

## Module 10: Circles

### Topic 1 Content: Angles Formed by Intersections in the Exterior of a Circle Transcript

Hi, guys. Welcome to geometry. In this topic we're going to cover angles formed by intersections in the exterior of a circle. Your knowledge of angle relationships and your background knowledge on circles is going to come in handy during this lesson. You ready to get started? Let's go.

Okay, so here we have two secants, right? We covered before that a secant is a line that intersects a circle at two points. We have our intersection right out here in the exterior of our circle. If we wanted to determine the measure of this angle, right here,  $X$ , the measure of this angle formed by this intersection in the exterior of our circle, this is what we need to do. Get the pen here.  $X$  would equal half the difference of  $Z$  and  $Y$ , because to determine the measure of an angle formed by an intersection in the exterior of your circle, you're going to need half the difference of your intercepted arcs.

What we have here, like we said a second ago, to get  $X$ , we have to find half the difference of  $Z$  and  $Y$ . Let's get ready to apply that in the next few examples. Take a look at this one. We have example one, so given the circle below, find  $X$  and  $Y$ . Here we have two tangents intersecting in the exterior of our circle, and it's okay if you have secants or tangents. It doesn't matter what is intersecting in the exterior of your circle, it's just the point that you do have in the intersection in the exterior.

To figure out what  $X$  equals, we would need half the difference of  $Y$  and this arc that measures 110 degrees. Now the problem is, we don't know what  $Y$  equals just yet. We do know enough about circles to figure that out. We know that the measure of the arcs, the sum of all the arcs of the circle is 360 degrees. We have 110 degrees taking up right here, so we just need to figure out what's remaining for the rest of this circle.

Let's first start out by figuring out  $Y$ .  $Y$  equals 360 minus 110. Okay, so that's 250. Now we know that  $Y$  equals 250. I'm going to bring that over to my circle. I'm going to scoot that work out of the way a little bit. Actually I'll scoot the circle over just a tad. Let's scoot this just down out of our way. I still want to reference it, but I just want to get it out of the way for the moment.

Okay, so we know that  $Y$ , 250 we have 250 degrees right here. Now we know the measure of this arc, and of this arc. Now we can figure out the measure of that angle, because  $X$  will equal half the difference of those arcs. We're running out of space here. Let's just scoot that a little over to the left. We need half the difference of 250 and 110. Scroll down here to get a little space. Let's get a little space even down below. There's a lot of little mental math calculations you can do with circles, or if you want to do like I'm doing, show you the work. There's a lot of small calculations that you have to do. I just want to make sure we don't get too crowded and we stay organized.

Okay, here we go.  $X$  is going to equal half the difference of 250 and 110. That's  $1/2$ . We do a little mental math here. That's 140. Half of 140, that's 70.  $X$  equals 70, which tells us, if we go back up to our circle, that the measure of this angle is 70 degrees. We're all done with that one.

Just to tie it all together, just to review what we did, we started out by realizing that we

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needed half the difference of these arcs, but we first had to determine what the measure of this arc was, so we used the fact that we knew that the sum of all the arcs of the circle is 360 degrees. We did 360 minus 110 to figure out that that arc was 250 degrees, and after we figured that out, we just needed half the difference of these arcs to figure out X. We did that work right down here. Half the difference of 250 and 110 was 140, which was 70, and we got to the end of that problem. See how it took a lot of different steps to get to the answer, but we did get there in the end.

Okay, let's take a look at the next one. Given the circle below, find X and Y. We've got a lot going on in this one, and like I said before, it may be a little intimidating at first when you're looking at it and there's so many different things going on that you're not just quite sure where to begin. Just start with what you know and you'll end up putting those pieces of the puzzle together and you'll get to the answer.

Look what we have here. I notice that I am given a couple of the arcs on the circle, but I don't know the measure of this arc. That's one of the arcs I've been asked to find, and if I look here, I do have an angle formed in the exterior of my circle. I know to figure out X, I'm going to need half the difference of my intercepted arcs here. Let me start out by figuring out the measure of this arc. I see I have 190 and 100.

Let me do my work for Y. I'll do it right underneath because I know I'm probably going to move it there to show the work anyway. Okay, so to figure out Y, I need to figure out how many degrees in my circle are left over for Y. Right now I have 190 and 100. 190 plus 100, that's 290, and 360 minus 290 is 70. There are 70 degrees left over in my circle, and that's Y. I know that Y equals 70, and I'm going to go ahead and bring that back to the circle, that I know that this is 70 degrees.

Now that I know the measure of that arc, I can find half the difference of my intercepted arcs to figure out what X is. Let's go ahead and do that work. I'm going to bring it down under here. I'll switch to black ink just to help us stay a little more organized. X will equal  $\frac{1}{2}$  of the difference, let's check out the measures of those arcs one more time, of 190 and 70. 190 minus 70. That's  $\frac{1}{2}$  of 120, and half of 120 is 60. I know that X equals 60.

Let's take that back up to the circle. Let's write that measure right in here, that X is 60 degrees. Before we leave this, let's just review and pull it all together here. We started out noticing that we needed to figure out the measure of this arc before we could figure out the measure of this angle, so because we knew that the sum of the arcs of our circle is 360 degrees, we found the sum of the two arcs that we knew, subtracted that from 360, and figured out that the measure of that arc was 70 degrees. Then once we knew that, we took half the difference of these intercepted arcs and figured out that the measure of X, or the measure of this angle, 60 degrees. All done with that one.

You're starting getting a little more comfortable working with these angles and circles. Okay, go ahead and try this one. Press pause. Take a few minutes, work through this one. Press play when you're ready to check your work.

Let's see how you did here. The senior class at a local high school is planning a fashion

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show to raise funds for the senior trip. The circle below models the stage and runways. Find  $X$  and  $Y$ . We have a similar setup to our previous example here. We're given the measures of some of the arcs on this circle. We're going to need to figure out this unknown measure here. Once we know that, we'll be able to figure out the measure of this angle. Okay, so let's see what we have here. We need to determine what is  $Y$ . Let's get a little workspace. I think I might use the calculator this time, just because we have a few large numbers we're working with here.

Okay, so first to figure out  $Y$ , we need to determine  $130$  plus  $110$ , plus  $80$ .  $130$  plus  $110$ , plus  $80$ . Make sure I copy those down right. Yes. Okay, let's put those in the calculator.  $130$  plus  $110$ , plus  $80$ .  $130$  plus  $110$ , plus  $80$ . Oop. Let's do that calculation one more time. Enter got pressed somehow.  $130$  plus  $110$ , plus  $80$ . There we go.  $320$  degrees.

Let's go back to our work. Okay, let's scroll down here and get some space. That was  $320$ , so  $360$  minus  $320$ , that is  $40$ . I know that  $Y$  equals  $40$ . Let's take that back up to the circle. Notice I keep writing the measures back in the circle and that's a good habit to keep, that once you know the value of something, go ahead and fill it in to your graphic. Fill it in to your circle because a lot of times that'll help you figure out exactly what you need to do next.

Here, now I see. I can figure out what  $X$  equals because it's going to be half the difference of these intercepted arcs. I'll do that work right off to the side here, put it in blue.  $X$  will equal  $1/2$  of  $110$  minus  $40$ . That is half of  $70$ , which is  $35$ . I'm getting a little crowded so I'm just going to shrink my work for  $Y$  a little bit, because I do want to look at all of this and pull it together. There we go, at the end, when we go ahead and review this. We used this to figure out that  $Y$  was  $40$ , and right here we used this to figure out that  $X$  is  $35$ . Now we know the measure of this angle,  $35$  degrees. You're all done with that one.

Now just to recap, just to pull together what we did, we started out by figuring out the measure of this arc right here, the arc that we didn't know the measure of at first. We figured out the sum of the arcs that we did know, subtracted that from  $360$ . We figured out that  $Y$  was  $40$ , and then to figure out  $X$ , we took half the difference of our intercept arcs and we figured out that  $X$  equaled  $35$ . Okay, good job there.

All right guys, you've reached the end of this topic. I hope you saw how your knowledge of angle relationships and your background knowledge of circles helps you get through this topic on angles formed by intersections in the exterior of your circle. Bye.