

Fixing Priya's Notebook: Seven Reaction Claims That Break the Atom Rule

Learning target: I can find the error in a claim about atoms, equations or mass in a chemical reaction, explain what went wrong, and rewrite the claim so it follows the rule that atoms are only regrouped.

Error analysis

About 35 min

Individual

MS-PS1-5 · practice

writing

independent practice

Name _____

Date _____

Period _____

Directions

Priya is a fictional student who kept careful notes but made seven mistakes in her reasoning. Read all seven entries and her atom tally. Part A asks you to sort the entries. Part B asks you to explain each error and rewrite the entry correctly, in Priya's voice, so that it still describes her observation but gets the science right. Part C asks you to write Priya a rule she can use next time. Write in complete sentences. The equations in the notebook are correct as written; the mistakes are in the reasoning, not in the equations.

You will need: This worksheet, Pencil

Priya's lab notebook, page 12 — Entry 1. Steel wool: 2.00 g before burning, 2.14 g after. The heat from the flame got stored inside the metal, and that stored heat is the extra 0.14 g. **Entry 2.** Equation for splitting water: $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$. Counting: on the left, H has 2 atoms (the small 2) and O has 1. On the right, H has 2 and O has 2. So the reaction created one oxygen atom. **Entry 3.** To fix Entry 2, I rewrote the water as H_2O_2 so both sides would have 2 oxygen atoms. Now it balances. **Entry 4.** Vinegar and baking soda in an open cup: 162.0 g before, 161.0 g after. The bubbles are just gas, and gas does not weigh anything, so 1.0 g of matter was destroyed by the reaction. **Entry 5.** When methane burns ($\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$), the carbon atom breaks apart into smaller pieces, and the pieces become the carbon dioxide. **Entry 6.** In the methane reaction there are 3 molecules before and 3 after, so the number of molecules is conserved in every reaction, just like atoms. **Entry 7.** The capped bottle stayed at 165.5 g during the fizzing because the cap kept the heat in, and heat is what the balance was weighing.

Priya's atom tally for burning magnesium: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

Element	Atoms before (reactants)	Atoms after (products)	Priya's conclusion
Mg	2	2	same
O	2	1	one oxygen atom disappeared

Priya's counting is wrong in one cell. Magnesium oxide (MgO) is an extended structure, so MgO is one repeating unit, not a molecule.

Part A: Sort the entries

1. For each entry, name the error type from this list: *energy counted as matter, subscript read as a total, subscript changed, gas treated as massless, atoms said to break, molecules confused with atoms*. Two entries share the same type. Then write one thing Priya observed or did correctly in that entry, because every entry has a correct observation inside it.

Error type (choose from the list)	One sentence: what Priya got right
Entry 1	
Entry 2	
Entry 3	
Entry 4	
Entry 5	
Entry 6	
Entry 7	

Part B: Explain and rewrite

2. Entry 1. Explain why heat cannot be the extra 0.14 g, and say what the balance was actually weighing. Then rewrite the entry correctly in Priya's voice.

3. Entries 2 and 3. Redo Priya's count for $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$, showing the multiplication for every term. Explain the counting mistake in Entry 2, then explain why the 'fix' in Entry 3 is worse than the original mistake. Rewrite both entries as one correct entry.

4. Entry 4. Priya's two readings are correct. Explain what is wrong with 'gas does not weigh anything' and with 'matter was destroyed,' then rewrite the entry so it says where the 1.0 g went and how she could check.

5. Entry 5. What really breaks when methane burns, and what stays whole? Rewrite the sentence so the carbon atom survives the reaction.

6. Entry 6. Use the equation $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$ (hydrogen peroxide breaking down) to show Priya a reaction where her claim fails. Count molecules and atoms on each side, then rewrite the entry so it says what is always conserved and what only sometimes stays the same.

7. Entry 7. Priya's reading is right and her reason is wrong. Explain what the cap really kept in, and rewrite the entry.

8. Redo Priya's magnesium tally for $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$. Below the table, write which cell she got wrong, the multiplication she skipped, and the corrected conclusion.

Atoms before (reactants)	Atoms after (products)	Same? (yes/no)
Mg		
O		
Total		

Part C: A rule for next time

9. Write Priya a checking rule in three or four sentences that would have caught all seven errors. It must cover: what to multiply when counting atoms, what you may and may not change in a formula, what a balance can and cannot weigh, and what to do when an open container's reading changes.

Three questions to ask every entry

Ask each entry three questions. First: is she counting atoms correctly? Count by multiplying the coefficient (the big number in front) by the subscript (the small number after a symbol) and add up each element across the whole side. Second: is she calling something matter that is not matter? Heat, light and energy do not sit on a balance; only atoms do. Third: if a reading changed, did she say where the atoms went or came from? If an entry says 'destroyed', 'created', 'broke apart' (about an atom) or 'weighs nothing' (about a gas), the entry needs repair.

Write the eighth entry

Write an Entry 8 for Priya's notebook about a reaction she has not seen in class: a glow stick snapped in a sealed tube reads 18.30 g before and 18.30 g after it stops glowing. Write it the way Priya would have written it with one of the seven error types hidden inside, then write the corrected version beside it and label which error type you planted. Finally, explain why light leaving the tube does not change the reading even though something clearly left.