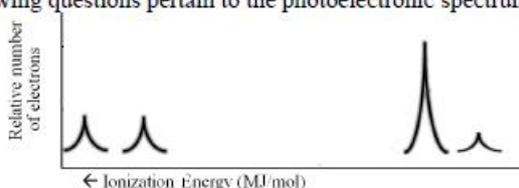


Atomic Structure and Properties
1.6 Photoelectron Spectroscopy (PES)
Worksheet

- 1) The following questions pertain to the element aluminum.
 - a. Draw a photoelectron spectrum for aluminum, which includes all of the peaks but does not include exact ionization energies.
 - b. Label each peak with numbers and letters that indicate its associated shell and subshell.
 - c. Indicate the number of electrons that are contained within each sublevel on your photoelectron spectrum for aluminum.
 - d. Which subshell contains the electron with the lowest ionization energy? Justify your answer.

- 2) The following questions pertain to the photoelectronic spectrum below.

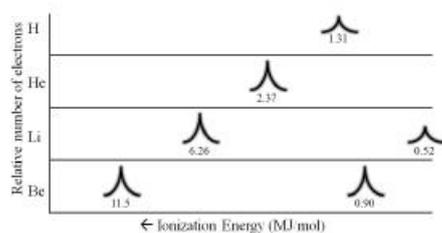


- a. Identify the element that would produce the above spectrum.
 - b. Label each peak with numbers and letters that indicate its associated shell and subshell.
 - c. Indicate the number of electrons that are contained within each sublevel on the photoelectron spectrum.
 - d. Which subshell contains the highest energy electron(s)? Justify your answer.
 - e. Which subshell contains the lowest energy electron(s)? Justify your answer.

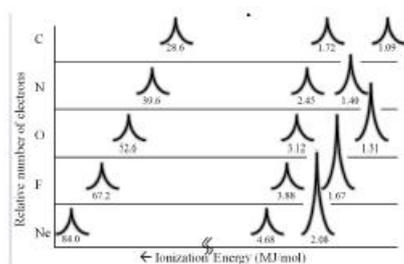
- 3) Photoelectron spectrometry (PES) data indicates that the ionization energy for an electron in the 2s orbital of calcium is 42.7 MJ/mol and the ionization energy for an electron in the 3s orbital of calcium is only 4.65 MJ/mol. Provide an explanation that accounts for this data.

- 4) Describe the modifications to the shell model that are required due to the experimental PES data that was provided in the lecture.

- 5) Do the photoelectron spectra below suggest a need to refine the shell model of the atom? If so, is there another model that provides a better explanation of this data? Justify your answers.



- 6) Do the photoelectron spectra below suggest a need to refine the shell model of the atom? If so, is there another model that provides a better explanation of this data? Justify your answers.



- 7) Argon, Ar, and the calcium cation, Ca^{2+} , are isoelectronic. Will they exhibit the same photoelectron spectra? Justify your answer.