>> Twenty point zero grams of aluminum reacts with 20.0 grams of oxygen. How many grams of aluminum oxide will form? You see here our equation. Four aluminums plus three oxygens yields two aluminum oxide products. OK, we're starting now with 20 grams of each of our starting materials. This is a good problem because it shows us why we have to convert to moles. Otherwise if we're looking at 20 of one verses 20 of the other we might have that false feeling that well gee we're starting with the same amount of both so they both should run out at the same time but we're going to find out they don't, that they actually give us different amounts of product. So let's look again at them individually starting with the aluminum. We're starting with 20 grams of aluminum times the molar mass, the reciprocal of it so we can cancel out grams of aluminum. Now normally I would stop at this point and give you an answer and then go on to the next step. But I want to show you something that we can do now that you're getting used doing things one-step at a time. We can go ahead and start putting some steps together. So to go from here to here to here we multiply by our molar mass. To go from here to here we multiply by the molar ratio. And what I've done is I've put it all in one step. So aluminum times moles over aluminum grams, that cancels out and leaves us with moles of aluminum and then times moles of Al2 O3 over moles of aluminum. You can see these moles of aluminum are going to cancel out leaving us now overall with moles of aluminum oxide. So we have 20 times 2 divided by 26.98 and divided again by 4. The answer we get for that is 0.371 moles of aluminum oxide. OK, so if we run this through to completion we use up all of our aluminum, this is the most – using just that aluminum this is the most we can make of our product. Now let's find out what the most we can of our product using 20 grams of oxygen. So we've got our 20 grams of oxygen times the molar mass of oxygen 02 as being 2 times 16 is 32. So we've got the reciprocal of our molar mass so that we can cancel out grams of oxygen. We have 20 divided by 32 here. You can see that we're going to end up with moles of oxygen. Now we're going to go ahead and put in our next step, which is our molar ratio of two products, two, three oxygens. So we have our two to three. We're able to now cancel out moles of oxygen and now look what's left. Everything has gotten canceled out except for the moles of product. So now it's just a matter of doing the math, 20 times 2 divided by 32 and then again divided by 3. The answer we get now is 0.417 moles of aluminum oxide. So if there's enough aluminum to use up all the – I'm sorry, if there's enough oxygen to use up all the aluminum, the aluminum will only make this much product. If there's enough aluminum to use up all the oxygen, the oxygen will only be able to make this much product. That's why we look for the smaller of the two because obviously this being the smaller amount, we're going to run out of aluminum and still have a little bit of oxygen left. So this is what we're going to use next. This is based on the limiting reactant. So we can go back and identify aluminum as our limiting reactant. If you're asked what is the limiting reactant in that equation, in that reaction, the limiting reactant we just found out based on these two numbers is aluminum. OK, now we're going to do our last step. We want to know what's the mass in grams of our product. So we're going to start with what we end up making, which is the 0.371 moles

of aluminum oxide, times the molar mass of aluminum oxide, which is 101.96. Moles will cancel leaving us with grams of aluminum oxide, 0.371 times 101.96 gives us 37.8 grams of aluminum oxide.