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SPEAKERS

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Previously, we looked at situations where we ended up adding the exponents, or subtracting the exponents. There, that was our first rule, or rule one A and one B. Now I want to show you a rule about what to do when we're multiplying exponents. Suppose I write five squared, multiplied by five squared, multiplied by five squared, you can see that I'm multiplying five squared, by itself at least twice, three times, or at least we've got three, five squared. Now according to the rules of exponents, we could write this as five squared to the power of three.

Now, we know that five squared times five squared times five squared is equal to 5 times 5 times 5 times 5 times 5, and so that's going to be equal to five to the power of six. Now also notice that if I have five squared to the power of three, if I take five squared, and I take that exponent to right here, and then multiply it by three, we also get five to the power of six. We can generalize this into a rule. So we'll call this rule two. And it says that if you have A to the power of N, so N is going to be a positive integer. A is going to be some real number. And we raise A to the power of N to the power of M, we can write this succinctly as A to the power of M times N, or just MN . One more example, just to make sure. We all understand, I've got say, well, let's not use five, let's use something else. 10 to the power of three raised to the power of 10. That's a very big number. But we can write that very big number succinctly using exponents, you get 10 to the power of three times 10, which is equal 10 to the power of 30.

What is a negative exponent? I'm going to go through an example here to illustrate to you and give you some understanding for what a negative exponent is. Let's start by writing say five to the power of three. For actually, let's make that a little more interesting. Let's go with five to the power of six. And what if we multiplied that by one over five to the power of three, five to the power of six, multiplied by one over five to the power of three. Well, if we write this out in full. You can see that five times one over five, that's just going to be equal to one. And so we could cross out some of these, and we're just going to be left with five to the power of three. Now rule one, it told us that if we have five to the power of six, divided by five to the power of three, this should be equal to five to the power of six minus three is equal to five to the power of three. And notice that this is the same answer we got from what we started with, from that five to the six multiply by one over five to the power of three.

So it turns out in general, if we have five to the six, multiplied by one over five to the power of three, that's equivalent to writing five to the power of six, multiplied by five to the power of negative three. So if we have one, over five to the power of three, that is equivalent to five, to the power of negative three, these two things are equivalent, they're equal to each other. So let's take a look for let's use this fact. And generalize it. When we do that, we get one over A. So A is some real number. If that one over A is raised to the power of N, where n is some positive integer, we can rewrite this as A to the power of negative N. You can think of a negative exponent as representing a fraction. A negative exponent represents a fraction, in the sense that I've shown it to you here. That's going to be our rule three. So that's the third thing I want you to remember about exponents. I'm calling them rules. Or you just think of them as the four things I really want you to remember about exponents from the module we're working through together.

Next, let's do an example together to illustrate how to use this rule three in practice. Now, suppose I have a fraction, let's say I have two over three to the power of negative two, I'm going to write this in a certain way to illustrate a point to you, I could write this as two over three, the fraction two over three to the power of two multiplied by negative one, we might want to do that, because whenever we have something to the power of negative one, we're going to flip the numerator and denominator. So I can rewrite this thing as three over two to the power of two, I've brought this negative one. inside the bracket, inside the inside the bracket, there is a fraction. And that fraction, two over three to the power of negative one is equal to three over two. And I just left the two exponent where it was. So this is an example of rule three. That's kind of neat. We often don't like working with negative exponents as an economist. And when I'm working in financial economics and finance, it's hard for me to interpret a negative exponent, it's much easier for me to interpret an equation that has positive exponents. So we like to convert from negative exponents to positive conversions, to positive exponents. And you can see here that if we kept going, we could actually do this calculation here and end up with nine over four. But if we just had this here with a negative exponent, we might not know what to do with that.

One more rule I want you to remember, we can call this rule four. I'll give it to you. And then I'll show you why it has to be true. So rule four says that if A is any real number, and we take A to the power of 0, A to the power of zero must be equal to one. Why is this the case? Well, let's consider this with an example. Suppose I have five to the power of two, multiplied by five to the power of negative two, while using rule one, if we use rule one, we're going to have five to the power of two minus two, which gives us five to the power of zero. So that's just rule one, this is rule one, I'll write it down. How do we know that rule four must be true? Well, if I write this out, we've got five times five, times one over five, times one over five. And that's just going to be equal to one. How many times does five go into five? Once. So anytime you have a real number raised to the power of zero, its value is equal to one. So its value is equal to one. Common mistake students make. If you don't look at real numbers with exponents of zero for a long time, it's easy to forget. But if we have five to the power of zero, that's equal to one, in fact, any number, any number, that's going to be the case.

Just as an example, we could have something like 100 times X. And let's just say X is a real number. Then I can write this as 100 to the power of 0, X to the power of zero. And that's just going to be one times one, which equals one. That finishes our videos on the rules of exponents. So in this most

recent video, you saw what to do when you've got a real number raised to an exponent, and then that whole real number raised to exponent raised to another exponent, and you ended up multiplying the exponents together. We also looked at what a negative exponent is, turns out that you can think of it like a fraction. And you saw that any real number raised to the power of zero is just going to be equal to one. Next, we're going to look at some problem in economics and business where we're applying these rules of exponents to answer answers interesting questions.