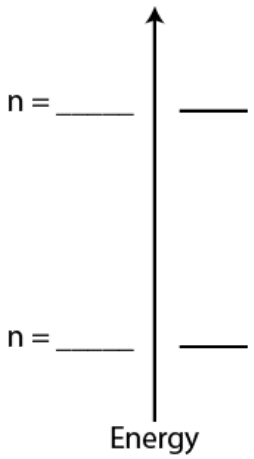
Atoms and Energy

1. Consider an electron in a hydrogen atom that is in the n = 5 energy level and moves to the n = 10 energy level.
    a. Sketch this process on the diagram

    b. Does this electron gain energy or lose energy? How do you know?

    c. Calculate the energy of each level. You should be able to find an equation in your notes that allows you to do this.



    d. Is energy required or produced when the electron changes levels?

    e. Calculate this difference in energy.

    f. Can this electron exist at any other energy levels? Explain your answer.

    g. What is the frequency of the photon that could make this process happen?

    h. What is the wavelength of the photon?

    i. Calculate the wavelength of the photon required to do this same process (n = 5 → n = 10) in a Li^{2+} ion. Remember to consider the atomic number of this single electron atom.

2. A photon with a wavelength of 1.003 μm is emitted from an excited hydrogen atom. What are the initial and final energy levels of the electron in this process? *Hint: remember that there are three distinct series of emission for hydrogen atoms.*

3. Consider Gadolinium (Z = 64)
    a. Write the full (not condensed) ground state electron configuration for this element.

    b. What is the condensed electron configuration?

    c. What is the condensed electron configuration of the **1st excited state** of Gd?

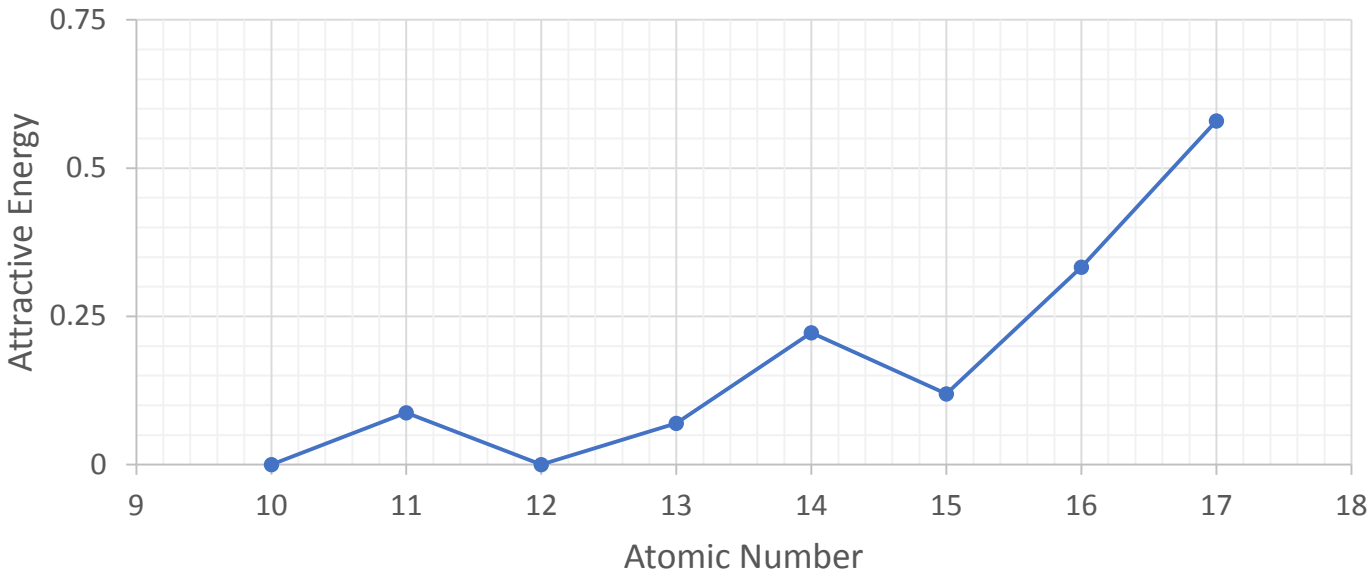
    d. Write two possible sets of quantum numbers for the highest energy electron in the ground state.

    e. Write two possible sets of quantum numbers for the highest energy electron in the **1st excited state.**

4. In your own words, why does copper NOT have a ground state electron configuration of [Ar] $4s^2$ $3d^9$?

5. Does electron affinity refer to the tendency to gain or lose an electron?

6. Consider the data in the chart below:



   a. Why does element 10 have an electron affinity of 0?

   b. Circle the steps that obey the general rule dictated by Coulomb's law?

   c. For all of steps that do not follow the general trend, use electron configurations to justify the deviation.

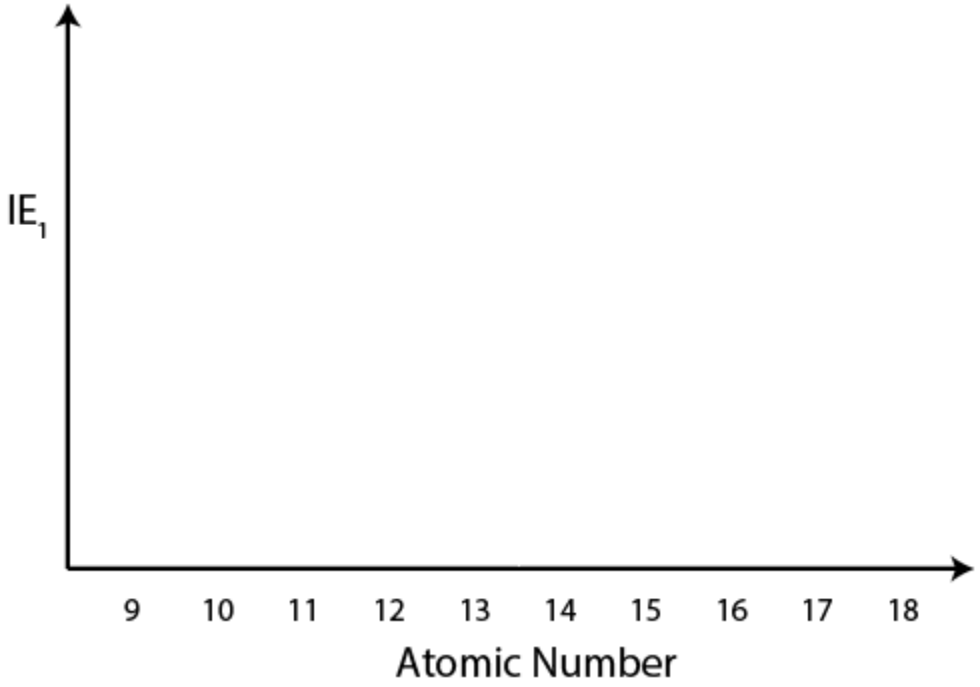
7. Consider these isoelectronic element: Xe, Ba^{+2}, Te^{-2}, I^{-1}, Cs^{+1}, Sb^{-3}:
   a. What does it mean to be isoelectronic?

   b. Which of these atoms has the largest radius? How did you reach this conclusion?

   c. Which has the smallest radius? How did you reach this conclusion?

8. On the graph below, predict the trend for the 1st ionization energies of the following elements:

F, Ne, Na, Mg, Al, Si, P, S, Cl, Ar



What unit do you think should be associated with the Y-axis?