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Chemical Reactions and Equation Balancing

Given and Introduction

Given statement: Sodium metal reacts with water to produce sodium hydroxide and hydrogen.

Goal: Identify the reactants and the products with balanced coefficients.

Identification of Reactants and Products

Reactants: Sodium metal (Na) and water (H_2O).

Products: Sodium hydroxide (NaOH) and hydrogen gas (H_2).

Step-by-Step Solution

Step 1: Write the unbalanced chemical equation

$$Na + H_2O \rightarrow NaOH + H_2$$

The reactants (sodium metal and water) and the products (sodium hydroxide and hydrogen gas) are placed in the equation but not yet balanced.

Step 2: Balance the sodium (Na) atoms

$$2Na + H_2O \rightarrow 2NaOH + H_2$$

Two Na atoms are required on the reactant side to balance the two Na atoms in the product side since each NaOH contains one Na atom.

Step 3: Balance the hydrogen (H) atoms

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

The product side has a total of 4 hydrogen atoms (2 in 2NaOH and 2 in H_2). Thus, the reactant side also needs 4 hydrogen atoms, which are achieved by using 2 H_2O molecules.

Step 4: Balance the oxygen (O) atoms

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

The left side has 2 oxygen atoms from 2 H_2O molecules, and the right side also has 2 oxygen atoms from 2 NaOH molecules.

Final Solution

$$\mathbf{2Na + 2H_2O \rightarrow 2NaOH + H_2}$$

This final balanced chemical equation represents the reaction of sodium metal with water, producing sodium hydroxide and hydrogen gas.

Correct Option:

$$\mathbf{2Na + 2H_2O \rightarrow 2NaOH + H_2}$$

All atoms (Na, H, and O) are balanced, satisfying the law of conservation of mass.

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