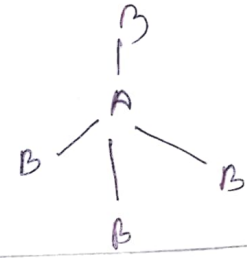
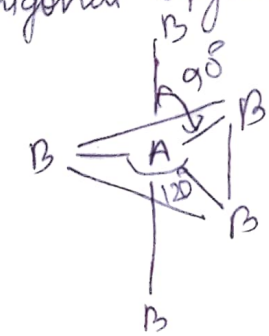
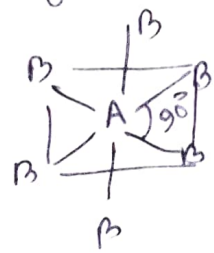
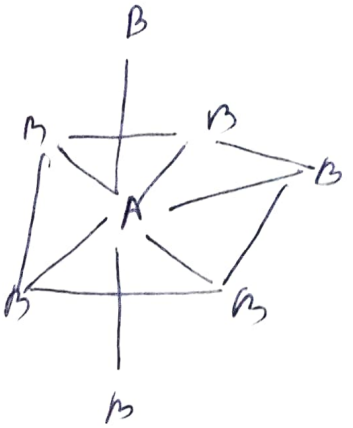
Relation between Total $e^{\ominus}$ pair, hybridisation and geometry of molecules :-

Total $e^{\ominus}$ pair	hybridisation	structure	angle
2	sp e.g. BeH_2, $BeCl_2$, CO_2	Linear B—A—B	180°
3	sp^2 e.g. BCl_3, $AlCl_3$, $AlBr_3$, CO_3^{2-}, NO_3^-, SO_2, $SnCl_2$, NO_2^-	Trigonal planar 	120°
4	sp^3 BH_4^-, SiF_4, NH_3, H_2O, CH_4,	Tetrahedral 	109°28'
5	sp^3d PCl_5, PF_5, SbF_5, XeO_3F_2, SF_4, XeO_2F_2, $[Cl_2^-]$, ClF_3, XeF_2, $XeOF_2$.	Trigonal bipyramidal 	axial with equatorial → 90° between equatorial } → 120° axial-axial → 180°
6	sp^3d^2 SF_6, $TeCl_6$, XeO_2F_2, IF_5, XeF_5^+, XeF_4, $[ICl_4]^{\ominus}$,	Octahedral 	between Two adjacent → 90° opposite → 180°

7 → sp^3d^3 → pentagonal bipyramidal

e.g. XeF_6, IF_6^-, $[ICl_6]^-$, $[TeCl_8]^{2-}$, $[XeF_5]^-$ etc



Q → ~~bet~~ bond angle NH_3 and NF_3 decreases from 107° to 102° and in H_2O and F_2O 104.5° to 103.1°. Explain.

Ans → NF_3 and NH_3 both have structures based on a tetrahedron with ~~a~~ one corner occupied by a lone pair. The high electronegativity of F pulls the bonding electrons further away from N than in NH_3. Thus repulsion between bond pairs is less in NF_3 than in NH_3. Hence, the lone pair in NF_3 causes a greater distortion ~~fro~~ from tetrahedral than NH_3. The same effect is found in H_2O and F_2O as F is more electronegative than H atom.

Dipole Moment

(*) Examples of molecules with ($\mu = 0$) →

Linear → $BeCl_2$, XeF_2, ICl_2^-, I_3^-

Trigonal planar → BH_3, BF_3, BCl_3, $AlCl_3$.

Tetrahedral → CH_4, SiF_4, CCl_4.

Square planar → XeF_4, ICl_4^-.

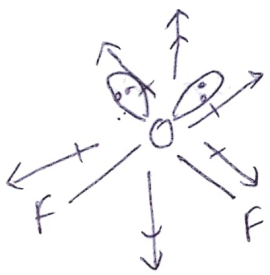
Trigonal bipyramidal → PF_5, PCl_5, SbF_5.

Octahedral → SX_6, $TeCl_6$.

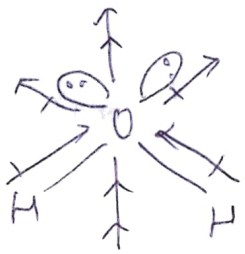
Pentagonal bipyramidal → IF_7.

Q → The dipole moment of F_2O is less than that of H_2O, although they have similar structure. Explain.

Ans:



$\mu = 0.3\ D$



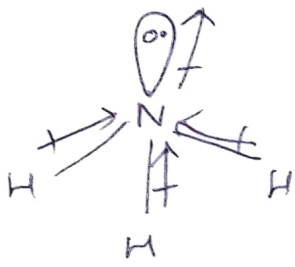
$\mu = 1.84\ D$.

In H_2O, as O atom is more electronegative than H-atom, so the resultant bond dipole moment is toward O-atom which means both the lone pair and bond pair moment are acting in the same direction and resultant dipole moment of H_2O is high. In case of F_2O, the bond dipole is acting towards F-atom, which is opposite to

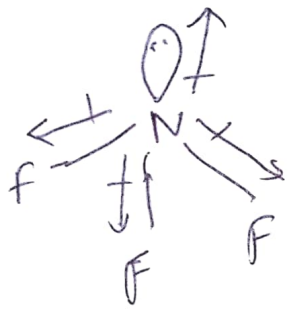
lone pair moment, as a result, resultant dipole moment is less in comparison to H_2O.

Q → Explain why NH_3 has higher dipole ment as compared to NF_3 although they have similar structure.

Ans →



$\mu = 1.5$ D



$\mu = 0.2$ D

explanation → as written above.

Q → what is dipole moment, bond moment.
what is unit of dipole moment.

Q → ~~long trans N_2F_2 molecule~~

Dipole moment order →

- HF > HCl > HBr > HI
- $CH_3Cl > CH_2Cl_2 > CHCl_3 > CCl_4$
- $CH_3Cl > CH_3F > CH_3Br > CH_3I$.