2s & 2p atomic orbitals are too widely separated in energy to allow significant mixing (hybridization) to occur.
Fluorine bond energies are “anomalous”. The F-F bond is very weak due to lone-pair/lone-pair repulsions (cf. O-O, N-N). Fluorine has tightly held, non-polarizable electrons, the atoms are small and no low-lying “d” atomic orbitals exist. The fluorine lone pairs are strong $\pi$-donors to atoms having low-lying empty orbitals. Fluorine forms strong, polar bonds to carbon, hydrogen and many other elements. Fluorine is very electrophilic and strongly oxidizing.
Molecular Orbital Diagram – Cl₂, Br₂, I₂

3s & 3p and higher atomic orbitals are not so widely separated in energy and allow significant mixing (hybridization) to occur.

This mixing causes the inversion of the σ and π molecular orbitals’ energy.
Interhalogens

Y is the heavier halogen!

Y\(^{+}\) \(\xrightarrow{-X^{\cdot}}\) YX \(\xrightarrow{+X^{\cdot}}\) YX\(_{2}^{-}\)

YX\(_{2}^{+}\) \(\xrightarrow{-X^{\cdot}}\) YX\(_{3}^{-}\) \(\xrightarrow{+X^{\cdot}}\) YX\(_{4}^{-}\)

YX\(_{4}^{+}\) \(\xrightarrow{-X^{\cdot}}\) YX\(_{5}^{-}\) \(\xrightarrow{+X^{\cdot}}\) YX\(_{6}^{-}\)

YX\(_{6}^{+}\) \(\xrightarrow{-X^{\cdot}}\) YX\(_{7}^{-}\) \(\xrightarrow{+X^{\cdot}}\) YX\(_{8}^{-}\)

Cs\(^{+}\)IF\(_{8}^{-}\)

Square antiprismatic?
Trihalide Anions

- The heavier halogen is invariably in the center position.
- The anion is linear or near linear. One Deviation is for Br$_3^-$ which is $171^\circ$most $176^\circ$ or higher.
- The bonding is almost certainly 3c-4e bonding.
- The two bonds in YX$_2$ species need not be equivalent and may vary with the cation.
- The bond length is longer than the single bond covalent radii. The formal bond order is 0.5. In BrI$_2^-$ the Br-I bond is longer than the I-I bond.
- Iodine forms an extensive set of polyiodine anions: I$_n^- \ n = \text{odd}$; I$_n^{2-} \ n = \text{even}$, I$_{16}^{4-}$. (see page 837).
Iodine Oxides and Oxoacids of Iodine

\[ \text{I}_2\text{O}_5 \quad \Delta H^\circ_f = -158.1 \text{ kJ} \]
\[ \text{I}_4\text{O}_9 \& \text{I}_2\text{O}_4 \text{ also known} \]

- Ortho-periodic acid
  - \( \text{H}_5\text{IO}_6 \)

- Dimer
  - \(-\text{H}_2\text{O}\)
  - \(-2\text{H}_2\text{O}\)

- Trimer

Mesopериодат (сделяння)

\[ \text{NaIO}_4 \quad \text{periодат} \]
\[ \text{K}_3\text{IO}_5 \quad \text{periодат} \]
\[ \text{K}_5\text{IO}_6 \quad \text{periодат} \]

\[ \text{I}_4\text{O}_9 \text{ also known} \]

- Ortho-periodic acid
  - \( \text{H}_5\text{IO}_6 \)

- Dimer
  - \(-\text{H}_2\text{O}\)
  - \(-2\text{H}_2\text{O}\)

- Trimer