

## Stoich Diary

Stoichiometry is the process of making various chemical calculations based upon a balanced chemical equation. The balanced chemical equation creates the "perfect" ratio of moles to moles to moles, which can be used to alter parts of this reaction and make predictions as to what would happen to the other parts.

We will use the STOICH-MOLE Map or bridge diagram to assist us to find our way through these types of problems. See below.

The problems we will encounter include:

Mole to Mole calculations, Grams to Grams calculations, Liters to Liters calculations, and number of particles to number of particles calculations, as well as any of the combinations between all of those. Look at this diagram. You can start at any point (shape) and get to any other shape, but converting to Moles, then using the simple Mole Ratio/Stoichiometry concepts.

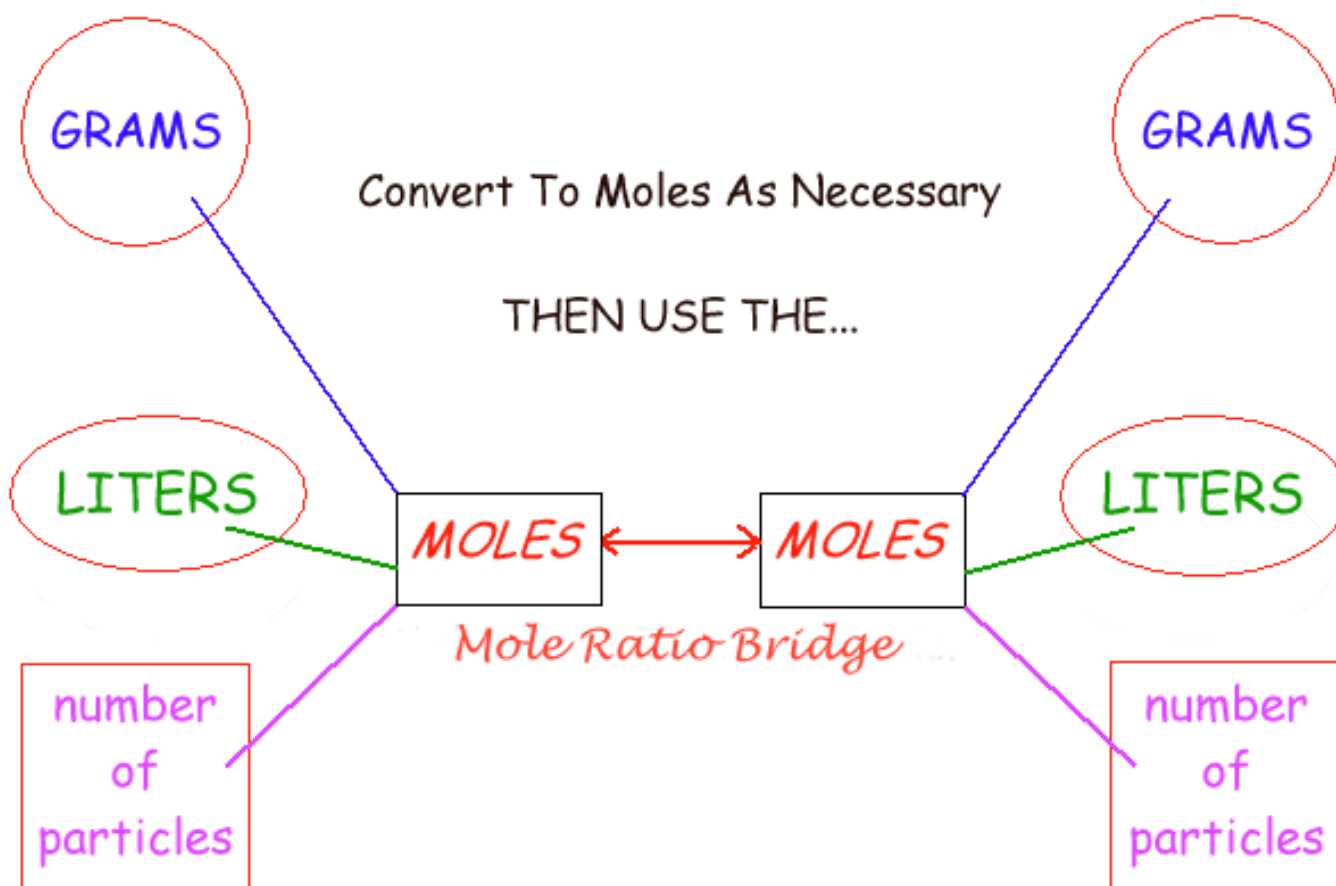
The most important idea in Stoichiometry is that it is all based upon the MOLE RATIO that is set in each individual chemical equation. The ratio is NOT JUST a set of numbers, rather it is a set of numbers that are each linked directly to a part of the balanced chemical reaction.

As the picture below illustrates, the only way to connect 2 parts of a balanced equation is through the MOLE RATIO. You MUST start Stoichiometry with a balanced equation, and if you have grams to start (for example) you must convert to moles. THEN you can predict how many moles of the other part of the problem will have. If your question asks not moles, but one of the OTHER THREE choices (grams, liters, or number of particles), then convert the number of MOLES you just figured out to those units.

STOICHIOMETRY is based upon the MOLE RATIO. Chemistry allows us to move from different units to moles, or from moles.

**Only put moles into the MOLE RATIO part of your problems.**

The connection between parts of a chemical equation and each other is the MOLE RATIO. We can look at any 2 parts at one time. The rest of the equation is not part of the problem.



Remember, to convert from... to moles, use these conversion factors:

Grams to moles: 1 mole = the molar mass of the substance

Liters to moles: 1 mole = 22.4 liters (of any gas at STP)

Number of Particles: 1 mole =  $6.02 \times 10^{23}$  particles

To convert from moles of one substance  
to moles of another substance,  
use the MOLE RATIO

How to solve stoich problems...a nice example problem, broken down neatly.

1. Decide which two parts of a balanced equation you are looking at.
2. Write "MR", then write the "chemical ratio" so you keep track of your numbers.
3. Write the mole ratio of these two chemicals into the problem.
4. Decide where the "X" goes (top or bottom of the ratio), put this "X" in.
5. Determine how many MOLES of the other part of the problem has, insert now.
6. Cross multiply to solve for X.
7. If necessary, convert X to proper units the question asks for.

For Example... if we use  $2\text{C}_2\text{H}_6 + 7\text{O}_2 \longrightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}$

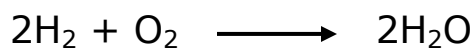
If our problem is this...

How many grams of oxygen are used up when 308 liters of ethane combusts completely?

step 1	We decide that we are looking at only carbon dioxide and ethane.
step 2	MR: $\frac{\text{oxygen}}{\text{ethane}}$
step 3	MR: $\frac{\text{oxygen}}{\text{ethane}} \quad \frac{7}{2}$
step 4	MR: $\frac{\text{oxygen}}{\text{ethane}} \quad \frac{7}{2} \quad \frac{X}{}$
step 5a	convert 308 L ethane to moles of ethane using the equality 22.4 L = 1 mole $308 \text{ Liters ethane} \times \frac{1 \text{ mole ethane}}{22.4 \text{ Liters}} = 13.8 \text{ moles (3SF)}$
step 5B	MR: $\frac{\text{oxygen}}{\text{ethane}} \quad \frac{7}{2} \quad \frac{X}{13.8}$
step 6	$2X = 96.6$ $X = 48.3 \text{ MOLES of OXYGEN}$
step 7	convert 48.3 moles O <sub>2</sub> to grams using the equality 1 mole O <sub>2</sub> = 32 grams $48.3 \text{ moles O}_2 \times \frac{32 \text{ grams oxygen}}{1 \text{ mole oxygen}} = 1550 \text{ grams oxygen (3SF)}$

STOICHIOMETRY connects balanced chemical equations with the ratios of substances in an equation, to real life chemical situations.

For instance, a balanced reaction of water synthesizing would be:



**2 molecules hydrogen & 1 molecule of oxygen form 2 molecules of water.**

**Or rather: 2 moles hydrogen & 1 mole of oxygen form 2 moles of water.**

Stoichiometry allows us to manipulate this equation into grams of a substance, or liters of gas of a substance, or even how many molecules of each component substance are being used. It allows this reaction to "be real" in the sense that normally measurable amounts can be connected to the balanced chemical reaction.