Chemical Bonding (Part-B)

JEE (Main) Exercises

Single Correct Answer Type

1. In which of the following is the O—N—O bond angle highest?
   (a) NO₂
   (b) NO
   (c) N₂O
   (d) NO₃

2. Which of the following has higher bond dipole moment?
   (a) H—C
   (b) N—O
   (c) P—H
   (d) None of these

3. Which of the following orbital is more directional?
   (a) s-orbital
   (b) p-orbital
   (c) sp-orbital
   (d) None of these

4. Select the incorrect geometry for hybridization:
   (a) sp = linear
   (b) sp²d = T.B.P.
   (c) sp³d² = P.B.P
   (d) All are correct

5. In benzene, what is the hybridization on each carbon atom?
   (a) sp²
   (b) sp³
   (c) sp³d
   (d) sp

6. What hybridization is expected on the central atom of each of the following molecules?
   (i) BeH₂
   (ii) CH₂Br₂
   (iii) PF₅
   (a) sp², sp, sp³, sp²
   (b) sp, sp², sp³d, sp²
   (c) sp², sp²d, sp³
   (d) sp², sp, sp³, sp²

7. Predict the geometry of the following species and describe the hybridization on the central atom:
   (i) PbCl₄
   (ii) SbBr₅
   (iii) BH₄⁻
   (iv) PCl₃
   (a) Tetrahedral sp³, octahedral sp³d³, tetrahedral sp³, tetrahedral sp³, respectively
   (b) Tetrahedral sp³, octahedral sp³d³, tetrahedral sp³, tetrahedral sp³, respectively
   (c) Tetrahedral sp³, octahedral sp³d³, tetrahedral sp³, pyramidal sp³, respectively
   (d) Trigonal planar sp², octahedral sp³d³, tetrahedral sp³, tetrahedral sp³, tetrahedral sp³, respectively

8. What is the value of 1D in SI units?
   (a) 3.336 × 10⁻¹⁰ cm
   (b) 3.36 × 10⁻¹⁰ cm
   (c) 333.6 × 10⁻¹⁰ cm
   (d) None of these

9. Arrange the following types of interactions in order of increasing stability (covalent, van der Waals’ force, hydrogen bonding):
   (a) Hydrogen bonding < covalent < van der Waals’ force
   (b) Covalent < hydrogen bonding < van der Waals’ force
   (c) Hydrogen < van der Waals’ force < covalent bonding
   (d) van der Waals’ force < hydrogen bonding < covalent

10. Which of the following is the correct order of strength of H-bonding in the given compound?
11. Which of the following molecule has a planar structure?
(a) O₂SF₂  
(b) OSF₂  
(c) XeF₄  
(d) ClO₄⁻

12. What is the shape of ClF₃⁻ ion?
(a) Bent  
(b) Linear  
(c) Pyramidal  
(d) None of these

13. Which of the following molecule is not hypovalent but completes its octet?
(a) AlCl₃  
(b) AlBr₃  
(c) AlF₃  
(d) All are hypovalent and complete their octet

14. Which of the following species are planar?
(a) I₃⁻, XeF₂, ClF₃  
(b) H₂O, O⁻Cl⁻, ICl₂⁺  
(c) XeF₄, Xe₂F₄, BF₃  
(d) All are correct

15. In which of the following molecules are all the bonds not of equal length?
(a) BCl₃  
(b) PF₃  
(c) CF₄  
(d) SF₆

16. The pair having similar geometry is:
(a) BH₃, NH₃  
(b) BeH₂, H₂O  
(c) Cl₂H₆, CCl₄  
(d) IF₅, PF₃

17. Which of the following molecules is not tetrahedral?
(a) CF₄  
(b) SF₄  
(c) CH₄  
(d) SIF₄

18. Which of the following pair does not have similar geometries?
(a) CH₄, CCl₄  
(b) BF₃, NH₃  
(c) H₂S, H₂O  
(d) PCl₅, SbCl₅

19. Which type of shape is found in SF₂ molecule?
(a) V-shaped  
(b) Bipyramidal  
(c) Linear  
(d) Irregular tetrahedral

20. Which of the following molecule/ion has a triangular pyramidal shape?
(a) BF₃  
(b) H₂O⁺  
(c) NO₃⁻  
(d) CO₃²⁻

21. Graphite has a two-dimensional layer structure and the nearest layers are joined together by:
(a) Electrovalent bonds  
(b) Covalent bonds  
(c) van der Waals’ forces  
(d) Metallic bonds

22. In XeF₂, XeF₄, and XeF₆, the number of lone pairs on Xe, respectively, is:
(a) 2, 3, 1  
(b) 1, 2, 3  
(c) 4, 1, 2  
(d) 3, 2, 1

23. The correct sequence of decrease in bond angles of following hydrides is:
(a) NH₃ > PH₃ > AsH₃ > SbH₃  
(b) NH₃ > AsH₃ > PH₃ > SbH₃  
(c) SbH₃ > AsH₃ > PH₃ > NH₃  
(d) PH₃ > NH₃ > AsH₃ > SbH₃

24. A lone pair of electrons in an atom implies:
(a) A pair of valence electrons  
(b) A pair of electrons  
(c) A pair of electrons involved in bonding  
(d) A pair of electrons not involved in bonding

25. Which of the following is soluble in water?
(a) CS₂  
(b) C₆H₅OH  
(c) CCl₄  
(d) CHCl₃

26. Which one of the following groupings represents a collection of isoelectronic species?
[At. No.: Cs = 55, Br = 35]
(a) Be, Al⁺⁺, Cl⁻  
(b) Ca⁺⁺, Cs⁺, Br⁻  
(c) Na⁺⁺, Ca⁺⁺, Mg²⁺  
(d) N²⁻, F⁻, Na⁺

27. The pair of species having identical shapes for molecules of both species is:
(a) BF₃, PCl₃  
(b) PF₃, IF₃  
(c) CF₄, SF₄  
(d) XeF₂, CO₂

28. Which of the following ion is not tetrahedral in shape?
(a) BF₄⁻  
(b) NH₄⁺  
(c) SF₄  
(d) CF₄

29. Which of the following are arranged in the decreasing order of dipole moment?
(a) CH₃Cl, CH₃Br, CH₃F  
(b) CH₂Cl₂, CH₃F, CH₃Br  
(c) CH₂Br₂, CH₃Cl, CH₃F  
(d) CH₂Br₂, CH₂Cl₂, CH₃Cl

30. Paramagnetism of oxygen is explained on the basis of which of the following electronic configuration?
(a) ¹s²2x²2p⁴  
(b) ¹s²2x²2p⁴  
(c) ¹s²2x²  
(d) None of these

31. An example of a polar covalent compound is:
(a) KCl  
(b) NaCl  
(c) CCl₄  
(d) HCl

32. Among the following, the molecule with the highest dipole moment is:
(a) CH₃Cl  
(b) CH₂Cl₂  
(c) CHCl₃  
(d) CCl₄
33. Shape of O₂F₂ is similar to that of:  
(a) C₂F₂  (b) H₂O₂  
(c) H₂F₂  (d) C₂H₂

34. The states of hybridization of boron and oxygen atoms in boric acid (H₃BO₃), respectively, are:  
(a) sp² and sp²  (b) sp² and sp³  
(c) sp³ and sp²  (d) sp³ and sp³

35. Decreasing order of C—C length in I. C₂H₄, II. C₂H₂, III. C₂H₆, IV. C₂H₆ is:  
(a) IV > III > I > II  (b) I > II > IV > III  
(c) II > I > IV > III  (d) IV > I > III > II

36. Which carbon is more electronegative?  
(a) sp³-hybridized carbon  (b) sp-hybridized carbon  
(c) sp²-hybridized carbon  (d) Always same irrespective of its hybrid state

37. Which of the following is least volatile?  
(a) HF  (b) HCl  
(c) HBr  (d) HI

38. Which of the following is not electron deficient?  
(a) NH₃  (b) BF₃  
(c) AlCl₃  (d) BH₃

39. Lattice energy of ionic compounds depends upon:  
(a) Packing of ions only  (b) Charge and size of ions  
(c) Charge on ion only  (d) Size of ions only

40. Which of the following gives the correct arrangement of compounds based on their bond strength?  
(a) HF > HCl > HBr > HI (b) HI > HBr > HCl > HF  
(c) HF > HBr > HCl > HI (d) HCl > HF > HBr > HI

41. Ionic compounds are formed most easily with:  
(a) Low E.A., high I.E.  (b) High E.A., low I.E.  
(c) Low E.A., low I.E.  (d) High E.A., high I.E.

42. Which of the following gas is linear?  
(a) CO₂  (b) SO₂  
(c) NO₂  (d) SO₃

43. Correct order of boiling point is:  
(a) HF > HI > HBr > HCl  (b) HF > HBr > HI > HCl  
(c) HCl > Br > HI > HF  (d) HCl > HF > HBr > HI

44. Correct order of bond length is:  
(a) CO₂ > CO > CO₂⁻  (b) CO₂ > CO > CO₂⁻  
(c) CO > CO₂ > CO₂⁻  (d) None of these

45. Which molecule is only electron donor?  
(a) NH₃  (b) BF₃  
(c) PF₅  (d) AsF₃

46. Which of the following is sp²-hybridized?  
(a) NH₃  (b) BeH₂  
(c) PCl₅  (d) AlCl₃

47. Among the following bonds, which has the most polar character?  
(a) C—O  (b) C—Br  
(c) C—F  (d) C—S

48. Octet rule is not valid for which of the following molecule?  
(a) CO₂  (b) H₂O  
(c) O₂  (d) CO

49. Which of the following has a giant covalent structure?  
(a) PbO₂  (b) SiO₂  
(c) NaCl  (d) AlCl₃

50. In which of the following is the angle between the two covalent bonds greatest?  
(a) CO₂  (b) CH₄  
(c) NH₃  (d) H₂O

51. The correct order regarding the electronegativity of hybrid orbitals of carbon is:  
(a) sp < sp² < sp³  (b) sp < sp² < sp³  
(c) sp > sp² < sp³  (d) sp > sp² < sp³

52. The lattice energy order for lithium halide is:  
(a) LiF > LiCl > LiBr > LiF  (b) LiCl > LiF > LiBr > LiF  
(c) LiBr > LiCl > LiF > LiF  (d) LiF > LiBr > LiCl > LiF

53. π-Bonding occurs in each of the following except:  
(a) CO₂  (b) C₂H₄  
(c) CN⁻  (d) CH₄

54. The structure of XeF₄ is:  
(a) Planar  (b) Tetrahedral  
(c) Square planar  (d) Pyramidal

55. Compound formed by sp³d-hybridization will have which of the following structure?  
(a) Trigonal bipyramidal  (b) T-shaped  
(c) Linear  (d) Either of these depending on the number of lone pair of electrons on central atom

56. Which bond is more polar?  
(a) Cl—Cl  (b) N—F  
(c) C—F  (d) O—F
57. Which of the following has the highest bond angle?
   (a) H₂O  (b) H₂S  
   (c) NH₃  (d) PH₃
58. Which of the following has the lowest bond angle?
   (a) NH₃  (b) BeF₂  
   (c) H₂O⁺  (d) CH₄
59. Coordinate compounds are formed by:
   (a) Transfer of electrons (b) Sharing of electrons  
   (c) Donation of electron pair (d) None of these
60. Compounds formed by sp³d²-hybridization will have which of the following geometry?
   (a) Square planar (b) Octahedral  
   (c) Trigonal bipyramidal (d) Pentagonal bipyramidal
61. As compared to covalent compounds, electrovalent compounds generally have:
   (a) High m.pt. and low b.pt. (b) Low m.pt. and high b.pt.  
   (c) High m.pt. and high b.pt. (d) Low m.pt. and low b.pt.
62. Which of the following statement is not correct?
   (a) Pi-bond always exists with sigma-bond according to V.B.T.  
   (b) Pi-bond can exist independently according to V.B.T. (c) Pi-bond is weaker than sigma-bond  
   (d) Sigma-bond is less reactive than pi-bond
63. Which hybridization results in nonplanar orbitals?
   (a) sp  (b) sp²  
   (c) sp³  (d) dsp²
64. For which of the following hybridization is the bond angle maximum?
   (a) sp²  (b) sp  
   (c) sp³  (d) dsp²
65. Among liq HF, liq NH₃, CH₄, CH₃OH, and N₂O₄, intermolecular hydrogen bond is expected in:
   (a) All  (b) None leaving one  
   (c) Three (d) None of these
66. CO₃ is isostructural with:
   (a) SnCl₂  (b) HgCl₂  
   (c) H₂O  (d) SCl₂
67. Which of the following has the shortest carbon–carbon bond length?
   (a) C₂H₆  (b) C₂H₄  
   (c) C₂H₂  (d) C₂H₂
68. Which group of atoms have nearly the same atomic radius?
   (a) Na, K, Rb, Cs  (b) Li, Br, B, C  
   (c) Fe, Co, Ni (d) F, Cl, Br, I
69. Which set have the strongest tendency to form anions?
   (a) Ga, In, Te  (b) Na, Mg, Al  
   (c) N, O, F (d) V, Cr, Mn
70. A molecule in which sp²-hybrid orbitals are used by the central atom in forming covalent bond is:
   (a) He₂  (b) SO₂  
   (c) PCl₅ (d) N₂
71. Which has a zero dipole moment?
   (a) ClF  (b) PCl₃  
   (c) SiF₄ (d) CFCl₃
72. The hybridization of carbon atoms in C==C single bond of CH==CH₂ is:
   (a) sp³  (b) sp²  
   (c) sp  (d) sp³
73. Which has the lowest anion to cation size ratio?
   (a) LiF  (b) NaF  
   (c) CsI (d) CsF
74. In allene structure, three carbon atoms are joined by:
   (a) Three σ- and three π-bonds  (b) Two σ- and one π-bond  
   (c) Two σ- and two π-bonds (d) Three π-bonds only
75. H-bonding is not present in:
   (a) Glycerine  (b) Water  
   (c) H₂S (d) HF
76. Which species has the maximum number of lone pair of electrons on the central atom?
   (a) ClO₃⁻  (b) XeF₄  
   (c) SF₄ (d) I₃⁻
77. Which of the following has a regular tetrahedral geometry?
   (a) SF₄  (b) BF₃  
   (c) XeF₄ (d) ClF₃
78. Which of the following has the least bond energy?
   (a) H₂  (b) Mg₂  
   (c) F₂ (d) O₂⁻
79. Which is the best description of a covalent bond?
   (a) Electrons are simultaneously attracted by more than one nucleus  
   (b) Filled orbitals of two or more atoms overlap one another
87. A diatomic molecule has a dipole moment of 1.2 D, if its bond distance is 1.0 Å. What fraction of an electronic charge e exists on each atom?
(a) 20% of e  
(b) 21% of e  
(c) 19% of e  
(d) 25% of e

88. Which of the possible molecule/species is having maximum values for dipole moment (where “A” is the central atom)?
(a) AX₃ (having one lone pair on central atom)
(b) AX₄ (tetrahedral)
(c) AX₄Y (having no lone pair on central atom)
(d) Cannot be predicted

89. Which of the following is an incorrect match?
(a) SiF₄ : Can act as Lewis acid
(b) Benzene : All C-atoms are sp²-hybridized
(e) PbBr₃ : Nonpolar
(d) CH₂ = C = CH₂ : Nodal planes of p-bonds are not lying in the same plane

90. Which of the following two species have the same shape?
(I) N₂⁺  (II) F⁻  (III) SO₄²⁻  (IV) NO₃⁻
(a) I and II  
(b) II and III  
(c) III and I  
(d) I and IV

91. SbF₅ reacts with XeF₄ and XeF₆ to form ionic compounds \([\text{XeF}_4]^+ [\text{SbF}_6]^-\) and \([\text{XeF}_6]^+ [\text{SbF}_6]^-\). The geometry of \(\text{XeF}_4^+\) ion and \(\text{XeF}_6^+\) ion, respectively, is:
(a) Square pyramidal, T-shaped
(b) Bent T-shaped, square pyramidal
(c) See-saw, square pyramidal
(d) Square pyramidal, see-saw

92. Which of the following is a neutral oxide?
(a) NO  
(b) NO₂  
(c) N₂O₃  
(d) N₂O₅

93. Which of the following is isoelectronic and isostructural with CO₂?
(a) NO₂  
(b) NO₃⁻  
(c) NO₂⁻  
(d) N₂O

94. Which out of \(\text{SO}_4^{2-}\), \(\text{SF}_4\), and \(\text{SF}_2\) does not undergo \(sp^3\)-hybridization?
(a) \(\text{SO}_4^{2-}\)  
(b) \(\text{SF}_2\)  
(c) \(\text{SF}_2\)  
(d) \(\text{SF}_4\)

95. In a system, the formation of chemical bond always decreases its:
(a) Kinetic energy  
(b) Potential energy  
(c) Repulsive forces  
(d) Coordinate bond
96. Which one of the following arrangements of molecules is correct on the basis of the dipole moment?
(a) $\text{BF}_3 > \text{NF}_3 > \text{NH}_3$  (b) $\text{NF}_3 > \text{BF}_3 > \text{NH}_3$
(c) $\text{NH}_3 > \text{BF}_3 > \text{NF}_3$  (d) $\text{NH}_3 > \text{NF}_3 > \text{BF}_3$

97. Fluorine molecule is formed by:
(a) The axial $p-p$ orbital overlap
(b) The side ways $p-p$ orbital overlap
(c) The $s-s$ orbital overlap
(d) The $s-p$ orbital overlap

98. Which of the following has $sp^3$-hybridization?
(a) $\text{SO}_2$  (b) $\text{H}_2\text{O}$
(c) $\text{NH}_3$  (d) $\text{SO}_3^2-$

99. Chemical bond implies:
(a) Repulsion
(b) Attraction
(c) Attraction and repulsion
(d) None of these

100. In $\text{OF}_2$, the number of bond pairs and lone pairs of electrons is, respectively:
(a) 2, 6  (b) 2, 8
(c) 2, 10  (d) 2, 9

101. Which of the following does not contain a coordinate bond?
(a) $\text{BH}_4^-$  (b) $\text{NH}_3$
(c) $\text{CO}_3^{2-}$  (d) $\text{H}_2\text{O}^+$

4. Element $X$ is strongly electropositive and element $Y$ is strongly electronegative. Both are univalent. The compound formed would be:
(a) $X^+ Y^-$  (b) $X^- Y^+$
(c) $X^- Y$  (d) $X \rightarrow Y$

5. Two ice cubes are pressed over each other and united to form one cube. Which force is responsible for holding them together?
(a) van der Waals' forces  (b) Covalent attraction
(c) Hydrogen bond formation  (d) Dipole-dipole attraction

6. Multiple covalent bonds exist in the molecule of:
(a) $\text{F}_2$  (b) $\text{H}_2$
(c) $\text{N}_2$  (d) $\text{C}_2\text{H}_4$

7. The type of bonds present in $\text{CuSO}_4 \cdot \text{H}_2\text{O}$ are ________ only:
(a) Electrovalent and covalent  (b) Electrovalent and coordinate
(c) Electrovalent, covalent, coordinate, and $\text{H}$-bond  (d) Covalent and coordinate

8. Carbon atoms in $\text{C}_2\text{(CN)}_2$ are:
(a) $sp$-hybridized  (b) $sp^2$-hybridized
(c) $sp$- and $sp^2$-hybridized  (d) $sp$, $sp^2$, and $sp^3$-hybridized

9. A triple bond is made of:
(a) One $\sigma$- and two $\pi$-bonds  (b) Two $\sigma$- and one $\pi$-bond
(c) Three $\sigma$- and three $\pi$-bonds  (d) One $\sigma$- and four $\pi$-bonds

10. The bonds present in $\text{N}_2\text{O}_4$ are:
(a) Ionic  (b) Covalent and coordinate
(c) Covalent  (d) Ionic and covalent

11. In which of the following molecules are all bonds not equal?
(a) $\text{AlF}_3$  (b) $\text{NF}_3$
(c) $\text{ClF}_3$  (d) $\text{BF}_3$

12. The hybridizations of atomic orbitals of nitrogen in $\text{NO}_2^+$, $\text{NO}_3^-$, and $\text{NH}_4^+$ are:
(a) $sp$, $sp^2$, and $sp^3$, respectively
(b) $sp$, $sp^2$, and $sp^3$, respectively
(c) $sp^2$, $sp$, and $sp^3$, respectively
(d) $sp^2$, $sp^3$, and $sp$, respectively

13. The shape of $\text{ClO}_4^-$ ion is:
(a) Square planar  (b) Square pyramidal
(c) Tetrahedral  (d) Trigonal bipyramidal
14. Which of the following species has a linear shape?
(a) NO₂⁺          (b) O₃
(c) NO₂⁻          (d) SO₂

15. Which of the following is not isostructural with SiCl₄?
(a) PO₄³⁻          (b) NH₄⁺
(c) SCl₄          (d) SO₄²⁻

16. Which of the following has sp²-hybridization?
(a) CO₂          (b) SO₂
(c) N₂O          (d) CO

17. Intramolecular hydrogen bonding is found in:
(a) Salicyldehyde    (b) Water
(c) Acetaldehyde    (d) Phenol

18. Which combination is best explained by the coordinate covalent bond?
(a) H₂ + I₂      (b) Mg + ½ O₂
(c) Cl + Cl      (d) H⁺ + H₂O

19. Two elements X and Y have following electronic configurations:
X = 1s², 2s² 2p², 3s² 3p⁶, 4s² and
Y = 1s², 2s² 2p², 3s² 3p³
The compound formed by the combination of X and Y is:
(a) XY₂      (b) X₂Y₂
(c) XY₃      (d) XY₅

20. The hybridization of carbon in diamond, graphite, and acetylene is:
(a) sp³, sp², sp
(b) sp³, sp, sp²
(c) sp², sp², sp³
(d) sp, sp, sp²

21. The angle between two covalent bonds is maximum in:
(a) CH₄        (b) H₂O
(c) CO₂        (d) SO₃

22. CO₂ has the same geometry as:
(i) HgCl₂     (ii) NO₂
(iii) SnCl₄   (iv) C₂H₄
(a) (i) and (iii) (b) (ii) and (iv) (c) (i) and (iv) (d) (iii) and (iv)

23. Which of the following is an electron-deficient compound?
(a) NH₃          (b) ICl
(c) BCl₃        (d) PCl₃

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

25. The weakest among the following is:
(a) Ionic bond    (b) Covalent bond
(c) Metallic bond (d) van der Waals' forces

26. An atom with atomic number 20 is most likely to combine chemically with the atom whose atomic number is:
(a) 11          (b) 16
(c) 18          (d) 10

27. Which of the following molecules will have a dipole moment?
(a) CO₂        (b) CCl₂
(c) XeF₂      (d) BeF₂

28. Which of the following molecules does not possess a permanent electric dipole moment?
(a) H₂S        (b) SO₂
(c) SO₃      (d) CS₂

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

30. The octet rule is not followed in:
(a) F₂        (b) NaF
(c) CaF₂     (d) BF₃

31. In which of the following is the bond angle maximum?
(a) NH₃      (b) NH₄⁺
(c) PCl₃    (d) SC₃

32. Which one of the following molecules will form a linear polymeric structure due to H-bonding?
(a) HCl    (b) H₂O
(c) H₂S    (d) NH₃

33. Which among the following has the largest dipole moment?
(a) NH₃      (b) H₂O
(c) HI      (d) SO₃

34. In which of the following pairs is the bond angle 109° 28'?
(a) [NH₄⁺], [BF₄⁻] (b) [NH₄⁺], [BF₃]
(c) NH₃, [BF₃]  (d) [NH₃], [BF₃]

35. The pair of species having identical shape of both species is:
(a) BF₃, PCl₃  (b) PF₃, IF₃
(c) CF₄, SF₄  (d) XeF₂, CO₂

36. Which pair of molecules will have a permanent dipole moment for both members?
37. The percentage s-character of the central atom in beryllium fluoride is:
(a) 25%  (b) 33.3%  (c) 50%  (d) 20%

38. In which of the following sets do we have sp^3d-hybridization?
(a) XeF_2, IBr_3, XeO_3
(b) IBr_3, SF_6^-, SF_5^-
(c) XeF_2, IBr_3, SF_6^-
(d) SF_5^+ and SF_6^-

39. Select the correct order for covalent radii:
(a) Octahedral radii > linear radii > tetrahedral radii
(b) Octahedral radii > tetrahedral radii > linear radii
(c) Linear radii > tetrahedral radii > octahedral radii
(d) Tetrahedral radii > octahedral radii > linear radii

40. Which molecule among AX_5, AX_4, AX_5, and AX_6 is most likely to have a trigonal bipyramidal structure if A has no lone pair?
(a) AX_3  (b) AX_5  (c) Both (a) and (b)  (d) AX_6

41. Which of the following structure is analogous of SO_3^2-?
(a) F_2SeO  (b) F_2SeO_2  (c) SO_4^2-  (d) SO_2

42. Select the correct statement:
(a) SF_4, ClF_4, SiCl_4, and CCl_4 have tetrahedral structure
(b) BF_3, ClF_3, and ICl_3 have trigonal planar structure
(c) XeF_2, BeCl_2, and ICl_3 have linear structure
(d) All are correct

43. Compare F—[O—F] and F—[O—F]_axial bond angle in IOF_3 molecule:
(a) F—[O—F] > F—[O—F]_axial
(b) F—[O—F]_axial > F—[O—F] > F—[O—F]
(c) F—[O—F]_axial > F—[O—F] > F—[O—F]
(d) None of these

44. Compare bond angles x and y from the following molecule:
(a) x > y  (b) y > x  (c) x = y  (d) x = y = 120°

45. The dipole moment of LiH is 1.964 x 10^{-19} cm and the interatomic distance between Li and H in this molecule is 1.596 Å. What is the percent ionic character in LiH?
(a) 78.6%  (b) 98.7%  (c) 8.67%  (d) 76.8%

46. The two molecules indicated below are capable of intramolecular hydrogen bonding which is likely to form more stable hydrogen bonds.

47. The HF_2^- ion exists in the solid state and also in liquid HF solution but not in dilute aqueous solution because:
(a) In aqueous solution, there is hydrogen bonding but each HF molecule hydrogen bond with the much more prevalent H_2O present instead of other HF molecules, and H_2O^- and F^- are much more likely to be formed
(b) HF is weaker acid than H_2O
(c) HF has H-bonding
(d) None of these

48. SbF_3 reacts with XeF_4 and XeF_6 to form ionic compounds [XeF_6^2+]_{SbF_3^{-}} and [XeF_6^{-}]_{SbF_3^2+}. The geometry of XeF_6^2+ ion and XeF_6^- ion, respectively, is:
(a) Square pyramidal, T-shaped
(b) Bent T-shaped, square pyramidal
(c) See-saw, square pyramidal
(d) Square pyramidal, see-saw

49. Select the correct option for following statements:
(I) sp^3 hybrid orbitals are at 90° to one another
(II) sp^3d^2 adjacent hybrid orbitals are at 90° to one another
(III) sp^2 hybrid orbitals are at 120° to one another
59. In \( \text{BrF}_3 \) molecule, the lone pairs occupy equatorial position to minimize:
(a) Lone pair–bend pair repulsion only
(b) Bond pair–bend pair repulsion only
(c) Lone pair–lone pair repulsion and lone pair–bond pair repulsion
(d) Lone pair–lone pair repulsion only

60. The correct order of bond angles (smallest first) in \( \text{H}_2\text{S}, \text{NH}_3, \text{BF}_3, \) and \( \text{SiH}_4 \) is:
(a) \( \text{H}_2\text{S} < \text{SiH}_4 < \text{NH}_3 < \text{BF}_3 \)
(b) \( \text{NH}_3 < \text{H}_2\text{S} < \text{SiH}_4 < \text{BF}_3 \)
(c) \( \text{H}_2\text{S} < \text{NH}_3 < \text{SiH}_4 < \text{BF}_3 \)
(d) \( \text{H}_2\text{S} < \text{NH}_3 < \text{BF}_3 < \text{SiH}_4 \)

61. The molecular shapes of \( \text{SF}_4, \text{CF}_4, \) and \( \text{XeF}_4 \) are:
(a) Different with 0, 1, and 2 lone pairs of electrons on central atom, respectively
(b) Different with 1, 0, and 2 lone pairs of electrons on central atom
(c) Same with 2, 0, and 1 lone pairs
(d) Same with 1, 1 lone pair in each case

62. In silicon dioxide:
(a) One Si atom is bonded to two O atoms
(b) There are double bonds between Si and O atoms
(c) Each Si atom is surrounded by four O atoms and each oxygen atom is bonded to two Si atoms
(d) Each Si atom is surrounded by two O atoms and each O is bonded to two Si atoms

63. Which of the following statement is incorrect for the dipole moment measurement of the compound?
(a) It helps to predict the percentage ionic character in a bond
(b) It helps to predict the shape of the molecule
(c) It helps to predict the particular \( \text{cis} \ trans \) isomers
(d) It helps to predict the bond energies of all bonds within the molecule

64. Which of the following contains both polar and nonpolar covalent bonds?
(a) \( \text{NH}_4\text{Cl} \)
(b) \( \text{HCN} \)
(c) \( \text{H}_2\text{O}_2 \)
(d) \( \text{CH}_4 \)

65. An \( sp^3 \) hybrid orbital contains:
(a) 1/4 \( s \)-character
(b) 1/2 \( s \)-character
(c) 2/3 \( s \)-character
(d) 3/4 \( s \)-character

66. Which contains a coordinate and a covalent bond?
(a) \( \text{BaCl}_2 \)
(b) \( \text{NH}_4\text{Cl} \)
(c) \( \text{HCl} \)
(d) \( \text{H}_2\text{O} \)

67. An atom of one element \( A \) has three electrons in its...
68. A dative bond is present in:
(a) SO_3
(b) NH_3
(c) BaCl_2
(d) N_2

69. Which of the following pair of species is not isostuctural?
(a) KrF_2, ICl_2
(b) SO_3, SO_3^2-
(c) CO_3^2-, BO_3^-
(d) SiO_4^4-, IO_4^-

70. If "n" number of H_3PO_4 molecules are polymerized to produce chain molecule and ring molecule separately, then the number of P-O-P linkages formed is, respectively:
(a) n and (n - 1)
(b) (n - 1) and (n - 1)
(c) (n - 1) and n
(d) n and n

71. The molecule having zero dipole moment is:
(a) CH_3Cl
(b) CH_2Cl_2
(c) CHCl_3
(d) CCl_4

72. The solubility of KCl is relatively more in (where D in dielectric constant):
(a) C_2H_6 (D = 0)
(b) (CH_3)_2CO (D = 2)
(c) CH_3OH (D = 32)
(d) CCl_4 (D = 0)

73. If a molecule MX_3 has a zero dipole moment, the sigma bonding orbitals used by M (at no. < 21) are:
(a) Pure p
(b) sp-hybrid
(c) sp^2-hybrid
(d) sp^3-hybrid

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

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

76. When the hybridization state of carbon atom changes from sp^3 to sp^2 and finally to sp, the angle between the hybridized orbitals:
(a) Decreases gradually
(b) Decreases considerably
(c) Is not affected
(d) Increases progressively

77. Which of the following is expected to have a linear structure?
(a) SO_2
(b) CO_2
(c) CO_3^2-
(d) SO_4^2-

78. Which of the following phenomenon will occur when two atoms of same spin will react?
(a) Bonding will not occur
(b) Orbital overlap will not occur
(c) Both (a) and (b)
(d) None of these

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

80. Among NH_3, BeCl_2, CO_2, and H_2O, the nonlinear molecules are:
(a) BeCl_2 and H_2O
(b) BeCl_2 and CO_2
(c) NH_3 and H_2O
(d) NH_3 and CO_2

81. Dipole moment is highest for:
(a) CHCl_3
(b) CH_2
(c) CHF_3
(d) CCl_4

82. Consider the following iodides:
\[ \begin{array}{c|c}
\text{PI}_3 & \text{AsI}_3 & \text{SbI}_3 \\
102^\circ & 102^\circ & 99^\circ \\
\end{array} \]

The bond angle is maximum in \( \text{PI}_3 \), which is:
(a) Due to small size of phosphorus
(b) Due to more bond pair-bond pair repulsion in \( \text{PI}_3 \)
(c) Due to less electronegativity of P
(d) None of these

83. Which of the following is the largest ion?
(a) Na^+
(b) Mg^{2+}
(c) O^{2-}
(d) F^-

84. The ionization potential order for which set is correct:
(a) Li > K > Cs
(b) B > Li > K
(c) Cs > Li > B
(d) Cs > Li > K

85. For the type of interactions: (I) covalent bond, (II) van der Waals' forces, and (III) hydrogen bonding, which represents the correct order of increasing stability?
(a) (I) < (III) < (II)
(b) (II) > (III) > (I)
(c) (II) > (I) > (III)
(d) (I) = (III) = (II)

86. Which of the molecule/species has sp^2-hybridization?
(a) CrO_2Cl_2
(b) PCl_4^-
(c) NH_4^+
(d) ClO_3^-

87. Identify the least stable ion amongst the following:
(a) Li^+
(b) Be^{2+}
(c) B^-
(d) C^-

88. Identify the pair in which the two species are isostuctural:
89. The total right-angles $\angle$ CPI in PCl$_5$, PCl$_4^+$, PCl$_3^-$ are _____, _____, respectively.
(a) 0, 1, 4  
(b) 6, 0, 4  
(c) 2, 4, 0  
(d) 6, 0, 12

90. Which molecule has a trigonal planar geometry?
(a) IF$_3$  
(b) PCl$_3$  
(c) NH$_3$  
(d) BF$_3$

91. The molecule having permanent dipole moment is:
(a) SF$_4$  
(b) XeF$_4$  
(c) SiF$_4$  
(d) BF$_3$

92. What is the formal charge on the chlorine atom in the oxyacid HOCIO$_2$ if it contains single bonds?
(a) 2$-$  
(b) 1$-$  
(c) 1$+$  
(d) 2$+$

93. The hybridization of P in phosphate ion (PO$_4^{3-}$) is the same as in:
(a) I in ICl$_4^-$  
(b) S in SO$_3$  
(c) N in NO$_5^-$  
(d) S in SO$_3^{2-}$

94. The electronegativity difference between N and F is greater than N and H, yet the dipole moment of NH$_3$ (1.5 D) is greater than that of NF$_3$ (1.2 D). This is because:
(a) In NH$_3$ as well as NF$_3$, the atomic dipole and bond dipole are in the opposite direction.
(b) In NH$_3$, the atomic dipole and bond dipole are in the opposite direction, whereas in NF$_3$, these are in the same direction.
(c) In NH$_3$ as well as in NF$_3$, the atomic dipole and bond dipole are in the same direction.
(d) In NH$_3$, the atomic dipole and bond dipole are in the same direction, whereas in NF$_3$, these are in the opposite direction.

95. Which of the following species have undistorted octahedral structures?
1. SF$_6$  
2. PF$_6^-$  
3. SiF$_6^{2-}$  
4. XeF$_6$

Select the correct answer using the codes given below:
(a) 2, 3, and 4  
(b) 1, 3, and 4  
(c) 2 and 3  
(d) 1, 2, and 3

96. In the anion HCOO$^-$, the carbon–oxygen bonds are found to be of equal length. This is because:
(a) The anion HCOO$^-$ has two resonating structures
(b) The anion is obtained by the removal of a proton from the acid molecule
(c) Electronic orbitals of carbon are hybridized
(d) The C = O bond is weaker than the C — O bond

97. An analysis of certain reaction was found to contain 254 g of X and 80 g of Y. If the atomic weight of X is 127 and that of Y is 16, then the formula of the compound containing X and Y is:
(a) X$Y$  
(b) X$_2$Y  
(c) X$_3$Y$_2$  
(d) X$_2$Y$_3$

98. How many bonding pairs and lone pairs surround the central atom in the $I_3^-$ ion?
Bonding pairs  
Lone pairs
(a) 5  
(b) 6  
(c) 7  
(d) 8

99. What hybrid orbitals are employed by carbon atoms 1, 2, and 3, respectively, as labeled in the compound shown?
\[ \text{H}_3\text{C} — \text{C} — \text{C} \equiv \text{N?} \]
(a) $sp^3$, $sp$, $s$  
(b) $sp^2$, $sp^2$, $sp$  
(c) $sp^2$, $sp^2$, $sp$  
(d) $sp^3$, $sp^2$, $sp^2$

100. Which reaction involves a change in the electron pair geometry for the underlined atom?
(a) BF$_3$ + F$-$$ \rightarrow$ BF$_3^-$$  
(b) NH$_3$ + H$^+$ $\rightarrow$ NH$_4^+$
(c) 2SO$_2$ + O$_2$ $\rightarrow$ 2SO$_3$  
(d) H$_2$O + H$^+$ $\rightarrow$ H$_3$O$^+$

**Multiple Correct Answers Type**

1. In V.B.T., the idea of hybridization was required to explain which of the following facts:
(a) The equivalence of the bonds in most of the compounds
(b) The stereochemistry of the molecules
(c) The better overlapping of the orbitals
(d) None of these

2. Which of the following molecule has/have structure similar to NH$_3$?
(a) PH$_3$  
(b) H$_2$O$^+$  
(c) SeF$_6^2-$  
(d) CH$_3$

3. Which of the following properties of water is related to the hydrogen bonding?
(a) High boiling point  (b) High heat of vaporization  
(c) Low density of ice compared to water  
(d) None of these

4. NH₃ is isoelectronic with:
   (a) H₂O  (b) CH₄  
   (c) HF  (d) None of these

5. Which of the following molecule(s) is/are planar?
   (a) ICl₂  (b) IF₂⁺  
   (c) SnI₂  (d) CdBr₂

6. Which of the following molecules are nonplanar and have a dipole moment?
   (a) CH₂Cl₂  (b) C₂H₂Cl₂ (cis)  
   (c) ICl₂  (d) NH₃

7. Which of the following molecules are planar and have an angular geometry?
   (a) ClO₃⁻  (b) Cl₇O⁺  
   (c) H₂O⁺  (d) BF₂

8. Which of the following molecule(s) have a bent shape?
   (a) ClF₂⁺  (b) ClF⁻  
   (c) BF₂  (d) None of these

9. Which of the following molecule(s) is/are having a square planar geometry?
   (a) ICl₄⁻  (b) BrF₄⁻  
   (c) XeF₄  (d) SF₄

10. Which of the following molecule(s) is/are having a linear geometry?
    (a) XeF₂  (b) ICl₂  
    (c) I⁻  (d) CO₂

11. Which of the following molecule(s) is/are having a see-saw geometry?
    (a) TeBr₄  (b) TeCl₄  
    (c) XeO₃F₂  (d) SF₄

12. Which of the following sets of molecule(s) is/are having a V-shape but different hybridization?
    (a) SnCl₂ and H₂O  (b) SO₂ and NO₂⁺  
    (c) BF₃ and SCl₂  (d) OF₂ and SCl₂

13. sp³-Hybridization is not shown by:
    (a) BeCl₂  (b) BF₃  
    (c) NH₃  (d) XeF₂

14. Which statement(s) is/are correct?
    (a) A double bond is shorter than a single bond  
    (b) A sigma bond is weaker than a π-bond  
    (c) A double bond is stronger than a sigma bond  
    (d) A covalent bond is stronger than a hydrogen bond

15. Which of the following molecule(s) is/are triangular pyramidal in shape?
    (a) NH₃  (b) NCl₃  
    (c) PF₃  (d) BCl₃

16. Which oxide(s) of nitrogen is/are not isoelectronic with CO₂?
    (a) NO₂  (b) N₂O  
    (c) NO  (d) N₂O₂

17. Which of the following species are deficient?
    (a) Cl⁻  (b) Br⁻  
    (c) BF₃  (d) NH₃⁺

18. Which compound contains double bond or triple bond?
    (a) C₂H₄  (b) H₂O  
    (c) N₂  (d) HCN

19. Which of the following molecule has/have structure similar to IF₃?
    (a) PCl₅  (b) BrF₃  
    (c) SF₅  (d) PF₅

20. Which of the following oxide(s) is/are amphoteric?
    (a) CO₂  (b) SO₂  
    (c) SnO₂  (d) PbO₂

21. Which of the following acid(s) is/are monobasic?
    (a) H₂PO₃  (b) H₃PO₃  
    (c) H₄P₂O₇  (d) H₃PO₂

22. Select the reaction in which coordinate bond is formed in product side:
    (a) BF₃ + F⁻ → BF₄⁻  
    (b) CO + BF₃ → OCF₅  
    (c) H₂O + H⁺ → H₃O⁺  
    (d) AlCl₃ + Cl⁻ → AlCl₄⁻

23. Which of the following molecules are planar and have a dipole moment?
    (a) H₂S  (b) I₃⁻  
    (c) CF₃  (d) H₂O

24. Which of the following molecule(s) is/are having two different types of bond lengths?
    (a) PF₃  (b) PCl₃  
    (c) IF₇  (d) SF₆