

## Determining Types of Chemical Reactions

The first thing you should be aware of is that there are five main types of chemical reactions.

- Synthesis or combination
- Decomposition
- Single replacement reactions, cationic or anionic (also known as single displacement reactions)
- Double replacement reactions (also known as double displacement reactions)
- Combustion reactions

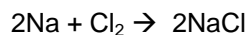
### Synthesis or Combination reactions:

Synthesis or combination reactions are when things come together. I like to think of it as when two elements find one another adorable and pleasing enough to want to join up with each other and form a compound.

How can you tell if the reactants are going to synthesize? Well, if you are given two elements, chances are that all they can do is to come together. If you are given a problem and two elements are listed, it is safe to assume that they will combine.

Do only elements combine? No, sometimes an element can combine with a compound. For it to be a synthesis reaction, one of the products is much larger than any of the reactants. This is different than a single-replacement reaction where you have an element plus a compound yields an element plus a compound. In a single-replacement reaction, nothing in the product is a conglomeration of reactants.

Example:



(don't forget diatomic elements are still elements)

### Decomposition Reactions

If all you are given as a reactant is a molecule or compound, you can bet that you are to show it decomposing, or falling apart. Decomposition essentially means falling apart. In terms of relationships, when a couple breaks up, their relationship decomposes. When something dies, its body decomposes.

How do you know what the products are of a decomposition reaction? If the problem says blah blah blah decomposes into its elements, then you know you are supposed to split the compound apart and for the products, write the elements that made up the compound. Don't forget that if there are diatomic elements, you need to indicate them with a subscript of 2 before balancing the equation. Otherwise, read the problem carefully and determine what the products are based on the information it gives you. For example, it may give you one or both of the products by name.

The seven diatomic molecules are: H<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>, F<sub>2</sub>, Cl<sub>2</sub>, I<sub>2</sub>, Br<sub>2</sub>.

Diatomic molecules are ones that can not exist by themselves in nature. In their elemental state, they are Siamese twins, stuck together for stability. To help remember the diatomic elements, recall the saying: 7-7-7. There are 7 diatomic molecules, and on the periodic table, they start with Nitrogen, element #7, and make a 7 on the periodic table going down the halogens, then include hydrogen.

## Single replacement reactions:

For a single replacement reaction to take place, one element replaces another one in a compound. It is as if your best friend steals your boy/girl friend.

There are two types of single replacement reactions: cationic and anionic

### Cationic single replacement reactions:

Look at the reactants. The element that is by itself...will it be a positive ion when it is an ion? If so, then the problem is a cationic single replacement reaction because that element is going to replace the positive ion in the compound. What is the positive ion in the compound in the reactant side ends out by itself on the product side.

Example:

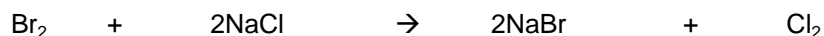


The magnesium takes on a positive charge when it is an ion so it will replace the positive ion, Na, in the compound, NaCl.

### Anionic single replacement reactions:

Look again at the reactants that you are given in your problem. Will the element that is by itself be a negative ion when it is an ion? If so, then the problem is an anionic single replacement reaction because that element is going to replace the negative ion in the compound. What is the negative ion in the compound in the reactant side ends out by itself on the product side.

Example:



The bromine takes on a negative charge when it is a bromide ion, so it will replace the chloride (negative) ion in the compound, NaCl.

## Double Replacement Reactions

In a double replacement reaction, there are two compounds who switch partners. If you are uncomfortable with polyatomic ions you will have trouble with these situations, so memorize them NOW!

After you swap partners, remember that compounds are written as positive ion then negative ion. When you rewrite the "new" formulas, make sure you write it cation then anion.

Example:



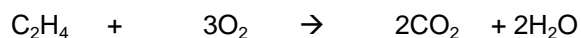
At first the sodium was with the chlorine, and as a product, the sodium is with the bromine. As a reactant, magnesium was with the bromine, as a product the magnesium is with the chlorine.

If you see two compounds and are asked to predict the products, almost always it will be a double replacement reaction. If you see two compounds that swapped partners, then it is a double replacement reaction.

## Combustion reactions:

Combustion reactions always involve burning. In this case, oxygen is a reactant. If the other reactant is a hydrocarbon (a compound made of only hydrogen and carbon) then the products are always carbon dioxide and water. If the other reactant has a formula similar to  $C_xH_yO_z$ , then the products will also be  $CO_2$  and  $H_2O$ .

example:



Practice: Identify the type of the following reactions AND balance the equations. If I made mistakes, please fix them. You can write S for synthesis, D for decomposition, CSR for cationic single replacement, ASR for anionic single replacement, DR for double replacement, or C for combustion.

