaired electron(s)?
   (a) \( \text{N}_2 \)   (b) \( \text{F}_2 \)
   (c) \( \text{O}_2 \)   (d) \( \text{O}_2^2- \)

71. Which of the following two are isomorphous?
   (a) \( \text{XeF}_2 \), \( \text{IF}_2^- \)   (b) \( \text{NH}_3 \), \( \text{BF}_3 \)
   (c) \( \text{CO}_3^2- \), \( \text{SO}_4^{2-} \)   (d) \( \text{PCl}_5 \), \( \text{ICl}_5 \)

72. According to molecular orbital theory for \( \text{O}_2^2- \):
   (a) Bond order is less than \( \text{O}_2 \) and \( \text{O}_2^+ \) is paramagnetic
   (b) Bond order is more than \( \text{O}_2 \) and \( \text{O}_2^+ \) is paramagnetic
   (c) Bond order is less than \( \text{O}_2 \) and \( \text{O}_2^+ \) is diamagnetic
   (d) Bond order is more than \( \text{O}_2 \) and \( \text{O}_2^+ \) is diamagnetic

73. The maximum number of 90° angles between bond pair–bond pair of electron is observed in:
   (a) \( sp^3d^2 \)-hybridization   (b) \( sp^3d^2 \)-hybridization
   (c) \( dp^2 \)-hybridization   (d) \( dp^2 \)-hybridization

74. Which species is diamagnetic in nature?
   (a) \( \text{He}_2^2 \)   (b) \( \text{H}_2 \)

75. Which of the following does not contain isoelectronic species?
   (a) \( \text{PO}_4^{3-} \), \( \text{SO}_4^{2-} \), \( \text{ClO}_4^- \)   (b) \( \text{CN}^- \), \( \text{N}_2 \), \( \text{C}_2^2- \)
   (c) \( \text{SO}_3^2- \), \( \text{CO}_3^{2-} \), \( \text{NO}_3^- \)   (d) \( \text{BO}_3^3- \), \( \text{CO}_3^{2-} \), \( \text{NO}_3^- \)

76. The correct increasing covalent nature is:
   (a) \( \text{NaCl} < \text{LiCl} < \text{BeCl}_2 \)   (b) \( \text{BeCl}_2 < \text{NaCl} < \text{LiCl} \)
   (c) \( \text{BeCl}_2 < \text{LiCl} < \text{NaCl} \)   (d) \( \text{LiCl} < \text{NaCl} < \text{BeCl}_2 \)

77. Which is expected to show paramagnetism?
   (a) \( \text{ClO}_2 \)   (b) \( \text{SO}_3 \)
   (c) \( \text{CO}_2 \)   (d) \( \text{SiO}_2 \)

78. Which of the following tetrahalide is not easily hydrolyzed?
   (a) \( \text{CCl}_4 \)   (b) \( \text{SiCl}_4 \)
   (c) \( \text{GeCl}_4 \)   (d) \( \text{SnCl}_4 \)

79. Which of the following molecule is planar?
   (a) \( \text{[I(CN)_2]}^- \)   (b) \( \text{PCl}_4^- \)
   (c) \( \text{PCl}_3 \)   (d) \( \text{SF}_4 \)

80. Which of the following molecule has \( sp^d \)-hybridization?
   (a) \( \text{SO}_4 \)   (b) \( \text{ClF}_3 \)
   (c) \( \text{XeF}_2 \)   (d) \( \text{AlF}_3 \)

81. Which of the following molecule/ion has a zero dipole moment?
   (a) \( \text{ClF}_3 \)   (b) \( \text{ICl}_2^- \)
   (c) \( \text{SF}_4 \)   (d) None of these

82. Select the correct ionic mobility order in water?
   (a) \( \text{Ba}^{2+} > \text{Be}^{2+} \)   (b) \( \text{Li}^+ > \text{Rb}^+ \)
   (c) \( \text{I}^- > \text{Cl}^- \)   (d) \( \text{Na}^+ > \text{Mg}^{2+} > \text{Al}^{3+} \)

83. Which of the following molecule is polar as well as planar?
   (a) \( \text{F}_2 \)   (b) \( \text{Cl}_2 \)
   (c) \( \text{H}_2 \)   (d) None of these

84. What is the hybridization of \( \text{Xe} \) in cationic part of solid \( \text{XeF}_2 \)?
   (a) \( sp^3d^5 \)   (b) \( sp^2d \)
   (c) \( sp^3d^9 \)   (d) \( sp^3 \)
85. Which of the following molecule(s)/ion(s) are isoelectronic?
(a) CO$_2$ and N$_2$O  
(b) CO$_2$ and CN$^{2-}$  
(c) C$_6$H$_6$ and B$_3$N$_3$H$_6$  
(d) All are isoelectronic

86. Select the correct order of polarizing power of cation?
(a) Na$^+$ > Mg$^+$ > Si$^{4+}$ > Al$^{3+}$  
(b) Mg$^+$ > Si$^{4+}$ > Al$^{3+}$ > Na$^+$  
(c) Na$^+$ < Mg$^+$ > Si$^{4+}$ > Al$^{3+}$ > Na$^+$  
(d) Al$^{3+}$ > Si$^{4+}$ > Mg$^{2+}$ > Na$^+$

87. Select the correct order of thermal stability of bicarbonates:
(a) NaHCO$_3$ > KHCO$_3$ > RbHCO$_3$ > CsHCO$_3$  
(b) RbHCO$_3$ > CsHCO$_3$ > NaHCO$_3$ > KHCO$_3$  
(c) KHCO$_3$ > RbHCO$_3$ > CsHCO$_3$ > NaHCO$_3$  
(d) NaHCO$_3$ > KHCO$_3$ > RbHCO$_3$ > CsHCO$_3$

88. Identify the correct order of bond angle in following species:
\[ \begin{align*}
&\text{CH}_3, \text{CH}_4, \text{CH}_5 \\
&\text{(a)} \ \text{CH}_3 > \text{CH}_4 > \text{CH}_5 \\
&\text{(b)} \ \text{CH}_4 > \text{CH}_2 > \text{CH}_3 \\
&\text{(c)} \ \text{CH}_3 > \text{CH}_4 > \text{CH}_5 \\
&\text{(d)} \ \text{CH}_4 = \text{CH}_2 = \text{CH}_4
\end{align*} \]

89. Which of the following molecule/ion has higher B-O bond length?
(a) H$_3$BO$_3$  
(b) [B(OH)$_4$]$^-$  
(c) Both (a) and (b) have equal B-O bond length  
(d) None of these

90. Which of the following molecules has $3C-4e^-$ bond?
(a) Al$_2$Cl$_6$  
(b) BeCl$_4$  
(c) I$_2$Cl$_6$  
(d) All are having $3C-4e^-$ bond

91. Which of the following molecule does not exist?
(a) Hc$_2$  
(b) H - H$^+$  
(c) He - He$^+$  
(d) Li$_2$

92. Certain derivatives of phenol such as Kr(phenol)$_2$, Xe(phenol)$_2$, Ru(phenol)$_2$, etc., may result due to which type of interaction?
(a) Dipole–dipole  
(b) Ion–dipole  
(c) Ion–induced dipole  
(d) Dipole–induced dipole

93. In organic homologous series, the higher members show the higher melting and boiling point due to the:
(a) Dipole–dipole interaction  
(b) Ion–dipole interaction  
(c) London dispersion forces  
(d) Dipole–induced dipole interaction

94. Select the correct order of unpaired $e^-$ of antibonding molecular orbitals in following species:
(a) O$_2$ > O$_2^+$ > O$_2^2-$  
(b) O$_2$ > O$_2^+$ > O$_2^2-$  
(c) O$_2$ > O$_2^+$ > O$_2^2-$  
(d) O$_2$ > O$_2^+$ > O$_2^2-$

95. Select the correct order of the first ionization potential:
(a) NO > N$_2$  
(b) N$_2$ > NO  
(c) NO > N$_2$  
(d) None of these

96. Select the correct order of the first ionization potential:
(a) F$_2$ > F  
(b) F$_2$ > F  
(c) F > F$_2$  
(d) None of these

97. Which of the following element does not show inert gas pair effect?
(a) Ti  
(b) Pb  
(c) Bi  
(d) Sn

98. Which of the following compound is not a strong oxidizing agent?
(a) PbO$_2$  
(b) PbCl$_4$  
(c) Pb$_2$O$_3$  
(d) CCl$_4$

99. Which of the following does show reducing property?
(a) Ge(II)  
(b) Sn(II)  
(c) Both (a) and (b)  
(d) None of these

100. Which of the following molecule is not showing zero dipole moment?
(a) C$_6$H$_5$(NO$_3$) (para)  
(b) C$_6$H$_4$(CH$_3$)$_2$ (para)  
(c) C$_6$H$_5$(OH)$_2$ (para)  
(d) All compounds are showing zero dipole moment

101. Which of the following molecule has almost zero dipole moment?
\[ \begin{align*}
&\text{(a)}  \\
&\text{(b)}  \\
&\text{(c)}  \\
&\text{(d)}
\end{align*} \]

102. Select the correct increasing order of $\pi$ bond formation tendency from the following:
(a) Si - O > P - O > S - O > Cl - O  
(b) Si - O < P - O < S - O < Cl - O  
(c) Cl - O < Si - O < P - O < S - O  
(d) Si - O < Cl - O < P - O < S - O

103. Choose the correct order of bond strength by overlapping of atomic orbitals:
(a) 1s-1s > 1s-2s > 1s-2p  
(b) 2s-2s > 2s-2p > 2p-2p  
(c) 2s-2p > 2s-2s > 2p-2p  
(d) 1s-1s > 1s-2s > 1s-2s
7. Compare S—O bond angle for the following molecules:

(a) $x > y$
(b) $y > x$
(c) $x = y$
(d) None of these

8. Compare $F\text{Br}O$ and $O\text{Br}O$ in $\text{FBrO}_3$ molecule:

(a) $F\text{Br}O > O\text{Br}O$
(b) $F\text{Br}O < O\text{Br}O$
(c) $F\text{Br}O = O\text{Br}O$
(d) None of these

9. Compare $x$ and $y$ bond angles for the above given molecules:

(a) $x > y$
(b) $y > x$
(c) $x = y$
(d) None of these

10. Compare $x$ and $y$ bond lengths for the above given molecule:

(a) $x > y$
(b) $y > x$
(c) $x = y$
(d) None of these

11. Which of the following reaction(s) is/are not possible?

(i) $(\text{CH}_3)_2\text{O} + \text{BF}_3 \rightarrow (\text{CH}_3)_2\text{O} \rightarrow \text{BF}_3$
(ii) $(\text{SiH}_3)_2\text{O} + \text{BF}_3 \rightarrow (\text{SiH}_3)_2\text{O} \rightarrow \text{BF}_3$
(iii) $\text{H}_3\text{N} + \text{BF}_3 \rightarrow \text{H}_3\text{N} \rightarrow \text{BF}_3$
(iv) $(\text{CH}_3)_2\text{O} + \text{BF}_3 \rightarrow (\text{CH}_3)_2\text{O} \rightarrow \text{BF}_3$

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

12. $\text{Si}_2\text{O}_3^{10-}$ unit is an example of:

(a) 2D silicate
(b) Double chain silicate
(c) Cyclic silicate
(d) 2D silicate

13. Which of the following molecule/ion has higher number of $e^-$ in A.B.M.O.?
(a) $O_2^+$  
(b) $O_2^-$  
(c) $O_2^{2-}$  
(d) All have equal number of unpaired $e^-$

14. Compare $x$ and $y$ bond angles in the following molecule:

(a) $x > y$  
(b) $y > x$  
(c) $x = y$  
(d) None of these

15. Predict the nature of metal oxide if $\phi = 2.1$ for metal cation:

(a) Amphoteric  
(b) Acidic  
(c) Basic  
(d) Neutral

16. The correct order of bond angle is:

(a) $H_2O > OF_2 > SF_2 > H_2S$  
(b) $H_2O > SF_2 > OF_2 > H_2S$  
(c) $H_2O > OF_2 > H_2S > SF_2$  
(d) $H_2O > H_2S > OF_2 > SF_2$

17. In which of the following molecules all $A-X$ bond lengths are identical?  
$[A = \text{central atom and } X = \text{surrounding atom}]$

(a) XeF$_4$  
(b) PF$_5$  
(c) Both (a) and (b)  
(d) SF$_4$

18. Which of the following species has smallest $N-O$ bond length?

(a) NO  
(b) NO$^-$  
(c) NO$^+$  
(d) N$_2$O

19. The compounds in which the mentioned bond angle in parenthesis is found to be greater than expected not due to back bonding is:

(a) $H_2SiNCS (\angle Si-N-C)$  
(b) $BI_3 (\angle I-B-I)$  
(c) $MeNCS (\angle CNC)$  
(d) None of these

20. Select from each set the molecule or ion having the smallest bond angle:

(i) NH$_3$, PH$_3$ or AsH$_3$  
(ii) $O_3^+$, $O_3$  
(iii) NO$_2^-$ or $O_3$  
(iv) $X-S-X$ angle in SOCl$_2$ and SOF$_2$

(a) NH$_3$, $O_3^+$, $O_3$, SOCl$_2$  
(b) PH$_3$, $O_3$, NO$_2^-$, SOF$_2$  
(c) AsH$_3$, $O_3$, NO$_2^-$, SOF$_2$  
(d) AsH$_3$, $O_3^+$, $O_3$, SOF$_2$

21. What will be the transition state to get BF$_2$Cl and BCl$_3$F from the reaction between BF$_3$ and BCl$_3$?

(a)  
(b)  
(c) Both (a) and (b)  
(d) None of these

22. Which of the following bond has the highest energy?

(a) Se-Se  
(b) Te-Se  
(c) S-S  
(d) O-O

23. Which of the following overlaps leads to sigma bonding if $x$ is internuclear axis?

(s-orbital)  
(p-orbital)  
(d)  
(d)  

24. The decreasing order of bond angle is:

(a) NO$_2 > NO_2^+ > NO_2$  
(b) NO$_2^+ > NO_2 > NO_2^+$  
(c) NO$_2^+ > NO_2 > NO_2^+$  
(d) NO$_2^+ > NO_2 > NO_2$

25. Which has higher bond energy and stronger bond?

(a) F$_2$  
(b) Cl$_2$  
(c) Br$_2$  
(d) I$_2$

26. Which of the following is most stable?

(a) Pb$^{2+}$  
(b) Ge$^{2+}$  
(c) Si$^{2+}$  
(d) Sn$^{2+}$

27. According to Fajans's rule, polarization is more when:

(a) Small cation and large anion  
(b) Small cation and small anion  
(c) Large cation and large anion  
(d) Large cation and small anion

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

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

29. Among the following compounds the one that is polar and has the central atom with $sp^3$-hybridization is:

(a) H$_2$CO$_3$  
(b) SiF$_4$  
(c) BF$_3$  
(d) HClO$_2$
30. Which pair represents isostuctural species?
(a) CH₃ and CH₂⁺
(b) NH₂ and NH₃
(c) SO₂⁻ and BF₄⁻
(d) NH₂ and BeF₂

31. Among KO₂, electron, BaO₂, and NO₃⁻, unpaired electron is present in:
(a) NO₂⁻ and BaO₂
(b) KO₂ and AlO₂⁻
(c) KO₂ only
(d) BaO₂ only

32. Among LiCl, BeCl₂, BCl₃, and CCl₄, the covalent bond character follows the order:
(a) LiCl > BeCl₂ > BCl₃ > CCl₄
(b) LiCl < BeCl₂ < BCl₃ < CCl₄
(c) LiCl > BeCl₂ > CCl₄ > BCl₃
(d) LiCl < BeCl₂ < CCl₄ < BCl₃

33. The correct order of decreasing polarisability of ion is:
(a) Cl⁻, Br⁻, I⁻, F⁻
(b) F⁻, I⁻, Br⁻, Cl⁻
(c) I⁻, Br⁻, Cl⁻, F⁻
(d) F⁻, Cl⁻, Br⁻, I⁻

34. The following compounds have been arranged in order of their increasing thermal stabilities. Identify the correct order:
(a) K₂CO₃, MgCO₃, CaCO₃, IV BeCO₃
(b) I > II > III > IV
(c) IV > II > III > I
(d) II > IV > III > I

35. Which has triangular planar shape?
(a) CH₃⁺
(b) ClO₂⁻
(c) H₂O⁺
(d) CaBr₂

36. Highest covalent character is found in which of the following?
(a) CaF₂
(b) CaCl₂
(c) CaCl₂
(d) CaBr₂

37. C—O—C angle in ether molecule is:
(a) 110°
(b) 90°
(c) 180°
(d) 109°28′

38. In P₄O₁₀ molecule, bridging P—O bond length is:
(a) Larger than that of in P₂O₅
(b) Lesser than that of in P₂O₅
(c) Equal to that of in P₂O₅
(d) Cannot be compared

39. The nodal plane in the π-bond of ethene is located in:
(a) The molecular plane
(b) A plane parallel to the molecular plane
(c) A plane perpendicular to the molecular plane which bisects the carbon–carbon σ-bond at right angle

40. The state of hybridization of boron and oxygen atom in boric acid (H₃BO₃) is respectively:
(a) sp³, sp³
(b) sp³, sp²
(c) sp³, sp²
(d) sp², sp²

41. Which of the following has regular tetrahedral shape?
(a) I⁻
(b) SF₄
(c) BF₄⁻
(d) XeF₄

42. The correct order of bond angles is:
(a) H₂S < NH₂ < BF₃ < SiH₄
(b) NH₂ < H₂S < SiH₄ < BF₃
(c) H₂S < NH₂ < SiH₄ < BF₃
(d) H₂S < SiH₄ < NH₂ < BF₃

43. Compare x and y bond angle in above molecule:
(a) x > y
(b) y > x
(c) x = y
(d) None of these

44. Compare B—B bond length in following molecules:
(a) x > y
(b) y > x
(c) x = y
(d) None of these

45. How many S—S linkage(s) is/are present in sodium tetraionate?
(a) 4
(b) 3
(c) 2
(d) 1

46. Find the maximum number of atoms that lie in the same plane in PCl₅ molecule:
(a) 3
(b) 5
(c) 4
(d) 2

47. In which of the following cases hydrolysis takes place through SN2 and SN1 mechanisms, respectively?
(A) P₄O₁₀, SiCl₄
(B) NC₃, NF₃
(C) SiCl₄, SiF₄
(D) SF₆, TeF₆

48. What may be the geometry of molecule if AX₃ molecule has non-zero dipole moment?
(a) Trigonal planar
(b) Bent T-shape
(c) Pyramidal
(d) Both (b) and (c)

49. If Hund's rule is not applicable, then bond order and magnetic behavior of O₂ molecule is:
(a) 2, Paramagnetic
(b) 2, Diamagnetic
(c) 2.5, Paramagnetic
(d) 2.5, Diamagnetic
50. The existence of intermolecular forces is supported by the facts:
(a) Non ideality of real gases
(b) Liquefaction of gases
(c) Both (a) and (b)
(d) None of these

51. Select the incorrect statement:
(a) On adding one electron in NO⁺, the bond length increases
(b) Boron is paramagnetic while carbon is diamagnetic
(c) CO and N₂ both have different bond order
(d) CO and N₂ both have same bond order

52. Select the correct order of first ionization potential:
(a) N > O₂   (b) O₂ > N
(c) O₂ = N   (d) None of these

53. Select the correct order of first ionization potential:
(a) N > N₂   (b) N < N₂
(c) N = N₂   (d) None of these

54. Select the correct order of polymerization tendency from the following:
(a) Si — O > P — O > S — O > Cl — O
(b) P — O > S — O > Cl — O > Si — O
(c) Cl — O > S — O > P — O > Si — O
(d) Si — O < P — O < S — O < Cl — O

55. Choose the incorrect statement:
(a) Reducing power in aqueous solution is maximum for lithium metal
(b) Electron affinity order O⁺ > O > O₂⁻ > O₂
(c) Order of oxidation number of oxygen O₂ > KO₂ > BaO₂ > K₂O
(d) pH of aqueous solution LiCl > BeCl₂ > MgCl₂ > AlCl₃

56. Given the species N₂, CO, NO⁺, and CN⁻ which of the following statements are true for this:
(I) All the species are diamagnetic
(II) All the species are isostuctural
(III) All the species have identical bond order
(IV) More than one species have zero dipole moment
(a) I, II, and III  (b) I, II, III, and IV
(c) III and IV  (d) I and II

57. Which is not correctly matched?
(a) XeO₃ : Trigonal bipyramidal
(b) ClF₃ : Bent T-shape
(c) XeOF₄ : Square pyramidal
(d) XeF₂ : Linear shape

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

59. Compare S–S bond length from the following molecules:

60. Compare bond length from the following molecules:

61. Compare bond angle from the following molecules:

62. Compare x, y, z bond angle from the above given molecule:

63. Compare bond length from the above given molecules:

64. xB–B
   F
   F
   \[ \text{and} \]
   O
   C
   C
   O
   \[ \text{and} \]
   I
   I
   \[ \text{and} \]
   I
   I
Compare \( x \) and \( y \) bond angle from the above given molecules:
(a) \( x > y \)  
(b) \( y > x \)  
(c) \( x = y \)  
(d) None of these

65. \[
\begin{array}{c}
H_3C \\
\text{Al} \\
\text{CH}_2 \\
\text{CH}_3 \\
\end{array}
\]
Compare \( x \) and \( y \) bond angle from the above given molecule:
(a) \( x > y \)  
(b) \( y > x \)  
(c) \( x = y \)  
(d) None of these

66. Which of the following compound is more basic with respect to exocyclic carbonyl oxygen?
(a) \[
\begin{array}{c}
\text{PO} \\
90^\circ \\
\text{OH} \\
\end{array}
\]
(b) \[
\begin{array}{c}
\text{Me} \\
\text{Me} \\
\text{P} \\
\text{O} \\
\end{array}
\]
(c) Both are equally basic  
(d) None of these

67. Select the correct order of Lewis basic strength for exocyclic carbonyl oxygen:
(a) \[
\begin{array}{c}
\text{Me} \\
\text{Me} \\
\text{N} \\
\text{O} \\
\end{array}
\]
(b) \[
\begin{array}{c}
\text{Me} \\
\text{Me} \\
\text{N} \\
\text{O} \\
\end{array}
\]
(c) \[
\begin{array}{c}
\text{Me} \\
\text{Me} \\
\text{N} \\
\text{O} \\
\end{array}
\]
(d) \[
\begin{array}{c}
\text{Me} \\
\text{Me} \\
\text{N} \\
\text{O} \\
\end{array}
\]

68. If the \( \pi \)-back bonding involves the vacant orbital of the central atom, then the bond angle gets widened due to:
(a) The increased \( \pi/\pi \) repulsion for the enhanced bond multiplicity  
(b) The decreased of \( \pi/\pi \) and \( \sigma/\sigma \) repulsion  
(c) Both (a) and (b)  
(d) None of the above

69. In which of the following structure, the number of shared oxygen atom per tetrahedron is two and half?
(a) 2D silicate  
(b) 3D silicate  
(c) Amphibole  
(d) Ortho silicate

70. Calculate the \% \( p \)-character in the orbital occupied by the lone pairs in water molecule:
\[ \text{Given: } \angle \text{HOH is } 104.5^\circ \text{ and } \cos (104.5^\circ) = -0.25 \]
(a) 80\%  
(b) 20\%  
(c) 70\%  
(d) 75\%

71. Correct order for the boiling point between \( \text{CCl}_4 \) and \( \text{SiCl}_4 \):
(a) \( \text{CCl}_4 > \text{SiCl}_4 \)  
(b) \( \text{SiCl}_4 > \text{CCl}_4 \)  
(c) \( \text{SiCl}_4 = \text{CCl}_4 \)  
(d) None of these

72. Hydration of central atom is independent of the phase/state of the compound in case of:
(a) \( \text{BeH}_2 \)  
(b) \( \text{N}_2 \text{O}_5 \)  
(c) \( \text{XeF}_6 \)  
(d) \( \text{PF}_3 \)

73. Select the correct order for I.E.:
(a) \( \text{CO} > \text{N}_2 \)  
(b) \( \text{N}_2 > \text{CO} \)  
(c) \( \text{N}_2 < \text{O}_2 \)  
(d) \( \text{N} < \text{O} \)

74. Which of the following molecules has the weakest bond?
(a) \( \text{H}_2 \)  
(b) \( \text{Li}_2 \)  
(c) \( \text{F}_2 \)  
(d) \( \text{O}_2 \)

75. Which of the following molecule/ion does not contain unpaired electron?
(a) \( \text{O}_2^+ \)  
(b) \( \text{B}_2 \)  
(c) \( \text{N}_2^+ \)  
(d) \( \text{O}_2 \)

76. Among the following species, identify the isostructural pairs:
\[
\text{NF}_3, \text{NO}_3, \text{BF}_3, \text{H}_2\text{O}^+, \text{HN}_3
\]
(a) \([\text{NF}_3, \text{NO}_3] \) and \([\text{BF}_3, \text{H}_2\text{O}^+]\)  
(b) \([\text{NF}_3, \text{HN}_3] \) and \([\text{NO}_3^-, \text{BF}_3]\)  
(c) \([\text{NF}_3, \text{H}_2\text{O}^+] \) and \([\text{NO}_3^-, \text{BF}_3]\)  
(d) \([\text{NF}_3, \text{H}_2\text{O}^+] \) and \([\text{HN}_3, \text{BF}_3]\)

77. Which of the following statements is correct for \( \text{CsBr}_2 \)?
(a) It is a covalent compound  
(b) It contains \( \text{Cs}^{2+} \) and \( \text{Br}^- \) ions  
(c) It contains \( \text{Cs}^+ \), \( \text{Br}^- \) and lattice \( \text{Br}_2 \) molecule  
(d) It contains \( \text{Cs}^+ \), \( \text{Br}^- \) and lattice \( \text{Br}_2 \) molecule

78. Iron is tougher than sodium because:
(a) Iron atom is smaller  
(b) Iron atoms are more closely packed  
(c) Metallic bonds are stronger in iron  
(d) None of these
79. van der Waals' forces are applied to:
(a) Inert gases only  (b) Rare gases only
(c) Mixture of gases  (d) Elementary gases only

80. The correct order of hybridization of the central atom in the following species NH₃, [PtCl₄]²⁻, PCl₅ and BCl₃ is:
(a) dsp², dsp³, sp³, sp³  (b) sp³, dsp³, sp³, d, sp²
(c) dsp², sp³, dsp³, sp³  (d) dsp², sp³, d, sp³

81. Specify the coordination geometry around and hybridization of N and B atom in a 1:1 complex of BF₃ and NH₃:
(a) N: tetrahedral, sp³; B: tetrahedral, sp³
(b) N: pyramidal, sp³; B: pyramidal, sp³
(c) N: pyramidal, sp³; B: planar, sp²
(d) N: pyramidal, sp³; B: tetrahedral, sp³

82. The bond order in NO is 2.5 while that in NO⁺ is 3.
Which statement is true for these two species?
(a) Bond length is unpredictable
(b) Bond length in NO is greater than that in NO⁺
(c) Bond length in NO⁺ is equal to that in NO
(d) Bond length in NO⁺ is greater than that in NO

83. Which of the following acid is not formed during the stepwise hydrolysis of P₂O₁₀ ?
(a) Tetrameta phosphoric acid
(b) Hypophosphoric acid
(c) Pyrophosphoric acid
(d) Tetra phosphoric acid

84. Which of the following overlapping is used for the formation of 3C - 2e⁻ bond in chain polymer of Be₂M₀₃?
(a) sp - sp - sp  (b) sp² - sp² - sp²
(c) sp² - sp³ - sp²  (d) sp³ - sp³ - sp³

85. Cl₂BeCl₂BeCl₂BeCl₂Cl₂
Compare x and y bond angle in above molecule:
(a) x > y  (b) y > x
(c) x = y  (d) None of these

86. Select the correct order of bond angle in following molecules:
(a) O > H  (b) O > Cl  (c) O > F  (d) None of these

87. Select the correct order of bond angle in following molecules:

88. [Be(OCH₃)₂]₆ is a high polymer, and is soluble in hydrocarbon solvent. Which type of bond is present in this polymer?
(a) 3C - 2e⁻  (b) 3C - 4e⁻
(c) 2C - 5e⁻  (d) None of these

89. Which type of bond is present in [BeF₂]₆ polymer?
(a) 3C - 2e⁻  (b) 3C - 4e⁻
(c) 2C - 3e⁻  (d) None of these

90. Compare x and y bond length in above molecules:
(a) x > y  (b) y > x
(c) x = y  (d) None of these

91. Which of the following hydrides has the strongest reducing nature?
(a) CH₃  (b) SiH₄
(c) GeH₄  (d) SnH₄

92. Which of the following molecule has intramolecular H-bonding?
(a) Ortho-nitrophenol  (b) Ortho-boric acid
(c) Both (a) and (b)  (d) None of these

93. If Pauli exclusion principle is not applicable and one orbital has three e⁺, then last e⁺ of N₂ molecule is present in:
(a) σ(2s) orbital  (b) σ(2s,2p) orbital
(c) π 2pₓ orbital  (d) π 2pᵧ orbital

94. Select the incorrect statement:
(a) If the orbitals differ largely in energy, the cost of hybridization energy becomes large
(b) The hybridization in phosphorus between 3s and 3p-orbitals may be possible and the participation of 3d-orbitals in the hybridization with the 3s and 3p-orbitals is not expected because of their (i.e., 3d-orbital) much higher energy
(c) The 3-orbital participation generally requires to bond with highly electronegative elements
(d) PF₅ does not exist but PCl₅, PF₃ exist through the formation of sp²d² hybridization
95. Select the incorrect statement:
(a) [SiH₄]²⁻ has sp³d² hybridization
(b) PF₅ has sp³d-hybridization
(c) SF₆ has sp³d² hybridization
(d) All are correct statements

96. Given the correct order of initials T or F for following statements. Use T if statement is true and F if it is false:
Statement-1: π bond is formed by sideways overlapping of dₓ²−y² and ρₓ orbital along x-axis.
(a) T F (b) F T
(c) T T (d) F F

97. Select the correct statement:
(a) The S — F bond length is longer in SF₆ compared to that in SF₂
(b) In PCl₃ axial bonds are smaller than that of equatorial bonds
(c) In SF₅, axial bonds are longer than that of equatorial bonds
(d) All are correct

98. Select the correct order of first ionization potential:
(a) O₂ > NO (b) O₂ < NO
(c) O < NO (d) O = NO

99. Select the correct order of first ionization potential:
(a) O₂⁺ > O₂ (b) O₂⁺ < O₂
(c) O₂ > O₂ (d) None of these

100. In case of Na metal, if the number of Na atoms increases, the difference in energy between successive MOs in Na₂(Na)₂ molecule:
(a) Increases (b) Decreases
(c) May increase or decrease (d) No change

101. Which of the following statement is/are true?
(I) Borazine is aromatic
(II) There are four isomeric substituted borazine molecule B₃N₃H₆X₂
(III) Borazine is more reactive towards addition reactions than benzene
(IV) Banana bonds in B₂H₆ are longer but stronger than normal B—H bonds
(a) I, II, and III (b) I, II, and IV
(c) I, II, III, and IV (d) only II

102. Which of the following statements are correct for the compound C₃N₃(N₃)₂?
(I) It contains three π bonds
(II) Its structure is planar
(III) C and N atoms are sp²-hybridized in the ring
(IV) N₂⁻ groups are attached with N-atoms
Select the correct code:
(a) I, II, and III (b) II and III
(c) I, III, and IV (d) All

103. N₂H₄ (hydrazine) combines with (CH₃)₂N via:
(a) An ionic bond (b) A coordinate bond
(c) A covalent bond (d) Combination is not possible

Multiple Correct Answers Type

1. Select the correct statements:
(a) The combination of s-orbital and p-orbital, with the increase of p-character, the bond angle decreases
(b) H—C—F bond angle > H—C—F bond angle in CH₃F molecule
(c) C—C—F bond angle > H—C—F bond angle in CHF₃ molecule
(d) All are correct statement

2. Which of the following molecule(s) is/are having pyramidal structure?
(a) PH₃ (b) P(SiH₃)₃
(c) NH₃ (d) PCl₃

3. Select the correct statements:
(a) The hybrid orbitals may be equivalent or not
(b) The hybridization defines a geometry of the molecule
(c) The hybrid orbitals are having much greater bonding strength compared to the pure atomic orbital
(d) The hybrid orbitals are having much lesser bonding strength compared to the pure atomic orbital

4. Select the correct statement(s) for bond distance:
(a) The bond distance decreases with the increase of bond order
(b) C—H < C—H < C—C (order of C—H bond distance)
(c) C—C < C—C < C—C (order of C—C bond distance)
(d) The bond distance increases with the increase of bond order
5. Bond length depends upon:
   (a) Bond order       (b) π-bonding
   (c) State of hybridization (d) None of these

6. Select the correct statements:
   (a) The bond length in BF$_3$ is shorter than that of BF$_4$
   (b) OCl$_2$ has $2p_x$-$3d_x$ back bonding
   (c) (AlCl$_3$)$_2$ is not electron deficient but (Al(Me)$_3$)$_2$ is electron deficient
   (d) In B$_2$H$_6$, all the hydrogens are not identical

7. Select the correct order of first ionization potential:
   (a) N$_2$ > O$_2$    (b) N$_2$ > O
   (c) O > O$_2$       (d) O$_2$ = N$_2$

8. Select the correct statements:
   (a) The +1 oxidation state compared to the +3 oxidation state gets gradually more stabilized as we move from top to bottom in III group
   (b) Tl (III) being unstable, acts as a good oxidizing agent to get reduced to Tl (I)
   (c) SnCl$_2$ is a good oxidizing agent
   (d) All are incorrect

9. Which of the following molecule(s) have zero dipole moment?
   (a) CH$_4$     (b) CBr$_4$
   (c) C$_2$H$_2$  (d) None of these

10. Which of the following molecules have zero dipole moment and tetrahedral structure?
    (a) CCl$_4$    (b) SnCl$_2$
    (c) SnCl$_4$   (d) CO$_2$

11. Select the correct statements:
    (a) van der Waals' radii is always larger than the covalent radii
    (b) The bond length of a particular bond depends on the state of hybridization of the involved atoms
    (c) When s-character increases, then bond length increases
    (d) All are incorrect

12. Which of the following silicates are nonplanar?
    (a) Single chain       (b) Double chain silicate
    (c) 2D or sheet-like silicate
    (d) Cyclic silicate

13. Select the correct statements:
    (a) Ca$_3$Si$_2$O$_5$ is an example of cyclic silicate
    (b) Four corner oxygen atoms per tetrahedron are shared in 3D silicates
    (c) 2D, sheet-like silicates are planar
    (d) Silicate are ionic covalent compound

14. Which of the following molecule(s) is/are planar?
    (a) ICl$_3$         (b) H$_2$O
    (c) XeF$_2$         (d) I$_2$

15. Select the correct diagram(s) for anti-bonding molecular orbitals:
    (a) [Diagram]        (b) [Diagram]
    (c) [Diagram]        (d) None of these

16. If $z$ is internuclear axis, then which type of overlapping is not possible?
    (a) s and $p_z$     (b) s and $p_y$
    (c) $p_x$ and $p_z$ (d) $p_y$ and $p_z$

17. Select the correct statement for non-bonding and anti-bonding orbitals:
    (a) Non-bonding orbitals have the same energy as the atomic orbitals from which they are formed
    (b) Anti-bonding orbitals have higher energy than the atomic orbitals from which they are formed
    (c) Non-bonding orbitals have lower energy than the atomic orbitals from which they are formed
    (d) Anti-bonding orbitals have lower energy than the atomic orbitals from which they are formed

18. Which of the following is true for B$_2$ and C$_3$ molecules according to M.O.T?
    (a) Both are having 1σ and 1π bond
    (b) Both are having same bond length
    (c) Both are having different bond order
    (d) B$_2$ is paramagnetic and C$_3$ is diamagnetic in nature

19. Select the correct statements:
    (a) For a given cation, covalent character increases with increase in the size of the anion
    (b) For a given anion, covalent character increases with decrease in the size of the cation
    (c) Covalent character increases with increasing charge on either ion
    (d) Covalent character is greater for cations with pseudo-inert gas configuration than the noble gas configuration

20. Which of the following statement(s) is/are correct?
    (a) B$_2$H$_6$ is non-planar  (b) B$_2$H$_6$ is non-polar
    (c) B$_2$H$_6$ is $e^-$ deficient
    (d) B$_2$H$_6$ has two 3C--2$e^-$ bond
21. Which of the following statement(s) is/are correct?
(a) Dipole moment of diborane is zero
(b) Diborane is a Lewis acid
(c) Diborane has incomplete octet
(d) Di-borane has four $2C-2e^-$ bond

22. Select the correct statement(s):
(a) In diborane 12 valence $e^-$ are involved in bonding
(b) In diborane, maximum six atoms, two boron and four terminal hydrogen, lie in the same plane.
(c) Diborane has ethane-like structure
(d) In diborane, bridging bonds are stronger and longer than the terminal bonds

23. Select the correct statement for $P_4O_{10}$:
(a) It has four $sp^3$-hybridized phosphorous atoms
(b) It has higher $s-sp^3$-character in P-O bond than the $P_2O_6$
(c) It has a cage-like structure
(d) It has $d_n - d_4$ bonding

24. Select the correct order of acidic nature of non-metal oxide:
(a) $CO > CO_2$
(b) $CO_2 > CO$
(c) $CO_3 > SiO_2$
(d) $CO_2 < SiO_2$

25. Select the correct order of acidic nature of non-metal oxide:
(a) $SO_3 > SO_2$
(b) $SO_2 > SO_3$
(c) $NO < NO_2$
(d) $NO > NO_2$

26. Select the correct order of acidic nature of metal oxide:
(a) $MnO < Mn_2O_4 < Mn_2O_7$
(b) $CrO < Cr_2O_3 < CrO_2$
(c) $CrO_2 < Cr_2O_3 < CrO_3$

27. Select the correct statement(s):
(a) Solubility of alkali metal's chlorate decreases down the group
(b) Solubility of alkali metal's perchlorate decreases down the group
(c) Solubility of alkali metal's nitrate decreases down the group
(d) Solubility of alkali earth metal's sulphate increases down the group

28. In each of the following pairs, select the species having the greater resonance stabilization:
(i) $HNO_3$ and $NO_3^-$ (pair I)
(ii) $H_2C == O$ and $HC \equiv CO^-$ (pair II)

29. Select the correct order of lattice energy:
(a) $LiF < LiBr < LiI$
(b) $LiCl > LiBr > LiF$
(c) $LiCl > NaCl > KCl$
(d) $BeCO_3 < MgCO_3 < SrCO_3 < BaCO_3$

30. Which of the following molecule(s) is/are having pyramidal structure?
(a) $ClO_3^-$
(b) $H_2O^+$
(c) $NH_3$
(d) $PCl_3$

31. Which of the following is/are paramagnetic in nature?
(a) $B_2$
(b) $O_2$
(c) $NO^-$
(d) $O_2^-$

32. The species having identical bond order with NO $^+$ are:
(a) $CN^-$
(b) $O_2^+$
(c) $CO$
(d) $N_2$

33. Which of the following is/are paramagnetic in nature:
(a) $O_2$
(b) $O_2^+$
(c) $O_2^-$
(d) $O_2^{2-}$

34. Which of the following is/are diamagnetic?
(a) Superoxide ion
(b) Oxygen molecule
(c) Carbon molecule
(d) Nitrogen molecule

35. Which of the following compounds possesses Lewis acid character?
(a) $AlF_3$
(b) $SiF_4$
(c) $PF_3$
(d) $BF_3$

36. The species that contain peroxide ions is/are:
(a) $KO_2$
(b) $SrO_2$
(c) $BaO_2$
(d) $Na_2O_3$

37. Which is/are not correct for $B_2H_6$ structure?
(a) It has $4B—H$ terminal bonds and two $3C—2e$ bonds
(b) It has six $B—H$ terminal bonds and one $3C—2e$ bond
(c) It has four $B—H$ terminal bonds two $3C—2e$ bonds and one $B—B$ bond
(d) It has ionic interaction between $[BH_3]^+$ and $[BH_4]^-$