Types of Chemical Reactions: Synthesis

Note: Slides contain audio. Click icon in bottom right corner to play.





There are millions of chemical reactions that are known to occur. Among these millions of reactions, certain types display similar characteristics. As a result, chemists are able to group reactions into 4 basic types to help organize these known reactions and to help chemists predict the products of unknown reactions.



Click to learn about synthesis reactions

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Synthesis Reactions

In a synthesis reaction, two reactants combine to form one larger product. The general formula for a synthesis reaction can be written as follows:

Click for the General Formula for a Synthesis Reaction



Synthesis Reactions

In a synthesis reaction (also called combination reactions), two reactants combine to form one larger product. The general formula for a synthesis reaction can be written as follows:



Where A and B are the reactants, and they combine to form the AB, the product. For a synthesis reaction to occur, the two reactant molecules must collide with each other, break any existing bonds between their atoms and form new bonds.

Synthesis Reaction Example



A good example of a synthesis reaction occurs when diatomic molecules of hydrogen gas burn in the air, combining with diatomic molecules of oxygen gas to form water. Try to write out the balanced chemical equation for this reaction and you will see the general formula for a synthesis reaction represented.

Balanced Synthesis Reaction Equation



A good example of a synthesis reaction occurs when diatomic molecules of hydrogen gas burn in the air, combining with diatomic molecules of oxygen gas to form water.

$2H_2 + O_2 \rightarrow 2H_2O$

The animation below represents this synthesis reaction occurring, as hydrogen and oxygen molecules react to form water molecules.



Synthesis reactions can also occur between more complex compounds.

Complex Synthesis Reactions



Water and carbon dioxide can combine in a synthesis reaction to produce an acid called carbonic acid, which has the formula H_2CO_3 . Write the balanced chemical equation for this reaction to see how it can be classified as a synthesis reaction.

Complex Synthesis Reaction Equation



Water and carbon dioxide can combine in a synthesis reaction to produce an acid called carbonic acid, which has the formula H₂CO₃.

$H_2O + CO_2 \rightarrow H_2CO_3$

This reaction is actually what causes "acid rain" to be produced. Air in our atmosphere contains CO_2 , whenever water makes contact with the air, some of the CO_2 this synthesis reaction will occur. The more CO_2 that is in the air, the more this reaction will occur. The consequences are that the ground and water that receive the acid rain become more acidic as more acid rain is produced. This acidification can have devastating effects on plants and animals exposed to this acid rain.



Depending on the types of reactants in a synthesis reaction, chemists can predict the product before the reaction ever occurs. For example, when a **metal from Group A** of the periodic table reacts with a **nonmetal**, the product is a compound that consists of the **metal cation** and the **nonmetal anion**.

For the following reaction predict the product:

$$K_{(s)} + Cl_{2(g)} \rightarrow$$

Click to See the Product



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$$2K_{(s)} + Cl_{2(g)} \rightarrow 2KCl_{(s)}$$

metal cation nonmetal anion
More Synthesis
Reactions



Depending on the types of reactants in a synthesis reaction, chemists can predict the product before the reaction ever occurs. For example, when a **metallic oxide** (metal-oxygen) reacts with **water**, the resulting product is a **metallic hydroxyide** (metal-OH).





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Test your understanding: Which of the following reactions is a synthesis reaction? (Click the box with the correct answer.)

 $CO_2 + H_2O \rightarrow H_2CO_3$

$$C_2H_8 + O_2 \rightarrow 2CO_2 + 4H_2O$$

 $2Fe + 6NaBr \rightarrow 2FeBr_3 + 6Na$

$$2HCI \rightarrow H_2 + Cl_2$$



Incorrect. Try again:

Which of the following reactions is a synthesis reaction? (Click the box with the correct answer.)

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Correct

In the reaction:

$CO_2 + H_2O \rightarrow H_2CO_3$

Two simple reactants combine to form one complex product molecule, indicating a synthesis reaction has taken place.

Test Your Understanding



Test your understanding:

Predict the product(s) of the following balanced synthesis reaction: (Click the box with the correct answer.)

 $Na_2O + H_2O \rightarrow$



Incorrect. Try again:

Predict the product(s) of the following balanced synthesis reaction: (Click the box with the correct answer.)

 $Na_2O + H_2O \rightarrow$



Correct

The balanced chemical equation for this synthesis, which shows the correct product is:

$Na_2O + H_2O \rightarrow 2NaOH$

Success Criteria



Success!

You have reached the end of this activity. You will know that you have achieved the goals for this activity when you can explain that different types of reactions can be sorted into 4 different categories. You will also be able to describe a synthesis reaction and identify a synthesis reaction based on the components of the reactants and products of a given reaction.



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