Chemical Reactions

What is a chemical reaction?

The original substance(s) in a chemical reaction is (are) called …

The substance(s) formed in a chemical reaction is (are) called …

The only way you can tell for sure that a chemical reaction has occurred is by testing the products. If the products have different properties than those of the reactants, a chemical reaction has taken place.

For ordinary chemical reactions, the atoms do not turn into other atoms. They simply rearrange to form other substances. The particles must collide for a rearrangement to occur.

What is a chemical equation?

Balancing Chemical Equations

All chemical equations are mole ratios.

$$2\,H_2 \quad + \quad O_2 \quad \rightarrow \quad 2H_2O$$

2 moles of Hydrogen + 1 mole of Oxygen → 2 moles of water

4 grams of Hydrogen + 32 grams of Oxygen → 36 grams of water

The law of conservation of mass tells us that the mass cannot be created or destroyed during a chemical reaction. When we balance equations, we are simply applying the law of conservation of mass. We are making sure that the numbers of atoms on the left side of the arrow (the reactants) are equal to those on the right side of the arrow (the products).

When trying to balance equations DO NOT change subscripts!

When balancing equations, use coefficients instead. Coefficients are numbers placed in front of a formula.

Steps for Balancing Chemical Equations

1. Write the correct symbols and formulas for all the reactants and products. Don't forget to use your subscripts here to balance your charges!!!
2. Count the number of atoms of each element on both sides of the equation.
3. Place coefficients in front of the unbalanced elements to get them to balance.
4. Repeat step 3 until every element has the same number of atoms on both sides of the equation.

Example:

$$\_\_\_\_\_\ H_2 + \_\_\_\_\_\ O_2 \rightarrow \_\_\_\_\_\ H_2O$$

On the left:	On the right:
Number of Hydrogen atoms =	Number of Hydrogen atoms =
Number of Oxygen atoms =	Number of Oxygen atoms =

The number of hydrogen atoms balances (2 on each side), but the number of oxygen atoms does not balance (2 on the left, 1 on the right). To balance the oxygen, we need increase the number of oxygen atoms on the right. We need more water to the right hand side.

$$\_\_\_\_\_\ H_2 + \_\_\_\_\_\ O_2 \rightarrow \_\_\_\_\_\ H_2O$$

On the left:	On the right:
Number of Hydrogen atoms =	Number of Hydrogen atoms =
Number of Oxygen atoms =	Number of Oxygen atoms =

Now the number of oxygen atoms balances (2 atoms on each side). But now the hydrogen atoms don't balance! We can correct this imbalance by adding more H_2 to the left-hand side of the equation.

$$\_\_\_\_\_ \ H_2 + \_\_\_\_\_ \ O_2 \rightarrow \_\_\_\_\_ \ H_2O$$

On the left:	On the right:
Number of Hydrogen atoms =	Number of Hydrogen atoms =
Number of Oxygen atoms =	Number of Oxygen atoms =

Now the number of hydrogen atoms on the left is equal to the number of hydrogen atoms on the right. This is also true for the oxygen atoms. This equation is balanced!

Example:

$$\_\_\_\_\_ \ KCl + \_\_\_\_\_ \ O_2 \rightarrow \_\_\_\_\_ \ KClO_3$$

On the left:	On the right:
Number of K atoms =	Number of K atoms =
Number of Cl atoms =	Number of Cl atoms =
Number of O atoms =	Number of O atoms =

Some Balancing Tips If You are Getting Stuck:
-Try balancing oxygens and hydrogens last. They often "fix themselves" by balancing other elements first.
-Try keeping polyatomic ions together when balancing if they show up on both sides of the equation as a polyatomic ion (rather than breaking them up into their individual ions).
-Try rewriting H_2O as HOH and treating the "OH" as a polyatomic ion.

Examples:

$$\_\_\_\_\_ \; C_3H_8 + \_\_\_\_\_ \; O_2 \rightarrow \_\_\_\_\_ \; CO_2 + \_\_\_\_\_ \; H_2O$$

$$\_\_\_\_\_ \; H_3PO_4 + \_\_\_\_\_ \; Ca \rightarrow \_\_\_\_\_ \; Ca_3(PO_4)_2 + \_\_\_\_\_ \; H_2$$

Example: (A tricky one)!

$$\_\_\_\_\_ \; C_4H_{10} + \_\_\_\_\_ \; O_2 \rightarrow \_\_\_\_\_ \; CO_2 + \_\_\_\_\_ \; H_2O$$

Example (Another tricky one)!

$$\_\_\_\_\_ \; C_2H_5OH + \_\_\_\_\_ \; O_2 \rightarrow \_\_\_\_\_ \; CO_2 + \_\_\_\_\_ \; H_2O$$

Try These On Your Own!

1. _____ $C_{12}H_{22}O_{11}$ + _____ O_2 → _____ CO_2 + _____ H_2O

2. _____ $Ca(OH)_2$ + _____ H_3PO_4 → _____ H_2O + _____ $Ca_3(PO_4)_2$

3. _____ Cr + _____ S_8 → _____ Cr_2S_3

4. _____ $NaHCO_3$ → _____ Na_2CO_3 + _____ CO_2 + _____ H_2O