

Tips & Tricks

- ✍ A chemical bond is expected to be formed when the energy of the aggregate formed is about 40 *kJ mole*⁻¹ lower than the separate particles.
- ✍ Formation of a chemical bond is always an exothermic process.
- ✍ Lattice energies of bi-bivalent solids > bi-univalent solids > uni-univalent solids. For example, lattice energy of $Mg^{2+}O^{2-}$ (3932 *kJ mole*⁻¹) > $Ca^{2+}(F^-)_2$ (2581 *kJ mole*⁻¹) > Li^+F^- (1034 *kJ mole*⁻¹).
- ✍ When co-ordination number increases, the coulombic forces of attraction increases and hence stability increases.
- ✍ Ionic solids have negative vapour pressure.
- ✍ As a general rule, atomic crystals are formed by the lighter elements of the middle columns of the periodic table.
- ✍ $FeCl_3$ is more covalent than $FeCl_2$ because polarising power of Fe^{3+} is more than that of Fe^{2+} . Similarly $SnCl_4$ is more covalent than $SnCl_2$.
- ✍ Boron forms the maximum number of electron deficient compounds than any other elements in the periodic table.
- ✍ Roughly each lone pair decreases the bond angle by 2.5°.
- ✍ Greater the number of the lone pairs at the two bonding atoms, greater is the repulsion between them and weaker is the bond.
- ✍ The actual number of *s*- and *p*-electrons present in the outermost shell of the element is called maximum covalency of that atom.
- ✍ The hydrogen bonds are tetrahedral in their directions and not planar.
- ✍ The hydrogen bond is stronger in HF and persists even in vapour state. Such bonds account for the fact that gaseous hydrogen fluoride is largely polymerised into the molecular species $H_2F_2, H_3F_3, H_4F_4, H_5F_5$ and H_6F_6 .
- ✍ Hydrogen bonding is strongest when the bonded structure is stabilised by resonance.
- ✍ Critical temperature of water is higher than that of O_2 because H_2O molecule has dipole moment.

Ordinary Thinking

Objective Questions

Electrovalent bonding

1. Which forms a crystal of $NaCl$ [CPMT 1972; NCERT 1976; DPMT 1996]
 - (a) $NaCl$ molecules
 - (b) Na^+ and Cl^- ions
 - (c) Na and Cl atoms
 - (d) None of the above
2. When sodium and chlorine reacts then [NCERT 1973]
 - (a) Energy is released and ionic bond is formed
 - (b) Energy is released and a covalent bond is formed
 - (c) Energy is absorbed and ionic bond is formed
 - (d) Energy is absorbed and covalent bond is formed
3. Which one is least ionic in the following compounds [CPMT 1976; BHU 1998]
 - (a) $AgCl$
 - (b) KCl
 - (c) $BaCl_2$
 - (d) $CaCl_2$
4. The electronic configuration of four elements L, P, Q and R are given in brackets
 $L(1s^2, 2s^2 2p^4), Q(1s^2, 2s^2 2p^6, 3s^2 3p^5)$
 $P(1s^2, 2s^2 2p^6, 3s^1), R(1s^2, 2s^2 2p^6, 3s^2)$
 The formulae of ionic compounds that can be formed between these elements are [NCERT 1983]
 - (a) L_2P, RL, PQ and R_2Q
 - (b) LP, RL, PQ and RQ
 - (c) P_2L, RL, PQ and RQ_2
 - (d) LP, R_2L, P_2Q and RQ
5. Electrovalent compound's [MP PMT 1984]
 - (a) Melting points are low
 - (b) Boiling points are low
 - (c) Conduct current in fused state
 - (d) Insoluble in polar solvent
6. A electrovalent compound is made up of [CPMT 1978, 81; MNR 1979]
 - (a) Electrically charged molecules
 - (b) Neutral molecules
 - (c) Neutral atoms
 - (d) Electrically charged atoms or group of atoms
7. Electrovalent bond formation depends on
 - (a) Ionization energy
 - (b) Electron affinity
 - (c) Lattice energy
 - (d) All the three above
8. In the following which substance will have highest boiling point [NCERT 1973; MP PMT 1987]
 - (a) He
 - (b) CsF
 - (c) NH_3
 - (d) $CHCl_3$
9. An atom of sodium loses one electron and chlorine atom accepts one electron. This results the formation of sodium chloride molecule. This type of molecule will be
 - (a) Coordinate
 - (b) Covalent
 - (c) Electrovalent
 - (d) Metallic bond
10. Formula of a metallic oxide is MO . The formula of its phosphate will be [CPMT 1986, 93]
 - (a) $M_2(PO_4)_2$
 - (b) $M(PO_4)$
 - (c) M_2PO_4
 - (d) $M_3(PO_4)_2$
11. From the following which group of elements easily forms cation
 - (a) F, Cl, Br
 - (b) Li, Na, K
 - (c) O, S, Se
 - (d) N, P, As
12. Which type of compounds show high melting and boiling points
 - (a) Electrovalent compounds
 - (b) Covalent compounds

- (c) Coordinate compounds
(d) All the three types of compounds have equal melting and boiling points
13. Lattice energy of an ionic compound depends upon [AIEEE 2005]
(a) Charge on the ion only
(b) Size of the ion only
(c) Packing of ions only
(d) Charge on the ion and size of the ion
14. In the given bonds which one is most ionic [EAMCET 1980]
(a) $Cs-Cl$ (b) $Al-Cl$
(c) $C-Cl$ (d) $H-Cl$
15. Element x is strongly electropositive and y is strongly electronegative. Both element are univalent, the compounds formed from their combination will be [IIT 1980]
(a) x^+y^- (b) x^-y^+
(c) $x-y$ (d) $x \rightarrow y$
16. In the formation of $NaCl$ from Na and Cl [CPMT 1985]
(a) Sodium and chlorine both give electrons
(b) Sodium and chlorine both accept electrons
(c) Sodium loses electron and chlorine accepts electron
(d) Sodium accepts electron and chlorine loses electron
17. Which of the following is an electrovalent linkage [CPMT 1974; DPMT 1984, 91; AFMC 1988]
(a) CH_4 (b) $MgCl_2$
(c) $SiCl_4$ (d) BF_3
18. Electrovalent compounds do not have [CPMT 1991]
(a) High M.P. and Low B.P. (b) High dielectric constant
(c) High M.P. and High B.P. (d) High polarity
19. Many ionic crystals dissolve in water because [NCERT 1982]
(a) Water is an amphiprotic solvent
(b) Water is a high boiling liquid
(c) The process is accompanied by a positive heat of solution
(d) Water decreases the interionic attraction in the crystal lattice due to solvation
20. The electronic structure of four elements A, B, C, D are
(A) $1s^2$ (B) $1s^2, 2s^2 2p^2$
(C) $1s^2, 2s^2 2p^5$ (D) $1s^2, 2s^2 2p^6$
The tendency to form electrovalent bond is largest in [MNR 1987, 95]
(a) A (b) B
(c) C (d) D
21. Chloride of metal is MCl_2 . The formula of its phosphate will be
(a) M_2PO_4 (b) $M_3(PO_4)_2$
(c) $M_2(PO_4)_3$ (d) MPO_4
22. The phosphate of a metal has the formula MPO_4 . The formula of its nitrate will be [CPMT 1971; MP PMT 1996]
(a) MNO_3 (b) $M_2(NO_3)_2$
(c) $M(NO_3)_2$ (d) $M(NO_3)_3$
23. In the transition of Zn atoms to Zn^{++} ions there is a decrease in the [CPMT 1972]
(a) Number of valency electrons
(b) Atomic weight
(c) Atomic number
(d) Equivalent weight
24. Phosphate of a metal M has the formula $M_3(PO_4)_2$. The formula for its sulphate would be [CPMT 1973; MP PMT 1996]
(a) MSO_4 (b) $M(SO_4)_2$
(c) $M_2(SO_4)_3$ (d) $M_3(SO_4)_2$
25. The molecular formula of chloride of a metal M is MCl_3 . The formula of its carbonate would be [CPMT 1987]
(a) MCO_3 (b) $M_2(CO_3)_3$
(c) M_2CO_3 (d) $M(CO_3)_2$
26. Sodium chloride easily dissolves in water. This is because [NCERT 1972; BHU 1973]
(a) It is a covalent compound
(b) Salt reacts with water
(c) It is a white substance
(d) Its ions are easily solvated
27. When $NaCl$ is dissolved in water the sodium ion becomes [NCERT 1974; CPMT 1989; MP PMT 1999]
(a) Oxidized (b) Reduced
(c) Hydrolysed (d) Hydrated
28. Solid $NaCl$ is a bad conductor of electricity since [AFMC 1980]
(a) In solid $NaCl$ there are no ions
(b) Solid $NaCl$ is covalent
(c) In solid $NaCl$ there is no motion of ions
(d) In solid $NaCl$ there are no electrons
29. Favourable conditions for electrovalency are
(a) Low charge on ions, large cation, small anion
(b) High charge on ions, small cation, large anion
(c) High charge on ions, large cation, small anion
(d) Low charge on ions, small cation, large anion
30. The sulphate of a metal has the formula $M_2(SO_4)_3$. The formula for its phosphate will be [DPMT 1982; CPMT 1972; MP PMT 1995]
(a) $M(HPO_4)_2$ (b) $M_3(PO_4)_2$
(c) $M_2(PO_4)_3$ (d) MPO_4
31. Ionic bonds are usually formed by combination of elements with [CBSE PMT 1995]
(a) High ionisation potential and low electron affinity
(b) Low ionisation potential and high electron affinity
(c) High ionisation potential and high electron affinity
(d) Low ionisation potential and low electron affinity
32. Molten sodium chloride conducts electricity due to the presence of
(a) Free electrons
(b) Free ions
(c) Free molecules
(d) Atoms of sodium and chlorine

33. The phosphate of a metal has the formula $MHPO_4$. The formula of its chloride would be
[NCERT 1974; CPMT 1977]
(a) MCl (b) MCl_2
(c) MCl_3 (d) M_2Cl_3
34. A number of ionic compounds e.g. $AgCl$, CaF_2 , $BaSO_4$ are insoluble in water. This is because [NCERT 1984]
(a) Ionic compounds do not dissolve in water
(b) Water has a high dielectric constant
(c) Water is not a good ionizing solvent
(d) These molecules have exceptionally high alternative forces in the lattice
35. What is the nature of chemical bonding between Cs and F
[MP PMT 1987; CPMT 1976]
(a) Covalent (b) Ionic
(c) Coordinate (d) Metallic
36. Which one of the following compound is ionic [MNR 1985]
(a) KCl (b) CH_4
(c) Diamond (d) H_2
37. Which of the following compound has electrovalent linkage [CPMT 1983, 84, 93]
(a) CH_3Cl (b) $NaCl$
(c) CH_4 (d) Cl_2
38. An ionic compound is generally a [MADT Bihar 1981]
(a) Good electrolyte (b) Weak electrolyte
(c) Non-electrolyte (d) Neutral
39. What metals combine with non-metals, the metal atom tends to
(a) Lose electrons
(b) Gain electrons
(c) Remain electrically neutral
(d) None of these
40. Chemical formula for calcium pyrophosphate is $Ca_2P_2O_7$. The formula for ferric pyrophosphate will be [NCERT 1977]
(a) $Fe_3(P_2O_7)_3$ (b) $Fe_4P_4O_{14}$
(c) $Fe_4(P_2O_7)_3$ (d) Fe_3PO_4
41. Among the bonds formed by a chlorine atom with atoms of hydrogen, chlorine, sodium and carbon, the strongest bond is formed between [EAMCET 1988; MP PMT 1993]
(a) $H-Cl$ (b) $Cl-Cl$
(c) $Na-Cl$ (d) $C-Cl$
42. Which of the following is least soluble [CPMT 1989]
(a) BeF_2 (b) SrF_2
(c) CaF_2 (d) MgF_2
43. Which of the following halides has maximum melting point
(a) $NaCl$ (b) $NaBr$
(c) NaI (d) NaF
44. The high melting point and insolubility in organic solvents of sulphonic acid are due to its structure. [IIT 1994]
(a) Simple ionic (b) Bipolar ionic
(c) Cubic (d) Hexagonal
45. Out of the following, which compound will have electrovalent bonding
(a) Ammonia (b) Water
(c) Calcium chloride (d) Chloromethane
46. The force which holds atoms together in an electrovalent bond is
(a) Vander Waal's force
(b) Dipole attraction force
(c) Electrostatic force of attraction
(d) All the above
47. The main reaction during electrovalent bond formation is
(a) Redox reaction (b) Substitution reaction
(c) Addition reaction (d) Elimination reaction
48. Electrovalent compounds are [CPMT 1996]
(a) Good conductor of electricity
(b) Polar in nature
(c) Low M.P. and low B.P.
(d) Easily available
49. Ionic compounds do not have [RPMT 1997]
(a) Hard and brittle nature
(b) High melting and boiling point
(c) Directional properties
(d) Soluble in polar solvents
50. Highest melting point would be of [RPMT 1999]
(a) He (b) $CsCl$
(c) NH_3 (d) $CHCl_3$
51. What is the effect of more electronegative atom on the strength of ionic bond [AMU 1999]
(a) Decreases (b) Increases
(c) Decreases slowly (d) Remains the same
52. An element X with the electronic configuration $1s^2, 2s^2 2p^6, 3s^2$ would be expected to form the chloride with the formula
(a) XCl_3 (b) XCl_2
(c) XCl (d) X_2Cl
53. Two element have electronegativity of 1.2 and 3.0. Bond formed between them would be [CPMT 1982; DCE 2000]
(a) Ionic (b) Polar covalent
(c) Co-ordinate (d) Metallic
54. Which of the following is least ionic [MP PET 2002]
(a) C_2H_5Cl (b) KCl
(c) $BaCl_2$ (d) $C_6H_5N^+H_3Cl^-$
55. Which type of bonding exists in Li_2O and CaF_2 respectively [RPET 2000]
(a) Ionic, ionic (b) Ionic, covalent
(c) Covalent, ionic (d) Coordinate, ionic
56. An atom with atomic number 20 is most likely to combine chemically with the atom whose atomic number is [BHU 2000]
(a) 11 (b) 14
(c) 16 (d) 10
57. Bond formed in crystal by anion and cation is [CBSE PMT 2000]
(a) Ionic (b) Metallic

- (c) Covalent (d) Dipole
58. Atoms or group of atoms which are electrically charged are known
(a) Anions (b) Cations
(c) Ions (d) Atoms
59. Which one is the strongest bond [Pb. PMT 2001]
(a) $Br-F$ (b) $F-F$
(c) $Cl-F$ (d) $Br-Cl$
60. The interionic attraction depends on interaction of [Kerala CET (Med.) 2002]
(a) Solute-Solute (b) Solvent-Solvent
(c) The charges (d) Molecular properties
61. Which of the following compounds is ionic [UPSEAT 2002]
(a) KI (b) CH_4
(c) Diamond (d) H_2
62. Which of the following pairs of species has same electronic configuration [UPSEAT 2002]
(a) Zn^{2+} and Ni^{2+} (b) Co^{+3} and Ni^{4+}
(c) Co^{2+} and Ni^{2+} (d) Ti^{4+} and V^{3+}
63. The energy that opposes dissolution of a solvent is [CPMT 2002]
(a) Hydration energy (b) Lattice energy
(c) Internal energy (d) Bond energy
64. Which of the following has highest melting point [RPET 2003]
(a) $BeCl_2$ (b) $MgCl_2$
(c) $CaCl_2$ (d) $BaCl_2$
65. Which of the following statements is not true for ionic compounds [RPET 2003]
(a) High melting point
(b) Least lattice energy
(c) Least solubility in organic compounds
(d) Soluble in water
66. Electrolytes are compound containing [MADT Bihar 1981]
(a) Electrovalent bond (b) Covalent bond
(c) Coordinate bond (d) Hydrogen bond
67. Which of the following hydrides are ionic [Roorkee 1999]
(a) CaH_2 (b) BaH_2
(c) SrH_2 (d) BeH_2
68. Which of the following conduct electricity in the fused state [Roorkee 2000]
(a) $BeCl_2$ (b) $MgCl_2$
(c) $SrCl_2$ (d) $BaCl_2$
- (c) 6 (d) 10
3. The electronic configuration of four elements are given in brackets
 $L(1s^2, 2s^2 2p^1)$, $M(1s^2, 2s^2 2p^5)$
 $Q(1s^2, 2s^2 2p^6, 3s^1)$, $R(1s^2, 2s^2 2p^2)$
The element that would most readily form a diatomic molecule is [NCERT 1983]
(a) Q (b) M
(c) R (d) L
4. In covalency [CPMT 1974, 76, 78, 81; AFMC 1982]
(a) Electrons are transferred
(b) Electrons are equally shared
(c) The electron of one atom are shared between two atoms
(d) None of the above
5. Which compound is highest covalent
(a) $LiCl$ (b) LiF
(c) $LiBr$ (d) LiI
6. The nature of bonding in graphite is [DPMT 1986; CPMT 1986]
(a) Covalent (b) Ionic
(c) Metallic (d) Coordinate
7. Which of the following substances has giant covalent structure [DPMT 1985, 86; NCERT 1975]
(a) Iodine crystal (b) Solid CO_2
(c) Silica (d) White phosphorus
8. With which of the given pairs CO resembles [BHU 2005]
(a) $HgCl$, CH (b) $HgCl$, $SnCl$
(c) CH , NO (d) NO and NO
9. The electron pair which forms a bond between two similar non-metallic atoms will be [IIT 1986]
(a) Dissimilar shared between the two
(b) By complete transfer from one atom to other
(c) In a similar spin condition
(d) Equally shared in between the two
10. For the formation of covalent bond, the difference in the value of electronegativities should be [EAMCET 1982]
(a) Equal to or less than 1.7 (b) More than 1.7
(c) 1.7 or more (d) None of these
11. Which type of bond is formed between similar atoms
(a) Ionic (b) Covalent
(c) Coordinate (d) Metallic
12. Covalent compounds are generally in water [CPMT 1987]
(a) Soluble (b) Insoluble
(c) Dissociated (d) Hydrolysed
13. Which one is the electron deficient compound [AIIMS 1982]
(a) ICl (b) NH_3
(c) BCl_3 (d) PCl_3
14. Which among the following elements has the tendency to form covalent compounds
(a) Ba (b) Be
(c) Mg (d) Ca
15. Silicon has 4 electrons in the outermost orbit. In forming the bonds
(a) It gains electrons (b) It loses electrons
(c) It shares electrons (d) None of these
16. Which of the following occurs when two hydrogen atoms bond with each others
(a) Potential energy is lowered
(b) Kinetic energy is lowered

Covalent bonding

1. The valency of sulphur in sulphuric acid is [NCERT 1974]
(a) 2 (b) 4
(c) 6 (d) 8
2. The number of electrons involved in the bond formation of N_2 molecule [IIT 1980; CPMT 1983, 84, 85; CBSE PMT 1992]
(a) 2 (b) 4

- (c) Electronic motion ceases
(d) Energy is absorbed
17. A bond with maximum covalent character between non-metallic elements is formed [NCERT 1982]
(a) Between identical atoms
(b) Between chemically similar atoms
(c) Between atoms of widely different electronegativities
(d) Between atoms of the same size
18. Amongst the following covalent bonding is found in [CPMT 1973]
(a) Sodium chloride (b) Magnesium chloride
(c) Water (d) Brass
19. Indicate the nature of bonding in diamond [EAMCET 1980; BHU 1996; KCET 2000]
(a) Covalent (b) Ionic
(c) Coordinate (d) Hydrogen
20. Octet rule is not valid for the molecule [IIT 1979; MP PMT 1995]
(a) CO_2 (b) H_2O
(c) CO (d) O_2
21. Which of the following compounds are covalent [IIT 1980; MLNR 1982]
(a) H_2 (b) CaO
(c) KCl (d) Na_2S
22. Indicate the nature of bonding in CCl_4 and CaH_2 [NCERT 1973]
(a) Covalent in CCl_4 and electrovalent in CaH_2
(b) Electrovalent in both CCl_4 and CaH_2
(c) Covalent in both CCl_4 and CaH_2
(d) Electrovalent in CCl_4 and covalent in CaH_2
23. If the atomic number of element X is 7, the best electron dot symbol for the element is [NCERT 1973; CPMT 2003]
(a) $X \cdot$ (b) $\cdot X \cdot$
(c) $\cdot \ddot{X} \cdot$ (d) $:\ddot{X}:$
24. Which is the most covalent [AFMC 1982]
(a) $C-O$ (b) $C-Br$
(c) $C-S$ (d) $C-F$
25. The covalent compound HCl has the ionic character as [EAMCET 1980]
(a) The electronegativity of hydrogen is greater than that of chlorine
(b) The electronegativity of hydrogen is equal to that of chlorine
(c) The electronegativity of chlorine is greater than that of hydrogen
(d) Hydrogen and chlorine are gases
26. The correct sequence of increasing covalent character is represented by [CBSE PMT 2005]
(a) $LiCl < NaCl < BeCl_2$ (b) $BeCl_2 < NaCl < LiCl$
(c) $NaCl < LiCl < BeCl_2$ (d) $BeCl_2 < LiCl < NaCl$
27. Bond energy of covalent $O-H$ bond in water is [EAMCET 1982]
(a) Greater than bond energy of $H-H$ bond
(b) Equal to bond energy of $H-H$ bond
(c) Less than bond energy of $H-H$ bond
(d) None of these
28. Solid CH_4 is [DPMT 1983]
(a) Molecular solid (b) Ionic solid
(c) Pseudo solid (d) Does not exist
29. A covalent bond is likely to be formed between two elements which
(a) Have similar electronegativities
(b) Have low ionization energies
(c) Have low melting points
(d) Form ions with a small charge
30. The bond between two identical non-metal atoms has a pair of electrons [CPMT 1986]
(a) Unequally shared between the two
(b) Transferred fully from one atom to another
(c) With identical spins
(d) Equally shared between them
31. The valency of phosphorus in H_3PO_4 is [DPMT 1984]
(a) 2 (b) 5
(c) 4 (d) 1
32. Which of the following substances has covalent bonding [AMU 1985]
(a) Germanium (b) Sodium chloride
(c) Solid neon (d) Copper
33. The covalency of nitrogen in HNO_3 is [CPMT 1987]
(a) 0 (b) 3
(c) 4 (d) 5
34. Hydrogen chloride molecule contains a [CPMT 1984]
(a) Covalent bond (b) Double bond
(c) Coordinate bond (d) Electrovalent bond
35. As compared to covalent compounds, electrovalent compounds generally have [CPMT 1990, 94; MP PMT 1997]
(a) Low melting points and low boiling points
(b) Low melting points and high boiling points
(c) High melting points and low boiling points
(d) High melting points and high boiling points
36. The interatomic distances in H_2 and Cl_2 molecules are 74 and 198 pm respectively. The bond length of HCl is [MP PET 1993]
(a) 272 pm (b) 136 pm
(c) 124 pm (d) 248 pm
37. On analysis, a certain compound was found to contain iodine and oxygen in the ratio of 254 gm of iodine and 80 gm of oxygen.

The atomic mass of iodine is 127 and that of oxygen is 16. Which of the following is the formula of the compound

- (a) IO (b) I_2O
(c) I_5O_2 (d) I_2O_5

38. Ionic and covalent bonds are present in

[CBSE PMT 1990; MNR 1990; KCET 2000; UPSEAT 2001]

- (a) CCl_4 (b) $CaCl_2$
(c) NH_4Cl (d) H_2O

39. Highest covalent character is found in [EAMCET 1992]

- (a) CaF_2 (b) $CaCl_2$
(c) $CaBr_2$ (d) CaI_2

40. Among the following which property is commonly exhibited by a covalent compound [MP PET 1994]

- (a) High solubility in water
(b) High electrical conductance
(c) Low boiling point
(d) High melting point

41. Atoms in the water molecule are linked by [MP PAT 1996]

- (a) Electrovalent bond
(b) Covalent bond
(c) Coordinate covalent bond
(d) Odd electron bond

42. Which is the correct electron dot structure of N_2O molecule

[MP PET 1996]

- (a) $:N=N=\ddot{O}$ (b) $:N \equiv N^+ - \ddot{O}^-$
(c) $\ddot{N} = \ddot{N} = \ddot{O}$ (d) $:N=N=\ddot{O}:$

43. A covalent bond between two atoms is formed by which of the following [MP PMT 1996]

- (a) Electron nuclear attraction
(b) Electron sharing
(c) Electron transfer
(d) Electrostatic attraction

44. The electronic configuration of a metal M is $1s^2, 2s^2 2p^6, 3s^1$. The formula of its oxides will be

[MP PET/PMT 1998]

- (a) MO (b) M_2O
(c) M_2O_3 (d) MO_2

45. Which of the following statements regarding covalent bond is not true [MP PET/PMT 1998]

- (a) The electrons are shared between atoms
(b) The bond is non-directional
(c) The strength of the bond depends upon the extent of overlapping
(d) The bond formed may or may not be polar

46. If the electronic configuration of $M = 2, 8, 3$ and that of $A = 2, 8, 7$, the formula of the compound is

[Bihar MEE 1996]

- (a) MA_3 (b) MA_2
(c) M_2A (d) MA_3

(e) M_3A

[CPMT 1981]

47. The table shown below gives the bond dissociation energies (E_{diss}) for single covalent bonds of carbon (C) atoms with element A, B, C and D. Which element has the smallest atoms [CBSE PMT 1994]

Bond	$E_{diss} (kJ mol^{-1})$
$C-A$	240
$C-B$	328
$C-C$	276
$C-D$	485

- (a) A (b) B
(c) C (d) D

48. If a molecule X_2 has a triple bond, then X will have the electronic configuration [CET Pune 1998]

- (a) $1s^2 2s^2 2p^5$ (b) $1s^2 2s^2 2p^3$
(c) $1s^2 2s^1$ (d) $1s^2 2s^2 2p^1$

49. Which of the following compounds does not follow the octet rule for electron distribution [CET Pune 1998]

- (a) PCl_5 (b) PCl_3
(c) H_2O (d) PH_3

50. The valency of $A = 3$ and $B = 2$, then the compound is

[Bihar MEE 1997]

- (a) A_2B_3 (b) A_3B_2
(c) A_3B_3 (d) A_2B_2
(e) None of these

51. The number of electrons shared by each outermost shell of N_2 is

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

52. Which of the following substances when dissolved in water will give a solution that does not conduct electricity

[JIPMER 1999]

- (a) Hydrogen chloride (b) Potassium hydroxide
(c) Sodium acetate (d) Urea

53. Which of the following atoms has minimum covalent radius

[DPMT 2000]

- (a) B (b) C
(c) N (d) Si

54. Boron form covalent compound due to [Pb. PMT 2000]

- (a) Small size (b) Higher ionization energy
(c) Lower ionization energy (d) Both (a) and (b)

55. Two elements X and Y have following electron configurations

$$X = 1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^2$$

$$\text{and } Y = 1s^2, 2s^2 2p^6, 3s^2 3p^6$$

The compound formed by combination of X and Y is

[DPMT 2001]

- (a) XY_5 (b) X_2Y_5
(c) X_5Y_3 (d) XY_2

56. Covalent compounds have low melting point because

[KCET 2002]

- (a) Covalent bond is less exothermic
(b) Covalent molecules have definite shape
(c) Covalent bond is weaker than ionic bond

- (d) Covalent molecules are held by weak Vander Waal's force of attraction
57. p and n -type of semiconductors are formed due to [UPSEAT 2002]
(a) Covalent bonds (b) Metallic bonds
(c) Ionic bonds (d) Co-ordinate bond
58. Which of the following is Lewis acid [RPET 2003]
(a) BF_3 (b) NH_3
(c) PH_3 (d) SO_2
59. Among the species : CO_2 , CH_3COO^- , CO , CO_3^{2-} , $HCHO$ which has the weakest carbon-oxygen bond [Kerala PMT 2004]
(a) CO_2 (b) CH_3COO^-
(c) CO (d) CO_3^{2-}
(e) $HCHO$
60. Valency of sulphur in $Na_2S_2O_3$ is [DPMT 1984]
(a) Two (b) Three
(c) Four (d) Six
61. The acid having $O-O$ bond is [IIT JEE Screening 2004]
(a) $H_2S_2O_3$ (b) $H_2S_2O_6$
(c) $H_2S_2O_8$ (d) $H_2S_4O_6$
62. The following salt shows maximum covalent character [UPSEAT 2004]
(a) $AlCl_3$ (b) $MgCl_2$
(c) $CsCl$ (d) $LaCl_3$
63. Which type of bond is present in H_2S molecule [MHCET 2003; Pb CET 2001]
(a) Ionic bond (b) Covalent bond
(c) Co-ordinate (d) All of three
64. H_2S is more acidic than H_2O , due to [BVP 2004]
(a) O is more electronegative than S
(b) $O-H$ bond is stronger than $S-H$ bond
(c) $O-H$ bond is weaker than $S-H$ bond
(d) None of these
65. Which of the following has covalent bond [AFMC 1988; DCE 2004]
(a) Na_2S (b) $AlCl_3$
(c) NaH (d) $MgCl_2$
66. The following element forms a molecule with eight its own weight atoms [MHCET 2004]
(a) Si (b) S
(c) Cl (d) P
67. In H_2O_2 , the two oxygen atoms have
(a) Electrovalent bond (b) Covalent bond
(c) Coordinate bond (d) No bond
68. Carbon has a valency of 2 in CO and 4 in CO_2 and CH_4 . Its valency in acetylene (C_2H_2) is [NCERT 1971]
(a) 1 (b) 2
(c) 3 (d) 4
69. Number of electrons in the valence orbit of nitrogen in an ammonia molecule are
(a) 8 (b) 5
(c) 6 (d) 7
70. Hydrogen atoms are held together to form hydrogen molecules by
(a) Hydrogen bond (b) Ionic bond
(c) Covalent bond (d) Dative bond
71. Strongest bond is [AFMC 1987]
(a) $C-C$ (b) $C-H$
(c) $C-N$ (d) $C-O$
72. The major binding force of diamond, silicon and quartz is [Kerala CET (Med.) 2002]
(a) Electrostatic force (b) Electrical attraction
(c) Co-valent bond force (d) Non-covalent bond force
73. Multiple covalent bonds exist in a molecule of [NCERT 1973]
(a) H_2 (b) F_2
(c) C_2H_4 (d) N_2
74. Which of the following does not obey the octet rule [EAMCET 1993]
(a) CO (b) NH_3
(c) H_2O (d) PCl_5
75. Which of the following statements is correct for covalent bond
(a) Electrons are shared between two atoms
(b) It may be polar or non-polar
(c) Direction is non-polar
(d) Valency electrons are attracted
76. Among CaH_2 , NH_3 , NaH and B_2H_6 , which are covalent hydride [Orissa JEE 2005]
(a) NH_3 and B_2H_6 (b) NaH and CaH_2
(c) NaH and NH_3 (d) CaH_2 and B_2H_6

Co-ordinate or Dative bonding

1. Which species has the maximum number of lone pair of electrons on the central atom? [IIT 2005]
(a) $[ClO]^-$ (b) XeF_4
(c) SF_6 (d) $[I]^-$
2. A simple example of a coordinate covalent bond is exhibited by
(a) C_2H_2 (b) H_2SO_4
(c) NH_3 (d) HCl
3. The bond that exists between NH_3 and BF_3 is called [AFMC 1982; MP PMT 1985; MNR 1994; KCET 2000; MP PET 2001; UPSEAT 2001]
(a) Electrovalent (b) Covalent
(c) Coordinate (d) Hydrogen
4. Which of the following does not have a coordinate bond [MADT Bihar 1984]
(a) SO_2 (b) HNO_3
(c) H_2SO_3 (d) HNO_2
5. Coordinate covalent compounds are formed by [CPMT 1990, 94]
(a) Transfer of electrons (b) Sharing of electrons
(c) Donation of electrons (d) None of these process
6. In the coordinate valency [CPMT 1989]
(a) Electrons are equally shared by the atoms
(b) Electrons of one atom are shared with two atoms
(c) Hydrogen bond is formed

- (d) None of the above
7. Which of the following contains a coordinate covalent bond [MNR 1990; IIT 1986]
- (a) N_2O_5 (b) $BaCl_2$
(c) HCl (d) H_2O
8. A coordinate bond is formed when an atom in a molecule has
- (a) Electric charge on it
(b) All its valency electrons shared
(c) A single unshared electron
(d) One or more unshared electron pair
9. Which has a coordinate bond [RPMT 1997]
- (a) SO_3^{2-} (b) CH_4
(c) CO_2 (d) NH_3
10. The compound containing co-ordinate bond is [AFMC 1999; Pb. CET 2002]
- (a) O_3 (b) SO_3
(c) H_2SO_4 (d) All of these
11. The number of dative bonds in sulphuric acid molecules is [MP PET 2002]
- (a) 0 (b) 1
(c) 2 (d) 4
12. Which of the following compounds has coordinate (dative) bond
- (a) CH_3NC (b) CH_3OH
(c) CH_3Cl (d) NH_3
13. The structure of orthophosphoric acid is [KCET 2003]
- (a) $\begin{array}{c} O \\ \uparrow \\ H-O-P-O-H \\ | \\ O \\ | \\ H \end{array}$ (b) $\begin{array}{c} H \\ | \\ O \leftarrow P-O-H \\ | \\ O \\ | \\ H \end{array}$
(c) $\begin{array}{c} H \\ | \\ O \leftarrow P-O-H \\ | \\ H \end{array}$ (d) $\begin{array}{c} O \\ \uparrow \\ H-O-P=O \end{array}$
14. What is the nature of the bond between B and O in $(C_2H_5)_2OBH_3$ [Orissa JEE 2003]
- (a) Covalent (b) Co-ordinate covalent
(c) Ionic bond (d) Banana shaped bond
15. Sulphuric acid provides a example of [Kerala CET (Med.) 2002]
- (a) Co-ordinate bonds
(b) Non-covalent compound
(c) Covalent and co-ordinate bond
(d) Non-covalent ion
- (a) BF_3 (b) CCl_4
(c) $BeCl_2$ (d) All of these
3. Which molecule has the largest dipole moment [CPMT 1991]
- (a) HI
(c) HBr (d) HF
4. The unequal sharing of bonded pair of electrons between two atoms in a molecule causes [EAMCET 1986]
- (a) Dipole
(b) Radical formation
(c) Covalent bond
(d) Decomposition of molecule
5. Which of the following will show least dipole character [NCERT 1975; Kurukshetra CEE 1998]
- (a) Water (b) Ethanol
(c) Ethane (d) Ether
6. Which of the following molecules will show dipole moment [NCERT 1972, 74; DPMT 1985]
- (a) Methane (b) Carbon tetrachloride
(c) Chloroform (d) Carbon dioxide
7. Which of the following compounds possesses the dipole moment [NCERT 1978; EAMCET 2003]
- (a) Water (b) Boron trifluoride
(c) Benzene (d) Carbon tetrachloride
8. Which bond angle θ would result in the maximum dipole moment for the triatomic molecule YXY [AIIMS 1980]
- (a) $\theta = 90^\circ$ (b) $\theta = 120^\circ$
(c) $\theta = 150^\circ$ (d) $\theta = 180^\circ$
9. Which of the following would have a permanent dipole moment [CBSE PMT 2000]
- (a) BF_3 (b) SiF_4
(c) SF_4 (d) XeF_4
10. Carbon tetrachloride has no net dipole moment because of [IIT 1982, 83; MP PMT 1985, 91; EAMCET 1988; AMU 1999]
- (a) Its planar structure
(b) Its regular tetrahedral structure
(c) Similar sizes of carbon and chlorine atoms
(d) Similar electron affinities of carbon and chlorine
11. The molecule which has the largest dipole moment amongst the following [MNR 1983]
- (a) CH_4 (b) $CHCl_3$
(c) CCl_4 (d) CHI_3
12. Positive dipole moment is present in [MNR 1986; MP PET 2000]
- (a) CCl_4 (b) C_6H_6
(c) BF_3 (d) HF
13. The polarity of a covalent bond between two atoms depends upon
- (a) Atomic size (b) Electronegativity
(c) Ionic size (d) None of the above
14. Pick out the molecule which has zero dipole moment [CPMT 1989; EAMCET 1993; MP PMT 1999]
- (a) NH_3 (b) H_2O
(c) BCl_3 (d) SO_2

Dipole moment

1. Which molecules has zero dipole moment [AIIMS 1980, 82, 91; Roorkee 2000; MH CET 2001]
- (a) H_2O (b) CO_2
(c) HF (d) HBr
2. In the following which one have zero dipole moment

15. Zero dipole moment is present in [DPMT 1986; IIT 1987]
 (a) NH_3 (b) H_2O
 (c) *cis* 1, 2-dichloroethene (d) *trans* 1, 2-dichloroethene
16. Which of the following is the most polar [AFMC 1988]
 (a) CCl_4 (b) $CHCl_3$
 (c) CH_3OH (d) CH_3Cl
17. Which one has minimum (nearly zero) dipole moment [IIT Screening 1994; CBSE PMT 1996]
 (a) Butene-1 (b) *cis* butene-2
 (c) *trans* butene-2 (d) 2-methyl-1-propene
18. Which one of the following is having zero dipole moment [RPMT 1997; EAMCET 1988; MNR 1991]
 (a) CCl_4 (b) CH_3Cl
 (c) CH_3F (d) $CHCl_3$
19. Which of the following molecules does not possess a permanent dipole moment [CBSE PMT 1994]
 (a) H_2S (b) SO_2
 (c) CS_2 (d) SO_3
20. Which of the following has zero dipole moment [CPMT 1997; AFMC 1998; CBSE PMT 2001]
 (a) CH_2Cl_2 (b) CH_4
 (c) NH_3 (d) PH_3
21. Fluorine is more electronegative than either boron or phosphorus. What conclusion can be drawn from the fact that BF_3 has no dipole moment but PF_3 does [Pb. PMT 1998]
 (a) BF_3 is not spherically symmetrical but PF_3 is
 (b) BF_3 molecule must be linear
 (c) The atomic radius of P is larger than the atomic radius of B
 (d) The BF_3 molecule must be planar triangular
22. Which molecule does not show zero dipole moment [RPET 1997, 99]
 (a) BF_3 (b) NH_3
 (c) CCl_4 (d) CH_4
23. The dipole moment of HBr is $1.6 \times 10^{-30} \text{ cm}$ and interatomic spacing is 1\AA . The % ionic character of HBr is [MP PMT 2000]
 (a) 7 (b) 10
 (c) 15 (d) 27
24. Non-polar solvent is [RPET 2000]
 (a) Dimethyl sulphoxide (b) Carbon tetrachloride
 (c) Ammonia (d) Ethyl alcohol
25. Which shows the least dipole moment [UPSEAT 2001; DPMT 1982]
 (a) CCl_4 (b) $CHCl_3$
 (c) CH_3CH_2OH (d) CH_3COCH_3
26. Which molecule has zero dipole moment [UPSEAT 2001]
 (a) H_2O (b) AgI
 (c) $PbSO_4$ (d) HBr
27. The dipole moment is zero for the molecule [IIT 1989; MP PMT 2002]
 (a) Ammonia (b) Boron trifluoride
 (c) Sulphur dioxide (d) Water
28. N_2 is less reactive than CN^- due to [UPSEAT 2003]
 (a) Presence of more electrons in orbitals
 (b) Absence of dipole moment
 (c) Difference in spin quantum no
 (d) None of these
29. In a polar molecule, the ionic charge is $4.8 \times 10^{-10} \text{ e.s.u.}$. If the inter ionic distance is one \AA unit, then the dipole moment is
 (a) 41.8 debye (b) 4.18 debye
 (c) 4.8 debye (d) 0.48 debye
30. Which of the following is a polar compound [Pb. CET 2000]
 (a) HCl (b) H_2Se
 (c) CH_4 (d) HI
31. Which of the following has no dipole moment [DCE 2002]
 (a) CO_2 (b) SO_3
 (c) O_3 (d) H_2O
32. Which of the following is non-polar [DCE 2002]
 (a) PCl_5 (b) PCl_3
 (c) SF_6 (d) IF_7
33. Identify the non-polar molecule in the set of compounds given : HCl, HF, H_2, HBr [UPSEAT 2004]
 (a) H_2 (b) HCl
 (c) HF, HBr (d) HBr
34. Dipole moment is shown by [IIT 1986]
 (a) 1, 4-dichlorobenzene
 (b) *cis* 1, 2-dichloroethene
 (c) *trans* 1, 2-dichloroethene
 (d) *trans* 1, 2-dichloro-2-pentene
35. If HCl molecule is completely polarized, so expected value of dipole moment is 6.12D (deby), but experimental value of dipole moment is 1.03D. Calculate the percentage ionic character [Kerala CET 2005]
 (a) 17 (b) 83
 (c) 50 (d) Zero
 (e) 90

Polarisation and Fajan's rule

1. BF_3 and NF_3 both molecules are covalent, but BF_3 is non-polar and NF_3 is polar. Its reason is [CPMT 1989; NCERT 1980]
 (a) In uncombined state boron is metal and nitrogen is gas
 (b) $B-F$ bond has no dipole moment whereas $N-F$ bond has dipole moment
 (c) The size of boron atom is smaller than nitrogen
 (d) BF_3 is planar whereas NF_3 is pyramidal
2. Which one is polar molecule among the following
 (a) CO_2 (b) CCl_4

- (c) H_2O (d) CH_4
3. If the electron pair forming a bond between two atoms A and B is not in the centre, then the bond is [AIIMS 1984]
 (a) Single bond (b) Polar bond
 (c) Non-polar bond (d) π bond
4. Which of the following liquids is not deflected by a non-uniform electrostatic field [NCERT 1978]
 (a) Water (b) Chloroform
 (c) Nitrobenzene (d) Hexane
5. Which of the following is non-polar [EAMCET 1983]
 (a) H_2S (b) $NaCl$
 (c) Cl_2 (d) H_2SO_4
6. Polarization is the distortion of the shape of an anion by an adjacently placed cation. Which of the following statements is correct [NCERT 1982]
 (a) Maximum polarization is brought about by a cation of high charge
 (b) Minimum polarization is brought about by a cation of low radius
 (c) A large cation is likely to bring about a large degree of polarization
 (d) A small anion is likely to undergo a large degree of polarization
7. The bonds between P atoms and Cl atoms in PCl_5 are likely to be [MP PMT 1987]
 (a) Ionic with no covalent character
 (b) Covalent with some ionic character
 (c) Covalent with no ionic character
 (d) Ionic with some metallic character
8. Two electrons of one atom A and two electrons of another atom B are utilized to form a compound AB . This is an example of
 (a) Polar covalent bond (b) Non-polar covalent bond
 (c) Polar bond (d) Dative bond
9. In which of the following molecule is the covalent bond most polar [AMU 1985; MP PET 2001]
 (a) HI (b) HBr
 (c) HCl (d) H_2
10. Amongst ClF_3 , BF_3 and NH_3 molecules the one with non-planar geometry is [MP PMT 1999]
 (a) ClF_3 (b) NH_3
 (c) BF_3 (d) None of these
11. Which of the following possesses highest melting point [CPMT 1999]
 (a) Chlorobenzene (b) o -dichlorobenzene
 (c) m -dichlorobenzene (d) p -dichlorobenzene
12. The polar molecule among the following is [Orissa JEE 1997]
 (a) CCl_4 (b) CO_2
 (c) CH_2Cl_2 (d) $CH_2 = CH_2$
13. Which of the following have both polar and non-polar bonds
 (a) C_2H_6 (b) NH_4Cl
 (c) HCl (d) $AlCl_3$
14. Which of the following has a high polarising power [CET Pune 1998]
 (a) Mg^{2+} (b) Al^{3+}
- (c) Na^+ (d) Ca^{2+}
15. Maximum covalent character is associated with the compound [RPMT 1999]
 (a) NaI (b) MgI_2
 (c) $AlCl_3$ (d) AlI_3
16. Polarizability of halide ions increases in the order [DCE 1999]
 (a) F^-, I^-, Br^-, Cl^- (b) Cl^-, Br^-, I^-, F^-
 (c) I^-, Br^-, Cl^-, F^- (d) F^-, Cl^-, Br^-, I^-
17. According to Fajan's rule, covalent bond is favoured by [AIIMS 1999]
 (a) Large cation and small anion
 (b) Large cation and large anion
 (c) Small cation and large anion
 (d) Small cation and small anion
18. Which of the following statements is correct [AMU 1999]
 (a) SF_4 is polar and non-reactive
 (b) SF_6 is non-polar and very reactive
 (c) SF_6 is a strong fluorinating agent
 (d) SF_4 is prepared by fluorinating SCl_2 with NaF
19. Choose the correct statement [RPMT 2000]
 (a) Amino polarisation is more pronounced by highly charged cation
 (b) Small cation has minimum capacity to polarise an anion.
 (c) Small anion has maximum polarizability
 (d) None of these
20. The ICl molecule is [DPMT 2001]
 (a) Purely electrovalent
 (b) Purely covalent
 (c) Polar with negative end on iodine
 (d) Polar with negative end on chlorine
21. Which of the following is a polar compound [AIIMS 2001]
 (a) HF (b) HCl
 (c) HNO_3 (d) H_2SO_4
22. Which of the following has zero dipole moment [MP PMT 2002]
 (a) ClF (b) PCl_3
 (c) SiF_4 (d) $CFCl_3$
23. Which of the following compounds has least dipole moment [RPET 2003]
 (a) PH_3 (b) $CHCl_3$
 (c) NH_3 (d) BF_3
24. Pauling's electronegativity values for elements are useful in predicting [UPSEAT 2004]
 (a) Polarity of bonds in molecules
 (b) Position of elements in electrochemical series
 (c) Co-ordination number
 (d) Dipole moment of various molecules
25. Amongst $LiCl$, $RbCl$, $BeCl_2$ and $MgCl_2$ the compounds with the greatest and the least ionic character, respectively, are [UPSEAT 2002]
 (a) $LiCl$ and $RbCl$ (b) $RbCl$ and $BeCl_2$
 (c) $RbCl$ and $MgCl_2$ (d) $MgCl_2$ and $BeCl_2$
26. Bond polarity of diatomic molecule is because of [UPSEAT 2002]

- (a) Difference in electron affinities of the two atoms
 (b) Difference in electronegativities of the two atoms
 (c) Difference in ionisation potential
 (d) All of these

Overlapping- σ and π bonds

- Triple bond in ethyne is formed from
 [MP PMT 1990; NCERT 1979; EAMCET 1978; AMU 1985; CPMT 1988; MADT Bihar 1982; MH CET 2000]
 (a) Three sigma bonds
 (b) Three pi bonds
 (c) One sigma and two pi bonds
 (d) Two sigma and one pi bond
- The bond in the formation of fluorine molecule will be
 [MP PMT 1987]
 (a) Due to $s-s$ overlapping
 (b) Due to $s-p$ overlapping
 (c) Due to $p-p$ overlapping
 (d) Due to hybridization
- Which type of overlapping results the formation of a π bond
 [DPMT 1981]
 (a) Axial overlapping of $s-s$ orbitals
 (b) Lateral overlapping of $p-p$ orbitals
 (c) Axial overlapping of $p-p$ orbitals
 (d) Axial overlapping of $s-p$ orbitals
- The number and type of bonds between two carbon atoms in calcium carbide are
 [AIEEE 2005]
 (a) One sigma, one pi (b) One sigma, two pi
 (c) Two sigma, one pi (d) Two sigma, two pi
- In a double bond connecting two atoms, there is a sharing of
 [CPMT 1977, 80, 81; NCERT 1975; Bihar MEE 1980; MP PET 1999]
 (a) 2 electrons (b) 1 electron
 (c) 4 electrons (d) All electrons
- Strongest bond is
 [DPMT 1990]
 (a) $C-C$ (b) $C=C$
 (c) $C\equiv C$ (d) All are equally strong
- π bond is formed
 [JIPMER 2002]
 (a) By overlapping of atomic orbitals on the axis of nuclei
 (b) By mutual sharing of pi electron
 (c) By sidewise overlapping of half filled p -orbitals
 (d) By overlapping of s -orbitals with p -orbitals
- The double bond between the two carbon atoms in ethylene consists of
 [NCERT 1981; EAMCET 1979]
 (a) Two sigma bonds at right angles to each other
 (b) One sigma bond and one pi bond
 (c) Two pi bonds at right angles to each other
 (d) Two pi bonds at an angle of 60° to each other
- In the series ethane, ethylene and acetylene, the $C-H$ bond energy is
 [NCERT 1977]
 (a) The same in all the three compounds
 (b) Greatest in ethane
 (c) Greatest in ethylene
 (d) Greatest in acetylene
- In a sigma bond
 (a) Sidewise as well as end to end overlap of orbitals take place

- (b) Sidewise overlap of orbitals takes place
 (c) End to end overlap of orbitals takes place
 (d) None of the above

- The number of sigma and pi bonds in 1-butene-3-yne are
 [IIT 1989]
 (a) 5 sigma and 5 pi (b) 7 sigma and 3 pi
 (c) 8 sigma and 2 pi (d) 6 sigma and 4 pi
- The most acidic compound among the following is
 [MP PET 1993]
 (a) CH_3CH_2OH (b) C_6H_5OH
 (c) CH_3COOH (d) $CH_3CH_2CH_2OH$
- Which of the following is not correct
 [CBSE PMT 1990]
 (a) A sigma bond is weaker than π bond
 (b) A sigma bond is stronger than π bond
 (c) A double bond is stronger than a single bond
 (d) A double bond is shorter than a single bond
- Strongest bond formed, when atomic orbitals
 (a) Maximum overlap (b) Minimum overlap
 (c) Overlapping not done (d) None of them
- The $p-p$ orbital overlapping is present in the following molecule
 (a) Hydrogen (b) Hydrogen bromide
 (c) Hydrogen chloride (d) Chlorine
- In N_2 molecule, the atoms are bonded by
 [MP PET 1996; UPSEAT 2001]
 (a) One σ , Two π (b) One σ , One π
 (c) Two σ , One π (d) Three σ bonds
- In which of following there exists a $p\pi-d\pi$ bonding
 [AFMC 2001]
 (a) Diamond (b) Graphite
 (c) Dimethyl amine (d) Trisilylamine
- Number of bonds in SO_2
 [DCE 2001]
 (a) Two σ and two π
 (b) Two σ and one π
 (c) Two σ , two π and one lone pair
 (d) None of these
- Which of the following has $p\pi-d\pi$ bonding
 [CBSE 2002]
 (a) NO_3^- (b) CO_3^{2-}
 (c) BO_3^{3-} (d) SO_3^{2-}
- Number of sigma bonds in P_4O_{10} is
 [AIEEE 2002]
 (a) 6 (b) 7
 (c) 17 (d) 16

Hybridisation

- Which molecule is not linear
 [CPMT 1994]
 (a) BeF_2 (b) BeH_2
 (c) CO_2 (d) H_2O
- The bond angle in water molecule is nearly or Directed bonds in water forms an angle of
 [NCERT 1980; EAMCET 1981; MNR 1983, 85; AIIMS 1982; CPMT 1989; MP PET 1994, 96; MP PET/PMT 1998]
 (a) 120° (b) 180°

- (c) $109^{\circ}28'$ (d) $104^{\circ}30'$
3. The central atom in a molecule is in sp^2 hybrid state. The shape of molecule will be [MP PMT 1987; CBSE PMT 1989]
 (a) Pyramidal (b) Tetrahedral
 (c) Octahedral (d) Trigonal planar
4. Which molecule is linear [MP PMT 1984; IIT 1982, 88; EAMCET 1993; CBSE PMT 1992; MP PET 1995; RPMT 1997]
 (a) NO_2 (b) ClO_2
 (c) CO_2 (d) H_2S
5. Which of the following molecules has trigonal planar geometry [CBSE PMT 2005]
 (a) IF_3 (b) PCl_3
 (c) NH_3 (d) BF_3
6. A sp^3 hybridized orbital contains [DPMT 1984; BHU 1985; CPMT 1976]
 (a) $\frac{1}{4}$ s - character (b) $\frac{1}{2}$ s - character
 (c) $\frac{2}{3}$ s - character (d) $\frac{3}{4}$ s - character
7. Structure of ammonia is [MP PMT 1987, 89, 91; CPMT 1975, 82; RPMT 1999; JIPMER 2002]
 (a) Trigonal (b) Tetrahedral
 (c) Pyramidal (d) Trigonal pyramidal
8. The bond angle in ethylene is [CPMT 1987]
 (a) 180° (b) 120°
 (c) 109° (d) 90°
9. Compound formed by sp^3d hybridization will have structure [BHU 1982; RPMT 1999]
 (a) Planar (b) Pyramidal
 (c) Angular (d) Trigonal bipyramidal
10. Which of the following formula does not correctly represent the bonding capacity of the atom involved [CBSE PMT 1990]
 (a) $\left[\begin{array}{c} H \\ | \\ H - P - H \\ | \\ H \end{array} \right]$ (b) $\begin{array}{c} F & & F \\ & \diagdown & / \\ & O \end{array}$
 (c) $O \leftarrow N \begin{array}{l} // \\ \backslash \\ O - H \end{array}$ (d) $H - C = C \begin{array}{l} // \\ \backslash \\ O - H \end{array}$
11. Which of the following statement is not correct [AIIMS 1983]
 (a) Hybridization is the mixing of atomic orbitals prior to their combining into molecular orbitals
 (b) sp^2 hybrid orbitals are formed from two p atomic orbitals and one s atomic orbital
 (c) d^2sp^3 hybrid orbitals are directed towards the corners of a regular octahedron
 (d) dsp^3 hybrid orbitals are all at 90° to one another
12. The mode of hybridisation of carbon in CO_2 is [CPMT 1991]
 (a) sp (b) sp^2
 (c) sp^3 (d) None of these
13. In which of the following the central atom does not use sp^3 hybrid orbitals in its bonding [MNR 1992]
 (a) BeF_3^- (b) OH_3^+
 (c) NH_2^- (d) NF_3
14. XeF_2 involves hybridisation [DPMT 1990]
 (a) sp^3 (b) sp^3d
 (c) sp^3d^2 (d) None of these
15. Which of the following hybridisation results in non-planar orbitals
 (a) sp^3 (b) dsp^2
 (c) sp^2 (d) sp
16. Octahedral molecular shape exists in hybridisation [DPMT 1990]
 (a) sp^3d (b) sp^3d^2
 (c) sp^3d^3 (d) None of these
17. The electronic structure of molecule OF_2 is a hybrid of
 (a) sp (b) sp^2
 (c) sp^3 (d) sd^3
18. Percentage of s-character in sp^3 hybrid orbital is
 (a) 25 (b) 50
 (c) 66 (d) 75
19. Shape of XeF_4 molecule is [BHU 1987; AFMC 1992; CET Pune 1998; Roorkee Qualifying 1998; DCE 2002]
 (a) Linear (b) Pyramidal
 (c) Tetrahedral (d) Square planar
20. For which of the following hybridisation the bond angle is maximum
 (a) sp^2 (b) sp
 (c) sp^3 (d) dsp^2
21. The $C-H$ bond distance is the longest in [MNR 1990]
 (a) C_2H_2 (b) C_2H_4
 (c) $C_2H_4Br_2$ (d) C_6H_6
22. The nature of hybridization in CH_2Cl-CH_2Cl for carbon is
 (a) sp (b) sp^2
 (c) sp^3 (d) sp^2d
23. Shape of methane molecule is [MNR 1983]
 (a) Tetrahedral (b) Pyramidal
 (c) Octahedral (d) Square planar
24. Which one amongst the following possesses an sp hybridized carbon in its structure [CBSE PMT 1989]
 (a) $CH_2 = C.Cl - CH = CH_2$

- (b) $C.Cl_2 = C.Cl_2$
 (c) $CH_2 = C = CH_2$
 (d) $CH_2 = CH - CH = CH_2$
25. Which of the following is the correct electronic formula of chlorine molecule [CPMT 1971]
 (a) $:\ddot{Cl}:\ddot{Cl}:$ (b) $:\ddot{Cl}^-::\ddot{Cl}^+:$
 (c) $:\ddot{Cl}:\ddot{Cl}:$ (d) $:\ddot{Cl}::\ddot{Cl}:$
26. In XeF_4 hybridization is
 (a) sp^3d^2 (b) sp^3
 (c) sp^3d (d) sp^2d
27. In $HCHO$, 'C' has hybridization [AIIMS 1987]
 (a) sp (b) sp^2
 (c) sp^3 (d) All the above
28. Which has the shortest C - C bond length [NCERT 1982; CPMT 1989]
 (a) C_2H_5OH (b) C_2H_6
 (c) C_2H_2 (d) C_2H_4
29. The hybridization of Ag in the linear complex $[Ag(NH_3)_2]^+$ is
 (a) dsp^2 (b) sp
 (c) sp^2 (d) sp^3
30. Experiment shows that H_2O has a dipole moment while CO_2 has not. Point out the structures which best illustrate these facts [DPMT 1984; NCERT 1983; CPMT 1984]
 (a) $O = C = O$; $H \begin{array}{c} \diagup O \diagdown \\ \diagdown \end{array} H$ (b) $O = C = O$; $H - O - H$
 (c) $\begin{array}{c} \diagup \\ O \\ \diagdown \end{array} C = \begin{array}{c} \diagdown \\ O \\ \diagup \end{array}$; $H - H - O$ (d) $\begin{array}{c} O \\ || \\ C = O \end{array}$; $\begin{array}{c} H \\ | \\ O - H \end{array}$
31. Which species do not have sp^3 hybridization [DPMT 1985]
 (a) Ammonia (b) Methane
 (c) Water (d) Carbon dioxide
32. As compared to pure atomic orbitals, hybrid orbitals have
 (a) Low energy (b) Same energy
 (c) High energy (d) None of these
33. The compound 1, 2-butadiene has [IIT 1983; MP PMT 1996]
 (a) Only sp hybridized carbon atoms
 (b) Only sp^2 hybridized carbon atoms
 (c) Both sp and sp^2 hybridized carbon atoms
 (d) sp , sp^2 and sp^3 hybridized carbon atoms
34. The number of unpaired electrons in O_2 molecule is [MNR 1983; Kerala PET 2002]
 (a) 0 (b) 1
 (c) 2 (d) 3
35. In the following molecule, the two carbon atoms marked by asterisk (*) possess the following type of hybridized orbitals
 $H_3C - C^* \equiv C^* - CH_3$ [NCERT 1984]
 (a) sp^3 orbital (b) sp^2 orbital
 (c) sp orbital (d) s orbital
36. The bond angle in carbon tetrachloride is approximately [MNR 1981; MP PMT 1987]
 (a) 90° (b) 109°
 (c) 120° (d) 180°
37. When two pairs of electrons are shared, bond is [MNR 1979]
 (a) Single covalent bond (b) Double covalent bond
 (c) Dative bond (d) Triple bond
38. The nature of hybridization in the NH_3 molecule is [EAMCET 1982]
 (a) sp (b) sp^2
 (c) sp^3 (d) sp^3d
39. Which one of the following compounds has bond angle as nearly 90° [MP PMT 1985]
 (a) NH_3 (b) H_2S
 (c) H_2O (d) CH_4
40. In ethene, the bond angle(s) is/are [CPMT 1985; BHU 1981] [CPMT 1976; AMU 1984; MP PMT 1985]
 (a) $109^\circ 28'$ (b) 120°
 (c) 180° (d) Different
41. Structure formula of H_2O_2 is [CPMT 1993]
 (a) $\begin{array}{c} H \\ \diagup \\ O \rightarrow O \\ \diagdown \\ H \end{array}$
 (b) $H - O - O - H$ (straight line)
 (c) $\begin{array}{c} H' \\ | \\ O - O \\ | \\ H \end{array}$
 (d) $\begin{array}{c} H' \\ | \\ O - O \\ | \\ H \end{array}$
- Where $\angle H - O - O = \angle O - O - H' = 101.5^\circ$ and all the four atoms are in the same plane
- (d) $\begin{array}{c} H' \\ | \\ O - O \\ | \\ H \end{array}$
- Where $\angle H - O - O = \angle O - O - H' = 97^\circ$ and the angle between $H - O - O$ plane and $O - O - H'$ plane is 101°
42. Number of shared electrons in between carbon-carbon atoms in ethylene molecule is [MADT Bihar 1983]
 (a) 2 (b) 4
 (c) 6 (d) 3
43. The structural formula of a compound is $CH_3 - CH = C = CH_2$. The type of hybridization at the four carbons from left to right are [CBSE PMT 1989]
 (a) sp^2 , sp , sp^2 , sp^3 (b) sp^2 , sp^3 , sp^2 , sp

- (c) sp^3, sp^2, sp, sp^2 (d) sp^3, sp^2, sp^2, sp^2
44. Acetate ion contains [AMU 1983]
 (a) One C, O single bond and one C, O double bond
 (b) Two C, O single bonds
 (c) Two C, O double bonds
 (d) None of the above
45. The two carbon atoms in acetylene are [AMU 1984; MADT Bihar 1982]
 (a) sp^3 hybridized (b) sp^2 hybridized
 (c) sp hybridized (d) Unhybridized
46. Among the following compounds which is planar in shape [AMU 1992]
 (a) Methane (b) Acetylene
 (c) Benzene (d) Isobutene
47. In methane the bond angle is [AMU 1983]
 (a) 180° (b) 90°
 (c) 120° (d) 109°
48. The angle between sp^2 orbitals in ethylene is [BHU 1987, 95; AMU 1985]
 (a) 90° (b) 120°
 (c) 180° (d) 109.5°
49. The species in which the central atom uses sp^2 hybrid orbitals in its bonding is [IIT 1988]
 (a) PH_3 (b) NH_3
 (c) H_3C^+ (d) SbH_3
50. Carbon atoms in diamond are bonded to each other in a configuration [CPMT 1981]
 (a) Tetrahedral (b) Planar
 (c) Linear (d) Octahedral
51. Which of the following molecules can central atom said to adopt sp^2 hybridization [CBSE PMT 1989; MP PET 1994]
 (a) BeF_2 (b) BCl_3
 (c) C_2H_2 (d) NH_3
52. In $[Cu(NH_3)_4]SO_4$, Cu has following hybridization [AIIMS 1988; UPSEAT 2001]
 (a) dsp^2 (b) sp^3
 (c) sp^2 (d) sp^3d^2
53. The hybridization of carbon atoms in C – C single bond of $HC \equiv C - CH = CH_2$ is [IIT 1991; MP PET 1995]
 (a) $sp^3 - sp^3$ (b) $sp^2 - sp^3$
 (c) $sp - sp^2$ (d) $sp^3 - sp$
54. The compound in which C^* uses sp^3 hybrids for bond formation is [IIT 1989]
 (a) $HCOOH^+$ (b) $(NH_3)_2CO^+$
 (c) $(NH_3)_3COH^+ HgCl_2$ (d) CH_3CHO^+
55. In diborane, the $H - B - H$ bond angle is 120° . The hybridization of boron is likely to be [BHU 1981; CBSE PMT 1999]
 (a) sp (b) sp^2
 (c) sp^3 (d) dsp^2
56. The number of shared pairs of electrons in propane is [BHU 1981]
 (a) 2 (b) 4
 (c) 6 (d) 10
57. s-character in sp hybridised orbitals are
 (a) $\frac{1}{3}$ (b) $\frac{1}{2}$
 (c) $\frac{1}{4}$ (d) $\frac{2}{3}$
58. The two types of bonds present in B_2H_6 are covalent and [IIT 1994]
 (a) Three centre bond (b) Hydrogen bond
 (c) Two centre bond (d) None of the above
59. In the compound $CH_3 \odot OCl$, which type of orbitals have been used by the circled carbon in bond formation [MP PET 1994]
 (a) sp^3 (b) sp^2
 (c) sp (d) p
60. The correct order of the O – O bond length in O_2 , H_2O_2 and O_3 is [CBSE PMT 1995]
 (a) $O_2 > O_3 > H_2O_2$ (b) $O_3 > H_2O_2 > O_2$
 (c) $H_2O_2 > O_3 > O_2$ (d) $O_2 > H_2O_2 > O_3$
61. The structure of PF_5 molecule is [AFMC 1995; JIPMER 2001]
 (a) Tetrahedral (b) Trigonal bipyramidal
 (c) Square planar (d) Pentagonal bipyramidal
62. Which of the following hybridisation has maximum s-characters
 (a) sp^3 (b) sp^2
 (c) sp (d) None of these
63. The PCl_5 molecule is a result of the hybridisation of [MP PET 1995; DCE 2000; MP PMT 2002]
 (a) sp^2d^2 (b) sp^3d
 (c) sp^3d (d) sp^2d^3
64. Hybridisation involves [MP PMT 1996]
 (a) Addition of an electron pair
 (b) Mixing up of atomic orbitals
 (c) Removal of an electron pair
 (d) Separation of orbitals
65. The geometry of sulphur trioxide molecule is
 (a) Tetrahedral (b) Trigonal planar
 (c) Pyramidal (d) Square planar
66. The shapes of BCl_3 , PCl_3 and ICl_3 molecules are all
 (a) Triangular (b) Pyramidal
 (c) T-shaped (d) All above are incorrect
67. In benzene molecule all C – C bond lengths are equal because

- (a) All carbon atoms are equivalent
(b) All carbon atoms are sp^2 hybridised
(c) All $C - C$ bonds in benzene, have same order
(d) All $C - C$ bonds are single covalent bond
68. Which one is false in the following statements [MP PET 1997]
(a) Each carbon in ethylene is in sp^2 hybridisation
(b) Each carbon in acetylene is in sp^3 hybridisation
(c) Each carbon in benzene is in sp^2 hybridisation
(d) Each carbon in ethane is in sp^3 hybridisation
69. Out of the following hybrid orbitals, the one which forms the bond at angle 120° , is [MP PMT 1997]
(a) d^2sp^3 (b) sp^3
(c) sp^2 (d) sp
70. As the p -character increases, the bond angle in hybrid orbitals formed by s and atomic orbitals [MP PMT 1997]
(a) Decreases (b) Increases
(c) Doubles (d) Remains unchanged
71. sp^3 hybridization leads to which shape of the molecule [MP PET/PMT 1998]
(a) Tetrahedron (b) Octahedron
(c) Linear (d) Plane triangle
72. Which of the following will be octahedral [MP PET 1999]
(a) SF_6 (b) BF_4^-
(c) PCl_5 (d) BO_3^{3-}
73. The hybrid orbitals used by central atoms in $BeCl_2$, BCl_3 and CCl_4 molecules are respectively [MP PMT 1999]
(a) sp^2 , sp^3 and sp (b) sp , sp^2 and sp^3
(c) sp^3 , sp and sp^2 (d) sp^2 , sp and sp^3
74. The structure of H_2O_2 is [CBSE PMT 1999; AFMC 2003]
(a) Planar (b) Non-planar
(c) Spherical (d) Linear
75. Which of the following is isoelectronic as well as has same structure as that of N_2O [CPMT 1999]
(a) N_3H (b) H_2O
(c) NO_2 (d) CO_2
76. CCl_4 has the hybridisation [DPMT 1996]
(a) sp^3d (b) dsp^2
(c) sp (d) sp^3
77. Compound having planar symmetry is [DPMT 1996]
(a) H_2SO_4 (b) H_2O
(c) HNO_3 (d) CCl_4
78. Which of the following compounds is not linear [CPMT 1996]
(a) $SnCl_2$ (b) HCl
(c) CO_2 (d) $HgCl_2$
79. Which one of the following statements is true for ammonium ion
(a) All bonds are ionic
(b) All bonds are coordinate covalent
(c) H atoms are situated at the corners of a square
(d) H atoms are situated at the corners of a tetrahedron
80. The bond angle in sp^2 hybridisation is [RPMT 1997]
(a) 180° (b) 120°
(c) 90° (d) $109^\circ 2'$
81. The correct order towards bond angle is [RPMT 1997]
(a) $sp < sp^2 < sp^3$
(b) $sp^2 < sp < sp^3$
(c) $sp^3 < sp^2 < sp$
(d) Bond angle does not depend on hybridisation
82. The geometry and the type of hybrid orbital present about the central atom in BF_3 is [IIT 1998; BHU 2001]
(a) Linear, sp (b) Trigonal planar, sp^2
(c) Tetrahedral, sp^3 (d) Pyramidal, sp^3
83. In graphite, electrons are [CBSE PMT 1997]
(a) Localised on every third C atom
(b) Present in antibonding orbital
(c) Localised on each C atom
(d) Spread out between the structure
84. The ammonium ion is [CET Pune 1998]
(a) Tetrahedral (b) Trigonal pyramidal
(c) Square planar (d) Square pyramidal
85. In sp hybridisation, shape is [Bihar MEE 1997]
(a) Angular (b) Tetrahedral
(c) Bipyramidal (d) Linear
(e) None of these
86. When the hybridisation state of carbon atom changes from sp^3 to sp^2 to sp , the angle between the hybridised orbitals [AIIMS 1998]
(a) Decreases gradually (b) Increases gradually
(c) Decreases considerably (d) All of these
87. The structure and hybridisation of $Si(CH_3)_4$ is [CBSE PMT 1996]
(a) Bent, sp (b) Trigonal, sp^2
(c) Octahedral, sp^3d (d) Tetrahedral, sp^3
88. The type of hybridisation of boron in diborane is [BHU 1999]
(a) sp -hybridisation (b) sp^2 -hybridisation
(c) sp^3 -hybridisation (d) sp^3d^2 -hybridisation
89. Which compound does not possess linear geometry

- (a) $CH_2 = CH_2$ (b) $HC \equiv CH$
(c) $BeCl_2$ (d) CO_2
90. Which of the following molecule does not show tetrahedral shape [RPET 1999]
(a) CCl_4 (b) $SiCl_4$
(c) SF_4 (d) CF_4
91. Pyramidal shape would be of [RPET 1999]
(a) NO_3^- (b) H_2O
(c) H_3O^+ (d) NH_4^+
92. What is the correct mode of hybridization of the central atom in the following compounds : NO_2^+ , SF_4 , PF_6^- [AMU 1999]
(a) sp^2 , sp^3 , d^2sp^3 (b) sp^3 , sp^3d^2 , sp^3d^2
(c) sp , sp^3d , sp^3d^2 (d) sp , sp^2 , sp^3
93. The hybridization in PF_3 is [DCE 2000]
(a) sp^3 (b) sp^2
(c) dsp^3 (d) d^2sp^3
94. Which of the following molecule is linear [MP PMT 2000]
(a) SO_2 (b) NO_2^+
(c) NO_2^- (d) SCl_2
95. The geometry of the molecule with sp^3d^2 hybridised central atom is [NCERT 1981; AFMC 1982; RPMT 2000]
(a) Square planar (b) Trigonal bipyramidal
(c) Octahedral (d) Square pyramidal
96. The bond angle in PH_3 is [RPMT 2000]
(a) Much less than NH_3
(b) Equal to that of NH_3
(c) Much greater than NH_3
(d) Slightly greater than NH_3
97. Which of the following has tetrahedral structure [CPMT 2000]
(a) CO_3^{2-} (b) NH_4^+
(c) $K_4[Fe(CN)_6]$ (d) None of these
98. The single, double and triple bond lengths of carbon in carbon dioxide are respectively [AIIMS 2000]
(a) 1.15, 1.22 and 1.10 Å (b) 1.22, 1.15 and 1.10 Å
(c) 1.10, 1.15 and 1.22 Å (d) 1.15, 1.10 and 1.22 Å
99. Shape of BF_3 molecule is [CPMT 2000; Pb. CET 2002]
(a) Linear (b) Planar
(c) Tetrahedral (d) Square pyramidal
100. In the complex $[SbF_5]^{2-}$, sp^3d hybridization is present. Geometry of the complex is [Pb. PMT 2000]
(a) Square (b) Square pyramidal
(c) Square bipyramidal (d) Tetrahedral
101. The bond angle is minimum in [Pb. PMT 2001; MP PET 2003; UPSEAT 2004]
(a) H_2Te (b) H_2Se
(c) H_2O (d) H_2S
102. The correct order of hybridization of the central atom in the following species NH_3 , $[PtCl_4]^{2-}$, PCl_5 and BCl_3 is [IIT Screening 2001; BHU 2005]
(a) dsp^2 , dsp^3 , sp^2 and sp^3 (b) sp^3 , dsp^2 , dsp^3 , sp^2
(c) dsp^2 , sp^2 , sp^3 , dsp^3 (d) dsp^2 , sp^3 , sp^2 , dsp^3
103. Which of the following pairs has same structure [BHU 2001]
(a) PH_3 and BCl_3 (b) SO_2 and NH_3
(c) PCl_5 and SF_6 (d) NH_4^+ and SO_4^{2-}
104. The smallest bond angle is found in [AIIMS 2001]
(a) IF_7 (b) CH_4
(c) BeF_2 (d) BF_3
105. Which of the following is not linear [DCE 2001]
(a) CO_2 (b) ClO_2
(c) I_3^- (d) None of these
106. Which of the following is not tetrahedral [MP PMT 2001]
(a) SCl_4 (b) SO_4^{2-}
(c) $Ni(CO)_4$ (d) $NiCl_4^{2-}$
107. As the s -character of hybridisation orbital increases, the bond angle [BHU 2002]
(a) Increases (b) Decreases
(c) Becomes zero (d) Does not change
108. The shape of IF_7 molecule is [AFMC 2002; MHCET 2003]
(a) Octahedral (b) Pentagonal bipyramidal
(c) Trigonal bipyramidal (d) Tetrahedral
109. A completely filled d orbital (d^{10}) [UPSEAT 2002]
(a) Spherically symmetrical
(b) Has octahedral symmetry
(c) Has tetrahedral symmetry
(d) Depends on the atom
110. Which has sp^3 hybridization of central atom [UPSEAT 2002]
(a) PCl_3 (b) SO_3
(c) BF_3 (d) NO_3^-
111. In which of the following species is the interatomic bond angle is $109^\circ 28'$ [AIEEE 2002]
(a) NH_3 , $(BF_4)^{-1}$ (b) $(NH_4)^+$, BF_3
(c) NH_3 , BF_4 (d) $(NH_2)^{-1}$, BF_3
112. A square planar complex is formed by hybridisation of which atomic orbitals [AIEEE 2002]
(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_y , p_z , d_{xy}
113. In benzene, all the six $C-C$ bonds have the same length because of [MP PET 2002]
(a) Tautomerism (b) sp^2 hybridisation

- (c) Isomerism (d) Inductive effect
114. The bond energies of $H-H$ and $Cl-Cl$ are 430 kJ mol^{-1} and 242 kJ mol^{-1} respectively, ΔH_f for HCl is 91 kJ mol^{-1} . The bond energy of HCl will be [MP PET 2003]
 (a) 427 kJ (b) 766 kJ
 (c) 285 kJ (d) 245 kJ
115. Which of the following has dsp^2 hybridization [MP PET 2003]
 (a) $NiCl_4^{2-}$ (b) $SnCl_4$
 (c) NH_4^+ (d) $PtCl_4^{2-}$
116. Which one of the following is a planar molecule [EAMCET 2003]
 (a) NH_3 (b) H_3O^+
 (c) BCl_3 (d) PCl_3
117. Which one of the following is a correct set with respect to molecule, hybridisation and shape [EAMCET 2003]
 (a) $BeCl_2$, sp^2 , linear
 (b) $BeCl_2$, sp^2 , triangular planar
 (c) BCl_3 , sp^2 , triangular planar
 (d) BCl_3 , sp^3 , tetrahedral
118. Which of the following compounds doesn't have linear structure [RPET 1997, 2003]
 (a) CO_2 (b) SO_2
 (c) $BeCl_2$ (d) C_2H_2
119. Which of the following bonds require the largest amount of bond energy to dissociate the atom concerned [UPSEAT 2003]
 (a) $H-H$ bond in H_2 (b) $C-C$ bond in CH_4
 (c) $N \equiv N$ bond in N_2 (d) $O=O$ bond in O_2
 (e) $C-C$ bond in ethane
120. The percentage s -character of the hybrid orbitals in methane, ethene and ethyne are respectively [KCET 2003]
 (a) 25, 33, 50 (b) 25, 50, 75
 (c) 50, 75, 100 (d) 10, 20, 40
121. Arrange the hydro-acids of halogens in increasing order of acidity
 (a) $HF < HCl < HBr < HI$ (b) $HI < HBr < HCl < HF$
 (c) $HF < HBr < HI < HCl$ (d) $HF < HI < HBr < HCl$
122. Which one has sp^2 -hybridisation [MP PMT 2004]
 (a) CO_2 (b) N_2O
 (c) SO_2 (d) CO
123. Among the following compounds the one that is polar and has central atom with sp^2 -hybridization is [MP PMT 2004; IIT 1997]
 (a) H_2CO_3 (b) BF_3
 (c) SiF_4 (d) $HClO_2$
124. The molecule which is pyramid shape is [MP PMT 2004; EAMCET 1985; IIT 1989]
 (a) PCl_3 (b) CO_3^{2-}
- (c) SO_3 (d) NO_3^-
125. Which of the following has a linear structure [MP PMT 2004]
 (a) CCl_4 (b) C_2H_2
 (c) SO_2 (d) C_2H_4
126. In a regular octahedral molecule, MX_6 , the number $X-M-X$ bonds at 180° is [CBSE PMT 2004]
 (a) Six (b) Four
 (c) Three (d) Two
127. sp^3d^2 hybrid orbitals are [MP PET 2004]
 (a) Linear bipyramidal (b) Pentagonal
 (c) Trigonal bipyramidal (d) Octahedral
128. In an octahedral structure, the pair of d orbitals involved in d^2sp^3 hybridization is [CBSE PMT 2004]
 (a) d_{x^2}, d_{xz} (b) d_{xy}, d_{yz}
 (c) $d_{x^2-y^2}, d_{z^2}$ (d) $d_{xz}, d_{x^2-y^2}$
129. The correct order of bond angles (smallest first) in H_2S, NH_3, BF_3 and SiH_4 is [AIEEE 2004]
 (a) $H_2S < NH_3 < SiH_4 < BF_3$
 (b) $NH_3 < H_2S < SiH_4 < BF_3$
 (c) $H_2S < SiH_4 < NH_3 < BF_3$
 (d) $H_2S < NH_3 < BF_3 < SiH_4$
130. Which one of the following has the regular tetrahedral structure
 (a) BF_4^- (b) SF_4
 (c) XeF_4 (d) $[Ni(CN)_4]^{2-}$
 (Atomic no. : $B = 5, S = 16, Ni = 28, Xe = 54$)
131. The states of hybridization of boron and oxygen atoms in boric acid (H_3BO_3) are respectively [AIEEE 2004]
 (a) sp^3 and sp^2 (b) sp^2 and sp^3
 (c) sp^2 and sp^2 (d) sp^3 and sp^3
132. The hybridisation in BF_3 molecule is [Pb. PMT 2004]
 (a) sp (b) sp^2
 (c) sp^3 [Orissa JEE 2003] (d) sp^3d
133. Among the compounds, BF_3, NCl_3, H_2S, SF_4 and $BeCl_2$, identify the ones in which the central atom has the same type of hybridisation [Kerala PMT 2004]
 (a) BF_3 and NCl_3 (b) H_2S and $BeCl_2$
 (c) BF_3, NCl_3 and H_2S (d) SF_4 and $BeCl_2$
 (e) NCl_3 and H_2S
134. The molecule of CO_2 has 180° bond angle. It can be explained on the basis of [AFMC 2004]
 (a) sp^3 hybridisation (b) sp^2 hybridisation
 (c) sp hybridisation (d) d^2sp^3 hybridisation
135. sp^3 hybridisation is found in [Pb. CET 2003; Orissa JEE 2005]

- (a) CO_3^{2-} (b) BF_3 (c) d^2sp^3 or sp^3d^2 (d) d^3sp^2 or d^2sp^3
- (c) NO_3^- (d) NH_3
136. Which set hybridisation is correct for the following compounds [Pb. CET 2003]
 NO_2 , SF_4 , PF_6^-
- (a) sp , sp^2 , sp^3
 (b) sp , sp^3d , sp^3d^2
 (c) sp^2 , sp^3 , d^2sp^3
 (d) sp^3 , sp^3d^2 , sp^3d^2
137. The state of hybridisation of B in BCl_3 is [Pb. CET 2000; BHU 2004]
 (a) sp (b) sp^2
 (c) sp^3 (d) sp^2d^2
138. The hybrid state of sulphur in SO_3 molecule is [DCE 2004]
 (a) sp^3d (b) sp^3
 (c) sp^3d^2 (d) sp^2
139. Which of the following molecules has pyramidal shape [DCE 2004; J&K CET 2005]
 (a) PCl_3 (b) SO_3
 (c) CO_3^{2-} (d) NO_3^-
140. The hybridization of IF_7 is [Pb. CET 2001]
 (a) sp^3d^3 (b) sp^2d
 (c) d^2sp^3 (d) sp^3
141. In which compound, the hydrogen bonding is the strongest in its liquid phase [Pb. CET 2001]
 (a) HF (b) HI
 (c) CH_4 (d) PH_3
142. Geometry of ammonia molecule and the hybridization of nitrogen involved in it are [MH CET 2004]
 (a) sp^3 -hybridization and tetrahedral geometry
 (b) sp^3 -hybridization and distorted tetrahedral geometry
 (c) sp^2 -hybridization and triangular geometry
 (d) None of these
143. Be in $BeCl_2$ undergoes [MH CET 2004]
 (a) Diagonal hybridization
 (b) Trigonal hybridization
 (c) Tetrahedral hybridization
 (d) No hybridization
144. Which of the following is non-linear molecule [DCE 2003]
 (a) CO_3 (b) CO_2
 (c) CS_2 (d) $BeCl_2$
145. The trigonal bipyramidal geometry results from the hybridisation [UPSEAT 2004]
 (a) dsp^3 or sp^3d (b) dsp^2 or sp^2d
146. The valency of carbon is four. On what principle it can be explained in a better way
 (a) Resonance (b) Hybridization
 (c) Electron transfer (d) None of the above
147. Hybridization is due to the overlapping of [MADT Bihar 1983]
 (a) Orbitals of different energy levels
 (b) Orbitals of different energy content
 (c) Orbitals of same energy content
 (d) None of the above
148. If a molecule MX_3 has zero dipole moment, the sigma bonding orbital used by M are [IIT 1981; MP PMT 1994; Kerala PMT 2004]
 (a) sp^3d - hybrid (b) sp - hybrid
 (c) sp^3d^2 - hybrid (d) sp^2 - hybrid
149. The linear structure is assumed by [IIT 1991]
 (a) $SnCl_2$ (b) NCO^-
 (c) CS_2 (d) NO_2^+
150. Hybridisation of central atom in NF_3 is [Orissa JEE 2005]
 (a) sp^3 (b) sp
 (c) sp^2 (d) dsp^2
151. The pair having similar geometry is [J&K CET 2005]
 (a) PCl_3 , NH_3 (b) $BeCl_2$, H_2O
 (c) CH_4 , CCl_4 (d) IF_5 , PF_5
152. The d-orbital involved in sp^3d hybridisation is [J&K CET 2005]
 (a) $d_{x^2-y^2}$ (b) d_{xy}
 (c) d_{z^2} (d) d_{zx}

Resonance

1. Which one in the following is not the resonance structure of CO_2
 (a) $O=C=O$ (b) $^-O-C\equiv O^+$
 (c) $^+O\equiv C-O^-$ (d) $O\equiv C=O$
2. Which of the following molecule contains one pair of non-bonding electrons
 (a) CH_4 (b) NH_3
 (c) H_2O (d) HF
3. Resonance is due to [NCERT 1981; Kurukshetra CEE 1998]
 (a) Delocalization of σ electrons
 (b) Delocalization of π electrons
 (c) Migration of H atoms
 (d) Migration of protons
4. Resonating structures have different [AMU 1983]
 (a) Atomic arrangements (b) Electronic arrangements
 (c) Functional groups (d) Alkyl groups

In the cyanide ion, the formal negative charge is on

[AMU 1984]

- (a) C
(b) N
(c) Both C and N
(d) Resonate between C and N
6. Which does not show resonance [CPMT 1990]
(a) Benzene (b) Aniline
(c) Ethyl amine (d) Toluene
7. The enolic form of acetone contains [IIT 1990; Bihar MEE 1997]
(a) 9 sigma bonds, 1 pi bond and 2 lone pairs
(b) 8 sigma bonds, 2 pi bonds and 2 lone pairs
(c) 10 sigma bonds, 1 pi bond and 1 lone pair
(d) 9 sigma bonds, 2 pi bonds and 1 lone pair
8. Point out incorrect statement about resonance [MP PET 1997]
(a) Resonance structures should have equal energy
(b) In resonance structures, the constituent atoms should be in the same position
(c) In resonance structures, there should not be the same number of electron pairs
(d) Resonance structures should differ only in the location of electrons around the constituent atoms
9. The number of possible resonance structures for CO_3^{2-} is [MP PMT 2000]
(a) 2 (b) 3
(c) 6 (d) 9
10. Resonance hybrid of nitrate ion is [RPET 2000]
(a) $^{-1/2}O \equiv \overset{\cdot\cdot}{N} \equiv O^{-1/2}$ (b) $^{-2/3}O \cdots \overset{\cdot\cdot}{N} \cdots O^{-2/3}$
 $\quad \quad \quad \vdots$ $\quad \quad \quad \vdots$
 $\quad \quad \quad O^{-1/2}$ $\quad \quad \quad O^{-2/3}$
(c) $^{-1/3}O \equiv \overset{\cdot\cdot}{N} \equiv O^{-1/3}$ (d) $^{-2/3}O \cdots \overset{+}{N} \cdots O^{-2/3}$
 $\quad \quad \quad \vdots$ $\quad \quad \quad \vdots$
 $\quad \quad \quad O^{-1/3}$ $\quad \quad \quad O^{-2/3}$
11. CO_3^{2-} anion has which of the following characteristics [Roorkee 1999]
(a) Bonds of unequal length
(b) sp^2 hybridization of C atom
(c) Resonance stabilization
(d) Same bond angles
- (c) PF_3 (d) NH_3
4. Which has the least bond angle [NCERT 1973; DPMT 1990; CBSE PMT 1990; UPSEAT 2003]
(a) NH_3 (b) BeF_2
(c) H_2O (d) CH_4
5. In compound X, all the bond angles are exactly $109^\circ 28'$, X is
(a) Chloromethane (b) Iodoform
(c) Carbon tetrachloride (d) Chloroform
6. The shape of SO_4^{2-} ion is [CPMT 1982; DPMT 1983, 84, 96; Bihar MEE 1997]
(a) Square planar (b) Tetrahedral
(c) Trigonal bipyramidal (d) Hexagonal
7. Which of the following molecules has one lone pair of electrons on the central atom [EAMCET 1980; AMU 1982; MNR 1989]
(a) H_2O (b) NH_3
(c) CH_4 (d) PCl_5
8. Of the following compounds, the one having a linear structure is [NCERT 1981; C
MP PMT 1985; AIIMS 1996]
(a) NH_2 (b) CH_4
(c) C_2H_2 (d) H_2O
9. XeF_6 is
(a) Octahedral (b) Distorted octahedral
(c) Planar (d) Tetrahedral
10. Which has maximum bond angle [CPMT 1993]
(a) CHF_3
(b) $CHCl_3$
(c) $CHBr_3$
(d) All have maximum bond angle
11. Of the following species the one having a square planar structure is [NCERT 1981; MP PMT 1994]
(a) NH_4^+ (b) BF_4^-
(c) XeF_4 (d) SCl_4
12. In which of the following is the angle between the two covalent bonds greatest [NCERT 1975; AMU 1982; MNR 1987; IIT 1981; CPMT 1988; MP PMT 1994]
(a) CO_2 (b) CH_4
(c) NH_3 (d) H_2O
13. As the s-character of hybridized orbital decreases, the bond angle
(a) Decreases (b) Increases
(c) Does not change (d) Becomes zero
14. XeF_2 molecule is [BHU 1982]
(a) Linear (b) Triangular planar
(c) Pyramidal (d) Square planar
15. Of the following sets which one does NOT contain isoelectronic species [AIEEE 2005]
(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) $BO_3^{3-}, CO_3^{2-}, NO_3^-$
16. A molecule which contains unpaired electrons is

VSEPR Theory

1. The structure of $[Cu(H_2O)_4]^{++}$ ion is [NCERT 1983; MP PMT 1983]
(a) Square planar (b) Tetrahedral
(c) Distorted rectangle (d) Octahedral
2. The bond angle in PH_3 would be expected to be close to
(a) 90° (b) 105°
(c) 109° (d) 120°
3. In which molecule are all atoms coplanar [MP PMT 1994]
(a) CH_4 (b) BF_3

[NCERT 1982]

- (a) Carbon monoxide (b) Molecular nitrogen
(c) Molecular oxygen (d) Hydrogen peroxide

17. H_2O is [MADT Bihar 1983]

- (a) A linear triatomic molecule
(b) A bent (angular) triatomic molecule
(c) Both of these
(d) None of these

18. Bond angle between two hybrid orbitals is 105° . % s-orbital character of hybrid orbital is [MP PMT 1986]

- (a) Between 20 – 21% (b) Between 19 – 20%
(c) Between 21 – 22% (d) Between 22 – 23%

19. The bond angle between $H-O-H$ in ice is closest to [CPMT 1989; UPSEAT 2002]

- (a) $120^\circ 28'$ (b) 60°
(c) 90° (d) 105°

20. Which of the following molecules does not have a linear arrangement of atoms [CBSE PMT 1989]

- (a) H_2S (b) C_2H_2
(c) BeH_2 (d) CO_2

21. BCl_3 is a planar molecule while NCl_3 is pyramidal, because

- (a) BCl_3 has no lone pair of electrons but NCl_3 has a lone pair of electrons
(b) $B-Cl$ bond is more polar than $N-Cl$ bond
(c) Nitrogen atom is smaller than boron atom
(d) $N-Cl$ bond is more covalent than $B-Cl$ bond

22. The isoelectronic pair is [AIIMS 2005]

- (a) Cl_2O, ICl_2^- (b) ICl_2^-, ClO_2
(c) IF_2^+, I_3^- (d) ClO_2^-, ClF_2^+

23. According to VSEPR theory, the most probable shape of the molecule having 4 electron pairs in the outer shell of the central atom is [MP PET 1996, 2001]

- (a) Linear (b) Tetrahedral
(c) Hexahedral (d) Octahedral

24. The molecular shapes of SF_4 , CF_4 and XeF_4 are

[AIEEE 2005]

- (a) The same with 2, 0 and 1 lone pairs of electrons on the central atom, respectively
(b) The same with 1, 1 and 1 lone pair of electrons on the central atoms, respectively
(c) Different with 0, 1 and 2 lone pairs of electrons on the central atom, respectively
(d) Different with 1, 0 and 2 lone pairs of electrons on the central atom, respectively

25. Which of the following species is planar [JIPMER 1997]

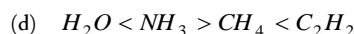
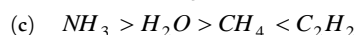
- (a) CO_3^{2-} (b) NH_2
(c) PCl_3 (d) None of these

26. The shape of CH_3^+ species is [RPET 1999]

- (a) Tetrahedral (b) Square planar
(c) Trigonal planar (d) Linear

27. Which of the following is the correct reducing order of bond-angle

- (a) $NH_3 < CH_4 < C_2H_2 < H_2O$

28. Which compound has bond angle nearly to 90°

[Pb. PMT 2001]

- (a) H_2O (b) H_2S
(c) NH_3 (d) CH_4

29. A lone pair of electrons in an atom implies [KCET 2002]

- (a) A pair of valence electrons not involved in bonding
(b) A pair of electrons involved in bonding
(c) A pair of electrons
(d) A pair of valence electrons

30. The bond angle of water is 104.5° due to [CPMT 2002]

- (a) Repulsion between lone pair and bond pair
(b) sp^3 hybridization of O
(c) Bonding of H_2O
(d) Higher electronegativity of O

31. The correct sequence of decrease in the bond angle of the following hydrides is [MP PET 2002]

- (a) $NH_3 > PH_3 > AsH_3 > SbH_3$
(b) $NH_3 > AsH_3 > PH_3 > SbH_3$
(c) $SbH_3 > AsH_3 > PH_3 > NH_3$
(d) $PH_3 > NH_3 > AsH_3 > SbH_3$

32. Central atom of the following compound has one lone pair of electrons and three bond pairs of electrons [JIPMER 2002]

- (a) H_2S (b) $AlCl_3$
(c) NH_3 (d) BF_3

33. Among KO_2 , AlO_2^- , BaO_2 and NO_2^+ unpaired electron is present in [MP PET 2003]

- (a) NO_2^+ and BaO_2 (b) KO_2 and AlO_2^-
(c) KO_2 only (d) BaO_2 only

34. True order of bond angle is [RPET 2003]

- (a) $H_2O > H_2S > H_2Se > H_2Te$
(b) $H_2Te > H_2Se > H_2S > H_2O$
(c) $H_2S > H_2O > H_2Se > H_2Te$
(d) $H_2O > H_2S > H_2Te > H_2Se$

35. Which of the following has not a lone pair over the central atom

- (a) NH_3 (b) PH_3
(c) BF_3 (d) PCl_3

36. In BrF_3 molecule, the lone pairs occupy equatorial positions to minimize [CBSE PMT 2004]

- (a) Lone pair- lone pair repulsion and lone pair-bond pair repulsion
(b) Lone pair- lone pair repulsion only
(c) Lone pair- bond pair repulsion only
(d) Bond pair- bond pair repulsion only

37. H_2O is dipolar, whereas BeF_2 is not. It is because

[BHU 2000]

[CBSE PMT 1989; 2004]

- (a) H_2O is linear and BeF_2 is angular

- (b) H_2O is angular and BeF_2 is linear
 (c) The electronegativity of F is greater than that of O
 (d) H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule
38. Maximum bond angle is present in [BVP 2004]
 (a) BCl_3 (b) BBr_3
 (c) BF_3 (d) Same for all
39. The shape of a molecule of NH_3 , in which central atoms contains lone pair of electron, is [MHCET 2003]
 (a) Tetrahedral (b) Planar trigonal
 (c) Square planar (d) Pyramidal
40. The largest bond angle is in [DCE 2002; MNR 1984]
 (a) AsH_3 (b) NH_3
 (c) H_2O (d) PH_3
41. The bond angle in ammonia molecule is [EAMCET 1980]
 (a) $91^\circ 8'$ (b) $93^\circ 3'$
 (c) $106^\circ 45'$ (d) $109^\circ 28'$
42. Which of the following gives correct arrangement of compounds involved based on their bond strength [BHU 2005]
 (a) $HF > HCl > HBr > HI$
 (b) $HI > HBr > HCl > HF$
 (c) $HF > HBr > HCl > HI$
 (d) $HCl > HF > HBr > HI$
43. Which one has a pyramidal structure [CBSE PMT 1990]
 (a) CH_4 (b) NH_3
 (c) H_2O (d) CO_2
44. Among the following the pair in which the two species are not isostructural is [CBSE PMT 2004]
 (a) BH_4^- and NH_4^+ (b) PF_6^- and SF_6
 (c) SiF_4 and SF_4 (d) IO_3^- and XeO_3
45. The maximum number of 90° angles between bond pair-bond pair of electrons is observed in [AIEEE 2004]
 (a) dsp^2 hybridization (b) sp^3d hybridization
 (c) dsp^3 hybridization (d) sp^3d^2 hybridization
- (a) O_2 (b) O_2^{-2}
 (c) O_2^{+1} (d) O_2^{-1}
5. The bond order is maximum in [AIIMS 1983, 85; CBSE PMT 1994; MP PET 2002]
 (a) O_2 (b) O_2^{-1}
 (c) O_2^{+1} (d) O_2^{-2}
6. Which of the following compounds of boron does not exist in the free form
 (a) BCl_3 (b) BF_3
 (c) BBr_3 (d) BH_3
7. Molecular orbital theory was developed mainly by [BHU 1987; Pb. CET 2003]
 (a) Pauling (b) Pauling and Slater
 (c) Mulliken (d) Thomson
8. The bond order of a molecule is given by [NCERT 1984]
 (a) The difference between the number of electrons in bonding and antibonding orbitals
 (b) Total number of electrons in bonding and antibonding orbitals
 (c) Twice the difference between the number of electrons in bonding and antibonding electrons
 (d) Half the difference between the number of electrons in bonding and antibonding electrons
9. Oxygen molecule is paramagnetic because [NCERT 1984; IIT 1984]
 (a) Bonding electrons are more than antibonding electrons
 (b) Contains unpaired electrons
 (c) Bonding electrons are less than antibonding electrons
 (d) Bonding electrons are equal to antibonding electrons
10. Which one is paramagnetic from the following [IIT 1989; CBSE PMT 1995]
 (a) O_2^- (b) NO
 (c) Both (a) and (b) (d) CN^-
11. The bond order in N_2^+ ion is [Pb. CET 2004]
 (a) 1 (b) 2
 (c) 2.5 (d) 3
12. Out of the following which has smallest bond length [RPMT 1997]
 (a) O_2 (b) O_2^+
 (c) O_2^- (d) O_2^{2-}
13. Which of the following molecule is paramagnetic [CPMT 1980; RPET 1999; MP PMT 1999; RPMT 2000]
 (a) Chlorine (b) Nitrogen
 (c) Oxygen (d) Hydrogen
14. Which molecule has the highest bond order
 (a) N_2 (b) Li_2
 (c) He_2 (d) O_2
15. The molecular electronic configuration of H_2^- ion is
 (a) $(\sigma 1s)^2$ (b) $(\sigma 1s)^2(\sigma^* 1s)^2$
 (c) $(\sigma 1s)^2(\sigma^* 1s)^1$ (d) $(\sigma 1s)^3$
16. The paramagnetic nature of oxygen molecule is best explained on the basis of [BHU 1996]
 (a) Valence bond theory (b) Resonance

Molecular orbital theory

1. Bond order is a concept in the molecular orbital theory. It depends on the number of electrons in the bonding and antibonding orbitals. Which of the following statements is true about it? The bond order [AIIMS 1980]
 (a) Can have a negative quantity
 (b) Has always an integral value
 (c) Can assume any positive or integral or fractional value including zero
 (d) Is a non zero quantity
2. The bond order of NO molecule is [MP PET 1996]
 (a) 1 (b) 2
 (c) 2.5 (d) 3
3. When two atomic orbitals combine they form
 (a) One molecular orbital (b) Two molecular orbital
 (c) Three molecular orbital (d) Four molecular orbital
4. Which of the following species is the least stable

- (c) Molecular orbital theory (d) Hybridization
17. In which case the bond length is minimum between carbon and nitrogen
(a) CH_3NH_2 (b) $C_6H_5CH=NOH$
(c) CH_3CONH_2 (d) CH_3CN
18. Which one of the following species is diamagnetic in nature
[AIEEE 2005]
(a) He_2^+ (b) H_2
(c) H_2^+ (d) H_2^-
19. Which one of the following oxides is expected exhibit paramagnetic behaviour
[CBSE PMT 2005]
(a) CO_2 (b) SO_2
(c) ClO_2 (d) SiO_2
20. The bond order in N_2 molecule is
[CBSE 1995; Pb. PMT 1999; MP PET 1997]
(a) 1 (b) 2
(c) 3 (d) 4
21. Which one is paramagnetic and has the bond order 1/2
[NCERT 1983]
(a) O_2 (b) N_2
(c) F_2 (d) H_2^+
22. When two atoms of chlorine combine to form one molecule of chlorine gas, the energy of the molecule
[AMU 1982]
(a) Greater than that of separate atoms
(b) Equal to that of separate atoms
(c) Lower than that of separate atoms
(d) None of the above statement is correct
23. An atom of an element A has three electrons in its outermost shell and that of B has six electrons in the outermost shell. The formula of the compound between these two will be
[CPMT 1974, 84; RPMT 1999]
(a) A_3B_4 (b) A_2B_3
(c) A_3B_2 (d) A_2B
24. The bond order of individual carbon-carbon bonds in benzene is
(a) One (b) Two
(c) Between 1 and 2 (d) One and two alternately
25. PCl_5 exists but NCl_5 does not because
[EAMCET 1977; MP PET/PMT 1988]
(a) Nitrogen has no vacant d-orbitals
(b) NCl_5 is unstable
(c) Nitrogen atom is much smaller
(d) Nitrogen is highly inert
26. Paramagnetism is exhibited by molecules
[NCERT 1979; MP PET 2002]
(a) Not attracted into a magnetic field
(b) Containing only paired electrons
(c) Carrying a positive charge
(d) Containing unpaired electrons
27. Which one of the following is paramagnetic
[DPMT 1985]
(a) H_2O (b) NO_2
(c) SO_2 (d) CO_2
28. The energy of a $2p$ orbital except hydrogen atom is
[AMU 1983]
(a) Less than that of $2s$ orbital
(b) More than that of $2s$ orbital
(c) Equal to that of $2s$ orbital
(d) Double that of $2s$ orbital
29. In the electronic structure of acetic acid, there are
[AMU 1983]
(a) 16 shared and 8 unshared electrons
(b) 8 shared and 16 unshared electrons
(c) 12 shared and 12 unshared electrons
(d) 18 shared and 6 unshared electrons
30. Which of the following does not exist on the basis of molecular orbital theory
[AFMC 1990; MP PMT 1996]
(a) H_2^+ (b) He_2^+
(c) He_2 (d) Li_2
31. In P_4O_{10} , the number of oxygen atoms attached to each phosphorus atom is
[IIT 1995]
(a) 2 (b) 3
(c) 4 (d) 2.5
32. Of the following statements which one is correct
(a) Oxygen and nitric oxide molecules are both paramagnetic because both contain unpaired electrons
(b) Oxygen and nitric oxide molecules are both diamagnetic because both contain no unpaired electrons
(c) Oxygen is paramagnetic because it contains unpaired electrons, while nitric oxide is diamagnetic because it contains no unpaired electrons
(d) Oxygen is diamagnetic because it contains no unpaired electrons, while nitric oxide is paramagnetic because it contains an unpaired electron
33. According to the molecular orbital theory, the bond order in C_2 molecule is
(a) 0 (b) 1
(c) 2 (d) 3
34. The molecular orbital configuration of a diatomic molecule is
[IIT 1980]
 $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_x^2 \begin{cases} \pi 2p_y^2 \\ \pi 2p_z^2 \end{cases}$
- Its bond order is
(a) 3 (b) 2.5
(c) 2 (d) 1
35. The difference in energy between the molecular orbital formed and the combining atomic orbitals is called
(a) Bond energy (b) Activation energy
(c) Stabilization energy (d) Destabilization energy
36. According to molecular orbital theory, the paramagnetism of O_2 molecule is due to presence of
[MP PMT 1997]
(a) Unpaired electrons in the bonding σ molecular orbital
(b) Unpaired electrons in the antibonding σ molecular orbital
(c) Unpaired electron in the bonding π molecular orbital
(d) Unpaired electrons in the antibonding π molecular orbital
37. The bond order in O_2^+ is
[MP PET 1999; BHU 2001]
(a) 2 (b) 2.5
(c) 1.5 (d) 3

38. Which of the following is paramagnetic [MP PET 1999]
 (a) O_2 (b) CN^-
 (c) CO (d) NO^+
39. If N_x is the number of bonding orbitals of an atom and N_y is the number of antibonding orbitals, then the molecule/atom will be stable if [DPMT 1996]
 (a) $N_x > N_y$ (b) $N_x = N_y$
 (c) $N_x < N_y$ (d) $N_x \leq N_y$
40. Which of the following molecular orbitals has two nodal planes
 (a) $\sigma 2s$ (b) $\pi 2p_y$
 (c) $\pi^* 2p_y$ (d) $\sigma^* 2p_x$
41. The number of nodal planes 'd' orbital has [KCET 1996]
 (a) Zero (b) One
 (c) Two (d) Three
42. Atomic number of an element is 26. The element shows [CPMT 1996]
 (a) Ferromagnetism (b) Diamagnetism
 (c) Paramagnetism (d) None of these
43. What is correct sequence of bond order [BHU 1997]
 (a) $O_2^+ > O_2^- > O_2$ (b) $O_2^+ > O_2 > O_2^-$
 (c) $O_2 > O_2^- > O_2^+$ (d) $O_2^- > O_2^+ > O_2$
44. Which bond is strongest [RPMT 1997]
 (a) $F-F$ (b) $Br-F$
 (c) $Cl-F$ (d) $I-F$
45. Which of the following is not paramagnetic [AIIMS 1997]
 (a) S^{-2} (b) N_2^-
 (c) O_2^- (d) NO
46. Which one of the following molecules is paramagnetic [Pb. PMT 1998]
 (a) CO_2 (b) SO_2
 (c) NO (d) H_2O
47. N_2 and O_2 are converted into monoanions N_2^- and O_2^- respectively, which of the following statements is wrong [CBSE PMT 1997]
 (a) In N_2 , the $N-N$ bond weakens
 (b) In O_2 , the $O-O$ bond order increases
 (c) In O_2 , bond length increases
 (d) N_2^- becomes diamagnetic
48. With increasing bond order, stability of a bond [CET Pune 1998]
 (a) Remains unaltered (b) Decreases
 (c) Increases (d) None of these
49. Which is not paramagnetic [DCE 1999, 2000]
 (a) O_2 (b) O_2^+
 (c) O_2^{2-} (d) O_2^-
50. The number of antibonding electron pairs in O_2^{2-} molecular ion on the basis of molecular orbital theory is [Pb. PMT 2000]
 (a) 4 (b) 3
 (c) 2 (d) 5
51. The bond order of He_2^+ molecule ion is [Pb. PMT 2000; Pb CET 2001]
 (a) 1 (b) 2
 (c) $\frac{1}{2}$ (d) $\frac{1}{4}$
52. Which of the following exhibit paramagnetism [DPMT 2000]
 (a) ClO_2 (b) ClO_2^-
 (c) NO_2 (d) NO
53. In which of the following pairs the two molecules have identical bond order [MP PMT 2000]
 (a) N_2, O_2^{2+} (b) N_2, O_2^-
 (c) N_2^-, O_2 (d) O_2^+, N_2
54. The bond order is not three for [MP PMT 2001]
 (a) N_2^+ (b) O_2^{2+}
 (c) N_2 (d) NO^+
55. In H_2O_2 molecule, the angle between the two $O-H$ planes is
 (a) 90° (b) 101°
 (c) 103° (d) 105°
56. Which of the following molecule has highest bond energy [AIIMS 2002]
 (a) $F-F$ (b) $C-C$
 (c) $N-N$ (d) $O-O$
57. Which of the following species would be expected paramagnetic
 (a) Copper crystals (b) Cu^+
 (c) Cu^{++} (d) H_2
58. Which of the following is correct for N_2 triple bond [CPMT 2002]
 (a) $3s$ (b) $1p, 2s$
 (c) $2p, 1s$ (d) $3p$
59. In which of the following pairs molecules have bond order three and are isoelectronics [MP PET 2003]
 (a) CN^-, CO (b) NO^+, CO^+
 (c) CN^-, O_2^+ (d) CO, O_2^+
60. Which of the following is paramagnetic [MP PET 2003]
 (a) O_2^+ (b) CN^-
 (c) CO (d) N_2
61. How many bonding electron pairs are there in white phosphorous
 (a) 6 (b) 12
 (c) 4 (d) 8
62. The atomicity of phosphorus is X and the $\hat{P}PP$ bond angle in the molecule is Y . What are X and Y [EAMCET 2003]
 (a) $X = 4, Y = 90^\circ$ (b) $X = 4, Y = 60^\circ$
 (c) $X = 3, Y = 120^\circ$ (d) $X = 2, Y = 180^\circ$

63. From elementary molecular orbital theory we can give the electronic configuration of the singly positive nitrogen molecular ion N_2^+ as
- $\sigma(1s)^2 \sigma^*(1s)^2 \sigma(2s)^2 \sigma^*(2s)^2 \pi(2p)^4 \sigma(2p)^1$
 - $\sigma(1s)^2 \sigma^*(1s)^2 \sigma(2s)^2 \sigma^*(2s)^2 \sigma(2p)^1 \pi(2p)^3$
 - $\sigma(1s)^2 \sigma^*(1s)^2 \sigma(2s)^2 \sigma^*(2p)^2 \pi(2p)^4$
 - $\sigma(1s)^2 \sigma^*(1s)^2 \sigma(2s)^2 \sigma^*(2s)^2 \sigma(2p)^2 \pi(2p)^2$
64. The paramagnetic property of the oxygen molecule due to the presence of unpaired electrons present in [Kerala PMT 2004]
- $(\sigma 2p_x)^1$ and $(\sigma^* 2p_x)^1$
 - $(\sigma 2p_x)^1$ and $(\pi 2p_y)^1$
 - $(\pi^* 2p_y)^1$ and $(\pi^* 2p_z)^1$
 - $(\pi^* 2p_y)^1$ and $(\pi 2p_y)^1$
 - $(\pi^* 2p_z)^1$ and $(\pi 2p_z)^1$
65. In PO_4^{3-} ion, the formal charge on each oxygen atom and $P-O$ bond order respectively are [DPMT 2004]
- 0.75, 1.25
 - 0.75, 1.0
 - 0.75, 0.6
 - 3, 1.25
66. The bond order in CO_3^{2-} ion between $C-O$ is [Pb. PMT 2004]
- Zero
 - 0.88
 - 1.33
 - 2
67. The bond order of O_2^+ is the same as in [CPMT 2004]
- N_2^+
 - CN^-
 - CO
 - NO^+
68. Bond order of O_2 is [DPMT 2004]
- 2
 - 1.5
 - 3
 - 3.5
69. The total number of electron that takes part in forming bonds in N_2 is [MP PET 2004]
- 2
 - 4
 - 6
 - 10
70. The bond length the species O_2 , O_2^+ and O_2^- are in the order of
- $O_2^+ > O_2 > O_2^-$
 - $O_2^+ > O_2^- > O_2$
 - $O_2 > O_2^+ > O_2^-$
 - $O_2^- > O_2 > O_2^+$
71. According to molecular orbital theory which of the following statement about the magnetic character and bond order is correct regarding O_2^+ [IIT JEE Screening 2004]
- Paramagnetic and bond order $< O_2$
 - Paramagnetic and bond order $> O_2$
 - Dimagnetic and bond order $< O_2$
 - Dimagnetic and bond order $> O_2$
72. The bond order in NO is 2.5 while that in NO^+ is 3. Which of the following statements is true for these two species [AIEEE 2004]
- Bond length in NO^+ is equal to that in NO
 - Bond length in NO is greater than in NO^+
 - Bond length in NO^+ is greater than in NO [UPSEAT 2003]
 - Bond length is unpredictable
73. Which of the following is diamagnetic [BVP 2004]
- Oxygen molecule
 - Boron molecule
 - N_2^+
 - None
74. Bond energies in NO , NO^+ and NO^- are such as [Pb. CET 2004]
- $NO^- > NO > NO^+$
 - $NO > NO^- > NO^+$
 - $NO^+ > NO > NO^-$
 - $NO^+ > NO^- > NO$
75. Which of the following is paramagnetic [UPSEAT 2004]
- B_2
 - C_2
 - N_2
 - F_2
76. The paramagnetic molecule at ground state among the following is [UPSEAT 2004]
- H_2
 - O_2
 - N_2
 - CO
77. Which has the highest bond energy [DCE 2002]
- F_2
 - Cl_2
 - Br_2
 - I_2
78. In O_2^- , O_2 and O_2^{2-} molecular species, the total number of antibonding electrons respectively are [DCE 2003]
- 7, 6, 8
 - 1, 0, 2
 - 6, 6, 6
 - 8, 6, 8
79. Which of the following is not paramagnetic [DCE 2002]
- O_2
 - O_2^{2+}
 - O_2^{2-}
 - O_2^-
80. Which of the following species have maximum number of unpaired electrons [AIIMS 1983]
- O_2
 - O_2^+
 - O_2^-
 - O_2^{2-}
81. The correct order in which the $O-O$ bond length increases in the following is [BHU 2000; CBSE PMT 2005]
- $H_2O_2 < O_2 < O_3$
 - $O_2 < H_2O_2 < O_3$
 - $O_2 < O_3 < H_2O_2$
 - $O_3 < H_2O_2 < O_2$
82. Correct order of bond length is [MP PET 2004; Orissa JEE 2005]
- $CO_3^{2-} > CO_2 > CO$
 - $CO_2 > CO > CO_3^{2-}$
 - $CO > CO_2 > CO_3^{2-}$
 - None of these
83. Which of the following is paramagnetic [DPMT 2005]
- N_2
 - C_2
 - N_2^+
 - O_2^{2-}
84. Among the following molecules which one have smallest bond angle [Orissa JEE 2005]
- NH_3
 - PH_3
 - H_2O
 - H_2S

Hydrogen bonding

1. In the following which bond will be responsible for maximum value of hydrogen bond
- $O-H$
 - $N-H$

- (c) $S-H$ (d) $F-H$
2. In which of the following hydrogen bond is present
(a) H_2 (b) Ice
(c) Sulphur (d) Hydrocarbon
3. In the following which has highest boiling point
[MP PMT 1989; RPMT 1997]
(a) HI (b) HF
(c) HBr (d) HCl
4. Which contains hydrogen bond [MP PMT 1989]
(a) HF (b) HCl
(c) HBr (d) HI
5. Contrary to other hydrogen halides, hydrogen fluoride is a liquid because [MP PMT 1990; AMU 1983; EAMCET 1980]
(a) Size of F atom is small
(b) HF is a weak acid
(c) HF molecule are hydrogen bonded
(d) Fluorine is highly reactive
6. In the following which species does not contain sp^3 hybridization
(a) NH_3 (b) CH_4
(c) H_2O (d) CO_2
7. As a result of sp hybridization, we get [IIT 1984]
(a) Two mutual perpendicular orbitals
(b) Two orbitals at 180°
(c) Four orbitals in tetrahedral directions
(d) Three orbitals in the same plane
8. The reason for exceptionally high boiling point of water is [DPMT 1986; NCERT 1976; AMU 1984; EAMCET 1979; MP PMT 1993; AIIMS 1996; KCET 2001; CPMT 2003]
(a) Its high specific heat
(b) Its high dielectric constant
(c) Low ionization of water molecules
(d) Hydrogen bonding in the molecules of water
9. Which concept best explains that *o*-nitrophenol is more volatile than *p*-nitrophenol [AIIMS 1980, 82; Kurukshetra CEE 1998; MP PET 2002]
(a) Resonance (b) Hyperconjugation
(c) Hydrogen bonding (d) Steric hindrance
10. Which contains strongest $H-H$ bond [IIT 1986; MP PET 1997, 2003; UPSEAT 2001, 03]
(a) $O-H \cdots S$ (b) $S-H \cdots O$
(c) $F-H \cdots F$ (d) $F-H \cdots O$
11. Which of the following compound can form hydrogen bonds [NCERT 1978; MP PMT 1997]
(a) CH_4 (b) $NaCl$
(c) $CHCl_3$ (d) H_2O
12. Of the following hydrides which has the lowest boiling point [CBSE PMT 1987]
(a) NH_3 (b) PH_3
(c) SbH_3 (d) AsH_3
13. The pairs of bases in DNA are held together by [NCERT 1978; DPMT 1985; CBSE PMT 1992]
(a) Hydrogen bonds (b) Ionic bonds
(c) Phosphate groups (d) Deoxyribose groups
14. Water has high heat of vaporisation due to [AFMC 1982]
(a) Covalent bonding (b) $H-H$ bonding
(c) Ionic bonding (d) None of the above
15. In which of the following compounds does hydrogen bonding occur
(a) SiH_4 (b) LiH
(c) HI (d) NH_3
16. Which among the following compounds does not show hydrogen bonding [MP PMT 1989]
(a) Chloroform (b) Ethyl alcohol
(c) Acetic acid (d) Ethyl ether
17. Acetic acid exists as dimer in benzene due to [CPMT 1982]
(a) Condensation reaction
(b) Hydrogen bonding [DPMT 1985]
(c) Presence of carboxyl group
(d) Presence of hydrogen atom at α -carbon
18. Which one among the following does not have the hydrogen bond [UPSEAT 2001]
(a) Phenol (b) Liquid NH_3
(c) Water (d) Liquid HCl
19. The bond that determines the secondary structure of a protein is [NCERT 1984; MP PMT 1993; KCET 2001]
(a) Coordinate bond (b) Covalent bond
(c) Hydrogen bond (d) Ionic bond
20. HCl is a gas but HF is a low boiling liquid. This is because [NCERT 1984; MP PMT 2001]
(a) $H-F$ bond is strong
(b) $H-F$ bond is weak
(c) Molecules aggregate because of hydrogen bonding
(d) HF is a weak acid
21. The relatively high boiling point of HF is due to [NCERT 1984]
(a) Hydrogen bonding
(b) Covalent bonding
(c) Unshared electron pair on F
(d) Being a halogen acid
22. Water is liquid due to [MADT Bihar 1983]
(a) Hydrogen bonding (b) Covalent bond
(c) Ionic bond (d) Vander Waals forces
23. The maximum possible number of hydrogen bonds in which an H_2O molecule can participate is [MP PMT 1986; MNR 1991; IIT 1992; MP PET 1999]
(a) 1 (b) 2
(c) 3 (d) 4
24. Hydrogen bonding is maximum in [IIT 1987; MP PMT 1991; MP PET 1993, 2001; MNR 1995; CPMT 1999; KCET (Med.) 2002]
(a) Ethanol (b) Diethyl ether

- (c) Ethyl chloride (d) Triethyl amine
25. The hydrogen bond is strongest in [BHU 1987; CBSE PMT 1990, 92]
(a) Water (b) Ammonia
(c) Hydrogen fluoride (d) Acetic acid
26. The high boiling point of ethanol (78.2°C) compared to dimethyl ether (-23.6°C), though both having the same molecular formulae $\text{C}_6\text{H}_6\text{O}$, is due to [MP PMT 1993]
(a) Hydrogen bonding
(b) Ionic bonding
(c) Coordinate covalent bonding
(d) Resonance
27. Methanol and ethanol are miscible in water due to [CPMT 1989]
(a) Covalent character
(b) Hydrogen bonding character
(c) Oxygen bonding character
(d) None of these
28. B.P. of H_2O (100°C) and H_2S (-42°C) explained by
(a) Vander Waal's forces (b) Covalent bond
(c) Hydrogen bond (d) Ionic bond
29. Strength of hydrogen bond is intermediate between [DPMT 1991]
(a) Vander Waal and covalent
(b) Ionic and covalent
(c) Ionic and metallic
(d) Metallic and covalent
30. In which of the following compounds intramolecular hydrogen bond is present [MP PET 1994]
(a) Ethyl alcohol (b) Water
(c) Salicylaldehyde (d) Hydrogen sulphide
31. Hydrogen bonding is formed in compounds containing hydrogen and [MP PET 1995]
(a) Highly electronegative atoms
(b) Highly electropositive atoms
(c) Metal atoms with d -orbitals occupied
(d) Metalloids
32. Which of the following compounds in liquid state does not have hydrogen bonding [MP PMT 1996]
(a) H_2O (b) HF
(c) NH_3 (d) C_6H_6
33. Compounds showing hydrogen bonding among HF , NH_3 , H_2S and PH_3 are
(a) Only HF , NH_3 and PH_3
(b) Only HF and NH_3
(c) Only NH_3 , H_2S and PH_3
(d) All the four
34. The high density of water compared to ice is due to [CBSE PMT 1997; BHU 1999; AFMC 2001]
(a) Hydrogen bonding interactions
(b) Dipole-dipole interactions
(c) Dipole-induced dipole interactions
(d) Induced dipole-induced dipole interactions
35. Ethanol and dimethyl ether form a pair of functional isomers. The boiling point of ethanol is higher than that of dimethyl ether due to the presence of [AIIMS 1998]
(a) Hydrogen bonding in ethanol
(b) Hydrogen bonding in dimethyl ether
(c) CH_3 group in ethanol
(d) CH_3 group in dimethyl ether
36. Which of the following hydrogen bonds are strongest in vapour phase [AMU 1999]
(a) $\text{HF} \cdots \text{HF}$ (b) $\text{HF} \cdots \text{HCl}$
(c) $\text{HCl} \cdots \text{HCl}$ (d) $\text{HF} \cdots \text{HI}$
37. Which of the following shows hydrogen bonding [CPMT 2000]
(a) NH_3 (b) P
(c) As (d) Sb
38. The boiling point of a compound is raised by [DPMT 2001]
(a) Intramolecular hydrogen bonding
(b) Intermolecular hydrogen bonding
(c) Covalent bonding
(d) Ionic covalent
39. The boiling point of water is exceptionally high because [KCET 2001]
(a) Water molecule is linear
(b) Water molecule is not linear
(c) There is covalent bond between H and O
(d) Water molecules associate due to hydrogen bonding
40. NH_3 has a much higher boiling point than PH_3 because [UPSEAT 2002; MNR 1994]
(a) NH_3 has a larger molecular weight
(b) NH_3 undergoes umbrella inversion
(c) NH_3 forms hydrogen bond
(d) NH_3 contains ionic bonds whereas PH_3 contains covalent bonds
41. Which one has the highest boiling point [MP PET 2002]
(a) Acetone (b) Ethyl alcohol
(c) Diethyl ether (d) Chloroform
42. Which of the following compounds has the highest boiling point
(a) HCl (b) HBr
(c) H_2SO_4 (d) HNO_3
43. Which of the following has minimum melting point [UPSEAT 2003]
(a) CsF (b) HCl
(c) HF (d) LiF
44. Hydrogen bond energy is equal to [UPSEAT 2003]
(a) $3 - 7 \text{ cal}$ (b) $30 - 70 \text{ cal}$
(c) $3 - 10 \text{ kcal}$ (d) $30 - 70 \text{ kcal}$
45. H_2O is a liquid while H_2S is gas due to [BHU 2003]
(a) Covalent bonding
(b) Molecular attraction
(c) $\text{H} - \text{bonding}$
(d) $\text{H} - \text{bonding}$ and molecular attraction

46. H – bonding is maximum in [BHU 2003]
 (a) C_6H_5OH (b) C_6H_5COOH
 (c) CH_3CH_2OH (d) CH_3COCH_3
47. Select the compound from the following which dissolves in water
 (a) CCl_4 (b) CS_2
 (c) $CHCl_3$ (d) C_2H_5OH
48. When two ice cubes are pressed over each other, they unit to form one cube. Which of the following force is responsible for holding them together [NCERT 1978]
 (a) Vander Waal's forces
 (b) Hydrogen bond formation
 (c) Covalent attraction
 (d) Dipole–dipole attraction
49. Which is the weakest among the following types of bond [NCERT 1979; MADT Bihar 1984]
 (a) Ionic bond (b) Metallic bond
 (c) Covalent bond (d) Hydrogen bond
50. H -bond is not present in [BCECE 2005]
 (a) Water (b) Glycerol
 (c) Hydrogen fluoride (d) Hydrogen Sulphide
8. In melting, the structure of solid [CPMT 1982]
 (a) Remains unchanged (b) Changes
 (c) Becomes compact (d) None of the above
9. Which of the following has the highest melting point [CPMT 1994]
 (a) Pb (b) Diamond
 (c) Fe (d) Na
10. In the formation of a molecule by an atom [AFMC 1995]
 (a) Attractive forces operate
 (b) Repulsive forces operate
 (c) Both attractive and repulsive forces operate
 (d) None of these
11. Which has weakest bond [RPMT 1997]
 (a) Diamond (b) Neon (Solid)
 (c) KCl (d) Ice
12. Which of the following exhibits the weakest intermolecular forces [AIIMS 1999; B]
 (a) He (b) HCl
 (c) NH_3 (d) H_2O
13. Glycerol has strong intermolecular bonding therefore it is [RPET 2000]
 (a) Sweet (b) Reactive
 (c) Explosive (d) Viscous
14. Among the following the weakest one is [Pb. PMT 2004; CPMT 2002]
 (a) Metallic bond (b) Ionic bond
 (c) Van der Waal's force (d) Covalent bond
15. Lattice energy of alkali metal chlorides follows the order [DPMT 2004]
 (a) $LiCl > NaCl > KCl > RbCl > CsCl$
 (b) $CsCl > NaCl > KCl > RbCl > LiCl$
 (c) $LiCl > CsCl > NaCl > KCl > RbCl$
 (d) $NaCl > LiCl > KCl > RbCl > CsCl$
16. In the following which molecule or ion possesses electrovalent, covalent and co-ordinate bond at the same time
 (a) HCl (b) NH_4^+
 (c) Cl^- (d) H_2O_2
17. Both ionic and covalent bond is present in the following [MNR 1986; MP PMT 2004]
 (a) CH_4 (b) KCl
 (c) SO_2 (d) $NaOH$
18. The formation of a chemical bond is accompanied by [MP PET 1995]
 (a) Decrease in energy
 (b) Increase in energy
 (c) Neither increase nor decrease in energy
 (d) None of these
19. Chemical bond implies [KCET 2002]

Types of bonding and Forces in solid

1. In a crystal cations and anions are held together by [EAMCET 1982]
 (a) Electrons (b) Electrostatic forces
 (c) Nuclear forces (d) Covalent bonds
2. In the following metals which one has lowest probable interatomic forces [MP PMT 1990]
 (a) Copper (b) Silver
 (c) Zinc (d) Mercury
3. In solid argon, the atoms are held together by [NCERT 1981; MP PET 1995]
 (a) Ionic bonds (b) Hydrogen bonds
 (c) Vander Waals forces (d) Hydrophobic forces
4. Which one is the highest melting halide [AIIMS 1980]
 (a) $NaCl$ (b) $NaBr$
 (c) NaF (d) NaI
5. The enhanced force of cohesion in metals is due to [NCERT 1972]
 (a) The covalent linkages between atoms
 (b) The electrovalent linkages between atoms
 (c) The lack of exchange of valency electrons
 (d) The exchange energy of mobile electrons
6. Which one of the following substances consists of small discrete molecules [CPMT 1987]
 (a) $NaCl$ (b) Graphite
 (c) Copper (d) Dry ice
7. Which of the following does not apply to metallic bond [CBSE PMT 1989]

[UPSEAT 2001]

- (a) Attraction
(b) Repulsion
(c) Neither attraction nor repulsion
(d) Both (a) and (b)
20. Which of the following statements is true [AIEEE 2002]
(a) HF is less polar than HBr
(b) Absolutely pure water does not contain any ions
(c) Chemical bond formation take place when forces of attraction overcome the forces of repulsion
(d) In covalency transference of electron takes place
21. Which of the following statements is true about $[Cu(NH_3)_4]SO_4$
(a) It has coordinate and covalent bonds
(b) It has only coordinate bonds
(c) It has only electrovalent bonds
(d) It has electrovalent, covalent and coordinate bonds
22. Blue vitriol has
(a) Ionic bond (b) Coordinate bond
(c) Hydrogen bond (d) All the above
23. The number of ionic, covalent and coordinate bonds in NH_4Cl are respectively [MP PMT 1999]
(a) 1, 3 and 1 (b) 1, 3 and 2
(c) 1, 2 and 3 (d) 1, 1 and 3
24. Covalent molecules are usually held in a crystal structure by [MP PET 1995]
(a) Dipole-dipole attraction
(b) Electrostatic attraction
(c) Hydrogen bonds
(d) Vander Waal's attraction
25. Critical Thinking
Objective Questions
1. The values of electronegativity of atoms A and B are 1.20 and 4.0 respectively. The percentage of ionic character of $A - B$ bond is
(a) 50 % (b) 43 %
(c) 55.3 % (d) 72.24%
2. O_2^{2-} is the symbol of ion [EAMCET 2003]
(a) Oxide (b) Superoxide
(c) Peroxide (d) Monoxide
3. The number of electrons that are paired in oxygen molecule is
(a) 7 (b) 8
(c) 14 (d) 16
4. When N_2 goes to N_2^+ , the $N - N$ bond distance and when O_2 goes to O_2^+ , the $O - O$ bond distance [IIT 1996]
(a) Decrease, increase (b) Increase, decrease
(c) Increase, increase (d) None of these
5. Which of the following contains a coordinate covalent bond
(a) $N_2H_5^+$ (b) $BaCl_2$
(c) HCl (d) H_2O
6. Which combination is best explained by the co-ordinate covalent bond [JIPMER 2001; CBSE PMT 1990]
(a) $H^+ + H_2O$ (b) $Cl + Cl$
(c) $Mg + \frac{1}{2} O_2$ (d) $H_2 + I_2$
7. Arrange the following compounds in order of increasing dipole moment. [CPMT 1988]
(I) Toluene (II) m -dichlorobenzene
(III) o -dichlorobenzene (IV) p -dichlorobenzene [IIT 1996]
(a) $I < IV < II < III$ (b) $IV < I < II < III$
(c) $IV < I < III < II$ (d) $IV < II < I < III$
8. The correct order of dipole moment is [Roorkee 1999]
(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) $H_2O < NH_3 < NF_3 < CH_4$
9. Which of the following has the highest dipole moment [AIIMS 2002]
(a) $\begin{array}{c} H \\ \diagup \\ C = O \\ \diagdown \\ H \end{array}$ (b) $\begin{array}{c} H & CH_3 \\ | & | \\ C & = C \\ | & | \\ CH_3 & H \end{array}$
(c) $\begin{array}{c} CH_3 & H \\ | & | \\ C & = C \\ | & | \\ CH_3 & H \end{array}$ (d) $\begin{array}{c} Cl & CH_3 \\ | & | \\ C & = C \\ | & | \\ CH_3 & Cl \end{array}$
10. Which of the following arrangement of molecules is correct on the basis of their dipole moments [AIIMS 2002]
(a) $BF_3 > NF_3 > NH_3$ (b) $NF_3 > BF_3 > NH_3$
(c) $NH_3 > BF_3 > NF_3$ (d) $NH_3 > NF_3 > BF_3$ [MP PET 2003]
11. The type of hybrid orbitals used by the chlorine atom in ClO_2^- is
(a) sp^3 (b) sp^2
(c) sp (d) None of these
12. Among the following species, identify the isostructural pairs, [IIT 1996]
 $NF_3, NO_3^-, BF_3, H_3O^+, HN_3$
(a) $[NF_3, NO_3^-]$ and $[BF_3, H_3O^+]$ [IIT 1995]
(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 $[HN_3, BF_3]$
13. In the compound $CH_2 = CH - CH_2 - CH_2 - C \equiv CH$, the $C_2 - C_3$ bond is of the type [IIT 1999]
(a) $sp - sp^2$ (b) $sp^3 - sp^3$

- (c) $sp - sp^3$ (d) $sp^2 - sp^3$
14. The correct order of increasing $C - O$ bond length of CO , CO_3^{2-} , CO_2 is [IIT 1999]
- (a) $CO_3^{2-} < CO_2 < CO$ (b) $CO_2 < CO_3^{2-} < CO$
- (c) $CO < CO_3^{2-} < CO_2$ (d) $CO < CO_2 < CO_3^{2-}$
15. In the dichromate dianion [IIT 1999]
- (a) 4 $Cr - O$ bonds are equivalent
- (b) 6 $Cr - O$ bonds are equivalent
- (c) All $Cr - O$ bonds are equivalent
- (d) All $Cr - O$ bonds are non-equivalent
16. Bond length of ethane (I), ethene (II), acetylene (III) and benzene (IV) follows the order [CPMT 1999]
- (a) $I > II > III > IV$ (b) $I > II > IV > III$
- (c) $I > IV > II > III$ (d) $III > IV > II > I$
17. Hybridisation state of chlorine in ClF_3 is [RPET 1999]
- (a) sp^3 (b) sp^3d
- (c) sp^3d^2 (d) sp^3d^3
18. Molecular shapes of SF_4 , CF_4 and XeF_4 are [IIT Screening 2000]
- (a) The same with 2, 0 and 1 lone pairs of electrons respectively
- (b) The same, with 1, 1 and 1 lone pairs of electrons respectively
- (c) Different, with 0, 1 and 2 lone pairs of electrons respectively
- (d) Different, with 1, 0 and 2 lone pairs of electrons respectively
19. Structure of IF_4^+ and hybridization of iodine in this structure are [UPSEAT 2001]
- (a) sp^3d , Linear
- (b) sp^3d^2 , T-shaped
- (c) sp^3d , Irregular tetrahedral
- (d) sp^3d^2 , Octahedral
20. In which of the following the central atom does not use sp hybrid orbitals in its bonding [UPSEAT 2001, 02]
- (a) BeF_3^- (b) OH_3^+
- (c) NH_2^- (d) NF_3
21. The magnetic moment of $K_3[Fe(CN)_6]$ is found to be 1.7 B.M. How many unpaired electron (s) is/are present per molecule
- (a) 1 (b) 2
- (c) 3 (d) 4
22. N_2 and O_2 are converted into monocations N_2^+ and O_2^+ respectively. Which is wrong [CBSE PMT 1997]
- (a) In N_2 , the $N - N$ bond weakens
- (b) In O_2 , the $O - O$ bond order increases
- (c) In O_2 , paramagnetism decreases
- (d) N_2^+ becomes diamagnetic
23. The common features among the species CN^- , CO and NO^+ are [IIT Screening 2001]
- (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
24. The number of $S - S$ bonds in sulphur trioxide trimer S_3O_9 is
- (a) Three (b) Two
- (c) One (d) Zero
25. Strongest intermolecular hydrogen bond is present in the following molecules pairs [IIT 1981; DCE 2000]
- (a) SiH_4 and SiF_4
- (b) $CH_3 - \overset{\overset{O}{||}}{C} - CH_3$ and $CHCl_3$
- (c) $H - \overset{\overset{O}{||}}{C} - OH$ and $CH_3 - \overset{\overset{O}{||}}{C} - OH$
- (d) H_2O and H_2O_2
26. A compound contains atoms X , Y , Z . The oxidation number of X is +2, Y is +5 and Z is -2. Therefore, a possible formula of the compound is [CPMT 1988]
- (a) XYZ_2 (b) $X_2(YZ_3)_2$
- (c) $X_3(YZ_4)_2$ (d) $X_3(Y_4Z)_2$
27. Bonds present in $CuSO_4 \cdot 5H_2O$ is [IIT 1983; DCE 2001]
- (a) Electrovalent and covalent
- (b) Electrovalent and coordinate
- (c) Electrovalent, covalent and coordinate
- (d) Covalent and coordinate
28. The ionization of hydrogen atom would give rise to [UPSEAT 2001]
- (a) Hybrid ion (b) Hydronium ion
- (c) Proton (d) Hydroxyl ion
29. Which can be described as a molecule with residual bonding capacity [JIPMER 2000]
- (a) $BeCl_2$ (b) $NaCl$
- (c) CH_4 (d) N_2



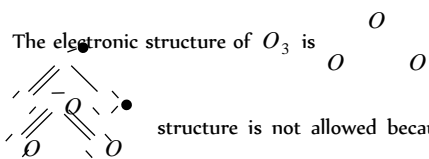
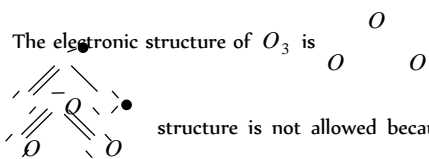
Assertion & Reason

For AIIMS Aspirants

Read the assertion and reason carefully to mark the correct option out of the options given below :

- (a) If both assertion and reason are true and the reason is the correct explanation of the assertion.
- (b) If both assertion and reason are true but reason is not the correct explanation of the assertion.
- (c) If assertion is true but reason is false.
- (d) If the assertion and reason both are false.
- (e) If assertion is false but reason is true.

1. Assertion : Water is a good solvent for ionic compounds but poor one for covalent compounds.
- Reason : Hydration energy of ions releases sufficient energy to overcome lattice energy and break hydrogen bonds in water, while covalent bonded compounds interact so weakly that even Vander

- Wall's forces between molecules of covalent compounds cannot be broken. [AIIMS 1996]
2. Assertion : The atoms in a covalent molecule are said to share electrons, yet some covalent molecules are polar.
Reason : In a polar covalent molecule, the shared electrons spend more time on the average near one of the atoms. [AIIMS 1996]
3. Assertion : Diborane is electron deficient
Reason : There are not enough valence electrons to form the expected number of covalent bonds [AIIMS 2001]
4. Assertion : A resonance hybrid is always more stable than any of its canonical structures
Reason : This stability is due to delocalization of electrons [AIIMS 1999]
5. Assertion : All $F-S-F$ angle in SF_4 greater than 90° but less than 180°
Reason : The lone pair-bond pair repulsion is weaker than bond pair-bond pair repulsion [AIIMS 2004]
6. Assertion : The electronic structure of O_3 is 
Reason :  structure is not allowed because octet around cannot be expanded. [IIT 1998]
7. Assertion : Bond order can assume any value number including zero
Reason : Higher the bond order, shorter is bond length and greater is bond energy [AIIMS 1999]
8. Assertion : Ortho nitrophenol molecules are associated due to the presence of intermolecular hydrogen bonding while paranitrophenol involves intramolecular, hydrogen bonding
Reason : Ortho nitrophenol is more volatile than the para nitrophenol [AIIMS 1999]
9. Assertion : Nitrogen molecule diamagnetic.
Reason : N_2 molecule have unpaired electrons.
10. Assertion : Ice is less dense than liquid water.
Reason : There are vacant spaces between hydrogen bonded water molecules in ice.
11. Assertion : Water is liquid but H_2S is a gas.
Reason : Oxygen is paramagnetic.
12. Assertion : Iodine is more soluble in water than in carbon tetrachloride.
Reason : Iodine is a polar compound.
13. Assertion : *o* and *p*-nitrophenols can be separated by steam distillation.
Reason : *o*-nitrophenol have intramolecular hydrogen bonding while *p*-nitrophenol exists as associated molecules.
14. Assertion : The fluorine has lower reactivity.
Reason : $F-F$ bond has low bond dissociation energy.
15. Assertion : σ is strong while π is a weak bond.
Reason : Atoms rotate freely about π bond.
16. Assertion : The crystal structure gets stabilized even though the sum of electron gain enthalpy and ionization enthalpy is positive.
Reason : Energy is absorbed during the formation of crystal lattice.
17. Assertion : Order of lattice energy for same halides are as $LiX > NaX > KX$.
Reason : Size of alkaline - earth metal increases from *Li* to *K*.
18. Assertion : Born-Haber cycle is based on Hess's law.
Reason : Lattice enthalpy can be calculated by Born-Haber cycle.
19. Assertion : Bond energy has order like $C-C < C=C < C \equiv C$.
Reason : Bond energy increases with increase in bond order.
20. Assertion : Electron affinity refers to an isolated atom's attraction for an additional electron while electronegativity is the ability of an element to attract electrons towards itself in a shared pair of electrons.
Reason : Electron affinity is a relative number and electronegativity is experimentally measurable.
21. Assertion : Geometry of SF_4 molecule can be termed as distorted tetrahedron, a folded square or see saw.
Reason : Four fluorine atoms surround or form bond with sulphur molecule.
22. Assertion : BF_3 has greater dipole moment than H_2S .
Reason : Fluorine is more electronegative than sulphur.
23. Assertion : The bond between two identical nonmetal atoms has a pair of electrons with identical spin.
Reason : Electrons are transferred fully from one atom to another.
24. Assertion : B molecule is diamagnetic.
Reason : The highest occupied molecular orbital is of σ type. [AIIMS 2005]
25. Assertion : The nearly tetrahedral arrangement of the orbitals about the oxygen atom allows each water molecule to form hydrogen bonds with as many as four neighbouring water molecules.
Reason : In ice each molecule forms four hydrogen bonds as each molecule is fixed in the space.
26. Assertion : The bond order of helium is always zero.
Reason : The number of electrons in bonding molecular orbital and antibonding molecular orbital is equal.

Answers

Electrovalent bonding

1	b	2	a	3	a	4	c	5	c
6	d	7	d	8	b	9	c	10	d
11	b	12	a	13	d	14	a	15	a
16	c	17	b	18	a	19	d	20	c

21	b	22	d	23	a	24	a	25	b
26	d	27	d	28	c	29	a	30	d
31	b	32	b	33	b	34	d	35	b
36	a	37	b	38	a	39	a	40	c
41	c	42	b	43	d	44	b	45	c
46	c	47	a	48	b	49	c	50	b
51	b	52	b	53	a	54	a	55	a
56	c	57	a	58	c	59	a	60	c
61	a	62	b	63	d	64	d	65	b
66	a	67	abc	68	bd				

Covalent bonding

1	c	2	c	3	B	4	b	5	d
6	a	7	c	8	a	9	d	10	a
11	b	12	b	13	c	14	b	15	c
16	a	17	a	18	c	19	a	20	b
21	a	22	a	23	c	24	c	25	c
26	c	27	a	28	a	29	a	30	d
31	b	32	a	33	d	34	a	35	d
36	b	37	d	38	c	39	d	40	c
41	b	42	b	43	b	44	b	45	b
46	d	47	d	48	b	49	a	50	a
51	b	52	d	53	c	54	d	55	d
56	d	57	a	58	a	59	d	60	a
61	c	62	a	63	b	64	b	65	b
66	b	67	b	68	d	69	b	70	c
71	c	72	c	73	cd	74	ad	75	ab
76	a								

Co-ordinate or Dative bonding

1	d	2	b	3	c	4	d	5	c
6	b	7	a	8	d	9	a	10	d
11	c	12	a	13	a	14	b	15	c

Dipole moment

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

Polarisation and Fajan's rule

1	d	2	c	3	b	4	d	5	c
6	a	7	b	8	a	9	c	10	b
11	d	12	c	13	b	14	b	15	d
16	d	17	c	18	b	19	a	20	d
21	a	22	c	23	d	24	a	25	b
26	b								

Overlapping - σ and π - bonds

1	c	2	c	3	b	4	b	5	c
6	c	7	c	8	b	9	d	10	c
11	b	12	c	13	a	14	a	15	d
16	a	17	d	18	c	19	d	20	d

Hybridisation

1	d	2	d	3	d	4	c	5	d
6	a	7	c	8	b	9	d	10	d
11	d	12	a	13	a	14	b	15	a
16	b	17	c	18	a	19	d	20	b
21	c	22	c	23	a	24	c	25	a
26	a	27	b	28	c	29	b	30	a
31	d	32	a	33	d	34	c	35	c
36	b	37	b	38	c	39	b	40	b
41	d	42	b	43	c	44	a	45	c
46	c	47	d	48	b	49	c	50	a
51	b	52	a	53	c	54	c	55	c
56	d	57	b	58	a	59	b	60	c
61	b	62	c	63	b	64	b	65	b
66	a	67	c	68	b	69	c	70	a
71	a	72	a	73	b	74	b	75	d
76	d	77	c	78	a	79	d	80	b
81	c	82	b	83	d	84	a	85	d
86	b	87	d	88	c	89	a	90	c
91	c	92	c	93	a	94	b	95	c
96	a	97	b	98	b	99	b	100	b
101	a	102	b	103	d	104	a	105	b
106	a	107	a	108	b	109	b	110	a
111	a	112	b	113	b	114	d	115	d
116	c	117	c	118	b	119	c	120	a
121	a	122	c	123	a	124	a	125	b
126	c	127	d	128	c	129	c	130	a
131	b	132	b	133	e	134	c	135	d

136	b	137	b	138	d	139	a	140	a
141	a	142	b	143	a	144	a	145	a
146	b	147	c	148	d	149	bcd	150	a
151	ac	152	a						

Resonance

1	d	2	b	3	b	4	b	5	b
6	c	7	a	8	c	9	b	10	c
11	abcd								

VSEPR Theory

1	a	2	a	3	b	4	c	5	c
6	b	7	b	8	c	9	b	10	a
11	c	12	a	13	a	14	a	15	c
16	c	17	b	18	d	19	d	20	a
21	a	22	d	23	b	24	d	25	a
26	c	27	b	28	b	29	a	30	a
31	a	32	c	33	c	34	a	35	c
36	b	37	b	38	d	39	d	40	b
41	c	42	a	43	b	44	c	45	d

Molecular orbital theory

1	a	2	c	3	b	4	b	5	c
6	d	7	c	8	b	9	c	10	b
11	c	12	b	13	c	14	a	15	c
16	c	17	d	18	b	19	c	20	c
21	d	22	c	23	b	24	c	25	a
26	d	27	b	28	b	29	a	30	c
31	c	32	a	33	c	34	a	35	c
36	d	37	b	38	a	39	a	40	c
41	c	42	a	43	b	44	a	45	a
46	c	47	b	48	c	49	c	50	a
51	c	52	b	53	a	54	a	55	a
56	c	57	c	58	c	59	a	60	a
61	a	62	b	63	a	64	c	65	a
66	c	67	a	68	a	69	c	70	a
71	b	72	b	73	d	74	c	75	a
76	b	77	b	78	a	79	c	80	a
81	c	82	a	83	c	84	d		

Hydrogen bonding

1	d	2	b	3	b	4	a	5	c
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6	d	7	b	8	d	9	c	10	c
11	d	12	b	13	a	14	b	15	d
16	d	17	b	18	d	19	c	20	c
21	a	22	a	23	d	24	a	25	c
26	a	27	b	28	c	29	a	30	c
31	a	32	b	33	d	34	a	35	a
36	a	37	a	38	b	39	d	40	c
41	a	42	c	43	b	44	c	45	c
46	b	47	d	48	b	49	d	50	d

Types of bonding and Forces in solid

1	b	2	d	3	c	4	c	5	d
6	d	7	d	8	b	9	b	10	c
11	d	12	a	13	d	14	c	15	a
16	b	17	d	18	a	19	d	20	c
21	d	22	d	23	a	24	d		

Critical Thinking Question

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

Assertion & Reason

1	a	2	a	3	a	4	a	5	c
6	b	7	b	8	e	9	c	10	a
11	b	12	d	13	a	14	e	15	c
16	c	17	c	18	b	19	a	20	c
21	b	22	e	23	d	24	d	25	a
26	a								