

# CHAPTER 12

## Application (p. 717)

1.  $2\pi(40)^2 \approx 10,053 \text{ ft}^2$     2. *Sample answers:*  
domed stadium, igloo

## Skill Review (p. 718)

1. 2:1    2. 3:4    3.  $A = \frac{1}{4}\sqrt{3}(4)^2$     4.  $A = \frac{1}{2}(3\sqrt{3})(6 \cdot 6)$   
 $\approx 6.9 \text{ in.}^2$      $\approx 93.5 \text{ m}^2$
5.  $A = \frac{1}{2}(1.2)(8 \cdot 1)$   
 $= 4.8 \text{ ft}^2$

## Lesson 12.1

### 12.1 Guided Practice (p. 723)

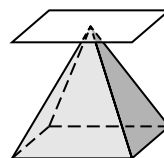
1. *Sample Answer:* A group of polygons put together in such a way as to enclose a region of space.
2. Yes; yes; a segment connecting any two points on its surface lies entirely inside or on the polyhedron.
3. Polyhedron; each face is a polygon.
4. Polyhedron; each face is a polygon.
5. Not a polyhedron because some of its faces are not polygons.
6.  $F + V = E + 2$     7.  $F + V = E + 2$   
 $F + 6 = 12 + 2$      $5 + V = 9 + 2$   
 $F = 8$      $V = 6$
8.  $F + V = E + 2$     9.  $F + V = E + 2$   
 $F + 10 = 15 + 2$      $20 + 12 = E + 2$   
 $F = 7$      $30 = E$

### 12.1 Practice and Applications (pp. 723–726)

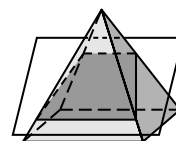
10. No; every face is not a polygon.
11. Yes; each face is a polygon.
12. Yes; each face is a polygon.
13.  $F = 5$      $V = 5$      $E = 8$
14.  $F = 8$      $V = 12$      $E = 18$
15.  $F = 10$      $V = 16$      $E = 24$
16. Regular; all faces are congruent regular polygons.  
Convex; any two points on its surface can be connected by a segment that lies entirely inside or on the polyhedron.
17. Not regular because all faces are not congruent polygons.  
Convex; any two points on its surface can be connected by a segment that lies entirely inside or on the polyhedron.

18. Not regular because all faces are not congruent polygons.  
Nonconvex because some segments which connect two points lie outside the polyhedron.
19. False; a polyhedron can be convex without being regular. See Example 2(b) on p. 720.
20. False; a polyhedron must have at least 4 faces.
21. True; a cube is composed of six congruent squares.
22. True; a tetrahedron has exactly four faces.
23. False; a cone is not a solid bounded by polygons.
24. True; an example would be a square pyramid or a prism.
25. circle    26. circle    27. pentagon    28. rectangle
29. circle    30. rectangle or square    31. rectangle
32. pentagon

33. yes    34. square

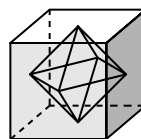


35. yes



36. tetrahedron
37. octahedron
38. dodecahedron
39. dodecahedron
40. octahedron    41. cube

42.    43.  $F + V = E + 2$   
 $5 + 6 = 9 + 2$   
 $11 = 11$



regular octahedron

44.  $F + V = E + 2$     45.  $F + V = E + 2$   
 $5 + 5 = 8 + 2$      $5 + 6 = 9 + 2$   
 $10 = 10$      $11 = 11$

## Chapter 12 continued

46.

| Platonic solid | Faces | Vertices | Edges |
|----------------|-------|----------|-------|
| Tetrahedron    | 4     | 4        | 6     |
| Cube           | 6     | 8        | 12    |
| Octahedron     | 8     | 6        | 12    |
| Dodecahedron   | 12    | 20       | 30    |
| Icosahedron    | 20    | 12       | 30    |

| Platonic solid | $F + V = E + 2$    |
|----------------|--------------------|
| Tetrahedron    | $4 + 4 = 6 + 2$    |
| Cube           | $6 + 8 = 12 + 2$   |
| Octahedron     | $8 + 6 = 12 + 2$   |
| Dodecahedron   | $12 + 20 = 30 + 2$ |
| Icosahedron    | $20 + 12 = 30 + 2$ |

47.  $E = \frac{1}{2}(20 \cdot 3)$   
 $= 30$  edges  
 $F + V = E + 2$   
 $20 + V = 30 + 2$   
 $V = 12$

48.  $E = \frac{1}{2}(8 \cdot 3 + 6 \cdot 4)$   
 $= \frac{1}{2}(24 + 24)$   
 $= \frac{1}{2}(48)$   
 $= 24$   
 $F + V = E + 2$   
 $14 + V = 24 + 2$   
 $V = 12$

49.  $E = \frac{1}{2}(8 \cdot 6 + 6 \cdot 4)$   
 $= \frac{1}{2}(48 + 24)$   
 $= \frac{1}{2}(72)$   
 $= 36$   
 $F + V = E + 2$   
 $14 + V = 36 + 2$   
 $V = 24$

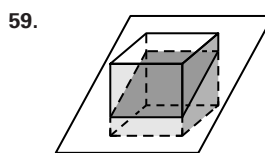
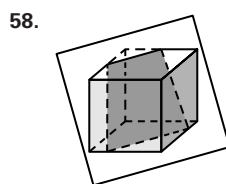
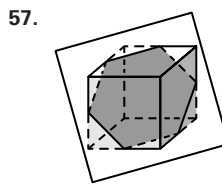
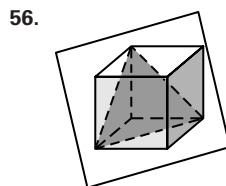
50.  $E = \frac{1}{2}(18 \cdot 4 + 8 \cdot 3)$   
 $= \frac{1}{2}(72 + 24)$   
 $= \frac{1}{2}(96)$   
 $= 48$   
 $F + V = E + 2$   
 $26 + V = 48 + 2$   
 $V = 24$

51.  $E = \frac{1}{2}(4 \cdot 6 + 4 \cdot 3)$   
 $= \frac{1}{2}(24 + 12)$   
 $= \frac{1}{2}(36)$   
 $= 18$   
 $F + V = E + 2$   
 $8 + V = 18 + 2$   
 $V = 12$

52.  $E = \frac{1}{2}(12 \cdot 5)$   
 $= \frac{1}{2}(60)$   
 $= 30$   
 $F + V = E + 2$   
 $12 + V = 30 + 2$   
 $V = 20$

54. C.  
 $F + V = E + 2$   
 $F + 12 = 18 + 2$   
 $F = 8$

55. B.  
 $(QS)^2 = \left(\frac{h}{2}\right)^2 + \left(\frac{h}{2}\right)^2$   
 $(QS)^2 = \frac{h^2}{4} + \frac{h^2}{4}$   
 $(QS)^2 = \frac{h^2}{2}$   
 $QS = \frac{h}{\sqrt{2}}$



### Lesson 12.1

#### 12.1 Mixed Review (p. 726)

60.  $A = bh$   
 $= (12)(8)$   
 $= 96 \text{ in.}^2$

61.  $A = \frac{1}{2}h(b_1 + b_2)$   
 $= \frac{1}{2}(16)(21 + 14)$   
 $= (8)(35)$

62.  $A = \frac{1}{2}d_1d_2$   
 $= \frac{1}{2}(49)(30)$   
 $= 735 \text{ m}^2$

63.  $A = \frac{1}{2}aP$   
 $= \frac{1}{2}(4.6)(48)$   
 $= 110.40 \text{ m}^2$

64.  $A = \frac{1}{2}aP$   
 $= \frac{1}{2}(4.22)(28)$   
 $= 59.08 \text{ ft}^2$

65.  $A = \frac{1}{4}\sqrt{3}s^2$   
 $= \frac{1}{4}\sqrt{3}(8)^2$   
 $\approx 27.71 \text{ cm}^2$

66.  $A = 6\left(\frac{1}{4}\sqrt{3}s^2\right)$   
 $A = \frac{6}{4}\sqrt{3}s^2$   
 $= \frac{6}{4}\sqrt{3}(4 \text{ ft})^2$   
 $\approx 41.57 \text{ ft}^2$

67.  $A = \frac{1}{2}aP$   
 $= \frac{1}{2}\left(\frac{8}{\tan 15^\circ}\right)(16 \cdot 12)$   
 $= \frac{4}{\tan 15^\circ}(192)$   
 $\approx 2866.22 \text{ in.}^2$

## Chapter 12 continued

$$\begin{aligned} 68. A &= \frac{115^\circ}{360^\circ} \cdot \pi(7)^2 \\ &= \frac{115^\circ}{360^\circ} \cdot 49\pi \\ &\approx 49.17 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} 70. A &= \frac{(180^\circ - 140^\circ)}{360^\circ} \cdot \pi(32)^2 \\ &= \frac{40^\circ}{360^\circ} \cdot 1024\pi \\ &\approx 357.44 \text{ in.}^2 \end{aligned}$$

$$\begin{aligned} 69. A &= \pi(43)^2 \\ &= 1849\pi \\ &\approx 5808.80 \text{ ft}^2 \end{aligned}$$

### 12.2 Developing Concepts (p. 727)

$$\begin{aligned} 1. \quad S.A. &= \text{Area } A + \text{Area } B + \text{Area } C + \text{Area } D + \text{Area } E + \\ &\quad \text{Area } F \\ &= (3 \cdot 7) + (5 \cdot 7) + (3 \cdot 5) + (7 \cdot 5) + (3 \cdot 5) + \\ &\quad (3 \cdot 7) \\ &= 21 + 35 + 15 + 35 + 15 + 21 \\ &= 142 \text{ sq units} \end{aligned}$$

$$\begin{aligned} 2. A &= 3 \cdot 7 = 21 \text{ sq units} \\ P &= 2(3) + 2(7) = 20 \text{ units} \\ h &= 5 \text{ units} \end{aligned}$$

$$\begin{aligned} 3. 2A + Ph &= 2(21) + (20)(5) \\ &= 42 + 100 \\ &= 142 \text{ sq units} \end{aligned}$$

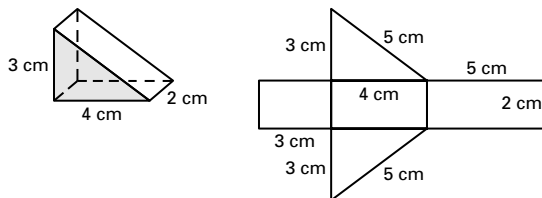
They are equal.

$$\begin{aligned} 4. \text{ Sample Answer: } S.A. &= 2(l \cdot w) + 2(w \cdot h) + 2(l \cdot h) \\ &\text{or } 2A + Ph \end{aligned}$$

### 12.2 Guided Practice (p. 731)

1. *Sample Answer:* Both have congruent faces which are in parallel planes. In both cases, the surface area is the sum of the area of the bases and the area of the lateral surface(s). A cylinder has bases which are not polygons whereas a prism does. The lateral area of a cylinder is the area of its curved surface. For a polyhedron, the lateral area is the sum of the areas of the lateral faces.

2. *Sample Answer:*



The lateral area is the area of 3 rectangles, one 3 cm by 2 cm, one 4 cm by 2 cm, and one 5 cm by 2 cm, for a total of 24 cm<sup>2</sup>. The surface area is the lateral area plus the area of the bases, 2  $\cong$  right triangles with a total area of 12 cm<sup>2</sup>. So the surface area is 36 cm<sup>2</sup>.

3. right cylinder 4. triangular prism 5. rectangular prism

6. top and bottom bases: 22 cm

front and back bases: 16 cm

left and right bases: 26 cm

7. top and bottom bases: 5 cm

front and back bases: 8 cm

left and right bases: 3 cm

8. top and bottom bases: 110 cm<sup>2</sup>

front and back bases: 128 cm<sup>2</sup>

left and right bases: 78 cm<sup>2</sup>

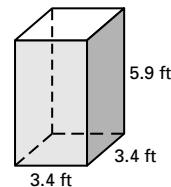
9. top and bottom bases: 24 cm<sup>2</sup>

front and back bases: 15 cm<sup>2</sup>

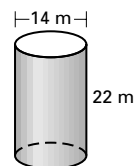
left and right bases: 40 cm<sup>2</sup>

$$\begin{aligned} 10. S.A. &= 2B + Ph \\ &= 2(24 \text{ cm}^2) + 110 \text{ cm}^2 \\ &= 158 \text{ cm}^2 \end{aligned}$$

11. *Sample Answer:*



12. *Sample Answer:*



### 12.2 Practice and Applications (p. 732–734)

13. right hexagonal prism 14. six 15. rectangle

16.  $\overline{VF}$ ,  $\overline{TE}$ ,  $\overline{SD}$ ,  $\overline{RC}$ ,  $\overline{QB}$ ,  $\overline{PA}$  (any four)

17. pentagonal prism 18. cylinder

19. triangular prism

$$\begin{aligned} 20. S.A. &= 2B + Ph \\ &= 2(9 \cdot 11) + (18 + 22)(10) \\ &= 198 + 400 \\ &= 598 \text{ in.}^2 \end{aligned}$$

$$\begin{aligned} 21. S.A. &= 2B + Ph \\ &= 2(2 \cdot 9) + (18 + 4)(7) \\ &= 36 + 154 \\ &= 190 \text{ m}^2 \end{aligned}$$

## Chapter 12 continued

22.  $S.A. = 2B + Ph$

$$\begin{aligned} &= 2\left(\frac{1}{4}\right)(\sqrt{3})(14)^2 + (42)(6) \\ &= 98\sqrt{3} + 252 \\ &\approx 421.74 \text{ ft}^2 \end{aligned}$$

23.  $S.A. = 2B + Ph$

$$\begin{aligned} &= 2\left(\frac{1}{2}(4\sqrt{2})(4)\right) + (16)(7.2) \\ &= 16\sqrt{2} + 115.2 \\ &\approx 137.83 \text{ m}^2 \end{aligned}$$

24.  $S.A. = 2B + Ph$

$$\begin{aligned} &= 2\left(\frac{1}{2}(2)(6.4)\right) + (15.11)(2.9) \\ &= 12.8 + 43.82 \\ &\approx 56.62 \text{ cm}^2 \end{aligned}$$

25.  $S.A. = 2B + Ph$

$$\begin{aligned} &= 2\left(6 \cdot \frac{1}{4} \cdot \sqrt{3} \cdot (2)^2\right) + (2 \cdot 6)(6.1) \\ &= 20.78 + 73.2 \\ &\approx 93.98 \text{ in.}^2 \end{aligned}$$

26.  $S.A. = 2\pi r^2 + 2\pi rh$

$$\begin{aligned} &= 2\pi(6 \text{ ft})^2 + 2\pi(6 \text{ ft})(11 \text{ ft}) \\ &= 72\pi + 132\pi \\ &= 204\pi \\ &\approx 640.88 \text{ ft}^2 \end{aligned}$$

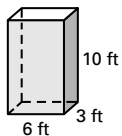
27.  $S.A. = 2\pi r^2 + 2\pi rh$

$$\begin{aligned} &= 2\pi(8 \text{ cm})^2 + 2\pi(8 \text{ cm})(8 \text{ cm}) \\ &= 128\pi + 128\pi \\ &= 256\pi \\ &\approx 804.25 \text{ cm}^2 \end{aligned}$$

28.  $S.A. = 2\pi r^2 + 2\pi rh$

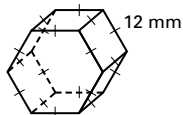
$$\begin{aligned} &= 2\pi(3.1)^2 + 2\pi(3.1)(10) \\ &= 81.22\pi \\ &\approx 255.16 \text{ in.}^2 \end{aligned}$$

29.  $S.A. = 2B + Ph$



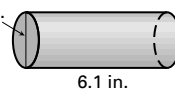
$$\begin{aligned} &= 2(18) + (18 \cdot 10) \\ &= 36 + 180 \\ &= 216 \text{ ft}^2 \end{aligned}$$

30.  $S.A. = 2B + Ph$



$$\begin{aligned} &= 2\left(6 \cdot \frac{1}{4} \cdot \sqrt{3} \cdot (12)^2\right) + (12 \cdot 6)(12) \\ &= 748.25 + 864 \\ &\approx 1612.25 \text{ mm}^2 \end{aligned}$$

31. 2.4 in.



$$\begin{aligned} S.A. &= 2\pi r^2 + 2\pi rh \\ &= 2\pi(1.2)^2 + 2\pi(1.2)(6.1) \\ &= 2.88\pi + 14.64\pi \\ &= 17.52\pi \\ &\approx 55.04 \text{ in.}^2 \end{aligned}$$

32.  $S = 2B + Ph$

$$\begin{aligned} 298 &= 2(7 \cdot 4) + (22)(x) \\ 298 &= 56 + 22x \\ 242 &= 22x \\ 11 \text{ ft} &= x \end{aligned}$$

33.  $S = 2B + Ph$

$$\begin{aligned} 870 &= 2 \cdot \left(\frac{1}{2} \cdot 12 \cdot 5\right) + (5 + 12 + 13)y \\ 870 &= 60 + 30y \\ 810 &= 30y \\ 27 \text{ m} &= y \end{aligned}$$

34.  $S = 2\pi r^2 + 2\pi rh$

$$\begin{aligned} 1202 &= 2(\pi)(7.5)^2 + 2(\pi)(7.5)(z) \\ 1202 &= 112.5\pi + 15\pi z \\ 848.57 &= 15\pi z \\ 18.01 \text{ in.} &\approx z \end{aligned}$$

35. For  $h = 1$  in.

$$\begin{aligned} S &= 2B + Ph \\ &= 2(2 \cdot 2) + (4.2)(1) \\ &= 8 + 8 \\ &= 16 \end{aligned}$$

For  $h = 2$  in.

$$\begin{aligned} S &= 2B + Ph \\ &= 2(2 \cdot 2) + (4 \cdot 2)(2) \\ &= 8 + 16 \\ &= 24 \text{ in.}^2 \end{aligned}$$

Doubling the height does not double the surface area.

36. For  $h = 1$  in.

$$\begin{aligned} S &= 2B + Ph \\ &= 2\left(\frac{1}{4}\sqrt{3}(3)^2\right) + (3 \cdot 3)(1) \\ &= 7.79 + 9 \\ &\approx 17 \text{ in.} \end{aligned}$$

For  $n = 2$  in.

$$\begin{aligned} S &= 2B + Ph \\ &= 2\left(\frac{1}{4}\sqrt{3}(3)^2\right) + (3 \cdot 3)(2) \\ &= 7.79 + 18 \\ &\approx 26 \text{ in.} \end{aligned}$$

Doubling the height does not double the surface area.

## Chapter 12 continued

37. For  $h = 1$  in.

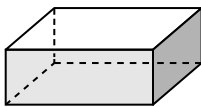
$$\begin{aligned} S &= 2B + Ph \\ &= 2\left(6 \cdot \frac{1}{4}\sqrt{3}(2)^2\right) + (6 \cdot 2)(1) \\ &= 20.78 + 12 \\ &\approx 33 \text{ in.} \end{aligned}$$

For  $h = 2$  in.

$$\begin{aligned} S &= 2B + Ph \\ &= 2\left(6 \cdot \frac{1}{4}\sqrt{3}(2)^2\right) + (6 \cdot 2)(2) \\ &= 20.78 + 24 \\ &\approx 45 \text{ in.} \end{aligned}$$

Doubling the height does not double the surface area.

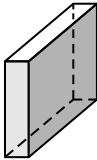
38. *Sample Answer:*



39. *Sample Answer:*



- 40.



41. *Sample Answer:* At least two sides would be longer or wider than the corresponding sides of the folded box. Several sides have to fold over to enclose the box and make its structure more rigid.

42.  $S = 2B + Ph$

$$\begin{aligned} &= 2(64)^2 + (64 \cdot 4)(414) \\ &= 114,176 \text{ m}^2 \end{aligned}$$

43.  $L.A. = 2\pi rh$

$$\begin{aligned} &= 2(\pi)(1)(4) \\ &= 8\pi \\ &\approx 25 \text{ in.}^2 \end{aligned}$$

44.  $A = (B + Ph) + (B + Ph)$

$$\begin{aligned} &= \left(\left(6 \cdot \frac{1}{2} \cdot \sqrt{3} \cdot 11^2\right) + (6 \cdot 11)(3)\right) \\ &\quad + \left(\left(6 \cdot \frac{1}{4} \cdot \sqrt{3} \cdot 5^2\right) + (6 \cdot 5)(3)\right) \\ &= 314.37 + 198 + 64.95 + 90 \\ &\approx 667 \text{ in}^2 \\ \frac{667 \text{ in.}^2}{130 \text{ in.}^2/\text{can}} &\approx 6 \text{ cans} \end{aligned}$$

45.  $S = 2\pi r^2 + 2\pi rh$

$$\begin{aligned} &= 2(\pi)(1.5)^2 + 2(\pi)(1.5)(4) \\ &= 4.5\pi + 12\pi \\ &= 16.5\pi \\ &\approx 52 \text{ in.}^2 \end{aligned}$$

46.  $S = 2\pi r^2 + 2\pi rh$

$$\begin{aligned} &= 2(\pi)(3)^2 + 2(\pi)(3)(8) \\ &= 18\pi + 48\pi \\ &= 66\pi \\ &\approx 207 \text{ in.}^2 \end{aligned}$$

47. *Sample Answer:* Let  $r$ ,  $h$ , and  $S$  be the radius, height, and surface area of the original cylinder. Then the surface area of the larger cylinder is  $2\pi(2r)^2 + 2\pi(2r)(2h) = 8\pi r^2 + 8\pi rh = 4(2\pi r^2 + 2\pi rh) = 4S$ .

48.  $S = 2(4 \cdot 6) + 2(5 \cdot 6) + 2(2 \cdot 6) + 2(3 \cdot 6) + 2(20 - 6)$

$$= 196 \text{ cm}^2$$

49.  $S = 2\pi(1.5)(6) + 2\pi(0.5)(6) + 2\pi(1.5)^2 - 2\pi(0.5)^2$

$$\begin{aligned} &= 18\pi + 6\pi + 4.5\pi - 0.5\pi \\ &= 28\pi \\ &\approx 87.96 \text{ in}^2 \end{aligned}$$

50.  $m\angle A = 61^\circ$

$$\tan 29^\circ = \frac{5}{BC}$$

$$BC = \frac{5}{\tan 29^\circ}$$

$$BC \approx 9.02$$

$$\sin 29^\circ = \frac{5}{AB}$$

$$AB = \frac{5}{\sin 29^\circ}$$

$$AB \approx 10.31$$

51.  $m\angle A = 58^\circ$

$$\sin 32^\circ = \frac{10.5}{AB}$$

$$AB = \frac{10.5}{\sin 32^\circ}$$

$$AB \approx 19.81$$

$$\tan 32^\circ = \frac{10.5}{BC}$$

$$BC = \frac{10.5}{\tan 32^\circ}$$

$$BC \approx 16.80$$

52.  $m\angle B = 44^\circ$

$$\cos 46^\circ = \frac{12}{AB}$$

$$AB = \frac{12}{\cos 46^\circ}$$

$$AB \approx 17.27$$

$$\tan 46^\circ = \frac{BC}{12}$$

$$\tan 46^\circ = BC$$

$$12.43 \approx BC$$

53.  $A = \frac{1}{2}aP$

$$\begin{aligned} &= \frac{1}{2}(19 \cos 36^\circ)(2)(19 \sin 36^\circ)(5) \\ &= 1805 \cos 36^\circ \sin 36^\circ \\ &\approx 858.33 \text{ m}^2 \end{aligned}$$

## Chapter 12 continued

$$54. A = \pi r^2$$

$$= \pi(14 \text{ ft})^2$$

$$= 196\pi$$

$$\approx 615.75 \text{ ft}^2$$

$$56. P = \frac{\overline{QS}}{\overline{PW}} = \frac{9}{22} \approx 41\% \quad 57. P = \frac{\overline{PU}}{\overline{PW}} = \frac{16}{22} = \frac{8}{11} \approx 73\%$$

$$58. P = \frac{\overline{QU}}{\overline{PW}} = \frac{14}{22} = \frac{7}{11} \approx 64\%$$

$$59. P = \frac{\overline{TW}}{\overline{PW}} = \frac{8}{22} = \frac{4}{11} \approx 36\%$$

$$60. P = \frac{\overline{PV}}{\overline{PW}} = \frac{20}{22} = \frac{10}{11} \approx 91\%$$

### Lesson 12.3

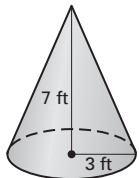
#### 12.3 Guided Practice (p. 738)

1. *Sample Answer:* All the faces of a pyramid are polygons and two lateral faces intersect in a lateral edge. A cone has no lateral faces. Its base is a  $\odot$  and its lateral surface is curved, so it has no lateral edges. Both are space figures with a vertex and a base. The altitude of each is the  $\perp$  distance from the vertex to the plane containing the base.

2. No; all the faces of any pyramid are triangles.

3. C 4. E 5. B 6. A 7. D

#### ART FOR EXERCISES 8–11



$$8. A = \pi r^2$$

$$= (\pi)(3)^2$$

$$= 9\pi$$

$$\approx 28.27 \text{ ft}^2$$

$$9. l^2 = 7^2 + 3^2$$

$$l^2 = 58$$

$$l \approx 7.62 \text{ ft}$$

$$10. \text{Lateral Area} = \pi r l$$

$$= (\pi)(3)(7.62)$$

$$= 22.86\pi$$

$$\approx 71.82 \text{ ft}^2$$

$$11. S.A. = \pi r^2 + \pi r l$$

$$= (\pi)(3)^2 + (\pi)(3)(7.62)$$

$$= 9\pi + 22.86\pi$$

$$= 31.86\pi$$

$$\approx 100.09 \text{ ft}^2$$

$$12. S = B + \frac{1}{2}Pl$$

$$= 9 + \frac{1}{2}(12)(2.5)$$

$$= 24 \text{ m}^2$$

$$13. S = B + \frac{1}{2}Pl$$

$$= 25\sqrt{3} + \frac{1}{2}(30)(12)$$

$$\approx 223.30 \text{ in.}^2$$

#### 12.3 Practice and Applications (pp. 738–741)

$$14. \ell^2 = 12^2 + 4^2$$

$$= 160$$

$$\ell = 4\sqrt{10} \text{ m}$$

$$\text{Lateral Area} = \frac{1}{2}b\ell$$

$$= \frac{1}{2}(8)(4\sqrt{10})$$

$$\approx 50.6 \text{ m}^2$$

$$15. \ell^2 = (22)^2 + (11)^2$$

$$= 605$$

$$\ell = 11\sqrt{5} \text{ in.}$$

$$\text{Lateral Area} = \frac{1}{2}b\ell$$

$$= \left(\frac{1}{2}\right)(22)(11\sqrt{5})$$

$$\approx 270.6 \text{ in.}^2$$

$$16. \ell^2 = (2)^2 + (7.1)^2$$

$$= 54.41$$

$$\ell = \sqrt{54.41} \text{ ft}$$

$$\text{Lateral Area} = \frac{1}{2}b\ell$$

$$= \frac{1}{2}(4)(\sqrt{54.41})$$

$$\approx 14.8 \text{ ft}^2$$

$$17. S = B + \frac{1}{2}Pl$$

$$= (11.2)^2 + \frac{1}{2}(4 \cdot 11.2)(17)$$

$$= 506.24 \text{ mm}^2$$

$$18. \ell^2 = 13^2 - 4^2$$

$$\ell^2 = 153$$

$$\ell = 3\sqrt{17}$$

$$S = B + \frac{1}{2}Pl$$

$$= \frac{1}{2}(8)(8 \cos 30^\circ) + \frac{1}{2}(3 \cdot 8)(3\sqrt{17})$$

$$\approx 27.71 + 148.43$$

$$\approx 176.14 \text{ cm}^2$$

## Chapter 12 continued

19.  $\ell^2 = 9^2 - 2.75^2$

$$\ell^2 = 73.4375$$

$$\ell = \sqrt{73.4375}$$

$$S = B + \frac{1}{2}Pl$$

$$= \frac{1}{2}aP + \frac{1}{2}Pl$$

$$= \frac{1}{2} \left( \frac{2.75}{\tan 30^\circ} \right) (5.5 \cdot 6) + \frac{1}{2} (5.5 \cdot 6) (\sqrt{73.4375})$$

$$\approx 78.59 + 141.40$$

$$\approx 219.99 \text{ cm}^2$$

20.  $\ell^2 = (14)^2 + (8)^2$

$$\ell^2 = 260$$

$$\ell = \sqrt{260}$$

$$\approx 16.1 \text{ in.}$$

21.  $\ell^2 = (9.2)^2 + (5.6)^2$

$$\ell^2 = 116$$

$$\ell = \sqrt{116}$$

$$\approx 10.78 \text{ cm}$$

22.  $\ell^2 = (\sqrt{2})^2 + (2)^2$

$$\ell^2 = 6$$

$$\ell = \sqrt{6}$$

$$\approx 2.4 \text{ ft}$$

23.  $S = \pi r^2 + \pi r l$

$$= \pi(7.8)^2 + \pi(7.8)(10)$$

$$= 60.84\pi + 78\pi$$

$$= 138.84\pi \text{ m}^2$$

24.  $S = \pi r^2 + \pi r l$

$$= \pi(5.9)^2 + \pi(5.9)(10)$$

$$= 34.81\pi + 59\pi$$

$$= 93.81\pi \text{ mm}^2$$

25.  $\ell^2 = 4.5^2 + 11^2$

$$\ell^2 = 141.25$$

$$\ell = \sqrt{141.25}$$

$$S = \pi r^2 + \pi r l$$

$$= \pi(4.5)^2 + \pi(4.5)(\sqrt{141.25})$$

$$\approx 20.25\pi + 53.48\pi$$

$$= 73.73\pi \text{ in.}^2$$

26. regular square pyramid

$$\ell^2 = 7^2 - 3.5^2$$

$$= 36.75$$

$$\ell = \sqrt{36.75}$$

$$S = B + \frac{1}{2}Pl$$

$$= (7)^2 + \frac{1}{2}(7 \cdot 4)(\sqrt{36.75})$$

$$\approx 49 + 84.87$$

$$\approx 133.9 \text{ ft}^2$$

27. right cone

$$S = \pi r^2 + \pi r l$$

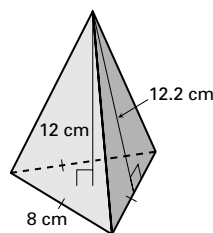
$$= (\pi)(2)^2 + (\pi)(2)(6)$$

$$= 4\pi + 12\pi$$

$$= 16\pi$$

$$\approx 50.3 \text{ cm}^2$$

28.



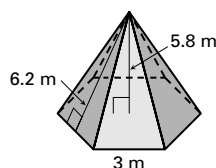
$$S = B + \frac{1}{2}Pl$$

$$= \frac{1}{4}\sqrt{3}(8)^2 + \frac{1}{2}(3 \cdot 8)(12.2)$$

$$= 27.71 + 146.4$$

$$= 174.1 \text{ cm}^2$$

29.



$$S = B + \frac{1}{2}Pl$$

$$= 6 \cdot \frac{1}{4} \cdot \sqrt{3}(3)^2 + \frac{1}{2}(6 \cdot 3)(6.2)$$

$$\approx 23.38 + 55.8$$

$$\approx 79.2 \text{ m}^2$$

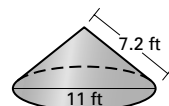
30.  $S = \pi r^2 + \pi r l$

$$= (\pi)(5.5)^2 + (\pi)(5.5)(7.2)$$

$$= 30.25\pi + 39.6\pi$$

$$= 69.85\pi$$

$$\approx 219.4 \text{ ft}^2$$



## Chapter 12 continued

$$31. \ell^2 = 12^2 + 9^2$$

$$= 225$$

$$\ell = 15$$

$$S = \pi r^2 + \pi r l$$

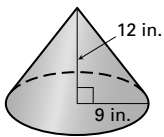
$$= (\pi)(9)^2 + (\pi)(9)(15)$$

$$= 81\pi + 135\pi$$

$$= 216\pi$$

$$= 254.47 \text{ in.}^2 + 424.12 \text{ in.}^2$$

$$\approx 678.56 \text{ in.}^2$$



$$32. \ell^2 = 6^2 + 8.8^2$$

$$= 113.44$$

$$\ell = \sqrt{113.44}$$

$$S = 2\left(B + \frac{1}{2}Pl\right)$$

$$= 2\left[(12)^2 + \frac{1}{2}(4 \cdot 12)(\sqrt{113.44})\right]$$

$$= 2(144 + 255.6)$$

$$= 799.2 \text{ units}^2$$

$$33. \ell^2 = 1.5^2 + 3^2$$

$$= 11.25$$

$$\ell = \sqrt{11.25}$$

$$S = (B + Ph) + 4\left(\frac{1}{2}b\ell\right)$$

$$= [(3)^2 + (12)(6)] + 4\left(\frac{1}{2}\right)(3)\left(\sqrt{11.25}\right)$$

$$\approx 90 + 20.1$$

$$\approx 110.1 \text{ sq units}$$

$$34. \ell^2 = 3^2 + 4^2$$

$$= 25$$

$$\ell = 5$$

$$S = \pi r^2 + 2\pi r h + \pi r l$$

$$= (\pi)(3)^2 + (2)(\pi)(3)(10) + (\pi)(3)(5)$$

$$= 9\pi + 60\pi + 15\pi$$

$$= 84\pi$$

$$\approx 263.9 \text{ sq units}$$

$$35. S = 72 \div 4 = 18$$

$$p = 18 \div 2 = 9$$

$$q^2 = p^2 + 12^2$$

$$q^2 = 9^2 + 12^2$$

$$q^2 = 225$$

$$q = 15$$

$$36. S = \pi r^2 + \pi r l$$

$$75.4 = (\pi)(3)^2 + (\pi)(3)(y)$$

$$75.4 = 9\pi + 3\pi y$$

$$47.13 = 3\pi y$$

$$\frac{47.13}{3\pi} = y$$

$$5 \text{ in.} = y$$

$$x^2 = y^2 - 3^2$$

$$= 25 - 9$$

$$= 16$$

$$x = 4 \text{ in.}$$

$$37. S = B + \frac{1}{2}Pl$$

$$333 = \frac{1}{2}(6.1)(42) + \frac{1}{2}(42)l$$

$$333 = 128.1 + 21l$$

$$204.9 = 21l$$

$$9.8 \text{ m} \approx l$$

$$h^2 = \ell^2 - 6.1^2$$

$$h^2 = 9.8^2 - 6.1^2$$

$$h^2 = 58.83 \text{ m}$$

$$h \approx 7.7 \text{ m}$$

$$38. \text{Lateral Area} = \frac{1}{2}Pl$$

$$= \frac{1}{2}(28 \cdot 4)(\sqrt{18^2 + 14^2})$$

$$= (56)(\sqrt{520})$$

$$\approx 1277 \text{ cm}^2$$

$$39. S = B + \frac{1}{2}Pl$$

$$= (707.75)^2 + \frac{1}{2}(4 \cdot 707.75)$$

$$\left(\sqrt{(471)^2 + (353\frac{7}{8})^2}\right)$$

$$= 500,910.06 + (1415.5)(589.125)$$

$$= 1,334,817 \text{ ft}^2$$

$$40. \text{Base} = 704 \text{ ft}$$

$$\text{Height} = 446 \text{ ft}$$

$$S = B + \frac{1}{2}Pl$$

$$= (704)^2 + \frac{1}{2}(4 \cdot 704)(\sqrt{446^2 + 352^2})$$

$$= 495,616 + 1408(568.1725)$$

$$\approx 1,295,603 \text{ ft}^2$$

The surface area is about 39,214 ft<sup>2</sup> less.

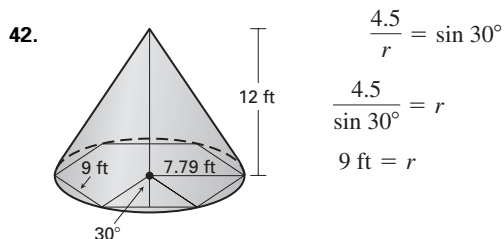
$$41. \text{Lateral Area} = \pi r l$$

$$= (\pi)(8 \text{ in.})(12 \text{ in.})$$

$$= 96\pi$$

$$\approx 302 \text{ in.}^2$$

## Chapter 12 continued



$$l^2 = 9^2 + 12^2$$

$$l^2 = 225$$

$$l = 15$$

$$\text{lateral area} = \pi r l$$

$$= \pi(9)(15)$$

$$= 135\pi$$

$$\approx 424 \text{ ft}^2$$

43. The surface area of the cup is about  $\frac{1}{4}$  the surface area of the original circle.  $m\angle ABC \approx 29^\circ$ .

44. B Column A: Area of base =  $4^2 = 16$

$$\text{Column B: Area of base} = \pi(3)^2 \approx 28.27$$

45. C Column A: Lateral edge length =  $\sqrt{4^2 + 3^2} = 5$

$$\text{Column B: Lateral edge length} = \sqrt{4^2 + 3^2} = 5$$

46. B

$$\text{Column A: Lateral Area} = \frac{1}{2}P\ell = \frac{1}{2}(16)(\sqrt{21}) \approx 36.66$$

$$\text{Column B: Lateral Area} = \pi r l = 3.14(3)(5) = 47.12$$

47.  $S = \pi r^2 + \pi r l$

$$= (\pi)(1)^2 + (\pi)(1)(\sqrt{(\sqrt{2})^2 + 1^2})$$

$$= \pi + \pi\sqrt{3}$$

$$= \pi(1 + \sqrt{3})$$

$$\approx 8.58 \text{ sq units}$$

48. Square

$$S = B + \frac{1}{2}Pl$$

$$= (1.414)^2 + \frac{1}{2}(4 \cdot 1.414)(1.58)$$

$$\approx 6.47 \text{ sq units}$$

Hexagon

$$S = B + \frac{1}{2}Pl$$

$$= \frac{1}{2}aP + \frac{1}{2}P\ell$$

$$= \left(\frac{1}{2}\right)\left(\frac{0.5}{\tan 30^\circ}\right)(6.1) + \frac{1}{2}(6.1)(1.65)$$

$$\approx 7.55 \text{ sq units}$$

Octagon

$$S = B + \frac{1}{2}Pl$$

$$= \frac{1}{2}aP + \frac{1}{2}P\ell$$

$$= \frac{1}{2}\left(\frac{0.3825}{\tan 22.5^\circ}\right)(8 \cdot 0.765) + \frac{1}{2}(8 \cdot 0.765)(1.68)$$

$$\approx 7.97 \text{ sq units}$$

49. *Sample Answer:* The surface area increases. As the number of sides increases, the surface area will approach the surface area of the cone.

### 12.3 Mixed Review (p. 741)

50.  $A = \frac{1}{4}\sqrt{3}s^2$

$$= \frac{1}{4}\sqrt{3}(21)^2$$

$$\approx 190.96 \text{ sq units}$$

51.  $A = \frac{1}{2}aP$

$$= \frac{1}{2}(5)(8)(2 \cdot 5 \tan 22.5^\circ)$$

$$\approx 82.84 \text{ sq units}$$

52.  $A = 6\left(\frac{1}{4}\right)(\sqrt{3})(3)^2$

$$\approx 23.38 \text{ sq units}$$

53.  $A = \frac{1}{2}\pi r^2$

$$190 = \frac{1}{2}(3.14)r^2$$

$$121 \approx r^2$$

$$11 \approx r$$

### 12.3 Quiz 1 (p. 742)

1. regular; convex

$$E = \frac{1}{2}(4 \cdot 3) = 6$$

$$F + V = E + 2$$

$$4 + V = 6 + 2$$

$$V = 4$$

2. not regular, convex

$$E = \frac{1}{2}(4 \cdot 3 + 4 \cdot 4)$$

$$E = 14$$

$$F + V = E + 2$$

$$8 + V = 14 + 2$$

$$V = 8$$

3. not regular, nonconvex

$$E = \frac{1}{2}(2 \cdot 6 + 6 \cdot 4) = 18$$

$$F + V = E + 2$$

$$8 + V = 18 + 2$$

$$V = 12$$

4.  $S = 2B + Ph$

$$= 2\left(\frac{1}{4} \cdot \sqrt{3} \cdot 7^2\right) + (21)(14)$$

$$\approx 42.44 + 294$$

$$\approx 336.44 \text{ sq units}$$

5.  $S = B + \frac{1}{2}Pl$

$$= (10)^2 + \frac{1}{2}(4 \cdot 10)(\sqrt{9^2 + 5^2})$$

$$\approx 100 + 205.91$$

$$\approx 305.9 \text{ m}^2$$

6.  $S = \pi r^2 + \pi r l$

$$= (\pi)(9)^2 + (\pi)(9)(\sqrt{9^2 + 16^2})$$

$$= 81\pi + 165.22\pi$$

$$= 246.22\pi$$

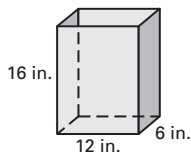
$$= 773.52 \text{ mm}^2$$

## Chapter 12 continued

### 12.3 Math & History (p. 742)

$$\begin{aligned} 1. \text{ Length} &= 4 + 16 = 20 \text{ in.} \\ \text{Width} &= 6 + 12 + 6 + 12 + 2 = 38 \text{ in.} \\ \text{Area} &= (20)(38) \\ &= 760 \text{ in.}^2 \end{aligned}$$

$$\begin{aligned} 2. \text{ 12 in. by 6 in.;} \\ S.A. &= B + Ph \\ &= (6 \cdot 12) + [2(12) + 2(6)](16) \\ &= 72 + 576 \\ &= 648 \text{ in.}^2 \end{aligned}$$



### Lesson 12.4

#### 12.4 Guided Practice (p. 746)

- square units; cubic units
- The two stacks have the same height and the same cross-sectional area at every level. Therefore, by Cavalieri's Principle, the two stacks have the same volume.

$$\begin{aligned} V &= l \times w \times h \\ &= 3 \times 3 \times 0.01(500) \\ &= 45 \text{ in.}^3 \end{aligned}$$

|    | $l$  | $w$  | $h$  | Volume  |
|----|------|------|------|---------|
| 3. | 17   | 3    | 5    | 255     |
| 4. | 2    | 8    | 10   | 160     |
| 5. | 4.8  | 6.1  | 5.5  | 161.04  |
| 6. | $6t$ | $3t$ | $3t$ | $54t^3$ |

$$\begin{aligned} 7. V &= \pi r^2 h \\ &= (\pi)(16)^2(15) \\ &= 540\pi \\ &\approx 1696.46 \text{ in.}^3 \\ 8. V &= l \times w \times h \\ &= (10)(8)(10) \\ &= 800 \text{ in.}^3 \\ 9. V &= l \times w \times h \\ &= 14 \text{ in.} \times 6 \text{ in.} \times 10 \text{ in.} \\ &= 840 \text{ in.}^3 \end{aligned}$$

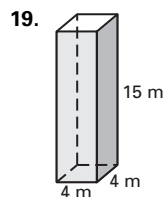
#### 12.4 Practice and Applications (p. 746–749)

- Sample Answer: 120 unit cubes; 3 layers of 4 rows of 10 cubes each
- Sample Answer: 100 unit cubes; 4 layers of 5 rows of 5 cubes each
- Sample Answer: 36 unit cubes; 6 layers of 3 rows of 2 cubes each

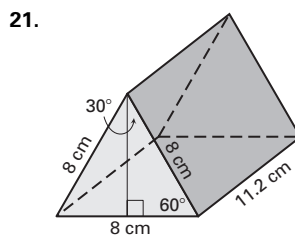
$$\begin{aligned} 13. V &= Bh \\ &= (8)(8)(8) \\ &= 521 \text{ in.}^3 \end{aligned}$$

$$\begin{aligned} 15. V &= Bh \\ &= 6\left(\frac{1}{4}\sqrt{3}(3.5)^2\right)(10 \text{ in.}) \\ &\approx 318.26 \text{ in.}^3 \end{aligned}$$

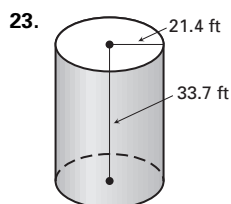
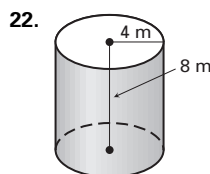
$$\begin{aligned} 17. V &= \pi r^2 h \\ &= (\pi)(3)^2(10.2) \\ &= 91.8\pi \\ &\approx 288.40 \text{ ft}^3 \end{aligned}$$



$$\begin{aligned} 20. V &= Bh \\ &= (24)^2(3 \text{ ft}) \\ &= 72 \text{ ft}^3 \end{aligned}$$



$$\begin{aligned} V &= Bh \\ &= \frac{1}{4}\sqrt{3}(8)^2(11.2) \\ &\approx 310.38 \text{ cm}^3 \end{aligned}$$



$$\begin{aligned} 14. V &= (4)(5)(12) \\ &= 240 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} 16. V &= \pi r^2 h \\ &= (\pi)(12)^2(15) \\ &= 2160\pi \\ &\approx 6785.84 \text{ m}^3 \end{aligned}$$

$$\begin{aligned} 18. V &= \pi r^2 h \\ &= (\pi)(3.5)^2(9.9) \\ &= 121.275\pi \\ &\approx 381.00 \text{ cm}^3 \end{aligned}$$

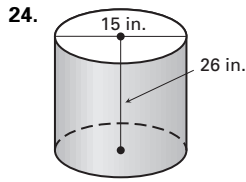
$$\begin{aligned} V &= Bh \\ &= (4)^2(15) \\ &= 240 \text{ m}^3 \end{aligned}$$

$$\begin{aligned} V &= Bh \\ &= (24)^2(3 \text{ ft}) \\ &= 72 \text{ ft}^3 \end{aligned}$$

$$\begin{aligned} V &= \pi r^2 h \\ &= (\pi)(4)^2(8) \\ &= 128\pi \\ &= 402.12 \text{ m}^3 \end{aligned}$$

$$\begin{aligned} V &= \pi r^2 h \\ &= (\pi)(21.4)^2(33.7) \\ &= 15433.252\pi \\ &\approx 48,484.99 \text{ ft}^3 \end{aligned}$$

## Chapter 12 continued



$$\begin{aligned} V &= \pi r^2 h \\ &= (\pi)(7.5)^2(26) \\ &= 1462.5\pi \\ &\approx 4594.58 \text{ in.}^2 \end{aligned}$$

25.  $V = Bh$   
 $= (6)(11)(14)$   
 $= 924 \text{ m}^3$

27.  $V = Bh$   
 $= (3)(3)(15 \sin 60^\circ)$   
 $= 116.91 \text{ cm}^3$

28.  $V = Bh$   
 $560 = (7)(8)u$   
 $560 = (56)u$   
 $10 \text{ ft} = V$

30.  $V = Bh$   
 $80 = \frac{1}{2}(8)(5)(w)$   
 $80 = (20)(w)$   
 $4 = w$

31.  $V = Bh$   
 $72.66 = (6)\frac{1}{4}\sqrt{3}(2)^2(x)$   
 $72.66 = 10.39(x)$   
 $6.99 \text{ in.} \approx x$

32.  $V = \pi r^2 h$   
 $3000 = (\pi)(9.3)^2 y$   
 $3000 = 271.72(y)$   
 $11.04 \text{ ft} \approx y$

33.  $V = \pi r^2 h$   
 $1696.5 = (\pi)(z)^2(15)$   
 $1696.5 = 47.12z^2$   
 $36 \approx z^2$   
 $6 \text{ m} \approx z$

34.  $V = (1.31)(0.66)(0.66) - 2(0.33)(0.39)(0.66)$   
 $= 0.57 - 0.17$   
 $= 0.40 \text{ ft}^3$

They are the same.

35.  $V = (10)(6)(2) + (3)(2)(5)$   
 $= 120 + 30$   
 $= 150 \text{ ft}^3$

36.  $V = (12.4)(7.8)(9) - (1.8)(3)(9)$   
 $= 870.48 - 48.6$   
 $= 821.88 \text{ m}^3$

37.  $V = (\pi)(8)^2(11) - (\pi)(3)^2(11)^2$   
 $= 704\pi - 99\pi$   
 $= 605\pi$   
 $= 1900.66 \text{ in.}^3$

38. First, convert measurements to yards.

$$\begin{aligned} V &= Bh \\ &= (10)(6)\left(\frac{4}{36}\right) \\ &\approx 6.67 \text{ yd} \end{aligned}$$

39. First, convert measurements to yards.

$$\begin{aligned} V &= Bh \\ &= \left(\frac{100}{3}\right)\left(\frac{50}{3}\right)\left(\frac{6}{36}\right) \\ &\approx 92.59 \text{ yd} \end{aligned}$$

40. First, convert measurements to yards.

$$\begin{aligned} V &= \pi r^2 h \\ &= (\pi)(8)^2\left(\frac{8}{36}\right) \\ &\approx 44.68 \text{ yd} \end{aligned}$$

41. No; the circumference of the base of the shorter cylinder is 11 in., so the radius is about 1.75 in. and the volume is about  $82 \text{ in.}^3$ . The circumference of the base of the taller cylinder is 8.5 in., so the radius is about 1.35 in. and the volume is about  $63 \text{ in.}^3$ .

42.  $V_{\text{block}} = (10)(9)(20)$   
 $= 1800 \text{ cm}^3$   
 $V_{\text{cyl}} = \pi(4.5)^2(12)$   
 $\approx 763.4 \text{ cm}^3$

$$\frac{1800 \text{ cm}^3}{763.4 \text{ cm}^3} \approx 2 \text{ candles}$$

43.  $V_{\text{prism}} = \frac{1}{2}(6)(8)(10)$   
 $= 240 \text{ cm}^3$

From Ex. 42, the volume of the block is  $1800 \text{ cm}^3$ , so

$$\frac{1800 \text{ cm}^3}{240 \text{ cm}^3} \approx 7 \text{ candles.}$$

44.  $V = 6 \cdot \frac{1}{4}\sqrt{3}(3)^2(12)$   
 $= 280.6 \text{ cm}^3$   
 $\frac{1800 \text{ cm}^3}{280.6 \text{ cm}^3} \approx 6 \text{ candles}$

## Chapter 12 continued

$$\begin{aligned}
 45. V_{\text{prism}} &= Bh \\
 &= (4)(3)(3) \\
 &= 36 \text{ in.}^3 \\
 V_{\text{cyl}} &= \pi r^2 h \\
 &= (3.14)(1.5 \text{ in.})^2(5.1 \text{ in.}) \\
 &= 36.05 \text{ in.}^3
 \end{aligned}$$

$$\begin{aligned}
 S_{\text{prism}} &= 2B + Ph \\
 &= 2(3 \cdot 3) + (12)(4) \\
 &= 66 \text{ in.}^2
 \end{aligned}$$

$$\begin{aligned}
 S &= 2\pi r^2 + 2\pi rh \\
 &= 2(\pi)(1.5)^2 + 2(\pi)(1.5)(5.1) \\
 &= 4.5\pi + 15.3\pi \\
 &= 19.8\pi \\
 &\approx 62.20
 \end{aligned}$$

They both have approximately the same volume, but the surface area of the cylinder is less so less metal is needed, thus reducing the cost.

$$\begin{aligned}
 46. V &= \pi r^2 h \\
 &= (\pi)(20)^2(23) \\
 &= 9200\pi \\
 &= 28,902.65 \text{ ft}^3 \\
 \frac{28,902.65 \text{ ft}^3}{0.1337 \text{ ft}^3/\text{gal}} &\approx 216,175 \text{ gallons}
 \end{aligned}$$

$$47. (216,175 \text{ gal})(8.56 \text{ lb}) = 1,850,458 \text{ lb}$$

$$\begin{aligned}
 48. A \quad V &= Bh \\
 1 &= l\left(\frac{4}{l}\right)x \\
 1 &= 4x \\
 \frac{1}{4} &= x \\
 49. E \quad V &= \pi r^2 h \\
 &= (\pi)(6)^2(10) \\
 &= 360\pi
 \end{aligned}$$

$$\begin{aligned}
 50. V_{\text{hor}} &= \pi r^2 h \\
 &= \pi(3)^2(5) \\
 &= 45\pi \text{ in.}^3 \\
 V_{\text{vert}} &= \pi r^2 h \\
 &= \pi(5)^2(3) \\
 &= 75\pi \text{ in.}^3
 \end{aligned}$$

The solid about the vertical line has the greater volume because volume is proportional to the square of the radius. The solid about the vertical line has the greater radius.

### Lesson 12.4

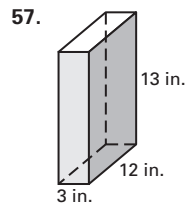
#### 12.4 Mixed Review (p. 749)

$$\begin{aligned}
 51. 2x + 5x + 5x &= 180^\circ & 52. x + 2x + 3x &= 180^\circ \\
 12x &= 180^\circ & 6x &= 180^\circ \\
 x &= 15^\circ & x &= 30^\circ
 \end{aligned}$$

$$30^\circ, 75^\circ, 75^\circ \qquad 30^\circ, 60^\circ, 90^\circ$$

$$\begin{aligned}
 53. 3x + 4x + 5x &= 180^\circ & 54. A &= \pi r^2 \\
 12x &= 180^\circ & &= (\pi)(5.06)^2 \\
 x &= 15^\circ & &= 25.6036\pi \\
 45^\circ, 60^\circ, 75^\circ & & &\approx 80.44 \text{ ft}^2
 \end{aligned}$$

$$\begin{aligned}
 55. s^2 &= 7^2 + 7^2 \\
 s^2 &= 98 \\
 s &= 7\sqrt{2} \\
 A &= s^2 \\
 &= (7\sqrt{2})^2 \\
 &= 98 \text{ m}^2 \\
 56. A &= \frac{1}{2}aP \\
 &= \frac{1}{2}(8.5)(6)(2 \cdot 8.5 \tan 30^\circ) \\
 &\approx 250.28 \text{ in.}^2
 \end{aligned}$$



$$\begin{aligned}
 S &= 2B + Ph \\
 &= 2(12 \cdot 3) + (30)(13) \\
 &= 462 \text{ in.}^2
 \end{aligned}$$

$$\begin{aligned}
 58. S &= \pi r^2 + \pi rl \\
 &= (\pi)(12.4)^2 + (\pi)(12.4)(17) \\
 &= 153.76\pi + 210.8\pi \\
 &= 364.56\pi \\
 &\approx 1145.30 \text{ ft}^2
 \end{aligned}$$

$$\begin{aligned}
 59. S &= B + \frac{1}{2}Pl \\
 &= (6)^2 + \frac{1}{2}(4 \cdot 6)(9) \\
 &= 144 \text{ cm}^2
 \end{aligned}$$

$$\begin{aligned}
 60. S &= B + \frac{1}{2}Pl \\
 &= 6 \cdot \frac{1}{4}\sqrt{3}(4)^2 + \frac{1}{2}(6 \cdot 4)(8) \\
 &\approx 137.57 \text{ in.}^2
 \end{aligned}$$

#### 12.4 Activity (p. 750)

1.  $r = 2.25$  and  $h = 4.53$ ; for values less than 2.25,  $S$  decreases and for values greater than 2.25,  $S$  increases.

### Lesson 12.5

#### Developing Concepts 12.5 (p. 751)

1. The area of the bases are the same:  $4 \text{ in.}^2$ .
2. The heights are the same.
3. The volume of the prism is greater; *Sample answer*: about 3 times greater.
4. The pyramid was filled about 3 times. So, the volume of the prism is 3 times greater.

Extension: The volume of a pyramid with base of area  $B$  and height  $h$  is equal to  $\frac{1}{3}Bh$ .

## Chapter 12 continued

### 12.5 Guided Practice (p. 755)

- cylinder
- Yes; according to Cavalieri's Principle, if two solids have the same height and the same cross-sectional area at every level, then they have the same volume.
- Yes; the volume of the rectangle prism is  $y^2x$ . The volume of the pyramid is  $\frac{1}{3}(y^2)(3x) = y^2x$ .
- (a)  $A = (5)^2 = 25 \text{ cm}^2$   
(b)  $V = \frac{1}{3}Bh = \left(\frac{1}{3}\right)(25)(4) = \frac{100}{3} \text{ cm}^3 \approx 33.3 \text{ cm}^3$
- (a)  $A = 2(\pi)(2) \approx 12.57 \text{ ft}^2$   
(b)  $V = \frac{1}{3}Bh = \frac{1}{3}(12.57 \text{ ft}^2)(4 \text{ ft}) = 16.76 \text{ ft}^3$
- (a)  $A = \frac{1}{4}\sqrt{3}(11)^2 \approx 52.39 \text{ m}^2$   
(b)  $V = \frac{1}{3}Bh = \frac{1}{3}(52.39)(14) \approx 244.51 \text{ m}^3$
- The height of the cone would be equal to  $\sqrt{(\text{slant height})^2 - \text{radius}^2}$ . Solve by using the Pythagorean Theorem.

### 12.5 Practice and Applications (pp. 755–757)

- $A = (9)(10.1) = 90.9 \text{ in.}^2$
- $A = \pi r^2 = (3.14)(6.1)^2 \approx 116.9 \text{ ft}^2$
- $A = 6 \cdot \frac{1}{4}\sqrt{3}(18)^2 \approx 841.8 \text{ mm}^2$
- $V = \frac{1}{3}Bh = \frac{1}{3}(10)^2(12) = 400 \text{ cm}^3$
- $V = \frac{1}{3}Bh = \frac{1}{3}(7)^2(5) = 81.7 \text{ m}^3$
- $V = \frac{1}{3}Bh = \frac{1}{3}\left(\frac{1}{4}\right)(\sqrt{3})(9.2)^2(12.7) = 155.2 \text{ ft}^3$
- $V = \frac{1}{3}Bh = \frac{1}{3}\left(\frac{1}{4}\sqrt{3}\right)(14)^2(18) = 509.2 \text{ in.}^3$
- $V = \frac{1}{3}Bh = \frac{1}{3}(6)\left(\frac{1}{4}\sqrt{3}\right)(10)^2(14.2) = 1229.8 \text{ mm}^3$
- $V = \frac{1}{3}Bh = \frac{1}{3}(6)\left(\frac{1}{4}\sqrt{3}\right)(12)^2(20) = 2494.2 \text{ cm}^3$
- $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}(\pi)(3)^2(\sqrt{6^2 - 3^2}) = 9\sqrt{3}\pi \approx 48.97 \text{ ft}^3$
- $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}(\pi)(5.75)^2(15.2) = 167.517\pi \approx 526.27 \text{ cm}^3$
- $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}(\pi)(7)^2(13) = 212.333\pi \approx 667.06 \text{ in.}^3$
- $V = \frac{1}{3}Bh = \frac{1}{3}(9)^2 h = 27 \cdot h$   
 $10 \text{ m} = h$
- $V = \frac{1}{3}Bh = \frac{1}{3}\left(\frac{1}{4}\sqrt{3}\right)(2\sqrt{3})^2 h = \sqrt{3}h$   
 $5 \text{ cm} = h$
- $V = V_{\text{cube}} + V_{\text{pyramid}} = (6)^3 + \frac{1}{3}(6)^2(6) = 288 \text{ ft}^3$
- $V = 2\left(\frac{1}{3}bh\right) = 2\left(\frac{1}{3}\right)(3.3)^2(2.3) = 16.70 \text{ cm}^3$
- $V = V_{\text{cube}} - V_{\text{cone}} = (5.1)^3 - \frac{1}{3}(3.14)(2.55)^2(5.1) = 132.65 - 34.73 \approx 97.92 \text{ m}^3$
- $V = V_{\text{cyl}} + V_{\text{cone}} = (\pi)(2.5)^2(7.5) + \frac{1}{3}\pi(2.5)^2(4) = 46.875 + 8.33\pi = 55.205\pi = 173.43 \text{ in.}^3$   
 $\frac{173.43 \text{ in.}^3}{14.4 \text{ in.}^3/\text{cup}} \approx 12 \text{ cups}$
- $\left(\frac{1}{2} \text{ cup}\right)(2)(3) = 3 \text{ cups}$   
The feeder will hold enough food for 3 days
- $V = \frac{1}{3}Bh = \frac{1}{3}(3.14)(4.15)^2(\sqrt{(10.1)^2 - (4.15)^2}) = (18.04)(\sqrt{84.79}) \approx 166 \text{ cm}^3$   
 $(166 \text{ cm}^3)(27) = 4482.0 \text{ cm}^3$
- $V = \frac{1}{3}Bh = \frac{1}{3}(3.14)(5)^2(10 \text{ cm}) \approx 261.8 \text{ cm}^3$   
 $80 - 65 = 15 \text{ mL/s in the funnel after 1 second.}$   
 $\frac{261.8 \text{ cm}^3}{15 \text{ cm}^3/\text{s}} \approx 17.5 \text{ seconds}$

## Chapter 12 continued

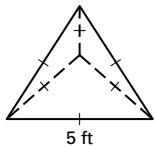
$$30. \sin 60^\circ = \frac{x}{5}$$

$$5 \sin 60^\circ = x$$

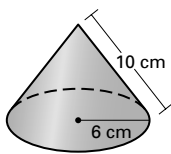
$$V = \frac{1}{3}Bh$$

$$= \frac{1}{3}\left(\frac{1}{4}\sqrt{3} \cdot 5^2\right)(5 \sin 60^\circ)$$

$$= 15.625 \text{ ft}^3$$

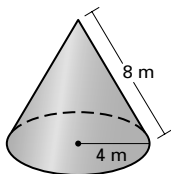


31.



$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}(3.14)(6)^2(8) \\ &\approx 301.59 \text{ cm}^3 \end{aligned}$$

32.

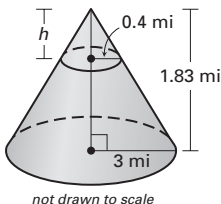


$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}(3.14)(4)^2(4\sqrt{3}) \\ &\approx 116.08 \text{ m}^3 \end{aligned}$$

$$33. V = \frac{1}{3}\pi r^2 h$$

$$\begin{aligned} &= \frac{1}{3}(3.14)(2\sqrt{2})^2(6) \\ &\approx 50.3 \text{ m}^3 \end{aligned}$$

34.



$$\begin{aligned} V &= 0.043 \text{ mi}^3 \\ V &= \frac{1}{3}\pi r^2 h \\ 0.043 &= \frac{1}{3}(3.14)(0.4)^2 h \\ 0.043 &= 0.17h \\ 0.25 \text{ mi} &\approx h \\ 1.83 - 0.25 &= 1.58 \text{ miles} \end{aligned}$$

$$35. V = \frac{1}{3}\pi r^2 h$$

$$\begin{aligned} &= \frac{1}{3}(3.14)(3.9)^2(3.9) \\ &\approx 62.12 \text{ in.}^3 \end{aligned}$$

36. *Sample answer:* No. It would take 62.12 min. for the sand to fall through not 60 minutes.

37. *Sample answer:* Assume that half the sand has accumulated after 30 min. Let  $r$  be the radius of the pile containing all the sand and  $r_1$  the radius of the pile containing half.  
 $\frac{1}{3}\pi(r_1)^3 = \frac{1}{2}\left(\frac{1}{3}\pi r^3\right)$ ,  
 so  $(r_1)^3 = \frac{1}{2}(r^3)$  and  $r_1 = \sqrt[3]{\frac{1}{2}} \cdot r$ .

$$\begin{aligned} 38. V &= [\text{area base}_1 + \text{area base}_2 + \text{geometric mean}] \frac{1}{3}h \\ &= [\pi(2)^2 + \pi(6)^2 + \sqrt{\pi(2)^2 \cdot \pi(6)^2}] \frac{1}{3}(9) \\ &= [4\pi + 36\pi + 37.70](3) \\ &= [163.364] 3 \\ &= 490.09 \text{ ft}^3 \end{aligned}$$

$$\begin{aligned} 39. V &= \left(\frac{1}{3}\right)h[\pi r_1^2 + \pi r_2^2 + \pi r_1 r_2] \\ &= \frac{1}{3}h\pi(r_1^2 + r_2^2 + r_1 r_2) \end{aligned}$$

### 12.5 Mixed Review (p. 758)

$$40. \frac{(9 - 2)(180^\circ)}{9} = 140^\circ = m \text{ int. } \angle; \text{ ext. } \angle = 40^\circ$$

$$41. \frac{(10 - 2)(180^\circ)}{10} = 144^\circ = m \text{ int. } \angle; \text{ ext. } \angle = 36^\circ$$

$$42. \frac{(19 - 2)(180^\circ)}{19} \approx 161^\circ = m \text{ int. } \angle; \text{ ext. } \angle \approx 19^\circ$$

$$43. \frac{(22 - 2)(180^\circ)}{22} \approx 163.6^\circ = m \text{ int. } \angle; \text{ ext. } \angle \approx 16.4^\circ$$

$$44. \frac{(25 - 2)(180^\circ)}{25} = 165.6^\circ = m \text{ int. } \angle; \text{ ext. } \angle = 14.4^\circ$$

$$45. \frac{(30 - 2)(180^\circ)}{30} = 168^\circ = m \text{ int. } \angle; \text{ ext. } \angle = 12^\circ$$

$$46. A = \pi r^2 = \pi(12.5)^2 \approx 490.87 \text{ in.}^2$$

$$47. A = \pi r^2 = \pi(16.3)^2 \approx 834.69 \text{ cm}^2$$

$$\begin{aligned} 48. C &= 2\pi r & A &= \pi(24)^2 \\ 48\pi &= 2\pi r & &\approx 1809.56 \text{ ft}^2 \\ 24 &= r & & \end{aligned}$$

$$\begin{aligned} 49. \text{Arc length} &= \frac{m \text{ arc}}{360^\circ} \times 2\pi r & A &= \pi r^2 \\ & & &= \pi(10)^2 \\ 2\pi &= \frac{36^\circ}{360^\circ} \cdot 2\pi r & &\approx 314.16 \text{ m}^2 \\ 10 &= r & & \end{aligned}$$

$$\begin{aligned} 50. E &= \frac{1}{2}(12 \cdot 8 + 20 \cdot 3) \\ &= 78 \end{aligned}$$

$$F + V = E + 2$$

$$32 + V = 78 + 2$$

$$V = 48$$

$$\begin{aligned} 51. E &= \frac{1}{2}(6 \cdot 4 + 8 \cdot 6) \\ &= 36 \end{aligned}$$

$$F + V = E + 2$$

$$14 + V = 36 + 2$$

$$V = 24$$

### 12.5 Quiz 2 (p. 758)

$$\begin{aligned} 1. V &= Bh \\ &= (10)(18)(6) \\ &= 1080 \text{ in.}^3 \end{aligned}$$

$$\begin{aligned} 2. V &= Bh \\ &= \frac{1}{2}(8 \cdot 15)(17) \\ &= 1020 \text{ ft}^3 \end{aligned}$$

$$\begin{aligned} 3. V &= \pi r^2 h \\ &= \pi(5)^2(14) \\ &\approx 1099.56 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} 4. V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi(4.5)^2(9) \\ &\approx 190.85 \text{ m}^3 \end{aligned}$$

## Chapter 12 continued

5.  $V = \frac{1}{3}Bh$   
 $= \frac{1}{3}(42)^2(36)$   
 $= 21,168 \text{ mm}^3$
6.  $V = \frac{1}{3}Bh$   
 $= \frac{1}{3} \cdot \frac{1}{4}\sqrt{3}(7)^2(9)$   
 $\approx 63.65 \text{ in.}^3$
7.  $V = \text{volume prism} + \text{volume pyramid}$   
 $V = Bh + \frac{1}{3}Bh$   
 $= \left(\frac{1}{2} \cdot \frac{5}{\tan 22.5} \cdot 80\right)(8) + \frac{1}{3}\left(\frac{1}{2} \cdot \frac{5}{\tan 22.5} \cdot 80\right)(11)$   
 $= 3862.74 + 1770.42$   
 $\approx 5633 \text{ ft}^3$

### Lesson 12.6

#### 12.6 Guided Practice (p. 762)

- equidistant; point
- Sample Answer:* The radius is  $\frac{1}{2}$  the diameter or 5 mm.  
 $\text{Volume} = \frac{4}{3}\pi r^3$  not  $\pi r^2$ .
- $\overline{TR}$ ,  $\overline{TS}$ , or  $\overline{QS}$     4.  $\overline{PQ}$ ,  $\overline{PS}$ , or  $\overline{PR}$
- $\overline{QS}$
- $C = 2\pi r$   
 $= 2\pi(3)$   
 $\approx 18.85 \text{ units}$
- $S = 4\pi r^2$   
 $= 4(3.14)(3)^2$   
 $\approx 113.1 \text{ sq units}$
- $V = \frac{4}{3}\pi r^3$   
 $= \frac{4}{3}(3.14)(3)^3$   
 $= 113.1 \text{ cu units}$
- $V = \frac{4}{3}\pi r^3$   
 $= \frac{4}{3}(3.14)(0.5 \times 10^{-8} \text{ cm})^3$   
 $\approx 5.24 \times 10^{-25} \text{ cm}^3$

#### 12.6 Practice and Applications (p. 762–765)

- $S = 4\pi r^2$   
 $= 4(3.14)(6.5)^2$   
 $= 530.93 \text{ m}^2$
- $S = 4\pi r^2$   
 $= 4(3.14)(18)^2$   
 $= 4071.50 \text{ cm}^2$
- $S = 4\pi r^2$   
 $= 4(3.14)(3.85)^2$   
 $\approx 186.27 \text{ ft}^2$
- $C = 2\pi r$   
 $7.4\pi = 2\pi r$   
 $\frac{7.4\pi}{2\pi} = r$   
 $3.7 \text{ in.} = r$
- $S = 4\pi r^2$   
 $= \frac{1}{2}(4)(3.14)(3.7)^2$   
 $\approx 86.02 \text{ in.}^2$
- $S = 4\pi r^2$   
 $= 4(3.14)(1.9)^2$   
 $= 45.4 \text{ in.}^2$
- $S = 4\pi r^2$   
 $= 4(3.14)(18)^2$   
 $= 4071.50 \text{ cm}^2$
- hemisphere
- $d = 2r$   
 $= 2(3.7 \text{ in.})$   
 $= 7.4 \text{ in.}$

$$18. S_{\text{Earth}} = 4\pi r^2 \qquad S_{\text{moon}} = 4\pi r^2$$

$$= 4\pi(3963.44)^2 \qquad = 4\pi(1077.5)^2$$

$$= 197,403,300 \text{ mi}^2 \qquad \approx 14,589,600 \text{ mi}^2$$

The surface area of the earth is about 13.5 times greater than the surface area of the moon.

19.  $S = \pi d^2$

Neptune:  $S = \pi(30,775)^2 \approx 2,975,404,400 \text{ mi}^2$

Triton:  $S = \pi(1680)^2 \approx 8,866,800 \text{ mi}^2$

Nereid:  $S = \pi(211)^2 \approx 139,900 \text{ mi}^2$

*Note:* Values for the diameter may vary depending on the source.

20.  $V = \frac{4}{3}\pi r^3$   
 $= \frac{4}{3}\pi(22)^3$   
 $\approx 44,602.24 \text{ cm}^3$

21.  $V = \frac{4}{3}\pi r^3$   
 $= \frac{4}{3}\pi(2.5)^3$   
 $\approx 65.45 \text{ in.}^3$

22.  $V = \frac{4}{3}\pi r^3$   
 $= \frac{4}{3}\pi(9.1 \text{ mm})^3$   
 $\approx 3156.55 \text{ mm}^3$

|     | Radius of sphere | Circumference of great circle | Surface area of sphere | Volume of sphere                 |
|-----|------------------|-------------------------------|------------------------|----------------------------------|
| 23. | 7 mm             | $14\pi \text{ mm}$            | $196\pi \text{ mm}^2$  | $\frac{1372\pi}{3} \text{ mm}^3$ |
| 24. | 6 in.            | $12\pi \text{ in.}$           | $144\pi \text{ in.}^2$ | $288\pi \text{ in.}^3$           |
| 25. | 5 cm             | $10\pi \text{ cm}$            | $100\pi \text{ cm}^2$  | $\frac{500\pi}{3} \text{ cm}^3$  |
| 26. | 10 m             | $20\pi \text{ m}$             | $400\pi \text{ m}^2$   | $\frac{4000\pi}{3} \text{ m}^3$  |

27. a.  $S = \pi r^2 + 2\pi rh + \frac{1}{2}(4\pi r^2)$   
 $= \pi(4.8)^2 + 2\pi(4.8)(9) + \frac{1}{2}(4)(\pi)(4.8)^2$   
 $\approx 488.58 \text{ in.}^2$
- b.  $V = \pi r^2 h - \frac{1}{2}(\frac{4}{3}\pi r^3)$   
 $= \pi(4.8)^2(9) - \frac{1}{2}(\frac{4}{3})(\pi)(4.8)^3$   
 $\approx 419.82 \text{ in.}^3$
28. a.  $S = \pi r^2 + 2\pi rh + \frac{1}{2}(4\pi r^2)$   
 $= \pi(10)^2 + 2\pi(10)(18) + 2\pi(10)^2$   
 $\approx 2073.45 \text{ cm}^2$
- b.  $V = \pi r^2 h + \frac{1}{2}(\frac{4}{3}\pi r^3)$   
 $= \pi(10)^2(18) + \frac{2}{3}\pi(10)^3$   
 $\approx 7749.26 \text{ cm}^3$
29. a.  $S = \pi rl + \frac{1}{2}(4\pi r^2)$   
 $= \pi(5.1)(13.22) + 2\pi(5.1)^2$   
 $\approx 375.24 \text{ ft}^2$
- b.  $V = \frac{1}{3}\pi r^2 h + \frac{1}{2}(\frac{4}{3}\pi r^3)$   
 $= \frac{1}{3}\pi(5.1)^2(12.2) + \frac{2}{3}\pi(5.1)^3$   
 $\approx 610.12 \text{ ft}^3$

## Chapter 12 continued

### 30. 1 meter

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi(1)^3 \\ &= \frac{4}{3}\pi \end{aligned}$$

$$\begin{aligned} S &= 4\pi r^2 \\ &= 4\pi(1)^2 \\ &= 4\pi \end{aligned}$$

### 2 meter

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi(2)^3 \\ &= \frac{32}{3}\pi \end{aligned}$$

$$\begin{aligned} S &= 4\pi r^2 \\ &= 4\pi(2)^2 \\ &= 16\pi \end{aligned}$$

### 3 meter

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi(3)^3 \\ &= 36\pi \end{aligned}$$

$$\begin{aligned} S &= 4\pi r^2 \\ &= 4\pi(3)^2 \\ &= 36\pi \end{aligned}$$

### 4 meter

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi(4)^3 \\ &= \frac{256}{3}\pi \end{aligned}$$

$$\begin{aligned} S &= 4\pi r^2 \\ &= 4\pi(4)^2 \\ &= 64\pi \end{aligned}$$

### 5 meter

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi(5)^3 \\ &= \frac{500}{3}\pi \end{aligned}$$

$$\begin{aligned} S &= 4\pi r^2 \\ &= 4\pi(5)^2 \\ &= 100\pi \end{aligned}$$

### 31. 1 m

$$\begin{aligned} \frac{V}{S} &= \frac{\frac{4}{3}\pi}{4\pi} \\ &= \frac{1}{3} \end{aligned}$$

### 4 m

$$\begin{aligned} \frac{V}{S} &= \frac{\frac{256}{3}\pi}{64\pi} \\ &= \frac{4}{3} \end{aligned}$$

### 2 m

$$\begin{aligned} \frac{V}{S} &= \frac{\frac{32}{3}\pi}{16\pi} \\ &= \frac{2}{3} \end{aligned}$$

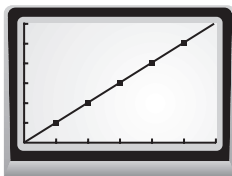
### 5 m

$$\begin{aligned} \frac{V}{S} &= \frac{\frac{500}{3}\pi}{100\pi} \\ &= \frac{5}{3} \end{aligned}$$

### 3 m

$$\begin{aligned} \frac{V}{S} &= \frac{36\pi}{36\pi} \\ &= 1 \end{aligned}$$

32.

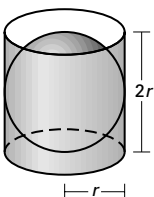


It is a straight line.

$\frac{V}{S}$  is a function of  $r$  and directly proportional to  $r$ .

33. No; let  $r$  be the radius of a sphere and  $S$  its surface area. If tripled, then the surface area is  $4\pi(3r)^2 = 4\pi(9r^2) = 9(4\pi r^2) = 9S$ . The surface area is multiplied by 9. (Another way to consider this is to note that surface area is a function of  $r^2$ , not of  $r$ , so tripling the value of  $r$  multiplies the value of  $S$  by  $3^2 = 9$ .)

34.



$$\begin{aligned} V &= \pi r^2 h \\ &= \pi r^2(2r) \\ &= 2\pi r^3 \end{aligned}$$

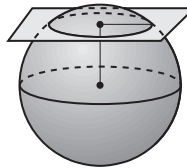
$$\begin{aligned} 35. \quad y &= \sqrt{(2\sqrt{2})^2 - 2^2} \\ &= 2 \end{aligned}$$

$$\begin{aligned} A &= \pi r^2 \\ &= (3.14)(2)^2 \\ &\approx 12.57 \text{ sq units} \end{aligned}$$

$$\begin{aligned} 36. \quad z &= \sqrt{6^2 + (6\sqrt{3})^2} \\ z &= 12 \end{aligned}$$

$$\begin{aligned} A &= \pi(12)^2 \\ &\approx 452.39 \text{ units}^2 \end{aligned}$$

37. Sample answer:



No. You would need to know the distance from the plane to the center of the sphere. Only then could the radius of the circle be determined and from that, the surface area.

$$\begin{aligned} 38. \quad S &= 4\pi r^2 \\ &= 4\pi\left(\frac{165}{2}\right)^2 \\ &\approx 85,529.86 \text{ ft}^2 \end{aligned}$$

No; the surface of the building does not appear to be smooth.

$$39. (267.3)(1000) = 267,300 \text{ ft}^2$$

$$\begin{aligned} 40. \quad V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}(3.14)\left(\frac{165}{2}\right)^3 \\ &\approx 2,352,071 \text{ ft}^3 \end{aligned}$$

$$\begin{aligned} 41. \quad V_{\text{slug}} &= \pi r^2 h \\ &= \pi(3)^2(6) \\ &= 54\pi \end{aligned}$$

$$\begin{aligned} V_{\text{BB}} &= \frac{4}{3}\pi r^3 \\ 54\pi &= \frac{4}{3}\pi r^3 \\ 40.5 &= r^3 \end{aligned}$$

$$3.43 \text{ cm} \approx r$$

$$\begin{aligned} 42. \quad V_{\text{cyl}} &= \pi r^2 h \\ &= \pi(2.57)^2(4.8) \\ &= 31.70\pi \\ V_{\text{BB}} &= \frac{4}{3}\pi r^3 \\ 31.70\pi &= \frac{4}{3}\pi r^3 \\ 23.78 &= r^3 \end{aligned}$$

$$2.88 \text{ cm} \approx r$$

$$\begin{aligned} 43. \quad V_{\text{BB}} &= \frac{4}{3}\pi(5)^3 \\ &= \frac{500}{3}\pi \\ V_{\text{cyl}} &= \pi r^2 h \\ \frac{500}{3}\pi &= \pi(4)^2 h \\ \frac{500}{3}\pi &= 16\pi h \\ \frac{500}{48} &= h \end{aligned}$$

$$10.42 \text{ cm} \approx h$$

$$\begin{aligned} 44. \quad V &= \frac{4}{3}r^3(\text{number of air bubbles}) \\ &= \frac{4}{3}\pi(0.5 \times 10^{-2})^3(1.446 \times 10^9) \\ &= 757.12 \text{ cm}^3 \end{aligned}$$

$$\frac{757.12}{946.34} \times 100 \approx 80\%$$

$$45. \frac{4}{3}\pi r^3 \quad 46. \pi r^2 \cdot 2r = 2\pi r^3$$

$$\begin{aligned} 47. \quad 2 \cdot \left(\frac{1}{3}\pi r^2 h\right) &= 2 \cdot \left(\frac{1}{3}\pi r^2 \cdot r\right) \\ &= \frac{2}{3}\pi r^3 \end{aligned}$$

48. Sample answer: The volume of the cylinder is greater than the volumes of both other solids; the volume of the cylinder is equal to the sum of the volumes of the sphere and the double-cone shaped solid.

## Chapter 12 continued

$$\begin{aligned}
 49. \quad & 5^2 = x^2 + (r)^2 \\
 & 25 - x^2 = (r)^2 \\
 & \sqrt{25 - x^2} = r \\
 & V = \frac{1}{3}\pi r^2 h \\
 & = \frac{1}{3}\pi(\sqrt{25 - x^2})^2(x + 5) \\
 & = \frac{1}{3}\pi(25 - x^2)(x + 5)
 \end{aligned}$$

### 12.6 Mixed Review (p. 765)

50. translation
51. translation,  $180^\circ$  rotation, vertical line reflection, horizontal glide reflection    52. translation
53. translation,  $180^\circ$  rotation
54. Similar by AA.  $\angle CAB \cong \angle CDE$  and  $\angle ACB \cong \angle DCE$  by vertical  $\angle$ s.  
Area of  $\triangle ABC = \left(\frac{4}{7}\right)^2(59.5) \approx 19.43$  sq units
55. Similar by AA.  $\angle ABC \cong \angle EDC$  and  $\angle ACB \cong \angle ECD$  by vertical  $\angle$ s.  
Area of  $\triangle ABC = \frac{1}{2}(8)(9) = 36$  sq units
56. Similar by AA.  $\angle C \cong \angle C$  and  $\angle ABC \cong \angle EDC$   
Area of  $\triangle ABC = \left(\frac{13}{9}\right)^2(37.35) \approx 77.93$  sq units
57.  $C = 2\pi r$   
 $= 2(3.14)(13.25)$   
 $= 83.25$  inches  
 $\frac{(100 \text{ ft})(12 \text{ in./ft})}{83.25 \text{ in.}} \approx 14.4$  revolutions

### Lesson 12.7

#### 12.7 Guided Practice (p. 769)

- $p^2: q^2; p^3: q^3$
- radius:  $\frac{6}{2} = \frac{3}{1}$  height:  $\frac{12}{4} = \frac{3}{1}$  The solids are similar because the radii and height are in the same ratio 3:1.
- Height:  $\frac{6}{3} = \frac{2}{1}$  Side:  $\frac{4}{2} = \frac{2}{1}$  Side:  $\frac{4}{4} = 1$  No. The solids are not similar because one pair of sides is not in the ratio 2:1.
- B The scale factor is 2:3.    5. C The scale factor is 2:1.
- A The scale factor is 4:3.    7.  $\sqrt[3]{\frac{216}{1331}} = \frac{6}{11}$
- $(1:3)^2 = 1:9$  so  $s = (36\pi)(9) = 324\pi \text{ m}^2$

#### 12.7 Practice and Applications (p. 769–771)

- No; radius  $= \frac{3}{2}$ ; height  $= \frac{4}{3}$
- Yes; radius  $= \frac{9}{4.5} = \frac{2}{1}$ ; height  $= \frac{2}{1}$
- Yes; sides  $= \frac{3}{2}, \frac{3}{2}$ , and  $\frac{1.5}{1}$
- Yes; height  $= \frac{4.8}{4} = \frac{1.2}{1}$  base  $= \frac{6}{5} = \frac{1.2}{1}$

13. always    14. sometimes    15. always    16. never

- $S = (28\pi)(2)^2 = 112\pi \text{ cm}^2$   
 $V = (20\pi)(2)^3 = 160\pi \text{ cm}^3$
- $S = (125.5)(3)^2 = 1129.5 \text{ m}^2$   
 $V = (87)(3)^3 = 2349 \text{ m}^3$
- $S = (24\pi)(4)^2 = 384\pi \text{ ft}^2$   
 $V = (12\pi)(4)^3 = 768\pi \text{ ft}^3$
- $S = (360)\left(\frac{5}{2}\right)^2 = 2250 \text{ in.}^2$   
 $V = (400)\left(\frac{5}{2}\right)^3 = 6250 \text{ in.}^3$
- Scale factor  $= \sqrt[3]{\frac{27}{216}} = \sqrt[3]{\frac{1}{8}} = \frac{1}{2}$   
Scale factor is 1:2.
- Scale factor  $= \sqrt[3]{\frac{27}{125}} = \frac{3}{5}$
- Scale factor  $= \sqrt[3]{\frac{36}{121.5}} = \frac{1.5}{1}$  or  $\frac{3}{2}$
- Scale factor  $= \sqrt{\frac{24}{384}} = \frac{1}{4}$
- $h = (5.5)(16) = 88$  in.
- $S = (12.9)(16)^2 = 3302.4 \text{ in.}^2$
- $V = (2)(16)^3 = 8192 \text{ in.}^3$
- Sample answer: True.  $V = \frac{4}{3}\pi r^3$  so the ratio would be  $x^3:y^3$ .
- True;  $S = 2B + Ph$ , but  $B = s^2$  so for a cube with side  $x$ , the area would be  $x^2$  and for a cube  $y$ , the area would be  $y^2$  for the base.
- $\frac{0.125}{12} = \frac{1}{96}$  or 1:96    31.  $S = 4\pi r^2$   
 $S = \frac{1}{2}(4)\pi(25\frac{1}{3})^2$   
 $\approx 4032 \text{ ft}^2$

$$32. S = \frac{4032}{(96)^2} \times \frac{144}{1} = 63 \text{ in.}^2$$

$$\begin{aligned}
 33. \quad V &= \frac{1}{2}\left(\frac{4}{3}\right)\pi r^3 \\
 &= \frac{2}{3}\pi\left(25\frac{1}{3}\right)^3 \\
 &= 34,051 \text{ ft}^3 \\
 V_{\text{model}} &= \frac{34,051}{(96)^3} \times \frac{(144 \times 12)}{1} = 66.5 \text{ in.}^3
 \end{aligned}$$

$$34. \frac{1}{2}\left(\frac{3}{2}\right)^3 = \frac{27}{16} = 1\frac{11}{16} \text{ cup}$$

$$35. E \quad V_{\text{small}} = (12)(7)(2) = 168$$

$$V_{\text{large}} = (24)(14)(4) = 1344 \quad \frac{1344}{168} = 8$$

$$36. \sqrt[3]{\frac{8}{125}} = \frac{2}{5} \quad S.A. = \left(\frac{2}{5}\right)^2 = \frac{4}{25}$$

D

## Chapter 12 continued

37. Sample answer:

$$\begin{aligned} V &= 12 \cdot \frac{4}{3}\pi r^3 \\ &= 12 \cdot \frac{4}{3}\pi(4.775)^3 \\ &= 1741.97\pi \text{ in.}^3 \end{aligned}$$

$$\begin{aligned} \text{Volume volleyball} &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi(4.135)^3 \\ &= 94.27\pi \text{ in.}^3 \end{aligned}$$

$$\frac{1741.97\pi}{94.27\pi} \approx 18 \text{ volleyballs}$$

Because of space between the volleyballs and a lack of knowledge of the dimensions of the crate, one can only estimate how many volleyballs will fill the crate.

$$\begin{aligned} 38. \quad S &= 2\pi r^2 + 2\pi rh & S &= 2\pi r^2 + 2\pi rh \\ 96\pi &= 2\pi r^2 + 2\pi r(2r) & 150\pi &= 2\pi r^2 + 2\pi r(2r) \\ 96\pi &= 6\pi r^2 & 150\pi &= 6\pi r^2 \\ 16 &= r^2 & 25 &= r^2 \\ 4 &= r & 5 &= r \\ 8 &= h & 10 &= h \end{aligned}$$

### 12.7 Mixed Review (p. 772)

39.  $\overline{LK}$  40.  $\overline{LJ}$  41.  $\overline{CA}$  42.  $\angle LKJ$  43.  $\angle BAC$

44.  $\triangle JLK$

$$\begin{aligned} 45. \quad S &= 2B + Ph \\ &= 2\left(\frac{1}{4}\sqrt{3}\right)(15)^2 + (45)(17) \\ &= 959.86 \text{ ft}^2 \end{aligned}$$

$$\begin{aligned} 46. \quad S &= \pi r^2 + \pi rl & 47. \quad S &= 4\pi r^2 \\ &= \pi(18)^2 + \pi(18)(21.4) & &= 4\pi(16.4)^2 \\ &= 2228.02 \text{ m}^2 & &= 3379.85 \text{ in.}^2 \end{aligned}$$

$$\begin{aligned} 48. \quad V &= \pi r^2 h & 49. \quad V &= \frac{1}{3}\pi r^2 h \\ 14,476.46 \text{ m}^3 &= \pi r^2(32) & 40,447.07 &= \frac{1}{3}\pi(22.8)^2 h \\ 144 \text{ m}^2 &= r^2 & 40,447.07 &= 544.38h \\ 12 \text{ m} &= r & 74.3 \text{ in.} &= h \\ d &= 24 \text{ m} \end{aligned}$$

### 12.7 Quiz 3 (p. 772)

$$\begin{aligned} 1. \quad S &= 4\pi r^2 & 2. \quad S &= 4\pi r^2 \\ &= 4(3.14)(10)^2 & &= 4(3.14)(1.88)^2 \\ &= 1256.64 \text{ cm}^2 & &= 44.41 \text{ in.}^2 \\ V &= \frac{4}{3}\pi r^3 & V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}(3.14)(10)^3 & &= \frac{4}{3}(3.14)(1.88)^3 \\ &= 4188.79 \text{ cm}^3 & &= 27.83 \text{ in.}^3 \end{aligned}$$

$$\begin{aligned} 3. \quad S &= 4\pi r^2 \\ &= 4(3.14)(5.4)^2 \\ &= 366.4 \text{ ft}^2 \end{aligned}$$

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}(3.14)(5.4)^3 \\ &= 659.58 \text{ ft}^3 \end{aligned}$$

5.  $x = 6.5$

**Large**

$$\begin{aligned} S &= 2B + Ph \\ &= 2(8 \cdot 6) + (28)(13) \\ &= 460 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} V &= Bh \\ &= (6 \cdot 8)(13) \\ &= 624 \text{ cm}^3 \end{aligned}$$

6.  $y = 3$

**Large**

$$\begin{aligned} S &= \pi r^2 + \pi rl \\ &= \pi(4.5)^2 + \pi(4.5)(12.82) \\ &= 244.86 \text{ ft}^2 \end{aligned}$$

$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi(4.5)^2(12) \\ &= 254.47 \text{ ft}^3 \end{aligned}$$

7.  $S = 4\pi r^2$

$$\begin{aligned} &= 4(3.14)(100)^2 \\ &= 125,663.71 \text{ ft}^2 \end{aligned}$$

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}(3.14)(100)^3 \\ &= 4,188,790.21 \text{ ft}^3 \end{aligned}$$

$$\begin{aligned} 4. \quad S &= 4\pi r^2 \\ &= 4(3.14)(15\sqrt{5})^2 \\ &= 14,137.17 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}(3.14)(15\sqrt{5})^3 \\ &= 158,058.33 \text{ m}^3 \end{aligned}$$

**Small**

$$\begin{aligned} S &= 2B + Ph \\ &= 2(3 \cdot 4) + (14)(6.5) \\ &= 115 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} V &= Bh \\ &= (3 \cdot 4)(6.5) \\ &= 78 \text{ cm}^3 \end{aligned}$$

**Small**

$$\begin{aligned} S &= \pi r^2 + \pi rl \\ &= \pi(3)^2 + \pi(3)(8.54) \\ &= 108.80 \end{aligned}$$

$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi(3)^2(8) \\ &= 75.40 \text{ ft}^3 \end{aligned}$$

8.  $r = \frac{100}{20} = 5$

$$\begin{aligned} S &= 125,663.71\left(\frac{1}{20}\right)^2 \\ &= 314.16 \text{ ft}^2 \end{aligned}$$

$$\begin{aligned} V &= 4,188,790.21\left(\frac{1}{20}\right)^3 \\ &= 523.60 \text{ ft}^3 \end{aligned}$$

### Chapter 12 Review (p. 774)

$$\begin{aligned} 1. \quad F + V &= E + 2 & 2. \quad F + V &= E + 2 \\ 32 + V &= 90 + 2 & F + 6 &= 10 + 2 \\ V &= 60 & F &= 6 \end{aligned}$$

$$\begin{aligned} 3. \quad F + V &= E + 2 & 4. \quad S &= 2B + Ph \\ 5 + 5 &= E + 2 & &= 2(4 \cdot 12) + (32)(9) \\ 8 &= E & &= 96 + 288 \\ & & &= 384 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} 5. \quad S &= 2\pi r^2 + 2\pi rh \\ &= 2(3.14)(6)^2 + 2(3.14)(6)(5) \\ &= 414.69 \text{ ft}^2 \end{aligned}$$

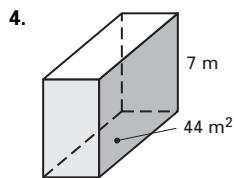
$$\begin{aligned} 6. \quad S &= 2\pi r^2 + 2\pi rh \\ &= 2(3.14)(5.5)^2 + 2(3.14)(5.5)(18) \\ &= 812.10 \text{ in.}^2 \end{aligned}$$

## Chapter 12 continued

7.  $S = B + \frac{1}{2}Pl$   
 $= 6^2 + \frac{1}{2}(24)(5)$   
 $= 96 \text{ cm}^2$
8.  $S = \pi r^2 + \pi r l$   
 $= (3.14)(6)^2 + (3.14)(6)(8)$   
 $= 263.89 \text{ in.}^2$
9.  $S = B + \frac{1}{2}Pl$   
 $= 6 \cdot \frac{1}{4}\sqrt{3}(4)^2 + \frac{1}{2}(24)(4\sqrt{3})$   
 $= 124.71 \text{ in.}^2$
10.  $V = Bh$   
 $= (64)(8)$   
 $= 512 \text{ cm}^3$
11.  $V = Bh$   
 $= 6 \cdot \frac{1}{4}\sqrt{3}(21)^2(37.2)$   
 $= 42,621.96 \text{ m}^3$
12.  $V = \pi r^2 h$   
 $= (3.14)(3.5)^2(8)$   
 $= 307.88 \text{ in.}^3$
13.  $V = \frac{1}{3}Bh$   
 $= \frac{1}{3}(30)^2(35)$   
 $= 10,500 \text{ in.}^3$
14.  $V = \frac{1}{3}Bh$   
 $= \frac{1}{3} \cdot \frac{1}{4}\sqrt{3}(19)^2(23)$   
 $= 1198.43 \text{ cm}^3$
15.  $V = \frac{1}{3}\pi r^2 h$   
 $= \frac{1}{3}(3.14)(8)^2(15)$   
 $= 1005.31 \text{ ft}^3$
16.  $S = 4\pi r^2$   
 $= 4(3.14)(14)^2$   
 $\approx 2463.01 \text{ m}^2$   
 $V = \frac{4}{3}\pi r^3$   
 $= \frac{4}{3}(3.14)(14)^3$   
 $= 11,494.04 \text{ m}^3$
17.  $S = 4\pi r^2$   
 $= 4(3.14)(\frac{1}{2})^2$   
 $= 3.14 \text{ in.}^2$   
 $V = \frac{4}{3}(3.14)(0.5)^3$   
 $= 0.52 \text{ in.}^3$
18.  $\frac{40}{20} = \frac{2}{1}$ ,  $\frac{12}{6} = \frac{2}{1}$   
 The solids are similar with a scale factor of 2:1.
19.  $\frac{5}{15} = \frac{1}{3}$ ,  $\frac{4}{12} = \frac{1}{3}$ ,  $\frac{8}{16} = \frac{1}{2}$  They are not similar because the ratios are not the same.

### Chapter 12 Test (p. 777)

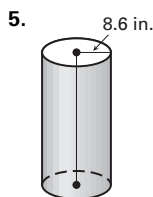
1.  $F = 8$ ;  $V = 12$ ;  $E = 18$     2.  $F = 5$ ;  $V = 6$ ;  $E = 9$   
 3.  $F = 9$ ;  $V = 14$ ;  $E = 21$



$$S = 2B + Ph$$

$$= 2(44) + (30)(7)$$

$$= 298 \text{ m}^3$$



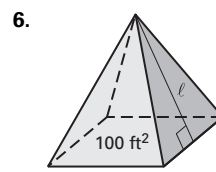
$$S = 2\pi r^2 + 2\pi r h$$

$$784\pi = 2\pi(8.6)^2 + 2\pi(8.6)h$$

$$784\pi = 147.92\pi + 17.2\pi h$$

$$636.08\pi = 17.2\pi h$$

$$36.98 \text{ in.} \approx h$$

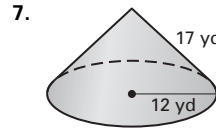


$$S = B + \frac{1}{2}Pl$$

$$340 = 100 + \frac{1}{2}(40)l$$

$$240 = 20l$$

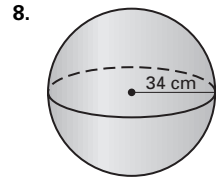
$$12 \text{ ft} = l$$



$$S = \pi r^2 + \pi r l$$

$$S = (3.14)(12)^2 + (3.14)(12)(17)$$

$$= 1093.27 \text{ yd}^2$$



$$S = 4\pi r^2$$

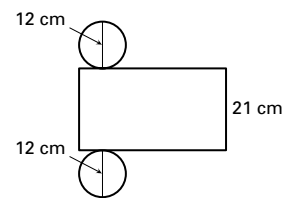
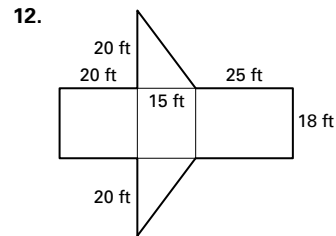
$$= 4(3.14)(34)^2$$

$$= 14,526.72 \text{ cm}^2$$

9.  $V = Bh$   
 $= \frac{1}{2}(20)(15)(18)$   
 $= 2700 \text{ ft}^3$

10.  $V = \pi r^2 h$   
 $= (3.14)(6)^2(21)$   
 $= 2375.04 \text{ cm}^3$

11.  $V = \frac{1}{3}Bh$   
 $= \frac{1}{3}(7)(5)(6)$   
 $= 70 \text{ ft}^3$

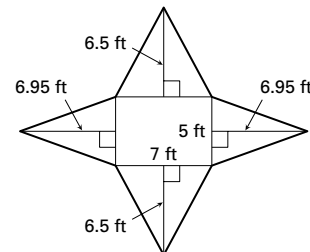


$$r = 15$$

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

$$= 4500\pi$$

$$\approx 14,137.17 \text{ cm}^3$$



13.  $V = \frac{4}{3}\pi r^3$   
 $= \frac{4}{3}\pi(15)^3$   
 $= 14,130 \text{ cm}$

## Chapter 12 continued

14. A plane may intersect a sphere in a point or in a circle. If the plane contains a diameter of the circle, the intersection is a great circle.

15.  $\frac{8}{27}$

**16. Prism**

$$S = 2B + Ph$$

$$= 2(16) + (16)(6)$$

$$= 128 \text{ in.}^2$$

$$V = Bh$$

$$= (16)(6)$$

$$= 96 \text{ in.}^3$$

**Cylinder**

$$S = 2\pi r^2 + 2\pi rh$$

$$= 2(3.14)(2)^2 + 2(3.14)(2)(7.64)$$

$$= 121.14 \text{ in.}^2$$

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

$$= (3.14)(2)^2(7.64)$$

$$= 96.01 \text{ in.}^3$$

The surface area of the cylinder is less than that of the prism, but the volumes are the same.

17.  $A = \frac{1}{2}aP$

$$= \frac{1}{2}(9.4)(15)(4)$$

$$= 282 \text{ ft}^2$$

18.  $L.A. = Ph$

$$= (15)(4)(59)$$

$$= 3540 \text{ ft}^2$$

$$V = Bh$$

$$= (282)(59)$$

$$= 16,638 \text{ ft}^3$$

19.  $A = \left(\frac{1}{1.25}\right)^2 = \frac{1}{1.5625}$

$$\text{Lateral Area} = (1.5625)(3540)$$

$$= 5531.25 \text{ ft}^2$$

$$V = \left(\frac{1}{1.25}\right)^3 = \frac{1}{1.95}$$

$$V = (1.25)^3(16,638)$$

$$= 32,496.09 \text{ ft}^3$$

### Chapter 12 Standardized Test (p. 778)

1. B

2. E  $S = 2B + Ph$

$$2608 = 2(6.8)(28) + 69.6h$$

$$2227.2 = 69.6h$$

$$32 \text{ m} = h$$

3. D  $L.A. = 2\pi rh$

$$= 2\pi(1.2)(8)$$

$$= 19.2\pi \text{ cm}^2$$

4. C  $V = Bh$

$$1650 = \frac{1}{2}(15)(x)(22)$$

$$1650 = 165x$$

$$10 \text{ m} = x$$

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

$$972\pi = \frac{4}{3}\pi r^3$$

$$729 = r^3$$

$$9 \text{ yd} = r$$

6. D  $V = Bh - \pi r^2 h$

$$= \frac{6}{4}\sqrt{3}(3)^2(2.5)(3.14)(1.5)^2(2.5)$$

$$= 40.79 \text{ ft}^3$$

7. E  $\frac{12}{36} = \frac{1}{3}$   $\frac{18}{54} = \frac{1}{3}$

$$V = \left(\frac{1}{3}\right)^3 = \frac{1}{27}$$

8. A Column A:  $C = 2\pi r = 2(3.14)(7.6) = 47.75 \text{ cm}$

$$\text{Column B: } P = 2(15.2) + 6 = 36.4 \text{ cm}$$

9. A Column A:  $S = 4\pi r^2 = 4(3.14)(7.6)^2 = 725.83 \text{ cm}^2$

$$\text{Column B: } S = B + \frac{1}{2}Pl = \frac{3}{2}\sqrt{3}(6)^2 + \frac{1}{2}(36)(15.2)$$

$$= 367.13$$

10. C

11. D  $V_{\text{small}} = \pi r^2 h$

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

$$= 80\pi$$

$$V_{\text{large}} = (4)^3(251.33)$$

$$= 5120\pi \text{ ft}^3$$

12. Side Roof  $= \sqrt{15^2 + 8^2} = 17$

$$\text{Area roof} = 2(52)(17) = 1768 \text{ ft}^2 \text{ not including ends}$$

$$\text{Area ends} = 2\left(\frac{1}{2}\right)(30)(8) = 240 \text{ ft}^2$$

$$\frac{1768}{32} = 56 \text{ sheets}$$

$$\frac{(1768 + 240)}{32} = 63 \text{ sheets including ends}$$

13.  $V = \text{Volume right prism} + \text{Volume triangular prism}$

$$= (30)(10)(52) + \frac{1}{2}(30)(8)(52)$$

$$= 15,600 + 6240$$

$$= 21,840 \text{ ft}^3$$

14.  $S = 2B + Ph$

$$= 2(30)(8)\left(\frac{1}{2}\right) + (64)(52)$$

$$= 240 + 3328$$

$$= 3568 \text{ ft}^2$$

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

$$= (3.14)(9)^2(9)$$

$$= 2290.22 \text{ cm}^3$$

16.  $V_{\text{bowl}} = \frac{1}{2}\left(\frac{4}{3}\right)(3.14)(10)^3$

$$= 2094.40 \text{ cm}^3$$

Find the volume of the bowl. If it is less than the volume of the souffle dish, then the peaches will fit in the souffle dish.

## Chapter 12 *continued*

17. volume of custard cups  $= 2(\pi \cdot (3.5)^2 \cdot 3.5)$   
 $\approx 269.39 \text{ cm}^3$

volume of bowl  $= \frac{1}{2} \cdot \frac{4}{3}\pi(10)^3$   
 $\approx 2094.40 \text{ cm}^3$

$$\frac{12}{2094.40} = \frac{x}{269.39}$$

$$2094.40x = 12(269.39)$$

$$x \approx 1.5 \text{ peaches or } 1\frac{1}{2} \text{ peaches}$$

18. *Sample answer:* Mark is not correct. Volume is a cubic quantity. If each dimension is reduced by  $\frac{1}{2}$ , the volume

would be reduced by  $\sqrt[3]{\frac{1}{2}}$  or  $\frac{1}{\sqrt[3]{2}}$ .

19.  $\frac{0.72}{0.57} \approx 1.26$ ; about 1: 1.26

20.  $h = 1.14 \times 1.26 = 1.44 \text{ cm}$

21.  $S = 2\pi r^2 + 2\pi rh$   
 $= 2(3.14)(0.57)^2 + 2(3.14)(0.57)(1.14)$   
 $= 6.12 \text{ cm}^2$

Large cylinder:  $r = 0.72 \text{ cm}$   $h = 1.44 \text{ cm}$

$$S = 2(3.14)(0.72)^2 + 2(3.14)(0.72)(1.44)$$
$$= 9.77 \text{ cm}^2$$

22.  $V = \pi r^2 h$   
 $= (3.14)(0.57)^2(1.14)$   
 $= 1.16 \text{ cm}^3$  for small cylinder

$$V = \pi r^2 h$$
$$= (3.14)(0.72)^2(1.44)$$
$$= 2.35 \text{ cm}^3$$

23.  $S = 2\pi r^2 + 2\pi rh$   
 $= 2(3.14)(2.16)^2 + 2(3.14)(2.16)(4.32)$   
 $= 87.94 \text{ cm}^2$

$$V = \pi r^2 h$$
$$= (3.14)(2.16)^2(4.32)$$
$$= 63.32 \text{ cm}^3$$

## Chapter 12 continued

### Cumulative Practice, Chs. 1–12 (p. 780)

1.  $4x - 2 = 6(x - 3)$

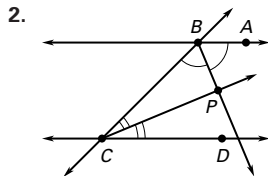
$$4x - 2 = 6x - 18$$

$$16 = 2x$$

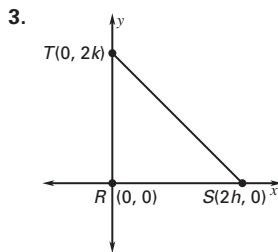
$$8 = x$$

So  $4x - 2 = 30^\circ$ .

The four  $\angle$ s are  $30^\circ, 30^\circ, 150^\circ, 150^\circ$ .



Consecutive interior  $\angle$ s are supplementary. If each interior  $\angle$  is bisected, then two of the interior  $\angle$ s of the triangle are complementary. The third  $\angle$  must be  $90^\circ$  in order for the sum of the  $\angle$ s to be  $180^\circ$ .



$\triangle RST$  is a rt.  $\triangle$  with vertices  $R(0, 0)$ ,  $S(2h, 0)$  and  $T(0, 2k)$ . The length of the hypotenuse is

$$\sqrt{(0 - 2h)^2 + (2k - 0)^2} =$$

$\sqrt{4h^2 + 4k^2} = 2\sqrt{h^2 + k^2}$ . The midpoint of the hypotenuse  $\overline{ST}$  is

$$\left(\frac{0 + 2h}{2}, \frac{0 + 2k}{2}\right) \text{ or } (h, k).$$

The length of the median is  $\sqrt{(h - 0)^2 + (k - 0)^2} = \sqrt{h^2 + k^2}$ . Therefore the median to the hypotenuse  $= \frac{1}{2}$  the length of the hypotenuse.

4.  $(AB)^2 = 144$ ;  $(BC)^2 = 64$ ;  $(AC)^2 = 225$  since  $(AC)^2 > AB^2 + BC^2$   $\triangle ABC$  is obtuse.  $\angle A$  is the smallest  $\angle$ .  $\angle B$  is the largest.

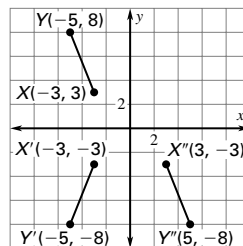
5.  $(XY)^2 = 100$ ;  $(YZ)^2 = 64$ ;  $(XZ)^2 = 36$ . Since  $(XY)^2 = (YZ)^2 + (XZ)^2$ ,  $\triangle XYZ$  is a rt.  $\triangle$ .  $\angle Z$  is the largest  $\angle$ , and  $\angle Y$  is the smallest.

| 6. Statement                             | Reason                                                                                      |
|------------------------------------------|---------------------------------------------------------------------------------------------|
| 1. $j \parallel k, m\angle 1 = 73^\circ$ | 1. Given                                                                                    |
| 2. $m\angle 1 + m\angle 2 = 180^\circ$   | 2. If two $\parallel$ lines are cut by a trans. the cons. int. $\angle$ s are supplementary |
| 3. $73^\circ + m\angle 2 = 180^\circ$    | 3. Substitution prop. of equality                                                           |
| 4. $m\angle 2 = 107^\circ$               | 4. Subtraction prop. of equality                                                            |

| 7. Statement                             | Reason                                             |
|------------------------------------------|----------------------------------------------------|
| 1. $ABDE$ and $CDEF$ are parallelograms. | 1. Given                                           |
| 2. $\angle 4 \cong \angle D$             | 2. Opp. $\angle$ s of a $\square$ are $\cong$ .    |
| 3. $m\angle 4 = m\angle D$               | 3. Def. of $\cong$ .                               |
| 4. $m\angle 6 + m\angle D = 180^\circ$   | 4. Consecutive $\angle$ s of a $\square$ are supp. |
| 5. $m\angle 6 + m\angle 4 = 180^\circ$   | 5. Substitution Prop. of Equality                  |
| 6. $\angle 4$ and $\angle 6$ are supp.   | 6. Def. of supplementary                           |

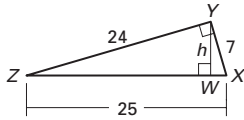
8. always 9. never  
10.  $180^\circ$  rotation about the origin



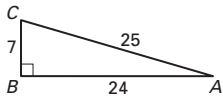
11. Sample answer:  $\angle A \cong \angle A$  by the reflexive prop. If two  $\parallel$  lines are cut by a transversal then corr.  $\angle$ s are  $\cong$  so  $\angle ABC \cong \angle ADE$ . By the AA Similarity Postulate  $\triangle ABC \sim \triangle ADE$ .
12.  $\frac{x}{4} = \frac{3}{5}$   
 $5x = 12$   
 $x = 2\frac{2}{5}$
13.  $\frac{\text{Perimeter of } \triangle ABC}{\text{Perimeter of } \triangle ADE} = \frac{5}{8}$   $\frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle ADE} = \left(\frac{5}{8}\right)^2 = \frac{25}{64}$

## Chapter 12 continued

$$\begin{aligned}
 14. \quad (\text{Hyp})^2 &= 7^2 + 24^2 & \frac{h}{24} &= \frac{7}{25} \\
 (\text{Hyp})^2 &= 625 & 25h &= 168 \\
 \text{Hyp} &= 25 & h &= 6.72
 \end{aligned}$$



$$\begin{aligned}
 15. \quad \sin \angle A &= \frac{7}{25} & \angle A &= \sin^{-1}\left(\frac{7}{25}\right) = 16.3^\circ \\
 \angle B &= 90^\circ - 16.3^\circ = 73.7^\circ
 \end{aligned}$$



$$\begin{aligned}
 16. \quad \widehat{AD} &= \widehat{DB} - \widehat{AB} & 17. \quad \angle ADB &= \frac{1}{2}(50^\circ) = 25^\circ \\
 &= 180^\circ - 50^\circ & & \\
 &= 130^\circ & &
 \end{aligned}$$

$$18. \quad \angle ACB = \frac{1}{2}(50^\circ) = 25^\circ \quad 19. \quad \angle EDB = \frac{1}{2}(180^\circ) = 90^\circ$$

$$20. \quad \angle EDA = \frac{1}{2}(\widehat{AD}) = \frac{1}{2}(130^\circ) = 65^\circ$$

$$21. \quad 40^\circ = \frac{1}{2}(180^\circ - \widehat{CD}) \quad 22. \quad \widehat{BC} = 80^\circ$$

$$80^\circ = 180^\circ - \widehat{CD}$$

$$\widehat{CD} = 100^\circ$$

$$23. \quad \widehat{ABD} = 50^\circ + 180^\circ = 230^\circ$$

$$24. \quad \angle BGC = \frac{1}{2}(80^\circ + 130^\circ) = 105^\circ$$

25.  $\overline{AB} \cong \overline{AC}$ ; if 2 segments from the same exterior point are tangent to a  $\odot$  then they are  $\cong$ .

26. It is a kite. 2 pairs of sides are congruent, but opposite sides are not congruent.

$$\begin{aligned}
 27. \quad EC \cdot ED &= AE \cdot EB & 28. \quad (DF)^2 &= BF \cdot FC \\
 18 \cdot 4 &= 6 \cdot AE & 6^2 &= 4 \cdot (4 + x) \\
 12 &= AE & 36 &= 16 + 4x \\
 & & 20 &= 4x \\
 & & 5 &= x
 \end{aligned}$$

$$29. \quad AE \cdot EB = ED \cdot CE$$

$$10 \cdot 7 = 3.5 \cdot CE$$

$$20 = CE$$

$$30. \quad \text{Center} = \left( \frac{-2 + 6}{2}, \frac{1 - 5}{2} \right) = (2, -2)$$

$$\text{Radius} = \sqrt{(2 - (-2))^2 + (-2 - 1)^2}$$

$$= \sqrt{42 + (-3)^2}$$

$$= \sqrt{25}$$

$$= 5 \text{ units}$$

$$(x - 2)^2 + (y + 2)^2 = 25$$

$$31. \quad C = 2\pi r \quad 32. \quad \text{center of the hexagon}$$

$$= 2(3.14)(5)$$

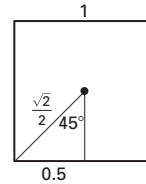
$$= 31.4 \text{ units}$$

33. the bisectors of the rt.  $\triangle$  formed by the  $\perp$  lines

$$34. \quad (25 - 2)(180^\circ) = 4140^\circ$$

$$\begin{aligned}
 35. \quad A &= \frac{1}{2}aP \\
 &= \frac{1}{2}(15 \tan 67.5^\circ)(240) \\
 &= 4345.6 \text{ cm}^2
 \end{aligned}$$

$$36. \quad \text{Let } s = \text{side of the square.} \quad P = \frac{\text{Area circle}}{\text{Area square}}$$



$$\begin{aligned}
 &= \frac{\frac{90^\circ}{360^\circ} \cdot \pi s^2}{s^2} \\
 &= \frac{\frac{1}{4} \pi s^2}{s^2} = \frac{\pi}{4}
 \end{aligned}$$

$$\frac{\pi}{4} - \frac{1}{2} \approx 29\%$$

$$\begin{aligned}
 37. \quad V &= \frac{1}{3}\pi r^2 h \\
 &= \frac{1}{3}\pi (3.5)^2 (6) \\
 &= 76.97 \text{ ft}^3
 \end{aligned}$$

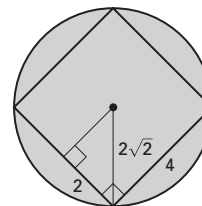
$$\begin{aligned}
 38. \quad V &= Bh \\
 &= 4(5)(5) \\
 &= 100 \text{ in.}^3
 \end{aligned}$$

$$\frac{1562.5}{100} = 15.625$$

$$\sqrt[3]{15.625} \approx 2.5$$

$$\text{Small:large} = 1:2.5$$

39.



$$\begin{aligned}
 A &= \pi r^2 \\
 &= (3.14)(2\sqrt{2})^2 \\
 &= 25.13 \text{ ft}^2
 \end{aligned}$$

$$\begin{aligned}
 40. \quad L.A. &= Ph \\
 &= (0.25)(6)(0.75) \\
 &= 1.125 \text{ in.}^2
 \end{aligned}$$

$$\begin{aligned}
 41. \quad S &= 4\pi r^2 \\
 &= 4(3.14)(0.75)^2 \\
 &= 7.07 \text{ in.}^2
 \end{aligned}$$