

Atoms in Chemical Reactions: Mastery Check

Learning target: I can count atoms in a given equation, sort a reaction by how its atoms regroup, predict and explain balance readings in open and closed systems, and compute the efficiency of a chemical process from mass data.

Retrieval and mastery check

About 35 min

Individual

MS-PS1-5 · assesses

MS-ETS1-3 · practice

independent practice

writing

visual modeling

Name _____

Date _____

Period _____

Directions

Work alone without notes. Part A has twelve short items; answer every one, and show your calculation on any numeric item. Part B is one synthesis paragraph. The equations on this quiz are correct as written; your job is to count, not to change them. Points are shown for each item; the quiz is worth 30 points.

You will need: This worksheet, Pencil

Part A: Retrieval items (24 points)

1. In the equation $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$ (steel wool burning), which substances are the reactants? 1 pt
☐ A. Fe_2O_3 only
☐ B. Fe and O_2
☐ C. O_2 and Fe_2O_3
☐ D. Fe only
2. In the same equation, how many oxygen atoms are in 3O_2 , and how many are in $2\text{Fe}_2\text{O}_3$? Show the multiplication for each. 2 pts

3. In 2NH_3 (two ammonia molecules), the small 3 is a: 1 pt
☐ A. coefficient; it counts molecules
☐ B. subscript; it counts hydrogen atoms in each molecule
☐ C. subscript; it counts nitrogen atoms in each molecule
☐ D. coefficient; it counts atoms in total
4. True or false: During a chemical reaction, atoms break apart into smaller pieces, and the pieces build the products. 1 pt
☐ True ☐ False Explain your thinking:

5. Tally the atoms in $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ (magnesium burning; MgO is an extended structure counted in repeating units). 3 pts

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

6. Sort each reaction by how its atoms regroup: breaking apart, joining together, or swapping partners. (a) $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$ (b) $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ (c) $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$. Give a one-phrase reason for each. 3 pts

7. A fizzing reaction runs inside a sealed rigid bottle on a balance. Before: 240.0 g. What does the balance read after the fizzing stops? Explain in one sentence. 2 pts

8. The same reaction runs in an open dish. Before: 85.6 g. After: 84.9 g. How much gas left the dish? Show the subtraction and name what carried the mass away. 2 pts

9. Steel wool reads 2.00 g before burning and 2.14 g after. The best explanation for the extra 0.14 g is: 1 pt

- ☐ A. heat from the flame was stored in the metal
- ☐ B. oxygen atoms from the air bonded to the iron atoms
- ☐ C. the balance drifted while the metal was hot
- ☐ D. iron atoms were created by the reaction

- 10.** Nitrogen and hydrogen react to form ammonia: $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$. Draw a BEFORE box and an AFTER box. Draw every atom as a labeled circle (N or H) with lines for bonds: nitrogen gas is two N atoms bonded together, hydrogen gas is two H atoms bonded together, and each ammonia molecule is one N atom bonded to three H atoms. Write the tally (N = __, H = __) under each box. 4 pts

- 11.** A process uses 300 kg of reactants per batch and produces 120 kg of the wanted product; everything else is waste. (a) How much waste is made per batch? (b) What is the efficiency, as the percentage of reactant mass that becomes wanted product? Show both calculations. 2 pts

- 12.** One sentence states the law of conservation of matter. Another sentence explains why it is true. Write both sentences and label which is the law and which is the explanation. 2 pts

Part B: Synthesis (6 points)

13. A cup of vinegar and baking soda on a balance lost 1.1 g while it fizzed. A pad of steel wool on a balance gained 0.14 g while it burned. Explain both readings using one rule about atoms. Your answer must: say what crossed the boundary in each case and in which direction; state what would happen to each reading inside a sealed container; and explain why a chemical engineer who wants less waste cares about this same rule. 6 pts

Before you start

Counting rule: multiply the big number in front (coefficient) by the small number after a symbol (subscript); a symbol with no subscript counts as 1. Add every element across the whole side of the arrow before you compare sides. Reading rule: in a sealed, rigid container the balance reading does not change; in an open one, the reading falls if a gas leaves and rises if atoms from the air join a solid. Efficiency rule: wanted product mass $\div$ reactant mass $\times 100$.

Write the hardest fair item

Write one quiz item of your own that a classmate could only answer by using the atom model, not by memory. It must include an equation (already correct), a sealed or open container, and a balance reading, and it must have a single defensible numerical answer. Write the full answer key for it, including the calculation and one wrong answer a student might give with the misconception that produces it.