Molecular Structures

Resonance
Bond length and strength
Formal Charge

Draw the Lewis Structure for O_3 (ozone)

Draw the structure and leave 2 lines

1) Resonance Structures:

A molecule or polyatomic ion that cannot be represented by a single Lewis Structure (there will be a double bond that can be placed on more than one identically attached atom)

***the actual molecule is a hybrid of the resonance structures**

Bond Length and Strength

	Bond Length	Bond Strength
Single bonds	longest	Weakest
Double bonds	middle	middle
Triple bonds	shortest	strongest

Note: The greater the bond energy, the shorter and stronger the bond.

Bond Energy:

	Bond energy (kJ/mol)
H—F	570
C—F	552
O—O	498
H—H	436
H—Cl	432
C—Cl	397
H—Br	366
H—I	299
C—Br	280
Cl—Cl	243
C—I	209
Br—Br	193
F—F	159
I—I	151

Don't write this down!

Practice:

C_2H_6 C_2H_4 C_2H_2

Leave 3 lines.

Which compound contains the longest C-C bond?

Leave 1 line.

Which compound contains the strongest C-C bond?

Leave 1 line.

2) Bond Energy:

Energy required to break a chemical bond and form neutral isolated atoms (reported in kJ/mol)

FIGURE 2.5

BOND LENGTHS AND BOND ENERGIES FOR SELECTED COVALENT BO

Don't write the table!

Bond	Average bond length (pm)	Average bond energy (kJ/mol)	Bond	Average bond length (pm)	A energy (kJ/mol)
H—H	75	436	C—C	154	346
F—F	142	159	C—N	147	305
Cl—Cl	199	243	C—O	143	358
Br—Br	229	193	C—H	109	418
I—I	266	151	C—Cl	177	327
H—F	92	569	C—Br	194	285
H—Cl	127	432	N—N	145	163
H—Br	141	366	N—H	101	386
H—I	161	299	O—H	96	459

Use the bond energy table to calculate the energy needed to break all covalent bonds in CH_4.

Leave 4-5 lines.

Use the bond energy table to calculate the energy needed to break all covalent bonds in CH_2O.

Leave 4-5 lines.

3) Formal Charge (FC):

- **A method used to determine the most likely possible Lewis structure**
- **The charge an atom would have if all the atoms in a molecule had the same electronegativity**

Steps for FC:

1. **Draw a possible Lewis structure.**
2. **Calculate the FC for each unique atom, where**

$$FC = (\#\ valence\ electrons) - dashes - dots$$

3. **Total the FC for all unique atoms.**
4. **Calculate the ΔFC for the structure.**

$$\Delta FC = FC_{max} - FC_{min}$$

5. **Do steps #1-4 for all possible structures. The Lewis structure with the ΔFC closest to zero will be preferred.**

6. When two Lewis structures have the same *ΔFC*, choose the one that has the <u>more negative charge on the most electronegative element.</u>

Draw 3 possible Lewis structures for SCN^- (make sure you put C in the center)

Draw the structures and we will finish the FC in class!