Problems and Solutions in INORGANIC CHEMISTRY for JEE (Main & Advanced)

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V. JOSHI

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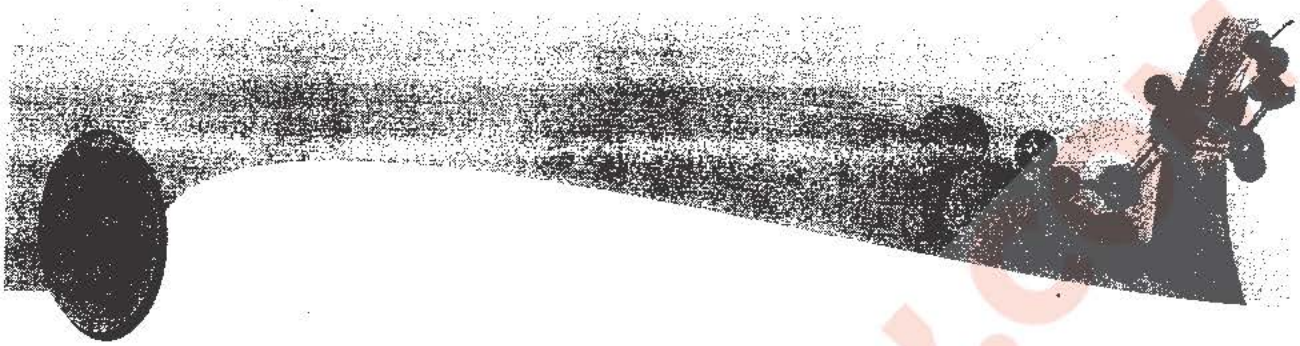


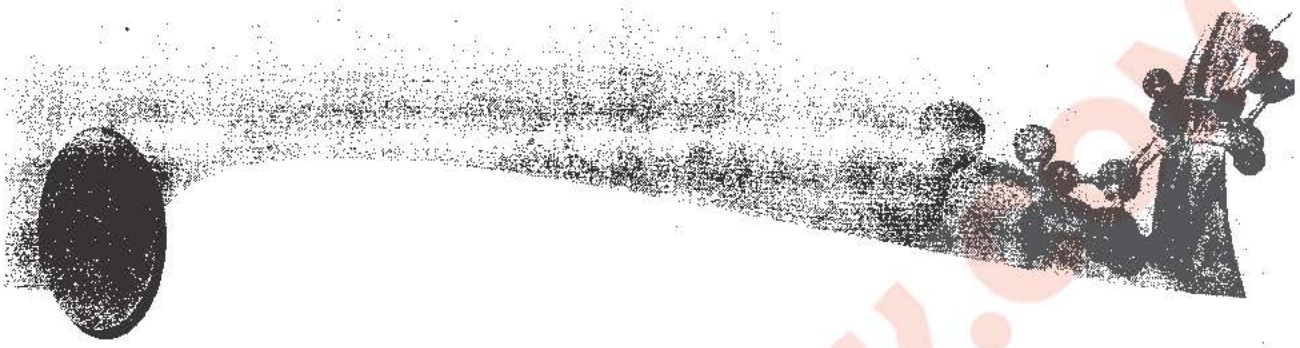
Preface

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.

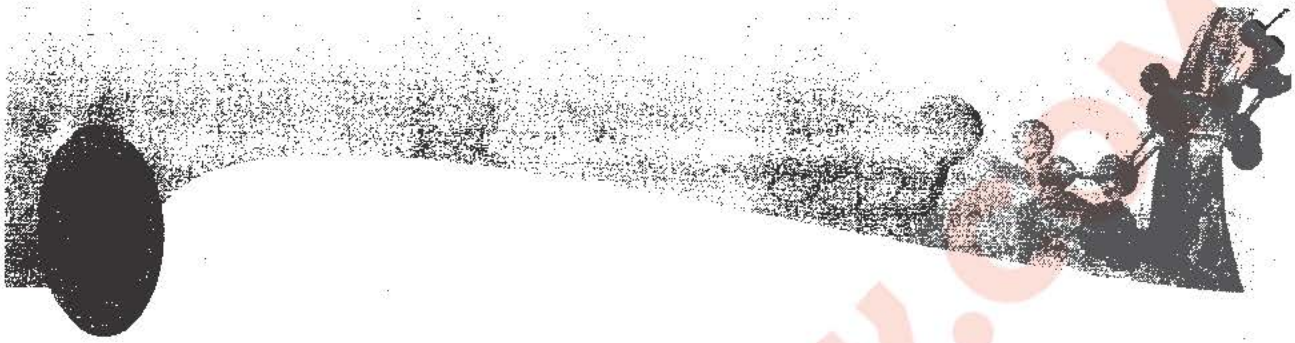
Most of the chapters in the book have been divided into eight sections, and the problems in each section have been designed such that they fulfill both the requirements of an aspirant, i.e., knowledge of subject and practice.

1. Single Correct Answer Type
2. Multiple Correct Answers Type
3. Comprehension Type
4. Assertion-Reasoning Type
5. Matching Column Type
6. Integer Answer Type
7. NCERT Exemplar Exercises
8. Archives (Previous Years' Questions)

V. JOSHI



Contents

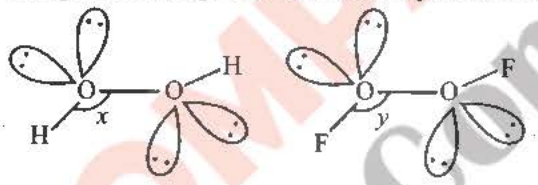


Chemical Bonding (Part-A)

JEE (Main) Exercises

Single Correct Answer Type

1. Compare bond angles for the following molecules:



(a) $x > y$ (b) $y > x$

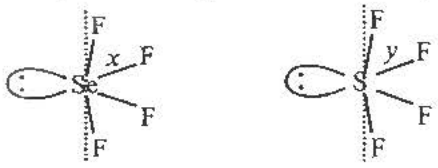
(c) $x = y$ (d) None of these

2. Compare bond lengths for the following molecules:

(a) $x > y$ (b) $y > x$

(c) $x = y$ (d) None of these

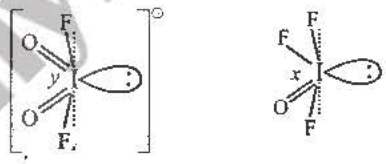
3. Compare bond lengths for the following molecules:



(a) $x > y$ (b) $y > x$

(c) $x = y$ (d) None of these

4.

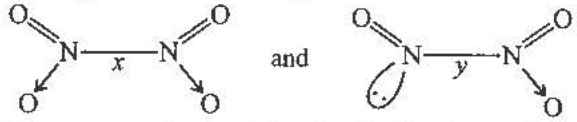


Compare x and y bond lengths for the above given molecules:

(a) $x > y$ (b) $y > x$

(c) $x = y$ (d) None of these

5.

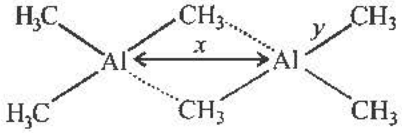


Compare x and y bond lengths for the above given molecules:

(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

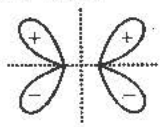
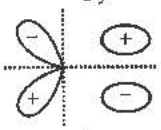
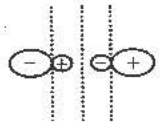
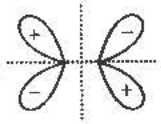
(c) 2D silicate (d) Single-chain silicate

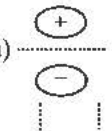
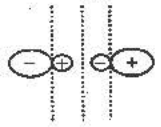
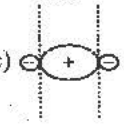
8. Which of the following silicate is called amphibole?

(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

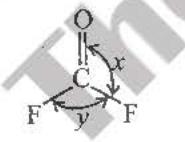
10. Select the correct diagram for the π^*2p_y-orbital:
   (a)  (b) 
   (c)  (d) 

11. Select the correct diagram for the $\sigma 2p_x$-orbital:
   (a)  (b) 
   (c)  (d) None of these

12. Nature of 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) CH_4 (d) Xe

14. The cationic part of solid 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) $\sqrt{\varphi} < 2.1$ (b) $\sqrt{\varphi} = 2.1$ to 3.2
   (c) $\sqrt{\varphi} > 3.2$ (d) None of these

17. Find out the similarities between I_2Cl_6 and Al_2Cl_6:
   (a) Both have 3C — $4e^-$ 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) N_2, O_2^{2+}, NO^+, $\overset{\ominus}{C}N$ (b) N_2^{2-}, O_2, NO^-, NO_2^+
   (c) NO, N_2^-, O_2^+, NO^{2+} (d) All are correct

19. In the hydrolysis of ICl, the products are:
   (a) HI + HCl (b) HI + HOCl
   (c) HCl + HOI (d) HOCl + 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 Al is greater than that of gallium
   (d) $XeF_5^{\oplus}$ 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_L (London force) > E_K (Dipole–dipole interaction)
   (d) All forces are equally strong

23. Which of the following compounds are the common product/s obtained in the hydrolysis of XeF_6 and XeF_4?
   (a) XcO_2F_2 (b) HF
   (c) 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) σ-bond, π-bond, and back-bond all are present together
   (d) Direction of dipole moment is from C to O

25. Find the incorrect match:
   (a) Al_2Cl_6 : 3C-4e bond is present
   (b) $Al_2(CH_3)_6$: All carbon atoms are sp^3-hybridized
   (c) I_2Cl_6 : Nonplanar
   (d) Al_2Br_6 : Nonpolar

26. Which the following interaction form nonbonding molecular orbital when z-axis is the bonding axis?

(a) $d_{yz} + d_{z^2}$ (b) $d_{yz} + d_{xy}$

(c) $d_{x^2-y^2} + d_{xy}$ (d) All form N.B.M.O.

27. Which of the following molecule/species is polar?

(a) O_3 (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_2O_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_2H_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) LiI (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^{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—$\underline{C}OOH$ (b) CH_3—$\underline{C}H_2$—OH

(c) CH_3—$\underline{C}O$—CH_3 (d) $CH_2 = \underline{C}H$—CH_3

43. A square planar complex is formed by hybridization of which atomic orbitals?

(a) s, p_x, p_y, d_{yz} (b) $s, p_x, p_y, d_{x^2-y^2}$

(c) s, p_x, p_y, d_{z^2} (d) s, p_x, p_z, 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 MgH_2 is:

(a) Zero (b) 1

(c) 2 (d) 4

47. Only iodine forms heptafluoride IF_7, but chlorine and bromine give pentafluorides. The reason for this is:

(a) Low electron affinity of iodine

(b) Unusual pentagonal bipyramidal structure of IF_7

(c) That the larger iodine atom can accommodate more number of smaller fluorine atom around it

(d) Low chemical reactivity of IF_7

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) C_2 (b) He_2^+

(c) H_2^+ (d) He_2

50. Which of the following has fractional bond order?

(a) O_2^{2+} (b) O_2^{2-}

(c) F_2^{2-} (d) H_2^-

51. The correct order of a dipole moment is:

(a) $CH_4 < NF_3 < NH_3 < H_2O$

(b) $NF_3 < CH_4 < NH_3 < H_2O$

(c) $NH_3 < NF_3 < CH_4 < H_2O$

(d) $H_2O < NH_3 < NF_3 < CH_4$

52. In water molecule, oxygen is:

(a) *sp*-hybridized (b) sp^3-hybridized

(c) sp^2-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) $F_2 > Cl_2 > Br_2 > I_2$: Bond dissociation energy

(c) $F_2 > Cl_2 > Br_2 > I_2$: Oxidizing power

(d) HI > HBr > HCl > HF: Acidic property in water

55. The species having octahedral shape is:

(a) SF_6 (b) BF_4^-

(c) PCl_5 (d) BO_3^{3-}

56. Which one of the following sets of ions represent a collection of isoelectronic species?

(a) K^+, Cl^-, Ca^{2+}, Sc^{3+} (b) Ba^{2+}, Sr^{2+}, K^+, Ca^{2+}

(c) N^{3-}, O^{2-}, F^-, S^{2-} (d) Li^+, Na^+, Mg^{2+}, Ca^{2+}

57. Which of the following molecules/ions are all the bonds not equal?

(a) SF_4 (b) SiF_4

(c) XeF_4 (d) BF_4^-

58. The decreasing values of bond angles from NH_3 (107°) to SbH_3 (91°) down the group-15 of the periodic table is due to:

(a) Increasing *bp–bp* repulsion

(b) Increasing *p*–orbital character in sp^3

(c) Decreasing *lp–bp* repulsion

(d) 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 < II < I < 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 *X*, 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) $PF_3 = PCl_3 = PBr_3 = PI_3$

(b) $PF_3 < PBr_3 < PCl_3 < PI_3$

(c) $PI_3 < PBr_3 < PCl_3 < PF_3$

(d) $PF_3 < PCl_3 < PBr_3 < PI_3$

63. Which compound among the following has more covalent character?

(a) $AlCl_3$ (b) AlI_3

(c) MgI (d) NaI

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 triangle (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^2, sp^3d (b) sp^3, sp^3
(c) sp^3, sp^3d^2 (d) sp^3, sp^3d

70. Which of the following molecular species has unpaired electron(s)?
(a) N_2 (b) F_2
(c) O_2^- (d) O_2^{2-}

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

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° angles between bond pair–bond pair of electron is observed in:
(a) sp^3d^2-hybridization (b) sp^3d-hybridization
(c) dsp^2-hybridization (d) dsp^3-hybridization

74. Which species is diamagnetic in nature?
(a) He_2^+ (b) H_2
(c) H_2^+ (d) 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) $SnCl_4$

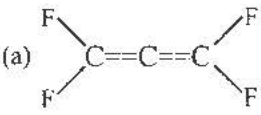
79. Which of the following molecule is planar?
(a) $[I(CN)_2]^-$ (b) PCl_3F_2
(c) PCl_5 (d) SF_4

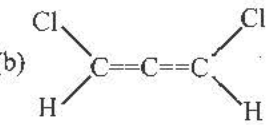
80. Which of the following molecule has sp^3d-hybridization?
(a) SOF_4 (b) SF_4
(c) XeF_3^+ (d) All

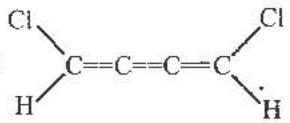
81. Which of the following molecule/ion has a zero dipole moment?
(a) ClF_3 (b) ICl_2^-
(c) SF_4 (d) None of these

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?

(a) 

(b) 

(c) 

(d) None of these

84. What is the hybridization of Xe in cationic part of solid XeF_6?
(a) sp^3d^3 (b) sp^3d
(c) sp^3d^2 (d) sp^3

85. Which of the following molecule(s)/ion(s) are isoelectronic?

(a) CO_2 and N_2O (b) CO_2 and CN_2^{2-}

(c) C_6H_6 and $B_3N_3H_6$ (d) All are isoelectronic

86. Select the correct order of polarizing power of cation?

(a) $Na^+ < Mg^{2+} < Si^{4+} < Al^{3+}$

(b) $Mg^{2+} > Si^{4+} > Al^{3+} > Na^+$

(c) $Na^+ < Mg^{2+} < Al^{3+} < Si^{4+}$

(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:

$\overset{\oplus}{C}H_3$, CH_4, $\overset{\ominus}{C}H_3$

(a) $\overset{\ominus}{C}H_3 > CH_4 > \overset{\oplus}{C}H_3$ (b) $CH_4 > \overset{\ominus}{C}H_3 > \overset{\oplus}{C}H_3$

(c) $\overset{\oplus}{C}H_3 > CH_4 > \overset{\ominus}{C}H_3$ (d) $\overset{\oplus}{C}H_3 = CH_4 = \overset{\ominus}{C}H_3$

89. Which of the following molecule/ion has higher B — O bond length?

(a) H_3BO_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 molecule has $3C - 4e^-$ bond?

(a) Al_2Cl_6 (b) Be_2Cl_4

(c) I_2Cl_6

(d) All are having $3C - 4e^-$ bond

91. Which of the following molecule does not exist?

(a) He_2 (b) $H — H^+$

(c) $He — He^+$ (d) Li_2

92. Certain derivatives of phenol such as Kr $(phenol)_2$, Xe $(phenol)_2$, Rn $(phenol)_2$, 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) $O_2 > O_2^{2-} > O_2^-$ (b) $O_2 > O_2^- > O_2^{2-}$

(c) $O_2 > O_2^{2-} \approx O_2^-$ (d) $O_2 \approx O_2^{2-} \approx O_2^-$

95. Select the correct order of the first ionization potential:

(a) $NO > N_2$ (b) $N_2 > NO$

(c) $NO \approx N_2$ (d) None of these

96. Select the correct order of the first ionization potential:

(a) $F_2 > F$ (b) $F_2 \approx F$

(c) $F > F_2$ (d) None of these

97. Which of the following element does not show inert pair effect?

(a) Tl (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_2O_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

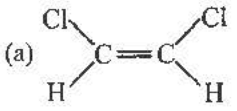
100. Which of the following molecule is not showing zero dipole moment?

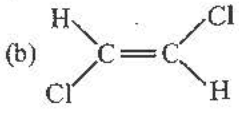
(a) $C_6H_4(NO_2)$ (para) (b) $C_6H_4(CH_3)_2$ (para)

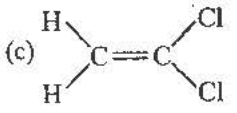
(c) $C_6H_4(OH)_2$ (para)

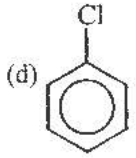
(d) All compounds are showing zero dipole moment

101. Which of the following molecule has almost zero dipole moment?

(a) 

(b) 

(c) 

(d) 

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) $2s$-$2p > 2s$-$2s > 2p$-$2p$ (d) $1s$-$1s > 1s$-$2p > 1s$-$2s$

JEE (Advanced) Exercises

Single Correct Answer Type

1. Which one of the following bonds has the highest bond energy?
   (a) C – C (b) Si – Si
   (c) Ge – Ge (d) Sn – Sn

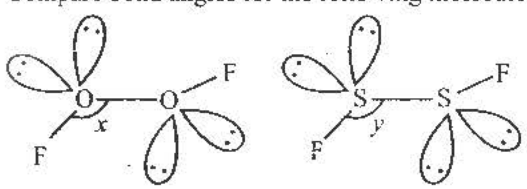
2. Which of the following is incorrect?
   (a) Among Cl, Ar, and K, K has the smallest ionization potential
   (b) Among CH_4, NH_3, and HF, HF has the highest boiling point
   (c) Among Cl_2, Br_2, and I_2, Br_2 has the lowest boiling point
   (d) Among HOI, HOBr, and HOCl, HOI is the weakest acid

3. PCl_5 and PBr_5 exist in sp^3d-hybrid state in gaseous phase. But in solid state, which of the following statement is true?
   (a) P in PCl_5 exists in sp^3-hybridization state, while P in PBr_5 exists in sp^3d^2 and sp^3-hybridization states
   (b) P in PCl_5 and PBr_5 exists in sp^3d^2 and sp^3-hybridization state
   (c) P in PCl_5 exists in sp^3d^2 and sp^3-hybridization states, while P in PBr_5 exists in sp^3-hybridization state
   (d) P in PCl_5 and PBr_5 exists in sp^3-hybridization state

4. Which of the following halide does not exist?
   (a) PbF_4 (b) $PbCl_4$
   (c) PbI_2 (d) PbI_4

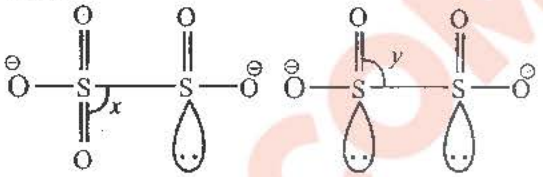
5. If the π-back bonding involves the lone pair of central atom, then bond angle gets opened up due to:
   (a) Increase of *bp/bp* repulsion for the enhanced bond multiplicity
   (b) Decrease of *lp/lp* and *lp/bp* repulsion(s) on the central atom
   (c) Both (a) and (b) (d) None of these

6. Compare bond angles for the following molecules:



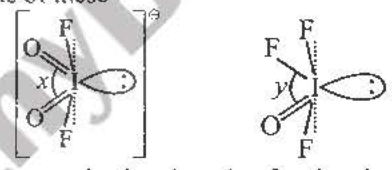
   (a) $x > y$ (b) $y > x$
   (c) $x = y$ (d) None of these

7. Compare S—O bond angle for the following molecules:

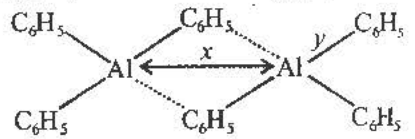


   (a) $x > y$ (b) $y > x$
   (c) $x = y$ (d) None of these

8. Compare $F-\hat{Br}-O$ and $O-\hat{Br}-O$ in $FBrO_3$ molecule:
   (a) $F-\hat{Br}-O > O-\hat{Br}-O$
   (b) $F-\hat{Br}-O < O-\hat{Br}-O$
   (c) $F-\hat{Br}-O = O-\hat{Br}-O$
   (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) $(CH_3)_2O + BF_3 \longrightarrow (CH_3)_2O \rightarrow BF_3$
    (ii) $(SiH_3)_2O + BF_3 \longrightarrow (SiH_3)_2O \rightarrow BF_3$
    (iii) $H_3N + BF_3 \longrightarrow H_3N \rightarrow BF_3$
    (iv) $(CH_3)_2O + BF_4^- \longrightarrow (CH_3)_2O \rightarrow BF_4^-$
    (a) (i) and (ii) (b) (i), (iii), and (iv)
    (c) (ii) and (iv) (d) (ii) and (iii)

12. $Si_6O_{18}^{12-}$ unit is an example of:
    (a) 3D silicate (b) Double chain silicate
    (c) Cyclic silicate (d) 2D silicate

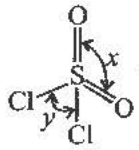
13. Which of the following molecule/ion has higher number of e^- in A.B.M.O.?

(a) O_2^+ (b) O_2^{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 = 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^-

(c) NO^+ (d) N_2O

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_3SiNCS ($\angle$ 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

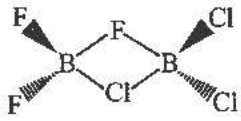
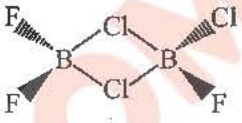
(a) NH_3, O_3^+, O_3, $SOCl_2$

(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_2Cl and BCl_2F from the reaction between BF_3 and BCl_3?

(a)  (b) 

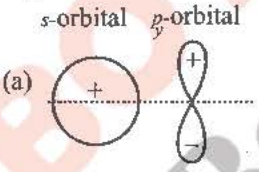
(c) Both (a) and (b) (d) None of these

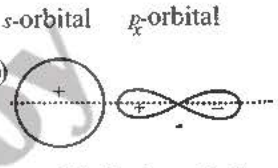
22. Which of the following bond has the highest energy?

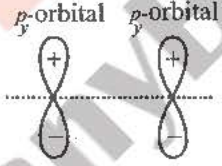
(a) Se—Se (b) Te—Te

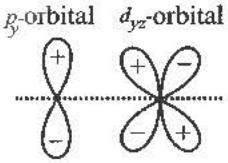
(c) S—S (d) O—O

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

(a) 

(b) 

(c) 

(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 Fajan's rule, polarization is more when:

(a) Small cation and large anion

(b) Small cation and small anion

(c) Large cation and large anion

(d) Large cation and small anion

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

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

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

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

(a) H_2CO_3 (b) SiF_4

(c) BF_3 (d) $HClO_2$

30. Which pair represents isostructural species?
(a) CH_3^- and CH_3^+ (b) NH_4^+ and NH_3
(c) SO_4^{2-} and BF_4^- (d) NH_2^- and BeF_2

31. Among KO_2, electron, BaO_2, and NO_2^+, unpaired electron is present in:
(a) NO_2^+ and BaO_2 (b) KO_2 and AlO_2^-
(c) KO_2 only (d) BaO_2 only

32. Among LiCl, $BeCl_2$, BCl_3, and CCl_4, the covalent bond character follows the order:
(a) LiCl > $BeCl_2$ > BCl_3 > CCl_4
(b) LiCl < $BeCl_2$ < BCl_3 < CCl_4
(c) LiCl > $BeCl_2$ > CCl_4 > BCl_3
(d) LiCl < $BeCl_2$ < BCl_3 > CCl_4

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) K_2CO_3 (II) $MgCO_3$ (III) $CaCO_3$ (IV) $BeCO_3$
(a) I < II < III < IV (b) IV < II < III < I
(c) IV < II < I < III (d) II < IV < III < I

35. Which has triangular planar shape?
(a) CH_3^+ (b) ClO_2^-
(c) H_3O^+ (d) ClO_3^-

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

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

38. In P_4O_{10} molecule, bridging P–O bond length is:
(a) Larger than that of in P_4O_6
(b) Lesser than that of in P_4O_6
(c) Equal to that of in P_4O_6
(d) Cannot be compared

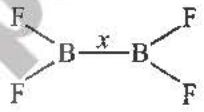
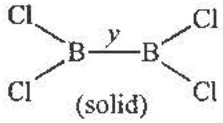
39. The nodal plane in the π-bond of ethene is located in:
(a) The molecular plane
(b) A plane parallel to the molecular plane
(c) A plane perpendicular to the molecular plane which bisects the carbon–carbon σ-bond at right angle
(d) A plane perpendicular to the molecular plane which contains the carbon–carbon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

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

41. Which of the following has regular tetrahedral shape?
(a) I_3^- (b) SF_4
(c) $[BF_4]^-$ (d) XeF_4

42. The correct order of bond angles is:
(a) $H_2S < NH_3 < BF_3 < SiH_4$
(b) $NH_3 < H_2S < SiH_4 < BF_3$
(c) $H_2S < NH_3 < SiH_4 < BF_3$
(d) $H_2S < SiH_4 < NH_3 < BF_3$

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:


(solid)
(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 tetrathionate?
(a) 4 (b) 3
(c) 2 (d) 1

46. Find the maximum number of atoms that lie in the same plane in PCl_5 molecule:
(a) 3 (b) 5
(c) 4 (d) 2

47. In which of the following cases hydrolysis takes place through S_N2 and S_N1 mechanism, respectively?
(A) P_4O_{10}, $SiCl_4$ (B) NCl_3, NF_3
(C) $SiCl_4$, SiF_4 (D) SF_4, TeF_6

48. What may be the geometry of molecule if AX_3 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 O_2 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 N_2 both have different bond order

(d) CO and N_2 both have same bond order

52. Select the correct order of first ionization potential:

(a) $N > O_2$ (b) $O_2 > N$

(c) $O_2 = N$ (d) None of these

53. Select the correct order of first ionization potential:

(a) $N > N_2$ (b) $N < N_2$

(c) $N \approx N_2$ (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 $O^+ > O > O_2^{2-} > O^{2-}$

(c) Order of oxidation number of oxygen $O_3 > KO_2 > BaO_2 > K_2O$

(d) pH of aqueous solution $LiCl > BeCl_2 > MgCl_2 > AlCl_3$

56. Given the species N_2, CO, NO^+, and CN^- which of the following statements are true for this:

(I) All the species are diamagnetic

(II) All the species are isostructural

(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) XeO_3 : Trigonal bipyramidal

(b) ClF_3 : Bent T-shape

(c) $XeOF_4$: Square pyramidal

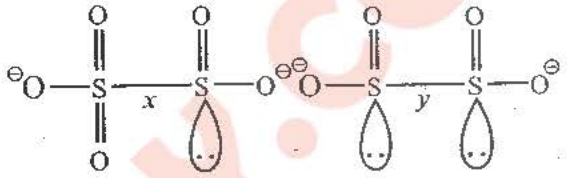
(d) XeF_2 ; Linear shape

58. The bond order of CO molecule on the basis of molecular orbital theory is:

(a) Zero (b) 2

(c) 3 (d) 1

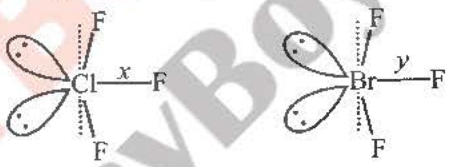
59. Compare S—S bond length from the following molecules:



(a) $x > y$ (b) $y > x$

(c) $x = y$ (d) None of these

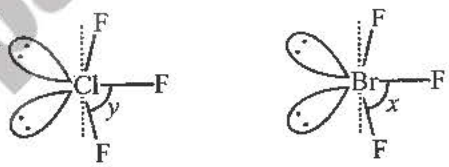
60. Compare bond length from the following molecules:



(a) $x > y$ (b) $y > x$

(c) $x = y$ (d) None of these.

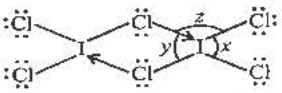
61. Compare bond angle from the following molecules:



(a) $x > y$ (b) $y > x$

(c) $x = y$ (d) None of these

62.

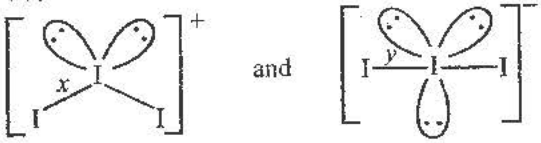


Compare x, y, z bond angle from the above given molecule:

(a) $x > y > z$ (b) $x > z > y$

(c) $y > x > z$ (d) $z > y > x$

63.

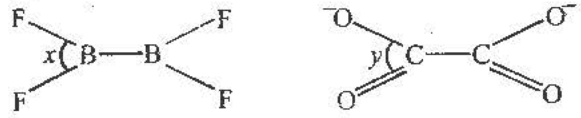


Compare bond length from the above given molecules:

(a) $x > y$ (b) $y > x$

(c) $x = y$ (d) None of these

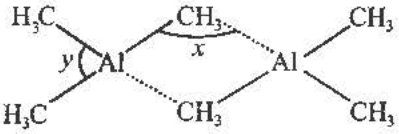
64.



Compare x and y bond angle from the above given molecules:

(a) $x > y$ (b) $y > x$

(c) $x = y$ (d) None of these

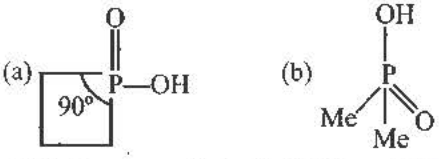
65. 

Compare x and y bond angle from the above given molecule:

(a) $x > y$ (b) $y > x$

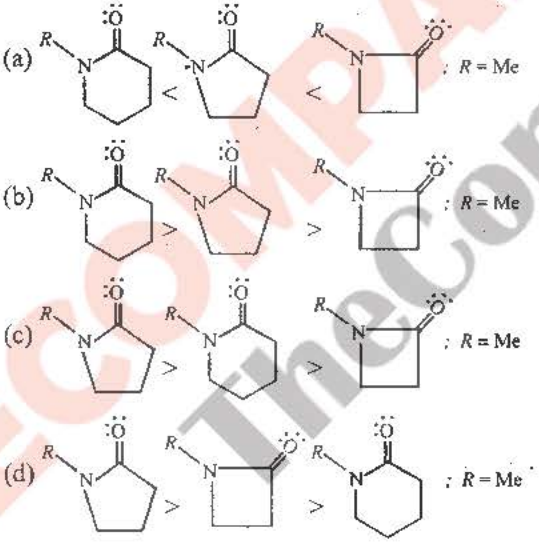
(c) $x = y$ (d) None of these

66. Which of the following compound is more basic with respect to exocyclic carbonyl oxygen?



(c) Both are equally basic (d) None of these

67. Select the correct order of Lewis basic strength for exocyclic carbonyl oxygen:



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 *lp/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

(c) Amphibole (d) Ortho silicate

70. Calculate the % *p*-character in the orbital occupied by the lone pairs in water molecule:

[Given: $\angle$ HOH is 104.5° and cos (104.5) = – 0.25]

(a) 80% (b) 20%

(c) 70% (d) 75%

71. Correct order for the boiling point between CCl_4 and $SiCl_4$:

(a) $CCl_4 > SiCl_4$ (b) $SiCl_4 > CCl_4$

(c) $SiCl_4 = CCl_4$ (d) None of these

72. Hybridization of central atom is independent of the phase/state of the compound in case of:

(a) BeH_2 (b) N_2O_5

(c) XeF_6 (d) PF_5

73. Select the correct order for I.E.:

(a) $CO > N_2$ (b) $N_2 > CO$

(c) $N_2 < O_2$ (d) $N < O$

74. Which of the following molecules has the weakest bond?

(a) H_2 (b) Li_2

(c) F_2 (d) O_2

75. Which of the following molecule/ion does not contain unpaired electrons?

(a) O_2^{2-} (b) B_2

(c) N_2^+ (d) O_2

76. Among the following species, identify the isostructural pairs:

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

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

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

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

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

77. Which of the following statement is correct for $CsBr_3$?

(a) It is a covalent compound

(b) It contains Cs^{3+} and Br^- ions

(c) It contains Cs^+, and Br_3^- ions

(d) It contains Cs^+, Br^- and lattice Br_2 molecule

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 NH_3, $[PtCl_4]^{2-}$, PCl_5 and BCl_3 is:

(a) dsp^2, dsp^3, sp^2, sp^3 (b) sp^3, dsp^2, sp^3d, sp^2

(c) dsp^2, sp^2, sp^3, dsp^3 (d) dsp^2, sp^3, sp^2, dsp^3

81. Specify the coordination geometry around and hybridization of N and B atom in a 1 : 1 complex of BF_3 and NH_3:

(a) N : tetrahedral, sp^3; B : tetrahedral, sp^3

(b) N : pyramidal, sp^3; B : pyramidal, sp^3

(c) N : pyramidal, sp^3; B : planar, sp^2

(d) N : pyramidal, sp^3; B : tetrahedral, sp^3

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 P_4O_{10}?

(a) Tetrameta phosphoric acid

(b) Hypophosphoric acid

(c) Pyrophosphoric acid

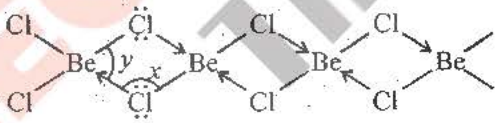
(d) Tetra polyphosphoric acid

84. Which of the following overlapping is used for the formation of $3C - 2e^-$ bond in chain polymer of $BeMe_2$?

(a) sp - sp - sp (b) sp^2 - sp^2 - sp^2

(c) sp^2 - sp^3 - sp^2 (d) sp^3 - sp^3 - sp^3

85.

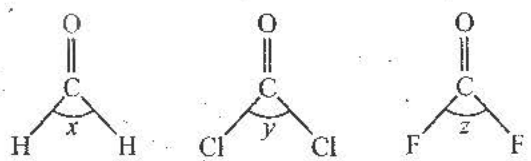


Compare x and y bond angle in above molecule:

(a) $x > y$ (b) $y > x$

(c) $x = y$ (d) None of these

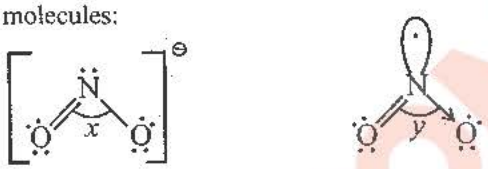
86. Select the correct order of bond angle in following molecules:



(a) $x > z > y$ (b) $x > y > z$

(c) $z > y > x$ (d) $y > x > z$

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



(a) $x < y$ (b) $y < x$

(c) $x = y$ (d) None of these

88. $[Be(OCH_3)_2]_n$ is a high polymer, and is soluble in hydrocarbon solvent. Which type of bond is present in this polymer?

(a) $3C\text{-}2e^-$ (b) $3C\text{-}4e^-$

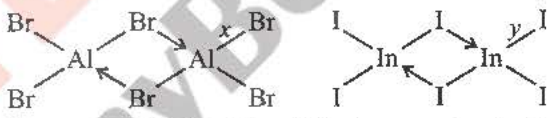
(c) $2C\text{-}3e^-$ (d) None of these

89. Which type of bond is present in $[BeF_2]_n$ 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) CH_4 (b) SiH_4

(c) GeH_4 (d) SnH_4

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 N_2 molecule is present in:

(a) $\sigma(2s)$ orbital (b) $\overset{*}{\sigma}(2S)$ orbital

(c) $\overset{*}{\pi} 2p_y$ orbital (d) $\pi\, 2p_y$ 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) PH_5 does not exist but PCl_5, PF_5 exist through the formation of sp^3d^2 hybridization

95. Select the incorrect statement:
(a) $[SiH_6]^{2-}$ has sp^3d^2 hybridization
(b) PF_5 has sp^3d-hybridization
(c) SF_6 has sp^3d^2-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 it is false:
Statement-1: π bond is formed by sideways overlapping of $d_{x^2-y^2}$ and p_y orbital along x-axis.
Statement-2: Zig-zag geometry would be suggested for the $[I(CN)_2]^-$.
(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 SF_6 compared to that in SF_2
(b) In PCl_5 axial bonds are smaller than that of equatorial bonds
(c) In IF_7 axial bonds are longer than that of equatorial bonds
(d) All are correct

98. Select the correct order of first ionization potential:
(a) $O_2 > NO$ (b) $O_2 < NO$
(c) $O < NO$ (d) $O = NO$

99. Select the correct order of first ionization potential:
(a) $O_2^{2+} > O_2$ (b) $O_2^{2+} < O_2$
(c) $O_2 \approx O_2$ (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 $(Na)_n$ 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 $B_3N_3H_4X_2$
(III) Borazine is more reactive towards addition reactions than benzene
(IV) Banana bonds in B_2H_6 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 $C_3N_3(N_3)_3$?
(I) It contains three pi bonds
(II) Its structure is planar
(III) C and N atoms are sp^2-hybridized in the ring
(IV) N_3^- 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. N_2H_4 (hydrazine) combines with $(CH_3)_3N$ via:
(a) An ionic bond (b) A coordinate bond
(c) A covalent bond
(d) Combination is not possible

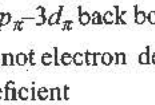
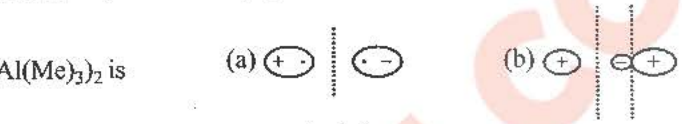
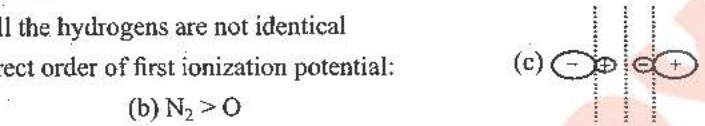
Multiple Correct Answers Type

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—$\hat{C}$—H bond angle > H—$\hat{C}$—F bond angle in CH_3F molecule
(c) F—$\hat{C}$—F bond angle > H—$\hat{C}$—F bond angle in CHF_3 molecule
(d) All are correct statement

2. Which of the following molecule(s) is/are having pyramidal structure?
(a) PH_3 (b) $P(SiH_3)_3$
(c) NH_3 (d) PCl_2^+

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—H (order of C—H bond distance)
(c) ≡C—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 $2p_\pi$–$3d_\pi$ back bonding
   (c) $(AlCl_3)_2$ is not electron deficient but $(Al(Me)_3)_2$ is electron deficient
   (d) In B_2H_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) $O_2 \approx N_2$
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) has/have zero dipole moment?
   (a) CH_4 (b) CBr_4
   (c) C_2H_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) $Ca_3Si_3O_9$ 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_2O
   (c) XeF_2 (d) $I_3^\ominus$
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 p_x (b) s and p_y
   (c) $p_x + p_z$ (d) $p_y + p_z$
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 B_2 and C_2 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_2 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_2H_6 is non-planar (b) B_2H_6 is non-polar
   (c) B_2H_6 is e^- deficient
   (d) B_2H_6 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%-character in P—O bond than the P_4O_6
(c) It has a cage-like structure
(d) It has $p_\pi - d_\pi$ 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) $SO_2 > SO_3$ (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) $MnO < Mn_3O_4 < Mn_2O_3 < Mn_2O_7$
(b) $CrO < Cr_2O_3 < CrO_3 < CrO_2$
(c) $MnO < Mn_2O_3 < Mn_3O_4 < Mn_2O_7$
(d) $CrO < Cr_2O_3 < CrO_2 < CrO_3$

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(=O)$O^\ominus$ (pair II)
(a) HNO_3 has greater resonance in pair (I)
(b) NO_3^- has greater resonance in pair (I)
(c) $H_2C=O$ has greater resonance in pair (II)
(d) H—C(=O)—$O^\ominus$ has greater resonance in 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_3O^+
(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_5 (d) BF_3

36. The species that contain peroxide ions is/are:
(a) KO_2 (b) SrO_2
(c) BaO_2 (d) Na_2O_2

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 $[BH_2]^+$ and $[BH_4]^-$

38. Which of the following is/are neutral oxide?
(a) CO (b) ZnO
(c) N_2O (d) SnO_2

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

40. Which of the following can act as Lewis acid?
(a) SiF_4 (b) $SnCl_4$
(c) CCl_4 (d) SF_4

41. Which of the following molecules is/are diamagnetic?
(a) Li_2 (b) B_2
(c) C_2 (d) N_2

42. Which of the fallowing oxides are amphoteric?
(a) HgO (b) ZnO
(c) PbO_2 (d) SnO_2

43. Which of the following is/are paramagnetic?
(a) H_2^+ (b) H_2^-
(c) H_2 (d) He_2^+

44. Select the correct statement(s):
(a) PbI_4, FeI_3 do not exist while $PbCl_4$, $FeCl_3$ exist
(b) $PbCl_4$, $FeCl_3$ do not exist white PbI_4, FeI_3 exist
(c) CO_2 is gaseous while SiO_2 is solid
(d) CO_2 is solid while SiO_2 gaseous

45. Select the correct order (for hydrolysis at room temperature):
(a) $SiCl_4 < CCl_4$ (b) $CCl_4 < SiCl_4$
(c) $NCl_3 > NF_3$ (d) $NCl_3 < NF_3$

46. Select the correct order (for hydrolysis at room temperature):
(a) $SF_4 < SF_6$ (b) $SF_4 > SF_6$
(c) $TeF_6 > SeF_6$ (d) $TeF_6 < SeF_6$

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 electrons are very much efficient to screen the valence electrons, then the effective nuclear charge experienced by outermost electron is less
(d) With the increases 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 anions with more negative charges are more polarizable
(b) The polarizability sequence is $I^- > Br^- > Cl^- > F^-$
(c) The covalency runs in the order $ZnCl_2 < CdCl_2 < HgCl_2$
(d) The polarizing power among the transition series varies as follows: 3*d*-series < 4*d*-series < 5*d*-series

52. Select the incorrect order for the given properties:
(a) Thermal stability : $BaSO_4 > SrSO_4 > CaSO_4$
(b) Solubility : $BaSO_4 > SrSO_4 > CaSO_4$
(c) Thermal stability : $Li_2CO_3 < Na_2CO_3 < K_2CO_3$
(d) Solubility : $Li_2CO_3 > Na_2CO_3 > K_2CO_3$

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) $Li_2O > Na_2O > K_2O > Rb_2O$

54. Which of the following order is /are correct for acidic nature of oxides?
(a) $Li_2O > Na_2O > K_2O > Rb_2O$
(b) MgO > CaO > SrO > BaO

(c) NiO > MgO > SrO > BaO

(d) Al_2O_3 > MgO > SrO > BaO

55. Which of the following oxides are amphoteric?

(a) ZnO (b) BeO

(c) Al_2O_3 (d) Pb_2O_3

56. Select the correct statement(s):

(a) The overlap become better when the overlapping orbitals have comparable energy

(b) The order of increasing tendency of polymerizations $SiO_4^{4-} > PO_4^{3-} > SO_4^{2-} > ClO_4^-$

(c) With the increase in positive oxidation state the energy of the 3*d*-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 moelcule(s) gives only acid(s) on hydrolysis?

(a) PCl_3 (b) SF_4

(c) NCl_3 (d) P_4O_6

58. Which of the following species have the same bond order?

(a) $\bar{C}N$, N_2 (b) N_2^{2+}, N_2^{2-}

(c) N_2^{2-}, O_2 (d) NO, N_2^{2+}

59. Which of the following conversions does not represent the process of dimerization?

(a) $BeH_2 \longrightarrow BeH_2$ (solid)

(b) $S_2O_3^{2-} \longrightarrow S_4O_6^{2-}$

(c) $NO \longrightarrow N_2O_2$ (d) $ClO_3 \longrightarrow Cl_2O_6$

60. Select the correct options for following statement(s):

(a) sp^3-hybrid orbitals are at 90° to one another

(b) sp^3d^2 adjacent hybrid orbitals are at 90° to one another

(c) sp^2-hybrid orbitals are at 120° to one another

(c) Bond order of N—O bond in NO_3^- is $1\frac{1}{3}$

61. Which of the following species/molecules have the same shape but different hybridization?

(a) XeF_2, CO_2 (b) I_3^-, $HgCl_2$

(c) OCl^-, CO (d) SO_2, OCl_2

62. Select the correct statement(s):

(a) The crystal structure of $NaHCO_3$ and $KHCO_3$ both show hydrogen bonding, but are different. In $NaHCO_3$ the HCO_3^- ions are linked into an infinite chain, while in $KHCO_3$ a dimeric anion is formed

(b) The BeX_2 molecules polymerize to form chains containing bridging halogen groups; for example, in $(BeF_2)_n$ and $(BeCl_2)_n$, each halogen forms one normal covalent bond and uses a lone pair to form a coordinate bond

(c) $[Be(Me_2)_n]$ has essentially the same structure as $(BeCl_2)_n$ 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 H_3O^+

63. Select the correct order for the given properties:

(a) $MgC_2O_4 > CaC_2O_4 > SrC_2O_4 > BaC_2O_4$: Solubility order

(b) $BeS_2O_3 < MgS_2O_3 < CaS_2O_3 < SrS_2O_3$: Solubility order

(c) $KO_3 < RbO_3 < CsO_3$: Thermal stability order

(d) $LiNO_3 < NaNO_3 < KNO_3 < CsNO_3$: Thermal stability order

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 : $NO_2^+ < NO_2^- < NO_3^-$

(c) Thermal stability : LiF > NaF > KF > RbF > CsF

(d) Hydrated size : $Be^{2+}(aq) < Mg^{2+}(aq) < Ca^{2+}(aq) < Sr^{2+}(aq) < Ba^{2+}(aq)$

66. Select the correct statements:

(a) XeF_2 is linear and XeF_6 is capped octahedral

(b) Xe can only form compounds with the highly electronegative elements