

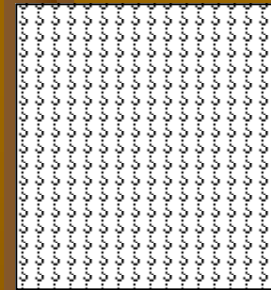


# *Chemical Reactions*



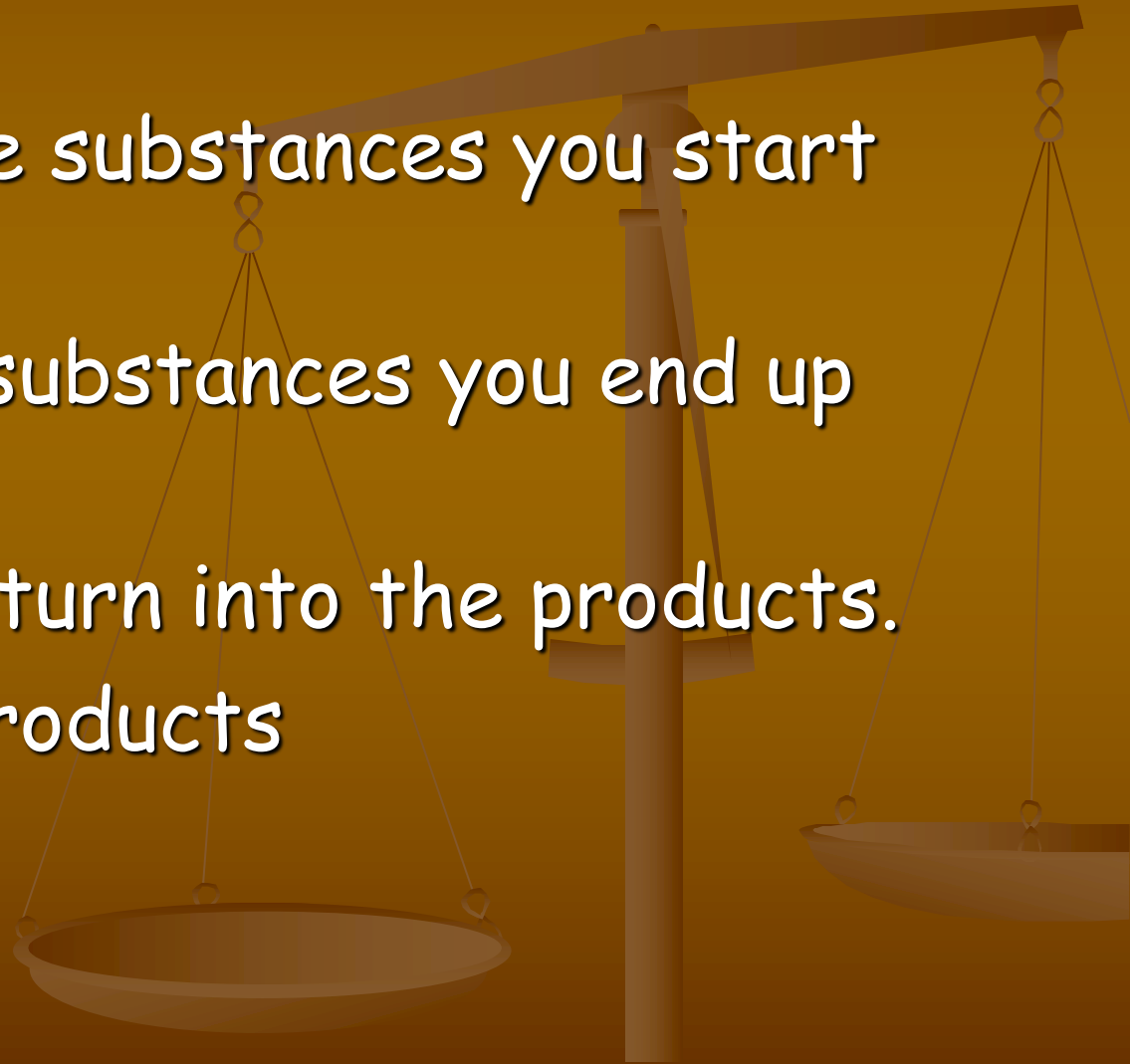
# Indicators of chemical reactions

- Emission of light or heat
- Formation of a gas
- Formation of a precipitate
- Color change
- Emission of odor



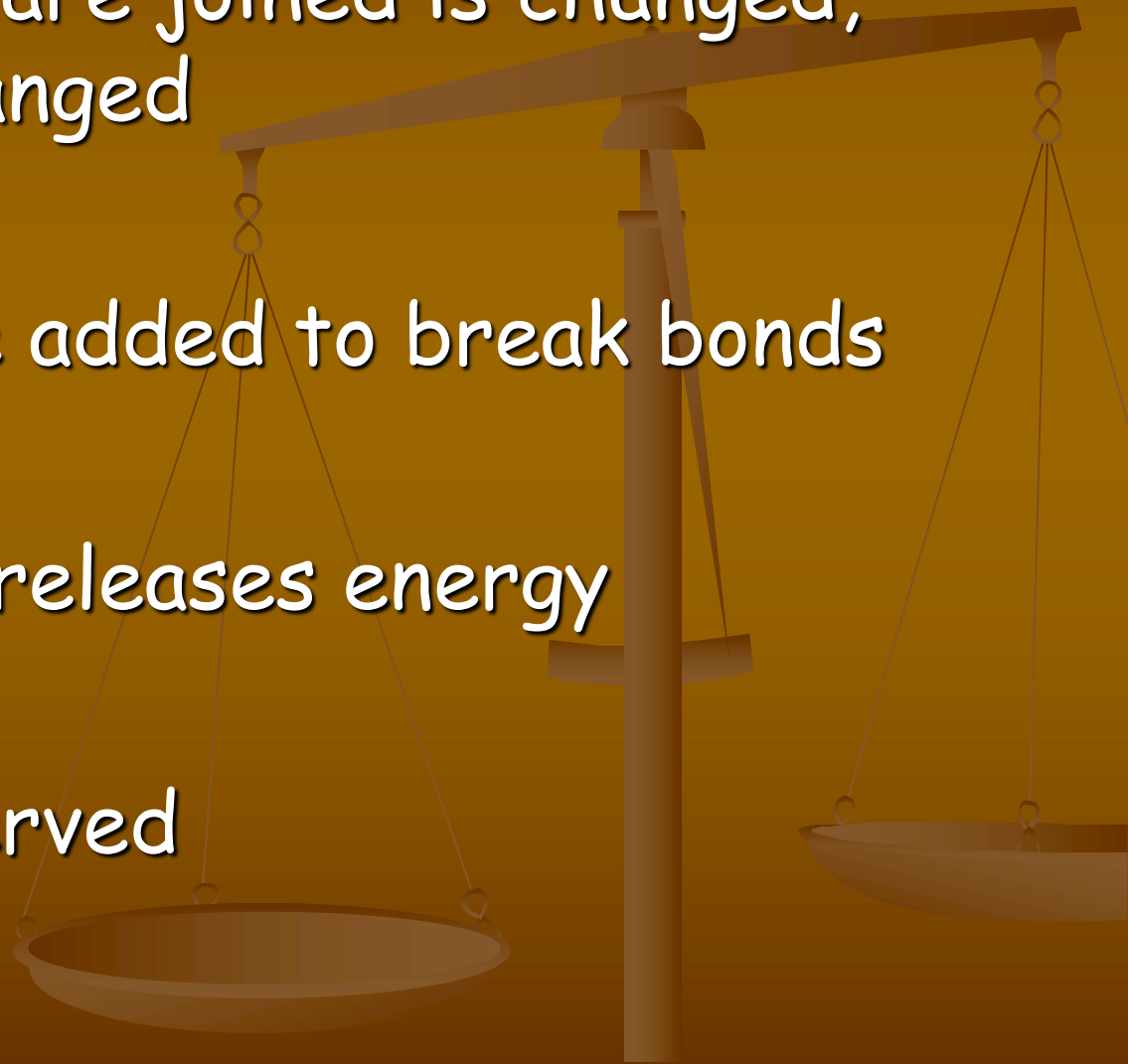
# All chemical reactions:

- have two parts
- Reactants - the substances you start with
- Products- the substances you end up with
- The reactants turn into the products.
- Reactants  $\rightarrow$  Products



# Describing chemical reaction

- The way atoms are joined is changed, they are rearranged
- Energy must be added to break bonds
- Forming bonds releases energy
- Energy is conserved



# Types of Reactions



- There are five types of chemical reactions we will talk about:
  1. Synthesis reactions
  2. \_\_\_\_\_ reactions
  3. Single displacement reactions
  4. \_\_\_\_\_ reactions
  5. Combustion reactions
- You need to be able to identify the type of reaction and predict the product(s)

# 1. Synthesis reactions

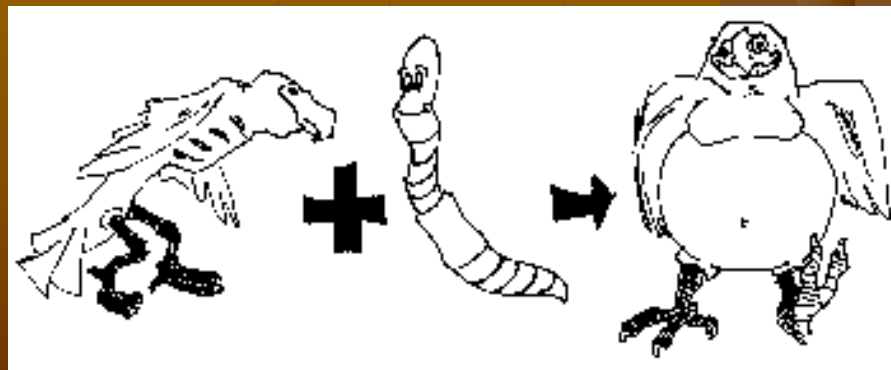
- **Synthesis reactions** occur when two substances (generally elements) combine and form a compound. (Sometimes these are called combination or addition reactions.)

**reactant + reactant  $\rightarrow$  1 product**

- Basically:  $A + B \rightarrow AB$

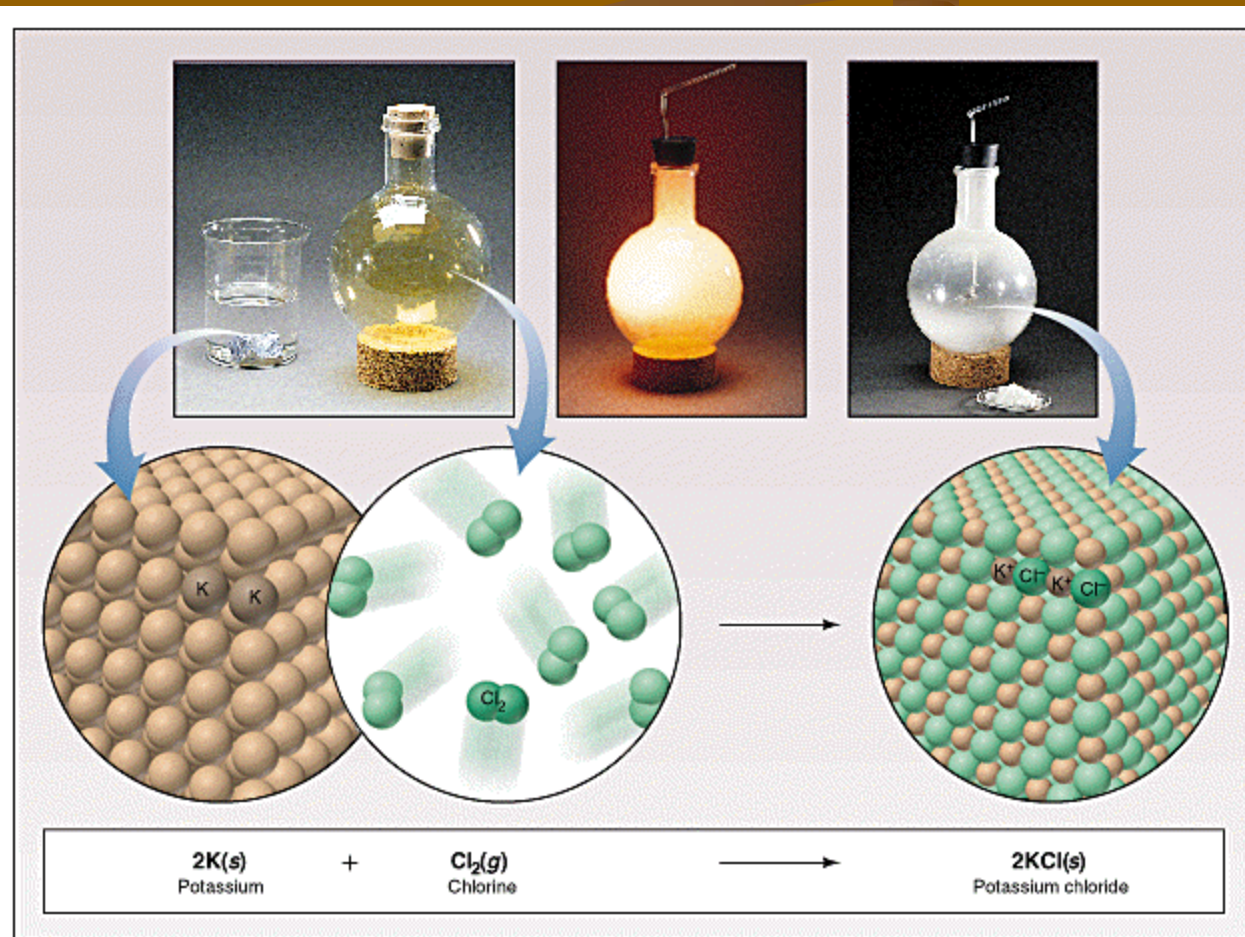
- Example:  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

- Example:  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$



# Synthesis Reactions

- Here is another example of a synthesis reaction



# Practice

- Predict the products. Write and balance the following synthesis reaction equations.
- Sodium metal reacts with chlorine gas



- Solid Magnesium reacts with fluorine gas



- Aluminum metal reacts with fluorine gas





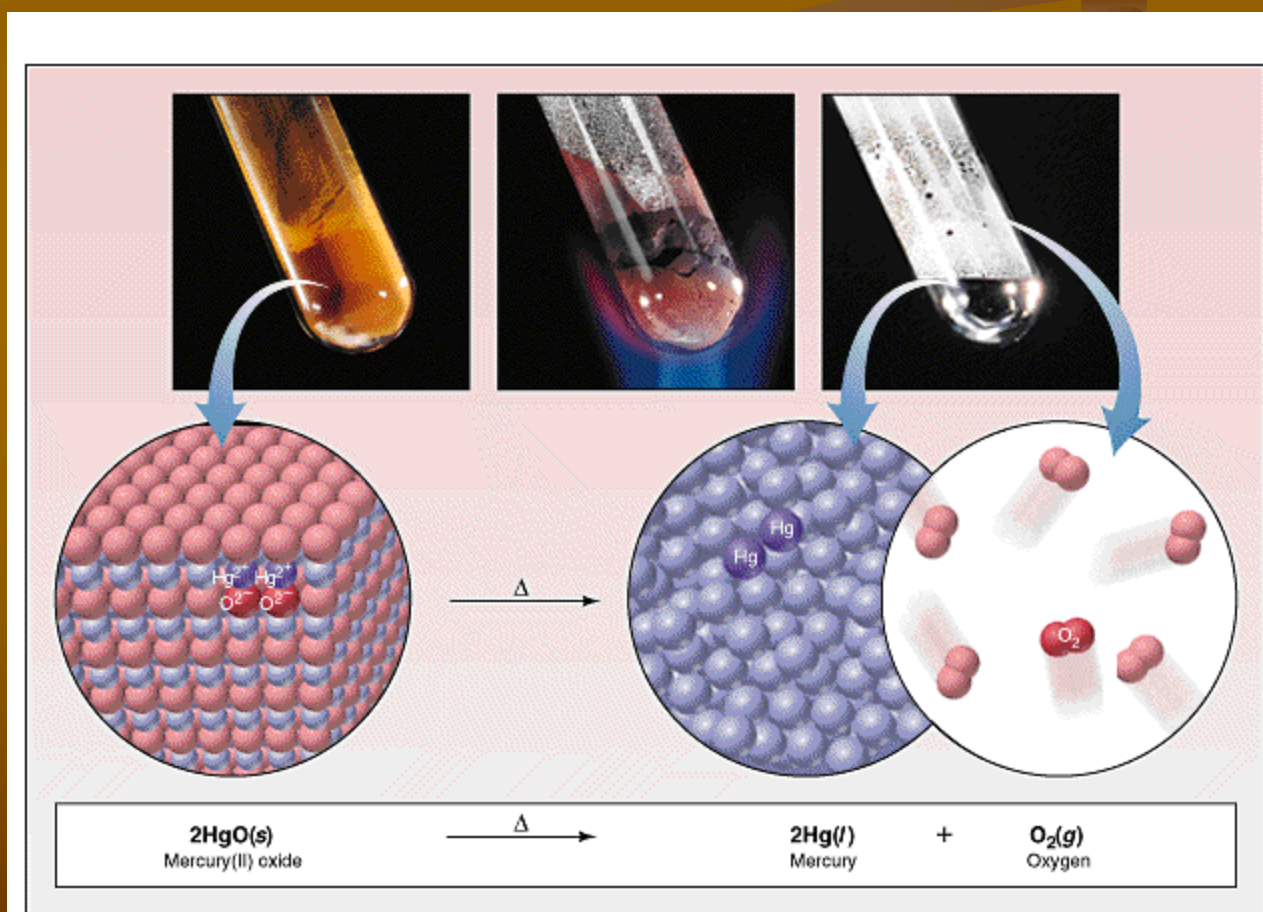
## 2. Decomposition Reactions

- **Decomposition reactions** occur when a compound breaks up into the elements or to simpler compounds
- **1 Reactant  $\rightarrow$  Product + Product**
- In general:  $AB \rightarrow A + B$
- Example:  $2 \text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
- Example:  $2 \text{HgO} \rightarrow 2\text{Hg} + \text{O}_2$



# Decomposition Reactions

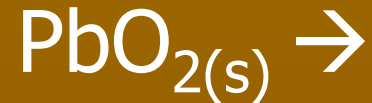
- Another view of a decomposition reaction:



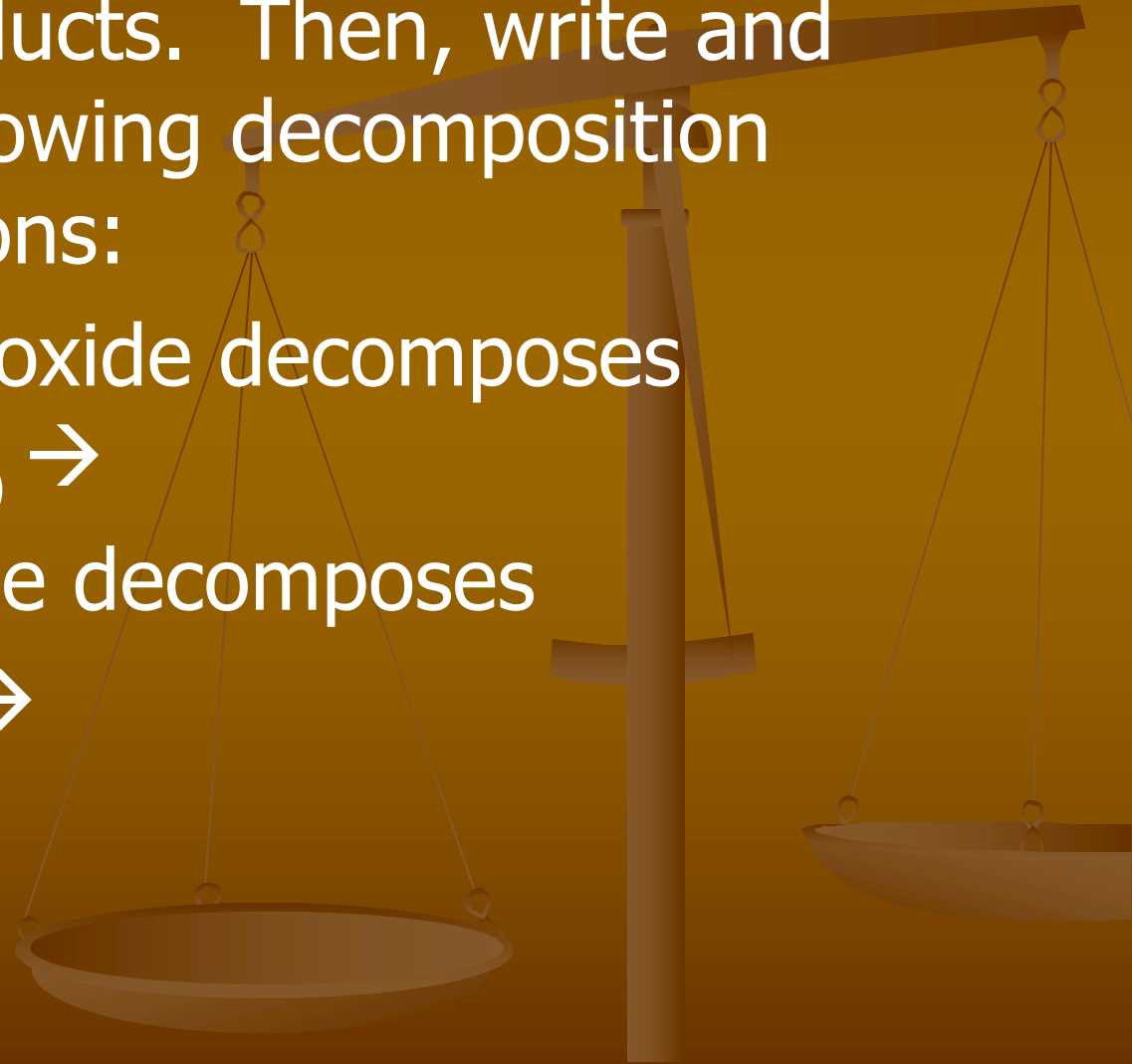
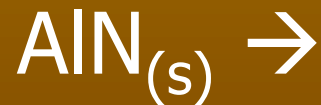
# Practice

- Predict the products. Then, write and balance the following decomposition reaction equations:

- Solid Lead (IV) oxide decomposes



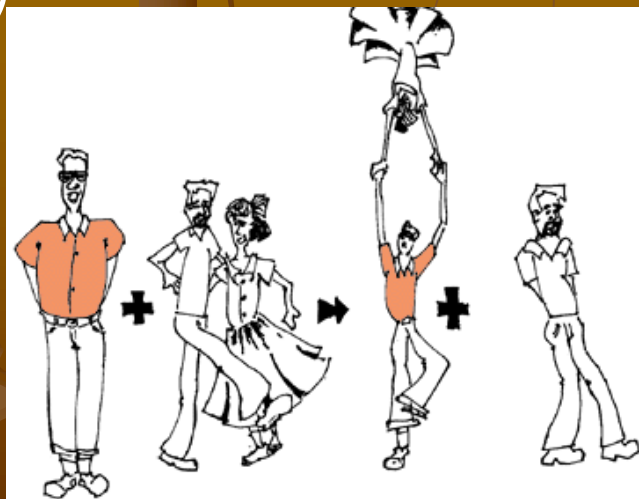
- Aluminum nitride decomposes



# 3. Single Replacement Reactions

- **Single Replacement Reactions** occur when one element replaces another in a compound.
- A metal can replace a metal (+) **OR** a nonmetal can replace a nonmetal (-).
- **element + compound  $\rightarrow$  element + compound**  
 $A + BC \rightarrow AC + B$  (if A is a metal) **OR**  
 $A + BC \rightarrow BA + C$  (if A is a nonmetal)  
(remember the cation always goes first!)

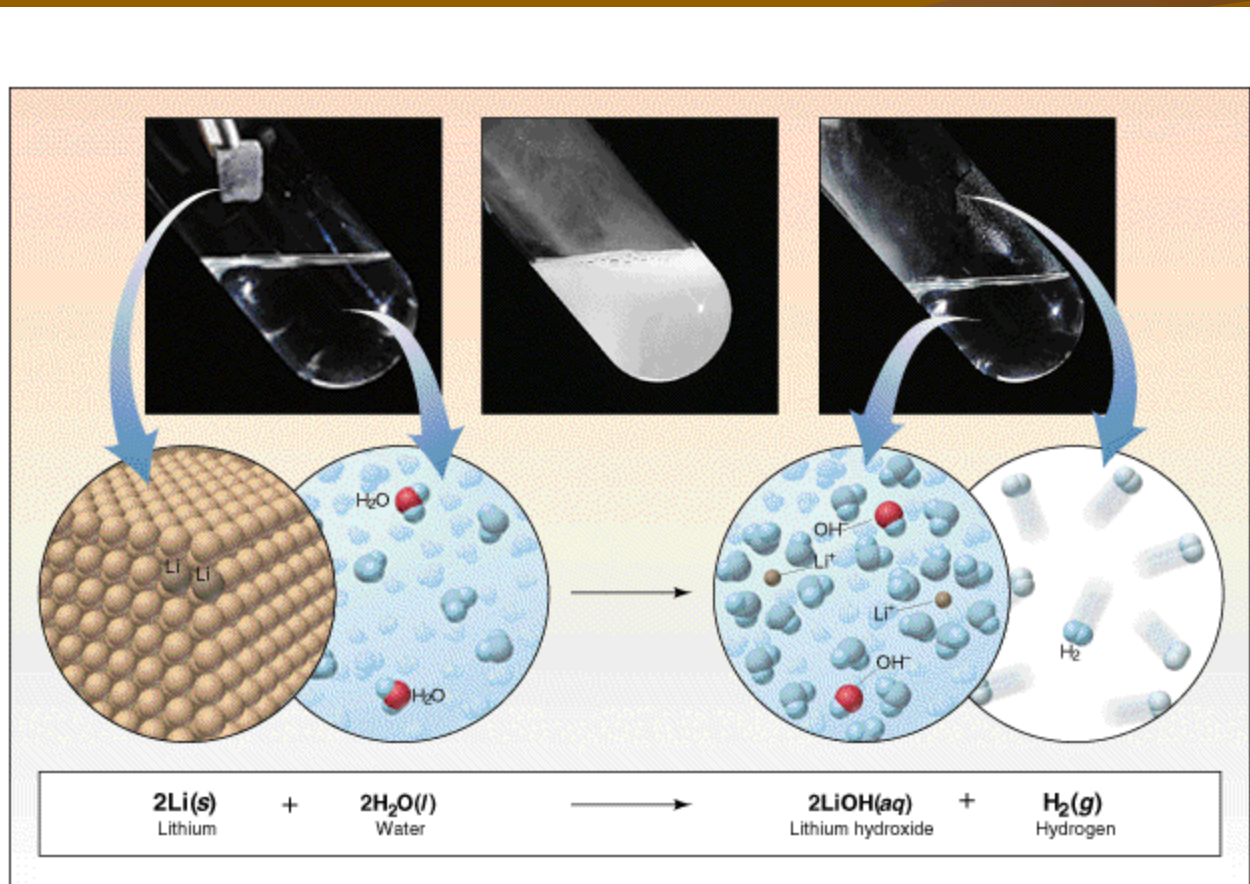
When  $H_2O$  splits into ions, it splits into  $H^+$  and  $OH^-$  (not  $H^+$  and  $O^{-2}$  !!)





# Single Replacement Reactions

- Another view:

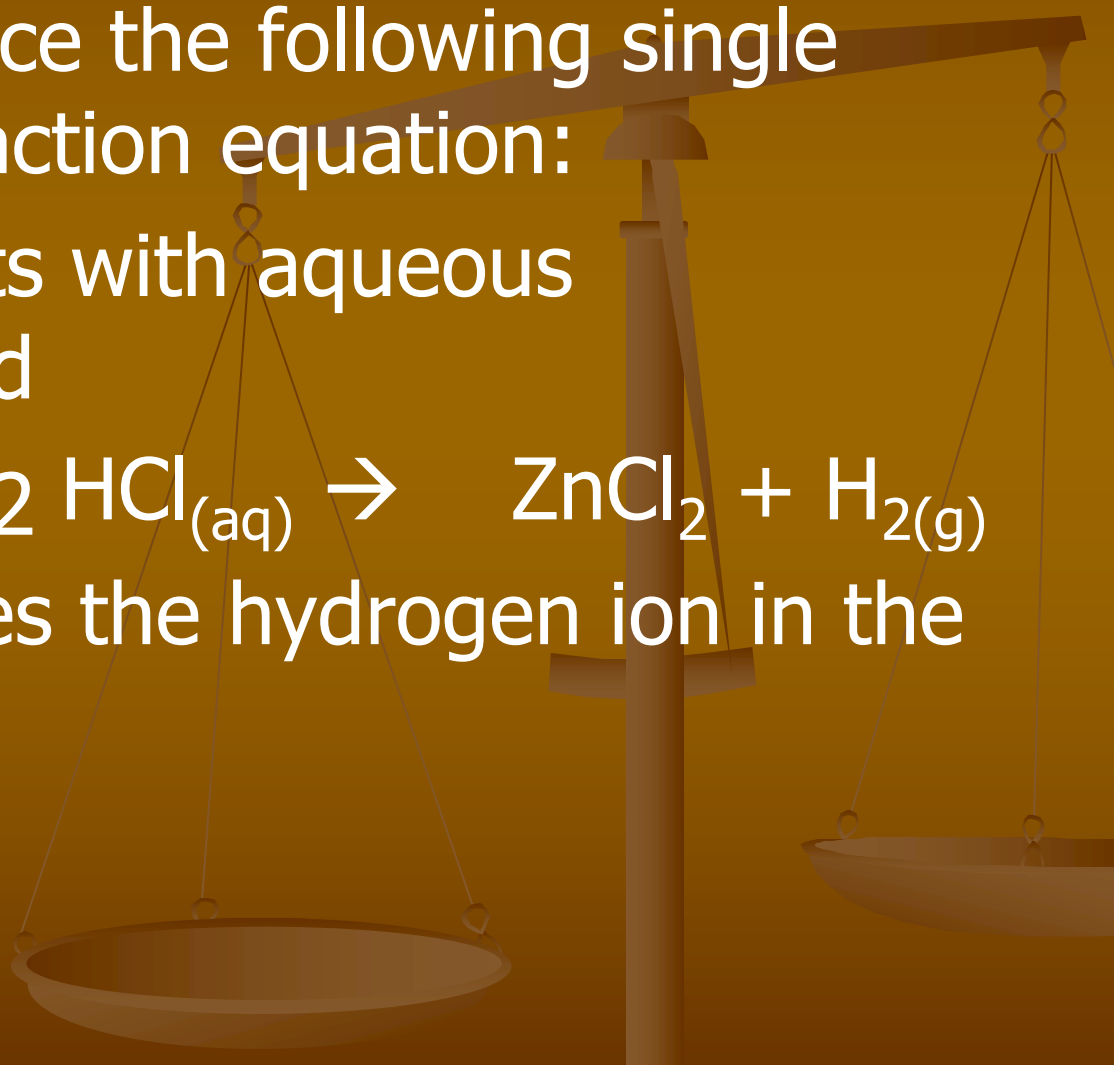


# Single Replacement Reactions

- Write and balance the following single replacement reaction equation:
- Zinc metal reacts with aqueous hydrochloric acid

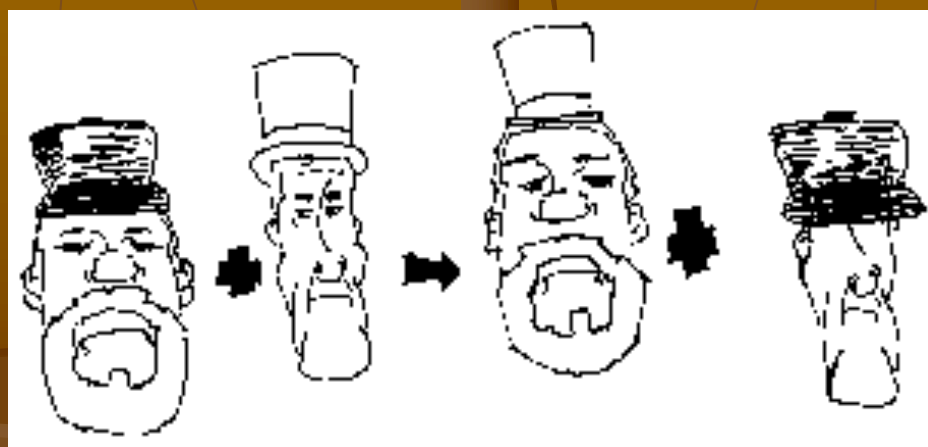


Note: Zinc replaces the hydrogen ion in the reaction



# 4. Double Replacement Reactions

- **Double Replacement Reactions** occur when a metal replaces a metal in a compound and a nonmetal replaces a nonmetal in a compound
- **Compound + compound  $\rightarrow$  compound + compound**
- **$AB + CD \rightarrow AD + CB$**



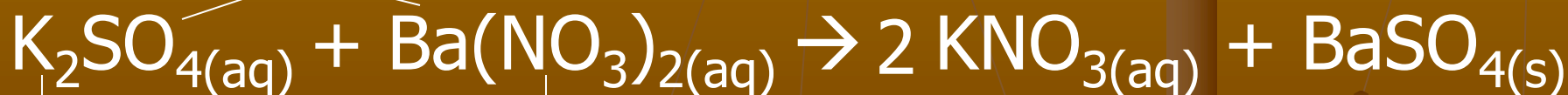
# Double Replacement Reactions

- Think about it like “foil”ing in algebra, first and last ions go together + inside ions go together

- Example:



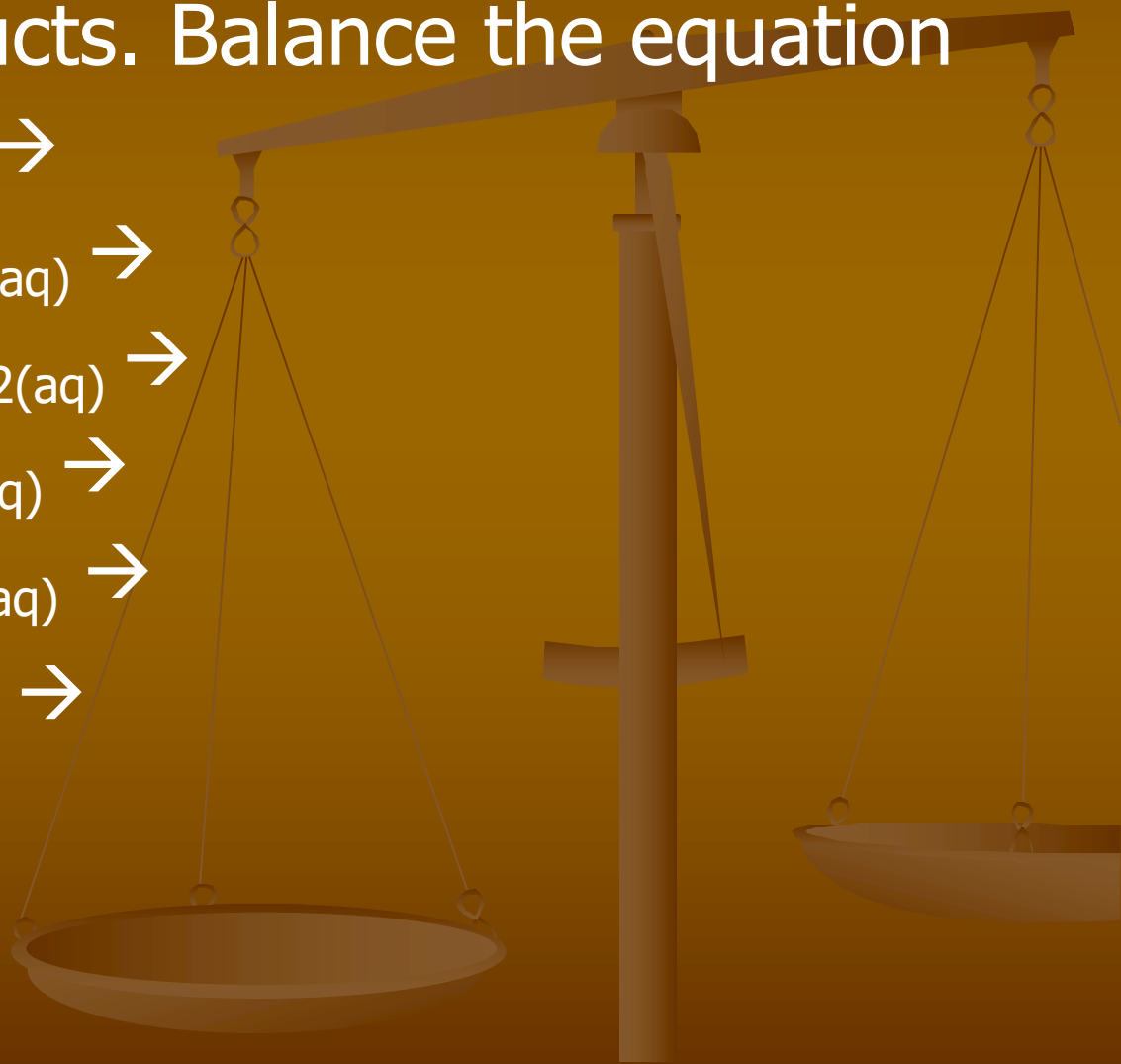
- Another example:





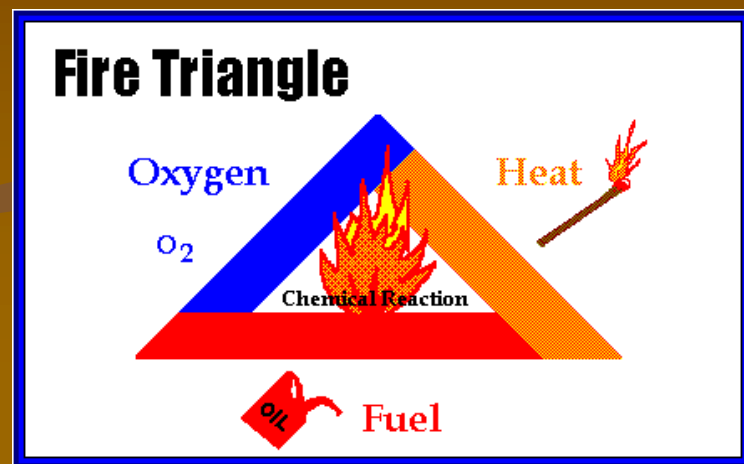
# Practice

• Predict the products. Balance the equation



# 5. Combustion Reactions

- **Combustion reactions** occur when a hydrocarbon reacts with oxygen gas.
- This is also called burning!!! In order to burn something you need the 3 things in the “fire triangle”:
  - 1) A Fuel (hydrocarbon)
  - 2) Oxygen to burn it with
  - 3) Something to ignite the reaction (spark)

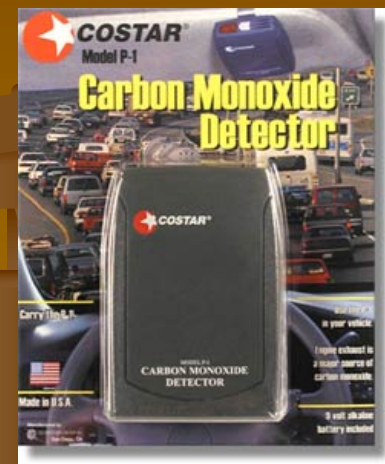




# Combustion Reactions



- In general:  
$$C_xH_y + O_2 \rightarrow CO_2 + H_2O$$
- Products in combustion are ALWAYS carbon dioxide and water. (although incomplete burning does cause some by-products like carbon monoxide)
- Combustion is used to heat homes and run automobiles (octane, as in gasoline, is  $C_8H_{18}$ )



# The Tell-Tale Face\* of Carbon Monoxide Poisoning

# Combustion Reactions



Edgar Allen Poe's drooping eyes and mouth are potential signs of CO poisoning.

## FLU-LIKE SYMPTOMS

1. Headache
2. Fatigue or Weakness
3. Muscle Aches or Pains
4. Nausea or Vomiting
5. Diarrhea or Bloating
6. Confusion or Memory Loss
7. Dizziness or Incoordination
8. Difficult or Shallow Breathing
9. Rapid Heart Beat or Chest Pain
10. Changes in Sensory Sensitivity to Lights, Sounds, Odors, Tastes or Touch

\*Edgar Allan Poe's drooping eye and mouth are signs of CO poisoning.

*Poe's "Painter Portrait" courtesy of Maryland Historical Society (reversed-image daguerreotype)*

## AT RISK FROM CARBON MONOXIDE

- CO is most harmful to pregnant women, children, the elderly and anyone with a chronic disorder affecting the blood, brain, heart, lungs or muscles, such as Anemia, Alzheimer's, Angina, Asthma or ALS.
- CO also worsens and may cause Autism, Chronic Fatigue Syndrome, Depression, Fibromyalgia, Impotence, Multiple Chemical Sensitivity, Parkinsonism and Psychiatric Disorders.

FOR MORE INFORMATION:  
MCS REFERRAL & RESOURCES

[www.mcsrr.org](http://www.mcsrr.org)  
1-800-466-9320

CARBON MONOXIDE SURVIVORS

[www.carbonmonoxide.org](http://www.carbonmonoxide.org)

## SOURCES OF CARBON MONOXIDE

- External from combustion sources such as vehicles (especially in winter and in buildings with attached garages), furnaces, water heaters, space heaters, ovens, tobacco smoke, explosives and gasoline-powered appliances of all kinds, especially generators and compressors.
- Internal from breakdown of heme and inhaled or ingested dichloromethane, also known as methylene chloride, a common ingredient in solvents and spray cans.

## EFFECTS OF CARBON MONOXIDE

- CO binds more tightly than oxygen to heme proteins, especially hemoglobin, myoglobin and cytochromes, impairing function of brain, muscle, liver and other organs.
- CO increases blood sugar, acidosis and polycythemia while decreasing metabolism, blood pressure and body temperature; at high levels, CO may cause coma or death within minutes.
- CO acts as a neurotransmitter modulating heart rate, respiration, blood vessel tone, learning, memory, sexual function and sensory sensitization (or habituation) to odors, light and sounds.
- CO poisoning in pregnancy may result in birth defects, mental retardation and low birth weight.
- Reoxygenation may cause brain lipid peroxidation with chronic neurological effects appearing later

## TREATMENT OF CARBON MONOXIDE POISONING

- 100% oxygen daily – hyperbaric if severe or normobaric, humidified and via a partial non-rebreather mask. Continue daily treatments of 1 to 2 hours until symptoms resolve and levels of carboxyhemoglobin, CO in exhaled breath and the arterio-venous gap in the partial pressure of oxygen all return to normal.
- In non-smokers, normal COHb is under 1.6%, normal breath CO is under 4ppm, and the normal arterio-venous PO2 gap is over 60 mmHg (venous sample drawn from antecubital fossa without a tourniquet).

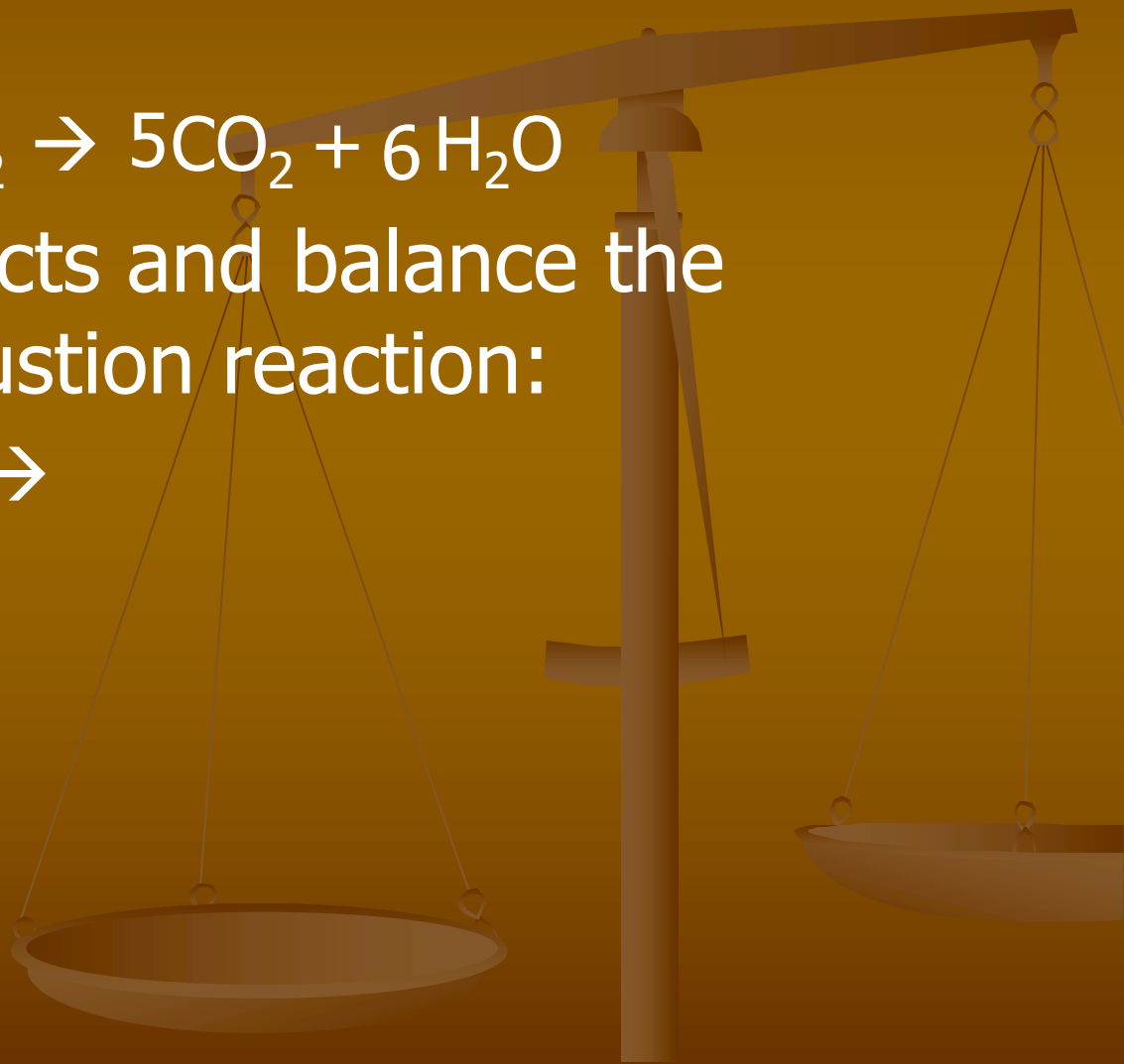


# Combustion

- Example

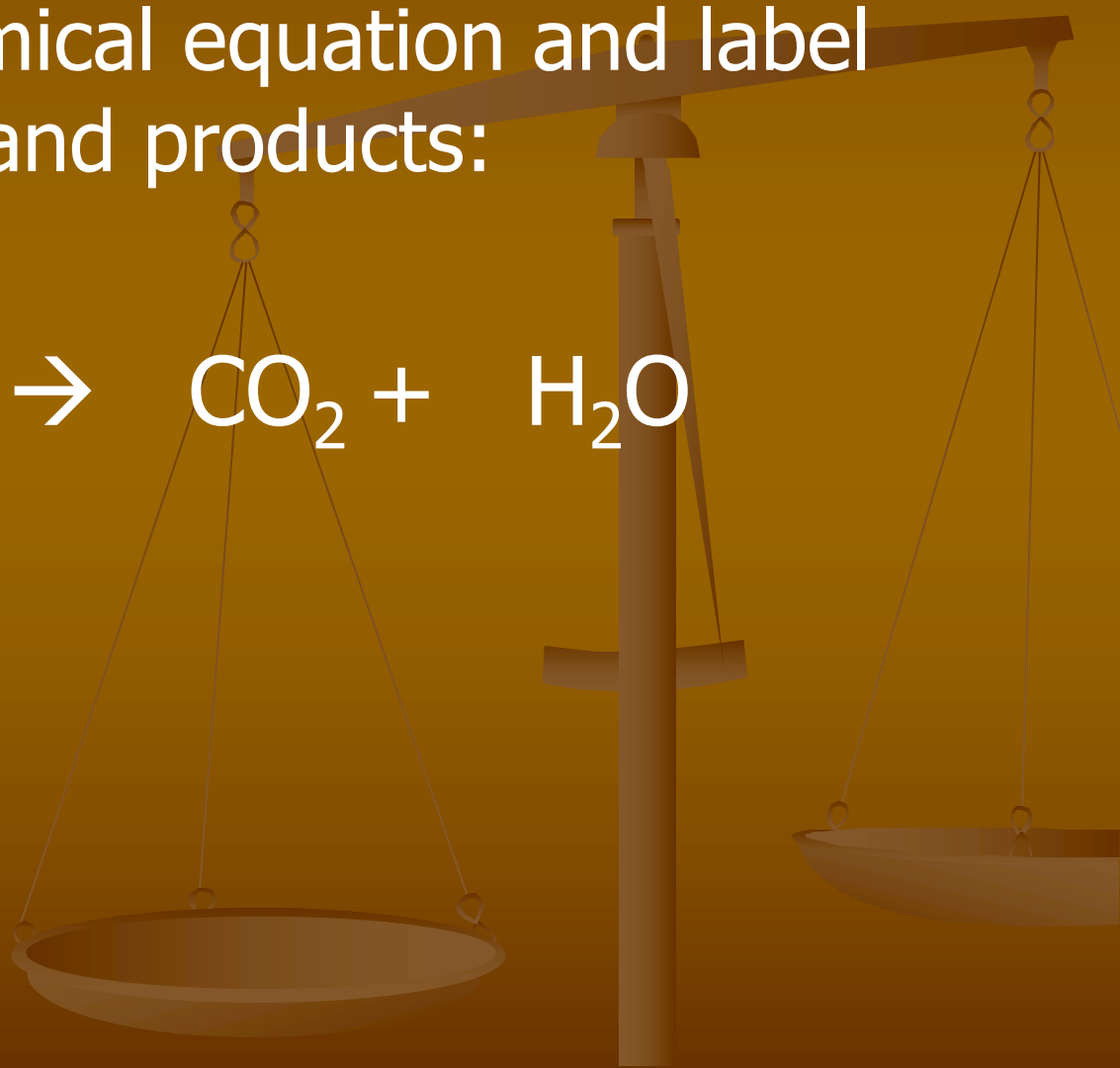


- Write the products and balance the following combustion reaction:



# Mixed Practice

- Copy this chemical equation and label the reactants and products:



# Mixed Practice

- State the type and predict the products:

