

Atoms and Molecules Class 9 GSEB Solutions Science

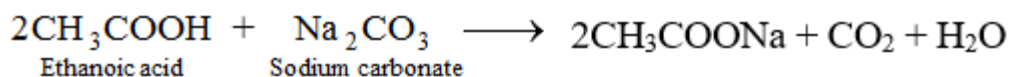
Chapter 3

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Q1. In a reaction, 5.3 g of sodium carbonate reacted with 6 g of ethanoic acid. The products were 2.2 g of carbon dioxide, 0.9 g water and 8.2 g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.

Sodium carbonate ethanoic acid \rightarrow sodium ethanoate carbon dioxide water

Ans:

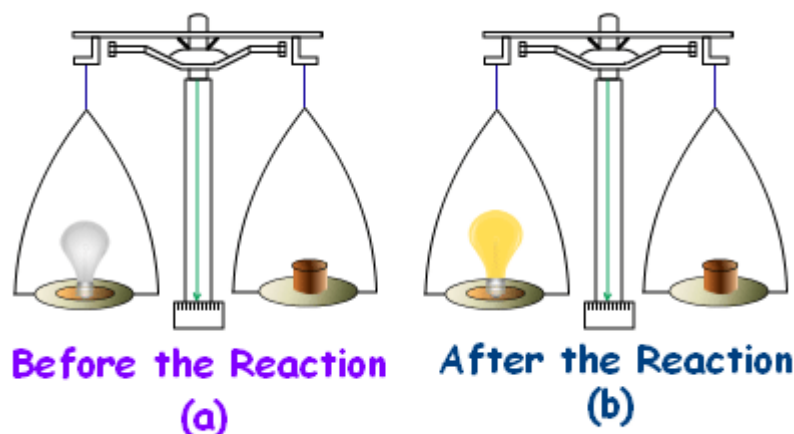


Mass of reactants = 5.3 g + 6 g = 11.3 g

Mass of products = 2.2 g + 0.9 g + 8.2 g = 11.3 g

Mass of reactants = Mass of products

Therefore, the law of conservation of mass is proven.



Law of Conservation of Mass Example

Q2. Hydrogen and oxygen combine in the ratio of 1 : 8 by mass to form water. What mass of oxygen gas would be required to react completely with 3g of hydrogen gas?

Ans: Since hydrogen and oxygen combine in the ratio of 1:8 by mass, 3g of hydrogen gas will react completely with 24 g of oxygen gas.

Q3. Which postulate of Dalton's atomic theory is the result of the law of conservation of mass?

Ans: Dalton's postulate that "atoms can neither be created nor destroyed," is a result of the law of conservation of mass.

Q4. Which postulate of Dalton's atomic theory can explain the law of definite proportions?

Ans: Atoms combine in a fixed ratio to form compounds, which can explain the law of definite proportions.

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Q1. Define atomic mass unit.

Ans: It is defined as equal to $1/12$ th of the mass of 1 atom of C-12. It is called unified mass denoted by 'u' these days.

Q2. Why is it not possible to see an atom with naked eyes?

Ans: The size of an atom is so small that it is not possible to see it with naked eyes. Also, the atom of an element does not exist independently.

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Q1. Write down the formulae of

(a) sodium oxide

(b) aluminium chloride

(c) sodium sulphide

(d) magnesium hydroxide

Ans:

(a) Formula of Sodium Oxide

Symbol \rightarrow Na \times O

Charge \rightarrow +1 \times -2

Formula \rightarrow Na₂O

(b) Formula of Aluminium Chloride

Symbol \rightarrow Al \times Cl

Charge \rightarrow +3 \times -1

Formula \rightarrow AlCl₃

(c) Formula of Sodium Sulphide

Symbol \rightarrow Na \times S

Charge \rightarrow +1 \times -2

Formula \rightarrow Na₂S

(d) Formula of Magnesium Hydroxide

Symbol \rightarrow Mg \times OH

Charge \rightarrow +2 \times 1

Formula \rightarrow Mg(OH)₂

Q2. Write down the names of compounds represented by the following formulae:

(a) Al₂(SO₄)₃

(b) CaCl₂

(c) K₂SO₄

(d) KNO₃

(e) CaCO₃

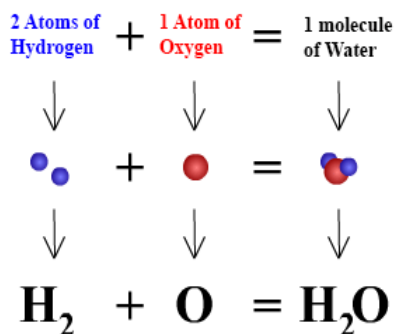
Ans:

(a) Aluminium sulphate

- (b) Calcium chloride
- (c) Potassium sulphate
- (d) Potassium nitrate
- (e) Calcium carbonate

Q3. What is meant by the term chemical formula?

Ans: The chemical formula of a compound is a symbolic representation of its composition.



Chemical Formula of Water

Q4. How many atoms are present in

- (a) H₂S molecule and
- (b) PO₄³⁻ ion?

Ans:

- (i) H₂S molecule has 2 atoms of hydrogen and 1 atom of sulphur hence **3 atoms** in totality.
- (ii) PO₄³⁻ ion has 1 atom of phosphorus and 4 atoms of oxygen hence **5 atoms** in totality.

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Q1. Calculate the molecular masses of H₂, O₂, Cl₂, CO₂, CH₄, C₂H₆, C₂H₄, NH₃, CH₃OH.

Ans:

Molecular mass of H₂ = 2 × Atomic mass of H

$$= 2 \times 1$$

$$= 2 \text{ u}$$

Molecular mass of O₂ = 2 × Atomic mass of O

$$= 2 \times 16$$

$$= 32 \text{ u}$$

Molecular mass of Cl₂ = 2 × Atomic mass of Cl

$$= 2 \times 35.5$$

$$= 71 \text{ u}$$

Molecular mass of CO₂ = Atomic mass of C₂ × Atomic mass of O

$$= 12 + (2 \times 16) = (12 + 32) \text{ u}$$

$$= 44 \text{ u}$$

Molecular mass of CH₄ = Atomic mass of C₄ × Atomic mass of H

$$= 12 + (4 \times 1) \text{ u} = (12 + 4) \text{ u}$$

$$= 16 \text{ u}$$

Molecular mass of $C_2H_6 = 2 \times \text{Atomic mass of C} + 6 \times \text{Atomic mass of H}$
 $= (2 \times 12 + 6 \times 1)u = (24 + 6)u$
 $= 30 u$

Molecular mass of $C_2H_4 = 2 \times \text{Atomic mass of C} + 4 \times \text{Atomic mass of H}$
 $= (2 \times 12 + 4 \times 1)u = (24 + 4)u$
 $= 28 u$

Molecular mass of $NH_3 = \text{Atomic mass of N} + 3 \times \text{Atomic mass of H}$
 $= (14 + 3 \times 1)u = (14 + 3)u$
 $= 17 u$

Molecular mass of $CH_3OH = \text{Atomic mass of C} + 3 \times \text{Atomic mass of H} + \text{Atomic mass of O} + \text{Atomic mass of H}$
 $= (12 + 3 \times 1 + 16 + 1)u = (12 + 3 + 17)u$
 $= 32 u$

Q2. Calculate the formula unit masses of ZnO , Na_2O , K_2CO_3 , given atomic masses of $Zn = 65 u$, $Na = 23 u$, $K = 39 u$, $C = 12 u$, and $O = 16 u$.

Ans:

(i) Formula unit mass of ZnO
 $= 65 + 16 = 81 u$

(ii) Formula unit mass of Na_2O
 $= 2 \times 23 + 16 = 46 + 16 = 62 u$

(iii) Formula unit mass of K_2CO_3
 $= 2 \times 39 + 12 + 3 \times 16$
 $= 78 + 12 + 48 = 138 u$

Exercises: Page No. 36

Q1. A 0.24 g sample of a compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen.

Calculate the percentage composition of the compound by weight.

Ans: Percentage of boron = $(\text{mass of boron} / \text{mass of the compound}) \times 100$
 $= (0.096g / 0.24g) \times 100$
 $= 40\%$

Percentage of oxygen = $100 - \text{percentage of boron}$
 $= 100 - 40$
 $= 60\%$

Q2. When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combination will govern your answer?

Ans: When 3.0 g of carbon is burnt in 8.00 g of oxygen, 11.00 g of carbon dioxide is produced.

Given that

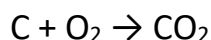
3.0 g of carbon combines with 8.0 g of oxygen to give 11.0 of carbon dioxide.

Find out

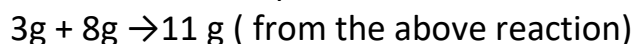
We need to find out the mass of carbon dioxide that will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen.

Solution

First, let us write the reaction taking place here.



As per the given condition, when 3.0 g of carbon is burnt in 8.00 g of oxygen, 11.00 g of carbon dioxide is produced.



The total mass of reactants = mass of carbon + mass of oxygen

$$= 3\text{g} + 8\text{g}$$

$$= 11\text{g}$$

The total mass of reactants = Total mass of products

Therefore, the law of conservation of mass is proved.

Then, it also depicts that carbon dioxide contains carbon and oxygen in a fixed ratio by mass, which is 3:8.

Thus, it further proves the law of constant proportions.

3 g of carbon must also combine with 8 g of oxygen only.

This means that $(50 - 8) = 42\text{g}$ of oxygen will remain unreacted.

The remaining 42 g of oxygen will be left un-reactive. In this case, too, only 11 g of carbon dioxide will be formed.

The above answer is governed by the law of constant proportions.

Q3. What are polyatomic ions? Give examples.

Ans: Polyatomic ions are ions that contain more than one atom, but they behave as a single unit.

Example: CO_3^{2-} , H_2PO_4^-

Q4. Write the chemical formulae of the following.

(a) Magnesium chloride

(b) Calcium oxide

(c) Copper nitrate

(d) Aluminium chloride

(e) Calcium carbonate.

Ans: The following are the chemical formula of the above-mentioned list:

(a) Magnesium chloride – MgCl_2

(b) Calcium oxide – CaO

(c) Copper nitrate – $\text{Cu}(\text{NO}_3)_2$

(d) Aluminium chloride – AlCl_3

(e) Calcium carbonate – CaCO_3

Q5. Give the names of the elements present in the following compounds.

(a) Quick lime

(b) Hydrogen bromide

(c) Baking powder

(d) Potassium sulphate.

Ans: The following are the names of the elements present in the following compounds:

- (a) Quick lime – Calcium and oxygen (CaO)
- (b) Hydrogen bromide – Hydrogen and bromine (HBr)
- (c) Baking powder – Sodium, Carbon, Hydrogen, Oxygen (NaHCO_3)
- (d) Potassium sulphate – Sulphur, Oxygen, Potassium (K_2SO_4)

Q6. Calculate the molar mass of the following substances.

- (a) Ethyne, C_2H_2
- (b) Sulphur molecule, S_8
- (c) Phosphorus molecule, P_4 (Atomic mass of phosphorus = 31)
- (d) Hydrochloric acid, HCl
- (e) Nitric acid, HNO_3

Ans: Listed below is the molar mass of the following substances:

- (a) Molar mass of Ethyne $\text{C}_2\text{H}_2 = 2 \times \text{Mass of C} + 2 \times \text{Mass of H} = (2 \times 12) + (2 \times 1) = 24 + 2 = 26\text{g}$
- (b) Molar mass of Sulphur molecule $\text{S}_8 = 8 \times \text{Mass of S} = 8 \times 32 = 256\text{g}$
- (c) Molar mass of Phosphorus molecule, $\text{P}_4 = 4 \times \text{Mass of P} = 4 \times 31 = 124\text{g}$
- (d) Molar mass of Hydrochloric acid, $\text{HCl} = \text{Mass of H} + \text{Mass of Cl} = 1 + 35.5 = 36.5\text{g}$
- (e) Molar mass of Nitric acid, $\text{HNO}_3 = \text{Mass of H} + \text{Mass of Nitrogen} + 3 \times \text{Mass of O} = 1 + 14 + 3 \times 16 = 63\text{g}$

