**Decomposition Reactions**

Important notes to remember: (1) NONE of the equations are balanced!! and (2) make sure to write correct formulas. **DO NOT** just copy the subscripts from the reactants over into the products.

During decomposition, one compound splits apart into two (**or more pieces**). These pieces can be elements or simpler compounds

Written using generic symbols, it is usually shown as:

AB ---> A + B

However, that really only works for splitting apart into the elements, like these examples.

HgO ---> Hg + O2  
H2O ---> H2 + O2  
MgCl2 ---> Mg + Cl2  
FeS ---> Fe + S

Decomposition can also split one compound into two simpler compounds (or compound and an element) as in these examples:

CaCO3 ---> CaO + CO2  
Na2CO3 ---> Na2O + CO2  
KClO3 ---> KCl + O2  
Ba(ClO3)2 ---> BaCl2 + O2

Notice how, in every case so far, there is only one substance on the left-hand (reactant) side. This is always the case in a decomposition reaction. Don't forget that!!

Figuring out what the products are in decomposition is harder (maybe you'll think it's easier!!) because you will have to recognize several categories of decomposition reactions. Here are your first (yes, there's more!) three:

1) All binary compounds (like the four in the first example set above) will break down into their elements.  
2) All carbonates (like the first two in the second example set above) break down to the oxide and carbon dioxide.  
3. Chlorates (like KClO3 and Ba(ClO3)2 in the example) will break down to the binary salt and oxygen.

Here is one more category of decomposition reactions:

Ca(OH)2 ---> CaO + H2O  
NaOH ---> Na2O + H2O  
HNO3 ---> N2O5 + H2O  
H3PO4 ---> P2O5 + H2O

The first two substances are **bases** and the last two are **acids**. In each case, the acid or base breaks down into the **oxide of the metal (in the case of bases)** or the **oxide of the nonmetal (in the case of acids)** plus water.

Here is one example of each category which are then solved below:

1) NaClO3 --->  
2) Li2CO3 --->  
3) KOH --->  
4) NaCl --->

**Example #1**

How to figure out the right (or product side):

(1) Identify the type of compound decomposing:

NaClO3 is a chlorate

Notice that you have to be able to "read" a formula and identify the parts (cation+ and anion-) that make it up.

(2) Apply the rule for that type:

chlorates decompose to the binary salt and oxygen gas

(3) Write two new (CORRECT!!) formulas using the rule from step two.

NaCl since Na is positive 1 and Cl is minus one  
O2 since oxygen is a diatomic gas

So the final answer looks like this:

NaClO3 ---> NaCl + O2

**Example #2**

How to figure out the right (or product side):

(1) Identify the type of compound decomposing:

Li2CO3 is a carbonate

(2) Apply the rule for that type:

carbonates decompose to the binary oxide and carbon dioxide gas

(3) Write two new (CORRECT!!) formulas using the rule from step two.

Li2O since Li is positive 1 and O is minus two  
CO2 is the formula for carbon dioxide gas

So the final answer looks like this:

Li2CO3 ---> Li2O + CO2

**Example #3**

How to figure out the right (or product side):

(1) Identify the type of compound decomposing:

KOH is a base

(2) Apply the rule for that type:

bases decompose to the binary oxide and water

(3) Write two new (CORRECT!!) formulas using the rule from step two.

K2O since K is positive 1 and O is minus two  
H2O is the formula for water

So the final answer looks like this:

KOH ---> K2O + H2O

**Example #4**

How to figure out the right (or product side):

(1) Identify the type of compound decomposing:

NaCl is a binary compound (that is not an acid or a base. I left this point until now.)

(2) Apply the rule for that type:

binary compounds decompose to the elements

(3) Write two new (CORRECT!!) formulas using the rule from step two.

Na is the proper symbol  
Cl2 is the proper symbol for chlorine since it is diatomic

So the final answer looks like this:

NaCl ---> Na + Cl2

**Example #5**

There is another type of acid which does not have oxygen in it. HCl, HBr and HI are examples. These acids simply decompose into their elements:

HCl ---> H2 + Cl2

**Practice Problems**

Note that none of the example problems above are balanced.

Write correct formulas for the products in these decomposition reactions. #3 might be tough - remember to preserve nitrogen's oxidation number.

1) Ni(ClO3)2 --->

2) Ag2O --->

3) HNO2 --->

4) Fe(OH)3 --->

5) ZnCO3 --->

6) Cs2CO3 --->

7) Al(OH)3 --->

8) H2SO4 --->

9) RbClO3 --->

10) RaCl2 --->

Answers

Write correct formulas for the products in these decomposition reactions. #3 might be tough - remember to preserve nitrogen's oxidation number. The first 3 are balanced.

1) Ni(ClO3)2 ---> NiCl2 + 3O2

2) Ag2O ---> 2Ag + O2

3) 2HNO2 --->N2O3 + H2O

4) Fe(OH)3 ---> Fe2O3 + H2O

5) Zn(CO3) ---> ZnO + CO2

6) Cs2CO3 ---> Cs2O + CO2

7) Al(OH)3 ---> Al2O3 + H2O

8) H2SO4 ---> SO3 + H2O

9) RbClO3 ---> RbCl + O2

10) RaCl2 ---> Ra + Cl2