*** Chemistry** **[480]**

1. Match List I with List II.

List I (Compound)	List II (Shape/geometry)
A. NH_3	I. Trigonal Pyramidal
B. BrF_5	II. Square Planar
C. XeF_4	III. Octahedral
D. SF_6	IV. Square Pyramidal

Choose the correct answer from the options given below:

(A) $A-II, B-IV, C-III, D-I$ (B) $A-III, B-IV, C-I, D-II$

(C) $A-II, B-III, C-IV, D-I$ (D) $A-I, B-IV, C-II, D-III$

Ans. : d

$NH_3 \Rightarrow sp^3$ hybridised with 1 lone pair.
Structure will be Trigonal Pyramidal.

$BrF_5 \Rightarrow sp^3d^2$ hybridised with 1 lone pair.
Structure will be Square Pyramidal.

$XeF_4 \Rightarrow sp^3d^2$ with two lone pairs.
Structure will be Square Planar.

$SF_6 \Rightarrow sp^3d^2$ with no lone pair.
Structure will be Octahedral.

$A-I, B-IV, C-II, D-III$

2. Identify the correct answer.

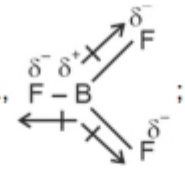
(A) BF_3 has non-zero dipole moment

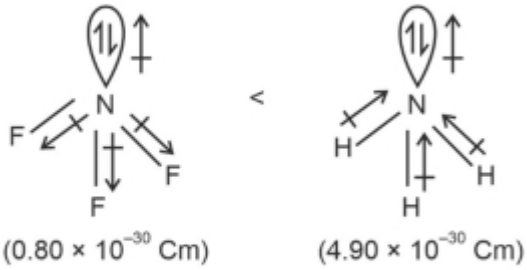
(B) Dipole moment of NF_3 is greater than that of NH_3

(C) Three canonical forms can be drawn for CO_3^{2-} ion

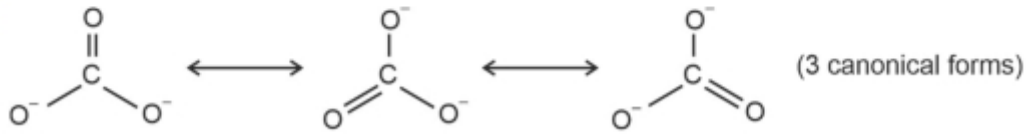
(D) Three resonance structures can be drawn for ozone

Ans. : c

(1) BF_3 i.e.,  ; Dipole moment = 0

(2) 

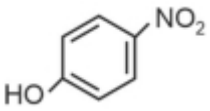
$(0.80 \times 10^{-30}$ Cm) < $(4.90 \times 10^{-30}$ Cm)

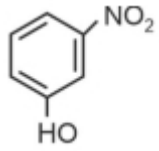
(3) 

(3 canonical forms)

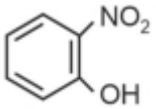
(4) In ozone; there are two resonating structures.

3. Intramolecular hydrogen bonding is present in

(A) 

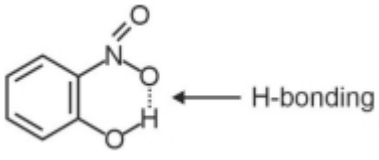
(B) 

(C) HF

(D) 

Ans. : d

In o-nitrophenol intramolecular H-bonding is present.



4. The number of σ bonds, π bonds and lone pair of electrons in pyridine, respectively are:

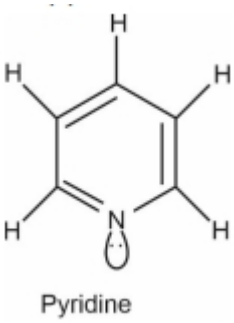
(A) $12, 2, 1$ (B) $11, 2, 0$ (C) $12, 3, 0$ (D) $11, 3, 1$

Ans. : d

No. of σ bonds $= 11$

No. of π bonds $= 3$

No. of lone pair of $e^- = 1$

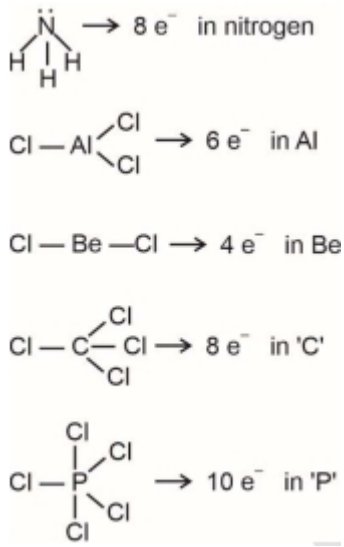


Pyridine

5. Amongst the following the total number of species NOT having eight electrons around central atom in its outermost shell, is $NH_3, AlCl_3, BeCl_2, CCl_4, PCl_5$:

(A) 1 (B) 3 (C) 2 (D) 4

Ans. : b



6. The correct order of energies of molecular orbitals of N_2 molecule, is

(A) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma 2p_z < \sigma^* 2p_z$

(B) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

(C) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

(D) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < \sigma^* 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y)$

Ans. : b

For molecules like B_2, C_2, N_2 etc. the increasing order of energies of various

molecular orbitals is

$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

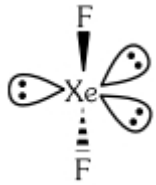
7. Amongst the following which one will have maximum 'lone pair - lone pair' electron repulsions?

(A) IF_5 (B) SF_4 (C) XeF_2 (D) ClF_3

Ans. : c

XeF_2

XeF_2 has maximum 3 lone-pair $-$ lone-pair repulsions



8. $\mathrm{BF_3}$ is planar and electron deficient compound. Hybridization and number of electrons around the central atom, respectively are:

(A) $\mathrm{sp^3}$ and 4 (B) $\mathrm{sp^3}$ and 6 (C) $\mathrm{sp^2}$ and 6 (D) $\mathrm{sp^2}$ and 8

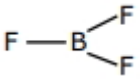
Ans. : c

$\ell \mathrm{p}$ on $\mathrm{CA} = 0$

σ-bond with boron $= 3$

$\therefore$ Stearic number $= 3$

Hybridization $= \mathrm{sp^2}$



9. Match List$-I$ with List$-II$.

List$-II$	List$-II$
(a) PCl_5	(i) Square pyramidal
(b) SF_6	(ii) Trigonal planar
(c) BrF_5	(iii) Octahedral
(d) BF_3	(iv) Trigonal bipyramidal

Choose the correct answer from the options given below.

(A) $(a)-(iv),(b)-(iii),(c)-(i),(d)-(ii)$

(B) $(a)-(ii),(b)-(iii),(c)-(iv),(d)-(i)$

(C) $(a)-(iii),(b)-(i),(c)-(iv),(d)-(ii)$

(D) $(a)-(iv),(b)-(iii),(c)-(ii),(d)-(i)$

Ans. : a

SN (Stearic number)

$\mathrm{PCl_5} \rightarrow 5 \rightarrow \ell \mathrm{p} = 0 \sigma = 5$ Trigonal bipyramidal

$SF_6 \rightarrow 6 \rightarrow \ell p = 0 \sigma = 6$ octahedral

$BrF_5 \rightarrow 6 \rightarrow \ell p = 1 \sigma = 5$ square pyramidal

$BF_3 \rightarrow 3 \rightarrow \ell p = 0 \quad \sigma = 3$ trigonal bipyramidal

10. Which of the following set of molecules will have zero dipole moment?

(A) Boron trifluoride, beryllium difluoride, carbon dioxide, $1,4-$dichlorobenzene

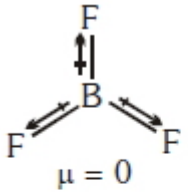
(B) Ammonia, beryllium difluoride, water, $1,4-$dichlorobenzene

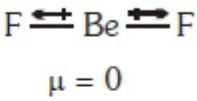
(C) Boron trifluoride, hydrogen fluoride, carbon dioxide, $1,3-$dichlorobenzene

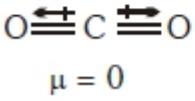
(D) Nitrogen trifluoride, beryllium difluoride, water, $1,3-$dichlorobenzene

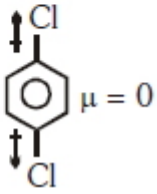
Ans. : a

$BF_3, BeF_2, CO_2 \& 1,4-$ dichloro benzene all are symmetrical structure.









11. Match the coordination number and type of hybridisation with distribution of hybrid orbitals in space based on Valence bond theory.

Coordination number and type of hybridisation	Distribution of hybrid orbitals In space
$(a)\ 4, sp^3$	(i) trigonal bipyramidal
$(b)\ 4, dsp^2$	(ii) octahedral
$(c)\ 5, sp^3d$	(iii) tetrahedral
$(d)\ 6, d^2sp^3$	(iv) square planar

Select the correct option

(A) $(a)-(iii)(b)-(i)(c)-(iv)(d)-(ii)$

(B) $(a)-(ii)(b)-(iii)(c)-(iv)(d)-(i)$

(C) $(a)-(iii)(b)-(iv)(c)-(i)(d)-(ii)$

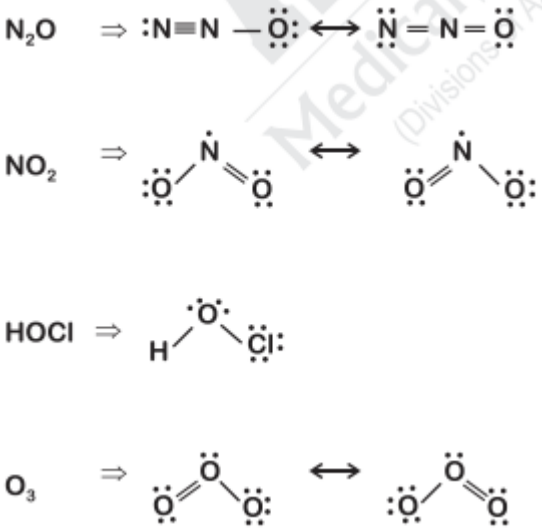
(D) $(a)-(iv)(b)-(i)(c)-(ii)(d)-(iii)$

Ans. : (C) $(a)-(iii)(b)-(iv)(c)-(i)(d)-(ii)$

12. Among the compounds shown below which one revealed a linear structure?

(A) N_2O (B) NO_2 (C) $HOCl$ (D) O_3

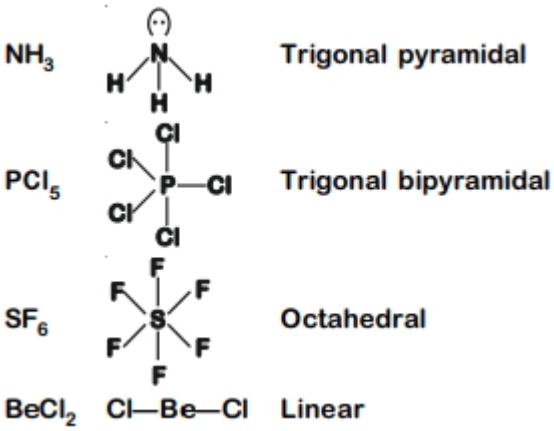
Ans. : a



13. Identify the wrongly match pair.

Molecule	Shape or geometry of molecule
(A) NH_3	Trigonal pyramidal
(B) PCl_5	Trigonal planar
(C) SF_6	Octahedral
(D) $BeCl_2$	Linear

Ans. : b



14. Match the compounds of Xe in column I with the molecular structure in column II.

Column - I	Column - II
(a) XeF_2	(i) Van Arkel method
(b) XeF_4	(ii) Linear
(c) XeO_3	(iii) Square pyramidal
(d) $XeOF_4$	(iv) Pyramidal

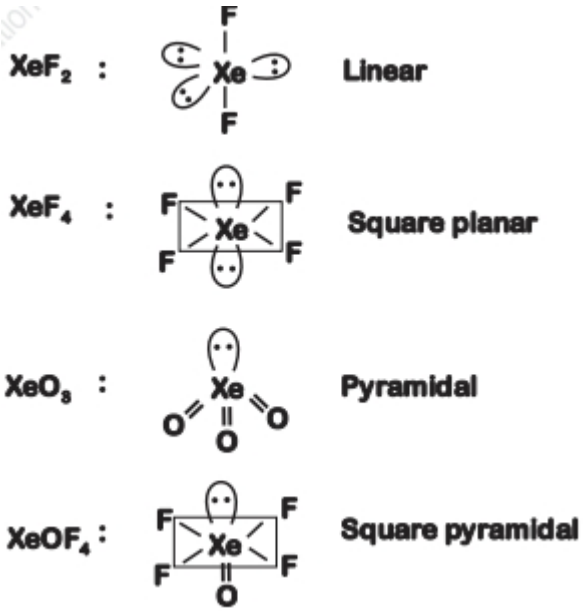
(A) $(a)-(ii)(b)-(i)(c)-(iv)(d)-(iii)$

(B) $(a)-(ii)(b)-(i)(c)-(iii)(d)-(iv)$

(C) $(a)-(ii)(b)-(iv)(c)-(iii)(d)-(i)$

(D) $(a)-(ii)(b)-(iii)(c)-(i)(d)-(iv)$

Ans. : a



15. Identify a molecule which does not exist.

(A) O_2 (B) He_2 (C) Li_2 (D) C_2

Ans. : b

$He_2 =$ Total electron $= 4$

$= \sigma_{1\sigma}^2 \sigma_{1\sigma}^{*2} \Rightarrow B.O. = \frac{1}{2}[Nb - Na] = \frac{1}{2}[2-2] = 0$

Bond order $= 0$, so He_2 does not exist.

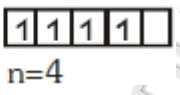
16. The calculated spin only magnetic moment of Cr^{2+} lon is..... $B.M.$

(A) 2.84 (B) 3.87 (C) 4.90 (D) 5.92

Ans. : c

$\mu = \sqrt{(n+2)}$ B.M. $= \sqrt{4(6)} == \sqrt{24}\ B.M.$

$= 4.90\ B.M.$

$Cr^{+2} = 3d^4$ 

17. Which of the following diatomic molecular species has only π bonds according to Molecular Orbital Theory?

(A) O_2 (B) N_2 (C) C_2 (D) Be_2

Ans. : c

According to $M.O.T.$ electronic configuration of C_2 molecule is

$\sigma 1s^2 < \sigma^* 1s^2 < \sigma 2s^2 < \sigma^* 2s^2 < \pi_2 p_x^2 = \pi_2 p_y^2$

so, C_2 molecule contain only π bond

18. Which of the following is paramagnetic ?

(A) N_2 (B) H_2 (C) Li_2 (D) O_2

Ans. : a

According to MOT

19. Which of the following is the correct order of dipole moment ?

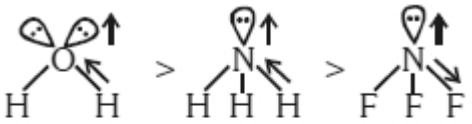
(A) $\mathrm{NH_3} < \mathrm{BF_3} < \mathrm{NF_3} < \mathrm{H_2O}$

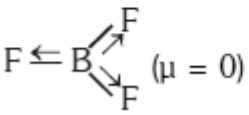
(B) $\mathrm{BF_3} < \mathrm{NF_3} < \mathrm{NH_3} < \mathrm{H_2O}$

(C) $\mathrm{BF_3} < \mathrm{NH_3} < \mathrm{NF_3} < \mathrm{H_2O}$

(D) $\mathrm{H_2O} < \mathrm{NF_3} < \mathrm{NH_3} < \mathrm{BF_3}$

Ans. : b





20. Which of the following pairs of compounds is isoelectronic and isostructural ?

(A) TeI_2, XeF_2 (B) $BeCl_2, XeF_2$ (C) IF_3, XeF_2 (D) IBr_2^-, XeF_2

Ans. : d

IBr_2^-, XeF_2

Total number of valence electrons are equal in both the species and both the species are also linear.

21. Which one of the following pairs of species have the same bond order ?

(A) O_2, NO^+ (B) CN^-, CO (C) N_2, O_2^- (D) CO, NO

Ans. : b

Total no. of electrons in $\mathrm{CN^-}$ is 14

Total no. of electrons in CO is also 14

hence B.O. of both $\mathrm{CN^-}$ &CO is 3

22. Predict the correct order among the following :

(A) bond pair $-$ bond pair $>$ lone pair $-$ bond pair $>$ lone pair $-$ lone pair

(B) lone pair $-$ bond pair $>$ bond pair $-$ bond pair $>$ lone pair $-$ lone pair

(C) lone pair $-$ lone pair $>$ lone pair $-$ bond pair $>$ bond pair $-$ bond pair

(D) lone pair $-$ lone pair $>$ bond pair $-$ bond pair $>$ lone pair $-$ bond pair

Ans. : c

According to $V.S.E.P.R.$ Theory lone-lone pair repulsion is maximum because lone pair electron held by nuclei of one atom there for occupy more space. Repulsion $\Rightarrow$ lone pair-lone pair $>$ lone pair-bond pair $>$ bond pair-bond pair

23. Which one of the following compounds shows the presence of intramolecular hydrogen bond ?

(A) H_2O_2

(B) HCN

(C) Cellulose

(D) Concentrated acetic acid

Ans. : c

H_2O_2, HCN and conc. CH_3COOH form intermolecular hydrogen bonding while cellulose has intramolecular hydrogen bonding.

24. In which of the following pairs, both the species are not isostructural ?

(A) Diamond, Silicon carbide

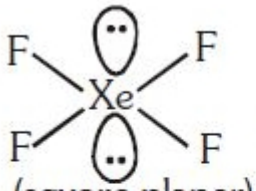
(B) NH_3, PH_3

(C) $XeF_4, XeO4$

(D) $SiCl_4, PCl_4^+$

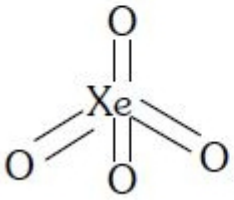
Ans. : c

Structures of XeF_4 is square planar.



(square planar) $sp^3\,d^2$ hybridisation

Structure of XeO_4 is tetrahedral



sp^3 hybridisation

so XeF_4 and XeO_4 are not isostructural

25. Which of the following options represents the correct bond order?

(A) $O_2^- > O_2 < O_2^+$ (B) $O_2^- < O_2 > O_2^+$ (C) $O_2^- > O_2 > O_2^+$ (D) $O_2^- < O_2 < O_2^+$

Ans. : d

According to molecular orbital theory (MOT)

	O_2^-	O_2	O_2^+
No. of e^-	17	16	15
Bond order	1.5	2	2.5

26. Which of the following molecules has the maximum dipole moment ?

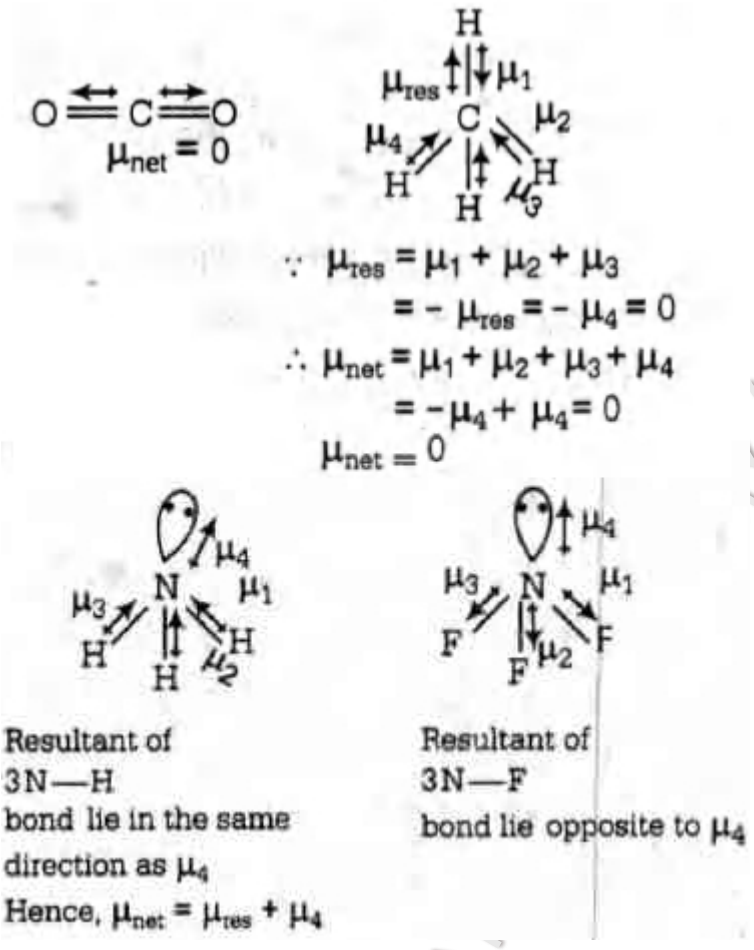
(A) CO_2 (B) CH_4 (C) NH_3 (D) NF_3

Ans. : c

CO_2 and CH_4 have zero dipole moment as these are symmetrical in nature.

Between NH_3 and NF_3, NF_3 has greater dipole mough in NH_3 and NF_3 both, N possesses one lone pair of electrons.

This is because in case of NH_3, the net N - H bond dipole is in the same direction as the direction of dipole of lone pair but in case of NF_3, the direction of net bond dipole of three- $N-F$ bonds is opposite than that of the dipole of the then lone pair.



27. Identify the correct order of solubility in aqueous medium.

(A) $Na_2S > CuS > ZnS$ (B) $Na_2S > ZnS > CuS$

(C) $CuS > ZnS > Na_2S$ (D) $ZnS > Na_2S > CuS$

Ans. : b

Ionic compounds are more soluble in water or in aqueous medium.

According to Fajans' rule,

Size of the cation increases the ionic character also increases.

Ionic character oc size of cation (if anion is same)

The order of size of cation is

$Na^+ > Zn^{2+} > Cu^{2+}$

∴ The order of ionic character and hence, of solubility in water is as

$Na_2S > ZnS > CuS$

28. The outer orbitals of C in ethene molecule can be considered to be hybridized to give three equivalent sp^2 orbitals. The total number of sigma (σ) and pi (π) bonds in ethene molecule is

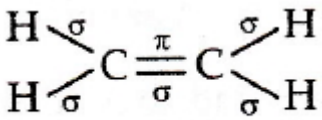
(A) 3 sigma (σ) and 2 pi (π) bonds

(B) 4 sigma (σ) and 1 pi (π) bonds

(C) 5 sigma (σ) and 1 pi (π) bonds

(D) 1 sigma (σ) and 2 pi (π) bonds.

Ans. : c

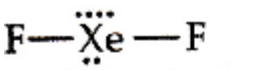


5 σ-bond and 1 π-bond

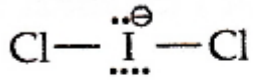
29. XeF_2 is isostructural with

(A) $SbCl_3$ (B) $BaCl_2$ (C) TeF_2 (D) ICl_2^-

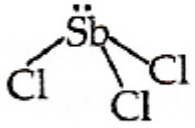
Ans. : c



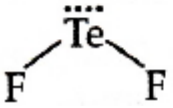
sp^3d, Linear



sp^3d, Linear



sp^3, Pyramidal



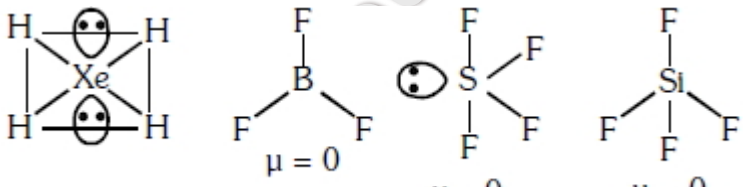
sp^3, V-shaped

30. Which of the following is a polar molecule ?

(A) SiF_4 (B) XeF_4 (C) BF_3 (D) SF_4

Ans. : d

Unsymmetrical distribution of e^- cloud leads to the formation of polar molecule



31. Which of the following is paramagnetic ?

(A) CN^- (B) NO^+ (C) CO (D) O_2^-

Ans. : d

CN^-, CO and NO^+ are isoelectronic with 14 electrons each and there is no unpaired electrons in the MO configuration of these species.

So these are diamagnetic. O_2^* is paramagnetic due to the presence of one unpaired electron.

$\left(CN^-, CO, NO^+\right) 14 = \sigma s^2, \sigma^* L^2, \sigma 2s^2, \sigma^* 2s^2 \sigma 2p_x^2$

$\pi 2p_y^2 \approx \pi 2p_z^2$ (No unpaired electron, diamagnetic)

$O_2^- = \sigma s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2$

$\pi 2p_x^2 \approx \pi 2p_z^2, \pi^* 2p_y^2 = \pi^* 2p_z^1$

(one unpaired electron, paramagnetic)

32. In which of the following ionization processes the bond energy increases and the magnetic behaviour changes from paramagnetic to diamagnetic.

(A) $O_2 \rightarrow O_2^+$ (B) $C_2 \rightarrow C_2^+$ (C) $NO \rightarrow NO^+$ (D) $N_2 \rightarrow N_2^+$

Ans. : c

In $C_2 - C_2^+$ electrons is removed from bonding molecular orbital so bond order decreases.

In $NO \rightarrow NO^+$ electrons is removed from anti bonding molecular orbital so bond order increases and nature changes from paramagnetic to diamagnetic.

33. Dipole-induced dipole interactions are present in which of the following pairs

(A) HCl and He atoms (B) SiF_4 and He atoms

(C) H_2O and alcohol (D) Cl_2 and CCl_4

Ans. : a

HCl is polar $(\mu \neq 0)$ and He is non-polar $(\mu = 0)$ gives dipole-induced dipole interaction.

34. The pair of species that has the same bond order in the following is

(A) CO, NO^+ (B) NO^-, CN^- (C) O_2, N_2 (D) O_2, B_2

Ans. : a

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_2^2, \pi 2p_x^2 \approx \pi 2p_x^2, \pi^* 2p_x^2 \approx \pi^* 2p_y^2$

Bond order $= \frac{N_b - N_a}{2}$ (where N_b = number of electrons in bonding molecular orbital N_a = number of electrons in anti $-$ bonding molecular orbital)

$O_2^{2-} (8 + 8 + 2 = 18)$

$BO = \frac{N_b - N_a}{2} = \frac{10-8}{2} = 1$

$B_2 (5 + 5 = 10) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1 \approx \pi 2p_y^1$

$BO = \frac{6-4}{2}$

similarly, order of;

$O_2^+ = 2.5, NO^+ = 3$

$NO = 2.5, CO = 3$

$N_2 = 3$ and $O_2 = 2$

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_2^2, \pi 2p_x^2 \approx \pi 2p_y^2, \pi^* 2p_x^2 \approx \pi^* 2p_y^2$

Bond order $= \frac{N_b - N_a}{2}$

(where $N_b =$ number of electrons in bonding molecular orbital

$\mathrm{N}_a =$ number of electrons in anti - bonding molecular orbital $O_2^{2-}(8+8+2=18)$

$\mathrm{BO} = \frac{\mathrm{N_b}-\mathrm{N_a}}{2} = \frac{10-\mathrm{g}}{2} = 1$

$\mathrm{B}_2(5+5=10) = \sigma 1\mathrm{s}^2, \sigma^* 1\mathrm{s}^2, \sigma 2\mathrm{s}^2, \sigma^* 2\mathrm{s}^2, \pi 2\mathrm{p}_\mathrm{x}^1 \approx \pi 2\mathrm{p}_\mathrm{y}^1$

$BO = \frac{6-4}{2}$

similarty, order of:

$O_2^+ = 2.5, \mathrm{NO}^+ = 3$

$\mathrm{NO} = 2.5, \mathrm{CO} = 3$

$\mathrm{N}_2 = 3$ and $\mathrm{O}_2 = 2$

35. Nodal plane in a ethylene molecule is

(A) Parallel to the bond axis

(B) Prependicular to the bond axis

(C) In the molecular plane

(D) None of these

Ans. : c

Nodal plane in ethylene is containing two nuclei.

36. Match list I with list II and select the correct answer

list I (species)	list II ($O-N-O$ angle)
$(A)\ NO_2^+$	$(1)\ 180^o$
$(B)\ NO_2$	$(2)\ 132^o$
$(C)\ NO_2^-$	$(3)\ 120^o$
$(D)\ NO_3^-$	$(4)\ 115^o$
	$(5)\ 109^o$

(A) $A-5,\ B-4,\ C-3,\ D-2$

(B) $A-5,\ B-2,\ C-4,\ D-3$

(C) $A-1,\ B-2,\ C-4,\ D-3$

(D) $A-1,\ B-4,\ C-3,\ D-2$

Ans. : c

NO_2^+ is sp and linear i.e. bond angle is 180°.

NO_2 has a bond angle of 132^0

NO_2^- is sp^2 and bond angle is less than 120° due to lone pair bond pair repulsion.

NO_3^- is sp^2 and trigonal planar i.e. bond angle is 120°.

37. According to $VSEPR$ theory

(A) the shape of the molecule depends upon the bonded electron pairs

(B) pair of electrons attract each other in valence shells

(C) the pairs of electrons tend to occupy such positions that minimise repulsions

(D) the pairs of electrons tend to occupy such positions that minimise distances from each other

Ans. : c

The $VSEPR$ theory assumes that each atom in a molecule will achieve a geometry that minimizes the repulsion between electrons in the valence shell of that atom.

Let's try to understand with example PF_5

Repulsion between the five pairs of valence electrons on the phosphorus atom in PF_5 can be minimized by distributing these electrons toward the corners of a trigonal bipyramid. Three of the positions in a trigonal bipyramid are labeled equatorial because they lie along the equator of the molecule. The other two are axial because they lie along an axis perpendicular to the equatorial plane. The angle between the three equatorial positions is 120° while the angle between an axial and an equatorial position is 90°

38. A molecule of the type AX_5 has square pyramidal geometry hence number of lone pairs on $'A'$ is

(A) 1 (B) 2 (C) 3 (D) 4

Ans. : a

Square pyramidal geometry $= sp^3d^2$ (5 Bond pair $+1$ lone pair)

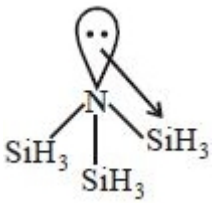
39. Which of the following is planar due to back bonding

(A) BF_3 (B) $N(CH_3)_3$ (C) $N(SiH_3)_3$ (D) PF_3

Ans. : c

$\text{hyb} = \text{sp}^2$

(Trigonal planar) $=$ due to back bonding



40. Which of the following properties correctly explain SiO_2

(A) Linear, basic (B) Tetrahedral, acidic

(C) Tetrahedral, basic (D) Linear, acidic

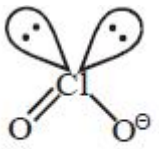
Ans. : b

SiO_2 is slightly acidic in nature. In SiO_2, Si has tetrahedral arrangement each silicon atom bonded with four oxygen atom

41. Which of the following species is non linear?

(A) ICl_2^- (B) I_3^- (C) N_3^- (D) ClO_2^-

Ans. : d



(bent)

42. Assertion : Bond angle of H_2S is smaller than H_2O.
Reason : Electronegativity of the central atom increases, bond angle decreases.
(A) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(B) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(C) If the Assertion is correct but Reason is incorrect.
(D) If both the Assertion and Reason are incorrect.

Ans. : c
Bond angle of $H_2S\,(92^o) < H_2O\,(104^o 31)$. As the electronegativity of the central atom decreases, bond angle decreases. In the present case, S is less electronegative than oxygen. Thus bond pairs in H_2S are more away from the central atom than in H_2O and thus repulsive forces between bond pairs are smaller producing smaller bond angle.

43. A molecule which contains unpaired electrons is
(A) Carbon monoxide (B) Molecular nitrogen
(C) Molecular oxygen (D) Hydrogen peroxide

Ans. : (c) Molecular oxygen contains unpaired electron so it is paramagnetic (according to MOT).

44. The bond order of NO molecule is
(A) 1 (B) 2 (C) 2.5 (D) 3

Ans. : (c) $\text{B.O.} = \frac{\text{No.of bonding}e^- - \text{No.of antibonding}e^-}{2} = \frac{8-3}{2} = \frac{5}{2} = 2.5$.

45. The bond order in N_2^+ ion is
(A) 1 (B) 2 (C) 2.5 (D) 3

Ans. : (c) $\text{B.O.} = \frac{\text{No.of}N_b - \text{No.of}N_a}{2} = \frac{5}{2} = 2.5$.

46. Which of the following molecule is paramagnetic
(A) Chlorine (B) Nitrogen (C) Oxygen (D) Hydrogen

Ans. : (c) Oxygen is paramagnetic due to the presence of two unpaired electron :
$O_2 = \sigma(1s)^2\sigma^*(1s)^2\sigma(2s)^2\sigma^*(2s)^2\ \sigma(2p_x)^2\pi(2p_y)^2\pi(2p_x)^2\pi^*(2p_y)^1\pi^*(2p_z)^1$

47. Which molecule has the highest bond order

(A) N_2 (B) Li_2 (C) He_2 (D) O_2

Ans. : a

Bond order is the number of chemical bonds between a pair of atoms.

N_2 has the highest bond order which is 3.

Li_2, He_2 and O_2 have bond orders $1, 0$ and 2 respectively.

48. Which one of the following is paramagnetic

(A) H_2O (B) NO_2 (C) SO_2 (D) CO_2

Ans. : (b)NO_2 has unpaired electrons so it would be paramagnetic.

49. According to the molecular orbital theory, the bond order in C_2 molecule is

(A) 0 (B) 1 (C) 2 (D) 3

Ans. : (c) $B.O.$ of carbon $= \frac{N_b - N_a}{2} = \frac{8-4}{2} = 2$.

50. The bond order in O_2^+ is

(A) 2 (B) 2.5 (C) 1.5 (D) 3

Ans. : (b) $B.O. = \frac{N_b - N_a}{2} = \frac{10-5}{2} = \frac{5}{2} = 2.5$.

51. Which of the following molecular orbitals has two nodal planes

(A) $\sigma 2s$ (B) $\pi 2p_y$ (C) $\pi^* 2p_y$ (D) $\sigma^* 2p_x$

Ans. : (c)$\pi^* 2p_y$ has two nodal planes.

52. What is correct sequence of bond order

(A) $O_2^+ > O_2^- > O_2$ (B) $O_2^+ > O_2 > O_2^-$ (C) $O_2 > O_2^- > O_2^+$ (D) $O_2^- > O_2^+ > O_2$

Ans. : (b) Correct Sequence of bond order is $O_2^+ > O_2 > O_2^{2-}$

$B.O$	-2.5	2	1.5

53. The bond order is not three for

(A) N_2^+ (B) O_2^{2+} (C) N_2 (D) NO^+

Ans. : (a) $B.O.$ for N_2^+ =$\frac{1}{2}[N_b - N_a]$

=$\frac{1}{2}[9-4] = \frac{5}{2} = 2.5$.

54. Which of the following is correct for N_2 triple bond

(A) $3s$ (B) $1p, 2s$ (C) $2p, 1s$ (D) $3p$

Ans. : c

It's Obvious.

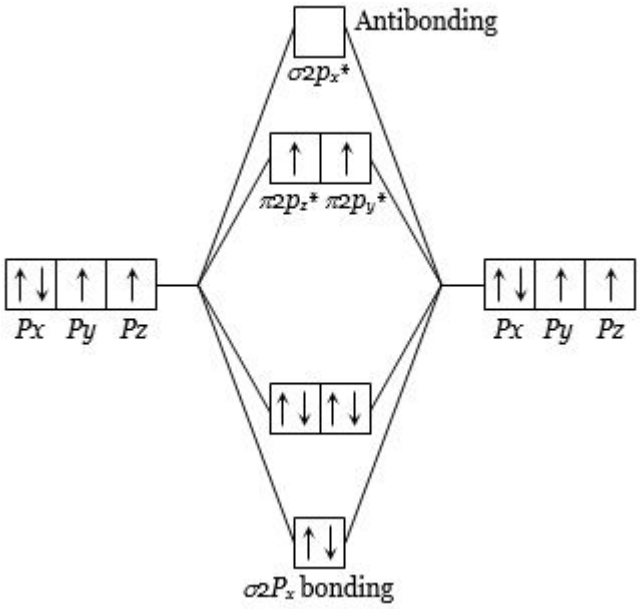
55. The paramagnetic property of the oxygen molecule due to the presence of unpaired electorns present in

(A) $(\sigma 2p_x)^1$ and $(\sigma^* 2p_x)^1$ (B) $(\sigma 2p_x)^1$ and $(\pi 2p_y)^1$

(C) $(\pi^* 2p_y)^1$ and $(\pi^* 2p_z)^1$ (D) $(\pi^* 2p_y)^1$ and $(\pi 2p_y)^1$

Ans. : (c) The paramagnetic property in oxygen came through unpaired electron which can be explained by molecular orbital theory.

So 2 unpaired of electron present in $\pi\ 2p_y^*$ and $\pi\ 2p_z^*$



56. The bond order of O_2^+ is the same as in

(A) N_2^+ (B) CN^- (C) CO (D) NO^+

Ans. : (a) $O_2^+(15e^-) = KK^*(\sigma 2s)^2(\sigma^* 2s)^2(\sigma 2p_x)^2$
$(\pi 2p_y)^2(\pi 2p_z)^2(\pi^* 2p_y)^1(\pi^* 2p_z)^0$

Hence, bond order $= \frac{1}{2}(10-5) = 2.5$ $N_2^+(13e^-) = KK^*(\sigma 2s)^2(\sigma^* 2s)^2(\sigma 2p_x)^2$
$(\pi\, 2p_y)^2(\pi\, 2p_z)^1$

Hence, bond order $= \frac{1}{2}(9-4) = 2.5$.

57. Bond order of O_2 is

(A) 2 (B) 1.5 (C) 3 (D) 3.5

Ans. : (a) Electronic configuration of O_2 is

$O_2 = (\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^2(\sigma^* 2p_z)^2$
$(\pi 2p_x^2 \equiv \pi 2p_y^2)\ (\pi^* 2p_x^1 \equiv \pi^* 2p_y^1)$

Hence bond order $= \frac{1}{2}[N_b - N_a]\ = \frac{1}{2}[10-6] = 2$.

58. What is not true about ice?

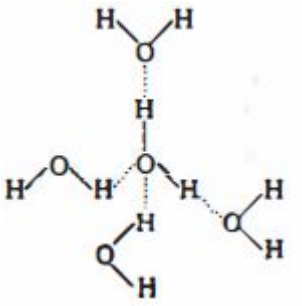
(A) It has open cage like structure

(B) It has less density than water

(C) Each O atom is surrounded by $4\,H$ atoms

(D) Each O atom has four $H-$ bonds around it

Ans. : d



59. Which of the following when dissolved in water forms a solution which is non-conducting?

(A) Green vitriol (B) Chile or Indian salt petre

(C) Alcohol (D) Potash alum

Ans. : c

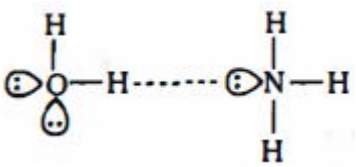
The compounds having covalent bonding will not conduct electricity.

Hence green vitriol which is $FeSO_4$ and indian salt petre and potash alum is ionic while alcohol is covalent in nature.

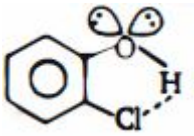
Hence alcohol is non conducting.

60. Which of the following is not a best representation of the $H-$ bond?

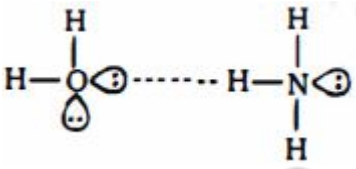
(A)



(B)



(C)



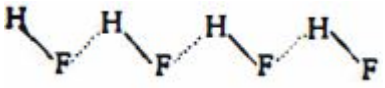
(D) None

Ans. : $(c)\, NH_3$ is stronger lewis base than H_2O and H_2O has more acidic $H-$ atom than NH_3.

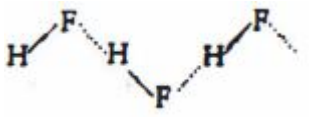
61. The $H-$ bonds in solid HF can be best represented as

(A) $H-F-H-F-H-F$

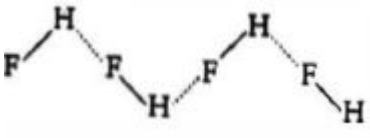
(B)



(C)



(D)



Ans. : c

The arrangement of bp and lp around F is tetrahedral. Therefore, angle should appear around F and not around H atom.

62. Hydrogen bonding present in

(A) KHF_2 (B) KH_2PO_4 (C) KH_2PO_2 (D) Both (A) and (B)

Ans. : (D) Both (A) and (B)

63. The hydrogen bond is not present in

(A) phenol (B) liquid HCl

(C) water (D) liquid NH_3

Ans. : b

Hydrogen bonding is formed in the compounds in which F, O and N atoms are attached to H atom. In HCl thereis no N, O or F and hence it does not form hydrogen bond.

64. Which of the following form dimer by $H-$ bond

(A) CH_3COOH (B) H_2SO_4 (C) $AlCl_3$ (D) $o-$ nitrophenol

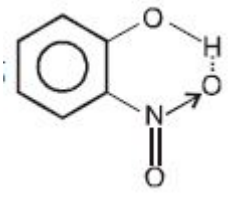
Ans.: (A) CH_3COOH

65. Which one of the following does not have intermolecular $H-$ bonding ?

(A) H_2O (B) $O-$ nitro phenol (C) HF (D) CH_3COOH

Ans. : b

It has intramolecular $H-$ bonding (figure)



66. In a crystal cations and anions are held together by

(A) Electrons (B) Electrostatic forces

(C) Nuclear forces (D) Covalent bonds

Ans. : (b)In electrovalent crystal has cation and anion are attached by electrostatic forces.

67. The enhanced force of cohesion in metals is due to

(A) The covalent linkages between atoms

(B) The electrovalent linkages between atoms

(C) The lack of exchange of valency electrons

(D) The exchange energy of mobile electrons

Ans. : d

Cohesive forces are attractive forces between similar molecules. Ex.,between water-water molecules.

The enhanced Cohesion force is due to the EXCHANGE OF ENERGY IN MOBILE ELECTRONS.

68. Which of the following has the highest melting point

(A) Pb (B) Diamond (C) Fe (D) Na

Ans. : (b)Diamond is the hardest substance it's melting point would be highest.

69. Which has weakest bond

(A) Diamond (B) Neon (Solid) (C) KCl (D) Ice

Ans. : b

Diamond containg a strong covalent bonds.

In potassium chloride (KCl) is containing an ionic bond.

In ice molecule containing hydrogen bond.

therefore, decreasing order of strong bond is as follows:-

Ionic $>$ Covalent $>$ Hydrogen $>$ Dipole-Dipole $>$ VanderWaal

70. Glycerol has strong intermolecular bonding therefore it is

(A) Sweet (B) Reactive (C) Explosive (D) Viscous

Ans. : (d) Glycerol has a three OH group hence it is viscous in nature.

71. Which of the following does not exists as ionic substance in solid state

(A) PBr_5 (B) N_2O_5 (C) Na_2SO_4 (D) H_2O

Ans. : d

In Solid state

PBr_5 exists as PBr_4^+ & Br^-

N_2O_5 exists as NO_3^- & NO_2^+

Na_2SO_4 exists as Na^+ & SO_4^{2-}

H_2O exist as H_2O only

72. Dipole-induced dipole interactions are present in which of the following pairs

(A) SiF_4 and $He\,atoms$ (B) H_2O and $alcohol$

(C) Cl_2 and CCl_4 (D) $HCl\,and\,He\,atoms$

Ans. : a

Dipole - induced dipole occurs between polar & Non-polar molecule

HCl He

Polar Non-polar

$\mu \neq 0$ $\mu = 0$

73. Among the following mixture dipole-dipole attraction is present ?

(A) CH_2Cl_2 and CCl_4 (B) He and He

(C) $CHCl_3$ and CH_2Cl_2 (D) C_6H_6 and CH_4

Ans. : (C) $CHCl_3$ and CH_2Cl_2

74. The boiling points of noble gases are illustrative of the operation of forces of the type

(A) ion-dipole (B) dipole-induced dipole

(C) ion-induced dipole (D) London dispersion forces

Ans. : (D) London dispersion forces

75. The bond that exists between NH_3 and BF_3 is called

(A) Electrovalent (B) Covalent (C) Coordinate (D) Hydrogen

Ans. : (c)NH_3 has lone pair of electron while BF_3 is electron deficient compound so they form a co-ordinate bond. $NF_3 \rightarrow BF_3$

76. Which of the following does not have a coordinate bond

(A) SO_2 (B) HNO_3 (C) H_2SO_3 (D) HNO_2

Ans. : (d) HNO_2 does not have co-ordinate bond.

Structure is $H - O - N = O$.

77. Which has a coordinate bond

(A) SO_3^{2-} (B) CH_4 (C) CO_2 (D) NH_3

Ans. : (a) ${SO_3}^{2-}$ has one coordinate bond.

$$O^- \leftarrow S \rightarrow O^-$$
$$\downarrow$$
$$O$$

78. The compound containing co-ordinate bond is

(A) O_3 (B) SO_3 (C) H_2SO_4 (D) All of these

Ans. : (d) Co-ordinate bond is a special type of covalent bond which is formed by sharing of electrons between two atoms, where both the electrons of the shared pair are contributed by one atom. Since this type of sharing of electrons exits in O_3, SO_3 and H_2SO_4. Therefore all these contains coordinate bond.

79. The number of dative bonds in sulphuric acid molecules is

(A) 2 (B) 1 (C) 0 (D) 4

Ans. : c

Dative bonds are formed by donation of a pair of electrons to the central atom. In sulphuric acid sulphur forms only covalent bond.

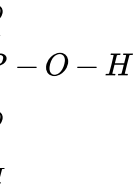
There is no dative (coordinate) bond in sulphuric acid.

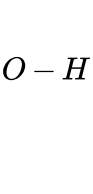
80. Which of the following compounds has coordinate (dative) bond

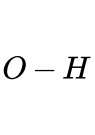
(A) CH_3NC (B) CH_3OH (C) CH_3Cl (D) NH_3

Ans. : (a) $CH_3N \rightarrow C$ contain dative bond.

81. The structure of orthophosphoric acid is

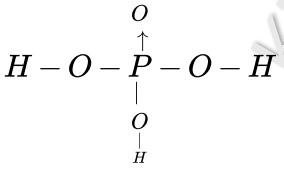
(A) 

(B) 

(C) 

(D) 

Ans. : (a) H_3PO_4 is orthophosphoric acid.



82. What is the nature of the bond between B and O in $(C_2H_5)_2OBH_3$

(A) Covalent (B) Co-ordinate covalent

(C) Ionic bond (D) Banana shaped bond

Ans. : b

$AsBH_3$ is a lewis acid, it can accept a lone pair of electron donated by alkoxy group hence the bond formed is co-ordinate covalent bond. $(C_2H_5)_2O$ gives one lone pair of an electron to BH_3. So, it is called the electron-pair donor.

83. The number of ionic, covalent and coordinate bonds in NH_4Cl are respectively

(A) $1,3\,and\,1$ (B) $1,3\,and\,2$ (C) $1,2\,and\,3$ (D) $1,1\,and\,3$

Ans. : (a) $\left[\begin{array}{c} H \\ | \\ H-N\rightarrow H \\ | \\ H \end{array}\right]^{+} Cl^{-}$.

Ionic bond $=1$,
Covalent bond $=3$
Co-ordinate bond $=1$.

84. The bonds in $K_4\,[Fe\,(CN)_6]$ are

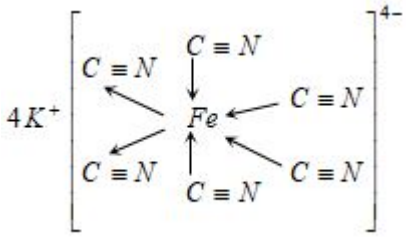
(A) All ionic

(B) All covalent

(C) Ionic and covalent

(D) Ionic, covalent and coordinate covalent

Ans. : (d) Structure of $K_4[Fe(CN)_6]$ is



85. Dative bond is present in

(A) O_3 (B) NH_3 (C) $BaCl_2$ (D) BI_3

Ans. : (C) $BaCl_2$

86. Bonds present in N_2O_5 (nitrogen pentaoxide) are

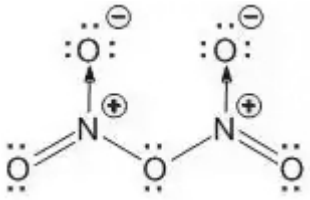
(A) only ionic (B) only covalent

(C) covalent and co-ordinate (D) covalent and ionic

Ans. : c

Since nitrogen and oxygen are non-metals, the bonds between them are NOT ionic. The structure of N_2O_5 is given above.

There are both covalent and coordinate covalent bonds.



87. Which of the following does not contain any co- ordinate bond?

(A) H_3O^+ (B) BF_4^- (C) HF_2^- (D) NH_4^+

Ans. : c

In option A, coordinate/dative bond is formed between lone pair of Oxygen atom and empty s orbital of H ion.

In option B, Boron atom has empty $2p$ orbital after formation of BF_3, so it can accept lone pair of fluorine atom (F atom has 3 lone pairs) and form BF_4^-.

In option C, there is no coordinate bonding but very strong Hydrogen bonding due to high electronegativity of Fluorine. (C) is the correct answer.

In option D, Nitrogen has one lone pair left after forming 3 covalent bonds with hydrogen, it forms coordinate bond by sharing that lone pair with H ion.

88. The $d-$ orbitals which are involved in hybridisation of central atom in ICl_4^-

(A) $d_{z^2}, d_{x^2-y^2}$ (B) $d_{x^2-y^2}, d_{xy}, d_{yz}, d_{zx}$ (C) $d_z^2, d_{xy}, d_{yz}, d_{xz}$ (D) d_{xy}, d_{xz}, d_{yz}

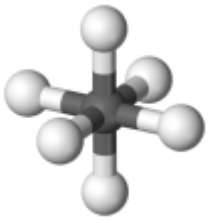
Ans.: (A) $d_{z^2}, d_{x^2-y^2}$

89. In a regular octahedral molecule MX_6, the number of $X-M-X$ bonds of 180^o are :-

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

Ans. : c

There are 3 number of bonds of $X-M-X$ at 180° in regular octahedral molecule (as in the image)



90. If Hund's rule is violated then select the $CORRECT$ statement regarding $[Ni(NH_3)_6]^{2+}$ is

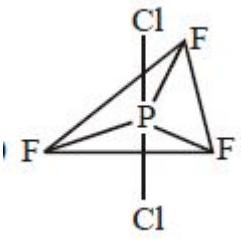
(A) sp^3d^2 , paramagnetic (B) d^2sp^3 , diamagnetic

(C) sp^3d^2 , diamagnetic (D) d^2sp^3 , paramagnetic

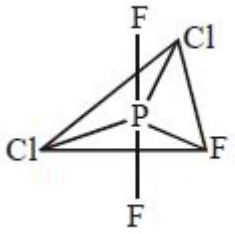
Ans. : (C) sp^3d^2 , diamagnetic

91. Choose the correct structure for PF_3Cl_2 molecule. (electron Affenity : $Cl > F$)

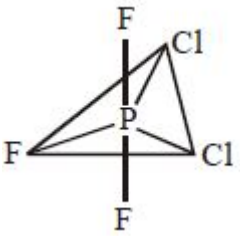
(A)



(B)



(C)



(D) $(B)\ and\ (C)$ both

Ans. : (D) $(B)\ and\ (C)$ both

92. Molecular shape of XeF_3^+ and SNF_3 species are respectively

(A) $T-$ shaped, Tetrahedral

(B) $T-$ shape, square pyramidal

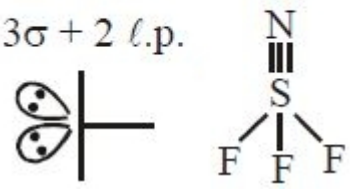
(C) See-saw, square pyramidal

(D) Square pyramidal, see-saw

Ans. : a

$XeF_3^+,\ SNF_3$

$3\sigma + 2\ \ell.p.$



93. Match the species given in Column I with the shape given in column II and mark the correct option:-

Column-I	Column-II (Shape)
$(A)\ SF_4$	(1) Tetrahedral
$(B)\ BrF_3$	(2) Pyramidal
$(C)\ BrO_3^-$	(3) Sea-Saw shaped
$(D)\ NH_4^+$	(4) Bent $T-$ shaped

(A) $A(3), B(2), C(1), D(4)$

(B) $A(3), B(4), C(2), D(1)$

(C) $A(1), B(2), C(3), D(4)$

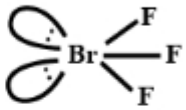
(D) $A(1), B(4), C(3), D(2)$

Ans. : b

A. SF_4

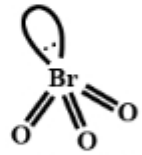
(See Saw Shaped)

B. BrF_3



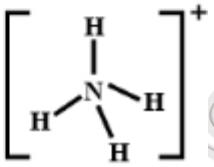
(Bent-shaped)

C. BrO_3^-



(Pyramidal)

D. NH_4^+



(Tetrahedral)

94. Match List $-I$ with List $-II$ and select the correct answer using the codes given below the lists

List$-I$	List$-II$
$(I)\ XeF_4$	(A) See-saw
$(II)\ I_3^-$	(B) Tetra hedral
$(III)\ XeO_2F_2$	(C) Bond angle 90^o
$(IV)\ SO_4^{2-}$	(D) Linear

(A) $(I)-(C), II-(D), III-(A), IV-(B)$

(B) $(I)-(B), II-(A), III-(C), IV-(D)$

(C) $(I)-(C), II-(B), III-(A), IV-(D)$

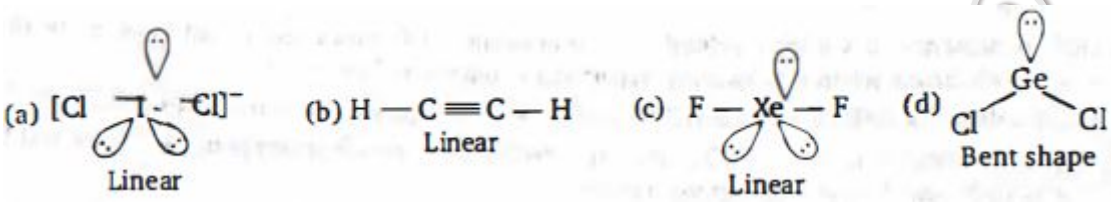
(D) $(I)-(A), II-(C), III-(B), IV-(D)$

Ans.: (A) $(I)-(C), II-(D), III-(A), IV-(B)$

95. $BeCl_2$ is not isostructural with

(A) ICl_2^- (B) C_2H_2 (C) XeF_2 (D) $GeCl_2$

Ans. :



96. Which of the following statements is incorrect for PCl_5 ?

(A) Its three $P-Cl$ bond lengths are equal

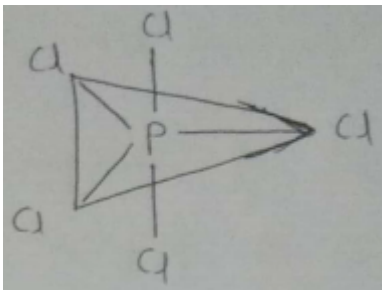
(B) It involves sp^3d hybridization

(C) It has an regular geometry

(D) Its shape is trigonal bipyramidal

Ans. : The three equatorial bond lengths of $P-Cl$ are equal while the two axial bond lengths are also equal but different from equatorial bond lengths.

It has sp^3d^2 hybridization and its shape is trigonal bipyramidal and not linear.



97. Give the correct order of initials T or F for following statements. Use T if statement is true and F if it is false :

(I) The order of repulsion between different pair of electrons is $l_P-l_P > l_P-b_P > b_P-b_P$

(II) In general, as the number of lone pair of electrons on central atom increases, value of bond angle from normal bond angle also increases

(III) The number of lone pair on O in H_2O is 2 while on N in NH_3 is 1

(IV) The structures of xenon fluorides and xenon oxyfluorides could not be explained on the basis of $VSEPR$ theory

(A) $TTTF$ (B) $TFTF$ (C) $TFTT$ (D) $TFFF$

Ans. : $(b)\ (ii)\ (F)$ In general as the number of lone pair of electrons on central atom increases, value of bond angle from normal bond angle decreases due to

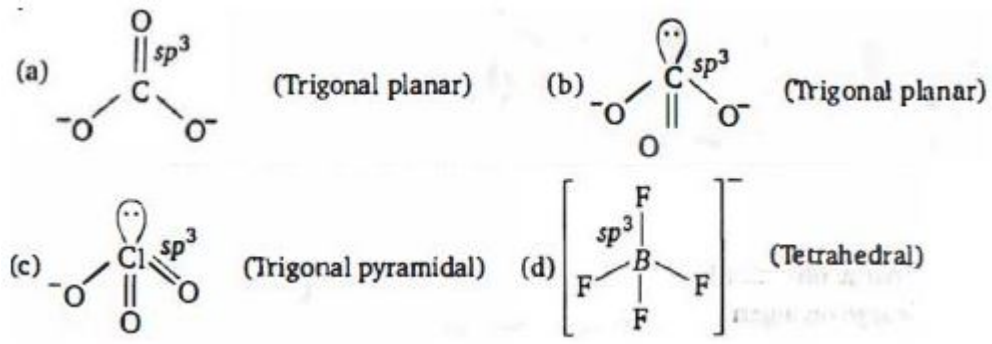
$l_p - l_p > l_p - b_p$

$(iv)\,(F)$Structures of xenon fluorides and xenon oxyfluoride are explained on the basis of $VSEPR$ theory. In $SOBr_2, S-O$ bond has maximum bond length in comparison to $S-O$ bond lengths in SOF_2 and $SOCl_2$, because in $SOBr_2, S-O$ bond has been formed by hybrid orbital containing less $s-$ character.

98. Which species is planar?

(A) CO_3^{2-} (B) SO_3^{2-} (C) ClO_3^- (D) BF_4^-

Ans. : a



99. Among the following species, the least angle around the central atom is in

(A) O_3 (B) I_3^- (C) NO_2^- (D) PH_3

Ans. : d

$(A)\,O_3$ molecule undergoes sp^2 hybridisation, so its bond angle is nearly 120°

$(B)\,I_3^-$ undergoes sp^3d hybridisation and linear shape so its bond angle is 180°.

$(C)\,NO_2^-$ undergoes sp^2 hybridisation and So, its bond angle is nearly 120°

$(D)\,PH_3$ undergoes sp^3 hybridisation and contains one lone pair, so its bond angle is mearly 90°

$\therefore$ Among all the options, PH_3 has least angle around the central atom.

100. Which ionic compound has the largest amount of lattice energy?

(A) NaF (B) AlF_3 (C) AlN (D) MgF_2

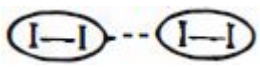
Ans. : (c) Lattice energy $\propto \frac{Charge\ of\ cation \times charge\ of\ anion}{Inter\ ionic\ distance}$

101. Iodine molecules are held in the solid lattice by .....

(A) London forces (B) dipole-dipole interactions

(C) covalent bonds (D) coulombic force

Ans. : (a) London forces between two I_2 molecules in solid lattice.



102. Carbon dioxide is gas, while SiO_2 is solid because

(A) CO_2 is a linear molecule, while SiO_2 is angular

(B) van der Waals' forces are very strong in SiO_2

(C) CO_2 is covalent, while SiO_2 is ionic

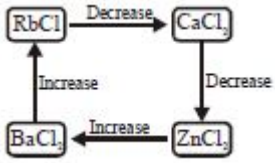
(D) Si cannot form stable bonds with O, hence Si has to form a $3D$ lattice

Ans. : d

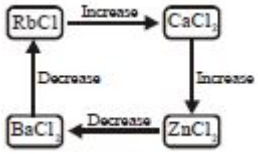
SiO_2 is solid because Si cannot form stable bonds with O, hence Si has to form a $3D$ lattice of SiO_2 molecules and form solid structure.

103. Which of the following diagram show correct change in the ionic character of given compounds according to Fajans rule ?

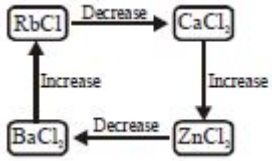
(A)



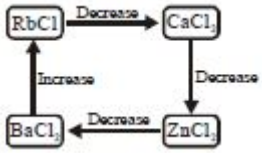
(B)



(C)



(D)

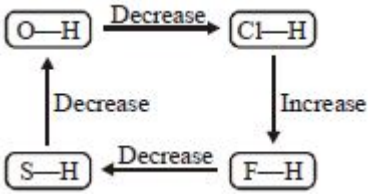


Ans. : a

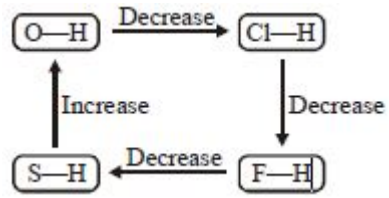
Ionic character $\propto \frac{1}{Polarisation}$

104. Which of the following diagrams shows correct change in the polarity of bond ?

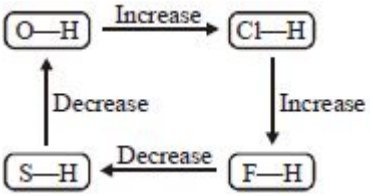
(A)



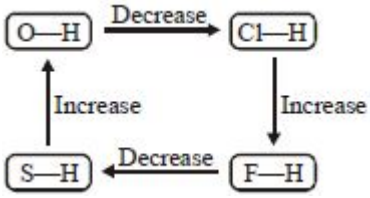
(B)



(C)



(D)



Ans. : d

Polarity of Bond $\propto \Delta EN$

105. Which of the following is the correct order for increasing bond angle ?

(A) $NH_3 < PH_3 < AsH_3 < SbH_3$

(B) $H_2O < OF_2 < Cl_2O$

(C) $H_3Te^+ < H_3Se^+ < H_3S^+ < H_3O^+$

(D) $BF_3 < BCl_3 < BBr_3 < BI_3$

Ans. : (c) Correct order of bond angle:

$(a)\, NH_3 < PH_3 < AsH_3 < SbH_3$ (As $E.N.$ value of $C.A. \uparrow$ bond angle $\downarrow$)

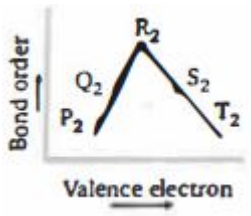
$(b)\, OF_2 < OH_2 < OCl_2$

$(c)\, H_3Te^+ < H_3Se^+ < H_3S^+ < H_3O^+$

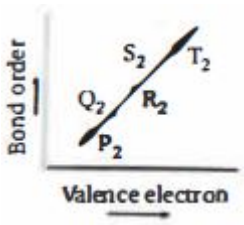
$(d)\, BF_3 = BCl_3 = BBr_3 = BI_3$

106. If P to T are second period $p-$ block elements then which of the following graph show correct relation between valence electrons in P_2 to T_2 (corresponding molecules) and their bond order is

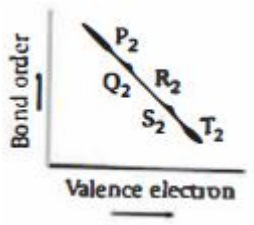
(A)



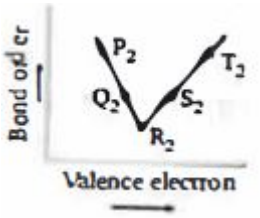
(B)



(C)



(D)

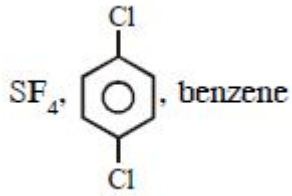


Ans. : a

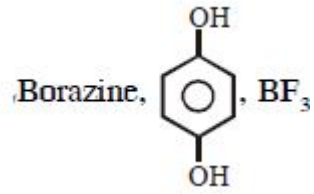
Species :	$P_2 : (B_2)$	$Q_2 : (C_2)$	$R_2 : (N_2)$	$S_2(O_2)$	$T_2 : (F_2)$
Bond order	1.0	2.0	3.0	2.0	1.0
Totnl No. of valence $e^- s$	6	8	10	12	14

107. Which set contain molecules with $\mu = 0$

(A)

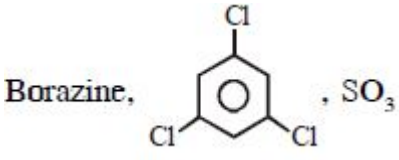


(B)



(C) ClF_3, SiF_4, SO_3

(D)



Ans. : d

All are symmetrical molecule

108. The magnetic moment of M^{x+} (atomic number $= 25$) is $\sqrt{15}\ BM$. The number of unpaired electrons and the value of x, respectively, are

(A) $4, 3$ (B) $3, 4$ (C) $3, 2$ (D) $5, 2$

Ans. : b

$\mathrm{M^{x+}(Z = 25)}$; electronic configuration is

$\mathrm{1s^2 2s^2 2p^6 3d^5 4s^2 3s^2 3p^6}$

or $d^5 =$ (figure)

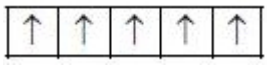
$\text{Magnetic moment } = \sqrt{n(n+2)}\ BM$

$= \sqrt{5(5+2)}\ BM = \sqrt{35}\ BM$

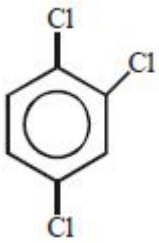
But given magnetic moment is $\sqrt{15}\ BM$ or $\sqrt{3(3+2)}\ BM$

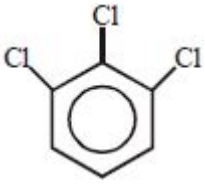
Hence, unpaired electrons $= 3$

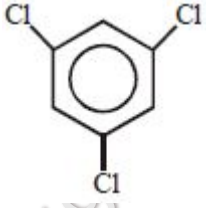
Therefore, the oxidation number is 4



109. Which has maximum dipole moment ?

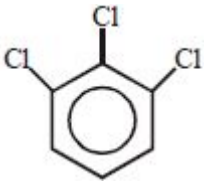
(A) 

(B) 

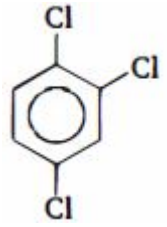
(C) 

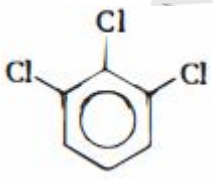
(D) 

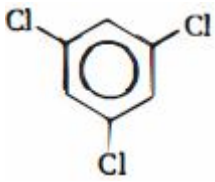
Ans. : (B)

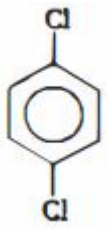


110. Which has maximum dipole moment?

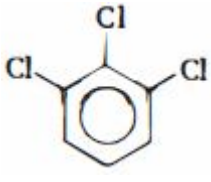
(A) 

(B) 

(C) 

(D) 

Ans. : (B)



111. The dipole moment of HCl is $1.03\ D$, if $H-Cl$ bond distance is $1.26\ \overset{o}{A}$, what is the percentage of ionic character in the $H-Cl$ bond? ..... %

(A) 60 (B) 39 (C) 29 (D) 17

Ans. : d

Dipole moment is the product of magnitude of charge and seperation between charges.

i.e., $P = q \times d$

here compound is HCl,you know as well, HCl is ionic compound in which one electron transfers from hydrogen to chlorine.

so, magnitude of charge on dipole, $q = 1.6 \times 10^{-19}\, C$

and seperation between charges = bond length $= 1.26 A^{\circ} = 1.26 \times 10^{-10}\, m$

so, dipole moment, $P = 1.6 \times 10^{-19} \times 1.26 \times 10^{-10}\, Cm \ = 2.016 \times 10^{-29}\, Cm$

we know, $1D = 3.335 \times 10^{-30}\, Cm$ [Debay, D is the unit of dipole moment]

$= 2.016 \times 10^{-29} / \left(3.335 \times 10^{-30}\right)$

$= 20.16 / 3.335$

$= 6.0449\, D$

now, percentage ionic character = experimental value/ theoretical value $\times 100$

$= 1.03\, D / 6.0449\, D \times 100$

$= 0.170 \times 100$

$= 17.00\,\%$

112. Select correct statement (s)

(A) Acidic strength of $HBr > HCl$ but reverse is true for their reducing property

(B) Basic strength of $PH_3 > AsH_3$ but reverse is true for their bond angle

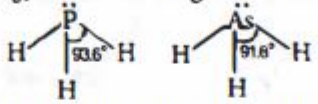
(C) Dipole moment of $CH_3Cl > CH_3F$ but reverse is true for their $H\hat{C}H$ bond angle

(D) K_{a_1} of fumaric acid is higher than maleic acid but reverse is true for their K_{a_2}

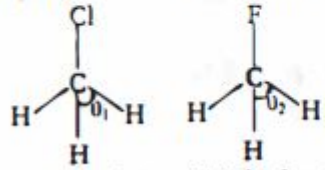
Ans. : c

(a)Acidic strength of HBr > HCl and their reducing properties are also in same order

(b)Basic strength of PH_3 > AsH_3, their bond angles are also in same order



(c) $\theta_2 > \theta_1$ because C—H bond has more s-character in CH_3F than in CH_3Cl.



(d) K_{a_1} of maleic acid is higher than K_{a_1} of fumaric acid but reverse is true for their K_{a_2}

113. The percentage Ionic character of the HBr molecule, if the dipole moment is $0.63\, D$ & HBr bond length $187.5\, Pm$ is ?..... $\%$

(A) 17 (B) 7 (C) 27 (D) 47

Ans. : b

Calculated $\mu = \mathrm{q} \times \mathrm{d}$

$= 4.8 \times 10^{-10}\ \mathrm{esu}\ \times 187.5 \times 10^{-10}\,\mathrm{cm}$

$= 9 \times 10^{-18}$ esu cm

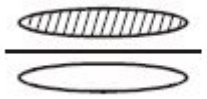
$= 9$ Debye $\left(1 \times 10^{-18} \text{ esu cm} = 1 \text{ Debye}\right)$ Observed $\mu = 0.63$ *Debye*

$\%$ Ionic character $= \frac{\mu_{\text{observed}}}{\mu_{\text{colculed}}} \times 100$

$= \frac{0.63}{9} \times 100 = 7\%$

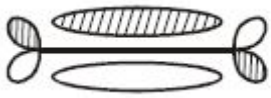
114. Which one of the following sketch is not correctly matched ?

(A)



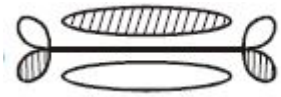
π_{2p}

(B)



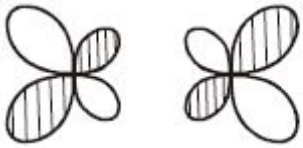
π_{3d}

(C)



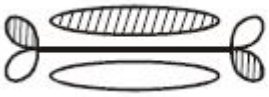
π_{3d}

(D)



π^{*}_{3d}

Ans. : (B)



π_{3d}

115. In which of the following species $p\pi = d\pi$ bond is present but $p\pi = p\pi$ bond is absent ?

(A) SiH_4 (B) CS_2 (C) SO_2 (D) SO_2Cl_2

Ans. : d

SO_2Cl_2 forms $p\pi - d\pi$ bond, Sulphur has a d-orbital and oxygen has a p-orbital so it forms a bond with oxygen.

It forms a Sigma bond with chlorine. It has a tetrahedral shape with asymmetric distribution of charge on the Sulphur atom.

116. The hybridization of the central atom will change when

(A) NH_3 combines with H^+ (B) H_3BO_3 combines with OH^-

(C) NH_3 forms NH_2^- (D) H_2O combines with H^+

Ans. : (b) $\underset{sp^3}{\ddot{N}H_3} + H^+ \rightarrow \underset{sp^3}{NH_4^+}$

$$2\underset{sp^3}{NH_3} \rightleftarrows \underset{sp^3}{NH_2^-} + \underset{sp^3}{NH_4^+}$$

$$\underset{sp^2}{H_3BO_3} + OH^- \rightarrow \underset{sp^3}{[B(OH)_4]^-}$$

$$\underset{sp^3}{H_2O} + H^+ \rightleftarrows \underset{sp^3}{H_3O^+}$$

117. Which of the following overlapping is not present in XeO_3 molecule ?

(A) $sp^3 + p_x$ (B) $sp^3 + p_y$ (C) $d_{xy} + p_x$ (D) $sp^3 + s$

Ans. : d

In XeO_3

Ground state of electronic configuration $Xe = [Kr]4d^{10}5s^2 5p^6$

Excited state of electronic configuration $Xe = [Kr]4d^{10}5s^2 5p^3 5d^3$

The electronic configuration of oxygen $= 1s^2 2s^2 2p^4$

In XeO_3, the hybridisation of Xe is sp^3, It form 3 σ bond and three π bonds with three oxygen atoms and contain one lone pair of electron.

The oxygen atom form bond with Xe like $sp^3 + p_x, sp^3 + p_y, sp^3 + p_z$, but never form $sp^3 + s$

118. Which is correct statement?

As the $s-$ character of a hybrid orbital decreases

(I) The bond angle decreases (II) The bond strength increases

(III) The bond length increases (IV) Size of orbitals increases

(A) $(I), (III)$ and (IV) (B) $(II), (III)$ and (IV)

(C) (I) and (II) (D) All are correct

Ans. : a

s-character is the contribution of sigma type bond in a hybridization: $sp^3 = 25\,\%$ s-character, $75\,\% p$-character $sp^2 = 33\,\% s$-character, $66\,\% p$-character $sp = 50\,\% p-$ character. The more s-character a bond has, the stronger and shorter the bond is. Hence the bond length decrease with increase in s character. An $sp - sp$ bond is strongest and $sp^3 - sp^3$ bond is weakest.

The bond angle of sp^3 is $109.5, sp^2$ is 120 and sp is 180 . An sp orbital is half s character, sp^2 is $1/3s$ character and sp^3 is $1/4s$ character, so increasing the s character corresponds to increasing the bond angle.

The size of the orbital depends upon the value of principal quantum number(n). Greater the value of n, larger is the size of the orbital and lesser the s-character

119. Assuming the bond direction to the z -axis, which of the overlapping of atomic orbitals of two atom (A) and (B) will result in bonding?

$(I)\, s-$ orbital of A and P_x -orbital of B

$(II)\, s-$ orbital of A and P_z orbital of B

$(Ill)\, p_y$ -orbital of A and p_z orbital of B

$(IV)\, s-$ orbital of both (A) and (B)

(A) I and IV (B) I and II (C) III and IV (D) II and IV

Ans. : d

As s is nondirectional so it will form bond in all directions.

Also p_z is directed on z-axis so it will form bond on z-axis.

So, II and IV are correct.

120. The correct order of $Cl - O$ bond order is

(A) $ClO_3^- < ClO_4^- < ClO_2^- < ClO^-$ (B) $ClO^- < ClO_4^- < ClO_3^- < ClO_2^-$

(C) $ClO^- < ClO_2^- < ClO_3^- < ClO_4^-$ (D) $ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$

Ans. : (C) $ClO^- < ClO_2^- < ClO_3^- < ClO_4^-$

----- Challenges are opportunities in disguise: Don't be discouraged by obstacles. View them as chances to learn, grow, and become stronger -----