Chemistry 221
The Basics of Balancing Chemical Equations

Step 1: Write the unbalanced equation using the correct chemical formula for each reactant and product. Keep organized and make a table underneath the reactants and products with the number of elements involved in the reaction.
Step 2: Find suitable coefficients, which are the numbers placed before chemical formulas to indicate how many units of each substance are required to balance the equation.
Step 3: Reduce coefficients to their smallest whole-number values, if necessary, by dividing them by a common divisor
Step 4: Check your answer to make sure that the numbers and kinds of atoms are the same on both sides of the equation.

Example: BALANCING EQUATIONS

Step 1: Write the unbalanced equation using the correct chemical formula for each reactant and product. Make a table with the total number of elements involved in the reactants and products of a reaction.

Reactants **Products**

$$Fe + O_2 \rightarrow Fe_2O_3$$

Number of units of each substance

Reactants side		Products side	
Fe	1	Fe	2
O	2	O	3

Step 2: Find suitable coefficients, which are the numbers placed before formulas to indicate how many formula units of each substance are required to balance the equation.

Reactants **Products**

$$Fe \;+\; O_2 \rightarrow Fe_2O_3$$

- ✓ Remember: if there is no number in front of the formula, it means there is 1 present.
- ✓ Remember: you can only add coefficients, not subscripts.
- ✓ Remember if there is a Subscript such as O_2, it means that there are 2 present.
- ✓ Remember: if there is a coefficient in front of a formula such as $3O_2$, that means that you multiply the 3 times 2, which equals 6.
- ✓ Make sure you keep track of the coefficients and change them in your table.
- ✓ Hint: Work with H's last.
- ✓ Hint: Start changing the coefficients in front of the most complex formula and end with the simplest formula. For example, change the coefficient in front of Fe_2O_3 instead of **Fe** because it is easier to change the **Fe** at the end.

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Step 3: By looking at this table it is obvious that there are unequal numbers of Fe and O in the products and reactants. Start with trial and error by changing the coefficients to the smallest whole-number values possible to attempt to make the amount of Fe and O the same on both sides.

- From the table, you know that there needs to be at least 3 O's on the Products side to make it equal to the O's on the Reactants side. But there is no way to put a coefficient in front of the Reactants to make it exactly equal to 3.
- Therefore, you have to find a common factor. A common factor of **3** O and **2** O is **6**. To do this put a **2** coefficient in front of $\mathbf{Fe_2O_3}$ on the products side to give us **2 x 3** O which is **6** and **2 x 2** Fe which is **4** Fe. Don't forget to change your table to keep track of reactants and products.

Reactants **Products**

$$Fe + O_2 \rightarrow 2Fe_2O_3$$

Reactants side		Products side		
Fe	1	Fe	~~2~~	4
O	2	O	~~3~~	6

- Next, balance for O on the reactants side by putting a 3 in front of the $\mathbf{O_2}$; the new number of oxygen is **3 x 2,** which equals **6**.
- You are almost done. Now balance for **Fe** on the reactants side by placing a **4** coefficient to get **4 Fe**.

Final balanced equation

Reactants **Products**

$$4Fe + 3\,O_2 \rightarrow 2Fe_2O_3$$

Number of units of each substance

Reactants side			Products side		
Fe	~~1~~	4	Fe	~~2~~	4
O	~~2~~	6	O	~~3~~	6

Step 4: Lastly, check to make sure there are equal numbers of substance on each side.