SOLUTION OF CHEMICAL BONDING

CHEMICAL BONDING-2

EXERCISE # 1

PART – I (भाग - I)

D-3. (1) **$Na_2S_2O_3$ (Sodium thiosulphate).**

$2 \times 1 + 2x + 3 \times (-2) = 0.$
$(+2) + 2x + (-6) = 0.$
$2x = (+6) + (-2).$
$2x = +4.$
$x = +2.$ (average oxidation number).

(2) **$Na_2S_4O_6$ (Sodium tetra-thionate)**

$2 \times (+1) + 4x + 6 \times (-2) = 0.$
$4x = (+12) + (-2).$
$4x = +10.$
$x = +\frac{10}{4} = +\frac{5}{2}$. (average oxidation number).

(3) **H_2SO_5 (Caro's acid)**

$2 \times (+1) + x + 2 \times (-1) + 2 \times (-1) + 3 \times (-2) = 0.$
$(+2) + x + (-2) + (-6) = 0.$
$x = +6.$ (average oxidation number).

(4) **$H_2S_2O_8$ (Marshal's acid).**

$2 \times (+1) + 2x + 2 \times (-1) + 6 \times (-2) = 0.$
$(+2) + 2x + (-2) + (-12) = 0.$
$2x = +12.$
$x = +6.$ (average oxidation number).

(5) **$H_2S_2O_7$ (Pyro sulphuric acid).**

$2 \times (+1) + 2x + 7 \times (-2) = 0.$
$(+2) + 2x = +14.$
$2x = (+14) + (-2).$
$2x = +12.$
$x = +6.$(average oxidation number).

(6) **S_8 (Crown sulphur).**

Oxidation no. of element in homogeneous molecule will be zero.

(7) **HNO_4 (Peroxynitric acid)**

$+1 + x + 2 \times (-1) + 2 \times (-2) = 0.$
$x = (+6) + (-1).$
$x = +5.$

(8) **C_3O_2 (Carbon suboxide)**

$3x + 2 \times (-2) = 0.$
$3x = +4.$
$x = 4/3.$

(9) **O_5O_4 (Osmium tetra oxide)**

$x + 4 \times (-2) = 0.$
$x = +8.$

(10) **PH_3 (phosphene)**

$x + 3 \times (+1) = 0.$
$x = -3.$

(11) **CrO_4^{2-} (cromate ion)**

$x + 4 \times (-2) = -2.$
$x = (+8) + (-2).$
$x = +6.$

(12) **$Cr_2O_7^{2-}$ (dichromate ion)**

$2 \times x + 7 \times (-2) = -2$.
$2x = (+14) + (-2)$.
$2x = +12$.
$x = +6$.

(13) **CrO_2Cl_2 (cromyl chloride)**
$x + 2 \times (-2) + 2 \times (-1) = 0$.
$x + (-4) + (-2) = 0$.
$x = +6$.

(14) **CrO_5 (chromium per oxide)**
$x + 4 \times (-1) + 1 \times (-2) = 0$.
$x = +6$.

(15) **Na_2HPO_4 (disodium hydrogen phosphate)**
$(2 \times +1) + (-1) + x + 4 \times (-2) = 0$.
$(+2) + (+1) + x + (-8) = 0$.
$x = (+8) + (3)$
$x = +5$.

(16) **FeS_2 (Ferrous disulphide or Fool's gold or Iron pyrite)**
$x + 2x - 1 = 0$.
$x = +2$.

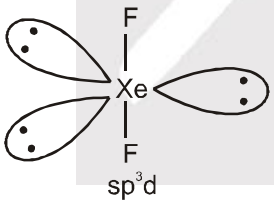
(17) **$C_6H_{12}O_6$ (Glucose or Fructose)**
$6 \times x + 12 \times (1) + 6 \times (-2) = 0$.
$6x + (+12) + (-12) = 0$.
$x = \frac{0}{6} = 0$.

(18) **NH_4NO_3 (Ammonium nitrate)**
$NH_4NO_3 \rightarrow [NH_4]^+ [NO_3]^-$.
NH_4^+
$x + 4 \times (+1) = +1$.
$x = -3$.
NO_3^-
$x + 3 \times (-2) = -1$.
$x = +5$.

PART – II (भाग - II)

A-1. To have minimum repulsions, the two lone pair occupy the trans positions in octahedral geometry.
हल. न्यून प्रतिकर्षण के लिये दो एकाकी इलेक्ट्रॉन युग्म अष्टफलकीय ज्यामिती में विपक्ष स्थिति (trans positions) में रहते हैं।

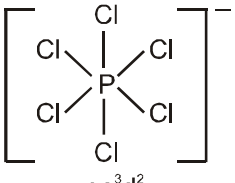
A-2. **(i)**



sp^3d

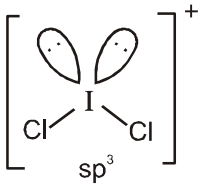
(ii) $[N = \overset{+}{N} = N]^{2-}$
sp

(iii) PCl_5 (s) exists as $[PCl_4]^+$ and $[PCl_6]^-$,



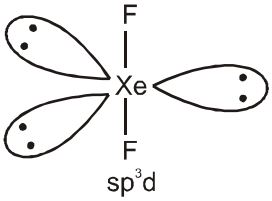
sp^3d^2

(iv) $I_2Cl_6(\ell) \rightleftharpoons [ICl_2]^+ + [ICl_4]^-$



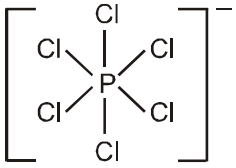
sp^3

self ionisation

हल : **(i)** 

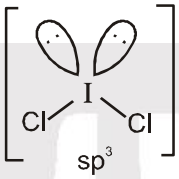
sp^3d

(ii) $[\overset{+}{N}=\overset{+}{N}=N]^{2-}$
sp

(iii) PCl_5 (s) का अस्तित्व $[PCl_4]^+$ और $[PCl_6]^-$, 

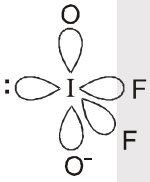
के रूप में है।

sp^3d^2

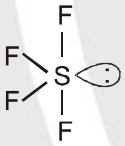
(iv) $I_2Cl_6(\ell) \rightleftharpoons [ICl_2]^+ + [ICl_4]^-$ 

sp^3

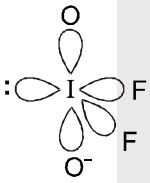
स्वतः आयनन

A-3. 

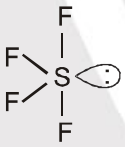
sp^3d but see-saw shape



see-saw

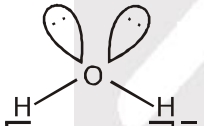
हल. 

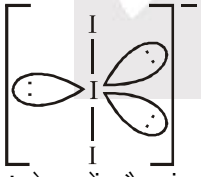
sp^3d परन्तु सी–सॉ आकृति



सी–सॉ (नैज आकृति)

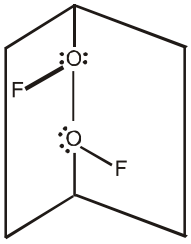
A-4. (A) $\underline{B}F_3\,(sp^2) + F^- \longrightarrow \underline{B}F_4^-\,(sp^3)$.
(B) $\underline{N}H_3\,(sp^3) + H^+ \longrightarrow \underline{N}H_4^+\,(sp^3)$
(C) $2\,\underline{S}O_2\,(sp^2) + O_2 \longrightarrow 2\,\underline{S}O_3\,(sp^2)$
(D) $H_2\underline{O}\,(sp^3) + H^+ \longrightarrow H_3\underline{O}^+\,(sp^3)$

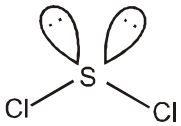
A-5. (A) 

(B) 

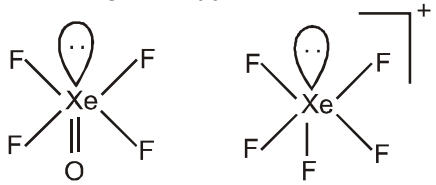
Number of bond pairs around I = 2; Number of lone pairs around I = 3.

I के चारों और बंध युग्मों की संख्या = 2; I के चारों और एकाकी युग्म = 3

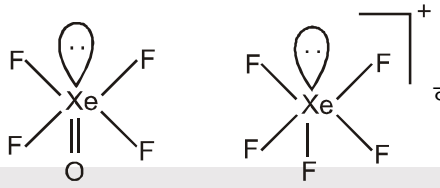
(C) 

(D) 

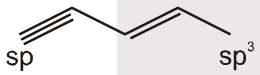
A-6. (A) XeO_3 is trigonal pyramid. (B) IOF_4^+ is see-saw.
(C) PCl_5 is trigonal bipyramidal.

(D)  square pyramidal.

हल : (A) XeO_3 त्रिकोणीय पिरेमिडीय है। (B) IOF_4^+ की नेज आकृति (see-saw) है।

(C) PCl_5 त्रिकोणीय द्विपिरेमिडीय है। (D)  वर्गीय पिरेमिडीय

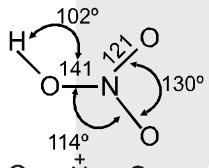
B-2. $N_3^{\ominus} \equiv [\overset{\ominus}{N} = \overset{\oplus}{N} = N^-]$; $NOCl \equiv O = N - Cl$ & $N_2O \equiv \overset{-}{N} = \overset{+}{N} = O$

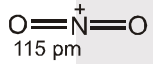
B-3. 

B-4.

XeF_7^+	sp^3d^3
PCl_4^+	sp^3
SF_6	sp^3d^2
PF_4^+	sp^3

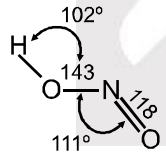
B-5.

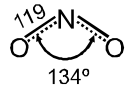
C-1. (A) 

(B) 

Bond angle is 180º because of sp hybridisation of nitrogen.

(बंध कोण 180º है, क्योंकि नाइट्रोजन का संकरण sp हैं।)

(C) 

(D) 

C-2. Central atom is sp hybridized and It is linear molecule.
केन्द्रीय परमाणु sp संकरित है तथा यह रेखीय (linear) अणु है।

C-3. As the electronegativity of central atom increases the bond angle increases due to repulsion between bond pair and bond pair as bond pairs are more close to the central atom.

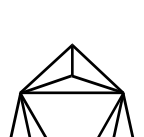
हल : बंध युग्म – बंध युग्म के मध्य प्रतिकर्षण के कारण केन्द्रीय परमाणु की विद्युतऋणता का मान बढ़ने पर बंध कोण का मान बढ़ता है क्योंकि बंध युग्म केन्द्रीय परमाणु के अधिक निकट होते है।

C-4. Due to absence of lone pair on N in NH_4^+,lp–lp, or lp –bp repulsion is not there.
NH_4^+ में N पर lone pair की उपस्थिति के कारण lp–lp या lp –bp प्रतिकर्षण नहीं होता है।

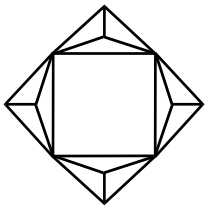
C-5. As per Drago's rule
ड्रेगो नियम के अनुसार

D-3. Refer to the text.

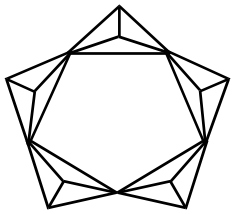
D-4.



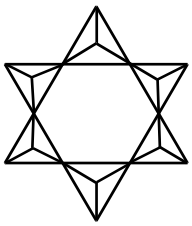
$[Si_3O_9]^{6-}$



$[Si_4O_{12}]^{8-}$



$[Si_5O_{15}]^{10-}$

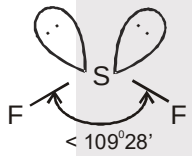


$[Si_6O_{18}]^{12-}$

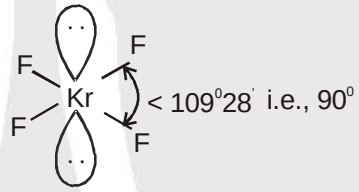
General formula of cyclic silicates is $[Si_n O_{3n}]^{2n-}$ (चक्रीय सिलीकेट का साधारण सूत्र $[Si_n O_{3n}]^{2n-}$ है)

PART – III (भाग - III)

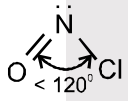
1. (A)



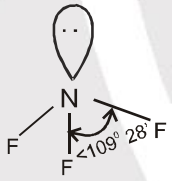
(B)



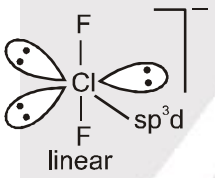
(C)



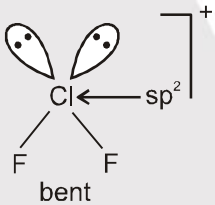
(D)



2. (A)

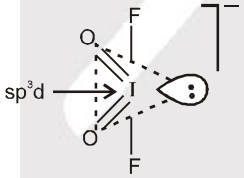


linear ;

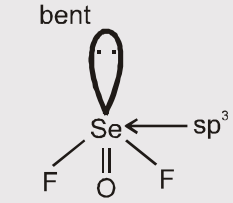


bent

(B)

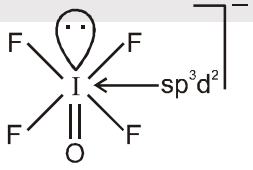


see - saw

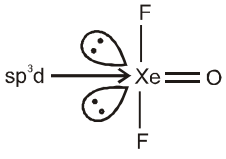


(trigonal pyramid)

(C)

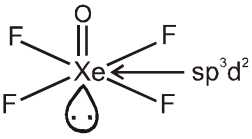


(square pyramidal)

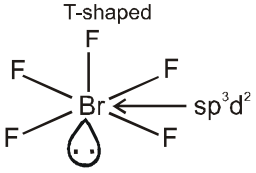


T-shaped

(D)

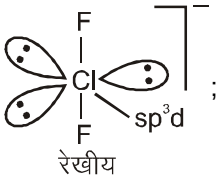


(square pyramidal)

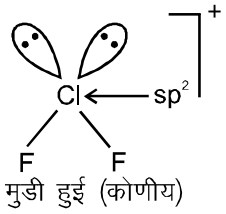


(square pyramidal)

हल. (A)

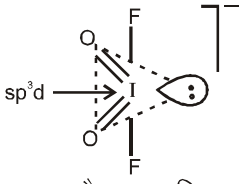


रेखीय

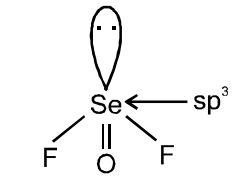


मुडी हुई (कोणीय)

(B)

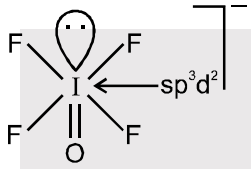


नैज आकृति



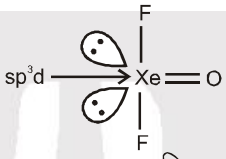
(त्रिकोणीय पिरेमिडीय)

(C)

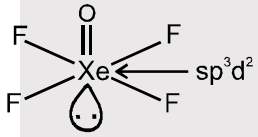


(वर्गाकार पिरेमिडीय)

T-आकृति

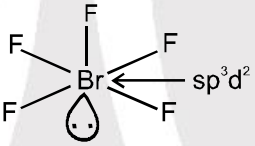


(D)



(वर्गाकार पिरेमिडीय)

(वर्गाकार पिरेमिडीय)

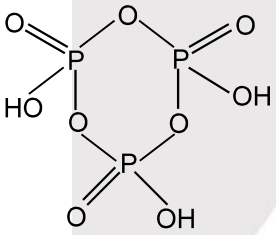


3. (A)

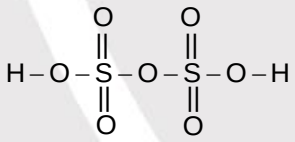
(B)

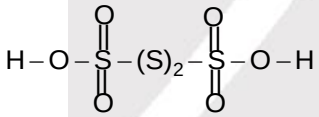
(C)

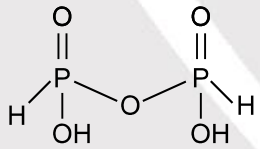
(D)



EXERCISE # 2







PART – I (भाग - I)

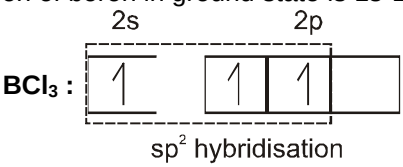
1. Both $PO_4^{3\ominus}$ & $SO_3^{2\ominus}$ have hybridisation sp^3

$PO_4^{3\ominus}$ व $SO_3^{2\ominus}$ दोनों का संकरण sp^3 है।

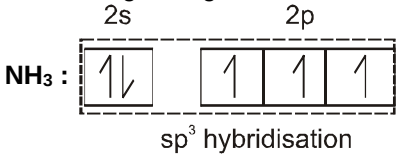
2. (a) Electronic configuration of boron in ground state is $1s^22s^22p^1$.

BCl_3 :

sp^2 hybridisation

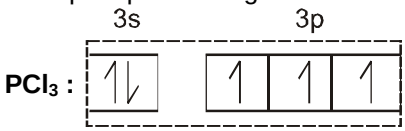


(b) Electronic configuration of nitrogen in ground state is $1s^2 2s^2 2p^3$.



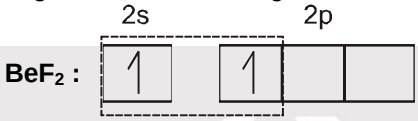
sp^3 hybridisation

(c) Electronic configuration of phosphorus in ground state is $1s^2 2s^2 2p^6 3s^2 3p^3$.



sp^3 hybridisation

(d) Electronic configuration of boron in ground state is $1s^2 2s^2$.



sp hybridisation

हल : (a) आद्य अवस्था में बोरॉन का इलेक्ट्रॉनिक अभिविन्यास $1s^2 2s^2 2p^1$ है।

sp^2 संकरित

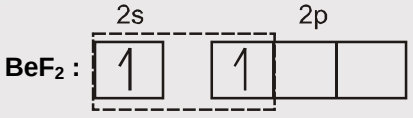
(b) आद्य अवस्था में नाइट्रोजन का इलेक्ट्रॉनिक अभिविन्यास $1s^2 2s^2 2p^3$ है।

sp^3 संकरित

(c) फास्फोरस का आद्य अवस्था में इलेक्ट्रॉनिक अभिविन्यास $1s^2 2s^2 2p^6 3s^2 3p^3$ है।

sp^3 संकरित

(d) बोरॉन का आद्य अवस्था में इलेक्ट्रॉनिक अभिविन्यास $1s^2 2s^2$ है।



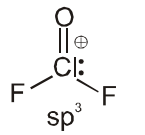
sp संकरित

4. A fact, to be remembered.
एक तथ्य, याद रखें।

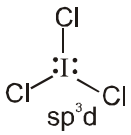
5. A fact, to be remembered.
एक तथ्य, याद रखें।

6. T shape geometry is possible in sp^3d hybridisation which indicates presence of two lone pairs in MX_3.
sp^3d संकरण में सम्भावित ज्यामिति T-आकृति है जो कि MX_3 में दो एकाकी युग्मों की उपस्थिति को दर्शाती है।

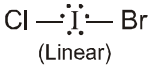
7.



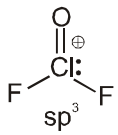
(Pyramidal)



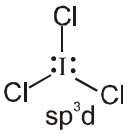
(T-shaped)



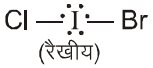
(Linear)



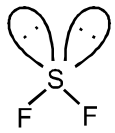
(पिरैमिडिय)

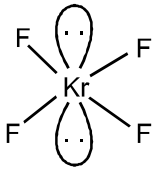


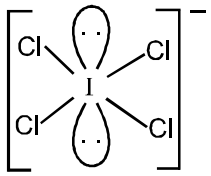
(T-आकृति)



(रैखीय)

8. (A) 

(B) 

(C) 

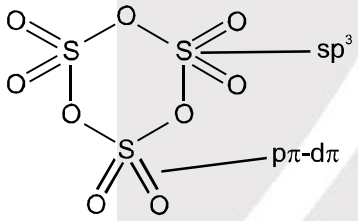
9. H_2S – No hybridisation bond angle ≈ 93º
NH_3 – Pyramidal 104.5º
CH_4 – Tetrahedral 109º28'
BF_3 – Triaganalplaner 120º
H_2S – कोई संकरण नहीं बंध कोण ≈ 93º
NH_3 – पिरेमिडिय 104.5º
CH_4 – चतुष्फलकीय 109º28'
BF_3 – त्रिकोणीय समतलीय 120º

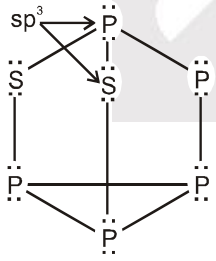
10. In sp^3d hybridisation (triogonal bipyramidal) the axial and equitorial bonds are different.
sp^3d संकरण (त्रिकोणीय द्विपिरेमिडीय) में अक्षीय व विषुवतीय बंध भिन्न होते है।

11. $O=\overset{\oplus}{N}=O$ Bond order (बंध क्रम) = 2
$^{\ominus}O-N=O$ Bond order (बंध क्रम)= 1.5

12. Due to small size of nitrogen, the lp–lp repulsion is more than that in P. Hence statement B is correct
Sol. नाइट्रोजन के छोटे आकार के कारण, lp–lp प्रतिकर्षण P से अधिक होता है। अतः (B) कथन सत्य है।

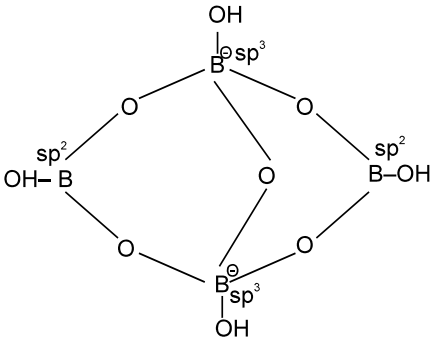
13. (A) Is anion of borax and does not contain any peroxide in it.
यह बोरेक्स का ऋणायन है और इसमें कोई परॉक्साइड नहीं होता है ।

14. 

15. Hybridisation is sp^3.
sp^3 संकरण हैं।


16. Hybridization of $2p_x$ and $2p_y$ does not take place without s-orbital.
s-कक्षक के बिना $2p_x$ तथा $2p_y$ कक्षकों के संकरण नहीं होता।

17. The correct formula of borax is $Na_2[B_4O_5(OH)_4].\ 8H_2O$. The structure of anion is :
(बोरेक्स का सही सूत्र $Na_2[B_4O_5(OH)_4].\ 8H_2O$ है ऋणायन की संरचना निम्न है :)

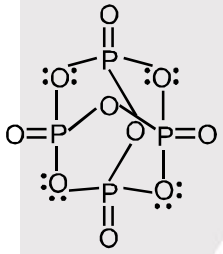


PART – II (भाग - II)

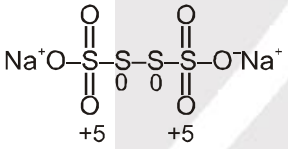
3. **No. of π bond (π-बंधों की संख्या)**

$XeOF_2$	1
XeO_2F_4	2
XeO_3	3
XeO_4	4
XeO_3F_2	3
$XeOF_4$	1
XeO_2F_2	2

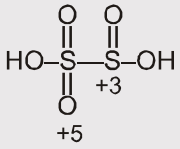
4. P_4O_{10}



5.



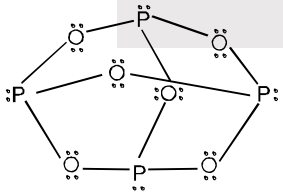
x = 5



y = 2

value of x × y is = 5 × 2 = 10

6.

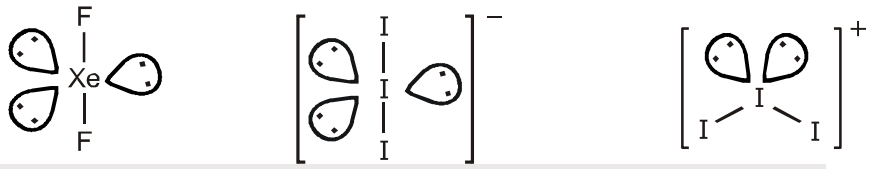


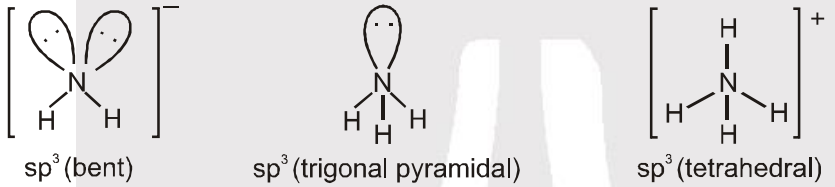
PART – III (भाग - III)

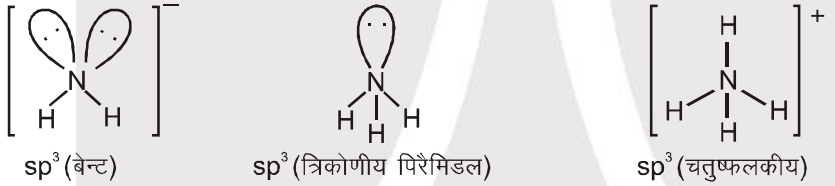
1. It is the orbital that undergo hybridisation and not the electrons. For example, for orbitals of nitrogen atom ($2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$) belonging to valency shell when hybridise to form four hybrid orbitals, one of which has two electrons (as before) and other three have one electron each. It is not necessary that only half filled orbitals participate in hybridisation. In some cases, even filled orbitals of valence shell take part in hybridisation.

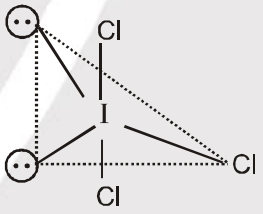
हल. कक्षक, संकरण में भाग लेते हैं न कि इलेक्ट्रॉन। उदाहरण के लिए, नाइट्रोजन परमाणु के $(2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1)$ कक्षक संयोजी कोश से संबंधित है जब चार संकरित कक्षक बनाने के लिए संकरण होता है तो इनमें से एक में दो इलेक्ट्रॉन (पहले वाला) तथा अन्य तीनों में केवल एक–एक इलेक्ट्रॉन हैं। यह आवश्यक नहीं है कि संकरण में केवल अर्द्ध पूरित कक्षक ही भाग लेंगे। कुछ परिस्थितियों में, संयोजी कोश के पूर्ण पूरित कक्षक भी संकरण में भाग लेते हैं।

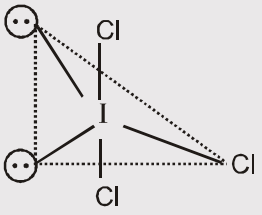
2. $H_2C = CH - C \equiv CH$
$sp^2 \quad sp^2 \quad sp \quad sp$

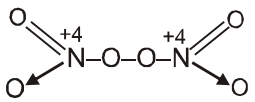
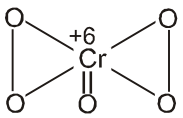
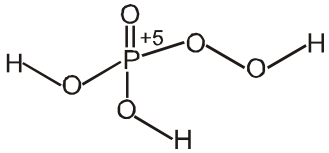
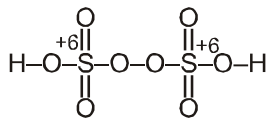
3. $O = \overset{+}{N} = O$ 

4. (A) 
sp^3 (bent) sp^3 (trigonal pyramidal) sp^3 (tetrahedral)

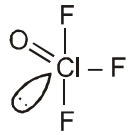
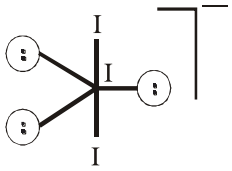
हल. (A) 
sp^3 (बेन्ट) sp^3 (त्रिकोणीय पिरैमिडल) sp^3 (चतुष्फलकीय)

5. B and C ⇒ Drago's rule, ICl_3 
sp^3d. T. shaped

B व C ⇒ ड्रेगो नियम से ICl_3 
sp^3d. T-आकृति

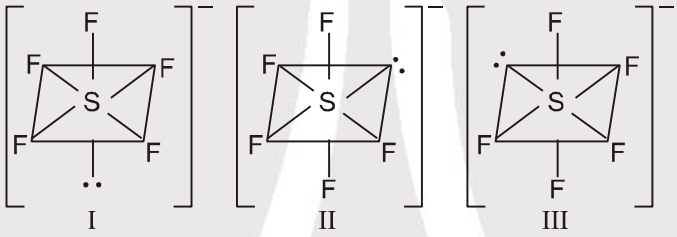
8. N_2O_6 
CrO_5 
H_3PO_5 
$H_2S_2O_8$ 

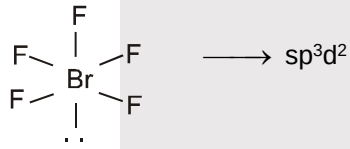
PART – IV (भाग - IV)

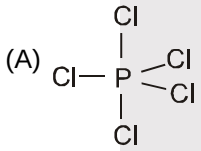
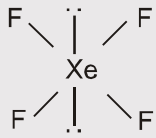
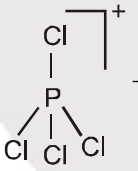
1.  

Cl-atom is in sp^3d hybridisation state. Hence geometry is trigonal bi-pyramidal which is similar to I_3^-
(Cl-परमाणु sp^3d संकरण अवस्था में है। अतः ज्यामिती त्रिभुजीय द्विपिरेमिडीय हैं जो कि I_3^- के समान हैं।)

2. Number of electrons pairs = 6; number of bond pairs = 5; number of lone pairs =1. According to VSEPR theory geometry of the molecule is square bipyramidal. As all positions are equivalent the lone pair of electrons can occupy any position in octahedral geometry as given below.
(इलेक्ट्रॉन युग्म की संख्या = 6 ; बंध युग्म की संख्या = 5 ; एकांकी युग्म की संख्या =1 VSEPR सिद्धांत के अनुसार अणु की ज्यामिति वर्गाकार द्विपिरेमिडीय होती हैं। चूँकि सभी स्थितियाँ समतुल्य हैं, एकांकी इलेक्ट्रॉन युग्म अष्टफलकीय ज्यामितीय में किसी भी स्थिति को घेर सकता हैं। जैसा नीचे दर्शाया गया हैं।)

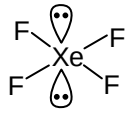

I II III

3. 

(A)  (B)  (C) 

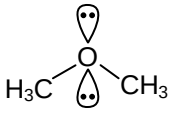
4. (A) With hydrogen sulphur does not undergo sp^3d^2 hybridisation because of larger difference in energies between s, p and d-orbitals. Sulphur show +6 oxidation state with highly electronegative elements like O and F.
(B) As fluorine is smaller and more electronegative than oxygen.
(C) I being large in size, cannot get accomodated around S.

Sol. सल्फर, हाइड्रोजन के साथ sp^3d^2 संकरण नहीं बनाता क्यों कि इनके मध्य s, p तथा d-कक्षकों में ऊर्जा का अन्तर अधिक होता है। (A) सल्फर अधिक विद्युत ऋणात्मक तत्व जैसे O एवं F के साथ +6 ऑक्सीकरण अवस्था दिखाता है।
(B) फ्लोरीन, ऑक्सीजन की तुलना में अधिक विद्युतऋणात्मक होता है तथा फ्लोरीन का आकार छोटा होता है।
(C) I आकार में बड़ा होता है इसलिए S के चारो ओर नहीं लिया जा सकता है।

5. XeF_4 

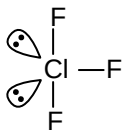
2 lone pair on central atom square planar sp^3d^2

केन्द्रीय परमाणु पर 2 एकाकी युग्म वर्ग समतलीय sp^3d^2

6. $CH_3–O–CH_3$ 

2 lone pair on central atom bent sp^3

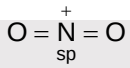
केन्द्रीय परमाणु पर 2 एकाकी युग्म बेन्ट (मुड़ी हुई) sp^3

7. ClF_3 is planar समतलीय है  T-shape आकृति sp^3d

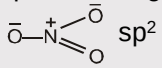
EXERCISE # 3

PART – I (भाग - I)

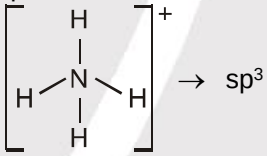
1. NO_2^+ Number of electron pairs = 2
Number of bond pairs = 2
Number of lone pair = 0
So, the species is linear with sp hybridisation.



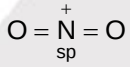
NO_3^- Number of electron pairs = 3
Number of bond pairs = 3
Number of lone pair = 0
So, the species is trigonal planar with sp^2 hybridisation.



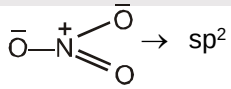
NH_4^+ Number of electron pairs = 4
Number of bond pairs = 4
Number of lone pair = 0
So, the species is tetrahedral with sp^3 hybridisation.



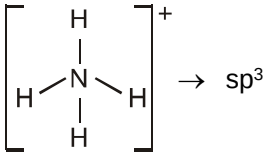
हल. NO_2^+ इलेक्ट्रॉन युग्मों की संख्या = 2
बन्ध युग्मों की संख्या = 2
एकांकी युग्म की संख्या = 0
इसलिए, स्पीशीज sp संकरण के साथ रेखीय है।



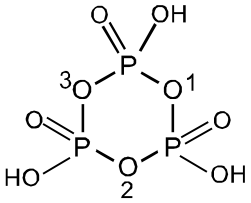
NO_3^- इलेक्ट्रॉन युग्मों की संख्या = 3
बन्ध युग्मों की संख्या = 3
एकांकी युग्म की संख्या = 0
इसलिए, स्पीशीज sp^2 संकरण के साथ त्रिकोणीय समतल है।



NH_4^+ इलेक्ट्रॉन युग्मों की संख्या = 4
बन्ध युग्मों की संख्या = 4
एकांकी युग्म की संख्या = 0
इसलिए, स्पीशीज sp^3 संकरण के साथ चतुष्फलकीय है।

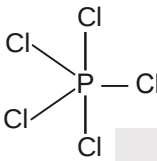


2.

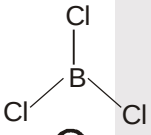


According to the structure of cyclic metaphosphoric acid, $(HPO_3)_3$, three are there P – O – P bonds.
(चक्रीय मेटाफास्फोरिक अम्ल, $(HPO_3)_3$ की संरचना के आधार पर यहाँ तीन P – O – P बन्ध है।)

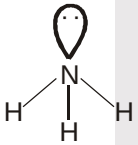
4.



steric number = 5, so sp^3d hybridisation;

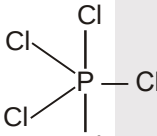


steric number = 3, so sp^2 hybridisation;

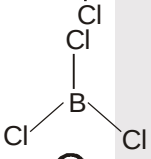


steric number = 4, so sp^3 hybridisation;

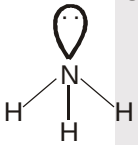
हल.



त्रिविम संख्या = 5, अतः sp^3d संकरण;

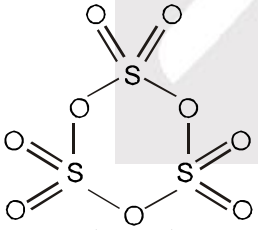


त्रिविम संख्या = 3, अतः sp^2 संकरण;



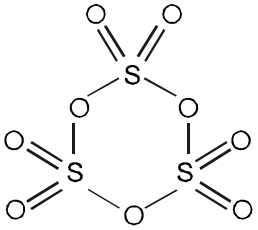
त्रिविम संख्या = 4, अतः sp^3 संकरण ;

5.



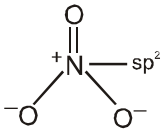
There is no S-S bond in S_3O_9 .

हल

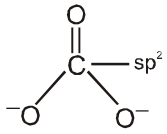


S_3O_9 में यहॉ S-S बंध नही है।

6. Number of electrons in NO_3^- = 7 + 3 × 8 + 1 = 32.
Number of electrons in CO_3^{2-} = 6 + 3 × 8 + 2 = 32.
So both are isoelectronic.
NO_3^- steric number = 3 ; CO_3^{2-} steric number = 3.



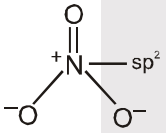
trigonal planar



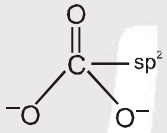
trigonal planar

As both have same shapes they are also isostructural (same hybridisation and no lone pair of electrons).

हल. NO_3^- में इलेक्ट्रॉन की संख्या = 7 + 3 × 8 + 1 = 32.
CO_3^{2-} में इलेक्ट्रॉन की संख्या = 6 + 3 × 8 + 2 = 32.
इसलिए दोनो समइलेक्ट्रॉनिक है।
NO_3^- स्टिरिक संरचना = 3 ; CO_3^{2-} स्टिरिक संख्या = 3.



त्रिभुजीय समतलीय



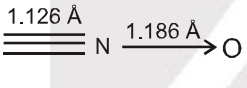
त्रिभुजीय समतलीय

चूंकि दोनों की आकृति समान होती है इसलिए वे दोनों भी समसंरचनात्मक होते है (समान संकरण तथा कोई एकाकी इलेक्ट्रॉन युग्म नही हैं)।

9. Steric number = 4 ; thus sp^3 hybridisation in P_4 . As each phosphorus is sp^3, so
% p character will be = $\frac{3}{4} \times 100 = 75$.

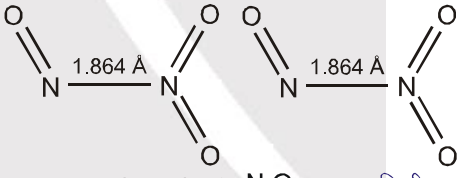
हल. स्टेरिक संख्या = 4 ; इस प्रकार P_4 में संकरण sp^3 है। इसी प्रकार प्रत्येक फास्फोरस (P) का संकरण sp^3 है, इसलिए
p लक्षणों की % = $\frac{3}{4} \times 100 = 75$ होगी।

10.* (A)



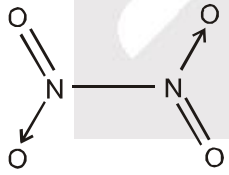
N_2O

(B)



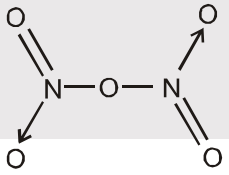
asymmetric form of N_2O_3 N_2O_3 का असम्मितीय रूप

(C)



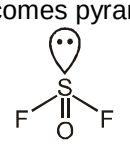
N_2O_4

(D)



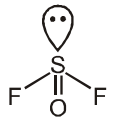
N_2O_5

11. According to VSEPR theory,
number of electron pairs = 4.
number of bond pairs = 3.
number of lone pair = 1.
So, the geometry is tetrahedral but on account of lone pair of electron, to have minimum repulsions, the shape becomes pyramidal as shown below.



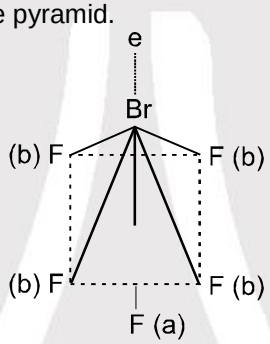
Pyramidal shape

हल. VSEPR सिद्धान्त के अनुसार,
इलेक्ट्रोनयुग्मों की संख्या = 4.
बन्ध युग्मों की संख्या = 3.
एकाकी युग्मों की संख्या = 1.
अतः ज्यामिति चतुष्फलकीय है किन्तु एकाकी युग्म के कारण प्रतिकर्षण कम करने के लिए आकृति पिरामिडल हो जाती है। जैसा कि नीचे दर्शाया गया है।



Pyramidal shape

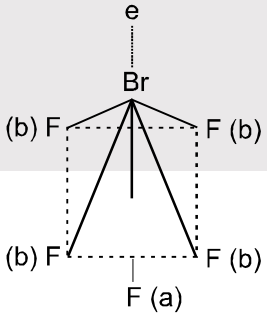
12. The spatial arrangement of six electron clouds (five bond pairs and one lone pair) round the central Br-atom is octahedral. Due to the presence of one lone pair of electrons in the axial hybrid orbital, the shape of BrF_5 gets distorted and becomes square pyramidal. Basal F-atoms are slightly displaced upwards from the base of the square pyramid.



Br – F(b) distance = 1.79 Å
Br – F(a) distance = 1.68 Å

F(b) – Br – F(b) angle = 89º 48'
F(b) – Br – F(a) angle = 86º 30'
F(b) – Br – e angle = 93º 30'

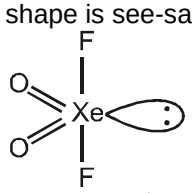
हल. केन्द्रिय परमाणु के चारों ओर छः इलेक्ट्रोनअभ्र (5 बंधित युग्म एवं एक एकाकी इलेक्ट्रोनयुग्म) का अन्तरिक्षीय(त्रिविम) विन्यास अष्टफलकीय है। अक्षीय संकरित कक्षकों में एकाकी इलेक्ट्रोनयुग्म की उपस्थिति के कारण BrF_5 की आकृति विकृत होकर वर्गाकार पिरामिडल हो जाती है। पिरामिड के आधार में उपस्थित F- परमाणु वर्गाकार पिरामिड के आधार से थोड़ा ऊपर की ओर हो जाते हैं।



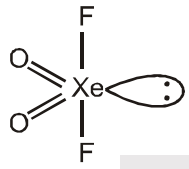
Br – F(b) दूरी = 1.79 Å
Br – F(a) दूरी = 1.68 Å

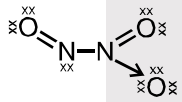
F(b) – Br – F(b) कोण = 89º 48'
F(b) – Br – F(a) कोण = 86º 30'
F(b) – Br – e कोण = 93º 30'

13. XeO_2F_2 has trigonal bipyramidal geometry. Due to presence of lone pair on equitorial position, the shape is see-saw.



XeO_2F_2 त्रिकोणीय द्विपिरामिडीय ज्यामितीय रखता है। निरक्षीय स्थिति पर एकाकी इलेक्ट्रॉन युग्म उपस्थित होने के कारण सी–सॉ आकृति होती है।



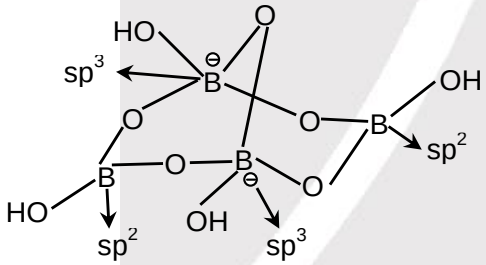


14. N_2O_3

15. Cl– Be–Cl (Sp) $\quad \overset{-}{N} = \overset{+}{N} = \overset{-}{N}$ (Sp) $\quad N \equiv N \rightarrow O$ (Sp)

$O = \overset{+}{N} = O$ (Sp)

16.* Structure of Borax



Correct formula of borax is $Na_2[B_4O_5(OH)_4].8H_2O$

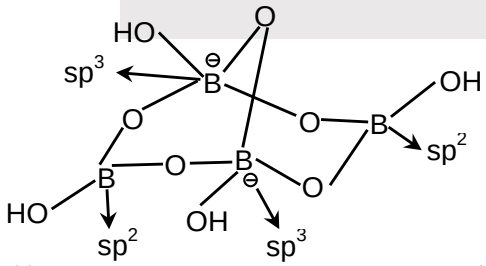
(A) Borax has tetranuclear. $(B_4O_5(OH)_4)^{2-}$ unit

(B) Only two 'B' atom lie in same plane

(C) two Boron are sp^2 & two are sp^3 hybridised.

(D) one terminal hydroxide per boron atom

Sol. बोरेक्स की संरचना



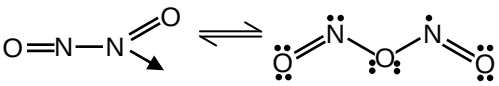
बोरेक्स की संरचना $Na_2[B_4O_5(OH)_4].8H_2O$ है।

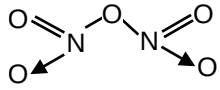
(A) बोरेक्स चतुर्नाभिकीय $(B_4O_5(OH)_4)^{2-}$ एकक है।

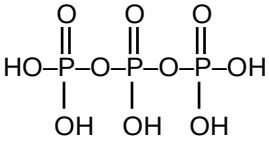
(B) केवल दो 'B' परमाणु समान तल में होते है।

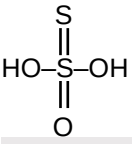
(C) दो बोरोन परमाणु sp^2 व दो बोरोन परमाणु sp^3 संकरित होते है।

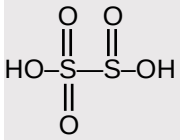
(D) प्रति बोरोन परमाणु पर एक अन्तस्थ हाइड्रोक्साइड है।

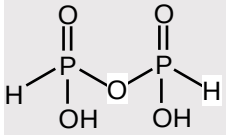
17. N_2O_3 = 

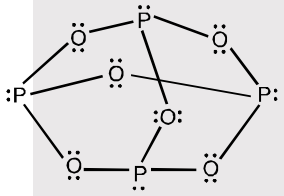
N_2O_5 = 

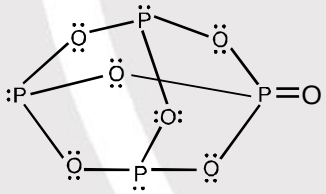
$H_5P_3O_{10}$ = 

$H_2S_2O_3$ = 

$H_2S_2O_5$ = 

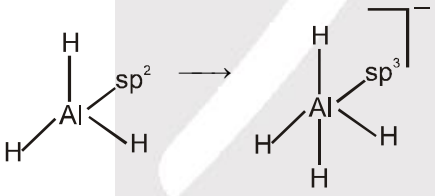
$H_4P_2O_5$ = 

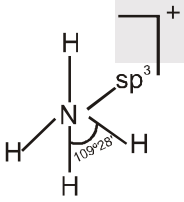
P_4O_6 = 

P_4O_7 = 

PART – II (भाग - II)

JEE(MAIN) OFFLINE PROBLEMS

1. 

2. 

3. (1) The sulphur is in sp^2 hybridisation but due to lp-bp repulsion the bond angle decreases to 119.5º.
(2) The oxygen is in sp^3 hybridisation but due to lp-lp repulsion the bond angle decreases to 104.5º.
(3) It is believed that pure p atomic orbitals participate in bonding and due to lp-lp repulsion the bond angle decreases to 92.5º.
(4) The nitrogen is in sp^3 hybridisation but due to lp-bp repulsion the bond angle decreases to 107º.

	SO_2	OH_2	SH_2	NH_3
Bond angle :	119.5º	104.5º	92.5º	107º

हल : (1) सल्फर में sp^2 संकरण होता हैं लेकिन lp-bp प्रतिकर्षण के कारण बंध कोण घटकर 119.5º हो जाता है।

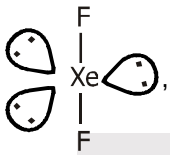
(2) ऑक्सीजन में sp^3 संकरण होता हैं लेकिन lp-lp प्रतिकर्षण के कारण बंध कोण घटकर 104.5º हो जाता है।

(3) इस अणु के लिए ऐसा माना जाता है कि शुद्ध p परमाण्विक कक्षक बंध बनाने में भाग लेते हैं तथा lp-lp प्रतिकर्षण के कारण बंध कोण घटकर 92.5º हो जाता है।

(4) नाइट्रोजन में sp^3 संकरण होता है। लेकिन lp-bp प्रतिकर्षण के कारण बंध कोण घटकर 107º हो जाता है।

	SO_2	OH_2	SH_2	NH_3
बंध कोण :	119.5º	104.5º	92.5º	107º

4. (1) CF_4 is tetrahedral where as SF_4 is see-saw shaped.

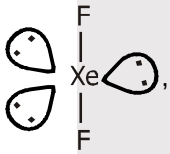
(2) 

, O = C = O both linear according to VSEPR.

(3) BF_3 is trigonal planar and PCl_3 is pyramidal.

(4) PF_5 is trigonal bipyramidal and IF_5 is square pyramidal.

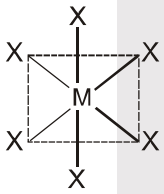
हल : (1) CF_4 चतुष्फलकीय हैं लेकिन SF_4 सी–सॉ आकृतिनुमा है।

(2) 

, O = C = O VSEPR के अनुसार दोनों रैखीय है।

(3) BF_3 त्रिकोणीय समतल हैं तथा PCl_3 पिरैमिडल है।

(4) PF_5 त्रिकोणीय द्विपिरैमिडिल हैं तथा IF_5 वर्गाकार पिरैमिडल है।

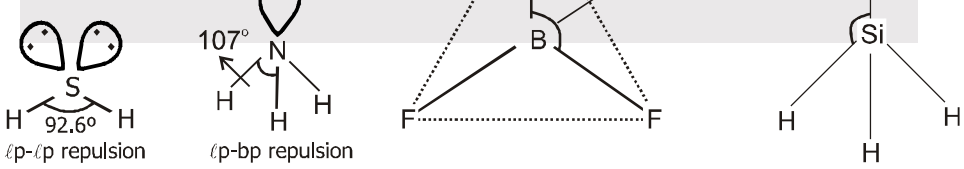
5. 

Maximum 12 bond angles are of 90º. (अधिकतम 12 बंध कोण 90º के हैं।)

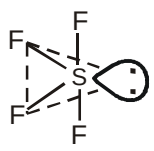
6. The correct order of bond angle (smallest first) is
बंध कोण को सही क्रम (सबसे छोटा प्रथम)

H_2S < NH_3 < SiH_4 < BF_3

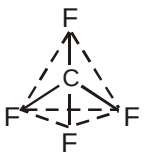
92.6º < 107º < 109º28' < 120º



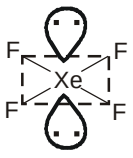
7. According to VSEPR theory



$\ell p = 1$
sp^3 d-hybridisation
see-saw shape

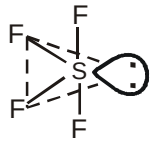


$\ell p = 0$
sp^3-hybridisation
tetrahedral shape

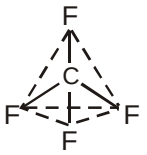


$\ell p = 2$
sp^3d^2-hybridisation
square planar shape

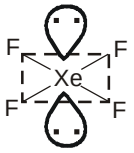
हल. VSEPR सिद्धान्त के अनुसार,



$\ell p = 1$
sp^3 d-संकरण
नेज आकृति (सी-सॉ)



$\ell p = 0$
sp^3-संकरण
चतुष्फलकीय आकृति

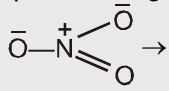


$\ell p = 2$
sp^3d^2-संकरण
वर्ग समतलीय संरचना

8. NO_2^+ Number of electron pairs = 2
Number of bond pairs = 2
Number of lone pair = 0
So, the species is linear with sp hybridisation.

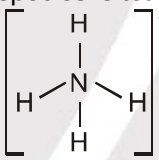
$$O = \underset{sp}{\overset{+}{N}} = O$$

NO_3^- Number of electron pairs = 3
Number of bond pairs = 3
Number of lone pair = 0
So, the species is trigonal planar with sp^2 hybridisation.



$\rightarrow sp^2$

NH_4^+ Number of electron pairs = 4
Number of bond pairs = 4
Number of lone pair = 0
So, the species is tetrahedral with sp^3 hybridisation.

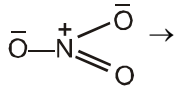


$\rightarrow sp^3$

हल. NO_2^+ इलेक्ट्रॉन युग्मों की संख्या = 2
बन्ध युग्मों की संख्या = 2
एकांकी युग्म की संख्या = 0
इसलिए, स्पीशीज sp संकरण के साथ रेखीय है।

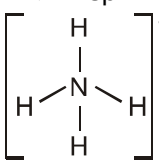
$$O = \underset{sp}{\overset{+}{N}} = O$$

NO_3^- इलेक्ट्रॉन युग्मों की संख्या = 3
बन्ध युग्मों की संख्या = 3
एकांकी युग्म की संख्या = 0
इसलिए, स्पीशीज sp^2 संकरण के साथ त्रिकोणीय समतल है।



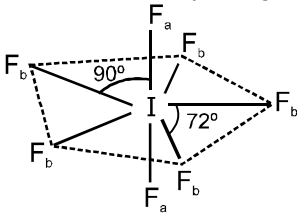
$\rightarrow sp^2$

NH_4^+ इलेक्ट्रॉन युग्मों की संख्या = 4
बन्ध युग्मों की संख्या = 4
एकांकी युग्म की संख्या = 0
इसलिए, स्पीशीज sp^3 संकरण के साथ चतुष्फलकीय है।



$\rightarrow sp^3$

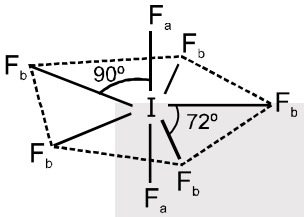
9. The structure is pentagonal bipyramid having sp^3d^3 hybridisation as given below :



$F_b - I - F_b = 72^o$ (5 number) ; $F_b - I - F_a = 90^o$ (10 number)

$F_b - I$ bond length = 1.858 ± 0.004 Å ; $F_a - I$ bond length = 1.786 ± 0.007 Å.

हल. पंचभुजीय द्विपिरामिड संरचना में संकरण sp^3d^3 निम्न प्रकार से दिया है :



$F_b - I - F_b = 72^o$ (संख्या = 5) ; $F_b - I - F_a = 90^o$ (संख्या = 10)

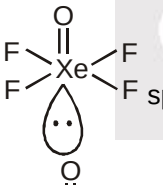
$F_b - I$ बंध लम्बाई = 1.858 ± 0.004 Å ; $F_a - I$ बंध लम्बाई = 1.786 ± 0.007 Å.

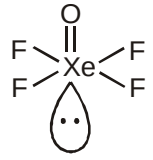
10. As electronegativity of central atom decreases, bond angle decreases.
(Hybridisation and number of lone pair on cental atom are same in all options)
केन्द्रिय परमाणु की विद्युतऋणता में कमी के साथ बन्ध कोण में कमी आती है।
(सभी विकल्पों में केन्दीय परमाणु का संकरण तथा एकाकी इलेक्ट्रॉन युग्म की संख्या समान है।)

11. PF_5 trigonal bipyramidal
BrF_5 square pyramidal (distorted)
PF_5 त्रिकोणीय द्विपिरामिडीय
BrF_5 वर्गाकार पिरामिडीय (विकृत)

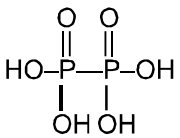
12. NO_2^- = sp^2
NO_3^- = sp^2
NO_2 = sp^2
NO_2^+ = sp

JEE(MAIN) ONLINE PROBLEMS

2.  sp^3d^2 hybridized with one position occupied by lone pair.

Sol.  sp^3d^2 संकरण जिसमें एक एकाकी युग्म होता है।

3. $H_4P_2O_6$ has P–P linkage. ($H_4P_2O_6$, P–P बन्धन रखता है।)

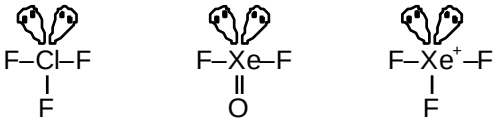


4. 1, 3 and 4 suggests that valency of X is +3. So, formula of chloride is XCl_3.

Sol. 1, 3 तथा 4 सुझाव देते है कि Xकी संयोजकता +3 है। अतः यौगिक का कलोराइड XCl_3 है।

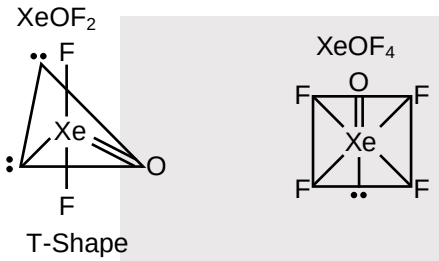
5. ClF_3, $XeOF_2$ & XeF_3^+ are sp^3d hybridized with 2 lone pair e's, hence all have (T-shape) identical shape.

ClF_3, $XeOF_2$ तथा XeF_3^+, sp^3d संकरीत है जिनमें 2 एकाकी इलेक्ट्रॉन युग्म है। सभी समान संरचना (T-आकृति) रखते है।



6. Fact

8.



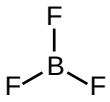
T-Shape

9.

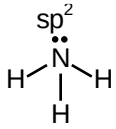
Graphite	**Diamond**
sp^2 hybridisation	sp^3 hybridisation
% P = $\frac{2}{3}$ × 100 = 67 %	% P = $\frac{3}{4}$ × 100 = 75 %

ग्रेफाइट	**हीरा**
sp^2 संकरण	sp^3 संकरण
% P = $\frac{2}{3}$ × 100 = 67 %	% P = $\frac{3}{4}$ × 100 = 75 %

10.

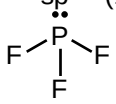


Bond angle = 120º



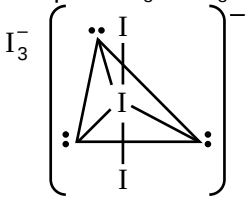
Bond angle = 107º

sp^3 (1 lone pair)



When central atom size ↑
Bond angle ↓

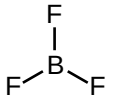
sp^3 $NH_3 > PF_3$



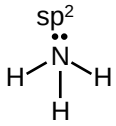
Bond angle 180º

sp^3d

Bond Angle $PF_3 < NH_3 < BF_3 < I_3^-$



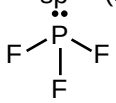
Sol.   बंध कोण = 120º



sp^2

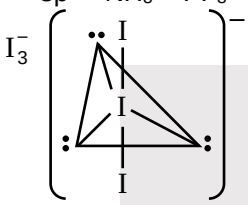
 बंध कोण = 107º

sp^3 (1 एकाकी युग्म)



 जब केन्द्रिय परमाणु का आकार ↑ बंध कोण ↓

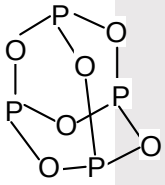
sp^3 $NH_3 > PF_3$



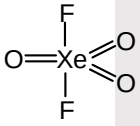
I_3^- बंध कोण 180º

sp^3d

बंध कोण $PF_3 < NH_3 < BF_3 < I_3^-$



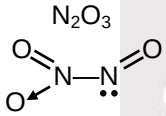
11.



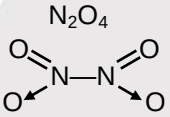
12. 5, 3, 0

sp^3 d hybridization

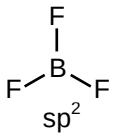
sp^3 d संकरण



13. N_2O_3 N_2O_4

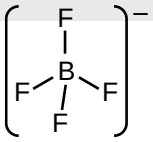


14. $BF_3 \longrightarrow BF_4^-$



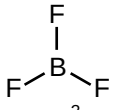
sp^2

Triangle planar



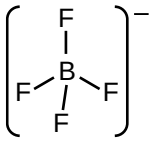
sp^3

Tetrahedral



sp^2

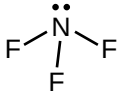
त्रिकोणीय समतलीय



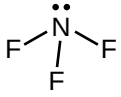
sp^3

चतुष्फलकीय

15. NF_3

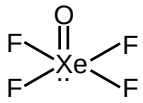


sp^3
Trigonal pyramidal

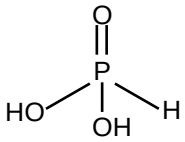


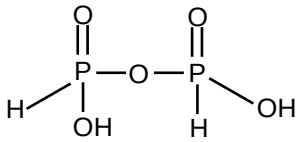
sp^3
त्रिकोणीय पिरामिडल

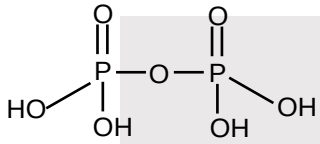
16.

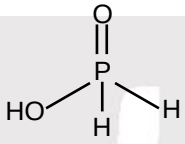


17.









18. C form most stable pπ-pπ bonds.
C सर्वाधिक स्थायी pπ-pπ बन्ध बनाता है।