Charge Balance

Use electron patterns to explain how compounds form.

PS.PS1.2 "Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, knowledge of the patterns of chemical properties, and formation of compounds."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline statements about outer electrons, circle ion charges, and number the steps that connect electron transfer to a neutral compound.

What Remains After the Flash?

1. In a laboratory, a thin strip of magnesium burns with an intense white light. A white solid remains where the shiny metal was. The strip did not turn into light or vanish: its atoms reacted with oxygen from the air. The result is a new compound with properties unlike those of the starting materials. To explain that change, look beyond color and brightness. Ask what happens to the atoms' outermost electrons, which are the electrons involved in bonding. An explanation should connect electron changes to the kind of compound that forms and to the evidence left behind.

2. Magnesium sits in Group 2 of the periodic table, so each magnesium atom has two outermost electrons. Oxygen sits in Group 16 and has six. During this reaction, a magnesium atom loses its two outer electrons, and an oxygen atom gains two. The magnesium atom becomes Mg^{2+}, and the oxygen atom becomes O^{2-}. Both ions now have stable outer-electron arrangements. Oppositely charged ions attract, creating an ionic solid. Equal numbers of these ions give the solid no overall electric charge, so its formula is MgO. The white solid is evidence that a new substance formed.

3. The periodic table lets scientists extend this explanation to new pairs. Calcium and strontium share magnesium's Group 2 pattern; lithium and sodium are Group 1 metals with one outer electron each. Sulfur shares oxygen's Group 16 pattern, while fluorine and bromine are Group 17 nonmetals with seven outer electrons each. A Group 1 atom can lose one electron, and a Group 17 atom can gain one. A Group 16 atom can gain two. These changes suggest ion charges and the lowest whole-number ratio that makes a compound neutral. They also help you revise an explanation if its proposed ratio leaves a net charge.

2 ANSWER WITH EVIDENCE

Use the passage

1. If calcium reacts with oxygen, what ions and formula do you predict? Explain using their group patterns.

2. If magnesium reacts with sulfur, what formula do you predict? Explain how electron transfer and charge balance support it.

3. If lithium reacts with oxygen, how many lithium ions are needed for each oxide ion? Give the formula and explain the ratio.

4. A student claims sodium and fluorine form Na_2F because fluorine gains two electrons. Revise the claim using outer-electron patterns.

3 YOUR TURN

Your own words

A classmate claims strontium and bromine form SrBr because one metal atom pairs with one nonmetal atom. Revise the claim in 3 to 4 sentences: identify each element's group and outer-electron change, give the ions and correct formula, and explain why SrBr is not neutral.

Charge Balance

PART 1 · READ AND MARK

Underline statements about outer electrons, circle ion charges, and number the steps that connect electron transfer to a neutral compound. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	If calcium reacts with oxygen, what ions and formula do you predict? Explain using their group patterns.	**Calcium shares magnesium's Group 2 pattern, so it forms Ca^{2+}. Oxygen forms O^{2-}; a one-to-one ratio gives CaO.**
2	If magnesium reacts with sulfur, what formula do you predict? Explain how electron transfer and charge balance support it.	**Magnesium loses two electrons to form Mg^{2+}. Sulfur shares oxygen's Group 16 pattern and gains two to form S^{2-}. The charges balance in MgS.**
3	If lithium reacts with oxygen, how many lithium ions are needed for each oxide ion? Give the formula and explain the ratio.	**Two Li^{+} ions balance one O^{2-} ion. Each lithium atom loses one electron, while oxygen gains two, giving Li_2O.**
4	A student claims sodium and fluorine form Na_2F because fluorine gains two electrons. Revise the claim using outer-electron patterns.	**Fluorine is in Group 17 and gains one electron, forming F^{-}. Sodium loses one electron, forming Na^{+}. They combine one-to-one as NaF.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Strontium is in Group 2 and loses two outer electrons to form Sr^{2+}; bromine is in Group 17 and each atom gains one electron to form Br^{-}. SrBr would have a net positive charge because one Br^{-} cannot balance one Sr^{2+}. Two bromide ions balance one strontium ion, so the compound's formula is $SrBr_2$.

Accept equivalent explanations that use group patterns to predict ion charges and balance the compound's total charge. For the open task, the revision must explain why two bromide ions are needed for each strontium ion.