

Decomposition

- Decomposition** is a type of chemical reaction in which a compound is broken down into two or more elements or simpler compounds.
 - $AB \rightarrow A + B$ where A and B represent elements
- Ionic compounds may decompose to produce elements.
Example: Sodium chloride (table salt) can be broken down into sodium metal and chlorine gas by melting salt at 800°C and running electricity through it.
 $2\text{NaCl} \rightarrow 2\text{Na} + \text{Cl}_2$
- Covalent compounds may decompose into elements.
Example: By running electricity through water, the water molecules decompose into hydrogen and oxygen gases.
 $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$

Quick Check

- Complete and balance the following decomposition reactions. Remember to check for diatomic elements as you write the formulas of the products.
 - $\text{Na}_2\text{O} \rightarrow$ _____
 - $\text{Mg}_3\text{N}_2 \rightarrow$ _____
 - $\text{CsI} \rightarrow$ _____
- Identify each reaction as synthesis, decomposition, or neither.
 - $2\text{AgCl} + \text{Cu} \rightarrow \text{CuCl}_2 + 2\text{Ag}$ _____
 - $2\text{Cr} + 3\text{F}_2 \rightarrow 2\text{CrF}_3$ _____
 - $2\text{NaCl} \rightarrow 2\text{Na} + \text{Cl}_2$ _____

Single Replacement

- Single replacement** is a type of chemical reaction in which one element replaces another element in a compound.
 - $A + BC \rightarrow B + AC$ where A is a metal, or
 - $A + BC \rightarrow C + BA$ where A is a non-metal
- Example of when A is a metal:
 - Aluminum foil in a solution of copper II chloride produces solid copper and aluminum chloride.
 $2\text{Al} + 3\text{CuCl}_2 \rightarrow 3\text{Cu} + 2\text{AlCl}_3$
- Example of when A is a non-metal:
 - When fluorine is bubbled through a sodium iodide solution, iodine and sodium fluoride are produced.
 $\text{F}_2 + 2\text{NaI} \rightarrow \text{I}_2 + 2\text{NaF}$

Double Replacement

- Double replacement** is a type of chemical reaction in which elements in different compounds exchange places.
 - $AB + CD \rightarrow AD + CB$Example: When potassium chromate and silver nitrate react, they form silver chromate in a solution of potassium nitrate.
 $\text{K}_2\text{CrO}_4 + 2\text{AgNO}_3 \rightarrow \text{Ag}_2\text{CrO}_4 + 2\text{KNO}_3$

Quick Check

- Complete and balance the following single replacement reactions.
 - $\underline{\hspace{1cm}} \text{K} + \underline{\hspace{1cm}} \text{NaCl} \rightarrow \underline{\hspace{4cm}}$
 - $\underline{\hspace{1cm}} \text{CuF}_2 + \underline{\hspace{1cm}} \text{Mg} \rightarrow \underline{\hspace{4cm}}$
 - $\underline{\hspace{1cm}} \text{F}_2 + \underline{\hspace{1cm}} \text{CsBr} \rightarrow \underline{\hspace{4cm}}$
- Complete and balance the following double replacement reactions.
 - $\underline{\hspace{1cm}} \text{Na}_3\text{PO}_4 + \underline{\hspace{1cm}} \text{MgI}_2 \rightarrow \underline{\hspace{4cm}}$
 - $\underline{\hspace{1cm}} \text{SrCl}_2 + \underline{\hspace{1cm}} \text{Pb}(\text{NO}_3)_2 \rightarrow \underline{\hspace{4cm}}$
 - $\underline{\hspace{1cm}} \text{AgNO}_3 + \underline{\hspace{1cm}} \text{Na}_2\text{CrO}_4 \rightarrow \underline{\hspace{4cm}}$
- Classify each reaction as synthesis, decomposition, single replacement, or double replacement.
 - $\text{NiBr}_2 + \text{ZnSO}_4 \rightarrow \text{ZnBr}_2 + \text{NiSO}_4$ _____
 - $2\text{Au} + \text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + \text{Au}_2\text{O}_3$ _____
 - $2\text{Pb} + \text{O}_2 \rightarrow 2\text{PbO}$ _____
 - $2\text{TiBr}_3 \rightarrow 2\text{Ti} + 3\text{Br}_2$ _____

Neutralization (acid-base)

- Neutralization (acid-base)** is a type of chemical reaction in which an acid (most compounds starting with H) and a base (most compounds ending in OH, or beginning with NH_4) combine to produce a salt and water.
 - Acid + base \rightarrow salt + water
 $\text{HX} + \text{MOH} \rightarrow \text{MX} + \text{H}_2\text{O}$ where X and M are elements
Examples:
 - Sulfuric acid is used to neutralize calcium hydroxide.
 $\text{H}_2\text{SO}_4 + \text{Ca}(\text{OH})_2 \rightarrow \text{CaSO}_4 + 2\text{H}_2\text{O}$
 - Phosphoric acid helps to neutralize the compounds that cause rust, such as iron (II) hydroxide.
 $\text{H}_3\text{PO}_4 + 3\text{Fe}(\text{OH})_2 \rightarrow \text{Fe}_3(\text{PO}_4)_2 + 6\text{H}_2\text{O}$

Combustion

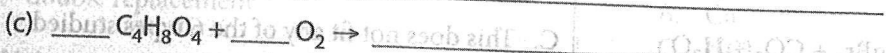
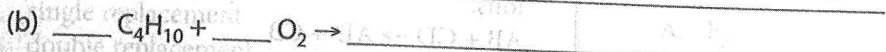
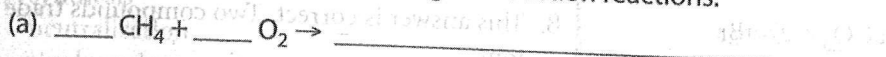
- Combustion** is a type of chemical reaction in which oxygen is one of the reactants and where heat is produced.
 - $\text{C}_x\text{H}_y + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ where X and Y represent integers
Examples:
 - Natural gas (methane) is burned in furnaces to heat homes.
 $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
 - An acetylene torch is used to weld metals.
 $2\text{C}_2\text{H}_2 + 5\text{O}_2 \rightarrow 4\text{CO}_2 + 2\text{H}_2\text{O}$
 - Carbohydrates like glucose combine with oxygen in our body to release energy.
 $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$

Quick Check

1. Complete and balance the following neutralization (acid-base) reactions.



2. Complete and balance the following combustion reactions.



3. Classify each reaction as synthesis, decomposition, single replacement, double replacement, neutralization, or combustion.

