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Balancing Chemical Equations

Topic: Chemistry

Question:

From the statement "sodium metal reacts with water to produce sodium hydroxide and hydrogen," identify the reactants and the products with balanced coefficients.

Step-by-Step Solution:

Step 1: Given and Introduction

Given:

- Sodium metal reacts with water.
- The products are sodium hydroxide (NaOH) and hydrogen (H_2).

Introduction: This is a basic chemical reaction where an alkali metal (Sodium) reacts with water to produce an alkali (Sodium Hydroxide) and hydrogen gas. The goal is to identify the reactants and the products, ensuring the chemical equation is balanced.

Supporting Statement: The task begins with understanding the given reactants and products, followed by writing a balanced chemical equation.

Step 2: Write the Unbalanced Equation

Unbalanced Equation:

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

This represents the initial, unbalanced form of the chemical reaction provided.

Supporting Statement: The unbalanced equation provides a clear picture of the reactants and products before balancing.

Step 3: Balance the Sodium Atoms

Balance the sodium (Na) atoms by ensuring there are equal numbers on both sides:

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

Now, there are 2 sodium atoms on both the reactant and product sides.

Supporting Statement: Balancing sodium atoms first is often a straightforward step in such reactions.

Step 4: Balance the Water and Hydrogen Atoms

Balance the hydrogen (H) and oxygen (O) atoms next:

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

Here, each molecule of H_2O has 2 hydrogen atoms, so 2 molecules of H_2O will have 4 hydrogen atoms. These 4 hydrogen atoms participate in forming 2 molecules of NaOH (2 H atoms each) and 1 molecule of H_2 (2 H atoms). This balances the hydrogen atoms in the equation.

Supporting Statement: Ensuring hydrogen and oxygen atoms are balanced might involve adjusting coefficients, as in this step.

Step 5: Final Check

Check the balancing:

- Sodium (Na): 2 on reactant side, 2 on product side.
- Hydrogen (H): 4 on reactant side ($2H_2O$), 4 on product side (2H in 2NaOH + 2H in H_2).
- Oxygen (O): 2 on reactant side ($2H_2O$), 2 on product side (2 in 2NaOH).

Supporting Statement: It is crucial to ensure all elements are balanced to confirm the chemical equation's

accuracy.

Final Step: Balanced Equation

The correctly balanced chemical equation is:

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

Supporting Statement: The balanced equation confirms that the conservation of mass is maintained and all elements are appropriately accounted for.

Final Solution:

The balanced equation that corresponds to the statement "sodium metal reacts with water to produce sodium hydroxide and hydrogen" is:

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

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