Table of Contents

Water Sources

Children discuss various methods of collecting and using water from different sources such as rain, taps, rivers, and hand pumps. Understanding these sources helps appreciate the importance of clean water and its availability.

Physical and Chemical Changes

Physical changes involve changes in state or form without altering the substance's chemical identity, such as dissolving salt in water. Chemical changes involve the formation of new substances, such as the reaction between baking soda and vinegar producing carbon dioxide gas.

Law of Conservation of Mass

This fundamental law states that mass is neither created nor destroyed in a chemical reaction. Experiments demonstrate that the total mass before and after a chemical reaction remains constant, even when gases are produced, provided the system is closed.

Law of Constant Proportions

Also known as the Law of Definite Proportions, it states that elements combine in fixed mass ratios to form compounds. For example, water always contains hydrogen and oxygen in a 1:8 mass ratio regardless of the source.

Dalton's Atomic Theory

Dalton proposed that matter is made of indivisible atoms, atoms of the same element are identical, and atoms combine in simple whole number ratios to form compounds. This theory explains the fixed proportions in compounds and conservation of mass in reactions.

Covalent Bonding

Covalent bonds form when atoms share electrons to achieve stable electronic configurations. Examples include hydrogen (H_2), chlorine (Cl_2), oxygen (O_2), and compounds like hydrogen chloride (HCl) and water (H_2O).

Ionic Bonding

Ionic bonds form by the transfer of electrons from one atom to another, creating positively charged cations and negatively

charged anions. These ions attract each other to form ionic compounds like sodium chloride (NaCl).

Naming Chemical Compounds

Covalent compounds use prefixes to indicate the number of atoms, while ionic compounds are named by listing the cation first followed by the anion. Polyatomic ions have specific names and valencies.

Properties of Ionic and Covalent Compounds

Ionic compounds are generally soluble in water and conduct electricity when dissolved, while covalent compounds may be insoluble in water and do not conduct electricity. Ionic compounds have high melting and boiling points compared to covalent compounds.

Molecular and Formula Unit Mass

Molecular mass is the sum of atomic masses in a molecule of a covalent compound. Formula unit mass is the sum of atomic masses in the simplest ratio of ions in an ionic compound.

Solved Examples

Example 9.1: Verifying Law of Conservation of Mass

Mass of calcium carbonate = 4.0 g

Mass of hydrochloric acid = 2.92 g

Total mass of reactants = 4.0 g + 2.92 g = 6.92 g

Mass of carbon dioxide = 1.76 g

Mass of water = 0.72 g
Mass of calcium chloride = 4.44 g
Total mass of products = 1.76 g + 0.72 g + 4.44 g = 6.92 g
Since total mass of reactants equals total mass of products, the law is obeyed.

Example 9.2: Calculating Mass of Carbon Dioxide Produced

Given: 12 g carbon + 32 g oxygen → 44 g carbon dioxide
For 2.4 g carbon, mass of carbon dioxide produced = (44/12) × 2.4 = 8.8 g

Example 9.3: Mass of Chlorine in Sodium Chloride

Mass ratio Na:Cl = 23:35.5
If 46 g sodium reacts, chlorine needed = (35.5/23) × 46 = 71 g

Example 9.4: Molecular Mass of Water

Atomic masses: H = 1 u, O = 16 u
Molecular mass = (1 × 2) + 16 = 18 u

Example 9.5: Molecular Mass of Carbon Dioxide

Atomic masses: C = 12 u, O = 16 u
Molecular mass = 12 + (16 × 2) = 44 u

Example 9.6: Formula Unit Mass of Sodium Oxide

Atomic masses: Na = 23 u, O = 16 u
Formula unit mass = (23 × 2) + 16 = 62 u

Example 9.7: Formula Unit Mass of Calcium Nitrate

Atomic masses: Ca = 40 u, N = 14 u, O = 16 u
Formula unit mass = 40 + 2 × (14 + 3 × 16) = 164 u

Practice Set

Conceptual Questions

- Level 1: What is the difference between a physical change and a chemical change?
- Level 2: Explain why the mass remains constant during a chemical reaction according to the Law of Conservation of Mass.

Application-based Question

- Level 3: Design an experiment to verify the Law of Conservation of Mass using vinegar and baking soda.

Answer Key

- Physical change involves change in form without new substances; chemical change produces new substances.
- Mass remains constant because matter is neither created nor destroyed in chemical reactions.
- Use a closed system with vinegar and baking soda, measure mass before and after reaction; mass remains constant.

Quick Reference Table

Common Mistakes and Misconceptions

Glossary