# Answers to Periodic Trends Lesson Questions : U2Ch5L3

## Essential Question

1. How can we predict the reactivity and properties of elements based on their positions on the periodic table?  
 - The periodic table is structured to reflect periodic trends, such as atomic radius, ionization energy, electronegativity, and electron affinity. Elements in the same group exhibit similar chemical properties due to their valence electron configuration. Positioning within a period helps predict reactivity, with metals being more reactive on the left and nonmetals being more reactive on the right.

## Progress Check 1

2. What are periodic trends, and how do they help scientists in predicting the properties of elements based on their positions on the periodic table?  
 - Periodic trends are systematic patterns in the properties of elements across periods and groups. These include trends in atomic radius, ionization energy, electronegativity, and electron affinity. For example, ionization energy increases across a period, helping scientists predict reactivity and bond formation.

## Progress Check 2

3. How does atomic size change as you move across a period from left to right? Why does this trend occur?  
 - Atomic size decreases across a period due to increasing nuclear charge. As protons are added, the nucleus exerts a stronger pull on electrons, reducing the atomic radius.

4. Why do elements on the left side of the periodic table generally exhibit more metallic properties compared to those on the right? Explain your reasoning.  
 - Metals on the left have larger atomic radii and lower ionization energies, making it easier for them to lose electrons. Nonmetals on the right have higher ionization energies and smaller radii, making them less metallic.

## Progress Check 3

5. Why is the ionization energy of potassium lower than that of sodium?  
 - Potassium has a larger atomic radius, meaning its outer electron is farther from the nucleus and experiences weaker attraction, making it easier to remove.

6. How would the reactivity of metals change if their ionization energy were to increase significantly across a group? Explain your reasoning.  
 - If ionization energy increased significantly, metals would become less reactive because it would require more energy to remove their valence electrons, reducing their tendency to participate in chemical reactions.

## Progress Check 4

7. What does it mean if an element has a high electron affinity?  
 - High electron affinity indicates that an element readily accepts electrons, releasing energy in the process. This is common in nonmetals, such as halogens, which form stable anions by gaining electrons.

8. Explain how the trend in electron affinity across a period helps predict the stability of the compounds formed by elements in that period.  
 - Electron affinity becomes more negative across a period, indicating stronger attraction for electrons. Elements with higher electron affinity form more stable anions, leading to the formation of stable ionic or covalent compounds.

## Progress Check 5

9. Why does electronegativity increase across a period on the periodic table?  
 - Electronegativity increases across a period due to increasing nuclear charge, which pulls electrons closer to the nucleus. This stronger attraction makes elements more effective at attracting shared electrons in a bond.

10. Predict how the difference in electronegativity between sodium and chlorine affects the type of bond formation. Explain your answer.  
 - Sodium (low electronegativity) and chlorine (high electronegativity) form an ionic bond. Sodium donates an electron to chlorine, resulting in the formation of oppositely charged ions that attract each other.

## Progress Check 6

11. What elements would be more reactive? Elements with a large atomic radius or with a small atomic radius? Explain.  
 - Elements with a large atomic radius are more reactive among metals because their outer electrons are less tightly held and easily lost. Among nonmetals, elements with smaller radii are more reactive due to stronger attraction for additional electrons.

12. What elements would be more reactive? Large ionization energy elements or small ionization energy elements? Explain.  
 - Elements with small ionization energy are more reactive because they lose electrons more easily. For example, alkali metals are highly reactive due to their low ionization energy.

## Lesson Check

13. How can atomic radius and ionization energy be correlated? Explain how a large atomic radius affects ionization energy.  
 - Atomic radius and ionization energy are inversely related. A larger atomic radius means outer electrons are farther from the nucleus, experiencing weaker attraction, which lowers ionization energy and makes electron removal easier.

14. Compare the electronegativity of elements residing in Group 1 and Group 17. Why are elements in Group 17 generally more electronegative than those in Group 1?  
 - Group 17 elements are more electronegative because they have higher nuclear charge and smaller atomic radii, enabling stronger attraction for shared electrons. Group 1 elements, with lower nuclear charge and larger radii, exhibit lower electronegativity.

15. Predict how the properties of an element would change if it were to be moved from Period 2 to Period 3 but stayed in the same group. Explain the reasoning for your answer.  
 - Moving to Period 3 increases the atomic radius due to the addition of an electron shell, reducing electronegativity and ionization energy. This makes the element less reactive as a nonmetal or more reactive as a metal.

16. Why does electron affinity become less negative as you move down the group on the periodic table?  
 - Electron affinity becomes less negative because the added electron is farther from the nucleus in larger atoms, experiencing weaker attraction and releasing less energy upon addition.

## Beyond the Lesson

17. How does understanding periodic trends of fundamental properties enable scientists to predict the behavior of elements in various situations?  
 - Understanding periodic trends helps scientists predict element behavior in reactions, bonding, and material design. For instance, knowledge of electronegativity and ionization energy guides the selection of elements for specific industrial and technological applications.