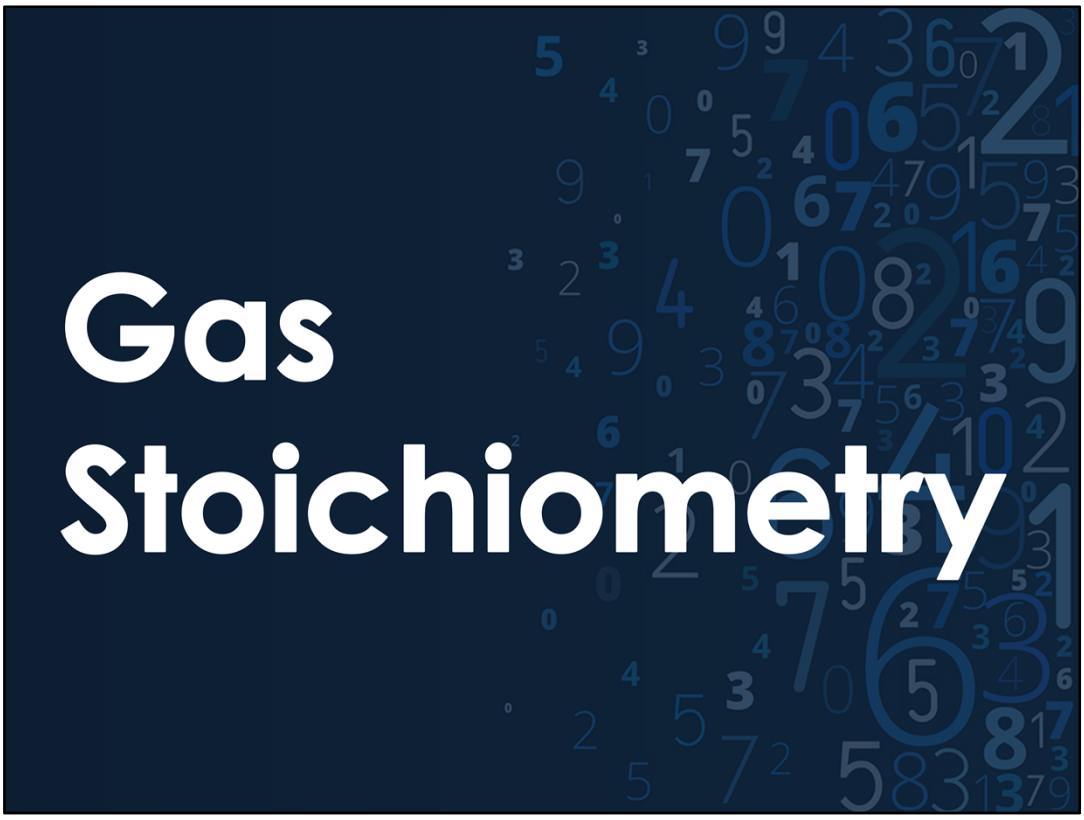
Module 9: States of Matter and Gas Laws
Topic 7 Content: Gas Stoichiometry Presentation Notes



Gas Stoichiometry

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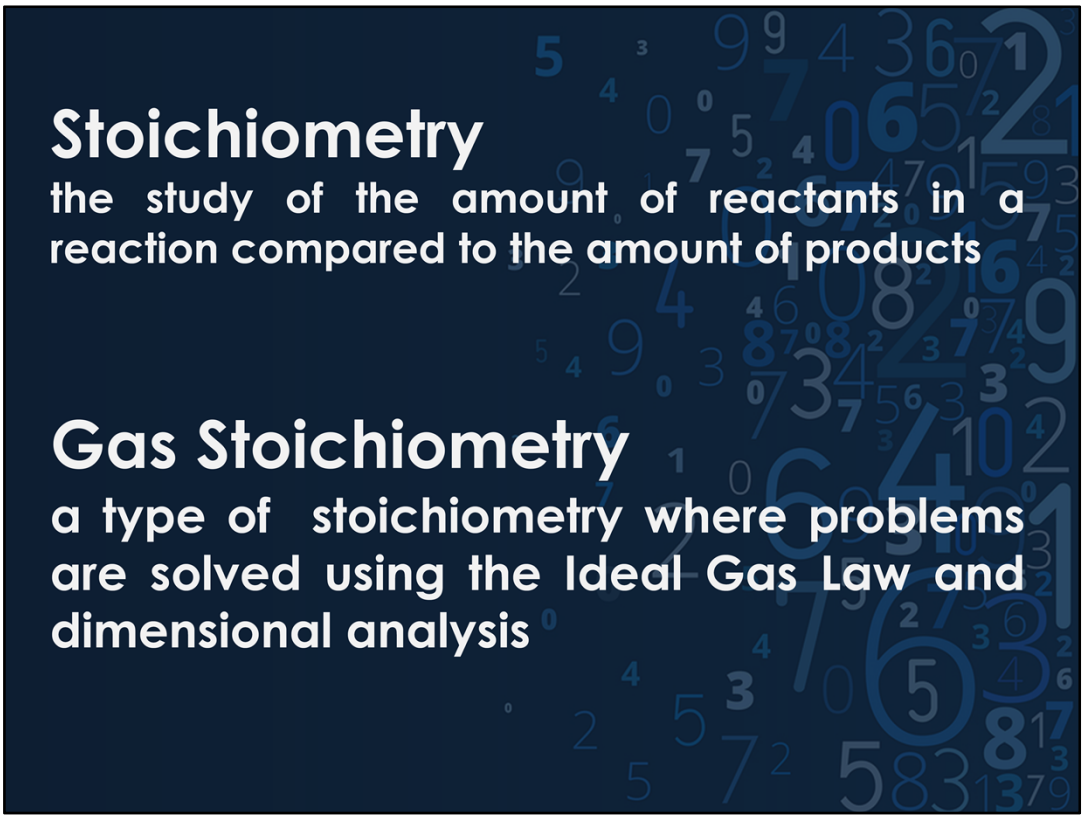
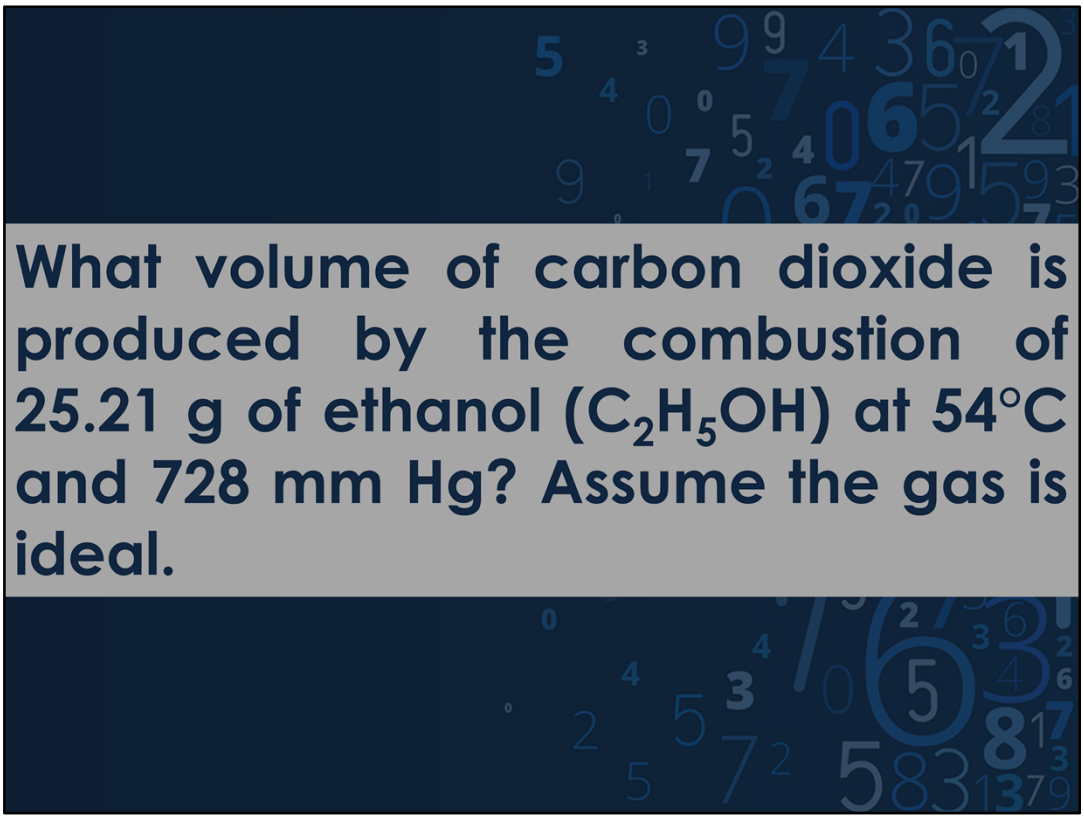
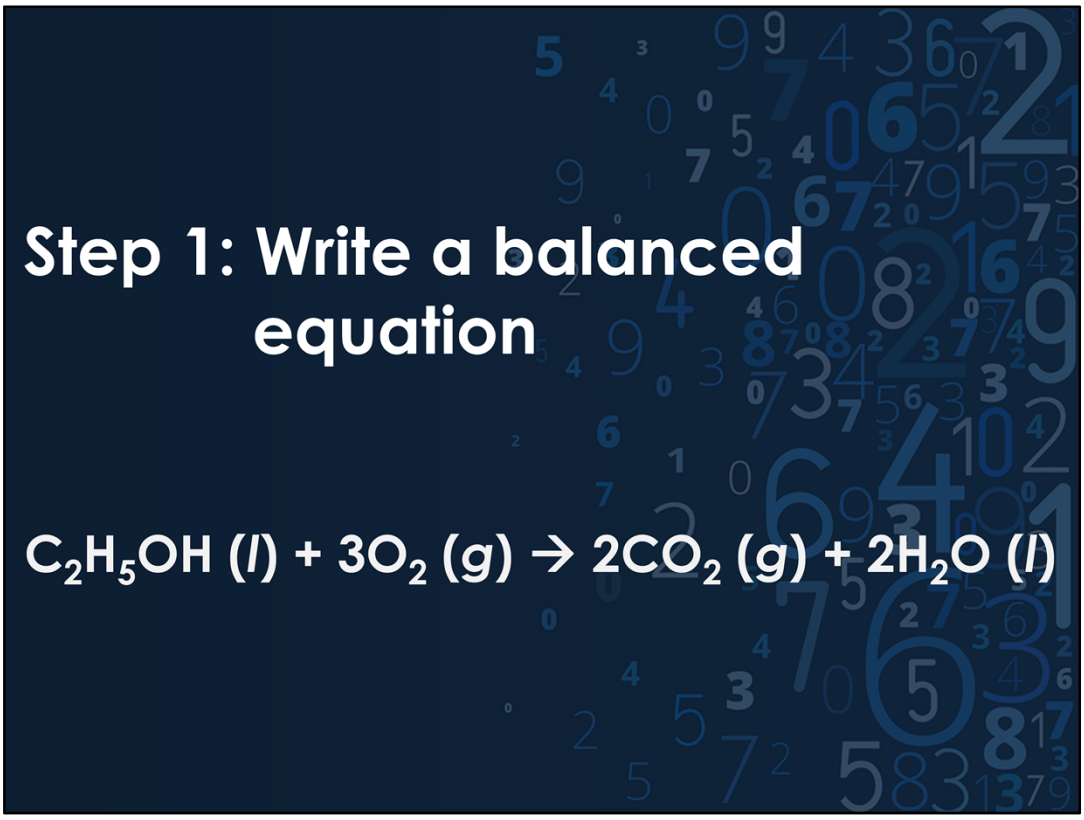


Stoichiometry is the study of the amount of reactants in a reaction compared to the amount of products, and the quantitative relationships between the two. How is this study used to solve problems that deal with gases? These problems are completed using the principles of the Ideal Gas Law through dimensional analysis.

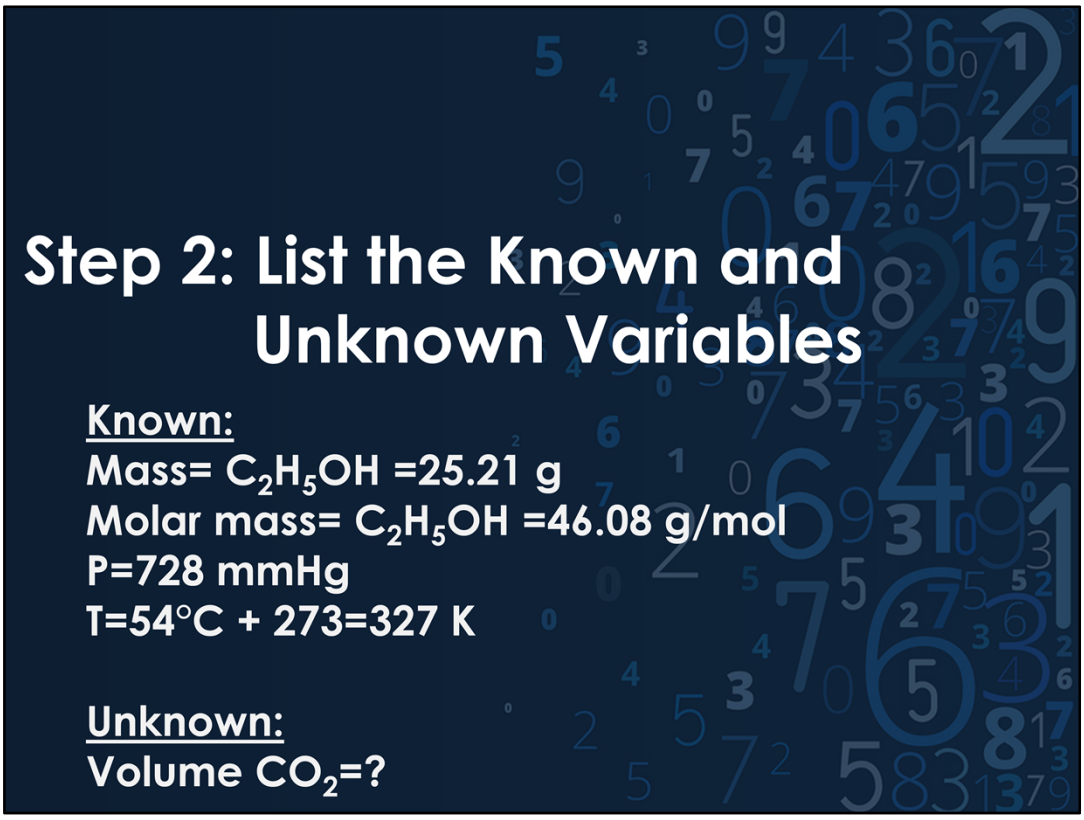


Gas stoichiometry problems are similar to other stoichiometry problems. Take a moment to review this example gas stoichiometry problem:

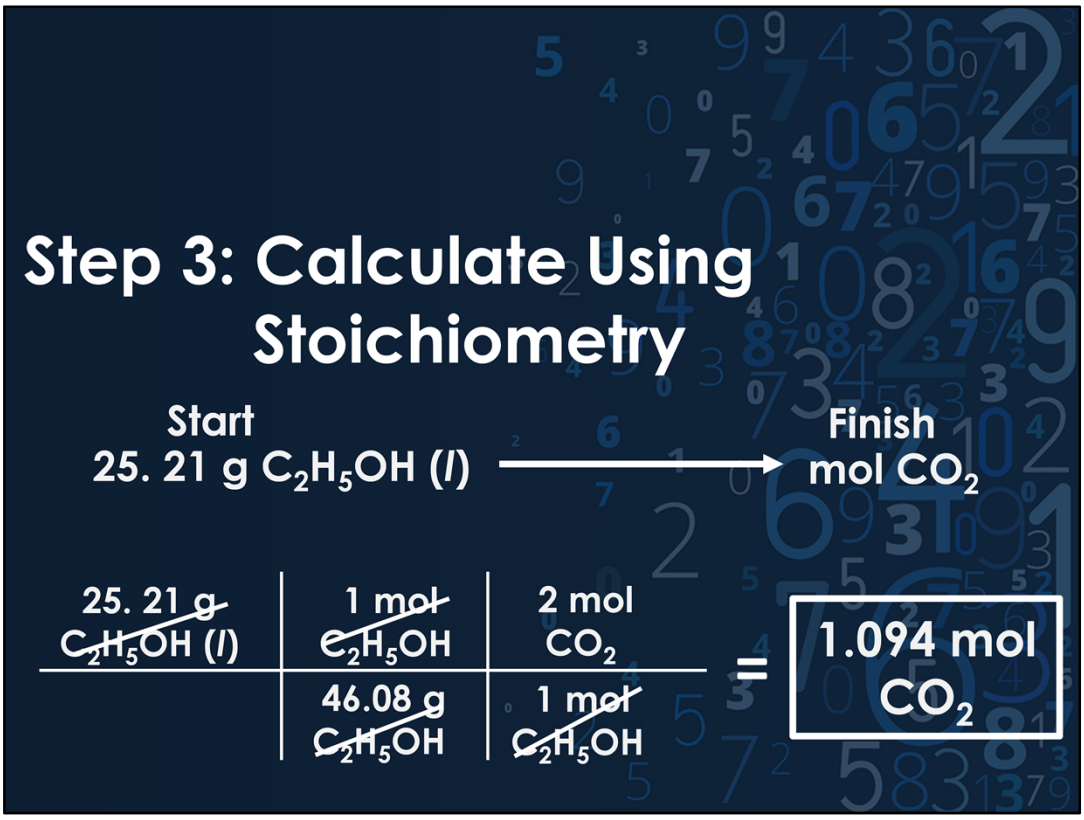
What volume of carbon dioxide is produced by the combustion of 25.21 g of ethanol at 54°C and 728 mm Hg? Assume the gas is ideal.



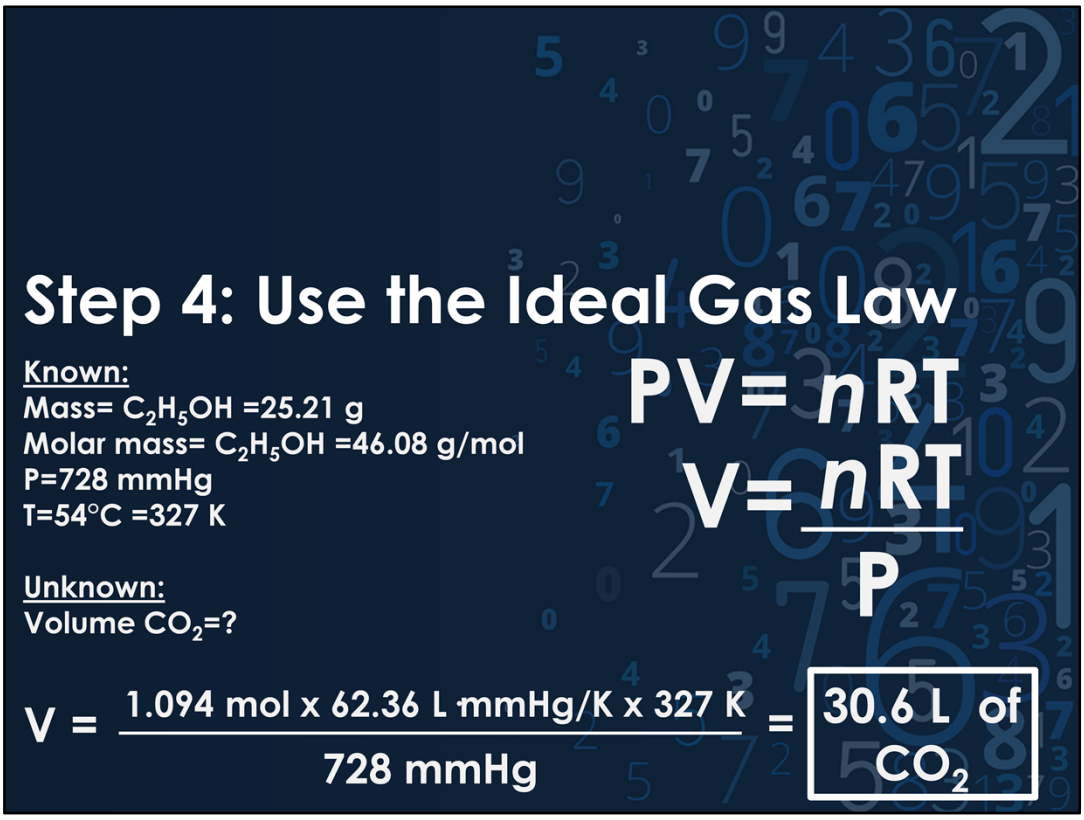
The first step in solving this problem is to write a balanced equation. Remember, in a combustion reaction, a substance will react with oxygen to form carbon dioxide and water. This means that ethanol and oxygen are reactants, and carbon dioxide and water are products. To balance the equation, make sure that there are equals amounts of reactants and products.



Then, list the known and unknown variables and solve the problem by setting up dimensional analysis. In this problem, the known variables are the mass of C_2H_5OH, molar mass of C_2H_5OH, pressure, and temperature. Since the temperature in the problem was given in Celsius, it will need to be converted to Kelvin.



After you have written the balanced chemical equation, you must calculate the number of moles of ethanol using stoichiometry. You will want to setup this problem using dimensional analysis. Remember, you are starting with 25.21 g of ethanol and converting for moles of carbon dioxide. Now, you should be able to solve the problem using mathematics. In this problem, 25.21 g of C_2H_5OH is multiplied by 1 mol of C_2H_5OH. Then, divide by 46.08 g of C_2H_5OH. Next, multiply by 2 mol of CO_2. Finally, divide by 1 mol of C_2H_5OH. You can see from the example that 1.094 mol of CO_2 is produced from the combustion of 25.21 of C_2H_5OH. However, this is not the volume of carbon dioxide. You will need to use the Ideal Gas Law to calculate the volume of carbon dioxide from the amount of gas.



The Ideal Gas Law states that pressure times volume is equal to the amount of gas times the gas constant times temperature. You are trying to find the volume of carbon dioxide produced from a combustion reaction. You have already found the amount of carbon dioxide through dimensional analysis. Now, you must rearrange the Ideal Gas Law equation to solve for volume. The new equations reads: volume equals amount of gas times the gas constant times temperature divided by pressure. Remember, you were given temperature and pressure. R is a constant, and you calculated the amount of gas in the first step. All that is left to do is plug in these known values and solve using mathematics. Volume equals 1.094 mol times 62.36 L•mmHg times 327 K divided by 728 mmHg. You can see from the example that 30.6 L of CO_2 is produced from the combustion of 25.21 g of C_2H_5OH.