

B. Noble gases @ 18 group (OK) Zero group elements

- The element of group 18 are Helium, Neon, Argon, Krypton, Xenon and Radon.
- All the elements are ~~or~~ in gases state at ordinary temperature.
- Their outermost Electronic configuration is $ns^2 np^6$
- they are chemically inert.
- These gases are rare in atmosphere therefore they are called as rare gases.

Inertness of noble gases

The electronic configuration of group 18 elements

Element	Symbol	At. No.	Electronic configuration	Valence shell e ⁻
Helium	He	2	$1s^2$	$1s^2$
Neon	Ne	10	$1s^2 2s^2 2p^6$	$2s^2 2p^6$
Argon	Ar	18	$1s^2 2s^2 2p^6 3s^2 3p^6$	$3s^2 3p^6$
Krypton	Kr	36	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$	$4s^2 4p^6$
Xenon	Xe	54	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6$	$5s^2 5p^6$
Radon	Rn	86	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6$	X

This configuration is very stable. They are chemically inactive. They have high ionization potential, zero electron affinity (sometimes -ve)

Compounds of Noble gases

When noble gas elements reacts with electronegative elements like Fluorine, oxygen then noble gas compounds are formed. some examples of Xe & Kr are

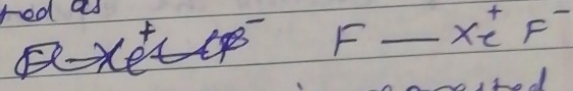
Compound type	Xenon	Krypton
Fluorides	XeF_2, XeF_4, XeF_6	KrF_2, KrF_4
oxyfluorides	$XeOF_4, XeO_2F_2$	-
oxide	XeO_3, XeO_4	-

Structure and Bonding in Xenon fluorides

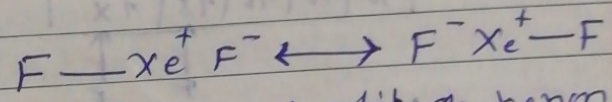
① Structure of Xenon difluoride [XeF₂]
There are three different structures have been put up with respect to nature of bonds in XeF₂.

① According to one view, Both Fluorine atoms are attached to Xenon atom by ionic bond as $F^- - Xe^{2+} - F^-$. According to this view, outermost orbit of xenon contain ~~six~~ ^{eight} electrons, out of these two electrons are transfer to two fluorine atoms and forms ionic bonds, and xenon ~~is~~ acquires two +ve charges while each fluorine atom acquires one -ve charge.

② According to another view, Xenon forms two bonds with two fluorine atoms. out of these two bonds, one is ionic bond while other is covalent bond. The ionic bond is formed by transfer of electron ~~while covalent bond is formed by sharing of electron~~ from xenon atom to one fluorine atom and covalent bond is formed by the sharing of one electron of xenon with electron of second fluorine atom. The structure of the molecule may be represented as



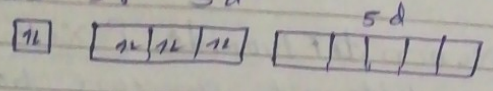
The actual structure ~~is~~ is represented by resonance as



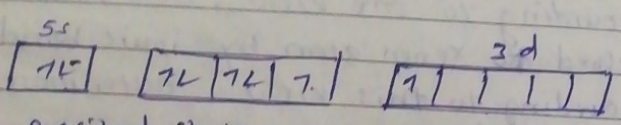
In this structure outermost orbit of xenon ~~contains~~ and fluorine contain eight electrons [octate rule] re

③ According to orbital theory, I
① In XeF₂, there is one xenon atom and two fluorine atoms. Xenon atom is central atom. Therefore it under-
-goes hybridization.]

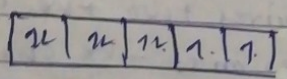
(i) The outermost electronic configuration of Xenon is $5s^2 5p^6 5d^0$



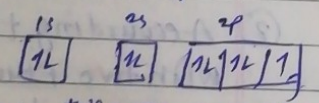
(ii) In the excited state one electron from 5p orbital is transferred to 5d orbital. Therefore E.C. of Xenon in excited state is



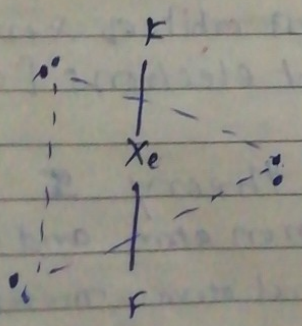
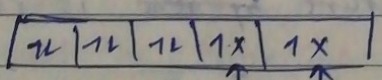
(iii) In the excited state Xenon atom undergoes sp^3d hybridization and forms five hybrid orbitals



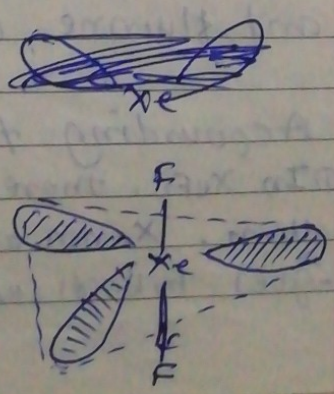
(iv) ~~The~~ E.C. of Fluorine is $1s^2 2s^2 2p^5$



(v) In the formation of XeF_2 molecule, two hybrid orbitals of Xenon overlap with two Fluorine atoms and forms two Xe-F bonds. As hybridization is sp^3d therefore expected geometry is trigonal bipyramidal, but due to the presence of three lone pair of electrons. The shape of XeF_2 is linear. The lone pairs of electrons are equatorial position.



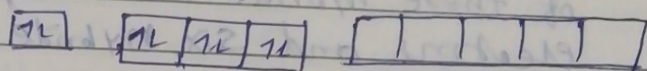
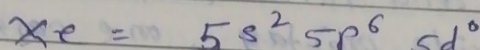
(of)



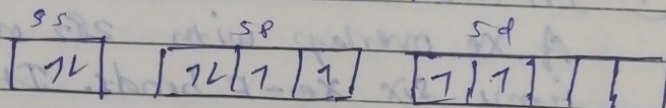
(2) Structure of Xenon tetrafluoride [XeF₄]

(i) In XeF₄, There is one Xe atom and four fluorine atoms. Xe atom is at centre. Therefore it undergoes hybridization.

(ii) ^{outermost} E.C. of Xenon is

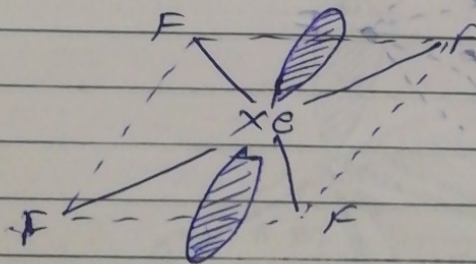


(iii) E.C. of Xe in excited state is



(iv) In the excited state, Xe atom undergoes sp³d² hybridization and forms 6 hybrid orbitals. out of these six hybrid orbitals, two contains lone pair of electrons and four contains unpaired electrons.

(v) In the formation of XeF₄ molecule, ~~two~~ four hybrid orbitals of Xe overlap with 2p_z orbitals of fluorine and forms four Xe-F bonds.



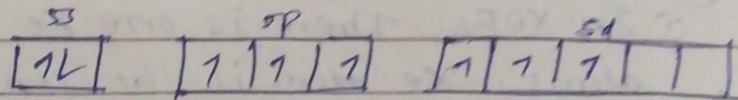
As hybridization is sp³d², the geometry is octahedral. But due to the presence of two lone pair of electrons, the shape of XeF₄ is square pyramidal. with bond angle 90°.

(3) Structure of XeF₆

(i) In XeF₆, There is one Xe atom and six fluorine atoms. Xe atom is at centre. Therefore it undergoes hybridisation.

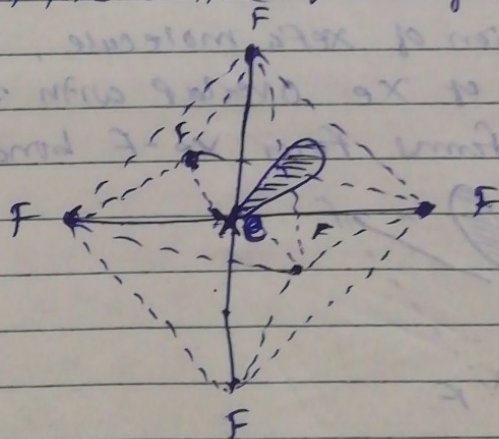
(ii) Outermost E.C. Xe is 5s² 5p⁶ 5d⁰

(ii) ~~In excited state~~. E.C. of Xenon in excited state is



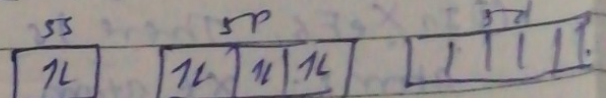
(w) In excited state, Xe atom undergoes sp^3d^2 hybridization and form 7 hybrid orbitals - out of these hybrid orbitals, one contain pair of electrons and six hybrid orbitals contain unpaired electrons.

(v) In the formation of XeF_6 , six hybrid orbitals of Xe overlap with $2p_z$ orbitals of fluorine and form six Xe-F bonds. It has distorted octahedral geometry. (The hybrid orbital with odd electrons occupy four equatorial and two axial positions, and hybrid orbital with lone pair of electron is present at the centre of triangular faces.)



(4) Structure of Xenon trioxide

- (i) In XeO_3 , there is one Xe atom and three oxygen atom. The Xe atom is at centre therefore it undergoes hybridization
- (ii) Outermost E.C. of Xe is $5s^2 5p^6 5d^0$

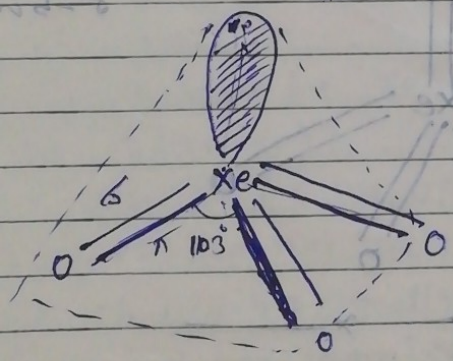
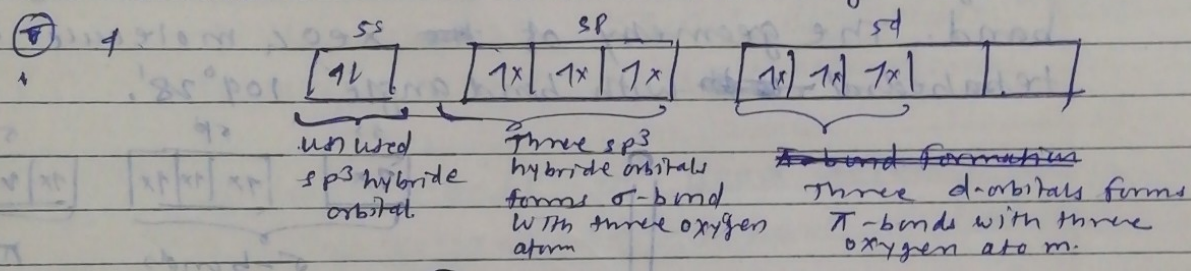


E.C. of Xenon in excited state is

(14) In the excited state, Xe atom undergoes sp^3 hybridization and forms four sp^3 hybrid orbitals. Out of these four hybrid orbitals one hybrid orbital contains lone pair of e⁻ and three hybrid orbitals contains unpaired electrons.

The three unpaired electrons in sd orbitals are unhybridised and used for the formation of three π -bonds because π bonds are not considered in hybridization.

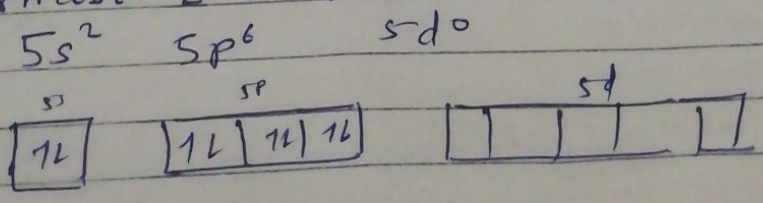
Due to the presence of one lone pair of electron, the molecule undergoes some distortion and possess pyramidal structure instead of tetrahedral structure with bond angle 103° .



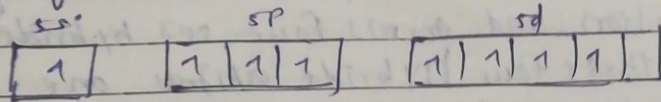
(5) Structure of Xenon tetra oxide [XeO₄]

(1) In XeO₄, there is one xenon atom and four oxygen atoms. The Xe atom is at centre therefore it undergoes hybridisation.

(2) The outermost E.C. of Xe is



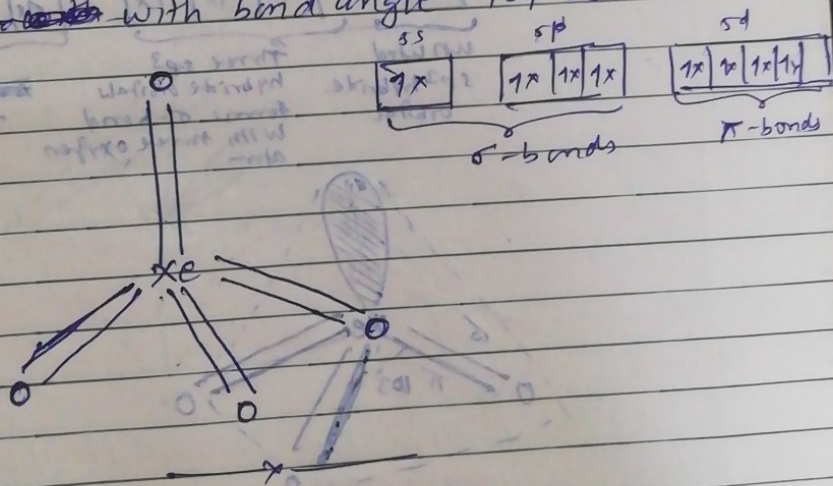
(iii) E.C. of Xe in excited state is



(iv) In the excited state, Xe atom undergoes sp^3 hybridisation and forms four sp^3 hybrid orbitals, which are directed towards four corners of regular tetrahedron.

The four unpaired electrons in 5d orbitals are unhybridized and used for the formation of four π -bonds with four oxygen atoms.

The four sp^3 hybrid orbitals of Xe overlap with four oxygen atoms and forms four Xe-O sigma bond. The geometry of ~~the~~ XeO_4 molecule is tetrahedral with bond angle $109^\circ 28'$.



(2) structure of Xenon tetra oxide [XeO_4]

As Xe is in excited state, it undergoes sp^3 hybridisation. The four sp^3 hybrid orbitals of Xe overlap with four oxygen atoms. The Xe atom is at the center of the tetrahedron.

