

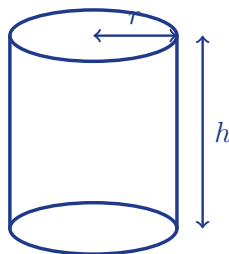
# Volume of Cylinders

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Score: \_\_\_\_\_ / 17

Think of a soup can or a drinking glass—that is a **cylinder**! Its volume tells you how much fits inside, and the formula is  $V = \pi r^2 h$ : find the area of the circular base ( $\pi r^2$ ) and multiply by the height. This is the exact same idea as prism volume (base area  $\times$  height), except the base happens to be a circle. One common trap: make sure you are using the *radius*, not the diameter—if the problem gives you the diameter, divide by 2 first. Answers come in *cubic* units because you are measuring three-dimensional space!



$$V = \pi r^2 h$$

## Key Concepts & Quick Review

### Volume of a Cylinder:

$$V = \pi r^2 h$$

where  $r$  = radius of the circular base and  $h$  = height.

**If given the diameter**, divide by 2 first:  $r = \frac{d}{2}$ .

Use  $\pi \approx 3.14$  (or the  $\pi$  button on your calculator) unless told otherwise.

**Units:** Volume is measured in *cubic* units ( $cm^3$ ,  $in^3$ ,  $ft^3$ , etc.).

## Examples

① Find the volume of a cylinder with radius 5 *cm* and height 10 *cm*. Use  $\pi \approx 3.14$ .

**Think It Through:** The base of this cylinder is a circle with radius 5 *cm*, so its area is  $\pi r^2 = 3.14 \times 25 = 78.5 \text{ cm}^2$ . Now imagine stacking that circle 10 *cm* high:  $V = 78.5 \times 10 = 785 \text{ cm}^3$ . That is all there is to cylinder volume—base area times height!

**Answer:** 785  $\text{cm}^3$

② A cylinder has a diameter of 8 *in* and a height of 12 *in*. Find its volume. Use  $\pi \approx 3.14$ .

**Think It Through:** Be careful—the problem gives the *diameter*, not the radius! Divide first:  $r = \frac{8}{2} = 4 \text{ in}$ . Now find the base area:  $3.14 \times 4^2 = 3.14 \times 16 = 50.24 \text{ in}^2$ . Multiply by the height:  $50.24 \times 12 = 602.88 \text{ in}^3$ .

**Answer:** 602.88  $\text{in}^3$



**Practice Problems**

Find the volume of each cylinder. Use  $\pi \approx 3.14$ . Round to the nearest hundredth.

- Find the volume of a cylinder with radius \_\_\_\_\_  
3 cm and height 7 cm.
- Find the volume of a cylinder with radius \_\_\_\_\_  
6 in and height 10 in.
- Find the volume of a cylinder with diame- \_\_\_\_\_  
ter 10 m and height 4 m.
- Find the volume of a cylinder with radius \_\_\_\_\_  
2 ft and height 9 ft.
- Find the volume of a cylinder with diame- \_\_\_\_\_  
ter 14 cm and height 5 cm.
- Find the volume of a cylinder with radius \_\_\_\_\_  
8 in and height 3 in.



- Find the volume of a cylinder with radius \_\_\_\_\_  
1.5 m and height 12 m.



- Find the volume of a cylinder with diame- \_\_\_\_\_  
ter 6 ft and height 8 ft.

- Find the volume of a cylinder with radius \_\_\_\_\_  
10 cm and height 10 cm.
- Find the volume of a cylinder with diame- \_\_\_\_\_  
ter 20 in and height 6 in.
- Find the volume of a cylinder with radius \_\_\_\_\_  
4 m and height 15 m.
- Find the volume of a cylinder with radius \_\_\_\_\_  
7 cm and height 2 cm.
- Find the volume of a cylinder with diame- \_\_\_\_\_  
ter 12 ft and height 11 ft.



- Find the volume of a cylinder with radius \_\_\_\_\_  
5 in and height 5 in.
- Find the volume of a cylinder with radius \_\_\_\_\_  
9 m and height 1 m.



**Study Tips**

- Always check whether you are given the **radius** or the **diameter**. Forgetting to divide the diameter by 2 is the most common mistake.
- Think of a cylinder as a stack of circles. The base area ( $\pi r^2$ ) times the height gives the total volume.
- Volume answers are always in **cubic units**. Don't forget the exponent 3!

**Word Problems**

- A soup can has a radius of 4 cm and a height of 11 cm. How many cubic centimeters of soup does it hold? Use  $\pi \approx 3.14$ . \_\_\_\_\_
- A cylindrical water tank has a diameter of 6 ft and a height of 8 ft. How many cubic feet of water can it hold? Use  $\pi \approx 3.14$ . \_\_\_\_\_



## Answer Keys

- |   |   |
|---|---|
| <p>1) <math>197.82 \text{ cm}^3</math></p> <p>2) <math>1,130.4 \text{ in}^3</math></p> <p>3) <math>314 \text{ m}^3</math></p> <p>4) <math>113.04 \text{ ft}^3</math></p> <p>5) <math>769.3 \text{ cm}^3</math></p> <p>6) <math>602.88 \text{ in}^3</math></p> <p>7) <math>84.78 \text{ m}^3</math></p> <p>8) <math>226.08 \text{ ft}^3</math></p> <p>9) <math>3,140 \text{ cm}^3</math></p> | <p>10) <math>1,884 \text{ in}^3</math></p> <p>11) <math>753.6 \text{ ft}^3</math></p> <p>12) <math>307.72 \text{ cm}^3</math></p> <p>13) <math>1,243.44 \text{ ft}^3</math></p> <p>14) <math>392.5 \text{ in}^3</math></p> <p>15) <math>254.34 \text{ m}^3</math></p> <p>16) <math>552.64 \text{ cm}^3</math></p> <p>17) <math>226.08 \text{ ft}^3</math></p> |
|---|---|

### Step-by-Step Explanations

**Strategy:** For Area & Perimeter of Composite Figures with Circles, break the figure into familiar parts, add included areas, subtract holes or removed pieces, and trace only the outside for perimeter. A quick boundary trace keeps area pieces and perimeter edges from getting mixed together.

**Practice 1:** Find the total area and perimeter. **Answer:**  $A=65.12$ ;  $P=30.56$

In the opening example, separate straight-sided pieces from circular pieces so each formula is used in the right place.

**Practice 15:** Find the area left after the quarter circle is removed. **Answer:** 15.38

For the end-of-set item, trace the outside edge for perimeter and count only the arcs and sides that are actually exposed.

**Word-problem notes:**

**16. Answer:** Total:  $90 \times 60 + \pi(30)^2 = 5,400 + 2,827.4 \approx 8,227.4 \text{ m}^2$ ; inside lane =  $2(90) + 2\pi(30) \approx 368.5 \text{ m}$ ; unwatered:  $\approx 2,827.4 \text{ m}^2$ .

The track shape is a rectangle with two semicircular ends, which together make one full circle of radius  $30 \text{ m}$ . So the enclosed area is the rectangle area  $90 \times 60 = 5,400 \text{ m}^2$  plus the circle area  $\pi(30)^2 \approx 2,827.4 \text{ m}^2$ . Add them to get about  $8,227.4 \text{ m}^2$ . For the inside lane length, use the two long straight sections,  $2 \times 90$ , plus the full circular part  $2\pi(30)$ . The sprinkler waters only the rectangle, so the unwatered part is exactly the two semicircular ends, which total about  $2,827.4 \text{ m}^2$ .

**17. Answer:** Rectangle + semicircle:  $4,800 + \frac{1}{2}\pi(30)^2 \approx 4,800 + 1,413.7 = 6,213.7 \text{ cm}^2$ ; medallion:  $\pi(10)^2 \approx 314.2$ ; colored:  $\approx 5,899.5 \text{ cm}^2$ .

Split the window into a rectangle and a semicircle. The rectangle area is  $60 \times 80 = 4,800 \text{ cm}^2$ . The arch is a semicircle with radius  $30 \text{ cm}$ , so its area is  $\frac{1}{2}\pi(30)^2 \approx 1,413.7 \text{ cm}^2$ . Adding gives a total window area of about  $6,213.7 \text{ cm}^2$ . The clear medallion has diameter  $20 \text{ cm}$ , so radius  $10 \text{ cm}$  and area about  $314.2 \text{ cm}^2$ . Subtract that from the total to get the colored glass area.



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