Chapter 4

Chemical Bonding and Molecular Structure

Solutions

SECTION - A

Objective Type Questions (One option is correct)

1. Shape of the compounds XeF_3^+ and XeF_5^+ are respectively

   (1) T-shape, square pyramid (2) Sea-saw, square pyramidal

   (3) Bent T-shaped, square pyramidal (4) T-shaped in both

Sol. Answer (3)

Hybridisation compound/ion shape

(i) sp^3d XeF_3^+ T

(ii) sp^3d^2 XeF_5^+ Square pyramid

2. In which of the following compounds, back bonding is possible?

   (1) PF_3 (2) PH_3 (3) NH_3 (4) NF_3

Sol. Answer (1)

In PF_3 due to presence of vacant *d* orbital.

3. The hybridisation of P in solid PBr_5 is/are

   (1) sp^3d (2) sp^3 (3) sp^3d^2 (4) Both (2) & (3)

Sol. Answer (2)

PBr_5 exist on $PBr_4^+Br^-$ in solid.

4. The compound in which *sp* mixing is present

   (1) N_2 (2) O_2 (3) C_2H_2 (4) Both (1) & (3)

Sol. Answer (4)

Fact

5. The correct sequence regarding bond angle

   (1) $NH_3 > PH_3 > AsH_3$ (2) $NH_3 = PH_3 = AsH_3$ (3) $AsH_3 > PH_3 > NH_3$ (4) $PH_3 > NH_3 > AsH_3$

Sol. Answer (1)

In hydride down the group bond angle decreases.

6. Correct regarding hydrogen bond strength and boiling point respectively

(1) $HF > H_2O$, $H_2O > HF$ (2) $HF > H_2O$, $HF > H_2O$

(3) $H_2O > HF$, $H_2O > HF$ (4) $HF > H_2O$, $HF = H_2O$

Sol. Answer (1)

Due to network structure in water.

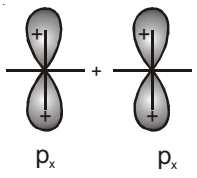
7. The correct order of pair regarding nodal surface

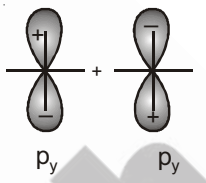
(1) $\sigma 2s > \sigma^* 2s$ (2) $\sigma 2s < \sigma^* 2p_z$ (3) $\sigma^* 2s > \sigma^* 2p_z$ (4) $\sigma^* 2p_z < \pi 2px$

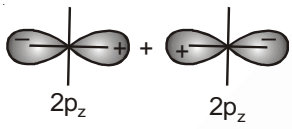
Sol. Answer (2)

Fact

8. Which of the following representation represent π^* molecular orbital, (z is considered as internuclear axis)?

(1) 

(2) 

(3) 

(4) 

Sol. Answer (2)

Opposite sign of wave function gives antibonding.

9. Choose the correct pair regarding dipole moment.

(1) $CH_3Cl > CH_3F$ (2) $NH_3 > NF_3$ (3) $HF > HCl$ (4) All of these

Sol. Answer (4)

Due to formation of pseudo dipole.

10. During oxidation, in which of the following bond order increase?

(1) N_2 (2) CO

(3) O_2^- (4) Both (2) & (3)

Sol. Answer (4)

Based on M.O. theory.

11. Choose the correct statement regarding PCl_5

(1) All P—Cl bond lenghts are equal

(2) $P—Cl_{axial}$ bond lengths is more than $P—Cl_{equatorial}$

(3) $P–Cl_{equatorial}$ bond lengths are more than $P–Cl_{axial}$

(4) $P–Cl_{equatorial}$ bond length may be equal or larger than $P—Cl_{axial}$

Sol. Answer (2)

In PCl_5, $P—Cl_{axial}$ bond length are large.

12. Which of the forces are considered as weakest?

(1) Ionic bond (2) Ion-dipole interaction

(3) Covalent bond (4) London forces

Sol. Answer (4)

Fact

13. How many orbitals on one phosphorus atom in P_4, have 25% s character?

(1) 0 (2) 2 (3) 4 (4) 3

Sol. Answer (3)

Fact

14. The hybridisation of S in orthorombic sulphur is

(1) *sp* (2) sp^3 (3) sp^2 (4) Unhybridised

Sol. Answer (2)

Hybridization of S in orthorhombic S_8.

15. Among the following which is incorrect statement?

(1) ClO_2 and NO are paramagnetic in nature

(2) Hybrid state of P in solid PCl_5 is sp^3d^2 and sp^3

(3) Bond angle is less for NH_4^+(H-N-H) than NO_3^- (O-N-O)

(4) $N(SiMe_3)_3$ is pyramidal like NMe_3

Sol. Answer (4)

16. Select the incorrect statement about $\left(NO_2^-\right)$.

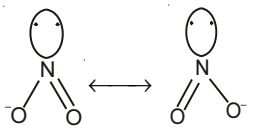
(1) All the N – O bonds are equivalent

(2) It has two resonating structure

(3) Both resonating structures have equal contribution towards resonance hybrid.

(4) Formal charge on nitrogen atom in both resonating structure is +1

Sol. Answer (4)



Formal charge of nitrogen is zero in both the resonating structures.

17. Consider the following statements:

I - The percentage ionic character according to Hannay- Smith equation in X–Y bond is 46% if electronegativity of X and Y are 1.4 and 3.4 respectively

II - Bond angle of PF_3 is more than PH_3.

III - In PCl_2F_3, all P-F bond lengths are equal

The correct statement(s) is(are)

(1) I only (2) II only (3) I and II only (4) I, II and III

Sol. Answer (3)

% ionic character = 16 $(X_A - X_B)$ + 3.5 $(X_A - X_B)^2$

18. Which of the following combination as per VBT does not result into formation of sigma bond? (Assume z-axis as internuclear axis)

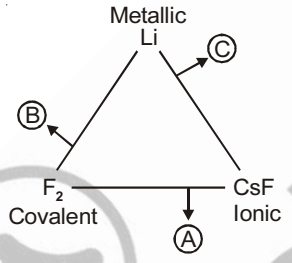
(1) $s + s$ (2) $s + d_{z^2}$ (3) $s + p_y$ (4) $p_z + d_{z^2}$

Sol. Answer (3)

SECTION - B

Objective Type Questions (More than one options are correct)

1. Given below is a triangle illustrating the transition between ionic, metallic and covalent bonding



Where (A), (B) and (C) respectively are compounds which have more ionic, covalent and metallic character respectively. Which combination go well for (A), (B) and (C)?

(1) MgF_2, I_2, Na_3Bi (2) IF_7, ClF, Na_3N (3) BeF_2, S_8, Na_3Sb (4) OF_2, ClF, NF_3

Sol. Answer (1, 3)

MgF_2	I_2	Na_3Bi
Ionic	Covalent	Metallic
BeF_2	S_8	Na_3Sb
Ionic	Covalent	Metallic

2. Amongst the given structures, which are permissible resonance forms?

(1) $\overset{\oplus}{C}H_2 - \ddot{N} - \ddot{O}:^{\ominus}]$ (2) $CH_2 = N = \ddot{O}:$ (3) $CH_2 = \overset{+}{N} - \ddot{O}:^{-}$ (4) $\overset{-}{C}H_2 - \overset{+}{N} = O$

Sol. Answer (1, 3, 4)

In option 2, N-atom has 5 bonds.

3. In solid PCl_5 exist as $[PCl_4]^+[PCl_6]^-$. The hybridisation of P is/are

(1) sp^3 (2) sp^3d (3) sp^3d^2 (4) sp^3d^3

Sol. Answer (1, 3)

Hybridization of P in PCl_4^+ is sp^3 while in PCl_6^- is sp^3d^2.

4. In which of the following case/s central atom is using same hybridised orbital to make bond with surrounding atom?

(1) SF_4 (2) XeO_2F_2 (3) XeO_3 (4) CO_3^{2-}

Sol. Answer (1, 2)

SF_4 and XeO_2F_2 both have 5 VSEP, 4 bond pair and 1 lone pair.

5. Which of the following can show variable valency?

(1) F (2) Cl (3) Br (4) I

Sol. Answer (2, 3, 4)

F do not have *d* orbital hence it is always monovalent but Cl, Br, I have d orbital hence can show variable valency.

6. Molecular axis is *Z* axis, then which of the following combination of orbitals will result in formation of *s* molecular orbitals?

(1) $p_x - p_x$ (2) $s - s$ (3) $p_z - p_z$ (4) $p_y - p_y$

Sol. Answer (2, 3)

If z is intermolecular axis then $p_x - p_x$ and $p_y - p_y$ will overlap sidewise.

7. Isostructural group of molecules are

(1) NH_3, NF_3, BF_3 (2) NO_3, NO_2, SF_4 (3) XeO_4, NH_4^+, CH_4 (4) CH_3^-, NH_3, NF_3

Sol. Answer (3, 4)

(XeO_4, NH_4^+, CH_4) and (CH_3^-, NH_3, NF_3) are isostructural.

8. CO_2 has same geometry as

(1) Hg_2Cl_2 (2) NO_2 (3) C_2H_2 (4) C_3H_6

Sol. Answer (1, 3)

CO_2, Hg_2Cl_2 and C_2H_2 all have linear geometry.

9. Which of the following is a correct statement?

(1) All molecules with polar bonds have dipole moment

(2) $SnCl_2$ is non-linear molecule

(3) Dipole moment of CH_3Cl is greater than CH_3F

(4) I_3^- has linear shape

Sol. Answer (2, 3, 4)

$SnCl_2$ has lone pair on central atom hence it is not linear.

Dipole moment of CH_3Cl is more than CH_3F because bond length of C–F is less (charge in both is same).

$\mu = q \times d$

I_3^- has a linear shape.

10. Which of the following is a correct statement?

(1) CO_2 is a monomer while SiO_2 is a three dimensional giant molecule

(2) Graphite is a nonconductor of electricity

(3) In $(CH_3)_3N$, C–N–C bond angle is approximately 107° whereas in $(SiH_3)_3N$, Si–N–Si bond angle is approximately 120°

(4) In CO_3^{2-} ion all C—O bonds are equal, while in H_2CO_3 all C—O bonds are not equal

Sol. Answer (1, 3, 4)

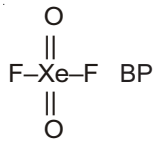
In $(SiH_3)_3N$ lone pair is delocalized hence lone pair-bond pair repulsion decreases, hence, bond angle increases.

11. Molecules with see-saw shape are

(1) SF_4 (2) $XeOF_4$ (3) XeO_2F_2 (4) $HgCl_2$

Sol. Answer (1, 3)

SF_4 BP = 4, LP = 1 $\Rightarrow$ VSEP = 5 , (5, 4, 1) seesaw



F–Xe–F BP = 4, LP = 1 $\Rightarrow$ VSEP = 5 , (5, 4, 1) seesaw

12. Bond order increases in which of the given transitions?

(1) $CO \longrightarrow CO^+$ (2) $N_2 \longrightarrow N_2^+$ (3) $O_2 \longrightarrow O_2^+$ (4) $O_2 \longrightarrow O_2^{2-}$

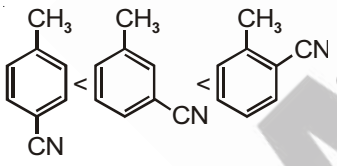
Sol. Answer (1, 3)

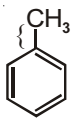
When $CO \longrightarrow CO^+$, bond order increases from 3 to 3.5 and when $O_2 \longrightarrow O_2^+$ bond order increases from 2 to 2.5 because in both case electron is removed from antibonding molecular orbital.

13. Which of the following is correct order as per the property mentioned with it?

(1) $\sigma_{2p_z} < \sigma^*_{2p_z} = \pi_{2p_y} < \pi^*_{2p_y}$ (Energy order for O_2 molecule)

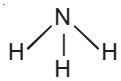
(2) $NH_3 > PH_3 > AsH_3$ (Bond angle)

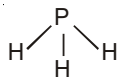
(3)  (Dipole moment)

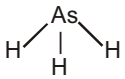
(4)  $< CH_2 = \overset{\frown}{CH - CH_3} < \overset{\frown}{CH_3 - CH_2} - CH = CH_2$ (C–C Bond length)

Sol. Answer (2, 4)

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





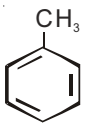


Size N < P < As

EN N > P > As

Bond angle increases with increasing electronegativity.

CH_3 is electron donating and CN is electron attracting, hence, order of dipole moment will be o < m < p

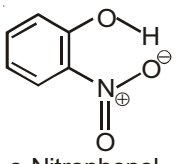
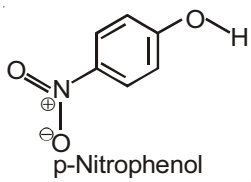


, CH_3 is donor hence bond length decreases.

CH_2=CH–CH_3, Here CH_3 can show hyper conjugation hence bond length will be between single and double bond.

CH_3–CH_2–CH=CH_2.

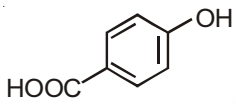
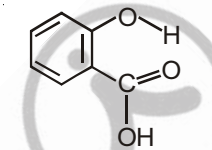
14. In which of the following pairs first partner is more soluble in water than second partner ?

(1)  and 

o-Nitrophenol p-Nitrophenol

(2) NaCl and AgCl

(3) $Be(OH)_2$ and $Ba(OH)_2$

(4)  and 

p-Hydroxybenzoic acid o-Hydroxybenzoic acid

Sol. Answer (2, 4)

NaCl is more soluble and p-hydroxy benzoic acid is more soluble.

15. Which of the following are correctly matched with name of bond present between them?

	Joining Entities	**Bond**
(1)	2 ice cubes pressed together	Hydrogen bonding
(2)	Hydrated sodium ions with hydrated chloride ion	Dipole-dipole interaction
(3)	H_2 gas molecules	Hydrogen bonding
(4)	HCl gas molecules	London's dispersive force

Sol. Answer (1, 2)

H_2 gas molecule can not form H-bonding.

HCl gas molecules have dipole interaction.

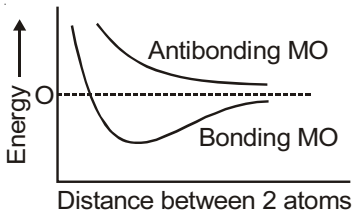
SECTION - C

Linked Comprehension Type Questions

Comprehension-I

In molecular orbital theory (MOT), the atoms in a molecule are supposed to loose their individual control over the electrons. The nuclei of the bonded atoms are considered to be present at equilibrium in inter-nuclear positions. The orbitals where the probability of finding electrons is maximum are multicentred orbitals called molecular orbitals extending over 2 or more nuclei when a pair of atomic orbitals combine and give rise to a pair of molecular orbitals – bonding and antibonding molecular orbital. Electron density is increased for bonding MO's in internuclear region

but decreased for antibonding MO's. Shielding of the nuclei by increased electron density in bonding MO's reduces inter nuclear repulsion & thus stabilizes the molecule whereas lower electron density in antibonding MO's increases the repulsion and destabilises the system.



1. Which of the following is the correct order of bond strength of given species?

(1) $N_2 > N_2^+ > N_2^-$ (2) $N_2 > N_2^- > N_2^+$ (3) $N_2^+ > N_2 > N_2^-$ (4) $N_2^- > N_2 > N_2^+$

Sol. Answer (1)

N_2^- 2.5

N_2^+ 2.5

N_2 3.0

N_2^- & N_2^+ both have same bond order but N_2 has higher number of antibonding electron. Hence correct order is $N_2^- < N_2^+ < N_2$.

2. Which of the following hetero-diatomic molecular ion is paramagnetic?

(1) NO^+ (2) CO (3) CN^- (4) NO^-

Sol. Answer (4)

$NO^{\ominus}$ is paramagnetic.

3. Which of the following species have identical value of bond order?

(1) F_2 and Ne_2 (2) C_2 and N_2 (3) N_2^+ and O_2^+ (4) All of these

Sol. Answer (3)

F_2 1

Ne_2 0

C_2 2

N_2 3

N_2^+ 2.5

O_2^+ 2.5

Both N_2^+ & O_2^+ have bond order 2.5

Comprehension-II

Properties of most ionic solids deviate from ideal ionic character because lattice may undergo some distortion. Cations are usually smaller than anions and have higher effective nuclear charge than the latter. The outer electron cloud in a cation is more firmly held than in an anion. Loose electron cloud of anion when attracted by electron cloud of cation gets distorted. This phenomenon is known as polarisation. Due to this polarisation, electron cloud of anion shifts towards cation which decreases magnitude of '+ve' charge on cation & '–ve' charge on anion. In other words, covalent character develops in ionic bond.

1. Which of the following is an ionic compound?

(1) AlF_3 (2) $AlCl_3$ (3) $AlBr_3$ (4) AlI_3

Sol. Answer (1)

Cations are same, hence, smaller the size of anion, lesser is polarization and greater will be ionic character.

2. Which of the following alkali metal carbonate decompose on heating?

(1) Li_2CO_3 (2) Na_2CO_3 (3) K_2CO_3 (4) Rb_2CO_3

Sol. Answer (1)

Li_2CO_3 has smaller cation hence more covalent character hence decompose on heating.

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

(1) LiCl & RbCl (2) RbCl & $MgCl_2$ (3) RbCl & $BeCl_2$ (4) $MgCl_2$ & $BeCl_2$

Sol. Answer (3)

LiCl $BeCl_2$

RbCl $MgCl_2$

Anions are same hence greatest ionic character is possessed by species having largest cation and least ionic character will be possessed by species containing smallest cation.

Comprehension-III

Electric dipole moment is a vector quantity. If a compound contain more than one polar bond then, the net electric dipole moment is equal to vector sum of individual dipole moment.

e.g., In H_2O

μ = 1.84D

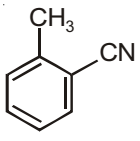
1. Which of the following compounds have zero dipole moment?

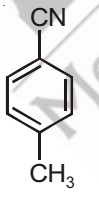
(1) SF_4 (2) ICl_4^- (3) H_2S (4) $SnCl_2$

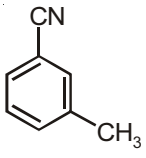
Sol. Answer (2)

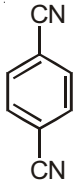
ICl_4^- is square planar molecule having zero dipole moment.

2. Out of following which has the highest dipole moment?

(1) 

(2) 

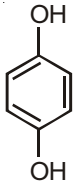
(3) 

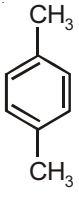
(4) 

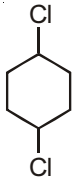
Sol. Answer (2)

CH_3— is e^- donor and —CN is e^- acceptor groups.

3. Which of the following compounds have zero dipole moment?

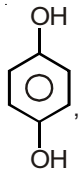
(1) 

(2) 

(3) 

(4) All of these

Sol. Answer (2)

In  , H atoms are not in same plane. In p-xylene both moments are cancelled.

4. A compound has molecular formula XeO_n where 'n' is number of oxygen atoms, dipole moment of the compound is minimum when n is

(1) 4 (2) 1 (3) 3 (4) 2

Sol. Answer (1)

XeO_4 has no lone pair and its dipole moment is zero.

Comprehension-IV

Lattice energy : Lattice energy is the amount of energy released when one mole of ionic compound is formed from its gaseous ions"

$$\underset{(g)}{Na^+} + \underset{(g)}{Cl^-} \longrightarrow NaCl\,(s) + \Delta x\ kJ$$

Lattice energy also depend on the 3-D arrangement of ion.

1. Which of the following has the highest Lattice energy?

(1) MgO (2) NaCl (3) CaO (4) KCl

Sol. Answer (1)

$$\text{Lattice energy} \propto \frac{q_1 q_2}{r^2}$$

2. In the given compounds least Lattice energy is present in

(1) AgF (2) AgBr (3) AgCl (4) NaCl

Sol. Answer (2)

3. LiF is insoluble in water due to

(1) Low hydration energy (2) High hydration energy

(3) Low Lattice energy (4) High Lattice energy

Sol. Answer (4)

LiF have very high lattice energy.

Comprehension-V

Shape of the compound depend on type and number of electron pair around central atom. These electron pair repel each other and stay as far as possible. The repulsion sequence is as

L.P.— L.P. > B.P. — L.P. > B.P. — B.P.

1. Choose the incorrect match

Compound	**Structure**
(1) $SnCl_2$	Linear
(2) CO_2	Linear
(3) I_3^-	Linear
(4) N_3^-	Linear

Sol. Answer (1)

$SnCl_2$ is bent shape molecule.

2. Which of the given compound is planar?

(1) XeF_5^- (2) XeF_4 (3) ICl_4^- (4) All of these

Sol. Answer (4)

3. d_{z^2} orbital take part in hybridisation

(1) dsp^3 (2) sp^3d^2 (3) d^2sp^3 (4) All of these

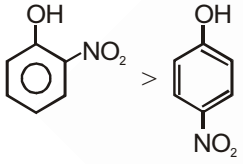
Sol. Answer (4)

d_{z^2} have largest lobes and can easily takes part in all three hybridization.

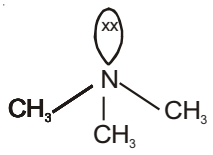
SECTION - D

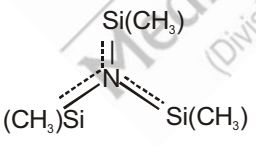
Matrix-Match Type Questions

1. Match the following.

Column-I (Order)	**Column-II (Property)**
(A) $(SiH_3)_3N < (CH_3)_3N$	(p) Volatility
(B) 	(q) Thermal stability
(C) $Na_2CO_3 > CaCO_3$	(r) Density
(D) Ice < water	(s) Basicity

Sol. Answer A(s), B(p), C(q), D(r)





In $NSi(CH_3)_3$, Si uses its vacant d-orbital for back bonding with lone pair electrons of central N atom, hence, has less tendency to release its electrons, hence, less basic.

Ortho nitro phenol shows intramolecular hydrogen bonding while para nitro phenol shows intermolecular hydrogen bonding hence ortho isomer is more volatile.

Na^+ is smaller than Ca^{+2}, hence, Na_2CO_3 has more lattice energy than $CaCO_3$. Hence, Na_2CO_3 is more thermally stable.

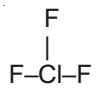
Water has high density than ice because ice forms cage like structure and large vacancies are created in ice.

2. Match the following.

Column-I (Molecule)	**Column-II (Number of lone pair + bond pair respectively at central atom)**
(A) ClF_3	(p) 2 + 2
(B) XeF_4	(q) 2 + 3
(C) I_3^-	(r) 2 + 4
(D) H_2S	(s) 3 + 2

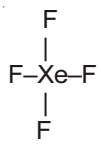
Sol. Answer A(q), B(r), C(s), D(p)

ClF_3 :



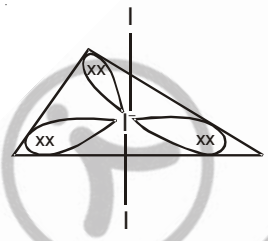
$\left.\begin{matrix} BP = 3 \\ LP = 2 \end{matrix}\right\} \Rightarrow 2 + 3$

XeF_4 :



$\left.\begin{matrix} BP = 4 \\ LP = 2 \end{matrix}\right\} \Rightarrow 2 + 4$

I_3^-



LP = 3, BP = 2 $\Rightarrow$ 3 + 2

H_2S : H–S–H

LP = 2, BP = 2 $\Rightarrow$ 2 + 2

3. Match the following.

Column-I (Molecule)	**Column-II (Hybridisation of central atom)**
(A) H_2Te	(p) sp^3d
(B) XeF_4	(q) sp^2
(C) $ICIF_2$	(r) sp^3
(D) HCOOH	(s) sp^3d^2

Sol. Answer A(r), B(s), C(p), D(q)

H_2Te

$$VSEP = \frac{1}{2}(V + M - C + A)$$

$$= \frac{1}{2}(6 + 2 - 0 + 0)$$

$$= \frac{8}{2} = 4 \Rightarrow sp^3$$

XeF_4

$$VSEP = \frac{1}{2}(8 + 4 - 0 + 0)$$

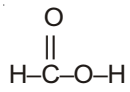
$$= \frac{12}{2} = 6 \Rightarrow sp^3d^2$$

$ICIF_2$

Cl is centre atom.

$$VSEP = \frac{1}{2}(7 + 3 - 0 + 0)$$

$$= \frac{10}{2} = 5 \Rightarrow sp^3d$$



Central atom is C.

If C attached with one double bond then sp^2.

4. Match the following

Column I	**Column II**
(A) NF_3	(p) Lowest bond angle among column I
(B) NH_3	(q) Lowest dipole moment among column II
(C) NO_2	(r) Incomplete octet
(D) N_2O	(s) 103° < Bond angle < 109°28'

Sol. Answer A(p), B(s), C(r), D(q)

SECTION - E

Assertion-Reason Type Questions

1. STATEMENT-1 : Polarisation is the distortion of the shape of an anion by an adjacently placed cation.

and

STATEMENT-2 : Maximum polarisation is brought about by a cation of high charge.

Sol. Answer (2)

Factual.

2. STATEMENT-1 : PH_3 and PF_3 are pyramidal in shape with one lone pair on P but PF_3 has greater bond angle than PH_3.

and

STATEMENT-2 : Back bonding is present in PF_3 but absent in PH_3.

Sol. Answer (1)

More E_N atom shall repel each other strongly, increasing the bond angle. But back-bonding is possible in PF_3 due to vacand d-orbitals in P and availability of lp on F.

3. STATEMENT-1 : AlF_3 is a high melting point solid whereas SiF_4 is a gas.

and

STATEMENT-2 : Both AlF_3 and SiF_4 are covalent molecules.

Sol. Answer (3)

AlF_3 is ionic, hence, a solid. SiF_4 is covalent, hence, a gas.

4. STATEMENT-1 : CS_2 behave as a non-polar solvent.

and

STATEMENT-2 : The shape of CS_2 is linear.

Sol. Answer (2)

S=C=S

C, S have almost same electronegativity, hence, CS_2 is non polar.

CS_2 is linear (BP = 2, LP = 0 , VSEP = 2)

5. STATEMENT-1 : PCl_5 has trigonal bipyramidal shape.

and

STATEMENT-2 : Length of all P–Cl bonds in PCl_5 is equal.

Sol. Answer (3)

In PCl_5 all bond angles and bond lengths are not equal.

6. STATEMENT-1 : The compounds which have polar bonds have non-zero dipole moment.

and

STATEMENT-2 : Dipole moment is a vector quantity.

Sol. Answer (4)

O=C=O

CO_2 has two polar bonds although it is non polar.

7. STATEMENT-1 : H_2O is liquid whereas H_2S is gas.

and

STATEMENT-2 : Oxygen is more electronegative than sulphur.

Sol. Answer (2)

H_2O is liquid due to Hydrogen-bonding; O is more electronegative than S but for Hydrogen-bonding one atom should be highly electronegative while S is not highly electronegative.

8. STATEMENT-1 : Boiling point of H_2O is more than HF.

and

STATEMENT-2 : Intermolecular hydrogen bonding in HF is stronger than H_2O.

Sol. Answer (2)

Boiling point of H_2O is higher because it forms four hydrogen bonds per molecule.

9. STATEMENT-1 : In LiCl, more covalent character is present than in LiF.

and

STATEMENT-2 : Polarizability of Cl^- is more than F^-.

Sol. Answer (1)

Larger will be anoin more will be polarisability.

10. STATEMENT-1 : O_2^- and O_2^+ are paramagnetic.

and

STATEMENT-2 : Bond order of O_2^+ and O_2^- is same.

Sol. Answer (3)

Bond order of O_2^+ and O_2^- are 2.5 and 1.5 respectively.

SECTION - F

Integer Answer Type Questions

1. How many no. of σ-bonds are present in H_2SO_4?

Sol. Answer (6)

Fact.

2. How many P–O–P bonds are present in P_4O_{10}?

Sol. Answer (6)

Fact.

3. How many hybrid orbitals are used for bond formation in SF_4?

Sol. Answer (4)

Hybridization is sp^3d.

$\therefore$ Five hybrid orbitals and one hybrid orbital is unused carrying lone pair.

4. How many right angle bonds are present in BrF_5?

Sol. Answer (0)

Its shape is distorted square pyramidal.

5. What will be the bond order between O—O in peroxide of sodium?

Sol. Answer (1)

Na_2O_2 contain O_2^{-2} anion having bond order one.

6. Maximum valency that is possible for P with Cl is _____.

Sol. Answer (6)

PCl_6^- exist.

7. Number of right angle bonds in PCl_5 is _____.

Sol. Answer (6)

Due to its trigonal bipyramidal shape.

8. Number of $p\pi$—$p\pi$ bond in given compound CN – CH = CH – CN is _____.

Sol. Answer (5)

4π between C & N and one π between C—C.

9. How many of the following are planar?

$C(CN)_3^-$, $\dot{C}H_3$, $\overset{(+)}{C}H_3$, H_2O, Polymeric BeH_2, Polymeric $BeCl_2$, B_2H_6, C_2H_2, NO_2^+, NO_2, NO_2^-

Sol. Answer (8)

$C(CN)_3^-$ is planar because there is bonding between C(2p) — CN^- (π^*) so this is planar

$\dot{C}H_3 \rightarrow sp^2$

$\overset{+}{C}H_3 \rightarrow sp^2$

NO_2^+, NO_2^-, $\dot{N}O_2 \rightarrow$ planar,

$H_2O \rightarrow$ planar

10. Consider the statements

(i) In $H_2C = SF_4$ the π bond lies in equitorial plane

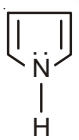
(ii) Correct order of B—N bond length is $B(NR_2)_3 > HB(NR_2)_2 > H_2B—NR_2$

(iii) Boiling point of water is more than HI

(iv) The correct order backbonding is $SiF_4 > SiCl_4 > SiBr_4 > SiI_4$

(v) The correct order of Si – X bond dipole moment is SiF = SiCl = SiBr = SiI

(vi) Ionisation energy of N_2 is more than NO.

(vii) Dipole moment of  is more than 

(viii) N_2H_4 is polar molecule with London dispersion forces, dipole-dipole forces and H-bonding

How many statements are correct?

Sol. Answer (7)

(i) Better overlap in this position

(ii) Due to crowding, order of back bonding decrease so bond length increase

(iii) More H-bonding

(iv) As size of halogen increases order of backbonding decreases.

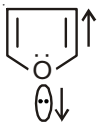
(v) Si – X dipoles are not all equal

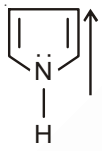
(vi) $N_2 \longrightarrow N_2^+ + 1e^-$

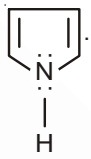
B.O = 2.5

$NO \longrightarrow NO^+ + 1e^-$

B.O = 3





Due to two opposing vector dipole moment in  is less than  .

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