

Reaction Types: Synthesis

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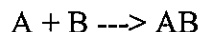
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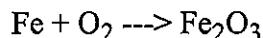
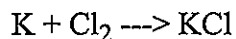
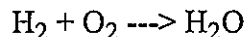
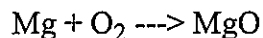
Important notes to remember: (1) NONE of the equations are balanced!! and (2) make sure to write correct formulas. DO NOT just copy the subscripts from the reactants over into the products.

Synthesis are, at this introductory level, almost always the reverse of a decomposition reaction. That means that two pieces join together to produce one, more complex compound. These pieces can be elements or simpler compounds. Complex simply means that the product compound has more atoms than the reactant molecules. Usually!!

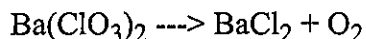
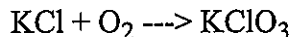
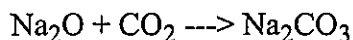
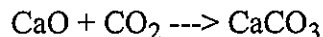
Written using generic symbols, it is usually shown as:



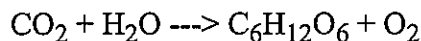
These are some examples:



Notice that two elements are combining in each example. Synthesis can also be two compounds making a more complex compound (or a compound and an element joining together) as in these examples:

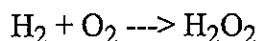


Notice how, in every case so far, there is only one substance on the right-hand (product) side. This is not always the case in a synthesis reaction. Sometimes there will be two products. Here's an example:



You might recognize this as the photosynthesis equation. However, the majority of what you will see at this level will be two substances combining to make one product.

Here's another example of a synthesis reaction:

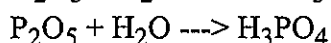
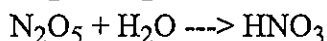
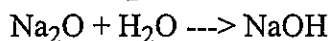
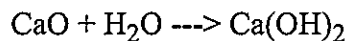


This happens to be a reaction that can never take place. Hydrogen peroxide is made in other ways, NOT by direct union of the elements. Nonetheless, it is a valid synthesis reaction and useful in contexts other than how H_2O_2 is made.

Since synthesis reactions are the reverse of decomposition, you might ask if the decomp. categories apply, just in reverse. The answer is yes!

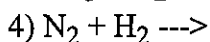
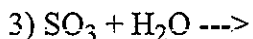
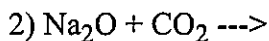
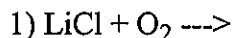
- 1) Direct union of two elements will produce a binary compound.
- 2) Metallic oxides and carbon dioxide react to produce carbonates.
3. Binary salts and oxygen react to produce a chlorate.

Here is one more category of decomposition reactions:



The first two substances are metallic oxides and the last two are nonmetallic oxides. In each case, the oxide plus water will produce a base (in the case of the metallic oxide) or an acid (in the case of the nonmetallic oxide).

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



Example #1

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

(1) Ask yourself what type of decomposition produces these products:

$\text{LiCl} + \text{O}_2$ are the products of a chlorate decomposing.

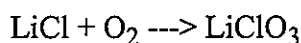
Notice that you have to be able to "read" a formula and identify the parts (cation and anion) that make it up.

(2) Write the reactant formula using the compounds from step one.

Chlorate is always ClO_3^-

Li is plus one

So the final answer looks like this:



Example #2

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

(1) Ask yourself what type of decomposition produces these products:

$\text{Na}_2\text{O} + \text{CO}_2$ are the products of a carbonate decomposing.

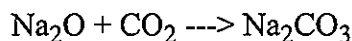
Notice that you have to be able to "read" a formula and identify the parts (cation and anion) that make it up.

(2) Write the reactant formula using the compounds from step one.

Carbonate is always CO_3^{2-}

Na is plus one

So the final answer looks like this:



Example #3

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

(1) Ask yourself what type of decomposition produces these products:

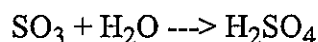
$\text{SO}_3 + \text{H}_2\text{O}$ are the products of an acid decomposing.

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

(2) Write the reactant formula using the compounds from step one. With special regard to acids and bases, you must preserve the oxidation number of the nonmetal (acid) or metal (base).

In SO_3 the S has an oxidation number of +6 H has its usual value of +1 and O has its usual value of -2

So the final answer looks like this:



If this oxidation number business is unknown to you, the only other way is to memorize a set of reactions. For example, SO_2 produces H_2SO_3 , SO_3 produces H_2SO_4 and so on.

Example #4

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

(1) Ask yourself what type of decomposition produces these products:

$\text{N}_2 + \text{H}_2$ are the products of a binary compound decomposing.

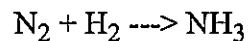
Notice that you have to be able to "read" a formula and identify the parts (cation and anion) that make it up.

(2) Write the reactant formula using the compounds from step one.

N has a charge of -3

H has its usual value of +1

So the final answer looks like this:

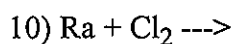
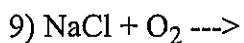
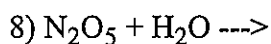
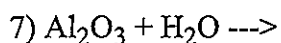
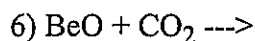
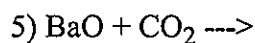
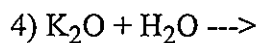
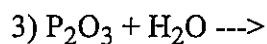
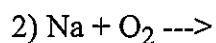
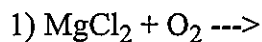


Positives are written first in formula, so why is NH_3 reversed? Good question. For the time being, just do it!

Practice Problems

Note that none of the example problems above are balanced. Your teacher may require this, but the ChemTeam will only provide some of the following answers balanced. The rest are up to you!!

Write correct formulas for the products in these synthesis reactions.



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