

# Covalent Bonding

## Part 2

### Covalent Bonding II

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#### Covalent Bond Strength

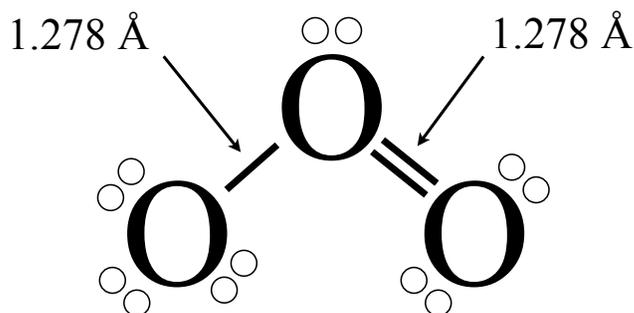
- Bond Enthalpy
  - The amount of energy needed to break a mole of gaseous molecules into their component atoms
  - Always positive values
    - Which means what?
  - Greater bond enthalpies indicate stronger bonds
    - Greater stability
- Bond Enthalpy and Bond Length
  - An inverse relationship
    - As bond enthalpy increases, bond length decreases
  - Multiple Bonds
    - Higher bond enthalpies
    - Smaller bond lengths

## Covalent Bonding II

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### Resonance Structures

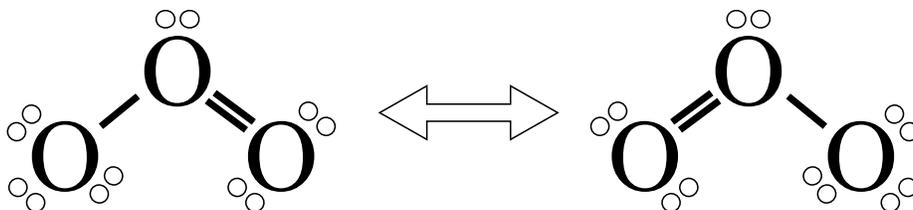
- In some instances one Lewis structure is not enough to accurately describe a molecule
- Consider ozone
  - $O_3$



## Covalent Bonding II

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### Resonance Structures



- These two structures are equivalent except for the placement of the electrons
- The Lewis structure of ozone is then the **average** of both possible structures.
  - Represented by including both confirmations and a double headed arrow
- Ozone does not oscillate between the two structures
  - It is truly an average of both structures
    - Equal bond lengths

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### Resonance Structures

- Important Terms
  - Resonance Stabilized Molecule
  - Confirmations
  - Resonance Structures
  - Delocalized Pi Bonding
- Terms to Avoid
  - $1\frac{1}{2}$  bond
  - Resonance Bonding
- Nitrate (p. 310 & 356)

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### Exceptions to the Octet Rule

- Molecules with an odd number of electrons
  - Be sure to give the more electronegative atom a full octet
- Molecules in which an atom has less than an octet
  - Many times these molecules can fulfill the octet rule by creating double bonded resonance structures
    - However, these double bonds create unfavorable formal charges
    - The structure without a full octet is more stable than the resonance structure which follows the octet rule
- Molecules in which an atoms has more than an octet
  - Only occurs for atoms in the third period and below
  - The d sublevel comes into play
  - Even elements in the 3p behave as if they have a 3d sublevel to fill
    - $\text{PCl}_5$
  - Size is also a factor
    - The larger atoms physically have more surface area around which other atoms can arrange themselves

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### Homework

- 8.55(no b) / 8.56
- 8.57 (old)
  - a) Use the concept of resonance to explain why all six C—C bonds in benzene are equal in length
  - b) Are the C—C bond lengths in benzene shorter than C—C single bonds? Are they shorter than C=C double bonds? `
- 8.57 (new)