

Writing complete equations

Let's say that you're interested in writing a chemical equation, but your teacher hasn't given you any formulas. In fact, let's say that your teacher, instead of giving you an equation, has just told you what the equation is like. For example, maybe your teacher told you to write the equation for "calcium reacting with hydrochloric acid to form calcium chloride, water, and heat." What should you do?



Hint: "Shoot heroin" probably isn't the best answer to this question.

Your best option is to read the tutorial below and then do what it says. Not only is it much better for you than heroin, but it's also safer, cheaper, and less likely to get you arrested.

The example we're going to do here is the following:

When hydrogen gas is heated with oxygen gas, water vapor is formed in an explosive process.

Let's figure out how to write an equation that will describe this...

Step 1: Write the formulas

Before you can write an equation of any kind, you need formulas. To do that, you'll have to go back to another tutorial and figure out how to do it. (Links: [Ionic naming tutorial](#), [covalent naming tutorial](#)).

In our example above, we have three chemical compounds: "hydrogen", "oxygen", and "water." Using our knowledge of naming compounds, we end up with a very incomplete equation that looks like this:

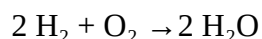


Let's move on to step 2!

Step 2: Balance the equation

If you thought you were done with balancing equations forever, it's time to come back to the planet Earth. Or wherever it is you used to live.

Again, I'll make the assumption that you already know how to balance equations and can figure this out for yourselves. If not, go have a look at the [balancing equation tutorial I've posted elsewhere](#) and learn the magic of balancing equations. In any case, when you've balanced the equation you got in step 1, you should end up with:

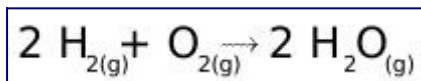


Step 3: Write the states of matter under each of the formulas

The states of matter to which I refer consist of one of the following:

- (s) is used to indicate that something is a solid.
- (l) is used to indicate that something is a liquid.
- (g) is used to indicate that something is a gas.
- (aq) is used to indicate that something is aqueous, which is to say that it's dissolved in water. Don't use (d), even though it makes more sense.

In the example I gave you, the states of matter are told to you for hydrogen and oxygen (they're gases) and is strongly hinted at in the case of water ("vapor" is just another term for "gas"). Given this information, we end up with the equation:

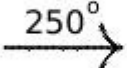
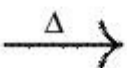
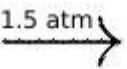
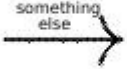
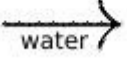


In some cases, the state of matter may be a little less obvious to you. Here's some stuff you can use to figure out the states of matter if you don't have what would appear to be enough information:

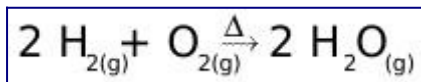
- Many common compounds have obvious states. For example, if nobody tells you the state of carbon dioxide in a formula, you can probably assume that it's a gas. Similarly, it's probably not a big deal to figure out that iron is a solid and chlorine is a gas. (However, if you are specifically told otherwise in the equation – go with what you were told!)
 - "Molten" or "melted" refer to the liquid state of a material.
 - "Vapors" or "fumes" are gases.
 - If something is said to be in solution, it's aqueous.
 - If something is "powdered" or "ground up", it's a solid.
 - If an ionic compound is formed in an aqueous environment, use a solubility chart like the one [here](#) to determine if it will be aqueous or solid.
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Step 4: Write symbols around the arrow to indicate how the reaction occurs

Though some reactions just take place on their own when you put reagents together, most of them require that you actually do something to make them take place. Though you can literally put almost anything over the arrow to indicate what you'll be doing, here are the most common ones you'll run into:

	Combining the reagents will cause the reaction to occur without any additional help.
	Perform the reaction at a temperature of 250 degrees.
	Add energy to the reagents to make them react. This usually means to just heat them over a Bunsen burner, but context is everything.
	Perform the reaction at a pressure of 1.5 atmospheres.
	Do whatever it says to make the reaction take place.
	If a compound is shown under the arrow, this usually means that the reaction uses this as a solvent.

In our example it was said that we “heated the reaction”, so a delta symbol (i.e. the little triangle over the arrow) is appropriate:



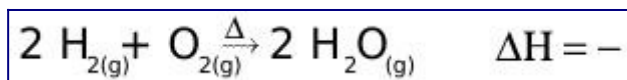
Step 5: Indicate whether the reaction gave off or released energy (and how much):

It's usually interesting for chemists to know whether a reaction gives off or releases energy, mainly because they don't want to be surprised when something explodes. As a result, equations are generally shown in a way that gives away this vital piece of information.

To do this, a symbol shown as ΔH indicates what happens with the energy. If ΔH is positive, this indicates that a reaction is endothermic (i.e. it has absorbed energy and the container it's in will feel cold). If it's negative, the reaction is exothermic (i.e. it releases energy making the surroundings hot).

If you are already familiar with ΔH values or are told a specific value for ΔH (it will most likely be in the form of “242 kJ/mol”), use that value. Otherwise, your instructor may or may not want you to just write “ $\Delta H = +$ ” for an endothermic reaction or “ $\Delta H = -$ ” for an exothermic reaction. It's probably best to ask.

In the example I gave, I just said that it exploded. This should indicate to you an exothermic reaction, so the final equation will be:



Images:

- Heroin addict: David Castillo Dominici via freedigitalphotos.net.
- All other graphics were made by me, because I'm awesome.