

ChemQuest 28

Chemical Reactions!

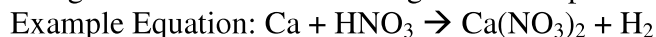
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Information: Introduction to Reactions

During a chemical reaction, new substances are formed. Reactants are transformed into different products. Atoms are never created or destroyed, but they are rearranged. A chemical equation represents what happens during a reaction. The following is an example of a chemical equation:



This equation describes the reaction of calcium (Ca) with nitric acid (HNO₃) to produce calcium nitrate (Ca(NO₃)₂) and hydrogen gas (H₂). You may notice that there are more total atoms on the right side than there are on the left side of the equation. If this seems strange to you, don't worry about it now; we'll fix this later.

Note in the above equation that hydrogen gas is written as H₂ and not simply as H. There are a few elements that exist as diatomic molecules. If a substance is diatomic then the substance must always be bonded to something. A hydrogen atom is diatomic and so it must be bonded to something else like in HCl or HNO₃. If nothing is available for it to bond to, it will bond to itself by forming H₂. All of the diatomic substances are listed below:

Br I N Cl H O F

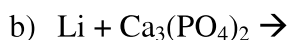
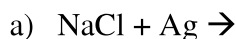
When by themselves these elements exist as Br₂, I₂, N₂, Cl₂, H₂, O₂, and F₂. By the way, you can remember these by recalling a made-up name: Mr. Brinclhof.

Critical Thinking Questions

- Consider the bromine atoms in this reaction: $\text{LiBr} + \text{P} \rightarrow \text{Li}_3\text{P} + \text{Br}_2$.
 - Why is bromine written as Br₂ on the right side?
 - Why is it not necessary for LiBr to be written as LiBr₂?
- What are the reactants in the example equation in the above information section?

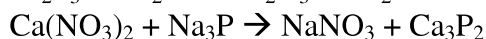
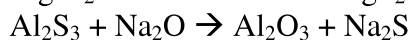
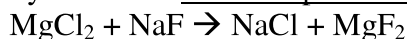
3. Answer the questions that follow based on this chemical equation: $\text{Na} + \text{MgCl}_2 \rightarrow \text{NaCl} + \text{Mg}$.
- Why can't NaMg be produced?
 - Why can't NaCl_2 be produced?
 - Are NaCl and Mg the only products that can be produced?
4. Given the following equation: $\text{Li} + \text{Ca}_3(\text{PO}_4)_2 \rightarrow \text{Li}_3\text{PO}_4 + \text{Ca}$.
- Why can't CaLi_2 be produced?
 - Why can't Li_3P be produced?
 - Are Li_3PO_4 and Ca the only substances that can be produced?
5. Write chemical equations for the following reactions.
- Aluminum sulfate reacts with barium to produce barium sulfate and aluminum.
 - Magnesium reacts with copper(I) nitrate to produce magnesium nitrate and copper.
 - Sodium reacts with calcium phosphide to produce sodium phosphide and calcium.
 - Phosphorus reacts with sodium chloride to produce sodium phosphide and chlorine.
6. Each of the reactions you wrote in question 5 follows a similar pattern. The same pattern is followed by the equations in questions 3 and 4. Describe this pattern.
7. a) How are reactions 5c and 5d different?
- b) How are reactions 5c and 5d similar?

8. Complete the following reactions:



Information: Single and Double Replacement Reactions

Each of the equations that you looked at in the above section is called a single replacement reaction. Notice that in each of them, a single atom replaces an ion from another reactant. Study what happens in the following reactions. They are called double replacement reactions.



Critical Thinking Questions

9. What is the difference between single replacement reactions and double replacement reactions?

10. Complete the following reactions by providing the formulas for the missing compound(s).

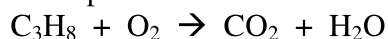


11. Name the two products in the reaction between calcium phosphate and sodium iodide.

12. Explain why when you mix the following reactants, no reaction occurs: $\text{Na}_2\text{SO}_4 + \text{NaCl} \rightarrow$

Information: Combustion, Synthesis, and Decomposition Reactions

Another type of reaction is a combustion reaction. During combustion, a hydrocarbon reacts with oxygen. The products for complete combustion are always the same—water and carbon dioxide and energy. The following equation is an example of the combustion of a hydrocarbon.

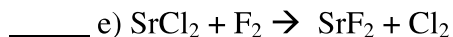
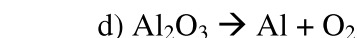
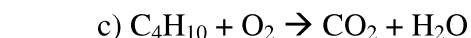
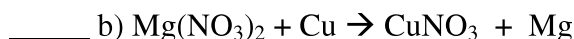
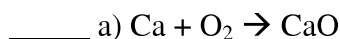


Two other types of reactions are synthesis and decomposition. During a synthesis reaction, several reactants combine to make a single product. During a decomposition, one reactant *decomposes* into two or more products. The following table shows some examples of these types of reactions.

Synthesis	Decomposition
$\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$	$\text{H}_2\text{O} \rightarrow \text{H}_2 + \text{O}_2$
$\text{Na} + \text{Cl}_2 \rightarrow \text{NaCl}$	$\text{NaCl} \rightarrow \text{Na} + \text{Cl}_2$

Critical Thinking Questions

13. Categorize each of the following reactions as single replacement (SR), double replacement (DR), synthesis (S), decomposition (D) or combustion (C).

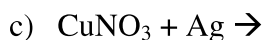
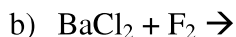
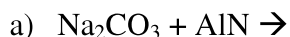


14. Write an equation for the combustion of C_3H_6 .

15. Write an equation for the decomposition of calcium oxide.

Practice Problems

1. Complete the following reactions.



2. Fill in the blanks for the missing reactant or product and then in the blank to the left of each equation indicate whether the reaction is a single replacement (SR), double replacement (DR), synthesis (S), decomposition (D) or combustion (C).

