Bond Type Clues

Use periodic-table position to predict how atoms bond.

CHE.4.3 "Predict the ionic or covalent nature of different atoms based on electronegativity trends and/or position on the periodic table."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline two rules about element positions that help predict bond type. Circle two clues about electronegativity that help explain those predictions.

What Holds These Atoms Together?

1. Two labeled containers in a chemistry lab hold potassium bromide and sulfur dichloride. Their names tell you which elements are paired, but not why their atoms stay together. To predict the kind of bonding, first find each element on the periodic table. Metals occupy much of the left and center; nonmetals cluster on the upper right. Hydrogen is a nonmetal even though it sits on the left. Potassium is a metal and bromine is a nonmetal, so potassium bromide is mainly ionic. Sulfur and chlorine are both nonmetals, so sulfur dichloride has covalent bonds.

2. Electronegativity describes how strongly an atom attracts shared electrons. Across a row of the periodic table, electronegativity generally rises from left to right. Up a column, it generally rises from bottom to top. Fluorine, near the upper right, strongly attracts electrons. When a metal and a nonmetal have a large difference, electrons tend to transfer, creating oppositely charged ions held together by attraction. When two nonmetals have a smaller difference, they usually share electrons. Those shared electrons form a covalent bond. The pattern is a prediction tool, not a guarantee for every substance.

3. A covalent bond can still be uneven. If one bonded nonmetal attracts electrons more strongly than the other, the shared electrons spend more time near that atom. This is called polar covalent bonding. Atoms of the same element attract equally, so a bond between them is nonpolar covalent. For most classroom predictions, use the element types first, then use electronegativity trends to judge whether sharing is even or uneven. A pair from opposite sides of the periodic table is more likely to be ionic than a pair of nearby nonmetals. Borderline cases need more evidence.

2 ANSWER WITH EVIDENCE

Use the passage

1. Sodium is a left-side metal, and oxygen is an upper-right nonmetal. Predict whether their bonding is mainly ionic or covalent. Explain your choice.

2. Carbon and oxygen are both nonmetals in the same row, with oxygen farther right. Predict their bond type and whether the electrons are shared evenly.

3. Which pair is more likely to bond ionically: magnesium with chlorine, or phosphorus with sulfur? Magnesium is a left-side metal; the other three elements are upper-right nonmetals. Explain.

4. Nitrogen and hydrogen are both nonmetals, but nitrogen attracts electrons more strongly. Predict whether their bond is ionic, polar covalent, or nonpolar covalent. Explain.

3 YOUR TURN

Your own words

Choose two different pairs from calcium, fluorine, selenium, and bromine: one you predict will bond mainly ionically and one you predict will bond covalently. Calcium is a left-side metal; the others are upper-right nonmetals. Explain both predictions using position and electronegativity.

ANSWER KEY

Bond Type Clues

PART 1 · READ AND MARK

Underline two rules about element positions that help predict bond type. Circle two clues about electronegativity that help explain those predictions. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Sodium is a left-side metal, and oxygen is an upper-right nonmetal. Predict whether their bonding is mainly ionic or covalent. Explain your choice.	**Mainly ionic. A metal and an upper-right nonmetal are likely to have a large electronegativity difference, favoring electron transfer.**
2	Carbon and oxygen are both nonmetals in the same row, with oxygen farther right. Predict their bond type and whether the electrons are shared evenly.	**Polar covalent. The two nonmetals share electrons, but oxygen attracts them more strongly, so sharing is uneven.**
3	Which pair is more likely to bond ionically: magnesium with chlorine, or phosphorus with sulfur? Magnesium is a left-side metal; the other three elements are upper-right nonmetals. Explain.	**Magnesium with chlorine. They are a metal and a nonmetal on opposite sides of the table; phosphorus and sulfur are both nonmetals.**
4	Nitrogen and hydrogen are both nonmetals, but nitrogen attracts electrons more strongly. Predict whether their bond is ionic, polar covalent, or nonpolar covalent. Explain.	**Polar covalent. The nonmetals share electrons unevenly because nitrogen attracts them more strongly.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Calcium and fluorine should bond mainly ionically because they lie on opposite sides of the periodic table and likely have a large electronegativity difference. Selenium and bromine should bond covalently because both are upper-right nonmetals, so they tend to share electrons.

Accept any calcium and nonmetal pair as a reasonable mainly ionic prediction, and any pair of the listed nonmetals as covalent, when the explanation uses position or electronegativity. These are predictions, so students need not claim that the pattern has no exceptions.