Formula Detectives

Read chemical formulas to count atoms.

P.7.5C.5 "Describe concepts used to construct chemical formulas (e.g., CH4, H2O) to determine the number of atoms in a chemical formula."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle every chemical formula in the passage, underline each subscript, and write a small 1 above each element symbol that has no subscript.

What a Formula Reveals

1. A chemical formula is a compact way to show which elements are present and how many atoms of each are represented. Each element begins with a capital letter; a second, lowercase letter can finish its symbol. The small number written below the line after a symbol is a subscript. It tells how many atoms of that element are counted. If there is no subscript, count one. In NH_3, for example, N stands for one nitrogen atom and H_3 stands for three hydrogen atoms. A fizzy drink contains dissolved CO_2, another formula you can decode.

2. Some formulas describe molecules, groups of atoms bonded together. For example, the formula NH_3 describes one molecule of ammonia. Other formulas describe ionic compounds, made of positive and negative ions arranged in a repeating pattern. An ionic formula gives the simplest ratio of ions in a formula unit, not the atoms in a separate molecule. KBr represents a formula unit with one potassium ion and one bromide ion, so its atom count is two. Road crews sometimes spread magnesium chloride, $MgCl_2$, on icy streets. Its formula can be read using the same subscript rule.

3. Food labels and lab bottles offer more formulas to investigate. Glucose, a sugar that cells use for energy, has the formula $C_6H_{12}O_6$. Ethanol, found in some fuels, has the formula C_2H_6O. To find a total atom count, read every element symbol, record its count, and add those counts. Do not treat a subscript as the count for the entire formula. A missing subscript still counts as one, even when other symbols have subscripts. This counting method works for both molecules and formula units, although the kinds of particles they represent differ.

2 ANSWER WITH EVIDENCE

Use the passage

1. In the CO_2 formula from the fizzy drink, how many atoms of each element are shown? What is the total?

2. How many atoms of each element are shown in one formula unit of $MgCl_2$? What is the total?

3. For the glucose formula, list the count for each element and find the total number of atoms.

4. For the ethanol formula, list the count for each element and find the total number of atoms.

3 YOUR TURN

Your own words

Create a practice formula using exactly two different element symbols chosen from H, O, C, and N, with at least one subscript. In two sentences, write your formula, give the atom count for each element, and find the total; your practice formula does not need to represent a real substance.

ANSWER KEY

Formula Detectives

GRADE 7 · P.7.5C.5

PART 1 · READ AND MARK

Circle every chemical formula in the passage, underline each subscript, and write a small 1 above each element symbol that has no subscript. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	In the CO_2 formula from the fizzy drink, how many atoms of each element are shown? What is the total?	**1 carbon atom and 2 oxygen atoms, for 3 atoms total.**
2	How many atoms of each element are shown in one formula unit of $MgCl_2$? What is the total?	**1 magnesium atom and 2 chlorine atoms, for 3 atoms total.**
3	For the glucose formula, list the count for each element and find the total number of atoms.	**6 carbon, 12 hydrogen, and 6 oxygen atoms, for 24 atoms total.**
4	For the ethanol formula, list the count for each element and find the total number of atoms.	**2 carbon, 6 hydrogen, and 1 oxygen atom, for 9 atoms total.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

My practice formula is C_2H_5. It shows two carbon atoms and five hydrogen atoms, for seven atoms in all.

For Part 1, each formula should be circled, each subscript underlined, and each element symbol without a subscript marked with a 1. For Part 3, accept any formula that follows the symbol and subscript rules and has correctly calculated counts; it need not represent a real substance.