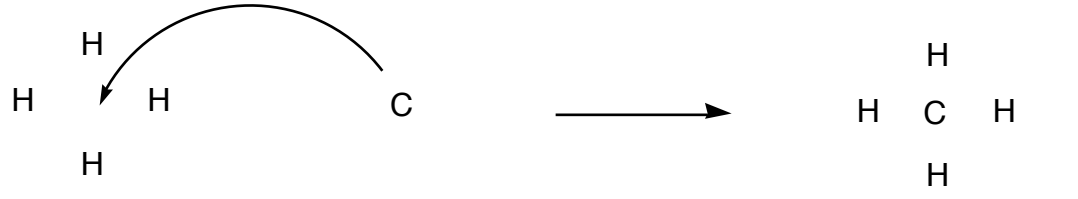
Problem 7, Chemistry 301X - 2006 -- tough problem, go slowly and don't panic

Methane is tetrahedral, everyone knows that. Yet we can imagine what methane would be like were it planar. Such a thought process leads to some ideas on how to stabilize planar methane. Resist the urge to change geometry - we really mean planar methane. Maintain planar geometry throughout.

Your task is to construct the bonding and nonbonding molecular orbitals for planar methane. We will not worry about ordering the antibonding orbitals in energy.

We will make planar methane from the molecular orbitals of square H_4 and the atomic orbitals of a carbon placed at the center of the square.



square H_4 seen from the top - you are looking right down on it.

planar methane seen from the top

a. Use the molecular orbitals of square H_4 you made earlier from those of linear H_4.

b. Show the appropriate atomic orbitals of carbon (recall Problem 6) and indicate how you will combine them with the molecular orbitals of square H_4

c. How many molecular orbitals will there be for planar methane? Carefully draw them.

d. Order the bonding molecular orbitals and any nonbonding orbitals in energy. You do not have to worry about the antibonding molecular orbitals.

e. Put in the appropriate number of electrons.