


Explore It!

The distance around a circle and the distance across a circle are related.



A. Use string to measure the distance across each circle. How many of these lengths does it take to go completely around the circle?

B. Use the string and a ruler to measure the distance across the circle and the distance around the circle. Complete the table. Round each measurement to the nearest quarter inch.

	Button	Disk	Dartboard
Distance Around the Circle	□	□	□
Distance Across the Circle	□	□	□

C. What do you notice about the ratio of the distance around the circle to the distance across the circle for each circle?

Lesson 8-5

Solve Problems Involving Circumference of a Circle

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I can...
solve problems involving radius, diameter, and circumference of circles.

Focus on math practices

Look for Relationships How can you estimate the distance around any circle when given the distance across the circle?

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Essential Question

How is the circumference of a circle related to the length of its diameter?

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I can...
solve problems involving radius, diameter, and circumference of circles.

EXAMPLE 1

Describe Parts of a Circle and Find Circumference to Solve Problems

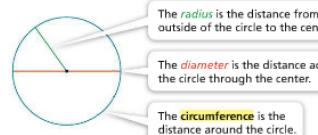
Mark recently replaced his front bicycle wheel. How far does the bike travel with each revolution of his new front wheel?

Look for Relationships
How is one revolution of the wheel related to linear distance?



Diameter = 26 inches

Relate the given information to the parts of a circle.



The **radius** is the distance from the outside of the circle to the center.

The **diameter** is the distance across the circle through the center.

The **circumference** is the distance around the circle.

π is the ratio of the circumference, C , of a circle to its diameter, d .

π is a decimal that never repeats or terminates. $\pi = 3.14159...$

$\frac{C}{d} = \pi$
 $C = \pi d$

Use the circumference formula to calculate the distance around the wheel.

$C = \pi d$
 $C = \pi(26)$
 $C = 26\pi$

The circumference is exactly 26π .

$C \approx 26(3.14)$
 $= 81.64$

To approximate the distance, use 3.14 for π .

The distance around the wheel is about 81.64 inches. So the bike travels about 81.64 inches with each revolution of the wheel.


Try It!

What is the circumference of the rim of a basketball hoop with a radius of 9 inches?

First, multiply the radius by to get the diameter, inches.

Then, multiply the diameter by 3.14 (an approximation for π) to get a circumference of about inches.

Convince Me! If the diameter is doubled, what happens to the circumference? Explain.



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EXAMPLE 2 Find the Diameter Using the Circumference

Kayla and Theo got on the Ferris wheel shown. About how high will they be at the top of the Ferris wheel? Use the circumference formula to find the diameter of the Ferris wheel.



ONE WAY Use 3.14 as an approximation for π .

$$C = \pi d$$

$$220 = (3.14)d$$

Substitute 3.14 for π .

$$\frac{220}{3.14} = \frac{3.14d}{3.14}$$

$$70 = d$$

ANOTHER WAY Use $\frac{22}{7}$ as an approximation for π .

$$C = \pi d$$

$$220 = \left(\frac{22}{7}\right)d$$

Substitute $\frac{22}{7}$ for π .

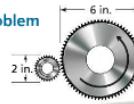
$$\frac{7}{22} \cdot 220 = \frac{7}{22} \cdot \frac{22}{7} d$$

$$70 = d$$

Kayla and Theo will be about 70 feet above the ground when at the top of the Ferris wheel.

EXAMPLE 3 Use Circumference to Solve a Problem

The larger gear turns twice per second. It causes the smaller gear to turn. How fast does the smaller gear turn per second?



STEP 1 Use the circumference formula to find the circumferences of the larger gear and the smaller gear.

Larger gear	Smaller gear
$C = \pi d$	$C = \pi d$
$C = (3.14)(6)$	$C = (3.14)(2)$
$C = 18.84$	$C = 6.28$

STEP 2 Divide to find the number of full turns the smaller gear makes when the larger gear makes one full turn.

$$\frac{18.84}{6.28} = 3$$

The smaller gear makes three full turns for every full turn of the larger gear.

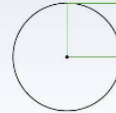
STEP 3 Multiply to find the number of full turns the smaller gear makes in one second.

$$3 \times 2 = 6$$

The larger gear turns two times per second.
The smaller gear makes 6 full turns per second.

Try It!

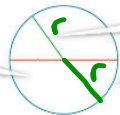
The circle has a circumference of 9.42 units. What is the area of the square? Use 3.14 for π . Explain how you found the answer.



KEY CONCEPT

The parts of a circle and their relationships are summarized in the diagram below.

The ratio of the circumference of a circle to its diameter is π . The value of π is approximately 3.14 or $\frac{22}{7}$.

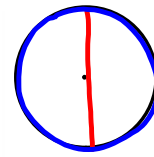
$$\pi = \frac{C}{d}$$


The radius of a circle is half the length of its diameter.

Circumference is the distance around a circle. It can be calculated using the formula $C = \pi d$ or equivalently $C = 2\pi r$.

$$C = 2 \cdot \pi \cdot r$$


$$\frac{C}{d} = 3.14 \dots$$



$$\frac{C}{d} = 3.14$$

Do You Understand?

- Essential Question** How is the circumference of a circle related to the length of its diameter?
- Construct Arguments** Are there any circles for which the relationship between the diameter and circumference cannot be represented by π ? Explain.
- Be Precise** Can you find the exact circumference of a circle when you multiply the diameter by $\frac{22}{7}$? Explain.

Do You Know How?

- What is the circumference of a circle with a radius of 5 inches?
- What is the diameter of a circle with a circumference of 10.99 feet?

$$\frac{C}{d} = \pi \cdot \frac{d}{d}$$

$$C = \pi \cdot d$$



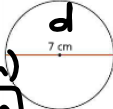
$C = \pi \cdot d$ or $C = 2 \cdot \pi \cdot r$

y: 4
4y

Practice & Problem Solving


7. Find the circumference of the circle. Use π as part of the answer.

$C = \pi \cdot d$
 $C = \pi \cdot (7\text{cm})$
 $C = 7\pi \text{ cm}$



9. Find the circumference of the circle. Use π as part of the answer.

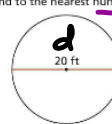
$C = 2\pi r$
 $C = 2\pi \cdot (12)$
 $C = (2 \cdot 12)\pi \rightarrow 24\pi \text{ mi}$



11. Find the diameter of a circle with a circumference of 27 centimeters. Use 3.14 for π . Round to the nearest tenth.


8. Find the circumference of the circle. Use 3.14 for π . Round to the nearest hundredth.

$C = \pi \cdot d$
 $C = (3.14) \cdot (20\text{ft})$
 $C = 62.8318 \dots$
 $C \approx 62.83\text{ft}$

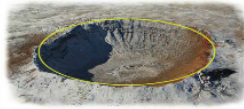


10. Find the circumference of the circle. Use 3.14 for π . Round to the nearest hundredth.

$C = 2\pi r$
 $C = 2(3.14)(9.5)$
 $C \approx 59.690 \dots$

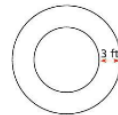


12. The distance around a meteor crater is 9,687 feet. Find the diameter of the crater. Use $\frac{22}{7}$ for π . Round to the nearest tenth.

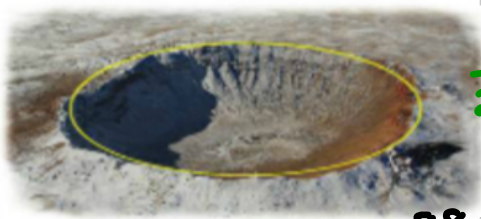


$C \approx 59.69 \text{ cm}$

13. **Make Sense and Persevere** The circumference of the inner circle is 44 feet. The distance between the inner circle and the outer circle is 3 feet. By how many feet is the circumference of the outer circle greater than the circumference of the inner circle? Use $\frac{22}{7}$ for π . Round to the nearest hundredth of a foot.



12. The distance around a meteor crater is 9,687 feet. Find the diameter of the crater. Use $\frac{22}{7}$ for π . Round to the nearest tenth.



$C = \pi \cdot d$
 $\frac{22}{7} \cdot 9687 = \frac{22}{7} \cdot d$

$3082.227 = d$

$3082.2\text{ft} \approx d$

The diameter of the crater is about 3082.2 ft.

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 $11 \overline{) 9687}$
 $\underline{-88}$
 88
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 07

14. **Generalize** What is the ratio of the radius to the circumference of any circle, using 3.14 for π ?

15. What is the radius of a circle with a circumference of 26.69 centimeters?

$$C = 2 \cdot \pi \cdot r$$

$$\frac{26.69}{2\pi} = \frac{2 \cdot \pi \cdot r}{2\pi}$$

$$4.247\dots = r$$

≈ 4.2 cm
The radius of the circle is about 4.2 cm.



16. **Higher Order Thinking** A unicycle wheel makes five rotations. The unicycle travels 37.94 feet. Find the diameter of the wheel in inches. Use 3.14 for π . Round to the nearest tenth of an inch.

Assessment Practice

17. Camille drew the figure shown at the right.

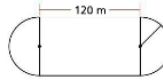
PART A

Find the perimeter of the figure. Use 3.14 for π . Round to the nearest hundredth.

PART B

Draw another figure that has the same perimeter as the given figure.

18. The diagram shows a track composed of a rectangle with a semicircle on each end. The area of the rectangle is 7,200 square meters. What is the perimeter of the track? Use 3.14 for π .



17. Camille drew the figure shown at the right.

PART A

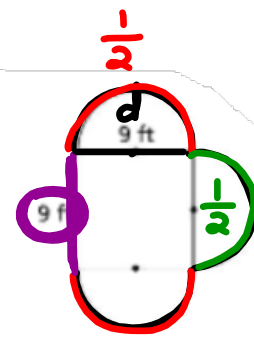
Find the perimeter of the figure. Use 3.14 for π . Round to the nearest hundredth.

Full \odot

$$C = \pi \cdot d$$

$$C = \pi (9)$$

$$C = 9\pi$$



$$9\pi \cdot 1\frac{1}{2}$$

$$\text{Total } \odot = 9\pi \cdot 1.5$$

$$42.411\dots \text{ ft}$$

$$+ 9$$

$$1 \text{ Full } \odot$$

$$+ \frac{1}{2} \odot$$

$$1\frac{1}{2} \text{ Total } \odot$$

Total ≈ 51.41 ft
Perimeter

