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.** $A = \frac{1}{4}\sqrt{3}(4)^2 \approx 6.9 \text{ in.}^2$ **4.** $A = \frac{1}{2}(3\sqrt{3})(6 \cdot 6) \approx 93.5 \text{ m}^2$

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 single region of space.

2. Yes; yes; a segment connecting any two points on the surface of any Platonic solid lies entirely inside or on the solid.

3. Polyhedron; each face is a polygon and the solid encloses a single region of space.

4. Polyhedron; each face is a polygon and the solid encloses a single region of space.

5. Not a polyhedron because some of its faces are not polygons.

6. $F + V = E + 2$
$F + 6 = 12 + 2$
$F = 8$

7. $F + V = E + 2$
$5 + V = 9 + 2$
$V = 6$

8. $F + V = E + 2$
$F + 10 = 15 + 2$
$F = 7$

9. $F + V = E + 2$
$20 + 12 = E + 2$
$30 = E$

12.1 Practice and Applications (pp. 723–726)

10. No; not every face is a polygon.

11. Yes; each face is a polygon and the solid encloses a single region of space.

12. Yes; each face is a polygon and the solid encloses a single region of space.

13. $F = 5 \quad V = 5 \quad E = 8$

14. $F = 8 \quad V = 12 \quad E = 18$

15. $F = 10 \quad V = 16 \quad E = 24$

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 not all faces are 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 not all faces are congruent polygons. Not convex 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.

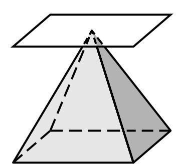
24. True; an example would be a square pyramid or a triangular prism.

25. circle **26.** circle **27.** pentagon **28.** rectangle

29. circle **30.** rectangle or square **31.** rectangle

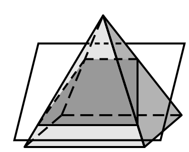
32. pentagon

33. yes



34. square

35. yes



36. tetrahedron

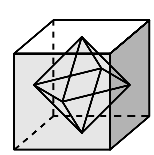
37. octahedron

38. dodecahedron

39. dodecahedron

40. octahedron **41.** cube

42.



regular octahedron

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

44. $F + V = E + 2$
$5 + 5 = 8 + 2$
$10 = 10$

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

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. $E = \frac{1}{2}(12 \cdot 5)$

$= \frac{1}{2}(60) = 30$

$F + V = E + 2$

$12 + V = 30 + 2$

$V = 20$

53. 6 molecules

54. C.

$F + V = E + 2$

$F + 12 = 18 + 2$

$F = 8$

55. B.

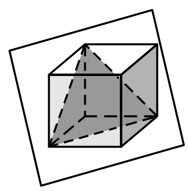
$(QS)^2 = \left(\frac{h}{2}\right)^2 + \left(\frac{h}{2}\right)^2$

$(QS)^2 = \frac{h^2}{4} + \frac{h^2}{4}$

$(QS)^2 = \frac{h^2}{2}$

$QS = \frac{h}{\sqrt{2}}$

56.



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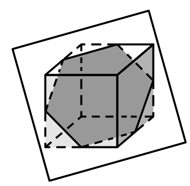
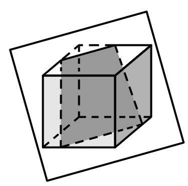


58.



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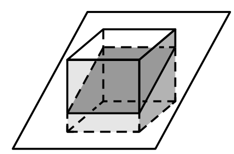


Lesson 12.1

12.1 Mixed Review (p. 726)

60. $A = bh$

$= (12)(8)$

$= 96 \text{ in.}^2$

61. $A = \frac{1}{2}h(b_1 + b_2)$

$= \frac{1}{2}(16)(21 + 14)$

$= (8)(35) = 280 \text{ ft}^2$

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

$= \frac{1}{2}\left(\frac{8}{\tan 15^\circ}\right)(16 \cdot 12)$

$= \frac{4}{\tan 15^\circ}(192)$

$\approx 2866.22 \text{ in.}^2$

68. $A = \frac{115°}{360°} \cdot \pi(7)^2$

$= \frac{115°}{360°} \cdot 49\pi$

$\approx 49.17 \text{ cm}^2$

69. $A = \pi(43)^2$

$= 1849\pi$

$\approx 5808.80 \text{ ft}^2$

70. $A = \frac{(180° - 140°)}{360°} \cdot \pi(32)^2$

$= \frac{40°}{360°} \cdot 1024\pi$

$\approx 357.44 \text{ in.}^2$

12.2 Developing Concepts (p. 727)

1.
$S.A. = \text{Area } A + \text{Area } B + \text{Area } C + \text{Area } D + \text{Area } E + \text{Area } F$

$= (3 \cdot 7) + (5 \cdot 7) + (3 \cdot 5) + (7 \cdot 5) + (3 \cdot 5) + (3 \cdot 7)$

$= 21 + 35 + 15 + 35 + 15 + 21$

$= 142$ sq units

2. $A = 3 \cdot 7 = 21$ sq units

$P = 2(3) + 2(7) = 20$ units

$h = 5$ units

3. $2A + Ph = 2(21) + (20)(5)$

$= 42 + 100$

$= 142$ sq units

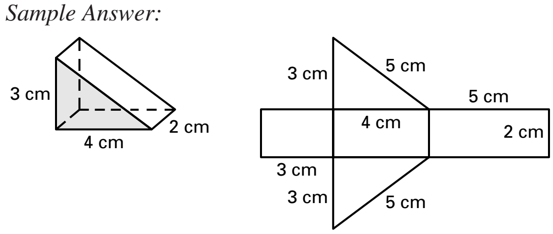
They are equal.

4. *Sample Answer:* $S.A. = 2(l \cdot w) + 2(w \cdot h) + 2(l \cdot h)$ or $2A + Ph$

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^2. The surface area is the lateral area plus the area of the bases, 2 ≅ right triangles with a total area of 12 cm^2. So the surface area is 36 cm^2.

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^2

front and back bases: 128 cm^2

left and right bases: 78 cm^2

9. top and bottom bases: 24 cm^2

front and back bases: 15 cm^2

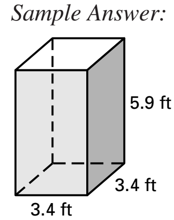
left and right bases: 40 cm^2

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

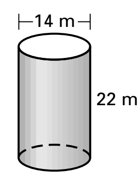
$= 2(24 \text{ cm}^2) + 110 \text{ cm}^2$

$= 158 \text{ cm}^2$

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

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

$= 2(9 \cdot 11) + (18 + 22)(10)$

$= 198 + 400$

$= 598 \text{ in.}^2$

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

$= 2(2 \cdot 9) + (18 + 4)(7)$

$= 36 + 154$

$= 190 \text{ m}^2$

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

$= 2\left(\frac{1}{4}\right)(\sqrt{3})(14)^2 + (42)(6)$

$= 98\sqrt{3} + 252$

$\approx 421.74 \text{ ft}^2$

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

$= 2\left(\frac{1}{2}(4\sqrt{2})(4)\right) + (16)(7.2)$

$= 16\sqrt{2} + 115.2$

$\approx 137.83 \text{ m}^2$

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

$\approx 2\left(\frac{1}{2}(2)(6.4)\right) + (15.11)(2.9)$

$\approx 12.8 + 43.82$

$\approx 56.62 \text{ cm}^2$

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

$= 2\left(6 \cdot \frac{1}{4} \cdot \sqrt{3} \cdot (2)^2\right) + (2 \cdot 6)(6.1)$

$\approx 20.78 + 73.2$

$\approx 93.98 \text{ in.}^2$

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

$= 2\pi(6 \text{ ft})^2 + 2\pi(6 \text{ ft})(11 \text{ ft})$

$= 72\pi + 132\pi$

$= 204\pi$

$\approx 640.88 \text{ ft}^2$

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

$= 2\pi(8 \text{ cm})^2 + 2\pi(8 \text{ cm})(8 \text{ cm})$

$= 128\pi + 128\pi$

$= 256\pi$

$\approx 804.25 \text{ cm}^2$

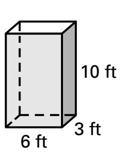
28. $S.A. = 2\pi r^2 + 2\pi rh$

$= 2\pi(3.1)^2 + 2\pi(3.1)(10)$

$= 81.22\pi$

$\approx 255.16 \text{ in.}^2$

29.



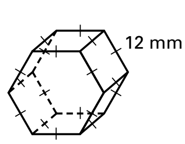
$S.A. = 2B + Ph$

$= 2(18) + (18 \cdot 10)$

$= 36 + 180$

$= 216 \text{ ft}^2$

30.



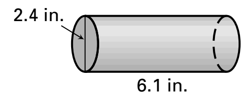
$S.A. = 2B + Ph$

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

$\approx 748.25 + 864$

$\approx 1612.25 \text{ mm}^2$

31.



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

$= 2\pi(1.2)^2 + 2\pi(1.2)(6.1)$

$= 2.88\pi + 14.64\pi$

$= 17.52\pi$

$\approx 55.04 \text{ in.}^2$

32. $S = 2B + Ph$

$298 = 2(7 \cdot 4) + (22)(x)$

$298 = 56 + 22x$

$242 = 22x$

$11 \text{ ft} = x$

33. $S = 2B + Ph$

$870 = 2 \cdot \left(\frac{1}{2} \cdot 12 \cdot 5\right) + (5 + 12 + 13)y$

$870 = 60 + 30y$

$810 = 30y$

$27 \text{ m} = y$

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

$1202 = 2(\pi)(7.5)^2 + 2(\pi)(7.5)(z)$

$1202 = 112.5\pi + 15\pi z$

$848.57 = 15\pi z$

$18.01 \text{ in.} \approx z$

35. For $h = 1$ in.

$S = 2B + Ph$

$= 2(2 \cdot 2) + (4.2)(1)$

$= 8 + 8$

$= 16 \text{ in.}^2$

For $h = 2$ in.

$S = 2B + Ph$

$= 2(2 \cdot 2) + (4 \cdot 2)(2)$

$= 8 + 16$

$= 24 \text{ in.}^2$

Doubling the height does not double the surface area.

36. For $h = 1$ in.

$S = 2B + Ph$

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

$\approx 7.79 + 9$

$\approx 17 \text{ in.}^2$

For $h = 2$ in.

$S = 2B + Ph$

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

$\approx 7.79 + 18$

$\approx 26 \text{ in.}^2$

Doubling the height does not double the surface area.

37. For $h = 1$ in.

$S = 2B + Ph$

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

$\approx 20.78 + 12$

$\approx 33 \text{ in.}^2$

For $h = 2$ in.

$S = 2B + Ph$

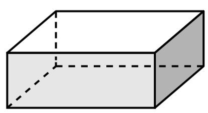
$= 2\left(6 \cdot \frac{1}{4}\sqrt{3}(2)^2\right) + (6 \cdot 2)(2)$

$\approx 20.78 + 24$

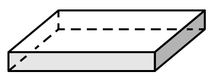
$\approx 45 \text{ in.}^2$

Doubling the height does not double the surface area.

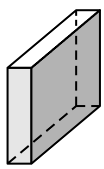
38. *Sample Answer:*



39. *Sample Answer:*



40. *Sample Answer:*



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. $S = 2B + Ph$

$= 2(64)^2 + (64 \cdot 4)(414)$

$= 114{,}176 \text{ m}^2$

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

$= 2(\pi)(1)(4)$

$= 8\pi$

$\approx 25 \text{ in.}^2$

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

$$= \left(\left(6 \cdot \frac{1}{2} \cdot \sqrt{3} \cdot 11^2\right) + (6 \cdot 11)(3)\right) + \left(\left(6 \cdot \frac{1}{4} \cdot \sqrt{3} \cdot 5^2\right) + (6 \cdot 5)(3)\right)$$

$\approx 314.37 + 198 + 64.95 + 90$

$\approx 667 \text{ in.}^2$

$\frac{667 \text{ in.}^2}{130 \text{ in.}^2/\text{can}} \approx 6$ cans

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

$= 2(\pi)(1.5)^2 + 2(\pi)(1.5)(4)$

$= 4.5\pi + 12\pi$

$= 16.5\pi$

$\approx 52 \text{ in.}^2$

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

$= 2(\pi)(3)^2 + 2(\pi)(3)(8)$

$= 18\pi + 48\pi$

$= 66\pi$

$\approx 207 \text{ in.}^2$

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

$= 18\pi + 6\pi + 4.5\pi - 0.5\pi$

$= 28\pi$

$\approx 87.96 \text{ in}^2$

50. $m\angle A = 61°$

$\tan 29° = \frac{5}{BC}$

$BC = \frac{5}{\tan 29°}$

$BC \approx 9.02$

$\sin 29° = \frac{5}{AB}$

$AB = \frac{5}{\sin 29°}$

$AB \approx 10.31$

51. $m\angle A = 58°$

$\sin 32° = \frac{10.5}{AB}$

$AB = \frac{10.5}{\sin 32°}$

$AB \approx 19.81$

$\tan 32° = \frac{10.5}{BC}$

$BC = \frac{10.5}{\tan 32°}$

$BC \approx 16.80$

52. $m\angle B = 44°$

$\cos 46° = \frac{12}{AB}$

$AB = \frac{12}{\cos 46°}$

$AB \approx 17.27$

$\tan 46° = \frac{BC}{12}$

$\tan 46° = BC$

$12.43 \approx BC$

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

$= \frac{1}{2}(19 \cos 36°)(2)(19 \sin 36°)(5)$

$= 1805 \cos 36° \sin 36°$

$\approx 858.33 \text{ m}^2$

54. $A = \pi r^2$
$= \pi(14 \text{ ft})^2$
$= 196\pi$
$\approx 615.75 \text{ ft}^2$

55. $A = (6)\left(\frac{1}{4}\sqrt{3}\right)(s^2)$
$= 6\left(\frac{1}{4}\right)\left(\sqrt{3}\right)(8)^2$
$\approx 166.28 \text{ in.}^2$

56. $P = \frac{QS}{PW} = \frac{9}{22} \approx 41\%$

57. $P = \frac{PU}{PW} = \frac{16}{22} = \frac{8}{11} \approx 73\%$

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

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

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

Lesson 12.3

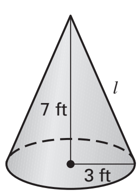
12.3 Guided Practice (p. 738)

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 ⊙ 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 ⊥ 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. 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. $l^2 = 12^2 + 4^2$
$l^2 = 160$
$l = 4\sqrt{10} \text{ m}$
Lateral Area $= \frac{1}{2}bl$
$= \frac{1}{2}(8)\left(4\sqrt{10}\right)$
$\approx 50.6 \text{ m}^2$

15. $l^2 = (22)^2 + (11)^2$
$l^2 = 605$
$l = 11\sqrt{5} \text{ in.}$
Lateral Area $= \frac{1}{2}bl$
$= \left(\frac{1}{2}\right)(22)\left(11\sqrt{5}\right)$
$\approx 270.6 \text{ in.}^2$

16. $l^2 = (2)^2 + (7.1)^2$
$l^2 = 54.41$
$l = \sqrt{54.41} \text{ ft}$
Lateral Area $= \frac{1}{2}bl$
$= \frac{1}{2}(4)\left(\sqrt{54.41}\right)$
$\approx 14.8 \text{ ft}^2$

17. $S = B + \frac{1}{2}Pl$
$= (11.2)^2 + \frac{1}{2}(4 \cdot 11.2)(17)$
$= 506.24 \text{ mm}^2$

18. $l^2 = 13^2 - 4^2$
$l^2 = 153$
$l = 3\sqrt{17}$
$S = B + \frac{1}{2}Pl$
$= \frac{1}{2}(8)(8 \cos 30°) + \frac{1}{2}(3 \cdot 8)\left(3\sqrt{17}\right)$
$\approx 27.71 + 148.43$
$\approx 176.14 \text{ cm}^2$

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

$\ell^2 = 73.4375$

$\ell = \sqrt{73.4375}$

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

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

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

$\approx 78.59 + 141.40$

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

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

$\ell^2 = 260$

$\ell = \sqrt{260}$

≈ 16.1 in.

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

$\ell^2 = 116$

$\ell = \sqrt{116}$

≈ 10.78 cm

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

$\ell^2 = 6$

$\ell = \sqrt{6}$

≈ 2.4 ft

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

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

$= 60.84\pi + 78\pi$

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

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

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

$= 34.81\pi + 59\pi$

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

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

$\ell^2 = 141.25$

$\ell = \sqrt{141.25}$

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

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

$\approx 20.25\pi + 53.48\pi$

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

26. regular square pyramid

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

$l^2 = 36.75$

$\ell = \sqrt{36.75}$

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

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

$\approx 49 + 84.87$

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

27. right cone

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

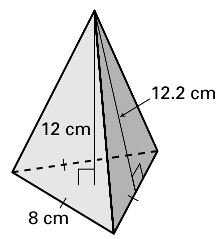
$= (\pi)(2)^2 + (\pi)(2)(6)$

$= 4\pi + 12\pi$

$= 16\pi$

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

28.



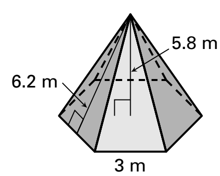
$S = B + \frac{1}{2}Pl$

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

$\approx 27.71 + 146.4$

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

29.



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

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

$\approx 23.38 + 55.8$

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

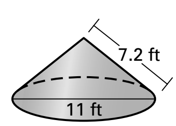
30. $S = \pi r^2 + \pi rl$

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

$= 30.25\pi + 39.6\pi$

$= 69.85\pi$

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



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

$\ell^2 = 225$

$\ell = 15$

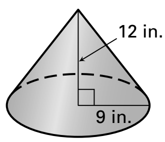
$S = \pi r^2 + \pi rl$

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

$= 81\pi + 135\pi$

$= 216\pi$

$\approx 678.58 \text{ in.}^2$



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

$\ell^2 = 113.44$

$\ell = \sqrt{113.44}$

$S = 2\left(\frac{1}{2}P\ell\right)$

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

$\approx 48(10.65)$

≈ 511.2 sq. units

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

$\ell^2 = 11.25$

$\ell = \sqrt{11.25}$

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

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

$\approx 81 + 20.1$

≈ 101.1 sq. units

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

$\ell^2 = 25$

$\ell = 5$

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

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

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

$= 84\pi$

≈ 263.9 sq. units

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

$p = 18 \div 2 = 9$ cm

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

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

$q^2 = 225$

$q = 15$ cm

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

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

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

$47.13 = 3\pi y$

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

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

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

$x^2 \approx 25 - 9$

$x^2 \approx 16$

$x \approx 4$ in.

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

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

$333 = 128.1 + 21l$

$204.9 = 21l$

$9.8 \text{ m} \approx l$

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

$h^2 \approx 9.8^2 - 6.1^2$

$h^2 \approx 58.83$ m

$h \approx 7.7$ m

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

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

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

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

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

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

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

$\approx 500{,}910.06 + (1415.5)(589.125)$

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

40. Base = 704 ft

Height = 446 ft

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

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

$\approx 495{,}616 + 1408(568.1725)$

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

The surface area is about 39,214 ft^2 less.

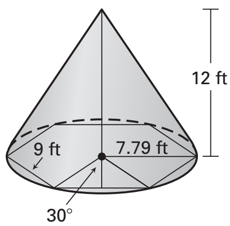
41. Lateral Area $= \pi rl$

$= (\pi)(8)(12)$

$= 96\pi$

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

42.



$$\frac{4.5}{r} = \sin 30°$$

$$\frac{4.5}{\sin 30°} = r$$

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

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

$l^2 = 225$

$l = 15$

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. $m\angle ABC \approx 29°$.

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

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

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

Column B: Slant height $= \sqrt{4^2 + 3^2} = 5$

46. B

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

Column B: Lateral Area $= \pi rl \approx 3.14(3)(5) \approx 47.12$

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

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

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

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

≈ 8.58 sq units

48. Square

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

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

≈ 6.47 sq units

Hexagon

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

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

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

≈ 7.55 sq units

Octagon

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

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

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

≈ 7.97 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, $\pi(1 + \sqrt{3})$.

12.3 Mixed Review (p. 741)

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

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

≈ 190.96 sq units

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

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

≈ 82.84 sq units

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

≈ 23.38 sq units

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

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

$121 \approx r^2$

$11 \approx r$; about 11 in.

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. $S = 2B + Ph$

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

$\approx 42.44 + 294$

$\approx 336.44 \text{ ft}^2$

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

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

$\approx 100 + 205.91$

$\approx 305.91 \text{ m}^2$

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

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

$= 81\pi + 165.22\pi$

$= 246.22\pi$

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

12.3 Math & History (p. 742)

1. Length $= 4 + 16 = 20$ in.

Width $= 6 + 12 + 6 + 12 + 2 = 38$ in.

Area $= (20)(38)$

$= 760$ in.^{2}

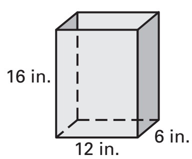
2. 12 in. by 6 in.;

$S.A. = B + Ph$

$= (6 \cdot 12) + [2(12) + 2(6)](16)$

$= 72 + 576$

$= 648$ in.^{2}



Lesson 12.4

12.4 Guided Practice (p. 746)

1. square units; cubic units

2. 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.

$V = l \times w \times h$

$= 3 \times 3 \times 0.01(500)$

$= 45$ in.^{3}

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

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

$= (\pi)(16)^2(15)$

$= 540\pi$

≈ 1696.46 in.^{3}

8. $V = l \times w \times h$

$= (10)(8)(10)$

$= 800$ in.^{3}

9. $V = l \times w \times h$

$= 14$ in. $\times$ 6 in. $\times$ 10 in.

$= 840$ in.^{3}

12.4 Practice and Applications (pp. 746–749)

10. 120 unit cubes; *Sample Answer:* 3 layers of 4 rows of 10 cubes each

11. 100 unit cubes; *Sample Answer:* 4 layers of 5 rows of 5 cubes each

12. 36 unit cubes; *Sample Answer:* 6 layers of 3 rows of 2 cubes each

13. $V = Bh$

$= (8)(8)(8)$

$= 512$ in.^{3}

14. $V = (4)(5)(12)$

$= 240$ cm^3

15. $V = Bh$

$= 6\left(\frac{1}{4}\sqrt{3}(3.5)^2\right)(10 \text{ in.})$

≈ 318.26 in.^{3}

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

$= (\pi)(12)^2(15)$

$= 2160\pi$

≈ 6785.84 m^3

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

$= (\pi)(3)^2(10.2)$

$= 91.8\pi$

≈ 288.40 ft^3

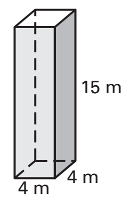
18. $V = \pi r^2 h$

$= (\pi)(3.5)^2(9.9)$

$= 121.275\pi$

≈ 381.00 cm^3

19.

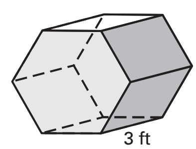


$V = Bh$

$= (4)^2(15)$

$= 240$ m^3

20.

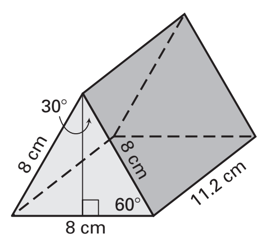


$V = Bh$

$= (24)^2(3)$

$= 72$ ft^3

21.

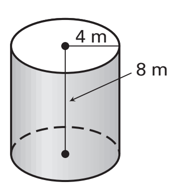


$V = Bh$

$= \frac{1}{4}\sqrt{3}(8)^2(11.2)$

≈ 310.38 cm^3

22.



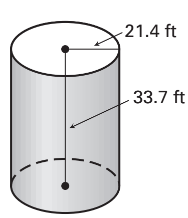
$V = \pi r^2 h$

$= (\pi)(4)^2(8)$

$= 128\pi$

≈ 402.12 m^3

23.



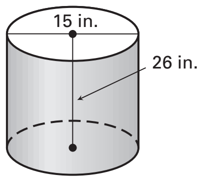
$V = \pi r^2 h$

$= (\pi)(21.4t)^2(33.7)$

$= 15433.252\pi$

$\approx 48{,}484.99$ ft^3

24.



$$\begin{aligned} V &= \pi r^2 h \\ &= (\pi)(7.5)^2(26) \\ &= 1462.5\pi \\ &\approx 4594.58 \text{ in.}^3 \end{aligned}$$

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

26. $$\begin{aligned} V &= \pi r^2 h \\ &= (\pi)(5)^2(8) \\ &\approx 628.32 \text{ ft}^3 \end{aligned}$$

27. $$\begin{aligned} V &= Bh \\ &= (3)(3)(15 \sin 60°) \\ &\approx 116.91 \text{ cm}^3 \end{aligned}$$

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

29. $$\begin{aligned} V &= v^3 \\ 2700 &= v^3 \\ 3\sqrt[3]{100} &= v \\ 13.92 \text{ yd} &\approx v \end{aligned}$$

30. $$\begin{aligned} V &= Bh \\ 80 &= \tfrac{1}{2}(8)(5)(w) \\ 80 &= (20)(w) \\ 4 \text{ cm} &= w \end{aligned}$$

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

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

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

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

They are the same.

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

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

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

38. First, convert measurements to yards.

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

39. First, convert measurements to yards.

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

40. First, convert measurements to yards.

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

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 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 in.^{3}.

42. $$\begin{aligned} V_{\text{block}} &= (10)(9)(20) \\ &= 1800 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} V_{\text{cyl}} &= \pi(4.5)^2(12) \\ &\approx 763.4 \text{ cm}^3 \end{aligned}$$

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

43. $$\begin{aligned} V_{\text{prism}} &= \tfrac{1}{2}(6)(8)(10) \\ &= 240 \text{ cm}^3 \end{aligned}$$

From Ex. 42, the volume of the block is 1800 cm^3, so

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

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

$$\frac{1800 \text{ cm}^3}{280.6 \text{ cm}^3} \approx 6 \text{ candles}$$

45. $V_{prism} = Bh$
$= (4)(3)(3)$
$= 36 \text{ in.}^3$

$V_{cyl} = \pi r^2 h$
$= (3.14)(1.5 \text{ in.})^2(5.1 \text{ in.})$
$\approx 36.05 \text{ in.}^3$

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

$S_{cyl} = 2\pi r^2 + 2\pi rh$
$= 2(\pi)(1.5)^2 + 2(\pi)(1.5)(5.1)$
$= 4.5\pi + 15.3\pi$
$= 19.8\pi$
$\approx 62.20 \text{ in.}^2$

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.

46. $V = \pi r^2 h$
$= (\pi)(20)^2(23)$
$= 9200\pi$
$\approx 28{,}902.65 \text{ ft}^3$

$\frac{28{,}902.65 \text{ ft}^3}{0.1337 \text{ ft}^3/\text{gal}} \approx 216{,}175$ gallons

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

48. A $V = Bh$
$1 = l\left(\frac{4}{l}\right)x$
$1 = 4x$
$\frac{1}{4} = x$

49. E $V = \pi r^2 h$
$= (\pi)(6)^2(10)$
$= 360\pi$

50. $V_{hor} = \pi r^2 h$
$= \pi(3)^2(5)$
$= 45\pi \text{ in.}^3$

$V_{vert} = \pi r^2 h$
$= \pi(5)^2(3)$
$= 75\pi \text{ in.}^3$

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)

51. $2x + 5x + 5x = 180$
$12x = 180$
$x = 15$
$30°, 75°, 75°$

52. $x + 2x + 3x = 180$
$6x = 180$
$x = 30$
$30°, 60°, 90°$

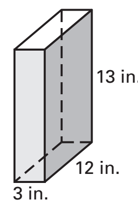
53. $3x + 4x + 5x = 180$
$12x = 180$
$x = 15$
$45°, 60°, 75°$

54. $A = \pi r^2$
$= (\pi)(5.06)^2$
$= 25.6036\pi$
$\approx 80.44 \text{ ft}^2$

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. $A = \frac{1}{2}aP$
$= \frac{1}{2}(8.5)(6)(2 \cdot 8.5 \tan 30°)$
$\approx 250.28 \text{ in.}^2$

57.



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

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

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

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

12.4 Activity (p. 750)

1. $r = 2.25$ and $h = 4.53$; for values of r 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 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 $\frac{1}{3}Bh$.

12.5 Guided Practice (p. 755)

1. cylinder

2. 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.

3. Yes; the volume of the rectangle prism is y^2x. The volume of the pyramid is $\frac{1}{3}(y^2)(3x) = y^2x$.

4. (a) $A = (5)^2 = 25 \text{ cm}^2$

(b) $V = \frac{1}{3}Bh = \left(\frac{1}{3}\right)(25)(4) = \frac{100}{3} \text{ cm}^3 \approx 33.3 \text{ cm}^3$

5. (a) $A = 2(\pi)(2) \approx 12.57 \text{ ft}^2$

(b) $V = \frac{1}{3}Bh = \frac{1}{3}(12.57 \text{ ft}^2)(4 \text{ ft}) = 16.76 \text{ ft}^3$

6. (a) $A = \frac{1}{4}\sqrt{3}(11)^2 \approx 52.39 \text{ m}^2$

(b) $V = \frac{1}{3}Bh = \frac{1}{3}(52.39)(14) \approx 244.51 \text{ m}^3$

7. 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)

8. $A = (9)(10.1) = 90.9 \text{ in.}^2$

9. $A = \pi r^2 = (3.14)(6.1)^2 \approx 116.9 \text{ ft}^2$

10. $A = 6 \cdot \frac{1}{4}\sqrt{3}(18)^2 \approx 841.8 \text{ mm}^2$

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

$= \frac{1}{3}(10)^2(12)$

$= 400 \text{ cm}^3$

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

$= \frac{1}{3}(7)^2(5)$

$\approx 81.7 \text{ m}^3$

13. $V = \frac{1}{3}Bh = \frac{1}{3}\left(\frac{1}{4}\right)\left(\sqrt{3}\right)(9.2)^2(12.7) \approx 155.2 \text{ ft}^3$

14. $V = \frac{1}{3}Bh = \frac{1}{3}\left(\frac{1}{4}\sqrt{3}\right)(14)^2(18) \approx 509.2 \text{ in.}^3$

15. $V = \frac{1}{3}Bh = \frac{1}{3}(6)\left(\frac{1}{4}\sqrt{3}\right)(10)^2(14.2) \approx 1229.8 \text{ mm}^3$

16. $V = \frac{1}{3}Bh = \frac{1}{3}(6)\left(\frac{1}{4}\sqrt{3}\right)(12)^2(20) \approx 2494.2 \text{ cm}^3$

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

$= \frac{1}{3}(\pi)(3)^2\left(\sqrt{6^2 - 3^2}\right)$

$= 9\sqrt{3}\pi$

$\approx 48.97 \text{ ft}^3$

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

$= \frac{1}{3}(\pi)(5.75)^2(15.2)$

$\approx 167.517\pi$

$\approx 526.27 \text{ cm}^3$

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

$= \frac{1}{3}(\pi)(7)^2(13)$

$\approx 212.333\pi$

$\approx 667.06 \text{ in.}^3$

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

$270 = \frac{1}{3}(9)^2h$

$270 = 27 \cdot h$

$10 \text{ m} = h$

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

$100\pi = \frac{1}{3}(\pi)(r^2)(12)$

$25 = r^2$

$5 \text{ in.} = r$

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

$5\sqrt{3} = \frac{1}{3}\left(\frac{1}{4}\sqrt{3}\right)\left(2\sqrt{3}\right)^2h$

$5\sqrt{3} = \sqrt{3}h$

$5 \text{ cm} = h$

23. $V = V_{\text{cube}} + V_{\text{pyramid}}$

$V = (6)^3 + \frac{1}{3}(6)^2(6)$

$= 288 \text{ ft}^3$

24. $V = 2\left(\frac{1}{3}Bh\right)$

$V = 2\left(\frac{1}{3}\right)(3.3)^2(2.3)$

$\approx 16.70 \text{ cm}^3$

25. $V = V_{\text{cube}} - V_{\text{cone}}$

$V \approx (5.1)^3 - \frac{1}{3}(3.14)(2.55)^2(5.1)$

$\approx 132.65 - 34.73$

$\approx 97.92 \text{ m}^3$

26. $V = V_{\text{cyl}} + V_{\text{cone}}$

$= (\pi)(2.5)^2(7.5) + \frac{1}{3}\pi(2.5)^2(4)$

$\approx 46.875\pi + 8.33\pi$

$\approx 55.205\pi$

$\approx 173.43 \text{ in.}^3$

$\frac{173.43 \text{ in.}^3}{14.4 \text{ in.}^3/\text{cup}} \approx 12 \text{ cups}$

27. $\left(\frac{1}{2} \text{ cup}\right)(2)(3) = 3 \text{ cups}$

The feeder will hold enough food for 3 days.

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

$\approx \frac{1}{3}(3.14)(4.15)^2\left(\sqrt{(10.1)^2 - (4.15)^2}\right)$

$\approx (18.04)\left(\sqrt{84.79}\right)$

$\approx 166 \text{ cm}^3$

$(166 \text{ cm}^3)(27) \approx 4482.0 \text{ cm}^3$

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

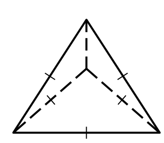
$\approx \frac{1}{3}(3.14)(5)^2(10 \text{ cm})$

$\approx 261.8 \text{ cm}^3$

$80 - 65 = 15$ mL/s in the funnel after 1 second.

$\frac{261.8 \text{ cm}^3}{15 \text{ cm}^3/\text{s}} \approx 17.5 \text{ seconds}$

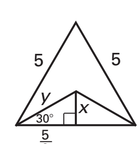
30.



5 ft

The solid is a triangular prism with congruent base and faces that are equilateral triangles with edge length 5 feet.

Let x = the apothem of the base triangle and y = the radius of the base triangle. Then half of a base edge will be the longer leg in a $30° - 60° - 90°\triangle$.



—CONTINUED—

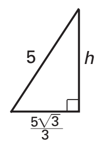
30. —CONTINUED—

$\frac{5}{2} = x\sqrt{3}$ $\qquad$ $y = 2x$

$\frac{5}{2\sqrt{3}} = x$ $\qquad$ $= 2\left(\frac{5\sqrt{3}}{6}\right)$

$\frac{5\sqrt{3}}{6} = x$ $\qquad$ $= \frac{5\sqrt{3}}{3}$

The height of the prism is one leg of a right triangle with hypotenuse an edge of the prism and other leg a radius of the base triangle.



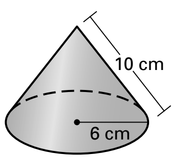
$5^2 = h^2 + \left(\frac{5\sqrt{3}}{3}\right)^2$ $\qquad$ $V = \frac{1}{3}Bh$

$25 = h^2 + \frac{25}{3}$ $\qquad$ $= \frac{1}{3} \cdot \left(\frac{1}{4} \cdot 5^2 \cdot \sqrt{3}\right) \cdot \frac{5\sqrt{6}}{3}$

$\frac{50}{3} = h^2$ $\qquad$ $= \frac{125\sqrt{2}}{12}$

$\frac{5\sqrt{6}}{3} = h$ $\qquad$ $\approx 14.73 \text{ ft}^3$

31.

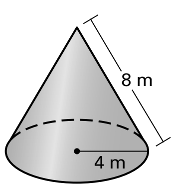


$V = \frac{1}{3}\pi r^2 h$

$\approx \frac{1}{3}(3.14)(6)^2(8)$

$\approx 301.59 \text{ cm}^3$

32.



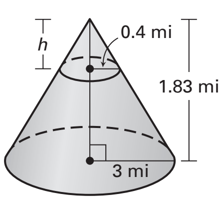
$V = \frac{1}{3}\pi r^2 h$

$\approx \frac{1}{3}(3.14)(4)^2(4\sqrt{3})$

$\approx 116.08 \text{ m}^3$

33. $V = \frac{1}{3}\pi r^2 h \approx \frac{1}{3}(3.14)(2\sqrt{2})^2(6) \approx 50.3 \text{ m}^3$

34.



not drawn to scale

$V = 0.043 \text{ mi}^3$

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

$0.043 \approx \frac{1}{3}(3.14)(0.4)^2 h$

$0.043 \approx 0.17h$

$0.25 \text{ mi} \approx h$

$1.83 - 0.25 \approx 1.58$ miles

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

$\approx \frac{1}{3}(3.14)(3.9)^2(3.9)$

$\approx 62.12 \text{ in.}^3$

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 $r_1 = \sqrt[3]{\frac{1}{2}} \cdot r$.

38. $V = [\text{area base}_1 + \text{area base}_2 + \text{geometric mean}]\frac{1}{3}h$

$= \left[\pi(2)^2 + \pi(6)^2 + \sqrt{\pi(2)^2 \cdot \pi(6)^2}\right]\frac{1}{3}(9)$

$\approx [4\pi + 36\pi + 37.70](3)$

$\approx [163.364]\,3$

$\approx 490.09 \text{ ft}^3$

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

$= \frac{1}{3}h\pi(r_1^2 + r_2^2 + r_1 r_2)$

12.5 Mixed Review (p. 758)

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

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

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

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

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

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

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

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

48. $C = 2\pi r$ $\qquad$ $A = \pi(24)^2$

$48\pi = 2\pi r$ $\qquad$ $\approx 1809.56 \text{ ft}^2$

$24 = r$

49. Arc length $= \frac{m\,\text{arc}}{360°} \times 2\pi r$ $\qquad$ $A = \pi r^2$

$2\pi = \frac{36°}{360°} \cdot 2\pi r$ $\qquad$ $= \pi(10)^2$

$10 = r$ $\qquad$ $\approx 314.16 \text{ m}^2$

50. $E = \frac{1}{2}(12 \cdot 8 + 20 \cdot 3)$ $\qquad$ $F + V = E + 2$

$= 78$ $\qquad$ $32 + V = 78 + 2$

$V = 48$

51. $E = \frac{1}{2}(6 \cdot 4 + 8 \cdot 6)$ $\qquad$ $F + V = E + 2$

$= 36$ $\qquad$ $14 + V = 36 + 2$

$V = 24$

12.5 Quiz 2 (p. 758)

1. $V = Bh$

$= (10)(18)(6)$

$= 1080 \text{ in.}^3$

2. $V = Bh$

$= \frac{1}{2}(8 \cdot 15)(17)$

$= 1020 \text{ ft}^3$

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

$= \pi(5)^2(14)$

$\approx 1099.56 \text{ cm}^3$

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

$= \frac{1}{3}\pi(4.5)^2(9)$

$\approx 190.85 \text{ m}^3$

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. $V =$ volume prism $+$ volume pyramid

$$V = Bh + \frac{1}{3}Bh$$
$$= \left(\frac{1}{2} \cdot \frac{5}{\tan 22.5} \cdot 80\right)(8) + \frac{1}{3}\left(\frac{1}{2} \cdot \frac{5}{\tan 22.5} \cdot 80\right)(11)$$
$$\approx 3862.74 + 1770.42 \approx 5633 \text{ ft}^3$$

Lesson 12.6

12.6 Guided Practice (p. 762)

1. equidistant; point

2. *Sample answer:* The radius is $\frac{1}{2}$ the diameter or 5 mm. Volume $= \frac{4}{3}\pi r^3$ not πr^2.

3. $\overline{TR}$, $\overline{TS}$, or $\overline{QS}$ **4.** $\overline{PQ}$, $\overline{PS}$, or $\overline{PR}$ **5.** $\overline{QS}$

6. $C = 2\pi r$
$= 2\pi(3)$
≈ 18.85 units

7. $S = 4\pi r^2$
$\approx 4(3.14)(3)^2$
≈ 113.1 sq. units

8. $V = \frac{4}{3}\pi r^3$
$\approx \frac{4}{3}(3.14)(3)^3$
≈ 113.1 cu. units

9. $V = \frac{4}{3}\pi r^3$
$\approx \frac{4}{3}(3.14)(0.5 \times 10^{-8} \text{ cm})^3$
$\approx 5.24 \times 10^{-25} \text{ cm}^3$

12.6 Practice and Applications (p. 762–765)

10. $S = 4\pi r^2$
$\approx 4(3.14)(6.5)^2$
$\approx 530.93 \text{ m}^2$

11. $S = 4\pi r^2$
$\approx 4(3.14)(18)^2$
$\approx 4071.50 \text{ cm}^2$

12. $S = 4\pi r^2$
$\approx 4(3.14)(3.85)^2$
$\approx 186.27 \text{ ft}^2$

13. hemisphere

14. $C = 2\pi r$
$7.4\pi = 2\pi r$
$\frac{7.4\pi}{2\pi} = r$
$3.7 \text{ in.} = r$

15. $d = 2r$
$= 2(3.7 \text{ in.})$
$= 7.4 \text{ in.}$

16. $S = \frac{1}{2}(4\pi r^2)$
$\approx \frac{1}{2}(4)(3.14)(3.7)^2$
$\approx 86.02 \text{ in.}^2$

17. $S = 4\pi r^2$
$\approx 4(3.14)(1.9)^2$
$\approx 45.4 \text{ in.}^2$

18. $S_{\text{Earth}} = 4\pi r^2$
$\approx 4\pi\left(\frac{24{,}903}{2\pi}\right)^2$
$\approx 197{,}402{,}900 \text{ mi}^2$

$S_{\text{moon}} = 4\pi r^2$
$= 4\pi(1077.5)^2$
$\approx 14{,}589{,}600 \text{ mi}^2$

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

19. $S = \pi d^2$

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

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

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

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	14π mm	$196\pi \text{ mm}^2$	$\frac{1372\pi}{3} \text{ mm}^3$
24.	6 in.	12π in.	$144\pi \text{ in.}^2$	$288\pi \text{ in.}^3$
25.	5 cm	10π cm	$100\pi \text{ cm}^2$	$\frac{500\pi}{3} \text{ cm}^3$
26.	10 m	20π 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. $V = \pi r^2 h - \frac{1}{2}\left(\frac{4}{3}\pi r^3\right)$
$= \pi(4.8)^2(9) - \frac{1}{2}\left(\frac{4}{3}\right)(\pi)(4.8)^3$
$\approx 419.82 \text{ in.}^3$

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. $V = \pi r^2 h + \frac{1}{2}\left(\frac{4}{3}\pi r^3\right)$
$= \pi(10)^2(18) + \frac{2}{3}\pi(10)^3$
$\approx 7749.26 \text{ cm}^3$

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. $V = \frac{1}{3}\pi r^2 h + \frac{1}{2}\left(\frac{4}{3}\pi r^3\right)$
$= \frac{1}{3}\pi(5.1)^2(12.2) + \frac{2}{3}\pi(5.1)^3$
$\approx 610.12 \text{ ft}^3$

30. **1 meter**

$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(1)^3 = \frac{4}{3}\pi$

$S = 4\pi r^2 = 4\pi(1)^2 = 4\pi$

2 meter

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

$S = 4\pi r^2 = 4\pi(2)^2 = 16\pi$

3 meter

$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(3)^3 = 36\pi$

$S = 4\pi r^2 = 4\pi(3)^2 = 36\pi$

4 meter

$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(4)^3 = \frac{256}{3}\pi$

$S = 4\pi r^2 = 4\pi(4)^2 = 64\pi$

5 meter

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

$S = 4\pi r^2 = 4\pi(5)^2 = 100\pi$

31. **1 m**

$\frac{V}{S} = \frac{\frac{4}{3}\pi}{4\pi} = \frac{1}{3}$

2 m

$\frac{V}{S} = \frac{\frac{32}{3}\pi}{16\pi} = \frac{2}{3}$

3 m

$\frac{V}{S} = \frac{36\pi}{36\pi} = 1$

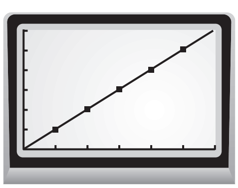
4 m

$\frac{V}{S} = \frac{\frac{256\pi}{3}}{64\pi} = \frac{4}{3}$

5 m

$\frac{V}{S} = \frac{\frac{500\pi}{3}}{100\pi} = \frac{5}{3}$

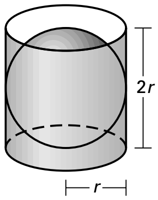
32.



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 the radius is 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.



$V = \pi r^2 h = \pi r^2(2r) = 2\pi r^3$

35. $y = \sqrt{(2\sqrt{2})^2 - 2^2} = 2$

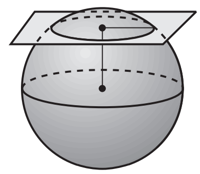
$A = \pi r^2 \approx (3.14)(2)^2 \approx 12.57$ sq units

36. $z = \sqrt{6^2 + (6\sqrt{3})^2}$

$z = 12$

$A = \pi(12)^2 \approx 452.39$ sq. units

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 sphere be determined and from that, the surface area.

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

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

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

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

41. $V_{slug} = \pi r^2 h = \pi(3)^2(6) = 54\pi$

$V_{BB} = \frac{4}{3}\pi r^3$

$54\pi = \frac{4}{3}\pi r^3$

$40.5 = r^3$

$3.43 \text{ cm} \approx r$

42. $V_{cyl} = \pi r^2 h = \pi(2.57)^2(4.8) = 31.70\pi$

$V_{BB} = \frac{4}{3}\pi r^3$

$31.70\pi = \frac{4}{3}\pi r^3$

$23.78 = r^3$

$2.88 \text{ cm} \approx r$

43. $V_{BB} = \frac{4}{3}\pi(5)^3 = \frac{500}{3}\pi$

$V_{cyl} = \pi r^2 h$

$\frac{500}{3}\pi = \pi(4)^2 h$

$\frac{500}{3}\pi = 16\pi h$

$\frac{500}{48} = h$

$10.42 \text{ cm} \approx h$

44. $V = \frac{4}{3}\pi r^3(\text{number of air bubbles})$

$= \frac{4}{3}\pi(0.5 \times 10^{-2})^3(1.446 \times 10^9)$

$= 757.12 \text{ cm}^3$

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

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

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

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.

49. $5^2 = x^2 + (r)^2$

$25 - x^2 = (r)^2$

$\sqrt{25 - x^2} = r$

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

$= \frac{1}{3}\pi\left(\sqrt{25 - x^2}\right)^2(x + 5)$

$= \frac{1}{3}\pi(25 - x^2)(x + 5)$

12.6 Mixed Review (p. 765)

50. translation

51. translation, 180° rotation, vertical line reflection, horizontal glide reflection **52.** translation

53. translation, 180° rotation

54. Similar by AA. $\angle CAB \cong \angle CDE$ and $\angle ACB \cong \angle DCE$ by vertical ∠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 ∠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. $C = 2\pi r$

$\approx 2(3.14)(13.25)$

≈ 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)

1. $p^2: q^2; p^3:q^3$

2. 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.

3. 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.

4. B The scale factor is 3:2. **5.** C The scale factor is 2:1.

6. A The scale factor is 4:3. **7.** $\sqrt[3]{\frac{216}{1331}} = \frac{6}{11}$

8. $(1:3)^2 = 1:9$ so $S = (36\pi)(9) = 324\pi \text{ m}^2$

12.7 Practice and Applications (p. 769–771)

9. No; radius: $\frac{3}{2}$; height: $\frac{4}{3}$

10. Yes; radius: $\frac{9}{4.5} = \frac{2}{1}$; height: $\frac{14}{7} = \frac{2}{1}$

11. Yes; sides: $\frac{2}{3}, \frac{2}{3}$, and $\frac{1}{1.5} = \frac{2}{3}$

12. 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

17. $S = (28\pi)(2)^2 = 112\pi \text{ cm}^2$

$V = (20\pi)(2)^3 = 160\pi \text{ cm}^3$

18. $S = (125.5)(3)^2 = 1129.5 \text{ m}^2$

$V = (87)(3)^3 = 2349 \text{ m}^3$

19. $S = (24\pi)(4)^2 = 384\pi \text{ ft}^2$

$V = (12\pi)(4)^3 = 768\pi \text{ ft}^3$

20. $S = (360)\left(\frac{5}{2}\right)^2 = 2250 \text{ in.}^2$

$V = (400)\left(\frac{5}{2}\right)^3 = 6250 \text{ in.}^3$

21. Scale factor $= \sqrt[3]{\frac{27}{216}} = \sqrt[3]{\frac{1}{8}} = \frac{1}{2}$

Scale factor is 1:2.

22. Scale factor $= \sqrt[3]{\frac{27}{125}} = \frac{3}{5}$

23. Scale factor $= \sqrt[3]{\frac{36}{121.5}} = \frac{2}{3}$

24. Scale factor $= \sqrt{\frac{24}{384}} = \frac{1}{4}$

25. $h = (5.5)(16) = 88$ in.

26. $S = (12.9)(16)^2 = 3302.4 \text{ in.}^2$

27. $V = (2)(16)^3 = 8192 \text{ in.}^3$

28. True; all spheres are similar; the scale factor of A to B is x:y, so the ratio of their volumes is x^3:y^3.

29. True; all cubes are similar; the scale factor of A to B is x:y, so the ratio of their surface areas is x^2:y^2.

30. $\frac{0.125}{12} = \frac{1}{96}$ or 1:96

31. $S = \frac{1}{2} \cdot 4\pi r^2$

$S = \frac{1}{2}(4)\pi\left(25\frac{1}{3}\right)^2$

$\approx 4032 \text{ ft}^2$

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

33. $V = \frac{1}{2}\left(\frac{4}{3}\right)\pi r^3$

$= \frac{2}{3}\pi\left(25\frac{1}{3}\right)^3$

$\approx 34{,}051 \text{ ft}^3$

$V_{model} \approx \frac{34{,}051}{(96)^3} \times \frac{(144 \times 12)}{1} \approx 66.5 \text{ in.}^3$

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

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

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

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

D

37. *Sample answer:*

$V = 12 \cdot \frac{4}{3}\pi r^3$

$= 12 \cdot \frac{4}{3}\pi(4.775)^3$

$= 1741.97\pi \text{ in.}^3$

Volume volleyball $= \frac{4}{3}\pi r^3$

$= \frac{4}{3}\pi(4.135)^3$

$= 94.27\pi \text{ in.}^3$

$\frac{1741.97\pi}{94.27\pi} \approx 18$ 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.

38.

$S = 2\pi r^2 + 2\pi rh$	$S = 2\pi r^2 + 2\pi rh$
$96\pi = 2\pi r^2 + 2\pi r(2r)$	$150\pi = 2\pi r^2 + 2\pi r(2r)$
$96\pi = 6\pi r^2$	$150\pi = 6\pi r^2$
$16 = r^2$	$25 = r^2$
$4 = r$	$5 = r$
$8 = h$	$10 = h$

12.7 Mixed Review (p. 772)

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

44. $\triangle JLK$

45. $S = 2B + Ph$

$= 2\left(\frac{1}{4}\sqrt{3}\right)(15)^2 + (45)(17)$

$\approx 959.86 \text{ ft}^2$

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

$= \pi(18)^2 + \pi(18)(21.4)$

$\approx 2228.02 \text{ m}^2$

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

$= 4\pi(16.4)^2$

$\approx 3379.85 \text{ in.}^2$

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

$14{,}476.46 \text{ m}^3 \approx \pi r^2(32)$

$144 \text{ m}^2 \approx r^2$

$12 \text{ m} \approx r$

$d \approx 24 \text{ m}$

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

$40{,}447.07 \approx \frac{1}{3}\pi(22.8)^2 h$

$40{,}447.07 \approx 544.38h$

$74.3 \text{ in.} \approx h$

12.7 Quiz 3 (p. 772)

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

$\approx 4(3.14)(10)^2$

$\approx 1256.64 \text{ cm}^2$

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

$\approx \frac{4}{3}(3.14)(10)^3$

$\approx 4188.79 \text{ cm}^3$

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

$\approx 4(3.14)(1.88)^2$

$\approx 44.41 \text{ in.}^2$

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

$\approx \frac{4}{3}(3.14)(1.88)^3$

$\approx 27.83 \text{ in.}^3$

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

$\approx 4(3.14)(5.4)^2$

$\approx 366.4 \text{ ft}^2$

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

$\approx \frac{4}{3}(3.14)(5.4)^3$

$\approx 659.58 \text{ ft}^3$

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

$\approx 4(3.14)\left(15\sqrt{5}\right)^2$

$\approx 14{,}137.17 \text{ m}^2$

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

$\approx \frac{4}{3}(3.14)\left(15\sqrt{5}\right)^3$

$\approx 158{,}058.33 \text{ m}^3$

5. $x = 6.5$ cm

Large	**Small**
$S = 2B + Ph$	$S = 2B + Ph$
$= 2(8 \cdot 6) + (28)(13)$	$= 2(3 \cdot 4) + (14)(6.5)$
$= 460 \text{ cm}^2$	$= 115 \text{ cm}^2$
$V = Bh$	$V = Bh$
$= (6 \cdot 8)(13)$	$= (3 \cdot 4)(6.5)$
$= 624 \text{ cm}^3$	$= 78 \text{ cm}^3$

6. $y = 3$ ft

Large	**Small**
$S = \pi r^2 + \pi rl$	$S = \pi r^2 + \pi rl$
$\approx \pi(4.5)^2 + \pi(4.5)(12.82)$	$\approx \pi(3)^2 + \pi(3)(8.54)$
$\approx 244.86 \text{ ft}^2$	$\approx 108.80 \text{ ft}^2$
$V = \frac{1}{3}\pi r^2 h$	$V = \frac{1}{3}\pi r^2 h$
$= \frac{1}{3}\pi(4.5)^2(12)$	$= \frac{1}{3}\pi(3)^2(8)$
$\approx 254.47 \text{ ft}^3$	$\approx 75.40 \text{ ft}^3$

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

$\approx 4(3.14)(100)^2$

$\approx 125{,}663.71 \text{ ft}^2$

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

$\approx \frac{4}{3}(3.14)(100)^3$

$\approx 4{,}188{,}790.21 \text{ ft}^3$

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

$S \approx 125{,}663.71\left(\frac{1}{20}\right)^2$

$\approx 314.16 \text{ ft}^2$

$V \approx 4{,}188{,}790.21\left(\frac{1}{20}\right)^3$

$\approx 523.60 \text{ ft}^3$

Chapter 12 Review *(p. 774)*

1. $F + V = E + 2$

$32 + V = 90 + 2$

$V = 60$

2. $F + V = E + 2$

$F + 6 = 10 + 2$

$F = 6$

3. $F + V = E + 2$

$5 + 5 = E + 2$

$8 = E$

4. $S = 2B + Ph$

$= 2(4 \cdot 12) + (32)(9)$

$= 96 + 288$

$= 384 \text{ m}^2$

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

$\approx 2(3.14)(6)^2 + 2(3.14)(6)(5)$

$\approx 414.69 \text{ ft}^2$

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

$\approx 2(3.14)(5.5)^2 + 2(3.14)(5.5)(18)$

$\approx 812.10 \text{ in.}^2$

7. $S = B + \frac{1}{2}Pl$
$= 6^2 + \frac{1}{2}(24)(5)$
$= 96 \text{ cm}^2$

8. $S = \pi r^2 + \pi rl$
$\approx (3.14)(6)^2 + (3.14)(6)(8)$
$\approx 263.89 \text{ in.}^2$

9. $S = B + \frac{1}{2}Pl$
$= 6 \cdot \frac{1}{4}\sqrt{3}(4)^2 + \frac{1}{2}(24)\left(4\sqrt{3}\right)$
$\approx 124.71 \text{ in.}^2$

10. $V = Bh$
$= (64)(8)$
$= 512 \text{ cm}^3$

11. $V = Bh$
$= 6 \cdot \frac{1}{4}\sqrt{3}(21)^2(37.2)$
$\approx 42{,}621.96 \text{ m}^3$

12. $V = \pi r^2 h$
$\approx (3.14)(3.5)^2(8)$
$\approx 307.88 \text{ in.}^3$

13. $V = \frac{1}{3}Bh$
$= \frac{1}{3}(30)^2(35)$
$= 10{,}500 \text{ in.}^3$

14. $V = \frac{1}{3}Bh$
$= \frac{1}{3} \cdot \frac{1}{4}\sqrt{3}(19)^2(23)$
$\approx 1198.43 \text{ cm}^3$

15. $V = \frac{1}{3}\pi r^2 h$
$\approx \frac{1}{3}(3.14)(8)^2(15)$
$\approx 1005.31 \text{ ft}^3$

16. $S = 4\pi r^2$
$\approx 4(3.14)(14)^2$
$\approx 2463.01 \text{ m}^2$
$V = \frac{4}{3}\pi r^3$
$\approx \frac{4}{3}(3.14)(14)^3$
$\approx 11{,}494.04 \text{ m}^3$

17. $S = 4\pi r^2$
$\approx 4(3.14)\left(\frac{1}{2}\right)^2$
$\approx 3.14 \text{ in.}^2$
$V \approx \frac{4}{3}(3.14)(0.5)^3$
$\approx 0.52 \text{ in.}^3$

18. $\frac{40}{20} = \frac{2}{1} \quad \frac{12}{6} = \frac{2}{1}$
The solids are similar with a scale factor of 2:1.

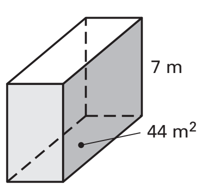
19. $\frac{5}{15} = \frac{1}{3}; \frac{4}{12} = \frac{1}{3}; \frac{8}{16} = \frac{1}{2}$ They are not similar because the ratios are not the same.

Chapter 12 Test *(p. 777)*

1. $F = 8; V = 12; E = 18$ **2.** $F = 5; V = 6; E = 9$

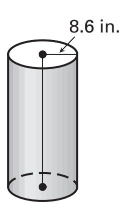
3. $F = 9; V = 14; E = 21$

4.



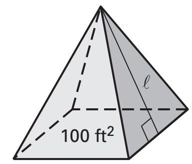
$S = 2B + Ph$
$= 2(44) + (30)(7)$
$= 298 \text{ m}^2$

5.



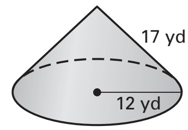
$S = 2\pi r^2 + 2\pi rh$
$784\pi = 2\pi(8.6)^2 + 2\pi(8.6)h$
$784\pi = 147.92\pi + 17.2\pi h$
$636.08\pi = 17.2\pi h$
$36.98 \text{ in.} \approx h$

6.



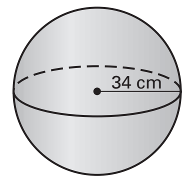
$S = B + \frac{1}{2}Pl$
$340 = 100 + \frac{1}{2}(40)l$
$240 = 20l$
$12 \text{ ft} = l$

7.



$S = \pi r^2 + \pi rl$
$S \approx (3.14)(12)^2 + (3.14)(12)(17)$
$\approx 1093.27 \text{ yd}^2$

8.



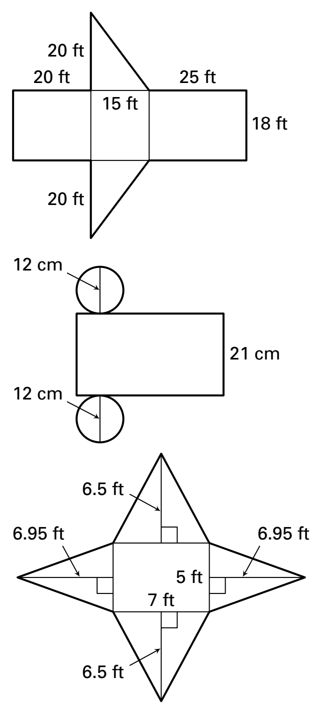
$S = 4\pi r^2$
$\approx 4(3.14)(34)^2$
$\approx 14{,}526.72 \text{ cm}^2$

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

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

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

12.



13. $r = 5 \cdot 3 \text{ cm} = 15 \text{ cm}$

$V = \frac{4}{3}\pi r^3$
$= \frac{4}{3}\pi(15)^3$
$\approx 14{,}137.17 \text{ cm}^3$

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

15. $\frac{\sqrt[3]{8}}{\sqrt[3]{27}} = \frac{2}{3}$

16. **Prism** | **Cylinder**

Prism:

$S = 2B + Ph$

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

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

$V = Bh$

$= (16)(6)$

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

Cylinder:

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

$\approx 2(3.14)(2)^2 + 2(3.14)(2)(7.64)$

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

$V = \pi r^2 h$

$\approx (3.14)(2)^2(7.64)$

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

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

Lateral Area $= (1.5625)(3540)$

$= 5531.25 \text{ ft}^2$

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

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

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

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

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

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

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: $C = 2\pi r \approx 2(3.14)(7.6) \approx 47.75 \text{ cm}$

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

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

Column B: $S = B + \frac{1}{2}Pl \approx \frac{3}{2}\sqrt{3}(6)^2 + \frac{1}{2}(36)(14.9)$

≈ 361.73

10. C

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

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

$= 80\pi$

$V_{large} = (4)^3(80\pi)$

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

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

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

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

$\frac{1768}{32} \approx 56$ sheets

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

13. $V =$ Volume right prism $+$ 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. $V = \pi r^2 h$

$\approx (3.14)(9)^2(9)$

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

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

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

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.

17. volume of custard cups $= 2(\pi \cdot (3.5)^2 \cdot 3.5)$

$\approx 269.39 \text{ cm}^3$

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

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

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

$2094.40x = 12(269.39)$

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

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

$$\sqrt[3]{\frac{1}{2}} \text{ or } \frac{1}{\sqrt[3]{2}} \approx 0.79.$$

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

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

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

$\approx 2(3.14)(0.57)^2 + 2(3.14)(0.57)(1.14)$

$\approx 6.12 \text{ cm}^2$

Large cylinder:

$S \approx (6.12 \text{ cm}^2)(1.26)^2$

$\approx 9.72 \text{ cm}^2$

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

$\approx (3.14)(0.57)^2(1.14)$

$\approx 1.16 \text{ cm}^3$ for small cylinder

$V \approx (1.16 \text{ cm}^3)(1.26)^3$

$= 2.32 \text{ cm}^3$

23. $S \approx (9.72 \text{ cm}^2)(3)^2$

$\approx 87.48 \text{ cm}^2$

$V \approx (2.32 \text{ cm}^3)(3)^3$

$\approx 62.64 \text{ cm}^3$

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

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

$4x - 2 = 6x - 18$

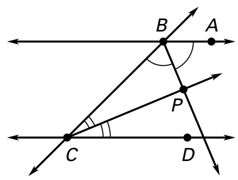
$16 = 2x$

$8 = x$

So $4x - 2 = 30$.

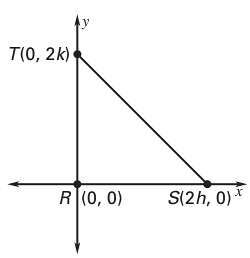
The measures of the four ∠s are 30°, 30°, 150°, 150°.

2.



Consecutive interior ∠s are supplementary. If each interior ∠ is bisected, then two of the interior ∠s of the triangle are complementary. The measure of the third ∠ must be 90° in order for the sum of the measures of the ∠s to be 180°.

3.



$\triangle RST$ is a rt. △ 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

$\left(\frac{0 + 2h}{2}, \frac{0 + 2k}{2}\right)$ 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. $\angle B$ is the largest ∠. $\angle A$ is the smallest ∠.

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

6.

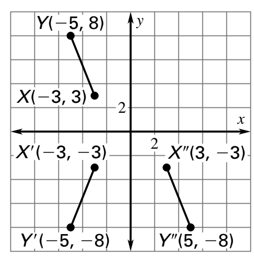
Statements	Reasons
1. $j \parallel k$, $m\angle 1 = 73°$	1. Given
2. $m\angle 1 + m\angle 2 = 180°$	2. If two ∥ lines are cut by a trans. the cons. int. ∠s are supplementary
3. $73° + m\angle 2 = 180°$	3. Substitution prop. of equality
4. $m\angle 2 = 107°$	4. Subtraction prop. of equality

7.

Statements	Reasons
1. *ABDE* and *CDEF* are parallelograms.	1. Given
2. $\angle 4 \cong \angle D$	2. Opp. ∠s of a ▱ are ≅.
3. $m\angle 4 = m\angle D$	3. Def. of ≅.
4. $m\angle 6 + m\angle D = 180°$	4. Consecutive ∠s of a ▱ are supp.
5. $m\angle 6 + m\angle 4 = 180°$	5. Substitution Prop. of Equality
6. $\angle 4$ and $\angle 6$ are supp.	6. Def. of supplementary

8. always **9.** never

10. 180° rotation about the origin



11. *Sample answer:* $\angle A \cong \angle A$ by the reflexive prop. If two ∥ lines are cut by a transversal then corr. ∠s are ≅ 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. $\frac{\text{Perimeter of } \triangle ABC}{\text{Perimeter of } \triangle ADE} = \frac{5}{8}$ $\quad \frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle ADE} = \left(\frac{5}{8}\right)^2 = \frac{25}{64}$

14. $(\text{Hyp})^2 = 7^2 + 24^2$

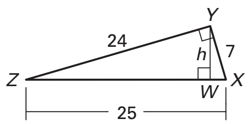
$(\text{Hyp})^2 = 625$

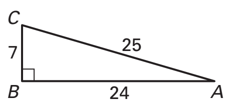
$\text{Hyp} = 25$

$\frac{h}{24} = \frac{7}{25}$

$25h = 168$

$h = 6.72$



15. 

$\sin \angle A = \frac{7}{25}$

$m\angle A = \sin^{-1}\left(\frac{7}{25}\right) \approx 16.3°$

$m\angle B \approx 90° - 16.3° \approx 73.7°$

16. $m\overset{\frown}{AD} = m\overset{\frown}{DB} - m\overset{\frown}{AB}$

$= 180° - 50°$

$= 130°$

17. $m\angle ADB = \frac{1}{2}(50°) = 25°$

18. $m\angle ACB = \frac{1}{2}(50°) = 25°$

19. $m\angle EDB = \frac{1}{2}(180°) = 90°$

20. $m\angle EDA = \frac{1}{2}(m\overset{\frown}{AD}) = \frac{1}{2}(130°) = 65°$

21. $40° = \frac{1}{2}(180° - m\overset{\frown}{CD})$

$80° = 180° - m\overset{\frown}{CD}$

$m\overset{\frown}{CD} = 100°$

22. $m\overset{\frown}{BC} = 80°$

23. $m\overset{\frown}{ABD} = 50° + 180° = 230°$

24. $m\angle BGC = \frac{1}{2}(80° + 130°) = 105°$

25. $\angle BAC$ and $\angle BPC$ are supplementary. $ABPC$ is a quadrilateral with two right angles, so the sum of the measures of the other two angles is 180°.

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

27. $EC \cdot ED = AE - EB$

$18 \cdot 4 = 6 \cdot AE$

$12 = AE$

28. $(DF)^2 = BF \cdot FC$

$6^2 = 4 \cdot (4 + x)$

$36 = 16 + 4x$

$20 = 4x$

$5 = x$

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

$10 \cdot 7 = 3.5 \cdot CE$

$20 = CE$

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

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

$= \sqrt{4^2 + (-3)^2}$

$= \sqrt{25}$

$= 5$ units

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

31. $C = 2\pi r$

$\approx 2(3.14)(5)$

≈ 31.4 units

32. center of the hexagon

33. the bisectors of the rt. ∠s formed by the ⊥ lines

34. $(25 - 2)(180°) = 4140°$

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

$= \frac{1}{2}(15 \tan 67.5°)(240)$

$\approx 4345.6 \text{ cm}^2$

36. Let s = side of the square.

$P = \dfrac{\text{Area of } \frac{1}{4} \text{ circle}}{\text{Area square}}$

$= \dfrac{\frac{90°}{360°} \cdot \pi s^2}{s^2}$

$= \dfrac{\frac{1}{4}\pi s^2}{s^2} = \dfrac{\pi}{4}$

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

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

$= \frac{1}{3}\pi(3.5)^2(6)$

$\approx 76.97 \text{ ft}^3$

38. $V = Bh$

$= 4(5)(5)$

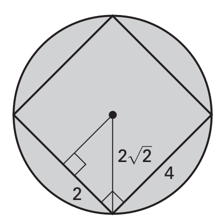
$= 100 \text{ in.}^3$

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

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

Small:large = 1:2.5

= 2:5

39. 

$A = \pi r^2$

$\approx (3.14)\left(2\sqrt{2}\right)^2$

$\approx 25.13 \text{ ft}^2$

40. $L.A. = Ph$

$= (0.25)(6)(0.75)$

$= 1.125 \text{ in.}^2$

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

$\approx 4(3.14)(0.75)^2$

$\approx 7.07 \text{ in.}^2$