

8-2 Types of Chemical Reactions

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Composition (or Synthesis) – two (or more) things combine

Decomposition – one thing breaks up

Single-Replacement (or Displacement) – one thing replaces another

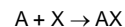
Double-Replacement – two things swap parts in solution

Combustion (Burning) – something combines with oxygen
☺ FIRE!! ☺

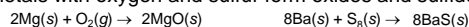
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8-2 Types of Composition Reactions

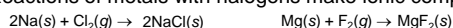
Composition – two or more substances make a new compound. Also called **Synthesis**.



Metals with oxygen and sulfur form oxides and sulfides

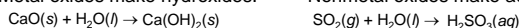


Reactions of metals with halogens make ionic compounds



Composition Reactions of oxides with water:

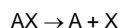
Metal oxides make hydroxides. Nonmetal oxides make acids.



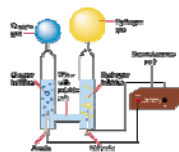
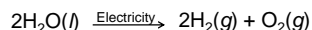
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8-2 Types of Decomposition Reactions

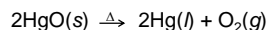
Decomposition – a substance breaks into two or more substances. These will often require heat or electricity to be added.



• **Electrolysis** – decomposition of a compound by an electric current



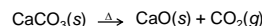
• Oxides of less-active metals can split into elements when heated



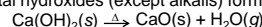
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8-2 Types of Decomposition Reactions

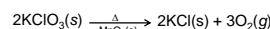
• Metal carbonates will produce a metal oxide and CO₂ when heated



• Metal hydroxides (except alkalis) form metal oxides and H₂O



• Metal chlorates form metal chlorides and oxygen when heated



• Certain acids can form nonmetal oxides and water

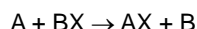


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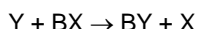
8-2 Types of Single Replacement Reactions

Single-Replacement – one element replaces a similar element in a compound. Also called **Displacement**.

Metal Replacement



Halogen Replacement



A more active element is needed to replace a similar, less active element in a compound. The Activity Series lists elements in order of activity.

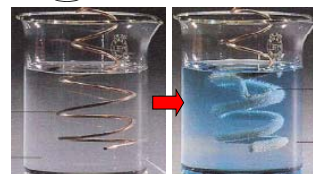
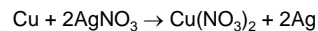
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8-2 Types of Single Replacement Reactions

Activity Series of Metals

Strongly reducing	↑	Li	<ul style="list-style-type: none"> • React with cold H₂O and acids, replacing hydrogen. • React with oxygen, forming oxides.
		Rb	
		K	
		Ba	
		Sr	
		Ca	
		Na	
		Mg	
		Al	
		Mn	
		Zn	<ul style="list-style-type: none"> • React with steam (but not cold water) and acids, replacing hydrogen. • React with oxygen, forming oxides.
		Cr	
		Fe	
		Co	
		Ni	
		Cd	<ul style="list-style-type: none"> • Do not react with water. • React with acids, replacing hydrogen. • React with oxygen, forming oxides.
		Pb	
		H ₂	
		Sn	
		Pb	
		H ₂	<ul style="list-style-type: none"> • React with oxygen, forming oxides.
		Bi	
		Pb	
		Hg	
		Pt	
		Au	<ul style="list-style-type: none"> • Fairly unreactive, forming oxides only indirectly.
Weakly reducing		Au	

Copper will replace silver because it is higher on the activity series.



Activity Series of Nonmetals

Most Active → Fluorine → Chlorine → Bromine → Iodine → Least Active

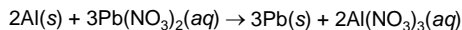
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8-2 Types of Single Replacement Reactions

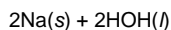
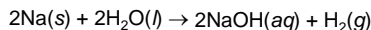
Replacement of a metal by another metal

Aluminum can replace lead because it is higher on the activity series.



Replacement of hydrogen in water by a metal

Highly active metals can react with cold water by replacing hydrogen. This forms a metal hydroxide and hydrogen gas.

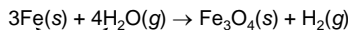


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8-2 Types of Single Replacement Reactions

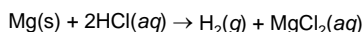
Replacement of hydrogen in steam by a metal

Less active metals can react with steam to form a metal oxide by replacing hydrogen. This forms a metal oxide and hydrogen gas.



Replacement of hydrogen in an acid by a metal

More active metals can react with an acid by replacing hydrogen to form a salt (metal compound) and hydrogen gas



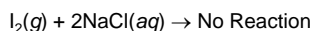
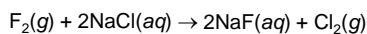
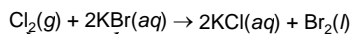
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8-2 Types of Single Replacement Reactions

Replacement of halogens

Halogen activity is most active with fluorine and decreases with halogen below.

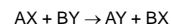
Fluorine → Chlorine → Bromine → Iodine



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8-2 Types of Double Replacement Reactions

Double-Replacement – ions in two compounds exchange in aqueous solution to form new compounds



This typically occurs when ions in solution form one compound that is:

- a precipitate (insoluble compound)
- an insoluble gas that bubbles out
- a molecular compound like water



The other compound is often soluble and remains in solution.

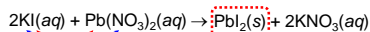
Solubility of many compounds can be predicted using Solubility Tables.

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8-2 Types of Double Replacement Reactions

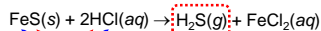
Formation of a precipitate

A precipitate forms when the cations of one reactant combine with the anions of another reactant to form an insoluble compound.



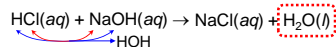
Formation of a gas

Some products can be insoluble gases that bubble out of solution.



Formation of water (Acid/Base Neutralization)

Some reactions will form a stable compound such as water

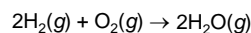


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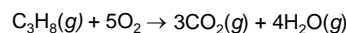
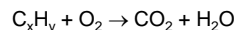
8-2 Types of Chemical Reactions

Combustion – a substance combines with oxygen releasing energy in the form of light and heat

Combustion is often described as “burning”. Some combustion reactions are also synthesis reactions.



Combustion of hydrocarbons will form CO_2 and H_2O as products.



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