INTRO TO CHEMISTRY FROM OER OPEN STAX

<https://saylordotorg.github.io/text_introductory-chemistry/s08-01-the-chemical-equation.html>

A chemical reaction expresses a chemical change. For example, one chemical property of hydrogen is that it will react with oxygen to make water. We can write that as follows:

hydrogen reacts with oxygen to make water

We can represent this chemical change more succinctly as

hydrogen + oxygen → water

where the + sign means that the two substances interact chemically with each other and the → symbol implies that a chemical reaction takes place. But substances can also be represented by chemical formulas. Remembering that hydrogen and oxygen both exist as diatomic molecules, we can rewrite our chemical change as

H2 + O2 → H2O

H2 + O2 → 2H2O

2H2 + O2 → 2H2O

EXAMPLES:

Write and balance the chemical equation for each given chemical reaction.

1. Hydrogen and chlorine react to make HCl.
2. Ethane, C2H6, reacts with oxygen to make carbon dioxide and water.

Solution

1. Let us start by simply writing a chemical equation in terms of the formulas of the substances, remembering that both elemental hydrogen and chlorine are diatomic:

H2 + Cl2 → HCl

There are two hydrogen atoms and two chlorine atoms in the reactants and one of each atom in the product. We can fix this by including the coefficient 2 on the product side:

H2 + Cl2 → 2HCl

Now there are two hydrogen atoms and two chlorine atoms on both sides of the chemical equation, so it is balanced.

1. Start by writing the chemical equation in terms of the substances involved:

C2H6 + O2 → CO2 + H2O

We have two carbon atoms on the left, so we need two carbon dioxide molecules on the product side, so that each side has two carbon atoms; that element is balanced. We have six hydrogen atoms in the reactants, so we need six hydrogen atoms in the products. We can get this by having three water molecules:

C2H6 + O2 → 2CO2 + 3H2O

Now we have seven oxygen atoms in the products (four from the CO2 and three from the H2O). That means we need seven oxygen atoms in the reactants. However, because oxygen is a diatomic molecule, we can only get an even number of oxygen atoms at a time. We can achieve this by multiplying the other coefficients by 2:

2C2H6 + O2 → 4CO2 + 6H2O

By multiplying everything else by 2, we don’t unbalance the other elements, and we now get an even number of oxygen atoms in the product—14. We can get 14 oxygen atoms on the reactant side by having 7 oxygen molecules:

2C2H6 + 7O2 → 4CO2 + 6H2O

As a check, recount everything to determine that each side has the same number of atoms of each element. This chemical equation is now balanced.