

# AIM | What is a chemical 12 | equation?

You may tear a sheet of paper into tiny pieces, but you still have paper. Each piece is still paper no matter how small. The way the atoms are linked together has not changed. No new products have been formed. The properties of the paper have not changed. Neither has its formula.

A change like tearing paper is called a *physical change*. In a physical change, only the appearance of a substance changes. The chemical makeup does *not* change.

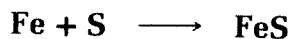
What happens when you burn paper? You no longer have paper. Paper is a compound made up mostly of carbon and hydrogen. When paper burns, it links up with oxygen from the air. Three products form—ash, water, and carbon dioxide. When paper burns, there is a change in the way atoms link together. New products form. Properties change.

A change like burning paper is called a *chemical change*. In a chemical change, the chemical makeup of a substance changes. New products form. Each product has its own properties. Each one has its own formula.

A chemical change is caused by a *chemical reaction*. The “story” of a chemical reaction is called a *chemical equation*. A chemical equation shows two things: (1) which substance(s) we start out with and (2) which substance(s) we end up with.

The substance or substances we start out with are called the *reactants*. The substance or substances we end up with are called the *products*.

This is an example of a chemical equation:



This equation describes the chemical reaction that takes place when a mixture of iron (Fe) and sulfur (S) are heated. The Fe and S are the *reactants*. The FeS (iron sulfide) is the *product*. The arrow means “produces” or “yields.”

The properties of iron sulfide are different from those of iron or sulfur.

# UNDERSTANDING CHEMICAL EQUATIONS

## Example 1

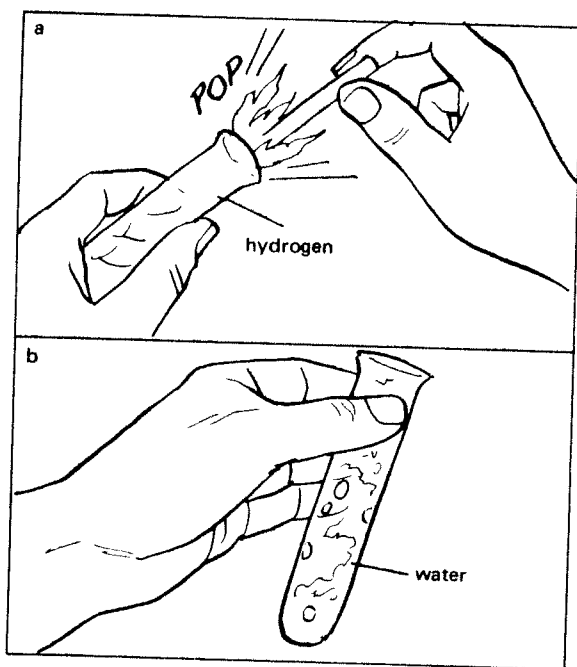
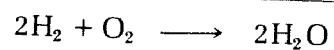


Figure A

Hydrogen can explode.

When hydrogen explodes it links up with oxygen to form water.

The equation below tells the story of this chemical equation.



Study the equation. Then answer these questions.

1. This formula has two *reactants*. Name them. \_\_\_\_\_  
\_\_\_\_\_
2. The reactants are \_\_\_\_\_.  
elements, compounds
3. This formula has one *product*. Name that product. \_\_\_\_\_
4. The product is \_\_\_\_\_.  
an element, a compound
5. Name the states of matter. \_\_\_\_\_  
\_\_\_\_\_
6. What is the state of hydrogen? \_\_\_\_\_
7. What is the state of oxygen? \_\_\_\_\_
8. What is the state of water? \_\_\_\_\_
9. Are the properties of hydrogen the same as the properties of water? \_\_\_\_\_
10. Are the properties of oxygen the same as the properties of water? \_\_\_\_\_
11. In a chemical reaction, properties \_\_\_\_\_ change.  
do, do not

12. a) Name the *kinds* of atoms on the reactant side of this equation. \_\_\_\_\_  
 \_\_\_\_\_
- b) Name the *kinds* of atoms on the product side. \_\_\_\_\_  
 \_\_\_\_\_
13. a) The kinds of atoms on the reactant side \_\_\_\_\_ the same as the  
 kinds of atoms on the product side. are, are not
- b) Are they in the same form? \_\_\_\_\_
- c) How are they different? Reactant side \_\_\_\_\_  
 Product side \_\_\_\_\_
14. The link-up of the atoms \_\_\_\_\_ changed.  
has, has not
15. In this reaction, atoms have \_\_\_\_\_.  
separated, linked up
16. In a chemical reaction, the link-up of the elements \_\_\_\_\_ change.  
does, does not
17. a) In a chemical equation, the reactants are on the \_\_\_\_\_ of the  
 arrow. right, left
- b) The products are on the \_\_\_\_\_.  
right, left

### Example 2



**Figure B**

Table salt ( $\text{NaCl}$ ) is a white solid. Your body contains this salt. It is necessary for life.



**Figure C**

Sodium ( $\text{Na}$ ) is a very dangerous solid. It can explode in water.

Swallowing sodium can cause death.

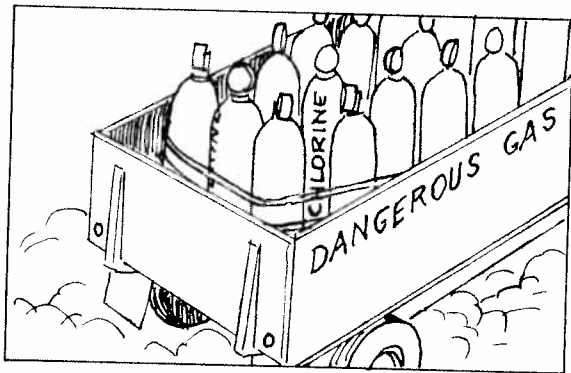
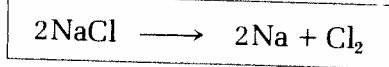


Figure D

Chlorine (Cl) is a deadly greenish-yellow gas. If you inhale enough of this gas, you will die.

Table salt can be melted. If an electric current passes through melted sodium chloride, a chemical reaction takes place. This is the chemical equation for this reaction.



Study the equation. Then answer these questions.

18. This reaction has one *reactant*. Name that reactant. \_\_\_\_\_
19. The reactant in its *natural* state is a \_\_\_\_\_  
solid, liquid, gas
20. The reactant \_\_\_\_\_ dangerous.  
is, is not
21. Name the *products*. \_\_\_\_\_
22. What is the state of sodium? \_\_\_\_\_
23. a) Is sodium dangerous? \_\_\_\_\_  
b) Are the properties of sodium the same as the properties of sodium chloride?  
\_\_\_\_\_
24. What is the state of chlorine? \_\_\_\_\_
25. a) Is chlorine dangerous? \_\_\_\_\_  
b) Are the properties of chlorine the same as the properties of sodium chloride?  
\_\_\_\_\_
26. In a chemical reaction, properties \_\_\_\_\_ change.  
do, do not
27. Name the *kinds* of atoms on the reactant side of this equation. \_\_\_\_\_
28. Name the *kinds* of atoms on the product side. \_\_\_\_\_
29. a) The kinds of atoms on the reactant side \_\_\_\_\_ the same as the  
atoms on the resultant side. are, are not  
b) Are they in the same form? \_\_\_\_\_  
c) How are they different? Reactant side \_\_\_\_\_  
Product side \_\_\_\_\_

30. The arrangement of the atoms \_\_\_\_\_ changed.  
has, has not
31. In this reaction, atoms have \_\_\_\_\_.  
separated, linked up
32. In a chemical reaction, the arrangement of the elements \_\_\_\_\_ change.  
does, does not

**COMPLETING SENTENCES** Complete the sentences with the choices below.

products  
chemical equation  
new  
arrow

right  
take part  
chemical  
reactants

physical  
yields  
reaction  
left

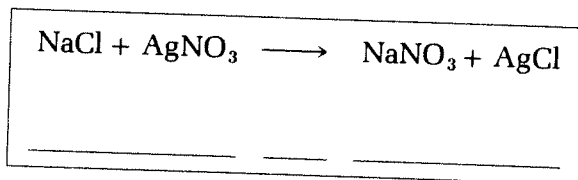
- A change in which no new products are formed is called a \_\_\_\_\_ change.
- A change in which new products are formed is called a \_\_\_\_\_ change.
- Another way of saying "chemical change" is "chemical \_\_\_\_\_."
- A set of symbols and formulas that describes a chemical reaction is called a \_\_\_\_\_.
- A chemical equation tells which substances \_\_\_\_\_ in a chemical reaction. It also tells which \_\_\_\_\_ substances are formed.
- The substances that take part in a chemical reaction are called the \_\_\_\_\_.
- The new substances that form in a chemical reaction are called the \_\_\_\_\_.
- In a chemical equation, the reactants are on the \_\_\_\_\_ side. The products are on the \_\_\_\_\_ side.
- In a chemical reaction, the reactants and products are separated by an \_\_\_\_\_.
- The arrow means "produces" or "\_\_\_\_\_".

**MATCHING** Match the two lists. Write the correct letter on the line next to each number.

- |                            |   |
|----------------------------|---|
| 1. _____ chemical reaction | a) substances that are changed in a chemical reaction |
| 2. _____ chemical equation | b) does not produce new products                      |
| 3. _____ reactants         | c) produces new products                              |
| 4. _____ products          | d) new substances from a chemical reaction            |
| 5. _____ physical change   | e) describes a chemical reaction                      |

### IDENTIFYING THE PARTS OF AN EQUATION

Look at the equation in the box. In each of the blanks below the equation, write *reactant*, *product*, or *yield*.



Now look at the list below. There you will find the *name* of each substance in this equation.

Write *reactant* next to each substance that is a reactant.

Write *product* next to each substance that is a product.

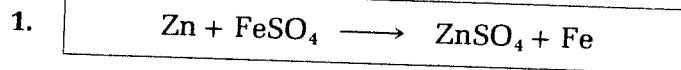
Sodium nitrate \_\_\_\_\_

Sodium chloride \_\_\_\_\_

Silver nitrate \_\_\_\_\_

Silver chloride \_\_\_\_\_

Now do the same for each of the equations that follow.

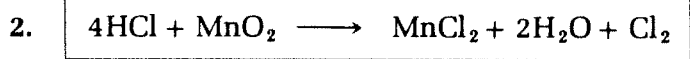


Zinc sulfate \_\_\_\_\_

Zinc \_\_\_\_\_

Iron \_\_\_\_\_

Iron sulfate \_\_\_\_\_



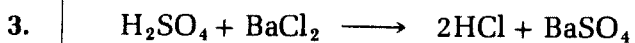
Chlorine \_\_\_\_\_

Manganese chloride \_\_\_\_\_

Manganese dioxide \_\_\_\_\_

Water \_\_\_\_\_

Hydrochloric acid (Hydrogen chloride) \_\_\_\_\_

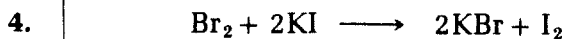


Barium chloride \_\_\_\_\_

Barium sulfate \_\_\_\_\_

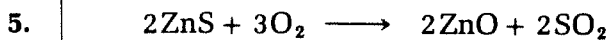
Hydrochloric acid (hydrogen chloride) \_\_\_\_\_

Sulfuric acid (hydrogen sulfate) \_\_\_\_\_



Potassium bromide \_\_\_\_\_ Iodine \_\_\_\_\_

Bromine \_\_\_\_\_ Potassium iodide \_\_\_\_\_



Oxygen \_\_\_\_\_ Sulfur dioxide \_\_\_\_\_

Zinc oxide \_\_\_\_\_ Zinc sulfide \_\_\_\_\_

## REACHING OUT

Sodium hydroxide reacts with hydrochloric acid (hydrogen chloride) to produce sodium chloride (table salt) and water. Write the equation that shows this reaction.

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