Ionization Energy Trends

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Show your work for written answers.

First ionization energy is the energy needed to remove one electron from a neutral gaseous atom. Use the periodic table to locate elements.

1 Which process represents the first ionization of a sodium atom?

(1) $Na(g) \rightarrow Na^{+}(g) + e^{-}$

(2) $Na^{+}(g) + e^{-} \rightarrow Na(g)$

(3) $Na(g) + e^{-} \rightarrow Na^{-}(g)$

(4) $Na^{+}(g) \rightarrow Na^{2+}(g) + e^{-}$

2 Potassium is one period below sodium in Group 1. Explain why potassium's first ionization energy is lower. [1]

Answer and work

_____

_____

3 Which change generally makes an electron harder to remove when other factors are similar?

(1) Weaker attraction to the nucleus

(2) Stronger attraction to the nucleus

(3) Greater distance from the nucleus

(4) Greater shielding by inner electrons

4 Across a period, the outermost electrons are generally in the same principal energy level. Explain why first ionization energy often rises from left to right. [1]

Answer and work

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_____

Comparing Period 3 Atoms

Use the information below to answer the questions.

The table gives rounded first-ionization energies from the NIST Atomic Spectra Database. For Mg, the first electron removed comes from a 3s orbital. For Al, it comes from a higher-energy 3p orbital.

Element	First ionization energy (eV per atom)
Na	5.14
Mg	7.65
Al	5.99
Si	8.15

5 Which element in the table needs the least energy to lose its first electron?

(1) Na

(2) Mg

(3) Al

(4) Si

6 By how much does first ionization energy decrease from Mg to Al? Include units. [1]

Answer and work

7 Use the orbital information to explain why Al has a lower first ionization energy than Mg despite having one more proton. [1]

Answer and work

8 Which statement correctly summarizes the four measurements?

(1) Energy rises at every step.

(2) Energy falls at every step.

(3) Energy rises from Na to Si overall, with a decrease from Mg to Al.

(4) The values are the same for Na and Si.