Preface

It is a matter of great pleasure for me to present this edition of Problems and Solutions in Inorganic Chemistry for JEE (Main & Advanced) before Joint Entrance Examination (JEE) aspirants. During teaching hours, I felt that the facts may be made more and more clear to the students through problematic approach. Although an ocean of material in inorganic is available with the students, but the approach to design the problems has been changed in recent years and if one tries in this ocean, it will be very difficult task to make the students more familiar with the trends and tricks to solve problems. The present problem book has been presented in the current scenario of stiff competition and is well equipped with the facts of subject, yet the winner is one who knows how to use these equipments with accuracy and efficiency. The book includes the problems based on the latest pattern being followed by JEE.

Most of the chapters in the book have been divided into eight sections, and the problems in each section have been designed such that they fulfill both the requirements of an aspirant, i.e., knowledge of subject and practice.

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Chemical Bonding (Part-A)

JEE (Main) Exercises

Single Correct Answer Type

1. Compare bond angles for the following molecules:
   \[ \text{O} \quad \text{O} \quad \text{O} \]
   \[ \text{H} \quad \text{F} \quad \text{H} \]
   \[ \text{F} \quad \text{O} \quad \text{F} \]
   (a) \( x > y \)
   (b) \( y > x \)
   (c) \( x = y \)
   (d) None of these

2. Compare bond lengths for the following molecules:
   \[ \text{O} \quad \text{O} \quad \text{O} \]
   \[ \text{F} \quad \text{F} \quad \text{F} \]
   (a) \( x > y \)
   (b) \( y > x \)
   (c) \( x = y \)
   (d) None of these

3. Compare bond lengths for the following molecules:
   \[ \text{O} \quad \text{O} \quad \text{O} \]
   \[ \text{F} \quad \text{F} \quad \text{F} \]
   (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:
   \[ \text{O} \quad \text{O} \quad \text{O} \]
   \[ \text{F} \quad \text{F} \quad \text{F} \]
   (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:
   \[ \text{N} \quad \text{N} \quad \text{O} \]
   \[ \text{O} \quad \text{O} \quad \text{O} \]
   (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:
   \[ \text{Al} \quad \text{Al} \quad \text{CH}_3 \quad \text{CH}_3 \quad \text{CH}_3 \]
   (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 silicates 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) \( \text{Diagram A} \)   (b) \( \text{Diagram B} \)
   (c) \( \text{Diagram C} \)   (d) None of these

11. Select the correct diagram for the \( \sigma2p_y \) orbital:
   (a) \( \text{Diagram A} \)   (b) \( \text{Diagram B} \)
   (c) \( \text{Diagram C} \)   (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) Ne   (b) He
   (c) \( \text{CH}_4 \)   (d) 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:
   (a) \( x > y \)   (b) \( y > x \)
   (c) \( x = y \)   (d) None of these

16. A metal oxide is acidic when:
   (a) \( \sqrt{\rho} < 2.1 \)   (b) \( \sqrt{\rho} = 2.1 \) to 3.2
   (c) \( \sqrt{\rho} > 3.2 \)   (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 3:\text{C} \rightarrow 4:\text{Cl} \) 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) \( \text{N}_2, \text{O}_2, \text{NO}^+ \)   (b) \( \text{N}_2^-, \text{O}_2^-, \text{NO}^+ \)
   (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) \( \text{HI} + \text{HOCl} \)
   (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 \( sp^3\text{d} \) 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 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) \( \text{XeOF}_2 \)   (b) \( \text{HF} \)
   (c) \( \text{XeO}_3 \)   (d) Both (b) and (c)

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

25. Find the incorrect match:
   (a) \( \text{Al}_2\text{Cl}_6 \) : 3:\text{C} \rightarrow 4:\text{Cl} \) 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) \( d_{x^2} + d_{z^2} \)  
(b) \( d_{x^2} + d_{xy} \)  
(c) \( d_{x^2} - d_{y^2} + d_{xy} \)  
(d) All form N.B.M.O.

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

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

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

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

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

32. Which of the following ions is diamagnetic?
(a) \( \text{N}_2^+ \)  
(b) \( \text{O}_2^- \)  
(c) \( \text{Be}^2+ \)  
(d) \( \text{NO}^- \)

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

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

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

36. Which compound possesses the greatest lattice energy?
(a) \( \text{LiBr} \)  
(b) \( \text{LiCl} \)  
(c) \( \text{LiF} \)  
(d) \( \text{LiI} \)

37. The common features among the species \( \text{CN}^-, \text{CO}_2, \) and \( \text{NO}^+ \) are:
(a) Bond order three and isoelectronic  
(b) Bond order three and weak field ligands  
(c) Bond order two and \( \pi \)-acceptors  
(d) Isoelectronic and weak field ligands

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

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) \( \text{ClF} \)  
(b) \( \text{PCl}_3 \)  
(c) \( \text{SiF}_4 \)  
(d) \( \text{CF}_3\text{Cl} \)

41. The bond order of \( \text{O}_2^- \) 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) \( \text{CH}_3-\text{COOH} \)  
(b) \( \text{CH}_3-\text{CH}_2-\text{OH} \)  
(c) \( \text{CH}_3-\text{C}_2=\text{O} \-\text{CH}_3 \)  
(d) \( \text{CH}_2=\text{C}=\text{CH} \)

43. A square planar complex is formed by hybridization of which atomic orbitals?
(a) \( s, p_x, p_y, d_x^2 \)  
(b) \( s, p_x, p_y, d_z^2, d_{x^2-y^2} \)  
(c) \( s, p_x, p_y, d_x^2 \)  
(d) \( s, p_x, p_y, d_{xy} \)

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

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 pentafluorides. The reason for this is:
(a) Low electron affinity of iodine
(b) Unusual pentagonal bipyramidal 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) O₂⁻
(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) sp³-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) BO₃⁻

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) XeF₆
(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 ionic bond repulsion
(b) Increasing p-orbital character in sp³
(c) Decreasing d-orbital repulsion
(d) Increasing electronegativity

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

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 X₂, all the bond angles are exactly 109°28'. X is:
(a) Chloromethane
(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) Al₂
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 $ICl_2^-$ is:
(a) Trigonal (b) Octahedral
(c) Square planar (d) None of these

67. In $H_2^+$ ion, the bond order is:
(a) Zero (b) $1/2$
(c) $1/2$ (d) 1

68. The shape of $ClO_3^-$ according to VSEPR model is:
(a) planar (b) Pyramidal
(c) Tetrahedral (d) Square planar

69. The state of hybridization for the transition state of hydrolysis mechanism of $BCl_3$ and $SF_4$ are respectively:
(a) $sp^3$, $sp^3d$ (b) $sp^3$, $sp^3$
(c) $sp^3$, $sp^3d$ (d) $sp^3d^2$, $sp^3d^2$

70. Which of the following molecular species has unpaired electron(s)?
(a) $N_2$ (b) $F_2$
(c) $O_2$ (d) $O_2^-$

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

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

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

74. Which species is diamagnetic in nature?
(a) $He^+_2$ (b) $H_2$

75. Which of the following does not contain isoelectronic species?
(a) $PO_4^{3-}$, $SO_4^{2-}$, $ClO_4^-$ (b) $CN^-$, $N_2$, $C_2^{2+}$
(c) $SO_3^{2-}$, $CO_3^{2-}$, $NO_3^-$ (d) $BO_3^{3-}$, $CO_3^{2-}$, $NO_3^-$

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

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

78. Which of the following tetrahalide is not easily hydrolyzed?
(a) $CCl_4$ (b) $SiCl_4$
(c) $GeCl_4$ (d) $SnCl_4$

79. Which of the following molecule is planar?
(a) $[I(CN)]_2^-$ (b) $PCl_3F_2$
(c) $PCl_5$ (d) $SF_4$

80. Which of the following molecule has $sp^3d$-hybridization?
(a) $SO_4^2-$ (b) $SF_4$
(c) $XeF_6^2-$ (d) All

81. Which of the following molecule/ion has a zero dipole moment?
(a) $ClF_3$ (b) $ICl_3^-$
(c) $SF_4$ (d) None of these

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

83. Which of the following molecule is polar as well as planar?

84. What is the hybridization of $Xe$ in cationic part of solid $XeF_6^{2-}$?
(a) $sp^3d$ (b) $sp^3d^2$
(c) $sp^3d^2$ (d) $sp^3$
85. Which of the following molecule(s)/ion(s) are isoelectronic?
   (a) CO₂ and N₂O ,  (b) CO₂ and CN⁻²  
   (c) C₆H₆ and B₃N₃H₆  (d) All are isoelectronic

86. Select the correct order of polarizing power of cation?
   (a) Na⁺ < Mg⁺ < Si⁴⁺ < Al³⁺  (b) Mg²⁺ < Si⁴⁺ < Al³⁺ < Na⁺  
   (c) Na⁺ < Mg²⁺ < Si⁴⁺ < Al³⁺ < Na⁺  (d) Al³⁺ < Si⁴⁺ < Mg²⁺ < Na⁺

87. Select the correct order of thermal stability of bicarbonates:
   (a) NaHCO₃ > KHCO₃ > RbHCO₃ > CsHCO₃  (b) RbHCO₃ > CsHCO₃ > NaHCO₃ > KHCO₃  
   (c) KHCO₃ > RbHCO₃ > CsHCO₃ > NaHCO₃  (d) NaHCO₃ < KHCO₃ < RbHCO₃ < CsHCO₃

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

89. Which of the following molecule/ion has higher B ↔ O bond length?
   (a) H₃BO₃  (b) [B(OH)₄]⁻  
   (c) Both (a) and (b) have equal B ↔ O bond length  (d) None of these

90. Which of the following molecule has 3C ↔ 4e⁻ bond?
   (a) Al₂Cl₆  (b) Be₂Cl₄  
   (c) I₂Cl₆  (d) All are having 3C ↔ 4e⁻ bond

91. Which of the following molecule does not exist?
   (a) He₂  (b) H₁⁻ → H⁻  
   (c) He — He⁺  (d) Li₂

92. Certain derivatives of phenol such as Kr (phenol)₂, Xe (phenol)₂, Ra (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) O₂ > O₂⁺ > O₂⁻  (b) O₂ > O₂⁺ > O₂⁻  
   (c) O₂ > O₂⁺ ≈ O₂⁻  (d) O₂ ≈ O₂⁺ ≈ O₂⁻

95. Select the correct order of the first ionization potential:
   (a) NO > N₂  (b) N₂ > NO  
   (c) NO ≈ N₂  (d) None of these

96. Select the correct order of the first ionization potential:
   (a) F₂ > F  (b) F = F  
   (c) F > F₂  (d) None of these

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

98. Which of the following compound is not a strong oxidizing agent?
   (a) PbO₂  (b) PbCl₄  
   (c) Pb₂O₃  (d) CCl₄

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) C₆H₆(NO₃) (para)  (b) C₆H₄(CH₃)₂ (para)  
    (c) C₆H₄(OH)₂ (para)  (d) All compounds are showing zero dipole moment

101. Which of the following molecule has almost zero dipole moment?
    (a) \[
    \begin{array}{c}
    \text{H} \\
    \text{Cl} \quad \text{C} = \text{Cl}
    \end{array}
    \]
    (b) \[
    \begin{array}{c}
    \text{C} \quad \text{C} = \text{C}
    \end{array}
    \]
    (c) \[
    \begin{array}{c}
    \text{H} \quad \text{Cl} \quad \text{Cl} \\
    \text{C} = \text{C} \quad \text{Cl}
    \end{array}
    \]
    (d) [See image]

102. Select the correct increasing order of π 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) 2p-2p > 2s-2p > 2p-2p  (d) 1s-1s > 1s-2p > 1s-2s
1. Which one of the following bonds has the highest bond energy?
(a) C – C  
(b) Si – Si  
(c) Ge – Ge  
(d) Sn – Sn  

2. Which of the following is incorrect?
(a) Among Cl, Ar, and K, K has the smallest ionization potential  
(b) Among CH₄, NH₃, and HF, HF has the highest boiling point  
(c) Among Cl₂, Br₂, and I₂, Br₂ has the lowest boiling point  
(d) Among HOCl, HOB₃, and HOCl, HOCl is the weakest acid  

3. PCl₃ and PB₃ exist in sp³d-hybrid state in gaseous phase. But in solid state, which of the following statements is true?
(a) P in PCl₃ exists in sp³-hybridization state, while P in PB₃ exists in sp³d² and sp³-hybridization states  
(b) P in PCl₃ and PB₃ exists in sp³d² and sp³-hybridization state  
(c) P in PCl₃ exists in sp³d² and sp³-hybridization states, while P in PB₃ exists in sp³-hybridization state  
(d) P in PCl₃ and PB₃ exists in sp³-hybridization state  

4. Which of the following halide does not exist?
(a) PbF₄  
(b) PbCl₄  
(c) PbI₂  
(d) Pb₂  

5. If the π-back bonding involves the lone pair of central atom, then bond angle gets opened up due to:
(a) Increase of lp/lp repulsion for the enhanced bond multiplicity  
(b) Decrease of lp/lp repulsion (s) on the central atom  
(c) Both (a) and (b)  
(d) None of these  

6. Compare bond angles for the following molecules:
(a) O – O  
(b) S – S  
(c) O – O  
(d) None of these  

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 – Br – O and O – Br – O in FBrO₃ molecule:
(a) F – Br – O > O – Br – O  
(b) F – Br – O < O – Br – O  
(c) F – Br – O = O – 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) (CH₃)₂O + BF₃ → (CH₃)₂O → BF₃  
(ii) (CH₃)₂O + BF₃ → (CH₃)₂O → BF₃  
(iii) H₃N + BF₃ → H₃N → BF₃  
(iv) (CH₃)₂O + BF₃ → (CH₃)₂O → BF₃  
(a) (i) and (ii)  
(b) (i), (iii), and (iv)  
(c) (ii) and (iv)  
(d) (i) and (iii)  

12. Si₈O₁₈³⁻ unit is an example of:
(a) 3D 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.?
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? ($A$ = central atom and $X$ = 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$_2$  
(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 are:
(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) $O_2^+$, $O_2^-$  
(iii) NO$^-_2$ or $O_2$  
(iv) $X=S-Y$ 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$_3$Cl and BCl$_2$F from the reaction between BF$_3$ and BCl$_3$?

(a) [Diagram of transition state]
(b) [Diagram of transition state]
(c) Both (a) and (b)  
(d) None of these

22. Which of the following bond has the highest energy?
(a) Se-Se  
(b) Te-Te  
(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-orbital)  
(f-orbital)

24. The decreasing order of bond angle is:
(a) NO$_2^+$ > NO$_3^+$ > NO$_2^-$  
(b) NO$_2^- > NO_2^+ > NO_2^-$  
(c) NO$_2^- > NO_2^+ > NO_2^- > NO_2^-$  
(d) NO$_2^- > NO_2^+ > NO_2^- > NO_2^-$

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 $O_2^2^-$, $O_2^-$, $O_2^-$, and $O_2^2^-$ follows the order:
(a) $O_2^- > O_2^- > O_2^- > O_2^- > O_2^-$  
(b) $O_2^- > O_2^- > O_2^- > O_2^-$  
(c) $O_2^- > O_2^- > O_2^- > O_2^-$  
(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) NH₃ and NH₂
(c) SO₂⁻ and BF₄⁻
(d) NH₂ and BF₂

31. Among KO₂, electron, BaO₂, and NO₃⁻, unpaired electron is present in:
(a) NO₃⁻ and BaO₂
(b) KO₂ and AlO₅
(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:
(I) K₂CO₃ (II) MgCO₃ (III) CaCO₃ (IV) BeCO₃
(a) I < II < III < IV
(b) IV < II < III < I
(c) IV < III < II < I
(d) II < IV < III < I

35. Which has triangular planar shape?
(a) CH₃⁺
(b) ClO₂⁻
(c) H₂O⁺
(d) ClO₇⁻

36. Highest covalent character is found in which of the following?
(a) CaF₂
(b) CaCl₂
(c) CaBr₂
(d) CaI₂

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 P₂O₆
(b) Lesser than that of in P₂O₆
(c) Equal to that of in P₂O₆
(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
(d) A plane perpendicular to the molecular plane which contains the carbon—carbon σ-bond

40. The state of hybridization of boron and oxygen atom in boric acid (H₃BO₃) is respectively:
(a) sp², sp³
(b) sp³, sp³
(c) sp³, sp²
(d) sp³, 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 < NH₃ < BF₃ < SiH₄
(b) NH₃ < H₂S < SiH₄ < BF₃
(c) H₂S < NH₃ < SiH₄ < BF₃
(d) H₂S < SiH₄ < NH₃ < BF₃

43. \[
\begin{array}{c}
\text{Cl}
\text{Cl}
\text{Cl}
\text{Cl}
\end{array}
\]

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:
\[
\begin{array}{c}
\text{Cl}
\text{Cl}
\text{Cl}
\text{Cl}
\end{array}
\]

\[
\begin{array}{c}
\text{Cl}
\text{F}
\text{F}
\text{F}
\end{array}
\]

(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 S₂N-2 and S₄N-1 mechanisms, respectively?
(A) P₂O₁₀, SiCl₄
(B) NCl₃, 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 O₁ > K₂O > Ba₂O₃ > K₂O
(d) pH of aqueous solution LiCl < BaCl₂ > 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:
65. Compare $x$ and $y$ bond angle from the above given molecules:
(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) $\text{PO}_2\text{H}$
(b) $\text{PMe}_3\text{O}$
(c) Both are equally basic
(d) None of these

67. Select the correct order of Lewis basic strength for exocyclic carbonyl oxygen:
(a) $\text{H}_2$
(b) $\text{Li}_2$
(c) $\text{F}_2$
(d) $\text{O}_2$

68. If the π-back bonding involves the vacant orbital of the central atom, then the bond angle gets widened due to:
(a) The increased $bp/bp$ repulsion for the enhanced bond multiplicity
(b) The decreased of $lp/lp$ and $bp/bp$ repulsion(s)
(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

70. Calculate the % $p$-character in the orbital occupied by the lone pairs in water molecule:
[Given: $\angle \text{HOH} = 104.5^\circ$ 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. Hybridization 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 electrons?
(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) $[\text{NF}_3,\text{HN}_3]$ and $[\text{H}_2\text{O}^+,\text{BF}_3]$

77. Which of the following statement is correct for CsBr$_2$?
(a) It is a covalent compound
(b) It contains Cs$^+$ and Br$^-$ ions
(c) It contains Cs$^+$ and Br$_3^-$ ions
(d) It contains Cs$^+$, Br$^-$ and lattice 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 BC₃ is:
   (a) dsp², dsp³, sp³, sp²
   (b) sp³, dsp², sp³,d, sp²
   (c) dsp², sp³, dsp³, sp²
   (d) dsp², sp³, dsp², sp²

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 P₄O₁₀⁻?
   (a) Tetra-meta phosphoric acid
   (b) Hypophosphoric acid
   (c) Pyrophosphoric acid
   (d) Tetro polyphosphoric acid

84. Which of the following overlapping is used for the formation of 3C–2e⁻ bond in chain polymer of BeMe₂?
   (a) sp - sp - sp
   (b) sp² - sp² - sp²
   (c) sp² - sp³ - sp²
   (d) sp⁻² - sp⁻³ - sp²

85. Cl⁻ Be⁺ Cl⁻ Be⁺ Cl⁻ Be⁺ Cl⁻
   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:
   
   [Image of molecules]
   (a) x > z > y
   (b) y > z > x
   (c) z > y > x
   (d) y > x > z

87. Select the correct order of bond angle in following molecules:
   
   [Image of molecules]
   (a) x < y
   (b) y < x
   (c) x = y
   (d) None of these

88. [Be(OCH₂)₃]₄⁻ 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 [BeF₃]⁺ 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) CH₄
   (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(2p) orbital
   (c) π2p₂ orbital
   (d) π2p₂ 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 d-orbital participation generally requires to bond with highly electronegative elements
   (d) PF₃ does not exist but PCl₅, PF₅ exist through the formation of sp²d⁵ hybridization
95. Select the incorrect statement:
(a) [SiH₆]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−ᵧ² and pₓ orbital along x-axis.
Statement-2: Zig-zag geometry would be suggested for the [I(CN)₂]⁻.

<table>
<thead>
<tr>
<th>(a) T</th>
<th>(b) F</th>
</tr>
</thead>
<tbody>
<tr>
<td>(c) T</td>
<td>(d) F</td>
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</tbody>
</table>

97. Select the correct statement:
(a) The S — F bond length is longer in SF₆ compared to that in SF₂
(b) In PCl₅ axial bonds are smaller than that of equatorial bonds
(c) In IF₅ 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 atom increases, the difference in energy between successive MOs in Na (Naₙ) 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 disubstituted borazine molecule B₃N₃H₄X₂
(III) Borazine is more reactive towards addition reactions than benzene
(IV) Banana bonds in B₂H₆ are longer but stronger than normal B—H bonds

<table>
<thead>
<tr>
<th>(a) I, II, and III</th>
<th>(b) I, II, and IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>(c) I, II, III, and IV</td>
<td>(d) only II</td>
</tr>
</tbody>
</table>

102. Which of the following statements are correct for the compound C₃N₃(N₃)₂?

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 e-orbital and p-orbital, with the increase of p-character, the bond angle decreases
(b) H — C — H bond angle > H — C — F bond angle in CH₃F molecule
(c) F — C — F bond angle > H — C — F bond angle in CH₃C 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) PCl₅

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) H — C — H < C — H < C — H (order of C — H bond distance)
(c) H — C — H < 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 BF₃ is shorter than that of BF₄
   (b) OCl₂ has 2pₓ–3dₓ back bonding
   (c) (AlCl₃)₂ is not electron deficient but (Al(Me)₃)₂ is electron deficient
   (d) In B₂H₆, all the hydrogens are not identical

7. Select the correct order of first ionization potential:
   (a) N₂ > O₂  (b) N₂ > O
   (c) O > O₂  (d) O₂ = N₂

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) SnCl₂ is a good oxidizing agent
   (d) All are incorrect

9. Which of the following molecule(s) has/have zero dipole moment?
   (a) CH₄  (b) CBr₄
   (c) C₂H₂  (d) None of these

10. Which of the following molecules have zero dipole moment and tetrahedral structure?
    (a) CCl₄  (b) SnCl₂
    (c) SnCl₄  (d) CO₂

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–π 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) Ca₃Si₂O₅ 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) ICl₃  (b) H₂O
    (c) XeF₂  (d) I²

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

16. If z is internuclear axis, then which type of overlapping is/are not possible?
    (a) s and pₓ  (b) s and pᵧ
    (c) pₓ + pₓ  (d) pₓ + pᵧ

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

18. Which of the following is/are true for B₂ and C₃ 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) B₂ is paramagnetic and C₃ 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) B₂H₆ is non-planar  (b) B₂H₆ is non-polar
    (c) B₂H₆ is σ-deficient
    (d) B₂H₆ has two 3C–2e 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 $P_4O_{10}$
(c) It has a cage-like structure
(d) It has $p-n - d_4$ bonding

24. Select the correct order of acidic nature of non-metal oxide:
(a) CO > CO$_2$
(b) CO$_2$ > CO
(c) CO$_2$ > SiO$_2$
(d) CO$_2$ < SiO$_2$

25. Select the correct order of acidic nature of non-metal oxide:
(a) SO$_4$ > SO$_3$
(b) SO$_3$ > SO$_2$
(c) NO < NO$_2$
(d) NO > NO$_2$

26. Select the correct order of acidic nature of metal oxide:
(a) MnO < Mn$_2$O$_4$ < Mn$_2$O$_3$ < Mn$_2$O$_7$
(b) CrO < Cr$_2$O$_3$ < Cr$_2$O$_7$
(c) MnO < Mn$_2$O$_3$ < Mn$_2$O$_4$ < Mn$_2$O$_7$
(d) CrO < Cr$_2$O$_3$ < Cr$_2$O$_7$

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) $H-C\equiv O$ and $HC\equiv O^-$ (pair II)

29. Select the correct order of lattice energy:
(a) LiF < LiBr < LiI
(b) LiCl > LiBr > LiI
(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$_3$O$^+$
(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$^-$ is/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) Super oxide 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$_2$O$_2$

37. Which is/are not correct for B$_2$H$_6$ 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$_2$]$^+$ and [BH$_4$]$^-$. 
38. Which of the following is/are neutral oxide?
(a) CO  (b) ZnO  
(c) N₂O  (d) SnO₂

39. Which of the following acids contain P in 5+ oxidation state?
(a) Orthophosphoric acid  (b) Metaphosphoric acid  
(c) Phosphoric acid  (d) Pyrophosphoric acid

40. Which of the following can act as Lewis acid?
(a) SiF₄  (b) SnCl₄  
(c) CCl₄  (d) SF₄

41. Which of the following molecules is/are diamagnetic?
(a) Li₂  (b) H₂  
(c) N₂  (d) H₂⁺

42. Which of the following oxides are amphoteric?
(a) HgO  (b) ZnO  
(c) PbO₂  (d) SiO₂

43. Which of the following is/are paramagnetic?
(a) H₂  (b) H₂⁺  
(c) H₂  (d) H₂⁻

44. Select the correct statement(s):
(a) PbCl₄, FeCl₃ do not exist while PbCl₂, FeCl₄ exist  
(b) PbCl₂, FeCl₃ do not exist while PbCl₄ exist  
(c) CO₂ is gaseous while SiO₂ is solid  
(d) CO₂ is solid while SiO₂ gaseous

45. Select the correct order (for hydrolysis at room temperature):
(a) SiCl₄ < CCl₄  (b) CCl₄ < SiCl₄  
(c) NCl₃ < NF₃  (d) NCl₃ > NF₃

46. Select the correct order (for hydrolysis at room temperature):
(a) SF₄ < SF₆  (b) SF₄ > SF₆  
(c) TeF₆ > SeF₆  (d) TeF₆ < SeF₆

47. Select the correct statement(s):
(a) The e⁻ cloud of cation will get deformed by that of the anion, but as the electrons in the cation are much more tightly bond due to excess positive charge on cation so distortion is negligible  
(b) With the increase of polarization, the degree of covalency increases  
(c) With the increase of ionic potential, the polarizing power of the cation increases  
(d) With the decrease of ionic potential the polarizing power of the cation increases

48. Select the correct statement(s):
(a) With the decrease of the size of the cation, the polarizing power increases

(b) With the decrease of positive charge on the cation, the polarizing power of cation increases

(c) If the inner electron is very much efficient to screen the valence electrons, then the effective nuclear charge experienced by outermost electron is less

(d) With the increase of positive charge on the cation, the polarizing power of cation increases

49. Select the correct order of polarizing power of cations when their size are almost same:
(a) Na⁺ > Cu⁺  (b) Cu⁺ > Na⁺  
(c) K⁺ > Ag⁺  (d) Ag⁺ > K⁺

50. Select the correct statement(s):
(a) For the same charge and the same size, a pseudo noble gas type cation with 18 e⁻ in the outermost shell is more polarizing than the cation of noble gas type with 8 e⁻ in the outermost shell  
(b) The degree of covalency increases in descending a group in the transition metal ions for a particular oxidation state

(c) Size increases in descending a group in the transition metal ions for a particular oxidation state  
(d) Covalency decreases in descending a group in the transition metal ions for particular oxidation

51. Select the correct statement(s):
(a) The larger ions with more negative charges are more polarizable  
(b) The polarizability sequence is I⁻ > Br⁻ > Cl⁻ > F⁻  
(c) The covalency runs in the order ZnCl₂ < CdCl₂ < HgCl₂  
(d) The polarizing power among the transition series varies as follows: 3d-series < 4d-series < 5d-series

52. Select the incorrect order for the given properties:
(a) Thermal stability : BaSO₄ > SrSO₄ > CaSO₄  
(b) Solubility : BaSO₄ > SrSO₄ > CaSO₄  
(c) Thermal stability : Li₂CO₃ < Na₂CO₃ < K₂CO₃  
(d) Solubility : Li₂CO₃ > Na₂CO₃ > K₂CO₃

53. Select the correct order of their thermal stability:
(a) LiF > NaF > KF > RbF > CsF  
(b) KF > KCl > KBr > KI  
(c) LiCl > NaCl > KCl > RbCl > CsCl  
(d) Li₃O > Na₃O > K₃O > Rb₃O

54. Which of the following order is/are correct for acidic nature of oxides?
(a) Li₂O > Na₂O > K₂O > Rb₂O  
(b) MgO > CaO > SrO > BaO
55. Which of the following oxides are amphoteric?
(a) ZnO
(b) BeO
(c) Al₂O₃
(d) PbO₂

56. Select the correct statement(s):
(a) The overlap becomes better when the overlapping orbitals have comparable energy
(b) The order of increasing tendency of polymerization is: SiO₄⁴⁻ > PO₄³⁻ > SO₄²⁻ > ClO₄⁻
(c) With the increase in positive oxidation state the energy of the 3d-orbitals gradually decreases and it favours the π-bonding interaction
(d) The system where the π bonding is not effective, the stabilization is attained through the single bonded structure, i.e., through the polymerization

57. Which of the following molecules gives only acid(s) on hydrolysis?
(a) PCl₃
(b) SF₄
(c) NCl₃
(d) P₄O₁₀

58. Which of the following species have the same bond order?
(a) CN⁻, N₂
(b) N₂⁺, N₃⁻
(c) N₂⁻, O₂
(d) NO, N₂⁺

59. Which of the following conversions do not represent the process of dimerization?
(a) BeH₂ → BeH₂ (solid)
(b) S₂O₃²⁻ → S₄O₆²⁻
(c) NO → N₂O₂
(d) Cl₂O₅ → Cl₂O₈

60. Select the correct options for following statement(s):
(a) sp³-hybrid orbitals are at 90° to one another
(b) sp²d₂ adjacent hybrid orbitals are at 90° to one another
(c) sp²-hybrid orbitals are at 120° to one another
(d) Bond order of N-O bond in NO₂ is \( \frac{1}{3} \)

61. Which of the following species/molecules have the same shape but different hybridization?
(a) XeF₂, CO₂
(b) I⁻, HgCl₂
(c) OCl⁻, CO
(d) SO₂, OCl₂

62. Select the correct statement(s):
(a) The crystal structure of NaHCO₃ and KHCO₃ both show hydrogen bonding, but are different. In NaH-
CO₃ the HCO₃⁻ ions are linked into an infinite chain, while in KHCO₃ a dimerization is formed
(b) The BeX₂ molecules polymerize to form chains containing bridging halogen groups; for example, in (BeF₂)ₙ and (BeCl₂)ₙ each halogen forms one normal covalent bond and uses a lone pair to form a coordinate bond.
(c) [Be(Me₂)₂] has essentially the same structure as [BeCl₂], but the bonding in the methyl compound is best regarded as three center two electron bonds covering one Me and Be atoms
(d) Beryllium salts are acidic when dissolved in pure water because the hydrated ion hydrolyzed producing H₂O⁺

63. Select the correct order for the given properties:
(a) MgC₂O₄ > CaC₂O₄ > SrCu₂O₄ > BaCu₂O₄
(b) K₂CO₃ > MgCO₃ > CaCO₃ > SrCO₃
(c) KO₃ > Rb₂O > Cs₂O
(d) LiNO₃ < NaNO₃ < KNO₃ < CsNO₃

64. Select the correct statements:
(a) More electronegative atom prefers the hybrid orbital of the central atom in which the s-character is less
(b) More electronegative atom prefers the hybrid orbital of the central atom in which the s-character is more
(c) Lone pair prefers to stay with that hybrid orbital which has less s-character
(d) Lone pair prefers to stay with that hybrid orbital which has more s-character

65. Select the correct order:
(a) Bond strength : NO⁻ > NO > NO⁺
(b) N—O bond angle : NO₂ > NO₂ > NO₃
(c) Thermal stability : LiF > NaF > KF > RbF > CsF
(d) Hydrated size : Be²⁺ (aq) < Mg²⁺ (aq) < Ca²⁺ (aq) < Sr²⁺ (aq) < Ba²⁺ (aq)

66. Select the correct statements:
(a) XeF₆ is linear and XeF₄ is capped octahedral
(b) Xe can only form compounds with the highly electronegative elements