

Molecular Geometry Worksheet

As you work through the steps in the lab procedures, record your experimental values and the results on this worksheet.

Table A: Exploring Simple Structures

| Molecules | Bond Lengths (\AA) | Bond Orders | Bond Angles ($^\circ$) | Hybridization on Central Atom | Molecular Shape |
|-----------------------|-------------------------------|--------------------------|--------------------------|-------------------------------|-----------------|
| N_2O | NN: NO: | NN: NO: | | | |
| SO_2 | SO: SO: | SO: SO: | | | |
| CH_2O | CO: CH: CH: | CO: CH: CH: | | | |
| H_2O | OH: OH: | OH: OH: | | | |
| NH_3 | NH: NH: NH: | NH: NH: NH: | | | |
| CH_4 | CH: CH: CH: CH: | CH: CH: CH: CH: | | | |

Question A1: For each of the six molecules, how did your Lewis structures compare to the molecular models and the models on the computer? Were they the same or different? Explain.

Question A2: For each of the six molecules, was your Lewis structure a good and accurate representation of the molecule's actual shape? Explain why or why not.

Question A3: Did the model set and computer models help you identify the molecular shape better than the Lewis structures? Do you think models are helpful with 3D visualization?

Question A4: Did you have any other interesting observations? Please elaborate.

Table B: Bond Order vs Bond Length

| Molecules | Bond Lengths (\AA) | Bond Orders | Hybridization on Carbons |
|------------------------|----------------------------------|-------------|-----------------------------|
| C_2H_6 | CC: | CC: | |
| C_2H_4 | CC: | CC: | |
| C_2H_2 | CC: | CC: | |

Question B1: What conclusions can you draw about bond order and bond length?

Question B2: Looking back at your data in Part A, are all single bonds the same length? Based on these observations, can you make a generalization about the length of all single bonds compared to double bonds or all double bonds compared to triple bonds? What general rule can you make?

Question B3: Did you have any other interesting observations? Please elaborate.

Table C: Resonance Structures

| Molecules | Bond Lengths Lengths (\AA) | Bond Orders | Bond Angles ($^\circ$) | Hybridization |
|------------------------|--|--|-----------------------------|---------------|
| C_6H_6 | CC: CC: CC: CC: CC: CC: | CC: CC: CC: CC: CC: CC: | CCC: | C's: |
| CO_3^{2-} | CO: CO: CO: | CO: CO: CO: | OCO: | C: |
| SCN^{1-} | CS: CN: | CS: CN: | SCN: | C: |

Question C1: Which of the three molecules had resonance structures that were equal? Which did not? Explain.

Question C2: How can you confirm that the resonance structures are equal for a molecule? Explain.

Question C3: If there was a molecule with unequal resonance structures, which structure is the best according to the computer modeling? Can you tell which structure the computer is displaying? How? Do your observations agree with what you have learned about formal charge?

Question C4: Did you have any other interesting observations? Please elaborate.