

Purpose:

- 1) To relate the shapes and bond angles of chemical species to the number of bonded and unbonded electron-pairs in the valence level of the central atom in the species.
- 2) To relate the polarity of molecules to the shape and symmetry of the species.
- 3) To calculate the Bond Energies of the species.

Materials: molecular modeling set

Procedure: Using the model kits provided, the above mentioned sections of your text book and your notes from the previous lecture, build each model listed in the table on the reverse side of this worksheet, draw the structure on a separate piece of paper, and complete the table. When finished with building the models and completing the table, answer the questions below.

Background Information:

- 1 ~ Molecular Shape Models from your textbook
- 2 ~ A table of Bond Dissociation Energies from your text book
- 3 ~ VSEPR arrangements:

No. of VSEPR's	Expected Orbital Angles	Expected Shapes	Modifications
2	180	Linear	-----
3	120	Trigonal planar	Bent
4	109.5	Tetrahedral	Trig. Planar (107°) or Bent (105°)

Questions: These questions are to be answered on a separate piece of paper after building the models and completing the table.

- 1) Why is a molecule of BF_3 nonpolar-planar whereas a molecule of NH_3 is trigonal pyramidal?
- 2) Why is a molecule of CO_2 linear whereas a molecule of H_2O is bent?
- 3) Explain why a molecule of CO_2 has polar bonds, and yet there is no net dipole on the carbon dioxide molecule (whereas a combination of Carbon & Oxygen would produce a dipole molecule).
- 4) What effect does the shape and polarity of a molecule have on the physical properties of the substance?
- 5) Define the terms: intermolecular attraction, van der Waals forces, dispersion forces, dipole interactions, and hydrogen bonds. How does the molecular shape affect these interactions between molecules (use these terms in your answer)?
- 6) Rank the 4 types of intermolecular attractions from question 5 in order of weakest to strongest (replace Van der Waals with Ionic).
- 7) What are some commonalities between NH_3 , H_2O , and HF ?
- 8) List the following molecules in order of increasing boiling point: CH_4 , NH_3 , H_2O , CF_4 .

Formula	Lewis Dot Structure	Number of Valence Electron-Pairs on the Central Atom	Number of Atoms Bonded to the Central Atom	Number of Lone Electron-Pairs on the Central Atom	Bond Angle	Shape	Polar or Nonpolar	Type of Intermolecular Attraction	Bond Dissociation Energy
CH ₄									
NH ₃									
H ₂ O									
CCl ₄									
BF ₃									
CO ₂									
H ₂ CO									
CH ₃ CH ₃									
CH ₂ CH ₂									
CHCH									
HCN									
<i>Hints ~</i>		<i># of sticks</i>	<i># of atoms</i>	<i>Nonbonding pairs</i>	----	----	----	----	<i>If not on sheet, look in textbook.</i>