Drawing Lewis Structures and Correlating with Bond Orders, Bond Lengths, and Bond Energies

Complete the Lewis structures for the compounds shown in the following table and answer questions on the other side.

Molecule	Lewis Structure	Bond of Interest	Bond Order	Bond Length	Bond Energy (kJ/mol)
H_2		H-H			436
Cl_2		Cl-Cl			243
H_2O		O-H			464
H_3CCH_3		C-C			346
H_2CCH_2		C-C			615
HCCH		C-C			835
CO_2		C-O			804
H_2CO		C-O			799
N_2		N-N			945
O_2		O-O			498

Bond order is equal to the number of shared pairs of electrons making up a particular bond. A single bond between two carbon atoms, for example, involves the sharing of a single pair of electrons between the atoms, giving a bond order of 1. When two electron pairs are shared we have a double bond, or a bond order of 2. A triple bond, of course, involves the sharing of three pairs of electrons and a bond order of 3. What is the bond order for the bond of interest in each Lewis structure?

What correlation, if any, do you find between bond order and bond strength. Briefly summarize your reasoning.

Bond lengths for single bonds can be estimated using covalent radii. Using the data in Figure 3.26 on page 100 of your text (given in nm), estimate the bond length for the bond of interest in each of your Lewis structures. For double bonds, use the following values: C-C double bond, 0.133 nm; C-C triple bond, 0.120, C-O double bond, 0.120, C-O triple bond, 0.113, O-O double bond, 0.121, and N-N triple bond, 0.116.

The bond energy for Cl_2 is given on the other side of this page. The bond energy for the Br-Br bond in Br_2 is 224 kJ/mol and that for the I-I bond in I_2 is 151 kJ/mol. What correlation, if any, do you find between bond length and bond strength. Briefly summarize your reasoning.

Which do you think is more important when it comes to predicting a bond's energy – the bond order of the bond length? Briefly explain.

Draw a Lewis structure for methanol, H_3COH, and predict whether it will take more energy to break the C-O bond in methanol or that in formaldehyde, H_2CO (see table on other side).