SCIENCE FOUNDATIONS

Balancing chemical equations

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how you show that nothing is created or destroyed in a reaction, like accounting for every atom when wood burns or bread rises. Wood burning in a fire turns into ash, smoke, and heat, but every atom that was in the wood is still there in some form. Bread rising uses yeast to turn sugar into gas, and the atoms are rearranged, not made or lost. Balancing an equation is just making sure the count of each kind of atom is the same on both sides, like balancing a set of books.



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Rule

Balancing chemical equations: atoms are never created or destroyed in a reaction, so each element must have the same number of atoms on both sides of the equation.

You balance by changing coefficients only, never subscripts, because changing a subscript changes the substance.

Worked examples

EXAMPLE 1

Q What is the balanced form of $H_2 + O_2 \rightarrow H_2O$?

SOLUTION

Count: left has 2 H and 2 O, right has 2 H and 1 O.

Balance oxygen first:

$H_2 + O_2 \rightarrow 2H_2O$

Balance hydrogen:

$2H_2 + O_2 \rightarrow 2H_2O$

The result is $2H_2 + O_2 \rightarrow 2H_2O$.

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EXAMPLE 2

Q What is the balanced form of $CH_4 + O_2 \rightarrow CO_2 + H_2O$?

SOLUTION

Count: carbon is balanced at 1 each side.

Balance hydrogen:

$CH_4 + O_2 \rightarrow CO_2 + 2H_2O$

Balance oxygen:

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

The result is $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.

Practice questions

1 Balance $H_2 + Cl_2 \rightarrow HCl$.

- **A** H2 + Cl2 -> HCl
- **B** H2 + Cl2 -> 2HCl
- **C** 2H2 + Cl2 -> 2HCl
- **D** H2 + 2Cl2 -> 2HCl

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2 Balance $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$.

- **A** 2C2H6 + 7O2 -> 4CO2 + 6H2O
- **B** C2H6 + 7O2 -> 4CO2 + 6H2O
- **C** 2C2H6 + 7O2 -> 4CO2 + 3H2O
- **D** 2C2H6 + 3O2 -> 4CO2 + 6H2O

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3 In the balanced equation $N_2 + 3H_2 \rightarrow 2NH_3$, how many hydrogen atoms are on each side?

- **A** 2
- **B** 3
- **C** 6
- **D** 4

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4 Balance $Mg + O_2 \rightarrow MgO$.

- A $Mg + O_2 \rightarrow MgO$
- B $2Mg + O_2 \rightarrow 2MgO$
- C $Mg + O_2 \rightarrow 2MgO$
- D $2Mg + 2O_2 \rightarrow 2MgO$

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5 Why balance equations?

- A Atoms are created
- B Molecules are destroyed
- C Atoms are conserved
- D Energy is created

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6 Can you change a subscript to balance?

- A Yes
- B No

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7 What is wrong with this equation: $2Fe + 3O_2 \rightarrow 2Fe_2O_3$?

- A Nothing, it is balanced
- B Iron is not balanced
- C Oxygen is not balanced
- D Both are unbalanced

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8 **Which of these equations is already balanced?**

- **A** $H_2 + O_2 \rightarrow H_2O$
- **B** $2H_2 + O_2 \rightarrow 2H_2O$
- **C** $H_2 + O_2 \rightarrow 2H_2O$
- **D** $2H_2 + 2O_2 \rightarrow 2H_2O$

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9 **How many aluminium atoms are in $2Al_2O_3$?**

- **A** 2
- **B** 3
- **C** 4
- **D** 6

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What must be equal on both sides?

A The number of each atom

B The number of molecules

C The mass of each molecule

D The number of each coefficient

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ANSWER KEY

1. H2 + Cl2 -> 2HCl

2. 2C2H6 + 7O2 -> 4CO2 + 6H2O

3. 6

4. 2Mg + O_2 -> 2MgO

5. Atoms are conserved

6. No

7. Iron is not balanced

8. $2H_2 + O_2 \rightarrow 2H_2O$

9. 4

10. The number of each atom

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