The Power of Calculator Software!

Zoom Chemistry

Version 1.00 Manual

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www.zoommath.com

Chapter 1

Typing Chemistry Problems

Typing Elements

Most of the time, Zoom Chemistry will guess whether you want an uppercase letter or a lowercase letter. If Zoom Chemistry guesses wrong, press MODE.

To type a letter on your graphing calculator, press the green **ALPHA** key and then press the key that's labeled with the green letter you want. To type an element symbol in Zoom Chemistry, just type the letters of that element symbol.

Most of the time, Zoom Chemistry will figure out whether you wanted an uppercase letter or a lowercase letter. But sometimes, Zoom Chemistry will guess wrong. If that happens, press **MODE** right away, and Zoom Chemistry will change the letter.

If you notice that Zoom Chemistry capitalized a letter wrong and you've typed a little more since then, press ◄ until the cursor is on the character right after the incorrect letter. Then press **MODE**. Zoom Chemistry will change the letter.

For example, if you type **ALPHA N ALPHA O**, Zoom Chemistry will print NO. If you want to type No instead (for the element Nobelium), then you will need to type **ALPHA N ALPHA O MODE**.

Typing Molecules

To type O_2, just type ALPHA O 2. Zoom Chemistry will automatically put the 2 down where it belongs.

In Zoom Chemistry, you can usually type a molecular formula just the way it looks. If the formula has a number in a subscript, just type the number. Zoom Chemistry will automatically put the number in a subscript.

For example, to type O_2, type **ALPHA O 2**. To type $Al(NO_3)_3$, type **ALPHA A ALPHA L (ALPHA N ALPHA O 3) 3**.

Typing Chemical Reactions

Press STO to type an arrow.

You can usually type a chemical reaction just the way it looks. To type the arrow in a chemical reaction, press **STO**. For example, to type $H_2 + O_2 \rightarrow H_2O$, type **ALPHA H 2 + ALPHA O 2 STO ALPHA H 2 ALPHA O**.

If you want to type a chemical reaction that includes the symbols (*g*), (*l*), (*s*), or (*aq*), then you should just leave those symbols out of the reaction. Zoom Chemistry doesn't understand those symbols. When you're balancing a reaction, those symbols don't matter anyway.

Typing Ions

To type H^+, just type ALPHA H +. Zoom Chemistry will eventually put the + up where it belongs.

You can easily type an ion with a charge of 1+ or 1-. Just type the ion's formula the way it looks. When you type a minus sign, Zoom Chemistry will automatically put it in a superscript. When you type a plus sign, Zoom Chemistry won't put it in a superscript right away, but as soon as you type another key, Zoom Chemistry will move the plus sign into a superscript if appropriate.

For example, to type $Ag^+ + Cl^-$, type **ALPHA A ALPHA G + + ALPHA C ALPHA L -**. When you press **+** the first time, it is printed as a normal plus sign, but when you press **+** the second time, Zoom Chemistry moves the first plus sign you typed into a superscript.

To type O^{2-}, type ALPHA O ^ 2 -.

Or type ALPHA O and then double-click the x^{-1} key.

When you want to type an ion with a charge that's more than 1+ or 1-, you have to use special keys. Do you know how to type exponents in Zoom Math? If so, then you won't have any trouble learning how to type ionic charges.

To type an ionic charge, press the **^** key. This moves the cursor up a little ways so you can type the number in the right place. For example, you can type SO_4^{2-} by typing **ALPHA S ALPHA O 4 ^ 2 -.**

If you prefer, you can type a positive ionic charge by pressing x^2. Each time you press x^2, the ionic charge will increase by 1. For example, if you want to type a charge of 3+, you can press x^2 three times. Similarly, you can type a negative charge of 3- by pressing x^{-1} three times.

Typing Electrons

To type an electron, type ALPHA E.

To type an electron, just type **ALPHA E**. Zoom Chemistry will automatically give the electron a charge of 1-.

Typing Grams and Moles

To type a number of grams, type ALPHA G after the number.

To type a number of grams of a molecule, type the number and then type **ALPHA G**. Then type the molecule's formula. Don't try to type spaces; Zoom Chemistry will automatically insert spaces for you. For example, to type 3.00 g Zn, just type **3 . 0 0 ALPHA G ALPHA Z ALPHA N**.

Zoom Chemistry doesn't understand any units other than grams.

Instead of typing 1.00 mol NaCl, type 1.00NaCl.

To type a number of moles of a molecule, leave out "mol." Zoom Chemistry doesn't understand what "mol" means. Just type the number and the molecular formula.

When you type a number followed by a molecular formula, Zoom Chemistry will assume that the number you typed is a number of moles. So if you want to type 0.350 mol H_2O, then type **0 . 3 5 0 ALPHA H 2 ALPHA O** instead. Zoom Chemistry will understand what you mean.

Editing Input

Press DEL to backspace.

To delete the last character you typed, press **DEL**.

To delete a character you typed previously, move the cursor back onto that character and press **DEL**.

To insert text, press **2nd INS** to switch to insert mode. Then put the cursor in the right place and type the text you want to insert.

Press ▲ to get back a problem you typed earlier.

If you are on a blank line at the start of a problem, you can get back the text of a previous problem by pressing ▲ repeatedly until the text of that problem appears. If you accidentally go too far, press ▼.

Chapter

2

Solving Chemistry Problems

Converting Between Grams and Moles

How many moles of H_2O are in 32.0 grams of H_2O? To find out, type 32.0 g H_2O.

To find out how many moles of a substance are in a certain number of grams of that substance, just type the number of grams of that substance and press **ENTER**. For example, if you want to know how many moles of H_2SO_4 are in 711 grams of H_2SO_4, type **7 1 1 ALPHA G ALPHA H 2 ALPHA S ALPHA O 4 ENTER**.

To find out how many grams of a substance are in a certain number of moles of that substance, type the number and the molecular formula of the substance and press **ENTER**. Don't type "mol." Zoom Chemistry will assume that the number you typed is a number of moles, and Zoom Chemistry will calculate the number of grams in that number of moles.

Zoom Chemistry doesn't understand any units except grams and moles. If you want to convert an answer to kilograms, you will have to do that yourself.

To show steps, press TRACE instead of ENTER.

You can see how Zoom Chemistry converts between grams and moles, one step at a time. Instead of pressing **ENTER**, press **TRACE** to see each step. If you want to go back a step, press ◀.

When showing steps, (S) is the molar mass of S.

When Zoom Chemistry shows the steps of converting between grams and moles, a substance's formula in parentheses refers to the molar mass of that substance, in grams per mole. For example, (NaCl) refers to the molar mass of NaCl in grams per mole.

If something goes off the edge of the screen, press WINDOW to look around.

When you **TRACE** a problem, sometimes a step will be too long to fit on the calculator screen. If that happens, press **WINDOW** and then use the arrow keys to look at the parts of the problem that aren't showing. When you're done looking around, press **WINDOW** again.

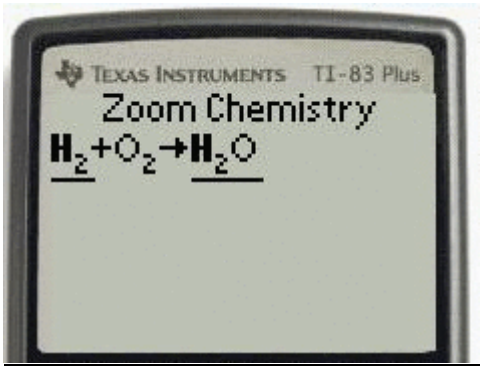
Balancing Chemical Reactions

To have Zoom Chemistry balance a chemical reaction, type the unbalanced chemical reaction and press **ENTER**.

After you buy a Registration Key, Zoom Chemistry can balance more complicated chemical reactions.

Zoom Chemistry can still balance chemical reactions if you don't have a Registration Key, but only when they involve exactly three substances and none of the substances are ions. If you buy a Registration Key, then Zoom Chemistry will balance more complicated chemical reactions, including ionic reactions.

To help you understand how Zoom Chemistry balances chemical reactions, here is a detailed step-by-step explanation of how Zoom Chemistry balances the chemical reaction $H_2 + O_2 \rightarrow H_2O$. (To follow along on your calculator, type $H_2 + O_2 \rightarrow H_2O$ and press **TRACE** instead of **ENTER** to see the first step.)



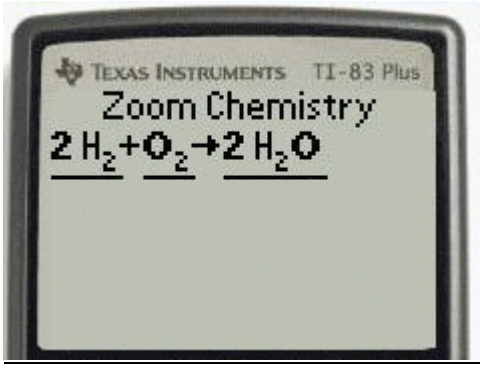
After each step, the element that Zoom Chemistry just balanced and the numbers that Zoom Chemistry just changed are printed in bold.

Zoom Chemistry decided to balance H first, so H is printed bold. The original reaction had two atoms of H in one molecule on the left and two atoms of H in one molecule on the right. H was already balanced! None of the coefficients had to change.

H will stay balanced as long as we have the same number of molecules of H_2 and H_2O. If we increase the coefficient of H_2 without changing the coefficint of H_2O, then this change will unbalance H. We don't want that to happen! So from now on, whenever we change the coefficient of H_2, we will also change the coefficient of H_2O to make sure that H stays balanced.

Underlined molecules keep a constant ratio. When we multiply one of them by a number, we must multiply the others by the same number.

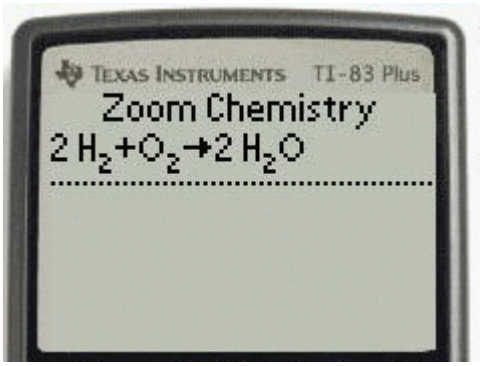
To help you remember that H_2 and H_2O must stay in the same ratio from now on, Zoom Chemistry underlines H_2 and H_2O.



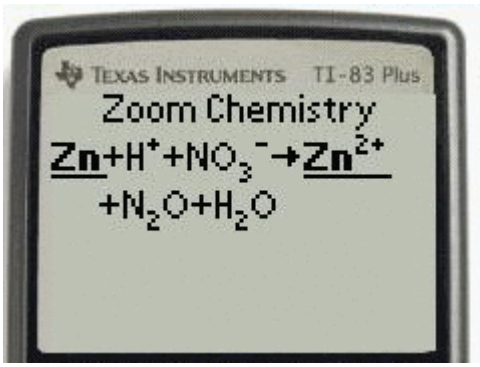
Zoom Chemistry just balanced O, so now O is printed bold. After the first step, we had two atoms of O on the left side of the reaction, but only one on the right side. To balance O, Zoom Chemistry had to double the amount of H_2O on the right side of the reaction.

Because H_2O was underlined, Zoom Chemistry could not just double the amount of H_2O. Instead, Zoom Chemistry had to double the amount of every molecule that was underlined. (O_2 was not underlined yet.) By doubling the amount of every underlined molecule, Zoom Chemistry balanced O and did not unbalance H.

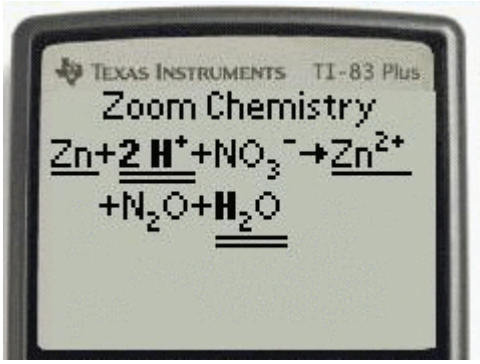
Now H and O are both balanced. The entire chemical reaction is balanced. When you press **TRACE**, the underlining and the bold font will disappear. You can go on to the next problem.



Next, here is a detailed explanation of how Zoom Chemistry balances the chemical reaction $Zn + H^+ + NO_3^- \rightarrow Zn^{2+} + N_2O + H_2O$. (You can follow along on your calculator, but only if you have a registered copy of Zoom Chemistry.)



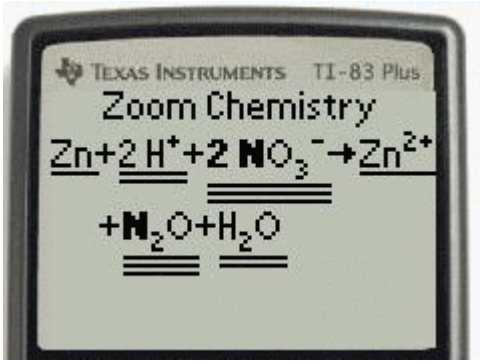
First, Zoom Chemistry recognized that Zn was already balanced. From now on, as long as the coefficient of Zn on the left side of the reaction is the same as the coefficient of Zn^{2+} on the right side of the equation, Zn will stay balanced. To indicate that Zn and Zn^{2+} must stay in the same ratio, Zoom Chemistry underlined them both.



Next, Zoom Chemistry balanced H. To balance H, Zoom Chemistry had to double the coefficient of H^+. From now on, to keep H balanced, we must make sure the coefficient of H^+ is always twice as much as the coefficient of H_2O.

Double underlined molecules are linked with each other, but not linked with molecules that have a different number of underlines.

If we change the coefficient of Zn or Zn^{2+}, then we will have to change both coefficients to make sure Zn stays balanced; and if we change the coefficient of H^+ or H_2O, then we will have to change both coefficients to make sure H stays balanced. But it's okay to change the coefficient of Zn without changing the coefficient of H^+. To help you remember which coefficients go together, Zoom Chemistry single-underlines Zn and Zn^{2+}, and double-underlines H^+ and H_2O.



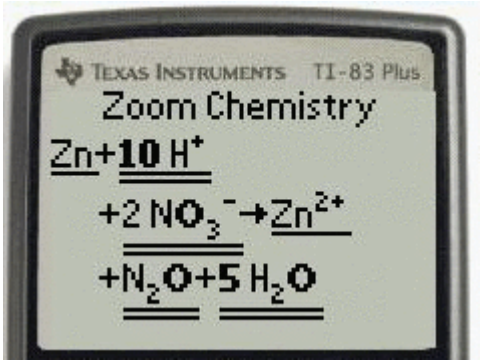
Next, Zoom Chemistry balanced N by doubling the coefficient of NO_3^-. To make sure N stays balanced, Zoom Chemistry triple-underlined NO_3^- and N_2O.

Zn, H, and N are all balanced now, but O and the electric charges are not balanced yet. Here is where the problem gets difficult. Zoom Chemistry wants to balance O next, but O appears in three different places. How can Zoom Chemistry balance O?

If you have six underlined atoms of O on the left and one atom with the same number of underlines on the right, that works the same as five on the left and zero on the right.

O is in two triple-underlined molecules. Because these molecules are both triple-underlined, they are linked together. Right now, the triple-underlined molecule on the left has six atoms of O, and the one on the right has one atom of O. Six minus one is five. Zoom Chemistry realizes that the triple-underlined group has five more atoms of O on the right side than the left side.

To make these calculations easier, Zoom Chemistry will pretend the triple-underlined group has five atoms of O on the left side and zero on the right side! If five atoms of O are in the triple-underlined group on the left side, and one atom of O is in H_2O on the right side, then Zoom Chemistry needs to multiply H_2O by five. That is what Zoom Chemistry does.



Remember, H_2O was double-underlined before this step. When Zoom Chemistry multiplied H_2O by five, Zoom Chemistry also had to multiply $\underline{\underline{2\ H^+}}$ by five.

When we balance an element that's in two different underlined groups, we combine the two groups into one big group.

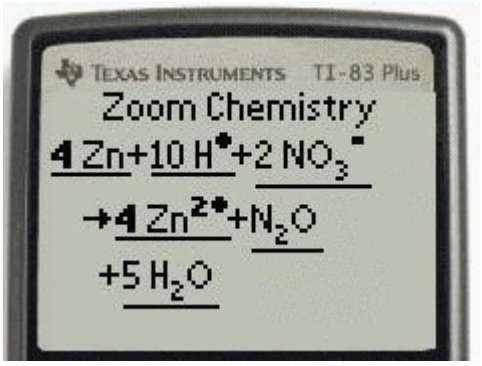
Before this step, H was balanced in the double-underlined group and N was balanced in the triple-underlined group. During this step, it was okay to change the coefficients in the double-underlined group without changing the triple-underlined group. But after this step, we need to make sure O stays balanced. We don't want to change the double-underlined group without changing the triple-underlined group, so Zoom Chemistry combines these two groups into one combined double-underlined group. We now have four double-underlined substances. If any of their coefficients changes, all of their coefficients must change.

Last, Zoom Chemistry must balance the electric charges. Electric charges appear in three different places.

If you have two electric charges in the same group on the same side of the reaction, add the charges together.

Once again, Zoom Chemistry will make the problem easier by combining different parts of a group. This time, the double-underlined group has two electric charges: a 10+ charge on the left from 10 H^+, and a 2- charge on the left from 2 NO_3^-. These charges are both on the same side, so Zoom Chemistry will add these charges together. The double-underlined group has an 8+ charge on the left side of the reaction.

The double-underlined group has an 8+ charge on the left side, and the single-underlined group has a 2+ charge on the right side. To balance the equation, Zoom Chemistry multiplies the single-underlined group by four.



Zoom Chemistry combined the single-underlined group with the double-underlined group. Now everything is in the single-underlined group, and everything is balanced. When you press **TRACE**, the underlining and the bold font disappear. You can go on to the next problem.

Grams and Moles in Chemical Reactions

You can type a number of grams or moles for one substance in a chemical reaction. Zoom Chemistry will calculate the numbers for the other substances.

When you type a chemical reaction, you can type a number of grams for one substance in that reaction, or you can type a number of moles. To type a number of grams, type the number, then **ALPHA G**, and then the substance. To type a number of moles, just type the number and then the substance. Don't type "mol."

If you type a number of grams for one substance, Zoom Chemistry will calculate the number of grams for all the other substances in that reaction. If you type a number of moles, Zoom Chemistry will calculate all the numbers of moles. Because Zoom Chemistry tries to calculate all the other numbers, you should only type a number for one substance.

If you specify the number of moles of a substance in a chemical reaction, and you press **TRACE** instead of **ENTER**, Zoom Chemistry will show each step of the calculation. First Zoom Chemistry will balance the reaction, ignoring the number of moles. Then Zoom Chemistry will multiply every coefficient by a certain number of moles to get the number that you originally typed. Zoom Chemistry will not show you the number of moles that it is multiplying by.

(How does Zoom Chemistry calculate the correct number of moles to multiply by? Zoom Chemistry takes the number you typed and divides it by the coefficient for that substance in the balanced chemical reaction.)

For example, if you type 6.00 H_2 + O_2 → H_2O **TRACE**, Zoom Chemistry will first calculate the balanced chemical reaction 2 H_2 + O_2 → 2 H_2O. Then Zoom Chemistry will multiply every coefficient in the balanced chemical reaction by 3.00 mol (because 6.00 divided by 2 is 3.00).

After Zoom Chemistry multiplies every coefficient by 3.00, the answer is 6.00 mol H_2 + 3.00 O_2 → 6.00 mol H_2O.

If you specify the number of grams of a substance in a chemical reaction and **TRACE**, Zoom Chemistry will balance the reaction first, ignoring the number of grams. Then Zoom Chemistry will figure out the right number of moles to multiply by (but Zoom Chemistry will not show you that number or explain why it's the right number). Finally, Zoom Chemistry will multiply each substance by its molar mass in grams per mole. This gives you an answer in grams for each substance. Because Zoom Chemistry carefully picked the appropriate number to multiply by, the number of grams that you specified for one substance will be the same number that Zoom Chemistry ends up with for that substance.

(How does Zoom Chemistry calculate the correct number to multiply by? Zoom Chemistry takes the number of grams you typed and converts it to moles, and then divides the number of moles by the coefficient for that substance in the balanced chemical reaction.)

For example, if you type 3.12 g H_2 + O_2 → H_2O **TRACE**, Zoom Chemistry will first calculate the balanced chemical reaction 2 H_2 + O_2 → 2 H_2O. Then Zoom Chemistry will multiply every coefficient in the balanced chemical reaction by 0.74 (because 3.12 g H_2 equals 1.55 mol H_2, and 1.55 divided by 2 is 0.74). The result of this step will be 1.548 mol H_2 + 0.774 mol O_2 → 1.548 mol H_2O. Last, Zoom Chemistry will multiply each substance by that substance's molar mass. The final answer will be 3.12 g H_2 + 24.8 g O_2 → 27.9 g H_2O.

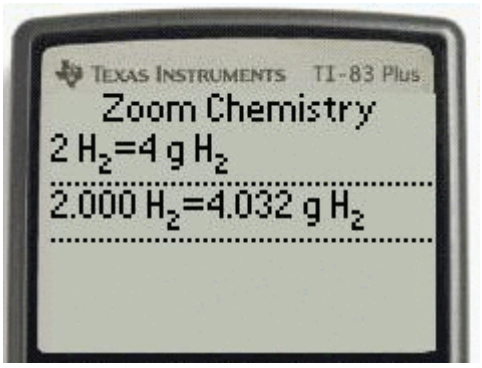
Significant Figures

Zoom Chemistry automatically gives the right number of significant figures for your answer.

If the problem you type contains a number of grams or a number of moles, Zoom Chemistry will count how many significant figures are in the number you typed. Every number in the answer that Zoom Chemistry gives will have just as many significant figures as the number you typed.

For example, if you type 3,120 g H_2 + O_2 → H_2O, Zoom Chemistry will notice that the number 3,120 has three significant figures. (The zero at the end doesn't count.) Zoom Chemistry will give the answer 3,120 g H_2 + 24,800 g O_2 → 27,900 g H_2O. Every number in this answer is rounded off to three significant figures.

Most of the time, Zoom Chemistry gets the right number of significant figures. But be careful. If you want to know how many grams are in two moles of H_2, and you type 2 H_2, Zoom Chemistry will round off your answer to one significant figure! If you want a more precise answer, type 2.000 H_2 instead.



Zoom Chemistry knows the molar mass of every element you can type, but Zoom Chemistry does not keep track of how many significant figures it knows for each element. In rare situations, this can cause Zoom Chemistry to give an answer that has too many significant figures. For example, Zoom Chemistry knows only four significant figures of the molar mass of Li, but if you type 1.0000 Li, then Zoom Chemistry will give you an answer that has five significant figures.