

**Question 1:**

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

Answer:

In the given reaction, sodium carbonate reacts with ethanoic acid to produce sodium ethanoate, carbon dioxide, and water.

Sodium + Ethanoic  $\longrightarrow$  Sodium + Carbon + Water  
carbonate acid ethanoate dioxide

Mass of sodium carbonate = 5.3 g (Given)

Mass of ethanoic acid = 6 g (Given)

Mass of sodium ethanoate = 8.2 g (Given)

Mass of carbon dioxide = 2.2 g (Given)

Mass of water = 0.9 g (Given)

Now, total mass before the reaction = (5.3 + 6) g

= 11.3 g

And, total mass after the reaction = (8.2 + 2.2 + 0.9) g

= 11.3 g

$\therefore$  Total mass before the reaction = Total mass after the reaction

Hence, the given observations are in agreement with the law of conservation of mass.

**Question 2:**

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 3 g of hydrogen gas?

Answer:

It is given that the ratio of hydrogen and oxygen by mass to form water is 1:8.

Then, the mass of oxygen gas required to react completely with 1 g of hydrogen gas is 8 g.

Therefore, the mass of oxygen gas required to react completely with 3 g of hydrogen gas is  $8 \times 3 \text{ g} = 24 \text{ g}$ .

**Question 3:**

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

Answer:

The postulate of Dalton's atomic theory which is a result of the law of conservation of mass is:

Atoms are indivisible particles, which can neither be created nor destroyed in a chemical reaction.

**Question 4:**

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

Answer:

The postulate of Dalton's atomic theory which can explain the law of definite proportion is:

The relative number and kind of atoms in a given compound remains constant.

**Question 1:**

Define atomic mass unit.

Answer:

Mass unit equal to exactly one-twelfth  $\left(\frac{1}{12^{\text{th}}}\right)$  the mass of one atom of carbon-12 is called one atomic mass unit. It is written as 'u'.

**Question 2:**

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

Answer:

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.

**Question 1:**

Write down the formulae of

- (i) sodium oxide
- (ii) aluminium chloride
- (iii) sodium sulphide
- (iv) magnesium hydroxide

Answer:

- (i) Sodium oxide  $\rightarrow \text{Na}_2\text{O}$
- (ii) Aluminium chloride  $\rightarrow \text{AlCl}_3$
- (iii) Sodium sulphide  $\rightarrow \text{Na}_2\text{S}$
- (iv) Magnesium hydroxide  $\rightarrow \text{Mg}(\text{OH})_2$

**Question 2:**

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

- (i)  $\text{Al}_2(\text{SO}_4)_3$
- (ii)  $\text{CaCl}_2$
- (iii)  $\text{K}_2\text{SO}_4$
- (iv)  $\text{KNO}_3$
- (v)  $\text{CaCO}_3$

Answer:

- (i)  $\text{Al}_2(\text{SO}_4)_3 \rightarrow$  Aluminium sulphate
- (ii)  $\text{CaCl}_2 \rightarrow$  Calcium chloride
- (iii)  $\text{K}_2\text{SO}_4 \rightarrow$  Potassium sulphate
- (iv)  $\text{KNO}_3 \rightarrow$  Potassium nitrate
- (v)  $\text{CaCO}_3 \rightarrow$  Calcium carbonate

**Question 3:**

What is meant by the term chemical formula?

Answer:

The chemical formula of a compound means the symbolic representation of the composition of a compound. From the chemical formula of a compound, we can know the number and kinds of atoms of different elements that constitute the compound.

For example, from the chemical formula  $\text{CO}_2$  of carbon dioxide, we come to know that one carbon atom and two oxygen atoms are chemically bonded together to form one molecule of the compound, carbon dioxide.

**Question 4:**

How many atoms are present in a

(i)  $\text{H}_2\text{S}$  molecule and

(ii)  $\text{PO}_4^{3-}$  ion?

Answer:

(i) In an  $\text{H}_2\text{S}$  molecule, three atoms are present; two of hydrogen and one of sulphur.

(ii) In a  $\text{PO}_4^{3-}$  ion, five atoms are present; one of phosphorus and four of oxygen.

**Question 1:**

Calculate the molecular masses of  $\text{H}_2$ ,  $\text{O}_2$ ,  $\text{Cl}_2$ ,  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{C}_2\text{H}_6$ ,  $\text{C}_2\text{H}_4$ ,  $\text{NH}_3$ ,  $\text{CH}_3\text{OH}$ .

Answer:

Molecular mass of  $\text{H}_2 = 2 \times$  Atomic mass of H

$$= 2 \times 1$$

$$= 2 \text{ u}$$

Molecular mass of  $\text{O}_2 = 2 \times$  Atomic mass of O

$$= 2 \times 16$$

$$= 32 \text{ u}$$

Molecular mass of  $\text{Cl}_2 = 2 \times$  Atomic mass of Cl

$$= 2 \times 35.5$$

$$= 71 \text{ u}$$

Molecular mass of  $\text{CO}_2 =$  Atomic mass of C +  $2 \times$  Atomic mass of O

$$= 12 + 2 \times 16$$

$$= 44 \text{ u}$$

Molecular mass of  $\text{CH}_4 =$  Atomic mass of C +  $4 \times$  Atomic mass of H

$$= 12 + 4 \times 1$$

$$= 16 \text{ u}$$

Molecular mass of  $\text{C}_2\text{H}_6 = 2 \times$  Atomic mass of C +  $6 \times$  Atomic mass of H

$$= 2 \times 12 + 6 \times 1$$

$$= 30 \text{ u}$$

Molecular mass of  $\text{C}_2\text{H}_4 = 2 \times$  Atomic mass of C +  $4 \times$  Atomic mass of H

$$= 2 \times 12 + 4 \times 1$$

$$= 28 \text{ u}$$

Molecular mass of  $\text{NH}_3 =$  Atomic mass of N +  $3 \times$  Atomic mass of H

$$= 14 + 3 \times 1$$

$$= 17 \text{ u}$$

Molecular mass of  $\text{CH}_3\text{OH} =$  Atomic mass of C +  $4 \times$  Atomic mass of H + Atomic mass of O

$$= 12 + 4 \times 1 + 16$$

$$= 32 \text{ u}$$

**Question 2:**

Calculate the formula unit masses of ZnO, Na<sub>2</sub>O, K<sub>2</sub>CO<sub>3</sub>, given atomic masses of Zn = 65 u, Na = 23 u, K = 39 u, C = 12 u, and O = 16 u.

Answer:

Formula unit mass of ZnO = Atomic mass of Zn + Atomic mass of O

$$= 65 + 16$$

$$= 81 \text{ u}$$

Formula unit mass of Na<sub>2</sub>O = 2 × Atomic mass of Na + Atomic mass of O

$$= 2 \times 23 + 16$$

$$= 62 \text{ u}$$

Formula unit mass of K<sub>2</sub>CO<sub>3</sub> = 2 × Atomic mass of K + Atomic mass of C + 3 × Atomic mass of O

$$= 2 \times 39 + 12 + 3 \times 16$$

$$= 138 \text{ u}$$

**Question 1:**

If one mole of carbon atoms weighs 12 gram, what is the mass (in gram) of 1 atom of carbon?

Answer:

One mole of carbon atoms weighs 12 g (Given)

i.e., mass of 1 mole of carbon atoms = 12 g

Then, mass of  $6.022 \times 10^{23}$  number of carbon atoms = 12 g

$$\begin{aligned} \text{Therefore, mass of 1 atom of carbon} &= \frac{12}{6.022 \times 10^{23}} \text{ g} \\ &= 1.9926 \times 10^{-23} \text{ g} \end{aligned}$$

**Question 2:**

Which has more number of atoms, 100 grams of sodium or 100 grams of iron (given, atomic mass of Na = 23 u, Fe = 56 u)?

Answer:

Atomic mass of Na = 23 u (Given)

Then, gram atomic mass of Na = 23 g

Now, 23 g of Na contains =  $6.022 \times 10^{23}$  number of atoms

$$\begin{aligned} \text{Thus, 100 g of Na contains} &= \frac{6.022 \times 10^{23}}{23} \times 100 \text{ number of atoms} \\ &= 2.6182 \times 10^{24} \text{ number of atoms} \end{aligned}$$

Again, atomic mass of Fe = 56 u (Given)

Then, gram atomic mass of Fe = 56 g

Now, 56 g of Fe contains =  $6.022 \times 10^{23}$  number of atoms

$$\begin{aligned} \text{Thus, 100 g of Fe contains} &= \frac{6.022 \times 10^{23}}{56} \times 100 \text{ number of atoms} \\ &= 1.0753 \times 10^{24} \text{ number of atoms} \end{aligned}$$



Therefore, 100 grams of sodium contain more number of atoms than 100 grams of iron.

**Question 1:**

A 0.24 g sample of 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.

Answer:

Mass of boron = 0.096 g (Given)

Mass of oxygen = 0.144 g (Given)

Mass of sample = 0.24 g (Given)

Thus, percentage of boron by weight in the compound =  $\frac{0.096}{0.24} \times 100\%$   
= 40%

And, percentage of oxygen by weight in the compound =  $\frac{0.144}{0.24} \times 100\%$   
= 60%

**Question 2:**

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 combinations will govern your answer?

Answer:

Carbon + Oxygen  $\longrightarrow$  Carbon dioxide

3 g of carbon reacts with 8 g of oxygen to produce 11 g of carbon dioxide.

If 3 g of carbon is burnt in 50 g of oxygen, then 3 g of carbon will react with 8 g of oxygen. The remaining 42 g of oxygen will be left un-reactive.

In this case also, only 11 g of carbon dioxide will be formed.

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

**Question 3:**

What are polyatomic ions? Give examples?

Answer:

A polyatomic ion is a group of atoms carrying a charge (positive or negative). For example, ammonium ion ( $\text{NH}_4^+$ ), hydroxide ion ( $\text{OH}^-$ ), carbonate ion ( $\text{CO}_3^{2-}$ ), sulphate ion ( $\text{SO}_4^{2-}$ ).

**Question 4:**

Write the chemical formulae of the following:

- (a) Magnesium chloride
- (b) Calcium oxide
- (c) Copper nitrate
- (d) Aluminium chloride
- (e) Calcium carbonate

Answer:

- (a) Magnesium chloride  $\rightarrow \text{MgCl}_2$
- (b) Calcium oxide  $\rightarrow \text{CaO}$
- (c) Copper nitrate  $\rightarrow \text{Cu}(\text{NO}_3)_2$
- (d) Aluminium chloride  $\rightarrow \text{AlCl}_3$
- (e) Calcium carbonate  $\rightarrow \text{CaCO}_3$

**Question 5:**

Give the names of the elements present in the following compounds:

- (a) Quick lime
- (b) Hydrogen bromide
- (c) Baking powder
- (d) Potassium sulphate

Answer:

Compound	Chemical formula	Elements present
Quick lime	CaO	Calcium, oxygen
Hydrogen bromide	HBr	Hydrogen, bromine
Baking powder	NaHCO <sub>3</sub>	Sodium, hydrogen, carbon, oxygen
Potassium sulphate	K <sub>2</sub> SO <sub>4</sub>	Potassium, sulphur, oxygen

**Question 6:**

Calculate the molar mass of the following substances:

- (a) Ethyne, C<sub>2</sub>H<sub>2</sub>
- (b) Sulphur molecule, S<sub>8</sub>
- (c) Phosphorus molecule, P<sub>4</sub> (atomic mass of phosphorus = 31)
- (d) Hydrochloric acid, HCl
- (e) Nitric acid, HNO<sub>3</sub>

Answer:

- (a) Molar mass of ethyne, C<sub>2</sub>H<sub>2</sub> = 2 × 12 + 2 × 1 = 28 g
- (b) Molar mass of sulphur molecule, S<sub>8</sub> = 8 × 32 = 256 g
- (c) Molar mass of phosphorus molecule, P<sub>4</sub> = 4 × 31 = 124 g
- (d) Molar mass of hydrochloric acid, HCl = 1 + 35.5 = 36.5 g
- (e) Molar mass of nitric acid, HNO<sub>3</sub> = 1 + 14 + 3 × 16 = 63 g

**Question 7:**

What is the mass of--

- (a) 1 mole of nitrogen atoms?
- (b) 4 moles of aluminium atoms (Atomic mass of aluminium = 27)?
- (c) 10 moles of sodium sulphite (Na<sub>2</sub>SO<sub>3</sub>)?

Answer:

(a) The mass of 1 mole of nitrogen atoms is 14 g.

(b) The mass of 4 moles of aluminium atoms is  $(4 \times 27) \text{ g} = 108 \text{ g}$

(c) The mass of 10 moles of sodium sulphite ( $\text{Na}_2\text{SO}_3$ ) is  
 $10 \times [2 \times 23 + 32 + 3 \times 16] \text{ g} = 10 \times 126 \text{ g} = 1260 \text{ g}$

**Question 8:**

Convert into mole.

(a) 12 g of oxygen gas

(b) 20 g of water

(c) 22 g of carbon dioxide

Answer:

(a) 32 g of oxygen gas = 1 mole

Then, 12 g of oxygen gas =  $\frac{12}{32} \text{ mole} = 0.375 \text{ mole}$

(b) 18 g of water = 1 mole

Then, 20 g of water =  $\frac{20}{18} \text{ mole} = 1.11 \text{ moles (approx)}$

(c) 44 g of carbon dioxide = 1 mole

Then, 22 g of carbon dioxide =  $\frac{22}{44} \text{ mole} = 0.5 \text{ mole}$

**Question 9:**

What is the mass of:

(a) 0.2 mole of oxygen atoms?

(b) 0.5 mole of water molecules?

Answer:

(a) Mass of one mole of oxygen atoms = 16 g

Then, mass of 0.2 mole of oxygen atoms =  $0.2 \times 16\text{g} = 3.2 \text{ g}$

(b) Mass of one mole of water molecule = 18 g

Then, mass of 0.5 mole of water molecules =  $0.5 \times 18 \text{ g} = 9 \text{ g}$

**Question 10:**

Calculate the number of molecules of sulphur ( $\text{S}_8$ ) present in 16 g of solid sulphur.

Answer:

1 mole of solid sulphur ( $\text{S}_8$ ) =  $8 \times 32 \text{ g} = 256 \text{ g}$

i.e., 256 g of solid sulphur contains =  $6.022 \times 10^{23}$  molecules

Then, 16 g of solid sulphur contains =  $\frac{6.022 \times 10^{23}}{256} \times 16$  molecules  
=  $3.76 \times 10^{22}$  molecules (approx)

**Question 11:**

Calculate the number of aluminium ions present in 0.051 g of aluminium oxide.

(Hint: The mass of an ion is the same as that of an atom of the same element.)

Atomic mass of Al = 27 u)

Answer:

1 mole of aluminium oxide ( $\text{Al}_2\text{O}_3$ ) =  $2 \times 27 + 3 \times 16$   
= 102 g

i.e., 102 g of  $\text{Al}_2\text{O}_3$  =  $6.022 \times 10^{23}$  molecules of  $\text{Al}_2\text{O}_3$

Then, 0.051 g of  $\text{Al}_2\text{O}_3$  contains =  $\frac{6.022 \times 10^{23}}{102} \times 0.051$  molecules  
=  $3.011 \times 10^{20}$  molecules of  $\text{Al}_2\text{O}_3$

The number of aluminium ions ( $\text{Al}^{3+}$ ) present in one molecule of aluminium oxide is 2.

Therefore, the number of aluminium ions ( $\text{Al}^{3+}$ ) present in  $3.011 \times 10^{20}$  molecules (0.051 g) of aluminium oxide ( $\text{Al}_2\text{O}_3$ ) =  $2 \times 3.011 \times 10^{20}$   
=  $6.022 \times 10^{20}$