HPS Graphing Periodic Trends Lab

**NAME___________________________per____

**DIRECTIONS:** Print out this lab and attach your graphs to the back of it.

**PURPOSE:** To determine how certain properties are periodic when the elements are arranged in periods or groups.

**MATERIALS:** HPS web page, graph paper.

**DISCUSSION:** There are many periodic trends that occur as you cross a period or go down a family on the Periodic Table. For example, as you go across a period the elements generally increase in atomic mass and become less metallic. As you go down a family (group) both the atomic mass and atomic number increase. When graphing this data use the rules of graphing in the Graphing Scientific Data program.

**REFERENCE:**

- **Angstrom** - A unit of distance equal to one ten-billionth of a meter (1 x 10e-10 meter).
- **Atomic Radius** - The distance from the center of the nucleus to the valence electron energy level.
- **Ionization energy** - the energy required to remove an electron from an atom.
- **Valence electrons** - the electrons that occupy the outside energy level in an atom.

**DATA:**

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic Number</th>
<th>Atomic Radius (Angstroms)</th>
<th>Ionization Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>1</td>
<td>0.79</td>
<td>314</td>
</tr>
<tr>
<td>He</td>
<td>2</td>
<td>0.49</td>
<td>567</td>
</tr>
<tr>
<td>Li</td>
<td>3</td>
<td>2.05</td>
<td>124</td>
</tr>
<tr>
<td>Be</td>
<td>4</td>
<td>1.4</td>
<td>215</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>1.17</td>
<td>191</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>0.91</td>
<td>260</td>
</tr>
<tr>
<td>N</td>
<td>7</td>
<td>0.75</td>
<td>335</td>
</tr>
<tr>
<td>O</td>
<td>8</td>
<td>0.65</td>
<td>314</td>
</tr>
<tr>
<td>F</td>
<td>9</td>
<td>0.57</td>
<td>402</td>
</tr>
<tr>
<td>Ne</td>
<td>10</td>
<td>0.51</td>
<td>497</td>
</tr>
<tr>
<td>Na</td>
<td>11</td>
<td>2.23</td>
<td>119</td>
</tr>
<tr>
<td>Mg</td>
<td>12</td>
<td>1.72</td>
<td>176</td>
</tr>
<tr>
<td>Al</td>
<td>13</td>
<td>1.82</td>
<td>138</td>
</tr>
<tr>
<td>Si</td>
<td>14</td>
<td>1.46</td>
<td>188</td>
</tr>
<tr>
<td>P</td>
<td>15</td>
<td>1.23</td>
<td>242</td>
</tr>
<tr>
<td>S</td>
<td>16</td>
<td>1.09</td>
<td>239</td>
</tr>
<tr>
<td>Cl</td>
<td>17</td>
<td>0.97</td>
<td>299</td>
</tr>
<tr>
<td>Ar</td>
<td>18</td>
<td>0.88</td>
<td>363</td>
</tr>
</tbody>
</table>

Using the data above, make a line graph the following data. **Draw a dark vertical line to separate the 3**
1. Atomic Radius (y) vs. Atomic Number (x) for the first 3 periods (18 elements).*
2. Ionization energy (y) vs. Atomic Number (x) for the first 3 periods (18 elements).*
3. Valence electrons (y) vs. Atomic Number (x) for the first 3 periods (18 elements).*

*Important: Label each point with the chemical symbol and draw vertical lines on your graph paper to show periods 1, 2 and 3.

Properties of the Alkali Metals & Halogens

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic Radius (Angstroms)</th>
<th>Ionization Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkali Metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Li</td>
<td>2.05</td>
<td>124</td>
</tr>
<tr>
<td>Na</td>
<td>2.23</td>
<td>119</td>
</tr>
<tr>
<td>K</td>
<td>2.77</td>
<td>100</td>
</tr>
<tr>
<td>Rb</td>
<td>2.98</td>
<td>96</td>
</tr>
<tr>
<td>Cs</td>
<td>3.34</td>
<td>90</td>
</tr>
<tr>
<td>Halogens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>0.57</td>
<td>402</td>
</tr>
<tr>
<td>Cl</td>
<td>0.97</td>
<td>299</td>
</tr>
<tr>
<td>Br</td>
<td>1.12</td>
<td>272</td>
</tr>
<tr>
<td>I</td>
<td>1.32</td>
<td>241</td>
</tr>
<tr>
<td>At</td>
<td>1.43</td>
<td>?</td>
</tr>
</tbody>
</table>

Fr & At are extremely rare - they exist only in trace amounts.

Using the data above, graph (line graph) the following data. Use element symbols on x-axis instead of atomic number. Connect your points since the data is extremely accurate.
1. Atomic Radius(y) vs. Alkali Metals(x) arranged in increasing atomic number.*
2. Ionization Energy (y) vs. Alkali Metals(x).
3. Atomic Radius(y) vs. Halogens(x).
4. Ionization Energy (y) vs. Halogens(x).

*Don't plot points for elements with questions marks. Maximum of 2 graphs per page.

Now that you have your data graphed, answer the conclusion questions on the next sheet.
Use your graphs to answer these Conclusion questions:

Circle the correct answer then explain why it is correct.

1. Radii of the atoms [increase, decrease] as you go across (L to R) a period? Explain why:

___________________________________________________________________________________

2. Radii of the atoms [increase, decrease] as you go down a family? Explain why.

___________________________________________________________________________________

3. The energy needed to remove an electron from an atom generally [increases, decreases] as you go across a period? Explain why this occurs.

___________________________________________________________________________________

4. What is the relationship between ionization energy and members of:

a. The Alkali Metals:______________________________________________________________

b. The Halogens:_______________________________________________________________

5. Circle the atom with the largest atomic radius (size) in each group:

a. aluminum, sulfur, phosphorus b. arsenic, bismuth, nitrogen

c. iron, lithium, silicon d. barium, beryllium, bromine

6. Circle the atom that would require the LEAST amount of energy to remove an e-

a. magnesium, chlorine, silicon b. lithium, cesium, potassium

c. fluorine, iodine, chlorine d. calcium, bromine, cobalt

7. Circle the atom that would require the MOST amount of energy to remove an e-

a. lithium, potassium, rubidium b. sodium, chlorine, silicon

c. polonium, oxygen, sulfur d. fluorine, iodine, chlorine

--------------Circle the correct answer(s) in the brackets below.--------------

8. Going across a period from left to right: The [ p+, N0, e- ] in the nucleus increase, thus pulling the [ p+, N0, e- ] closer towards the center of the atom and [ increasing, decreasing ] the atomic radii. Because of this increase in [ electromagnetic, strong ] force atoms tend to [ gain, lose] electrons as you go across the periodic table.

9. Going down a metallic family: The number of [p+ N0 e-] energy levels increases by one, making the atomic radius [larger, smaller]. Because the electrons are farther from the nucleus they tend to be [gained, lost] more easily. Therefore metals tend to be [ more, less ] chemically active as you go down a family.