**Graphing Periodic Trends**

The Periodic Table is arranged according to Periodic Law. The Periodic Law states that when elements are arranged in order of increasing atomic number, their physical and chemical properties show a periodic pattern. These patterns can be discovered by examining the changes in properties of elements on the Periodic Table. The properties that will be examined in this lesson are: atomic size, electronegativity, and ionization energy.

**Procedure**

1. Use excel (office 365) or a similar program to create 3 graphs (scatterplot – straight link connections between data points). Give the graph an appropriate title and label the axes (the x-axis is ‘atomic number’ for all graphs).

2. Cut and paste the graphs onto a word document so that their x-axes are in line.

3. Label/high-light the data points with the symbol of each alkali metal, halogen and noble gas.

4. Use your graphs to complete the analysis questions (**type your response in a different colour!).** below. Post your completed assignment to your edublog (2 students may post identical assignments) **using the tag:** **mstilsnerchem11coop**

1. **Data Table** X Y1 Y2 Y3

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Element Symbol** | **Atomic #** | **Atomic Radius (pm)** | **1st Ionization Energy (kJ/mol)** | **Electronegativity \*(Pauling Scale)** |
| H | 1 | 53 | 1311 | 2.20 |
| He | 2 | 31 | 2371 |  0 |
| Li | 3 | 167 | 520 | 0.98 |
| Be | 4 | 112 | 899 | 1.57 |
| B | 5 | 87 | 800 | 2.04 |
| C | 6 | 67 | 1086 | 2.55 |
| N | 7 | 56 | 1402 | 3.04 |
| O | 8 | 48 | 1313 | 3.44 |
| F | 9 | 42 | 1680 | 3.98 |
| Ne | 10 | 36 | 2080 |  0 |
| Na | 11 | 190 | 496 | 0.93 |
| Mg | 12 | 145 | 737 | 1.31 |
| Al | 13 | 118 | 577 | 1.61 |
| Si | 14 | 111 | 786 | 1.90 |
| P | 15 | 98 | 1011 | 2.19 |
| S | 16 | 88 | 999 | 2.58 |
| Cl | 17 | 79 | 1251 | 3.16 |
| Ar | 18 | 71 | 1520 |  0 |
| K | 19 | 243 | 419 | 0.82 |
| Ca | 20 | 194 | 590 | 1.00 |
| Sc | 21 | 184 | 633 | 1.36 |
| Ti | 22 | 176 | 659 | 1.54 |
| V | 23 | 171 | 651 | 1.63 |
| Cr | 24 | 166 | 653 | 1.66 |
| Mn | 25 | 161 | 717 | 1.55 |
| Fe | 26 | 156 | 762 | 1.83 |
| Co | 27 | 152 | 760 | 1.88 |
| Ni | 28 | 149 | 737 | 1.91 |
| Cu | 29 | 145 | 745 | 1.90 |
| Zn | 30 | 142 | 906 | 1.65 |
| Ga | 31 | 136 | 579 | 1.81 |
| Ge | 32 | 125 | 762 | 2.01 |
| As | 33 | 114 | 944 | 2.18 |
| Se | 34 | 103 | 941 | 2.55 |
| Br | 35 | 94 | 1139 | 2.96 |
| Kr | 36 | 88 | 1350 | 0 |

**ANALYSIS QUESTIONS:** use the periodic table below to summarize the following trends.

1. Based on your graphs, what is the ***trend*** in atomic radius across a period? Down a family?

The atomic radius is getting bigger down a family and is getting smaller across a period.

1. Based on your graphs, what is the ***trend*** in ionization energy across a period? Down a family?

The ionizing energy is getting smaller down a family and getting bigger across a period

1. Based on your graphs, what is the ***trend*** in electronegativity across a period? Down a family?

The electronegativity is getting smaller down a family and bigger across a period.

4a) What is happening to the number of protons and the number of energy levels as you move across the periodic table from left to right? How and why does this affect atomic radius.

The number of protons increase and the energy levels spike. This causes the atomic radius to spike.

b) What happens to the number of energy levels as you move down a column on the periodic table. How and why does this effect ionization energy?

It increases and it lowers the ionizing energy

c) What happens to the effective nuclear charge as you move across a period on the periodic table? How does this effect ionization energy and electronegativity?

it increases and it makes it the ionizing energy low and electronegativity high.

5a) Which group contains elements which are easiest to ionize? Explain why this is the case.

The alkali metals because they have a big atomic radius.

b) Explain why the third ionization energy of Ca would be much higher than the 1st and 2nd ionization energy Ca

Because the electrons are much closer to the nucleus

6. Which element would have the highest electronegativity in each set below? Explain why this is.

a) Ca, Be or Mg b) B, Li, or F

Be because it’s nucleus is closer to the surface. F because it has a small atomic radius

7. Write (or type) the electron configuration of each atom (high-light the valence electrons) and it’s corresponding ion below each sketch (atomic radii are given in angstroms (1 x 10-10 M).





1. N 1s²2s²2p³ N^3- 1s²2s²2p⁶
2. O 1s²2s²2p⁴ O^2- 1s²2s²2p⁶
3. F 1s²2s²2p⁵ F^1- 1s²2s²2p⁶
4. Na [Ne] 3s¹ Na 1s²2s²2p⁶
5. Mg [Ne] 3s² Mg 1s²2s²2p⁶
6. Al [Ne] 3s²3p¹ Al 1s²2s²2p⁶

9. Over the blank periodic table provided, write or type the number of valence electrons and the expected ion charge for the **transition metal** block and for the families to the left and right of the transitions metals (the alkali metals have been done as an example).

Note: Carbon and boron do not normally form ions and are thus blanked-out

# valence e: 1

Ion charge: +1



1. Transition Metals # of valence e: 3-12 Ion charge:+1 +2 +3
2. Alkali Earth Metals # of valence e:2 Ion charge:+2
3. Halogens # of valence e:7 Ion charge:-2
4. Noble gases # of valence e:8\* Ion charge:0