

F3. Matter & Chemical, Physical Processes

Reactants, Products, and the Chemistry of Our World"

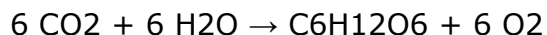
In the intricate dance of the natural world, matter constantly undergoes changes through chemical and physical processes. These transformations are at the heart of the science of chemistry and the study of the substances that make up our Earth's crust, living matter, oceans, and atmosphere. To understand this, we'll explore chemical equations, the limited number of elements, and the significance of reactants and products in chemical reactions.

Reactants and Products: The Essence of Chemical Reactions

At the core of chemistry are chemical reactions, where substances called reactants combine and rearrange their atoms to form new substances called products. Think of this process as nature's way of recycling and rearranging the building blocks of matter. Chemical reactions are like the alchemical wizards of our world, transforming one substance into another.









Chemical Equations: A Visual Representation

To represent chemical reactions, scientists use chemical equations. These equations provide a visual and symbolic way to describe the reactants, the process, and the products. For example, consider the equation for photosynthesis:



This equation tells us that six carbon dioxide molecules (CO_2) and six water molecules (H_2O) react to form one molecule of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) and six molecules of oxygen (O_2).

Chemical and Physical Changes

Chemical change: A chemical reaction forms new products.		Physical change: Matter changes form but not chemical identity.	
 Combustion	 Rotting	 Melting	 Shredding
 Rusting	 Digestion	 Boiling	 Chopping

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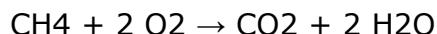
Limited Number of Elements

It's fascinating to think that the astounding diversity of matter on Earth is primarily composed of just a limited number of elements. The elements are like the alphabet of chemistry, with each element having its own unique properties and characteristics.

In fact, the Earth's crust, living matter, oceans, and atmosphere are all made up of a relatively small set of elements. Elements like oxygen, carbon, hydrogen, and nitrogen are the building blocks of life. Silicon, aluminum, and iron dominate the Earth's crust, while gases like nitrogen, oxygen, and carbon dioxide fill our atmosphere.

Chemistry in Action: An Example

To see these concepts in action, let's consider the combustion of methane (CH₄), a natural gas commonly used for heating and cooking. When methane reacts with oxygen (O₂), it forms carbon dioxide (CO₂) and water (H₂O). This chemical reaction is vital for understanding the energy transformations that occur when we burn natural gas.



This equation shows that one molecule of methane combines with two molecules of oxygen to produce one molecule of carbon dioxide and two molecules of water.

1. What are the substances that combine and rearrange their atoms to form new substances in a chemical reaction called?
 - a) Products
 - b) Chemical equations
 - c) Matter
 - d) Reactants
2. What is the purpose of chemical equations in chemistry?
 - a) To describe the reactants and products of a chemical reaction
 - b) To provide a visual representation of elements
 - c) To define the periodic table
 - d) To calculate atomic mass
3. Which of the following elements is NOT commonly found in Earth's crust?
 - a) Oxygen
 - b) Silicon
 - c) Carbon
 - d) Helium

4. Which of the following is a chemical change?
- a) Boiling
 - b) Rusting
 - c) Melting
 - d) Shredding
5. Which of the following represents the chemical equation for photosynthesis?
- a) $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$
 - b) $\text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$
 - c) $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
 - d) $\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
6. Which gas is commonly found in Earth's atmosphere and is essential for respiration?
- a) Carbon dioxide (CO_2)
 - b) Oxygen (O_2)
 - c) Hydrogen (H_2)
 - d) Nitrogen (N_2)
7. What are the building blocks of life and make up a significant portion of living matter?
- a) Noble gases
 - b) Halogens
 - c) Metals
 - d) Oxygen, carbon, hydrogen, and nitrogen
8. In the combustion of methane (CH_4), what are the products of the reaction?
- a) Carbon and water
 - b) Carbon dioxide and oxygen
 - c) Carbon dioxide and water
 - d) Methane and oxygen
9. Which element is NOT commonly found in the Earth's atmosphere?
- a) Oxygen (O)
 - b) Carbon (C)
 - c) Iron (Fe)
 - d) Nitrogen (N)
10. What are the products of photosynthesis?
- a) One molecule of glucose and oxygen
 - b) One molecule of glucose and 6 molecules of oxygen
 - c) Two molecules of glucose and three molecules of oxygen
 - d) One molecule of oxygen and six molecules of glucose

ANSWERS & EXPLANATIONS

1. d) Reactants

Reactants are the substances that combine and rearrange their atoms to form new substances in a chemical reaction.

2. a) To describe the reactants and products of a chemical reaction

Chemical equations are used in chemistry to describe the reactants, the process, and the products of a chemical reaction.

3. d) Helium (He)

Helium is a noble gas and is not commonly found in Earth's crust.

4. c) Rusting

Rusting is a chemical change. The rest are physical changes.

5. a) $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$

This represents the chemical equation for photosynthesis, where carbon dioxide and water react to form glucose and oxygen.

6. b) Oxygen (O_2)

Oxygen is commonly found in Earth's atmosphere and is essential for respiration.

7. d) Oxygen, carbon, hydrogen, and nitrogen

These elements are the building blocks of life and make up a significant portion of living matter.

8. c) Carbon dioxide and water

In the combustion of methane (CH_4), the products of the reaction are carbon dioxide (CO_2) and water (H_2O).

9. c) Iron (Fe)

Iron is not commonly found in the Earth's atmosphere.

10. b) One molecule of glucose and 6 molecules of oxygen

During photosynthesis, six carbon dioxide molecules (CO_2) and six water molecules (H_2O) react to form one molecule of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) and six molecules of oxygen (O_2).