Multiplying Polynomials

Transcript

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Narrator: Hello, and welcome to video number ten in this series. And in this video, I'll demonstrate how to multiply polynomials. So you may remember from Video one in this series that we talked about how to multiply A plus B times C plus D. And we use the acronym foil to talk about this. So we look at the first terms, A and C and multiply them together, and then the outside terms, A and D, and then the inside terms, B and C, and then the last terms, B and D. So we refer to that as foil.

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Narrator: And we can demonstrate that with a simple example, say, three plus four times two plus one. So the first term is three times two, would be six, and then the last term is three times one, be three, and then the inner terms, four times two, be eight, and then the last terms, four and one, be four. And so that comes to 9, 17 for 21. And we can apply something similar to multiplying polynomials. So as an example, let's do two X squared plus three times X minus four.

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Narrator: So the first terms here, two X squared and X, multiply those together. So you have two times X squared times X, which is the same as two times X cubed. And then we're going to do the outer terms. So two X squared and minus four. So minus eight times X squared, and then the inner terms, three and X, three times X, and then the last terms, three and minus four.

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Narrator: So let's do a few more examples to make sure we've got the idea. Let's do X squared minus two X times minus three X plus one. So first terms, X squared times minus three x. So that would be minus three X cubed, and then the outer terms. It's X squared and plus one, and then the inner terms minus two X times minus three X, which should be plus six X squared.

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Narrator: And then the last terms, we got minus two x and plus one, so minus two X. We wouldn't want to leave it like this because we can simplify this because we've got X squared and six x squared. So right minus three X cubed plus seven X squared, minus two X. Another example as to three x minus two squared. So this fits with this pattern because we've got three x minus two times three X minus two.

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Narrator: But rather than writing it all out, I'm going to kind of minimize the amount of writing I'm doing and just kind of think ahead to what I'm calculating. I'm going to have if I think about the first terms, I've got three X times another three X, so I'll have nine X squared. And then if I think about the outer terms, so I'll think of three X minus two, three X minus two. So the outer terms, we got three X, and then we got minus two. So we've got minus six X.

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Narrator: And then if we think about the inner terms, so three X minus two, three X minus two, we're gonna have minus two times three X. So we'll have another minus six X. And then finally the last terms minus two times minus two plus four. And again, we want to simplify that by collecting the minus six xs together, nine X squared, -12 X plus four. And this is a very common calculation, and so it's good to see the pattern here and to be able to do this kind of calculation quickly in the minimum number of steps.

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Narrator: Ideally, you want to go straight from here to the final answer. And then the next one is also very common four x plus three, four X minus three. And you can kind of see the pattern here. We've got four x plus something, and they're four x minus the same thing. Four x minus three is called the conjugate of four x plus three.

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Narrator: And what happens when we have this kind of example, we'll have four X times four X, so we'll have 16 X squared. And then we're going to have plus three times four X, which would be 12 X, but we've also got four X times minus three so -12 X. So we'll have plus 12 X -12 X, the Xs will go away. And then we got plus three times minus three, so we've got minus nine. So you can see how we kind of lose a couple of terms there.

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Narrator: They kind of cancel each other out. So these last two examples are very common. Moving forward, you'll see this a lot. When there are more than two terms in a polynomial, we have to be extra careful to make sure that we get all the partial products. So, for example, let's do a polynomial with three terms.

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Narrator: And we'll multiply it by a polynomial with two terms. So there's going to be three times six partial products here. So to be systematic, what I'm going to do is I'm going to do

minus two X cubed times each of these two terms first. So minus two x cubed times three X squared. It's going to be minus six X to the five, and then we'll have minus two X cubed times minus one, so plus two X cubed.

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Narrator: And then we'll have minus three X times three X squared, so minus nine X cubed, and then minus three X times minus one plus three X. And then we'll have four times three X squared, 12 X squared. And then finally the constant plus four times minus one, which would be minus four. And we need to collect like terms. So we got two X cubed here and a minus nine X cubed here.

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Narrator: So we've got the six minus six X to the five, and then two minus nine minus seven X cubed. And then we've got I'll do the X squared term next. And then three X, and then minus four. We can also combine the ideas from this video with the ideas from the last video and work with examples like the following. So let's do minus X plus three.

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Narrator: We'll multiply it by four X squared plus three X, and then we'll subtract two X times minus three X squared plus two X plus four. So now we're able to deal with quite complex polynomial expressions, and you just have to go through and be careful and make sure you're getting all those partial products, and then you're collecting like terms. So let's do minus X times each of these pieces of minus four X cubed minus three X squared. Now we've got plus three times each of these terms. We have 12 X squared and nine X.

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Narrator: And then we got minus two X times each of these terms. So we'll have plus six X cubed, and then minus four X squared, and then minus eight X. And then let's collect like terms. So let's look for the highest power of X is X cubed, and we got minus four here and plus six here, we've got plus two X squared. Sorry, X cubed. And then X squared,

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Narrator: we've got minus three plus 12, minus four. So that's going to be plus five X squared. X is got nine here, minus eight there. And then we don't have a constant term. So that's it. So at this point,

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Narrator: pause the video and see if you can work through the next two problems. So we're going to have minus four X cubed plus X times two X squared minus three. So you just have four partial products to worry about there. And then we'll do a more complicated example. We'll do minus three X squared times three X squared, minus X minus four plus two X squared plus three X times two X squared, minus three X.

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Narrator: So let's see what you got for this first example. I'll do that here. We've got minus four X cubed times two X squared. That is minus eight X to the five. And then we've got minus four X cubed times minus three, so that will be 12 X cubed.

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Narrator: And then we got plus X times two X squared, so plus two X cubed, and then finally minus three X. And we need to collect these two terms because they both involve X cubed. So that's going to be minus eight X to the five and then 14 X cubed, and then minus three X. That's the first one and then the second one. We'll do that here.

00:12:51:16 - 00:13:33:86
Narrator: So we got minus three X squared times plus three X squared, so that would be minus nine X to the four. Then we got minus three X squared times minus X plus three x cubed minus three X squared minus four, so plus 12 X squared. And then hopefully you notice here that we've got conjugates. So we've got something plus something, and then the same thing, but with a minus, so we know that some of the terms drop out. So all I have to worry about is these two terms multiplied together.

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Narrator: So that's going to be four X to the four. And then the last two terms multiplied together, plus three X times minus three X minus nine X squared. And if we collect like terms, we got minus nine X to the four plus four X to the four, that's going to be minus five X to the four. And we've got three X cubed, and then the X squared, we got 12 here minus nine here, so plus three X squared. So that's all for this video.

00:14:20:76 - 00:14:30:16
Narrator: And in the next video, I'll stay with polynomials, but we'll start thinking about factoring polynomials.