



McCord

Friday, October 4

Announcements

- EXAM 2 is on Tuesday
 - Your room assignments and version numbers will be posted on Quest in the near future.
 - LM18/19 were due at noon today.
 - HW6 is due Monday at 5PM
 - Shawn's Exam 2 review session is at 5 PM on Monday (PAI 3.02)

Learning Objectives

Electron Configuration and Bonding

- Master using Lewis Structures to predict bonding in compounds
- Employ the concept of resonance
- Use formal charge to help predict the best possible Lewis Structure

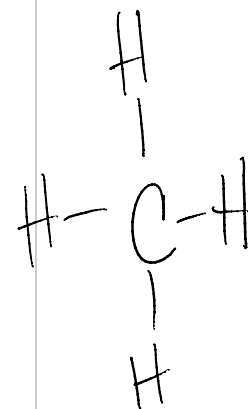
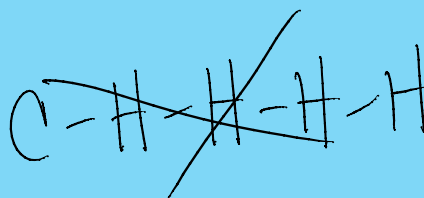
Covalent Compounds

- What is attached to what?

- Valence Electrons
- Lewis Symbols
- Lewis Structure
- Satisfy the Octet

- Examples

- H_2
- CH_4



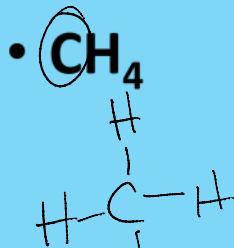
Lewis Structure Rules

- Determine total number of valence electrons
- Predict total number of bonds ($S = N - A$),
where $S/2 =$ number of bonds
- Draw skeletal structure
- Place nonbonding electrons
- Fix the number of bonds

$$\# \text{ bonds} = \frac{S}{2}$$

e^-
 $S =$ shared
 $N =$ need
 \uparrow (octet rule)
2 H, He
8 C, N, O, F
 $A =$ available
(valence)

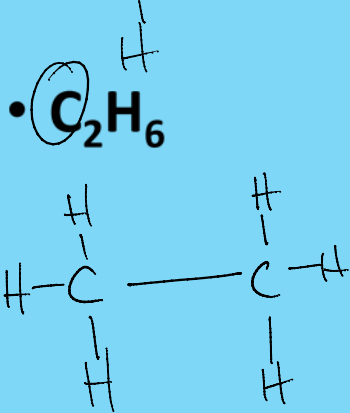
Examples



$$\begin{array}{l}
 \text{C: } \frac{N}{8 \times 1 = 8} \\
 \text{H: } \frac{2 \times 4 = 8 +}{16}
 \end{array}$$

$$\begin{array}{l}
 \text{A} \\
 \text{C: } \frac{4 \times 1 = 4}{1} \\
 \text{H: } \frac{1 \times 4 = 4 +}{8}
 \end{array}$$

$$\begin{aligned}
 S &= N - A \\
 S &= 16 - 8 = 8 \\
 \frac{8}{2} &= 4 \\
 &\times 4 \text{ bonds} \times
 \end{aligned}$$

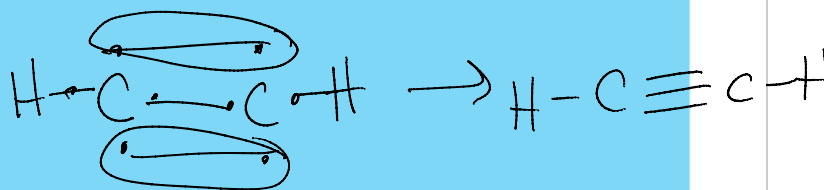
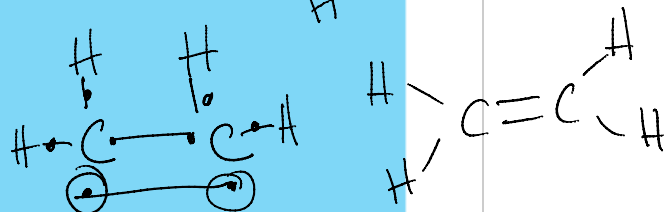
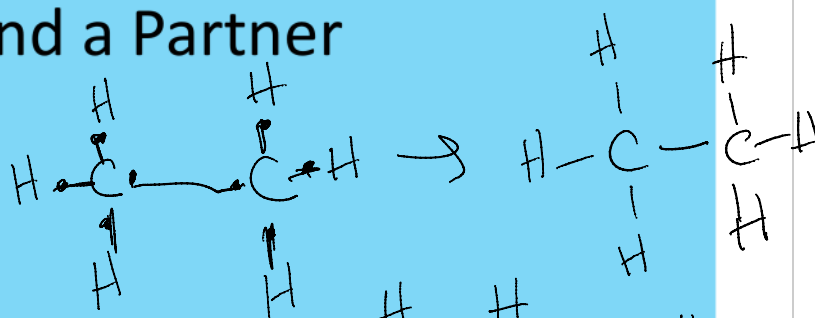
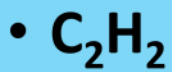
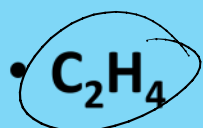


$$\begin{array}{l}
 \text{W} \\
 \text{C: } 8 \times 2 = 16 \\
 \text{H: } \frac{2 \times 6 = 12 +}{28}
 \end{array}$$

$$\begin{array}{l}
 \text{A} \\
 \text{C: } 4 \times 2 = 8 \\
 \text{H: } \frac{1 \times 6 = 6 +}{14}
 \end{array}$$

$$\begin{aligned}
 S &= 28 - 14 = 14 \\
 \frac{14}{2} &= 7 \\
 &\times 7 \text{ bonds} \times
 \end{aligned}$$

Find a Partner



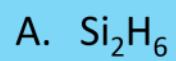
Bond Strength and Bond Length

Bond Type	Bond Strength [kJ mol ⁻¹]	Bond Length [pm]
C-C	348	154
C=C	614	134
C≡C	839	120

Strength
37271
length
17273

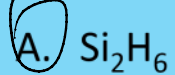
iClicker Question

- Which molecule will have the strongest silicon-silicon bond?

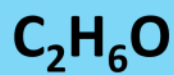


iClicker Question

- Which molecule will have the longest silicon-silicon bond?

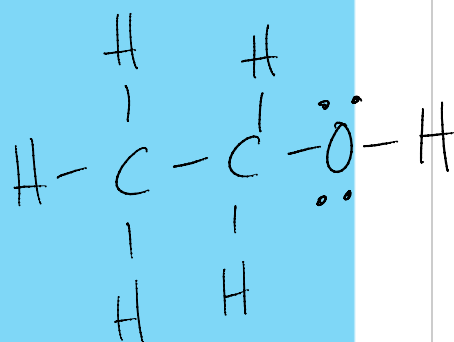
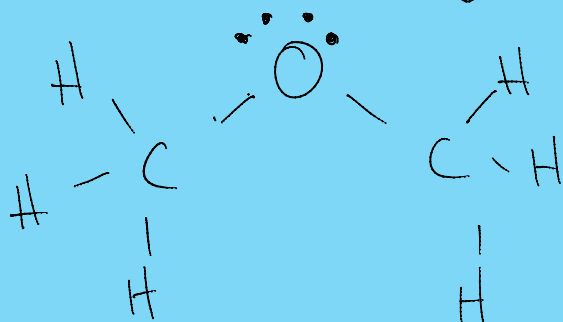


Find a DIFFERENT Partner



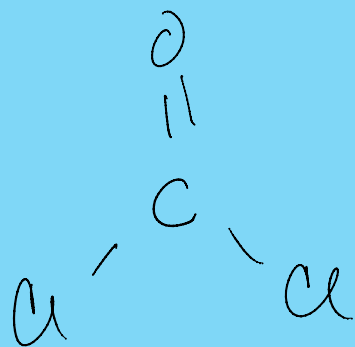
ethanol

ether

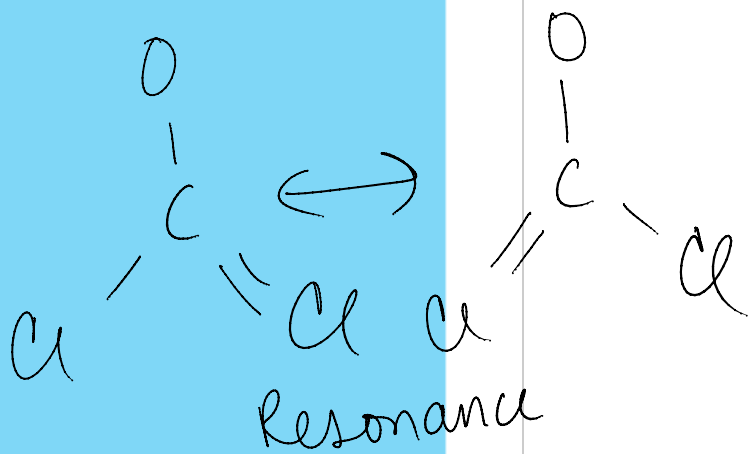


Where is the double bond?

COCl₂



COCl₂

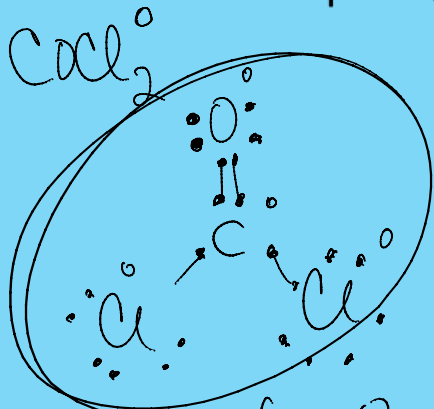


How do we evaluate our Lewis Structures?

- Formal Charge

– FC = Group # - (bonds + nonbonded e⁻)

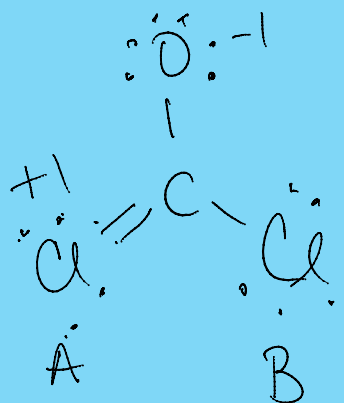
FC = want - have
 ↓ ↓
 valence bonding



O: 6 - 6 = 0

C: 4 - 4 = 0

Cl: 7 - 7 = 0 ←
 n +



O: 6 - 7 = -1

C: 4 - 4 = 0

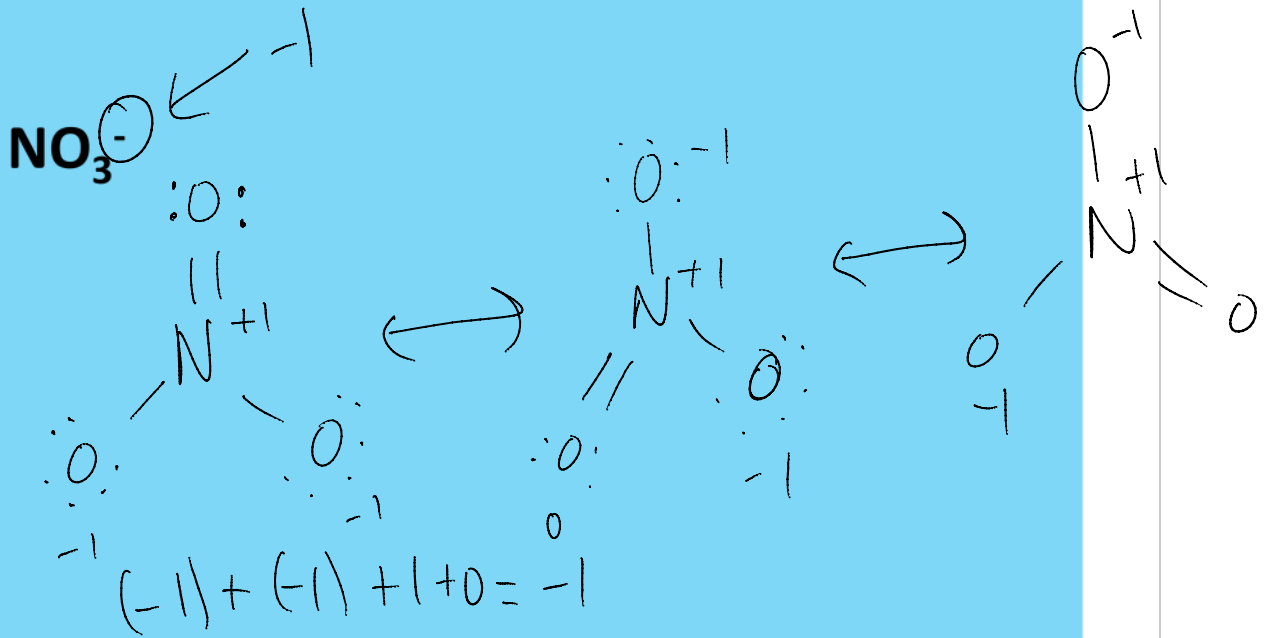
Cl_A: 7 - 6 = +1

Cl_B: 7 - 7 = 0
 +

0 = total

$0 = \text{total}$

Can a molecule have multiple **VALID** structures?



iClicker Question

An average N-O bond is 136 pm in length. An average N=O bond is 115 pm in length. Which choice describes the actual bond lengths for the nitrogen-oxygen bonds in the nitrate ion?

- A. Both nitrogen-oxygen bonds are 136 pm.
- B. Both nitrogen-oxygen bonds are 115 pm.
- C. One nitrogen-oxygen bond is 136 pm and the other is 115 pm.
- D. Both nitrogen-oxygen bonds are 125.5 pm.

Exceptions to the Octet Rule

- RnCl_2



- BeCl_2



- PCl_5

