Name _____ Date _____ Period _____

Chem 05-05 13B EPP Chemical Periodicity: Ionization Energy, Electron Affinity, and Electronegativity

Ionization energy is the energy needed to remove an electron from a gaseous atom. Ionization energy is low for metals, which lose electrons easily; it is high for nonmetals, which tend to gain electrons. Ionization energy increases across a period and decreases down a group on the periodic table.

Electron affinity is a measure of the energy change accompanying the addition of an electron to a gaseous atom. This process can be thought of as the reverse of ionization. Nonmetals readily gain electrons; thus electron affinities are generally high for nonmetals. It is difficult to measure electron affinities for metals, but they are usually low. The general trend for electron affinities is an increase across a period and a decrease down a group in the table.

Electronegativity is the tendency for an atom to attract electrons to itself when it combines with other elements. The concept is a combination of ionization energy and electron affinity. Electronegativity increases across a row on the periodic table, and it decreases down a group. This trend combines the trends for ionization energy and electron affinity. The problems on this worksheet deal with these trends.

Example A
Compare the ionization energy of sodium to that of potassium.

Solution
Soldium's ionization energy should be higher than that of potassium because although both elements have only one electron in their outer ***s*** orbital, sodium has its 1*s* electron in the third energy level, and potassium's is in the fourth level. Sodium is a smaller atom and it holds on to its outer electron more tightly than potassium.

You Try It
1) Explain the difference in ionization energy between lithium and beryllium.

Example B
Will the electronegativity of barium be larger or smaller than that of strontium?

Solution
Both elements are in Group IIA and have the same number of outer electrons. The difference lies in where those outer electrons are located. Barium's outer electrons are in the 6th energy level and those of strontium are located in the 5th level. Barium is a larger atom and thus cannot hold its own electrons or those of other elements as tightly as strontium. Barium's electronegativity is therefore lower than the electronegativity of strontium.

You Try It

2) Compare the electronegativity of tellurium to that of antimony. Explain.

Problems for You To Try

3) The first and second ionization energies for magnesium are both relatively low, but the third ionization energy requirement jumps to five times the previous level. Explain. What is the most likely ion for magnesium to become when it bonds with other atoms?

4. Choose the element with the greatest first ionization energy.
   a. sodium or magnesium
   b. carbon or aluminum
   c. calcium or strontium
   d. helium or lithium

5. Which element has
   a. The lowest ionization energy _____
   b. The highest second ionization energy _____
   c. The highest electronegativity _____
   d. The highest ionization energy _____

6. Arrange the following elements in order of increasing electronegativity.
   a. gallium, aluminum, indium _____, _____, _____
   b. calcium, selenium, arsenic _____, _____, _____
   c. oxygen, fluorine, sulfur _____, _____, _____
   d. phosphorus, oxygen, germanium _____,_____, _____

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