Count the Atoms

Compare two versions of a reaction to see which conserves atoms.

P.7.5E.3 "Compare and contrast balanced and unbalanced chemical equations to demonstrate the number of atoms does not change in the reaction."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each water and camp-stove equation, circle numbers placed in front of formulas, and write the atom counts beside each arrow to show which versions conserve every element.

What Changed in the Equation?

1. At a science fair, imagine a reaction inside a sealed container. The materials can change, but atoms cannot escape or appear from nowhere. An equation places starting substances on the left of an arrow and products on the right. For example, $C + O_2 \rightarrow CO_2$ shows one carbon atom and two oxygen atoms on each side. The arrow means the starting substances react to form the product. Counting atoms on both sides helps test whether an equation represents the conservation of atoms.

2. A model of water forming starts with this draft equation: $H_2 + O_2 \rightarrow H_2O$. Another version reads $2H_2 + O_2 \rightarrow 2H_2O$. A small number below a symbol, called a subscript, tells how many atoms of that element are in one molecule. A large number in front, called a coefficient, multiplies every atom in the formula that follows. To compare the versions, count each element separately on both sides of each arrow. Changing a coefficient changes the number of molecules shown, but changing a subscript changes the substance named by the formula.

3. A camp stove burns methane, a fuel with the formula CH_4. One proposed equation is $CH_4 + O_2 \rightarrow CO_2 + H_2O$. A revised equation is $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$. In both versions, the same kinds of atoms appear before and after the arrow. Yet having the right kinds of atoms is not enough: each kind must also have the same number on each side. A balanced equation shows that atoms have been rearranged, not created or destroyed. A draft with mismatched counts does not accurately represent how many particles react.

2 ANSWER WITH EVIDENCE

Use the passage

1. In the draft water equation, how many hydrogen and oxygen atoms are on each side of the arrow? Which count does not match?

2. Compare the two water equations. What changed, and how do the hydrogen and oxygen counts compare across the arrow in the second version?

3. Does the proposed camp-stove equation conserve both hydrogen and oxygen atoms? Give the counts on each side.

4. Compare the revised camp-stove equation with the proposed one. Which coefficients changed, and what are the carbon, hydrogen, and oxygen counts on each side now?

3 YOUR TURN

Your own words

A different reaction starts with $N_2 + H_2 \rightarrow NH_3$. Write this unbalanced equation and a balanced version, compare the nitrogen and hydrogen counts on both sides of each arrow, and explain what you changed without changing any formulas.

ANSWER KEY

Count the Atoms

GRADE 7 · P.7.5E.3

PART 1 · READ AND MARK

Underline each water and camp-stove equation, circle numbers placed in front of formulas, and write the atom counts beside each arrow to show which versions conserve every element. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	In the draft water equation, how many hydrogen and oxygen atoms are on each side of the arrow? Which count does not match?	**Hydrogen: 2 on each side. Oxygen: 2 on the left and 1 on the right, so oxygen does not match.**
2	Compare the two water equations. What changed, and how do the hydrogen and oxygen counts compare across the arrow in the second version?	**A coefficient of 2 was added before H_2 and H_2O. The second version has 4 hydrogen atoms and 2 oxygen atoms on each side.**
3	Does the proposed camp-stove equation conserve both hydrogen and oxygen atoms? Give the counts on each side.	**No. Hydrogen is 4 on the left and 2 on the right. Oxygen is 2 on the left and 3 on the right.**
4	Compare the revised camp-stove equation with the proposed one. Which coefficients changed, and what are the carbon, hydrogen, and oxygen counts on each side now?	**The revised equation has a coefficient of 2 before O_2 and H_2O. Each side has 1 carbon, 4 hydrogen, and 4 oxygen atoms.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

$N_2 + H_2 \rightarrow NH_3$: left N 2, H 2; right N 1, H 3. $N_2 + 3H_2 \rightarrow 2NH_3$: left N 2, H 6; right N 2, H 6. I added coefficients of 3 and 2 without changing the formulas.

Accept counts written in words or labeled with element symbols. In Part 3, the balanced version must have equal counts of nitrogen and hydrogen on both sides, with subscripts unchanged.