

PERIODIC TABLE TRENDS WITH HYPERCHEM LITE

LAB MOD3.COMP

From Gannon University SIM

INTRODUCTION

The Periodic Table is an arrangement of the elements in order of their atomic numbers so that elements with similar properties fall in the same column. The elements are grouped in the Periodic Table according to both their physical and chemical properties and their electron configurations.

The electron cloud surrounding the nucleus of the atom determines the size of the atom. Since this distance is somewhat fuzzy, the atomic radius of an atom is one-half the distance between the nuclei of identical atoms joined in a molecule. A chemical bond is a link between atoms resulting from the mutual attraction of their nuclei for electrons. A chemical bond or bond length is the distance from the nucleus of one atom to the nucleus of the other bonded atom and is usually measured in Angstroms. An **Angstrom unit, Å**, is 10^{-10} m or 10^{-8} cm.

There is a gradual decrease in atomic radii across the periods (columns) of the Periodic Table. This results from the increasing positive charge of the nuclei of the atoms. As electrons add to s and p sublevels in the same main-energy level, they are gradually pulled closer to the more highly charged nucleus.

The atomic radii on the main-group elements generally increase moving down a group (column). In the atoms of each element in the group, the outer electrons occupy s sublevels in successively higher main energy levels and are therefore farther from the nucleus.

PURPOSE

The purpose of this experiment is to learn to measure bond length and to examine Periodic Table trends in bond length within the periods and groups, using the HyperChem Lite computer software program.

EQUIPMENT/MATERIALS

Laptop computer with HyperChem Lite installed
Wireless Printer and Paper

HyperChem Lite CD
Ball and stick model kit

SAFETY

- Keep goggles on hand for use when dealing with glass, chemicals and/or fire.



PROCEDURE




The HyperChem Lite Window

1. To start HyperChem Lite, put cursor in the HyperChem Lite Icon, then double click on left mouse. The HyperChem Lite window will open the following list of features:
 - a. Menu Bar: contains the different HyperChem Lite menus which include: File, Edit, Build, Display, Set-up, Compute, Cancel and Help.
 - b. Tool Bar: the left side of the screen contains the tools to draw, select, display and move atoms and molecules.
 - c. Workspace: displays current atoms or molecules.
 - d. Status Line: show a brief description of menu item selected and information about drawing.
 - e. Title Bar: shows name of file working on.
 - f. Control Menu Button: contains commands to move, resize, maximize, and close HyperChem Lite windows. It also contains the switch command, which lets you activate other windows.



Measuring Bond Length:

Halogen: Group 17- Non-metals



1. *Left-double click* on the draw icon (). The element table dialog box will appear. *Left-double click* on Fluorine (F) in the periodic table.
2. *Left click* in the workspace. A Fluorine atom will appear.
3. *Left click* Build. *Left click* on Add Hydrogen. An HF molecule will appear. *Left click* on Display. *Left click* on Renderings. Select balls and cylinders, shaded and highlighted. *Left click* OK. F2 will alternate between stick and balls and cylinders rendering.
4. Under Setup, *left click* on molecular mechanics. (This step is only necessary for building the first model in the program.)
5. Select Compute, *left click* on Geometry Optimization. Select Polak-Ribiere. *Left click* OK. HF molecule model is now complete and geometrically correct.
6. Measure the bond length. *Left click* on Selection Tool (). *Left click* on Fluorine and drag cursor to Hydrogen. The bond length will appear on the lower left below the workspace.
7. Record bond length in Angstroms for the H-F bond on Data Sheet.

8. Clear HF molecule by *left clicking* in an open area of the workspace. All the atoms will turn green. Select Edit and *left click* on clear. Select yes to remove the previous molecule.
9. *Left-double click* on drawing icon () . *Left-double click* in Chlorine (Cl); repeat steps 3-6 as above. Record bond length. Clear molecule.
10. *Left-double click* on drawing icon () . *Left-double click* in Bromine (Br); repeat steps 3-6 as above. Record bond length. Clear molecule.
11. *Left-double click* on drawing icon () . *Left-double click* in Iodine (I); repeat steps 3-6 as above. Record bond length. Clear molecule.

Group 16- Non-metals

1. *Left-double click* on drawing icon () . *Left-double click* in Oxygen (O); repeat steps 3-6 from the Halogens section. Record bond length. Clear molecule.
2. *Left-double click* on drawing icon () . *Left-double click* in Sulfur (S); repeat steps 3-6 from the Halogens section. Record bond length. Clear molecule.

Groups 14 and 15- Non-metals

1. L-double click on drawing icon () . Left double click in Nitrogen (N); repeat steps 3-6 as above. Record bond length. Clear molecule.
2. L-double click on drawing icon () . Left double click in Carbon (C); repeat steps 3-6 as above. Record bond length. Clear molecule.

DATA SHEET

Name _____

Name _____

Period _____ Class _____

Date _____

PERIODIC TRENDS WITH HYPERCHEM LITE

A. Bond distance for Halogens to Hydrogen:

H - F _____ Å

H - Cl _____ Å

H - Br _____ Å

H - I _____ Å

B. Bond distance for group 16 to hydrogen.

H-O-H _____ Å

H-S-H _____ Å

C. Bond distance for groups 15 and 14 to hydrogen.

H-N-H _____ Å
|
H

H
|
H-C-H _____ Å
|
H

D. From your data, what is the trend on bond length as you go across the periodic table? What is the trend on bond length as you go down the group in the periodic table? Explain