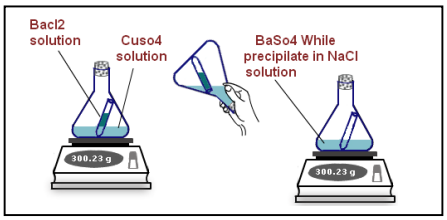
# 05. ATOMS AND MOLECULES

## Questions and Answers

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

**A.**




(OR)

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

**A. Experiment:**

**Aim:** To verify the law of conservation of mass.

**Material required:** Lead nitrate, potassium iodide, distilled water, conical flask, spring balance, test tube, stand, rubber cork, thread etc.

**Procedure**

1. Prepare a solution by dissolving approximately 2 grams of lead nitrate in 100 ml of distilled water.
2. Prepare another solution by dissolving approximately 2 gm of Potassium iodide in 100 ml water.
3. Take 100ml solution of lead nitrate in 250ml conical flask.
4. Also take 4ml solution of potassium iodide in test tube.
5. Hang the test tube in the flask carefully, without mixing the solutions. Put a cork on the flask.
6. Weigh the flask with its contents Carefully.
7. Now tilt and swirl the flask, so that the two solutions mix.
8. Weigh the flask again by the same Balance.
9. Record your observations:

Weight of flask and contents before mixing = ……

Weight of flask and contents after mixing = ……

We observed that a chemical reaction took place and the mass remained same before and after chemical reaction.

Therefore, mass was neither created nor destroyed in the chemical reaction.

Hence The law of conservation of mass is verified.

**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?**

**A.** Mass of Copper sulphate = 15.9 g

Mass of Sodium Carbonate = 10.6 g

Total mass of reactants = 26.5 g

Mass of Sodium sulphate = 14.2 g

Mass of Calcium carbonate = 12.3 g

Total mass of products = 26.5 g

* The total mass of reactants is equal to the total mass of products.

The law of conservation of mass is obeyed in this reaction.

**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.**

**A.** $CaO + CO_2 \rightarrow CaCO_3$

Mass of Calcium oxide = 112 g

Mass of Carbon dioxide = 'x' g

Mass of Calcium carbonate = 200 g

According to law of conservation of mass,

The total mass of reactants is equal to the total mass of products.

$x + 112 = 200$

$\rightarrow x = 200 - 112$

$\rightarrow x = 88$ g

Mass of Carbon dioxide = 88 g.

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**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 of composition of the components by weight.**

**A.** Mass of compound = 0.24 g

Mass of oxygen = 0.144 g

Mass of Boron = 0.096 g

Weight percentage of oxygen in compound

$= \frac{mass\ of\ oxygen}{mass\ of\ compound}$ x 100

$= \frac{0.144}{0.24}$ x100 $= \frac{12}{20}$ x 100 =12 x 5 =60%

Weight percentage of boron in compound

$= \frac{mass\ of\ boron}{mass\ of\ compound}$ x 100

$= \frac{0.096}{0.24}$ x100 $= \frac{8}{20}$ x 100 = 8 x 5 = 40%

**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.?**

**A.** 'O' is the symbol of oxygen atom.

'$O_2$' is the formula of oxygen molecule.

So the answer given by Shamitha is correct.

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

**A.** If we do not have standard symbols for elements, it is very difficult to remember all the names in different languages. Developments and research works on elements would have stopped at earlier stages due to confusion.

**8. Mohith said "$H_2$ differs from 2H". Justify.**

**A.** Yes. Mohith is correct.

$H_2$ differs from 2H.

$H_2$ represents one hydrogen molecule.

2H represents two hydrogen atoms.

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

**A.** No. Lakshmi's statement is wrong.

(i) CO is the formula of Carbon monoxide molecule. It is a compound.

(ii) Co is the symbol of Cobalt atom. It is an element.

**10. The formula of water molecule is $H_2O$. What information you get from this formula.**

**A.** $H_2O$ is the formula of Water. It tell us

(i) one molecule of water

(ii) It is the oxide of Hydrogen

(iii) It consists of three atoms

(iv) Its molecular weight=(2x1+1x16) =18u

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

**A.** $O_2$ represents Oxygen molecule.

2 Oxygen molecules are denoted by $2O_2$

$N_2$ represents Nitrogen molecule.

5 Nitrogen molecules are denoted by $5N_2$

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

**A.** Formula of given metallic oxide is MO.

It means the valence of 'Metal' and 'Oxygen' are equal.

The valency of Oxygen = 2

The valency of Metal (M) = 2

The valency of Chlorine = 1

According to Criss-cross method:

$M^2$ $Cl^1$

$M_1$ $Cl_2$

The formula of Metallic chloride of the metal given is $MCl_2$.

**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.**

**A.** Formula of calcium hydroxide = $Ca(OH)_2$

So the valency of Ca = 2

Formula of Zinc phosphate = $Zn_3(PO_4)_2$

So the valency of $(PO_4)$ = 3

According to Criss-cross method:

$Ca^2$ $(PO_4)^3$

$Ca_3$ $(PO_4)_2$

The formula of Calcium Phosphate is $Ca_3(PO_4)_2$.

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

(a) common salt (b) baking soda

**A.** (c) washing soda (d) vinegar

| Common Name | Chemical Name | Formula |
|---|---|---|
| Common salt | Sodium chloride | NaCl |
| Baking soda | Sodium bi carbonate | $NaHCO_3$ |
| Washing soda | Sodium carbonate | $Na_2CO_3$ |
| Vinegar | Acetic acid | $CH_3COOH$ |

**15. Calculate the mass of the following.**

**a) 0.5 mole of $N_2$ gas.**

**b) 0.5 mole of N atoms.**

**c) 3.011 X $10^{23}$ number of N atoms.**

**d) 6.022 X $10^{23}$ number of $N_2$ molecules.**

**A. (a)** atomic mass of Nitrogen = 14 u

Molar mass of Nitrogen ($N_2$) = 28 g

Mass of 1 mole of $N_2$ gas = 28 g

Mass of 0.5 mole of $N_2$ gas = 0.5 x 28

= 14 g.

**(b)** atomic mass of Nitrogen = 14 u

Mass of 1 mole of N atoms = 14 g

Mass of 0.5 mole of N atoms = 0.5 x 14

= 7 g.

**(c)** atomic mass of Nitrogen = 14 u

Mass of 1 mole of N atoms = 14 g

Mass of 6.022x$10^{23}$ number of N atoms

= 14 g.

Mass of 3.011x$10^{23}$ number of N atoms

$= \frac{3.011\ X\ 10^{23}}{6.022\ X\ 10^{23}}$ x14 = $\frac{1}{2}$ x 14 = 7 g

**(d)** atomic mass of Nitrogen = 14 u

Molar Mass of $N_2$ molecule = 28 g

Mass of 6.022x$10^{23}$ number of $N_2$

molecules $N_2$ = 28 g.

**16. Calculate the number of particles in each of the following**

**a) 46g of Na** **b) 8g of $O_2$**

**c) 0.1 mole of hydrogen**

**A. (a)** atomic mass of Na = 23 u

Molar mass of sodium (Na) = 23 g

Number of particles in 23 g of Na

= 6.022x$10^{23}$

Number of particles in 46 g of Na

= $\frac{46}{23}$ x 6.022x$10^{23}$

= 2 x 6.022x$10^{23}$

= 12.046 x $10^{23}$

**(b)** atomic mass of 'O" = 16 u

Molar mass of oxygen ($O_2$) = 32 g

Number of particles in 32 g of $O_2$

= 6.022x$10^{23}$

Number of particles in 8 g of $O_2$

= $\frac{8}{32}$ x 6.022x$10^{23}$

= $\frac{1}{4}$ x 6.022x$10^{23}$

= 1.5055 x $10^{23}$

**(c)** atomic mass of 'H" = 1 u

Molar mass of hydrogen ($H_2$) = 1 g

Number of particles in 1 mole of $H_2$

= 6.022x$10^{23}$

Number of particles in 0.1 mole of $H_2$

= 0.6022x$10^{23}$

**17. Convert into mole.**

**a) 12g of $O_2$ gas** **b) 20g of water.**

**c) 22g of carbon dioxide.**

**A. (a)** Molar mass of oxygen ($O_2$) = 32 g

32 g of $O_2$ consists of 1 mole.

12 g of $O_2$ consists of $\frac{12}{32}$ x1= 0.375 moles

**(b)** Water molecule formula is $H_2O$

Molar mass of water = (2x1+1x16)

= 2 + 16

= 18 g

18 g of water consists of 1 mole.

20 g of $O_2$ consists of $\frac{20}{18}$ x1= 1.11 moles

**(c)** Carbon dioxide formula is $CO_2$

Molar mass of $CO_2$ = (1x12+2x16)

= 12 + 32

= 44 g

44 g of $CO_2$ consists of 1 mole.

22 g of $CO_2$ consists of $\frac{22}{44}$ x1= 0.5 moles

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

**A.** According to Criss-cross method the valencies arranged as subscripts in the formula.

(i) In $FeCl_2$ the valency of chlorine is 1.

So the valency of Fe' is 2.

(Because there are 2 chlorine atoms)

(ii) In $FeCl_3$ the valency of chlorine is 1.

So the valency of Fe' is 3.

(Because there are 3 chlorine atoms)



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

**A.** Atom atomic mass

| | |
|---|---|
| H | 1 |
| S | 32 |
| O | 16 |
| C | 12 |

(i) Molar mass of Sulphuric acid ($H_2SO_4$)

= 2x1 + 1x32 + 4x16

= 2 + 32 + 64

= 98 g

(ii) Molar mass of Glucose ($C_6H_{12}O_6$)

= 6x12 + 12x1 + 6x16

= 72 + 12 + 96

= 180 g

**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)

**A. (a)** atomic mass of Na = 23 u

The number of atoms in 23 g of sodium

$= 6.022 \times 10^{23}$

The number of atoms in 100g of sodium

$= \frac{100}{23} \times 6.022 \times 10^{23}$

$= 4.35 \times 6.022 \times 10^{23}$

**(b)** atomic mass of Fe = 56 u

The number of atoms in 56 g of Iron

$= 6.022 \times 10^{23}$

The number of atoms in 100g of Iron

$= \frac{100}{56} \times 6.022 \times 10^{23}$

$= 1.79 \times 6.022 \times 10^{23}$

100g of sodium contains more atoms than 100g of Iron.

**21.** Complete the following table.

| Anions► / Cations▼ | Chloride | Hydroxide | Nitrate | Sulphate | Carbonate | Phosphate |
|---|---|---|---|---|---|---|
| Sodium | NaCl | NaOH | $NaNO_3$ | $Na_2SO_4$ | $Na_2CO_3$ | $Na_3PO_4$ |
| Magnesium | $MgCl_2$ | $Mg(OH)_2$ | $Mg(NO_3)_2$ | $MgSO_4$ | $MgCO_3$ | $Mg_3(PO_4)_2$ |
| Calcium | $CaCl_2$ | $Ca(OH)_2$ | $Ca(NO_3)_2$ | $CaSO_4$ | $CaCO_3$ | $Ca_3(PO_4)_2$ |
| Aluminium | $AlCl_3$ | $Al(OH)_3$ | $Al(NO_3)_3$ | $Al_2(SO_4)_3$ | $Al_2(CO_3)_3$ | $AlPO_4$ |
| Ammonium | $NH_4Cl$ | $NH_4OH$ | $NH_4NO_3$ | $(NH_4)_2SO_4$ | $(NH_4)_2CO_3$ | $(NH_4)_3PO_4$ |

**22.** Fill the following table.

| Sl No | Name | Symbol / Formula | Atomic mass / Molar mass | Number of particles Present in molar mass |
|---|---|---|---|---|
| 1 | Atomic oxygen | O | 16 g | $6.022 \times 10^{23}$ atoms of oxygen |
| 2 | Molecular oxygen | $O_2$ | 32 g | $6.022 \times 10^{23}$ molecules of oxygen |
| 3 | Sodium | Na | 23 g | $6.022 \times 10^{23}$ atoms of sodium |
| 4 | Sodium ion | $Na^+$ | 23 g | $6.022 \times 10^{23}$ ions of sodium |
| 5 | Sodium chloride | NaCl | 38.5 g | $6.022 \times 10^{23}$ molecules of NaCl |
| 6 | Water | $H_2O$ | 18 g | $6.022 \times 10^{23}$ molecules of water |

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