Patterns Behind Properties

Use periodic position to predict atomic behavior.

CHE.3 "Students will demonstrate an understanding of the periodic table as a systematic representation to predict properties of elements. Explore and communicate the organization of the periodic table, including history, groups, families..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline two rules about atomic radius and two rules about first ionization energy. Circle the positions or groups you could use with those rules to compare elements.

Choosing a Contact Material

1. A phone charger needs a conducting contact and an insulating coating. The periodic table helps engineers predict which elements might work, even before testing a sample. Mendeleev arranged elements by repeating properties and left gaps for elements not yet found. Today, atomic number sets the order. Vertical columns are groups, whose members often behave alike because of their outer electrons. Lithium and sodium are in group 1, while magnesium is in group 2. Across period 3, sodium, magnesium, sulfur, and chlorine appear from left to right. Sulfur is in group 16, and chlorine is in group 17.

2. The left side of the table holds most metals, which usually conduct heat and electricity well. Nonmetals cluster on the right and usually conduct poorly. Metalloids near the boundary between them often act as semiconductors. Transition metals occupy the central block and commonly form more than one type of positive ion. Moving across a period from left to right, atomic radius generally decreases as stronger nuclear attraction pulls electrons closer. The energy required to remove one electron, called first ionization energy, generally rises. These trends are useful for predictions, but they are not exact rules for every neighboring pair.

3. Down a group, atoms gain occupied energy levels, so atomic radius generally increases and first ionization energy generally decreases. Group 1 metals tend to lose one outer electron and form ions with a 1+ charge. Group 17 nonmetals tend to gain one electron and form ions with a 1− charge. A positive ion is smaller than its parent atom because losing electrons can remove its outer energy level. A negative ion is larger than its parent atom because added electrons increase electron repulsion. These patterns help compare materials for a contact or a coating, but a real design still needs testing.

2 ANSWER WITH EVIDENCE

Use the passage

1. Lithium and sodium are in the same group. Which atom generally has the larger radius, and which has the higher first ionization energy? Explain using their positions.

2. Which would you predict to conduct electricity better, sodium or chlorine? Use their groups and the metal and nonmetal pattern to explain.

3. Sulfur and chlorine are in the same period. Which generally has the higher first ionization energy? Explain using their positions.

4. If a chlorine atom gains an electron, what charge does its ion have, and how does the ion's radius compare with the atom's radius? Explain the size change.

3 YOUR TURN

Your own words

A technician must choose magnesium or sulfur for a conducting contact. In four sentences, recommend one element, compare their atomic radii and first ionization energies, and explain your predictions using their positions in period 3.

Patterns Behind Properties

PART 1 · READ AND MARK

Underline two rules about atomic radius and two rules about first ionization energy. Circle the positions or groups you could use with those rules to compare elements. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Lithium and sodium are in the same group. Which atom generally has the larger radius, and which has the higher first ionization energy? Explain using their positions.	**Sodium has the larger atomic radius because it is below lithium. Lithium has the higher first ionization energy because that energy generally decreases down a group.**
2	Which would you predict to conduct electricity better, sodium or chlorine? Use their groups and the metal and nonmetal pattern to explain.	**Sodium should conduct better. It is a group 1 metal, while chlorine is a group 17 nonmetal.**
3	Sulfur and chlorine are in the same period. Which generally has the higher first ionization energy? Explain using their positions.	**Chlorine generally has the higher first ionization energy because it is to the right of sulfur in period 3.**
4	If a chlorine atom gains an electron, what charge does its ion have, and how does the ion's radius compare with the atom's radius? Explain the size change.	**The ion, Cl^-, has a 1− charge and is larger than the chlorine atom because the added electron increases electron repulsion.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Magnesium is the better choice for a conducting contact because it is a metal, while sulfur is a nonmetal. Both are in period 3, but magnesium lies to the left of sulfur. Magnesium generally has the larger atomic radius because radius decreases from left to right. Sulfur generally has the higher first ionization energy because that energy increases across a period.

Accept predictions that use the stated general trends rather than claiming every neighboring pair follows them without exception. For the open task, look for magnesium as the conductor and correct comparisons of both properties.