Objectives

- Students will develop the equation for a circle centered at (0, 0) from the Pythagorean Theorem.
- Students will write equations of circles given a radius and center at (0, 0)
- Students will solve equations of circles for y in terms of x.

Vocabulary

- Radius
- Center
- Circle
- Pythagorean Theorem

About the Lesson

- In this activity students will explore the creation of a circle skirt
- Students will need familiarity with the Pythagorean Theorem.
- Students will need to be able to solve equations involving squares and square roots.
- Students will need to be able to find the radius of a circle given its circumference.

TI-Nspire™ Navigator™

- Send out the *STYLE_BY_STEM.tns* file.
- Monitor student progress using Class Capture
- Use Class Capture to monitor student's use of the TI-Nspire document.

Activity Materials

- Compatible TI Technologies : TI-Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld
- Watch for additional Tech Tips throughout the activity for the specific technology you are using. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire Apps. Slight variations to these directions may be required if using technologies other than the handheld.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

TI-Nspire document

STYLE_BY_STEM.tns

Integration of Algebra, Geometry and Fashion

In this activity, the students will investigate how the points on a circle can lead to some mathematics that is useful when designing a particular type of skirt for a special client.

1. Open the document: STYLE_BY_STEM.tns

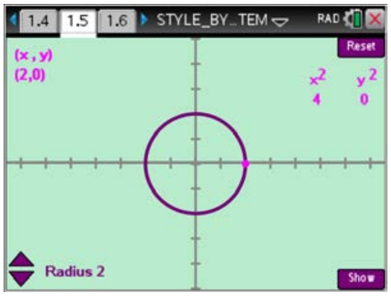
2. Read the opening screen and move to page 1.2.

3. Read pages 1.2 to 1.4 and make notes as needed.

4. Navigate to page 1.5. Use the right and left arrow keys to move the red point around the circle. Right moves the point clockwise and left moves counter clockwise.

   As you move the point around the circle what patterns do you notice? What values are *X* and *Y* always between?

   Answer: Answers may vary, but lead students to a discussion of how *X* and *Y* are always between -2 and 2. Also how X^2 and Y^2 are always positive.



> **Teacher Tip:** Student responses may vary if they have changed the radius. Be sure they keep the radius constant while answering questions 4 – 6.

> **Tech Tip:** For the iPad, use your finger or a stylus to move the red point around the circle

5. For the original circle, move the point to nine different positions and fill out the table below.

Note that students' values may differ. Also note that the values are rounded to the nearest hundredth.

X	Y	X^2	Y^2	X^2+Y^2
0.00	2.00	0.00	4.00	4.00
0.39	1.96	0.15	3.85	4.00
0.77	1.85	0.59	3.41	4.00
1.11	1.66	1.23	2.77	4.00
1.41	1.41	2.00	2.00	4.00
1.66	1.11	2.77	1.33	4.00
1.85	0.77	3.41	0.59	4.00
1.96	0.39	3.85	0.15	4.00
2.00	0.00	4.00	0.00	4.00

Use your work in the table to answer the questions below.

a. Between what two values is X^2 always between?

Answer: 0 and 4.

b. What is the maximum value for Y^2?

Answer: 4

c. What do you notice about the sum of X^2 and Y^2?

Answer: It has a constant value. 4. Some students should comment that this is the radius squared.

d. Why do you suppose this happens?

Answer: Answers will vary, but students should talk about the constraint of the (x, y) pair lying on the circle.

6. Press the + key to show a right triangle.

a. As you move the point around now, what coordinate value corresponds to the length of the horizontal leg of the triangle? What coordinate value corresponds to the length of the vertical leg?

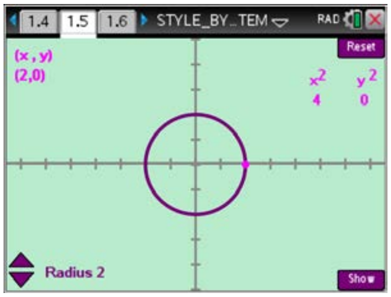
Answer: The X coordinate goes with the horizontal leg and the Y coordinate goes with the vertical leg.

b. What part of the triangle represents the radius of the circle?

Answer: The hypotenuse.

c. Write an equation showing how the lengths of the legs are related to the length of the hypotenuse of the triangle.

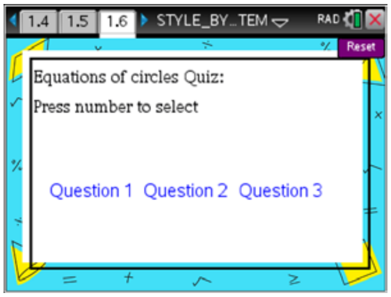
Answer: $X^2+Y^2=4$ **or** $X^2+Y^2=R^2$



7. Press the up and down arrow keys or type a number 1 – 4 to change the radius. Does the pattern you noticed in part 6c. hold true for any circle centered at (0, 0)? Explain

   Answer: Yes. For each radius chosen, the sum of X^2 and Y^2 remains constant, equivalent to the radius squared.

8. Based on your exploration, what is the equation of a circle centered at (0, 0) with radius *r*?
   Answer: $X^2 + Y^2 = R^2$

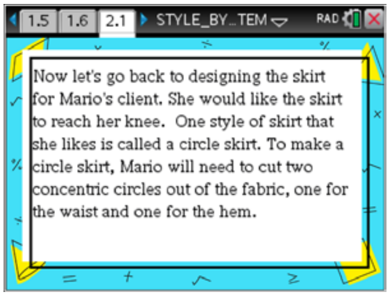


9. Move to page 1.6. Use the number keys to select an item for the Equations of a Circle Quiz. Write your answers to all three questions below. Show the necessary work. (Hint: the equals sign is under the test menu on your calculator)

   a. Question 1: What is the equation of a circle with radius 5, centered at (0, 0)?
      Answer: $X^2 + Y^2 = 25$

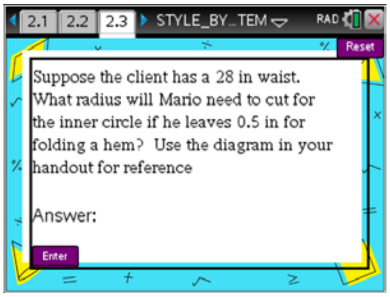
   b. Question 2: What is the radius of a circle that is defined by the equation, $X^2 + Y^2 = 144$?
      Answer: 12

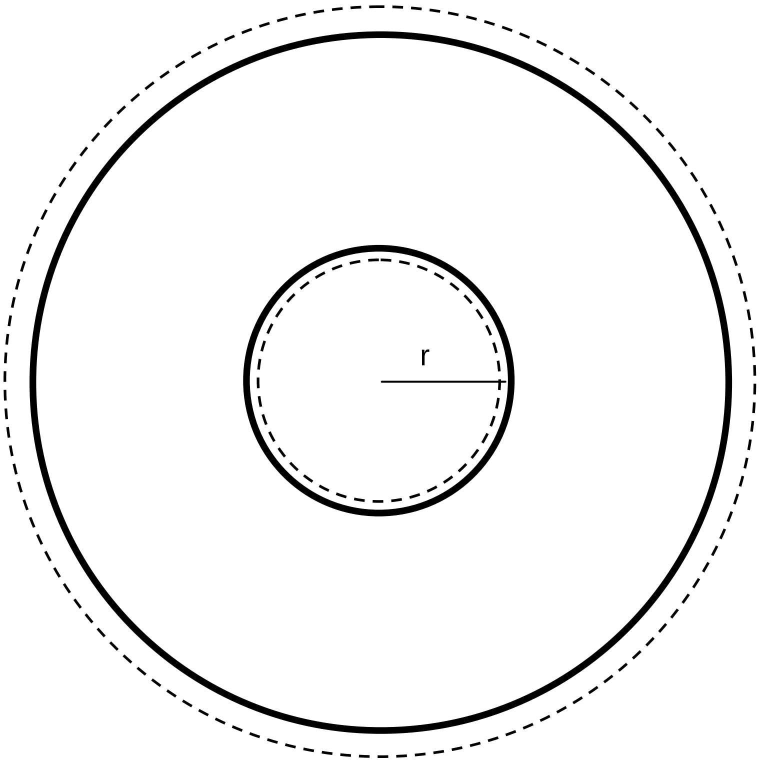
   c. Question 3: What is the equation of the circle with radius $\sqrt{24}$, centered at (0, 0)?
      Answer: $X^2 + Y^2 = 24$



10. Now that you have generalized the equation for a circle at (0, 0), we are ready to get back to designing the circle skirt with Mario. Press ▶ to proceed to page 2.1. Read pages 2.1 and 2.2 making notes if necessary.

11. Answer the question on page 2.3 using the diagram of the pattern below. The dashed lines are the cuts and the solid lines represent where the hems will be folded.

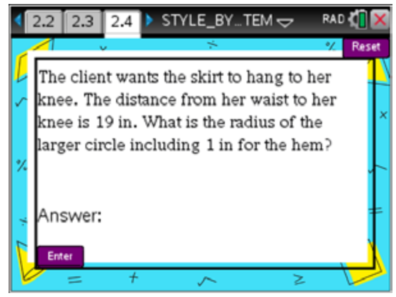


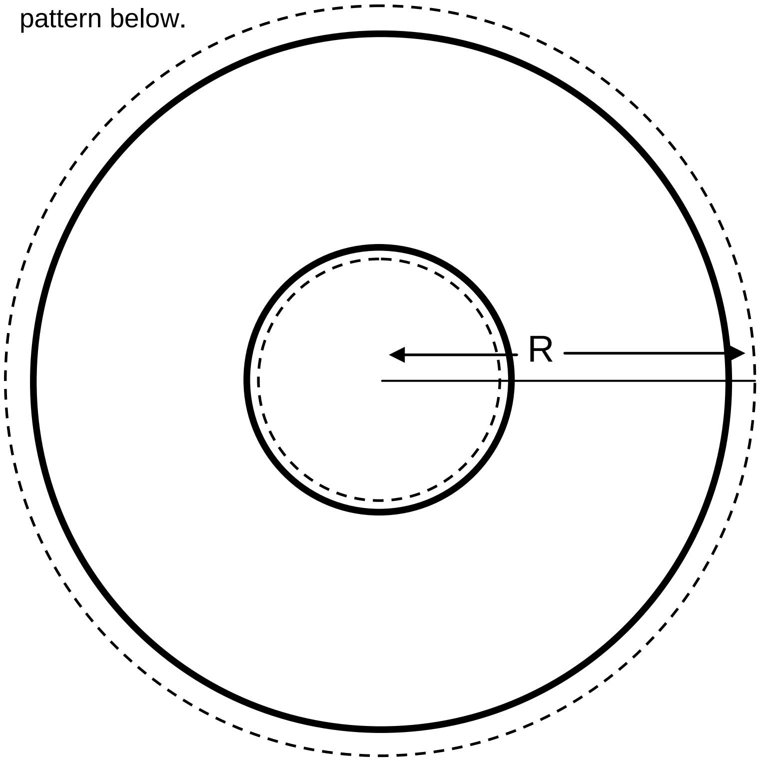


Round your answer to the nearest half inch.

Answer: $\frac{28}{2\pi} \approx 4.5$ **and** $4.5 - 0.5 = 4$ **So, the cut radius should be 4 inches.**

12. Answer the question on page 2.4 using the diagram of the pattern below.





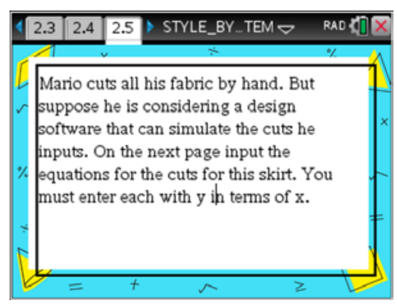
Round your answer to the nearest half inch.

Answer: $4+19+1=24$ **inches.**

13. Read page 2.5. Write the equations for the circles of each cut Mario will have to make. Assume that the center of the skirt is at (0, 0).

Answer: $X^2+Y^2=24^2$ **for the large radius and**

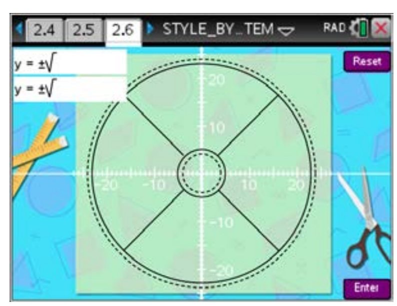
$X^2+Y^2=4^2$ **for the small radius**



14. On page 2.6 make sure to solve your equations from part 14 for Y in terms of X, then enter the positive portion of the equations into the appropriate prompts. The outer hem equation goes in the top box and the inner hem equation goes in the bottom box.

Answer: $Y=\sqrt{576-X^2}$ **for the outer hem and**

$Y=\sqrt{16-X^2}$ **for the inner hem.**



Note: Page 2.6 provides additional practice writing equations of circles with randomly generated circle skirt patterns by selecting the new button.