

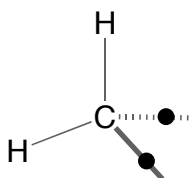
Carbene, CH_2 , is a highly reactive species with $0/1/8/6$ shared electrons in the C-second shell.

Carbenes can be sp^2 -hybridized with one lobe of the hybrid containing $2e$ from C, and with an unoccupied p -orbital; this is called the *singlet / triplet* state.

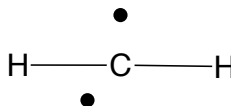
Alternatively, carbenes can be sp^3 -hybridized with one electron in each of the hybrid lobes that does not point to a hydrogen; this is a *singlet / triplet* state.

Another possibility is a sp -hybridized carbon with an electron in the two remaining p -orbitals; here we call this an *unstable triplet* state.

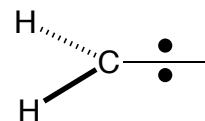
Draw the three possibilities for hybridization in carbenes, by superimposing the hybrid and unused p -orbitals on the diagram below. Circle the correct identifying option in each case.



singlet / triplet / unstable triplet

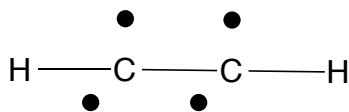


singlet / triplet / unstable triplet

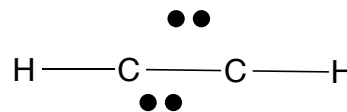


singlet / triplet / unstable triplet

Like two *unstable triplets* joined, ethyne, HCCH , has σ -bonded $sp / sp^2 / sp^3$ hybridized C-atoms. Before the p -orbitals are mixed, each with two unpaired electrons occupy an empty p -orbital. Show this by completing the diagram below on the left, filling in the hybrid orbitals and the unused p -orbitals.



*ethyne before mixing
p-orbitals*



*ethyne after mixing
p-orbitals*