Name:_____ Period:_____ Date:_____

IONIZATION ENERGY ACTIVITY

Background: Based on the Bohr model of the atom, we know that electrons absorb energy to get to higher energy levels and then fall back to lower energy levels, emitting colors depending on how far electrons fall (remember spectra??!).
And then learned more about the complexity of the atomic structure and electrons are on specific energy levels within regions of space around the nucleus we call orbitals. When multiple electrons are present, some electrons are easier (i.e. require less energy) to remove from the atom than others. The chart of ionization energy on the next page provides information about the amount of energy required to remove the two highest electrons.

Learning Target: I can analyze first and second ionization energy data in order to explain the periodic trend for ionization based on the outer shell electron configuration of the elements as you go across the table.

Directions: First, answer the questions below and then read through the remaining questions.

1. What does first ionization energy mean?

2. What does second ionization energy mean?

3. When trying to remove an electron from an atom, which electrons do you suspect are the ones easiest to remove?

4.
    a. Make a graph that shows how the ionization energies vary with atomic number. Note the atomic numbers (x-axis) range from 1 to 36 and the ionization energies (y-axis) range from 7 to 121.2. Plot the first ionization energy data from the chart in one color, connecting the data points as you go along.
    b. Plot the values for the second ionization energies in a different color.
    c. Include a title and legend on your graph.

5. Look at the graph of the first ionization energies and answer the following questions:
    a. What kinds of patterns do you see? How could you quickly relate the shape of the graph to someone who had not seen it? (If you were given a piece of blank paper and only five seconds, how would you sketch the pattern of ionization patterns?)

    b. Where are the ionization energies the largest? The smallest?

    c. What happens to the ionization energies as the atomic number increases?

    d. Group the elements by their ionization energies into four consecutive "periods". List the range of atomic numbers in each group.

    e. Is there any interruption in the general trend of ionization energies as the atomic number increases for a "period" (row)? If so, describe it.

6. Look at the second colored graph line you drew. Describe how the two graphs are alike and/or different. Do you see similarities between the two graphs?

7. What does it mean if an element has a high first ionization energy? A low first ionization energy?

8. What does it mean if an element has a low first ionization energy and a high second ionization energy?

9. Would you expect elements with very high ionization energies or very low ionization energies to have the ***most*** stable arrangement of electrons? EXPLAIN.

10. Based on their ionization energies, which elements in the second period (atomic number 3 through 10) of the periodic table ***have the most stable arrangement*** of electrons in their atoms? What is the noble gas notation for these elements?

11. Which elements in the second period (atomic number 3 through 10) of the periodic table have the ***least stable arrangement*** of electrons in their atoms? What is the noble gas notation for these elements?

12. Which elements in the third period (atomic numbers 11 through 18) of the periodic table have the ***most stable arrangements*** of electrons in their atoms? What is the noble gas notation for these elements?

13. Which elements in the fourth period (atomic numbers 19 through 36) of the periodic table have the ***most stable arrangement*** of electrons? What is the noble gas notation for these elements?

14. How can you explain the patterns you see with elements that are most stable using their electron configurations?

15. Mendeleev assigned elements to the same column of the periodic table because the elements had similar properties, both physical and chemical. How, then, does the number of and location of the electrons in the outermost energy level and sublevel (s, p, d, or f) relate to chemical properties? Make a statement acknowledging that electrons (as opposed to the nucleus) are the key to the chemical properties of the elements.

16. Take your graph and rotate it 90 degrees, you will find that the graph reminds you of the periodic table, constructed by Mendeleev because of similar chemical and physical properties of elements. What is the relationship between ionization energy and the rows of the periodic table?

17. Electronegativity has a very similar trend across the periodic table as ionization energy. Using your analysis above and what you know about electronegativity of an atom, explain why it would have a similar trend as ionization energy.