

# 8.2

## Circumference of a Circle

### Focus on...

After this lesson, you will be able to...

- estimate and calculate the circumference of a circle given its diameter or its radius
- solve problems involving the circumference of circles



The traditional Plains Indian powwow is an annual celebration. People gather together for storytelling, singing, dancing, and feasting. The powwow grounds are circles and the performers dance around the circle in a clockwise direction. How would you determine the distance a dancer travels in one complete trip around the circle?

### Explore the Math

#### Materials

- circular objects (cans, glasses, Frisbees™, yo-yos, wheels, etc.)
- string
- metre stick
- ruler
- calculator

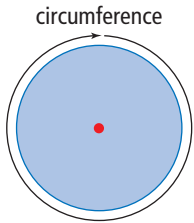
#### How does the circumference of a circle relate to its diameter?

1. Copy the following table into your notebook. Put ten rows under the column headings, so you can record data for ten objects.

Object	Circumference, $C$ (cm)	Diameter, $d$ (cm)	Circumference $\div$ Diameter

### circumference

- the distance around a circle
- usually represented by the variable  $C$
- this is a linear measurement



2. Using classroom objects, or objects from around the school, choose two circular objects of different diameters and a length of string. Use the string to measure the **circumference** of each object. Record your data in the table.



3. Use a ruler or metre stick to measure and record the diameter of each object. This is the measurement across the widest part of the circle. Record your data in the table.



4. Share your data with four classmates and gather theirs so that you have a total of ten objects in your table.
- Calculate the values of  $C \div d$  in the last column of the table, to the nearest hundredth.
  - What do you notice about your calculated values?
  - What number is approximately equal to your calculated values?
  - Why do you think there are some differences in your calculated values?

## Reflect on Your Findings

### pi

- the ratio of the circumference of a circle to its diameter,  $\frac{C}{d}$
- symbol for pi is  $\pi$

### Did You Know?

The value of pi is a non-repeating, non-terminating decimal. The most commonly used approximation for pi is 3.14.

- What is the approximate ratio between  $C$  and  $d$ ?
- This ratio represents a constant value called **pi**. It is represented by the Greek symbol  $\pi$ . Press the  $\pi$  key on your calculator. What is the approximate value of  $\pi$ ?
- Write a formula that shows how to find the circumference of a circle if you know its diameter.
- Write a formula that shows how to find the circumference of a circle if you know its radius.
- Compare your formulas with those of your classmates. Make sure that everyone agrees on the formulas.

### WWW Web Link

To learn more about pi, go to [www.mathlinks7.ca](http://www.mathlinks7.ca) and follow the links.

## Example 1: Use Diameter to Find Circumference

Traffic circles, or roundabouts, are used in some neighbourhoods to slow down traffic. Vehicles enter the circle and drive around in a counterclockwise direction.



- Estimate the circumference of this traffic circle.
- What is the circumference of the traffic circle, to the nearest tenth of a metre?
- Is your estimate reasonable?

### Solution

You are given the diameter of the traffic circle. You need to find the circumference.

$$C = \pi d, d = 5.2 \text{ m}$$

Use the formula  $C = \pi \times d$ . Use an approximate value for  $\pi$  to estimate and calculate the circumference. Substitute the diameter into the formula.

- When estimating, use 3 as an approximate value for  $\pi$ .  
The diameter of the traffic circle is about 5 m.

$$C = \pi \times d$$

$$C \approx 3 \times 5$$

$$C \approx 15$$

The circumference of the traffic circle is approximately 15 m.

The actual value should be higher because you estimated using numbers smaller than the actual numbers.

- When calculating, use 3.14 as an approximate value for  $\pi$ .

$$C = \pi \times d$$

$$C \approx 3.14 \times 5.2$$

$$C \approx 16.3$$

The circumference of the traffic circle is approximately 16.3 m.

$$\boxed{C} \quad \boxed{3.14} \quad \boxed{\times} \quad \boxed{5.2} \quad \boxed{=} \quad 16.328$$

Check that you rounded your answer to the correct number of decimal places.

Remember to use the proper units in your final answer.

- The answer of 16.3 m is close to but a bit higher than the estimate of 15 m. The estimate of 15 m is reasonable.

Understand

Plan

Do It!

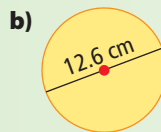
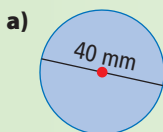
### Tech 3 Link

If your calculator has a  $\pi$  key, you can use the  $\pi$  key instead of the value 3.14.

Look Back

### Show You Know

Estimate and calculate the circumference of each circle, to the nearest tenth of a unit.



## Example 2: Use Radius to Find Circumference

The carousel is a popular children's amusement park ride. The radius of a carousel is 6.1 m.



- Estimate the circumference of the carousel. Should the actual value be higher or lower than the estimate?
- What is the circumference of the carousel, to the nearest tenth of a metre?
- Andrew sits on a horse on the inside of the carousel. The horse is 3.2 m from the centre of the carousel. How far does Andrew travel in one rotation of the carousel, to the nearest tenth of a metre?

### Solution

Use the formula  $C = 2 \times \pi \times r$ .

Recall that  $d = 2 \times r$ .



- When estimating, use 3 as an approximate value for  $\pi$ .

The radius of the carousel is about 6 m.

$$C = 2 \times \pi \times r$$

$$C \approx 2 \times 3 \times 6$$

$$C \approx 36$$

The circumference of the carousel is approximately 36 m.

The actual value should be higher because you estimated using numbers smaller than the actual numbers.

- When calculating, use 3.14 as an approximate value for  $\pi$ .

$$C = \blacksquare, r = 6.1 \text{ m}$$

$$C = 2 \times \pi \times r$$

$$C \approx 2 \times 3.14 \times 6.1$$

$$\boxed{C} \boxed{2} \boxed{\times} \boxed{3.14} \boxed{\times} \boxed{6.1} \boxed{=} \boxed{38.308}$$

$$C \approx 38.3$$

Round to the nearest tenth, which is one decimal place.

The circumference of the carousel is approximately 38.3 m.

- $C = \blacksquare, r = 3.2 \text{ m}$

$$C = 2 \times \pi \times r$$

$$C \approx 2 \times 3.14 \times 3.2$$

$$\boxed{C} \boxed{2} \boxed{\times} \boxed{3.14} \boxed{\times} \boxed{3.2} \boxed{=} \boxed{20.096}$$

$$C \approx 20.1$$

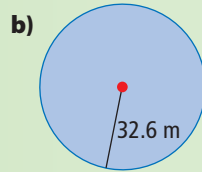
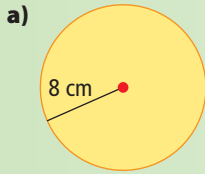
$$2 \times 3 \times 3 = 18$$

M E

Andrew travels approximately 20.1 m in one rotation of the carousel.

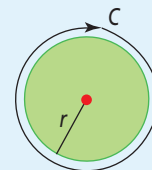
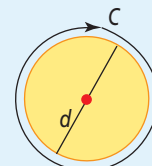
## Show You Know

Estimate and calculate the circumference of each circle, to the nearest tenth of a unit.



## Key Ideas

- The circumference of a circle is approximately three times its diameter. Use this value to estimate the circumference before calculating it.
- The ratio of the circumference of a circle to its diameter is represented by the constant value called pi, often written as  $\pi$ . The value of  $\pi$  is approximately 3.14.
- The formula relating the circumference,  $C$ , of a circle to its diameter,  $d$ , is  $C = \pi \times d$ .
- The formula relating the circumference,  $C$ , of a circle to its radius,  $r$ , is  $C = 2 \times \pi \times r$ .



## Communicate the Ideas

1. How would you determine the circumference of the circles in this Inuit artwork?
2. Dara attempts to solve the following question:

*What is the circumference of the circle, to the nearest tenth of a centimetre?*

Here is her solution:

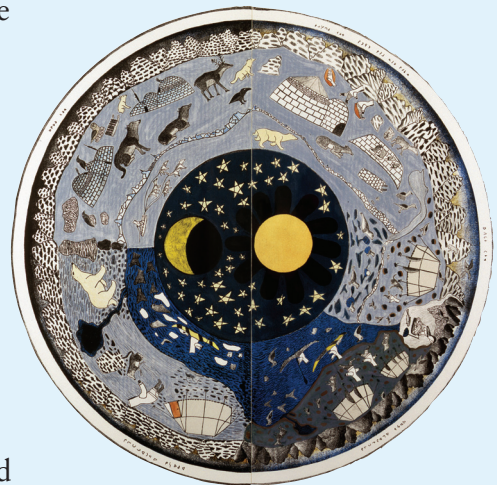
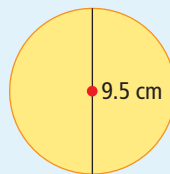
$$C = 2 \times \pi \times r$$

$$C \approx 2 \times 3.14 \times 9.5$$

$$C \approx 59.7$$

The circumference is 59.7 cm.

Is her solution correct? If not, identify the error and write a correct solution.



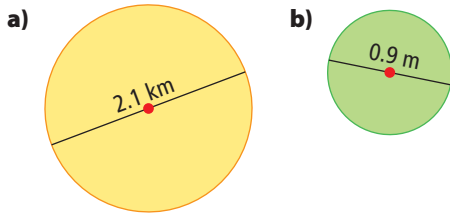
## Practise

Use 3.14 for  $\pi$  in calculations.

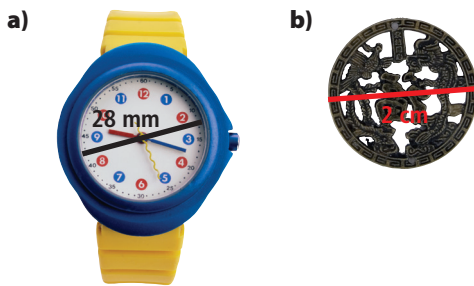
Round all answers to the nearest tenth of a unit unless otherwise specified.

For help with #3 to #6, refer to Example 1 on page 275.

3. Estimate and then calculate the circumference of each circle.



4. Estimate and then calculate the circumference of each circle.

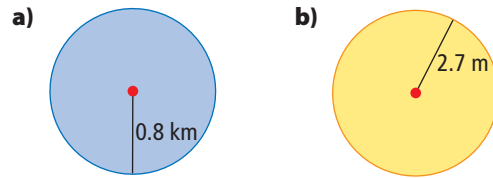


5. Suki is walking on a circular path around a park. If the circle has a diameter of 3 km, how far does she walk? Answer to the nearest kilometre.
6. The Deep Bay crater in Saskatchewan has a diameter of approximately 13 km. What is the circumference of the crater? Answer to the nearest kilometre.

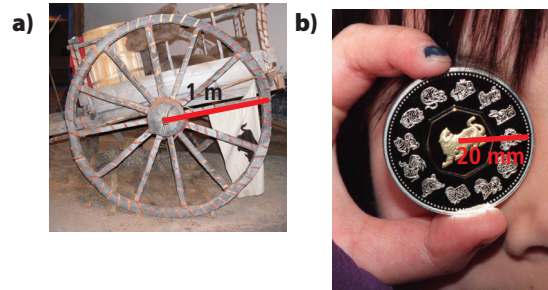


For help with #7 to #10, refer to Example 2 on page 276.

7. Estimate and then calculate the circumference of each circle.



8. Estimate and then calculate the circumference of each circle.



9. Ashley sits on a carousel horse that is 4.8 m from the centre of the carousel. How far does she travel in one rotation of the carousel?
10. The Medicine Wheel is an important symbol of the peaceful relationships among all living things. A number of stone Medicine Wheels can be found across southern Alberta. If the radius of a Medicine Wheel is 1.2 m, how far do you travel when you walk around the Medicine Wheel?



**WWW** Web Link

To learn more about Medicine Wheels, go to [www.mathlinks7.ca](http://www.mathlinks7.ca) and follow the links.

## Apply

11. Todd is practising skating drills. He skates around the face-off circle of the ice rink. If the circle has a radius of 4.5 m, how far does he skate when he goes around the circle twice?
12. Van wants to decorate some circular picture frames by gluing fancy ribbons around the circumference of each frame. She has 3.8 m of ribbon. If each frame has a diameter of 0.12 m, how many frames can she decorate?
13. A Ferris wheel has a diameter of 45.9 m.
- What is the circumference of the Ferris wheel?
  - The distance between cars on the Ferris wheel is approximately 6 m. How many cars are there on the Ferris wheel?

14. Consider the following statement.

*If the radius of a circle is doubled, the circumference is also doubled.*

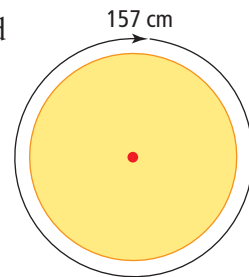
Which of the following best describes the statement? Use examples to support your answer.

- Always true
- Sometimes true
- Never true

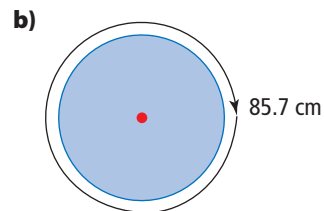
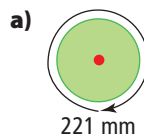
15. A basketball hoop has a circumference of 1.6 m. If a basketball has a diameter of 0.24 m, can two basketballs fit through the hoop at the same time? Justify your answer.

## Extend

16. Describe how you could use the circumference formula to determine the diameter of this circle.



17. What is the diameter of each circle with the given circumference?



18. A gardener has 36 m of fencing to make a circular enclosure. What is the radius of the largest circle that she can make?
19. A BMX bike tire has a diameter of approximately 0.45 m. A mountain bike tire has a diameter of approximately 0.6 m. In a 400-m race, how many more times will the BMX bike tire have to turn than the mountain bike tire?

## MATH LINK

The tabla is the most popular percussion instrument used in northern India. The frame for a tabla is made of wood. A single strip of wood is bent to form a circle. If a drum has a diameter of 38.5 cm, what length of wood is needed to make the frame?

