Topics Discussed:
- Recap on Hybridization
- Molecular Orbital Theory
- Drawing Chemical Structures
- Isomers

Recap on Hybridization

Examples

1. 
   \[
   \text{H}_3\text{C} - \text{C}^\ddagger\text{O} \\
   \text{H}
   \]
   3 different directions of electron pairs, no lone pairs off of central carbon
   Sp2 hybridized

2. 
   \[
   \text{H}_3\text{C} - \text{C} = \text{N}
   \]
   2 directions of electron pairs off of central carbon
   linear molecule
   no lone electron pairs around central carbon
   Sp hybridized

3. 
   \[
   \text{H}^+ - \text{O} - \text{H}^-
   \]
   bent molecule
   2 loan pairs off of O
   4 directions of electron pairs off of O
   Sp3 hybridized
Molecular Orbital Theory (MO Theory) – describes covalent bonds using a more mathematical and quantitative approach

1. Additive combinations result in bonding molecular orbitals
2. Subtractive combinations result in antibonding molecular orbitals

In Molecular Orbital Theory, bonding electrons are not localized to atoms

**Molecular Orbital Diagrams**

Electrons go into lower energy orbitals before higher energy orbitals
Additive combinations are lower energy than subtractive combinations

**Principles of Molecular Orbital Theory**

1. Molecular Orbitals are to molecules what Atomic Orbitals are to atoms
2. Molecular Orbitals are formed by linear combinations of atomic orbitals and are always equal in number to the number of atomic orbitals on separate atoms (conservation of atomic orbitals)
3. There are 3 types of Molecular Orbitals
   a. Bonding Molecular Orbitals- lower in energy than the atomic orbitals they came from
   b. Antibonding Molecular Orbitals- higher in energy than the atomic orbitals they came from
   c. Nonbonding Molecular Orbitals- about the same amount of energy as the atomic orbitals they came from
Example $O_2$

$\cdot \overset{\cdot}{O} = \overset{\cdot}{O} \cdot$

*Bond Order* - Number of bonding pairs – number of antibonding pairs

The Bond Order of $O_2$ is 2
Drawing Chemical Structures

Structural Formulas
1. Dash Bond Formula
2. Condensed Formulas
3. Line Bond formula

Example 1 C₃H₈ Propane
1. 
   \[ \text{H} \quad \text{H} \quad \text{H} \]
   \[ \text{H} - \text{C} - \text{C} - \text{C} - \text{H} \]
   \[ \text{H} \quad \text{H} \quad \text{H} \]
2. CH₃CH₂CH₃
3.

Example 2 C₆H₁₄

Line Bond Formula

Can also be written as CH₃ CH₂ CH₂ CH₂ CH₃ or CH₃ (CH₂)₄ CH₃ using condensed formulas
Isomers—different compounds with the same chemical formula

C\textsubscript{5}H\textsubscript{12} Pentane

Constitutional isomers—differ in connectivity

C\textsubscript{6}H\textsubscript{14} hexane

Stereoisomers—different compounds with the same formula and same connectivity, but different 3D geometries.

cis

trans