Particle in a box

\[ y = \sin \omega x \]

\[ n = 1 \quad 0 \text{ nodes} \quad n = 2 \quad 1 \text{ node} \quad n = 3 \quad 2 \text{ nodes} \quad n = 4 \quad 3 \text{ nodes} \]

\( \text{but} - 1,3\text{-diene} \quad \overset{\text{(carbon)}}{\Rightarrow} \quad \text{but} - 1,2\text{-diene} \)

Due to conjugation, the single bond in buta-1,3-diene is shorter than an average C-C bond.

hyperconjugation - the partial donation of electron density to a neighboring orbital through an interaction that does not involve a bond.

Conjugation - the full delocalization of \( \sigma \) density across multiple orbitals due to full \( \pi \) bonding overlaps.
Hyperconjugation:

2 π bonds → 4 π e⁻

The # of MOs in a π system is always equal to the # of π orbitals in that system.

Bond order = \( \frac{\# \text{ bonding e}⁻ - \# \text{ antibonding}}{2} \)

HOMO-LUMO

High-Occupied Molecular Orbital
Lowest-Unoccupied Molecular Orbital