

# Chemical Reaction Types

Synthesis

Combustion

Decomposition

Single Replacement

Double Replacement



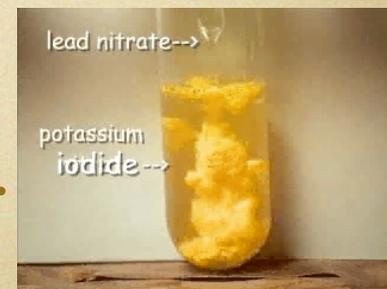
# Ways to observe a chemical reaction has occurred:

- A color change.
- A change in temperature.
- A change in mass.
- Effervescence (gas produced)



Burning a piece of paper produces all four of these.

- Precipitate  
(solid form in reaction between to liquids).

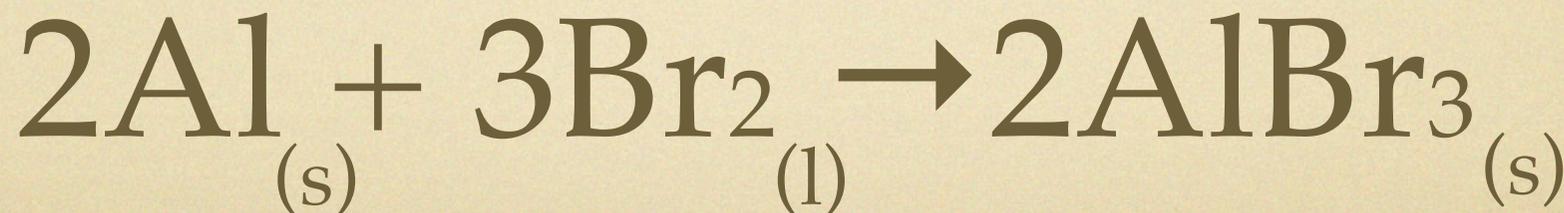


# Synthesis



- A synthesis reaction occurs when two or more substances combine to form one substance.
- Most synthesis reactions involve two elements combining to form a compound.  
element      compound
- The general formula is  $A + B \rightarrow AB$   
element

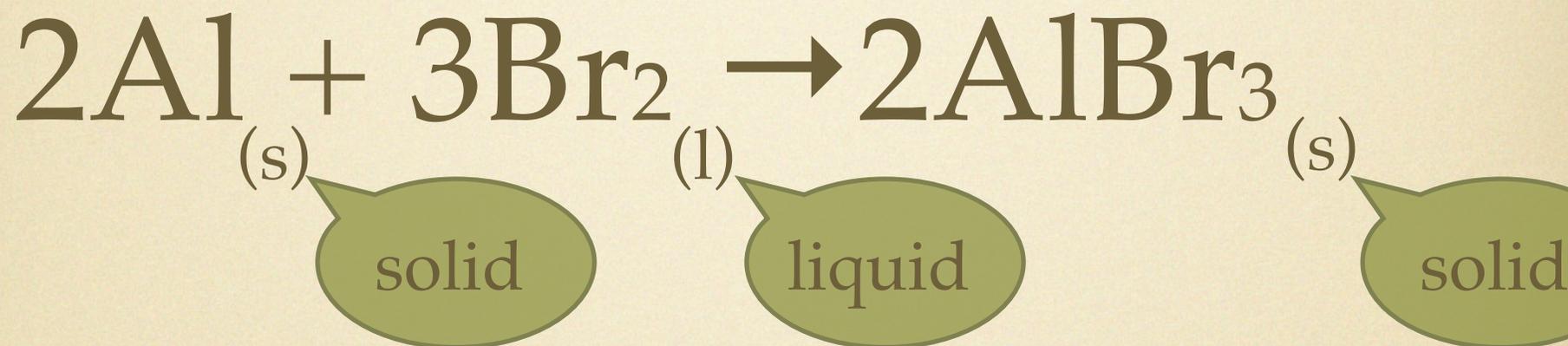
Synthesis of Aluminum bromide



# Phase subscripts



Synthesis of Aluminum bromide



Use the following subscripts to show phases of the reactants and products:

(s) = solid

(l) = liquid

(g) = gas

(aq) = dissolved in water

# Lighting a Burner

Please observe how to light a burner.

When heating an object over a flame hold it in the upper two-thirds of the flame.

The inner cone at the bottom of the flame is unburned gas.



# Combustion



- A Combustion reaction is a synthesis reaction in which oxygen is one of the reactants.
- The general formula is  $A + O_2 \rightarrow A_xO_z$
- Most elements react with oxygen in a combustion reaction to form oxides.

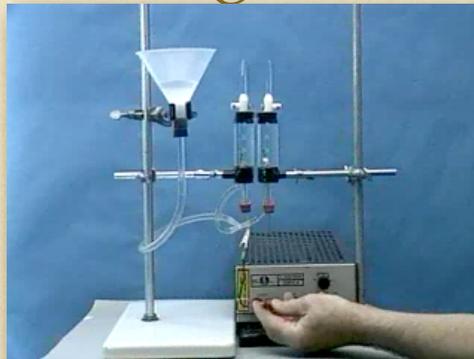
Here are some  
combustion  
movies  
involving oxygen  
combining with  
Mg, Fe, P and S.



# Decomposition



- A decomposition reaction occurs when one substance breaks down into two or more substances.
- The general formula is  $AB \rightarrow A + B$
- Most decomposition reactions involve one compound breaking down into two elements



Decomposition of Water



# Decomposition

Some reactions require very little activation energy to react. This is the case in the decomposition reaction of nitrogen triiodide.

Being struck by a feather provides enough heat (activation energy) to set off the reaction.



Decomposition of Nitrogen triiodide



# Solubility



- Solubility is the ability to dissolve in water.
- Substances that dissolve in water, such as sugar, are soluble. Substances that do not dissolve in water, such as rust, are insoluble.
- Elements: Metals are insoluble solids at RT, Nonmetals are generally soluble. Exceptions: C, S, P are insoluble nonmetal solids.
- To determine if a compound is soluble, consult the *solubility table*. Find the anion, then go across to see if, when combined with the

# Solubility Table

## Solubilities of common ionic compounds

	<u>anion in compound</u>	<u>solubility</u>
Usually Soluble	nitrates	all soluble
	nitrites	all soluble except Ag <sup>+</sup>
	acetates	all soluble except Ag <sup>+</sup> , Hg <sup>+</sup>
	chlorides	all soluble except Ag <sup>+</sup> , Hg <sup>+</sup> , Pb <sup>+2</sup> , Cu <sup>+</sup>
	bromides	all soluble except Ag <sup>+</sup> , Hg <sup>+</sup> , Pb <sup>+2</sup>
	iodides	all soluble except Ag <sup>+</sup> , Hg <sup>+</sup> , Pb <sup>+2</sup>
	sulfates	all soluble except Pb <sup>+2</sup> , Ba <sup>+2</sup> , Sr <sup>+2</sup> , Ca <sup>+2</sup>
Not Usually Soluble	sulfites	all <b>insoluble</b> except Na <sup>+</sup> , K <sup>+</sup> , NH <sub>4</sub> <sup>+</sup>
	sulfides	all <b>insoluble</b> except Na <sup>+</sup> , K <sup>+</sup> , NH <sub>4</sub> <sup>+</sup> , Ba <sup>+2</sup> , Sr <sup>+2</sup> , Ca <sup>+2</sup>
	phosphates	all <b>insoluble</b> except Na <sup>+</sup> , K <sup>+</sup> , NH <sub>4</sub> <sup>+</sup>
	carbonates	all <b>insoluble</b> except Na <sup>+</sup> , K <sup>+</sup> , NH <sub>4</sub> <sup>+</sup>
	oxides	all <b>insoluble</b> except Na <sup>+</sup> , K <sup>+</sup> , Ba <sup>+2</sup> , Sr <sup>+2</sup> , Ca <sup>+2</sup>
	hydroxides	all <b>insoluble</b> except Na <sup>+</sup> , K <sup>+</sup> , Ba <sup>+2</sup> , Sr <sup>+2</sup> , Ca <sup>+2</sup> , NH <sub>4</sub> <sup>+</sup>

Are these compound soluble or insoluble?

silicon dioxide ← anion

copper(II) chloride ← anion

# Dissociation of Ionic Compounds in solution

When soluble ionic compounds, such as NaCl are placed in water, the crystalline lattice breaks apart into individual ions. These ions are then free to move about in the solution.

While dissolving is a physical change, an equation can show that the crystalline lattice of salt breaks apart into individual ions when dissolved in water.

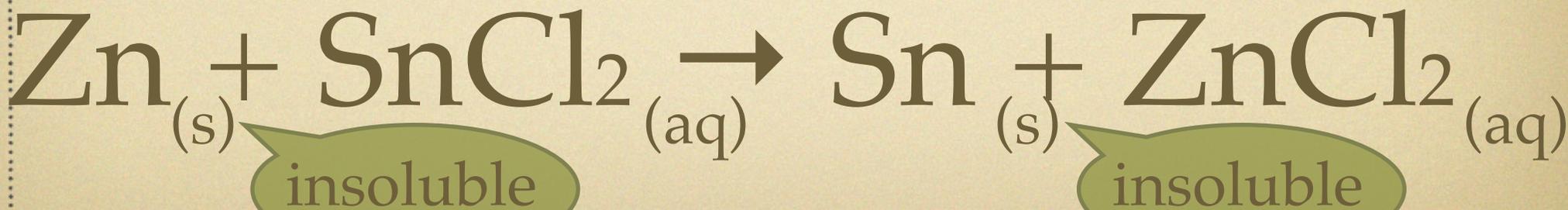




# Single Replacement

- A Single Replacement reaction occurs when a more active element replaces a less active ion in a compound. Use the Activity Series to tell.
- The general formula is  $A + BC \rightarrow AC + B$   
Metals replace less active metals, nonmetals replace less active nonmetals.

Single Replacement Reaction



# Double Replacement



- A Double Replacement reaction occurs when two metallic ions switch places and one of the products is insoluble in water and forms a solid. Use the Solubility Table to tell if a precipitate will form.
- The general formula is  $AB + CD \rightarrow AD + \downarrow CB$   
In this reaction compound  $CB$  is insoluble and forms a precipitate.

## Double Replacement Reaction



precipitate