Types of Chemical Reactions: Single Displacement Reactions

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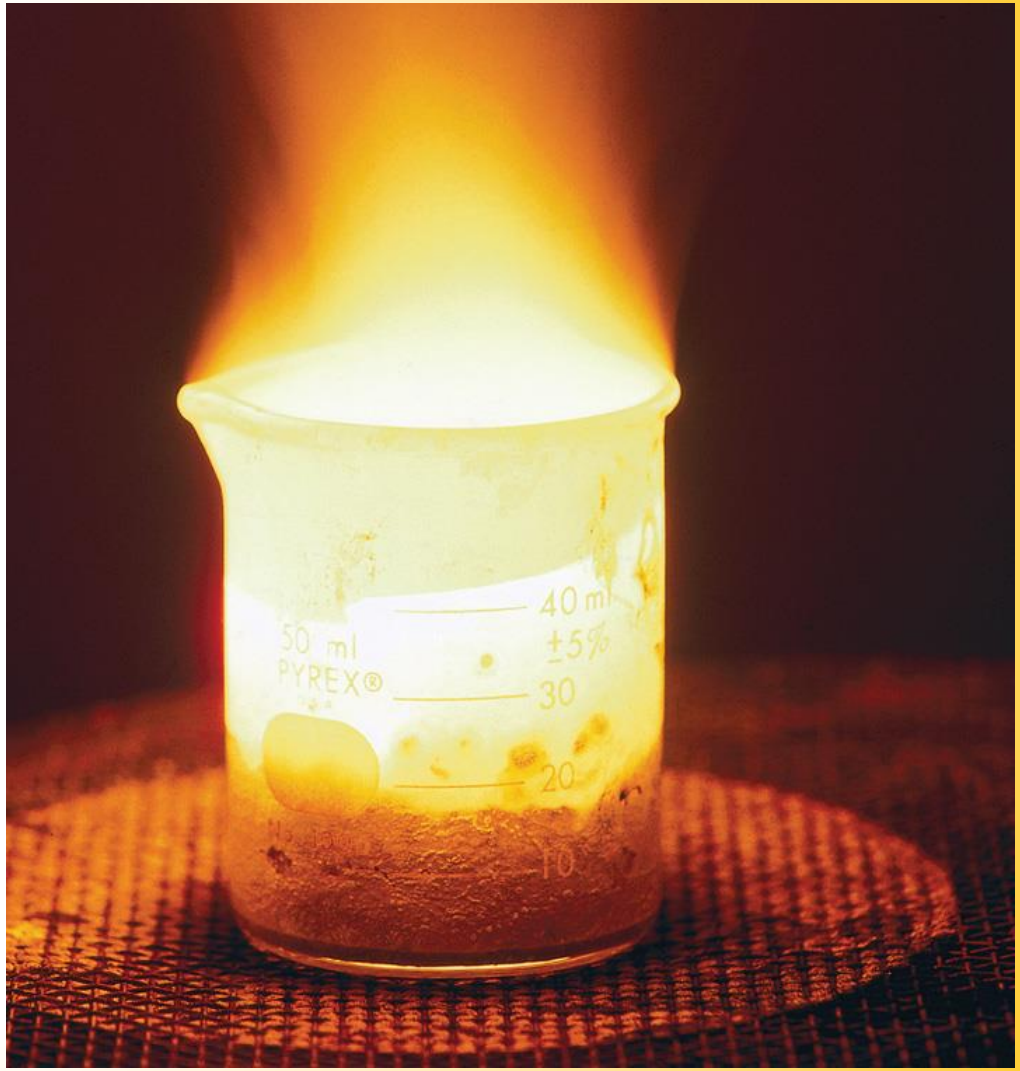

ROSEDALE ACADEMY

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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

Click this icon to play audio

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 Single Displacement Reaction

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:

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

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

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

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:

$$\mathbf{Mg + 2HCl \rightarrow MgCl_2 + H_2}$$

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.)

$CO_2 + H_2O \rightarrow H_2CO_3$

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

$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

$2HCl \rightarrow H_2 + Cl_2$

Incorrect. Try again:

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

$CO_2 + H_2O \rightarrow H_2CO_3$

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

$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

$2HCl \rightarrow H_2 + Cl_2$

Correct

In the reaction:

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

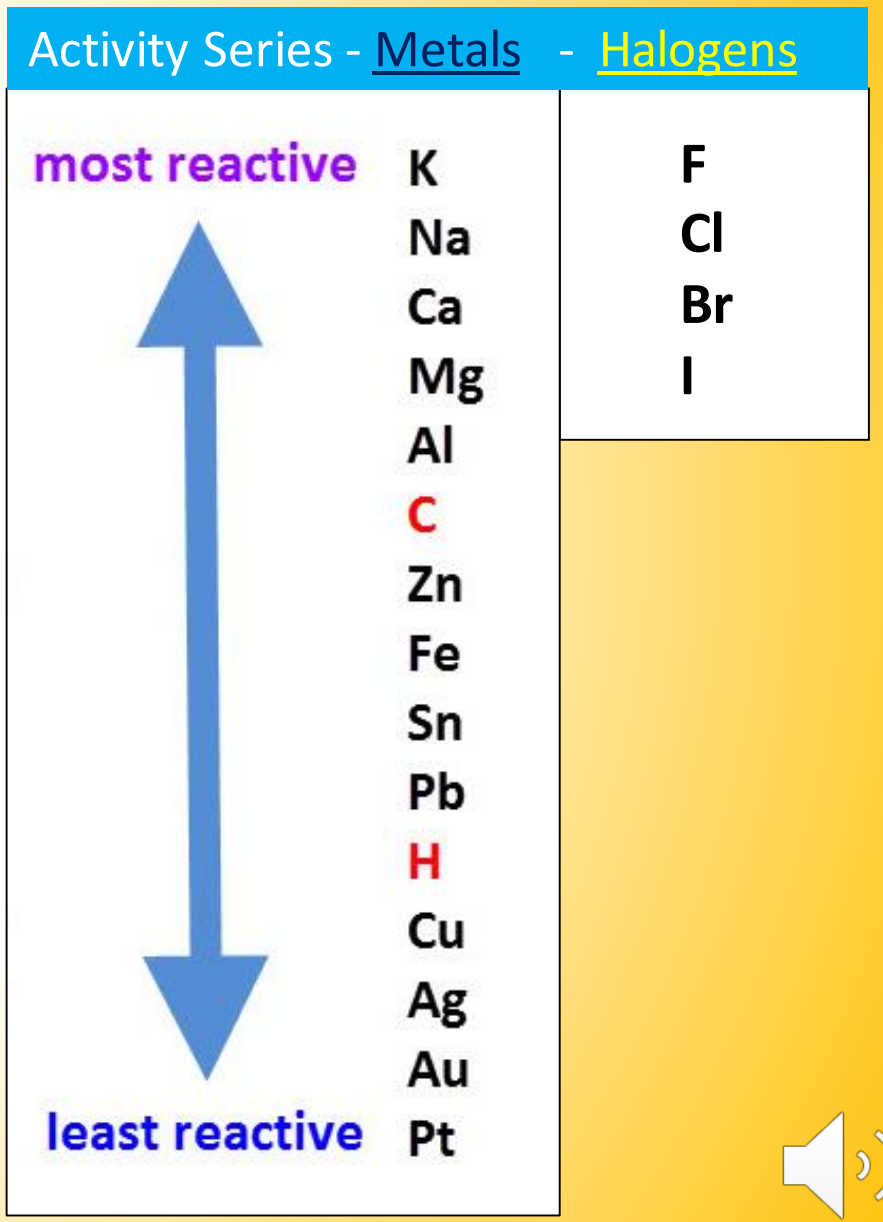
The Zn displaces the Cu from the reactant compound ($CuSO_4$) to form the product $ZnSO_4$:

If a compound and an element are mixed will a single displacement reaction always occur? Click the button below to find out.

Activity Series

Certain elements are more reactive than others. The term reactive refers to how likely an element is to be involved in a reaction. The reactivity of elements has been analyzed and organized in a chart called an activity series. To apply the activity series to predict whether a single displacement reaction will occur use the following rules:

1. One element can displace elements below it from compounds in solution but cannot replace elements above it.
2. The farther apart two elements are, the more likely that a displacement reaction will occur quickly.

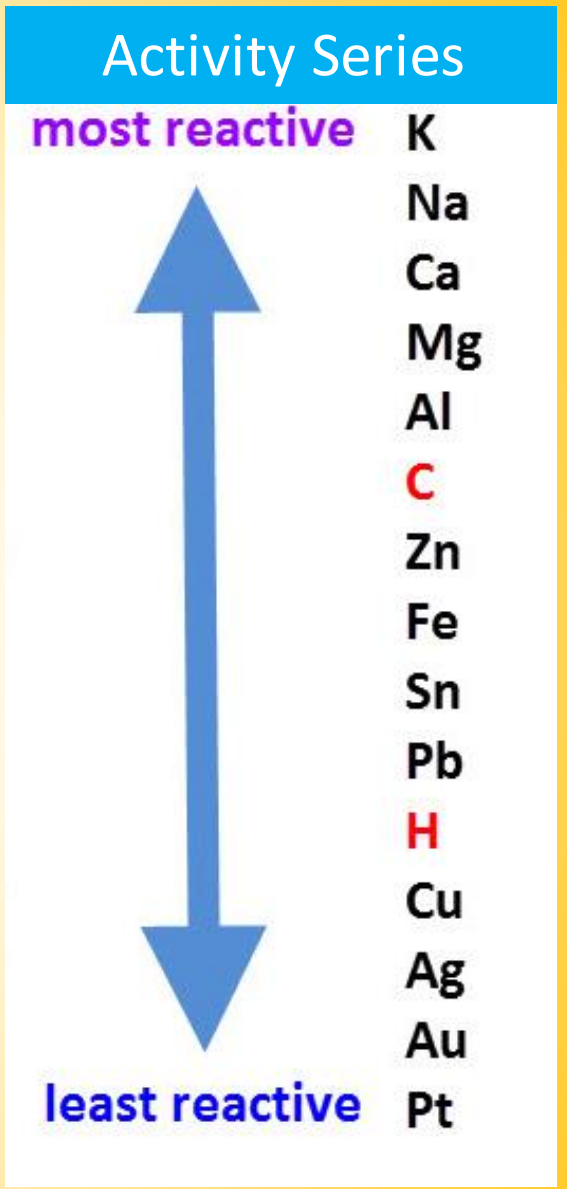


Predict whether the following reaction will occur:

$$Mg_{(s)} + CuSO_{4\,(aq)} \rightarrow$$

Yes the reaction will occur.

No the reaction will not occur.



The correct answer is YES. This reaction will occur. You can predict this reaction will occur because Mg is higher on the activity series than Cu.

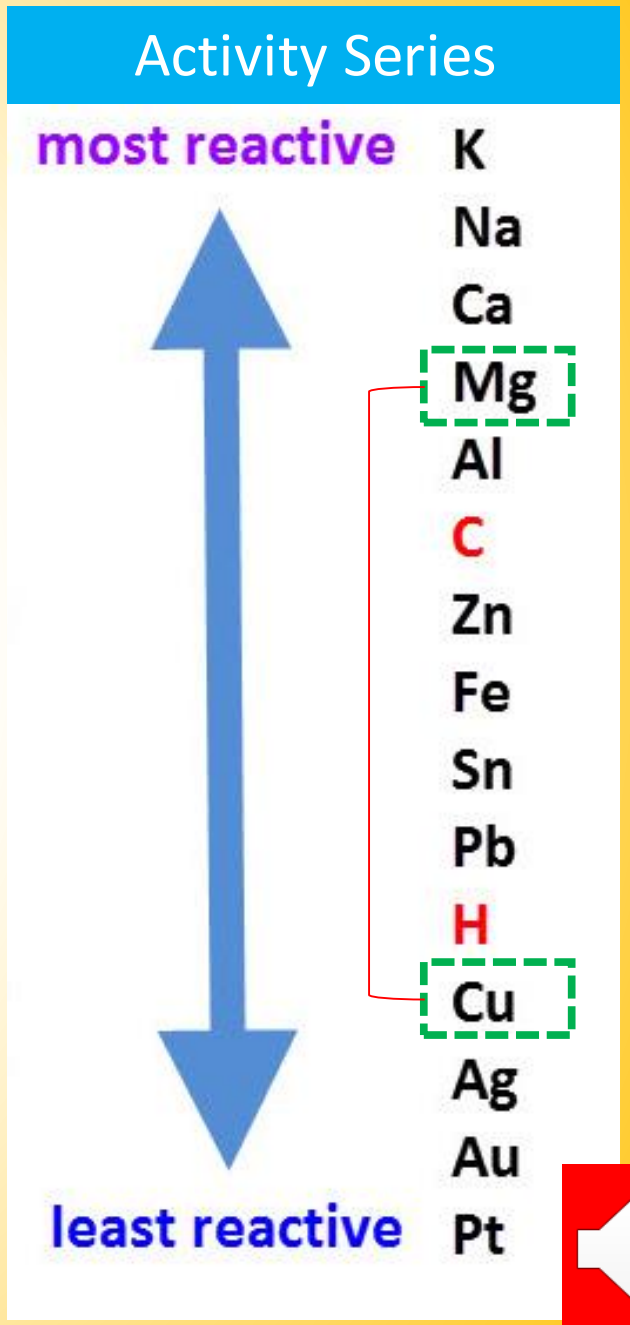
Yes the reaction will occur.

No the reaction will not occur.

Now that you know the reaction will occur, try to predict the product and write the balanced chemical equation for this reaction:

$$Mg_{(s)} + CuSO_{4\,(aq)} \rightarrow$$

Balanced Reaction



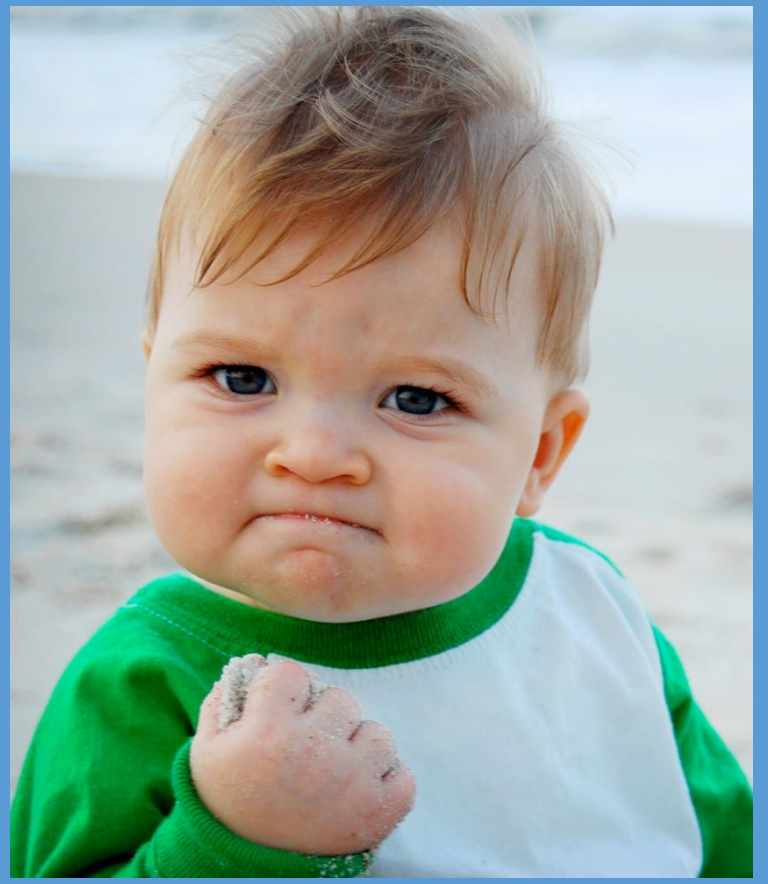
Balanced Reaction:

$$Mg_{(s)} + CuSO_{4\,(aq)} \rightarrow MgSO_{4\,(aq)} + Cu_{(s)}$$

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 describe and identify single displacement reactions, can give examples of these reactions and can use an activity series to determine whether a reaction will occur.



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