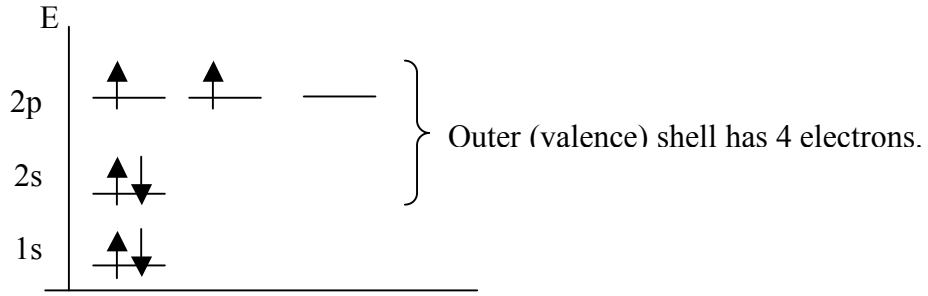
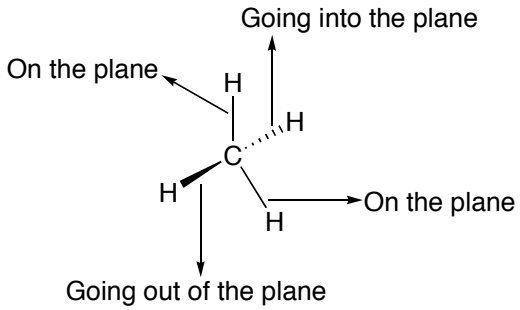
Carbon (C)



- For carbon to obtain inert gas configuration it can either give up 4 or gain 4 electrons.
- Since full loss or gain of electrons is unfavorable (would generate -4 or +4 charge), carbon shares 4 electrons to form "covalent bonds".

e.g. CH_4, methane



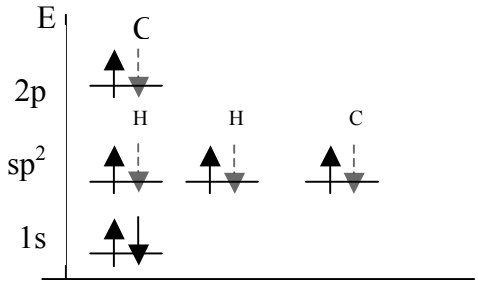
- Atomic orbitals of carbon are hybridized to give 4 sp^3 orbitals.
- Carbon is bonded with 4 H atoms (covalent bonds) where each atom has the inert gas configuration

sp^3 hybridization

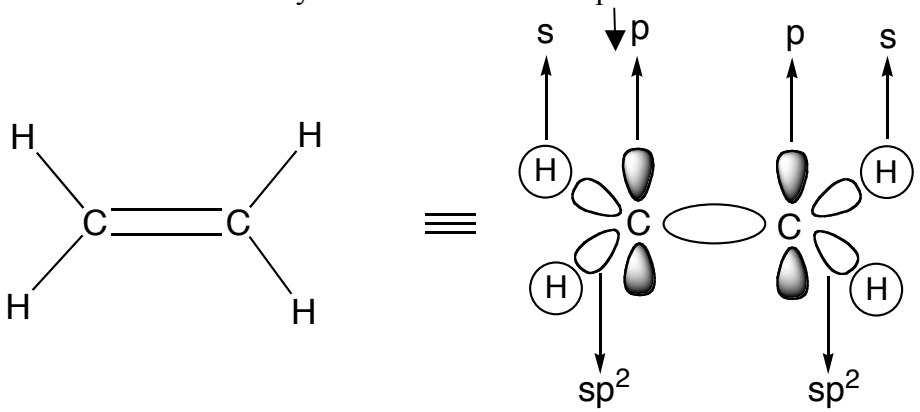
- 4 atoms connected to carbon
- Mixing of the single 2s and the three 2p orbitals.
- Tetrahedral geometry
- Single bonds : free rotation
- Bond angles of 109^o

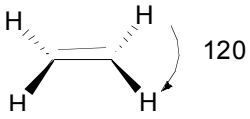
sp^2 hybridization

- 3 atoms connected to carbon.
- Mixing of the single 2s and 2 out of the three 2p orbitals. One p-orbital left over.
- Planar geometry
- Usually double bonds – do not rotate
- Bond angles of 120^o



Ex) Ethylene/Ethene: Commonly used as an artificial ripener for fruits.

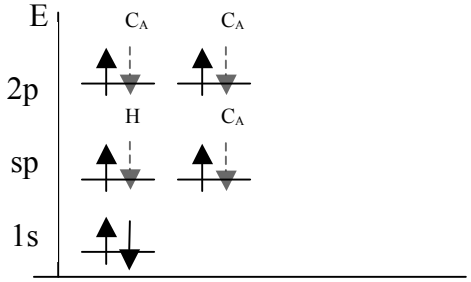




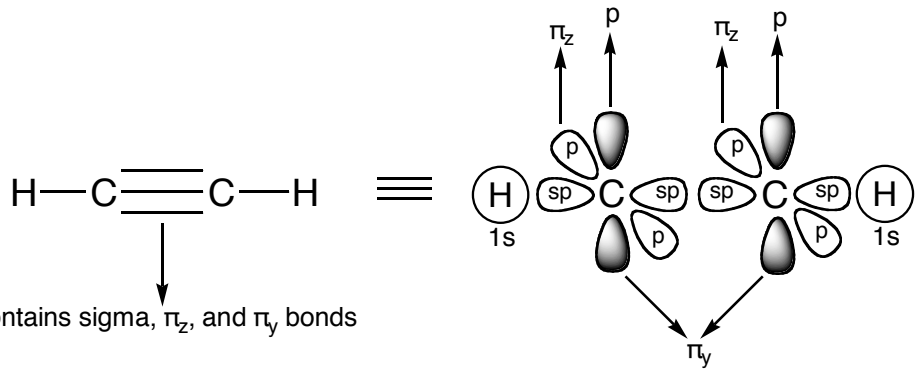
- When atomic orbitals overlap they form molecular orbitals.
- Double bond contains one σ bond and one π bond.
- π bond fixes geometry, does not allow rotation round double bond.
- σ bond has free rotation.

<u>sp hybridization</u>

- Two atoms bonded to central atom
- Linear geometry
- Usually triple bonds
- Bond angle is 180°



eg) Acetylene/Ethyne



- Hybridization occurs in order to optimize geometry and decrease non-bonded interactions between atoms having inert gas configuration.

Some common Bond Lengths to remember:

- Single bonds of H to C, O, N, F are ~1 Å = 10^{-8} cm
- Single bonds between C, N, or O are ~1.5 Å
- Double bonds between C, N, or O are ~1.35 Å
- Triple bonds between C, N, or O are ~1.2 Å

Representation of Molecules

- Show only electrons in outer (valence) shell
- Non-bonding electrons may not be shown
- Use element symbols, but carbon can be represented by point of angle or end of line
- Hydrogens and bonds to them from carbon are optional, show others