

**CHEMICAL BONDING**

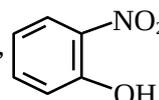
- Number of molecules/species from the following having one unpaired electron is \_\_\_\_\_.  
 $O_2, O_2^+, NO, CN, O^{2-}$
- Number of elements from the following that CANNOT form compounds with valencies which match with their respective group valencies is \_\_\_\_\_.  
 B, C, N, S, O, F, P, Al, Si  
 (1) 7 (2) 5  
 (3) 6 (4) 3
- Which one of the following molecules has maximum dipole moment?  
 (1)  $NF_3$  (2)  $CH_4$   
 (3)  $NH_3$  (4)  $PF_5$
- Number of molecules/ions from the following in which the central atom is involved in  $sp^3$  hybridization is \_\_\_\_\_.  
 $NO_3^-, BCl_3, ClO_2^-, ClO_3$   
 (1) 2 (2) 4  
 (3) 3 (4) 1
- The total number of species from the following in which one unpaired electron is present, is \_\_\_\_\_.  
 $N_2, O_2, C, O, O_2^+, H_2^+, CN_2^+, He^+$
- In which one of the following pairs the central atoms exhibit  $sp^2$  hybridization ?  
 (1)  $BF_3$  and  $NO_2^-$  (2)  $NH_2^-$  and  $H_2O$   
 (3)  $H_2O$  and  $NO_2$  (4)  $NH_2^-$  and  $BF_3$
- Total number of electron present in ( $\pi^*$ ) molecular orbitals of  $O_2, O_2^+$  and  $O_2^-$  is \_\_\_\_\_.
- The correct increasing order for bond angles among  $BF_3, PF_3$  and  $C F_3$  is :  
 (1)  $PF_3 < BF_3 < C F_3$  (2)  $BF_3 < PF_3 < C F_3$   
 (3)  $C F_3 < PF_3 < BF_3$  (4)  $BF_3 = PF_3 < C F_3$

- Number of molecules from the following which are exceptions to octet rule is \_\_\_\_\_.  
 $CO_2, NO_2, H_2SO_4, BF_3, CH_4, SiF_4, ClO_2, PCl_5, BeF_2, C_2H_6, CHCl_3, CBr_4$

- Match **List I** and with **List II**.

List-I (Molecule)		List-II (Shape)	
A	$NH_3$	I.	Square pyramid
B.	$BrF_5$	II.	Tetrahedral
C.	$PCl_5$	III.	Trigonal pyramidal
D.	$CH_4$	IV.	Trigonal bipyramidal

Choose the **correct** answer from the option below :

- (1) A-IV, B-III, C-I, D-II  
 (2) A-II, B-IV, C-I, D-III  
 (3) A-III, B-I, C-IV, D-II  
 (4) A-III, B-IV, C-I, D-II
- When  $\psi_A$  and  $\psi_B$  are the wave functions of atomic orbitals, then  $\sigma^*$  is represented by :  
 (1)  $\psi_A - 2\psi_B$   
 (2)  $\psi_A - \psi_B$   
 (3)  $\psi_A + 2\psi_B$   
 (4)  $\psi_A + \psi_B$
- Number of molecules having bond order 2 from the following molecule is \_\_\_\_\_.  
 $C_2, O_2, Be_2, Li_2, Ne_2, N_2, He_2$
- Number of molecules from the following which can exhibit hydrogen bonding is \_\_\_\_\_.  
 (nearest integer)  
 $CH_3OH, H_2O, C_2H_6, C_6H_6,$    
 $HF, NH_3$

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 14. Match **List I** with **List II** :

<b>List-I</b> (Compound / Species)		<b>List-II</b> (Shape / Geometry)	
A.	SF <sub>4</sub>	I.	Tetrahedral
B.	BrF <sub>3</sub>	II.	Pyramidal
C.	BrO <sub>3</sub> <sup>-</sup>	III.	See saw
D.	NH <sub>4</sub> <sup>+</sup>	IV.	Bent T-shape

 Choose the **correct** answer from the options given below :

- (1) A-II, B-III, C-I, D-IV
- (2) A-III, B-IV, C-II, D-I
- (3) A-II, B-IV, C-III, D-I
- (4) A-III, B-II, C-IV, D-I

 15. Match **List I** with **List II** :

<b>List-I</b> (Hybridization)		<b>List-II</b> (Orientation in Space)	
A.	sp <sup>3</sup>	I.	Trigonal bipyramidal
B.	dsp <sup>2</sup>	II.	Octahedral
C.	sp <sup>3</sup> d	III.	Tetrahedral
D.	sp <sup>3</sup> d <sup>2</sup>	IV.	Square planar

 Choose the **correct** answer from the options given below :

- (1) A-III, B-I, C-IV, D-II
- (2) A-II, B-I, C-IV, D-III
- (3) A-IV, B-III, C-I, D-II
- (4) A-III, B-IV, C-I, D-II

 16. Match **List I** with **List II** :

<b>List-I</b> (Molecule / Species)		<b>List-II</b> (Property / Shape)	
A.	SO <sub>2</sub> Cl <sub>2</sub>	I.	Paramagnetic
B.	NO	II.	Diamagnetic
C.	NO <sub>2</sub> <sup>-</sup>	III.	Tetrahedral
D.	I <sub>3</sub> <sup>-</sup>	IV.	Linear

 Choose the **correct** answer from the options given below :

- (1) A-IV, B-I, C-III, D-II
- (2) A-III, B-I, C-II, D-IV
- (3) A-II, B-III, C-I, D-IV
- (4) A-III, B-IV, C-II, D-I

 17. Total number of species from the following with central atom utilising sp<sup>2</sup> hybrid orbitals for bonding is.....

 NH<sub>3</sub>, SO<sub>2</sub>, SiO<sub>2</sub>, BeCl<sub>2</sub>, C<sub>2</sub>H<sub>2</sub>, C<sub>2</sub>H<sub>4</sub>, BCl<sub>3</sub>, HCHO, C<sub>6</sub>H<sub>6</sub>, BF<sub>3</sub>, C<sub>2</sub>H<sub>4</sub>Cl<sub>2</sub>

 18. In the lewis dot structure for NO<sub>2</sub><sup>-</sup>, total number of valence electrons around nitrogen is .....

 19. Match **List - I** with **List - II**.

<b>List - I</b>	<b>List - II</b>
(A) ICl	(I) T -Shape
(B) ICl <sub>3</sub>	(II) Square pyramidal
(C) ClF <sub>5</sub>	(III) Pentagonal bipyramidal
(D) IF <sub>7</sub>	(IV) Linear

 Choose the **correct** answer from the options given below:

- (1) (A)-(I), (B)-(IV), C-(III), D-(II)
- (2) (A)-(I), (B)-(III), C-(II), D-(IV)
- (3) (A)-(IV), (B)-(I), C-(II), D-(III)
- (4) (A)-(IV), (B)-(III), C-(II), D-(I)

 20. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

**Assertion (A)** : NH<sub>3</sub> and NF<sub>3</sub> molecule have pyramidal shape with a lone pair of electrons on nitrogen atom. The resultant dipole moment of NH<sub>3</sub> is greater than that of NF<sub>3</sub>.

**Reason (R)** : In NH<sub>3</sub>, the orbital dipole due to lone pair is in the same direction as the resultant dipole moment of the N-H bonds. F is the most electronegative element.

 In the light of the above statements, choose the **correct** answer from the options given below:

- (1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**
- (2) **(A)** is false but **(R)** is true
- (3) **(A)** is true but **(R)** is false
- (4) Both **(A)** and **(R)** are true but **(R)** is NOT the correct explanation of **(A)**



**CHEMICAL BONDING**

30. The linear combination of atomic orbitals to form molecular orbitals takes place only when the combining atomic orbitals
- have the same energy
  - have the minimum overlap
  - have same symmetry about the molecular axis
  - have different symmetry about the molecular axis
- Choose the **most appropriate** from the options given below:
- A, B, C only
  - A and C only
  - B, C, D only
  - B and D only
31. Give below are two statements:
- Statement-I** : Noble gases have very high boiling points.
- Statement-II**: Noble gases are monoatomic gases. They are held together by strong dispersion forces. Because of this they are liquefied at very low temperature. Hence, they have very high boiling points.
- In the light of the above statements. choose the **correct answer** from the options given below:
- Statement I is false but Statement II is true.
  - Both Statement I and Statement II are true.
  - Statement I is true but Statement II is false.
  - Both Statement I and Statement II are false.
32. A diatomic molecule has a dipole moment of 1.2 D. If the bond distance is  $1\text{\AA}$ , then fractional charge on each atom is  $\times 10^{-1}$  esu. (Given:  $1\text{ D} = 10^{-18}$  esu cm)
33. Which of the following is least ionic ?
- $\text{BaCl}_2$
  - $\text{AgCl}$
  - $\text{KCl}$
  - $\text{CoCl}_2$
34. The total number of molecular orbitals formed from 2s and 2p atomic orbitals of a diatomic molecule.

35. Match List-I with List-II.

List-I (Molecule)		List-II (Shape)	
(A)	$\text{BrF}_5$	(I)	T-shape
(B)	$\text{H}_2\text{O}$	(II)	See saw
(C)	$\text{ClF}_3$	(III)	Bent
(D)	$\text{SF}_4$	(IV)	Square pyramidal

- (A)-I, (B)-II, (C)-IV, (D)-III
  - (A)-II, (B)-I, (C)-III, (D)-IV
  - (A)-III, (B)-IV, (C)-I, (D)-II
  - (A)-IV, (B)-III, (C)-I, (D)-II
36. Given below are two statements:
- Statement-I**: Since fluorine is more electronegative than nitrogen, the net dipole moment of  $\text{NF}_3$  is greater than  $\text{NH}_3$ .
- Statement-II**: In  $\text{NH}_3$ , the orbital dipole due to lone pair and the dipole moment of NH bonds are in opposite direction, but in  $\text{NF}_3$  the orbital dipole due to lone pair and dipole moments of N-F bonds are in same direction.
- In the light of the above statements. Choose the most appropriate from the options given below.
- Statement I is true but Statement II is false.
  - Both Statement I and Statement II are false.
  - Both statement I and Statement II is are true.
  - Statement I is false but Statement II is are true.
37. The number of species from the following which are paramagnetic and with bond order equal to one is \_\_\_\_.
- $\text{H}_2, \text{He}_2^+, \text{O}_2^+, \text{N}_2^+, \text{O}_2^-, \text{F}_2^-, \text{Ne}_2, \text{B}_2^+$
38. Number of compounds with one lone pair of electrons on central atom amongst following is \_\_\_\_.
- $\text{O}_3, \text{H}_2\text{O}, \text{SF}_4, \text{ClF}_3, \text{NH}_3, \text{BrF}_5, \text{XeF}_4$
39. The total number of anti bonding molecular orbitals, formed from 2s and 2p atomic orbitals in a diatomic molecule is \_\_\_\_.



## SOLUTIONS

**1. Ans. (2)**
**Sol.** According to M.O.T.

 $O_2 \rightarrow$  no. of unpaired electrons = 2

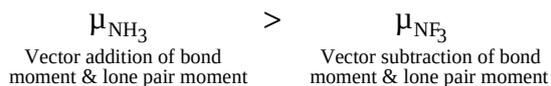
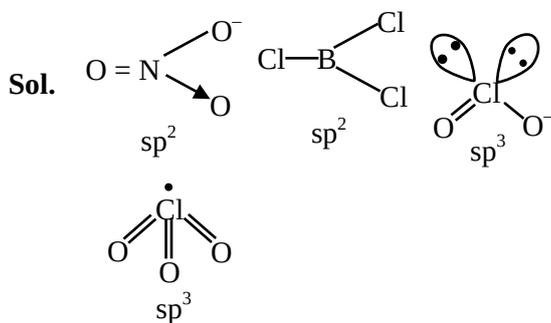
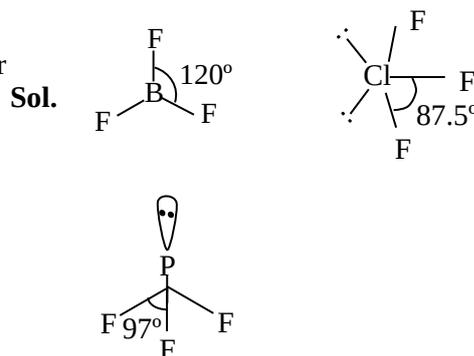
 $O_2^- \rightarrow$  no. of unpaired electron = 1

 $NO \rightarrow$  no. of unpaired electron = 1

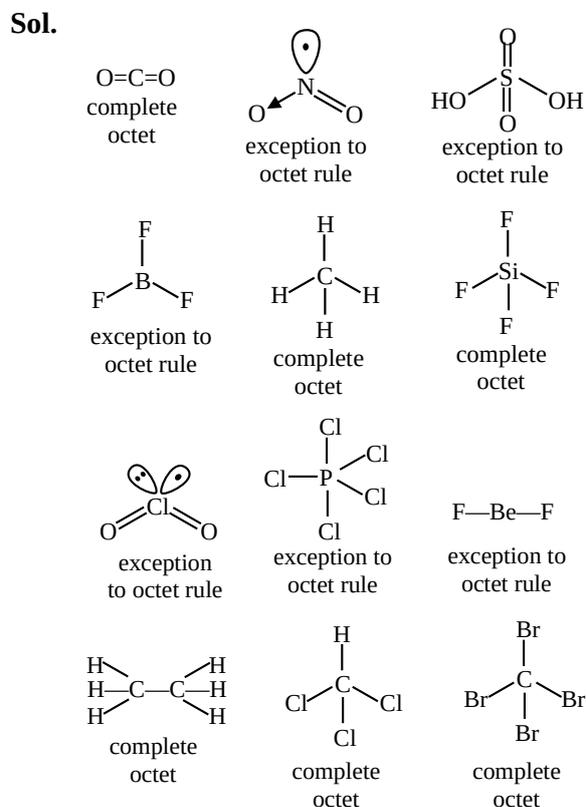
 $CN^- \rightarrow$  no. of unpaired electron = 0

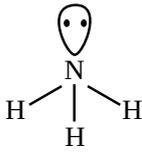
 $O_2^{2-} \rightarrow$  no. of unpaired electron = 0

**2. Ans. (4)**
**Sol.** N, O, F can't extend their valencies upto their group number due to the non-availability of vacant 2d like orbital.

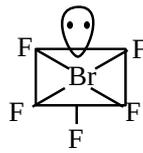
**3. Ans. (3)**
**Sol.**  $CH_4$  &  $PF_5$ ,  $\mu_{net} = 0$  (non polar)

**4. Ans.(1)**

**5. Ans. (4)**
**Sol.** One unpaired  $e^-$  is present in :  $C_2^- O_2^- H_2^+ He^+$ 
**6. Ans. (1)**
**Sol.**  $BF_3 \rightarrow sp^2$ 
 $NO_2^- \rightarrow sp^2$ 
 $H_2O \rightarrow sp^3$ 
 $NO_2 \rightarrow sp^2$ 
 $NH_2^- \rightarrow sp^3$ 
**7. Ans. (6)**
**Sol.**  $O_2(16e) : (\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\sigma_{2p})^2 [(\pi_{2p})^2 = (\pi_{2p}^*)^2], [(\pi_{2p}^*)^1 = (\pi_{2p}^*)^1]$   
 Number of  $e^-$  present in  $(\pi^*)$  of  $O_2 = 2$   
 Number of  $e^-$  present in  $(\pi^*)$  of  $O_2^+ = 1$   
 Number of  $e^-$  present in  $(\pi^*)$  of  $O_2^- = 3$   
 So total  $e^-$  in  $(\pi^*) = 2 + 1 + 3 = 6$ 
**8. Ans. (3)**


Order of bond angle is

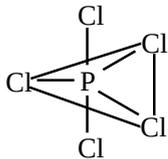
 $ClF_3 < PF_3 < BF_3$ 
**9. Ans. (6)**


**10. Ans. (3)**
**Sol.**


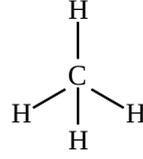
Trigonal pyramidal



Square pyramidal



Trigonal bipyramidal



Tetrahedral

**11. Ans. (2)**
**Sol.** Antibonding molecular orbitals are formed by destructive interference of wave functions.

$$(ABMO) \sigma^* = \psi_A - \psi_B$$

**12. Ans. (2)**
**Sol.**  $C_2$ 

$$(12e^-) : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2 \left[ \pi 2p_x^2 = \pi 2p_y^2 \right]$$

$$B.O. = \frac{8-4}{2} = 2$$

 $O_2$ 

$$(16e^-) : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2$$

$$\left[ \pi 2p_x^2 = \pi 2p_y^2 \right] \left[ \pi^* 2p_x^1 = \pi^* 2p_y^1 \right]$$

$$B.O. = \frac{10-6}{2} = 2$$

 $Be_2$ 

$$(8e^-) : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$$

$$B.O. = \frac{4-4}{2} = 0$$

 $Li_2$ 

$$(6e^-) : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2$$

$$B.O. = \frac{4-2}{2} = 1$$

 $Ne_2$ 

$$(20e^-) : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2$$

$$\left[ \pi 2p_x^2 = \pi 2p_y^2 \right] \left[ \pi^* 2p_x^2 = \pi^* 2p_y^2 \right] \sigma^* 2p_z^2$$

$$B.O. = \frac{10-10}{2} = 0$$

 $N_2$ 

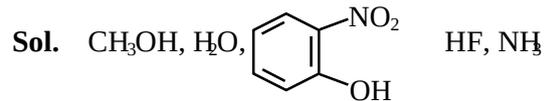
$$(14e^-) : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2 \left[ \pi 2p_x^2 = \pi 2p_y^2 \right] \sigma 2p_z^2$$

$$B.O. = \frac{10-4}{2} = 6$$

 $He_2$ 

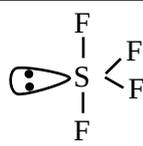
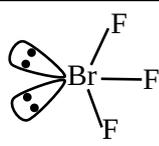
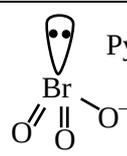
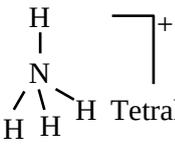
$$(4e^-) : \sigma 1s^2, \sigma^* 1s^2$$

$$B.O. = \frac{2-2}{2} = 0$$

**13. Ans.(5)**


Can show H-bonding.

**14. Ans. (2)**
**Sol.**

(A)	$SF_4$	$sp^3d$ hybridisation	
(B)	$BrF_3$	$sp^3d$ hybridisation	 Bent T-Shape
(C)	$BrO_3^-$	$sp^3$ hybridisation	 Pyramidal
(D)	$NH_4^+$	$sp^3$ hybridisation	 Tetrahedral

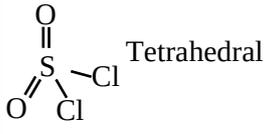
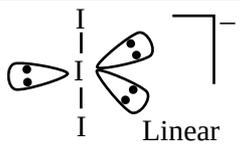
**15. Ans. (4)**
**Sol.**  $sp^3 \rightarrow$  Tetrahedral

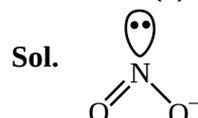
 $dsp^2 \rightarrow$  Square planar

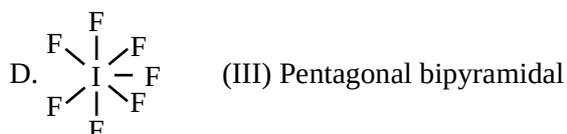
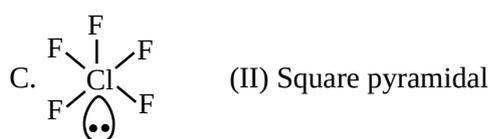
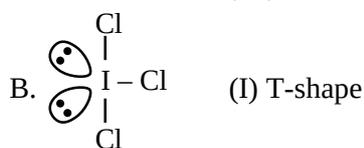
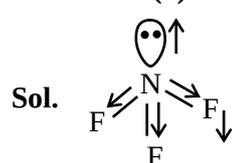
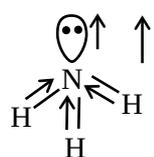
 $sp^3d \rightarrow$  Trigonal Bipyramidal

 $sp^3d^2 \rightarrow$  Octahedral

**CHEMICAL BONDING**
**16. Ans. (2)**
**Sol.**

(A)	SO <sub>2</sub> Cl <sub>2</sub>	sp <sup>3</sup>	 Tetrahedral
(B)	NO		Paramagnetic
(C)	NO <sub>2</sub> <sup>-</sup>		Diamagnetic
(D)	I <sub>3</sub> <sup>-</sup>	sp <sup>3</sup> d	 Linear

**17. Ans. (6)**
**Sol.** Central atom utilising sp<sup>2</sup> hybrid orbitals  
 SO<sub>2</sub>, C<sub>2</sub>H<sub>4</sub>, BCl<sub>3</sub>, HCHO, C<sub>6</sub>H<sub>6</sub>, BF<sub>3</sub>
**18. Ans. (8)**

 Number of valence e<sup>-</sup> around N-atom = 8

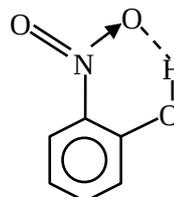
**19. Ans. (3)**
**Sol.** A. I - Cl (IV) linear

**20. Ans. (1)**

 Resultant dipole moment = 0.80 × 10<sup>-30</sup> cm

 Resultant dipole moment = 4.90 × 10<sup>-30</sup> cm

**21. Ans. (6)**
**Sol.** H<sub>2</sub>, CO<sub>2</sub>, BF<sub>3</sub>, CH<sub>4</sub>, SiF<sub>4</sub>, BeF<sub>2</sub>

are symm. molecule so dipole moment is zero

**22. Ans. (2)**
**Sol.** (A) Generally hydrogen bonding exists when H is covalently bonded to the highly electronegative atom like F, O, N.

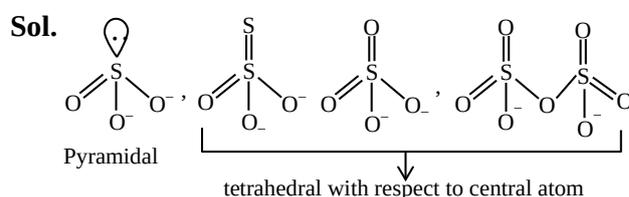
(B) Intramolecular H bonding is present in



(C) Intermolecular Hydrogen bonding is present in HF

(D) The magnitude has Hydrogen bonding in solid state is greater than liquid state.

(E) Hydrogen bonding has powerfull effect on the structure &amp; properties of compound like melting point, boiling point, density etc.

**23. Ans.(3)**

**24. Ans. (5)**
**Sol.** Polar molecule : NE<sub>3</sub>, H<sub>2</sub>O, H<sub>2</sub>S, HBr, HCl  
 (μ ≠ 0)

 Non Polar molecule: BeCl<sub>2</sub>, BCl<sub>3</sub>, XeF<sub>4</sub>, CCl<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>  
 (μ = 0)

So answer is 5.

**25. Ans. (3)**
**Sol.** Increasing order of ionic character

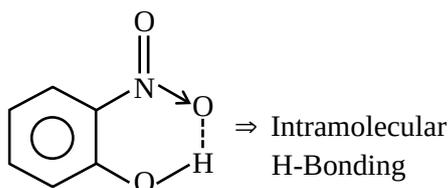
 N<sub>2</sub> < SO<sub>2</sub> < ClF<sub>3</sub> < K<sub>2</sub>O < LiF

Ionic character depends upon difference of electronegativity (bond polarity).

**26. Ans. (4)**
**Sol.** Unlike NH<sub>3</sub>, PH<sub>3</sub> molecules are not associated through hydrogen bonding in liquid state. That is why the boiling point of PH<sub>3</sub> is lower than NH<sub>3</sub>.

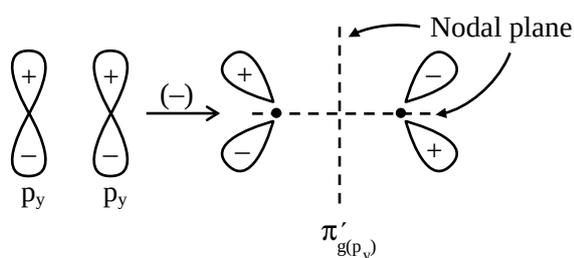
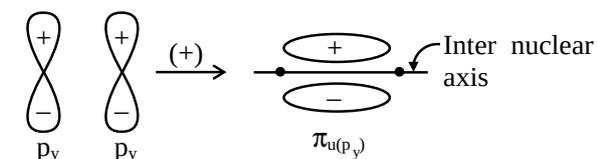
27. Ans. (4)

Sol.  $H_2O, NH_3, C_2H_5OH \Rightarrow$  Intermolecular H-Bonding



28. Ans. (3)

Sol. A  $\pi$  bonding molecular orbital has higher electron density above and below inter nuclear axis



29. Ans. (4)

Sol.  $NH_3 \rightarrow sp^3$   
 $SO_2 \rightarrow sp^2$   
 $SiO_2 \rightarrow sp^3$   
 $BeCl_2 \rightarrow sp$   
 $CO_2 \rightarrow sp$   
 $H_2O \rightarrow sp^3$   
 $CH_4 \rightarrow sp^3$   
 $BF_3 \rightarrow sp^2$

30. Ans. (2)

Sol. \* Molecular orbital should have maximum overlap

\* Symmetry about the molecular axis should be similar

31. Ans. (4)

Sol. Statement I and II are False

Noble gases have low boiling points

Noble gases are held together by weak dispersion forces.

32. Ans. (0)

Sol.  $\alpha = 1.2 D = q \cdot d$

$$\Rightarrow 1.2 \cdot 10^{-10} \text{ esu } \text{Å} = q \cdot 1 \text{Å}$$

$$\therefore q = 1.2 \cdot 10^{-10} \text{ esu}$$

33. Ans.(2)

Sol.  $AgCl < CoCl_2 < BaCl_2 < KCl$  (ionic character)

Reason :  $Ag^+$  has pseudo inert gas configuration.

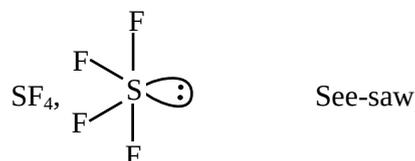
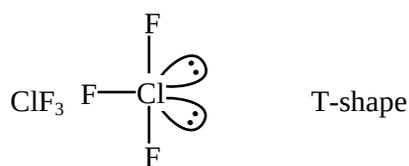
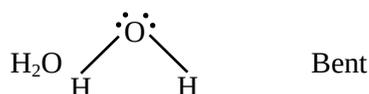
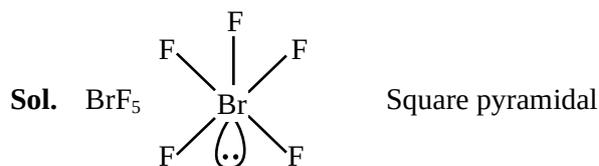
34. Ans.( 8)

Sol. Two molecular orbitals  $\sigma_{2s}$  and  $\sigma^*_{2s}$ .

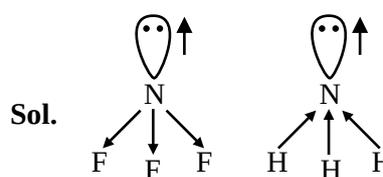
Six molecular orbitals  $\sigma_{2p_z}$  and  $\sigma^*_{2p_z}$ .

$\pi_{2p_x}, \pi_{2p_y}$  and  $\pi^*_{2p_x}, \pi^*_{2p_y}$

35. Ans.(4)

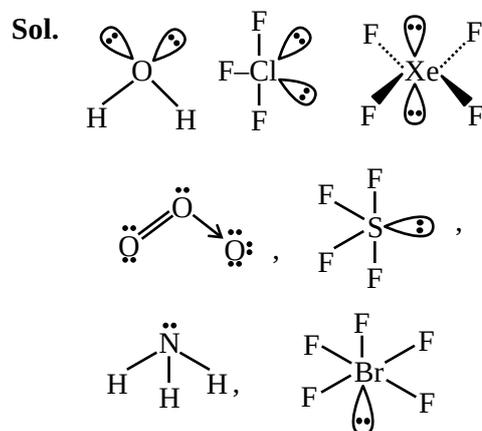


36. Ans.(2)



**CHEMICAL BONDING**
**37. Ans. (1)**

Sol.	Magnetic behaviour	Bond order
H <sub>2</sub>	Diamagnetic	1
He <sub>2</sub> <sup>+</sup>	Paramagnetic	0.5
O <sub>2</sub> <sup>+</sup>	Paramagnetic	2.5
N <sub>2</sub> <sup>2-</sup>	Paramagnetic	2
O <sub>2</sub> <sup>2-</sup>	Diamagnetic	1
F <sub>2</sub>	Diamagnetic	1
Ne <sub>2</sub> <sup>+</sup>	Paramagnetic	0.5
B <sub>2</sub>	Paramagnetic	1

**38. Ans. (4)**

**39. Ans. (4)**

Sol. Antibonding molecular orbital from 2s = 1  
 Antibonding molecular orbital from 2p = 3  
 Total = 4

**40. Ans. (6)**

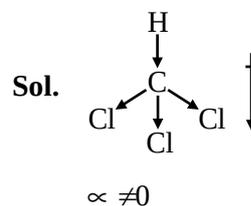
Sol. CO  $\Rightarrow$   $\bar{C} \equiv O^+$  : BO = 3  
 NO<sup>+</sup>  $\Rightarrow$  N  $\equiv$  O<sup>+</sup> : BO = 3

**41. Ans. (3)**
**Sol.**

Compounds	SO <sub>3</sub>	H <sub>2</sub> SO <sub>3</sub>	SOCl <sub>2</sub>	SF <sub>4</sub>	BaSO <sub>4</sub>	H <sub>2</sub> S <sub>2</sub> O <sub>7</sub>
O.S. of Sulphur:	+6	+4	+4	+4	+6	+6

**42. Ans. (4)**

Sol. The non-polar molecules are CO<sub>2</sub>, H<sub>2</sub>, CH<sub>4</sub> and BF<sub>3</sub>

**43. Ans. (4)**


CHCl<sub>3</sub> is polar molecule and rest all molecules are non-polar.

**44. Ans. (3)**

Sol. Molecules with zero dipole moment = CO<sub>2</sub>, CH<sub>4</sub>, BF<sub>3</sub>