Balancing equations answers pdf

Attention: This post was written a few years ago and does not necessarily reflect the latest changes to the AP® program. We are gradually updating these posts and will remove this disclaimer when this post is updated. Thanks for your patience! Of all the skills known in chemistry, balancing chemical equations is perhaps the most important master. So much of the part of chemistry depends on this important skill, including stochiometry, reaction analysis, and lab work. This comprehensive guide will show you steps to balance even the most complex reactions and guide you through a number of examples, easy to complex. The ultimate goal of balancing chemical reactions is to make both sides, re-agents and products equal to the number of atoms per element. This is the result of a general law on the protection of mass mass, which states that nothing can be created or destroyed. So, if we start with ten atoms of oxygen before the reaction, we must end up with ten atoms of oxygen after the reaction. This means that chemical reactions do not alter the actual building blocks of the substance; rather, they just change the layout of the blocks. An easy way to understand this is to picture a house made of blocks. We can't break the house apart and build a plane, but the color and shape of the actual blocks won't change. But how do we manage to balance these equations? We know that the number of atoms in each element must be the same on either side of the equation, so it's just a matter of finding the right odds (numbers in front of each molecule) to make that happen. It is best to start with an atom that shows up least on one side and balance it for the first time. Then move to the atom that shows up the least of the times and so on. At the end, make sure to count the number of atoms on each side of each element again, just be sure. We illustrate this example:$P_4O_{10} + H_2O \rightarrow H_3PO_4$First, let's look at the element that is displayed most frequently. Note that oxygen occurs twice on the left side, so there is no good element to start with. We could start with phosphorus or hydrogen, so let's start with phosphorus. There are four phosphorus atoms on the left side, but only one on the right side. So, we can put a coefficient of 4 molecules that are phosphorus on the right side to balance them. $P_4O_{10} + H_2O \rightarrow 4\ H_3PO_4$Now we can control hydrogen. We still want to avoid balancing oxygen because it occurs in more than one molecule on the left side. The easiest way is to start with molecules that appear only once on each side. So, there are two molecules of hydrogen on the left side and twelve on the right side (notice that there are three molecules of H_3PO_4, and we have four molecules). To balance them, we have to put 6 h_2O ahead of the left. $P_4O_{10} + 6\ H_2O \rightarrow 4\ H_3PO_4$ At this point we can check the oxygen to see if Balance. On the left, we have ten atoms of oxygen from P_4O_{10} and six of H_2O for a total of 16. On the right, we also have 16 (four molecules, four molecules). So the oxygen's already in balance. This gives us the final balanced equation$P_4O_{10} + 6\ H_2O \rightarrow 4\ H_3PO_4$Balancing Chemical Equations Practice Problems Try to balance these ten equations yourself, then check the answers below. They range from difficulty, so don't get discouraged if some of them seem too heavy. Remember to start with an element that shows up at least, and continue from there. The best way to solve these problems is slowly and systematically. Looking at everything at once can easily get overwhelming. Success! $CO_2 + H_2O \rightarrow C_6H_{12}O_6 + O_2$ $SiCl_4 + H_2O \rightarrow H_4SiO_4 + HCl$ $Al + HCl \rightarrow AlCl_3 + H_2$ $Na_2CO_3 + HCl \rightarrow NaCl + H_2O + CO_2$ $C_7H_6O_2 + O_2 \rightarrow CO_2 + H_2O$ $Fe_2(SO_4)_3 + KOH \rightarrow K_2\ 2SO_4 + Fe(OH)_3$ $Ca(PO_4)_2 + SiO_2 \rightarrow P_4O_{10} + CaSiO_3$ $KClO_3 \rightarrow KClO_4 + KCl$ $Al_2(SO_4)_3 + Ca(OH)_2 \rightarrow Al(OH)_3 + CaSO_4$ $H_2SO_4 + HI \rightarrow H_2S + I_2 + H_2O$Complete Solutions:1. $CO_2 + H_2O \rightarrow C_6H_{12}O_6 + O_2$The first step is to focus on the elements , which appear only once on either side of the equation. Both carbon and hydrogen meet this requirement here. So let's start with carbon. There's only one carbon atom on the left, but six on the right side. So, we add a coefficient of six carbon-containing molecules to the left.$6CO_2 + H_2O \rightarrow C_6H_{12}O_6 + O_2$Next, let's look at hydrogen. There are two hydrogen atoms on the left and twelve on the right. So, we add a coefficient of six hydrogen molecules on the left.$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + O_2$Now it's time to check oxygen. There are a total of 18 oxygen molecules on the left ($6\times2 + 6\times1$). There are eight oxygen molecules on the right. Now we have two ways to make up for the better side: We can either multiply $C_6H_{12}O_6$ or O_2 odds. However, if we change the $C_6H_{12}O_6$, the odds on the left will also change because we will change the number of carbon and hydrogen atoms. To avoid this, it usually helps to change only the molecule that contains the least elements; in this case O_2. So we can add a odds of six o_2 on the right. Our last response is:$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$2. $SiCl_4 + H_2O \rightarrow H_4SiO_4 + HCl$The only element that occurs more than once on the same side of the equation here is hydrogen, so we can start with any other element. Let's start watching silicon. Note that there is only one silicon atom on both sides, so we do not have to add any coefficients yet. Next thing we know, let's see chlorine. There are four chlorine atoms on the left and only one on the right. So, we're adding the odds to the right. $SiCl_4 + H_2O \rightarrow H_4SiO_4 + 4HCl$Next, let's look at oxygen. Remember that we first want to analyse all the elements that occur only once on one side of the equation. There's only one oxygen atom on the left, but four on the right. Therefore, we add four on the left side of the equation. $SiCl_4 + 4H_2O \rightarrow H_4SiO_4 + 4HCl$We is almost ready! We just need to check the number of hydrogen atoms on either side. There's eight on the left and eight on the right, so we're done. Our last response is$SiCl_4 + 4H_2O \rightarrow H_4SiO_4 + 4HCl$As always, make sure to check that the number of atoms on each element balances on both sides before proceeding.3. $Al + HCl \rightarrow AlCl_3 + H_2$This problem is a little complicated, so be careful. If one atom is one on either side of the equation, it is easiest to start with this element. So, we'll start by counting aluminum atoms from both sides. There's one on the left and one on the right, so we don't have to add any odds yet. Next, let's see hydrogen. There's also one on the left, but two on the right. So, we'll add the odds of two to the left. $Al + 2HCl \rightarrow AlCl_3 + H_2$Next, let's look at chlorine. Now there are two on the left, but three on the right. It's not as simple as just adding a odds to one side. We need chlorine atoms to equal the number on both sides, so we have to get two and three equal. We can achieve this by finding the lowest common order. In that case, we can multiply two by three and three by two to get the lowest six-fold. So, we multiplied $2HCl$ three and $AlCl_3$ two: $Al + 6HCl \rightarrow 2AlCl_3 + H_2$Me we have studied all the elements, so it's easy to say that we've done. However, always make sure to check. In this case, because we added a coefficient of aluminum containing molecule on the right side, aluminum is no longer balanced. One's on the left, but two on the right. So, we add another odds.$2Al + 6HCl \rightarrow 2AlCl_3 + H_2$Me not quite ready yet. Looking at the equation for the last time, we can see that hydrogen is also unbalanced. There's six on the left, but two on the right. So, with one final adjustment, we get our final answer: $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$4. $Na_2CO_3 + HCl \rightarrow NaCl + H_2O + CO_2$50000, balancing equations are becoming easier and you can hang on to it. Looking at sodium, we can see that it occurs twice on the left, but once on the right. So we can add your first odds to NaCl on the right. $Na_2CO_3 + HCl \rightarrow 2NaCl + H_2O + CO_2$Next, let's look at carbon. There is one on the left and one on the right, so there are no odds to add. Since oxygen occurs in more than one place on the left, we save it last. Instead, look at the hydrogen. There are one on the left and two on the right, so we add the right coefficient. $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$Then, looking at chlorine, we can see that it is already balanced between the two on each side. Now we can go back to see the oxygen. There are three on the left and three on the right, so our last answer is$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$5. $C_7H_6O_2 + O_2 \rightarrow CO_2 + H_2O$Me can start balancing this equation by looking at either carbon or hydrogen. Looking we can see that there are seven atoms on the left and only one on the right. So we can add the odds of seven to the right. $C_7H_6O_2 + O_2 \rightarrow 7CO_2 + H_2O$Then, hydrogen, has six atoms on the left and two on the right. So, we're adding the odds to the right. $C_7H_6O_2 + O_2 \rightarrow 7CO_2 + 3H_2O$Now, oxygen, things get a little complicated. Oxygen occurs in every molecule in the equation, so we have to be very careful when balancing it. There are four oxygen atoms on the left and 17 atoms on the right. There is no clear way to balance these numbers, so we have to use a little trick: dialects. Now that we write our final answer, we can't add dialects because it's not the right form, but sometimes it helps them to solve the problem. Also try to avoid excessive manipulation of organic molecules. You can easily identify organic molecules, otherwise known as CHO molecules, because they consist only of carbon, hydrogen and oxygen. We don't like working with these molecules because they're quite complicated. Also, larger molecules tend to be more stable than smaller molecules, and less likely to react in large quantities. So, to balance four and seventeen, we can multiply O_2 on the left by 7.5. This gives us $C_7H_6O_2 + 7.5O_2 \rightarrow 7CO_2 + 3H_2O$ Keep in mind, fractions (and decimal places) are not allowed in official balanced equations, so multiply all two to get an integer values. Our last response is now$2C_7H_6O_2 + 15O_2 \rightarrow 14CO_2 + 6H_2O$6. $Fe_2(SO_4)_3 + KOH \rightarrow K_2SO_4 + Fe(OH)_3$-We can start by balancing the iron on both sides. There are two on the left, while there is only one on the right. So, we're adding the odds two to the right. $Fe_2(SO_4)_3 + KOH \rightarrow K_2SO_4 + 2Fe(OH)_3$-Then we can look at sulfur. There's three on the left, but only one on the right. So, we're going to add the odds of three on the right side. $Fe_2(SO_4)_3 + KOH \rightarrow 3K_2SO_4 + 2Fe(OH)_3$-We are almost ready. All that's left is to balance potassium. There's one atom on the left and six atoms on the right so we can balance them by adding six odds. Our last answer, you will be$Fe_2(SO_4)_3 + 6KOH \rightarrow 3K_2SO_4 + 2Fe(OH)_3$-7. $Ca_3(PO_4)_2 + SiO_2 \rightarrow P_4O_{10} + CaSiO_3$ Looking at calcium, we can see that there are three on the left and one on the right, so we can add a coefficient of three on the right to balance them. $Ca_3(PO_4)_2 + SiO_2 \rightarrow P_4O_{10} + 3CaSiO_3$ Then, phosphorus, we see that there are two on the left and four on the right. To balance them, add coefficient two on the left.$2Ca_3(PO_4)_2 + SiO_2 \rightarrow P_4O_{10} + 3CaSiO_3$ Notice that in doing so we changed the number of calcium atoms on the left. Each time you add a coefficient, check whether the step affects the elements that you have already balanced. In this case, the number of calcium atoms on the left has increased to six, while it is still three on the right, so we can change the coefficient on the right to reflect this change.$2Ca_3(PO_4)_2 + SiO_2 \rightarrow P_4O_{10} + 6CaSiO_3$ Since oxygen occurs in every molecule in the equation, we currently skip it. Focusing on we see that there is one on the left but six on the right, so we can add a coefficient left.$2Ca_3(PO_4)_2 + 6SiO_2 \rightarrow P_4O_{10} + 6CaSiO_3$ Now, we check the number of oxygen atoms on both sides. There are 28 atoms on the left and 28 on the right. So, after checking that all other atoms are the same on both sides, we get a definitive answer$2Ca_3(PO_4)_2 + 6SiO_2 \rightarrow P_4O_{10} + 6CaSiO_3$ 8. $KClO_3 \rightarrow KClO_4 + KCl$See problem is especially complex because every atom except oxygen occurs in every molecule in the equation. Since the oxygen seems the least of the times, we'll start there. There are three on the left and four on the right. To balance them, we find the lowest common multiple; in that case, by 12 December 2013, the date of the By adding a coefficient of four on the left and three on the right, we can balance oxygens.$4KClO_3 \rightarrow 3KClO_4 + KCl$Now, we can control potassium and chlorine. There are four potassium molecules on the left and four potassium molecules on the right, so they are balanced. Chlorine is also balanced, four on each side, so we're finished, the final answer$4KClO_3 \rightarrow 3KClO_4 + KCl$9. $Al_2(SO_4)_3 + Ca(OH)_2 \rightarrow Al(OH)_3 + CaSO_4$ We can start here by balancing aluminum atoms on both sides. There are two molecules on the left, while there is only one on the right, so we add two times to the right. $Al_2(SO_4)_3 + Ca(OH)_2 \rightarrow 2Al(OH)_3 + CaSO_4$ Now we can control sulphur. There are three on the left and there is only one on the right, so adding the three coefficient balances them. $Al_2(SO_4)_3 + Ca(OH)_2 \rightarrow 2Al(OH)_3 + 3CaSO_4$ Moves right along calcium, there is only one on the left, but three on the right, so we should add a coefficient of three. $Al_2(SO_4)_3 + 3Ca(OH)_2 \rightarrow 2Al(OH)_3 + 3CaSO_4$ Double scan all atoms, we can see that all the elements are balanced, so our final equation is$Al_2(SO_4)_3 + 3Ca(OH)_2 \rightarrow 2Al(OH)_3 + 3CaSO_4$ 10. $H_2SO_4 + HI \rightarrow H_2S + I_2 + H_2O$Because hydrogen occurs more than once on the left, we temporarily skip and move to sulfur. There's one atom on the left and one on the right, so there's nothing to balance. Looking at the oxygen, there are four on the left and one on the right, so we can add coefficient four to balance them. $H_2SO_4 + HI \rightarrow H_2S + I_2 + 4H_2O$The left has only one iodine and two on the right, so a simple coefficient change can balance them. $H_2SO_4 + 2HI \rightarrow H_2S + I_2 + 4H_2O$Now, we can look at the most complex element: hydrogen. There are four on the left and 10 on the right. So, we know that we need to change the coefficient to either H_2SO_4 or HI. We want to change something that requires the least tweaking later, so we change the coefficient to HI. To get to the left side of ten atoms of hydrogen, we need HI to have eight atoms of hydrogen, because H_2SO_4 already has two. So, we change the coefficient to 8.$H_2SO_4 + 8HI \rightarrow H_2S + I_2 + 4H_2O$But it also changes the balance of iodine. Now there are eight on the left, but only two on the right. To solve this problem, we add odds of 4 After checking that everything else balances as well, we get the final answer to $H_2SO_4 + 8HI \rightarrow H_2S + 4I_2 + 4H_2O$As most skills, the practice makes perfect when learning how to balance chemical equations. Keep working hard and try to do as many problems as possible to help you hone your balancing skills. Do you have any tips or tricks to help you balance chemical equations? Let us know in the comments! Let's put it all to life. Try this general chemistry practice question: Looking for more general chemistry practice? You will find thousands of practice Albert.io. Albert.io, you can customize your learning experience to guide the internship where you need the most help. We will challenge you to practice questions that will help you achieve mastery in general chemistry. Are you a teacher or administrator interested in increasing General Chemistry student results? More information about our school licenses can be found here. Here.