Element Detective

Use periodic patterns to predict element properties

CHE.1.e "Construct explanations of how periodic trends can be used to predict the properties of elements."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline two statements that describe how a property changes on the periodic table. Circle the atomic cause of each change, then give each cause and its matching change the same number.

What an Element's Position Tells Us

1. A phone battery depends on lithium ions moving between its electrodes. To predict how an element might behave, chemists look at its position on the periodic table, not just its name. Columns are groups, and rows are periods. Lithium, sodium, and potassium sit in Group 1, from top to bottom. Magnesium sits to the right of sodium in the same period, while calcium sits below magnesium in Group 2. Fluorine, chlorine, and bromine occupy Group 17, from top to bottom. These positions reveal patterns even before an element is tested.

2. An atom's radius is an estimate of its size. Going down a group, atoms gain an occupied electron shell, so their radii usually increase. The outer electrons are farther from the nucleus and are shielded by inner electrons. They are generally easier to remove. In Group 1, easier electron loss usually means more vigorous reactions with water, although a prediction is not a safe reason to try a reaction. Across a period from left to right, atomic radius usually decreases. The number of protons rises, but electrons enter the same outer shell, so the stronger nuclear pull draws them closer.

3. First ionization energy is the energy needed to remove one electron from a gaseous atom. It generally increases from left to right across a period and decreases down a group. A lower first ionization energy supports a prediction that an atom will lose its outer electron more easily. Halogens in Group 17 often gain an electron during reactions. Their pull on shared electrons in a chemical bond generally weakens down the group because the outer region is farther from the nucleus and more shielded. Periodic trends describe typical patterns, not guarantees for every comparison. A strong prediction names the trend and links it to an atomic cause.

2 ANSWER WITH EVIDENCE

Use the passage

1. Which atom likely has a larger radius, lithium or sodium? Explain using their positions.

2. Which atom likely has a lower first ionization energy, magnesium or calcium? Explain why.

3. Predict whether sodium or magnesium has the smaller atomic radius. Connect your prediction to nuclear pull.

4. In a chemical bond, which atom likely attracts shared electrons more strongly, chlorine or bromine? Explain using a group trend.

3 YOUR TURN

Your own words

A sealed sample is labeled X. Its element is in Group 1 directly below potassium. In three or four sentences, predict its atomic radius, first ionization energy, and likely water reactivity compared with potassium, and explain your reasoning.

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PART 1 · READ AND MARK

Underline two statements that describe how a property changes on the periodic table. Circle the atomic cause of each change, then give each cause and its matching change the same number. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Which atom likely has a larger radius, lithium or sodium? Explain using their positions.	**Sodium. It is below lithium in Group 1, and atomic radius usually increases down a group as atoms gain electron shells.**
2	Which atom likely has a lower first ionization energy, magnesium or calcium? Explain why.	**Calcium. It is below magnesium in Group 2, where added shells and shielding make an outer electron easier to remove.**
3	Predict whether sodium or magnesium has the smaller atomic radius. Connect your prediction to nuclear pull.	**Magnesium. It is to the right of sodium in the same period and has a stronger nuclear pull on electrons in the same outer shell.**
4	In a chemical bond, which atom likely attracts shared electrons more strongly, chlorine or bromine? Explain using a group trend.	**Chlorine. It is above bromine in Group 17, and the pull on shared electrons generally weakens down the group as shielding increases.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Element X likely has a larger atomic radius than potassium because it has another occupied electron shell. Its outer electron is farther from the nucleus and more shielded, so X likely has a lower first ionization energy. Because Group 1 metals generally react more vigorously with water as electron loss becomes easier down the group, X would likely react more vigorously than potassium.

Accept explanations that connect position to a property trend and, when requested, to electron shells, shielding, or nuclear pull. Treat the water-reactivity prediction as a trend-based expectation, not a guarantee.