CHEMISTRY

BOOKS - MODERN PUBLICATION CHEMISTRY (KANNADA ENGLISH)

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Multiple Choice Questions Level I

1. Which of the following molecules is not an exception to the octet rule ?

A. BF_3

B. CO_2

C. IF_7

D. PF_5

Answer: B

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2. An ionic compound A^+B^- is most likely to be formed when :

A. The ionisation energy of A is high and electron affinity of B is low

B. The ionisation energy of A is low and electron affinity of B is high

C. Both the ionisation energy of A and electron affinity of B are high

D. Both the ionisation energy of A and electron affinity of B are low.

Answer: B

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3. Which of the following statements concerning ionic compounds is false ?

A. They consist of ions

B. They have generally high melting and boiling points

C. They conduct electricity in the solid state

D. They are generally soluble in polar solvents.

Answer: C

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4. Point out the non - existing molecule out of the following ?

A. CBr_4

B. XeF_4

C. SF_6

D. NF_5

Answer: D

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5. Covalent compounds generally have :

A. low melting points and are soluble in polar solvents

B. low melting points and are insoluble in polar solvents

C. high melting points and are soluble in polar solvents

D. high melting points and are insoluble in polar solvents.

Answer: B

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6. Which of the following statements concerning covalent bond is false ?

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 be polar or non - polar.

Answer: B

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7. An element forms compounds of the type MCl_3, M_2O_5 and Ca_3M_2 but does not form MF_5. The element could be :

A. Al

B. B

C. N

D. P

Answer: C

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8. A molecule with zero dipole moment among the following is :

A. $CHCl_3$

B. CH_3Cl

C. CH_2Cl_2

D. CCl_4

Answer: D

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9. The compound which contains both ionic and covalent is

A. CH_4

B. CS_2

C. KCN

D. KCl

Answer: C

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10. The type of bonds present in ammonium chloride are :

A. Only covalent

B. Only ionic

C. Co-ordinate and covalent.

D. Ionic, co-ordinate and covalent.

Answer: D

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11. An atom of element A has 3 electrons in its valence shell and an atom of B has 6 electrons in its valence shell. The formula of the compound between these two atoms will be :

A. A_3B_6

B. AB_2

C. A_3B_2

D. A_2B_3

Answer: D

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12. The elements A and B have the following electronic configurations :

$A: 1s^2 2s^2 2p^6 3s^2 3p^4$

$B: 1s^2 2s^2 2p^6 3s^2 3p^2$

A and B are likely to form a compound of formula :

A. AB

B. A_2B

C. AB_2

D. AB_3

Answer: B

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13. The number of π- electrons in naphthalene is

A. 5

B. 10

C. 6

D. 12

Answer: B

14. The molecule/ion having pyramidal shape is :

A. PCl_3

B. SO_3

C. CO_3

D. NH_4^+

Answer: A

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15. In BCl_3, the hybridisation state of Boron is

:

A. sp

B. sp^2

C. sp^3

D. sp^3d

Answer: B

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16. The bond angles in molecules H_2O, NH_3, CH_4 and CO_2 are in the order :

A. $H_2O > NH_3 > CH_4 > CO_2$

B. $H_2O < NH_3 < CH_4 < CO_2$

C. $H_2O < NH_3 < CO_2 < CH_4$

D. $H_2O > NH_3 > CO_2 > CH_4$

Answer: B

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17. A molecule MX_3 has no dipole moment. The sigma bonding orbital used by M (atomic no < 21) is :

A. sp^3 hybridised

B. p unhybridised

C. sp hybridised

D. sp^2 hybridised.

Answer: C

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18. The geometry of NF_5 molecule is :

A. Trigonal bipyramidal

B. Square planar

C. Tetrahedral

D. The molecule does not exist

Answer: D

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19. Which of the following hybrid orbitals has highest s - character ?

A. sp^2

B. sp^3

C. sp

D. none of the above

Answer: A

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20. CO_2 is isostructural with :

A. 1. $SnCl_2$

B. 2. C_2H_2

C. 3. NO_2

D. 4. H_2O

Answer: B

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21. A molecule has two lone pairs and two bond parts around the central atom. The molecular shape is expected to be :

A. 1. V - shaped

B. 2. Triangular

C. 3. Linear

D. 4. Tetrahedral

Answer: A

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22. Which of the following pairs does not have similar geometries ?

A. 1. CH_4, CCl_4

B. 2. BF_3, NH_3

C. 3. H_2O, H_2S

D. 4. PCl_5, $SbCl_5$

Answer: B

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23. Which of the following molecules has the higehest bond angle ?

A. BF_3

B. NH_3

C. SO_2

D. SF_6

Answer: A

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24. The geometry of ClO_4^- ion is :

A. Tetrahedral

B. Octahedral

C. Trigonal bipyramidal

D. Pyramidal.

Answer: A

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25. The molecule/ion having pyramidal shape is :

A. PCl_3

B. SO_3

C. CO_3

D. NO_3^-

Answer: A

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26. The octahedral shape is associated with :

A. PF_5

B. SF_4

C. TeF_6

D. ClF_3

Answer: C

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27. Which of the following does not involve sp^3 hybridisation of the central atom ?

A. H_3O^+

B. ClO_4^-

C. SF_4

D. ClO_3^-

Answer: C

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28. An example of a bent molecule having bond angle greater than tetrahedral angle is :

A. H_2O

B. H_3O^+

C. NO_2^-

D. NO_2^+

Answer: C

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29. In NO_3^- ion, the nitrogen atom involves :

A. sp hybridisation

B. sp^2 hybridisation

C. sp^3 hybridisation

D. dsp^2 hybridisation

Answer: B

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30. Among $NCl_3, PCl_3, AsCl_3,$ the decreasing order of bond angle is :

A. $NCl_3, PCl_3, AsCl_3$

B. $NCl_3, AsCl_3, PCl_3$

C. $AsCl_3, PCl_3, NCl_3$

D. $AsCl_3, NCl_3, PCl_3$

Answer: A

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31. XeF_2 molecule is :

A. Angular

B. Triangular planar

C. Linear

D. None of these

Answer: C

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32. PCl_5 molecule has the geometry :

A. Trigonal bipyramidal

B. Octahedral

C. Square planar

D. Square bipyramidal

Answer: A

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33. An example of a molecule having two lone pairs and three bond pairs is :

A. 1. XeF_2

B. 2. SF_4

C. 3. H_3O^+

D. 4. ClF_3

Answer: D

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34. The hybridisation that can account for the shape of ClF_3 molecule is :

A. 1. dsp^2

B. 2. dsp^3

C. 3. d^2sp^3

D. 4. sp^3d^2

Answer: B

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35. Bond angle in PH_3 is :

A. 1. greater than in PF_3

B. 2. smaller than in PCl_3

C. 3. larger than in BF_3

D. 4. same as in NH_3

Answer: A

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36. The hybridisation possessed by oxygen atom in OF_2 molecule is :

A. sp

B. sp^2

C. sp^3

D. dsp^2

Answer: C

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37. Which of the following molecules is linear ?

A. NO_2

B. ClO_2

C. SO_2

D. CO_2

Answer: D

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38. In which of the following, the bond angle is maximum ?

A. NH_3

B. NH_4^+

C. PCl_(3)

D. SCl_2

Answer: B

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39. In an octahedral structure, the pair of d - orbitals involved in d^2sp^3 hybridisation is :

A. 1. $d_{x^2-y^2}, d_{xz}$

B. 2. d_{z^2}, d_{zx}

C. 3. d_{xy}, d_{yz}

D. 4. $d_{x^2-y^2}, d_{z^2}$

Answer: D

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40. Which of the following species has a linear shape ?

A. SO_2

B. NO_2^+

C. O_3

D. NO_2^-

Answer: B

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41. Which of the following species contains three bond pairs and one lone pair around the central atom ?

A. PCl_3

B. H_2O

C. BF_3

D. NH_2^-

Answer: A

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42. Pentagonal bipyramidal structure contains bond angles approximately

A. 1. $120^\circ, 90^\circ, 180^\circ$

B. 2 $120^\circ, 72^\circ, 180^\circ$

C. 3. $72^\circ, 90^\circ, 120^\circ$

D. 4. $72^\circ, 90^\circ, 180^\circ$

Answer: D

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43. Which of the d - orbital is used in sp^3d hybridization ?

A. d_{xy}

B. $d_{x^2-y^2}$

C. d_{z^2}

D. d_{yz}

Answer: C

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44. In which of the following molecule/ion all the bonds are not equal ?

A. XeF_4

B. BF_4^-

C. C_2H_4

D. SiF_4

Answer: C

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45. Which of the following angle corresponds to sp^2 hybridisation ?

A. 90°

B. 120°

C. 180°

D. 109°

Answer: B

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46. Which of the following species is paramagnetic ?

A. 1. CO

B. 2. NO^+

C. 3. N_2

D. 4. B_2

Answer: D

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47. Which of the following species has bond order equal to $1/2$?

A. 1. He_2

B. 2. H_2^+

C. 3. O_2^-

D. 4. O_2^+

Answer: C

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48. Which of the following M.Os. Containing electron/electrons has highest energy in B_2 molecule ?

A. $\sigma 2s$

B. $\sigma 2p_z$

C. $\pi 2p_x$

D. $\sigma^* 2s.$

Answer: C

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49. Which of the following molecules is expected to be paramagnetic in nature ?

A. N_2

B. H_2

C. O_2

D. Be_2

Answer: C

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50. Which of the following is diamagnetic ?

A. 1. B_2

B. 2. O_2

C. 3. O_2^+

D. 4. O_2^{2+}

Answer: D

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51. Which of the following has maximum number of unpaired electrons ?

A. O_2

B. O_2^+

C. O_2^-

D. O_2^{2-}

Answer: A

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52. If z-axis is the molecular axis, then the p-mole-cular orbitals are formed by the overlap of :

A. 1. 2s and $2p_x$

B. 2. $2p_x$ and $2p_z$

C. 3. $2p_x$ and $2p_x$

D. 4. $2p_x$ and $2p_z$

Answer: C

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53. Which of the following combinations is not allowed (assume z - axis as internuclear axis) ?

A. 2s and 2s

B. $2p_x$ and $2p_x$

C. 2s and $2p_z$

D. $2p_x$ and $2p_y$

Answer: D

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54. Which of the following combinations of atomic orbitals gives antibonding π MO (assume z - axis as internuclear axis) ?

A. 1. $2s + 2p_z$

B. 2. $2p_y + 2p_y$

C. 3. $2p_x - 2p_x$

D. 4. $2p_z - 2p_z$

Answer: C

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55. Which of the following has bond order equal to 1.5 ?

A. O_2

B. O_2^+

C. O_2^-

D. O_2^{2-}

Answer: C

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56. The bond strength is maximum in :

A. O_2^+

B. O_2^-

C. O_2^{2-}

D. O_2

Answer: A

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57. The calculated bond order in superoxide ion is :

A. 1. 2.5

B. 2. 2

C. 3. 1.5

D. 4. 1

Answer: C

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58. Which of the following has the smallest bond length ?

A. 1. O_2

B. 2. O_2^-

C. 3. O_2^+

D. 4. O_2^{2-}

Answer: C

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59. According to MO theory, O_2^+ possesses :

A. bond order of 2.5

B. three unpaired electrons

C. diamagnetic character

D. stability lower than O_2

Answer: A

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60. Which one of the following molecular species has the highest bond order ?

A. O_2

B. O_2^-

C. O_2^+

D. O_2^{2-}

Answer: C

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61. The bond order in peroxide ion is :

A. larger than in O_2 molecule

B. smaller than in superoxide ion

C. equal to that in N_2 molecule

D. greater than in F_2 molecule.

Answer: B

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62. Which of the following statements is wrong ?

A. 1. The bonding molecular orbitals possess lower energy than the isolated atoms

B. 2. Both Be_2 and He_2 cannot exist

C. 3. B_2 molecule is paramagnetic

D. 4. O_2^+ and N_2^+ have same bond order.

Answer: B

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63. N_2 and O_2 are converted to mono cations N_2^+ and O_2^+ respectively. Which is wrong ?

A. In N_2^+, $N - N$ bond weakens

B. In O_2^+, the $O - O$ bond order increases

C. In O_2^+, the paramagnetism decreases

D. N_2^+ becomes diamagnetic.

Answer: D

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64. Which one of the following molecular species has the highest bond order ?

A. NO^-

B. O_2^+

C. N_2

D. CN^-

Answer: B

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65. The correct statement with regard to H_2^+ and H_2^- is :

A. both H_2^+ and H_2^- do not exist

B. H_2^- is more stable than H_2^+

C. H_2^+ is more stable than H_2^-

D. Both H_2^+ and H_2^- are equally stable.

Answer: C

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66. According to molecular orbital theory, which of the lists ranks the nitrogen species in terms of increasing bond order ?

A. $N_2^{2-} < N_2^- < N_2$

B. $N_2 < N_2^{2-} < N_2^-$

C. $N_2^- < N_2^{2-} < N_2$

D. $N_2^- < N_2 < N_2^{2-}$

Answer: A

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67. The molecule not having π - bond is

A. 1. Cl_2

B. 2. O_2

C. 3. N_2

D. 4. CO_2

Answer: A

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68. Which one of the following species does not exist under normal conditions ?

A. B_2

B. Li_2

C. Be_2^+

D. Be_2

Answer: D

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69. The pair of species with the same bond order is

A. 1. N_2, O_2

B. 2. O_2^{2-}, B_2

C. 3. O_2^+, NO^+

D. 4. NO, CO

Answer: B

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70. What is the bond order of carbon molecule.

A. 1

B. 2

C. 0

D. 3

Answer: B

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71. Which one of the following is paramagnetic ?

A. N_2

B. NO

C. CO

D. F_2

Answer: B

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72. Which of the following is not correct with respect to bond length of the species ?

A. $C_2 > C_2^{2-}$

B. $B_2^+ > B_2$

C. $N_2^+ > N_2$

D. $O_2 > O_2^-$

Answer: D

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73. When O_2 is converted to O_2^+

A. 1. both paramagnetic character and bond order increase

B. 2. bond order decreases

C. 3. paramagnetic character increases

D. 4. paramagnetic character decreases and the bond order increases

Answer: D

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74. Which of the following order of energies of molecular orbitals of N_2 is correct ?

A. 1.

$$\left(\pi 2p_y\right) < \left(\sigma 2p_z\right) < \left(\pi^* 2p_x\right) = \left(\pi^* 2p_y\right)$$

B. 2.

$$\left(\pi 2p_y\right) > \left(\sigma 2p_z\right) > \left(\pi^* 2p_z\right) = \left(\pi^* 2p_y\right)$$

C. 3.

$$\left(\pi 2p_y\right) > \left(\sigma 2p_z\right) > \left(\pi^* 2p_x\right) = \left(\pi^* 2p_y\right)$$

D. 4.

$$(\pi 2p_y) > (\sigma 2p_z) < (\pi^* 2p_x) = (\pi^* 2p_y)$$

Answer: A

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75. Ammonta has higher boiling point than expected because :

A. 1. It forms NH_4OH with water

B. 2. its density decreases on freezing

C. 3. it has strong intermolecular covalent bonds

D. 4. it has strong intermolecular hydrogen bonds.

Answer: D

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76. Methanol and ethanol are miscible in water due to :

A. 1. covalent character

B. 2. hydrogen bonding character

C. 3. ionic bonding character

D. 4. tendency to form coordinate bonds.

Answer: B

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77. Water has high boiling point.

A. water is ionic

B. water is covalent

C. water has hydrogen bonded structure

D. water is angular molecule

Answer: C

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78. Which concept best explains the fact that o-nitrophenol is more volatile than p-nitrophenol ?

A. Resonance

B. Steric hindrance

C. Hydrogen bonding

D. Hyper conjugation

Answer: C

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79. Which of the following has lowest boiling point ?

A. HF

B. HCl

C. HBr

D. HI

Answer: B

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80. Hydrogen bond is strongest in

A. $O - H \ldots . S$

B. $S - H \ldots . O$

C. $F - H \ldots . . O$

D. $F - H \ldots . . F$

Answer: D

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81. The pair of molecules having strongest intermolecular hydrogen bonds is :

A. SiH_4 and SiF_4

B. H_2O and H_2O_2

C. CH_3COCH_3 and $CHCl_3$

D. HCOOH and CH_3OH

Answer: D

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82. Intermolecular forces in solid hydrogen are

:

A. Covalent forces

B. Van der Waals forces

C. Hydrogen bonds

D. All of these

Answer: B

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83. Hydrogen fluoride is liquid unlike other halides because :

A. F_2 is highly reactive

B. HF molecules associate due to hydrogen bonding

C. HF is weakest acid of all hydrogen halides

D. fluorine is smallest of all halogen atoms

Answer: B

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84. The coupling between base units of DNA is through :

A. hydrogen bonding

B. electrostatic bonding

C. covalent bonding

D. Van der Waals' forces

Answer: A

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85. Which of the following shows maximum diversity?

A. water at $25^\circ C$

B. ice at $-4^\circ C$

C. water at $4^\circ C$

D. ice at $0^\circ C$

Answer: C

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86. The high density of water compared to ice is due to :

A. dipole - dipole interactions

B. hydrogen bonding interactions

C. dipole induced dipole interactions

D. none of the above

Answer: B

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87. In which of the following pairs, the first compound does not have higher boiling point than the second ?

A. H_2O and H_2S

B. CH_4 and SiH_4

C. HF and HCl

D. HI and HBr

Answer: B

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88. In which of the following sets of molecule is the order of increasing boiling points not correct ?

A. 1. HBr, HCl, HF

B. 2. H_2S, H_2Se, H_2O

C. 3. CH_4, C_2H_6, C_3H_8

D. 4. CH_4, SiH_4, GeH_4

Answer: A

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89. H_2O is dipolar whereas BeF_2 is not. It is because

A. H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule.

B. H_2O is linear but BeF_2 is angular

C. H_2O is angular and BeF_2 is linear

D. the electronegativity of F is greater than that of O.

Answer: C

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90. In which of the following substances will hydrogen bond be strongest ?

A. HCl

B. H_2O

C. HI

D. H_2S

Answer: B

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Multiple Choice Questions Level Ii

1. Which of the following molecules have dipole moment ?

(i) BeF_2 (ii) BF_3 (iii) NF_3 (iv) H_2S

A. 1. (i) and (iii)

B. 2. (iii) and (iv)

C. 3. (ii) and (iii)

D. 4. only (iii)

Answer: B

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2. The ion that is isoelectronic with CO is :

A. CN^-

B. O_2^+

C. N_2^+

D. O_2^-

Answer: A

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3. Which of the following has highest melting point?

A. NaCl

B. NaBr

C. NaF

D. NaI

Answer: C

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4. In which of the following molecules, the central atom has two lone pairs of electrons ?

A. SF_4

B. BrF_5

C. XeF_4

D. XeF_2

Answer: C

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5. Dipole moment is shown by :

A. 1. 1, 4- dichloro benzene

B. 2. Cis -1,2 -dichlorethene

C. 3. Trans -1,2-dichloroethene

D. 4. Ethane

Answer: B

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6. Sulphuric acid molecule contains :

A. only covalent bonds

B. covalent and ionic bonds

C. covalent and coordinate bonds

D. covalent, ionic and coordinate bonds

Answer: D

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7. If the electronegativity difference between two atoms is 2.0, the percentage covalent character of the molecule is :

A. $46\ \%$

B. $72\ \%$

C. $54\ \%$

D. $10\ \%$

Answer: A

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8. $AlCl_3$ is covalent and AiF_3 is ionic. This fact can be explained on the basic of :

A. Crystal structure

B. Fazan rules

C. Lattice energy

D. Valence bond theory

Answer: B

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9. Which of the following ions can be polarized more as compared to other ions ?

A. I^-

B. Br^-

C. Cl^-

D. F^-

Answer: A

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10. The maximum possible number of hydrogen bonds a water molecule can form is :

A. 2

B. 4

C. 3

D. 1

Answer: B

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11. The bonds present in N_2O_5 are :

A. Only ionic

B. Only covalent

C. Covalent and ionic

D. Covalent and coordinate

Answer: D

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12. Amongst $LiCl$, $RbCl$, $BeCl_2$ and $MgCl_2$, the compounds with the greatest and the least ionic character respectively are :

A. $LiCl$, $RbCl$

B. RbCl and $BeCl_2$

C. $RbCl$, $MgCl_2$

D. $MgCl_2$ and $BeCl_2$

Answer: B

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13. A molecule in which sp^2 hybrid orbitals are used by the central atom in forming covalent bonds is :

A. PCl_5

B. NH_3

C. SO_2

D. XeF_2

Answer: C

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14. The molecule having one unpaired electron is

A. NO

B. CO

C. CN^-

D. O_2

Answer: A

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15. Which of the following species does not exist ?

A. $SnCl_6^{2-}$

B. $GeCl_6^{2-}$

C. CCl_6^{2-}

D. $SiCl_6^{2-}$

Answer: C

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16. The $C - H$ bond distance is longest in

A. C_2H_2

B. C_2H_4

C. $C_2H_2Br_2$

D. C_2H_6

Answer: D

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17. Solid NaCl is a bad conductor of electricity because

A. solid NaCl is covalent

B. in solid NaCl there are strong attractive forces

C. in solid NaCl there are no mobile electrons

D. in solid NaCl there are no ions.

Answer: B

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18. The compound in which carbon uses sp^3 hydrid orbitals for bond formation is :

A. HCOOH

B. $(NH_2)_2CO$

C. $(CH_3)_3COH$

D. $CH_2 = C = O$

Answer: C

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19. The dipole moment of o, m and p-dichlorobenzene will be in the order :

A. $o > p > m$

B. $p > o > m$

C. $o > m > p$

D. $m > o > p$

Answer: C

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20. Both BF_3 and NF_3 are covalent compounds. But BF_3 is non - polar while NF_3 is polar. This is because :

A. atomic size of Boron is smaller than that of nitrogen

B. Nitrogen is more electronegative than Boron.

C. BF bonds have less polarity than NF bonds.

D. BF_3 is planar but NF_3 is pyramidal in shape.

Answer: D

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21. Anhydrous $AlCl_3$ is covalent but $AlCl_3.6H_2O$ is ionic because :

A. $AlCl_3$ has dimeric structure

B. ionization energy of aluminium is low

C. lattice energy in $AlCl_3.6H_2O$ becomes high

D. hydration energy compensates the high ionization energy of Al.

Answer: D

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22. The types of bonds present in $CuSO_4.5H_2O$ are :

A. Electrovalent and covalent

B. Electrovalent, and coordinate covalent

C. Electrovalent, covalent and coordinate covalent

D. Covalent and coordinate covalent

Answer: C

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23. Which of the following statements is wrong ? According to Fazan's rules, the covalent character is facoured by :

A. small size of cation

B. the cation having 18 electrons shell

C. small size of anion

D. high charge of cation and anion

Answer: C

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24. Which of the following compounds has the largest lattice energy ?

A. 1. LiBr

B. 2. LiCl

C. 3. LiF

D. 4. LiI

Answer: C

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25. Which of the following is not the correct resonating structure of carbon dioxide ?

A. $O = C = O$

B. $O^+ \equiv C - O^-$

C. $^-O - C \equiv O^+$

D. $O = {}^-C \equiv O^+$

Answer: D

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26. Which of the following statements is not correct regarding hybridisation ?

A. 1. The hybridised orbitals are always equivalent in energy and shape

B. 2. The hybrid orbitals are more effective in forming stable σ - and π - bonds than the pure atomic orbitals

C. 3. Promotion is not essential condition prior to hybridisation

D. 4. The filled orbitals can also participate in hybridisation

Answer: B

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27. A diatomic molecule is stable only when :

A. 1. Number of bonding and antibonding molecular orbitals are equal

B. 2. Number of electrons in bonding and antibonding molecular orbitals are equal

C. 3. Number of electrons in bonding molecular orbitals is greater than in antibonding orbitals

D. 4. The bond order is zero

Answer: C

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28. Which of the following molecules involve sp^3d^2 hybridisation ?

A. 1. PF_5

B. 2. IF_7

C. 3. NF_3

D. 4. SF_6

Answer: D

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29. With the help of Valence Bond theory account for hybridisation, geometry and magnetic property of $\left[Ni(CN)_4\right]^{2-}$ complex ion $[Z \text{ for } Ni = 28]$

A. sp^3

B. dsp^2

C. sp^3d

D. sp^3d^2

Answer: B

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30. The geometry of IF_7 molecule is :

A. 1. Trigonal bipyramidal

B. 2. Tetrahedral

C. 3. Pentagonal bipyramidal

D. 4. Octahedral

Answer: C

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31. Which of the following species is paramagnetic :

A. 1. O_2^-

B. 2. CN^-

C. 3. CO

D. 4. O_2^{2-}

Answer: A

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32. Which of the following species is paramagnetic ?

A. B_2, O_2, N_2

B. B_2, O_2, N_2^+

C. B_2, F_2, O_2

D. B_2, O_2, Li_2

Answer: B

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33. The bond order in O_2^+ is same as in

A. 1. N_2^+

B. 2. CN^-

C. 3. NO^+

D. 4. CO

Answer: A

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34. The bond order in N_2^+, O_2 and F_2 follows the order :

A. 1. $F_2 < N_2^+ < O_2$

B. 2. $N_2^+ < O_2 < F_2$

C. 3. $O_2 < F_2 < N_2^+$

D. 4. $F_2 < O_2 < N_2^+$

Answer: D

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35. The bond lengths in O_2, O_2^+ and O_2^- species follow the order :

A. 1. $O_2^- < O_2 < O_2^+$

B. 2. $O_2^- < O_2^+ < O_2$

C. 3. $O_2^+ < O_2 < O_2^-$

D. 4. $O_2 < O_2^+ < O_2^-$

Answer: C

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36. The hybridisation of carbon atoms in $C-C$ single bond in $HC \equiv C-CH=CH_2$ is :

A. 1. sp^3-sp^3

B. 2. sp^2-sp^3

C. 3. $sp-sp^2$

D. 4. sp^3-sp

Answer: C

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37. Which of the following has a bond formed by the overlap of $sp - sp^3$ hybrid orbitals ?

A. CH 3 −C≡C−H

B. $CH_3 - CH = CH - CH_3$

C. $CH_3 = CH - CH = CH_2$

D. $CH \equiv CH$

Answer: A

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38. The type of hybrid orbitals used by the chlorine atom in ClO_2^- ion is :

A. 1. sp^3

B. 2. sp^2

C. 3. . sp

D. 4. none of these

Answer: A

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39. Which of the following molecules is linear ?

A. $SnCl_2$

B. NO_2^+

C. H_2O

D. CO_3^{2-}

Answer: B

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40. The enolic form of Acetone contains :

A. 1. 9σ bonds, 1π bond and 2 lone pairs

B. 2. 8σ bonds, 2π bonds and 2 lone pairs

C. 3. 10σ bonds, 1π bond and 1 lone pair

D. 4. 9σ bond, 2π bonds and 1 lone pair

Answer: A

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41. Which of the following has smallest bond angle ?

A. NO_2^+

B. NO_2

C. NO_2^-

D. NO_3^-

Answer: C

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42. The pair of molecules having strongest intermolecular hydrogen bonds is :

A. H_2 and H_2O

B. CH_3COOH and HCOOH

C. CH_3COOH and CH_3COCH_3

D. SiH_4 and $SiCl_4$

Answer: B

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43. Which of the following has the highest polarizing power ?

A. K^+

B. Ca^{2+}

C. Mg^{2+}

D. Na^+

Answer: C

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44. When two ice cubes are pressed over each other, they unite to form one cube. Which of the forces is responsible to hold them together ?

A. 1. Hydrogen bond formation

B. 2. Van der Waals forces

C. 3. Covalent bonds

D. 4. Dipole interactions

Answer: A

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45. The number of sigma and pi bonds in tetra - cyanoethene are :

A. 5σ and 9π

B. 5σ and 8π

C. 9σ and 9π

D. 9σ and 7π

Answer: C

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46. Layers of carbon atoms in graphite are held together by :

A. 1. Covalent bonds

B. 2. Hydrogen bonds

C. 3. Van der Waals forces

D. 4. Double bonds

Answer: C

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47. H_2O is a liquid while H_2S is a gas. This is due to :

A. difference in the state of hybridisations of O and S in their compounds

B. high molecular mass of H_2S as compared to H_2O.

C. strong hydrogen bonding in H_2O molecules as compared to H_2S molecule

D. $H-O-H$ bond angle in H_2O is 104.5° while $H-S-H$ bond angle in

H_2S is 92°

Answer: C

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48. Types of bonding in solid carbon dioxide are :

A. Hydrogen bonding

B. Covalent bonding

C. Van der Waals forces

D. Ionic bonding

Answer: C

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49. NH_3 and BF_3 form adduct readily because they form :

A. ionic bond

B. covalent bond

C. coordinate bond

D. hydrogen bond

Answer: C

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50. The hybridisation of C in diamond, graphite and ethyne is in the order

A. sp^3, sp^2, sp

B. sp, sp^3, sp^2

C. sp^2, sp, sp^3

D. sp, sp^2, sp^3

Answer: A

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51. The correct order of the $O-O$ bond length in O_2, H_2O_2 and O_3 is :

A. $H_2O_2 > O_3 > O_2$

B. $O_2 > O_3 > H_2O_2$

C. $O_2 > H_2O_2 > O_3$

D. $O_3 > H_2O_2 > O_2$

Answer: A

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52. Of the following species the one having planar structure is

A. NH_4^+

B. BF_4

C. XeF_4

D. $SiCl_4$

Answer: C

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53. The bond order in NO^+ is :

A. same as in O_2^+ and N_2^+

B. same as in CO^+

C. same as in N_2 and CN^-

D. same as in N_2^+ and CN.

Answer: C

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54. Which of the following is an electron deficient compound ?

A. B_2H_6

B. Al_2Cl_6

C. $NaBH_4$

D. H_3BO_3

Answer: A

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55. If A is the central atom of the molecule containing A and X atoms and E is the number of lone pairs around it, then VSEPR notation AX_3E will be for the molecules :

A. ICl_4, PCl_3

B. NH_3, H_2O

C. ClO_3^-, NH_3

D. ClO_3^-, ClO_4^-

Answer: C

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56. The correct order of increasing $C-O$ bond length of CO, CO_3^{2-} and CO_2 is :

A. $CO_3^{2-} < CO_2 < CO$

B. $CO_2 < CO_3^{2-} < CO$

C. $CO < CO_3^{2-} < CO_2$

D. $CO < CO_2 < CO_3^{2-}$

Answer: D

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57. The electronegativity values of atoms A and B are 1.8 and 4.0 respectively. The percentage of covalent character of A-B bond is :

A. $50\ \%$

B. $27.8\ \%$

C. $47\ \%$

D. $56.2\ \%$

Answer: B

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58. Which of the following does not have dipole moment ?

A. 1. ClO_2

B. 2. SO_2

C. 3. NO_2^+

D. 4. NO_2

Answer: C

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59. The number of σ and π bonds between two carbon atoms in calcium carbide are :

A. one σ, one π

B. one σ, two π

C. two σ, one π

D. one σ, $1\frac{1}{2}\pi$.

Answer: B

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60. Which one of the following has highest dipole moment ?

A. NH_3

B. PH_3

C. SbH_3

D. AsH_3

Answer: A

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61. Which one of the following molecules will form a linear polymeric structure due to hydrogen bonding ?

A. 1. HCl

B. 2. HF

C. 3. H_2O

D. 4. NH_3

Answer: B

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62. Which of the following two are isostructural ?

A. XeF_2, IF_2^-

B. NH_3, BF_3

C. CO_3^{2-}, SO_3^{2-}

D. PCl_5, ICl_5

Answer: A

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63. Which one of the following arrangements of molecules is correct on the basis of their dipole moments ?

A. $BF_3 > NF_3 > NH_3$

B. $NF_3 > BF_3 > NH_3$

C. $NH_3 > BF_3 > NF_3$

D. $NH_3 > NF_3 > BF_3$

Answer: D

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64. Among the following the pair in which the two species are not iso - structural is

A. IO_3^- and XeO_3

B. BH_4^- and NH_4^+

C. PF_6^- and SF_6

D. SiF_4 and SF_4

Answer: D

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65. The correct sequence of increasing covalent character is represented by

A. $LiCl < NaCl < BeCl_2$

B. $BeCl_2 < LiCl < NaCl$

C. $NaCl < LiCl < BeCl_2$

D. $BeCl_2 < NaCl < LiCl$

Answer: C

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66. Which of the following statement is correct

?

A. K_2O_2 and O_2 are paramagnetic.

B. Both KO_2 and K_2O_2 are diamagnetic

C. KO_2 is diamagnetic while O_2 and K_2O_2 are paramagnetic.

D. KO_2 and O_2 are paramagnetic while K_2O_2 is diamagnetic

Answer: D

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67. In which of the following molecules are all the bonds not equal ?

A. BF_3

B. AlF_3

C. NF_3

D. ClF_3

Answer: D

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68. The correct order regarding the electronegativity of hybrid orbitals or carbon is:

A. $sp > sp^2 > sp^3$

B. $sp < sp^2 > sp^3$

C. $sp < sp^2 < sp^3$

D. $sp > sp^2 < sp^3$

Answer: A

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69. In which of the following pairs, the two species are isostructural :

A. BrO_3^- and XeO_3

B. SF_4 and XeF_4

C. SO_3^{2-} and NO_3^-

D. BF_3 and NF_3

Answer: A

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70. Two types of FXF angles are present in which of the following molecule (X = S, Xe, C) ?

A. SF_4

B. XeF_4

C. SF_6

D. CF_4

Answer: A

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71. SF_2, SF_4 and SF_6 have hybridisations at sulphur atom respectively as

A. sp^2, sp^3, sp^3d^2

B. sp^3sp^3, sp^3d^2

C. sp^3, sp^3d, sp^3d^2

D. sp^3, spd^2, d^2sp^3

Answer: C

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72. Among the following, the compound that contains ionic, covalent and co-ordinate linkage is

A. NH_4Cl

B. NaCl

C. CaO

D. NH_3

Answer: A

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73. In which of the following species, all the three types of hybrid carbons are present ?

A. $CH_2 = C = CH_2$

B. $CH_3 - CH = CH - CH_2^+$

C. $CH_3 - C \equiv C - CH_2^+$

D. $CJH_3 - CH = CH - CH_2^-$

Answer: C

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74. Which of the following represents the arrangement in increasing order of bond order and bond dissociation energy ?

A. $O_2^+ < O_2^{2-} < O_2^- < O_2$

B. $O_2^{2-} < O_2^- < O_2 < O_2^+$

C. $O_2 < O_2^+ < O_2^{2-} < O_2^-$

D. $O_2^{2-} < O_2^- < O_2^+ < O_2$

Answer: B

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75. In which one of the following species the central atom has the type of hybridization which is not the same as that present in the other three ?

A. $SbCl_5^{2-}$

B. PCl_5

C. SF_4

D. I_3^-

Answer: A

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76. Which one of the following pairs is isostructural (i.e., having the same shape and hybridization) ?

A. $[BF_4^-$ and $NH_4^+]$

B. $[BCl_3$ and $BrCl_3]$

C. $[NH_3$ and $NO_3^-]$

D. $[NF_3$ and $BF_3]$

Answer: A

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77. The sp^3d^2 hybridization of central atom of molecule would lead to

A. 1. square planae geometry

B. 2. tetrahedral geometry

C. 3. trigonal bipyramidal geometry

D. 4. octahedral geometry

Answer: D

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78. Which of the following are isoelectronic molecules ?

A. NO^+ and F_2^{2-}

B. CO and O_2^{2-}

C. CO and NO^+

D. O_2^{2-} and N_2

Answer: C

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79. When O_2 is converted to O_2^{2-},

A. both paramagnetic character and bond order increase

B. bond order decreases

C. paramagnetic character increases

D. paramagnetic character decreases and the bond order increases

Answer: D

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80. Which one of the following is the correct statement ?

A. 1. O_2 molecule has bond order 2 and is diamagnetic.

B. 2. N_2 molecule has bond order 3 and is paramagnetic

C. 3. H_2 molecule has bond order zero and is diamagnetic

D. 4. He_2 ton has bond order zero and is diamagnetic

Answer: D

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81. In which of the following species is the underlined carbon having sp^3 hybridisation ?

A. $CH_3 - \underline{C}OOH$

B. $CH_3\underline{C}H_2OH$

C. $CH_3 - \underline{C}O - CH_3$

D. $CH_2 = \underline{C}H - CH_3$

Answer: B

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82. Which of the following pair of molecules will have permanent dipole moment for both molecules ?

A. 1. NO_2 and CO_2

B. 2. NO_2 and O_3

C. 3. SiF_4 and CO_2

D. 4. SiF_4 and NO_2

Answer: B

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83. Which of the following are isoelectronic and iso structural ?

NO_3^- , CO_3^{2-} , ClO_3^- , SO_3

A. 1. NO_3^-, CO_3^{2-}

B. 2. SO_3, NO_3^-

C. 3. ClO_3^-, CO_3^{2-}

D. 4. CO_3^{2-}, SO_3

Answer: A

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84. The correct order of bond angle (smallest first) in H_2S, NH_3, BF_3 and SiH_4 is :

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. $H_2S < NH_3 < BF_3 < SiH_4$

Answer: A

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85. 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 ?

A. Bond length in NO^+ is equal to that in NO.

B. Bond length in NO is greater than in NO^+.

C. Bond length in NO^+ is greater than in NO.

D. Bond length is unpredictable.

Answer: B

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86. Which one of the following has the regular tetrahedral structure ?

A. BF_4^-

B. SF_4

C. XeF_4

D. $\left[Ni(CN)_4\right]^{2-}$

Answer: A

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87. The maximum number of 90° angles between bond pair - bond pair of electrons is observed in

A. 1. dsp^2 hybridization

B. 2. sp^3d hybridization

C. 3. dsp^3 hybridization

D. 4. sp^3d^2 hybridization

Answer: D

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88. According to MO theory, which of the following statements about the magnetic character and bond order is correct regarding O_2^+.

A. 1. Paramagnetic and bond order $< O_2$

B. 2. Paramagnetic and bond order $> O_2$

C. 3. Diamagnetic and bond order $< O_2$

D. 4. Diamagnetic and bond order $> O_2$

Answer: B

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89. Total number of lone pair of electrons in $XeOF_4$ is

A. 0

B. 1

C. 2

D. 3

Answer: B

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90. Which one of the following species is diamagnetic in nature ?

A. He_2^+

B. H_2

C. H_2^+

D. H_2^-

Answer: B

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91. Lattice enthalpy of an ionic compound depends upon

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.

Answer: D

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

A. 1. the same with 2, 0 and 1 lone pairs of electrons on the central atom respectively.

B. 2. the same with 1, 1 and 1 lone pair of electrons on the central atoms respectively.

C. 3. different with 0, 1 and 2 lone pairs of electrons on the central atom respectively.

D. 4. different with 1, 0 and 2 lone pairs of electrons on the cetral atom respectively.

Answer: D

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93. Of the following sets, which one does not contain isoelectronic species ?

A. $PO_4^{3-}, SO_4^{2-}, ClO_4^-$

B. CN^-, N_2, C_2^{2-}

C. $SO_3^{2-}, CO_3^{2-}, NO_3^-$

D. $BO_3^{3-}, CO_3^{2-}, NO_3^-$

Answer: C

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94. Which species has the maximum number of lone pair of electrons on the central atom ?

A. 1. ClO_3^-

B. 2. XeF_4

C. 3. SF_4

D. 4. $[I_3]^-$

Answer: D

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95. Which of the following molecules/ions does not contain unpaired electrons ?

A. 1. B_2

B. 2. N_2^+

C. 3. O_2

D. 4. O_2^{2-}

Answer: D

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96. In which of the following molecules / ions are all the bonds not equal ?

A. SiF_4

B. XeF_4

C. BF_4^-

D. SF_4

Answer: D

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97. The species having bond order different from that in CO is :

A. NO^-

B. NO^+

C. CN^-

D. N_2

Answer: A

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98. In which of the following ionization processes, the bond order has increased and the magnetic character has changed ?

A. $NO \rightarrow NO^+$

B. $O_2 \rightarrow O_2^+$

C. $N_2 \rightarrow N_2^+$

D. $C_2 \rightarrow C_2^+$

Answer: A

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99. Which of the following hydrogen bond is the strongest ?

A. F - H ..... F

B. O - H ..... O

C. O - H ..... F

D. O - H ..... N

Answer: A

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100. Which of the following species exhibits the diamagnetic behaviour ?

A. O_2^+

B. O_2

C. NO

D. O_2^{2-}

Answer: D

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Multiple Choice Questions Level Iii

1. The correct order of stability of the following resonance structures is

(I) $H_2C = \overset{+}{N} = \overset{-}{N}$ (II) $H_2\overset{+}{C} - N = \overset{-}{N}$

(III) $H_2\overset{-}{C} - \overset{+}{N} \equiv N$ (IV) $H_2\overset{-}{C}N = \overset{+}{N}$

A. $I > II > IV > III$

B. $I > III > II > IV$

C. $II > I > III > IV$

D. $III > I > IV > II$

Answer: B

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2. Among the following the maximum covalent character is shown by the compound :

A. $AlCl_3$

B. $MgCl_2$

C. $FeCl_2$

D. $SnCl_2$

Answer: A

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3. The structure of IF_7 is :

A. octahedral

B. pentagonal bipyramidal

C. square pyramidal

D. trigonal bipyramidal

Answer: B

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4. The hybridisation of orbitals of N atom in NO_3^-, NO_2^+ and NH_4^+ are respectively :

A. sp, sp^3, sp^2

B. sp^2, sp^3, sp

C. sp, sp^2, sp^3

D. sp^2, sp, sp^3

Answer: D

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5. The number of types of bonds between two carbon atoms in calcium carbide is :

A. One sigma, one pi

B. Two sigma, one pi

C. Two sigma, two pi

D. One sigma, two pi

Answer: D

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6. Which of the following has maximum number of lone pairs associated with Xe ?

A. XeF_4

B. XeF_6

C. XeF_2

D. XeO_3

Answer: C

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7. In which of the following pairs the two species are not isostructural ?

A. AlF_6^{3-} and SF_6

B. CO_3^{2-} and NO_3^-

C. $PCl_4{}^4SiCl_4$

D. PF_5 and BeF_5

Answer: D

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8. In which of the following pairs of molecules / ions, both the species are not likely to exist ?

A. H_2^+, He_2^{2-}

B. H_2^-, He_2^{2-}

C. H_2^{2+}, He_2

D. H_2^-, He_2^{2+}

Answer: C

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9. Stability of the species Li 2 , Li 2 − and Li 2 + increases in the order:

A. $Li_2 < Li_2^+ < Li_2^-$

B. $Li_2^- < Li_2^+ < Li_2$

C. $Li_2 < Li_2^- < Li_2^+$

D. $Li_2^- < Li_2 < Li_2^+$

Answer: B

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Recent Examination Questions

1. Among the following, the compound that contains ionic, covalent and coordinate linkage is :

A. NH_4Cl

B. NaCl

C. CaO

D. NH_3

Answer: A

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2. A covalent molecule AB_3 has pyramidal structure. The number of lone pair and bond pair electrons in the molecule are respectively.

A. 0 and 3

B. 3 and 1

C. 1 and 3

D. 2 and 2

Answer: A

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3. Arrange the following in the increasing order order of their bond order : O_2, O_2^+, O_2^- and O_2^{2-} :

A. $O_2^{2-}, O_2^-, O_2^+, O_2$

B. $O_2^+, O_2, O_2^-, O_2^{2-}$

C. $O_2, O_2^+, O_2^-, O_2^{2-}$

D. $O_2^{2-}, O_2^-, O_2, O_2^+$

Answer: B

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4. Which of the following conversions involves change in both hybridisation and shape ?

A. $CH_4 \rightarrow C_2H_6$

B. $NH_3 \rightarrow NH_4^+$

C. $BF_3 \rightarrow BF_4^-$

D. $H_2O \rightarrow HO^+$

Answer: C

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5. When O_2 is converted to O_2^+

A. both paramagnetic character and bond order increase

B. bond order decreases

C. paramagnetic character increase

D. paramagnetic character decreases and the bond order increases

Answer: D

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6. Among the following, the compound that contains ionic, covalent and co-ordinate linkage is

A. NaOH

B. NaCl

C. NaCN

D. NaNC

Answer: D

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7. The percentage of p-character of the hybrid orbitals in graphite and diamond are respectively.

A. 1. 33 and 25

B. 2. 50 and 75

C. 3. 67 and 75

D. 4. 33 and 75

Answer: A

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8. Which one of the following has no unpaired electrons ?

A. O_2

B. O_2^-

C. O_2^+

D. O_2^{2-}

Answer: D

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9. Which of the following is not a characteristic of a covalent compound ?

A. Low melting point

B. No definite geometry

C. Insoluble in polar solvent

D. Small difference in electronegativity between the combining atoms

Answer: B

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10. d^2sp^3 hybridisation of the atomic orbitals gives :

A. Square planar structure

B. Triangular structure

C. Tetrahedral structure

D. Octahedral structure

Answer: D

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11. Which of the following is diamagnetic ?

A. H_2^+

B. He_2^+

C. O_2

D. N_2

Answer: D

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12. The number of anti - bonding electrons present in O_2^- molecular ion is :

A. 8

B. 7

C. 5

D. 4

Answer: C

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13. The pair compounds having identical shapes for their molecules is :

A. $CH_4.\ SF_4$

B. $BCl_3.\ ClF_3$

C. $XeF_2.\ ZnCl_2$

D. SO_2, CO_2

Answer: C

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14. The correct arrangement of the species in the decreasing order of the bond length between carbon and oxygen in them is

A. $CO, CO_2, HCO_3^-, CO_3^{2-}$

B. $CO_2, HCO_3^-, CO, CO_3^{2-}$

C. $CO_3^{2-}, HCO_3^-, CO_2, CO$

D. $CO, CO_3^-, CO_2, HCO_3^-$

Answer: C

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15. One of the following conversion results in the change of hybridization and gemetry :

A. BF_3 to BF_4

B. CH_4 to C_2H_6

C. H_2O to H_3O^+

D. NH_3 to NH_4^+

Answer: A

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16. Using MOT, compare O_2^+ and O_2^- species and choose the incorrect option.

A. O_2^+ is diamagnetic while O_2^- is paramagnetic

B. O_2^+ have higher bond order than O_2^-

C. Both O_2^+ and O_2^- are paramagnetic

D. O_2^- is less stable.

Answer: A

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17. Pick the INCORRECT statement among those given below :

A. Multiple covalent bonds are shorter than single set of atoms.

B. Bond strength varies inversely with bond length.

C. Bond order of isoelectronic spectes will be same.

D. Bond enthalpy increases with increasing bond length.

Answer: D

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