Applying Exponent Properties

Transcript

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Narrator: Hello, and welcome to video number seven in this series. And in this video, I'll review how to do arithmetic using numbers with exponents. So if we have A to the M, and we want to multiply by A to the N, same base and exponents of M and N, we just add the exponents together. So for example, two cubed times two squared is two to the three plus two, two to the five. And we can see that makes sense if we write this out because we'll have two times two times two for the two cubed, and then two times two for the two squared.

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Narrator: And we can see that we don't really need the brackets here. We've just got two multiplied by two, five times. If we have A to the M divided by A to the N, then we subtract the exponents. So for example, two to the 5/2 cubed is two squared. That makes sense too, because if we write this out, you got two times two times 2 five of these guys, divided by the denominator, three of them, and then we could cancel three sets, and we're left with just two squared in the numerator.

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Narrator: And then the next example of arithmetic with exponents is if I have a to the M, and then I raise that to the power N, then we multiply the exponents M times N. So for example, 2 to the three squared would be two to the six. And that makes sense, too, because two to the three is just two times two times two. And if we square it, we're multiplying it by itself. And so, again, the brackets don't really play a role here.

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Narrator: We've got two times two, six times. So let's just work through a few more examples and throw some negative numbers in there to make sure that this works even when we have negative either bases or exponents. So let's try minus two squared, minus two cubed. So according to our method up here, we add the exponents because we've got the same base. So that's going to be minus two to the five.

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Narrator: And so two to the five is 32, and then we've got a negative sign, because it's an odd exponent, the answer is going to be odd, as well. So we'll have -32. Let's try two squared and two to the minus three. So we're multiplying these two together, and we just add the exponents because we have the same base, and two minus three is minus one. And remember the definition when we have a negative exponent is that's equivalent to one over to the power one, which is just 1/2, which is just one half.

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Narrator: Next example, let's do minus two squared over minus two cubed. So this is this example here, so we subtract the exponents. So I'll just write down the base and then subtract the exponents, two minus three, be minus one. Remember, minus one means put it in the denominator. So we have one over minus two and another way of writing that is just minus one half.

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Narrator: And then let's do two to the -2/2 to the three. So write down the base, subtract the exponents minus two minus three, so minus five. That's the same as 1/2 to the five. So that's the same as 1/32. Let's do some examples of this pattern here, where we've got an exponent and then apply another exponent to the whole thing.

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Narrator: So we'll do minus two squared, and then we'll cube that. So in this case, I multiply the exponents, write down the base, multiply the exponents, two times three is six. So now I've got two to the six is 64, and I've got even exponent. So the negative sign, if I've got an even exponent, it'll become a positive, so that just stays up plus 64. Then one last example here.

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Narrator: Let's do two to the minus two cubed. So write down my base, multiply my exponents, so two to the minus six. So that's the same as 1/2 to the six. So that's equal to 1/64. So that's working with numbers.

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Narrator: These rules also apply when we're dealing with variables. So let's do a few examples with variables. So for example, if we did four, say X to the five and then three X to the minus two. So I want to collect together like terms. I'll collect together constants, and I'll collect together variable terms with X.

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Narrator: So four times three is 12, and then X to the five times X to the minus two would be X to the three. And then let's do a division example as to four, say X cubed, and let's do two X to the five, say. So now I'm going to have 4/2 will be two, and then X to the three divided by X to the five. So I subtract the exponents, three minus five, I have to have X to the

minus two and X to the minus two is just X squared in the denominator. And then let's do just one more example.

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Narrator: Let's do X to the four, Y squared, and let's have an X to the minus three in the denominator and also let's have a Y to the five. So looking at the Xs, I've got four minus minus three. So that's going to be X to the seven. And I've got for the Ys, I've got two minus five. So that's going to be Y cubed.

00:08:38:83 - 00:09:44:29
Narrator: Let's explore a few more rules around working with exponents. If I have a product of two numbers or two expressions, A, B, and I have an exponent applied to that product, that's the same as if I apply the exponent to each piece separately and then multiply them. An example here is, let's suppose I have four times two, and I square that. One way to calculate it would be to multiply four by two to get eight and have eight squared, which is 64, or the other way is to apply this rule here and apply the exponent to each piece separately. I'll have four squared times two squared, which is 16 times four, which is 64.

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Narrator: Similarly, if I have a quotient, A over B, and I apply an exponent to the quotient, I get the same answer if I apply that exponent to each piece separately and then do the division. So for example, if I had 4/2, squared. I can either do the 4/2 first, which would give me two and then square it, that would be four or I could do four squared divided by two squared, which is 16/4, which is four. This idea here also applies when we have variables. I've just given number examples up to now, but let's do some examples with variables.

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Narrator: So let's do two X, Y to the minus one, and the whole thing to the minus two, and then let's have an X minus two and then a Y squared, and let's cube all that. So looking at any constants first, got a two here to the minus two, that's going to be four in the denominator. As far as the Xs go, I've got X to the minus two and then X to the minus two cubed. X to the minus two cubed would be X to the minus six. I've got X to the minus two here, I've got X to the minus eight.

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Narrator: And then the Ys, I've got y to the minus one to the minus two, so that's going to be Y squared, minus one times minus two is two. And then I've got Y squared cubed, so that's going to be Y to the six. So white to the two here, y to the six here, I've got Y to the eight. Then it's often good practice to express any final number without using any negative exponents. The way to express a number with a negative exponent in a different fashion that doesn't use a negative exponent is to place the base in the denominator and make the exponent positive.

00:12:27:11 - 00:13:10:72
Narrator: This is going to be the same as one quarter of Y to the eight divided by X to the eight and another way to write that in a shorthand way is like this. Y over X to the power eight. Let's do one more example using variables. Let's do two X cubed, and let's put a Y in here and let's apply a four to the whole thing. Then let's let's do a division for this example.

00:13:10:72 - 00:13:44:42
Narrator: Let's do five and then X Y squared, and let's square that. Looking at the constants first, I've got two to the four, which is 16. And then I've got just a five in the denominator. I've got 16/5. Then looking at the Xs, I've got X cubed to the four, that's going to be X to the 12.

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Narrator: In the denominator, I've got X squared. X to the 12 divided by X squared would be X to the ten. And then the Ys, I've got Y to the fourth power. So in the numerator, I've got white at the four, and then the denominator got Y squared squared, which is also Y to the four. So the Ys are actually going to cancel out here, and that's my final answer.

00:14:12:60 - 00:15:11:09
Narrator: At this point, pause the video and see if you can work through the next two problems that I'll write up here and simplify them using these ideas that we've gone through in this video. So for the first one, work on simplifying this expression here. I'm going to have X, Y squared. And I'm going to cube that and then we'll have two X to the fourth power, and then a Y, and we've got a minus one exponent for that. And then the second one, let's do five, and then X squared Y to the minus two, and we'll cube that.

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Narrator: And then we'll divide all that by we'll have a minus three, and then an X and then a minus one, and then a Y, and we'll apply a square to that whole term. Let's see how you did on this first one. First of all, looking for the constants. We have a two here with a minus one. That's going to be two in the denominator.

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Narrator: As far as the Xs go, got X cube, and then X to the four with a minus one, that's going to be X to the minus four. X cube times X to the minus four, three minus four is minus one. So X to the minus one is X in the denominator. Then the Ys, we're going to have Y squared cubed, that's Y to the six, and then we've got a Y to the minus one. So we've got Y to the six times Y to the minus one, so we've got Y to the five.

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Narrator: And then for the second one, let's look for the constant terms first, just the numbers with no exponents. Sorry, no variables. So we've got five and it's not got any exponent with it, so it's just going to be five in the numerator. And then in the denominator, we've got minus three squared. We've got nine in the denominator.

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Narrator: And then the Xs, we got X squared cubed. So it's going to be X to the six. And then we got X to the minus one squared, so it's going to be X to the minus two. X to the six in the numerator, X to the minus two in the denominator, six minus minus two is eight. So have X to the eight.

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Narrator: The numerator. And then the Ys, we got Y to the minus two cubes, so why to the minus six, and then we've got Y squared. Y to the minus six in the numerator. Y squared in the denominator, minus six minus two would be minus eight, and that is the same as Y to the eight in the denominator. So this is one way of writing this final answer.

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Narrator: Another way is to write it like this as 5/9 times X over Y to the eight. So that's it for this video. And in the next video, I'll continue our exploration of exponents and we'll look at exponents that are fractions, and that's going to lead us onto a discussion of roots.