

### Check Skills You'll Need

1. **Vocabulary Review**  
What does a number's exponent show?

Simplify each expression.

2.  $3^4$
3.  $6^2$
4.  $7(8)^3$
5.  $2 \cdot 1^2$

**GO for Help**  
Skills Handbook  
p. 391

### What You'll Learn

To find the surface area and volume of a sphere

**New Vocabulary** sphere

### Why Learn This?

Many objects have the shape of a sphere, including toys. To make these objects, it is helpful to know about the surface area and volume of spheres.

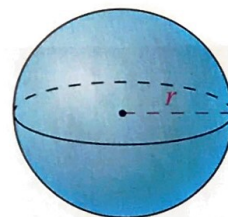
A **sphere** is the set of all points in space that are the same distance from a center point.



### KEY CONCEPTS Surface Area of a Sphere

The surface area of a sphere is four times the product of  $\pi$  and the square of the radius  $r$ .

$$\text{S.A.} = 4\pi r^2$$

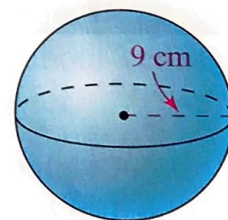


### EXAMPLE Finding the Surface Area of a Sphere

- 1 Find the surface area of the sphere at the right to the nearest square centimeter.

$$\begin{aligned} \text{S.A.} &= 4\pi r^2 && \leftarrow \text{surface area of a sphere} \\ &= 4\pi(9^2) && \leftarrow \text{Substitute.} \\ &= 324\pi && \leftarrow \text{Simplify.} \\ &\approx 1017.87602 && \leftarrow \text{Use a calculator.} \end{aligned}$$

The surface area of the sphere is about  $1,018 \text{ cm}^2$ .



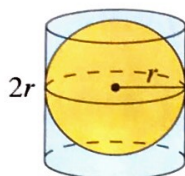
### Test Prep Tip

Simplify the product of whole numbers before you multiply by the decimal values.

### Quick Check

1. A sphere has a radius of 7 ft. Find its surface area to the nearest square foot.

Consider a sphere with radius  $r$  inside a cylinder with radius  $r$  and height  $2r$ . You know how to find the volume of the cylinder.



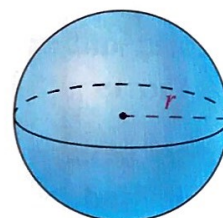
$$\begin{aligned} V &= Bh && \leftarrow \text{volume of a cylinder} \\ &= (\pi r^2)(2r) && \leftarrow \text{Substitute } \pi r^2 \text{ for } B \text{ and } 2r \text{ for } h. \\ &= 2\pi r^3 && \leftarrow \text{Simplify.} \end{aligned}$$

The volume of the sphere is two thirds of the volume of the cylinder.

### KEY CONCEPTS Volume of a Sphere

The volume of a sphere is four thirds of the product of  $\pi$  and the radius  $r$  cubed.

$$V = \frac{4}{3}\pi r^3$$



### EXAMPLE Finding the Volume of a Sphere

- 2 **Gridded Response** The diameter of a sphere in a water fountain is 4 ft. What is the volume of the sphere to the nearest cubic foot?

**Estimate** Use 3 for  $\pi$ . The radius of the sphere is 2 ft. The volume of the sphere is about  $\frac{4}{3}(3)(2)^3 = 32 \text{ ft}^3$ .

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 && \leftarrow \text{volume of a sphere} \\ &= \frac{4}{3}\pi(2^3) && \leftarrow \text{Substitute 2 for } r. \\ &= \frac{32}{3}\pi && \leftarrow \text{Simplify.} \\ &\approx 33.51032164 && \leftarrow \text{Use a calculator.} \end{aligned}$$

The volume of the sphere is about  $34 \text{ ft}^3$ .

**Check for Reasonableness** The answer  $34 \text{ ft}^3$  is close to the estimate of  $32 \text{ ft}^3$ . The answer is reasonable.

		3	4
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

### Quick Check

2. **Globes** A globe in a brass stand has a diameter of 40 in. What is the volume of the globe to the nearest cubic inch?





# Check Your Understanding

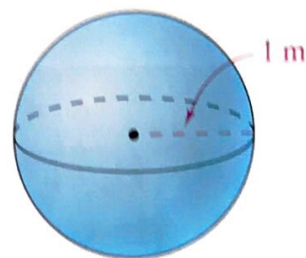
**Vocabulary** Match each solid's definition with the correct term.

1. exactly one circular base and one vertex
2. two bases that are parallel, congruent circles
3. set of all points in space that are the same distance from a center point

- A. cylinder
- B. sphere
- C. cone

Use the sphere at the right for Exercises 4–6.

4. Which is the correct expression for the surface area of the sphere:  $\frac{4}{3}(3.14)(1)^3$  or  $4(3.14)(1)^2$ ?
5. What is the surface area of the sphere?
6. What is the volume of the sphere?



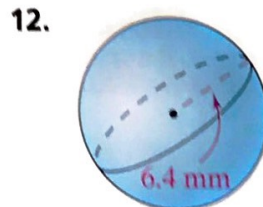
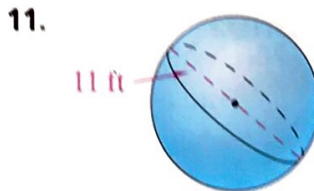
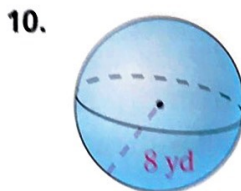
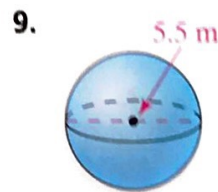
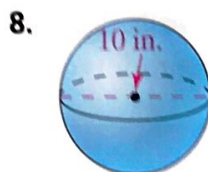
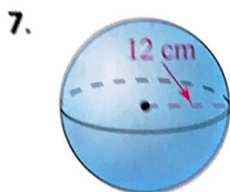
## Homework Exercises

For more exercises, see Extra Skills and Word Problems.

### GO for Help

For Exercises	See Examples
7–12	1 and 2
13	2

Find each sphere's surface area and volume to the nearest whole number.



13. **Mental Math** A model of the moon has a radius of about 3 cm. Find the volume of the model to the nearest cubic centimeter.

### GPS

14. **Guided Problem Solving** Water covers approximately 70% of Earth's surface. The diameter of Earth is about 13,000 km. Find the approximate area of Earth that is covered by water.

- What is the formula for the surface area of a sphere?
- What is the surface area of Earth?
- What is 70% of Earth's surface area?

15. **Baseball** Balls used in major league baseball have diameters that range from 2.86 in. to 2.94 in. What is the difference in surface area between the largest and the smallest baseball?

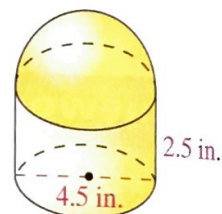
16. The circumference of a glass terrarium in the shape of a sphere is about 12.5 in. What is the surface area of the terrarium to the nearest square inch?
17. **Error Analysis** Your classmate found the volume of a sphere with a radius of 5 ft to be  $500\pi$  ft<sup>3</sup>. What error did your classmate make?

**Gemstones** A jeweler sells spherical gemstones for pendants. Find the surface area and volume of each gemstone to the nearest whole number.

18. jasper:  $r = 3$  cm      19. rose quartz:  $d = 40$  mm  
 20. topaz:  $d = 4$  mm      21. pearl:  $r = 0.6$  cm

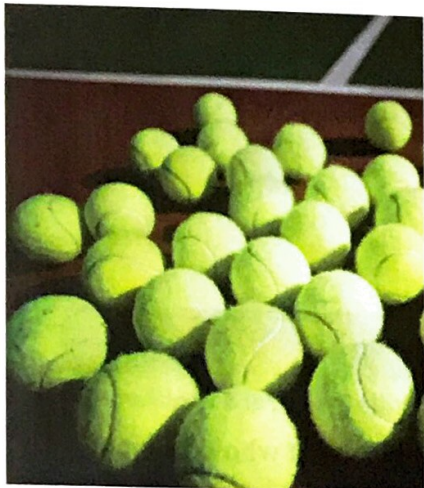
22. **Tennis** Tennis balls have a diameter of 2.5 in. A can holds three balls and has the shape of a cylinder.  
 a. Find the total volume of the balls to the nearest whole cubic unit.  
 b. Find the volume of the can to the nearest whole cubic unit. Assume the balls touch the can on the sides, top, and bottom.

23. Find the surface area and volume of the figure at the right. Round to the nearest whole number.



24. **Writing in Math** Suppose you know the surface area of a sphere. Explain how you would find the volume of the sphere.

25. **Challenge** The volume of Mars is about  $1.642 \times 10^{11}$  km<sup>3</sup>. What is the radius of Mars to the nearest kilometer?

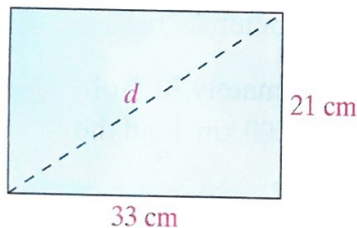


## Test Prep and Mixed Review

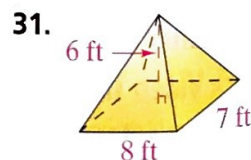
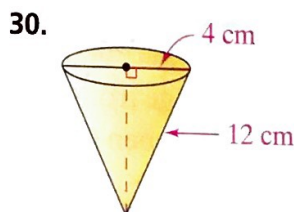
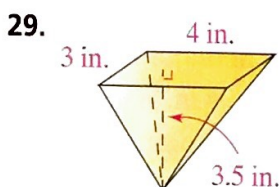
**Practice**

### Gridded Response

26. A bowling ball is required to have a radius of no more than 4.3 inches and a weight of no more than 16 pounds. To the nearest cubic inch, what is the volume of a ball with radius 4.3 inches?
27. A cylinder has a height of 19 ft. and a diameter of 10 ft. What is the volume of the cylinder to the nearest cubic foot?
28. A popular laptop produced by a computer company has a monitor with dimensions shown in the diagram at the right. A new model of the laptop has a monitor that is 3 cm wider and 4 cm taller. How much longer is the diagonal length  $d$  of the new model than the old model? Round to the nearest centimeter.



Find the volume of each figure to the nearest cubic unit.



**GO for Help**

For Exercises	See Lesson
29–31	9–3