Atoms And Molecules

Improve your learning

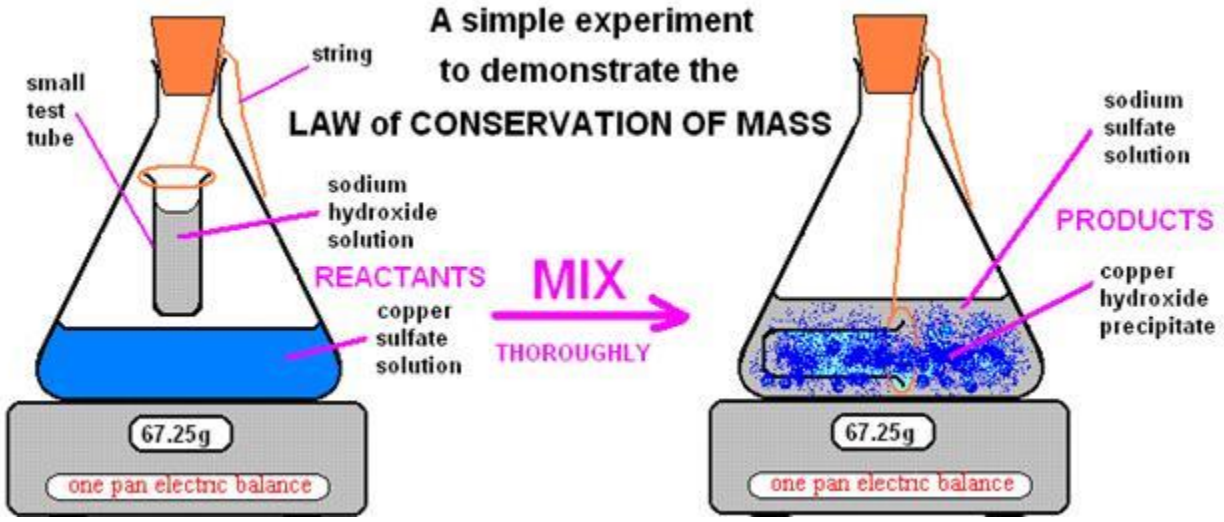
Q. 1. Draw the diagram to show the experimental setup for the law of conservation of mass.

Answer : Step 1: Take a flask and take a mixture of sodium hydroxide solution and copper sulphate solution.

Step 2: Weight the flask and note it.

Step 3: Now mix the whole mixture thoroughly.

Step 4: Now, weight the flask.



We will observe that after mixing there is no change in the mass. This explains the law of conservation of mass.

Q. 2. Explain the process and precautions in verifying law of conservation of mass.

Answer : Law of conservation of mass states that “Matter is neither created nor destroys in a chemical reaction. More simply, the mass of products is equal to the mass of reactants in a chemical reaction.

Q. 3. 15.9g. of copper sulphate and 10.6g of sodium carbonate react together to give 14.2g of sodium sulphate and 12.3g of copper carbonate. Which law of chemical combination is obeyed? How?

Answer : Law of conservation of mass is obeyed.

Explanation:

$$\underset{15.9g}{CuSO_4} + \underset{10.6g}{Na_2CO_3} \rightarrow \underset{14.2g}{NaSO_4} + \underset{12.3g}{CuCO_3}$$

Total mass of reactants = 15.9g + 10.6g = 26.5g

Total mass of products = 14.2g + 12.3g = 26.5g

As there is no change in the mass of reactants and products, hence law of conservation is obeyed.

Q. 4. Carbon dioxide is added to 112g of calcium oxide. The product formed is 200g of calcium carbonate. Calculate the mass carbon dioxide used. Which law of chemical combination will govern your answer.

Answer : The reaction taking place is:

$$\underset{?}{CO_2} + \underset{112g}{CaO} \rightarrow \underset{220g}{CaCO_3}$$

Let the mass of CO_2 is xg.

According to the law of conservation of mass, the mass of reactants is equal to the mass of products.

Therefore,

$\Rightarrow x + 112g = 220g$

$\Rightarrow x = 220g – 112g$

$\Rightarrow x = 108g$

Thus, the mass of carbon dioxide is 108g.

Q. 5. 0.24g sample of compound of oxygen and boron was found by analysis to contain 0.144g of oxygen and 0.096g of boron. Calculate the percentage composition of the compound by weight.

Answer : Given: Mass of compound = 0.24g

Mass of oxygen = 0.144g

Mass of boron = 0.096g

To calculate the percent of the composition of oxygen, we apply the formula:

$$\% \text{ composition of oxygen} = \frac{\text{Mass of oxygen}}{\text{Mass of compound}} \times 100$$

$$\Rightarrow \% \text{ composition of oxygen} = \frac{0.144g}{0.24g} \times 100$$

⇒ % composition of oxygen = 0.6g × 100

⇒ % composition of oxygen = 60%

To calculate the percent of the composition of boron, we apply the formula:

$$\% \text{ composition of boron} = \frac{\text{Mass of boron}}{\text{Mass of compound}} \times 100$$

$$\Rightarrow \% \text{ composition of boron} = \frac{0.096g}{0.24g} \times 100$$

⇒ % composition of boron = 0.4g × 100

⇒ % composition of boron = 40%

Total percentage composition of compound is 60% + 40% = 100%

Q. 6. In a class, a teacher asked to write the molecular formula of oxygen Shamita wrote the formula as O_2 and Priyanka as O. which one is correct? State the reason.

Answer : Shamita wrote the correct formula of oxygen as O_2 because:

i. A molecule of oxygen has two atoms.

ii. It is diatomic in nature (atomicity = 2)

iii. Thus, writing oxygen as O_2 indicates two separate atoms of oxygen.

Note: Atomicity is the number of atoms constituting a molecule.

Q. 7. Imagine what would happen if we do not have standard symbols for elements?

Answer : If we do not have standard symbols for elements, then it will take a lot of time to write the full name of the elements and compounds every time to describe a reaction.

Q. 8. Mohit said "H_2 differs from 2H". Justify.

Answer :

H_2	2H
In H_2, there is one molecule of hydrogen which is bonded to two atoms.	In 2H, there are two atoms of hydrogen which are not bonded to each other.

Q. 9. Lakshmi gives a statement "CO and Co both represents element". Is it correct? State reason.

Answer : No, CO does not represent element whereas Co represents element because the first letter of the symbol is always the upper case and the second letter is always lower case.

In CO, the second letter is uppercase whereas in Co, the second letter is lowercase. Hence Co represents an element.

Q. 10. The formula of the water molecule is H_2O. What information you get from this formula.

Answer : To get the information, first, we will see the elements present in a molecule of the compound.

Second, we will count the number of atoms of each element of that molecule.

In H_2O:

i. 2 atoms of hydrogen and one atom of oxygen are present.

ii. There are total three atoms present in a molecule of water.

Q. 11. How would you write 2 molecules of oxygen and 5 molecules of Nitrogen.

Answer : For oxygen:

⇒ First, write the symbol of oxygen – $\boxed{O}$

⇒ Now write 2 as a subscript after O – $\boxed{O_2}$

For nitrogen:

⇒ First, write the symbol of nitrogen – $\boxed{N}$

⇒ Now write 5 as a subscript after N – $\boxed{N_5}$

Q. 12. The formula of a metal oxide is MO. Then write the formula of its chloride.

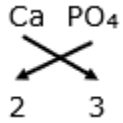
Answer : The formula of its chloride is $MOCl_2$

Q. 13. Formula of calcium hydroxide is $Ca(OH)_2$ and zinc phosphate is $Zn_3(PO_4)_2$. Then write the formula to calcium phosphate.

Answer : Valency of Ca = 2

Valency of PO_4 = 3

Now, apply the criss cross method



So the formula will be $Ca_3(PO_4)_2$

Q. 14. Find out the chemical names and formulae for the following common household substances.

a) common salt
b) baking soda
c) washing soda
d) vinegar

Answer : a) Common salt

Chemical name – sodium chloride

Chemical formula – NaCl

b) Baking soda

Chemical name – sodium bicarbonate

Chemical formula – $NaHCO_3$

c) Washing soda

Chemical name – sodium carbonate

Chemical formula – Na_2CO_3

d) Vinegar

Chemical name – acetic acid

Chemical formula – CH_3COOH

Q. 15. A. Calculate the mass of the following

0.5 mole of N_2 gas.

Answer : 0.5 mole of N_2 gas

First, we apply the formula:

$$\text{No. of moles} = \frac{\text{Mass of } N_2}{\text{Molar mass of } N_2}$$

⇒ Mass of N_2 = No. of moles × Molar mas of N_2

⇒ Mass of N_2 = 0.5 mole × 2(atomic mass of nitrogen)

⇒ Mass of N_2 = 0.5 × 2 × 14

⇒ Mass of N_2 = 14g

Thus, the mass of N_2 gas is 14g.

Q. 15. B. Calculate the mass of the following

0.5 mole of N atoms.

Answer : 0.5 mole of N atoms

First, we apply the formula:

$$\text{No. of moles} = \frac{\text{Mass of N}}{\text{Molar mass of N}}$$

⇒ Mass of N atoms = No. of moles × Molar mass of N

⇒ Mass of N atoms = 0.5 mole × (atomic mass of nitrogen)

⇒ Mass of N atoms = 0.5 × 14

⇒ Mass of N_2 = 7g

Thus, the mass of N atoms is 7g.

Q. 15. C. Calculate the mass of the following

3.011×10^{23} number of N atoms.

Answer : 3.011 X 10^{23} number of N atoms.

As we know that 1 mole = 6.022 X 10^{23}atoms

$$\Rightarrow 3.011 \times 10^{23}\text{atoms} = \frac{3.011 \times 10^{23}\text{atoms}}{6.022 \times 10^{23}\text{atoms}}$$

⇒ 1/2 mole = 0.5 mole

For 0.5 mole of N atoms

First, we apply the formula:

$$\text{No. of moles} = \frac{\text{Mass of N}}{\text{Molar mass of N}}$$

⇒ Mass of N atoms = No. of moles × Molar mass of N

⇒ Mass of N atoms = 0.5 mole × (atomic mass of nitrogen)

⇒ Mass of N atoms = 0.5 × 14

⇒ Mass of N atoms = 7g

Thus, mass of 3.011 × 10^{23} number of N atoms is 7g

Q. 15. D. Calculate the mass of the following

6.022 × 10^{23} number of N_2 molecules.

Answer : 6.022 X 10^{23} number of N_2 molecules.

As we know that 1 mole = 6.022 X 10^{23}atoms

For 1 mole of N_2 molecules:

First, we apply the formula:

$$\text{No. of moles} = \frac{\text{Mass of } N_2 \text{ molecule}}{\text{Molar mass of } N_2 \text{ molecule}}$$

⇒ Mass of N_2 = No. of moles × Molar mass of N_2

⇒ Mass of N_2 = 1 mole × 2(atomic mass of nitrogen)

⇒ Mass of N_2 = 1mole × 28u

⇒ Mass of N_2 = 28g

Thus, mass of 6.022 × 10^{23} number of N_2 molecules is 28g.

Q. 16. A. Calculate the number of particles in each of the following

46g of Na

Answer : The number of particles present in one mole of any substance is has a fixed value of 6.022 × 10^{23}. This number is called Avogadro constant(N_A).

Mass of Na = 46g

Molar mass of Na = 23u

Apply the formula given below:

Number of particles = number of moles × 6.022 × 10^{23}

$\Rightarrow$ $\text{We can write, Number of particles} = \frac{\text{mass}}{\text{molar mass}} \times 6.022 \times 10^{23}$

$\Rightarrow$ $\text{Number of particles} = \frac{46\text{g}}{23\text{u}} \times 6.022 \times 10^{23}$

$\Rightarrow$ Number of particles = $2 \times 6.022 \times 10^{23}$

$\Rightarrow$ Number of particles = 12.046×10^{23}

Thus, 46g of Na contains 12.046×10^{23} particles.

Q. 16. B. Calculate the number of particles in each of the following

8g of O_2

Answer : The number of particles present in one mole of any substance is has a fixed value of 6.022×10^{23}. This number is called Avogadro constant(N_A).

Mass of O_2 = 8g

Molar mass of O_2 = 32u

Apply the formula given below:

Number of particles = number of moles $\times 6.022 \times 10^{23}$

$\Rightarrow$ $\text{We can write, Number of particles} = \frac{\text{mass}}{\text{molar mass}} \times 6.022 \times 10^{23}$

$\Rightarrow$ $\text{Number of particles} = \frac{8\text{g}}{32\text{u}} \times 6.022 \times 10^{23}$

$\Rightarrow$ Number of particles = $0.25 \times 6.022 \times 10^{23}$

$\Rightarrow$ Number of particles = 1.5×10^{23}

Thus, 8g of O_2 contains 1.5×10^{23} particles.

Q. 16. C. Calculate the number of particles in each of the following

0.1 mole of hydrogen

Answer : The number of particles present in one mole of any substance is has a fixed value of 6.022×10^{23}. This number is called Avogadro constant(N_A).

Number of mole of hydrogen = 0.1 mole

Molar mass of H_2 = 2u

Apply the formula given below:

Number of particles = number of moles × 6.022 × 10^{23}

⇒ Number of particles = 0.1 mole × 6.022 × 10^{23}

⇒ Number of particles = 6.022 × 10^{24}

Thus, 0.1 mole of hydrogen contains 6.022 × 10^{24}particles.

Q. 17. A. Convert into mole

12g of O_2 gas.

Answer : Mass of O_2 gas = 12g

Molar mass of O_2 = 32u

Apply the formula:

$$\text{No. of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

$$\Rightarrow \text{No. of moles} = \frac{12g}{32u}$$

⇒ No. of moles = 0.37

Thus, the 12g of O_2 gas is 0.37 mole

Q. 17. B. Convert into mole

20g of water.

Answer : Mass of water(H_2O) = 20g

Molar mass of H_2O = 18u

Apply the formula:

$$\text{No. of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

$$\Rightarrow \text{No. of moles} = \frac{20\text{g}}{18\text{u}}$$

⇒ No. of moles = 1.11

Thus, the 20g of water is 1.11 mole

Q. 17. C. Convert into mole

22g of carbon dioxide.

Answer : Mass of CO_2 gas = 22g

Molar mass of CO_2 = 44u

Apply the formula:

$$\text{No. of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

$$\Rightarrow \text{No. of moles} = \frac{22\text{g}}{44\text{u}}$$

⇒ No. of moles = 0.5

Thus, the 22g of CO_2 gas is 0.5 mole

Q. 18. Write the valencies of Fe in $FeCl_2$ and $FeCl_3$

Answer : In $FeCl_2$, the valency of Fe is + 2

In $FeCl_3$, the valency of Fe is + 3

Q. 19. Calculate the molar mass of Sulphuric acid (H_2SO_4) and glucose ($C_6H_{12}O_6$)

Answer : Molar mass of sulphuric acid (H_2SO_4):

⇒ 2(atomic mass of hydrogen) + (atomic mass of Sulphur) + 4(atomic mass of oxygen)

⇒ 2 × 1 + 32 + 4 × 16

⇒ 2 + 32 + 64

⇒ 98 u

Thus, the molar mass of H_2SO_4 is 98 u.

Molar mass of glucose ($C_6H_{12}O_6$):

⇒ 6(atomic mass of carbon) + 12(atomic mass of hydrogen) + 6(atomic mass of oxygen)

⇒ 6 × 12 + 12 × 1 + 6 × 16

⇒ 72 + 12 + 96

⇒ 108 u

Thus, the molar mass of $C_6H_{12}O_6$ is 108 u.

Q. 20. Which has more number of atoms - 100g of sodium or 100g of iron? Justify your answer. (atomic mass of sodium = 23u, atomic mass of iron = 56u)

Answer : For sodium

Given: Mass of sodium = 100g

Molar mass of sodium = 23u

Number of atoms = number of moles × 6.022×10^{23}

⇒ $\text{We can write, Number of atoms} = \frac{\text{mass}}{\text{molar mass}} \times 6.022 \times 10^{23}$

⇒ $\text{Number of atoms} = \frac{100\text{g}}{23\text{u}} \times 6.022 \times 10^{23}$

⇒ Number of atoms = $4.34 \times 6.022 \times 10^{23}$

⇒ Number of atoms = 2.613×10^{24}

⇒ Thus, 100g of sodium contains 2.613×10^{24} atoms.

For iron

Given: Mass of iron = 100g

Molar mass of iron = 55.8u

Number of atoms = number of moles × 6.022×10^{23}

⇒ $\text{We can write, Number of atoms} = \frac{\text{mass}}{\text{molar mass}} \times 6.022 \times 10^{23}$

⇒ $\text{Number of atoms} = \frac{100\text{g}}{55.8\text{u}} \times 6.022 \times 10^{23}$

⇒ Number of atoms = $1.79 \times 6.022 \times 10^{23}$

⇒ Number of atoms = 1.07×10^{24}

⇒ Thus, 100g of iron contains 1.07×10^{24} atoms.

Therefore, 100g of sodium has more number of atoms.

Q. 21. Complete the following table.

Anions → ↓ Cations	Chloride	Hydroxide	Nitrate	Sulphate	Carbonate	Phosphate
Sodium	NaCl					
Magnisium				$MgSO_4$		
Calcium						
Aluminium						
Ammonium						$(NH_4)_3PO_4$

Answer :

Anions → ↓ Cations	**Chloride**	**Hydroxide**	**Nitrate**	**Sulphate**	**Carbonate**	**Phosphate**
Sodium	NaCl	NaOH	$NaNO_3$	$NaSO_4$	Na_2CO_3	Na_3PO_4
Magnesium	$MgCl_2$	$Mg(OH)_2$	$Mg(NO_3)_2$	$MgSO_4$	$MgCO_3$	$Mg_3(PO_4)_2$
Calcium	$CaCl_2$	$Ca(OH)_2$	$Ca(NO_3)_2$	$CaSO_4$	$CaCO_3$	$Ca_3(PO_4)_2$
Aluminum	$AlCl_3$	$Al(OH)_3$	$Al(NO_3)_3$	$Al_2(SO_4)_3$	$Al_2(CO_3)_3$	$AlPO_4$
Ammonium	NH_4Cl	NH_4OH	$NH_4(NO_3)$	$(NH_4)_2SO_4$	$(NH_4)_2CO_3$	$(NH_4)_3PO_4$

Q. 22. Fill the following table

S. No.	Name	Symbol/Formula	Molar mass	Number of particles present in molar mass
1.	Atomic oxygen		16g	6.022×10^{23} atoms of oxygen
2.	Molecular oxygen			
3.	Sodium			
4.	Sodium ion		23 g	
5.	Sodium chloride			6.022×10^{23} units of sodium chloride
6.	Water			

Answer :

S. No.	Name	Symbol / Formula	Molar mass	Number of particles present in molar mass
1.	Atomic oxygen	O	16u	6.022×10^{23} atoms of oxygen
2.	Molecular oxygen	O_2	32u	6.022×10^{23} molecules of oxygen
3.	Sodium	Na	23u	6.022×10^{23} units of sodium
4.	Sodium ion	Na^+	23u	6.022×10^{23} units of sodium ion
5.	Sodium chloride	NaCl	23 + 35.5 = 58.5u	6.022×10^{23} units of sodium chloride
6.	Water	H_2O	$2 \times 1 + 16 = 18u$	6.022×10^{23} units of water