Periodic Trends II: Electron Affinity, Atomic Radius & Ionic Radius

Background
In this investigation you will examine the electron affinity of select atoms from the periodic table. You will have the opportunity to analyze the effect that electron affinity has on other periodic trends, including atomic radius and ionic radius.

1. What subatomic particles are located in the nucleus of an atom? Does the nucleus of the atom have a charge? Is so, what is it?

2. What factors determine the size (radius) of an atom? Explain.

3. Draw a Bohr model for Magnesium (Mg) and Chlorine (Cl). Which atom should be larger?

4. Is it more difficult to remove a valence electron from a Magnesium (Mg) atom or a Chlorine (Cl) atom? Explain.

5. What does a positively charged ion indicate in terms of its subatomic particles? Use the Calcium ion Ca$^{+2}$ as a specific example in your explanation.

6. What does a negatively charged ion indicate in terms of its subatomic particles? Use the Fluoride ion F$^{-1}$ as a specific example in your explanation.

*Check your answers before moving on to the next portion of the activity.
**Procedure**
Using your computer, tablet or mobile device, navigate to the website: http://www.teachchemistry.org/electron-affinity
You should see the picture below on your screen:

![Periodic Table of Elements](image1)

**Investigation**
1. Choose any element shown in green from *group 7* on the periodic table by clicking the on the element symbol. You should see details about the element that you chose appear at the bottom of the screen. An example is shown below.

![Electron Configuration](image2)

- a. How many valence electrons are present in this atom?
- b. How can this atom become stable?
- c. Attempt to add an electron to the atom. Describe what happened:
- d. Comparing the neutral atom and its anion, what do you notice about the radius in the side-by-side comparison? Do the data values support the visual representation?
- e. Are there any other noticeable differences between the neutral atom and its anion (other than size)? List them below:
f. Explain why there is a difference in size between the neutral atom and its anion, making specific reference to subatomic particles.

Reset the selected data using the reset symbol.

2. Choose any element shown in green from group 1 on the periodic table by clicking the element symbol. You should see details about the element that you chose appear at the bottom of the screen. An example is shown below:

![Diagram of Sodium atoms]

a. How many valence electrons are present in this atom?

b. How can this atom become stable?

c. Attempt to add an electron to the atom. Describe what happened:

d. Why did this atom behave differently than the atom chosen in question 1?

Reset the selected data using the reset symbol.

3. Choose one of the following elements by clicking on the element symbol:
   - Oxygen (O)
   - Phosphorous (P)
   - Sulfur (S)

You should see details about the element that you chose appear at the bottom of the screen.

a. How many valence electrons are present in this atom?
b. How can this atom become stable?

c. Attempt to stabilize the atom by adding the necessary number of electrons. Describe what happened:

d. Comparing the neutral atom and its anion, what do you notice about the radius in the side-by-side comparison? Do the data values support the visual representation?

e. Are there any other noticeable differences between the neutral atom and its anion (other than size)? List them below:

f. Explain why there is a difference in size between the neutral atom and its anion, making specific reference to subatomic particles.

4. Consider the elements located in group 7 on the periodic table.

   a. What do you notice about the electron affinity values for each of these group 7 elements compared to the values for other elements that are in the same period?

   b. Which atom in group 7 should have the largest atomic radius (consider only F, Cl, Br and I)? Why?

   c. Based on your answer to part b, and what you have learned so far, which anion in group 7 should have the largest ionic radius (consider only F⁻¹, Cl⁻¹, Br⁻¹ and I⁻¹)? Why?

   d. Interact with the simulation and select the atoms mentioned in part b & c., to determine if your predictions are correct. Explain your analysis below:

   e. Based on your answers above, can you make a general statement about the ionic radius trend of anions within a group?
Review Questions
5. Decide whether the following statements are true or false, and briefly explain your choice in the space provided after each statement:

a. **True or False**: Metals usually have stronger electron affinity than non-metals.

b. **True or False**: Noble gas elements have a very large value for electron affinity.

c. **True or False**: Negative anions have a larger ionic radius than the atomic radius of their neutral atom.

d. **True or False**: The value for electron affinity is a negative value because when an electron is added to the outer shell of an atom, energy is released.

e. **True or False**: Electron affinity values generally increase from left to right in a period on the periodic table.

f. **True or False**: A larger numerical value for electron affinity means it is more difficult for an electron to be added to an atom.

**Using the simulation, check your predicted answers to see if you are correct!**