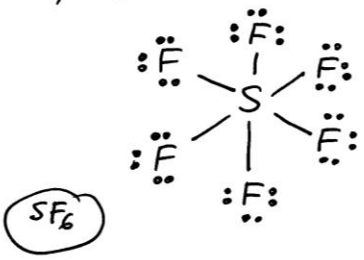
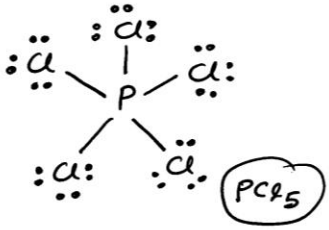
MORE THAN EIGHT VALENCE ELECTRONS
(Expanded Valence Shells)

(c) More than Eight Valence Electrons
(Expanded Valence Shells)

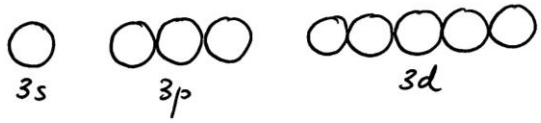
1. Expanded octets occurs only with elements in the third period and beyond. In the first or second period, the element strictly follow octet rule ($8e^-$ valence shell)
2. Expanded valence shells occurs only with a large central non-metal atom in which d orbitals are available, that is one from Period 3 or higher.
3. For example : sulfur hexafluoride, SF_6 – six single bonds, one to each fluorine, for a total of 12e's.





PCl_5, SF_6, PF_5, SF_4 – compound form from element P and S (Period 3 elements) but their Period 2 analogs NCl_5, NF_5, OF_6 or OF_4 do not exist. This is because elements in Period 2 only have 2s and 2p valence orbitals available for bonding electrons. The four orbitals in the second shell ($n=2$) can only hold a maximum of $8e^-$ (ie $2s^2 2p^6$), thus limiting a second-period central atom to eight valence electrons (octet) around it.

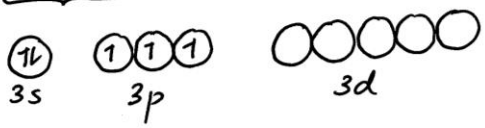
Beginning with the 3rd Period ($n=3$): 3s 3p 3d, five 3d orbitals are available in addition to the 3s and 3p orbitals.



For phosphorous and sulfur, its valence shell orbital diagram shows the vacant 3d orbitals available.

P: $1s^2 2s^2 2p^6 \underline{3s^2 3p^3}$
($Z=15$)

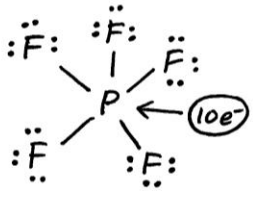
Valence shell orbital diagram of P →



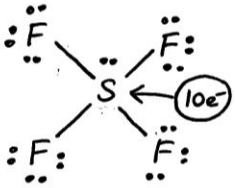
Valence shell orbital diagram of S →

By using the 3d orbitals to accomodate additional e's, phosphorous/sulfur as a <u>central atom</u> can share five or six electron pairs to expand its octet as

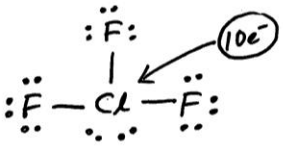
Lewis structures for Ions/Molecules with more than 8e's Around Central atom.



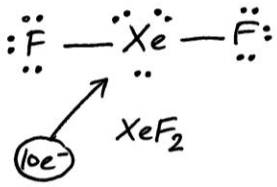
PF_5



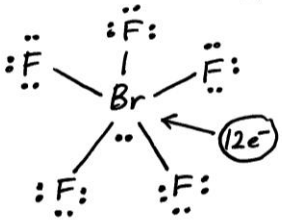
SF_4



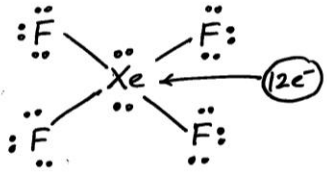
ClF_3



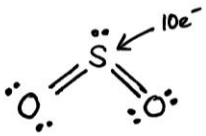
XeF_2



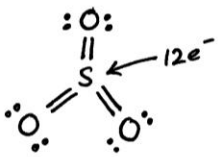
BrF_5



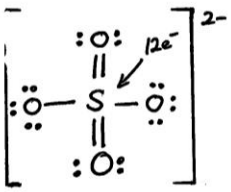
XeF_4



SO_2



SO_3



SO_4^{2-}

Prepared by
V.Manoharan
vmano@usm.my
manovv1955@yahoo.com
04-6533888 ext 3566