NAME: HONORS CHEMISTRY

SECTION: Ionization Energy and Electron Configurations

The equations for the first and second ionizations of any element (X) are given by the following equations. IE_1 is the first ionization energy, and IE_2 is the second ionization energy.

First ionization: $X_{(g)} + IE_1 \rightarrow X^+_{(g)} + e^-$

Second ionization: $X^+_{(g)} + IE_2 \rightarrow X^{2+}_{(g)} + e^-$

In words, the first equation says that when one mole of element X absorbs energy equal to IE_1, a mole of electrons is lost, leaving a mole of gaseous X^+ ions.

1. State in words what is happening in the equation for the second ionization.

2. a) Fill in Table 1 below by writing electron configurations for Na, Mg, and Al. Write the equations for the ionization of the first electron from each of the three elements. Include in each equation the actual ionization energy in kJ, found in Table 2. (Use the equations above as models).
   b) Now, write the electron configurations for the ions (X^+) formed by the first ionization. Write the equations for the second ionization and the electron configurations for the ions formed (X^{2+}).

Table 1	Na	Mg	Al
Electron configuration, X			
Equation for first ionization			
Electron configuration: X^+			
Equation for second ionization			
Electron configuration: X^{2+}			

3. Identify the first electron that is removed from sodium. From what orbital is it removed?

4. Identify the second electron that is removed from sodium. From what orbital is it removed?

Table 2

Element	IE_1 (kJ)	IE_2(kJ)
Na	498	4560
Mg	736	1445
Al	577	1815

5. How many times larger is the second ionization energy of sodium than the first ionization energy?

Table 2

Element	IE_1 (kJ)	IE_2(kJ)
Na	498	4560
Mg	736	1445
Al	577	1815

6. How many times larger is the second ionization energy of magnesium than the first ionization energy?

7. After comparing the electron configurations and the ionization energies of sodium and magnesium, suggest a reason why IE_2 for sodium is so large.

8. Predict how many times larger IE_3 for Mg will be than IE_2. *Clearly state your reason for your answer.*

9. Considering the electron configuration of aluminum, predict the magnitude of IE_3 for aluminum.