Chapter 7 – Covalent Bonds

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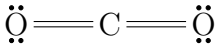
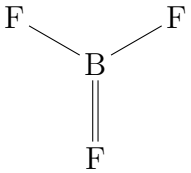
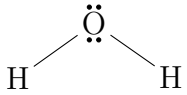
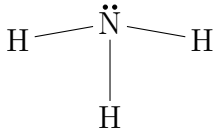
- Lewis Structures:
  1. Sum Valence Electrons
  2. Connect atoms with lines
  3. Arrange remaining e^- to satisfy octet rule
- Resonance – Being able to draw more than one Lewis structure
- Halogens will almost never have double bonds
- Molecular Shapes:
  1. Linear
     - Bond angle equals 180°
     - Usually non-polar
     - Ex:
       
  2. Triangular Planar
     - Bond angle equals 120°
     - Usually non-polar
     - Ex:
       
  3. Bent
     - Bond angle equals 109.5°
     - Appears as a linear, but bent
     - Always polar

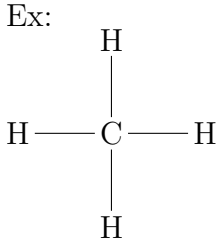
- Ex:



4. Tri-Pyramid
   - Bond angle equals 109.5°
   - Appears as a three dimensional, triangular pyramid
   - Always polar
   - Ex:



5. Tetrahedral
   - Bond angle equals 109.5°
   - Appears as a three dimensional, square pyramid
   - Usually non-polar
   - Ex:



- Expanded Octets: $5\,e^-$ pairs

1. Tri-Bipyramid (5 atoms)
   (a) Usually non-polar
2. Seesaw (4 atoms)
   (a) Always polar
3. T Shape (3 atoms)
   (a) Always polar
4. Linear (2 atoms)
   (a) Usually non-polar

- Expanded Octets: $6\,e^-$ pairs

  - Octahedral (6 atoms)
    1. Usually non-polar
  - Square Pyramid (5 atoms)
    1. Always polar

- Square Planar (4 atoms)
    1. Usually non-polar

- VESPR – e^- pairs repel, and double and triple bonds count as one pair.
- Molecular Polarity – The negative side is what repels branching atoms, while the branching atoms are attracted to the positive side.
- Exceptions – NF_3 has a bond angle of 102°, CF_4 has a bond angle of 109.5°. This is because lone pairs repel more than bonding pairs.
- These types of graphs show the appropriate bond distance between two atoms:

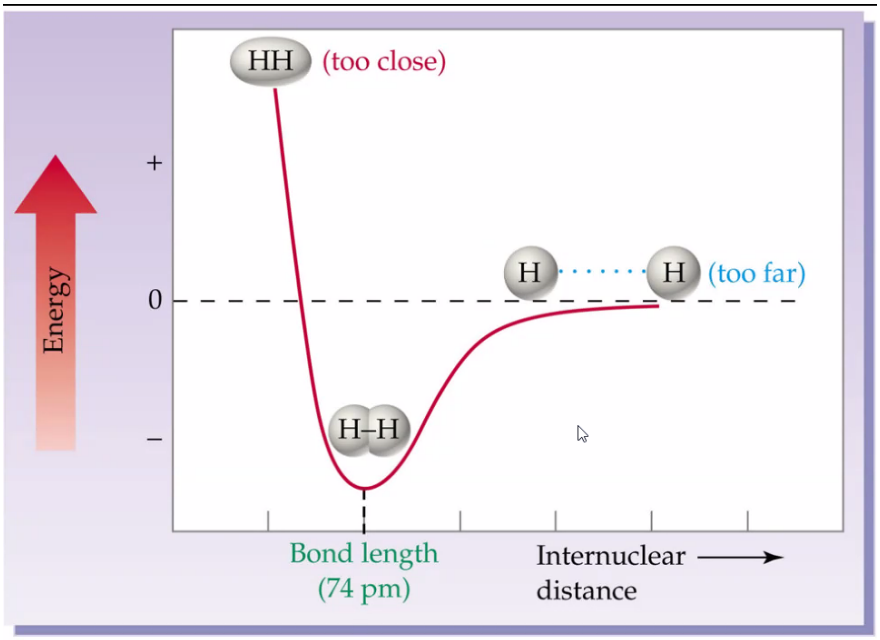


Figure 1: Best Bonding Distance For H_2

- The AP Exam will show a graph like the following and ask what is incorrect. Horizontal is determined by protons, while vertical is determined by size of the atom. In this case, F_2 should be left of I_2

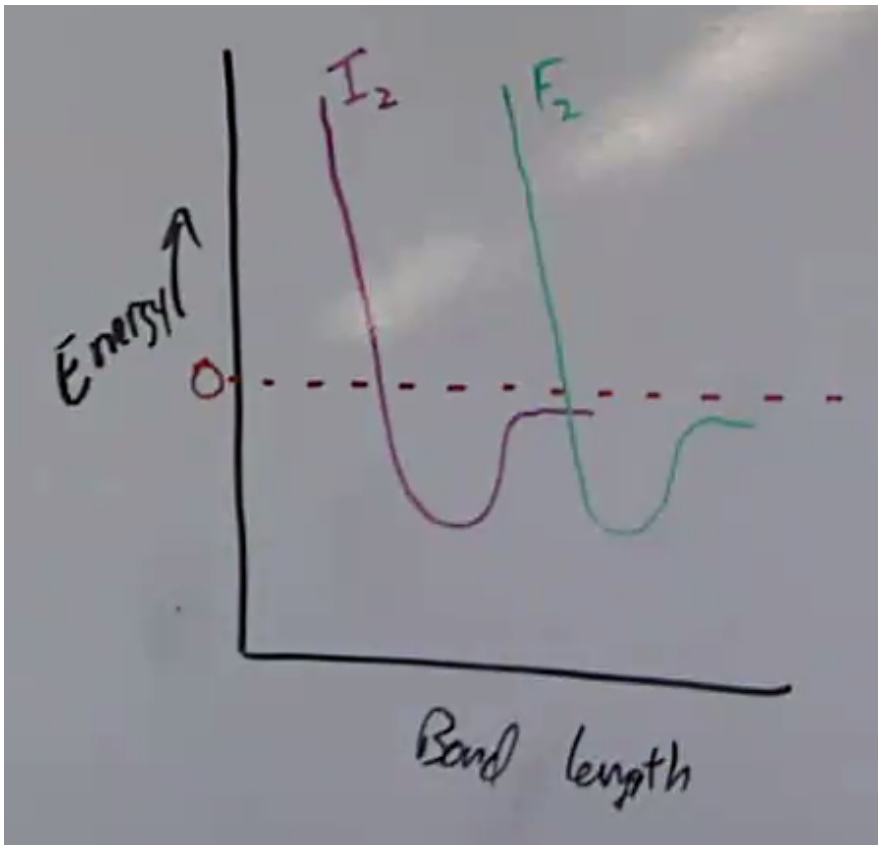
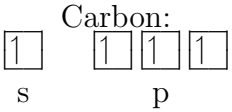


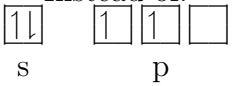
Figure 2: Incorrect Energy Required to Break I_2 and F_2 Bonds

- Hybridization of Orbitals − When an atom should be able to bond an n amount of times, but, according to the box diagram, it can not, electrons are moved around to fit the expected number of bonds. (Ex. sp^3 for C, sp^2 for B, or sp for Be)
- *Example:*

Carbon:



Instead of:



- Table for hybridization:

e^- pairs	hybrid
2	sp
3	sp^2
4	sp^3
5	sp^3d
6	sp^3d^2

- Sigma and Pi Bonds − Sigma (σ)-bond on axis, while Pi (π)-bond not on axis
- Coulomb's Law: The force between two charged particles is proportional to the magnitude of each of the two charges, and inversely proportional to the square of the distance between them (further apart, weaker force) ($\frac{kq_1q_2}{r^2}$)
- Electron Shielding − Core electrons are generally closer to the nucleus than calence electrons and are considered to "shield" the valence electrons from the full electrostatic attraction of the nucleus
- Lattice Energy − Energy of an ionic structure
- *Example:* Which has more lattice energy, $ZnCl_2$ or ZnO?

  ZnO has more lattice energy than $ZnCl_2$ because oxygen has a larger negative charge