LIVE

CHEMICAL BONDING

ONE SHOT & PYQs

In JEE-MAIN

6:00 PM Tonight

By VJ Sir

Hybridisation :→

Inter mixing of atomic orbitals having less energy diff

T.H.O = number of σ bonds + no of l.p

(total hybrid orbital)

T.H.O =	Hybridisation
2	sp
3	sp^2
4	sp^3
5	sp^3d
6	sp^3d^2
7	sp^3d^3

total no of val. e^-	2	3	4	5	6	7	8
	Be	B	C	N	O	F	Ne

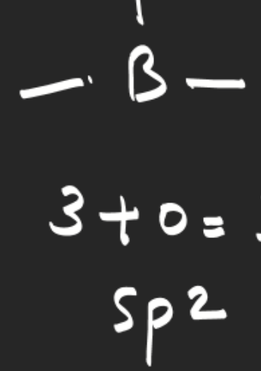
$BeCl_2$

Cl — Be — Cl

$= 2 + 0 = 2$

$= sp$

BCl_3



$3 + 0 = 3$

sp^2

CH_4

$4 + 0 = 4$ $\underline{sp^3}$

PCl_5

$5+0=5$

sp^3d

SF_6

$6+0$

6

sp^3d^2

IF_7

$=7+0$

$=7$

$=sp^3d^3$

XeF_2

$2+3=5$

sp^3d

XeF_4

$4+2$

6

sp^3d^2

XeO_3

$3+1=4$

sp^3

XeO_4

$4+0=4sp^3$

SO_2

$2+1=3$

sp^2

SO_3

$3+0=3$

sp^2

NH_3

$3+1$

$4\ sp^3$

H_2O

$2+2=4$

sp^3

XeO_3F_2

XeO_2F_2

XeF_5^+

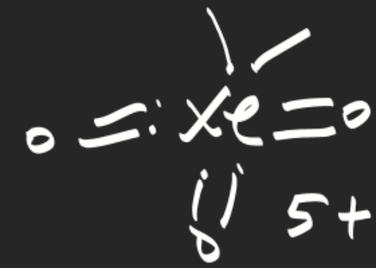
XeF_5^-

I_3^-

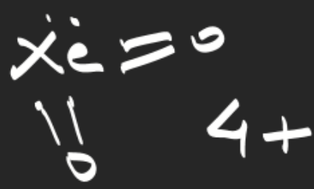
I_3^+

NH_4^+

NO_2^+



$5+0=5\ sp^3d$



$4+1=5\ sp^3d$

$5+1=6\ sp^3d^2$

$5+2=7$

sp^3d^3

I_3^+

$2+3=5\ sp^3d$

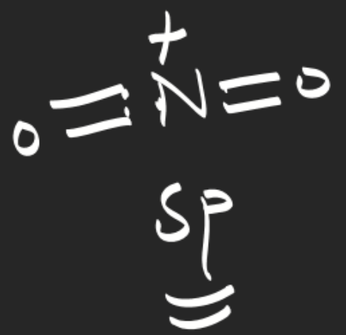
$2+2=4\ sp^3$

NH_4^+

$4+0=4$

sp^3

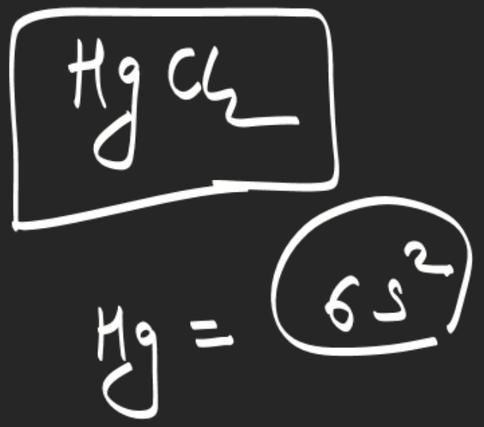
NO_2^+



sp

$2+0=2$

sp



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T.H.O	no of σ bond	no of l.p	electron geometry	geometry shape	B.A	example
2	2	0	linear	linear	180	
2	1	1				
3	3	0	trigonal planar	trigonal planar	120 = 3	
3	2	1		V-shape Bent Angular		
3	1	2		linear		

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4	4	0			109.5° = tet.	CCl_4
4	3	1			Pyramidal	< 109.5° NH_3
4	2	2	tet.		V-shape Bent Angular	<< 109.5 H_2O
4	1	3	tet		linear	

Ques Which of the following molecule have tetrahedral e^- geometry

(1) NH_3 (2) PCl_5 (3) SF_4 (4) none

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5	5	0	T·B·P	90° 120° 180°	PCl_5
5	4	1	T·B·P	See saw $< 90°$ $< 120°$	SF_4
5	3	2	T·B·P	Bent T-shape $< 90°$	ClF_3
5	2	3	T·B·P	linear 180°	XeF_2

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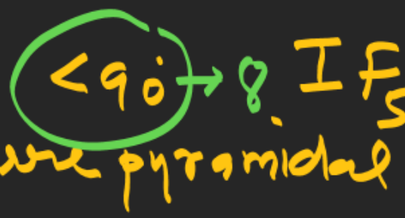
6 6 0  Octahedral  90° = 12, 180 = 3 SF_6

5 5 1 Oct. Square bipyramidal   <90° → 8. IF_5 Square pyramidal

6 4 2 Oct.  90° Sq planar

JEE Advanced PYQs Que find the number of <90° in BrF_5

Ans = 8

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7 7 0

90° = 10
72° = 5

IF7

Pentagonal bipyramidal

(P.B.P)

7 6 1

P.B.P

Pentagonal pyramidal

<90°
<72°

7 5 2

P.B.P

Pentagonal planar

72° = 5

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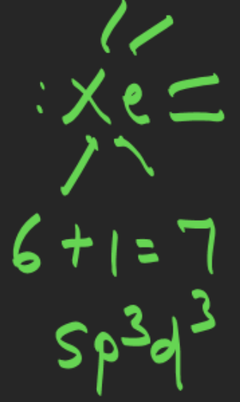
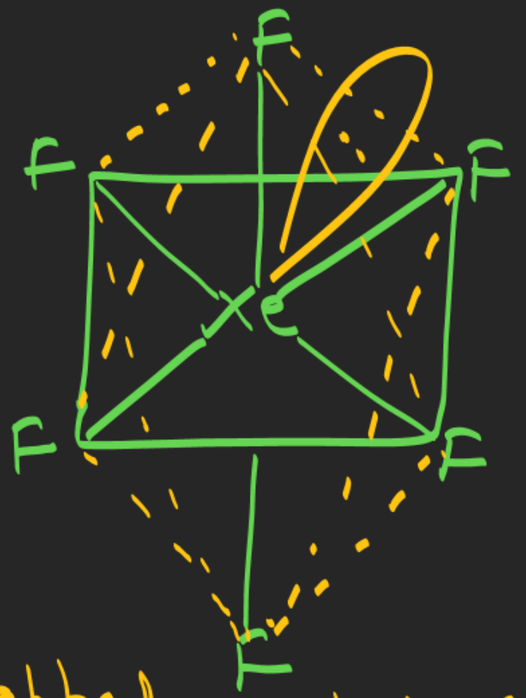
XeF_6





Stereo chemically active l.p

Capped octahedral

or distorted octahedral

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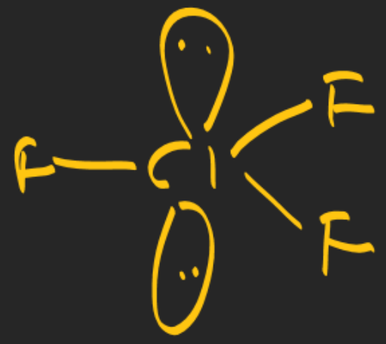
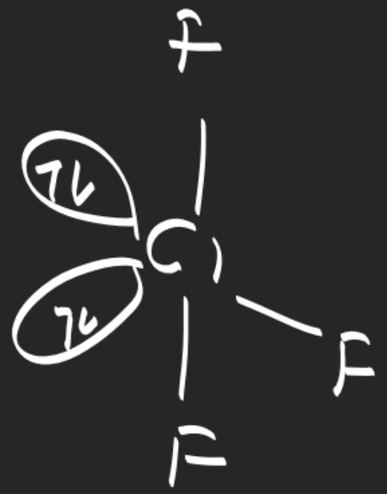
Que Which of the following geometry of ClF_3 is correct

(1) 

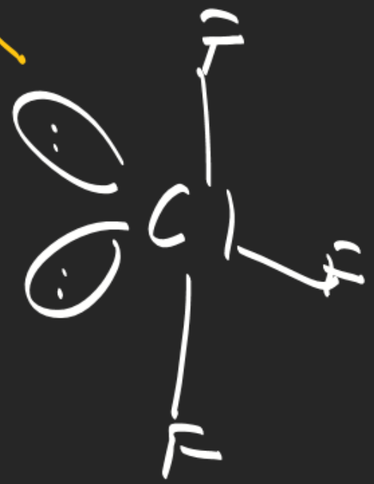
(2) 

(3) 

(4) none



X



X

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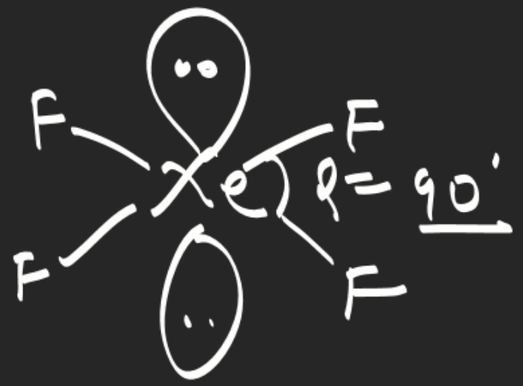
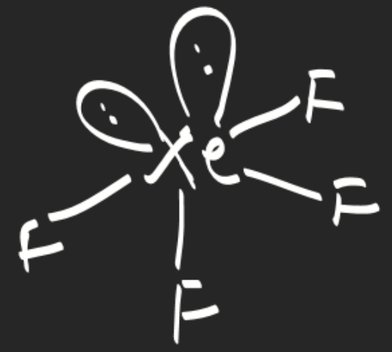
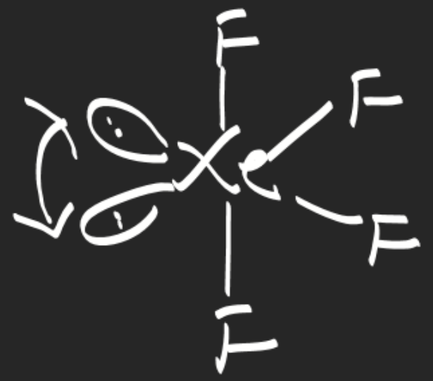
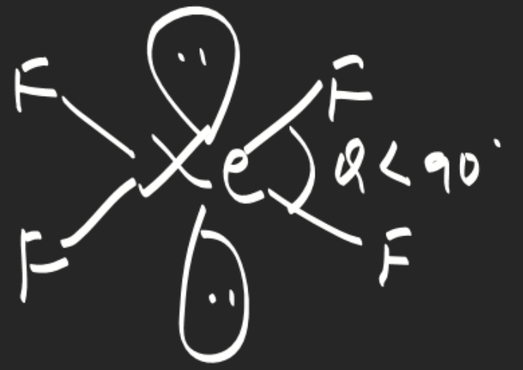
ans Which of the following shape of XeF_4 is Correct



Sq. planar

① 

② 

③ 

none

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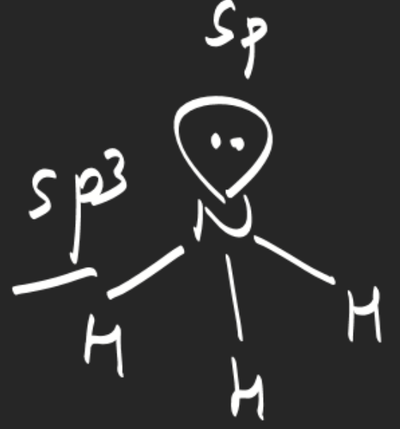
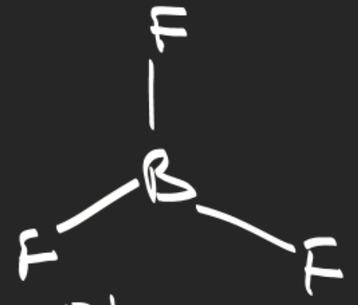
Planar | nonplanar

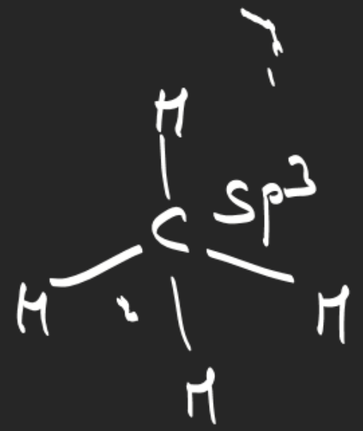
Planar



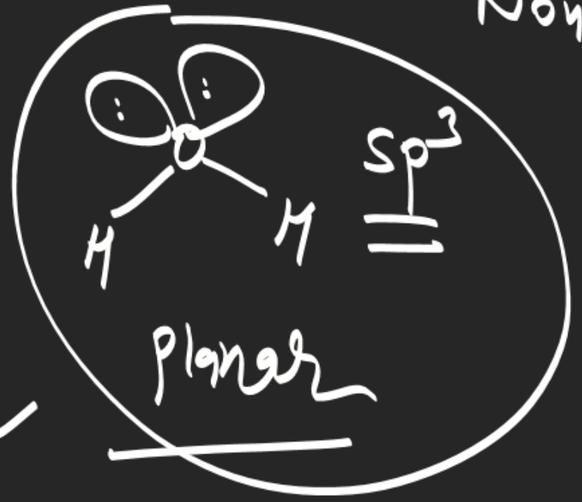
Non-planar



Planar



Non Planar



Planar

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Maximum atom in one plane = 3

Such plane = ?

Find the number plane in which same atoms present = 4 plane

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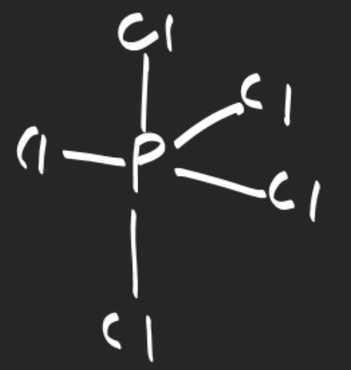
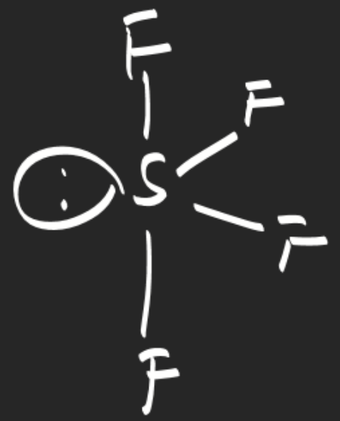
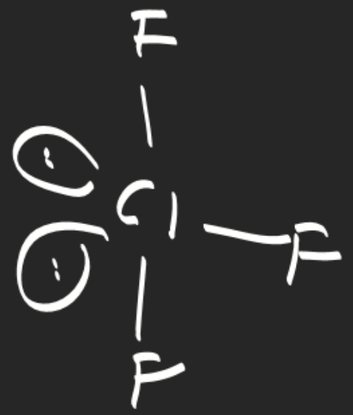


nonplanar



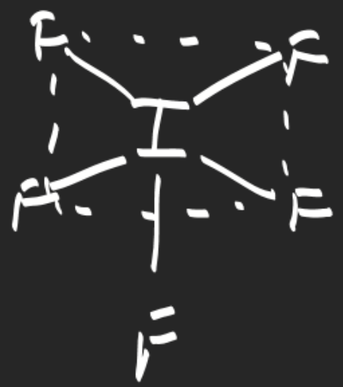
NP



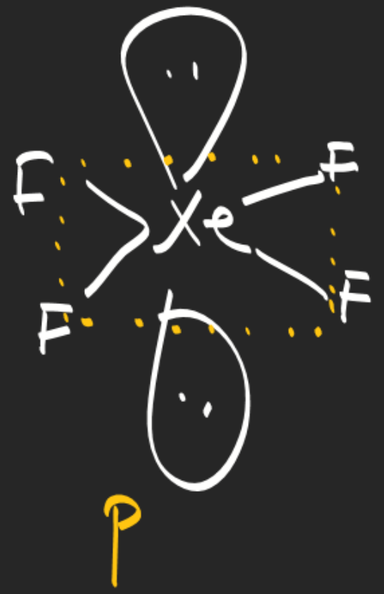
P

P

Np



Np



P

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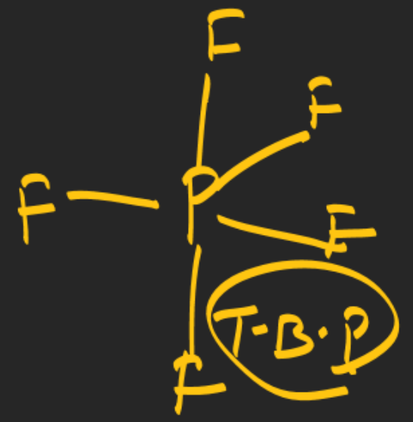
hyb. in solid state



PF_5

Solid liq. gas

$PCl_{5(s)} \longrightarrow PCl_4^+ + PCl_6^-$

$PBr_{5(s)} \longrightarrow PBr_4^+ + Br^-$

$PI_{5(s)} \longrightarrow PI_4^+ + I^-$

$XeF_{6(s)} \longrightarrow XeF_5^+ + F^-$

$N_2O_5 \longrightarrow NO_2^+ + NO_3^-$

$N_2O_4 \longrightarrow NO^+ + NO_3^-$

$Cl_2O_6 \longrightarrow ClO_2^+ + ClO_4^-$

$I_2Cl_6 \longrightarrow ICl_2^+ + ICl_4^-$

donot exist

donot exist

BCl_4^- ICl_7 $PI_{5(g)}$ (T·B·P)

PBr_6^- SCl_6 SBr_4 SI_6

PBr_6^-

Steric rep.

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V.S.E.P.R

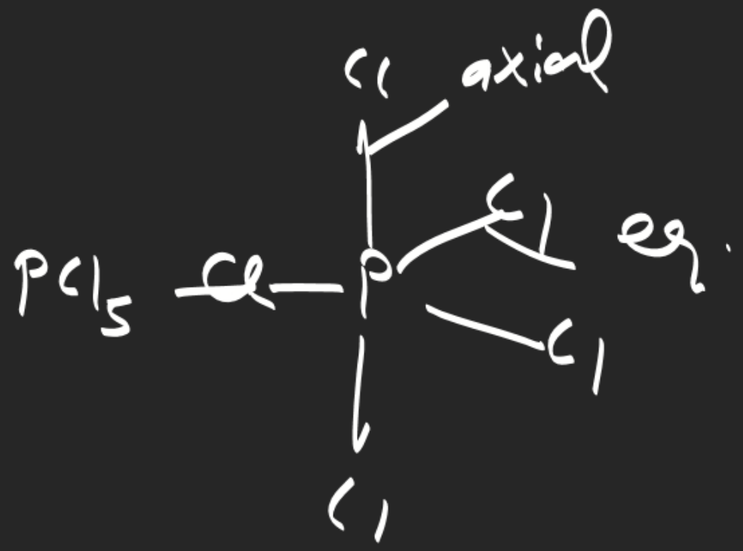
$l.p - l.p > l.p - B.p > B.p - B.p$

sp

sp^2

sp^3

sp^3d



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T.B.P

SF_4

at 90°

l.p - B.p = 2

See-Saw

90°
120°

l.p - B.p = 3

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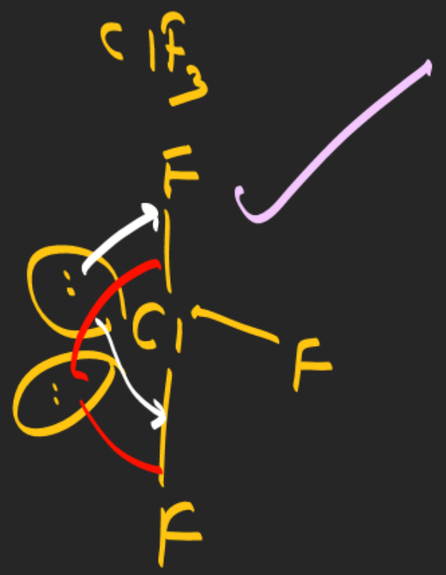
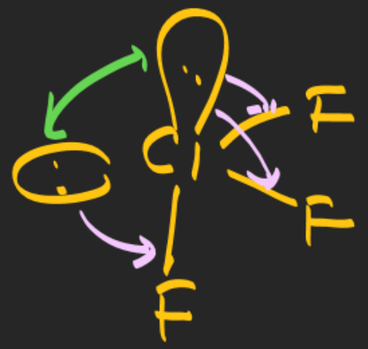
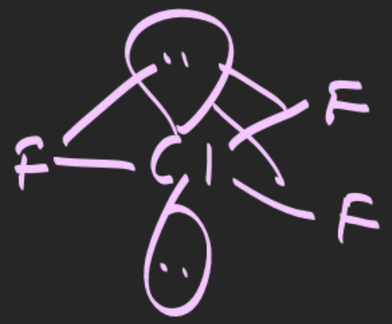


Bent

at 90°





$l.p - l.p = 0$ $\quad l.p - l.p = 1$ $\quad l.p . l.p = 0$

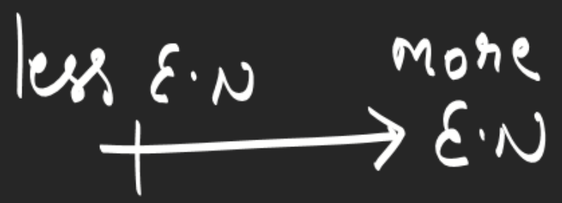
$l.p - B.p = 4$ $\quad l.p - B.p = 3$ $\quad l.p - B.p = 6$

Polar | non polar

dipole moment

$$\mu = e \times d \quad \text{esu} \times \text{cm}$$

OR



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non polar
H_2 N_2 O_2

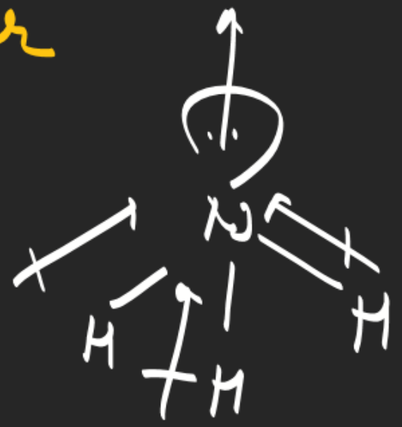
- Molecule
  - diatomic
    - Homonuclear — E.N diff = 0
    - Heteronuclear — E.N diff ≠ 0
  - polyatomic
    - $\mu_{net} = 0$ nonpolar
    - $\mu_{net} \neq 0$ Polar

sp
linear
Planar
$\mu = 0$
nonpolar

sp^2
Trigonal planar
Planar
$\mu = 0$
Non polar

$\mu \neq 0$ Polar

$\mu = 0$
nonpolar



$\mu \neq 0$
Polar

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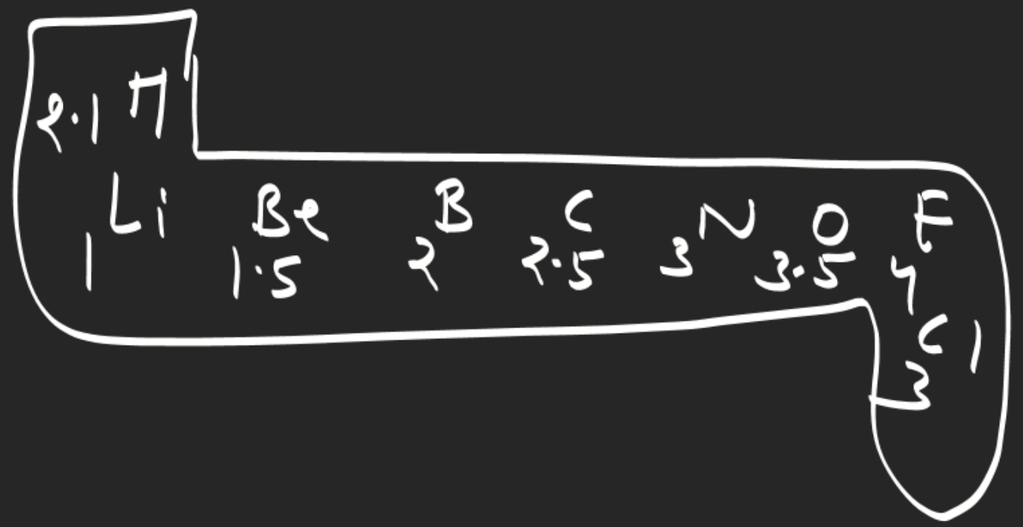
$N \overset{0.9}{-} H$ < $N - F$

PYQs

Que Compare bond dipole moment and dipole moment of NH_3 and NF_3

Bond dipole ∝ E.N diff



$\mu_{NH_3} > \mu_{NF_3}$

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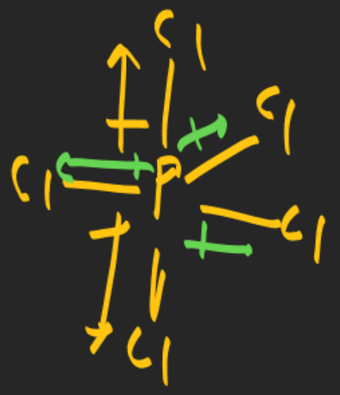
PCl_5



$\mu = 0$

nonpolar

$\mu = 0$

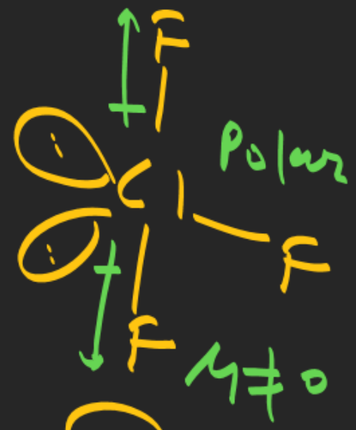
nonpolar

$\mu \neq 0$

polar

$\mu \neq 0$

polar

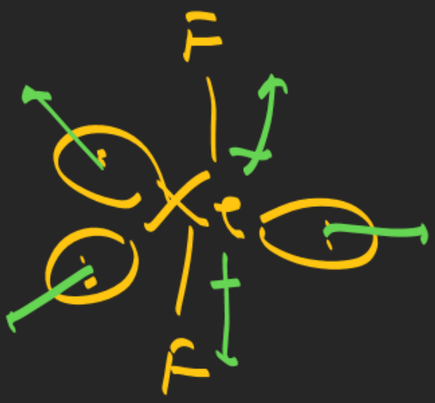


Polar

$\mu \neq 0$

$\mu = 0$

Non polar



$\mu = 0$

non polar

ans Find the hyb. of Cation part of solid PCl_5

$$PCl_5 \longrightarrow PCl_4^+ + PCl_6^-$$

$4 + 0 = 4\ sp^3$

$$\% \text{ Ionic Ch} = \frac{\mu_{ob}}{\mu_{th}} \times 100$$

μ_{ob} = given

μ_{th} = e x d esu x cm

$e = 4.8 \times 10^{-10}$ esu

1 Debye = 10^{-18} esu x cm

Calculate % of Ionic ch. in HCl

if observed dipole moment of HCl is 1.03 D

and distance of HCl bond is 1.275 Å

$$\% \text{ of Ionic ch.} = \frac{1.03 \times 10^{-18}}{4.8 \times 10^{-10}} \times 1.275 \times 10^{-8} \text{ cm}$$

(esu)

$$= \frac{1.03}{4.8 \times 1.275} \times 100$$

$\simeq 17\%$

Que What is shape of Cation part of solid Cl_2O_6

$$Cl_2O_6 \longrightarrow ClO_2^+ + ClO_4^-$$

V-shape
Angular

$2 + 1 = 3\ sp^2$

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CHEMICAL BONDING

5. Complex $[ML_5]$ can exhibit trigonal bipyramidal and square pyramidal geometry. Determine total number of ~~108°~~ 180°, 90° & 120° L-M-L bond angles.

180 = 1 2
90 = 6 8
120 = 3

Dipole moment

★ $CH_3Cl > CH_2Cl_2 > CHCl_3 > CCl_4$

★ $CH_3Cl > CH_3F > CH_3Br > CH_3I$

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CHEMICAL BONDING

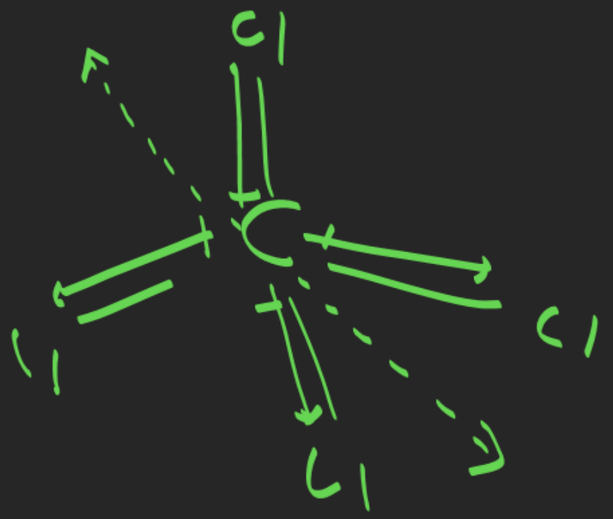
7. If AB_4 molecule is a polar molecule, a possible geometry of AB_4 is

(A) Tetrahedral

(B) Rectangular planar

(C) Square pyramidal

(D) Square planar



$\mu = 0$

nonpolar

$\mu = 0$

nonpolar

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CHEMICAL BONDING

9. The molecular geometry of SF_6 is octachedral . What is the geometry of SF_4(including lone pair(s) of electrons, is any)?

(A) Tetrahedral

(B) Trigonal bipyramidal

(C) Square planar

(D) Pyramidal

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10. The shape/structure of $[XeF_5]^-$ and XeO_3F_2, respectively, are

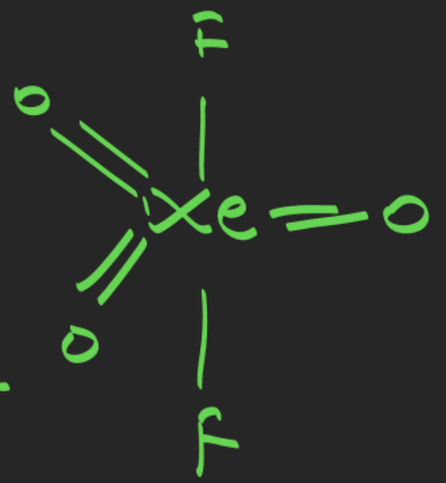
(A) Pentagonal planar and trigonal bipyramidal

(B) Trigonal bipyramidal and pentagonal planar

(C) Octahedral and square pyramidal

(D) Trigonal bipyramidal and trigonal bipyramidal

Pentagonal planar



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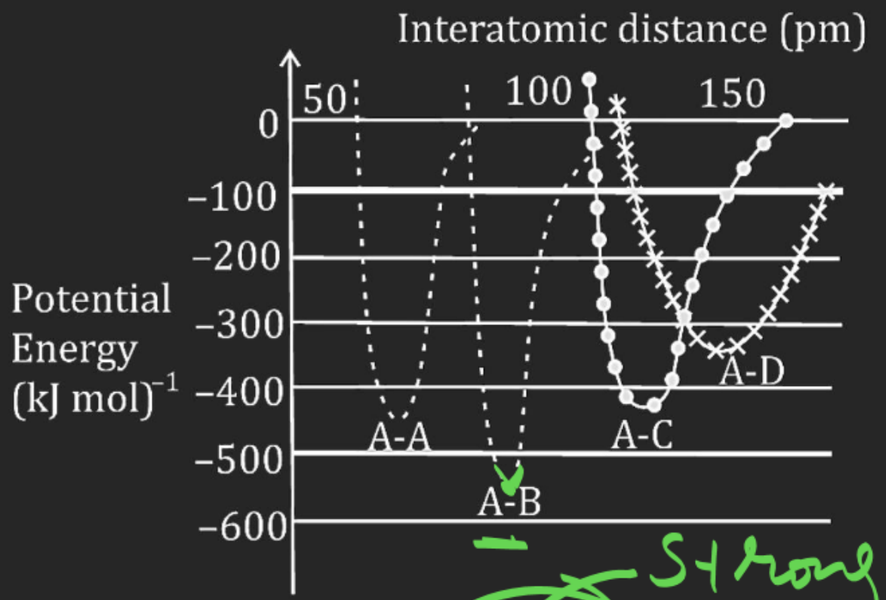
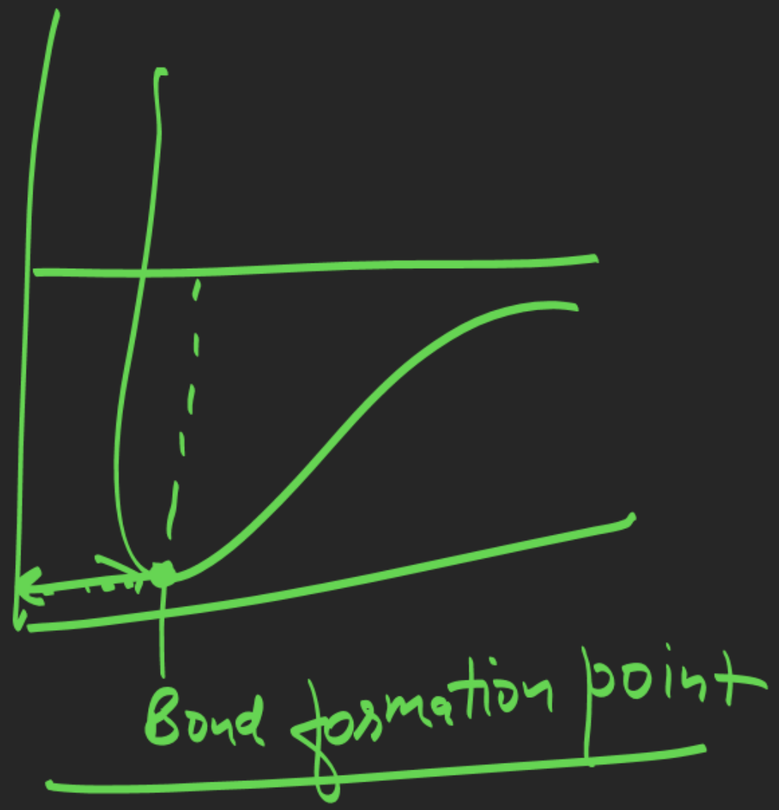
CHEMICAL BONDING

12. The intermolecular potential energy for the molecules A, B, C and D given below suggests that:





(A) A– B has the stiffest bond

(B) A – D has the shortest bond length

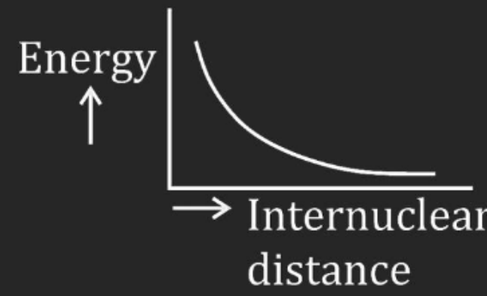
(C) A–A has the largest bond enthalpy

(D) D is more electronegative than other atoms

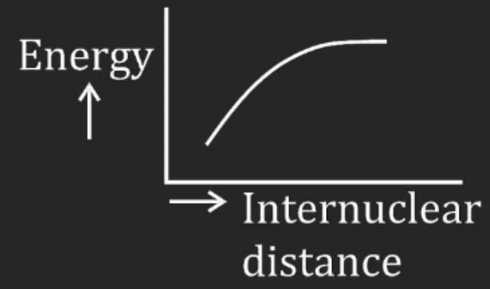
CHEMICAL BONDING

13. The potential energy curve for the H_2, molecule as a function of internuclear distance is

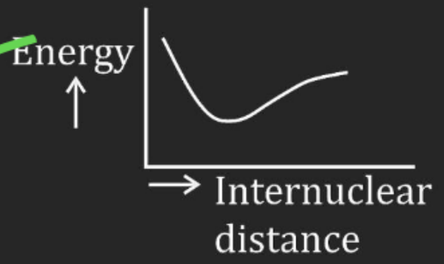
(A)

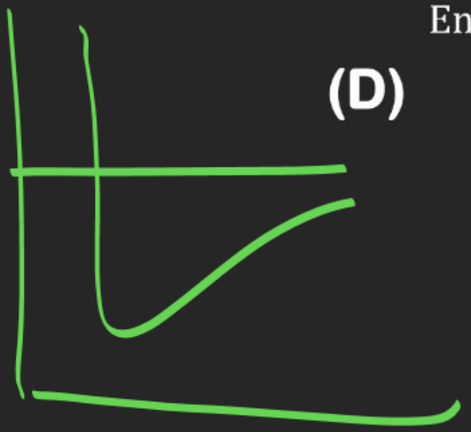


(B)

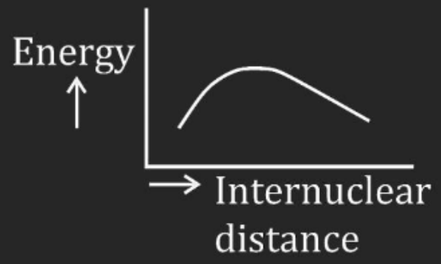


(C)





(D)



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CHEMICAL BONDING

14. The compound that the largest H – M – H bond angle (M = N, O, S, C) is

(A) H_2S (B) CH_4 (C) NH_3 (D) H_2O

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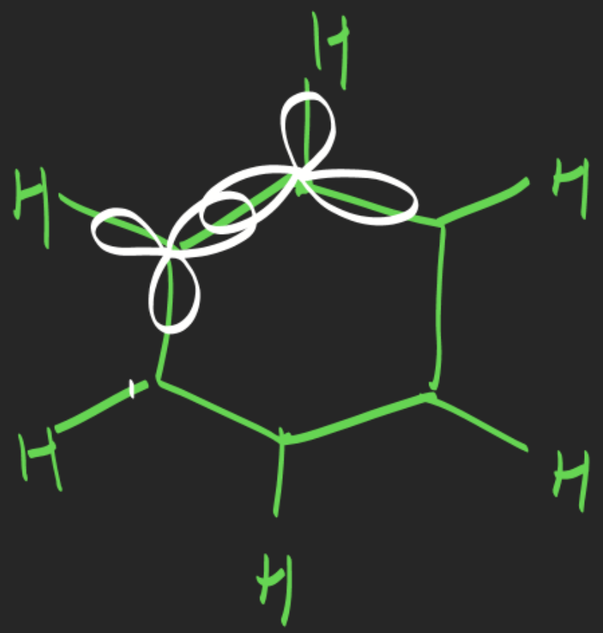
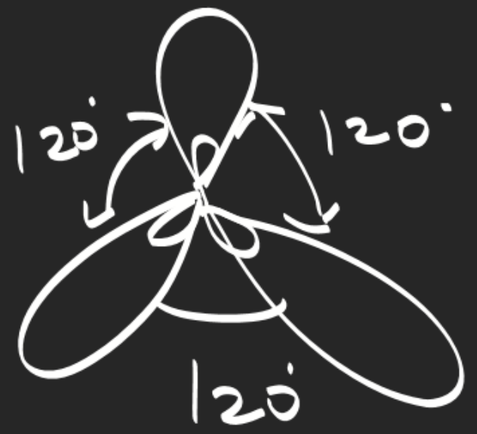
CHEMICAL BONDING

21. The number of sp^2 hybrid orbitals in a molecule of benzene is:

(A) 24 (B) 18 (C) 12 (D) 6



Sp^2



one Carbon Has — 3 sp^2 hyb. orbital

So 6 Carbon Have $\Rightarrow$ 18

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CHEMICAL BONDING

(2021)

1. Which of the following are isostructural pairs?

(a) SO_4^{2-} and CrO_4^{2-}

(b) $SiCl_4$ and $TiCl_4$

(c) NH_3 and NO_3^-

(d) BCl_3 and $BrCl_3$

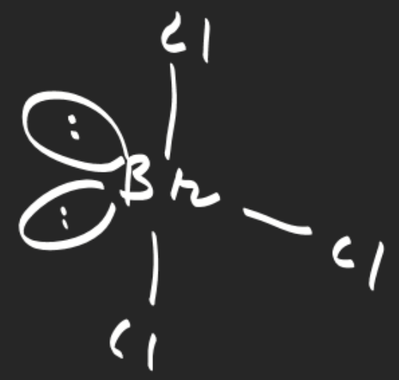
(A) A and C only

(B) A and B only

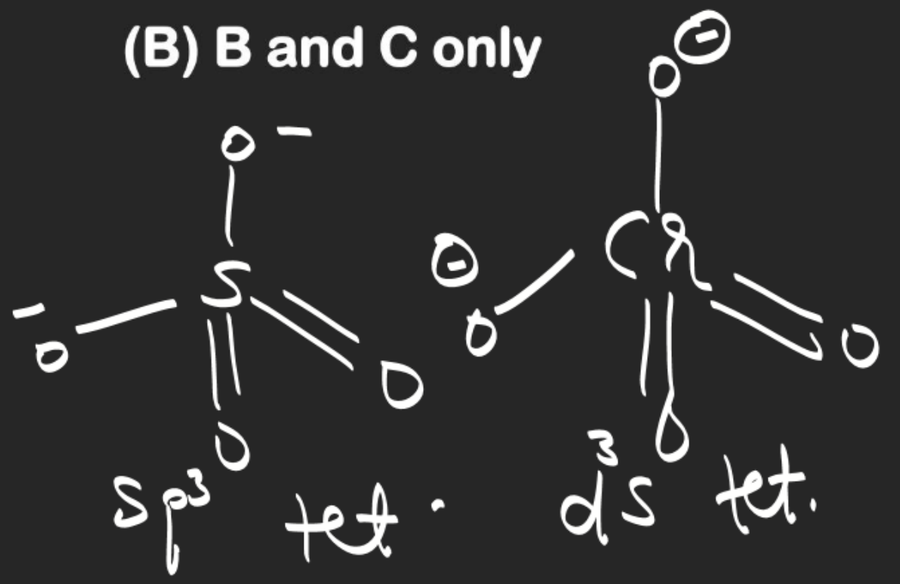
(B) B and C only

(D) C and D only

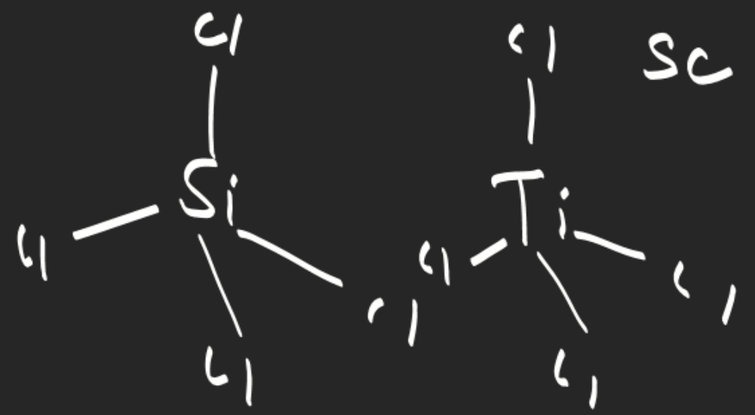
Trigonal Planar



Bent T-shape



sp^3 tet. d^3s tet.



Sc $Ti = 3d^2 4s^2$

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CHEMICAL BONDING

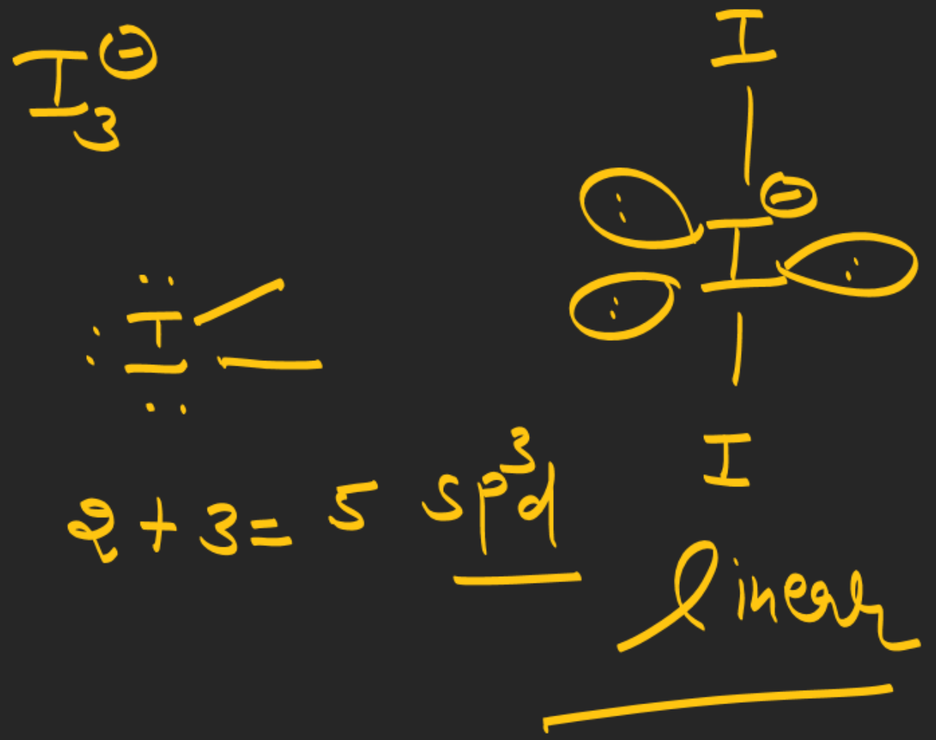
2. The correct shape and I-I-I bond angles respectively in I_3^- ion are:

(A) Trigonal planar; 120°

(B) Distorted trigonal planar, 135° and 90°

(C) Linear; 180°

(D) T-shaped; 108° and 90°



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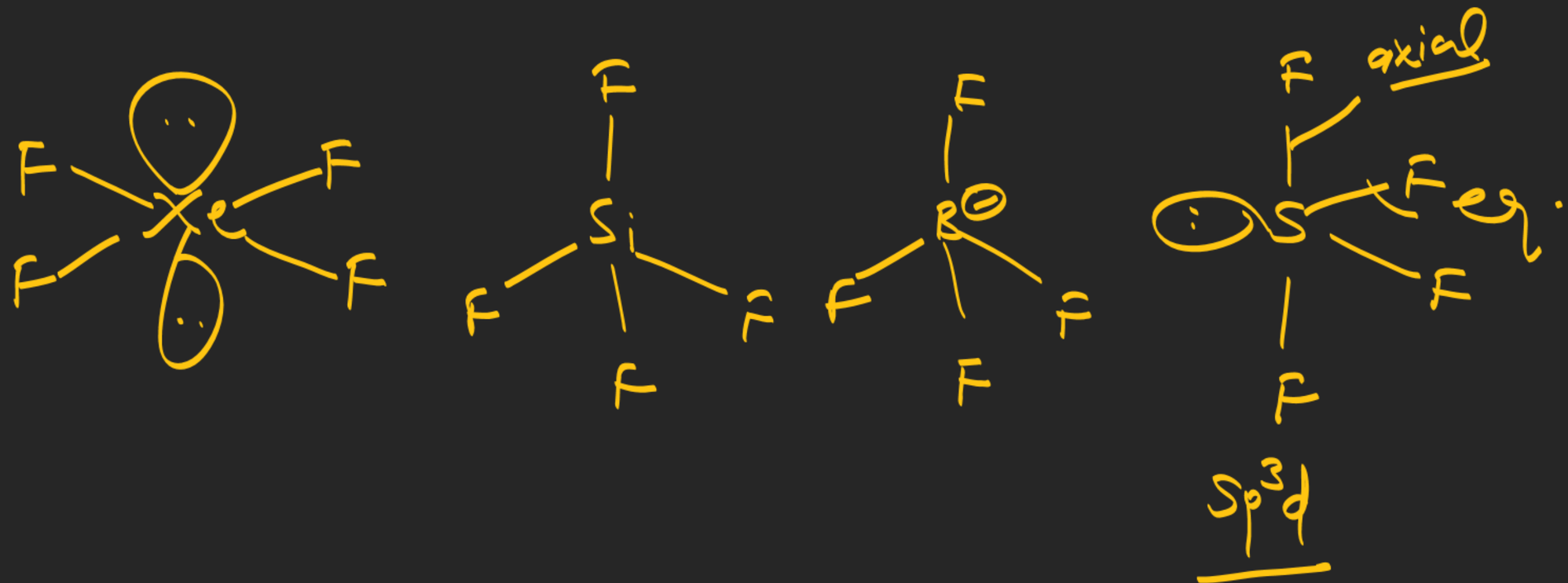
CHEMICAL BONDING

4. Which among the following species has unequal bond lengths?

(A) XeF_4 (B) SiF_4 (C) BF_4^- (D) SF_4



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CHEMICAL BONDING

7. Given below are two statements: one is labelled as Assertion and the other is labelled as Reason : Assertion A: The H – O – H bond angle in water molecule is 104.5°

Reason R : The lone pair – lone pair repulsion of electrons is higher than the bond pair - bond pair repulsion.

(A)A is false but is true

(B) Both and are true, but is not the correct explanation of A

(C)A is true but is false

(D) Both A and R are true, and is the correct explanation of A

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CHEMICAL BONDING

8. A central atom in a molecule has two lone pairs of electrons and forms three single bonds. The shape of this molecule is:

(A) see-saw

(B) planar triangular

(C) T-shaped

(D) trigonal pyramidal

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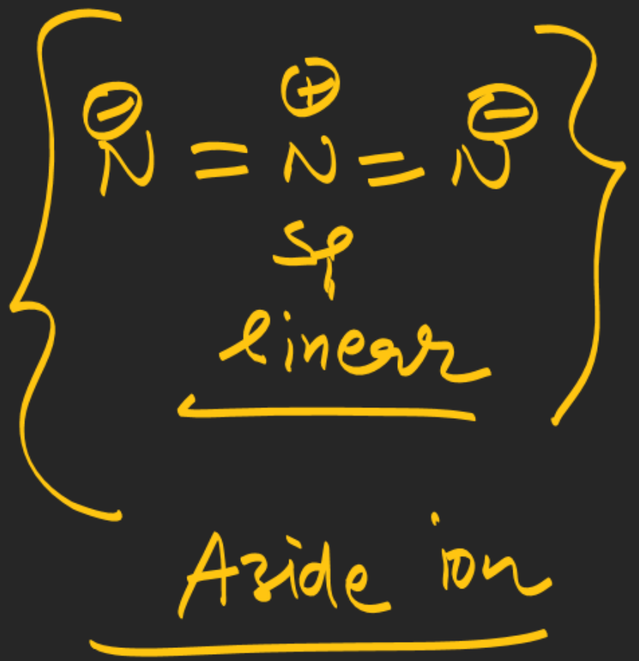
CHEMICAL BONDING

9. Amongst the following, the linear species is:

(A) NO_2 (B) Cl_2O (C) O_3 ~~(D) N_3^-~~



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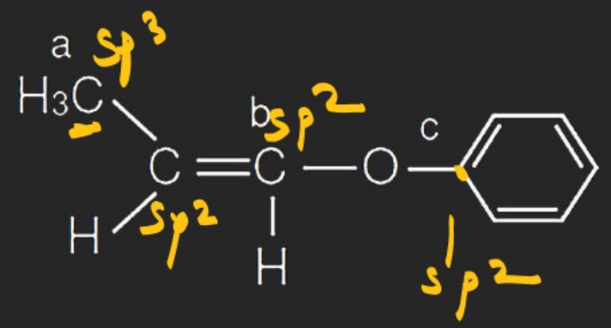
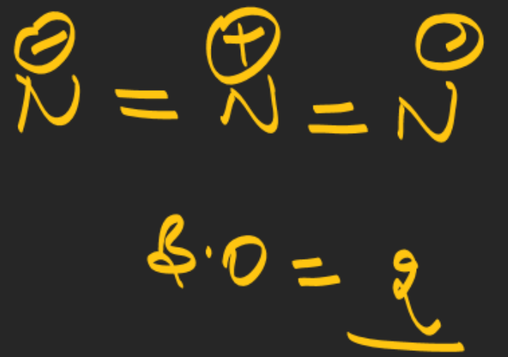
CHEMICAL BONDING

12. In the following molecules,





Hybridisation of carbon a, b and c respectively are :

(A) sp^3 ,sp,sp

(B) sp^3 ,sp^2 ,sp

(C) sp^3 ,sp^2 ,sp^2

(D) sp^3 ,sp,sp^2

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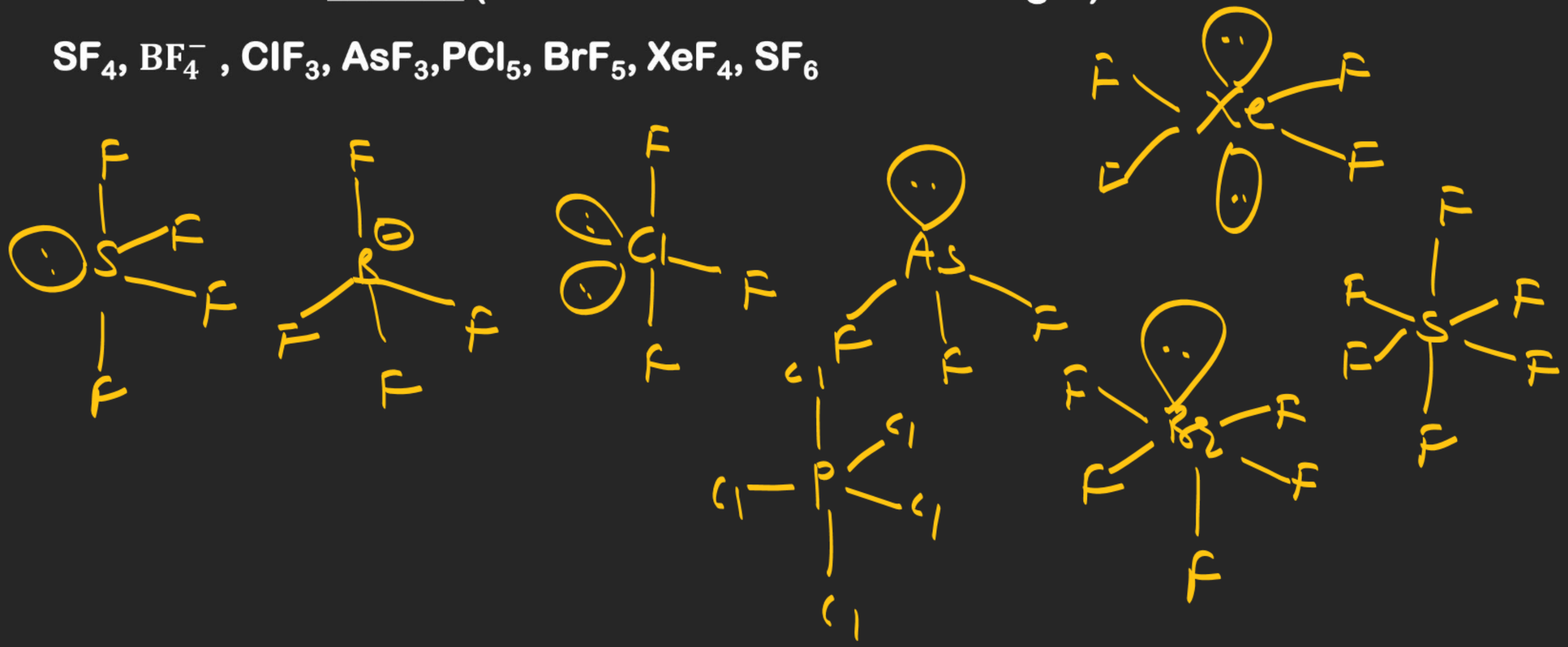
CHEMICAL BONDING

13. The number of species below that have two lone pairs of electrons in their central atom is_____ (Round off to the Nearest integer)

SF_4, BF_4^- , ClF_3, AsF_3,PCl_5, BrF_5, XeF_4, SF_6



order of dipole moment

$CH_3Cl > CH_3F > CH_3Br > CH_3I$

$CH_3Cl > CH_2Cl_2 > CHCl_3 > CCl_4$