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San Francisco de Paula

How To Balance Chemical Equations

1. Reactants go on the left hand side and products go on the right hand side of a chemical equation. Be sure to write the correct formulas for the reactants and products.
 - Remember atoms are conserved in a chemical reaction. ie they are neither created or destroyed. So all the atoms in the reactants must end up somewhere among the products.
2. Count the number of atoms of each element, compound or ion in the reactants and products. If they are not equal proceed further.
3. Balance the atoms one at a time by placing *coefficients* in front of the formula so that the numbers of atoms of each element are equal on both sides of the equation. Remember atoms may exist in an element, compound or ion.
 - It is usually easier to start with the atoms that occur in only one substance on each side of the equation.
 - Balance the atoms that occur in compounds before attempting to balance atoms that occur in elemental form. e.g. H₂, O₂ or Cl₂
 - To make it easier if a polyatomic ion appears unchanged on both sides of the equation treat it as a whole unit.
 - When no *coefficient* is written in front of a formula it is assumed to be 1.
4. Numbers appearing in the formulas are known as *subscripts*. These can never be changed when balancing the equation or you will change the identity of the substance.
 - Remember with subscripts, any number to the right of parentheses multiplies each subscript within the parentheses.
eg Fe₂(SO₄)₃ contains 2 Fe atoms, 3 S atoms and 12 O atoms.
5. Finally make sure that all the coefficients are in the smallest possible whole number ratio.

Example :

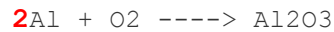
Let us try to balance the following equation: **Al + O₂ -----> Al₂O₃**

When aluminium reacts with oxygen, aluminium oxide is created. As you notice, in the aluminium oxide molecule there are two aluminium atoms and three oxygen atoms. They do not come out of nowhere so must have been present in the reactants too; this equation needs to be balanced.

Step 1: Make sure you have the same aluminium atoms on the left as on the right, so add the coefficient 2 to the aluminium on the left:



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Step 2: Now you need to balance the oxygen atoms. Think about the smallest number possible by which you can multiply 2 (as in O₂) and 3 (as in Al₂O₃) in order to get the same number.

- Multiplying the O₂ by 2 would not do as it would give 4 oxygens, not three
- Multiplying O₂ by three and Al₂O₃ by 2 would give us on both sides 6 oxygen atoms, so the same. Oxygen is balanced.



Step 3: As you noticed, you just unbalanced aluminium again, you have 2 on the left and 4 on the right. Simply add the coefficient 4 to the aluminium at the left to correct the problem.



Reactants: 4 x Al and 6 x O₂

Product: 4 x Al and 6 x O₂

THE EQUATION IS BALANCED