

## Module 9: Polygons

### Topic 2 Content: Exterior Angles of a Polygon Transcript

Hi, guys. Welcome to Geometry. This topic is going to focus on the exterior angles of a polygon. Now, your knowledge of the interior angles of a polygon is going to come in handy for you during this topic. Are you ready to get started? Let's go.

Just so you understand what an exterior angle is, I'm actually going to throw back to an interior angle. Let me get my pen here. I'm just going to star this angle right here. We're going to focus on this one. I know that this is an interior angle in this polygon. What happens is, if you extend the side of a polygon, you create an exterior angle. I'm going to star that one in black. I have my interior angle and then this new angle that I've created by extending a side is an exterior angle. There's a special relationship between the interior angle of a polygon and its corresponding exterior angle, or you can think about it as the exterior angle that matches to that interior angle. You may recognize this. We talked about this angle relationship earlier on in the course. If I pull this out right here, an exterior angle and its corresponding or its matching interior angle form a linear pair. That means the sum of an interior angle with its matching or its corresponding exterior angle is 180 degrees. That's a special relationship between interior and exterior angles in a polygon.

Now that you know what an exterior angle is, take a look here. In a polygon, whether it's regular like this three sided polygon here or its non-regular like this three sided polygon here, the sum of your exterior angles is always 360 degrees. Here I have a three sided polygon or a triangle. If you focus just on those exterior angles,  $120 + 120 + 120$  is 360 degrees. If I have a regular polygon, the sum of the exterior angles is always 360 and if I have a non-regular polygon. In this case, I have an exterior angle that's 120, 160, and 80, but it is still the sum 360 degrees. For any polygon you have, whether it's regular or it's non-regular, the sum of those exterior angles, 360 degrees.

Keep that in mind and take a look at this first example. Here we're asked to solve for  $x$ . We're given some angle measures here in our polygon. One thing I want you to notice on this one is that ... Let me circle this here. Have an exterior angle here and an exterior angle here and here and here, but I'm missing the one I need right here. I need to use this interior angle to figure out the measure for this exterior angle. Remember what we discussed that an interior and its corresponding exterior angle have a sum of 180 degrees. That means that if this angle is 130, then  $180 - 130$ , that's 50 degrees. This exterior angle right here, 50 degrees. Now that I know that, I can use what I know about the sum of exterior angles, set up my equation, and solve for  $x$ . I know the sum is going to have to be 360. I'll have  $3x + 30 + 2x + 50 + 80 + 60$  ... I'm about to run off here, so let's scoot some things a little bit. Let me take that. I'm going to scoot it right down here so we have some more workspace. Let me make sure I got them all.  $3x + 30 + 2x + 50 + 80 + 60$ , that's all going to add up to equal 360.

Now let's take our equation and let's solve for  $x$ . Let's scroll down a little bit here and let's combine our like terms. We have  $3x + 2x$ , so that's  $5x$ . Then we have  $30 + 50 + 80 + 60$ . Let's combine these a little bit and then go to the calculator. We have  $80 + 30 + 50$ , which is 80.  $80 + 80$  is 160. Let's do  $160 + 60$ .  $160 + 60$ , 220. Let's get this back up here. We have  $5x + 220 = 360$ . Subtract 220 from each side. Let's get rid of that there.  $5x = 140$ . Let's divide by 5, extend that a little bit.  $x =$ , we're going to have 140 divided by 5. Back to our calculator, 140 divided by 5. That is 28.  $x = 28$ . We're all done with this one.

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We see how, I'm going to scroll back up to the top. First we determined if we did actually have measures of exterior angles. Remember, we went around and we circled those angles. We realized we were missing one, but we figured it out because we knew this was a linear pair, so that exterior angle had to measure 50 degrees. Once we knew that, we set up our equation. We knew that the sum of our exterior angles was 360 degrees. We used our algebra skills. We solved for  $x$ . We figured out that  $x = 28$ . You see how a lot of things came together for us here, but we were able to work our way to that answer.

Let's move on to the next one. This one is your turn. Let me move that out of your way. Go ahead and press pause, take a few minutes, work your way through this one. Press play when you're ready to check your answer.

All right, let's see how you did on this one. Let me make sure I've got my pen. The first thing I'm going to make sure I have exterior angles. In this case, they're all exterior, so I don't need to do any extra math work to figure out any of these measures. I know that the sum of my exterior angles, always 360.  $12x + 140 + 100 = 360$ . Let's combine like terms here.  $12x + 240 = 360$ . Subtract 240 from each side.  $12x = 360 - 240$ . That's 120. Last step, divide each side by 12. We have  $x = 10$ . We're all done and we've got it. This one didn't have that extra step, so it was a little more straight forward, but again, you used what you knew about the sum of exterior angle measures, you set up your equation, you used your algebra skills, and you solved for  $x$ .

Let's keep going here. Now what is the measure of angle 3 in the regular pentagon below? Let's look at what we have here. I notice I have exterior angle measures marked. Angle 3 is one of those exterior angles and I'm told that this is a regular pentagon. What that means is that each of these exterior angles is congruent, each of those measures. I need to figure out what's the sum of the measures. I need to split that sum equally up among these angles. Since these are exterior angles, I know their sum is 360. I need to figure out 360 divided by 5. I need to divide that by 5 which will have me basically split up that sum between those five angles. Let's go to our calculator. 360 divided by 5. That is 72. Back to our work. Let's go full screen. That equals 72. That means that each of these angle measures is 72 degrees, but I was specifically asked for the measure of angle 3. The measure of angle 3 is 72 degrees. You're all done with that one. All right, good job on that.

Let's keep going here. It's your turn. Go ahead and press pause. Take a few minutes, work your way through this one. Press play when you're ready to check your work.

All right, let's see how you did here. What's the measure of each exterior angle of a regular 18-gon? I have a polygon with 18 sides. 360, because I know the sum is 360 degrees but needs to be split up equally between those 18 angles. 360 divided by 18, 360 divided by 18, that is 20. That means that each of those exterior angles in this regular 18-gon measures 20 degrees. You're all done with that one. Good job.

All right guys, you've reached the conclusion of this topic on the exterior angles of a polygon. I hope you saw how your knowledge of interior angles as well as your algebra skills helped you get through this lesson. Bye.