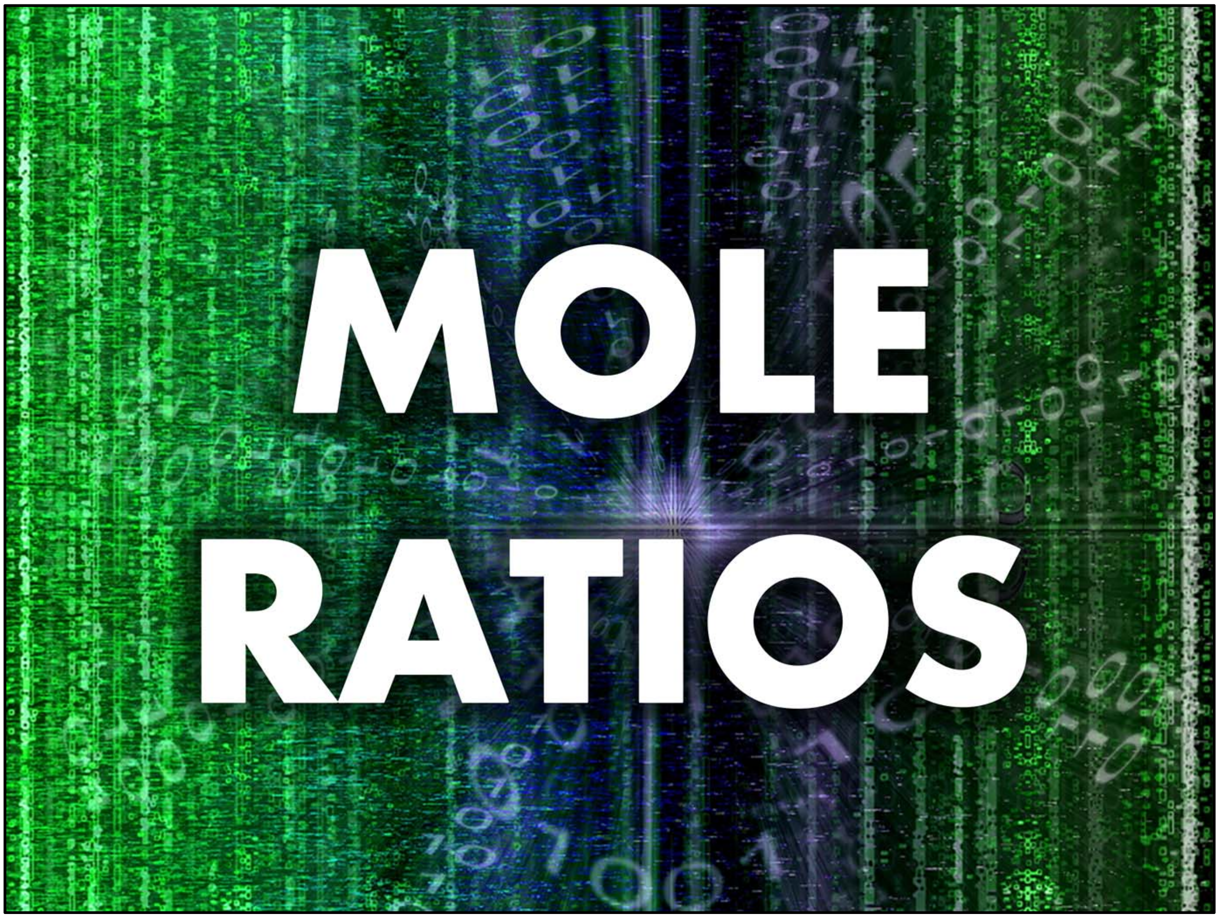
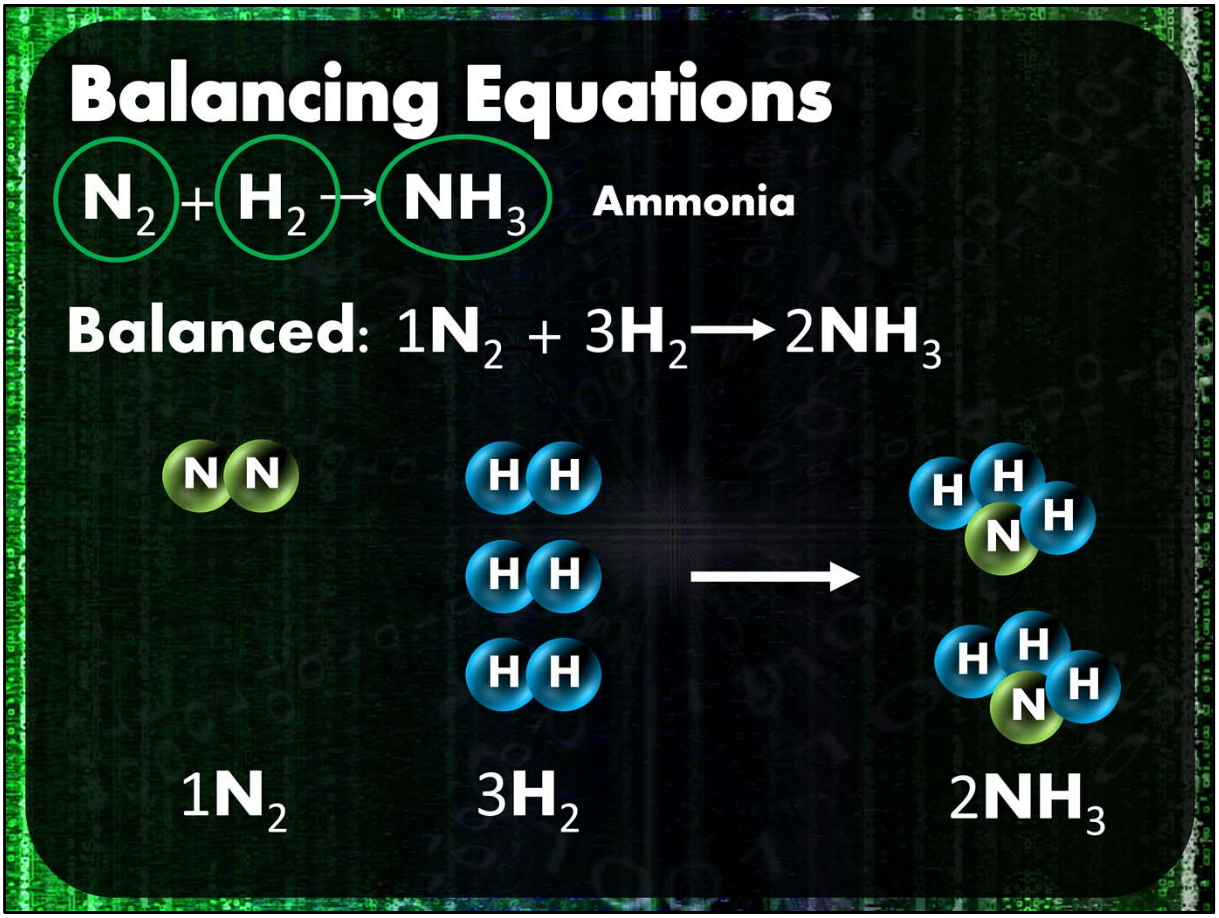
Module 7: Stoichiometry
Topic 1 Content: Mole Ratios Presentation Notes



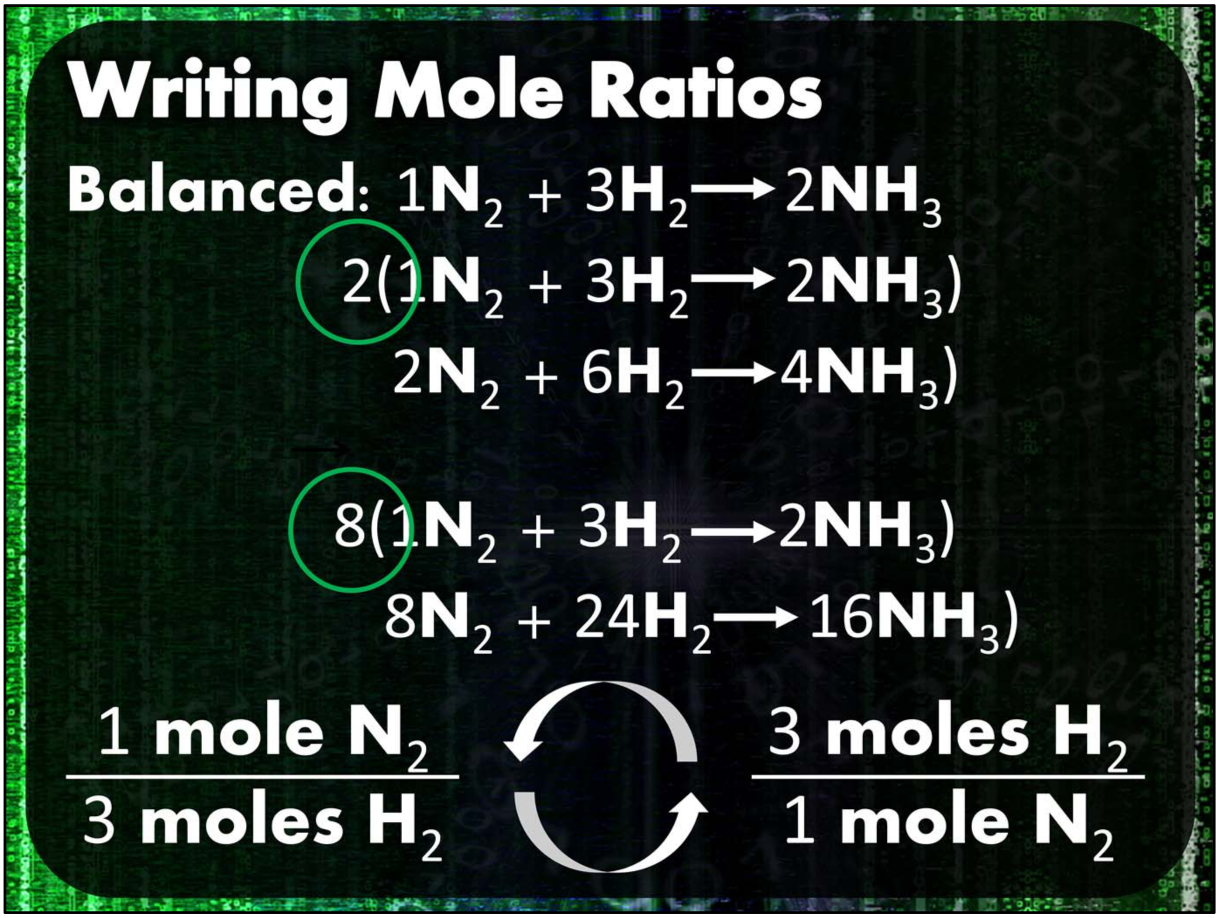
Mole Ratios



Looking at an equation visually shows the moles of the elements, and how those elements combine to form a balanced equation. For example, look at the equation that represents how nitrogen and hydrogen react to form ammonia. The equation, as written out as elements, is: N_2+ H_2→NH_3. This equation has to be balanced, so it is rewritten as: $1N_2$+ $3H_2$→$2NH_3$. Another way to state this balanced equation is "one mole of nitrogen reacts with three moles of hydrogen to form two moles of ammonia." This could also be stated as: “one molecule of nitrogen reacts with three molecules of hydrogen to form two molecules of ammonia.” The coefficients in a balanced equation also represent “molecules”.

Module 7: Stoichiometry

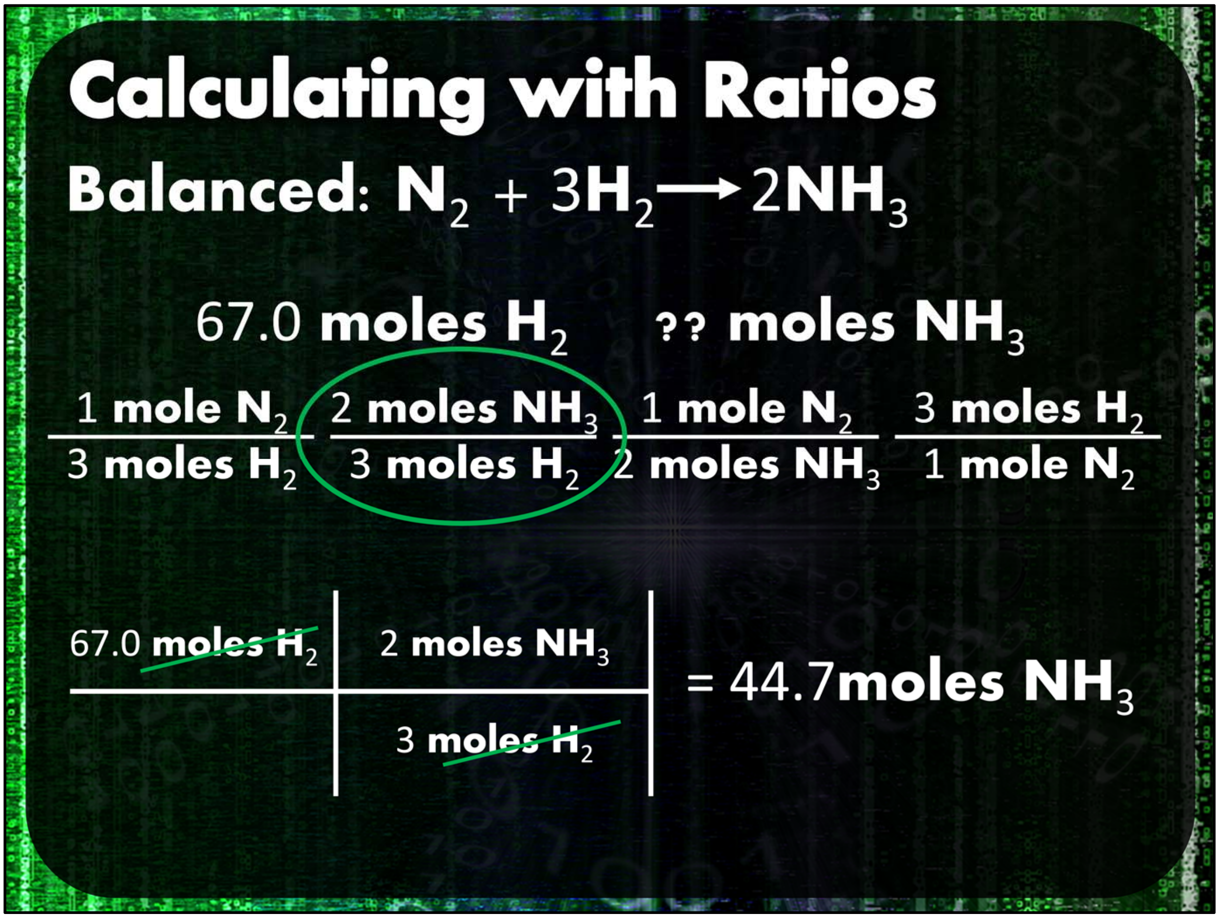
Topic 1 Content: Mole Ratios Presentation Notes



Ratios can be written from balanced equations. If twice as many moles of ammonia were needed, then it would be necessary to start the reaction with twice as many moles of nitrogen and hydrogen. Each coefficient needs to be multiplied by the same amount, which in this instance is 2. This equation would be written as: $2N_2 + 6H_2 \rightarrow 4NH_3$.

If you started with 8 moles of nitrogen, then each of the other substances needs to be multiplied by 8, so the equation would also require 24 moles of hydrogen to produce 16 moles of ammonia. Each coefficient needs to be multiplied by the same amount. This equation is written as: $8N_2 + 24H_2 \rightarrow 16NH_3$.

From the original reaction, it is possible to write out several mole ratios as conversion factors. These ratios are useful when calculating the mole amounts of elements in a compound. Here are two mole ratios for the balanced equation: 1 mole of nitrogen, or N_2, over 3 of hydrogen, or H_2, and 3 moles of hydrogen, or H_2, over 1 mole of nitrogen, N_2. Notice that these two ratios are reciprocal. This is important to note, since there are instances when one ratio fits the equation, and other times when the reciprocal is used.



Why study mole ratios? Mole ratios can be used in calculations. Using the equation for ammonia, 1 molecule of N_2 plus 3 molecules of H_2 yields 2 molecules of ammonia, or NH_3. From 67.0 moles of hydrogen, how many moles of ammonia could be produced? This question needs to be solved using dimensional analysis.

In order to solve this problem, the first thing to do is to think about the ratio that you will have to use. Look at the mole ratios listed, and decide which one would is used in the calculation. Notice that some of the ratios are reciprocals of each other. When choosing the mole ratio you will be using, look at what unit you need for the final answer, as well as what will cancel out.

The ratio that you will be using is the one that reads 2 moles of NH_3 over 3 moles of H_2. Why is this ratio used? This ratio is used so that the hydrogen moles will cancel out and the remaining unit will be NH_3. Now, use dimensional analysis to calculate the amount of moles of ammonia. In order to calculate the moles of ammonia, 67.0 moles of H_2 is multiplied by 2 moles of NH_3 over 3 moles of H_2. The moles of H_2 will cancel out and 67.0 is multiplied by 2 moles of NH_3 and divided by 3. Multiply 67.0 times 2 moles of NH_3 and divide by 3 to get the answer of 44.7 moles of NH_3.