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To balance a chemical equation in chemistry, you must follow the law of conservation of mass, which stipulates that the total molar mass of the reactants must be equal to the total molar mass of the products. This is done by writing numerical coefficients to indicate how many moles of each substance are present during a chemical reaction.It’s important to note that you can only use whole numbers when balancing equations in chemistry. A balanced chemical equation that has whole numbers as coefficients serves as the standard for calculating the proportion of the same substances with variable amounts. This is very useful in laboratory analytical experiments and in chemical manufacturing. Read on to learn more about chemical equations and how to balance an equation in chemistry.What are chemical equations?Chemical equations are symbolic representations of ideal chemical reactions. They typically include the symbols of the elements in chemical formulas, which are usually written with numerical coefficients preceding them to ensure the chemical equation is balanced.Chemical equations also contain plus signs where applicable, such as when there are two or more reactants or two or more products. The reactants are on the left-hand side of the equation while the products are on the right.An arrow symbol (rather than an equals symbol) is normally used to separate the reactants from the products. Although the arrow usually points to the direction of the products, a chemical equation sometimes contains two arrows that point in either direction. This indicates dynamic equilibrium, which means the reaction goes both ways.Other notations may also be written above the arrow to indicate the presence of a catalyst, while small letters in parentheses after the subscripts signal the state or phase of matter e.g solid, liquid or gas.Here is a simple example of a chemical equation representing the reaction between hydrogen and oxygen, which forms water.2H2 + O2 → 2H2OThe balanced chemical equation indicates that two moles of diatomic hydrogen must react with one mole of diatomic oxygen to produce two moles of water.Balancing equations in chemistryBalancing equations in chemistry is akin to accounting or bookkeeping in finance; the credit side must equal the debit side. This is crucial for establishing the standard ideal proportional relationship between the reactants and products based on the law of conservation of mass.The basic assumptions in balancing chemical equations are the following:The law of conservation of mass – this states that “mass can neither be created nor destroyed” in chemical reactions, so the total mass of the reactants is equal to the total mass of the productsThe substances involved are 100% pure – in actual experiments, it would be very difficult or even virtually impossible to obtain 100% pure reactants; there will always be some contaminants or impurities. In chemical equations, however, you can theoretically assume that the reactants are absolutely pureThe reaction occurs under standard conditions – the standard conditions refer to the temperature, pressure, and concentration of the reactants. These are 25°C, 1 atm and 1M, respectively.Examples of chemical equationsNot all chemical equations are written as balanced chemical reactions when it comes to elements or molecules. Some are half equations, such as those representing electrochemical reactions in batteries. Here are some examples:Zn = Zn2+ + 2e– (oxidation reaction)2H+ + 2e– = H2 (reduction reaction)HCl + NaOH → NaCl + H2O (acid-base neutralisation) 6CO2 + 6H2O + light → C6H12O6 + 6O2 (photosynthesis)C12H22O11 (s) + H2SO4 (aq) + 1/2 O2 (g) → 11C (s) + CO2 (g) + 12H2O (g) + SO (dehydration of sucrose)2Na + Cl2 → 2NaClCH4 + 2O2 → 2H2O + CO2 (complete combustion of methane)Steps to balance a chemical equation In most cases, balancing chemical equations is a case of trial and error. It may involve some degree of intuition, although you can also be methodical in your approach. Put simply, it’s about ensuring that the corresponding coefficients would result in equal numbers of atoms on both sides of the equation. Here are some steps that you can follow to balance a chemical equations:Step 1: Write the reactants and the products.Step 2: Count the number of atoms on both sides of the equation. If they are already equal then there’s no need to balance the equation. However, if they aren’t, you’ll need to proceed to the next step.Step 3: You may want to tabulate the number of atoms for easy comparison. It’s important that you don’t alter the subscripts as this will automatically change the chemical identities of the substances involved.Step 4: Change the numerical coefficients relating to the atoms or groups of atoms. There may be some cases when atoms are grouped together. Instead of treating them individually, you can treat them as groups.Step 5: Repeat step 2. If the equation is still not balanced, you’ll need to try other coefficients.The steps outlined above follow the traditional “trial and error” method. However, another way to balance a chemical equation is by using the algebraic method. Although similar to the trial and error method, it involves some basic algebra of assigning symbols to the unknown coefficients. For example, if you want to balance the chemical equation C6H12O6 + O2 → CO2 + H2O, follow these steps: SummaryBalancing chemical equations is important for two main reasons – it allows us to make comparisons in analytical experiments and it helps with efficiency in manufacturing. The main methods of balancing chemical equations are the traditional “trial and error” technique and the algebraic method. A chemical equation tells you what happens during a chemical reaction. A balanced chemical equation has the correct number of reactants and products to satisfy the Law of Conservation of Mass. In this article, we’ll talk about what a chemical equation is, how to balance chemical equations, and give you some examples to aid in your balancing chemical equations practice. What Is a Chemical Equation? Simply put, a chemical equation tells you what’s happening in a chemical reaction. Here’s what a chemical equation looks like: Fe + O2 → Fe2O3 On the left side of the equation are the reactants. These are the materials that you start with in a chemical reaction. On the right side of the equation are the products. The products are the substances that are made as a result of a chemical reaction. In order for a chemical reaction to be correct, it needs to satisfy something called the Law of Conservation of Mass, which states that mass can’t be created or destroyed during a chemical reaction. That means that each side of the chemical equation needs to have the same amount of mass, because the amount of mass can’t be changed. If your chemical equation has different masses on the left and right side of the equation, you’ll need to balance your chemical equation. How to Balance Chemical Equations—Explanation and Example Balancing chemical equations means that you write the chemical equation correctly so that there is the same amount of mass on each side of the arrow. In this section, we’re going to explain how to balance a chemical equation by using a real life example, the chemical equation that occurs when iron rusts: Fe + O2 → Fe2O3 #1: Identify the Products and Reactants The first step in balancing a chemical equation is to identify your reactants and your products. Remember, your reactants are on the left side of your equation. The products are on the right side. For this equation, our reactants are Fe and O2. Our products are Fe2 and O3. #2: Write the Number of Atoms Next, you need to determine how many atoms of each element are present on each side of the equation. You can do this by looking at the subscripts or the coefficients. If there is no subscript or coefficient present, then you just have one atom of something. Fe + O2 → Fe2O3 On the reactant side, we have one atom of iron and two atoms of oxygen. On the product side, we have two atoms of iron and three atoms of oxygen. When you write out the number of products, you can see that the equation isn’t balanced, because there are different amounts of each atom on the reactant side and the product side. That means we need to add coefficients to make this equation balanced. #3: Add Coefficients Earlier, I mentioned that there are two ways to tell how many atoms of a particular element exist in a chemical equation: by looking at the subscripts and looking at the coefficients. When you balance a chemical equation, you change coefficients. You never change subscripts. A coefficient is a whole number multiplier. To balance a chemical equation, you add these whole number multipliers (coefficients) to make sure that there are the same number of atoms on each side of the arrow. Here’s something important to remember about coefficients: they apply to every part of a product. For instance, take the chemical equation for water: H2O. If you added a coefficient to make it 2H2O, then the coefficient multiples across all of the elements present. So, 2H2O means that you have four atoms of hydrogen and two atoms of oxygen. You don’t just multiply against the first element present. So, in our chemical equation (Fe + O2 → Fe2O3), any coefficient you add to the product has to be reflected with the reactants. Let’s look at how to balance this chemical equation. On the product side, we have two atoms of iron and three atoms of oxygen. Let’s tackle iron first. When first looking at this chemical equation you might think that something like this works: 2Fe + O2 → Fe2O3 While that balances out the iron atoms (leaving two on each side), oxygen is still unbalanced. That means we need to keep looking. Taking iron first, we know that we’ll be working with a multiple of two, since there are two atoms of iron present on the product side. Knowing that using two as a coefficient won’t work, let’s try the next multiple of two: four. 4Fe + O2 → 2Fe2O3 That creates balance for iron by having four atoms on each side of the equation. Oxygen isn’t quite balanced yet, but on the product side we have six atoms of oxygen. Six is a multiple of two, so we can work with that on the reactant side, where two atoms of oxygen are present. That means that we can write our balanced chemical equation this way: 4Fe + 3O2 → 3Fe2O3 3 Great Sources of Balancing Chemical Equations Practice There are many places you can do balancing chemical equations practice online. Here are a few places with practice problems you can use: Balancing Chemical Equations: Key Takeaways Balancing chemical equations seems complicated, but it’s really not that hard! Your main goal when balancing chemical equations is to make sure that there are the same amount of reactants and products on each side of the chemical equation arrow. What’s Next? Looking for more chemistry guides? We have articles that go over six physical and chemical change examples, the 11 solubility rules, and the solubility constant (Ksp), as well as info info on AP Chem, IB Chemistry, and Regents Chemistry. Writing a research paper for school but not sure what to write about? Our guide to research paper topics has over 100 topics in ten categories so you can be sure to find the perfect topic for you. Want to know the fastest and easiest ways to convert between Fahrenheit and Celsius? We've got you covered! Check out our guide to the best ways to convert Celsius to Fahrenheit (or vice versa). Are you studying clouds in your science class? Get help identifying the different types of clouds with our expert guide. 