

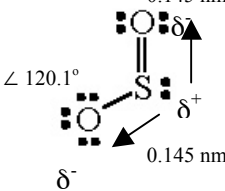
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Worksheet: The Structure of Molecules I

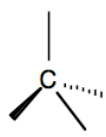
Molecular models consist of colored spheres (atoms) that are connected and correspond to various common geometries and connections that link them together. The connections come in longer and shorter lengths that represent longer and shorter bonds.

SEE: <http://chemconnections.org/general/chem120/VSEPR/>

1. Complete the following table with Lewis structures for the respective compounds: **1A.** CO₂, **1B.** SO₃, **1C.** H₂O, **2A.** NH₃, **2B.** CCl₂F₂, **2C.** N₂O, **3A.** IF₅, **3B.** O₃, **3C.** BF₃, **4A.** SO₂, **4B.** SF₆, **4C.** PF₃Cl₂. B) View the molecule by clicking on the link below and accurately describe the shape of the molecule, [The images must be manipulated in order to get an accurate view of the molecules.] For example, **4A: SO₂, bent shape**

	A	B	C
1			
2			
3			
4	<p>SO₂, S=6e⁻, O=6e⁻, SO₂=18e⁻, bent shape, polar 0.145 nm</p> 		

2. A). Find H₂O, CCl₂F₂, CO₂, BF₃, and NH₃ in the completed table. Using jmol, examine the on-line molecules; determine the bond lengths and bond angles of each molecule. Enter them in the table below. Draw each of the molecules in 3-d. Consider the electronegativities of the bonded atoms. Indicate which bonded atoms are relatively more electronegative and which are more electropositive using δ^- and δ^+ to represent the respective partial charges. Use an arrow to represent the dipole vector for each bond. Indicate if the molecule is polar or non-polar. Rank the molecules: 1 to 5, from the lowest dipole moment, which equals 0 D, to the highest, which equals 1.85 D.

	<i>3-d Structure</i>	<i>Bond length(s) nm</i>	<i>Bond angle(s) \angle°</i>	<i>Polar or Non-polar</i>	<i>Dipole Moment Rank</i>
H ₂ O					
CCl ₂ F ₂		C-Cl C-F	C-Cl C-F		
CO ₂					
BF ₃					
NH ₃					

The Structure of Molecules

3. In sulfur dioxide the bond lengths for each of the S-O bonds is the same, 0.145 nm, Explain how this difference can be reconciled. Show resonance structures that illustrate your explanation.
4. In sulfur trioxide the bond lengths for each of the S-O bonds are the same, 0.157 nm. Briefly explain the difference between the longer bond length in sulfur trioxide versus sulfur dioxide, and also why sulfur trioxide is non-polar but sulfur dioxide is polar.