Lab Experiment: Using Word, Formula & Net Ionic Equations

Discussion: A **chemical equation** is a shorthand method of representing a chemical change that is either known or predicted to occur. The starting materials, called **reactants,** are listed first on the left side of the equation. An arrow is used to show the direction of change into the **products**, listed on the right side. Any special requirements needed to cause the reaction to occur, such as heating or adding a catalyst, are listed above the arrow. All chemical equations must conform to the law of conservation of mass. This means that no atoms may be created or destroyed during a chemical change. Therefore, the total number of atoms of each element and their masses MUST always remain the same in the reactants and products. **Word equations** provide only the names of the reactants and products involved in a chemical reaction. **Balanced formula equations** are more detailed, because the formulas show exactly which elements and how many atoms of each are involved in the reaction. **Coefficients** are placed in front of the chemical formulas to balance the total number of atoms of each element found in the reactants and products. Soluble compounds that are strong electrolytes separate into their component ions. This would include ionic compounds and strong acids and bases. When identical ions are found among both the reactants and the products, they are considered to be **spectator ions** that play no direct role in the reaction. Therefore, spectator ions are not included in the final **Net Ionic Equation**.

Objective: To provide a series of chemical reactions that can be described by using both word equations and balanced formula equations. AP Chemistry students should practice writing only the ***balanced net ionic equations*** for each chemical reaction, excluding spectator ions that do not undergo any chemical change.

Procedure:

1. Obtain one small piece of calcium metal (0.1-0.3 g) and add it to 10 mL of distilled water in a small, 150 mL beaker. Record your observations. Write the balanced formula equation below.

Word equation: calcium + water → calcium hydroxide + hydrogen gas (a diatomic molecule)

Balanced Formula Equation:

***Balanced Net Ionic Equation*:**

2. Obtain 5 mL of 1 molar (1 M) hydrochloric acid. While stirring, slowly add this acid to the mixture inside the beaker from Step 1. If no observable change occurs, add more acid in 1 mL increments until a reaction is evident. Record your observations. Write the balanced formula equation below.

Word equation: calcium hydroxide + hydrochloric acid → calcium chloride + water

Balanced Formula Equation:

***Balanced Net Ionic Equation*:**

3a. Obtain 5 mL of 1 M potassium carbonate. While stirring, slowly add the solution to the mixture inside the beaker from Step 2. Initially, bubbling should occur as the potassium carbonate reacts with the excess hydrochloric acid in the mixture. Write the balanced formula equation below.

Word equation: potassium carbonate + hydrochloric acid → potassium chloride + water + carbon dioxide gas

Balanced Formula Equation:

***Balanced Net Ionic Equation*:**

3b. After the bubbling subsides, a second reaction will become evident. If necessary, continue to add more potassium carbonate in 1 mL increments until the second reaction occurs. Record your observations. Write the balanced formula equation below.

Word equation: potassium carbonate + calcium chloride → potassium chloride + calcium carbonate

Balanced Formula Equation:

***Balanced Net Ionic Equation*:**

4. Obtain 5 mL of 1 M nitric acid. While stirring, slowly add the acid to the mixture inside the beaker from Step 3. If no observable change occurs, add more acid in 1 mL increments until a reaction is evident. Record your observations. Write the balanced formula equation below.

Word equation: calcium carbonate + nitric acid → calcium nitrate + water + carbon dioxide

Balanced Formula Equation:

***Balanced Net Ionic Equation*:**

5. Obtain 5 mL of 1 M sodium hydroxide. While stirring, slowly add this basic solution to the mixture inside the beaker from Step 4. If no observable change occurs, add more of the base in 1 mL increments until a reaction is evident. Record your observations. Write the balanced formula equation below.

Word equation: calcium nitrate + sodium hydroxide → calcium hydroxide + sodium nitrate

Balanced Formula Equation:

***Balanced Net Ionic Equation*:**

6. Obtain 5 mL of 1 M acetic acid. While stirring, slowly add the acid to the mixture inside the beaker from Step 5. If no observable change occurs, add more acid in 1 mL increments until a reaction is evident. Record your observations. Write the balanced formula equation below.

Word equation: calcium hydroxide + acetic acid → calcium acetate + water

Balanced Formula Equation:

***Balanced Net Ionic Equation*:**

7. Obtain 5 mL of 1 M sodium phosphate. While stirring, slowly add this solution to the mixture inside the beaker from Step 6. If no observable change occurs, add more sodium phosphate in 1 mL increments until a reaction is evident. Record your observations. Write the balanced formula equation below.

Word equation: calcium acetate + sodium phosphate → calcium phosphate + sodium acetate

Balanced Formula Equation:

***Balanced Net Ionic Equation*:**

8. Obtain 5 mL of 1 M sulfuric acid. While stirring, slowly add this acid to the mixture inside the beaker from Step 7. If no observable change occurs, add more acid in 1 mL increments until a reaction is evident. Record your observations. Write the balanced formula equation below.

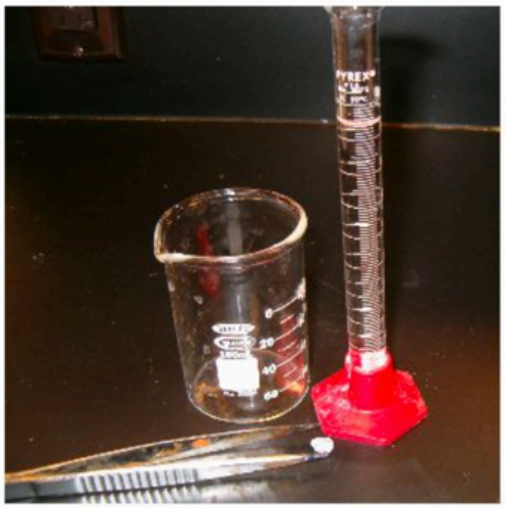
Word equation: calcium phosphate + sulfuric acid → calcium sulfate + phosphoric acid

Balanced Formula Equation:

***Balanced Net Ionic Equation*:**

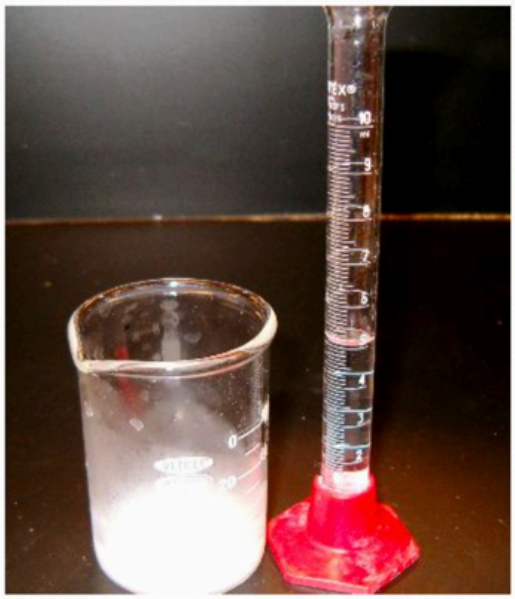
Calcium Reactions Experiment: Writing Balanced Formula Equations

piece of calcium and 10 mL of water



reaction after mixing forms calcium hydroxide and hydrogen gas

calcium hydroxide and hydrochloric acid →

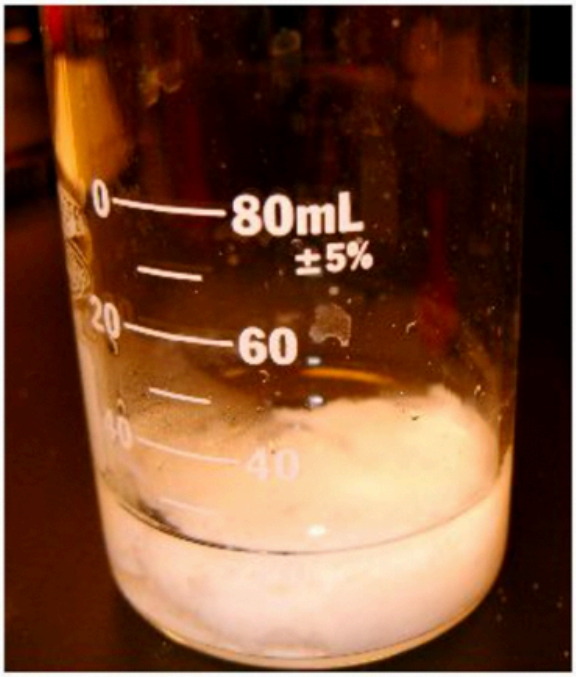


calcium chloride and water

Excess hydrochloric acid and potassium carbonate → potassium chloride, water and carbon dioxide gas

calcium chloride and potassium carbonate →

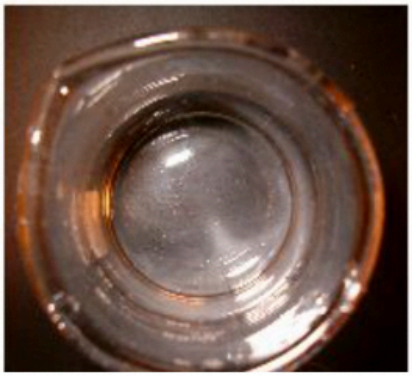
calcium carbonate and potassium chloride



calcium carbonate and nitric acid →

calcium nitrate, water and carbon dioxide gas

Initial bubbling leads to the dissolved precipitate as more nitric acid is added.



calcium nitrate and sodium hydroxide → calcium hydroxide and sodium nitrate

calcium hydroxide and acetic acid → calcium acetate and water

calcium acetate and sodium phosphate → calcium phosphate and sodium acetate

calcium phosphate and sulfuric acid → calcium sulfate and phosphoric acid