Unit 1 – Chapter 7: Atomic Structure & Periodicity **Name ______________**

PES Questions from Russ Maurer **Period _____________**

1. Below is the PES of sulfur and a table of successive ionization energies. The energy scale for the PES is in MJ/mol (1MJ = 1000 kJ). There is exactly one peak on this graph whose energy corresponds to an ionization energy in table 7.2. What is it? Why doesn't anything else match up?

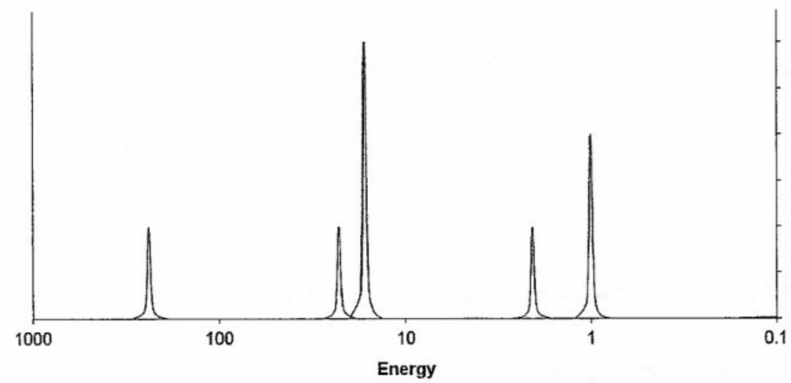
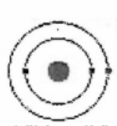


TABLE 7.2 • Successive Values of Ionization Energies, *I*, for the Elements Sodium through Argon (kJ/mol)

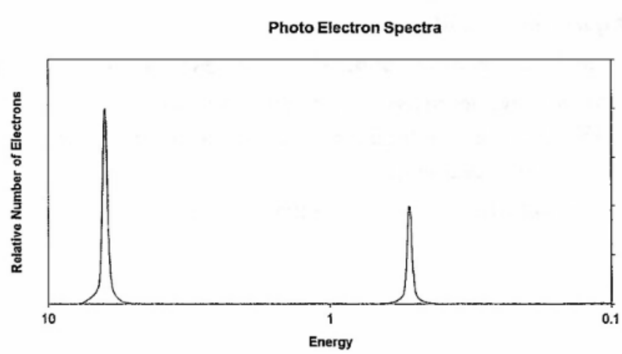
Element	I_1	I_2	I_3	I_4	I_5	I_6	I_7
Na	496	4562			(inner-shell electrons)		
Mg	738	1451	7733				
Al	578	1817	2745	11,577			
Si	786	1577	3232	4356	16,091		
P	1012	1907	2914	4964	6274	21,267	
S	1000	2252	3357	4556	7004	8496	27,107
Cl	1251	2298	3822	5159	6542	9362	11,018
Ar	1521	2666	3931	5771	7238	8781	11,995

(From Brown et al., *Chemistry the Central Science 12 ed.*, copyright Pearson Prentice Hall)

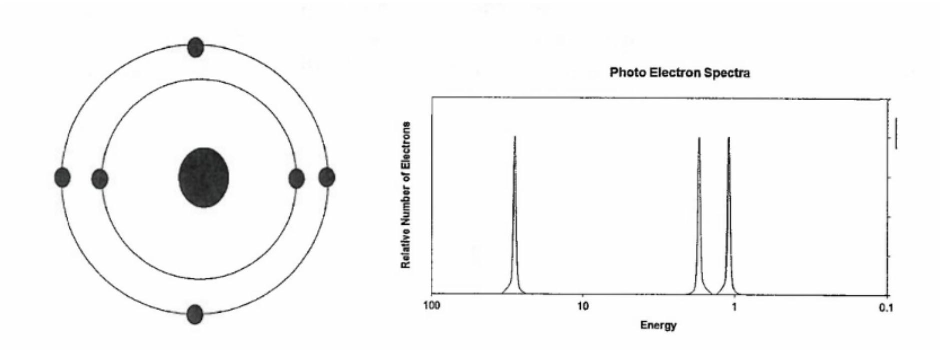
2. Here is a picture of the original Bohr model of lithium (Z = 3) and next to it, the PES of lithium. Is there anything in the PES data for this element that requires revision of the Bohr model?



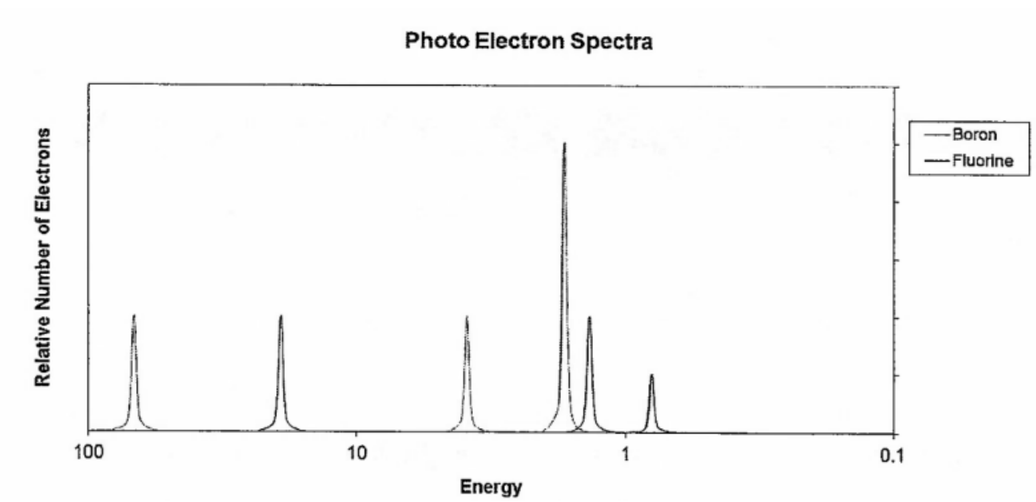
Lithium (Li)
Bohr Model



3. Similarly, here is the original Bohr model of carbon and the corresponding PES. Is there anything in the PES data for this element that requires revision of the Bohr model? Explain.



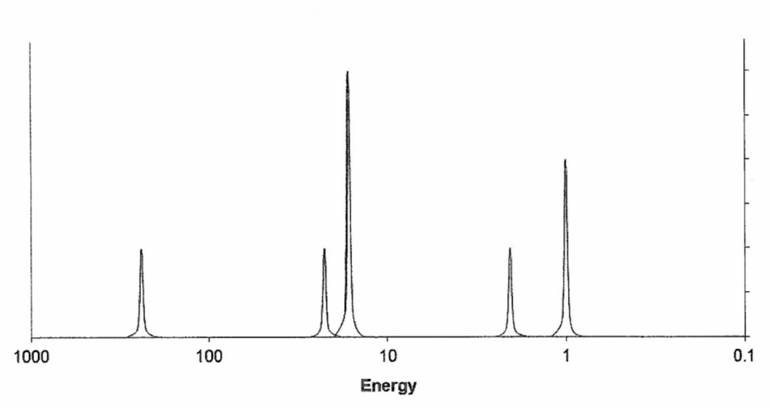
4. Here is a PES spectrum of boron (Z = 5; blue) superimposed on that of fluorine (Z = 9; pink)



a. Why are the fluorine peaks to the left of the boron peaks?

b. Why is there one peak in fluorine that is so much taller than all the others?

5. Below is shown the PES spectrum of sulfur (atomic number = 16).



a. Write the full electron configuration of sulfur.

b. Label each peak in the spectrum to show which subshell it represents (i.e. 1s, 2, etc).

c. On the spectrum, sketch in the relative locations and correct peak heights for the spectrum of aluminum (atomic number = 13). By relative location, I mean correctly to the left or right of the same subshell peak in the sulfur spectrum.

d. Draw a circle around the sulfur peak whose energy is equal to the first ionization energy of sulfur.