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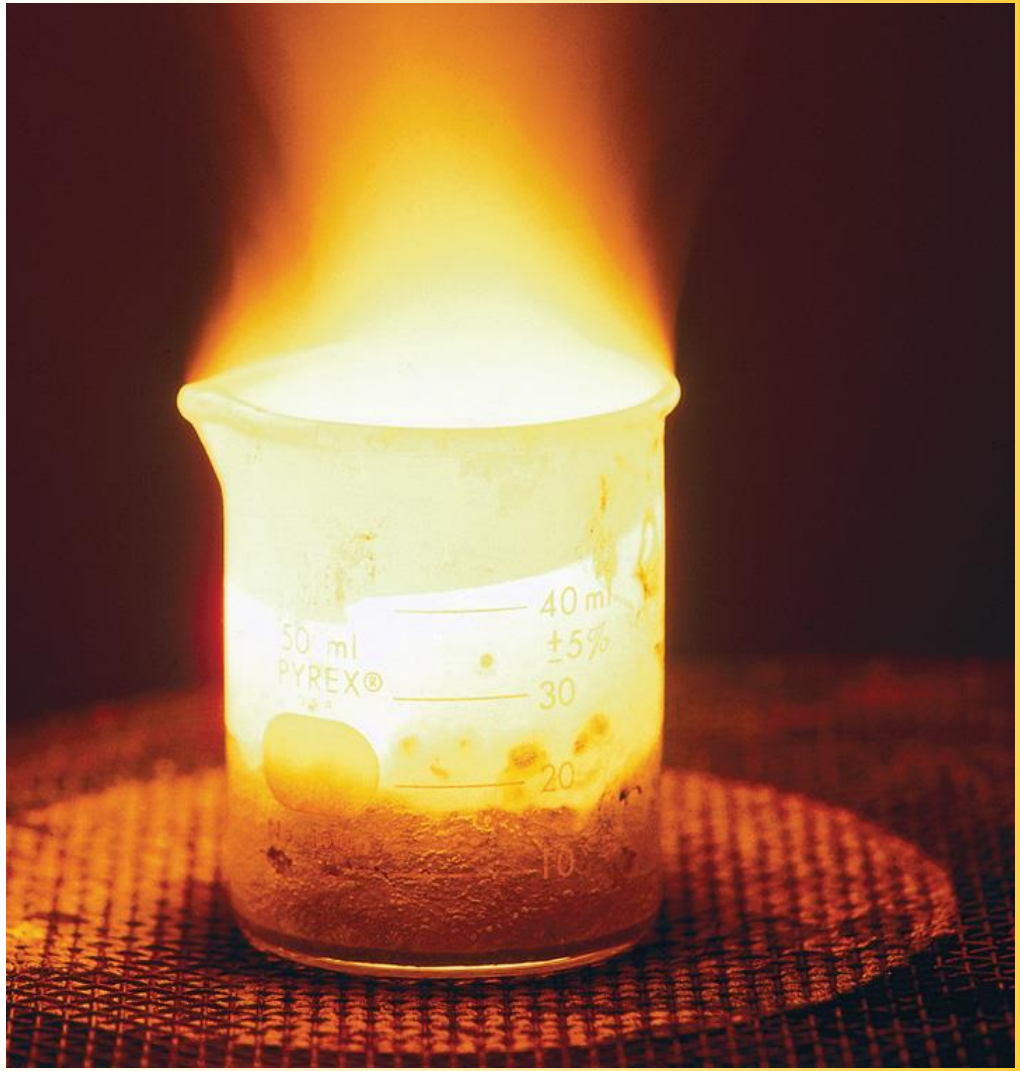
Types of Chemical Reactions: Single & Double Displacement Reactions



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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.

Synthesis

Decomposition

Single Displacement

Double Displacement

Click to learn about single displacement reactions

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Single Displacement Reactions

In a single displacement reaction, a single element replaces (or displaces) another element in a compound. A general formula for a single displacement reaction can be written as follows:

Click for the General Formula for a Synthesis Reaction

Single Displacement Reactions

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In a single displacement reaction, a single element replaces (or displaces) another element in a compound. A general formula for a single displacement reaction can be written as follows:

$$AB + C \rightarrow AC + B$$

OR

$$A + BC \rightarrow AC + B$$

As you can see, in this reaction, the element C displaces the element B from the reactant compound AB to form the product compound AC.

Single Displacement Reaction Example

Single Displacement Reactions

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A good example of a single displacement reaction occurs when magnesium (Mg) replaces hydrogen in hydrogen chloride (HCl) to form the products: magnesium chloride ($MgCl_2$) and hydrogen gas (H_2). Try to write the balanced equation for this reaction:

Balanced Single Displacement Reaction Equation

Single Displacement Reactions

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A good example of a single displacement reaction occurs when magnesium (Mg) replaces hydrogen in hydrogen chloride (HCl) to form the products: magnesium chloride ($MgCl_2$) and hydrogen gas (H_2). Try to write the balanced equation for this reaction:

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

Notice how the Mg replaces the H atom in the product compound.

Test Your Understanding

Test your understanding:

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

$CO_2 + H_2O \rightarrow H_2CO_3$

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

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

$2HCl \rightarrow H_2 + Cl_2$

Incorrect. Try again:

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

$CO_2 + H_2O \rightarrow H_2CO_3$

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

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

$2HCl \rightarrow H_2 + Cl_2$

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Correct

In the reaction:

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

The Fe displaces the Na from the reactant compound (NaBr) to form the product $FeBr_3$:

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

The next type of reaction we will explore is similar to a single displacement reaction and is known as a **double** displacement reaction. Can you guess what this reaction looks like based on its name?

Double Displacement Reactions

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Double Displacement Reactions

Recall that negative ions (-) are called anions and positive ions (+) are called cations. In a double displacement reaction the anions and cations of different molecules switch places (or displace each other) to form two different product compounds. Given this information, try to predict the general formula for a double displacement reaction.

Click for the General Formula for a Double Displacement Reaction

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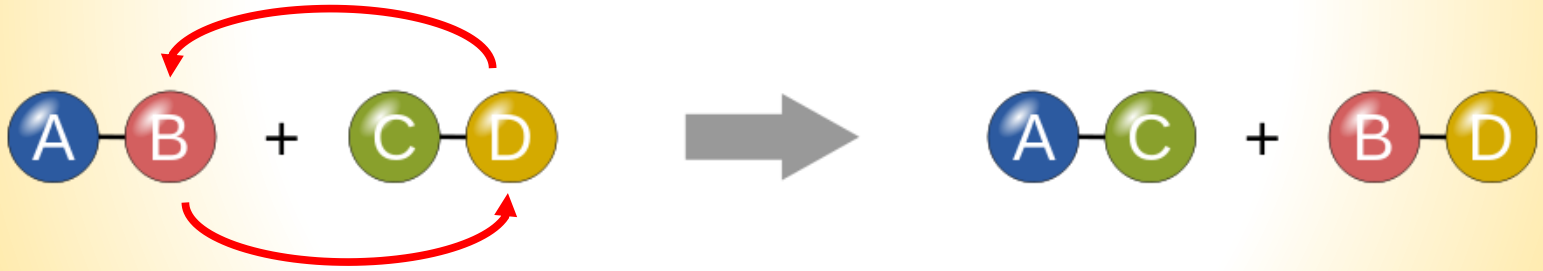
Double Displacement Reactions

In a double displacement reaction the anions and cations of different molecules switch places (or displace each other) to form two different product compounds. The general formula for a double displacement reaction is:

$$AB + CD \rightarrow AD + CB$$



As you can see, in this reaction, the anion D switches places with the anion B to form the products AD and CB.

Double Displacement Reaction Example

Double Displacement Reactions

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A good example of a double displacement reaction is the reaction between barium hydroxide ($Ba(OH)_2$) and sodium sulfate (Na_2SO_4). Based on what you know about double displacement reactions try to predict the products of this reaction and write the balanced chemical equation.

Balanced Double Displacement Reaction Equation

Double Displacement Reactions

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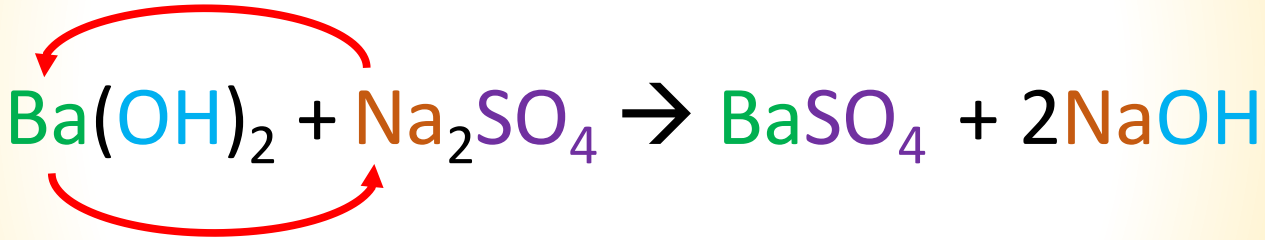
A good example of a double displacement reaction is the reaction between barium hydroxide ($Ba(OH)_2$) and sodium sulfate (Na_2SO_4). The balanced chemical equation for this double displacement reaction is:

$$Ba(OH)_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaOH$$

Notice how the cations Ba and Na have switched places in the product compounds:



Test Your Understanding

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

$CO_2 + H_2O \rightarrow H_2CO_3$

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

$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

Incorrect. Try again:

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

$CO_2 + H_2O \rightarrow H_2CO_3$

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

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

$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

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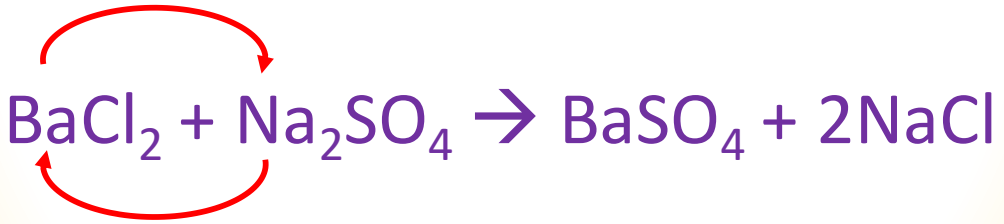
Correct

In the reaction:

$$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$$

The cations Ba and Na switch (displace) with each other forming two new product compounds.



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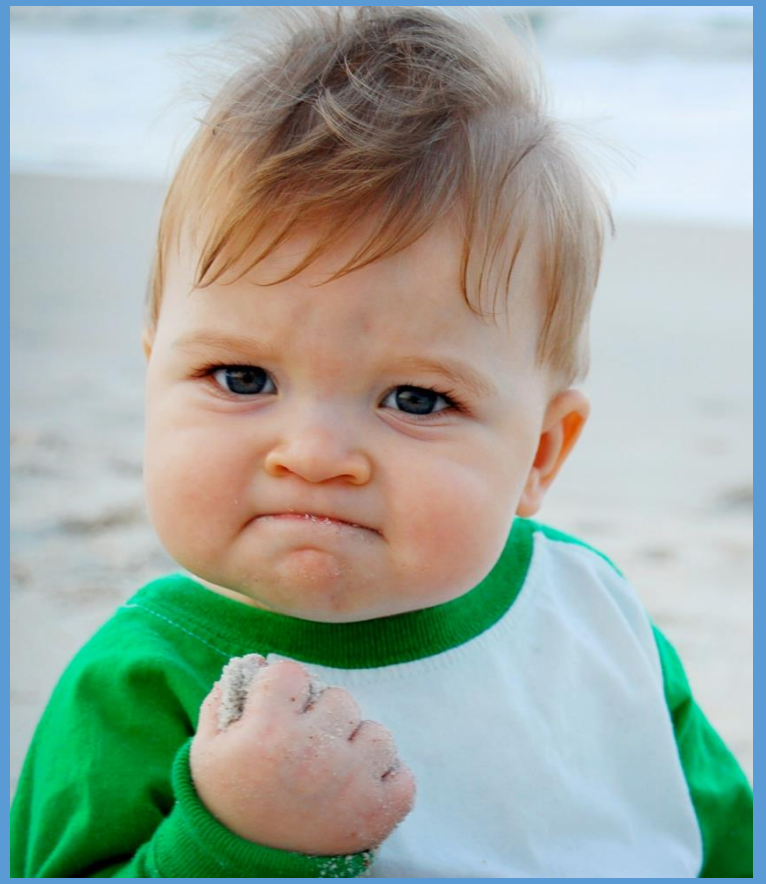
Success!

You have reached the end of this activity. You will know that you have achieved the goals for this activity when you can describe and identify single and double displacement reactions and can give examples of these reactions.



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