Balancing chemical equations questions and answers pdf

In order to continue enjoying our site, please confirm your identity as a man. Thank you so much for your cooperation. Attention: This post was written several years ago and may not reflect the latest changes in the AP® program. We are gradually updating these posts and will remove this disclaimer when this post is updated. Thank you for your patience! Of all the skills to know about chemistry, balancing chemical equations is perhaps the most important thing to master. So many pieces of chemistry depend on this vital skill, including stoicimimetrics, reaction analysis and laboratory work. This comprehensive guide will show you the steps to balance even the most challenging reactions and will get you through a range of examples, from simple to complex. The ultimate goal for balancing chemical reactions is to make both sides of the reaction, reactions and products, equal in the number of atoms per element. This stems from the universal law of mass preservation, which states that matter cannot be created or destroyed. So if we start with ten oxygen atoms before the reaction, we have to end up with ten oxygen atoms after the reaction. This means that chemical reactions do not alter the actual building blocks of matter; instead, they just change the arrangement of blocks. An easy way to understand this is to imagine a house made of blocks. We can dismantle the house and build a plane, but the color and shape of the actual blocks don't change. But how do we balance these equations? We know that the number of atoms of each element must be the same on both sides of the equation, so it's just a matter of finding the correct coefficients (numbers in front of each molecule) to make it happen. It is best to start with an atom that appears on one side at least once, and first to balance. Then proceed to an atom that shows the second smallest number of times and so on. Finally, make sure you re-count the atoms of each element on each side, just to be sure. Let's illustrate this by example: P4O10 + H2O → H3PO4First, let's look at the element that appears at least often. Notice that oxygen occurs twice on the left side, so this is not a good element to start with. We can start with phosphorus or hydrogen, so let's start with phosphorus. On the left there are four phosphorus atoms, but only one on the right. So we can put odds of 4 on a molecule that has phosphorus on the right to balance them out. P4O10 + H2O → 4 H3PO4 Now we can check the hydrogen. We still want to avoid balancing oxygen, as it occurs in multiple molecules on the left. It is easiest to start with molecules that appear only once on each side. So there are two hydrogen molecules on the left and twelve on the right (notice that there are three per H3PO4 molecule, and we have four molecules). So, balance We need to put a six in front of H2O on the left. P4O10 + 6 H2O → 4 H3PO4At this point, we can check the oxygen to see if they balance. On the left we have ten oxygen atoms from P4O10 and six from H2O for a total of 16. On the right we also have 16 (four per molecule, with four molecules). So the oxygen is already balanced. This gives us the final balanced equationP4O10 + 6 H2O → 4 H3PO4Balancing Chemical Equations Practice ProblemsTry to balance these ten equations yourself, and then check the answers below. They move in a level of difficulty, so do not get discouraged if some of them seem too heavy. Just do not forget to start with the element that appears the least and proceed to give away. The best way to approach these problems is slowly and systematically. Watching everything at once can easily get overwhelming. good luck! CO2 + H2O → C6H12O6 + O2SiCl4 + H2O → H4SiO4 + HClAl + HCl → AlCl3 + H2Na2CO3 + HCl → → NaCl + H2O + CO2C7H6O2 + O2 → CO2 + H2OFe2(SO4)3 + KOH → K2SO4 + Fe(OH)3 Ca(PO4)2 + SiO → P4O10 + CaSiO3 KClO3 → KClO4 + KClAl2(SO4)3 + Ca(OH)2 → Al(OH)3 + CaSO4 H2SO4 + HI → H2S + I2 + H2OComplete Solutions:1. CO2 + H2O → C6H12O6 + O2 The first step is to focus on elements that appear only once on each side of the equation. Here both carbon and hydrogen meet this requirement. So we're going to start with carbon. There's only one carbon atom on the left, but six on the right. So, we add coefficient six to the molecule containing carbon on the left.6CO2 + H2O → C6H12O6 + O2Next, let's look at hydrogen. There are two hydrogen atoms on the left and twelve on the right. So, we will add coefficient six to the molecule containing hydrogen on the left.6CO2 + 6H2O → C6H12O6 + O2Now, it's time to check for oxygen. There are a total of 18 oxygen molecules on the left (6×2 + 6×1). There are eight oxygen molecules on the right. Now we have two options for loading the right: We can either multiply C6H12O6 or O2 by coefficient. However, if we change C6H12O6, the odds for everything else on the left will also have to be changed, as we will change the number of carbon and hydrogen atoms. To prevent this, it usually helps only to change the molecule containing the smallest elements; in this case, O2. So we can add odds of six to O2 on the right. Our final answer will be:6CO2 + 6H2O → C6H12O6 + 6O22. SiCl4 + H2O → H4SiO4 + HClOne element that occurs multiple times on the same side of the equation here is hydrogen, so we can start with any other element. Let's start by looking at silicon. Notice that there is only one silicone atom on both sides, so we do not need to add any odds yet. Then let's look at the chlorine. On the left there are four chlorine atoms, and on the right there is only one. So we'll add odds of four on the right. SiCl4 + H2O → H4SiO4 + 4HClNext, let's look at the oxygen. Remember that first we want to analyse all the elements that are only one on one side of the equation. There's only one oxygen atom on the left, but four on the right. So we'll add odds of four on the left side of the equation. SiCl4 + 4H2O → H4SiO4 + 4HClWe are almost finished! We just need to check the number of hydrogen atoms on each side. The left has eight and the right has eight, so we're done. Our final answer isSiCl4 + 4H2O → H4SiO4 + 4HClAs always, make sure that the number of atoms of each element is balanced on each side before proceeding.3. Al + HCl → AlCl3 + H2Os problem is a bit tricky, so be careful. Whenever one atom is alone on both sides of the equation, it's easiest to start with that element. So we're going to start by counting aluminum atoms on both sides. There's one on the left and one on the right, so we don't need to add any odds yet. Then let's look at the hydrogen. There's also one on the left, but two on the right. So we'll add odds of two on the left. Al + 2HCl → AlCl3 + H2Next, we will look at chlorine. Now there are two on the left, but three on the right. Now, it's not as simple as just adding odds to one side. We need the number of chlorine atoms to be the same on both sides, so we have to get two and three to be equal. We can do this by finding the lowest common multiple. In this case, we can multiply two by three and three by two to get the lowest common multiple of six. So, we will multiply the 2HCl by three and AlCl3 by two:Al + 6HCl → 2AlCl3 + H2SI we looked at all the elements, so it is easy to say that we are finished. However, always check. In this case, since we have added a coefficient to the molecule containing aluminum on the right, aluminum is no longer balanced. One's on the left, but two on the right. So, we will add another coefficient.2Al + 6HCl → 2AlCl3 + H2Na we are not quite finished yet. Looking at the equation one last time, we see that hydrogen is also unbalanced. Six are on the left, but two on the right. So, with one final adjustment, we get a definitive answer:2Al + 6HCl → 2AlCl3 + 3H24. Na2CO3 + HCl → NaCl + H2O + CO2Hopefully to this point, balancing the equation becomes easier and you're getting hanged from it. Looking at sodium, we see it occur twice on the left, but once on the right. So we can add our first odds to NaCl on the right. Na2CO3 + HCl → 2NaCl + H2O + CO2Next, let's look at carbon. There's 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 will save it for last. Instead, look at the hydrogen. One's on the left and two's on the right, so we'll add the odds to the left. Na2CO3 + 2HCl → 2NaCl + H2O + CO2Then, looking at chlorine, we see that it is already balanced with two on each side. Now we can go back and look at the oxygen. There are three on the left and three on the right, so our final answer isNa2CO3 + 2HCl → + H2O + CO25. C7H6O2 + O2 → CO2 + H2OMo start balancing this equation by looking at carbon or hydrogen. Looking at the carbon, we see that there are seven atoms on the left and only one on the right. So we can add odds of seven on the right. C7H6O2 + O2 → 7CO2 + H2OThen, for hydrogen, there are six atoms on the left and two on the right. So we'll add odds of three on the right. C7H6O2 + O2→ 7CO2 + 3H2ONow, for oxygen, things will get a little tricky. Oxygen occurs in every molecule in the equation, so we have to be very careful when balancing. On the left are four oxygen atoms, and on the right are 17. There is no obvious way to balance these numbers, so we have to use a little trick: fractions. Now, when writing our final answer, we can't include fractions because it's not the right form, but sometimes it helps to use them to solve problems. Also, try to avoid over-manipulating organic molecules. You can easily identify organic molecules, otherwise known as CHO molecules, because they are made only of carbon, hydrogen and oxygen. We don't like working with these molecules, because they're pretty complex. Also, larger molecules tend to be more stable than smaller molecules, and are less likely to react in large quantities. So, to balance four and seventeen, we can multiply the O2 on the left by 7.5. This will give us USC7H6O2 + 7.5O2 → 7CO2 + 3H2ORemember, fractions (and decimals) are not allowed in formally balanced equations, so multiply everything by two to get integer values. Our final answer is now2C7H6O2 + 15O2 → 14CO2 + 6H2O6. Fe2(SO4)3 + KOH → K2SO4 + Fe(OH)3-We can start by balancing iron on both sides. The left has two, while the right has only one. So, on the right, we'll add odds of two. Fe2(SO4)3 + KOH → K2SO4 + 2Fe(OH)3-Then we can look at sulfur. Three are on the left, but only one on the right. So we'll add odds of three to the right. Fe2(SO4)3 + KOH → 3K2SO4 + 2Fe(OH)3-We are almost done. All that's left is to balance the potassium. There is one atom on the left and six on the right, so we can balance them by adding odds of six. Our final answer, then, isFe2(SO4)3 + 6KOH → 3K2SO4 + 2Fe(OH)3-7. Ca3(PO4)2 + SiO2 → P4O10 + CaSiO3 Looking at calcium, we see that three are on the left and one on the right, so we can add a coefficient of three on the right to balance them out. Ca3(PO4)2 + SiO2 → P4O10 + 3CaSiO3 Then, for phosphorus, we see that there are two on the left and four on the right. To balance them, add odds of two on the left.2Ca3(PO4)2 + SiO2 → P4O10 + 3CaSiO3 Let us know that this has changed the number of calcium atoms on the left. Each time you add a coefficient, double-check that the step affects any element you've already balanced. In this case, the number of calcium atoms on the left side has increased to six while three more are on the right, so we can change the on the right to reflect this. reflected. + SiO2 → P4O10 + 6CaSiO3 Since oxygen occurs in each molecule in the equation, for now we will skip it. Focusing on silicone, we see that one is on the left, but six on the right, so we can add the coefficient to the left.2Ca3(PO4)2 + 6SiO2 → P4O10 + 6CaSiO3 Now we will check the number of oxygen atoms on each side. The left has 28 atoms and the right has 28. So, after checking if all other atoms are the same on both sides, we get a definitive answer2Ca3(PO4)2 + 6SiO2 → P4O10 + 6CaSiO3 8. KClO3 → KClO4 + KClIt is especially tricky because every atom, except oxygen, occurs in every molecule in the equation. So, since oxygen appears at least once, 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 this case, on October 12, 2014, By adding coefficient four on the left and three on the right we can balance oxygen.4KClO3 → 3KClO4 + KClNow, we can check potassium and chlorine. There are four potassium molecules on the left and four on the right, so they are balanced. Chlorine is also balanced, with four on each side, so we're done, with a final response of 4KClO3 → 3KClO4 + KCl9. Al2(SO4)3 + Ca(OH)2 → Al(OH)3 + CaSO4 Here we can start by balancing aluminum atoms on both sides. The left one has two molecules while the right one has only one, so we'll add odds of two on the right. Al2(SO4)3 + Ca(OH)2 → 2Al(OH)3 + CaSO4 Now we can check the sulfur. There are three on the left and only one on the right, so adding odds three will balance that. Al2(SO4)3 + Ca(OH)2 → 2Al(OH)3 + 3CaSO4 Moving straight with calcium, there is only one on the left, but three on the right, so the coefficient of three should be added. Al2(SO4)3 + 3Ca(OH)2 → 2Al(OH)3 + 3CaSO4 Double check of all atoms, we see that all elements are balanced, so our final equationAl2(SO4)3 + 3Ca(OH)2 → 2Al(OH)3 + 3CaSO4 10. H2SO4 + HI → H2S + I2 + H2OSince hydrogen occurs repeatedly on the left side, we will temporarily skip it and move on to sulfur. There's one atom on the left and one on the right, so there's nothing to balance yet. Looking at the oxygen, there are four on the left and one on the right, so we can add odds of four to balance them. H2SO4 + HI → H2S + I2 + 4H2OThere is only one iodine on the left and two on the right, so a simple change in coefficient can balance those. H2SO4 + 2HI → H2S + I2 + 4H2ONow, we can look at the most challenging element: hydrogen. There are four on the left and ten on the right. So we know we need to change the coefficient of either H2SO4 or HI. We want to change something that will require the least amount of tweaks after that, so we will change the HI coefficient. For the left side to have ten hydrogen atoms, we need HI to have eight hydrogen atoms, since H2SO4 already has two. So we will change the coefficient from 2 to 8.H2SO4 + 8HI → H2S + I2 + 4H2OHowever, it also changes for iodine. Now there are eight on the left, but only two on the right. To fix this, we will add odds of 4 on the right. After checking that everything else balances, we also get the ultimate answerH2SO4 + 8HI → H2S + 4I2 + 4H2OAs with most skills, the practice makes perfect when learning how to balance chemical equations. Keep working hard and try to make 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 into practice. Try this general chemistry question:Looking for more general chemistry? You can find thousands of questions about the practice Albert.io. 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