Predict the Products

Use reaction patterns to model chemical changes.

CHE.6.1 "Develop and use models to predict the products of chemical reactions (e.g., synthesis reactions; single replacement; double displacement; and decomposition, including exceptions such as decomposition of hydroxides, chlorates, carbonates..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each reaction pattern, circle the clues that tell you which products will form, and number the steps for predicting and balancing products. Use your marks to help you answer the questions.

What Will Form?

1. A chemical equation is a model, not a photograph of atoms. When magnesium burns in oxygen, two reactants join: $2Mg + O_2 \rightarrow 2MgO$. This synthesis pattern predicts one compound from simpler substances. The bright light from burning magnesium once made it useful in camera flashes. A decomposition reaction starts with one compound and forms simpler products. For example, hydrogen peroxide slowly breaks down: $2H_2O_2 \rightarrow 2H_2O + O_2$. Oxygen bubbles can show that the peroxide is changing. Coefficients balance atoms, while subscripts identify substances and must not be changed to balance an equation.

2. Other reactions exchange partners rather than simply joining or splitting. In single replacement, a more reactive element displaces a less reactive one from a compound. Zinc placed in copper(II) sulfate solution produces zinc sulfate and copper: $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$. Iron can also displace copper, but copper cannot displace zinc. In double displacement, ions from two compounds switch partners. Mixing calcium chloride and sodium carbonate forms solid calcium carbonate and dissolved sodium chloride: $CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + 2NaCl$. The solid is a precipitate. Similar mineral deposits can clog household pipes when dissolved ions meet.

3. A pattern needs a special rule before it can predict some products. When heated, many metal carbonates form a metal oxide and carbon dioxide; copper(II) carbonate forms copper(II) oxide and carbon dioxide. Many metal hydroxides, including copper(II) hydroxide, form a metal oxide and water when heated. Metal chlorates usually form a metal chloride and oxygen when heated. Some unstable acids split too: carbonic acid forms water and carbon dioxide, which escapes as bubbles in a fizzy drink. These are not all simple splits into elements. Identify the starting substance, choose the appropriate product rule, then balance the equation.

2 ANSWER WITH EVIDENCE

Use the passage

1. Zinc joins with oxygen to form zinc oxide, ZnO. Write a balanced equation and identify the reaction pattern.

2. Iron is placed in copper(II) sulfate solution. Predict the products and write a balanced equation. Iron forms iron(II) sulfate, $FeSO_4$, in this reaction.

3. Solutions of calcium nitrate, $Ca(NO_3)_2$, and sodium carbonate, Na_2CO_3, are mixed. Predict the solid and write a balanced equation. The other product is sodium nitrate, $NaNO_3$.

4. Calcium carbonate, $CaCO_3$, is heated until it decomposes. Use the carbonate rule to predict its products and write a balanced equation.

3 YOUR TURN

Your own words

Choose an everyday-life reaction not named in the passage or questions. Write a balanced equation, name its reaction pattern, and explain how the pattern predicts the products and why the reaction matters.

ANSWER KEY

Predict the Products

PART 1 · READ AND MARK

Underline each reaction pattern, circle the clues that tell you which products will form, and number the steps for predicting and balancing products. Use your marks to help you answer the questions. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Zinc joins with oxygen to form zinc oxide, ZnO. Write a balanced equation and identify the reaction pattern.	**$2Zn + O_2 \rightarrow 2ZnO$; synthesis.**
2	Iron is placed in copper(II) sulfate solution. Predict the products and write a balanced equation. Iron forms iron(II) sulfate, $FeSO_4$, in this reaction.	**$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$. Iron displaces copper.**
3	Solutions of calcium nitrate, $Ca(NO_3)_2$, and sodium carbonate, Na_2CO_3, are mixed. Predict the solid and write a balanced equation. The other product is sodium nitrate, $NaNO_3$.	**$Ca(NO_3)_2 + Na_2CO_3 \rightarrow CaCO_3 + 2NaNO_3$. Solid calcium carbonate is the precipitate.**
4	Calcium carbonate, $CaCO_3$, is heated until it decomposes. Use the carbonate rule to predict its products and write a balanced equation.	**$CaCO_3 \rightarrow CaO + CO_2$.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

An aluminum pan develops a thin protective coating when its surface reacts with oxygen: $4Al + 3O_2 \rightarrow 2Al_2O_3$. This is synthesis because two reactants join to form one compound, aluminum oxide. The coating helps protect the metal underneath from further corrosion.

Accept equivalent balanced equations and accurate product names. For the open task, accept a chemically accurate everyday example that is distinct from the passage and questions and explains how its reaction pattern predicts the products.