

BASIC CONSTITUENTS OF MATTER

Substances are classified into pure substances and mixtures. Water, sugar, carbon etc. are examples for pure substances and saline water, air, lemon juice etc. are examples for mixtures.

Substances can also be classified into compounds and elements.

Compounds: Pure substances that can be decomposed to other substances through chemical process are called compounds.

Example.1. Water: It can be decomposed to hydrogen and oxygen by passing electric current through it.

2. Sugar: Sugar can be decomposed to carbon and water by heating it.

Elements: Pure substances that cannot be split into other substance are called elements.

Hydrogen, Oxygen, Aluminium, Iron etc. are examples for elements.

Compounds are formed by combining two or more elements through chemical reaction.

Origin of the names of Elements.

More than 100 stable elements are discovered so far. Elements are known in the names of continents, countries, planets, satellites, scientists etc. A few examples are given in the table.

Name of the Element	Basis of naming.
Polonium	Poland - Country
Americium	America - Country
Francium	France - Country
Curium	Marie Curie - Scientist
Mendelevium	Mendeleev – Scientist.
Rutherfordium	Rutherford - Scientist.
Europium	Europe - Continent
Neptunium	Neptune – Planet.
Titanium	Titan – Satellite
Chlorine	(chloro) colour – Physical property
Chromium	(chrome) colour - Physical property
Indium	(Indigo) colour - Physical property

Symbols: For convenience, symbols of elements are used instead of writing full name of them. The symbols are assigned in different ways.

Method.1: The first letter of the English name of the elements is used as symbols.

Examples. Carbon – C, Hydrogen – H, Oxygen – O

Method.2: Along with the first letter, second letter or any prominent letter is also used as symbol.

Examples. Calcium – Ca, Chlorine – Cl, Bromine – Br, Chromium – Cr

Method.3: Letter or letters of Latin name of the elements are used as symbol.

Examples: Sodium – Natrium – Na. Potassium – Kalium – K

Copper – Cuprum – Cu Iron – Ferrum – Fe

Atoms and molecules: Atom is the smallest particle that shows all the characteristic properties of an element. All elements are made of their own atoms.

Atoms of all elements cannot exist as single atoms. So they combine with two or more atoms to form molecules. Molecules are the smallest particle that can exist independently.

Representation of Atoms and molecules: Symbols of elements are used to represent atoms.

For example: H – means one hydrogen atom. 4 Na – means four sodium atoms.

Molecules are represented by symbols of the element with the subscription of number of atoms present in that molecule.

Example: H_2 – One Hydrogen molecule. (A hydrogen molecule consists two hydrogen atoms)

O_3 – One Ozone molecule . (There are three oxygen atoms present in one ozone molecule)

P_4 - Phosphorous molecule (One phosphorous molecule consists four phosphorous atoms.)

Mono atomic molecules: Molecules with only one atom are called mono atomic molecules.

Helium (He), Neon (Ne), Argon (Ar) etc. are examples for mono atomic molecules.

Diatomc molecules: Molecules having two atoms in it are called diatomic molecules.

Examples: H_2 , O_2 , N_2 .

Polyatomic molecules: Molecules with more than two atoms are polyatomic molecules.

Examples: P_4 , S_8 , O_3

For representing more than one molecules, the number of molecules is written to the left of the molecule.

Example: $3H_2$ – means three hydrogen molecules. It is noted that there are six hydrogen atoms in $3H_2$.

$5O_3$ - means five ozone molecules.

$2He$ – two helium molecules.

Compounds: Compound molecules are formed by the combination of different elements.

Millions of various substances are formed by combining two or more various atoms of limited number of elements.

Examples:1. Carbon dioxide – carbon + Oxygen. 2. Water – Hydrogen + Oxygen.

3. Sugar – Carbon + Hydrogen + Oxygen. 4. Hydrogen chloride – Hydrogen + Chlorine.

A compound is obtained from different sources. Whichever be the source, the ratio of various atoms of an element present in a molecule of a compound is same.

For example one carbon atom and two oxygen atoms are present in every carbon dioxide molecule. Hence it is represented CO_2 . This representation is known as **chemical formula**.

Similarly chemical formula of water is H_2O .

The structure of water, carbon dioxide and methane molecules are shown in the figure.



From chemical formula of a compound we get

the information about which of the elements and how many atoms are present in one molecule.

Example:1. Sulphuric acid (H_2SO_4) – It consists two hydrogen atoms, one sulphur atom and four oxygen atoms.

2. Ammonia (NH_3) – One nitrogen and three hydrogen atoms.

Reactants and products.

It is by combining two or more substances through chemical reaction, new substances are formed. The substance taking part in chemical reaction is called reactants and substances so produced are called products.

When Zinc reacts with hydrochloric acid, hydrogen and zinc chloride are formed.

Here Zinc and Hydrochloric acids are reactants and hydrogen and Zinc chloride are products.

The chemical reaction is expressed as an equation given below.

$Zn + HCl \rightarrow H_2 + ZnCl_2$ It is known as chemical equation.

In this equation number of atoms on both sides are not equal. (There are two hydrogen atoms and two chlorine atoms on the right side, but there are only one hydrogen atom and one chlorine atom on the left). So the equation is to be balanced.

The chemical equation in which number of the atoms of each element on both sides are equal is called balanced chemical equation.

The balanced equation of the above mentioned reaction is $Zn + 2HCl \rightarrow H_2 + ZnCl_2$

PRACTICE QUESTIONS & ANSWERS

- What are elements? Give two examples for the same and their symbols.
- What are compounds? Give two examples for compounds and write down their constituent elements.
- Elements were named after countries, continents, planets and satellites. Cite this with a few examples.
- Give two examples for elements whose symbols were derived from their Latin names.
- Molecules are the smallest particles that can exist independently.

Write down one example each for mono atomic, diatomic and poly atomic molecules.

6. Symbols of a few elements are given below. Identify the elements. Ca, S, Be, Fe, Cr, Cu, H, Cl
 7. Write down the symbols of Sodium, Sulphur, Nitrogen, Potassium, Carbon and Zinc.
 8. Elements are existed in solid, liquid and gaseous state. Give one example for each.
 9. Identify the relation of the first pair and fill the second accordingly.
 a. Na: Natrium; K: b. Chlorine: Colour; Titanium: c. H₂: Diatomic molecule; P₄:
 d. Water: Compound; Carbon: e. Plutonium: Name of planet; Francium:
 10. Complete the following statements properly.
 a. and are the constituent elements of water.
 b. was the scientist who discovered that water can be split into Hydrogen and Oxygen by passing electric current through it.
 c. are the substances formed by combining different elements through chemical process.
 d. Substances that cannot be decomposed through chemical process are called
 11. Hydrogen burns in oxygen to give water. Identify the reactants and products in this process.
 12. Find out the number of molecules and total number of atoms in the following.
 O₂, 3N₂, 4Na, CO₂, NaCl, 3H₂O, 4NH₃, C₆H₁₂O₆.
 13. Write down the chemical formula for Water, Carbon dioxide and Sulphuric acid and identify the constituent elements and find out the total number of atoms present in each molecule.
 14. Briefly explain what is reactants and products with example.
 15. 'H' is the symbol of Hydrogen. What do 4H₂, 3H, H₂ indicate?
 16. Classify the following into elements and compounds.
 Sugar, Iron, Carbon, Water, Sodium chloride, Copper sulphate and Sodium.

17. Find whether the following statements are 'true' or 'false'.

- a. All molecules are formed by the combination of atoms of different elements.
 b. Molecules of a compound are formed by combining atoms of different elements.
 c. All molecules contain more than one atom.
 d. The number of atoms of each element on both sides of a balanced chemical equation should be equal.
 e. The number of molecules on both sides of a balanced chemical equation may not be equal.

18. In a balanced chemical equation, number of atoms of each element on either side is equal. Check whether the following equations are *balanced* or *not*.

- a. H₂ + Cl₂ → 2HCl b. Mg + O₂ → MgO c. C + O₂ → CO₂. d. N₂ + H₂ → NH₃.
 e. H₂ + O₂ → H₂O + O₂. f. NaOH + H₂SO₄ → Na₂SO₄ + H₂O
 g. H₂ + I₂ → 2HI h. N₂ + O₂ → NO. i. CH₄ + 2O₂ → CO₂ + 2H₂O

19. It is given the models of the molecules of Methane, Carbon dioxide and Water. Identify the elements in each molecule and write down their chemical formula.

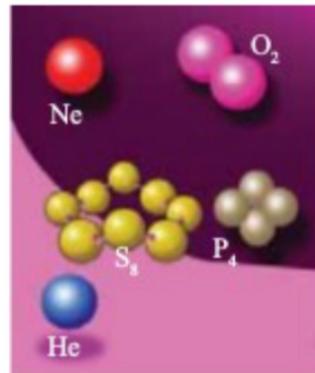


20. Match the contents in the columns of A&B.

A	B
Chlorine	Planet
Curium	Colour
Plutonium	Continent
Europium	Scientist

21. Models of the molecules of a few elements are given.

- a. Which are the elements seen in the figure?
 b. Classify them into mono atomic, diatomic and polyatomic molecules.



PRACTICE QUESTIONS & ANSWERS

1. What are elements? Give two examples for the same and their symbols.

Ans. Pure substances that cannot be decomposed through chemical process are called elements.

Examples. Hydrogen (H), Carbon (C).

2. What are compounds? Give two examples for compounds and write down their constituent elements.

Ans. Substance formed by the combination of more than one element through chemical reaction is compound. Compounds can be decomposed to other substance through chemical process.

Example: 1. Water – Hydrogen and oxygen are the constituent elements of water.

2. Sugar: It is a compound formed by combining Carbon, Hydrogen and Oxygen.

3. Elements were named after countries, continents, planets and satellites. Cite this with a few examples.

Ans.

Name of the Element	Basis for the naming.
Americium	Name of country
Europium	Name of continent.
Neptunium	Name of planet
Titanium	Name of satellite.

4. Give two examples for elements whose symbols were derived from their Latin names.

Ans. Iron - Ferrum - Fe, Potassium - Kalium - K

5. Molecules are the smallest particles that can exist independently.

Write down one example each for mono atomic, diatomic and poly atomic molecules.

Ans. Mono atomic molecule: Helium (He)

Diatomeric molecule: Oxygen (O₂), Poly atomic molecule: Phosphorous(P₄)

6. Symbols of a few elements are given below. Identify the elements.

Ca, S, Be, Fe, Cr, Cu, H, Cl

Ans. Ca: Calcium, S: Sulphur, Be: Beryllium, Fe: Iron, Cr: Chromium,

Cu: Copper, H: Hydrogen, Cl: Chlorine.

7. Write down the symbols of Sodium, Sulphur, Nitrogen, Potassium, Carbon and Zinc.

Ans. Sodium:Na, Sulphur:S, Nitrogen:N, Potassium:K, Carbon:C, Zinc:Zn

8. Elements are existed in solid, liquid and gaseous state. Give one example for each.

Ans. Solid: Carbon, Liquid: Mercury, Gas: Hydrogen.

9. Identify the relation of the first pair and fill the second accordingly.

a. Na: Natrium; K: b. Chlorine: Colour; Titanium: c. H₂: Diatomic molecule; P₄:

d. Water: Compound; Carbon: e. Plutonium: Name of planet; Francium:

Ans. a. Kalium b. Satellite c. Polyatomic molecule. d. Element. e. Name of country.

10. Complete the following statements properly.

a. and are the constituent elements of water.

b. was the scientist who discovered that water can be split into Hydrogen and Oxygen by passing electric current through it.

c. are the substances formed by combining different elements through chemical process.

d. Substances that cannot be decomposed through chemical process are called

Ans. a. Hydrogen & Oxygen. b. Sir Humphrey Davy. c. Compounds d. Elements.

11. Hydrogen burns in oxygen to give water. Identify the reactants and products in this process.

Ans. Reactants: Hydrogen and Oxygen. Product: Water.

12. Find out the number of molecules and total number of atoms in the following.
 O_2 , $3N_2$, $4Na$, CO_2 , $NaCl$, $3H_2O$, $4NH_3$, $C_6H_{12}O_6$.

Substance	Number of molecules	Total number of atoms.
O_2	1	2
$3N_2$	3	6
$4Na$	4	4
CO_2	1	3
$NaCl$	1	2
$3H_2O$	3	9
$4NH_3$	4	16
$C_6H_{12}O_6$	1	24

13. Write down the chemical formula for Water, Carbon dioxide and Sulphuric acid and identify the constituent elements and find out the total number of atoms present in each molecule.

Ans. Water: H_2O : Hydrogen & Oxygen. Total number of atoms = 3

Carbon dioxide: CO_2 : Carbon & Oxygen. Total number of atoms = 3

Sulphuric acid.: H_2SO_4 : Hydrogen, Sulphur & Oxygen. Total number of atoms = 7

14. Briefly explain what is reactants and products with example.

Ans. New substances are produced through chemical reactions. The substances taking part in a chemical reaction are called reactants and that formed as the result of a chemical reaction are called products.

Example: Zinc chloride and hydrogen are formed by the chemical reaction between Zinc and hydrochloric acid. Here Zinc & Hydrochloric acid are reactants and Zinc chloride and Hydrogen are products.

15. 'H' is the symbol of Hydrogen. What do $4H_2$, $3H$, H_2 indicate?

Ans. $4H_2$: It indicates four hydrogen molecules. $3H$: Three hydrogen atoms.

H_2 : One hydrogen molecule.

16. Classify the following into elements and compounds.

Sugar, Iron, Carbon, Water, Sodium chloride, Copper sulphate and Sodium.

Ans. Elements: Iron, Carbon, Sodium.

Compounds: Sugar, Water, Sodium chloride, Copper sulphate.

17. Find whether the following statements are 'true' or 'false'.

a. All molecules are formed by the combination of atoms of different elements.

b. Molecules of a compound are formed by combining atoms of different elements.

c. All molecules contain more than one atom.

d. The number of atoms of each element on both sides of a balanced chemical equation should be equal.

e. The number of molecules on both sides of a balanced chemical equation may not be equal.

Ans. a. All molecules are formed by the combination of atoms of different elements – False.

b. Molecules of a compound are formed by combining atoms of different elements. - True.

c. All molecules contain more than one atom. - False.

d. The number of atoms of each element on both sides of a balanced chemical equation should be equal-

True

e. The number of molecules on both sides of a balanced chemical equation may not be equal. - True.

18. In a balanced chemical equation, number of atoms of each element on either side is equal. Check whether the following equations are *balanced* or *not*.

a. $H_2 + Cl_2 \rightarrow 2HCl$ b. $Mg + O_2 \rightarrow MgO$ c. $C + O_2 \rightarrow CO_2$. d. $N_2 + H_2 \rightarrow NH_3$.

e. $H_2 + O_2 \rightarrow H_2O + O_2$. f. $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

g. $H_2 + I_2 \rightarrow 2HI$ h. $N_2 + O_2 \rightarrow NO$. i. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

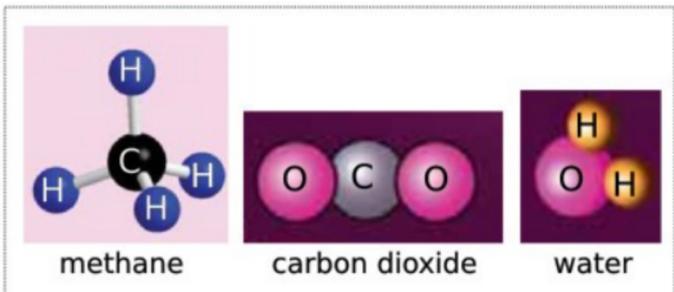
Ans. a,c,g&i are balanced equations.

19. It is given the models of the molecules of Methane, Carbon dioxide and Water. Identify the elements in each molecule and write down their chemical formula.

Ans.i.Methane: Carbon and Hydrogen - CH_4

ii.Carbon dioxide:Carbon and Oxygen - CO_2

iii. Water: Hydrogen and Oxygen. - H_2O



20. Match the contents in the columns of A&B.

A	B
Chlorine	Planet
Curium	Colour
Plutonium	Continent
Europium	Scientist

Ans.

A	B
Chlorine	Colour
Curium	Scientist
Plutonium	Planet
Europium	Continent

21. Models of the molecules of a few elements are given.

a. Which are the elements seen in the figure?

b. Classify them into mono atomic, diatomic and polyatomic molecules.

Ans.a. Ne – Neon, O_2 – Oxygen. S_8 - Sulphur. P_4 – Phosphorous

He – Helium.

b. Ne, He: Mono atomic molecules,

O_2 – Diatomic molecule,

S_8, P_4 – Poly atomic molecule.

