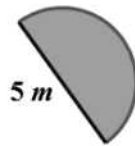Name _____   Date_____

# More Problems on Area and Circumference

1. Ken's landscape gardening business creates odd-shaped lawns that include semicircles. Find the area of this semicircular section of the lawn in this design. Use $\frac{22}{7}$ for π.


5 m

2. In the figure below, Ken's company has placed sprinkler heads at the center of the two small semicircles. The radius of the sprinklers is 5 ft. If the area in the larger semicircular area is the shape of the entire lawn, how much of the lawn will not be watered? Give your answer in terms of π and to the nearest tenth. Explain your thinking.


10 ft.
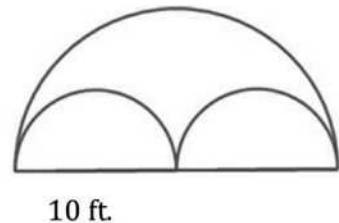
1. Mark created a flowerbed that is semicircular in shape, as shown in the image. The diameter of the flower bed is 5 m.
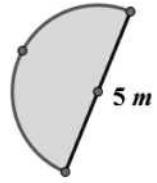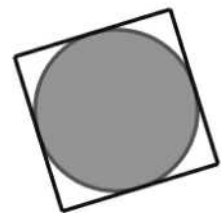
   a. What is the perimeter of the flower bed? (Approximate π to be 3.14.)

   b. What is the area of the flowerbed? (Approximate π to be 3.14.)

2. A landscape designer wants to include a semicircular patio at the end of a square sandbox. She knows that the area of the semicircular patio is 25.12 cm^2.

   a. Draw a picture to represent this situation.

   b. What is the length of the side of the square?

3. A window manufacturer designed a set of windows for the top of a two-story wall. If the window is comprised of 2 squares and 2 quarter circles on each end, and if the length of the span of windows across the bottom is 12 feet, approximately how much glass will be needed to complete the set of windows?
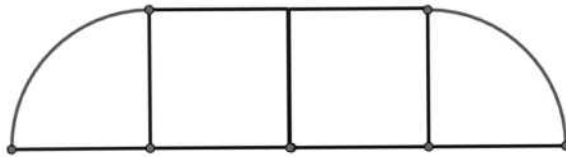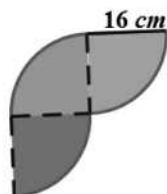

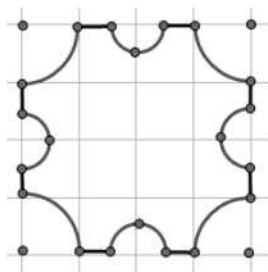4. Find the area of the shaded region. (Approximate π to be $\frac{22}{7}$.)
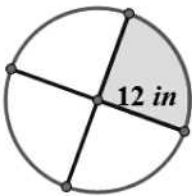
5. The figure below shows a circle inside of a square. If the radius of the circle is 8 cm, find the following and explain your solution.

   a. The circumference of the circle.

   b. The area of the circle.
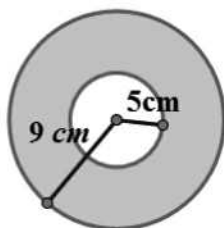
   c. The area of the square.

6. Michael wants to create a tile pattern out of three quarter circles for his kitchen backsplash. He will repeat the three quarter circles throughout the pattern. Find the area of the tile pattern that Michael will use. Approximate π as 3.14.

16 cm

7. A machine shop has a square metal plate with sides that measure 4 cm each. A machinist must cut four semicircles, with a radius of $\frac{1}{2}$ cm and four quarter circles with a radius of 1 cm from its sides and corners. What is the area of the plate formed? Use $\frac{22}{7}$ to approximate π.

8. A graphic artist is designing a company logo with two concentric circles (two circles that share the same center but have different radii). The artist needs to know the area of the shaded band between the two concentric circles. Explain to the artist how he would go about finding the area of the shaded region.

5cm
9 cm

9. Create your own shape made up of rectangles, squares, circles, or semicircles and determine the area and perimeter.

1. Ken's landscape gardening business creates odd-shaped lawns that include semicircles. Find the area of this semicircular section of the lawn in this design. Use $\frac{22}{7}$ for π.

If the diameter is 5 m, then the radius is $\frac{5}{2}$ m. Using the formula for area of a semicircle,

$A = \frac{1}{2}\pi r^2$, $A \approx \frac{1}{2} \cdot \frac{22}{7} \cdot \left(\frac{5}{2}\,\text{cm}\right)^2$. *Using the order of operations,*

$A \approx \frac{1}{2} \cdot \frac{22}{7} \cdot \frac{25}{4}\,\text{cm}^2 \approx \frac{550}{56} \approx 9.8\,\text{m}^2$.
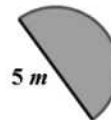
5 m

2. In the figure below, Ken's company has placed sprinkler heads at the center of the two small semi-circles. The radius of the sprinklers is 5 ft. If the area in the larger semicircular area is the shape of the entire lawn, how much of the lawn will not be watered? Give your answer in terms of π and to the nearest tenth. Explain your thinking.

The area not covered by the sprinklers would be the area between the larger semicircle and the two smaller ones. The area for the two semicircles is the same as the area of one circle with the same radius of 5 ft. The area not covered by the sprinklers can be found by subtracting the area of the two smaller semicircles from the area of the large semicircle.

10 ft.

Area Not Covered = Area of large semicircle − Area of two smaller semicircles

$$A = \frac{1}{2}\pi \cdot (10\,\text{ft.})^2 - \left(2 \cdot \left(\frac{1}{2}(\pi \cdot (5\,\text{ft.})^2)\right)\right)$$

$$A = \frac{1}{2}\pi \cdot 100\,\text{ft}^2 - \pi \cdot 25\,\text{ft}^2$$

$$A = 50\pi\,\text{ft}^2 - 25\pi\,\text{ft}^2 = 25\pi\,\text{ft}^2$$

Let $\pi \approx 3.14$

$A \approx 78.5\,\text{ft}^2$

The sprinklers will not cover $25\pi\,\text{ft}^2$ or $78.5\,\text{ft}^2$ of the lawn.

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1. Mark created a flowerbed that is semicircular in shape. The diameter of the flower bed is 5 m.
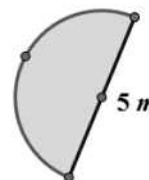
   a. What is the perimeter of the flower bed? (Approximate π to be 3.14.)

   The perimeter of this flower bed is the sum of the diameter and one-half the circumference of a circle with the same diameter.

   $P = \text{diameter} + \frac{1}{2}\pi \cdot \text{diameter}$

   $P \approx 5\,\text{m} + \frac{1}{2} \cdot 3.14 \cdot 5\,\text{m}$

   $P \approx 12.85\,\text{m}$

   5 m

b. What is the area of the flowerbed? (Approximate π to be 3.14.)

$$A = \frac{1}{2}\pi\,(2.5\text{ m})^2$$
$$A = \frac{1}{2}\pi\,(6.25\text{ m}^2)$$
$$A \approx 0.5 \cdot 3.14 \cdot 6.25\text{ m}^2$$
$$A \approx 9.8\text{ m}^2$$

2. A landscape designer wants to include a semicircular patio at the end of a square sandbox. She knows that the area of the semicircular patio is 25.12 cm^2.

a. Draw a picture to represent this situation.

b. What is the length of the side of the square?

If the area of the patio is 25.12 cm^2, then we can find the radius by solving the equation $A = \frac{1}{2}\pi r^2$ and substituting the information that we know. If we approximate π to be 3.14 and solve for the radius, r, then $25.12\text{ cm}^2 \approx \frac{1}{2}\pi r^2$.

$$\frac{2}{1} \cdot 25.12\ \text{cm}^2 \approx \frac{2}{1} \cdot \frac{1}{2}\pi r^2$$
$$50.24\ \text{cm}^2 \approx 3.14 r^2$$
$$\frac{1}{3.14} \cdot 50.24\ \text{cm}^2 \approx \frac{1}{3.14} \cdot 3.14 r^2$$
$$16\ \text{cm}^2 \approx r^2$$
$$4\ \text{cm} \approx r$$

The length of the diameter is 8 cm; therefore, the length of the side of the square is 8 cm.

3. A window manufacturer designed a set of windows for the top of a two-story wall. If the window is comprised of 2 squares and 2 quarter circles on each end, and if the length of the span of windows across the bottom is 12 feet, approximately how much glass will be needed to complete the set of windows?
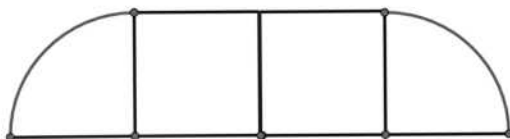
The area of the windows is the sum of the areas of the two quarter circles and the two squares that make up the bank of windows. If the span of windows is 12 feet across the bottom, then each window is 3 feet wide on the bottom. The radius of the quarter circles is 3 feet, so the area for one quarter circle window is $A = \frac{1}{4}\pi \cdot (3\text{ ft.})^2$ or $A \approx 7.065\text{ ft}^2$. The area of one square window is $A = (3\text{ ft.})^2$ or 9 ft^2. The total area is $2(\text{area of quarter circle}) + 2(\text{area of square})$, or $A \approx (2 \cdot 7.065\text{ ft}^2) + (2 \cdot 9\text{ ft}^2) \approx 32.13\text{ ft}^2$.

4. Find the area of the shaded region. (Approximate π to be $\frac{22}{7}$.)
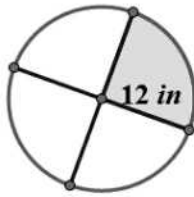
$$A = \frac{1}{4}\pi(12 \text{ in})^2$$

$$A = \frac{1}{4}\pi \cdot 144 \text{ in}^2$$

$$A \approx \frac{1}{4} \cdot \frac{22}{7} \cdot 144 \text{ in}^2$$

$$A \approx \frac{792}{7} \text{ in}^2 \text{ or } 113.1 \text{ in.}$$

5. The figure below shows a circle inside of a square. If the radius of the circle is 8 cm, find the following and explain your solution.

   a. The circumference of the circle

   $$C = 2\pi \cdot 8 \text{ cm}$$

   $$C = 16\pi \text{ cm}$$

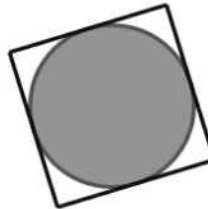   b. The area of the circle

   $$A = \pi \cdot (8 \text{ cm})^2$$
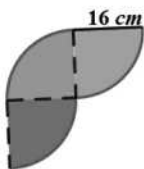
   $$A = 64\,\pi \text{ cm}^2$$

   c. The area of the square

   $$A = 16 \text{ cm} \cdot 16 \text{ cm}$$

   $$A = 256 \text{ cm}^2$$

6. Michael wants to create a tile pattern out of three quarter circles for his kitchen backsplash. He will repeat the three quarter circles throughout the pattern. Find the area of the tile pattern that Michael will use. Approximate π as 3.14.

   There are three quarter circles in the tile design. The area of one quarter circle multiplied by 3 will result in the total area.
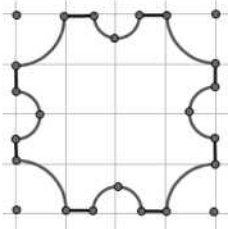
   16 cm

   $$A = \frac{1}{4}\pi \cdot (16 \text{ cm})^2$$

   $$A \approx \frac{1}{4} \cdot 3.14 \cdot 256 \text{ cm}^2$$

   $$A \approx 200.96 \text{ cm}^2$$

   The area of the tile pattern is $A \approx 3 \cdot 200.96 = 602.88 \text{ cm}^2$.

7. A machine shop has a square metal plate with sides that measure 4 cm each. A machinist must cut four semicircles with a radius of $\frac{1}{2}$ cm and four quarter circles with a radius of 1 cm from its sides and corners. What is the area of the plate formed? Use $\frac{22}{7}$ to approximate π.

The area of the metal plate is determined by subtracting the four quarter circles (corners) and the four half-circles (on each side) from the area of the square. Area of the square: $A = (4 \text{ cm})^2 = 16 \text{ cm}^2$.

The area of four quarter circles is the same as the area of a circle with a radius of 1 cm: $A \approx \frac{22}{7}(1 \text{ cm})^2 \approx \frac{22}{7} \text{ cm}^2$.

The area of the four semicircles with radius $\frac{1}{2}$ cm is

$$A \approx 4 \cdot \frac{1}{2} \cdot \frac{22}{7} \cdot \left(\frac{1}{2} \text{ cm}\right)^2$$

$$A \approx 4 \cdot \frac{1}{2} \cdot \frac{22}{7} \cdot \frac{1}{4} \text{ cm}^2 \approx \frac{11}{7} \text{cm}^2.$$

Area of metal plate:

$$A \approx 16 \text{ cm}^2 - \frac{22}{7} \text{ cm}^2 - \frac{11}{7} \text{ cm}^2 \approx \frac{79}{7} \text{ cm}^2$$

8. A graphic artist is designing a company logo with two concentric circles (two circles that share the same center but have different radii). The artist needs to know the area of the shaded band between the two concentric circles. Explain to the artist how he would go about finding the area of the shaded region.
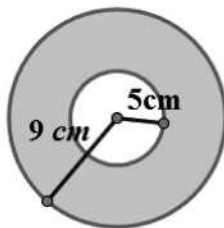
The artist should find the areas of both the larger and smaller circles. Then, the artist should subtract the area of the smaller circle from the area of the larger circle to find the area between the two circles. The area of the larger circle is

$A = \pi \cdot (9 \text{ cm})^2 \text{ or } 81\pi \text{ cm}^2.$

The area of the smaller circle is

$A = \pi (5 \text{ cm})^2 \text{ or } 25\pi \text{ cm}^2.$

The area of the region between the circles is $81\pi \text{ cm}^2 - 25\pi \text{ cm}^2 = 56\pi \text{ cm}^2$. If we approximate π to be 3.14, the then $A \approx 175.84 \text{ cm}^2$.

9. Create your own shape made up of rectangles, squares, circles, or semicircles and determine the area and perimeter.

Student answers may vary.