Module 3: Lines
Topic 2 Content: Midpoint Formula Transcript

Hi guys. Welcome to Geometry. This topic's going to focus on the midpoint formula. Your knowledge of the coordinate plane and how to find the mean of a set of data is going to help you get through this topic. You ready to get started? Let's go. Okay. Let's take a look at this example of finding the midpoint of a segment on the number line. This is going to help warm us up to finding the midpoint of a segment on the coordinate plane. Here I have A at three on the number line and B at seven. I'm asked to find the midpoint of this segment, the line segment that connects those two points. I could just count, right? I could count the distance from A to B, and then just go half that. The midpoint just means the middle point of a segment. From A to B, that's one, two, three, four units. Half of four is two, so one, two. That means five is the midpoint, right? That's one way that you could find the midpoint of a segment.

Now how I could use what I know about mean to find the midpoint is I can consider my endpoints as my set of data. Let me erase that midpoint, because we're going to pretend we don't know it just yet. If I know I have a segment that has endpoints three and seven to find the middle of those two points, some more room here. Three plus seven, that's ten. Ten divided by two, that's five. That's another way, another strategy that I could use to find the midpoint of a segment. Now when we're on the number line, those like I said are some strategies we could take. On the coordinate plane, it's a little bit different, but we really use the same way of thinking about it in order to actually derive the midpoint formula.

Let's say, "All right, I'm on a coordinate plane here. I want to find the middle point between these two segments." Well I know that an ordered pair is made up of an X and a Y coordinate, right? I'm going to just estimate for a second, and say, "All right, well the midpoint appears to be about right here." Let's say that's the midpoint. Now how I figured that out is I went about halfway between the X coordinates, and about half ... Between my X values, and about halfway between the Y values, right? That let me find the middle of this segment.

Now if I wanted to represent that algebraically, because that's what's going to actually lead us to the formula, halfway between these X values here, let's say about right there, I'd represent that by adding them together, and dividing by two. Halfway between the Y values, same idea. Add those together and divide by two. That is actually the midpoint formula. This is the formula that you can use to find the midpoint of a segment on the coordinate plane. All right? Let me show it to you formally just so you have it. Given any points, C and D are just general points, the midpoint, M is what we're calling it here, is given by this formula. You'll find the sum of your X coordinates, divide by two, and you'll find the sum of your Y coordinates, and divide by two. Okay?

All right, let's try an example. We've been given two points here. We're asked to find the midpoint of this segment. The midpoint formula is another formula that you want to memorize. You want to get in the habit of writing it down every time you need to use it. Before I do write it down though, the first thing I'm going to do is label these points. This is my X sub one, Y sub one, and X sub two, Y sub two.

Now that I have that, I'm going to write down the midpoint formula. X sub one plus X sub two divided by two, and Y sub one plus Y sub two divided by two. Then I'm going to actually slide this over a bit, because I'm going to work to the right of this. Okay.

All right, so now that we have the formula down, we're going to substitute the coordinates into the formula. That's going to give us the midpoint. All right, so X sub one's negative eight, and X sub two is two. Negative eight plus two divided by two. Y sub one is three, and Y sub two is five, so three plus five divided by two. I just need to simplify my expressions in here. I'm going to end up at the midpoint of this segment. I'm going to scroll a little bit to get some workspace. I still want to see the problem though. There we go. Okay, so simplify the numerator here. Negative eight plus two, that's negative six. I have negative six divided by two. Three plus five, that's eight. Eight divided by two, and I'm going to keep on simplifying. Negative six divided by two, that's negative three, and eight divided by two is four. The midpoint of this segment is at negative three, four. Okay?

That's the process that you'll take when you have to find the midpoint of a segment. Now I showed all the steps, because I wanted you to see all the work, but if you get comfortable and feel like you can skip a few steps here and there, that's fine as long as you keep everything accurate. All right? Okay, now it's time for you to try one. Go ahead and press pause and take a few minutes, and work your way through this. When you're ready to check your work, press play.

All right, let's see how you did. The first thing I'm going to do before I get started finding the midpoint is label my coordinates. All right, so now that I've got that down, that out of my way, I'm going to write down the midpoint formula, because it's one I need to memorize. X sub one plus X sub two, divided by two, and Y sub one plus Y sub two, divided by two. Let me just slide that over a bit so I can write to the write of it. All right, now I'm going to substitute my coordinates into the formula. X sub one is ten. X sub two's negative eight. Ten plus negative eight divided by two. Y sub one's nine. You sub two is one. Nine plus one, divided by two. I'm going to simplify this, get some more workspace here. Okay, ten plus negative eight. That's two. I have two divided by two. Nine plus one, that's ten, so ten divided by two.

Two divided by two? That's just one. Ten divided by two, that's five. The midpoint of this segment is located at one, five. All right? Okay, good job on that.

Now there's another type of problem that you need to know how to solve that involves the midpoint formula. Take a little bit. Read this one. I've been given JK, segment JK. Now they're telling me that J's at seven, four. I'm actually already being given that the midpoint's at ten, negative two. What I have to do is find the coordinates of K. It's still an application of the midpoint formula, but it's got a little twist to it. How you answer this question, you're going to start out by labeling the point that they gave you. I'm going to label this X sub one, Y sub

one. Now I want you to take a minute and actually think about the midpoint formula. X sub one plus X sub two, divided by two. Y sub one plus Y sub two, divided by two. This is the midpoint formula. When I'm all done with it, what I get is ... Switch colors here for a second. I get my midpoint. I'm going to call it X sub M, Y sub M, just to represent the midpoint.

What happened here is that I know X sub one. I already know the X coordinate of the midpoint. I had seven plus some value. I divided it by two, and I got ten. For the Ys, I had four plus some value. I divided it by two, and I got negative two. What I have to figure out is what are those missing values? What is that X sub two and that Y sub two? How we're going to do that is we're going to actually solve two different equations. One of them's going to give us the answer for X sub two, and the other for Y sub two. Here we go.

Let's start with the Xs first. I know that my X sub one is seven. Seven plus X sub two, because right now I don't know what it is, divided by two, I know that that is going to equal, let's move this so we can see the midpoint again. It's going to equal ten. This is our X sub M, our Y sub M. seven plus X sub two divided by two is ten. Let's solve this. When we do, we'll know what X sub two is. All righty? What I want to do first, I want to get rid of that two. I want to clear this fraction on the left side. I'm going to multiply this side of my equation by two. Whatever I do to one side, I know I have to do to the other. On the left side is what happens is the twos cancel, because I've cleared that fraction. I'm just left with seven plus X sub two. Let's get some room here.

Seven plus X sub two equals ten times two. That's twenty. Subtract seven from each side. On the left side this is going to cancel. We're left with X sub two equals thirteen. Right now I know that the X coordinate of K is at thirteen. I just need to follow the same process and get the Y coordinate. All right, so let's get this out of our way a little bit. Let's move this. We're going to group it together. We're going to make it a little smaller. I still want you to see it, but I just need it a little more workspace here. Okay. Now I'm going to follow that same process, but for the Ys.

I know my Y sub one is four. I thought I didn't have my pen. There we go. Four plus our Y sub two is unknown right now. Divided by two, don't forget that, equals our Y sub M, that Y coordinate of the midpoint, which is negative two. Let's get this out of the way. There's so much work for math, I know. You need a lot of workspace. All right, so let's just simplify this equation. I want to clear the fraction like I did over here. I'm going to multiply the left side by two and the right side by two. My twos cancel out here on the left. I'm just left with four plus Y sub two. Let's see. We're getting a little crowded. Let's scoot that over a little bit. Okay, so I'm just let with four plus Y sub two equals negative two times two. That's negative four. Now subtract four from each side, cancel. Y sub two equals negative eight. You're all done. You just need to write your answer as an ordered pair. K, the coordinates are thirteen negative eight. You're all done. You've got that one. Keep that in mind, and I want you to try this one. You've been given the coordinates of P here, and the midpoint and you have to find

the coordinates of Q. Press pause, even rewind me back, and listen to that last example again. When you're ready to check your work on this one, go ahead and press play. All right, let's see how you did here. Now remember, you always want to start by labeling your coordinates. X sub one, Y sub one, and then because this is the midpoint, we're going to go ahead and label it X sub M, Y sub M. I'm going to write down the midpoint formula. We're going to be moving a lot of things around here, getting some workspace. X sub one plus X sub two, divided by two. Y sub one plus Y sub two, divided by two equals X sub M, Y sub M.

Okay, so we know X sub one is five. Let's start with our X coordinate. Five plus X sub two, divided by two equals the X coordinate of our midpoint. It's negative one. Now let's just solve this equation. Let's get a little more space. All right I'm going to cancel out the fraction, clear this fraction here by multiplying both sides by two. Two's cancel out on the left, and I'm left with five plus X sub two, and negative one times two, that's negative two. Now the last step, get some more space, to solve for X sub two. Subtract five from each side, cancel. We're left with X sub two on the left. Negative two minus five is negative seven. We've got the X coordinate. Now we just need to get the Y coordinate. Let's move a few things around here, get some space. Let's group that together. Then just get it out of our way a little bit. Okay.

Now we're going to follow that same process, but with the Ys this time. Let me get my pen back. All right. Y sub one is two. Two plus Y sub two divided by two equals the Y coordinate of our midpoint is six. Now let's clear this fraction. I'm going to multiply the left side by two and the right side. Twos cancel out, and I'm just left with two plus Y sub two. Six times two, that's twelve. Subtract two from each side. Cancel out again. We're just left with Y sub two on the left and ten on the right. We have the coordinates of that missing point. It's location is at negative seven, ten. All right, great job on that one. You've reached the conclusion of this lesson on the midpoint formula. I hope you saw how to use that formula to determine the midpoint of a segment on the coordinate plane. Bye.