

Explore It!

Latoya cut a circle into 8 equal sections and arranged the pieces to form a shape resembling a parallelogram.

Lesson 10-6

Solve Problems Involving Area of a Circle

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I can...
solve problems involving the area of a circle.

A. How is the base length of the new shape related to the circumference of the circle?

B. How is the height of the new shape related to the radius of the circle?

C. Since this new shape was made from a circle, use the information from the diagram and the formula for the area of the parallelogram, $A = bh$, to discover the formula for the area of a circle.

Focus on math practices

Look for Relationships The formula $A = bh$ can be used to find a good estimate for the area of the cut-out diagram. What would happen to this estimate if the circle were cut into 100 sections? 1,000 sections?

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Essential Question

How can the area formula for a circle be used to solve problems?

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EXAMPLE 1

Solve Problems Involving the Area of a Circle

The floor of a new butterfly conservatory will be a circle with an 18-foot radius. The material for the floor will cost \$3.95 per square foot. About how much will the floor cost?

STEP 1 Use the formula for the area of a circle to find the area of the floor.

An approximation for π is 3.14.

$$A = \pi r^2$$

$$A \approx (3.14)(18)^2$$

$$A \approx (3.14)(324)$$

$$A \approx 1,017.36$$

The area of the floor of the new conservatory is about 1,018 square feet.

Reasoning Why round the area to the next whole foot?

STEP 2 Calculate the cost of the necessary floor material.

Cost per square foot

$$3.95 \times 1,018 = 4,021.10$$

Total square feet of floor Total cost of the floor

The total cost of the floor will be about \$4,021.

Try It!

At a school play, there is a spotlight above the center of the floor that covers a lighted area with a radius of 7 feet. What is the area covered by the spotlight?

$$A = \pi r^2$$

$$A = \left(\frac{22}{7}\right) \cdot \square^2$$

An approximation for π is $\frac{22}{7}$.

$$A = \frac{22}{7} \cdot \square$$

$$A = \square$$

The area covered by the spotlight is about \square square feet.

Convince Me! If the diameter of a circle is given, how would you find the area?

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EXAMPLE 2 Use Area to Find the Radius and Diameter

The athletic department wants to paint the school's mascot logo on the gym locker room wall. They start by painting a solid blue circle on the wall. What is the maximum diameter of the logo if only one quart of blue paint is used?

$A = \pi r^2$
 $78.5 = (3.14) \cdot r^2$
 $\frac{78.5}{3.14} = \frac{(3.14) \cdot r^2}{3.14}$
 $25 = r^2$
 $5 = r$

The radius is the unknown in the equation.
 An approximation for π is 3.14.
 What number times itself is equal to 25?

The radius is 5 feet, so the diameter of the school's mascot logo can be up to 10 feet.

1 quart of blue paint covers 78.5 ft².

EXAMPLE 3 Use Circumference to Find the Area of a Circle

Ellie needs new grass in the circular pen for her chickens. What is the area of the pen?

Look for Relationships How can you use the circumference to find the information needed to calculate the area?

176 feet of fencing

STEP 1 Find the radius, r , of the circular pen.
 $C = 2\pi r$
 $176 = 2 \cdot \left(\frac{22}{7}\right) \cdot r$
 $176 = \frac{44}{7} \cdot r$
 $\frac{7}{44} \cdot 176 = \frac{7}{44} \cdot \left(\frac{44}{7}\right) \cdot r$
 $28 = r$

An approximation for π is $\frac{22}{7}$.

STEP 2 Use the radius to find the area of the circular pen.
 $A = \pi r^2$
 $A = \frac{22}{7}(28)^2$
 $A = 2,464$

The area of the circular pen is about 2,464 square feet.

The radius of the circular pen is about 28 feet.

Try It!

- How far away can a person live from a radio station and hear its broadcast if the signal covers a circular area of 40,000 square miles? Write your answer as a whole number.
- What circular area is covered by the signal if the circumference is 754 miles?

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KEY CONCEPT

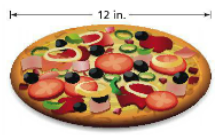
You can find the area, A , of a circle using the formula $A = \pi r^2$ where r is the radius.

$A = \pi r^2$
 Common approximations for π are 3.14 and $\frac{22}{7}$.

$A = \pi \cdot r^2$
 $r = \frac{d}{2}$

- Do You Understand?**
- Essential Question** How can the area formula for a circle be used to solve problems?
 - Be Precise** Is an area calculation exact when you use 3.14 or $\frac{22}{7}$ as a value for π ? Explain.
 - Use Structure** If you know the diameter of a circle, how can you find the area?

- Do You Know How?**
- For 4–7, use 3.14 for π .
- What is the area of a circle with a radius of 8 inches?
 - What is the radius of a circle with an area of 28.26 square feet?
 - What is the area of a circle with a circumference of 25.12 meters?
 - The diameter of a pizza is 12 inches. What is its area?

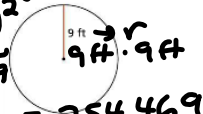


nearest tenth $A = \pi \cdot r^2$

Practice & Problem Solving

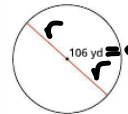
8. Find the area of the circle. Use 3.14 for π .

$A = \pi \cdot (9)^2$
 $A = \pi \cdot 9 \cdot 9$
 $A = \pi \cdot 81 = 254.469 \dots$
 $\approx 254.5 \text{ ft}^2$



9. Find the area of the circle. Use 3.14 for π .

$r = \frac{106}{2} = 53 \text{ yd}$
 $A = \pi (53 \text{ yd})^2$
 $A = \pi \cdot 53 \text{ yd} \cdot 53 \text{ yd}$



10. Jaylon created this stained-glass window. The upper two corners are quarter circles, each with a radius of 4 inches. Find the area of the window. Use 3.14 for π .



11. The circumference of a circle is 50.24 meters. What is the area of the circle? Use 3.14 for π .

$8824.7337 \dots$
 $A \approx 8824.73 \text{ yd}^2$

12. Higher Order Thinking A circular flower bed is 20 meters in diameter and has a circular sidewalk around it that is 3 meters wide. Find the area of the sidewalk in square meters. Use 3.14 for π . Round to the nearest whole number.

13. A circular plate has a circumference of 16.3 inches. What is the area of this plate? Use 3.14 for π . Round to the nearest whole number.

14. A water sprinkler sends water out in a circular pattern. How many feet away from the sprinkler can it spread water if the area formed by the watering pattern is 379.94 square feet?

$A = \pi \cdot r^2$

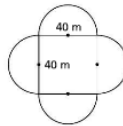
15. The circumference of a circular rug is 24.8 meters. What is the area of the rug? Use 3.1 for π . Round your answer to the nearest tenth.

$A = (3.1) \cdot (4)^2$
 $A = 3.1 \cdot (4 \cdot 4)$
 $A = 3.1 \cdot (16) \approx 49.6 \text{ m}^2$



$C = 2 \cdot \pi \cdot r$
 $24.8 = 2(3.1) \cdot r$
 $24.8 = 6.2 \cdot r$
 $4 = r$
 $r = 4 \text{ m}$

16. Frank wants to find the area enclosed by the figure at the right. The figure has semicircles on each side of a 40-meter-by-40-meter square. Find the area enclosed by the figure. Use 3.14 for π .



Assessment Practice

17. The radius of Circle A is 6 millimeters. The radius of Circle B is 3 millimeters greater than the radius of Circle A. The radius of Circle C is 5 millimeters greater than the radius of Circle B. The radius of Circle D is 3 millimeters less than the radius of Circle C.

PART A

What is the area of each circle? Use 3.14 as an approximation for π . Round each area to the nearest tenth as needed.

PART B

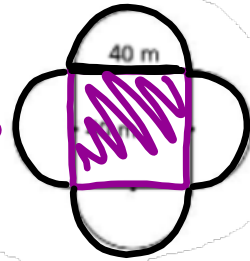
How many times greater is the area of Circle D than the area of Circle A? Round to the nearest tenth.

18. The circumference of a hubcap of a tire is 81.58 centimeters. Find the area of this hubcap. Use 3.14 as an approximation for π .

16. Frank wants to find the area enclosed by the figure at the right. The figure has semicircles on each side of a 40-meter-by-40-meter square. Find the area enclosed by the figure. Use 3.14 for π .

$$A_{\square} = l \cdot w = s^2$$

$$40\text{m} \cdot 40\text{m} = 1600\text{m}^2$$



2 whole circles

$$A_{\circ} = \pi r^2$$

$$A_{\circ} = \pi \cdot (20\text{m})^2$$

$$A_{\circ} = \pi \cdot (20\text{m})(20\text{m}) \quad \swarrow \text{1 circle}$$

$$A = \pi \cdot 400\text{m}^2 = 1256.637 \dots \text{m}^2$$

$$\times 2$$

$$\approx 2513.274 \text{m}^2$$

$$d = 40\text{m}$$

$$r = \frac{40}{2} = 20\text{m}$$

