

Chemical Bonding

1. Bonding Concepts, Ionic & Covalent Compounds

- Q 1. Bond formation is an
(A) Exothermic phenomena
(B) Endothermic Phenomena
(C) Either Exothermic or endothermic
(D) No energy change occur
- Q 2. The bond strength of C–C bond is approximately in the range of **[JEE Main 2009]**
(A) 1 Kcal/mol (B) 10 Kcal/mol
(C) 100 Kcal/mol (D) 1000 Kcal/mol
- Q 3. Bonding happens to
(A) Complete octet configuration to each atom
(B) to fill outermost orbits completely
(C) to gain stability
(D) to gain energy
- Q 4. Van der waal bonding is an example of
(A) Primary Bonding
(B) Secondary Bonding
(C) both A & B
(D) Non – Metallic Bonding
- Q 5. Secondary bonding gives information about
(A) State of the matter
(B) Structure of the substance
(C) Geometry of the molecule
(D) None of these
- Q 6. Following statements are given
(1) NaCl(s) is a good conductor of electricity
(2) Covalent compounds are weaker than Ionic compounds except giant covalent compounds
(3) NaCl (molten) is conductor of electricity.
(4) Ionic Compounds are non-directional so do not show isomerism and Hybridisation
which of the following statements is/are correct?
(A) 1, 2 & 3 (B) 1, 3 & 4
(C) 2, 3 & 4 (D) 2 & 3 only
- Q 7. **Assertion (A):** Sodium chloride formed by action of chlorine gas on sodium metal is a stable compound. **[NCERT Exemplar]**
Reason (R): This is because sodium & chloride ions acquire octet in sodium chloride formation.
(A) A and R both are correct and R is the correct explanation of A
(B) A and R both are correct but R is not the correct explanation of A
(C) A is true but R is false
(D) A and R both are false
- Q 8. Thermal Stability of some salts is given. Which is correct?
(A) $\text{Li}_2\text{CO}_3 < \text{Na}_2\text{CO}_3 > \text{K}_2\text{CO}_3$
(B) $\text{Li}_2\text{O} > \text{Na}_2\text{O} > \text{K}_2\text{O}$
(C) $\text{HF} < \text{HCl} < \text{HBr}$
(D) $\text{BeSO}_4 > \text{MgSO}_4 > \text{CaSO}_4$
- Q 9. Order of solubility in water is given below. Select the correct option.
(1). $\text{BeF}_2 > \text{CaF}_2 > \text{MgF}_2$
(2). $\text{LiHCO}_3 < \text{NaHCO}_3 < \text{KHCO}_3$
(3). $\text{LiClO}_4 > \text{NaClO}_4 > \text{KClO}_4$
(4). $\text{LiOH} > \text{NaOH} > \text{KOH}$
(A) 1, 2 & 4 (B) 2, 3 & 4
(C) 3 & 4 (D) 1, 2 & 3
- Q 10. Which of the following salt is soluble in water?
(A) LiF (B) Li_2CO_3
(C) Li_3PO_4 (D) BeCO_3
- Q 11. Ionic Compounds are formed when attraction between cation & anion is
(A) Maximum (B) Minimum
(C) Zero (D) Positive
- Q 12. In covalent compound formation
(A) Attractive force between Nucleus–Electron is less than repulsive force between Nucleus–Nucleus & Electron–Electron.
(B) Attractive force between Nucleus–Electron is more than repulsive force between Nucleus–Nucleus & Electron–Electron.
(C) Attractive force between Nucleus–Electron is equal to repulsive force between Nucleus–Nucleus & Electron–Electron.
(D) None of these
- Q 13. Element X is Strongly Electropositive & Y is Strongly Electronegative. Both are univalent. The compound formed would be
(A) X^+Y^- (B) $\text{X}-\text{Y}$
(C) $\text{X}-\text{Y}^+$ (D) $\text{X} \rightarrow \text{Y}$
- Q 14. Both Ionic & Covalent Bonds are present in
(A) CH_4 (B) NaOH
(C) KCl (D) SO_2

- Q 15. Which of the following compound contains Ionic as well as Covalent Bonds is
 (A) $C_2H_4Cl_2$ (B) CH_3I
 (C) NaN_3 (D) H_2O_2
- Q 16. In which of the following compounds bonds are non – directional?
 (A) NCl_3 (B) $RbCl$
 (C) $BeCl_2$ (D) BCl_3
- Q 17. The dielectric constant of H_2O is 80. The electrostatic force of attraction between Na^+ and Cl^- will be [CBSE PMT 1994]
 (A) Reduced to 1/40 in water than in air
 (B) reduced to 1/80 in water than in air
 (C) will increase to 80 in water than in air
 (D) will remain unchanged

2. Percentage Ionic & Covalent Character, Dipole Moment, Fajan's Rule

- Q 1. Which of the following compound is 100% covalent?
 (A) NH_3 (B) $NaCl$
 (C) Cl_2 (D) None of these
- Q 2. Electronegativity of Cesium is 0.7 & that of Flourine is 4.0. The bond formed between the two is
 (A) Covalent (B) Electrovalent
 (C) Co-ordinate (D) Metallic
- Q 3. When electronegativity difference between atom A & atom B is 1.2 then the bond formed is considered as
 (A) Ionic Bond (B) Covalent Bond
 (C) Polar Covalent Bond (D) Metallic Bond
- Q 4. **Assertion (A):** the atom in covalent molecule share its electrons yet some covalent molecule are polar. [AIIMS 1996]
Reason (R): In polar covalent molecule, the shared electrons spend more time than the average near one of the atom.
 (A) A and R both are correct and R is the correct explanation of A
 (B) A and R both are correct but R is not the correct explanation of A
 (C) A is true but R is false
 (D) A and R both are false
- Q 5. Dipole moment of HX is 2.59×10^{-30} coulomb-meter. Bond length of HX is 1.39 \AA . Calculate the percentage ionic character of molecule
 (A) 11.6 % (B) 5.8 %
 (C) 20.2 % (D) None of these
- Q 6. Dipole moment of HCl is 1.03 D . If bond length of HCl bond is 1.26 \AA then Calculate the percentage ionic character of HCl bond.
 (A) 60 % (B) 39 %
 (C) 29 % (D) 17 %
- Q 7. Which molecule contain both polar & Non-Polar Bond?
 (A) NH_4Cl (B) HCN
 (C) H_2O_2 (D) CH_4
- Q 8. Percentage ionic character depends on the
 (A) Dipole moment (B) Electronegativity
 (C) Bond length (D) All
- Q 9. Among the following molecule which has the highest dipole moment [IIT-JEE 2003S]
 (A) CH_3Cl (B) CH_2Cl_2
 (C) $CHCl_3$ (D) CCl_4
- Q 10. Which of the molecule has polar bonds but zero dipole moment?
 (A) O_2 (B) $CHCl_3$
 (C) CF_4 (D) None of these
- Q 11. Which of the following pair of molecules have permanent dipole moment?
 (A) NO_2 & CO_2 (B) NO_2 & O_3
 (C) SiF_4 & CO_2 (D) SiF_4 & NO_2
- Q 12. The dipole moments of the given molecules are such that
 (A) $BF_3 > NF_3 > NH_3$ (B) $NF_3 > BF_3 > NH_3$
 (C) $NH_3 > NF_3 > BF_3$ (D) $NH_3 > BF_3 > NF_3$
- Q 13. The charge by size ratio of a cation determine the polarizing power of a cation. Which of the following represent the correct order of polarizing power of cation $K^+, Ca^{2+}, Mg^{2+}, Be^{2+}$ [AIEEE 2007]
 (A) $Ca^{2+} < Mg^{2+} < Be^{2+} < K^+$
 (B) $Mg^{2+} < Be^{2+} < K^+ < Ca^{2+}$
 (C) $Be^{2+} < K^+ < Ca^{2+} < Mg^{2+}$
 (D) $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

- Q 14. The correct order of Ionic Character is
 (A) $\text{NaCl} > \text{KCl} > \text{RbCl}$ (B) $\text{NaCl} < \text{KCl} < \text{RbCl}$
 (C) $\text{NaCl} = \text{KCl} = \text{RbCl}$ (D) None of these
- Q 15. The correct order of covalent character is
 (A) $\text{BeO} < \text{MgO} < \text{CaO}$ (B) $\text{BeO} > \text{MgO} > \text{CaO}$
 (C) $\text{BeO} = \text{MgO} = \text{CaO}$ (D) None of these
- Q 16. The correct order of Ionic Character is
 (A) $\text{ZnO} > \text{CaO}$ (B) $\text{ZnO} < \text{CaO}$
 (C) $\text{ZnO} = \text{CaO}$ (D) None of these
- Q 17. Arrange the bonds in order of increasing Ionic Character in the molecule. LiF , K_2O , N_2 , SO_2 & ClF_3 [NCERT]
- Q 18. The correct order of covalent character is
 (A) $\text{NaCl} > \text{Na}_2\text{O} > \text{Na}_3\text{N}$ (B) $\text{NaCl} < \text{Na}_2\text{O} < \text{Na}_3\text{N}$
 (C) $\text{NaCl} = \text{Na}_2\text{O} = \text{Na}_3\text{N}$ (D) None of these
- Q 19. The correct order of Ionic character is
 (A) $\text{NaF} > \text{NaCl} > \text{NaBr} > \text{NaI}$
 (B) $\text{NaF} < \text{NaCl} < \text{NaBr} < \text{NaI}$
 (C) $\text{NaF} = \text{NaCl} = \text{NaBr} = \text{NaI}$
 (D) None of these
- Q 20. Which is the most ionic? [IIT JEE 1993]
 (A) P_2O_5 (B) CrO_3
 (C) MnO (D) Mn_2O_7

3. Lewis Structure Theory, Formal Charge

- Q 1. Lewis structure theory is based on
 (A) Octet Rule
 (B) Energy minimisation Principle
 (C) Energy Maximisation Principle
 (D) None of these
- Q 2. The number of electrons being shared in nitrogen molecule is
 (A) 4 (B) 2 (C) 8 (D) 6
- Q 3. which bond is not present in CO molecule?
 (A) Pi-bond (B) electrovalent bond
 (C) a sigma bond (D) a dative bond
- Q 4. The correct structure of NC^- is
 (A) $:\text{C} \equiv \text{N}^-$ (B) $\text{C} \equiv \text{N}^-$
 (C) $:\text{C} \equiv \text{N}:$ (D) None of these
- Q 5. In NH_3 , number of lone pair of electrons on N atom is
 (A) 1 (B) 2
- (C) 3 (D) None of these
- Q 6. The type of bond present in N_2O_5 are
 (A) Only covalent (B) Only ionic
 (C) ionic & covalent (D) covalent & coordinate
- Q 7. Which of the following are hypervalent?
 1. ClO_4^- 2. BF_3 3. SO_4^{2-} 4. CO_3^{2-}
 (A) 1, 2, 3 (B) 1, 3
 (C) 3, 4 (D) 1, 2
- Q 8. Which of the following sets of species does not follow octet - rule?
 (A) CO , PCl_5 , PCl_3 , AlCl_3
 (B) AlCl_3 , BF_3 , PCl_5 , SF_6
 (C) CO , B_2H_6 , NH_3 , H_2O
 (D) H_2O , NH_3 , CO_2 , AlCl_3
- Q 9. In which of the following the maximum number of lone pairs is present on the central atom?
 (A) $[\text{ClO}_3^-]$ (B) XeF_4
 (C) SF_4 (D) I_3
- Q 10. 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^-
- Q 11. Which of the following is correct lewis structure of POCl_3 ?
- $$\begin{array}{c} \text{O} \\ \uparrow \\ \text{Cl} - \text{P} - \text{Cl} \\ | \\ \text{Cl} \end{array}$$

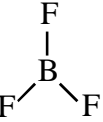
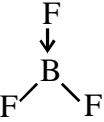
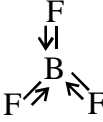
(A)

$$\begin{array}{c} \text{O} \\ || \\ \text{Cl} - \text{P} - \text{Cl} \\ | \\ \text{Cl} \end{array}$$

(B)
- $$\begin{array}{c} \text{O} \\ || \\ \text{Cl} - \text{P} - \text{O} - \text{Cl} \\ | \\ \text{Cl} \end{array}$$

(C)

(D) both A & B
- Q 12. The most stable lewis structure of SCN^- is
 (A) $:\text{S} \equiv \text{C} \rightarrow \text{N}^-$ (B) $:\text{S} = \text{C} = \text{N}^-$
 (C) $:\text{S}^- - \text{C} \equiv \text{N}:$ (D) $\text{S}^- = \text{C} = \text{N}:$
- Q 13. The lewis structure of SO_4^{2-}
- $$\begin{array}{ccccccc} \square & \square & \square & \square & \square & \square & \square \\ | & | & | & | & | & | & | \\ -\text{O} & -\text{O} & -\text{S} & -\text{O} & -\text{O} & -\text{O} & - \\ | & | & | & | & | & | & | \\ \square & \square & \square & \square & \square & \square & \square \end{array}$$
- Is wrong because
 (A) Octet rule violation
 (B) Formal Charge violation
 (C) High Repulsion between l.p. of electrons
 (D) Linear Structure

- Q 14. In PO_4^{3-} ion the formal charge on the oxygen atom of P – O bond is [NCERT Exemplar]
(A) 1 (B) –1 (C) –0.75 (D) +0.75
- Q 15. Which of the following statement about formal charge is correct?
(A) For stable molecule, formal charge on atom must be equal to zero.
(B) For any atom, formal charge can be zero, negative, positive or fractional.
(C) Formal charge on any atom is always integral
(D) Sum of formal charge of all atoms of a chemical species is equal to zero.
- Q 16. The correct lewis structure of BF_3 is
- (A)  (B) 
- (C)  (D) Both A & B
- Q 17. NH_3 & BF_3 combines readily because of formation of
(A) Covalent Bond (B) Hydrogen Bond
(C) Ionic Bond (D) Coordinate Bond
- Q 18. Which of the following contains both electrovalent and co-ordinate bond?
(A) CH_4 (B) H_2O_2
(C) NH_4Cl (D) HCN
- Q 19. How many electron pairs are present in IF_7 molecule?
(A) 6 (B) 7 (C) 5 (D) 8
- Q 3. Resonance in a molecule
(A) Increases stability (B) Increases energy
(C) Decreases Stability (D) None of these
- Q 4. Which of the given structure is Real Structure?
(A) Cannnonical Structure
(B) Resonating Structure
(C) Resonance Hybrid
(D) None of these
- Q 5. Resonating Structure of a molecule can not have
(A) Identical Bonding
(B) Identical arrangement of atoms
(C) Nearly same energy content
(D) the same number of paired electrons
- Q 6. Write resonating structure of SO_2 , NO_2 & NO_3^-
[NCERT]
- Q 7. In $BeCl_2(s)$, $BeCl_2$ molecules are attached together by
(A) $2C - 2e$ bond (B) $3C - 2e$ bond
(C) $3C - 4e$ bond (D) all of these
- Q 8. Molecule (s) possessing three – Centre two electron bonds and three – Centre – four electron Bonds would include
(A) B_2H_6 and SiF_4 (B) XeF_6 and BF_3
(C) B_2H_6 and XeF_8 (D) B_2H_6 alone
- Q 9. The two type of bonds present in B_2H_6 are covalent and [IIT JEE 1990]
- Q 10. X–X Bond is absent in which of the following compounds having general formula X_2H_6 ?
1. B_2H_6 2. C_2H_6 3. Al_2H_6 4. Si_2H_6
(A) 2, 4 (B) 3, 4
(C) 1, 2 (D) 1, 3
- Q 11. NO_2 dimerises to form N_2O_4 because
(A) NO_2 has Incorrect lewis Structure
(B) NO_2 has unpaired electrons
(C) NO_2 is brown in colour
(D) NO_2 is paramagnetic
- Q 12. NO molecule does not dimerises to form N_2O_2 because
(A) NO is stable molecule
(B) NO has odd electrons
(C) N_2O_2 isn't stable due to high l.p.–l.p. repulsion
(D) NO is not reactive at all
- Q 13. Which of the following formula does not correctly represent the bonding capacities of the atoms involved?

4. Resonance, Banana Bonding, odd electron species

- Q 1. In CO_3^{2-} , C–O bond has
(A) 1 double bond & 2 single bond character
(B) Partial double bond character only
(C) 2 double bond & 1 single bond character
(D) Partial Single bond character only
- Q 2. In Resonance, which type of electrons take part?
(A) Sigma electrons (B) Pi – electrons
(C) Bonded Pair electrons (D) None of these

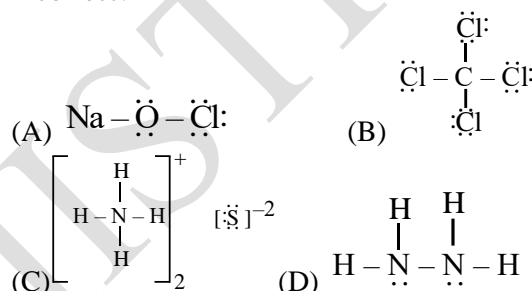
- (A) NH_4^+ (B) OF_2
 (C) HNO_3 (D) $\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{H}$
- Q 14. The order of O–O bond length in O_2 , H_2O_2 , O_3 is
 (A) $\text{O}_2 > \text{O}_3 > \text{H}_2\text{O}_2$ (B) $\text{O}_3 > \text{H}_2\text{O}_2 > \text{O}_2$
 (C) $\text{H}_2\text{O}_2 > \text{O}_3 > \text{O}_2$ (D) $\text{O}_2 > \text{H}_2\text{O}_2 > \text{O}_3$
- Q 15. The correct order of C–O bond lengths among CO , CO_3^{2-} , CO_2 is
 (A) $\text{CO} > \text{CO}_3^{2-} < \text{CO}_2$ (B) $\text{CO} > \text{CO}_3^{2-} > \text{CO}_2$
 (C) $\text{CO} < \text{CO}_3^{2-} < \text{CO}_2$ (D) $\text{CO} < \text{CO}_3^{2-} > \text{CO}_2$
- Q 16. Arrange the molecules H_2 , F_2 , O_2 , and N_2 in the order in increasing bond length
 (A) $\text{N}_2 < \text{H}_2 < \text{O}_2 < \text{F}_2$ (B) $\text{N}_2 < \text{O}_2 < \text{H}_2 < \text{F}_2$
 (C) $\text{H}_2 < \text{N}_2 < \text{O}_2 < \text{F}_2$ (D) $\text{O}_2 < \text{N}_2 < \text{H}_2 < \text{F}_2$
- Q 17. Which of the following compounds processes Lewis acid character?
 1. BF_3 2. SiF_4 3. PF_3
 Select the correct answer using the codes given below:
 (A) 1 alone (B) 1, 2 and 3
 (C) 2 and 3 (D) 1 and 3

5. Exceptions in Lewis Structure theory

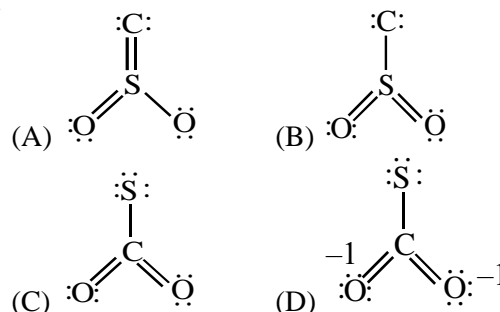
- Q 1. Which of the following statements is Incorrect?
 (A) Covalent bonds are directional
 (B) Ionic bonds are non directional
 (C) A polar bond is formed between two atoms which have same electronegativity value.
 (D) The presence of polar bonds in a polyatomic molecule may results in zero dipole moment.
- Q 2. The octet rule is not obeyed in
 (A) CO_2 (B) PCl_3
 (C) PCl_5 (D) SiF_4
- Q 3. To which of the following species octet rule is applicable?
 (A) BrF_5 (B) SF_6
 (C) IF_7 (D) CO
- Q 4. The CN^- and N_2 are isoelectronic, but in contrast to CN^- , N_2 is chemically inert because of
 (A) Low bond energy
 (B) Absence of bond polarity
 (C) Unsymmetrical electron distribution

(D) Presence of more no. of electron in bonding orbitals

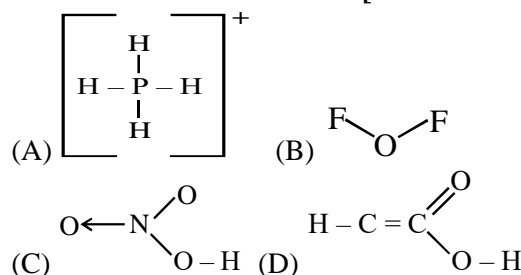
- Q 5. Which of the following does not contain coordinate bond?
 (A) AlCl_3 (B) CO
 (C) $[\text{Fe}(\text{CN})_6]^{4-}$ (D) N_3^-
- Q 6. Which of the following does not contain coordinate bond?
 (A) CH_3NC (B) CO
 (C) O_3 (D) CO_3^{2-}
- Q 7. Which of the following lewis diagram is Incorrect?



- Q 8. The possible structure of monothiocarbonate (CSO_2^{2-}) is



- Q 9. Which of the following structure does not correctly represent the bonding capacities of the atoms involved? [CBSE PMT 1991]



- Q 10. The valency of sulphur in sulphuric acid is
 (A) 2 (B) 8 (C) 4 (D) 6
- Q 11. Which of the following statements is correct for CsBr_3 is

- (A) it is a covalent compounds
 (B) it contains Cs^{3+} and Br^- ions
 (C) it contains Cs^+ & Br_3^- ions
 (D) it contains Cs^+ , Br^- & lattice Br_2 molecule
- Q 12. Which of the following has maximum number of lone pairs is present on the central atom?

[IIT JEE 2005]

- (A) $[\text{ClO}_3]^-$ (B) XeF_4
 (C) SF_4 (D) I_3^-
- Q 13. Which of the following has O–O linkage?

[IIT JEE 2004]

- (A) $\text{H}_2\text{S}_2\text{O}_4$ (B) $\text{H}_2\text{S}_2\text{O}_8$
 (C) $\text{H}_2\text{S}_4\text{O}_6$ (D) $\text{H}_2\text{S}_2\text{O}_6$
- Q 14. Which of the following species is monovalent species?

- (A) O^{2-} (B) S^{2-}
 (C) N^{3-} (D) OH^-

- Q 15. The structure of O_4 as $\begin{array}{c} \text{:}\ddot{\text{O}}\text{---}\ddot{\text{O}}\text{:} \\ | \quad | \\ \text{:}\ddot{\text{O}}\text{---}\ddot{\text{O}}\text{:} \end{array}$ is unstable because

- (A) High l.p.–l.p. repulsion
 (B) High Angle Strain
 (C) Low Energy
 (D) Both A & B

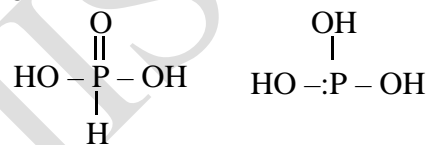
6. Method to Draw Lewis Structure

Draw the lewis structure of following Species

- | | | |
|-------------------------------|-----------------------------------|-------------------------------|
| 1). PCl_5 | 2). SF_6 | 3). IF_7 |
| 4). POCl_3 | 5). SOF_4 | 6). SiF_6^{2-} |
| 7). PCl_6^- | 8). XeOF_4 | 9). XeF_2 |
| 10). I_3^- | 11). XeO_6^{4-} | 12). XeF_4 |
| 13). XeF_6 | 14). XeO_3 | 15). XeO_4 |
| 16). XeO_2F_2 | 17). ICl_3 | 18). BrF_5 |
| 19). ClF_3 | 20). H_3PO_2 | 21). H_3PO_3 |
| 22). H_3PO_4 | 23). CrO_4^{2-} | 24). H_2CrO_3 |
| 25). MnO_4^- | 26). $\text{Cr}_2\text{O}_7^{2-}$ | 27). H_2SO_4 |
| 28). H_2SO_3 | 29). SOCl_2 | 30). SO_2 |
| 31). SO_2Cl_2 | 32). PCl_4^+ | 33). CO |

- | | | |
|---|--|---|
| 34). N_2O | 35). NO_2^- | 36). H_2SO_5 |
| 37). Mn_2O_7 | 38). Cl_2O_7 | 39). HClO_4 |
| 40). HClO_3 | 41). P_4O_6 | 42). P_4O_{10} |
| 43). $\text{H}_2\text{S}_2\text{O}_3$ | 44). $\text{H}_2\text{S}_2\text{O}_4$ | 45). $\text{H}_2\text{S}_2\text{O}_5$ |
| 46). $\text{H}_2\text{S}_2\text{O}_6$ | 47). $\text{H}_2\text{S}_2\text{O}_7$ | 48). $\text{H}_2\text{S}_2\text{O}_8$ |
| 49). P_4S_3 | 50). P_4S_5 | 51). P_4S_7 |
| 52). $\text{H}_4\text{P}_2\text{O}_6$ | 53). $\text{H}_4\text{P}_2\text{O}_7$ | 54). $(\text{SO}_3)_3$ |
| 55). $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ | 56). $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ | 57). $\text{H}_3\text{BO}_3(\text{s})$ |
| 58). $\text{B}_3\text{N}_3\text{H}_6$ | 59). $\text{C}_3\text{N}_3(\text{NH}_2)_3$ | 60). $\text{C}_3\text{N}_3(\text{N}_3)_3$ |

- Q 2. H_3PO_3 can be represented by structure 1 & 2 shown below. Can these two structures can be taken as resonating structure of H_3PO_3 . If not, give reason for it.



- Q 3. The type of bonds present in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is [IIT JEE 1983]

- (A) electrovalent & covalent
 (B) electrovalent & coordinate covalent
 (C) electrovalent, covalent & coordinate covalent
 (D) covalent & coordinate covalent

7. VSEPR Model

- Q 1. VSEPR Model is based on
 (A) Energy Minimisation Principle
 (B) Energy conservation Principle
 (C) Energy Maximisation Principle
 (D) Not related to energy terms at all
- Q 2. The correct order of B.P. & l.p. electron repulsion is
 (A) l.p. – l.p. > B.P. – B.P. > l.p. – B.P.
 (B) B.P. – B.P. > l.p. – B.P. > B.P. – B.P.
 (C) l.p. – l.p. > l.p. – B.P. > B.P. – B.P.
 (D) None of these
- Q 3. The bond having highest bond dissociation energy is [AIIMS 2002]
 (A) N – N (B) C – C
 (C) F – F (D) O – O

Q 4. Which of the following species does not have linear structure?

- (A) BeCl_2 (B) N_2O
(C) CNO^- (D) NO_2^-

Q 5. Which of the following species does not have linear Structure?

- (A) PO_3^- (B) COCl_2
(C) NO_2^- (D) POCl_2^+

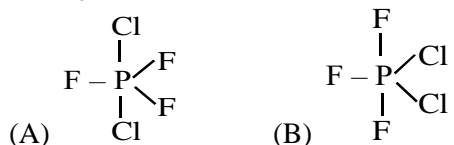
Q 6. Which of the following has tetrahedral Structure?

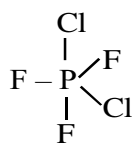
- (A) $\text{S}_2\text{O}_3^{2-}$ (B) XeO_4^{2-}
(C) PCl_4^- (D) BrO_3^-

Q 7. Which of the following does not have trigonal bipyramidal Structure?

- (A) SOCl_4 (B) IO_2Cl_3
(C) XeO_3F_2 (D) IF_5

Q 8. Which of the following is correct structure of PCl_2F_3 ?



- (C)  (D) None of these

Q 9. Which of the following species have octahedral structure?

- (A) SO_4^{2-} (B) IOCl_5
(C) XeOF_4 (D) XeF_6

Q 10. Which of the following is correct about structure of XeOF_6 ?

- (A) $\text{Xe}=\text{O}$ is kept on equatorial Plane
(B) $\text{Xe}=\text{O}$ is kept on axial Plane
(C) $\text{Xe}=\text{O}$ can be kept on any plane
(D) None of these

Q 11. Which of the following structure is a strained structure?

- (A) N_2O_5 (B) NO_3^-
(C) PCl_5 (D) XeF_4

Q 12. $\text{PCl}_5(\text{s})$ conduct electricity because it dissociates

- (A) PCl_4^+ , PCl_6^- (B) PCl_4^+ , Cl^-
(C) PCl_6^- , Cl^+ (D) None of these

Q 13. $\text{H}-\text{B}-\text{H}$ Bond angle in BH_4^- is

- (A) 180° (B) 120°
(C) 109° (D) 90°

Q 14. Maximum bond angle is present in

- (A) BBr_3 (B) BCl_3
(C) BF_3 (D) same bond angle in all

Q 15. In a regular octahedral shape of MX_6 , the number of $\text{X}-\text{M}-\text{X}$ bond angle is [CBSE PMT 2004]

- (A) 3 (B) 2 (C) 6 (D) 4

8. Shape of Chemical Species

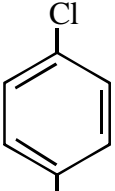
Q 1. Find Geometrical shape of following chemical species.

- | | | |
|---------------------------|-----------------------------------|----------------------------------|
| 1). N_2 | 2). SO_2 | 3). SO_3 |
| 4). NO_2^- | 5). NO_3^- | 6). CH_2Cl_2 |
| 7). NH_3 | 8). PCl_3 | 9). SOCl_2 |
| 10). CCl_3^- | 11). IO_2Cl | 12). IO_3^- |
| 13). H_2O | 14). XeO_3 | 15). XeO_2 |
| 16). NH_2^- | 17). SF_4 | 18). IOCl_3 |
| 19). XeOF_2 | 20). ICl_3 | 21). PCl_4^- |
| 22). BrCl_4^+ | 23). BrCl_3 | 24). IO_2Cl_2^- |
| 25). XeOF_2 | 26). I_3^- | 27). I_3^+ |
| 28). BrF_2^- | 29). IF_2^+ | 30). IF_5 |
| 31). BrF_5 | 32). SF_5^- | 33). XeF_4 |
| 34). CrO_4^{2-} | 35). CNO^- | 36). N_2O |
| 37). HClO_3 | 38). H_2SO_4 | 39). $\text{S}_2\text{O}_3^{2-}$ |
| 40). SO_2 | 41). PO_3^- | 42). ICl_4^- |
| 43). NH_4^+ | 44). PO_4^{3-} | 45). IF_4^+ |
| 46). SO_3^{2-} | 47). XeF_6 | 48). SOF_4 |
| 49). SF_6^{2-} | 50). SeO_3^{2-} | 51). SOF_4 |
| 52). PCl_6^- | 53). XeOF_4 | 54). XeF_2 |
| 55). ClF_3 | 56). H_3PO_2 | 57). H_3PO_4 |
| 58). MnO_4^- | 59). $\text{Cr}_2\text{O}_7^{2-}$ | 60). H_2SO_4 |

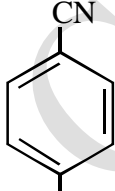
Q 2. Molecular shape of SF_4 , CF_4 & XeF_4 are

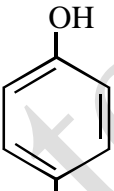
[IIT JEE 2000S]

- (A) the same, with 2, 0 & 1 lone pairs of

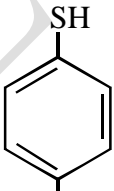
- electrons respectively
 (B) the same, with 1, 1 & 1 lone pairs of electrons
 Respectively
 (C) different, with 0, 1 & 2 lone pairs of electrons
 Respectively
 (D) different, with 1, 0 & 2 lone pairs of electrons
 Respectively
- Q 3. Among the following species, identify the isostructural pairs. [IIT JEE 1996]
 NF_3 , NO_3^- , BF_3 , H_3O^+ , HN_3
 (A) NF_3 , NO_3^- & BF_3 , H_3O^+
 (B) NF_3 , HN_3 & NO_3^- , BF_3
 (C) NF_3 , H_3O^+ & NO_3^- , BF_3
 (D) NF_3 , H_3O^+ & BF_3 , HN_3
- Q 4. The pair of species having identical shapes for the molecule is [AIEEE 2003]
 (A) XeF_2 & CO_2 (B) BF_3 & PCl_3
 (C) PF_5 & IF_5 (D) CF_4 & SF_4
- Q 5. In which of the following species, all bond angles are not equal? [AIEEE 2006]
 (A) XeF_4 (B) BF_4^-
 (C) SF_4 (D) SiF_4
- Q 6. For which of the following molecule, significant $\mu \neq 0$? [JEE Main 2014]
- 

(i)



(ii)
- 

(iii)



(iv)
- (A) only (i) (B) (i) & (ii)
 (C) only (iii) (D) All of these
- (B) ICl_4^- - Square Planar
 (C) $[\text{SbF}_5]^{2-}$ - Square bipyramidal
 (D) NH_2^- - Pyramidal
- Q 8. Which of the following species is/are isostructural with XeF_4 ? [IIT JEE 1991]
 (A) ICl_4^- (B) I_5^-
 (C) BrF_4^- (D) XeO_4
- Q 9. Which of the following pairs is/are isostructural? [IIT JEE 1996]
 (A) SF_4 & SiF_4 (B) SF_6 & SiF_6^{2-}
 (C) SiF_6^{2-} & SeF_6^{2-} (D) XeO_6^{4-} & TeF_6^{2-}
- Q 10. Which of the following has octahedral geometry? [IIT JEE 1996]
 (A) SbCl_6^- (B) SnCl_6^{2-}
 (C) XeF_6 (D) IO_6^{5-}
- Q 11. Shape of NH_3 is similar to [IIT JEE 1997]
 (A) SeO_3^{2-} (B) CH_3^-
 (C) BH_3 (D) CH_3^+
- Q 12. Which of the following has same shape as NH_2^+ ? [IIT JEE 1998]
 (A) CO_2 (B) SnCl_2
 (C) SO_2 (D) BeCl_2
- Q 13. Which of the following is/are linear? [IIT JEE 1998]
 (A) I_3^- (B) I_3^+
 (C) PbCl_2 (D) XeF_2
- Q 14. Which of the following are linear? [IIT JEE 1999]
 (A) ICl_2^- (B) I_3^-
 (C) N_3^- (D) ClO_2
- Q 15. The true statement about N_3^- is [AIIMS 2004]
 (A) it has not linear structure
 (B) it is called pseudo-halogen
 (C) the formal charge on N is -1
 (D) it is isoelectronic with NO_2

More than one answers correct:

- Q 7. Mark the Incorrect match of shape [IIT-JEE 1988]
 (A) XeOF_2 - Trigonal Planar

9. Back-Bonding, Bond Angle

- Q 1. The bond dissociation energy of B – F in BF_3 is 646 KJ/mol whereas that of C – F in CF_4 bond is 515 KJ/mol. The correct reason for higher bond strength of B – F bond compared to C – F bond is [AIEEE 2008]
- (A) stronger σ bond between B & F in BF_3 as compared to that in between C & F in CF_4
 (B) significant $p\pi - p\pi$ interaction between B & F in BF_3 whereas there is no possibility of such interaction between C & F in CF_4
 (C) lower degree of $p\pi - p\pi$ interaction between B & F in BF_3 than in between C & F in CF_4
 (D) smaller size of B atom as compared to that of C atom.
- Q 2. Among the following triatomic species, the least angle around the central atom is
- (A) O_3 (B) I_3^-
 (C) NO_2^- (D) PH_3
- Q 3. Which of the following has largest bond angle?
- (A) NH_3 (B) NO_2^-
 (C) N_2O (D) NO_2
- Q 4. The bond angle of NH_3 , NH_4^+ & NH_2^- are in the order
- (A) $\text{NH}_2^- > \text{NH}_3 > \text{NH}_4^+$
 (B) $\text{NH}_4^+ > \text{NH}_3 > \text{NH}_2^-$
 (C) $\text{NH}_3 > \text{NH}_2^- > \text{NH}_4^+$
 (D) $\text{NH}_3 > \text{NH}_4^+ > \text{NH}_2^-$
- Q 5. The correct order of H – M – H bond angle is
- (A) $\text{NH}_3 < \text{PH}_3 < \text{SbH}_3 < \text{BiH}_3$
 (B) $\text{SbH}_3 < \text{AsH}_3 < \text{PH}_3 < \text{NH}_3$
 (C) $\text{NH}_3 < \text{PH}_3 < \text{BiH}_3 < \text{SbH}_3$
 (D) $\text{BiH}_3 < \text{SbH}_3 < \text{AsH}_3 < \text{PH}_3$
- Q 6. The decreasing bond angles from NH_3 (106°) to SbH_3 (101°) down group –15 of the periodic table is due to [AIEEE 2006]
- (A) decreasing l.p – b.p repulsion
 (B) decreasing electronegativity
 (C) increasing b.p. – b.p. repulsion
 (D) increasing p character in SP^3
- Q 7. The bond angle of the given Compounds are such that
- (A) $\text{TeH}_2 > \text{SeH}_2 > \text{SH}_2 > \text{OH}_2$
 (B) $\text{OH}_2 > \text{SH}_2 > \text{SeH}_2 > \text{TeH}_2$
 (C) $\text{SH}_2 > \text{SeH}_2 > \text{TeH}_2 > \text{OH}_2$
 (D) $\text{TeH}_2 > \text{OH}_2 > \text{SH}_2 > \text{SeH}_2$
- Q 8. In compounds type ECl_3 , where E = B, P, As or Bi, the angles Cl – E – Cl for different E are in the order
- (A) $\text{B} > \text{P} = \text{As} = \text{Bi}$ (B) $\text{B} > \text{P} > \text{As} > \text{Bi}$
 (C) $\text{B} < \text{P} = \text{As} = \text{Bi}$ (D) $\text{B} < \text{P} < \text{As} < \text{Bi}$
- Q 9. The correct order of bond angles (smallest first) in H_2S , NH_3 , BF_3 & SiH_4 is
- (A) $\text{H}_2\text{S} > \text{SiH}_4 > \text{NH}_3 > \text{BF}_3$
 (B) $\text{NH}_3 > \text{SH}_2 > \text{SiH}_4 > \text{BF}_3$
 (C) $\text{SH}_2 > \text{NH}_3 > \text{SiH}_4 > \text{BF}_3$
 (D) $\text{SH}_2 > \text{NH}_3 > \text{BF}_3 > \text{SiH}_4$
- Q 10. Which of the following compounds has the smallest bond angle?
- (A) OH_2 (B) SH_2
 (C) NH_3 (D) SO_2
- Q 11. The correct increasing order of adjacent bond angle among BF_3 , PF_3 & ClF_3 is
- (A) $\text{BF}_3 < \text{PF}_3 < \text{ClF}_3$ (B) $\text{PF}_3 < \text{BF}_3 < \text{ClF}_3$
 (C) $\text{ClF}_3 < \text{PF}_3 < \text{BF}_3$ (D) $\text{ClF}_3 = \text{PF}_3 = \text{BF}_3$
- Q 12. In BrF_5 , no. of F – Br – F bond angle equal to 90° is
- (A) 0 (B) 1 (C) 4 (D) 5
- Q 13. In SF_4 , no. of F – S – F bond angle equal to 120° ?
- (A) 1 (B) 2
 (C) 3 (D) None of these
- Q 14. In which of the following molecule backbonding is not happening?
- (A) BF_3 (B) PCl_3
 (C) PF_3 (D) NF_3
- Q 15. Which of the following molecule has $p\pi - p\pi$ backbonding
- (A) BF_3 (B) BCl_3
 (C) NF_3 (D) PCl_3
- Q 16. The correct order of extent of backbonding is
- (A) $\text{BI}_3 > \text{BBr}_3 > \text{BCl}_3 > \text{BF}_3$
 (B) $\text{BI}_3 < \text{BBr}_3 < \text{BCl}_3 < \text{BF}_3$
 (C) $\text{BCl}_3 > \text{BF}_3 > \text{BBr}_3 > \text{BI}_3$
 (D) All have equal extent of backbonding
- Q 17. Which of the following is not affected by backbonding?
- (A) Bond Angle (B) Bond Length
 (C) Hybridisation (D) All of these are affected
- Q 18. Which of the following is correct order of Bond Angle?

- (A) $\text{PF}_3 > \text{PCl}_3 > \text{PBr}_3$ (B) $\text{PBr}_3 > \text{PCl}_3 > \text{PF}_3$
 (C) $\text{PCl}_3 = \text{PF}_3 > \text{PBr}_3$ (D) $\text{PCl}_3 > \text{PBr}_3 > \text{PF}_3$
- Q 19. The correct order of increasing X–O–X bond angle is (X = H, F or Cl)
 (A) $\text{H}_2\text{O} > \text{Cl}_2\text{O} > \text{F}_2\text{O}$ (B) $\text{Cl}_2\text{O} > \text{H}_2\text{O} > \text{F}_2\text{O}$
 (C) $\text{F}_2\text{O} > \text{Cl}_2\text{O} > \text{H}_2\text{O}$ (D) $\text{F}_2\text{O} > \text{H}_2\text{O} > \text{Cl}_2\text{O}$
- Q 20. The correct order of Bond angle is
 (A) $\text{NCl}_3 > \text{NBr}_3 > \text{NH}_3 > \text{NF}_3$
 (B) $\text{NBr}_3 > \text{NCl}_3 > \text{NH}_3 > \text{NF}_3$
 (C) $\text{NBr}_3 > \text{NCl}_3 > \text{NF}_3 > \text{NH}_3$
 (D) $\text{NH}_3 > \text{NBr}_3 > \text{NCl}_3 > \text{NF}_3$
- Q 21. The correct order of Bond Angle is
 (A) $\text{OF}_2 < \text{SF}_2$ (B) $\text{SF}_2 > \text{OF}_2$
 (C) $\text{OF}_2 = \text{SF}_2$ (D) None of these
- Q 22. The correct order of Bond angle
 (A) $\text{OBr}_2 > \text{OCl}_2 > \text{OH}_2$
 (B) $\text{OF}_2 > \text{OCl}_2 > \text{OBr}_2$
 (C) $\text{OBr}_2 = \text{OCl}_2 > \text{OH}_2$
 (D) $\text{OBr}_2 = \text{OCl}_2 = \text{OH}_2$
- 10. Bond Length, Bond Strength**
- Q 1. The correct order of B–F bond length order in BF_3 & BF_4^- is
 (A) $\text{BF}_3 > \text{BF}_4^-$ (B) $\text{BF}_4^- > \text{BF}_3$
 (C) $\text{BF}_4^- = \text{BF}_3$ (D) None of these
- Q 2. The correct order of N – H bond length in NH_3 & NH_4^+ is
 (A) $\text{NH}_3 > \text{NH}_4^+$ (B) $\text{NH}_3 < \text{NH}_4^+$
 (C) $\text{NH}_3 = \text{NH}_4^+$ (D) None of these
- Q 3. Among the given compounds
 (I) BF_3 (II) BF_2NH_2 (III) BF_2OH (IV) BF_4^-
 (A) $\text{IV} > \text{III} > \text{II} > \text{I}$ (B) $\text{IV} > \text{II} > \text{III} > \text{I}$
 (C) $\text{IV} > \text{II} > \text{III} > \text{I}$ (D) $\text{IV} > \text{I} > \text{II} > \text{III}$
- Q 4. The correct order of B – X (X = F, N, O) Bond length in above problem is
 (A) $\text{IV} > \text{I} > \text{III} > \text{II}$ (B) $\text{IV} > \text{III} > \text{II} > \text{I}$
 (C) $\text{IV} > \text{II} > \text{III} > \text{I}$ (D) $\text{IV} > \text{I} > \text{II} > \text{III}$
- Q 5. In the compounds of Formula $\text{O}=\text{CX}_2$ (X = F, Cl, Br), the correct order of C=O bond length is
 (A) $\text{COF}_2 > \text{COCl}_2 > \text{COBr}_2$
 (B) $\text{COF}_2 = \text{COCl}_2 = \text{COBr}_2$
 (C) $\text{COF}_2 < \text{COCl}_2 < \text{COBr}_2$
 (D) $\text{COCl}_2 > \text{COF}_2 > \text{COBr}_2$
- Q 6. In above problem, the correct order of bond angle X – C – X for X is
 (A) $\text{F} - \text{C} - \text{F} > \text{Cl} - \text{C} - \text{Cl} > \text{Br} - \text{C} - \text{Br}$
 (B) $\text{F} - \text{C} - \text{F} = \text{Cl} - \text{C} - \text{Cl} = \text{Br} - \text{C} - \text{Br}$
 (C) $\text{F} - \text{C} - \text{F} < \text{Cl} - \text{C} - \text{Cl} < \text{Br} - \text{C} - \text{Br}$
 (D) $\text{Cl} - \text{C} - \text{Cl} > \text{F} - \text{C} - \text{F} > \text{Br} - \text{C} - \text{Br}$
- Q 7. Which of the following compound form addition product with BF_3 ?
 (A) $(\text{SiH}_3)_3\text{N}$ (B) $(\text{CH}_3)_2\text{O}$
 (C) $(\text{SiH}_3)_2\text{O}$ (D) All of these
- Q 8. Which of the following is an isostructural Pairs?
 (A) NMe_3 & $\text{N}(\text{SiH}_3)_3$
 (B) $\text{CH}_3 - \text{N} = \text{C} = \text{O}$ & $\text{SiH}_3 - \text{N} = \text{C} = \text{O}$
 (C) H_2O & F_2O
 (D) All are isostructural
- Q 9. The correct order of acidic strength of BX_3 is
 (A) $\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3 > \text{BI}_3$
 (B) $\text{BF}_3 = \text{BCl}_3 = \text{BBr}_3 = \text{BI}_3$
 (C) $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3 < \text{BI}_3$
 (D) None of these
- Q 10. The correct stability order is
 (A) $:\text{CF}_2 > :\text{CCl}_2 > :\text{CBr}_2$
 (B) $:\text{CF}_2 = :\text{CCl}_2 = :\text{CBr}_2$
 (C) $:\text{CF}_2 < :\text{CCl}_2 < :\text{CBr}_2$
 (D) $:\text{CCl}_2 > :\text{CF}_2 > :\text{CBr}_2$
- Q 11. Cl_2O has bond angle
 (A) less than $109^\circ 28'$ (B) less than 90°
 (C) greater than $109^\circ 28'$ (D) greater than 120°
- Q 12. Which of the molecules/ions having linear structure?
 (A) $\text{F}_2\text{C} = \text{C} = \text{CF}_2$ (B) $\text{F}_2\text{B} - \text{C} = \text{C} - \text{CB}_2$
 (C) $(\text{SiH}_3)_3$ (D) $\text{NH}_2 - \text{NH}_2$
- Q 13. Select the Incorrect statement
 (A) Trimethylamine and Trisilylamine have different structure
 (B) Trisilylamine is less basic than Trimethylamine
 (C) Trisilylamine shows $\text{p}\pi - \text{d}\pi$ bonding
 (D) Trisilylamine shows $\text{p}\pi - \text{p}\pi$ bonding
- Q 14. **Assertion (A):** Among the two O–H bonds in H_2O molecule, the energy required to break the first O–H bond and the other O–H bond is the same. [NCERT Exemplar]

Reason (R): This is because the electronic configuration around oxygen is the same after breakage of one O–H bond.

- (A) A and R both are correct and R is the correct explanation of A
 (B) A and R both are correct but R is not the correct explanation of A
 (C) A is true but R is false
 (D) A and R both are false

11. Hybridisation, SP, SP², SP³ Hybridisation

- Q 1. The concept of hybridization is given
 (A) to know the structure of a chemical species
 (B) to explain the structure of a chemical species given by VSEPR model
 (C) to know the more stable structure
 (D) to do energy conservation
- Q 2. The process of hybridization is
 (A) Exothermic
 (B) Endothermic
 (C) Neither Exothermic nor Endothermic
 (D) can be Exothermic or Endothermic
- Q 3. Direct participation of atomic orbital of carbon in CH₄ molecule formation leads to
 (A) Bond angle equal to 90°
 (B) Bond angle equal to 109°28'
 (C) Three C – H bonds are equivalent
 (D) both A & C
- Q 4. Which of the following is NOT characteristics of hybridization?
 (A) it is intraatomic process
 (B) No of orbitals remained conserved in hybridisation.
 (C) Hybridisation can happen between any set of atomic orbitals.
 (D) In any molecule, hybridisation may or may not occur
- Q 5. When ground state C-atoms are subjected to react, they normally undergo three process – excitation, hybridization and bonding simultaneously. Now which of the following statements is (are) true
 (A) Excitation is endothermic, hybridization is exothermic and bonding is endothermic
 (B) All are exothermic
 (C) All are endothermic
 (D) Excitation is endothermic hybridization is neither exothermic nor endothermic and bonding is exothermic.
- Q 6. Which of the following energy relations is(are) correct?
 (A) $E_{2p} > E_{2sp^3} > E_{2sp^2} > E_{2sp} > E_{2s}$
 (B) $E_{2s} > E_{2sp} > E_{2sp^2} > E_{2sp^3} > E_{2p}$
 (C) $E_{2sp^2} = E_{2s} > E_{2p} + E_{2p} + E_{2p}$
 (D) $E_{2sp^3} = E_{2s} + E_{2p} + E_{2p} + E_{2p}$
- Q 7. Which of the following is the correct order of size
 (A) $2s > 2sp > 2sp^2 > 2sp^3 > 2p$
 (B) $2p > 2sp^3 > 2sp^2 > 2sp > 2s$
 (C) $2sp^3 > 3p > 2p$
 (D) $2sp^3 > 3s > 2s$
- Q 8. In 2sp hybridization, 2s orbital can be mixed with
 (A) Only 2p_x
 (B) Only 2p_y
 (C) Only 2p_z
 (D) any one of 2p_x, 2p_y and 2p_z
- Q 9. On hybridization of one S and one P orbitals, we get **[IIT JEE 1984]**
 (A) two mutually perpendicular orbitals
 (B) two orbitals at 180°
 (C) four orbitals directed tetrahedrally
 (D) three orbitals in one plane
- Q 10. In sp² orbital, character of p_z will be
 (A) always 33.33%
 (B) always 0%
 (C) always 66.66%
 (D) either 33.33% or 0%
- Q 11. In sp³orbital
 (A) Characters of p_x, p_y and p_z are equal
 (B) Character of s, p_x, p_y and p_z are equal
 (C) s-character is more than p_z character
 (D) Character of p_x, p_y and p_z are not equal
- Q 12. Which is the correct order of electronegativity?
 (A) sp³C > sp²C > sp³C
 (B) spC > sp²C > sp³C
 (C) sp²C > sp C > sp³C
 (D) sp³C > sp C > sp²C
- Q 13. The relative strength of the σ-bond formed between SP³ – SP³, SP² – SP², and SP – SP
 (A) 2: 1.99 : 1.93 (B) 2: 1.93 : 1.73

- (C) 1.99 : 1.93: 1.73 (D) None of these
- Q 14. Overlapping powers (overlap integrals) of 2s, 2p, 2sp³, 2sp² and 2sp orbitals are in the order
 (A) 2s>2p>2sp³>2sp²>2sp
 (B) 2p>2s>2sp³>2sp²>2sp
 (C) 2sp³>2sp²>2sp>2p>2s
 (D) 2sp³>2sp²>2sp>2s>2p
- Q 15. If a molecule MX₃ has zero dipole moment, the sigma bonding orbitals used by M (Z < 21) are
 [IIT JEE 1981]
 (A) Pure P orbitals (B) SP hybridized orbitals
 (C) SP² orbitals (D) SP³ orbitals

12. Sigma & Pi bonds, SP³d, SP³d², dsp² Hybridisation

- Q 1. Which of the following is not a property of a π bond?
 (A) it is secondary bonding
 (B) π bond is always weaker than σ bond
 (C) Electron cloud lie along the InterNucleus axis
 (D) Electron cloud of π bond can delocalize easily.
- Q 2. Considering X-axis as internuclear axis, which out of the following will not form a sigma bond and why?
 [NCERT]
 (A) 1S & 1S (B) 1S & 2Px
 (C) 2Py & 2Py (D) 1S & 2S
- Q 3. CH₂=C=CH₂, In this molecule
 (A) All C-atoms are sp²-hybridized.
 (B) Two C-atoms are sp²- hybridized and one C-atom is sp-hybridized.
 (C) All carbons are sp hybridized
 (D) None of the C-atoms is hybridized.
- Q 4. In [Ag(CN)₂]⁻, the number of pi (π) bonds are
 [AIIMS 2006]
 (A) 2 (B) 3 (C) 4 (D) 6
- Q 5. Which of the following contains equal no of σ & π bonds?
 [CBSE PMT 2015]
 (A) HCO₃⁻ (B) XeO₄
 (C) (CN)₂ (D) CH₂(CN)₂
- Q 6. Which of the following compounds has maximum number of sp-hybridized C-atoms?
 (A) (CN)₂
 (B) H₂C=CH-CN
 (C) HC≡C-CH₂-CH=C=C-CH₂
 (D) CH₂=C=CH-CN
- Q 7. PCl₅ does not exist because
 (A) Phosphorous does not form bond with H atom
 (B) Phosphorous is not able to form 5 bonds
 (C) Hybridisation between 3S, 3P & 3d orbitals is not possible
 (D) None of these
- Q 8. In trigonal bipyramidal structure of PCl₅, SP³d hybridization involves which of the following d orbital?
 (A) d_{x²-y²} (B) d_{XY} (C) d_{YZ} (D) d_{z²}
- Q 9. Describe the hybridization in PCl₅. Why are axial bond longer than equatorial bonds? [NCERT]
- Q 10. SF₆ exist but SCl₆ does not exist because
 (A) Hybridisation between 3S, 3P & 3d is not possible in SCl₆
 (B) Cl is a larger atom which can't be kept around S in large number, causes electronic repulsion between lone pair of electrons of Cl.
 (C) Cl is less electronegative than F
 (D) None of these
- Q 11. SP³d² hybridisation involves which of the following d-orbitals?
 [CBSE PMT 2004]
 (A) d_{x²-y²}, d_{z²} (B) d_{XY}, d_{YZ}
 (C) d_{ZX}, d_{XY} (D) d_{XY}, d_{x²-y²}
- Q 12. Among the given d – orbitals, which are involved in SP³d³ hybridisation?
 (A) d_{ZX}, d_{XY}, d_{YZ} (B) d_{XY}, d_{x²-y²}, d_{YZ}
 (C) d_{YZ}, d_{ZX}, d_{z²} (D) Any three d orbitals
- Q 13. dsp² Hybridisation is formed by mixing
 (A) S + P_x + P_y + d_{XY} (B) S + P_x + P_y + d_{x²-y²}
 (C) S + P_x + P_y + d_{z²} (D) None of these
- Q 14. MnO₄⁻ has which of the following hybridization?
 (A) SP³ (B) Sd³
 (C) dsp² (D) None of these
- Q 15. CrO₅ has which of the following hybridization?
 (A) SP³d (B) Sp²d²

- (C) Sd^4 (D) Sd^3
- Q 16. What is not true about hybridization?
 (A) Hybrid orbitals from relatively stronger bonds than pure atomic orbitals.
 (B) Hybrid orbitals form sigma bonds
 (C) Orientation of electron from lower sub – level to higher sub–level of the valence shell is essential for hybridization
 (D) None of these
- Q 17. Hybridization of carbon in C_3O_2 is
 (A) SP (B) SP^2
 (C) SP^3 (D) both SP & SP^2

13. Rules to calculate Hybridisation, Overlapping of Orbitals

- Q 1. Find Hybridisation of central atom in following chemical species.
- | | | |
|-------------------|-------------------|--------------------|
| 1). N_2 | 2). SO_2 | 3). SO_3 |
| 4). NO_2^- | 5). NO_3^- | 6). CH_2Cl_2 |
| 7). NH_3 | 8). PCl_3 | 9). $SOCl_2$ |
| 10). CCl_3^- | 11). IO_2Cl | 12). IO_3^- |
| 13). H_2O | 14). XeO_3 | 15). XeO_2 |
| 16). NH_2^- | 17). SF_4 | 18). $IOCl_3$ |
| 19). $XeOF_2$ | 20). ICl_3 | 21). PCl_4^- |
| 22). $BrCl_4^+$ | 23). $BrCl_3$ | 24). $IO_2Cl_2^-$ |
| 25). $XeOF_2$ | 26). I_3^- | 27). I_3^+ |
| 28). BrF_2^- | 29). IF_2^+ | 30). IF_5 |
| 31). BrF_5 | 32). SF_5^- | 33). XeF_4 |
| 34). CrO_4^{2-} | 35). CNO^- | 36). N_2O |
| 37). $HClO_3$ | 38). H_2SO_4 | 39). $S_2O_3^{2-}$ |
| 40). SO_2 | 41). PO_3^- | 42). ICl_4^- |
| 43). NH_4^+ | 44). PO_4^{3-} | 45). IF_4^+ |
| 46). SO_3^{2-} | 47). XeF_6 | 48). SOF_4 |
| 49). SF_6^{2-} | 50). SeO_3^{2-} | 51). SOF_4 |
| 52). PCl_6^- | 53). $XeOF_4$ | 54). XeF_2 |
| 55). ClF_3 | 56). H_3PO_2 | 57). H_3PO_4 |

- 58). MnO_4^- 59). $Cr_2O_7^{2-}$ 60). H_2SO_4

- Q 2. The Type of Hybridisation of Nitrogen in NO_2^+ , NO_3^- & NH_4^+ respectively are expected to be
[IIT JEE 2000S/NCERT Exemplar]
 (A) SP, SP^3 & SP^2 (B) SP, SP^2 & SP^3
 (C) SP^2 , SP & SP^3 (D) SP^2 , SP^3 & SP
- Q 3. Isostructural species are those which have same shape & hybridization. Among the given, identify isostructural species. **[NCERT Exemplar]**
 (A) NF_3 & BF_3 (B) BF_4^- & NH_4^+
 (C) BCl_3 & $BrCl_3$ (D) NH_3 & NO_3^-
- Q 4. Hybridisation of the underline atom changes in **[AIEEE 2002]**
 (A) AlH_3 changes to AlH_4^-
 (B) H_2O changes to H_3O^+
 (C) NH_3 changes to NH_4^+
 (D) In all cases
- Q 5. The maximum number of 90° angles between bond pair of e^- is observed in **[AIEEE 2004]**
 (A) dsp^2 hybridisation (B) sp^3d hybridization
 (C) dsp^3 hybridisation (D) sp^3d^2 hybridisation
- Q 6. Which of the following conversions involve change in both hybridization & shape? **[AIIMS 2017]**
 (A) $CH_4 \longrightarrow C_2H_6$ (B) $NH_3 \longrightarrow NH_4^+$
 (C) $BF_3 \longrightarrow BF_4^-$ (D) $H_2O \longrightarrow H_3O^+$
- Q 7. **Assertion (A):** the central atom of NH_3 and H_2O both are SP^3 hybridised yet H–N–H bond angle is greater than H–O–H bond angle
[AIIMS 2014, NCERT Exemplar]
Reason (R): In NH_3 , N has one l.p of electron whereas in H_2O , O has two l.p of electrons.
 (A) A and R both are correct and R is the correct explanation of A
 (B) A and R both are correct but R is not the correct explanation of A
 (C) A is true but R is false
 (D) A and R both are false
- Q 8. In SO_2 molecule, two π bonds are formed by
 (A) both by $p\pi - p\pi$ overlapping
 (B) both by $p\pi - d\pi$ overlapping
 (C) one by $p\pi - p\pi$ & one by $p\pi - d\pi$ overlapping

- (D) None of these
- Q 9. Among the following, the true statements are
 (i) PH_3 & BiCl_5 do not exist.
 (ii) $p\pi - d\pi$ is present in SO_2
 (iii) SF_4 & CH_4 has same shape.
 (iv) I_3^- has bent shape [AIIMS 2017]
 (A) I, iii (B) I, ii, iii
 (C) I, iv (D) I, ii, iv
- Q 10. In SO_3 , all three π - bonds
 (A) equivalent (B) two are equivalents
 (C) None are equivalents
 (D) None of these
- Q 11. Which of the following has $p\pi - d\pi$ bonding?
 [CBSE PMT 2002]
 (A) NO_3^- (B) SO_3^{2-}
 (C) BO_3^{3-} (D) CO_3^{2-}
- Q 12. In COCl_2 , the $\text{C}=\text{O}$ π bond is formed by
 (A) $p\pi - p\pi$ overlapping
 (B) $p\pi - d\pi$ overlapping
 (C) $d\pi - d\pi$ overlapping
 (D) None of these
- Q 13. In SOF_4 , the $\text{S}=\text{O}$ π bonds are formed by
 (A) $p\pi - p\pi$ overlapping
 (B) $p\pi - d\pi$ overlapping
 (C) $d\pi - d\pi$ overlapping
 (D) None of these
- Q 14. In XeO_4 , four π (π) bonds are
 (A) Equivalent (B) Not Equivalent
 (C) Only 3 are equivalent
 (D) only 2 are equivalent
- 14. Other Concepts related to Hybridisation**
- Q 1. The bond angle and hybridization in ether (CH_3OCH_3) is
 (A) $106^\circ 51'$, SP^3 (B) $104^\circ 31'$, SP^3
 (C) 110° , SP^3 (D) 180° , SP^2
- Q 2. Maximum s - character in bonds formed by central atom with other atom, is
 (A) CH_4 (B) XeO_3
 (C) XeO_6^{4-} (D) SF_4
- Q 3. Which of the following molecule has bond (E-H) with maximum p - character?
 (A) CH_4 (B) PH_3
 (C) AsH_3 (D) SbH_3
- Q 4. Which of the following molecule has bond (E-H) with maximum p - character?
 (A) CH_4 (B) NH_3
 (C) C_2H_2 (D) All have equal
- Q 5. The N - N bond length in N_2H_4 & N_2F_4 have following order?
 (A) $\text{N}_2\text{H}_4 > \text{N}_2\text{F}_4$ (B) $\text{N}_2\text{H}_4 < \text{N}_2\text{F}_4$
 (C) $\text{N}_2\text{H}_4 = \text{N}_2\text{F}_4$ (D) None of these
- Q 6. The C-C bond length in C_2H_4 & C_2F_4 have following order?
 (A) $\text{C}_2\text{H}_4 > \text{C}_2\text{F}_4$ (B) $\text{C}_2\text{H}_4 < \text{C}_2\text{F}_4$
 (C) $\text{C}_2\text{H}_4 = \text{C}_2\text{F}_4$ (D) None of these
- Q 7. In a molecule MX_4 has zero dipole moment (atomic number < 21) the sigma bonding orbitals used by M is
 (A) pure p orbitals (B) SP hybrids
 (C) SP^2 hybrid (D) SP^3 hybrids
- Q 8. BF_3 and NF_3 both are covalent molecule but NF_3 is polar whereas BF_3 is non-polar. This is because
 (A) Nitrogen atoms is smaller than Boron atom
 (B) N - F bond is polar than B - F bonds
 (C) NF_3 is pyramidal, whereas BF_3 is Planar Trigonal
 (D) BF_3 is electron deficient whereas NF_3 is not
- Q 9. Carbon atom in $\text{C}_2(\text{CN})_4$ is
 (A) SP - Hybridised
 (B) SP^2 - Hybridised
 (C) SP^2 and SP - Hybridised
 (D) SP , SP^2 and SP^3 - Hybridised
- Q 10. Which of the following is the correct set with respect to molecule, hybridization and shape?
 (A) BeCl_2 , SP^2 , Linear
 (B) BeCl_2 , SP^2 , Triangular Planar
 (C) BeCl_3^- , SP^2 , Triangular Planar
 (D) BeCl_3 , SP^3 , Tetrahedral
- Q 11. Specify the co-ordination geometry around and hybridization of N and B atoms in a 1:1 complex of BF_3 and NH_3 . [IIT JEE 2002]
 (A) N : Tetrahedral, SP^3 ; B : Tetrahedral, SP^3
 (B) N : Pyramidal, SP^3 ; B : Planar, SP^3
 (C) N : Pyramidal, SP^3 ; B : Planar, SP^2
 (D) N : Pyramidal, SP^3 ; B : Tetrahedral, SP^3

- Q 12. In which of the following molecule/ion all the bonds are not equal? [NCERT Exemplar]
 (A) XeF₄ (B) BF₄⁻
 (C) C₂H₄ (D) SiF₄
- Q 13. Which of the following model of chemical Bonding includes both classical and quantum concepts?
 (A) VSEPR (B) Hybridisation
 (C) MOT (D) Lewis Structure
- Q 14. V.B.T. does not give any information about
 (A) Magnetic Properties
 (B) Bond length & Bond Strength
 (C) Structure of the species
 (D) All are given by V.B.T

15. Molecular Orbital Theory

- Q 1. In MOT, electron is treated as
 (A) Wave (B) Particle
 (C) Dual Nature (D) Matter
- Q 2. Molecular orbitals are obtained by
 (A) Mixing of atomic orbitals
 (B) Solving $H\Psi = E\Psi$ in molecule
 (C) Both A & B
 (D) None of these
- Q 3. Linear combination of atomic orbitals (LCAO) of 1s – orbitals of two produces
 (A) Single MO (B) two MO
 (C) four MO (D) Hybrid MO
- Q 4. In Sigma (σ) MO, the no of nodal plane is
 (A) 0 (B) 1
 (C) 2 (D) None of these
- Q 5. In AntiBonding MO, maximum electron density lie
 (A) outside the region between two nuclei
 (B) inside the region between two nuclei
 (C) at nodal plane (D) beside nodal surface
- Q 6. MO formation is
 (A) Exothermic (B) Endothermic
 (C) No Energy Change (D) No Stability Change
- Q 7. The molecular orbital shown in the diagram is



- (A) Π^* (B) Π
 (C) σ 2Pz (D) σ^*
- Q 8. During the formation of a molecular orbital from atomic orbitals, probability of electron density is
 (A) Minimum in the nodal plane
 (B) maximum in the nodal plane
 (C) Zero in the nodal plane
 (D) Zero on the surface of the lobe
- Q 9. **Assertion (A):** bond order of a molecule can assume any value positive or negative, integral or fractional, including zero. [AIIMS 1995]
Reason (R): it depends on number of electrons in the bonding and anti-bonding orbitals.
 (A) A and R both are correct and R is the correct explanation of A
 (B) A and R both are correct but R is not the correct explanation of A
 (C) A is true but R is false
 (D) A and R both are false
- Q 10. The pair of species having same bond order is [CBSE PMT 2013]
 (A) O₂²⁻, B₂ (B) O₂⁺, NO⁺
 (C) NO, CO (D) N₂, O₂
- Q 11. The stability order of H₂ & H₂⁻ is
 (A) H₂ > H₂⁻ (B) H₂ < H₂⁻
 (C) H₂ = H₂⁻ (D) Can't predict
- Q 12. **Assertion (A):** H₂ molecule is more stable than HeH molecule. [AIIMS 2010]
Reason (R): the antibonding electrons in the molecule destabilise it.
 (A) A and R both are correct and R is the correct explanation of A
 (B) A and R both are correct but R is not the correct explanation of A
 (C) A is true but R is false
 (D) A and R both are false
- Q 13. Which of the following species is not Stable?
 (A) H₂⁺ (B) H₂⁻
 (C) He₂ (D) Li₂
- Q 14. Which of the following species does not exist in nature?
 (A) H₂ (B) He₂
 (C) Li₂ (D) Both B & C

- Q 15. The number of π MO formed by P-orbitals combination is
(A) 1 (B) 3 (C) 4 (D) 1
- Q 16. Which of the following pair contains a set of degenerate orbitals? [AIIMS 2010]
(A) σ_{2s} , σ_{1s} (B) Π_{2px} , Π^*_{2px}
(C) Π_{2px} , Π_{2py} (D) σ_{2pz} , Π_{2py}

16. MOT including P orbitals, Bond order, Magnetic character

- Q 1. Which of the molecular orbital has two nodal surfaces?
(A) Π_{2p} (B) σ_{2p} (C) π_{2p}^* (D) σ_{2p}^*
- Q 2. The number of nodal planes present in π^*_{2p} and π_{2p} molecular orbitals respectively is
(A) 1,2 (B) 2,2 (C) 2,1 (D) 0,1
- Q 3. A nodal plane containing the internuclear axis exists in
(A) π -bonds (B) σ -bonds
(C) ϕ -bonds (D) antibonding π -orbitals
- Q 4. Number of Non bonding electrons in N_2 is
(A) 4 (B) 10 (C) 12 (D) 14
- Q 5. Which molecule/ion out of the following does not contain unpaired electrons? [NCERT Exemplar]
(A) N_2^+ (B) O_2 (C) O_2^{2-} (D) B_2
- Q 6. Pick out the incorrect statement?
(A) N_2 has greater dissociation energy than N_2^+
(B) O_2 has lower dissociation energy than O_2^+
(C) Bond length in N_2^+ is less than N_2
(D) Bond strength of NO^+ is less than in NO
- Q 7. In the formation of N_2^+ from N_2 , the electrons is removed from
(A) S orbital (B) P orbital
(C) S^* orbital (D) P^* orbital
- Q 8. Correct order of Bond Strength is
(A) $N_2 > N_2^{2-} > N_2^{2+}$ (B) $N_2 > N_2^{2+} > N_2^{2-}$
(C) $N_2^{2-} > N_2 > N_2^{2+}$ (D) $N_2^{2+} > N_2 > N_2^{2-}$
- Q 9. How many unpaired electrons are present in N_2^+

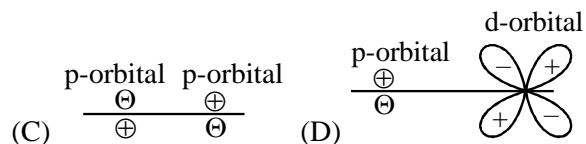
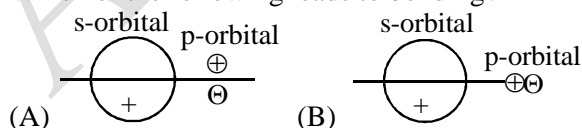
- (A) 1 (B) 2 (C) 3 (D) 4
- Q 10. In B_2 formation, two bonded electron pairs lie
(A) σ M.O. (B) π M.O.
(C) σ^* M.O. (D) π^* M.O.
- Q 11. Assuming the Hund's rule is violated, the bond order and magnetic nature of the diatomic molecule B_2 is [IIT JEE 2010]
(A) 1 & diamagnetic (B) 0 & diamagnetic
(C) 1 & paramagnetic (D) 0 & paramagnetic
- Q 12. In C_2 molecule, we have
(A) $1\sigma + 1\pi$ Bond (B) 2σ Bond
(C) 2π Bond (D) None of these
- Q 13. A simplified applications of MO theory to hypothetical molecule OF would give its bond order as
(A) 2 (B) 1.5 (C) 1.0 (D) 0.5
- Q 14. Maximum bond energy is
(A) F_2 (B) N_2
(C) O_2 (D) Equal
- Q 15. Correct order of bond length is
(A) $O_2^{2+} > O_2 > O_2^{2-}$ (B) $O_2^{2-} > O_2 > O_2^{2+}$
(C) $O_2 > O_2^{2+} > O_2^{2-}$ (D) $O_2^{2-} > O_2^{2+} > O_2$
- Q 16. When N_2 changes to N_2^+ , the N – N bond distance and when O_2 changes to O_2^+ the O – O distance [IIT JEE 1996]
- Q 17. According to MO theory, which of the following statement about magnetic character & bond order is correct regarding O_2^+ is [IIT JEE 2003S]
(A) paramagnetic & Bond order $< O_2$
(B) paramagnetic & Bond order $> O_2$
(C) Diamagnetic & Bond order $< O_2$
(D) Diamagnetic & Bond order $< O_2$
- Q 18. Consider the following statements.[AIIMS 2015]
I. bond length in N_2^+ is 0.02 \AA greater than in N_2
II. bond length in NO^+ is 0.09 \AA less than in NO
III. O_2^{2-} has shorter bond length O_2
Which of the following statements are true?
(A) I & II (B) II & III
(C) I, II & III (D) I & III
- Q 19. Assertion (A): F_2 molecule has bond order 1. [AIIMS 2008]

Reason (R): the number of electrons in the anti – bonding molecular orbitals is two less than that in bonding molecular orbitals

- (A) A and R both are correct and R is the correct explanation of A
 (B) A and R both are correct but R is not the correct explanation of A
 (C) A is true but R is false
 (D) A and R both are false

17. Magnetic character, Overlapping of MO

- Q 1. Which of the following species exhibits the diamagnetic behavior?
 (A) NO (B) O_2^{2+} (C) O_2^+ (D) O_2
- Q 2. Which of the following species is paramagnetic?
 (A) NO^+ (B) O_2^{2-} (C) CN (D) CO
- Q 3. Which of the following molecules/ions does not contain unpaired electrons?
 (A) O_2^{2-} (B) B_2 (C) N_2^+ (D) O_2
- Q 4. Among KO_2 , AlO_2^- , BaO_2 & NO_2^+ , unpaired electrons is present in
 (A) KO_2 only (B) NO_2^+ & BaO_2
 (C) KO_2 & AlO_2^- (D) BaO_2 only
- Q 5. Where is an electron added to during the change of NO^+ to NO ?
 (A) σ orbital (B) π orbital
 (C) σ^* orbital (D) π^* orbital
- Q 6. Which one of the following is the molecule with the lowest bond order?
 (A) CO (B) CO_2
 (C) NO_3^- (D) CN^-
- Q 7. The ion that is isoelectronic with CO is
 (A) CN^- (B) O_2^+ (C) O_2^- (D) N_2^+
- Q 8. Which of the following leads to bonding?



Q 9.

List - I

List - II

- P. 1. $p - d\pi$ Antibonding
- Q. 2. $d - d\sigma$ Bonding
- R. 3. $p - d\pi$ bonding
- S. 4. $d - d\sigma$ antibonding

Code:

	P	Q	R	S
(A)	2	1	3	4
(B)	4	3	1	2
(C)	2	3	1	4
(D)	4	3	1	2

- Q 10. Assuming $2S - 2P$ mixing is NOT operative, the paramagnetic species among the following is
 [JEE ADV 2014]
 (A) Be_2 (B) B_2 (C) C_2 (D) N_2
- Q 11. A Sigma (σ) bond may between two P_x orbitals containing one unpaired electrons each when they approach each other approximately along
 (A) X – axis (B) Y – Axis
 (C) Z – Axis (D) Any Direction
- Q 12. In H-F molecule formation, M.O. formation occur by
 (A) $1s - 2p$ mixing (B) $1s - 2s$ mixing
 (C) $2s - 2p$ mixing (D) $2p - 2p$ mixing
- Q 13. In CO_3^{2-} , Bond order of any C – O bond is
 (A) $3/4$ (B) $4/3$
 (C) $2/3$ (D) $3/2$

Q 14. In NO_3^- , Bond order of N–O bond is

- (A) 3/4 (B) 2/3
(C) 4/3 (D) 3/2

Q 15. In CO_2 , Bond order of C–O bond is

- (A) 4/3 (B) 5/3
(C) 2 (D) 3

18. Secondary Bonding

Q 1. Which of the following bond is weakest?

- (A) Covalent Bond (B) Dipole – Dipole bond
(C) Hydrogen Bond (D) London force

Q 2. Between two HBr molecule, the interaction developed is

- (A) Dipole – Dipole Bonding
(B) Covalent Bonding
(C) Hydrogen Bonding
(D) Van der waal Bonding

Q 3. Dipole-dipole forces act between the molecules possessing permanent dipole. Ends of dipoles possess 'partial charges'. The partial charge is

[NCERT Exemplar]

- (A) more than unit electronic charge
(B) equal to unit electronic charge
(C) less than unit electronic charge
(D) double the unit electronic charge

Q 4. Between HCl & Ar, the bonding developed is

- (A) Dipole – Dipole Bonding
(B) Dipole – Induced Dipole Bonding
(C) Van der waal Bonding
(D) Hydrogen Bonding

Q 5. The ion – dipole interaction is related to

- (A) Proportional to r^2
(B) Inversely Proportional to r^2
(C) Inversely Proportional to r^3
(D) Proportional to r^2

Q 6. Van der waal Bonding is also named as

- (A) London dispersion force
(B) Induced Dipole – Induced Dipole Bonding
(C) Both A & B (D) None of these

Q 7. Van der waal bonding is directly related to

- (A) mass of species
(B) No of electrons in species
(C) Volume of species

(D) Both B & C

Q 8. The interaction energy of London force is inversely proportional to sixth power of the distance between two interacting particles but the magnitude depends upon [NCERT Exemplar]

- (A) charge of interacting particles
(B) mass of interacting particles
(C) polarisability of interacting particles
(D) strength of permanent dipoles in the particles

Q 9. A non Polar species with high polarisability has higher strength of

- (A) Van der waal Bonding
(B) Dipole – Dipole bonding
(C) Hydrogen Bonding
(D) None of these

Q 10. The correct order of strength of van der waal bonding is

- (A) $CO_2 > CH_4 > H_2$ (B) $CH_4 > CO_2 > H_2$
(C) $CO_2 < CH_4 < H_2$ (D) $CH_4 > H_2 > CO_2$

Q 11. The correct order of strength of Van der waal bonding is

- (A) $H_2 > He$ (B) $He > H_2$
(C) $H_2 = He$ (D) Can't Say

Q 12. Van der waal Bonding is

- (A) Always weaker than dipole bonding
(B) Always weaker than Hydrogen Bonding
(C) weaker than dipole bonding when molecules are of comparable weight
(D) None of these

Q 13. Dry Ice exist as solid due to

- (A) Covalent bonding
(B) Van der waal Bonding
(C) Hydrogen Bonding
(D) None of these

Q 14. On which factor the strength of Van der waal force doesn't depend

- (A) Increase in the number of electrons in a molecule increases the magnitude of the van der waal forces between the molecules
(B) Larger the size of the interacting molecules increases the magnitude of the van der waal forces
(C) The strength of van der waal forces increases the lowering of temperature
(D) Increase in mass increases the strength the van der waal force

19. Hydrogen Bonding

- Q 1. Ethanol has a higher boiling point than dimethyl ether though they have same molecular weight. This is due to [AIEEE 2003 Based]
(A) Resonance (B) Coordinate bonding
(C) Hydrogen bonding (D) Ionic bonding
- Q 2. Which of the following exhibit Hydrogen bonding?
(A) CH₄ (B) H₂Se
(C) N₂H₄ (D) H₂S
- Q 3. Which of the following does not have hydrogen bonding? [IIT JEE 1983]
(A) Phenol (B) liquid NH₃
(C) Water (D) Liquid HCl
- Q 4. The volatility of HF is low because of
(A) its low polarisability
(B) the weak dispersion interaction between the molecules
(C) its small molecular mass
(D) its strong hydrogen bonding
- Q 5. Which of the dominant intermolecular bonding present in CH₃OH which must be overcome in converting liquid CH₃OH into gas? [CBSE PMT 2009]
(A) Hydrogen Bonding
(B) Dipole – Dipole Interaction
(C) Covalent bonds
(D) London dispersion force
- Q 6. Which of the following compounds have significant intermolecular Hydrogen Bonding? HF, CH₃OH, N₂O₄, CH₄
(A) HF, N₂O₄ (B) HF, CH₃OH, CH₄
(C) HF, CH₃OH (D) CH₃OH, CH₄
- Q 7. The compound with highest boiling point is
(A) CH₃OH (B) CH₃Br
(C) CH₃Cl (D) CH₄
- Q 8. Hydrogen Bonding is maximum in
(A) Ethanol (B) Diethyl ether
(C) Ethyl Chloride (D) Triethyl amine
- Q 9. Pair of molecules with strongest intermolecular Hydrogen bond is [IIT JEE 1981]
[SiH₄ & SiF₄, CH₃COCH₃ & CHCl₃ & HCOOH & CH₃COOH]
- Q 10. On Pressing two ice cube together, one cube is formed. Which is responsible for it?
(A) London Force (B) Covalent force
(C) Hydrogen Bond (D) Dipole – Dipole bond
- Q 11. Which of the following Hydrogen bonding is the strongest?
(A) O–H ----F (B) O–H ----N
(C) F–H ----F (D) O–H ----O
- Q 12. Which of the Hydrogen bond will be the strongest one? [JEE Main 2007]
(A) F–H----O (B) O–H----F
(C) F–H----F (D) O–H----O
- Q 13. Intramolecular Hydrogen Bonding is found in
(A) Salicylaldehyde (B) Water
(C) Acetaldehyde (D) Phenol
- Q 14. Which of the molecule shows the presence of intramolecular Hydrogen bonding? [NEET 2016]
(A) H₂O₂ (B) HCN
(C) Cellulose (D) Conc. Acetic acid
- Q 15. Salicylaldehyde does not have
(A) Intermolecular H – Bonding
(B) Intramolecular H – Bonding
(C) Have low boiling point
(D) its steam volatile
- Q 16. The boiling point of a compound is raised by [AIIMS 1998, 1996]
(A) Intermolecular Hydrogen Bonding
(B) volatility of compound
(C) Intramolecular hydrogen Bonding
(D) Non – Polarity in the molecule
- Q 17. Which of the following does not have intermolecular Hydrogen bonding?
(A) H₂O (B) O – Nitrophenol
(C) HF (D) CH₃COOH
- Q 18. O–Nitrophenol is less soluble in water than m–Nitrophenol & p–Nitrophenol because [AIEEE 2012]
(A) O–Nitrophenol is more volatile steam than those of m–Nitrophenol & p–Nitrophenol
(B) O–Nitrophenol shows intramolecular H bond
(C) O–Nitrophenol shows intermolecular H bond
(D) melting point of O–Nitrophenol is lower than those of m–Nitrophenol & p–Nitrophenol
- Q 19. For HF, H₂O₂, H₂S & H₂O the correct order of increasing extent of hydrogen bonding is
(A) H₂O > HF > H₂O₂ > H₂S
(B) H₂O > HF > H₂S > H₂O₂
(C) HF > H₂O₂ > H₂O > H₂S
(D) HF > H₂O > H₂O₂ > H₂S

- Q 20. Hydrogen bond is formed in many compounds e.g. H_2O , HF & NH_3 . The boiling point of such compounds depends to a large extent on the strength of Hydrogen bond and the number of Hydrogen bonds. The correct decreasing order of Boiling point is [NCERT Exemplar]
 (A) $\text{HF} > \text{H}_2\text{O} > \text{NH}_3$ (B) $\text{H}_2\text{O} > \text{HF} > \text{NH}_3$
 (C) $\text{NH}_3 > \text{HF} > \text{H}_2\text{O}$ (D) $\text{NH}_3 > \text{H}_2\text{O} > \text{HF}$
- Q 21. KF combines with HF to form KHF_2 , the compounds contains the species
 (A) K^+ , F^- & H^+ (B) K^+ , F^- & HF
 (C) K^+ & $[\text{HF}_2]^-$ (D) $[\text{KHF}]^+$ & F^-
- Q 22. **Assertion (A):** HF_2^- ion exist in solid state and in liquid state but not in aqueous solution.
 [AIIMS 2010]
Reason (R): the magnitude of hydrogen bond in between $\text{HF} - \text{HF}$ molecule is weaker than that in between HF & H_2O molecule.
 (A) A and R both are correct and R is the correct explanation of A
 (B) A and R both are correct but R is not the correct explanation of A
 (C) A is true but R is false
 (D) A and R both are false
- 20. Metallic Bonding, Semiconductor**
- Q 1. Which of the following properties can be explained on the basis of metallic bonding only?
 (A) Density (B) Refractive Index
 (C) Conductivity (D) Chemical Properties
- Q 2. Which of the following is model for metallic bonding?
 (A) Electron Sea Model (B) Band Model
 (C) Both A & B (D) Hybridisation Model
- Q 3. Which of the following does not apply to metallic bonding? [CBSE PMT 1989]
 (A) Overlapping of valence orbitals
 (B) mobile valence electrons
 (C) Delocalised electrons
 (D) Highly directed electrons
- Q 4. The Band of Bonding molecular orbital is called
 (A) Valence Band (B) Conduction Band
 (C) Sigma Band (D) Core Band
- Q 5. In which of the following substance, the energy gap between valence band & conduction band is maximum?
 (A) Silicon (B) Diamond
 (C) Iron (D) Graphite
- Q 6. The conductivity of Semi-metal can be increased by
 (A) Doping (B) Heating
 (C) Applying voltage (D) All of these
- Q 7. Addition of arsenic in trace amounts to pure germanium will result in the formation of
 (A) n-type semiconductor
 (B) p-type semiconductor
 (C) germanium arsenide
 (D) a superconducting alloy
- Q 8. Pure silicon doped with phosphorous atom is a/an
 (A) metallic conductor
 (B) n-type semiconductor
 (C) p-type semiconductor
 (D) insulator
- Q 9. Pure Si is doped with B atom leads to formation of
 (A) n-type semiconductor
 (B) p-type semiconductor
 (C) h - type semiconductor
 (D) Semi conductor is not formed
- Q 10. In p-type semiconductor, current carrying particle has
 (A) Positive charge (B) Negative charge
 (C) Zero Charge
 (D) Both Positive & Negative Charge
- Q 11. The electrical conductivity of Metals is in the range of
 (A) $10^3 - 10^5 \text{ S.cm}^{-1}$ (B) $10^{-6} - 10^4 \text{ S.cm}^{-1}$
 (C) $10^{-18} - 10^{-4} \text{ S.cm}^{-1}$ (D) None of these

Answer Key

1. Bonding Concepts, Ionic & Covalent

Compounds

- | | | |
|---------|---------|---------|
| (1). A | (2). C | (3). C |
| (4). C | (5). A | (6). C |
| (7). A | (8). B | (9). D |
| (10). D | (11). A | (12). B |
| (13). B | (14). B | (15). C |
| (16). B | (17). B | |

2. Ionic Character, Dipole Moment, Fajan's Rule

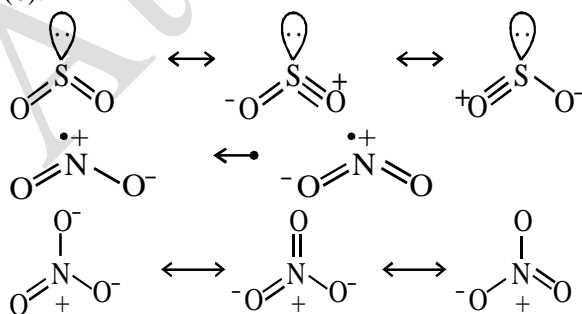
- | | | |
|---------|---|---------|
| (1). D | (2). B | (3). C |
| (4). A | (5). A | (6). D |
| (7). C | (8). D | (9). B |
| (10). C | (11). B | (12). C |
| (13). D | (14). B | (15). B |
| (16). B | (17). $N_2 < SO_2 < ClF_3 < LiF < K_2O$ | |
| (18). B | (19). A | (20). C |

3. Lewis Structure Theory, Formal Charge

- | | | |
|---------|---------|---------|
| (1). A | (2). D | (3). B |
| (4). B | (5). A | (6). D |
| (7). B | (8). B | (9). D |
| (10). C | (11). B | (12). B |
| (13). C | (14). B | (15). C |
| (16). A | (17). D | (18). C |
| (19). B | | |

4. Resonance, Banana Bonding, odd electron species

- | | | |
|--------|--------|--------|
| (1). B | (2). B | (3). A |
| (4). C | (5). A | |
| (6). | | |

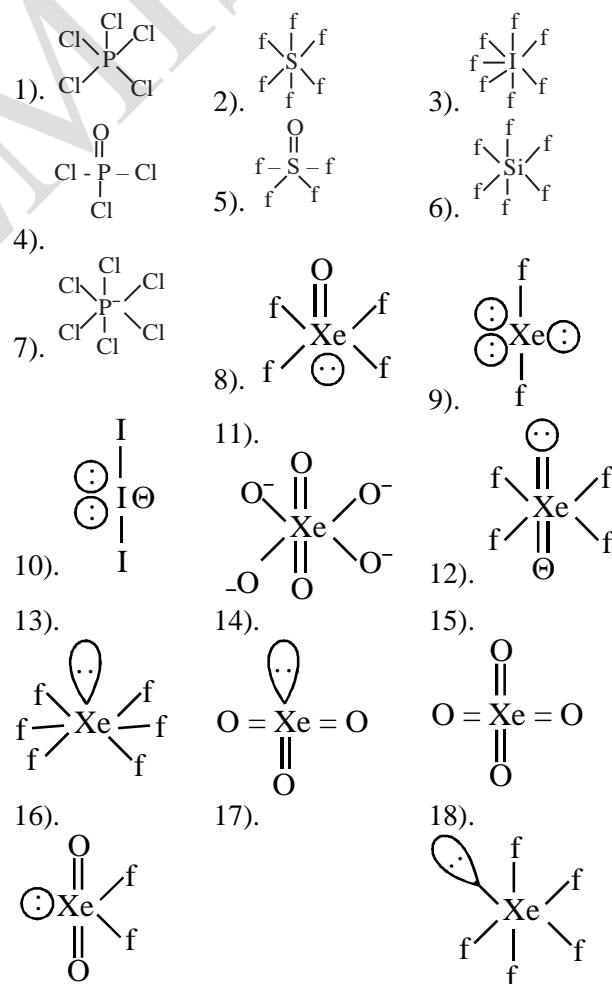


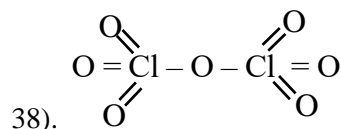
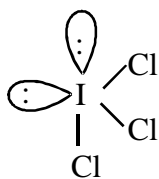
- | | | |
|---------|---------|-------------------|
| (7). B | (8). D | (9). 3C – 2e Bond |
| (10). D | (11). B | (12). C |
| (13). D | (14). C | (15). D |
| (16). C | (17). A | |

5. Exceptions in Lewis Structure theory

- | | | |
|---------|---------|---------|
| (1). C | (2). C | (3). D |
| (4). B | (5). A | (6). D |
| (7). A | (8). D | (9). D |
| (10). D | (11). C | (12). D |
| (13). B | (14). D | (15). D |

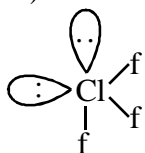
6. Method to Draw Lewis Structure



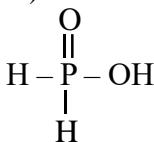


38).

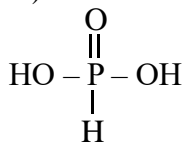
19).



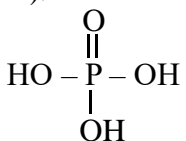
20).



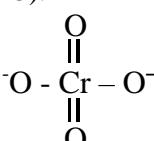
21).



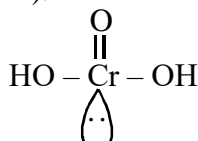
22).



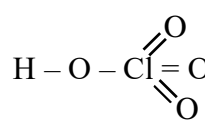
23).



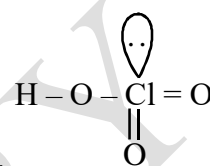
24).



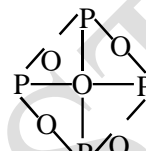
39).



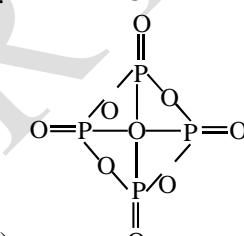
40).



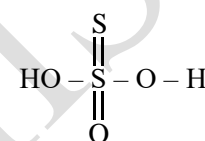
41).



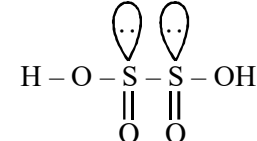
42).



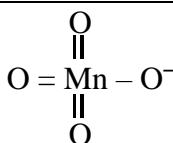
43).



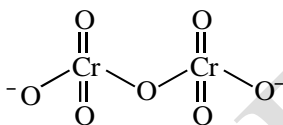
44).



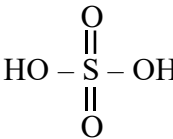
25).



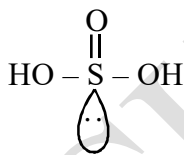
26).



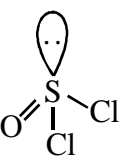
27).



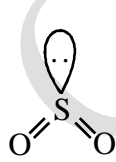
28).



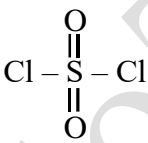
29).



30).



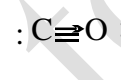
31).



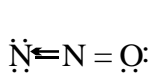
31).



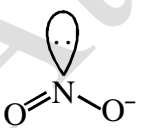
33).



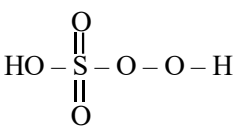
34).



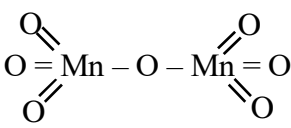
35).



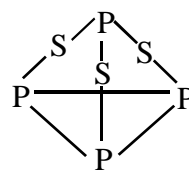
36).



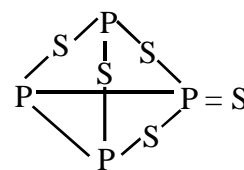
37).

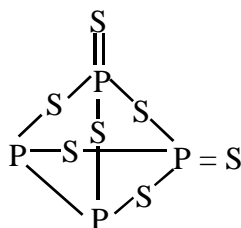


49).

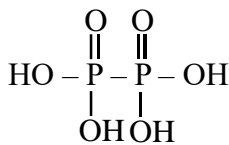


50).

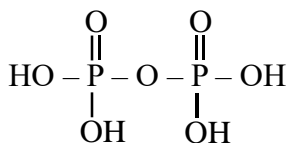




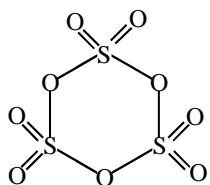
51).



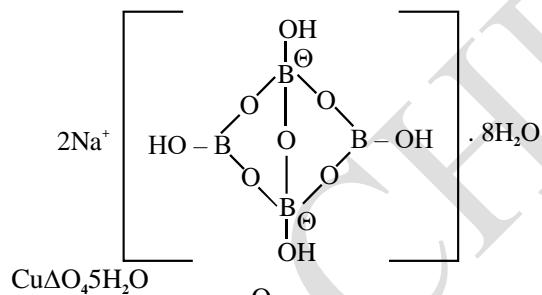
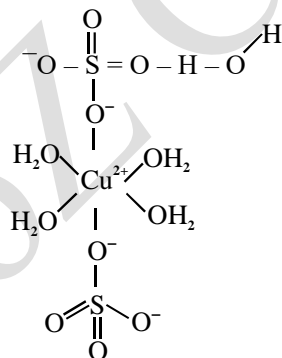
52).



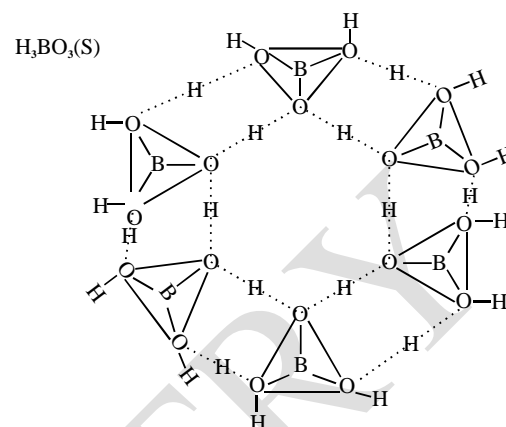
53).



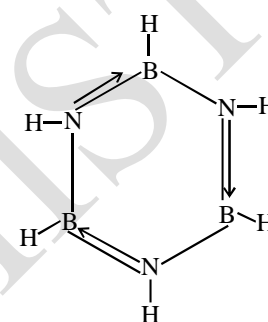
54).

55). $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O} : \text{Na}_2 [\text{B}_4\text{O}_5 (\text{OH})_4] \cdot 8\text{H}_2\text{O}$  $\text{Cu}\Delta\text{O}_4\cdot 5\text{H}_2\text{O}$ 

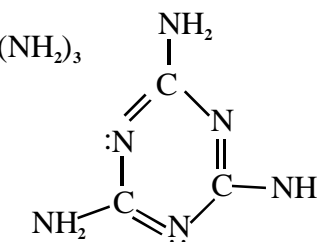
56).



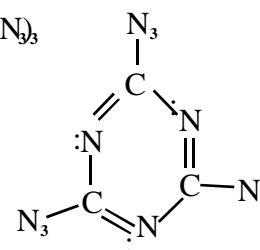
57).

 $\text{B}_3\text{N}_3\text{H}_6$ 

58).

 $\text{C}_3\text{N}_3 (\text{NH}_2)_3$ 

59).

 $\text{C}_3\text{N}_3 (\text{N}_3)$ 

60).

- (2). No resonating structure as position of atom changes in given structure. In resonating structure, only electrons changes its position
 (3). C

7. VSEPR Model

- | | | |
|---------|---------|---------|
| (1). A | (2). C | (3). C |
| (4). D | (5). C | (6). A |
| (7). D | (8). B | (9). B |
| (10). B | (11). C | (12). A |
| (13). C | (14). D | (15). A |

8. Shape of Chemical Species

- (1).
1). Linear 2). Bent Shape 3). Triangular Planar
4). Bent shape 5). Triangular Planar 6). Tetrahedral

7). Pyramidal 8). Pyramidal 9). Pyramidal
10). Pyramidal 11). Pyramidal 12). Pyramidal
13). Bent Shape 14). Pyramidal 15). Bent Shape

16). Bent Shape 17). Sea Saw 18). Sea Saw

19). T-shape 20). T-shape 21). Sea Saw
22). Sea Saw 23). T-shape 24). Sea Saw
25). T-shape 26). Linear 27). Bent Shape

28). Linear 29). Bent Shape 30). Square Pyramidal
31). Square Pyramidal 32). Square Pyramidal 33). Square Planar
34). Tetrahedral 35). Linear 36). Linear

37). Pyramidal 38). Tetrahedral 39). Tetrahedral

40). Bent Shape 41). Triangular Planar 42). Square Planar
43). Tetrahedral 44). Tetrahedral 45). Sea Saw

46). Pyramidal 47). Distorted Octahedral 48). Square Pyramidal
49). Distorted Octahedral 50). Tetrahedral 51). Square Pyramidal
52). Octahedral 53). Square Pyramidal 54). Linear

55). T-shape 56). Tetrahedral 57). Tetrahedral

58). Tetrahedral 59). Tetrahedral 60). Tetrahedral

- | | | |
|-----------|--------|---------------|
| (2). D | (3). C | (4). A |
| (5). D | (6). D | (7). A, D |
| (8). A, C | (9). B | (10). A, B, D |

- | | | |
|---------------|------------|------------|
| (11). A, B | (12). B, C | (13). A, D |
| (14). A, B, C | (15). C | |

9. Shape of Chemical Species

- | | | |
|---------|---------|---------|
| (1). B | (2). D | (3). B |
| (4). B | (5). D | (6). B |
| (7). B | (8). B | (9). B |
| (10). C | (11). C | (12). A |
| (13). D | (14). D | (15). D |
| (16). B | (17). D | (18). B |
| (19). A | (20). B | (21). B |
| (22). A | | |

10. Bond Length, Bond Strength

- | | | |
|---------------|---------|------------|
| (1). B | (2). C | (3). B |
| (4). A | (5). A | (6). A |
| (7). B | (8). C | (9). C |
| (10). A | (11). C | (12). B, C |
| (13). A, B, C | (14). D | |

11. Hybridisation, SP, SP², SP³ Hybridisation

- | | | |
|---------|---------|---------|
| (1). B | (2). C | (3). D |
| (4). C | (5). D | (6). A |
| (7). B | (8). D | (9). B |
| (10). D | (11). B | (12). B |
| (13). A | (14). C | (15). C |

12. Sigma & Pi bonds, SP³d, SP³d², dsp² Hybridisation

- | | | |
|--|---------|---------|
| (1). C | | |
| (2). C, because parallel overlapping occur | | |
| (3). B | (4). C | (5). B |
| (6). C | (7). C | (8). D |
| (9). In PCl_5 , P is sp^3d hybridized. Axial Bonds are larger because of higher l.p. – l.p. repulsion | | |
| (10). B | (11). A | (12). A |
| (13). B | (14). B | (15). C |
| (16). B | (17). D | |

13. Hybridisation Determination, Overlapping of Orbitals

- | | | |
|-------------------------------------|-------------------------------------|-------------------------------------|
| (1). | | |
| 1). SP | 2). SP ² | 3). SP ² |
| 4). SP ² | 5). SP ² | 6). SP ³ |
| 7). SP ³ | 8). SP ³ | 9). SP ³ |
| 10). SP ³ | 11). SP ³ | 12). SP ³ |
| 13). SP ³ | 14). SP ³ | 15). SP ³ |
| 16). SP ³ | 17). SP ³ d | 18). SP ³ d |
| 19). SP ³ d | 20). SP ³ d | 21). SP ³ d |
| 22). SP ³ d | 23). SP ³ d | 24). SP ³ d |
| 25). SP ³ d | 26). SP ³ d | 27). SP ³ |
| 28). SP ³ d | 29). SP ³ | 30). SP ³ d |
| 31). SP ³ d | 32). SP ³ d ² | 33). SP ³ d ² |
| 34). Sd ³ | 35). SP | 36). SP |
| 37). SP ³ | 38). SP ³ | 39). SP ³ |
| 40). SP ² | 41). SP ² | 42). SP ³ d ² |
| 43). SP ³ | 44). SP ³ | 45). SP ³ d |
| 46). SP ³ | 47). SP ³ d ² | 48). SP ³ d |
| 49). SP ³ d ³ | 50). SP ³ | 51). SP ³ d |
| 52). SP ³ d ² | 53). SP ³ d ² | 54). SP ³ d |
| 55). SP ³ d | 56). SP ³ | 57). SP ³ |
| 58). Sd ³ | 59). Sd ³ | 60). SP ³ |
- (2). B (3). B (4). A
 (5). D (6). C (7). A
 (8). C (9). D (10). B
 (11). B (12). A (13). A
 (14). A

14. Other Concepts related to Hybridisation

- | | | |
|---------|---------|---------|
| (1). C | (2). A | (3). D |
| (4). C | (5). A | (6). B |
| (7). D | (8). C | (9). C |
| (10). C | (11). A | (12). C |
| (13). B | (14). A | |

15. Molecular Orbital Theory

- | | | |
|---------|---------|---------|
| (1). A | (2). C | (3). B |
| (4). A | (5). A | (6). C |
| (7). D | (8). C | (9). A |
| (10). A | (11). A | (12). B |
| (13). C | (14). D | (15). C |
| (16). C | | |

16. MOT of P orbitals, Bond order, Magnetic character

- | | | |
|----------------------------|---------|---------|
| (1). C | (2). A | (3). B |
| (4). A | (5). C | (6). D |
| (7). B | (8). B | (9). A |
| (10). B | (11). A | (12). C |
| (13). B | (14). B | (15). B |
| (16). Increases, decreases | | |
| (17). B | (18). A | (19). A |

17. Magnetic character, Overlapping of MO

- | | | |
|---------|---------|---------|
| (1). B | (2). C | (3). A |
| (4). A | (5). D | (6). C |
| (7). A | (8). B | (9). C |
| (10). C | (11). A | (12). A |
| (13). B | (14). C | (15). C |

18. Secondary Bonding

- | | | |
|---------|---------|---------|
| (1). D | (2). A | (3). C |
| (4). B | (5). C | (6). C |
| (7). D | (8). C | (9). A |
| (10). A | (11). A | (12). C |
| (13). B | (14). D | |

19. Hydrogen Bonding

- | | | |
|-----------------------------------|---------|---------|
| (1). C | (2). C | (3). D |
| (4). D | (5). A | (6). C |
| (7). A | (8). A | |
| (9). HCOOH & CH ₃ COOH | | |
| (10). C | (11). C | (12). A |
| (13). A | (14). C | (15). A |
| (16). A | (17). B | (18). B |
| (19). C | (20). B | (21). C |
| (22). A | | |

20. Metallic Bonding, Semiconductor

- | | | |
|---------|---------|--------|
| (1). C | (2). C | (3). D |
| (4). A | (5). B | (6). D |
| (7). A | (8). B | (9). B |
| (10). C | (11). A | |