Physical Sciences SCI 051
Chapter 17
How Chemicals React
Sections 17.1

17.1 – Chemical Equations

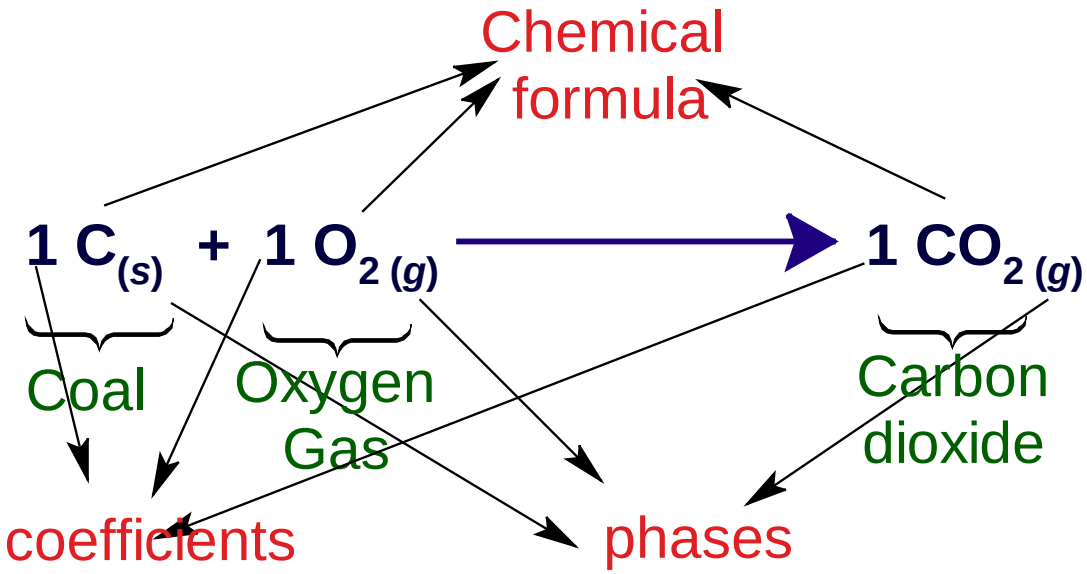
A chemical equation: shows the reacting substances (reactants) to the left of an arrow that points to the newly formed substances (products)

Reactants ⟶ **Products**

$2\ H_2(g) + 1\ O_2(g) \longrightarrow 2\ H_2O(g)$ (balanced)

17.1 – Chemical Equations

- Reactants and products are represented by their elemental or chemical formulas.



- Coefficients: numbers are placed in front of the reactants or products to show the ratio in which they either combine

- Phases are shown as:
  - (*s*) for solid
  - (*ℓ*) for liquid
  - (*g*) for gas
  - (*aq*) for aqueous solution (Compounds dissolved in water)

17.1 – Chemical Equations

Law of Mass Conservation: the matter is neither created nor destroy during a chemical reaction

The number of times atoms appear before the arrow must be equal to the number of times they appear after the arrow. (the chemical equation must be balanced

Example

$$2H_{2\,(g)} + 1\,O_{2\,(g)} \longrightarrow 2\,H_2O_{(g)}$$

4 hydrogen atoms

2 Oxygen atoms

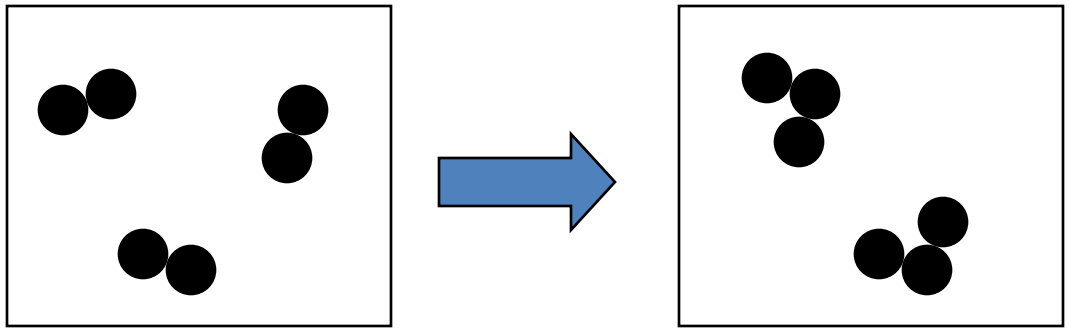
2 molecules of water contains 4 hydrogen atoms and 2 oxygen atoms

By convention, the coefficient (1) is omitted

$$2H_{2\,(g)} + O_{2\,(g)} \longrightarrow 2\,H_2O_{(g)}$$

Chemical Equations
CHECK YOUR NEIGHBOR

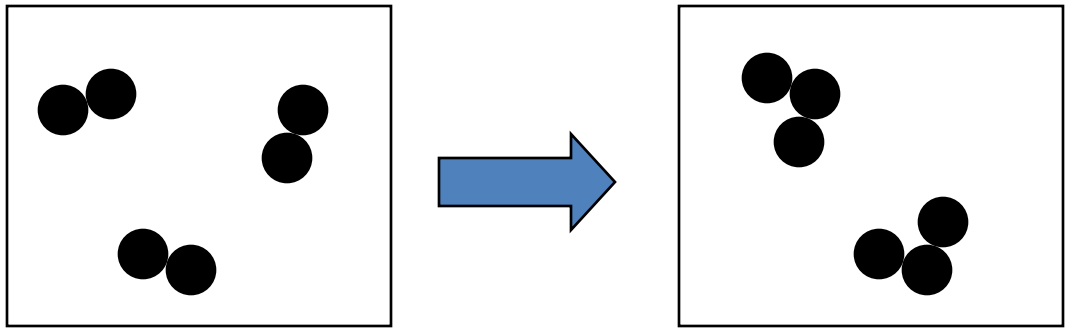
In total, how many atoms are represented by the following schematic for a chemical reaction?



A. 2
B. 5
C. 6
D. 12

Chemical Equations
CHECK YOUR ANSWER

In total, how many atoms are represented by the following schematic for a chemical reaction?



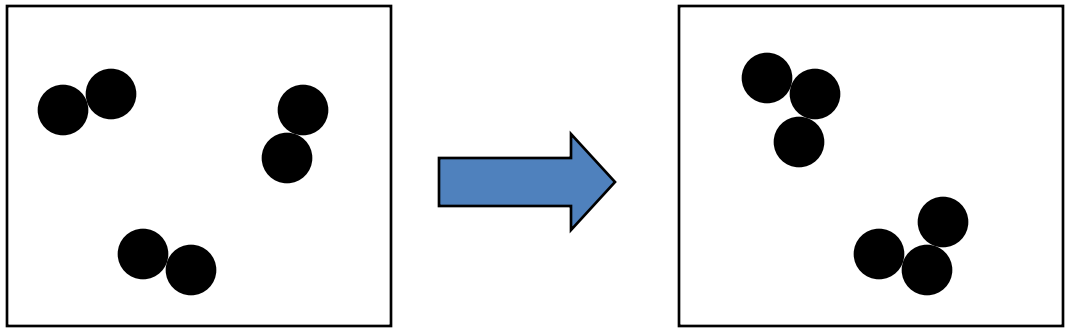
A. 2
B. 5
C. 6
D. 12

Explanation:

The atoms of the reactants are the SAME atoms of the products, except in a different configuration.

Chemical Equations
CHECK YOUR ANSWER

In total, how many atoms are represented by the following schematic for a chemical reaction?



$3\ O_2$ ⟶ $2\ O_3$

A. 2
B. 5
C. 6
D. 12

"conventional" equation format

All you see here are six atoms!

Chemical Equations
CHECK YOUR NEIGHBOR

Is the following chemical equation balanced?

$$1\ CH_4 + 2\ O_2 \rightarrow 2\ H_2O + 1\ CO_2$$

A. No, because the molecules have changed.

B. Yes, because the coefficients on each side add up to the same number.

C. No, because there are more oxygen atoms in the products.

D. Yes, because the same atoms appear before and after.

Chemical Equations
CHECK YOUR ANSWER

Is the following chemical equation balanced?

$$1\ CH_4 + 2\ O_2 \rightarrow 2\ H_2O + 1\ CO_2$$

A. No, because the molecules have changed.

B. Yes, because the coefficients on each side add up to the same number.

C. No, because there are more oxygen atoms in the products.

D. Yes, because the same atoms appear before and after.

Chemical Equations
CHECK YOUR ANSWER

Balance the following equation

$$NO_{(g)} \rightarrow N_2O + NO_{2\,(g)}$$

Note: we have to change the coefficient, not the subscripts, because changing the subscripts means changing the identity of the compound

Answer:

$$NO_{(g)} \rightarrow N_2O + NO_{2\,(g)}$$

Not balanced

1 nitrogen atom
1 oxygen atom

3 nitrogen atom
3 oxygen atom

$$3NO_{(g)} \rightarrow N_2O + NO_{2\,(g)}$$

Balanced

3 nitrogen atoms and 3 oxygen atoms on each side of the arrow

Chemical Equations
CHECK YOUR ANSWER

Balance the following equation

$$H_{2\,(g)} + N_{2\,(g)} \rightarrow NH_{3\,(g)}$$

Answer:

$$H_{2\,(g)} + N_{2\,(g)} \rightarrow NH_{3\,(g)}$$

Not balanced

2 nitrogen atoms
2 hydrogen atoms

1 nitrogen atom
3 hydrogen atoms

$$3H_{2\,(g)} + N_{2\,(g)} \rightarrow 2NH_{3\,(g)}$$

Balanced

2 nitrogen atoms and 6 hydrogen atoms on each side of the arrow