Office Hours: M 1:30pm - 3:00pm
(in Park 169) W 11:00am - 12:00pm
or by appointment (email me)
or just email me with questions!

TA Hours w/ Sodtugs: T&Th 7:00pm - 8:00pm
(in Park ____)

Q-center: https://www.brynmawr.edu/inside/offices-services/q-center/q-center-schedule

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Polarity and Intermolecular Forces

Drawing Organic Molecules

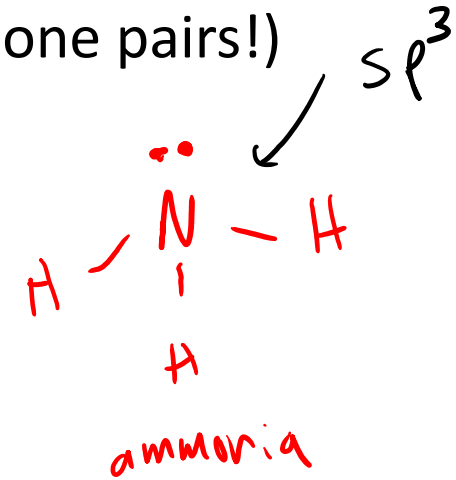
9/4/2026

No recitation this afternoon.

Molecular vs electron geometry

Molecular geometry – describes shape formed by the atoms

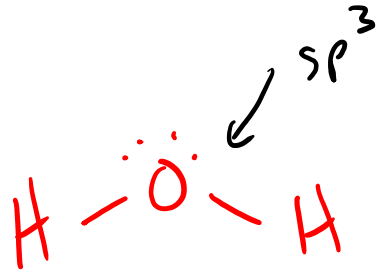
Electron geometry – describes shape formed by the electron groups (including the lone pairs!)



ammonia

e⁻ geometry: tetrahedral

molecular geometry: trigonal pyramid



tetrahedral

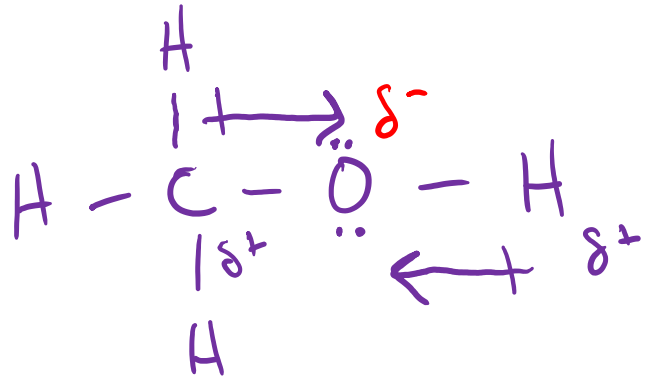
bent

☆ need to know all 2-, 3-, & 4- coordinate geometries from gen chem.

Molecule polarity

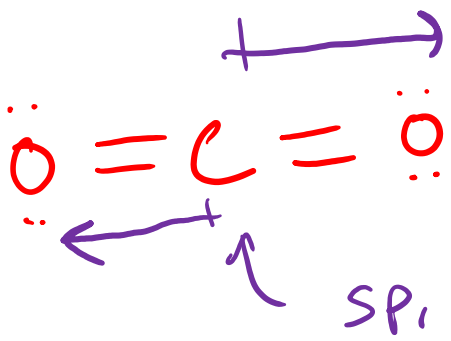
δ+ → δ−

A molecule is polar if it has a *net dipole moment* – or exhibits permanent, partial charges on atoms due to polar bonds.



A molecule can have polar bonds, but be nonpolar overall!

Symmetry!



cancel out!

nonpolar.

CCl_4

Intermolecular forces (IMF)

- Inter - between molecular - molecules forces - forces

  not bonds within (intra) a molecule.

- Forces that hold a molecule near its neighbor

  >> Its neighbor could be a different molecule than itself << A→←A or A→←B

- Determine many important physical properties of molecules!
  - Melting point, boiling point, solubility, affinity for SiO_2 (for chromatography)

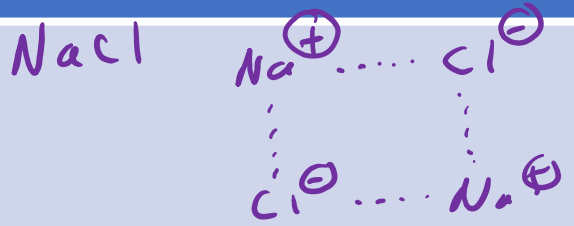
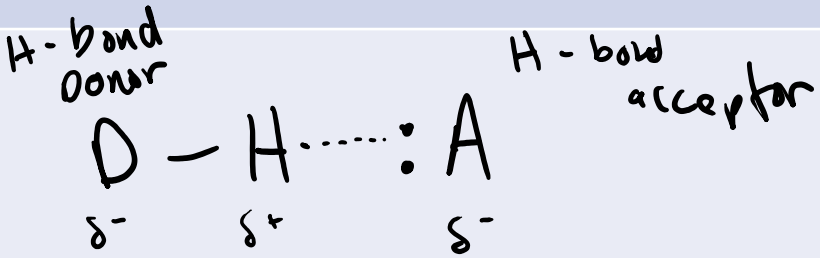
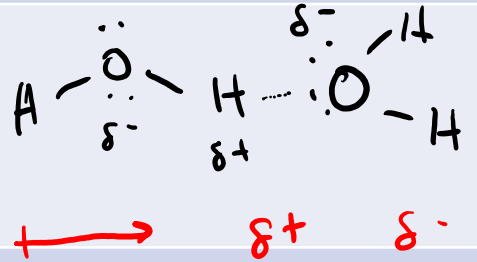
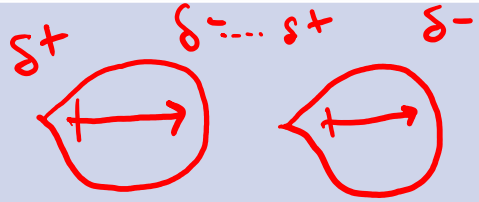
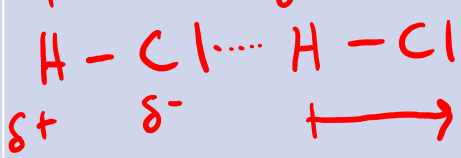
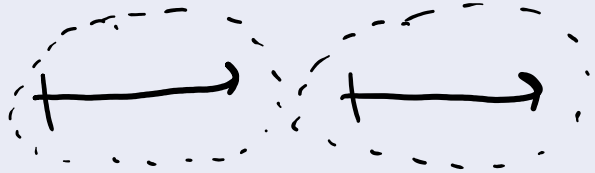
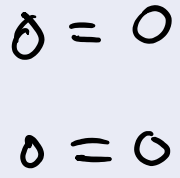
    neighbor is same molecule

    ↳ IMF w/ "self" + other both matter!

- Crucial to biochemistry!
  - Protein folding, DNA helixes, epigenetic control of DNA, enzyme binding affinity, etc.

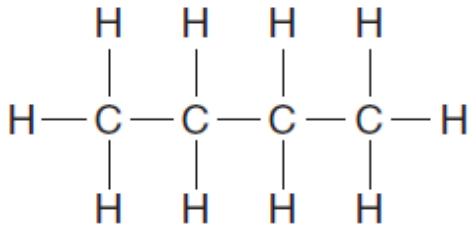
- IMF is always based on ⊕ + ⊖ attraction!

Common types of IMF, from strongest (top) to weakest (bottom)

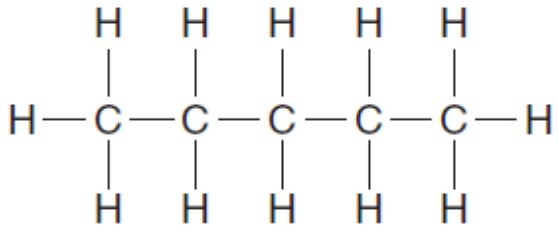
Force	Cartoon	Energy (kJ/mol)	Example
Ionic (electrostatic)		400-4000	
H-bond D, A: F, N or O.		10-40	
Dipole-dipole in polar molecules		5-25	
Induced dipole-induced dipole (London Dispersion or just "Dispersion")		0.05-40	

↳ everything. esp. nonpolar molecules.

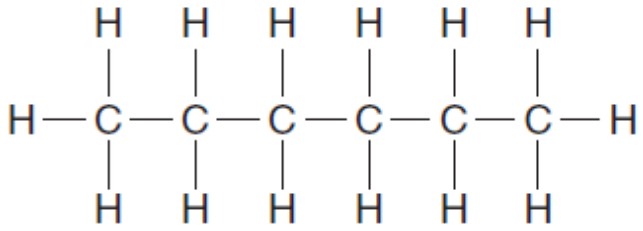
London Dispersion & Molecule Size



Butane
(C_4H_{10})
Boiling point = 0°C



Pentane
(C_5H_{12})
Boiling point = 36°C

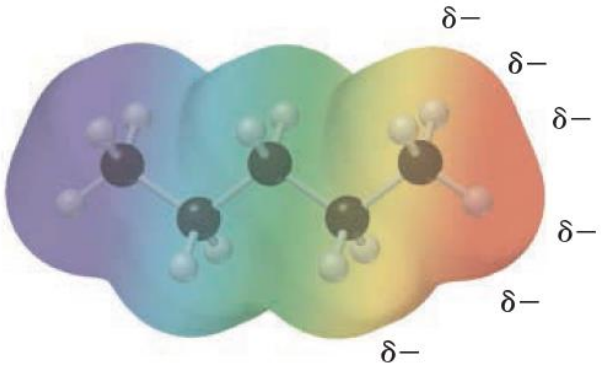


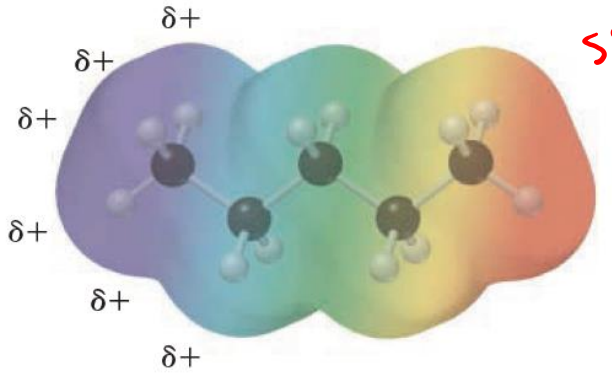
Hexane
(C_6H_{14})
Boiling point = 69°C

more e^- → more chance of significant charge separation (transient)

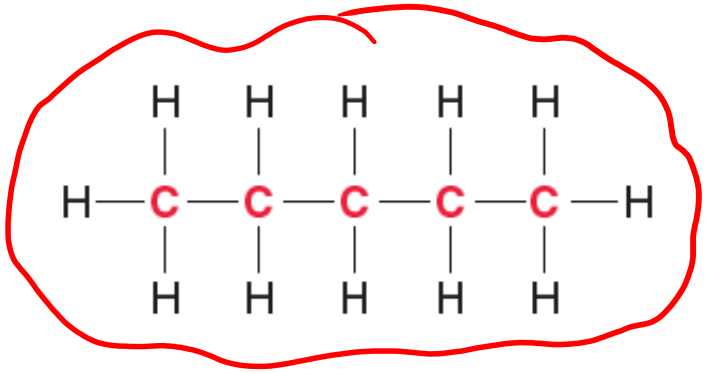
longer chain → more e^-

→ stronger dispersion force of attraction.

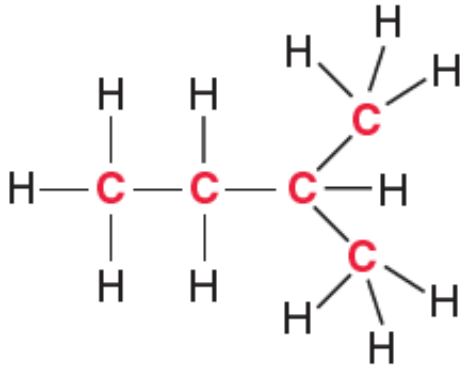




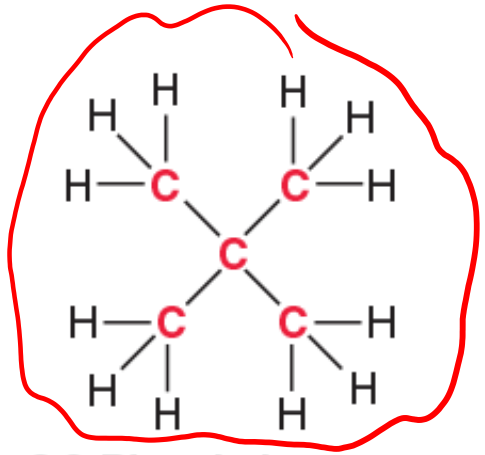
London Dispersion & Molecule Shape



Pentane
Boiling point = 36°C



2-Methylbutane
Boiling point = 28°C

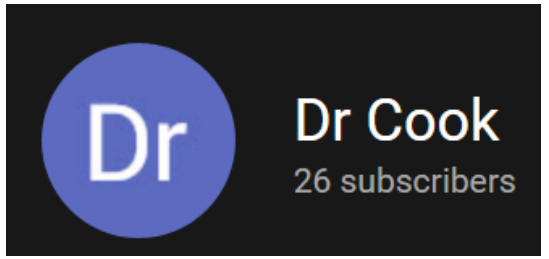


2,2-Dimethylpropane
Boiling point = 10°C

all are C_5H_{12} → same # of total e^-

branching weakens dispersion → e^- can't transiently shift as far in molecule.

IMF & Physical properties



- Solubility – "like dissolves like"
  - polar molecules dissolve in polar solvents
  - nonpolar molecules in " nonpolar solvents
  - ionic compounds? need polar solvent.
- Melting point/boiling point

  stronger IMF → higher m.p. & b.p.

- Affinity for SiO_2 – in lab ~~this~~ next week

Poll

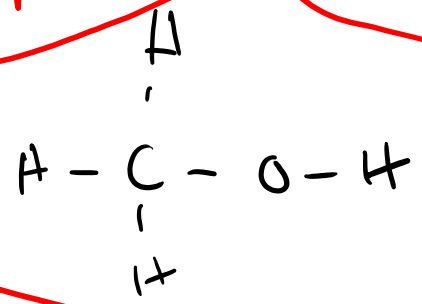
nonpolar? polar? H-bond?

Which molecule has the highest melting point?

A. CH_4 nonpolar

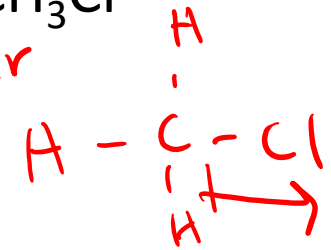
B. CCl_4 nonpolar

C. CH_3OH



H-bond!

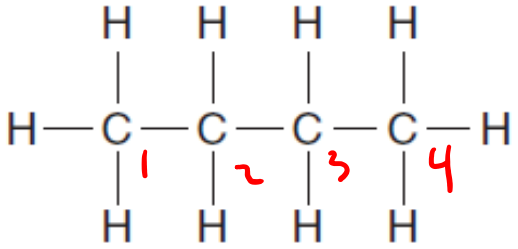
D. CH_3Cl polar



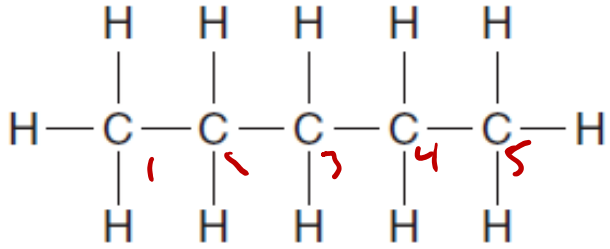
$CH_4 < CCl_4 < CH_3Cl < CH_3OH$

Extra practice: rank all 4 choices from lowest to highest boiling point.

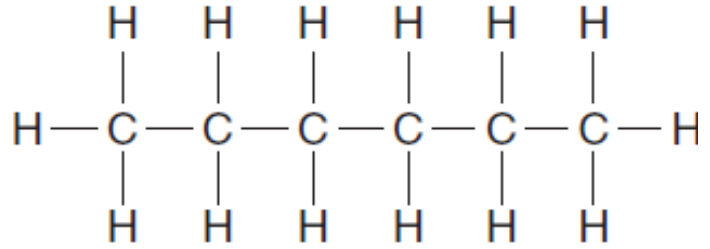
Drawing Molecules: Bond-Line Structures



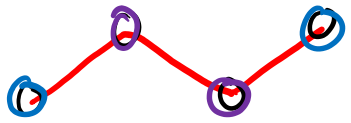
Butane
(C_4H_{10})



Pentane
(C_5H_{12})



Hexane
(C_6H_{14})



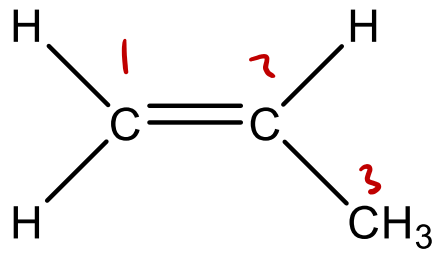
The longest Carbon chain is drawn in a "zig-zag" format

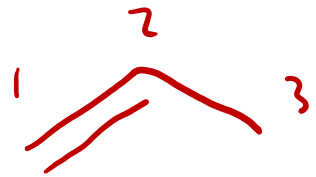
C never makes more than 4 bonds!

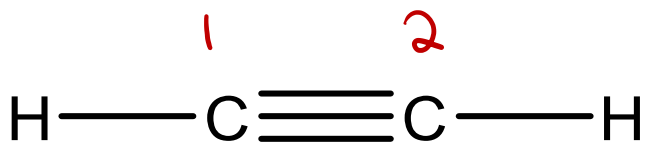
Carbons are represented as endpoints or corners of lines.

Hydrogens attached to Carbons are not shown.
[Assume each Carbon makes a total of 4 bonds to determine the number of implied Hydrogens]

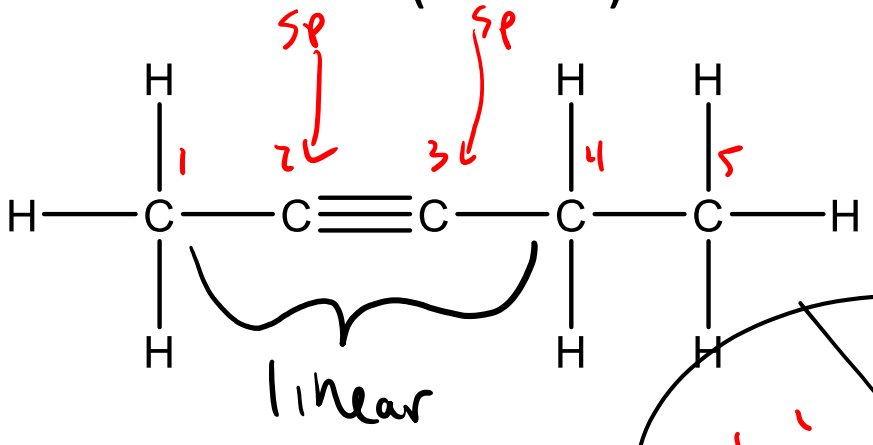
Carbon-Carbon multiple bonds are shown with multiple lines

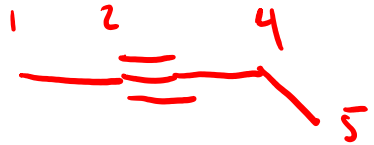


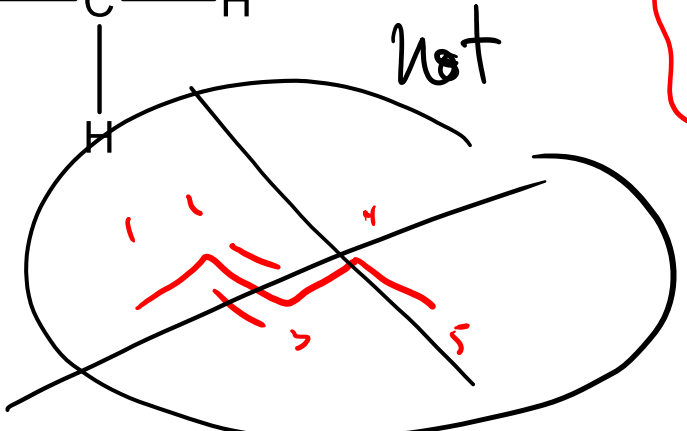


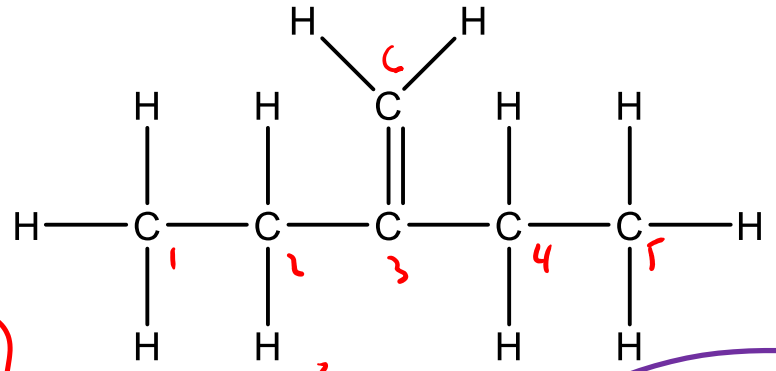


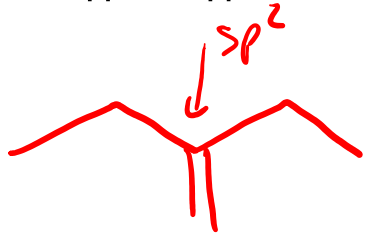
The geometry of the bond-line structure should reflect the hybridization of each carbon! (VSEPR)

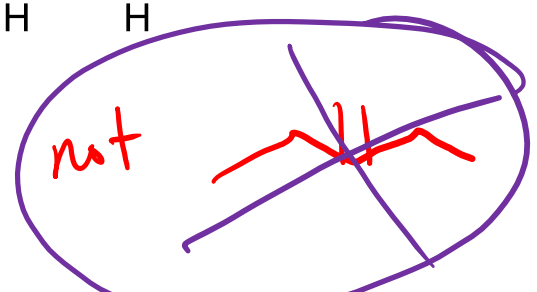






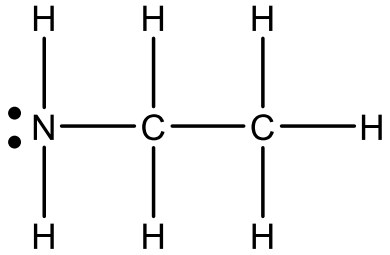


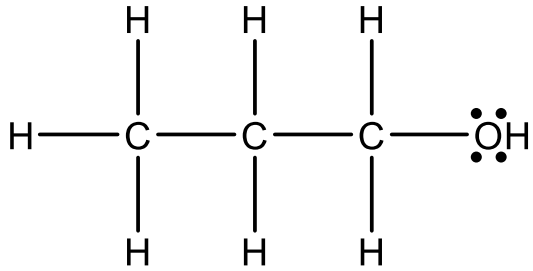




Heteroatoms (not C or H) are <u>always drawn</u>

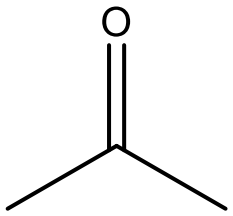
Heteroatoms <u>always</u> have their number of H's labeled clearly

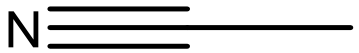


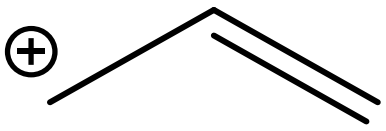


Lone pairs are *<u>not shown</u>* in bond-line structures, but

Formal charges are **<u>always shown</u>.**







Nonzero formal charges: Carbon

Carbon never makes more than 4 bonds, but sometimes it makes fewer:

Nonzero formal charges: Nitrogen

Nonzero formal charges: Oxygen