Working With Chemical Equations Script

In this video we will review working with chemical equations. We will see how to write out states of matter, balance equations and use equations to quantify the outcomes of chemical reactions and solve chemical problems.

There are some definitions that we need to learn before moving on with our discussion of chemical reactions. A reaction equation is the notation used to illustrate a chemical reaction. This is the chemical equation for the reaction of hydrogen gas with oxygen gas to form water vapor. The reactants are materials consumed in a chemical reaction, and products are materials produced in a chemical reaction. For the formation of water, hydrogen and oxygen gas are the reactants and water is the product. When writing reaction equations, be sure to include states of matter for each of the products and reactants as a subscript after each molecule in the reaction; (s) denotes a solid, (l), a liquid, (g), a gas and (aq) indicates aqueous.

We know that elements combine in different ways to form substances, and that all samples of a pure substance contain the same proportion of elements by mass, but how does this translate to chemical reactions? We need to understand that mass is conserved in a chemical reaction. The law of conservation of mass states that in a chemical reaction atoms are rearranged through the making and breaking of chemical bonds, atoms are not altered or destroyed. This is an important concept because it means that in a chemical reaction mass is neither created nor destroyed, and the mass of the products must equal the mass of the reactants. We can use this knowledge to determine the amount of products we can expect, or the amount of reactants required in chemical reactions. Stoichiometry is the term used to describe calculations that relate reaction quantities.

The most important step in chemical reaction calculations is balancing the chemical reaction equation. Reaction equations must be balanced to account for all of the products and reactants in the chemical reaction. Here is the chemical equation for water as an unbalanced and balanced equation. In the unbalanced equation there is an unequal amount of oxygen atoms on the reactant side compared to the product side of the reaction equation. Placing a co-efficient of two in front of the hydrogen and water molecules balances the reaction equation. A co-efficient in a chemical reaction indicates the number of molecules. We can now say that two molecules of hydrogen react with one molecule of oxygen to form two molecules of water. There is no guaranteed method for balancing chemical equations, it takes practice to be proficient. A general guideline for balancing equations is to write out the skeletal equation first, and balance atoms that appear in more complex molecules before balancing atoms that appear as free elements. Check your answer by summing the number of atoms on each side of the reaction equation. In the reaction of iron with oxygen, balance the oxygen first before balancing iron. The number of iron atoms on each side of the equation is four, and the number of oxygen atoms on each side of the equation is six. Always balance reaction equations first in chemical reaction problems.

In an ideal chemical reaction, there would be exactly enough reactants to form products, practically, this is not always the case. What happens if there is more of one reactant than another? In a chemical reaction the reactant that limits the amount of products that can be formed is called the limiting reagent.

We know that products are formed in a chemical reaction, and mass is conserved. The yield of a reaction is the amount of products formed in a chemical reaction. Stoichiometric calculations can give us the theoretical yield, or maximum amount of products, that can be formed from a chemical reaction. However, in real world applications the amount of products formed is generally not the theoretical yield, side reactions and reaction conditions contribute to reducing the expected amount of products. The actual yield is the amount of products actually recovered following a chemical reaction. Chemists are often interested in the performance of a reaction as measured by the percent yield. Percent yield is the actual yield, divided by the theoretical yield, multiplied by one hundred. This section contains an additional video on calculating limiting reagents and yields.

Many of the chemical reactions we are interested in occur in solution. Chemical problems and laboratories use solutions and solution concentrations frequently. It is important to learn solution terminology. A solution is a homogenous mixture of two or more substances consisting of ions or molecules. A solute is the material present in a solution that has the smaller molar amount, a solvent is the material present in a solution that has the larger molar amount. Solubility refers to the maximum amount of solute that can dissolve in a solvent at a given temperature. A lot of the solution chemistry we are interested in takes place in aqueous solutions; an aqueous solution is a solution where the solvent is water. Generally when we say a material is insoluble we are referring to a substance that does not dissolve in water. Similarly, the term soluble generally means a substance that will dissolve in water.

Calculations for solutions and solution reactions are reliant on the concentration of a solution. The concentration of a solution is the amount of dissolved solute in a specific amount of solvent, and the most common concentration notation used is molarity. Molarity is the number of moles of solute per liter of solution. The unit for molarity is an uppercase M which is equivalent to moles per liter.

When performing dilutions we can use the formula $M_1V_1= M_2V_2$, the M in this equation is the molarity of a solution, and the V represents the volume of a solution. You have already had the opportunity to practice manipulating this formula in the chemical math portion of the numeracy module.

This concludes the stoichiometry tutorial video. Now that you have an understanding of chemical reactions and solutions you should be able to apply your skills to chemical reaction calculations. This section contains many detailed examples with solutions. You are encouraged to read through the process of solving a problem, and work through the problem yourself to gain a clear understanding of chemical reaction calculations. After completing this video you should be able to define: Reactant, product, limiting reagent, theoretical yield, actual yield, percent yield, solute, solvent, solubility, aqueous solutions, and molarity. You should be able to discuss the law of conservation of mass, and be able to balance chemical equations. You should have an

understanding of limiting reagents, yields of a chemical reaction and solution concentrations.