Noble Gases

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CHEMISTRY OF NOBLE GASES

XeF_2

GMP:→

$$Xe + F_2 \xrightarrow[Ni\ tube]{400^\circ C} XeF_2 \quad [or\ in\ uv\ light]$$

1 : 2

Properties:→

(i) $XeF_2 + H_2 \longrightarrow Xe + 2HF$

(ii) $XeF_2 + F_2 \longrightarrow XeF_4$

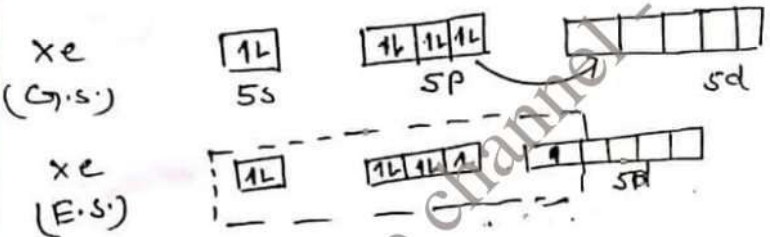
(iii) $XeF_2 + 2KI \longrightarrow Xe + 2KF + I_2$

(iv) $XeF_2 + 2HNO_3 \rightarrow Xe(NO_3)_2 + 2HF$

(v) $2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$

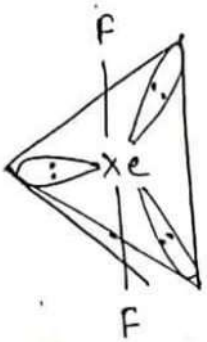
Str. ~~Actor~~ According to VBT

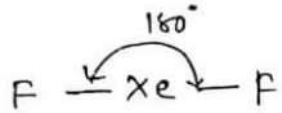
XeF_2 2 B.P + 3 l.P.



5 sp^3d Hybrid orbital

in str. of XeF_2 for minimum Repulsion l.p. occupies equatorial position





Linear shape

XeF_4

GMP :-

$$Xe + 2F_2 \xrightarrow[Ni\ tube]{300^\circ C} XeF_4$$

1 : 4

Properties

(i) $XeF_4 + Pt \longrightarrow Xe + PtF_4$

(ii) $XeF_4 + 2SF_4 \rightarrow Xe + 2SF_6$

(iii) $6XeF_4 + 12H_2O \longrightarrow 3O_2 + 2XeO_3 + 4Xe + 24HF$

(iv) $XeF_4 + 4HCl \longrightarrow Xe + 4HF + 2Cl_2$

(v) $3XeF_4 + 4NH_3 \rightarrow 3Xe + 12HF + 2N_2$

$\downarrow 12NH_3$

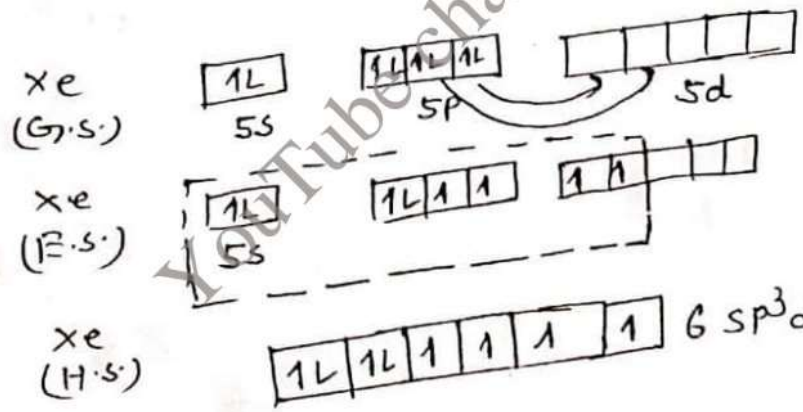
$12NH_4F$

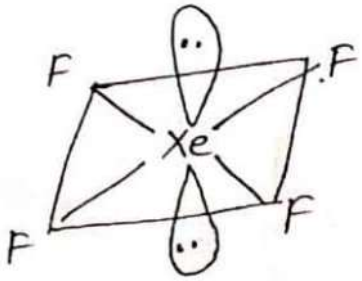
(vi) $XeF_4 + O_2F_2 \longrightarrow XeF_6 + O_2$

(vii) $XeF_4 + 2H_2 \rightarrow Xe + 4HF$

Str.

XeF_4 $\quad 4B.P + 2L.P \rightarrow sp^3d^2$





Square planar

XeF_6 :→

GMP:- $Xe + 3F_2 \xrightarrow[60\ Atm]{300^\circ C} XeF_6$

1 : 20

Properties:

(i) $2XeF_6 + SiO_2 \rightarrow 2XeOF_4 + SiF_4$

(ii) $2XeOF_4 + SiO_2 \rightarrow 2XeO_2F_2 + SiF_4$

(iii) $2XeOF_4 + SiO_2 \rightarrow \underline{2XeO_3}\ (\text{explosive}) + SiF_4$

Hydrolysis

$XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$

$XeOF_4 + H_2O \rightarrow XeO_2F_2 + 2HF$

$XeO_2F_2 + H_2O \rightarrow XeO_3 + 2HF$

$2XeF_6 + 16NaOH \rightarrow Na_4XeO_6 + Xe + O_2 + 12NaF + 8H_2O$

Sodium perxenate

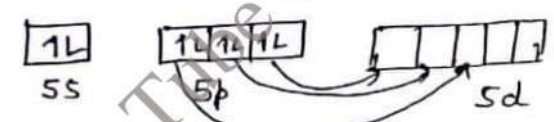
$XeF_6 + 3H_2 \rightarrow Xe + 6HF$

$XeF_6 + SbF_5 \rightarrow XeF_6 \cdot SbF_5$

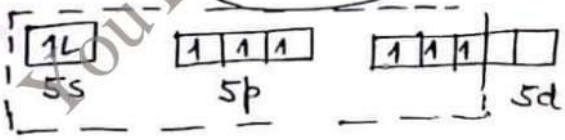
Str.

$XeF_6 \rightarrow 6\ B.P + 1\ L.P \rightarrow$ Distorted / Capped / Octahedral or Pentagonal pyramidal

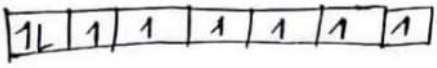
Xe (G.S.)



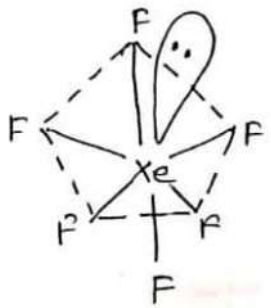
Xe (E.S.)



Xe (H.S.)



$7\ sp^3d^3$ Hybrid orbital



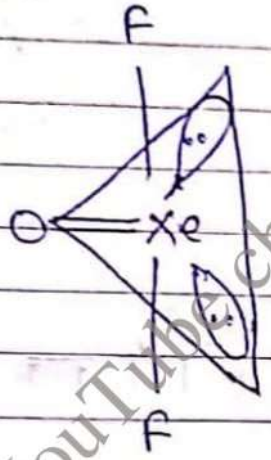
XeNON - OXy fluorides

(i) $XeOF_2$

Xe (G.S) — 5s | 5p | 5d

Xe (E.S) — 5s | 5p | 5d ($P\pi - d\pi$)

Xe (H.S) — 5 sp^3d Hybrid orbital



F — Xe — F

|| $P\pi - d\pi$

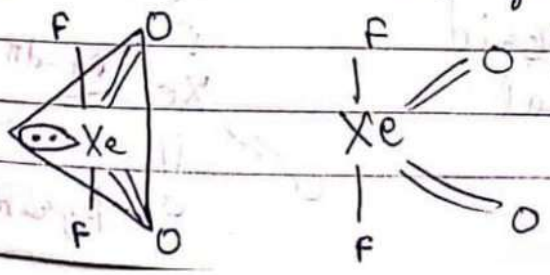
O

'T' shape

(ii) XeO_2F_2

Similar as above

(2 $P\pi - d\pi$ bond form)



Distorted tetrahedral or See-Saw

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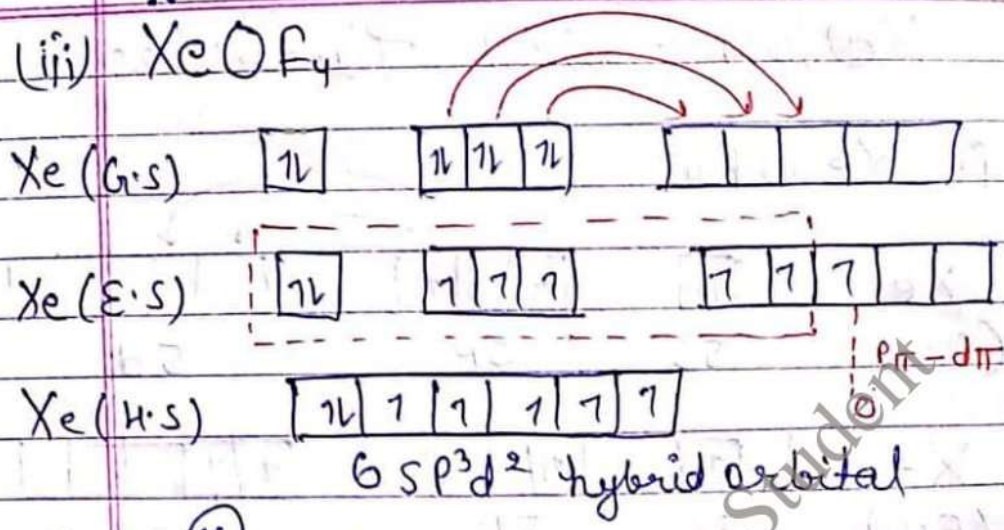
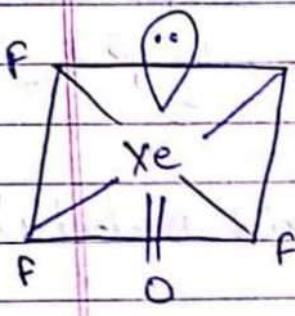
(iii) $XeOF_4$



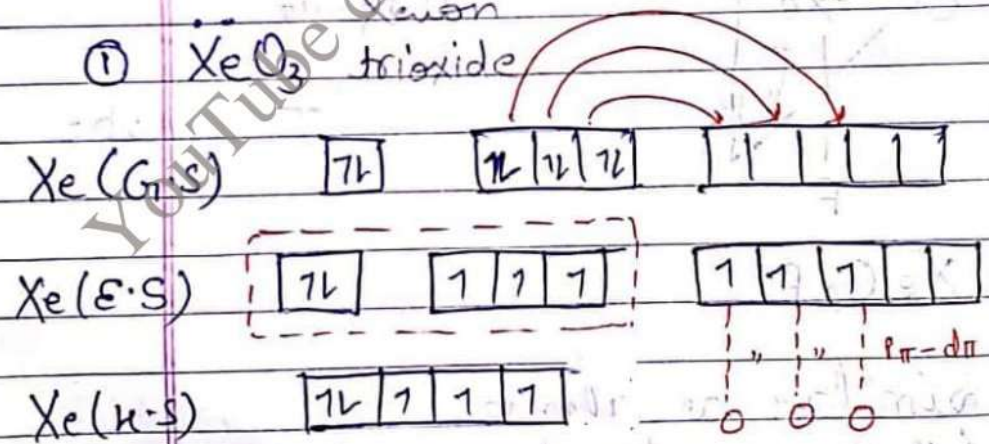
6 sp^3d^2 hybrid orbital



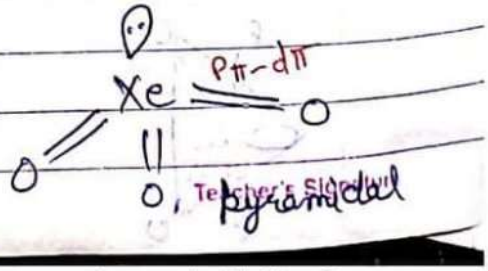
square pyramidal

Xenon - Oxides

① XeO_3 Xenon trioxide

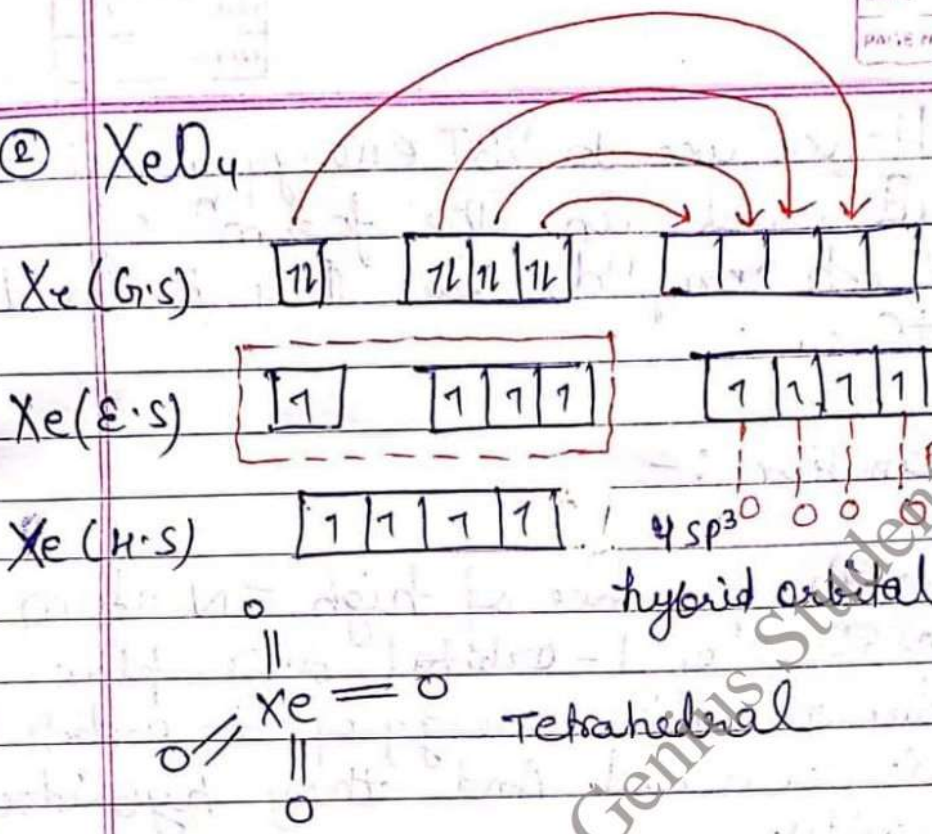


4 sp^3 hybrid orbital



pyramidal

② XeO_4



Bonding in Xe Compounds

Although the str of most of the Xe comp^{n}ds can be explained satisfactorily by the VBT. However promot^{n}/ excitation of e^- from 5P to 5d requires a lots of energy which cannot be compensated even by the energy obtain from bond form^{n}.

for eg → 960 KJ/mole energy is required for

$5s^2 sp^6 \rightarrow 5s^2 5p^5 5d^1$

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Hence acc to VBT energy must be absorbed in the formⁿ of such compⁿds. But this is not true.

Explanation :-

① In the presence of high EN atom contracⁿ of d-orbital take place due to which energy of d-orbital is decreased. And they hybridised easily.

② MOT for bonding in XeF_2

Acc to MOT XeF_2 have 3c bond in which 4e⁻ remains. In XeF_2 $5P_z$ orbital of Xe and 2 $2P_z$ orbital of flourine atom form 3 new molecular orbital.
i.e Bonding MO, NBMO, ABMO

Out of them BMO, and NBMO have 2-2e⁻. In linear arrangment overlapping of orbitals take place maxᵐ. Hence str of XeF_2

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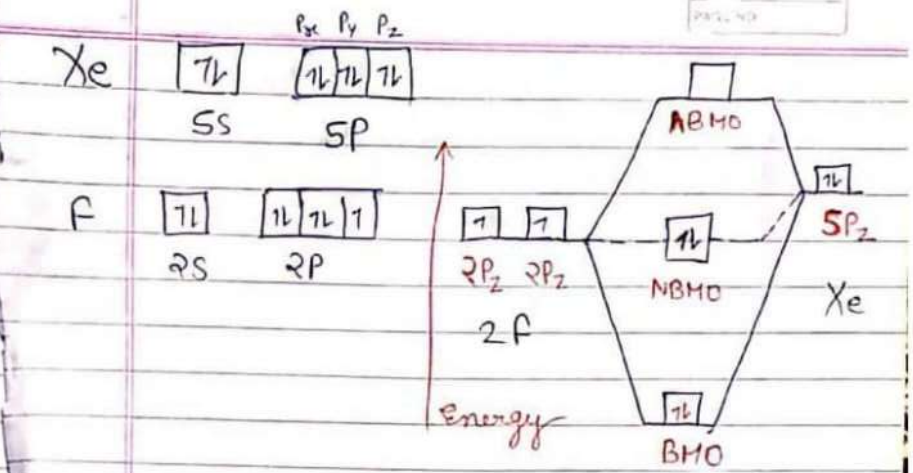

XeF_2

Formula of Apatite
$Ca_5(PO_4)_3(OH, F, Cl)$
↑ ↑
Three chlorine apatite apatite

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