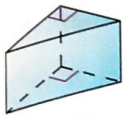
9-2 Volumes of Prisms and Cylinders

Check Skills You'll Need

1. **Vocabulary Review** Is a *cylinder* also a *prism*? Explain.

Describe the base and name the figure.

2. 

3. 

GO for Help Lesson 9-1

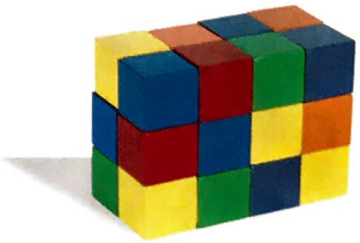
What You'll Learn

To find the volumes of prisms and cylinders

New Vocabulary volume

Why Learn This?

When you load a car, you consider the amount of space, or volume, each object occupies.

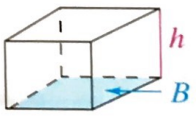


Volume is the number of unit cubes, or cubic units, needed to fill a solid. In the prism to the right, each layer has 2×4, or 8, cubes. The prism has 3 layers, so its volume is 8×3, or 24, cubic units.

CONTENT STANDARDS 8.G.7, 8.G.9

KEY CONCEPTS Volume of a Prism

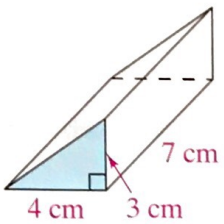
The volume V of a prism is the product of the base area B and the height h.



$$V = Bh$$

EXAMPLE Finding Volume of a Triangular Prism

1 Find the volume of the triangular prism.



Step 1 Find the base area B.

$$B = \frac{1}{2}bh \quad \leftarrow \text{area of triangle}$$

$$= \frac{1}{2} \cdot 4 \cdot 3 \quad \leftarrow \text{Substitute.}$$

$$= 6 \quad \leftarrow \text{Multiply.}$$

Step 2 Use the base area to find the volume.

$$V = Bh \quad \leftarrow \text{volume of a prism}$$

$$= 6 \cdot 7 \quad \leftarrow \text{Substitute.}$$

$$= 42 \quad \leftarrow \text{Multiply.}$$

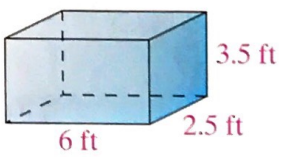
The volume of the triangle is 42 cm^3.

Vocabulary Tip

In some formulas, such as the area of a triangle, $A = bh$ and the volume of a prism, $V = Bh$, the variable h represents a different measurement. You need to make sense of what each variable refers to in the formula you select.

Quick Check

1. Find the volume of the prism at the right.



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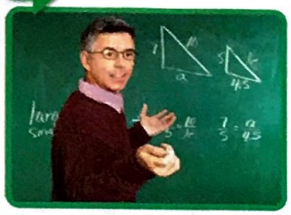

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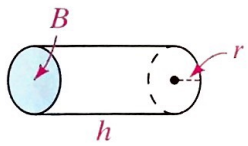
You can think of a cylinder with height h as having h layers of circles stacked on top of each other. Then the volume of the cylinder is the product of its base area and its height.

Since the bases of cylinders are circles, you can use the formula for the area of a circle to find a cylinder's base area.

KEY CONCEPTS Volume of a Cylinder

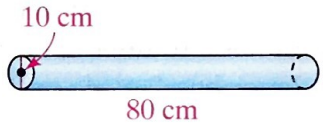
The volume V of a cylinder is the product of the base area B and the height h.

$$V = Bh$$



EXAMPLE Finding the Volume of a Cylinder

2 Find the volume of the cylinder below to the nearest cubic centimeter.



Estimate Use 3 for π. The area of the base is about 3×5^2 cm^2, or 75 cm^2. The volume is about 75×80 cm^3, or 6,000 cm^3.

Step 1 Find the area of the base.

$$\begin{aligned} B &= \pi r^2 && \leftarrow \text{area of a circle} \\ &= \pi(5^2) && \leftarrow \text{Substitute.} \\ &= 25\pi && \leftarrow \text{Simplify.} \end{aligned}$$

Step 2 Use the base area to find the volume.

$$\begin{aligned} V &= Bh && \leftarrow \text{volume of a cylinder} \\ &= 25\pi \cdot 80 && \leftarrow \text{Substitute } 25\pi \text{ for } B \text{ and } 80 \text{ for } h. \\ &= 2{,}000\pi && \leftarrow \text{Simplify.} \\ &\approx 6283.185307 && \leftarrow \text{Use a calculator.} \end{aligned}$$

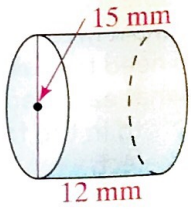
The volume of the cylinder is about 6,283 cm^3.

Check for Reasonableness The answer 6,283 cm^3 is close to the estimate of 6,000 cm^3. The answer is reasonable.

Quick Check

2. a. Estimation Estimate the volume of the cylinder at the right. Use 3 for π.

b. Find the volume of the cylinder to the nearest cubic millimeter.



More Than One Way

Find the volume of a cylinder with a radius of 3 m and a height of 8 m.

Jasmine's Method

I can first find base area B. Then I can multiply by the height h.

$B = \pi r^2$ ← area of a circle
$= \pi(3^2)$ ← Substitute.
$= 9\pi$ ← Simplify.

$V = Bh$ ← volume of a prism
$= 9\pi \cdot 8$ ← Substitute 9π for B and 8 for h.
$= 72\pi$ ← Multiply.
≈ 226.1946711 ← Use a calculator.

The volume is about 226 m^3.

Kevin's Method

I can find the volume by combining formulas first.

$V = Bh$ ← volume of a prism
$= \pi r^2 h$ ← Use πr^2 for B.
$= \pi(3^2)(8)$ ← Substitute 3 for r and 8 for h.
$= 72\pi$ ← Simplify.
≈ 226.1946711 ← Use a calculator.

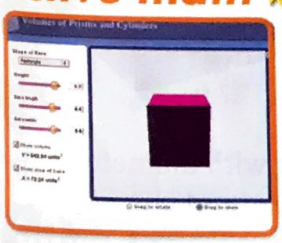
The volume is about 226 m^3.

Choose a Method

Find the volume of the cylinder with a radius of 12 ft and a height of 4.5 ft. Explain why you chose the method you used.

Check Your Understanding

Online active math



For: Volumes Activity
Use: Interactive Textbook, 9-2

1. **Vocabulary** Give three examples of cubic units.

2. **Estimation** Estimate the volume of a cylinder with a base area of 2.7 $in.^2$ and a height of 2.3 in.

Mental Math **Match the volume with the solid.**

3. a cube with each edge 10 ft long

4. a rectangular prism with a square base 7 ft on each side and a height of 10 ft

5. a cylinder with a base area of 100 ft^2 and a height of 8 ft

A. 490 ft^3
B. 1,000 ft^3
C. 800 ft^3

Homework Exercises

For more exercises, see Extra Skills and Word Problems.

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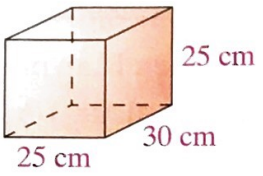
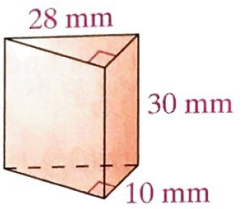
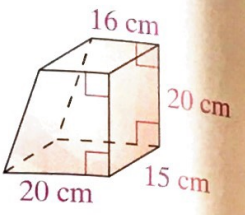
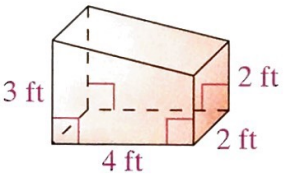
For Exercises	See Examples
6–11	1
12–14	2

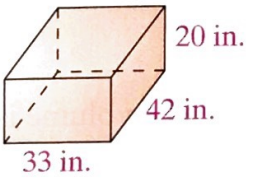
Find the volume of each prism to the nearest whole cubic unit.

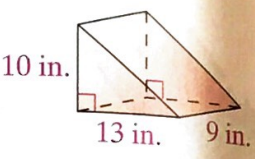
6. 

7. 

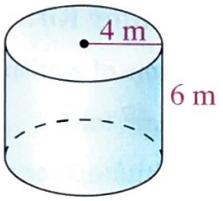
8. 

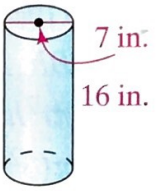
9. 

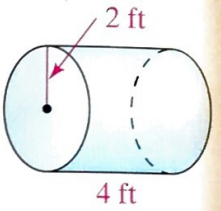
10. 

11. 

Find the volume of each cylinder to the nearest whole cubic unit.

12. 

13. 

14. 

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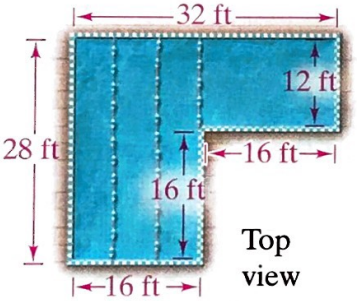
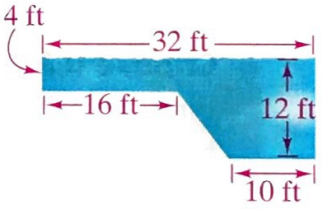
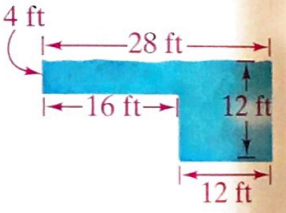
15. **Guided Problem Solving** Below are the top, front, and right views of a pool. Find the volume of the pool.



Top view



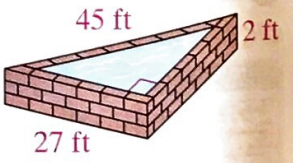
Front view



Right view

- You can use the strategy *Draw a Picture* to help you see the solids that make up the pool.
- What prisms make up the pool?

16. **Landscaping** A goldfish pond in the shape of a triangular prism sits in the center of a mall. Use the diagram at the right to find the volume of the pond.



17. **Choose a Method** Find the volume of a cylinder with diameter 11 ft and height 6.2 ft. Explain why you chose the method you used.

18. **Algebra** A rectangular prism with a volume of 48 units^3 has edge lengths that are whole units. One edge length is 4 units. What are the possible combinations of lengths of the other two edges?

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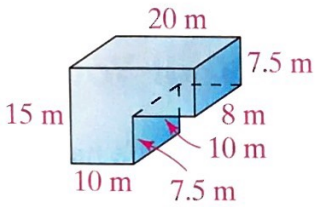
19. **Number Sense** Which has a greater effect on the volume of a cylinder, doubling the radius or doubling the height? Explain.

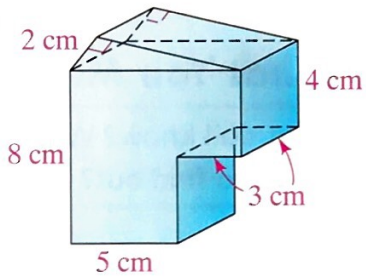
20. A store keeps about 240 boxes of crayons in its inventory.
   a. If each box measures 6 in. by 2.5 in. by 4 in., how many cubic inches of storage space does the store need for the crayons?
   b. One cubic foot is equal to $(12 \text{ in.})^3$, or $1{,}728 \text{ in.}^3$. Find the number of cubic feet necessary for storing 240 boxes of crayons.

Find the volume of each prism to the nearest whole cubic unit.

21.



22.



23. **Writing in Math** Explain how you would find the radius of a cylinder with a height of 20 in. and a volume of 565.5 in.^3.

24. **Food** You cut a 3-in. circle in the center of a 3-in.-high cake and served the outer ring. The cake had a diameter of 12 in. How much cake did you serve?

25. **Challenge** A rectangular prism has square bases and a height of 11 ft. Its lateral area is 308 ft^2. Find its volume.

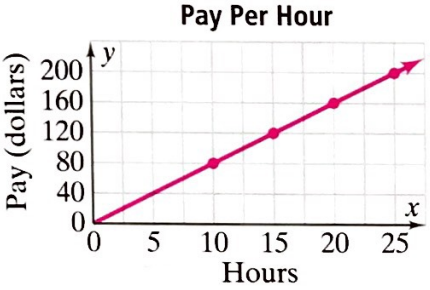
Test Prep and Mixed Review

Practice

Multiple Choice

26. A refrigerator is 30 inches wide, 30 inches deep, and 5 feet 6 inches tall. Which is closest to the volume of the refrigerator in cubic feet?
   (A) 10.5 ft^3 (B) 34 ft^3 (C) 55 ft^3 (D) 75 ft^3

27. The graph at the right shows the pay that an employee earns for working different numbers of hours. What does the employee earn each hour?
   (F) \$8 (H) \$12
   (G) \$10 (J) \$14



28. A courtyard has the shape of a rectangle 45 ft long and 28 ft wide. How long is a sidewalk from one corner diagonally to the opposite corner?
   (A) 47 ft (B) 50 ft (C) 53 ft (D) 56 ft

If $x = 6$, find y for each function.

29. $y = 3x - 7$ 30. $y = 7x + 4$ 31. $y = -2x + 9$

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For Exercises	See Lesson
29–31	3-2