

AP[®] CHEMISTRY
2007 SCORING GUIDELINES (Form B)

Question 6

	First Ionization Energy (kJ mol ⁻¹)	Second Ionization Energy (kJ mol ⁻¹)	Third Ionization Energy (kJ mol ⁻¹)
Element 1	1,251	2,300	3,820
Element 2	496	4,560	6,910
Element 3	738	1,450	7,730
Element 4	1,000	2,250	3,360

The table above shows the first three ionization energies for atoms of four elements from the third period of the periodic table. The elements are numbered randomly. Use the information in the table to answer the following questions.

(a) Which element is most metallic in character? Explain your reasoning.

Element 2. It has the lowest first-ionization energy. Metallic elements lose electron(s) when they become ions, and element 2 requires the least amount of energy to remove an electron.	One point is earned for the identification. One point is earned for the justification.
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(b) Identify element 3. Explain your reasoning.

Magnesium. Element 3 has low first and second ionization energies relative to the third ionization energy, indicating that the element has two valence electrons, which is true for magnesium. (The third ionization of element 3 is dramatically higher, indicating the removal of an electron from a noble gas core.)	One point is earned for the identification. One point is earned for the justification.
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(c) Write the complete electron configuration for an atom of element 3.

$1s^2 2s^2 2p^6 3s^2$	One point is earned for the correct electron configuration.
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(d) What is the expected oxidation state for the most common ion of element 2?

1+	One point is earned for the correct oxidation state.
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Question 6 (continued)

(e) What is the chemical symbol for element 2?

Na	One point is earned for the correct symbol.
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(f) A neutral atom of which of the four elements has the smallest radius?

Element 1	One point is earned for the correct identification of the element.
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