

**Unit 9 Day 7: Periodic Trends FRQ Practice**  
(Laying the Foundation, 6 points)

Answer the following questions using principles of atomic and molecular structure. The elements in the table above (W, X, Y, and Z) are actual elements found in either period 2 or 3 in the periodic table.

Element	First Ionization Energy (kJ mol <sup>-1</sup> )	Second Ionization Energy (kJ mol <sup>-1</sup> )	Third Ionization Energy (kJ mol <sup>-1</sup> )	Fourth Ionization Energy (kJ mol <sup>-1</sup> )
W	520	7298	11815	—
X	900	1757	14850	21000
Y	801	2427	3660	25000
Z	496	4562	6910	9543

1) Which of the elements above is an alkaline earth metal? Explain. (2 points)

1 pt [Element X, b/c

1 pt [ → it shows a large jump in IE after 2<sup>nd</sup> e<sup>-</sup> removed  
 ⇒ it has 2 valence e<sup>-</sup> ⇒ alkaline earth metal

2) For the alkaline earth metal that you identified above:

a) Why is the second ionization energy higher than the first ionization energy? Explain using principles of atomic structure. (2 points)

IE<sub>2</sub> > IE<sub>1</sub>, b/c:

1 pt [ → removal of 1<sup>st</sup> e<sup>-</sup> causes less e<sup>-</sup>/e<sup>-</sup> repulsion

1 pt [ ⇒ 2<sup>nd</sup> e<sup>-</sup> is closer to the nucleus and requires more energy to remove

b) Why is the third ionization energy higher than the second ionization energy? Explain with Coulomb's Law. (2 points)

IE<sub>3</sub> > IE<sub>2</sub>, b/c:

1 pt [ → removal of 2<sup>nd</sup> e<sup>-</sup> removed last valence e<sup>-</sup>  
 → next e<sup>-</sup> removed is in a lower energy level, closer to the nucleus

1 pt [ → Coulomb's law says decreasing distance between opposite charges increases attraction between them.  
 ⇒ greater energy needed to remove 3<sup>rd</sup> e<sup>-</sup>