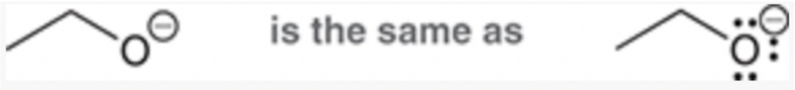
Session 2 Worksheet

You do not have to write lone pairs if you don't want to, however, you MUST include a formal charge (if applicable)



Resonance

- Shows distribution of charge

Resonance structures:

- used when

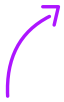
We represent resonance structures with Brackets and double sided arrows

[⇄]

Note: the resonance structures are not switching back and forth! The hybrid is a mixture of both structures

Resonance hybrid of 1 and 2

Curved Arrows:



Shows e^- as if they are moving, but they're not

Use a double-barbed arrow, single-barbed arrows show the movement of radicals (single e-)

Molecular Orbitals

Molecular Orbital (MO):

- Represents the region of space where one or two electrons of a molecule are likely to be found
- Have a wave-like behavior with + and − lobes

Remember

The +/- lobes are not an indicator of charge, simply, they are an illustration of displacement

Bonding MO:

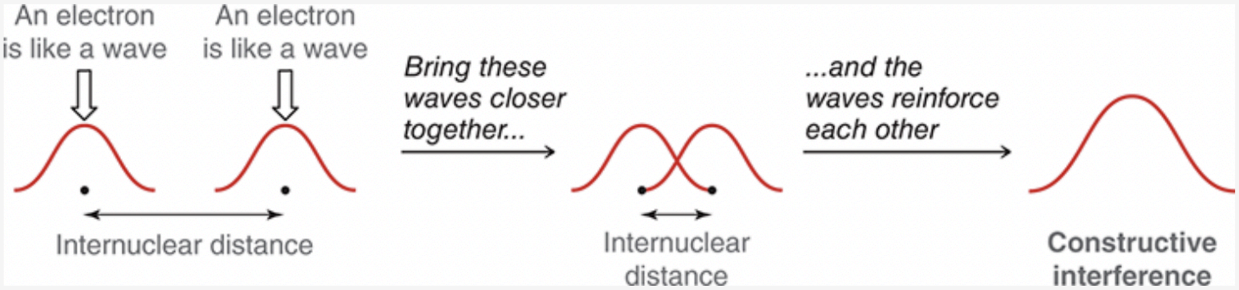
- Result of constructive interference
- forms bonds
- lower in energy

Anti-bonding MO:

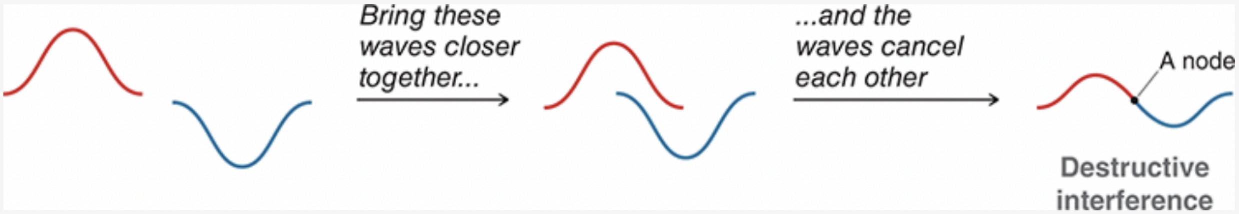
- Result of destructive interference
- does not form bonds
- higher in energy

which molecular orbital will be formed first?

bonding MO

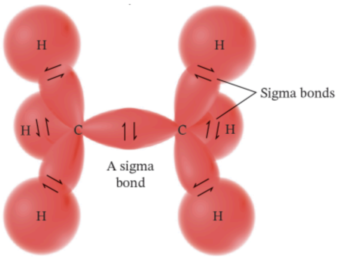
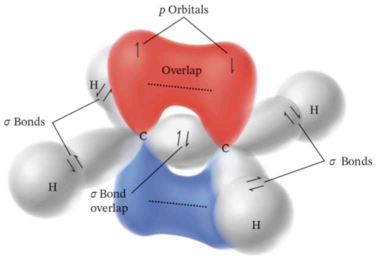
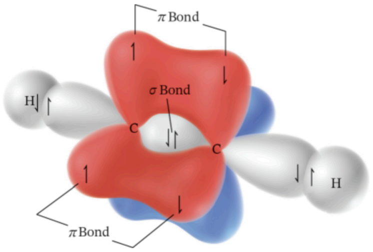
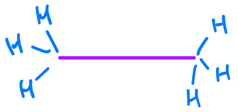
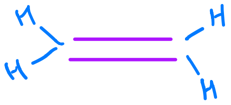
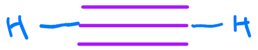


IGURE 1.11 Constructive interference resulting from the interaction of two electrons.

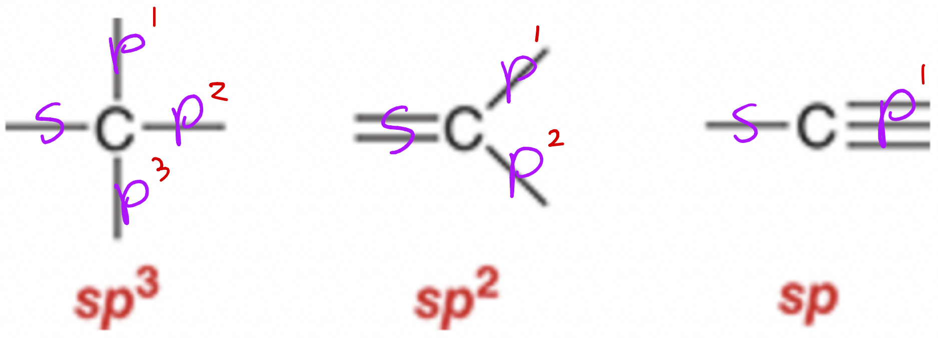


Hybridized Orbitals:

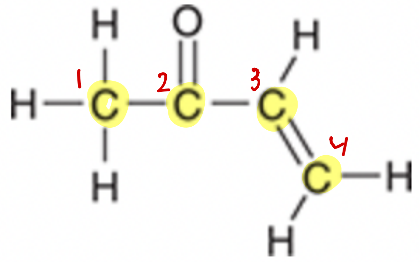
- A combination of pure atomic orbitals
- for this class we only focus on s and p

	Sp3	Sp2	Sp
Diagram			
What's Happening	A combination of 1s orbital and 3p orbitals	An overlap of p orbitals forms 1 pi bond	An overlap of p orbitals forms 2 pi bonds
Bond-line			
Geometry	tetrahedral	trigonal planar	linear
Angles	109.5°	120°	180°

Hybridization life hack!!!



Determine the hybridization state of each carbon:



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C1 = sp^3

C2 = sp^2

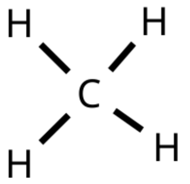
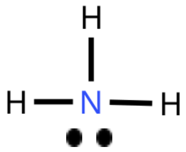
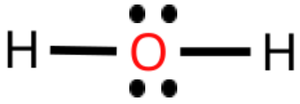
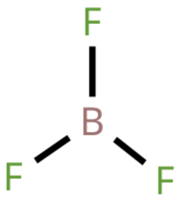
C3 = sp^2

C4 = sp^2

VSEPR Theory:

- valence Shell electron pair repulsion
- Used to predict the geometry of an atom

Common Molecular Shapes:

Compound	Bonding e- pairs	Lone e- pairs	Steric number	Arrangement of e- pairs	Molecular Geometry
	4	0	4	tetrahedral	tetrahedral
	3	1	4	tetrahedral	trigonal pyramidal
	2	2	4	tetrahedral	Bent
	3	0	3	Trigonal planar	trigonal planar
H—Be—H	2	0	2	Linear	Linear

Steric # = # single bond + # lone pairs

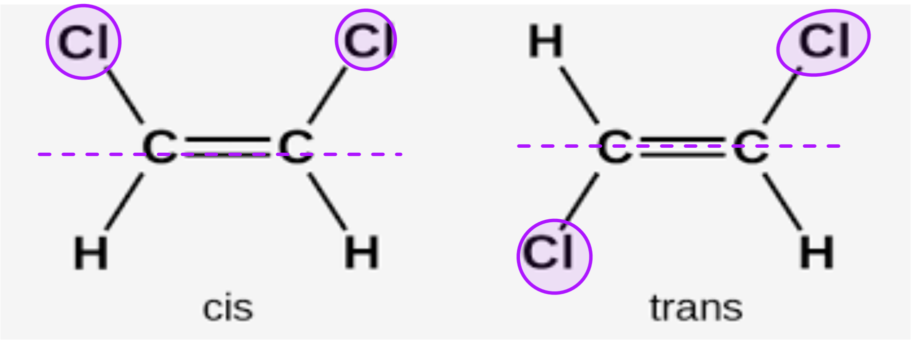
Cis/trans Steroisomerism:

Cis: on the same plane

Trans: on opposite ends of the plane

We can think of the molecule as being on a plane and separating this plane evenly either through the molecule itself or through a double/triple bond

Ex:



Restricted Rotation:

AKA, the properties of a single, double, and triple bond

Order the bonds:

Length

longest shortest

/ → // → ///

Energy

high low

/// → // → /

Strength

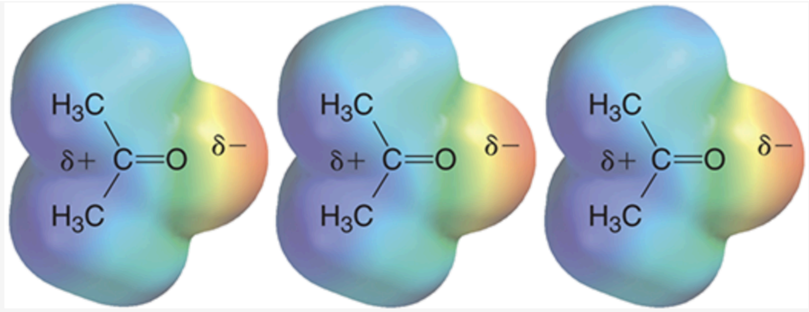
stronger weaker

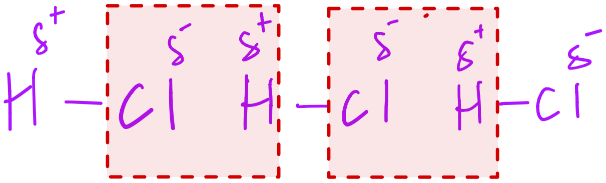
/// → // → /

Intermolecular Forces

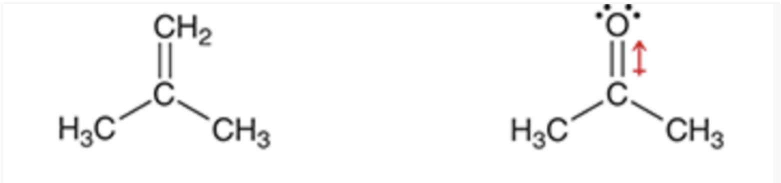
Dipole-Dipole:

The resulting net attraction between two dipoles





How does this affect bp and mp?



Isobutylene
Melting point = −140.3°C
Boiling point = −6.9°C

Acetone
Melting point = −94.9°C
Boiling point = 56.3°C

Isobutylene lacks a significant dipole moment, so the mp and bp are much lower

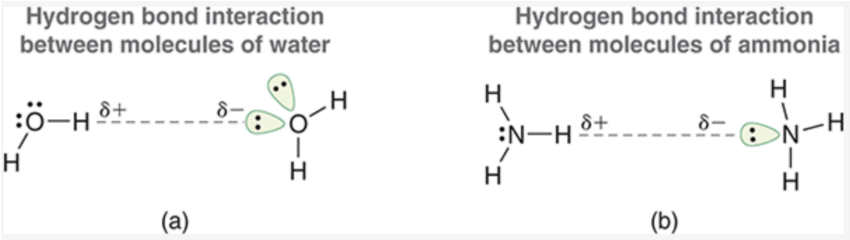
compared to Acetone, which has Strong net dipole

Hydrogen Bonding:

- Not technically a “bond”, more like another form of attraction

A hydrogen is connected to an ____EN atom____ (__O or N__)

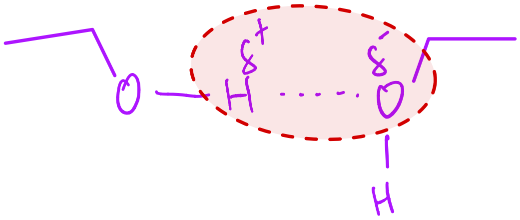
In most cases, H-bonding takes priority


Hydrogen bond interaction between molecules of water

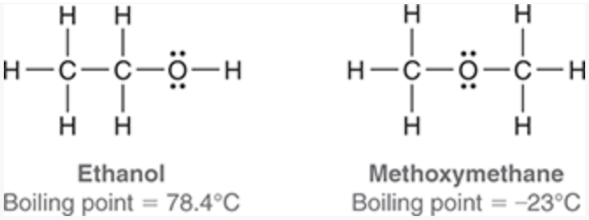
(a)

Hydrogen bond interaction between molecules of ammonia

(b)

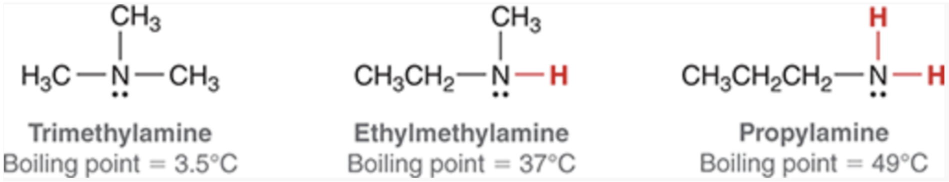


How does this affect bp & mp?


Ethanol
Boiling point = 78.4°C

Methoxymethane
Boiling point = −23°C

Ethanol has a higher bp because it has a hydrogen bonded to, versus Methoxymethane, which only has a ____C-O____bond


Trimethylamine
Boiling point = 3.5°C

Ethylmethylamine
Boiling point = 37°C

Propylamine
Boiling point = 49°C

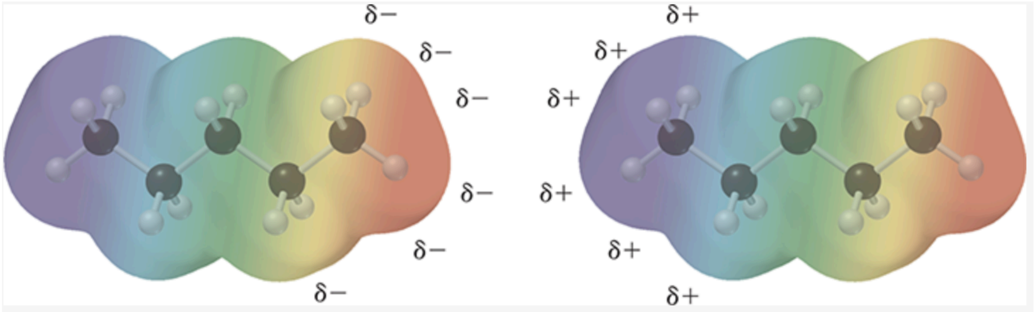
Notice how as more hydrogens are bonded to the Nitrogen atom, the ____higher____ the bp gets

London Dispersion Forces:

A consideration of the __positive__ and __Negative__ charges on a whole molecule, rather than the entire atom

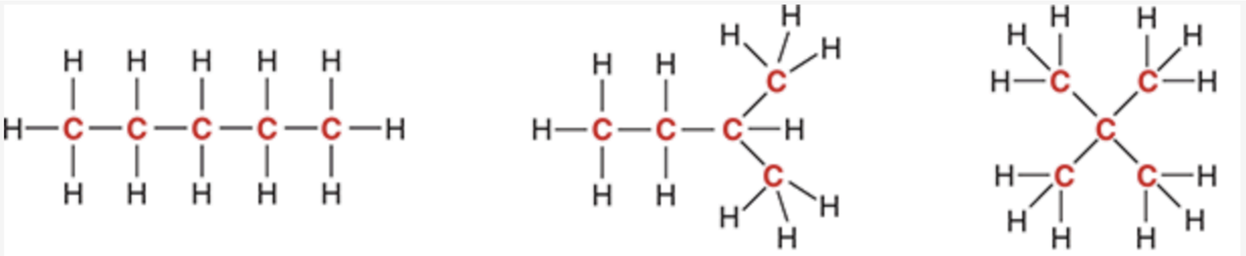
Usually observed in large __hydrocarbons__

This force is transient, or __temporary__



How does this affect bp and mp?

The __longer__ the carbon chain, the __higher__ ~~higher~~ the bp



Pentane
Boiling point = 36°C

2-Methylbutane
Boiling point = 28°C

2,2-Dimethylpropane
Boiling point = 10°C

The more __branching__, the __lower__ the bp