Atomic Radius Lab

Name_____ Hr___

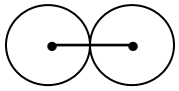
Purpose:

Determine the trend in atomic radius of atoms based on their locations in the periodic table.

Background:

The nucleus of an atom occupies a very small fraction of the atomic volume. The rest of the space is filled by the electrons traveling in the orbitals or electron "clouds". Just as it is difficult to determine the edge of a cloud, it is difficult to know when an atom "ends". The outer limit is fuzzy and variable.

Chemists have developed a method to determine the size of atomic radius. Using techniques such as X-ray diffraction and electron microscopy, chemists measure the distance between the nuclei of two adjoining atoms. Then they divide the distance in half and call it the radius of the atom. Consider that the location of the nucleus of an atom is stable. However, the edges of orbitals are "fuzzy" and can change according to conditions.



5.30 angstroms
(530 picometers)

Determine the radius of the atom on the left: _____

Hypothesis:

a) How will the size of the atoms change moving down a column/group of the periodic table? Why?

b) How will the size of the atoms change moving across a period of the periodic table? Why?

Procedure:

Using the clay provided by your teacher, create a sphere to represent an atom of the periodic table. You will be assigned an element that you will produce to appropriate dimensions. Atomic radii are often given in angstroms (10^{-10} meters). You will make your sphere in centimeters. *Remember, the diameter of a sphere is double the radius!*

Atomic # & Symbol	Atomic Radius (Å)	Atomic # & Symbol	Atomic Radius (Å)	Atomic # & Symbol	Atomic Radius (Å)
1 H	0.37	12 Mg	1.60	33 As	1.20
2 He	0.31	13 Al	1.43	34 Se	1.19
3 Li	1.52	14 Si	1.18	35 Br	1.14
4 Be	1.12	15 P	1.10	36 Kr	1.12
5 B	0.85	16 S	1.03	37 Rb	2.48
6 C	0.77	17 Cl	1.00	38 Sr	2.15
7 N	0.75	18 Ar	0.98	52 Te	1.42
8 O	0.73	19 K	2.27	53 I	1.33
9 F	0.72	20 Ca	1.97	54 Xe	1.31
10 Ne	0.71	31 Ga	1.35	87 Fr	2.70
11 Na	1.86	32 Ge	1.22	88 Ra	2.20

Analysis and Conclusion:

If you were absent on the day we created the clay atomic models, see Figure 3.2 on p. 143 of the textbook, in order to answer the #2-5:

1. Explain in your own words how chemists determine the atomic radius of an atom.

2. What trend in atomic radius do you notice going down a family of the periodic table?

3. What explanation can you give, in terms of energy levels, for the trend in question #2?

4. What trend in atomic radius do you notice moving across a period of the periodic table?

5. What explanation can you give, in terms of an energy level, for the trend in question #4?

6. Graph the relationship between atomic radius and atomic number for the **first 20 elements of the periodic table only** (see the data on the front page). Plot the atomic number on the x-axis and the atomic radius on the y-axis. A complete graph will include:

□ dots for each point	□ a smooth curve to connect the points	□ use of whole page
□ equal increments	□ axis labels	□ units
□ a descriptive title	□ labels for alkali metals and noble gases	

7. Describe the relationship you observe on your graph. Discuss the data that you plotted.

8. Use your graph and the relationship you described in #7 to analyze the following elements. Provide a brief explanation for each of your choices.

a) Li, O, C, F (circle smallest atom)

b) Be, Ca, Sr, Ba (circle largest atom)

c) Al, Si, Ga (circle largest atom)

d) Cs, Ba, Fr, Ra (circle smallest atom)