Atoms on Both Sides

Use atom counts to balance reaction equations.

PHS.4.3 "Apply the concept of conservation of matter to balancing simple chemical equations."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Number the four unbalanced equations in reading order. In each one, underline an element symbol whose atom count differs across the arrow, then circle a subscript that helped you find the mismatch.

The Reaction Display

1. At a science museum, a display shows how substances change during chemical reactions. An equation names the starting substances, called reactants, on the left of an arrow and the products on the right. The arrow does not erase atoms. In a closed system, each element must have the same number of atoms before and after a reaction. To balance an equation, change only the whole-number coefficients placed before formulas. A coefficient multiplies every atom in that formula. For example, 2 Na + Cl_2 → 2 NaCl shows two sodium atoms and two chlorine atoms on each side. Changing a subscript would describe a different substance.

2. The display begins with two reactions involving oxygen. Hydrogen and oxygen can combine to form water: $H_2 + O_2 \rightarrow H_2O$. Magnesium can burn in oxygen and leave a white solid called magnesium oxide: $Mg + O_2 \rightarrow MgO$. Both equations show the substances involved, but neither has matching atom counts on both sides as written. A small subscript is part of a substance's formula; it tells how many atoms of an element occur in one particle or formula unit. A missing subscript means one atom. Count the atoms in every formula before choosing coefficients, and check again afterward.

3. Other displays show reactions without oxygen. Nitrogen and hydrogen can form ammonia, a substance used to make fertilizer: $N_2 + H_2 \rightarrow NH_3$. Aluminum can combine with chlorine to form aluminum chloride: $Al + Cl_2 \rightarrow AlCl_3$. These are starting equations, not finished balances. When a coefficient is written before a formula, multiply the count of every element in that formula by the coefficient. A coefficient of one is usually left unwritten. If the counts do not match, adjust coefficients and recount until each element has the same total on both sides. The formulas themselves must stay unchanged.

2 ANSWER WITH EVIDENCE

Use the passage

1. Balance the water equation. How many hydrogen atoms and oxygen atoms are on each side of your balanced equation?

2. Balance the magnesium oxide equation. How many magnesium atoms and oxygen atoms are on each side?

3. Balance the ammonia equation. How many nitrogen atoms and hydrogen atoms are on each side?

4. Balance the aluminum chloride equation. How many aluminum atoms and chlorine atoms are on each side?

3 YOUR TURN

Your own words

A fifth display describes iron reacting with oxygen to form iron(III) oxide. Balance $Fe + O_2 \rightarrow Fe_2O_3$, then show the iron and oxygen atom counts on both sides.

ANSWER KEY

Atoms on Both Sides

HIGH SCHOOL · PHS.4.3

PART 1 · READ AND MARK

Number the four unbalanced equations in reading order. In each one, underline an element symbol whose atom count differs across the arrow, then circle a subscript that helped you find the mismatch. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Balance the water equation. How many hydrogen atoms and oxygen atoms are on each side of your balanced equation?	**$2\ H_2 + O_2 \rightarrow 2\ H_2O$. Each side has 4 hydrogen atoms and 2 oxygen atoms.**
2	Balance the magnesium oxide equation. How many magnesium atoms and oxygen atoms are on each side?	**$2\ Mg + O_2 \rightarrow 2\ MgO$. Each side has 2 magnesium atoms and 2 oxygen atoms.**
3	Balance the ammonia equation. How many nitrogen atoms and hydrogen atoms are on each side?	**$N_2 + 3\ H_2 \rightarrow 2\ NH_3$. Each side has 2 nitrogen atoms and 6 hydrogen atoms.**
4	Balance the aluminum chloride equation. How many aluminum atoms and chlorine atoms are on each side?	**$2\ Al + 3\ Cl_2 \rightarrow 2\ AlCl_3$. Each side has 2 aluminum atoms and 6 chlorine atoms.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

$4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$. The reactants have 4 iron atoms and 6 oxygen atoms. The product side also has 4 iron atoms and 6 oxygen atoms.

Accept any equivalent whole-number balance, including coefficients that are the same multiple of those shown. Atom counts must match the student's coefficients on both sides.