

Solutions Stoichiometry

When I was young and taking chemistry for the first time, my teacher kept mentioning something called stoichiometry. Given that I had no interest in chemistry and that I was rebelling against my scientist father, I ignored everything my teacher had to say.

This turned out to be good, because my teacher was an idiot. He was wrong about stoichiometry, particularly stoichiometry involving solutions. Fortunately, I'm less of an idiot than he is, so I'm able to share with you the magic of solutions stoichiometry.



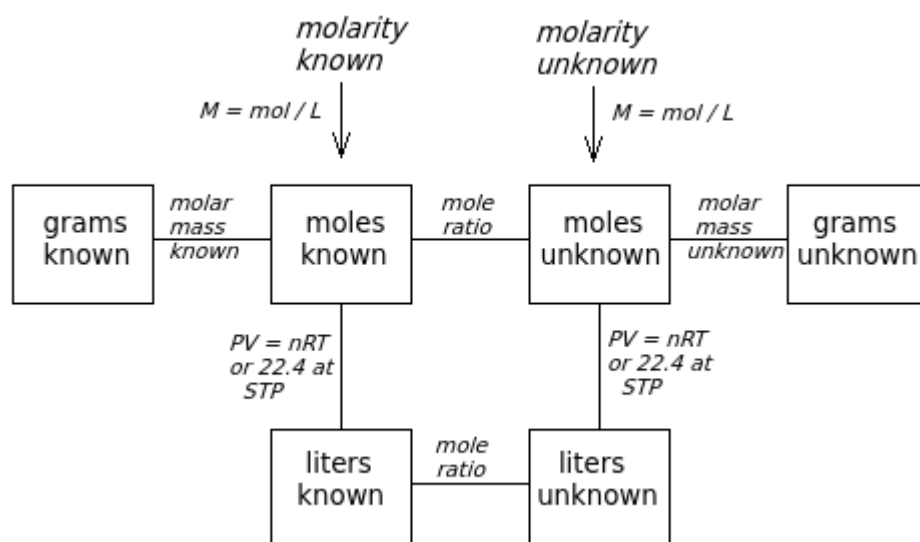
Imagine this guy in a lime green lab coat, complaining about his roommate/mom. That was my chemistry teacher!

What is stoichiometry?

Stoichiometry is the method that you use to figure out how much stuff you'll make in a chemical reaction, or how much stuff you'll need to make a set amount of some product. I'm not going to go into it in huge detail, but I will refer you to a tutorial where I go over the basics in great detail. [Here it is!](#) Seriously, the rest of this won't make sense if you don't understand basic stoichiometry, so visit that link and make all of our lives easier.

How do I do stoichiometry?

Well, the first step in learning about this is to read the tutorial above, which I will kindly link to again: [link](#). Now that you've reviewed that, it's time to refer to a new-and-improved version of the diagram that I love using to describe stoichiometry:



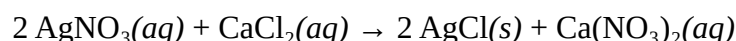
After all the stoichiometry we've done, this is the final thing you'll need to learn. The bottom part with all the stuff in boxes should look familiar, with the only new stuff being the "molarity known" and "molarity unknown" part on the top.

The reason that the "molarity known" and "molarity unknown" parts aren't in boxes with everything else is that you can't just stick these things into a t-chart like you do with all the other terms in stoichiometry. Instead, given the information about a solution (which you can presumably use to figure out molarity) and the equation $M = \text{mol} / L$, you can find the number of moles of the known and just take it from there like any other stoichiometry equation.

But enough talking. Let's do an example.

An example

For whatever reason, I want to perform the following chemical reaction:



And let's pretend, for the sake of argument, that I have 2.50 liters of a 0.500 M AgNO_3 solution. If I combine this AgNO_3 solution with enough calcium chloride for it to react completely, how many grams of AgCl solid will I make?

Answer: Use the chart to figure out what you need to do.

Step 1: Figure out what calculations you need to do.

- The problem here tells you that you're starting with 2.50 L of a 0.500 M silver nitrate solution, so we'll start in the "molarity known" section on the left side of the chart (because we know the molarity of the solution as part of the question).
- We want to find out how much AgCl will be made, so we want to finish at the "grams unknown" section (our answer is, of course, unknown to us at this time).
- To figure out what calculations we need to perform, we simply go from one section to the next until we reach our final destination. In this particular example, we do three calculations: One from "molarity known" to "moles known", one from "moles known" to "moles unknown", and one from "moles unknown" to "grams unknown." And since you've already read the stoichiometry tutorial, this should be fairly straightforward.

Step 2: Do the first calculation and figure out how many moles of silver nitrate are present.

Using $M = \text{mol} / L$, we plug in the following values:

- $M = 0.500 \text{ M}$
- $L = 2.50 \text{ L}$

And so if you put this into the molarity equation, we find that we'll have 1.25 moles of silver nitrate in our initial solution.

Step 3: Do regular stoichiometry until you get your final answer

Because I know you already know how to do this because you understood the stoichiometry tutorial, this should be pretty straightforward if you use the t-chart method. Essentially, you just need to do two more calculations, from "moles known" to "grams unknown." This requires a two-step t-chart:

<i>1.25 mol silver nitrate</i>	<i>2 mol AgCl</i>	<i>143.32 g AgCl</i>
	<i>2 mol silver nitrate</i>	<i>1 mol silver nitrate</i>

(For those of you who don't understand where these came from, the "1.25 mol silver nitrate" is the answer from step 2, the next step where "2 mol" is on both the top and the bottom refers to the mole ratio that you get from the equation, and the 143.32 g AgCl is the molar mass of silver chloride).

Anyway, when you figure out the answer, you should find that you'll make 179 grams of silver chloride precipitate in this reaction. Which is the answer. So go celebrate!

Seriously. That's the whole tutorial.

Image credit (man with glasses): *Image courtesy of stockimages at FreeDigitalPhotos.net*