Photoelectron Spectroscopy and Ionization Energy Name _____ Hour____

Review

- Which orbitals exist in each of the following energy levels?
  - n = 1
  - n = 2
  - n = 3
  - n = 4

What is the maximum number of electrons that can go in:

The first energy level?	_____	An "s" orbital?	_____
The second energy level?	_____	A set of "p" orbitals?	_____
The third energy level?	_____	A set of "d" orbitals?	_____

Once you are finished with the review, go through the photoelectron spectroscopy PowerPoint (as a presentation – not just looking at the slides) and answer the questions on this document. Slide numbers are in the right hand corner. Answer the questions based on the slide corresponding to the question.

SLIDE 1-3

1. In your own words, describe how PES works

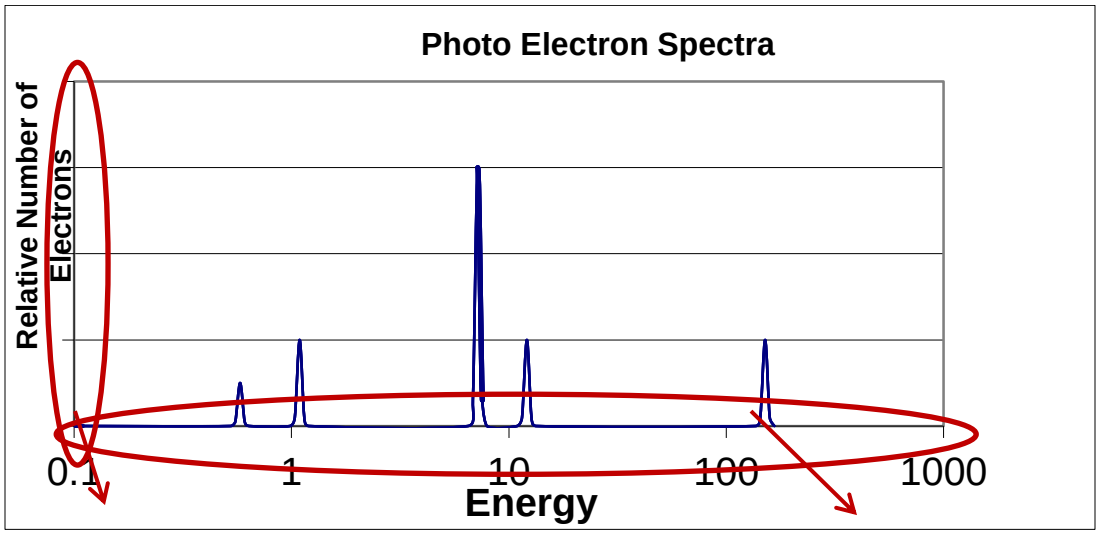
Key idea: PES measures the energy necessary to _____ a specific electron from the atom.

SLIDE 4

2. In the lithium atom, how many electrons are in the first energy level? _____
3. How many electrons are in the second energy level? _____
4. Watch the slide multiple times. Take note of where electrons go once they enter the kinetic energy analyzer.
5. When an electron is taken from the first energy level, does it have a higher binding energy or lower binding energy than when an electron is taken from the second energy level? _____
6. Notice after you have watched the slide that the peak of the electrons with the higher binding energy is twice as large as the peak with the lower binding energy. Explain why this is.

7. Do electrons closest to the nucleus have a higher binding energy or lower binding energy? _____

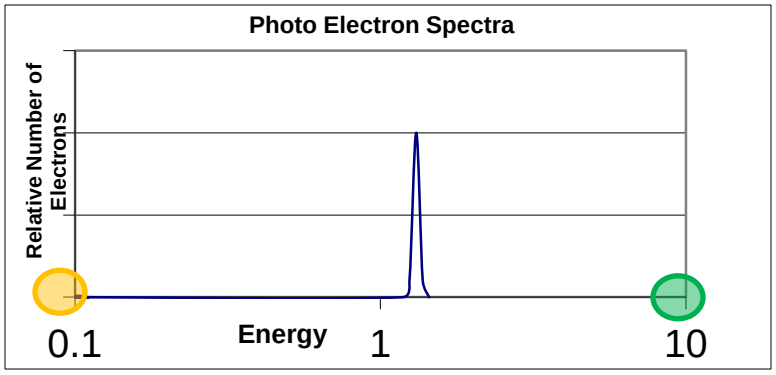
SLIDE 5



8. What is represented on the Y axis?

9. What is represented on the X axis?

10. What is "ionization energy"?



11. If a nucleus were drawn on a Photo Electron Spectra, would it generally go in the place of the orange dot or green dot? Why?

12. Using the information from the chart and the answers to questions 10 and 11, does it more or less energy to remove an electron that is closer to the nucleus? _____

13. Circle which energy level/orbital it would be easier to remove an electron from:

- n=1 OR n=2
- 2p OR 2s
- 1s OR 3p

SLIDE 6

- Notice that 2s and 2p are closer together than 1s is to 2s. Why should there be a bigger energy "gap" between energy levels than between orbitals at the same energy level?

SLIDE 7

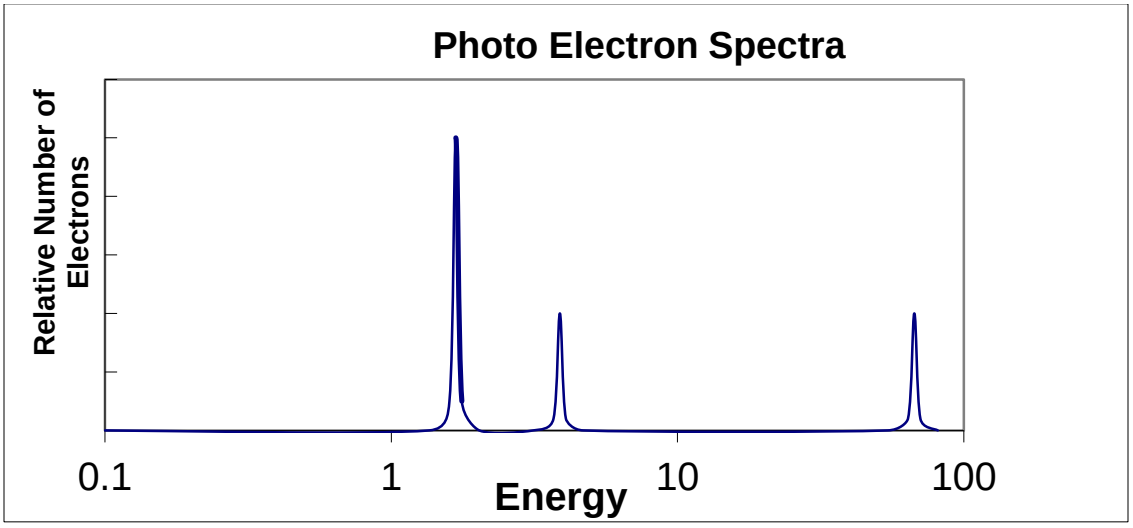
14. Which element is represented in the spectrum shown?

What is its electron configuration?

Why is one peak so much bigger than the others?

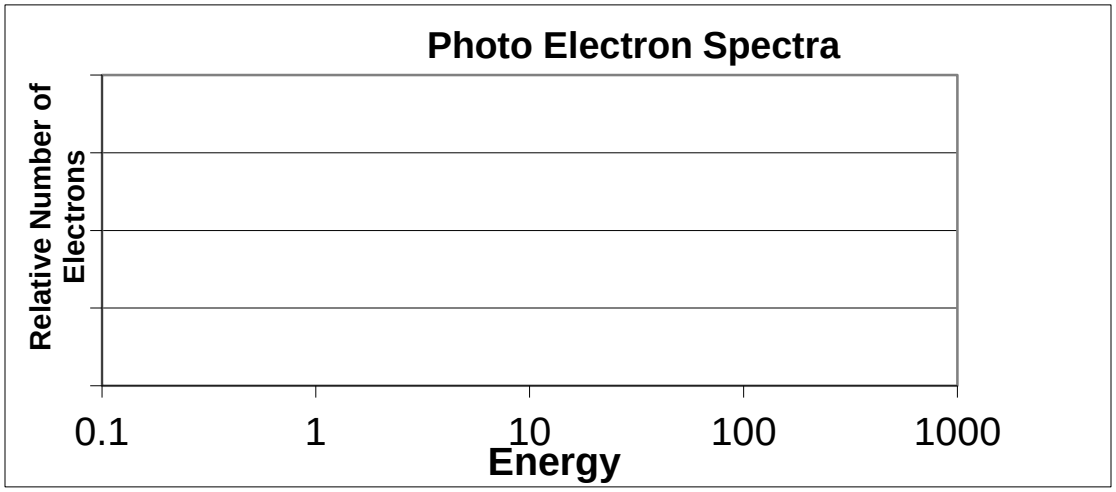
In which orbitals are the electrons that are in the peak labeled "A"?

15. What element is represented by the graph below? _____ What is its electron configuration? _____ Label each sublevel (orbital) on the graph.

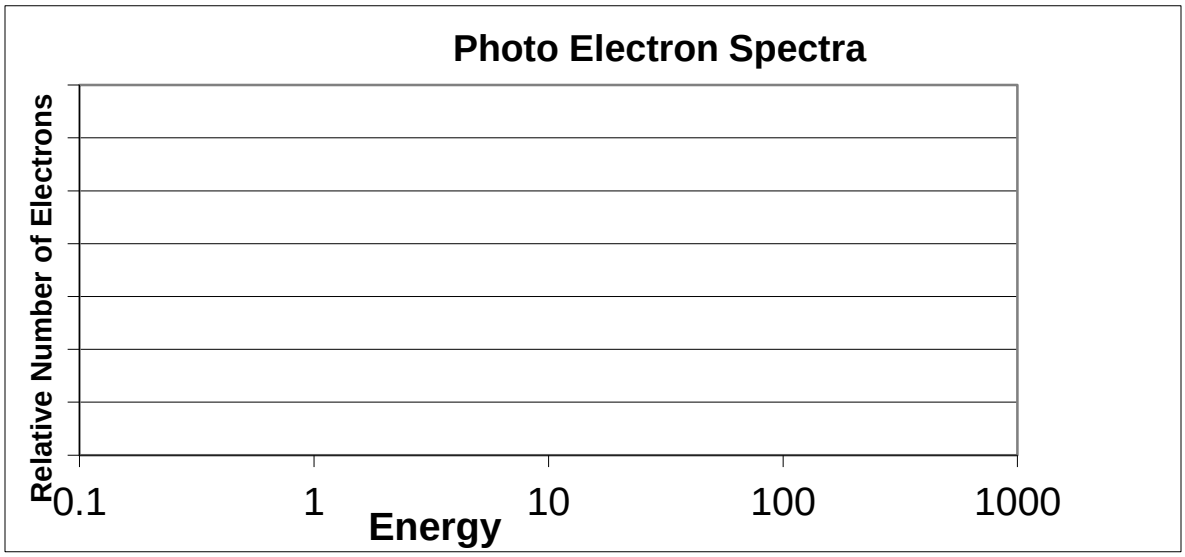


SLIDE 8

16. Sketch the PES for Aluminum below. Don't worry about exact energies of the peaks, but do pay attention to approximate the separation between individual peaks in terms of energy.



17. After you check your answer for aluminum, sketch the PES for Chlorine below



SLIDE 9

The helium peak is farther to the right (higher energy) thus more energy is needed to remove the 1s electrons in helium. They must be held more tightly because there is a higher effective nuclear charge (Helium below has 2 protons pulling on its 1s electrons but hydrogen below only has 1 proton pulling on its 1s electron)

SLIDE 10

19. Why is the 1s peak for nitrogen further to the left (less energy) than the 1s peak for oxygen?