Chapter 8

Covalent vs. Ionic Bonding

- How have we learned that atoms obtain a noble gas configuration?
- Atoms gain or lose electrons and their ions form ionic bonds
- Covalent bonds are formed when two or more atoms bond and share electrons.
  - Only involves valence electrons
  - Use Lewis dot structures to predict covalent bonding.

Covalent Bonds

- Diatomic molecules (atoms that like to exist as doubles!) – H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2

- All of these molecules are more STABLE than if they were single atoms. WHY?!

- Draw the Lewis dot structure for F

How many bonds will F form?

What is the octet rule?

Lewis Dots and Diatomics

Shared electron pair
covalently bonded pair

Unshared electron pair
Lone pair

Now fluorine has an octet and is much more stable than just F itself

Lewis structure is translated into  bonded pair is a line connecting the two atoms: SINGLE BOND

Draw the Diatomics

- Draw the Lewis dot structures for each atom and for the diatomic molecule that formed. Draw the bonded molecule.
- Cl
- H
- I

Single Bonds

- Draw the Lewis dot structures for:

  O and H
- Draw molecules formed between those atoms and H.

- Now you try when H reacts with Br, Se, and N

Draw the Structures

- Draw lewis dot structures for atoms, and for the resulting molecules
- N and Br
- O and H
- I and I
- C and H

Draw Lewis Structures

- PH_3
- CCl_4
- H_2S

All of these structures have single covalent bonds

SIGMA BONDS (σ)

Warm Up!

- Draw the complete Lewis structures for

- Hydrochloric acid
- Carbon tetrachloride
- Phosphorous tribromide
- Dihydrogen oxide

- Homework: Chapter 8 – 92-104 all Due Friday

Today's Agenda

- QOTD: How do you distinguish between single and multiple bonds and what is their structure?

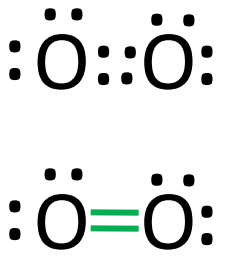
- Single (sigma) vs. multiple (pi) bonds and their properties
- Structures of sigma and pi bonds.
- Resonance structures

Multiple Bonds

- Sometimes atoms can form octets only if they form _double_ or _triple_ bonds.

- A double covalent bond forms when two pairs of electrons are shared between two atoms and complete their _octets_.

- For example O 



Multiple Bonds

- Try N_2
- Draw Lewis structure for N atom
- Connect single electrons
- Draw bonds and lone pairs

Multiple Bonds

- Single covalent bonds are called _sigma σ_ bonds.
- Multiple covalent bonds (double or triple) are called pi bonds (π).

- It's important to remember that any molecule with multiple bonds has BOTH _σ_ and _π_ bonds!!
- Something like A=A has one sigma and one pi bond.

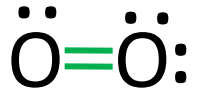
Try These

- Why do atoms form covalent bonds?

- Draw Lewis structures for the atoms and molecules of the following:

  O_2 N_2

- List the types of bonds (sigma and/or pi) in each.

So  has a sigma bond and two pi bonds and  has one sigma and one pi.

σ vs. π bonds

- Bond length
  - Single bonds – longest (furthest distance apart)
  - Double bonds – shorter (slightly closer together)
  - Triple bonds – shortest (atoms closest together)
- Bond strength
  - Shorter bond lengths, stronger bond

  Single bonds are weakest, triple bonds are strongest.

Bonds and Energy

- If the bond is strong then is takes high energy to break it!

The triple bond of N_2 is very strong and hard to break!

- Bond dissociation energy is how much energy necessary to break a particular bond. N_2 has a very high bond dissociation energy.

Endo vs. Exothermic

- If it requires more energy to break a bond than to form a new one – **endothermic**. (Requires energy (heat) to react)

- If more energy is released forming a product than is required to break bonds – **exothermic** (Releases energy (heat) when it reacts)

How To Draw the Correct Lewis Structure

1. Assume symmetry! If there are two of the same atoms, they most likely surround the central atom.
2. Determine the TOTAL number of valence electrons.
3. Determine the # of electrons needed to fill each octet. (Oxygen has 6 valence e^- and needs 2 more!)
4. Draw Lewis structures and put them together.
5. Complete the octet with extra lone pair electrons.
6. Check to make sure all octets are complete!

Practice!

Try these:

NH_3

C_2H_4

HCN

Warm Up!

- Draw Lewis structures for

CH_2F_2

Carbon dioxide

Dihydrogen dioxide

C_2H_2

How many sigma and pi bonds per molecule?

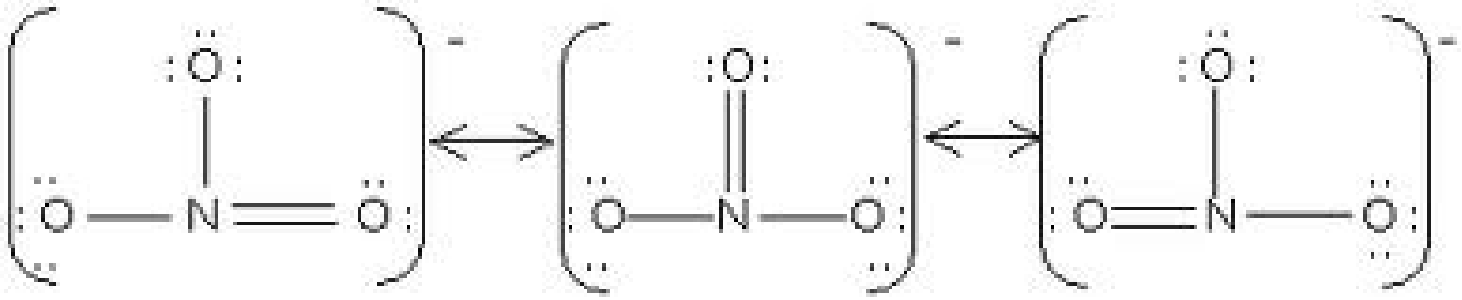
Todays Agenda

- QOTD: How do Lewis structures lead us to the molecular structure of compounds?

- Resonance and exceptions to the octet rule.
- VSEPR Theory of molecular geometry and polarity notes and practice handout.

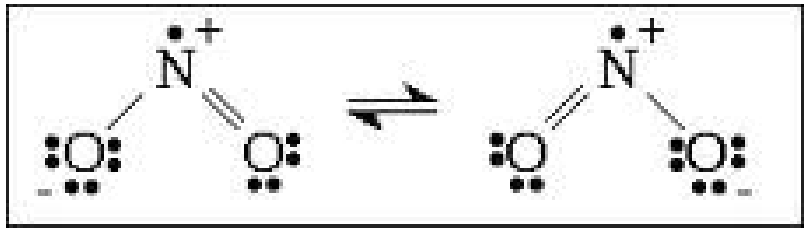
Resonance

- It is possible to work out more than 1 possible structure when a molecule has a ___double___ and ___single___ bond.
- Consider NO_3^-

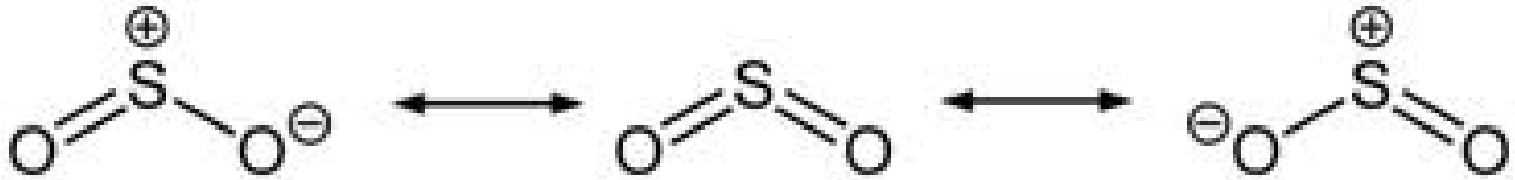


Draw Resonance Structures

- NO_2^-



- SO_2



Exceptions to the Octet Rule

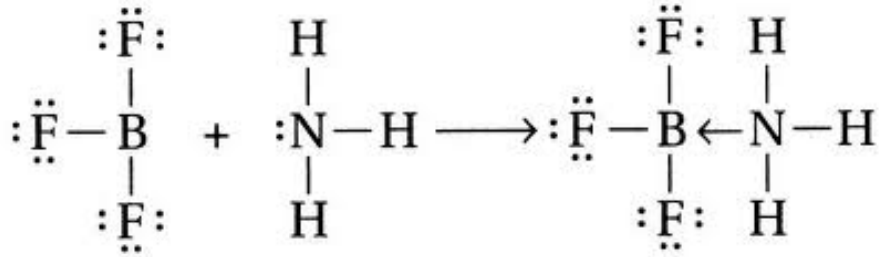
- **Suboctets!**

Boron and H don't need 8 electrons to be stable.

H only shares 2

Boron only shares 6

Coordinate covalent bonds form when one atom donates two electrons to share.

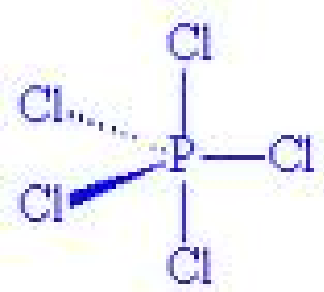


Exceptions to the Octet Rule

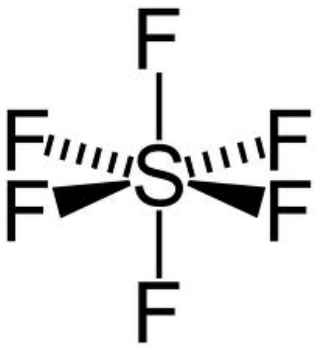
- **Expanded octets!**
- Phosphorous and sulfur can have MORE than 8 total electrons.

  P can share 10 electrons

  S can share 12 electrons

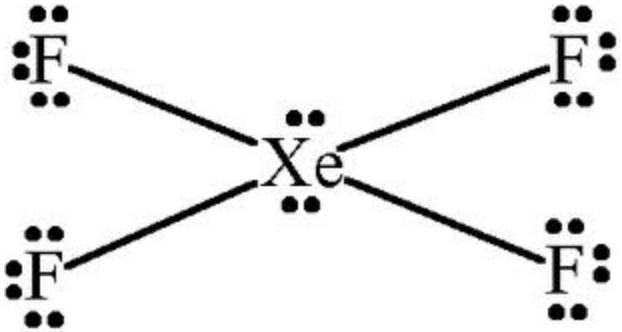


- **Odd number of valence e^-**
- Usually involving nitrogen
- NO_2 NO and ClO^-



Practice with Expanded Octets

- Draw the Lewis structure for XeF_4



- Draw Lewis structures for these molecules: sulfur hexafluoride, boron trihydride

phosphorous pentachloride, silicon tetrafluoride