

5.4

Surface Area of a Cylinder

Focus on...

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

- find the surface area of a cylinder



Glow sticks work because of a chemical reaction. There are two solutions in separate compartments inside the stick. Once you bend the stick, the two solutions mix. This mixture creates a new solution that gives off light. The colour of the glow stick depends on the dye in the mixture. How might you determine how much plastic would be needed to make a glow stick to fit around your wrist?

Explore the Math

cylinder

- a three-dimensional object with two parallel and congruent circular bases

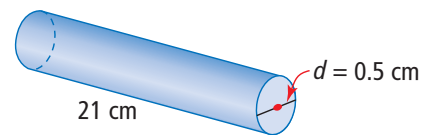


cylinder

How do you find the surface area of a right cylinder?

Work with a partner.

- Draw the net of a glow stick. Use the actual dimensions from the diagram shown.
 - Describe each face of your net.



- How can you use what you know about circles to help you find the surface area of the glow stick?

- What is the surface area of the glow stick, to the nearest hundredth of a square centimetre? Include the units in your final answer.
- Share your strategies with another group.

Reflect on Your Findings

- Would your method work for any right cylinder? Explain your reasoning.

Example 1: Determine the Surface Area of a Right Cylinder

- Estimate the surface area of the can.
- What is the surface area of the can? Express your answer to the nearest hundredth of a square centimetre?



Solution

The surface area of the can is found by adding the areas of the two circular bases and the rectangular side that surrounds them.

The width, w , of the rectangle is the height of the can.

The length, l , of the rectangle is equal to the circumference of the circle.

- To estimate, use approximate values:

$$d \approx 8 \text{ cm}, w \approx 10 \text{ cm}, \pi \approx 3.$$

$$\begin{aligned} \text{Area of circle} &= \pi \times r^2 \\ &\approx 3 \times 4 \times 4 \\ &\approx 48 \end{aligned}$$

r^2 means
 $r \times r$

How is the radius related to the diameter?

There are two circles:

$$2 \times 48 = 96$$

The area of the two circles is approximately 96 cm^2 .

$$\begin{aligned} \text{Area of rectangle} &= l \times w \\ &= (\pi \times d) \times w \\ &\approx 3 \times 8 \times 10 \\ &\approx 240 \end{aligned}$$

What formulas could you use to find the circumference of a circle?

The area of the rectangle is approximately 240 cm^2 .

$$\begin{aligned} \text{Estimated surface area} &= \text{area of two circles} + \text{area of rectangle} \\ &\approx 96 + 240 \\ &\approx 340 \end{aligned}$$

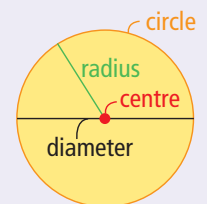
The estimated surface area is 340 cm^2 .

Did You Know?

Pop cans are cylinders. The world's largest Coke™ can is located in Portage la Prairie, Manitoba.

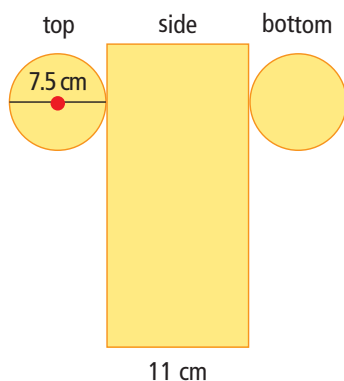


Literacy Link



Strategies**Draw a Diagram****b) Method 1: Use a Net**

Draw the net and label the measurements.



The diameter of the circle is 7.5 cm.

Determine the radius.

$$7.5 \div 2 = 3.75$$

The radius of the circle is 3.75 cm.

Find the area of one circle.

$$A = \pi \times r^2$$

$$A \approx 3.14 \times 3.75^2$$

$$A \approx 44.15625$$

Use 3.14 as an approximate value for π .

The area of one circle is approximately 44.15625 cm².

Find the area of two circles.

$$2 \times 44.15625 = 88.3125$$

The area of both circles is approximately 88.3125 cm².

Find the area of the rectangle using the circumference of the circle.

$$A = l \times w$$

$$A = (\pi \times d) \times w$$

$$A \approx 3.14 \times 7.5 \times 11$$

$$A \approx 259.05$$

The area of the rectangle is approximately 259.05 cm².

Calculate the total surface area.

$$\text{Surface area} = 88.3125 + 259.05$$

$$= 347.3625$$

The total surface area is approximately 347.36 cm².

Round your answer at the end of the calculation.

Tech Link

If your calculator has a π key, you can use it to get a more accurate answer.

Method 2: Use a Formula.

Use this formula to find the total surface area of any cylinder.

$$S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)$$

$$S.A. \approx 2 \times (3.14 \times 3.752) + (3.14 \times 7.5 \times 11)$$

$$S.A. \approx 88.3125 + 259.05$$

$$S.A. \approx 347.3625$$

The total surface area is 347.36 cm², to the nearest hundredth.

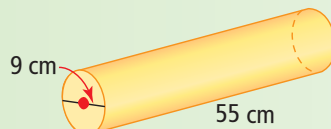
This formula incorporates each shape and its area formula to find the surface area.

$$2 \times (\pi \times r^2) + (\pi \times d) \times h$$

two circles circle area formula + rectangle area formula (length is the circumference of a circle; width is the height of the cylinder)

Show You Know

Calculate the surface area of this cylinder to the nearest tenth of a square centimetre.



Literacy Link

The abbreviation S.A. is often used as a short form for surface area.

Example 2: Use the Surface Area of a Cylinder

Calculate the surface area of this totem pole, including the two circular bases. The pole stands 2.4 m tall and has a diameter of 0.75 m. Give your answer to the nearest hundredth of a square metre.

Solution

The cylinder has two circular bases.

The area of one circle is:

$$A = \pi \times r^2$$
$$A \approx 3.14 \times 0.375^2$$

$$r = d \div 2$$

$$A \approx 0.4415625$$

The area of the circle is approximately 0.4415625 m².

There are two circles, so the area of both circles is approximately 0.883125 m².

Calculate the total surface area.

$$S.A. \approx 0.883125 + 5.652$$

$$S.A. \approx 6.535125$$

The total surface area is approximately 6.54 m².

The side of the cylinder is a rectangle.

The area of the rectangle is:

$$A = (\pi \times d) \times h$$

$$A \approx 3.14 \times 0.75 \times 2.4$$

$$A \approx 5.652$$

The area of the rectangle is approximately 5.652 m².

Replace one dimension with the formula for the circumference of a circle.



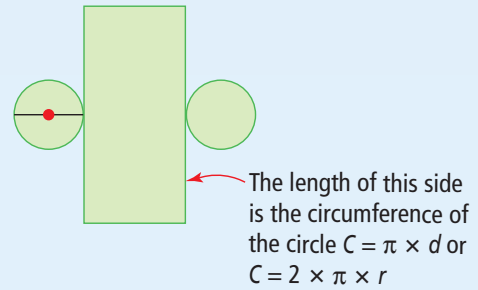
This metal totem pole was created by Todd Baker, Squamish Nation. It represents the Birth of the Bear Clan, with the princess of the clan on the top half and the bear on the bottom half.

Show You Know

Calculate the surface area of a cylindrical waste bucket without a lid that measures 28 cm high and 18 cm in diameter. Give your answer to the nearest square centimetre.

Key Ideas

- The surface area of a cylinder is the sum of the areas of its faces.
- A net of a cylinder is made up of one rectangle and two circles.
- To find one of the dimensions of the rectangle, calculate the circumference of the circle.



Communicate the Ideas

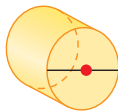
1. What are the similarities and differences between finding the surface area of a prism and finding the surface area of a cylinder?
2. Explain why you need to find the circumference of a circle to find the surface area of a cylinder.

Check Your Understanding

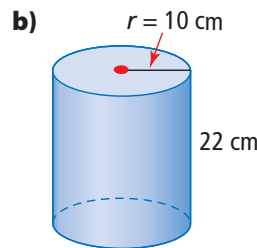
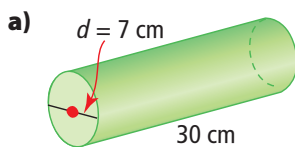
Practise

For help with #3 to #7, refer to Examples 1 and 2 on pages 183–185.

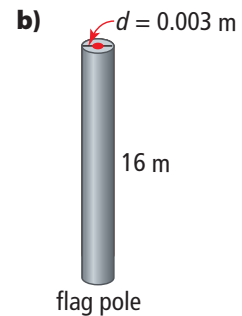
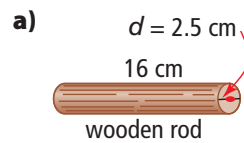
3. a) Draw a net for this cylinder.
b) Sketch a different net for this cylinder.



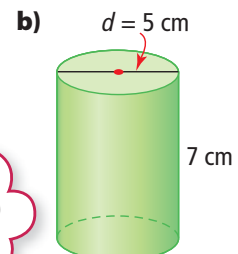
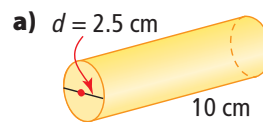
4. Estimate the surface area of each cylinder. Then, calculate each surface area to the nearest tenth of a square centimetre.



5. Find the surface area of each object to the nearest tenth of a square unit.



6. Use the formula $S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)$ to calculate the surface area of each object. Give each answer to the nearest hundredth of a square unit.



You can simplify the formula:

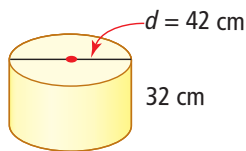
$$S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)$$

$$= 2\pi r^2 + \pi dh$$

7. Do you prefer to find the surface area of a cylinder by using the sum of the area of each face or by using a formula? Give at least two reasons for your choice.

Apply

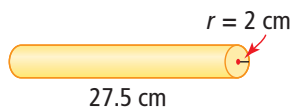
8. Anu wants to re-cover the cylindrical stool in his bedroom. How much material does he need if there is no overlap and he does not cover the bottom of the stool?



9. Kaitlyn and Hakim each bought a tube of candy. Both containers cost the same amount. Which container required more plastic to make?



10. Paper towel is rolled around a cardboard tube. Calculate the outside surface area of the tube.

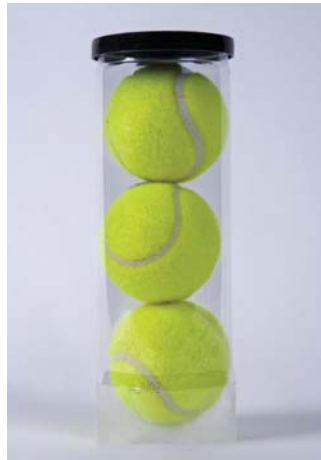


Did You Know?

Each person produces about 1.59 kg of trash each day. Most of this is paper products.

Extend

11. If each tennis ball has a diameter of 7 cm, calculate the amount of material needed to make a can that holds three tennis balls.



12. Coins can be stored in a plastic wrapper similar to a cylinder. A roll of dimes contains 50 coins. Each dime has a diameter of 17.5 mm and a thickness of 1 mm. Calculate the minimum surface area of the plastic wrapper.
13. A paint roller in the shape of a cylinder with a radius of 4 cm and a length of 21 cm is rolled vertically on a wall.
- What is the length and width of the wet path after ten complete rolls?
 - What area does the paint cover?

MATH LINK

For the cylindrical building you created in the Math Link on page 175, how much material do you need to cover the exterior walls and the roof of the building?

Did You Know?

Douglas J. Cardinal, one of the world's most acclaimed architects, uses his European, Blackfoot, and Ojibwa roots when designing buildings. He is known for his design of The Canadian Museum of Civilization in Gatineau, Québec, as well as a number of buildings in Western Canada, such as Telus World of Science in Edmonton and First Nations University of Canada in Regina.