

PfaffModule5L03

📅 Wed, 2/2 5:13PM ⌚ 12:54

SUMMARY KEYWORDS

square root, power, derivative, carefully, pi, step, dz, differentiate, problem, parentheses, write, polynomial, rewrite, visual reminder, bottom, careful, linearity, constant, thirds, lecture

SPEAKERS

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Welcome. In an earlier lecture, I talked about how to take the derivative of a polynomial. In this lecture, I want to kind of I want to deal with circumstances where the powers are a little bit different. And the reason I wanted to do this was A, to emphasize that you do it exactly the same way. B, is to remind us that sometimes when we're looking at something, and it isn't immediately clear as a power, it actually is a power. So that we could then just use the same rule. And C, is to kind of remind us of all these rules of how things like the square root and so on, switch over to be powers, because sometimes those things are easy to forget. So I want to give a little bit of reminder of that, or practice with that. So let's just get started, I want to take the derivative with respect to X. Actually, let's go ahead and take the derivative with respect to let's, let's do it with respect to something else. Let's do it with respect to Z, I like to emphasize that we can change around our variables, it's not a problem. So the square root of Z. And then I have plus 16 divided by, and then I have the cube root of Z here. Okay, and then I have plus the square root of 2 times, and then I have Z to the pi.

Okay, so this is what I'm going to differentiate. So the first thing I want to kind of do is to rewrite this as powers. Okay? So I'm going to get, I'm just I'm not even, you know, differentiating yet, but I'm leaving that there. So that I remember I do have to differentiate that I haven't differentiated yet. I know that this might seem redundant and silly, and so on. But it actually could be really helpful. Even for people who do these kinds of things all the time. If we don't give ourselves these little reminders, we kind of get carried away and forget, there are still steps left to do, okay? So all I'm doing here is the power. So I'm going to take Z, this is the $\frac{1}{2}$ power when we take the square root. This one is like a double doozy because on the bottom, so I've got the cubed root of Z. So that should be Z to the $\frac{1}{3}$. But it's on the bottom, so becomes Z to the minus $\frac{1}{3}$. Okay, so I have plus 16, Z to the right $\frac{1}{3}$ from the cube root minus $\frac{1}{3}$ because it's on the bottom, so minus $\frac{1}{3}$. Okay, and now we have the square root of two, right? This is just a constant, I don't have to change it around. And then I have Z and then the power is pi. That's okay, pi is a number. It's good. We leave it there. Okay, now everything's in terms of powers. So in the first step, what did I do here, I just rewrote everything as power. So step one rewrite as powers.

That's not a problem, we can do that. Okay, next step. In this step, I just kind of want to use my linearity to kind of break these up, so that we, just like we did when we did the polynomial, so let's go

ahead and do that. So I've got there's no constant in front of this one. So I can just go $D \cdot DZ$, and then Z to the $1/2$, right? Okay, for this one, I can pull out the constant and then I take $D \cdot DZ$ of Z to the minus $1/3$. Okay? My constant here's a square root of 2 so I can pull that out and I get, and then I want $D \cdot DZ$, so let's just kind of write that properly here. And I have $D \cdot DZ$ of, and then I have Z to the π , okay, now everything is just the, we just have these kinds of powers inside okay? So what I did, I used this kind of linearity here to kind of break it apart and pull out constants okay. So use this this linearity to break apart and pull out constants.

That was all I did. Okay, now we're ready to go with the power rule. Okay, and we check, right, what was the first thing we want to make sure to check? We want to make sure to check, right Z , and then this is the Z , right? Z matches up with Z . Z matches up with Z . Okay, we can use the power rule. So that's the first thing to check. And then let's go ahead and this one and turn our powers to the color that we're used to them being. So to kind of have a visual reminder of what we're doing. It's kind of consistent inside our minds in case colors, easier to remember. Okay, and then we just go ahead and do this. Okay, so let's do the first one here, we have to drop down our power. So we have $1/2$, and then we have this Z , right, so I dropped down my power. And now remember, this is the tricky part, I got $1/2$ minus 1. okay? And we're going to have, we'll sort out what each of these is, but let's just leave it like that for now. And then we have, let's leave our 16 outside of this, so that we don't get ourselves confused, and then just do this inside of the parentheses. So I want to drop down to minus $1/3$. And then I want to take Z to the, and then I have minus $1/3$ minus 1 plus, and then I have the square root of 2. And then I have I can drop down the π Z to the π minus 1.

Okay, so now let's just kind of go through these and compute. So π minus 1, that's just π minus 1. I'm not going to be able to simplify that. This one here, what do I get if I take minus $1/3$ minus 1? So let's look at this one for a second. Okay, so let's let's, let's just kind of do this a little bit carefully. Because there's multiple things get confused by here. So let's just rewrite it as minus $1/3$. And then let's just do this over the common denominator. Okay? In fact, it's going to, it's going to kind of help to do plus and then minus up here, okay, so I just kind of moved the minus sign. So I'm still subtracting off one, though, that's not a problem. And so what do I get? I get minus four thirds. Okay? A little bit carefully. Right, so this is minus $1/3$, minus 3 over 3, because it's a minus 1, I moved the minus to the top here and made that a plus. And then right, I can just add the tops, leave the bottom as a 3. Okay? And then we have $1/2$ minus 1. We can also do this a little bit carefully, I know these things get, it's easy to make mistakes. So let's go $1/2$, minus and then for 1, I have 2 over 2. It might again help to kind of do this business where I turn that into a plus and put the minus 2 on top. Okay, so I have 1 minus 2, so that's minus 1, and then over 2. Okay. So now that I've gone ahead and computed all those, I can just kind of write this out. So I have $1/2$ Z , right to the this power here. So this is the minus $1/2$. Okay, so I took care of this one. This one, I actually have to multiply the 16 and the minus $1/3$. So I get minus, and I end up with 16 over 3 if I got this correct, right? We have 1 minus and it's, it's multiplication, so we do end up with that minus there. The 16 is like 16 over 1, if that helps to see it so that you can multiply the tops and bottoms. In contrast, when you're adding, and you add the tops and leave the bottom the same. And so I got that correct, it looks like. And then we move on with that and we have Z to the, and then I have this power here I computed which is minus four thirds. And then I'm going to keep on going and now I have the square root of 2 times π . So plus the square root of 2 times π and then I have Z to the π minus 1. Nothing happened with that. Okay, and that's my final answer.

Okay, so there were a number of steps in here. And maybe I should, I should kind of say, one of the

things that's kind of going on here, what's kind of important here is kind of a careful use of parentheses. And then, and this kind of one step at a time. There's a lot going on when you encounter mathematics where there's a lot going on. It doesn't mean you can't do it, you just break it apart into doing it very carefully, one step at a time, with a lot of parentheses and kind of making sure you know, you've got each step correct. Even when they're tricky, like this one was a little bit tricky, which had a lot going on. The key kind of in going through all this, we could still use our linearity to kind of get it all broken apart like that. That's not a problem. We did have to rewrite these as powers. Right? When you have square roots and cube roots, these are actually powers square root, it's the $1/2$ power the cube roots the $1/3$ power. If it's on the bottom, you have to add minus, like, becomes a minus power. So we can did that conversion here, our square root becomes a $1/2$ power, our cube root becomes a $1/3$ power, and it's on the bottom. So there's a minus.

And now we can just kind of break it apart with this linearity like we did with polynomials, not a problem. And then the thing to be careful of here is that we kind of do it very carefully. I actually find it useful and helpful to break it apart with this step where I write a minus 1 for each of those, and then I compute them carefully. I cannot tell you how many times I've competed those incorrectly if I wasn't, you know, I didn't really write it out. And so with, you know, it kind of helps to put things over a common denominator, so that you're then just adding what's on top. And if you're subtracting off something, just move the minus to the top like that. Makes it a little easier, fewer mistakes. And then that's just it. That's our derivative. The other thing to be careful of, there's a lot of things to be careful of here. Another thing is to make sure you recognize like, always write the derivative sign when you still have it. Why? Because it will, there's so many steps going on here. You may not believe me on this, but it's very likely that you will think that you've differentiated when you haven't yet. Like you're like, oh I did so many steps, I must be done. No, you still have to differentiate. Okay, so I hope that made some sense, and I'll see you in the next lecture.