

# Balancing Chemical Reactions

Chemical reactions are like recipes in that the quantity and types of ingredients, or **reactants**, can be related to the quantity and type of cooked food, or **product(s)**

## Atom Accounting

How many nitrogen atoms are in 1  $\text{N}_2\text{O}_5$  molecule?

In one molecule, there are two nitrogen atoms, as notated by the subscript 2.

How many nitrogen atoms are in 2  $\text{N}_2\text{O}_5$  molecules?

2 molecules  $\times$  2 nitrogen = 4 nitrogen atoms

How many phosphate groups and oxygen atoms are in 1 formula unit of  $\text{Cu}_3(\text{PO}_4)_2$ ?

1 formula unit  $\times$  2 phosphate groups  $\times$  4 oxygen atoms = 8 oxygen atoms

How many oxygen atoms are in 3 formula units of  $\text{Cu}_3(\text{PO}_4)_2$ ?

3 formula units  $\times$  2 phosphate groups  $\times$  4 oxygen atoms = 24 oxygen atoms

How many oxygen atoms are in 1 molecule of  $\text{CO}_2$  and 1 molecule of  $\text{H}_2\text{O}$ ?

(1 molecule  $\text{CO}_2$   $\times$  2 oxygen atoms) + (1 molecule  $\text{H}_2\text{O}$   $\times$  1 oxygen atom) = 3 oxygen atoms

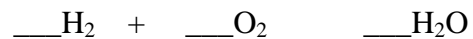
How many oxygen atoms are in 4 molecules of  $\text{CO}_2$  and 7 molecules of  $\text{H}_2\text{O}$ ?

(4 molecules  $\text{CO}_2$   $\times$  2 oxygen atoms) + (7 molecule  $\text{H}_2\text{O}$   $\times$  1 oxygen atom) = 15 oxygen atoms

How many oxygen atoms are in 7 formula units of  $\text{Cu}_3(\text{PO}_4)_2$  and 4 formula units of  $\text{Na}_2\text{SO}_4$ ?

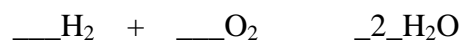
(7 formula units  $\times$  2 phosphate groups  $\times$  4 oxygen atoms) + (4 formula units  $\times$  4 oxygen atoms) =  
72 oxygen atoms

**Example:** Hydrogen gas and oxygen gas yields water



Reactants	Products
H = 2	H = 2
O = 2	O = 1

The oxygen atoms are unbalanced on the right side, so the coefficient of water has to be increased. Let's try 2 molecules. Do not forget to recalculate the count of each atom type in the molecule(s) you're increasing.



Reactants	Products
H = 2	H = 4

## Practice Problems