Module 3: Lines
Topic 3 Content: Slopes of Parallel and Perpendicular Lines Transcript

Hi guys. Welcome to Geometry. This topics going to focus on the slopes of parallel and perpendicular lines. Get ready to apply some of those Algebra skills to this new Geometry concept. You ready to get started? Let's go.

Okay, so like I mentioned slope is something that you learned in Algebra I and probably even a little bit before that, back in middle school. You know there are two ways to determine the slope of the line that passes through two points. I could use the formula, right? Given coordinates, I could just use the slope formula and calculate the slope between two points. Another way that I could calculate the slope between two points is to actually count the rise over run on a coordinate plane. Like I said, it's a good idea to start with the point furthest to the left when counting rise over run. I could count my rise as two here and my run is like it was four there, right? Then I could just reduce that and say my slope is one half. Now how we're going to apply this concept here in Geometry is we're going to find the slopes of lines parallel and perpendicular to a given line. Take this point, for example or these two points. I have A, -4, 3 and B at -1, 2 and I want to find the slope of a line parallel to this line.

Because I wasn't given a coordinate plane to work with here, I'm going to use the slope formula. I'm going to start by labeling my points. Ah, I think I can squeeze it in there. X of 1, Y of 1. X of 2, Y of 2 and I'm going to use the slope formula, which you probably have memorized from Algebra I, right? Y is of 2 minus Y of 1 over X of 2 minus X of 1. Let's see here Y of 2 minus Y of 1. 2 minus 3. X of 2 minus X of 1. -1 minus -4. Now, the first thing that's jumping out at me before I even go any further is that I have a double negative. I'm going to go ahead and make that a +. 2-3, that's -1. -1 plus 4, that's 3. Right now I know that the slope of AB of line AB is -1/3. This is the slope of AB. Of that line. Now, knowing what you do from Algebra I, you know that parallel lines have the same slope. If I want to know the slope of line parallel to line AB, it's going to have exactly the same slope.

The slope of that line is also going to be -1/3. Now before I write this down, write this answer down, I want to make sure you're clear on something. Whether I write -1 over 3 or 1 over -3 or -1/3 and put it right in the middle, these all mean the same thing. I know sometimes it can get confusing when you're not quite sure, "Well, if the negative was up here and then it was down there, does it all mean the same thing?" It does. You can write it any way you want to. Okay? They all mean -1/3. All right? That was the answer to this one. The slope of that line that's parallel to Line AB, -1/3.

Take a look at this example. What's the slope of a line perpendicular to line AB? Okay. Let's see about this one. Now because we're using the same two points. We're still using Line AB, I'm going to cut out a little bit of the work here because we already know that the slope of AB, of that line is -1/3. Okay because we just saw that on our last slide. Now the slope of line perpendicular to line AB, there's something you have to know about that. Remember from Algebra I that perpendicular lines have opposite reciprocal slopes. Okay? By opposite reciprocal, what I mean by that is that they have opposite signs and they're the reciprocals or the flips of one another. If the slope of AB is -1/3 then the slope of line perpendicular to AB ... I'm going to use my little perpendicular symbol. It's going to have the opposite sign. Instead of being negative it's going to be positive. Then instead of 1 over three, three over 1 and because my denominator is 1 here, I can write this even more simply, is that that slope is

just going to be 3. Okay?

The slope of the line perpendicular to line AB is going to have the opposite reciprocal slope. Another characteristic of perpendicular slopes or lines that are perpendicular is that their slopes have a product of -1. That's also another way that you could check to verify that your slopes are perpendicular. For example, what I mean by that? The slope of Line AB, -1/3, the slope of the line perpendicular to it we said is 3 or 3 over 1. If you found this product, -1 times 3 is -3 and 3 times 1 is 3 and -3 divided by 3 is -1. That's another way you can verify that you're lines are perpendicular. Their slopes should have a product of -1. All right? Okay. Take a look at this. I want you to go ahead and take a shot at this. Press pause and take a few minutes and work your way through this example and when you're ready to check your work, go ahead and press play.

All right. Let's see how you did here. We're being asked to find the slope of a line parallel and perpendicular to DE, so before I can answer those questions I need to know the slope of DE. I'm going to go ahead and label X of 1, Y of 1, X of 2, Y of 2. I'm going to calculate my slope. Going to write the formula out because it's one I'm sure you've got committed to memory from Algebra I. Y of 2 minus Y of 1, that's 5 minus 8 and X of 2 minus X of 1 is 11 minus 6 so 5 minus 8, that's -3 and 11 minus 6, that's 5. Right now I know that the slope of Line DE is -3/5. Now the slope of the line parallel to DE is going to have to be exactly the same. Right? For part A, same slope. It's also -3/5. Now, the slope of the line perpendicular to Line DE, I know it's going to have to have an opposite reciprocal slope. Instead of being negative, this slope will be positive and instead of 3 over 5, 5 over 3 and you're all done. Got those. All right? Good job on that.

Now take a look at this example. We're going to make a move to actually working on the coordinate plane. Here we're being asked to graph the line parallel to line M that passes through Point B. Because I wasn't actually given coordinates and I'm not using the slope formula or I could, but it's going to be easier to just work on the coordinate plane. I need to find 2 good points on this line. By good points what I mean is that they're going to lie on the line and then they're going to hit these little grid squares at corners. When I do that I'm guaranteeing that my values are a positive or negative number. Positive or negative whole numbers. Okay? I think I'll go ahead and grab this point here. Let's me get my pen. I'll switch to red, so it'll stand out. This point here, that looks like a good point. This one look like a good point also. I hit the corner of a grid square and I'm on my line. Now, I need to determine the slope between these two points. Good rule of thumb like you learned in Algebra I to start with the point furthest to the left. It looks like I'm rising 1 here and I'm running 3.

The slope of Line M is 1/3. If I want to graph a line parallel to line M that passes through B, what I'm going to do is start at B and I'm going to count out that same slope. From B I'm going to rise 1 and run 1, 2, 3. That would actually give me a point that lies on the line that passes through Point B and it's parallel to Line M. Now that's not actually the only correct answer to this problem. You could continue to count out slopes of 1 over 3 all along that line that passes through B and any of those points would be correct answers. What I mean by that? Let's get this out of my way so I can show you what I mean. This is one of those answers where you could really say, "Hey, well I didn't exactly what you got, but I'm still correct, also." We counted

from B, right? We rose 1, ran 3. I could continue that. I could rise 1, run 3 and I'm off the grid, so I'm going to stop in that direction or you could do those opposite moves and you could get some points that are to the left of B.

I could drop 1, 3 to the left and off ... I'm going to go off the grid after that, so I'm going to stop there. Any of these points ... Let's see how straight of a line I can draw free hand. Any of those points along that line are correct answers to this question. This is a line parallel to Line M, passes through B. Okay? Well, let's try another one. Actually, let's get you to try this one. Go ahead and get that graph paper out or you can press pause and just kind of count it out on the screen, but take a few minutes and work your way through this one. When you're ready to check your answer, press play. Okay, let's see how you did here. Again, we were graphing a line parallel to our given line that passes through C, so we need to determine the slope of the line we were given. Make sure I've got my red ink here and I do. Let's find some good points on this line. Think I'll pick this point here and that's another good point there. I'm going to count my slope so I'm going to count the rise over run.

I rise 2 and run 3 so line T has a slope of 2/3. From C, I'm going to count out that same slope to guarantee that my new line's going to be parallel to line D. From C, I'm going to rise 2, run 1, 2, 3. That's one possible correct answer. Now I'm going to go off the grid if I go any further, but I can get some points that are on the left side of C. Let's see. I can drop 2 and 3 to the left. Now, right? It looks like I'm going to go off the grid if I go any further there, but those are a couple of good points. Either of those would have been a correct answer. Okay? Let's try our hand at some perpendicular lines on the coordinate plane. Given these two lines you see I threw in that perpendicular symbol there, we want to determine if Line M is perpendicular to Line N. To answer that question we're going to need what their slopes are. Let's find a couple good points on Line M. Looks like we got a good one here at the origin and there's a good one right here.

Now let's count out that rise over run. Looks like I have to rise 1 and run 2 to get to that point, so the slope of Line M is 1/2. All right. Line N, let's get a couple of good points. Here's one here. This looks like a good one right here. Starting with the point furthest left, I'm actually going down, so Line N has a negative slope. I went down 2, 1 to the right, so it's slope -2/1. I'm actually going to leave it like that. I'm not going to simplify it to -2 just yet because I want you to take a peek at this now. Compare those slopes. If these lines are perpendicular, they should be opposite reciprocals and they are. They're the opposite signs of one another and they're the reciprocals or the flips of one another, so Line M is perpendicular to Line N. Another way you could verify that remember is by finding the product of their slopes. It's a little a work space. 1/2 times -2 over 1. 1 times -2, that's -2. 2 times 1, that's 2 and -2 divided by 2 is -1. See, they're product is also -1.

All right. Time for you to try one. Here, I want you to determine are the lines parallel, perpendicular or neither one? Okay. Take a few minutes and work your way through this one. All right. Let's see how you did here. Let's figure out what our slopes are. For Line P, let's get a couple of good points. That looks like a good one there and here. Starting from the left, actually have to go down 2 and 1, 2, 3, 4, 5 to the right, so the slope of Line P, -2/5. For W, this looks like a good point. Here's another good one. Let's see here, starting from the left. 1,

2, 3, 4. Rise 4 and run 3. The slope is 4/3. These slopes are not the same, so these lines aren't parallel. They're not opposite reciprocals of one another, so they're not perpendicular, so that means these lines neither one. If I would have graphed them on the same coordinate plane they would intersect, but they wouldn't be perpendicular. They wouldn't intersect to form right angles. Okay? All right. Great job, guys. You've reached the conclusion of your lesson on slopes of parallel and perpendicular lines. We saw how Algebra I often makes its way into Geometry. Bye.