Hybrid Orbitals

Eg. CH_4

all four bonds are equal. One is not more energetic than the other

Electron Configuration

2p ↑ ↑ —

2s ↑↓

1s ↑↓

← How does carbon form 4 bonds with only 2 half filled orbitals?

Promotion of an e^-

2p ↑ ↑ → ↑

2s ↑

1s ↑↓

as 2s e^- gets promoted to 2p

This would mean that the 4 e^- are involved in bonding are $2s^1, 2p_x^1, 2p_y^1, 2p_z^1$

∴ not all bonds would be equal. This is NOT the case

✗

Hybridization of orbitals

s 25% p 75%

These 4 orbitals Hybridize to create

2p ↑ ↑ ⇒ ↑ ↑ ↑ ↑ sp^3

2s ↑↓

1s ↑↓

1. promotes
2. hybridizes

(4 sp^3 hybrid orbitals)

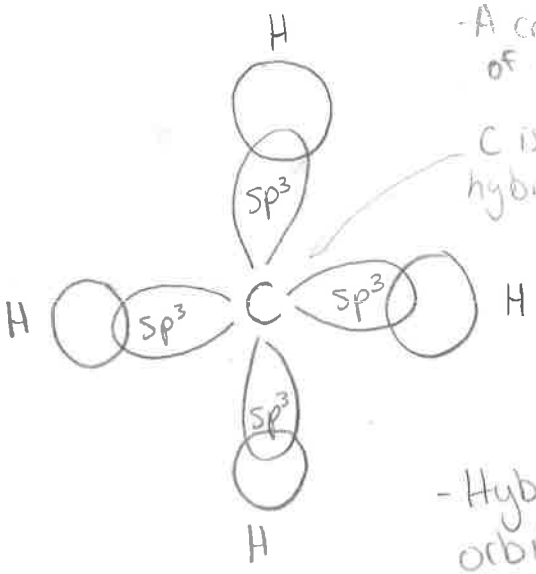
shape of an sp^3

- each sp^3 orbital has the same shape and energy.

∴ bonds would be identical and they are right

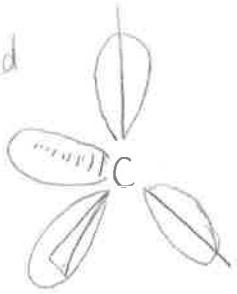
✓

- CH_4
- the 1s orbital of H overlaps with an sp^3 orbital of carbon



C is sp^3 hybridized

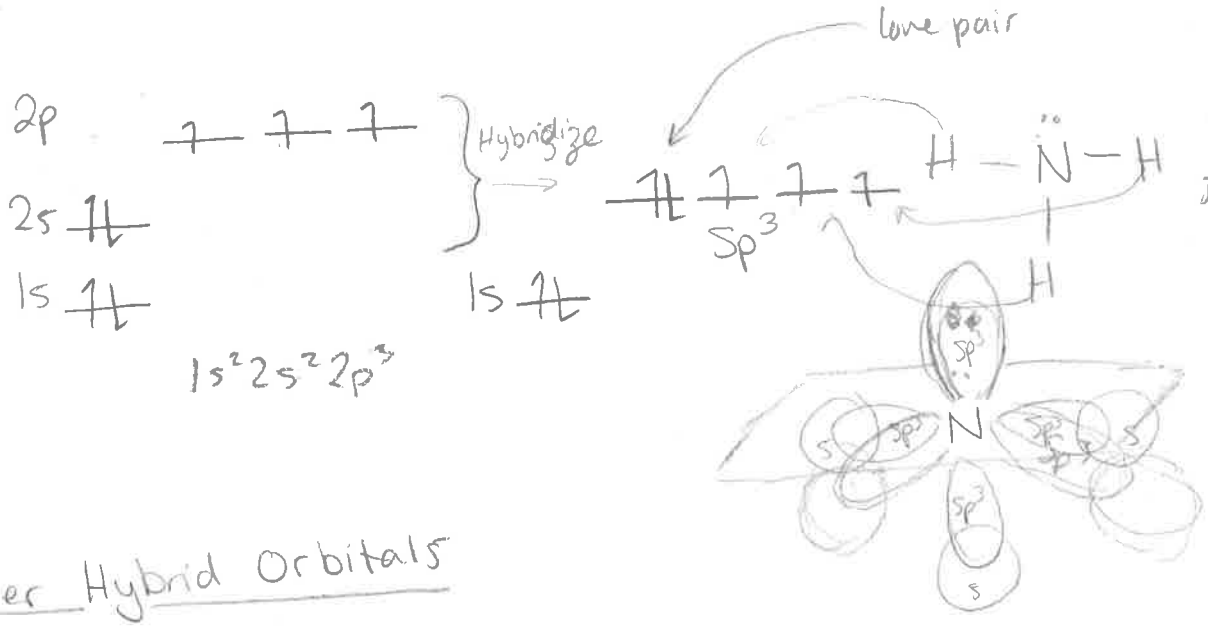
- A covalent bond is the overlap of two half filled orbitals containing electrons of opposite spins.



- Hybridization of atomic orbitals to form hybridized orbitals

- See ppt

NH_3



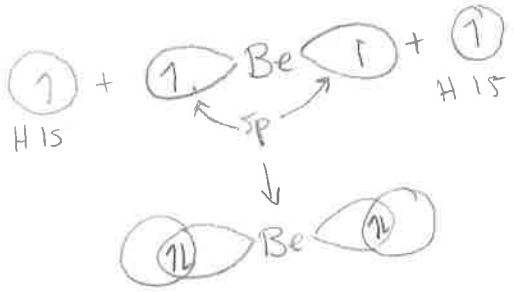
$1s^2 2s^2 2p^3$

Other Hybrid Orbitals

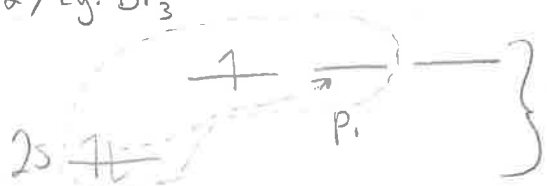
1) Eg. BeH_2

= 2 sp hybrid orbitals
↳ 1s + 1p = 2sp

$1s^2 2s^2$



2) Eg. BF_3



= 3 sp^2 hybrid orbitals

$1s^2 2s^2 2p^1$

Hybridization - a theoretical process involving the combination of atomic orbitals to create a new set of orbitals for covalent bonding

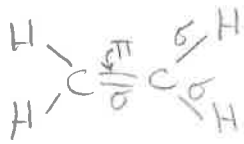
Double and Triple Bonds

Sigma bond - "normal" overlap of orbitals (end-to-end overlap)
Pi bond - overlap of orbitals (side by side)

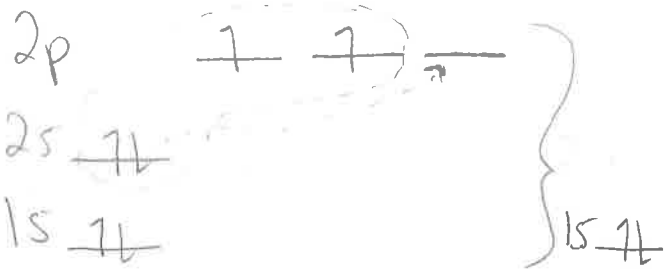
= sigma bond

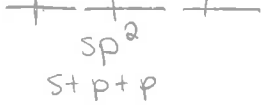
= pi bond { Double or Triple bond

Ethene

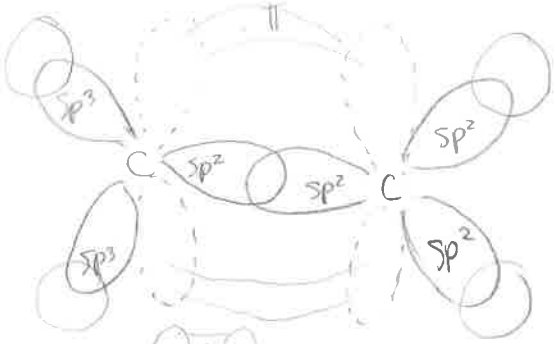


Determine the hybridization of the carbon
- will need 3 hybridized orbitals
- one left over p orbital





opening for a double bond
leaves 1p unhybridized



(Draw σ bonds first in one plane)

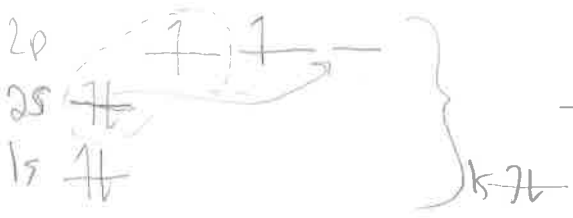
Also

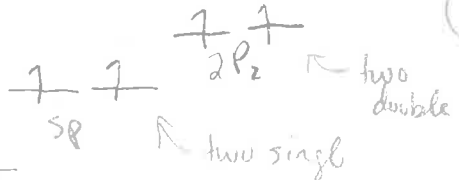
pi bond in C_2H_4

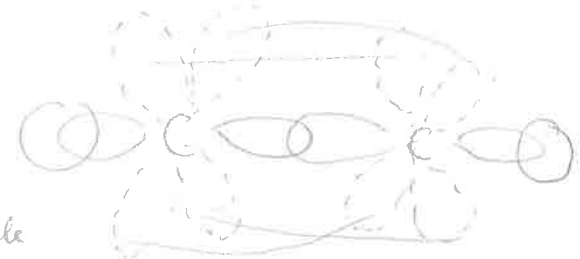
- sp^2 hybridized

See ppt

Ethylene $H-C\equiv C-H$ ($\sigma\ \sigma\ \pi\ \pi\ \sigma$)







perpendicular like orientation

See ppt.