## Mole-Mole Problems

The solution procedure used below involves making two ratios and setting them equal to each other. This is called a proportion. One ratio will come from the coefficients of the balanced equation and the other will be constructed from the problem. The ratio set up from data in the problem will almost always be the one with an unknown in it.

You will then cross-multiply and divide to get the answer.

What happens if the equation isn't balanced? Answer - **balance it**. You cannot do these problems correctly without a balanced equation. I am constantly amazed at the number of people who forget to balance the equation first.

How will I know which substances to use in the ratio? Answer - **you will have to read the problem and understand the words in it. I can not teach this part!!!!!**

Here is the first equation we'll use:

N2 + 3 H2 ---> 2 NH3

Problem #1: if we have 2.00 mol of N2 reacting with sufficient H2, how many moles of NH3 will be produced?

**Solution Comments**

1. The ratio from the problem will have N2 and NH3 in it.
2. How do you know which number goes on top or bottom in the ratios? Answer: it does not matter, except that you observe the next point ALL THE TIME.
3. When making the two ratios, be 100% certain that numbers are in the same relative positions. For example, if the value associated with NH3 is in the numerator, then MAKE SURE it is in both numerators.
4. Use the coefficients of the two substances to make the ratio from the equation.
5. Why isn't H2 involved in the problem? Answer: The word "sufficient" removes it from consideration. And it is not referred to as part of the problem.

Let's use this ratio to set up the proportion: Molar-Ratio-NH3-N2

That means the ratio from the equation is: Molar-Ratio-2-1

The ratio from the data in the problem will be: Molar-Ratio-x-2

The proportion (setting the two ratios equal) is: Molar-Ratio-Ex1-Proportion

Solving by cross-multiplying gives x = 4.00 mol of NH3 produced.

Example #2 - Suppose 6.00 mol of H2 reacted with sufficient nitrogen. How many moles of ammonia would be produced?

Let's use this ratio to set up the proportion: Molar-Ratio-NH3-H2

That means the ratio from the equation is: Molar-Ratio-2-3

The ratio from the data in the problem will be: Molar-Ratio-6

The proportion (setting the two ratios equal) is: Molar-Ratio-Ex2-Proportion

Solving by cross-multiplying and dividing gives x = 4.00 mol of NH3 produced.

Example #3 - We want to produce 2.75 mol of NH3. How many moles of nitrogen would be required?

Before the solution, a brief comment: notice that hydrogen IS NOT mentioned in this problem. If any substance ISN'T mentioned in the problem, then assume there is a sufficient quantity of it on hand. Since that substance isn't part of the problem, then it's not part of the solution.

Let's use this ratio to set up the proportion: Molar-Ratio-NH3-N2

That means the ratio from the equation is: Molar-Ratio-2-1

The ratio from the data in the problem will be: Molar-Ratio-2

The proportion (setting the two ratios equal) is: Molar-Ratio-Ex3-Proportion

Solving by cross-multiplying and dividing (plus rounding off to three significant figures) gives x = 1.38 mol of N2 needed.

### Practice Problems

Here's the equation to use for all three problems (Note: It’s my favorite equation):

2 H2 + O2 ---> 2 H2O

1) How many moles of H2O are produced when 5.00 moles of oxygen are used?

2) If 3.00 moles of H2O are produced, how many moles of oxygen must be consumed?

3) Suppose 4.00 grams of H2 were used? How many grams of water would be produced? (This is a mass-mass problem, and is more like the ones on quizzes and tests in my class.)

Here's the equation to use for all three problems:

2 H2 + O2 ---> 2 H2O

1) How many moles of H2O are produced when 5.00 moles of oxygen are used?

Here are the two substances in the molar ratio I used: Molar-Ratio-O2-H2O

The molar ratio from the problem data is: Molar-Ratio-5

The proportion to use is: Molar-Ratio-Ans1-Proportion

2) If 3.00 moles of H2O are produced, how many moles of oxygen must be consumed?

Here are the two substances in the molar ratio I used: Molar-Ratio-O2-H2O

The molar ratio from the problem data is: Molar-Ratio-3

The proportion to use is: Molar-Ratio-Ans2-Proportion

3) Suppose 4.00 grams of H2 were used? How may grams of water would be produced?

4.00 grams of H2 is 2.00 moles. The H2 / H2O ratio is 2/2, so 2.00 mole of H2O are produced. That's 36.0 grams and that's the answer.

Congratulations if you got it right. However, don't stop there. Do enough problems to the point you believe you have the technique nailed and then continue to do more problems.

Now. If number three did not make sense, go on to the mass-mass tutorial.