VSEPR (Valence shell electron pair repulsion theory)

Order of repulsion

Lp-Lp > Lp - Bp > Bp- Bp

Lp : lone pair/ non bonding pair
Bp : Bond pair

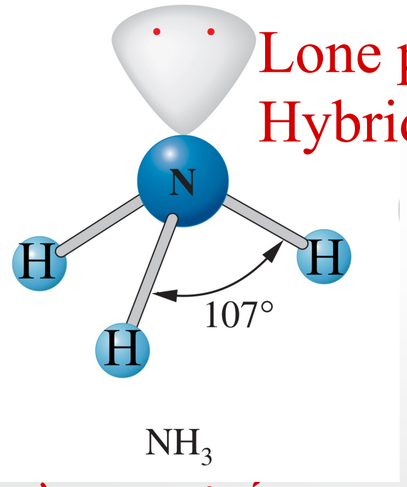
(Q) Apply concept of hybridisation in $\ddot{N}H_3$ molecule.

(Ans) SN = σ Bond + lp

= 3 + 1

= 4

Hybridization : sp^3



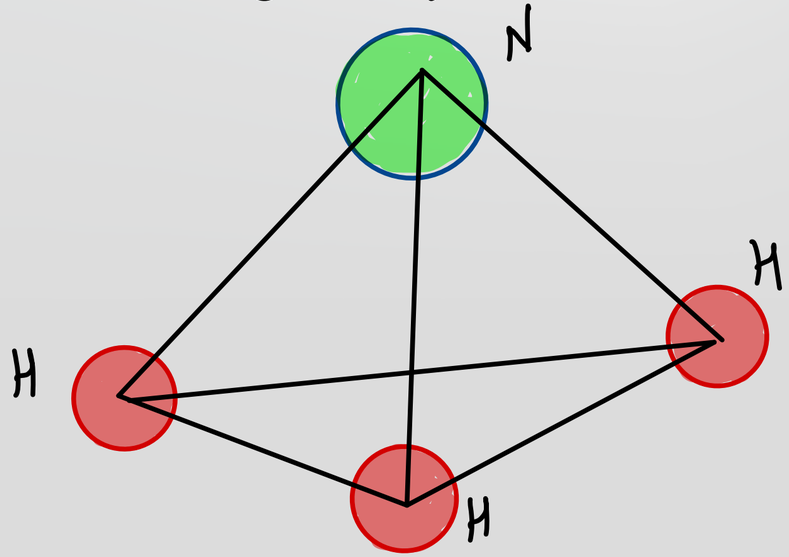
NH_3

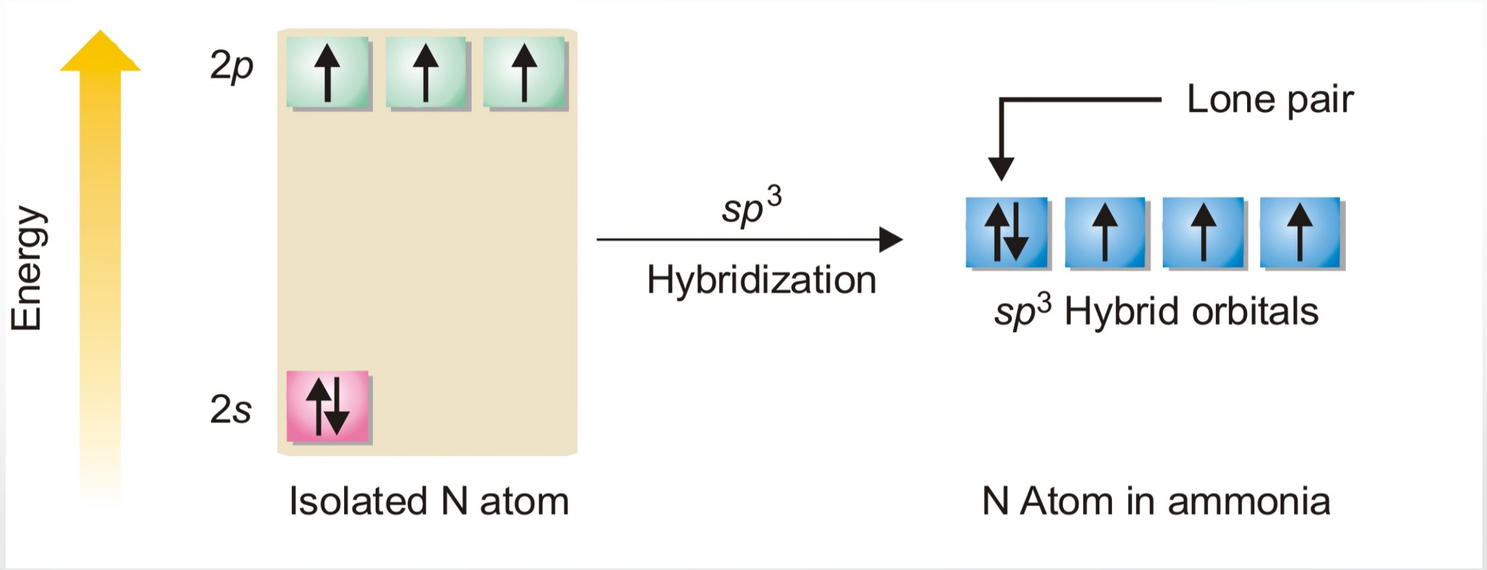
Lone pair in Sp3 Hybrid orbital

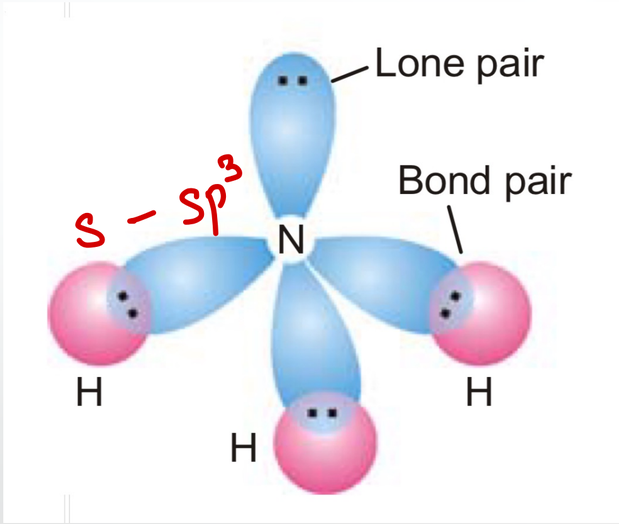
Geometry/Shape : trigonal pyramidal

Non planar molecule

Electronic geometry: tetrahedral







Example 4: NH3

SN = 3+1 =4

Hyb : SP^3

Calculation of hybridisation

Total hybrid orbital (T.H.O) / steric No. (S.N) = number of sigma bond + lone pair

THO/SN	Hybridisation
2	Sp
3	Sp^2
4	Sp^3
5	$Sp^3 d$
6	$Sp^3 d^2$
7	$Sp^3 d^3$

Note: π Bond not counted in calculating THO

Hybridisation (Atomic orbital used)

1. $sp\ (s+p_x)$

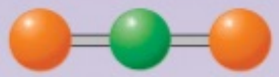
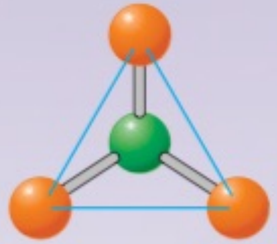
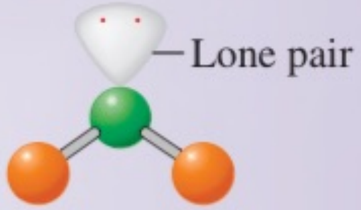
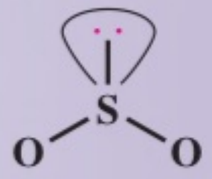
2. $sp^2(s+p_x+p_y)$

3. $sp^3(s+p_x+p_y+p_z)$

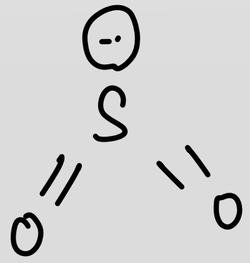
4 $sp^3d(s+p_x+p_y+p_z+d_z^2)$ *

5 $sp^3d^2(s+p_x+p_y+p_z+d_z^2+d_{x^2-y^2})$

6. $sp^3d^3\ (s+p_x+p_y+p_z+d_z^2+d_{x^2-y^2}+d_{xy})$

Electron Pairs: Total	Bonding	Lone	Arrangement of Pairs	Molecular Geometry		Hybridisation	Example	
SN.	Bp.	Lp						
2	2	0	Linear	Linear AX_2		Sp	BeF_2	F—Be—F
3	3	0	Trigonal planar	Trigonal planar AX_3		Sp2	BF_3	
	2	1		Bent (or angular) AX_2			SO_2	

example:



σ bond = 2

lp = 1

SN = 3

Hyb: sp^2

Calculating steric number for molecule

1.BeF2

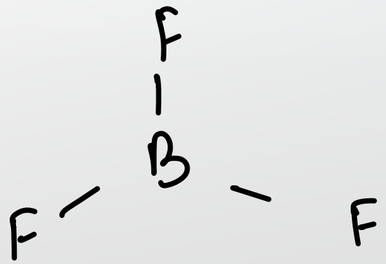
① F – Be – F

SN = σ Bond + lp
= 2 + 0
= 2

Hybridization : Sp
Shape: linear.

2. BF3

②

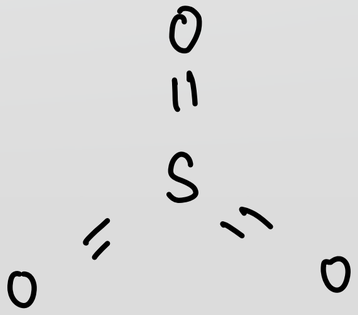


SN = σ Bond + lp
= 3 + 0
= 3

Hybridization : sp^2
Shape: Trigonal planar.

3. SO3

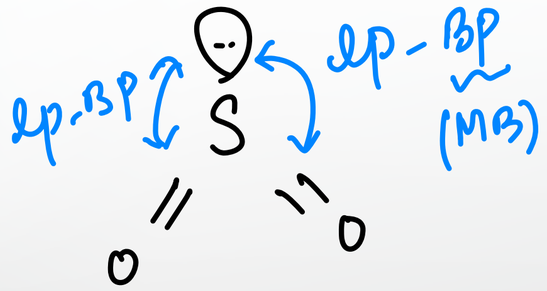
③



SN : σ Bond + lp
= 3 + 0
= 3

Hybridization : sp^2
Shape : Trigonal planar.

(4) SO_2



SN : σ Bond + lp

: 2 + 1

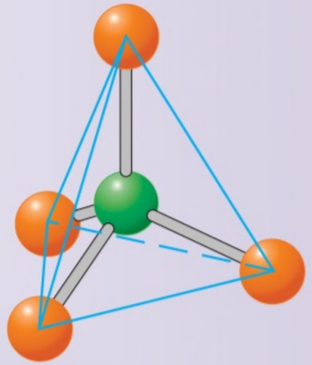
: 3

Hybridization : sp^2

Shape : V shape / Bent / angular.

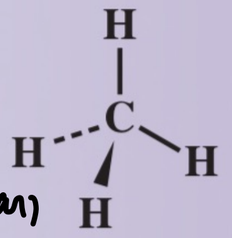
Chemical Bonding

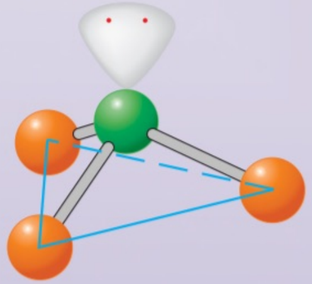
SN.	Bp.	Lp	Arrangements of pair	Molecular shape
4	4	0	Tetrahedral	Tetrahedral AX_4
	3	1		Trigonal pyramidal AX_3
	2	2		V / Bent (or angular) AX_2



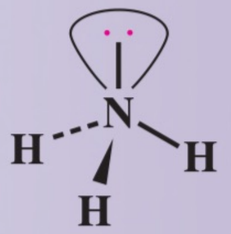
Sp3

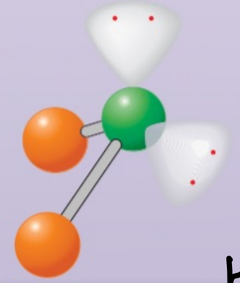
CH_4 (nonplanar)

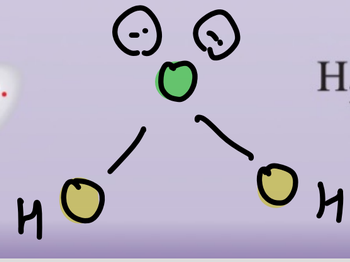




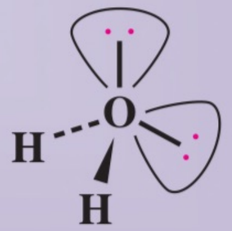
NH_3 (non planar)





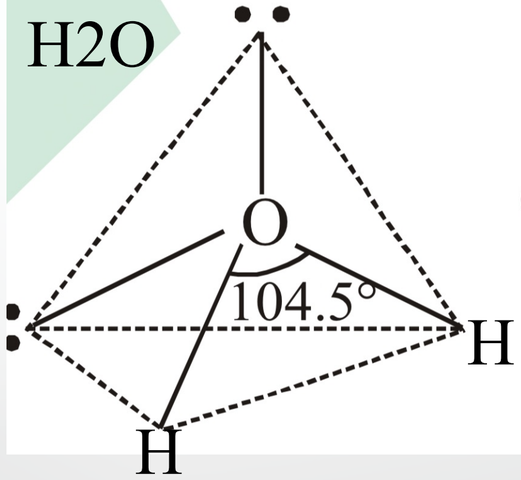


H_2O

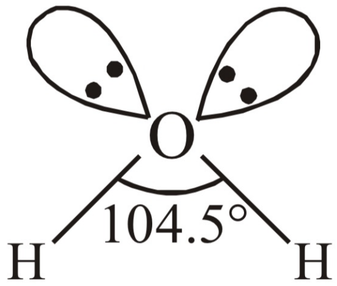


planar.

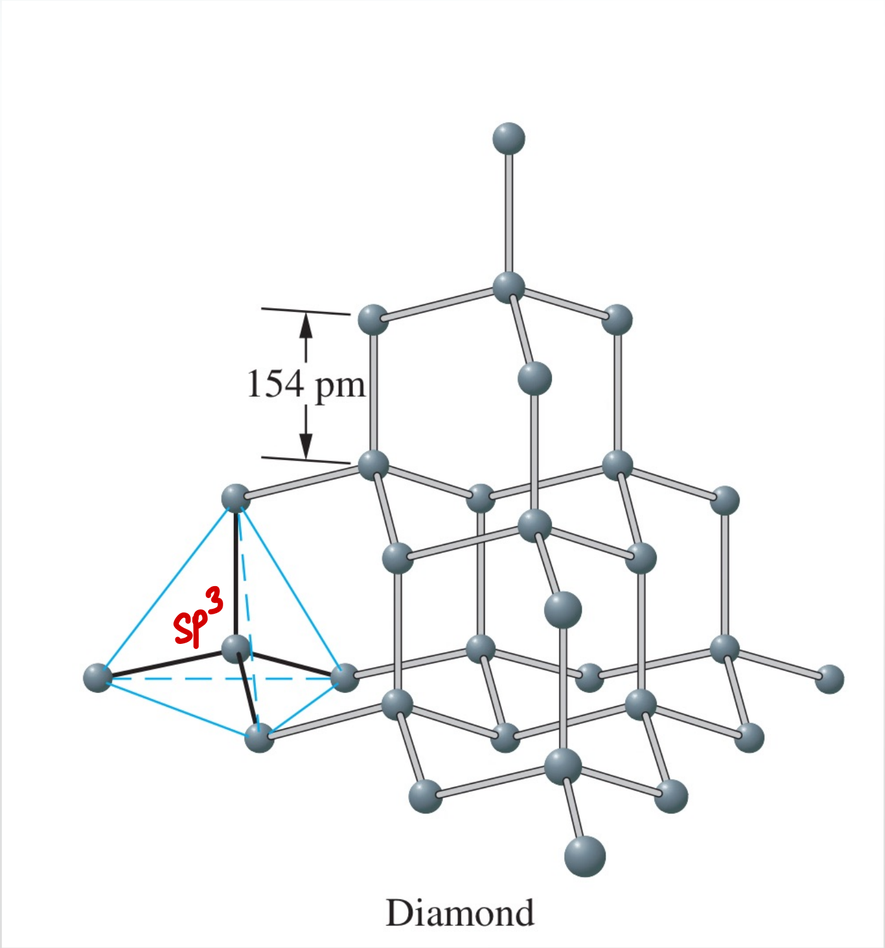
H2O



OR



Bent / V / angular



Diamond

SN = σ Bond + lp

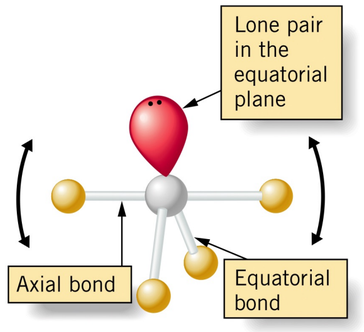
= 4 + 0

SN = 4

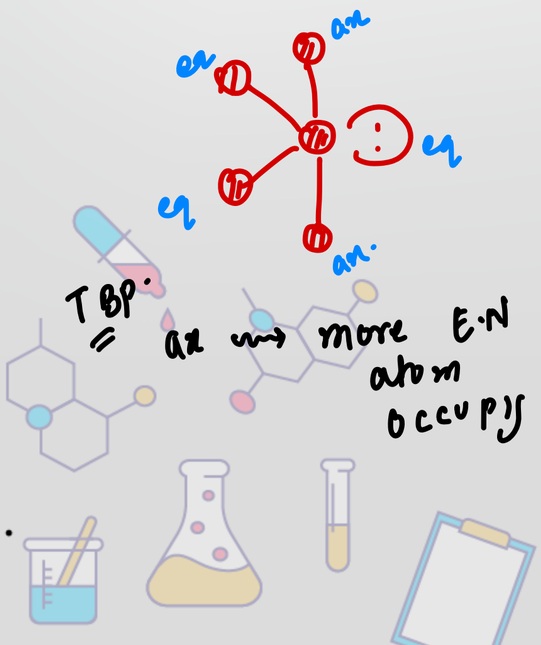
Hyb: sp^3

Arrangement: Tetrahedral

Chemical Bonding



Example :SF4



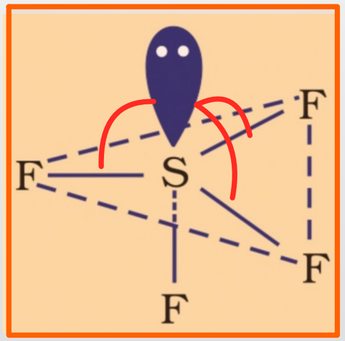
Sp3d

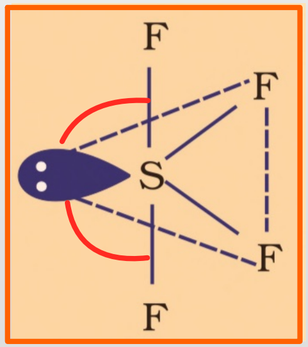
Folded square

Electron Pairs: Total	Bonding	Lone	Arrangement of Pairs	Molecular Geometry		Example	
5	5	0	Trigonal bipyramidal	Trigonal bipyramidal AX_5	Axial atom; Axial atom	PCl_5	Cl, Cl, Cl, P, Cl, Cl
	4	1		Seesaw (or distorted tetrahedron) AX_4	Lone pair	SF_4	F, F, S, F, F
	3	2		T-shaped AX_3	Lone pairs	ClF_3	F, F, Cl, F
	2	3		Linear AX_2	Lone pair; Lone pairs	XeF_2	F, Xe, F

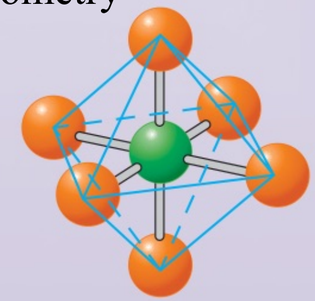
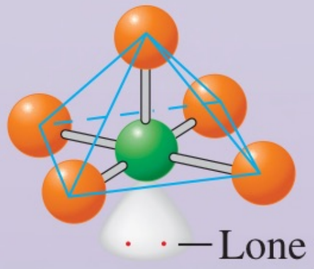
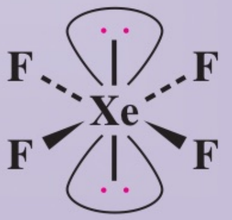
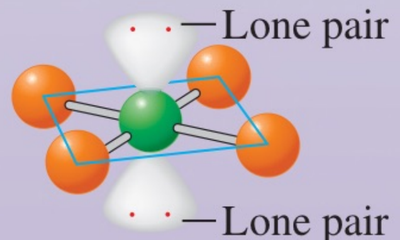
** In TBP lone pair occupy equatorial position and more electro negative atom occupy axial position .
Reason : To minimise lone pair bond pair repulsion.

Among the given below structure of SF4 ,which is more stable structure.





✓

SN.	Bp.	Lp.		Molecular geometry	Sp3d2	
6	6	0	Octahedral	Octahedral AX_6	SF_6	
				Square bipyramidal		
	5	1		Square pyramidal AX_5	IF_5	
						
	4	2		Square planar AX_4	XeF_4	
						

Element.	Be	B.	C.	N.	O.	F.	Ne
Valence e.	2.	3.	4.	5.	6.	7.	8

Find hybridisation / shape for the molecule given below

1.NH3

① 

SN = 3+1 = 4

Hyb: sp^3

Shape/Geo: Trigonal pyramidal.

2.H2O

① 

SN = 2+2 = 4

Hyb: sp^3

Shape/Geo: V/Bent/Angular.

3.CO2

③ O = C = O

SN = 2+0 = 2

Hyb: sp

Shape/Geo: Linear.