1. **Why is s-p mixing more important in Li₂ than in F₂?**

The extent of orbital mixing is inversely proportional to their energy separation. The energy gap between the 2s and 2p orbital in the elements becomes larger as the atomic number increases. It is larger in F than in Li so the importance of s-p mixing is smaller.

In H (or in H-like ion), there is no energy difference between 2s and 2p. The energy of an orbital is dependent only on the \( n \) quantum number.

In atoms with more than one electron, 2s is lower in energy than 2p. An electron in a 2s orbital is less well shielded by the other electrons than an electron in a 2p orbital. (Equivalently, the 2s orbital is more penetrating.) The 2s electron experiences a higher nuclear charge and drops to lower energy.

As the nuclear charge increases across the Li – F period, both 2s and 2p lower in energy due to the increased nuclear charge but the 2s is affected to a larger degree, as shown in the figure opposite.

2. **How many core, \( \sigma \)-bonding, and \( \pi \)-electrons are there in**

   (a). **Acetylene**

   \( \text{C}_2\text{H}_2 \): total electron count = \((2 \times 6 \text{ (C)} + 2 \times 1 \text{ (H)}) = 14.\)
   - Each C has a 1s\(^2\) core: there are 2 \( \times \) 2 core electrons. Total for core = 4.
   - There are 3 \( \sigma \) bonds (2 \( \times \) C-H and 1 C-C), each requiring 2 e\(^-\). Total for \( \sigma \) bonding = 6.
   - There are 2 \( \pi \) bonds in the triple bond, each requiring 2 e\(^-\). Total for \( \pi \) bonding = 4.
   - Check: 4 (core) + 6 (\( \sigma \)) + 4 (\( \pi \)) = 14.

(b). **Ethylene**

   \( \text{C}_2\text{H}_4 \): total electron count = \((2 \times 6 \text{ (C)} + 4 \times 1 \text{ (H)}) = 16.\)
   - Each C has a 1s\(^2\) core: there are 2 \( \times \) 2 core electrons. Total for core = 4.
   - There are 5 \( \sigma \) bonds (4 \( \times \) C-H and 1 C-C), each requiring 2 e\(^-\). Total for \( \sigma \) bonding = 10.
   - There is 1 \( \pi \) bond in the double bond, requiring 2 e\(^-\). Total for \( \pi \) bonding = 2.
   - Check: 4 (core) + 10 (\( \sigma \)) + 2 (\( \pi \)) = 16.

(c). **Benzene**

   \( \text{C}_6\text{H}_6 \): total electron count = \((6 \times 6 \text{ (C)} + 6 \times 1 \text{ (H)}) = 42.\)
   - Each C has a 1s\(^2\) core: there are 6 \( \times \) 2 core electrons. Total for core = 12.
   - There are 12 \( \sigma \) bonds (6 \( \times \) C-H and 6 C-C), each requiring 2 e\(^-\). Total for \( \sigma \) bonding = 24.
   - There are 3 \( \pi \) bonds, each requiring 2 e\(^-\). Total for \( \pi \) bonding = 6
   - Check: 12 (core) + 24 (\( \sigma \)) + 6 (\( \pi \)) = 42.
Buckminsterfullerene

$C_{60}$: total electron count = $60 \times 6 \text{ (C)} = 360$.

- Each C has a $1s^2$ core: there are $60 \times 2$ core electrons. Total for core = 120.
- Each C uses 3 valence electrons for $\sigma$ bonds. Total for $\sigma$ bonding = $60 \times 3 = 180$.
- Each C uses 1 valence electron for $\pi$ bonds. Total for $\pi$ bonding = $60 \times 1 = 60$.
- Check: $120 \text{ (core)} + 180 \text{ (}\sigma\text{)} + 60 \text{ (}\pi\text{)} = 360$. 