Limiting Reagent Example Script

This video explains how to calculate the limiting reagent and percent yield of a chemical reaction.

We will be looking at the reaction between hematite and carbon. We can see from our balanced reaction equation that two molecules of hematite, react with three molecules of carbon, to produce four molecules of solid iron and three molecules of carbon dioxide gas.

The problem asks; what is the limiting reagent when five hundred fifty grams of hematite react with one hundred grams of carbon? What is the maximum amount of iron that could be produced from this reaction? What is the percent yield if the actual mass of iron produced is three hundred grams?

The first step to completing this problem is to identify what the problem is asking, we need to identify the limiting reagent. This will be either hematite or carbon. We need to calculate the theoretical yield of iron. The actual yield of iron given in the question is in grams, from this it can be inferred that our theoretical yield should be in grams as well. Finally we need to calculate the percent yield of the reaction.

We are given required pieces of information in the problem, such as: the mass of hematite and the mass of carbon provided for the reaction, and the mass of iron actually produced from the reaction.

We need to gather some information that is missing from the problem, such as: the molar masses of hematite, carbon, and iron. We also need the formula for percent yield.

Now that we have all the information required we can set the problem up using unit analysis. We can find the theoretical yield and limiting reagent in one step. We use the stoichiometric relationship between the reactants and the desired product, in this case iron, to calculate the amount of product that can be produced from each reactant.

Set up both equations making sure that the units cancel, and that the stoichiometric conversion for hematite to iron is included, that is, 4 moles of iron are produced from two moles of hematite.

Now that the problem is set up, we can do the calculations, and round to the appropriate significant figures. Six hundred twenty grams of iron could be produced from a hundred grams of carbon, and three hundred eighty five grams of iron could be produced from five hundred fifty grams of hematite. This makes the limiting reagent hematite, and the theoretical yield of iron three hundred eighty five grams.

Now we can move on to the percent yield. The formula for percent yield is the actual yield, divided by the theoretical yield, multiplied by one hundred. Remember to use your non-rounded mass of iron in the calculation. The percent yield of this reaction is seventy seven point nine percent.

Now that we have completed the calculations required for this problem, all that is remaining is to write our concluding statement. The limiting reagent in a chemical reaction between five hundred fifty grams of hematite, and one hundred grams of carbon, is hematite. The maximum mass of iron that could be produced by this reaction is three hundred eighty five grams. seventy seven point nine percent.

This concludes our limiting reagent and yield example, after watching this video you should be able to: determine the limiting reagent and calculate the theoretical yield and percent yield of a chemical reaction.