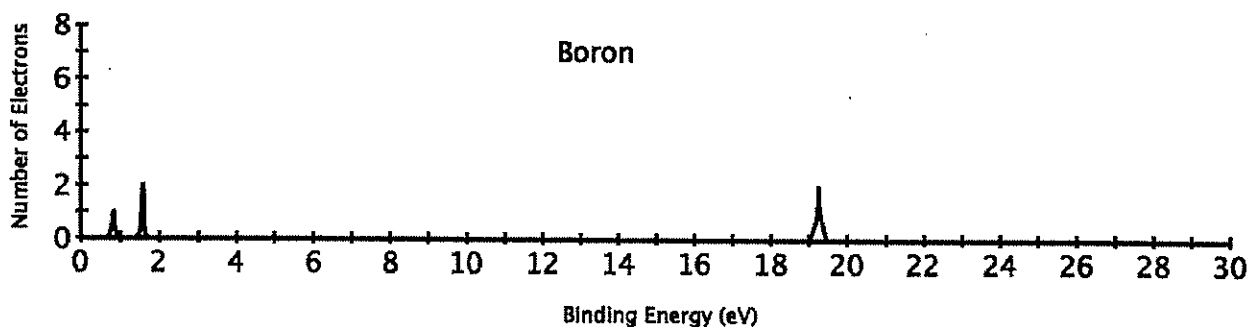
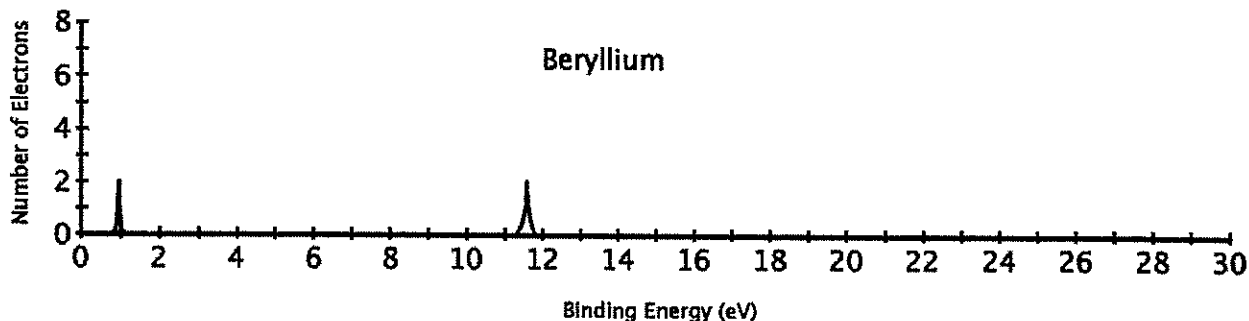


### PES & Periodic Trends

1) Answer the following questions related to the elements boron and beryllium make sure to reference both elements in your answers. Below are the photoelectron spectra for beryllium and boron.



A) The first ionization of Boron is lower than the first ionization energy of beryllium.

Explain. *The outer most e<sup>-</sup> in B is in the 2p orbital while in Be the outer most e<sup>-</sup> is in the 2s orbital. The 2p orbital is further from the nucleus reducing the attractive force of B's protons.*

B) Both beryllium and boron have electrons in only the first and second energy levels but boron has three PES peaks while beryllium has only two PES peaks.

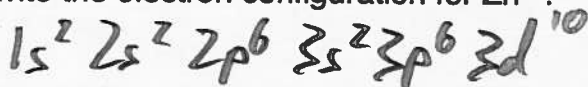
*Boron has electrons in both the 2s and 2p orbitals while Beryllium has electrons in only the 2s. Both atoms have electrons in the 1s orbital. Since the 2s + 2p orbitals are different in energy*

C) The right most peak for boron is much higher in energy than the right most peak of beryllium. Explain. *they general different peak*

*In both B + Be the right most peaks represent electrons in the 1s orbital since B has more protons it's 1s electrons will be attracted more strongly.*

2) Answer the following questions related to electron configuration.

A) Write the electron configuration for  $Zn^{2+}$ .



← Zn and all transition metals lose the 4s electrons first.

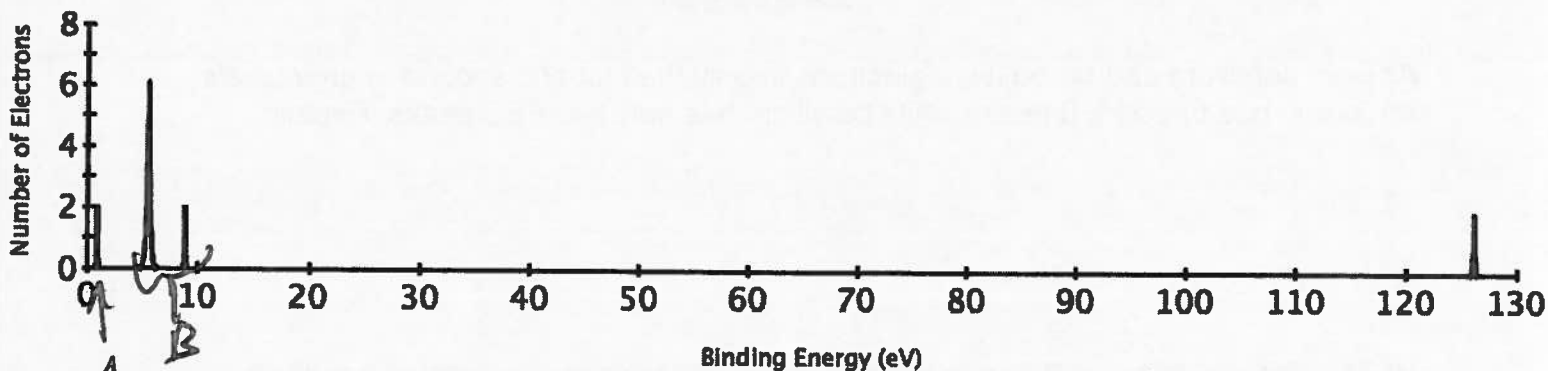
B) Which species Zn or  $Zn^{2+}$  will have a lower ionization energy? Justify your answer.

Zn will have a lower first ionization energy,  $Zn^{2+}$  has already lost 2  $e^-$  from the 4s orbital the next electron must come from the 3d orbital and is harder to remove than a 4s electron.

C) Potassium has a lower first ionization energy than sodium. Explain.

The outermost electron in potassium is in the 4s orbital which is further from the nucleus and has more electron shielding than the outermost electron of sodium which is in the 3s orbital.

D) An unknown species is analyzed and found to have the following photoelectron



spectrum.

Based on the PES spectrum what charge is this element likely to form. Justify your answer.

Based on the spectrum the element is likely to form a +2 charge. There are 2 electrons with very low ionization energy (labeled A) these are likely the 3s electrons they are relatively far away from the nucleus and have greater electron shielding. The next group of electrons (B) are closer and have higher binding energy.