

Vocabulary and Concept Check

This alphabetical list of vocabulary terms in Chapter 12 includes a page reference where each term was introduced.

**Assessment** A vocabulary test/review for Chapter 12 is available on p. 716 of the Chapter 12 Resource Masters.

Lesson-by-Lesson Review

- For each lesson,
- the main ideas are summarized,
  - additional examples review concepts, and
  - practice exercises are provided.

Vocabulary PuzzleMaker

**ELL** The Vocabulary PuzzleMaker software improves students' mathematics vocabulary using four puzzle formats—crossword, scramble, word search using a word list, and word search using clues. Students can work on a computer screen or from a printed handout.

MindJogger Videoquizzes

**ELL** MindJogger Videoquizzes provide an alternative review of concepts presented in this chapter. Students work in teams in a game show format to gain points for correct answers. The questions are presented in three rounds.

- Round 1 Concepts (5 questions)
- Round 2 Skills (4 questions)
- Round 3 Problem Solving (4 questions)

Vocabulary and Concept Check

- |                        |                           |                              |                          |
|------------------------|---------------------------|------------------------------|--------------------------|
| axis (p. 655)          | great circle (p. 671)     | oblique prism (p. 649)       | regular prism (p. 637)   |
| bases (p. 637)         | hemisphere (p. 672)       | orthogonal drawing (p. 636)  | regular pyramid (p. 660) |
| circular cone (p. 666) | lateral area (p. 649)     | perspective view (p. 636)    | right cone (p. 666)      |
| cone (p. 638)          | lateral edges (p. 649)    | Platonic solids (p. 638)     | right cylinder (p. 655)  |
| corner view (p. 636)   | lateral faces (p. 649)    | polyhedron (p. 637)          | right prism (p. 649)     |
| cross section (p. 639) | net (p. 644)              | prism (p. 637)               | slant height (p. 660)    |
| cylinder (p. 638)      | oblique cone (p. 666)     | pyramid (p. 637)             | sphere (p. 638)          |
| edges (p. 637)         | oblique cylinder (p. 655) | reflection symmetry (p. 642) | surface area (p. 644)    |
| face (p. 637)          |                           | regular polyhedron (p. 637)  |                          |

A complete list of postulates and theorems can be found on pages R1–R8.

**Exercises** Match each expression with the correct formula.

- lateral area of a prism **d**
- surface area of a prism **i**
- lateral area of a cylinder **b**
- surface area of a cylinder **h**
- lateral area of a regular pyramid **a**
- surface area of a regular pyramid **j**
- lateral area of a cone **e**
- surface area of a cone **g**
- surface area of a sphere **c**
- surface area of a cube **f**

- |                        |                              |
|------------------------|------------------------------|
| a. $L = \frac{1}{2}Pl$ | f. $T = 6s^2$                |
| b. $L = 2\pi rh$       | g. $T = \pi r\ell + \pi r^2$ |
| c. $T = 4\pi r^2$      | h. $T = 2\pi rh + 2\pi r^2$  |
| d. $L = Ph$            | i. $T = Ph + 2B$             |
| e. $L = \pi r\ell$     | j. $T = \frac{1}{2}Pl + B$   |

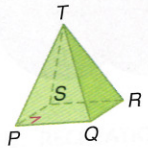
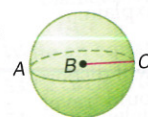
Lesson-by-Lesson Review

12-1 Three-Dimensional Figures

**Concept Summary**

- A solid can be determined from its orthogonal drawing.
- Solids can be classified by bases, faces, edges, and vertices.

Examples

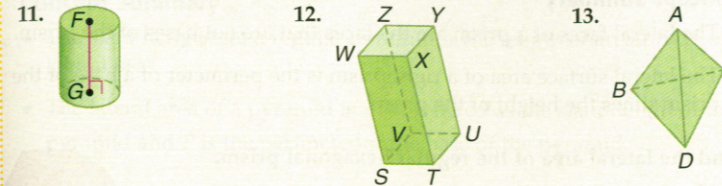
- Identify each solid. Name the bases, faces, edges, and vertices.
- a.  The base is a rectangle, and all of the lateral faces intersect at point T, so this solid is a rectangular pyramid.  
Base:  $\square PQRS$   
Faces:  $\triangle TPQ, \triangle TQR, \triangle TRS, \triangle TSP$   
Edges:  $\overline{PQ}, \overline{QR}, \overline{RS}, \overline{PS}, \overline{PT}, \overline{QT}, \overline{RT}, \overline{ST}$   
Vertices: P, Q, R, S, T
- b.  This solid has no bases, faces, or edges. It is a sphere.

FOLDABLES Study Organizer

For more information about Foldables, see Teaching Mathematics with Foldables.

Have students look through the chapter to make sure they have included notes and examples in their Foldables for each lesson of Chapter 12. Encourage students to refer to their Foldables while completing the Study Guide and Review and to use them in preparing for the Chapter Test.

**Exercises** Identify each solid. Name the bases, faces, edges, and vertices. See Example 2 on page 638. 11–13. See margin.

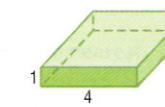


12-2 Nets and Surface Area

Concept Summary

- Every three-dimensional solid can be represented by one or more two-dimensional nets.
- The area of the net of a solid is the same as the surface area of the solid.

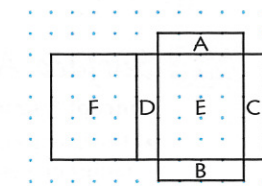
Draw a net and find the surface area for the right rectangular prism shown.



Use rectangular dot paper to draw a net. Since each face is a rectangle, opposite sides have the same measure.

To find the surface area of the prism, add the areas of the six rectangles.

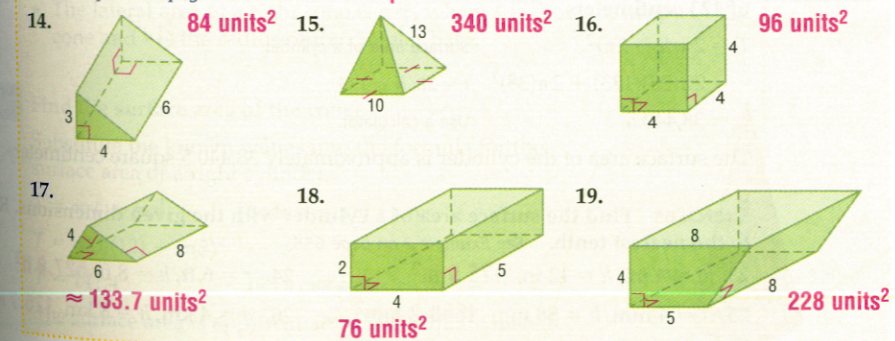
$$\begin{aligned} \text{Surface area} &= A + B + C + D + E + F \\ &= 4 \cdot 1 + 4 \cdot 1 + 5 \cdot 1 + 5 \cdot 1 + 4 \cdot 5 + 4 \cdot 5 \\ &= 4 + 4 + 5 + 5 + 20 + 20 \\ &= 58 \end{aligned}$$



The surface area is 58 square units.

**Exercises** For each solid, draw a net and find the surface area.

See Example 3 on page 645. 14–19. See p. 685D for nets.



Answers

- cylinder; bases:  $\odot F$  and  $\odot G$
- Sample answer: rectangular prism; bases: rectangle  $WXYZ$  and rectangle  $STUV$ ; faces: rectangles  $WXYZ, STUV, WXTS, XTUY, YUVZ,$  and  $WZVS$ ; edges:  $\overline{WX}, \overline{XY}, \overline{YZ}, \overline{ZW}, \overline{ST}, \overline{TU}, \overline{UV}, \overline{VS}, \overline{WS}, \overline{XT}, \overline{YU},$  and  $\overline{ZV}$ ; vertices: S, T, U, V, W, X, Y, and Z
- Sample answer: triangular prism; base:  $\triangle BCD$ ; faces:  $\triangle ABC, \triangle ABD, \triangle ACD,$  and  $\triangle BCD$ ; edges:  $\overline{AB}, \overline{BC}, \overline{AC}, \overline{AD}, \overline{BD},$  and  $\overline{CD}$ ; vertices: A, B, C, and D



### 12-3 Surface Areas of Prisms

See pages 649–654.

#### Concept Summary

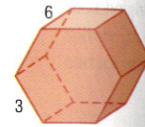
- The lateral faces of a prism are the faces that are not bases of the prism.
- The lateral surface area of a right prism is the perimeter of a base of the prism times the height of the prism.

**Example** Find the lateral area of the regular hexagonal prism.

The bases are regular hexagons. So the perimeter of one base is  $6(3)$  or 18. Substitute this value into the formula.

$$\begin{aligned} L &= Ph && \text{Lateral area of a prism} \\ &= (18)(6) && P = 18, h = 6 \\ &= 108 && \text{Multiply.} \end{aligned}$$

The lateral area is 108 square units.



**Exercises** Find the lateral area of each prism. See Example 1 on page 650.

20. **1080 units<sup>2</sup>**    21. **72 units<sup>2</sup>**    22. **92 units<sup>2</sup>**

### 12-4 Surface Areas of Cylinders

See pages 655–659.

#### Concept Summary

- The lateral surface area of a cylinder is  $2\pi$  multiplied by the product of the radius of a base of the cylinder and the height of the cylinder.
- The surface area of a cylinder is the lateral surface area plus the area of both circular bases.

**Example** Find the surface area of a cylinder with a radius of 38 centimeters and a height of 123 centimeters.

$$\begin{aligned} T &= 2\pi rh + 2\pi r^2 && \text{Surface area of a cylinder} \\ &= 2\pi(38)(123) + 2\pi(38)^2 && r = 38, h = 123 \\ &\approx 38,440.5 && \text{Use a calculator.} \end{aligned}$$

The surface area of the cylinder is approximately 38,440.5 square centimeters.

**Exercises** Find the surface area of a cylinder with the given dimensions. Round to the nearest tenth. See Example 2 on page 656.

23.  $d = 4$  in.,  $h = 12$  in. **175.9 in<sup>2</sup>**    24.  $r = 6$  ft,  $h = 8$  ft **527.8 ft<sup>2</sup>**  
 25.  $r = 4$  mm,  $h = 58$  mm **1558.2 mm<sup>2</sup>**    26.  $d = 4$  km,  $h = 8$  km **125.7 km<sup>2</sup>**

### 12-5 Surface Areas of Pyramids

See pages 660–665.

#### Concept Summary

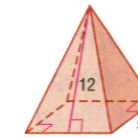
- The slant height  $\ell$  of a regular pyramid is the length of an altitude of a lateral face.
- The lateral area of a pyramid is  $\frac{1}{2}P\ell$ , where  $\ell$  is the slant height of the pyramid and  $P$  is the perimeter of the base of the pyramid.

**Example** Find the surface area of the regular pyramid.

The perimeter of the base is  $4(5)$  or 20 units, and the area of the base is  $5^2$  or 25 square units. Substitute these values into the formula for the surface area of a pyramid.

$$\begin{aligned} T &= \frac{1}{2}P\ell + B && \text{Surface area of a regular pyramid} \\ &= \frac{1}{2}(20)(12) + 25 && P = 20, \ell = 12, B = 25 \\ &= 145 && \text{Simplify.} \end{aligned}$$

The surface area is 145 square units.



**Exercises** Find the surface area of each regular pyramid. Round to the nearest tenth if necessary. See Example 2 on pages 661 and 662.

27. **304 units<sup>2</sup>**    28. **472.0 units<sup>2</sup>**    29. **33.3 units<sup>2</sup>**

### 12-6 Surface Areas of Cones

See pages 666–670.

#### Concept Summary

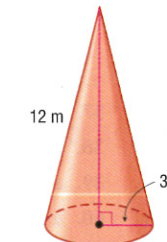
- A cone is a solid with a circular base and a single vertex.
- The lateral area of a right cone is  $\pi r\ell$ , where  $\ell$  is the slant height of the cone and  $r$  is the radius of the circular base.

**Example** Find the surface area of the cone.

Substitute the known values into the formula for the surface area of a right cylinder.

$$\begin{aligned} T &= \pi r\ell + \pi r^2 && \text{Surface area of a cone} \\ T &= \pi(3)(12) + \pi(3)^2 && r = 3, \ell = 12 \\ T &\approx 141.4 && \text{Use a calculator.} \end{aligned}$$

The surface area is approximately 141.4 square meters.





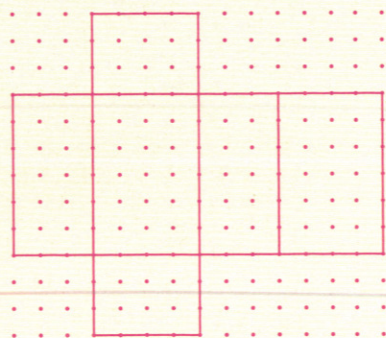
Answers (page 683)

4. Sample answer: rectangular prism; bases: rectangles  $PQRS$  and  $TUVW$ ; faces: rectangles  $PQRS$ ,  $TUVW$ ,  $SPUT$ ,  $QRWV$ ,  $STWR$ , and  $PUVQ$ ; edges:  $\overline{PS}$ ,  $\overline{QR}$ ,  $\overline{VW}$ ,  $\overline{UT}$ ,  $\overline{PU}$ ,  $\overline{ST}$ ,  $\overline{RW}$ ,  $\overline{QV}$ ,  $\overline{PQ}$ ,  $\overline{SR}$ ,  $\overline{UV}$ ,  $\overline{TW}$ ; vertices:  $P$ ,  $Q$ ,  $R$ ,  $S$ ,  $T$ ,  $U$ ,  $V$ , and  $W$

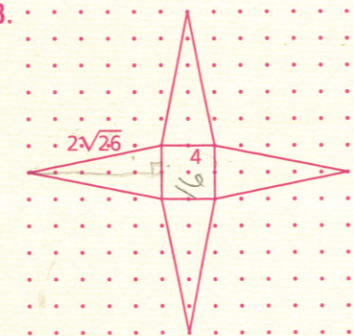
5. sphere

6. cone; base:  $\odot F$ ; vertex:  $H$

7.

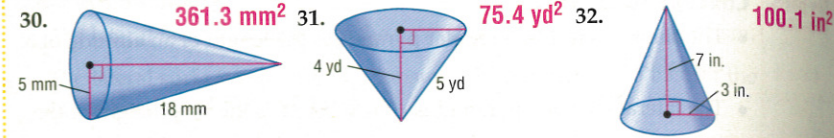


8.



**Exercises** Find the surface area of each cone. Round to the nearest tenth.

See Example 2 on page 667.



12-7 Surface Areas of Spheres

See pages 671–676.

Concept Summary

- The set of all points in space a given distance from one point is a sphere.
- The surface area of a sphere is  $4\pi r^2$ , where  $r$  is the radius of the sphere.

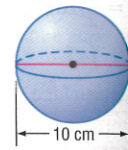
Examples

- a. Find the surface area of a sphere with a diameter of 10 centimeters.

$$T = 4\pi r^2 \quad \text{Surface area of a sphere}$$

$$= 4\pi(5)^2 \quad r = 5$$

$$\approx 314.2 \quad \text{Use a calculator.}$$



The surface area is approximately 314.2 square centimeters.

- b. Find the surface area of a hemisphere with radius 6.3 inches.

To find the surface area of a hemisphere, add the area of the great circle to half of the surface area of the sphere.

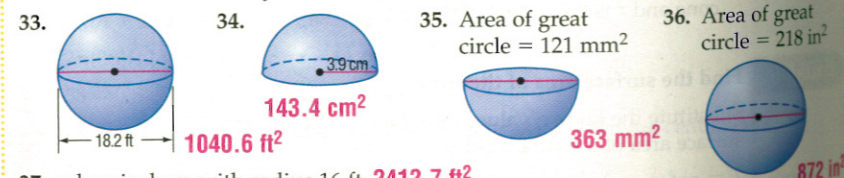
$$\text{surface area} = \frac{1}{2}(4\pi r^2) + \pi r^2 \quad \text{Surface area of a hemisphere}$$

$$= \frac{1}{2}[4\pi(6.3)^2] + \pi(6.3)^2 \quad r = 6.3$$

$$\approx 374.1 \quad \text{Use a calculator.}$$

The surface area is approximately 374.1 square inches.

**Exercises** Find the surface area of each sphere or hemisphere. Round to the nearest tenth if necessary. See Example 2 on page 673.



37. a hemisphere with radius 16 ft  $2412.7 \text{ ft}^2$   
 38. a sphere with diameter 5 m  $78.5 \text{ m}^2$   
 39. a sphere that has a great circle with an area of  $220 \text{ ft}^2$   $880 \text{ ft}^2$   
 40. a hemisphere that has a great circle with an area of  $30 \text{ cm}^2$   $90 \text{ cm}^2$

Vocabulary and Concepts

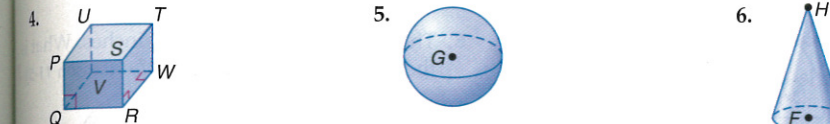
Match each expression to the correct formula.

1. surface area of a prism **c**
2. surface area of a cylinder **a**
3. surface area of a regular pyramid **b**

- a.  $T = 2\pi rh + 2\pi r^2$   
 b.  $T = \frac{1}{2}Pl + B$   
 c.  $T = Ph + 2B$

Skills and Applications

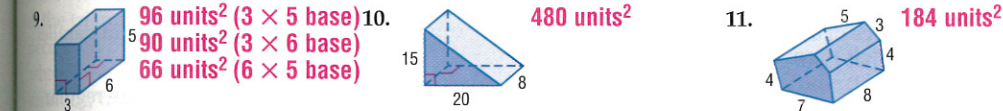
Identify each solid. Name the bases, faces, edges, and vertices. 4–6. See margin.



For each solid, draw a net and find the surface area. 7–8. See margin for nets.



Find the lateral area of each prism.



Find the surface area of a cylinder with the given dimensions. Round to the nearest tenth.

12.  $r = 8 \text{ ft}$ ,  $h = 22 \text{ ft}$   $1508.0 \text{ ft}^2$     13.  $r = 3 \text{ mm}$ ,  $h = 2 \text{ mm}$   $94.2 \text{ mm}^2$     14.  $r = 78 \text{ m}$ ,  $h = 100 \text{ m}$   $87,235.7 \text{ m}^2$

The figure at the right is a composite solid of a tetrahedron and a triangular prism. Find each measure in the solid. Round to the nearest tenth if necessary.

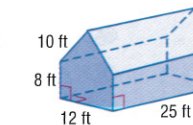
15. height  $12.9 \text{ units}$     16. lateral area  $190.8 \text{ units}^2$     17. surface area  $206.4 \text{ units}^2$

18.  $h = 24$ ,  $r = 7$   $703.7 \text{ units}^2$     19.  $h = 3 \text{ m}$ ,  $\ell = 4 \text{ m}$   $55.2 \text{ units}^2$     20.  $r = 7$ ,  $\ell = 12$   $417.8 \text{ units}^2$

Find the surface area of each sphere. Round to the nearest tenth if necessary.

21.  $r = 15 \text{ in.}$   $2827.4 \text{ in}^2$     22.  $d = 14 \text{ m}$   $615.8 \text{ m}^2$   
 23. The area of a great circle of the sphere is 116 square feet.  $464 \text{ ft}^2$

24. **GARDENING** The surface of a greenhouse is covered with plastic or glass. Find the amount of plastic needed to cover the greenhouse shown.  $1188 \text{ ft}^2$



25. **STANDARDIZED TEST PRACTICE** A cube has a surface area of 150 square centimeters. What is the length of each edge? **D**  
 (A) 25 cm    (B) 15 cm    (C) 12.5 cm    (D) 5 cm

Assessment Options

**Vocabulary Test** A vocabulary test/review for Chapter 12 can be found on p. 716 of the Chapter 12 Resource Masters.

**Chapter Tests** There are six Chapter 12 Tests and an Open-Ended Assessment task available in the Chapter 12 Resource Masters.

Chapter 12 Tests			
Form	Type	Level	Pages
1	MC	basic	703–704
2A	MC	average	705–706
2B	MC	average	707–708
2C	FR	average	709–710
2D	FR	average	711–712
3	FR	advanced	713–714

MC = multiple-choice questions  
FR = free-response questions

Open-Ended Assessment

Performance tasks for Chapter 12 can be found on p. 715 of the Chapter 12 Resource Masters. A sample scoring rubric for these tasks appears on p. A28.

ExamView® Pro

Use the networkable ExamView® Pro to:

- Create multiple versions of tests.
- Create modified tests for Inclusion students.
- Edit existing questions and add your own questions.
- Use built-in state curriculum correlations to create tests aligned with state standards.
- Apply art to your tests from a program bank of artwork.

Portfolio Suggestion

**Introduction** Surface area is a concept applied in the manufacturing of containers such as boxes and cans.

**Ask Students** Have students think of a product they would like their imaginary manufacturing company to produce. Students should design the three-dimensional container that their product would ship in, make a net of the design, and then calculate the surface area of the container. Have students add their designs and calculations to their portfolios.