

Chapter 13 continued

9. $\sin(-135^\circ)$
 $\sin 45^\circ = -\frac{\sqrt{2}}{2}$
11. $\cos(-420^\circ) = \frac{1}{2}$ 12. $\tan\left(-\frac{2\pi}{3}\right) = \sqrt{3}$
13. $\sin \frac{5\pi}{3} = -\frac{\sqrt{3}}{2}$ 14. $\cos 870^\circ = -\frac{\sqrt{3}}{2}$
15. $\tan(-30^\circ) = -\frac{\sqrt{3}}{3}$ 16. $\sin \frac{23\pi}{6} = -\frac{1}{2}$
17. $\tan^{-1} 2.3$
 1.16; 66.5°
19. $\cos^{-1} 0.95$
 0.318; 18.2°
21. $\tan^{-1}(-4)$
 -1.33; -76°
23. $\sin^{-1} 0.1$
 0.100; 5.74°
25. $\sin \theta = 0.25$
 $\sin^{-1} 0.25 \approx 14.5^\circ$
 $180^\circ - 14^\circ = 166^\circ$
27. $\tan \theta = 7$
 $\tan^{-1} 7 \approx 82^\circ$
 $180^\circ + 82^\circ = 262^\circ$
29. $\cos \theta = -0.3$
 $\cos^{-1}(-0.3) \approx 107^\circ$
 $180^\circ + 73^\circ = 253^\circ$
31. $d = \frac{V^2}{32} \sin 2\theta = \frac{40^2}{32} \sin 2(55) = \frac{1600}{32} \sin 110 = 47 \text{ ft}$
10. $\tan \frac{8\pi}{3} = -\sqrt{3}$
18. $\sin^{-1}(-0.6)$
 -0.644; -36.9°
20. $\sin^{-1} 0.23$
 0.232; 13.3°
22. $\cos^{-1}(-0.8)$
 2.5; 143°
24. $\tan^{-1} 10$
 1.47; 84.3°
26. $\cos \theta = 0.21$
 $\cos^{-1} 0.21 \approx 77.9^\circ$
 $360^\circ - 78^\circ = 282^\circ$
28. $\sin \theta = -0.44$
 $\sin^{-1}(-0.44) \approx -26^\circ$
 $180^\circ + 26^\circ = 206^\circ$
30. $\tan \theta = -4.5$
 $\tan^{-1}(-4.5) \approx -77^\circ$
 $180^\circ - 77^\circ = 103^\circ$

Lesson 13.5

13.5 Guided Practice (p. 803)

- The ambiguous case; because there may be no triangle, one triangle, or two triangles.
- B and C
- If $a < b \sin A$; if $a > b$ or $a = b \sin A$; if $b \sin A < a < b$.
- one triangle 5. no triangle 6. one triangle
- two triangles
- $A = 180^\circ - 110^\circ - 34^\circ$
 $A = 36^\circ$

$$\frac{a}{\sin 36^\circ} = \frac{14}{\sin 34^\circ} = \frac{c}{\sin 110^\circ}$$

$$\frac{a}{\sin 36^\circ} = \frac{14}{\sin 34^\circ}$$

$$0.5592a = 8.229$$

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$$a = 14.7$$

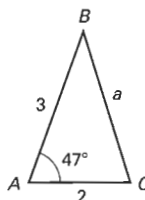
$$\frac{14}{\sin 34^\circ} = \frac{c}{\sin 110^\circ}$$

$$0.5592a = 13.1557$$

$$c = 23.5$$

9. $\frac{25}{\sin 95^\circ} = \frac{19}{\sin B}$
 $25 \sin B = 18.93$
 $\sin B = 0.7571$
 $B = 49.2^\circ$
 $A = 180^\circ - 49.2^\circ - 95^\circ$
 $= 35.8^\circ$
 $\frac{25}{\sin 95^\circ} = \frac{a}{\sin 35.8^\circ}$
 $14.624 = 0.9962a$
 $14.68 = a$

11. $A = \frac{1}{2}(3)(2) \sin 47^\circ$
 $= 2.19 \text{ units}^2$



10. $C = 180^\circ - 64^\circ - 70^\circ$
 $= 46^\circ$

$$\frac{5}{\sin 46^\circ} = \frac{a}{\sin 70^\circ}$$

$$4.6985 = 0.7193a$$

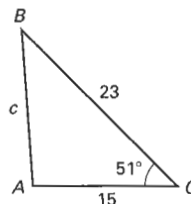
$$6.532 = a$$

$$\frac{5}{\sin 46^\circ} = \frac{b}{\sin 64^\circ}$$

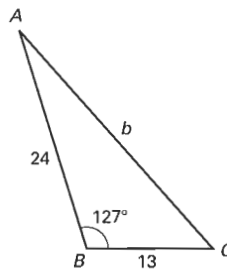
$$4.494 = 0.7193b$$

$$6.2477 = b$$

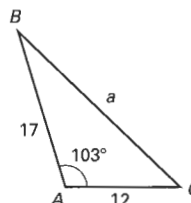
12. $A = \frac{1}{2}(23)(15) \sin 51^\circ$
 $= 134.06 \text{ units}^2$



13. $A = \frac{1}{2}(24)(13) \sin 127^\circ$
 $= 124.59 \text{ units}^2$



14. $A = \frac{1}{2}(17)(12) \sin 103^\circ$
 $= 99.39 \text{ units}^2$



15. $A = \frac{1}{2}(450)(620) \sin 100^\circ$

$$= 137,380.68 \text{ yd}^2$$

$$137,380.68 \div 4840 = 28.38 \text{ acres}$$

$$28.38 \text{ acres} (2200) = \$62,445.76$$

13.5 Practice and Applications (pp. 803-806)

16. 1 triangle 17. no triangle 18. 1 triangle
 19. 2 triangles 20. no triangle 21. 1 triangle
 22. 2 triangles 23. no triangle

Chapter 13 continued

24. $B = 180^\circ - 82^\circ - 55^\circ$

$$= 43^\circ$$

$$\frac{8}{\sin 55^\circ} = \frac{c}{\sin 82^\circ}$$

$$7.922 = 0.8192c$$

$$9.67 = c$$

$$\frac{8}{\sin 55^\circ} = \frac{b}{\sin 43^\circ}$$

$$0.8192b = 5.456$$

$$b = 6.66$$

26. $\frac{10}{\sin 75^\circ} = \frac{5}{\sin C}$
 $4.8296 = 10 \sin C$

$$0.48296 = \sin C$$

$$28.88^\circ = C$$

$$B = 180^\circ - 28.88^\circ - 75^\circ$$

$$= 76.12^\circ$$

$$\frac{10}{\sin 75^\circ} = \frac{b}{\sin 76.12^\circ}$$

$$9.708 = 0.9659b$$

$$10.05 = b$$

$$B \approx 76.12^\circ, C \approx 28.9^\circ,$$

$$b = 10.1$$

28. $A = 180^\circ - 110^\circ - 30^\circ$

$$= 40^\circ$$

$$\frac{15}{\sin 40^\circ} = \frac{b}{\sin 110^\circ}$$

$$14.0954 = 0.6428b$$

$$b = 21.93$$

$$\frac{c}{\sin 30^\circ} = \frac{15}{\sin 40^\circ}$$

$$7.5 = 0.6428c$$

$$11.67 = c$$

$$A \approx 40^\circ, b \approx 21.9, c \approx 11.67$$

30. $\frac{10}{\sin 20^\circ} = \frac{11}{\sin C}$

$$3.762 = 10 \sin C$$

$$0.3762 = \sin C$$

$$C = 22.1^\circ$$

$$B = 180^\circ - 22.1^\circ - 20^\circ = 137.9^\circ$$

$$\frac{b}{\sin 137.9^\circ} = \frac{10}{\sin 20^\circ}$$

$$6.704 = 0.3420b$$

25. $C = 180^\circ - 45^\circ - 60^\circ$

$$C = 75^\circ$$

$$\frac{34}{\sin 75^\circ} = \frac{b}{\sin 60^\circ}$$

$$29.44 = 0.9659b$$

$$30.5 = b$$

$$\frac{34}{\sin 75^\circ} = \frac{a}{\sin 45^\circ}$$

$$24.04 = 0.9659a$$

$$a = 24.89$$

27. $\frac{30}{\sin 60^\circ} = \frac{20}{\sin C}$
 $17.321 = 30 \sin C$

$$0.5774 = \sin C$$

$$C = 35.3^\circ$$

$$A = 180^\circ - 60^\circ - 35.3^\circ$$

$$= 84.7^\circ$$

$$\frac{a}{\sin 84.7^\circ} = \frac{30}{\sin 60^\circ}$$

$$29.8717 = 0.866a$$

$$34.49 = a$$

$$A \approx 84.7^\circ, C \approx 35.3^\circ,$$

$$a \approx 34.5$$

29. $\frac{10}{\sin A} = \frac{8}{\sin 130^\circ}$

$$8 \sin A = 6.128$$

$$\sin A = 0.766$$

$$A = 50^\circ$$

$$A + B = 180^\circ$$

no triangle

$$19.6 = b$$

$$B \approx 137.9^\circ, C \approx 22.1^\circ, b = 19.6 \text{ or}$$

$$C = 180^\circ - 22.1^\circ = 157.9^\circ$$

$$B = 180^\circ - 157.9^\circ - 20^\circ = 2.1^\circ$$

$$\frac{10}{\sin 20^\circ} = \frac{b}{\sin 2.1^\circ}$$

$$0.3664 = 0.3420b$$

$$1.07 = b$$

$$B \approx 2.1^\circ, C \approx 157.9^\circ, b = 1.07$$

31. $\frac{9}{\sin 95^\circ} = \frac{8}{\sin A}$

$$7.970 = 9 \sin A$$

$$0.8855 = \sin A$$

$$A = 62.3^\circ$$

$$B = 180^\circ - 62.3^\circ - 95^\circ = 22.7^\circ$$

$$\frac{b}{\sin 22.7^\circ} = \frac{9}{\sin 95^\circ}$$

$$3.4732 = 0.9962b$$

$$3.486 = b$$

$$A \approx 62.3^\circ, B \approx 22.7^\circ, b = 3.486$$

32. $C = 180^\circ - 70^\circ - 60^\circ = 50^\circ$

$$\frac{a}{\sin 70^\circ} = \frac{25}{\sin 50^\circ}$$

$$23.4923 = 0.766a$$

$$a = 30.67$$

$$\frac{b}{\sin 60^\circ} = \frac{25}{\sin 50^\circ}$$

$$0.766b = 21.65$$

$$b = 28.26$$

$$a = 30.7, C = 50^\circ, b = 28.3$$

33. $\frac{32}{\sin 16^\circ} = \frac{92}{\sin B}$

$$25.36 = 92 \sin B$$

$$0.7925 = \sin B$$

$$B = 52.42^\circ$$

$$A = 180^\circ - 16^\circ - 52.4^\circ$$

$$= 111.6^\circ$$

$$\frac{a}{\sin 111.6^\circ} = \frac{32}{\sin 16^\circ}$$

$$29.75 = 0.2756a$$

$$107.9 = a$$

$$A \approx 111.6^\circ, B \approx 52.4^\circ, a = 107.9 \text{ or}$$

$$B = 180^\circ - 52.4^\circ = 127.6^\circ$$

$$A = 180^\circ - 16^\circ - 127.6^\circ$$

$$= 36.4^\circ$$

Chapter 13 continued

33. —CONTINUED—

$$\frac{a}{\sin 36.4} = \frac{32}{\sin 16^\circ}$$

$$18.9894 = 0.2756a$$

$$a = 68.9$$

$$A \approx 36.4^\circ, B \approx 127.6^\circ, c = 68.9$$

34. $B = 180^\circ - 10^\circ - 130^\circ = 40^\circ$

$$\frac{5}{\sin 40^\circ} = \frac{a}{\sin 10^\circ}$$

$$0.6428a = 0.86824$$

$$a = 1.35$$

$$\frac{c}{\sin 130^\circ} = \frac{5}{\sin 40^\circ}$$

$$3.83 = 0.6428c$$

$$5.96 = c$$

$$B \approx 40^\circ, a = 1.35, c = 5.96$$

35. $\frac{26}{\sin 35^\circ} = \frac{12}{\sin A}$

$$6.8829 = 26 \sin A$$

$$0.2647 = \sin A$$

$$15.35^\circ = A$$

$$C = 180^\circ - 15.4^\circ - 35^\circ = 129.6^\circ$$

$$\frac{c}{\sin 129.6} = \frac{26}{\sin 35^\circ}$$

$$20.03 = 0.5736c$$

$$34.92 = c$$

$$C \approx 129.6^\circ, A \approx 15.4^\circ, c = 34.9$$

36. $\frac{9}{\sin 145^\circ} = \frac{5}{\sin B}$

$$2.8679 = 9 \sin B$$

$$0.3187 = \sin B$$

$$B = 18.58^\circ$$

$$A = 180^\circ - 18.6^\circ - 145^\circ = 16.4^\circ$$

$$\frac{a}{\sin 16.4^\circ} = \frac{9}{\sin 145^\circ}$$

$$2.5411 = 0.5736a$$

$$a = 4.43$$

$$A \approx 16.4^\circ, B \approx 18.6^\circ, a = 4.43$$

37. $A = \frac{1}{2}(17)(33) \sin 25^\circ = 118.5 \text{ units}^2$

38. $A = \frac{1}{2}(21)(17) \sin 130^\circ = 136.7 \text{ units}^2$

39. $A = \frac{1}{2}(8)(5) \sin 120^\circ = 17.3 \text{ units}^2$

40. $A = \frac{1}{2}(11)(18) \sin 85^\circ = 98.6 \text{ units}^2$

41. $A = \frac{1}{2}(16)(21) \sin 75^\circ = 162.3 \text{ units}^2$

42. $A = \frac{1}{2}(11)(24) \sin 110^\circ = 124 \text{ units}^2$

43. $A = \frac{1}{2}(3)(8) \sin 125^\circ = 9.8 \text{ units}^2$

44. $A = \frac{1}{2}(13)(13) \sin 29^\circ = 41 \text{ units}^2$

45. $A = \frac{1}{2}(15)(9) \sin 96^\circ = 67.1 \text{ units}^2$

46. $A = \frac{1}{2}(10)(12) \sin 32^\circ = 31.8 \text{ units}^2$

47. $A = \frac{1}{2}(14)(12) \sin 65^\circ = 76.1 \text{ units}^2$

48. $A = \frac{1}{2}(18)(36) \sin 35^\circ = 185.8 \text{ units}^2$

49. $A = \frac{1}{2}(4)(5) \sin 115^\circ = 9.06 \text{ units}^2$

50. $C = 180^\circ - 80^\circ - 65^\circ = 35^\circ$

$$\frac{c}{\sin 35^\circ} = \frac{17}{\sin 65^\circ}$$

$$9.751 = 0.9063c$$

$$10.76 = c$$

$$A = \frac{1}{2}(17)(10.8) \sin 80^\circ = 90.4 \text{ units}^2$$

51. $\frac{20}{\sin 98^\circ} = \frac{12}{\sin A}$

$$11.8832 = 20 \sin A$$

$$0.5942 = \sin A$$

$$36.5^\circ = A$$

$$B = 180^\circ - 98^\circ - 36.5^\circ = 45.5^\circ$$

$$\text{Area} = \frac{1}{2}(20)(12) \sin 45.5^\circ = 85.6 \text{ units}^2$$

52. $\frac{26}{\sin 105^\circ} = \frac{18}{\sin C}$

$$17.3867 = 26 \sin C$$

$$0.66872 = \sin C$$

$$C = 42^\circ$$

$$A = 180^\circ - 105^\circ - 42^\circ = 33^\circ$$

$$\text{Area} = \frac{1}{2}(26)(18) \sin 33^\circ = 127.4 \text{ units}^2$$

53. *Sample answer:* Let the side lengths be 10 and 15. The equation is $A = 75 \sin x$.

54. No; A reaches a maximum of 75 for $x = 90^\circ$, and then decreases.

55. 90°

Chapter 13 continued

$$56. \frac{7.5}{\sin 25^\circ} = \frac{15}{\sin B}$$

$$6.3393 = 7.5 \sin B$$

$$0.8452 = \sin B$$

$$B = 57.7^\circ$$

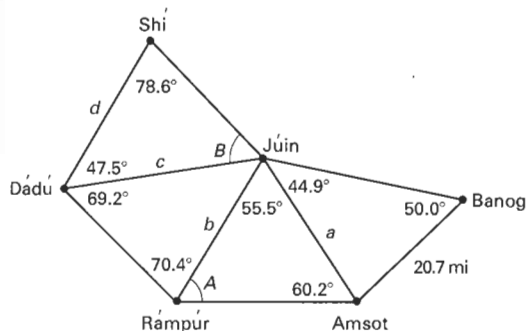
$$A = 180^\circ - 57.7^\circ - 25^\circ = 97.3^\circ$$

$$\frac{a}{\sin 97.3^\circ} = \frac{7.5}{\sin 25^\circ}$$

$$7.4392 = 0.42262a$$

$$a = 17.6 \text{ miles}$$

Exs. 57–59



$$57. \frac{20.7}{\sin 44.9^\circ} = \frac{a}{\sin 50^\circ}$$

$$15.8571 = 0.70587a$$

$$a = 22.5 \text{ miles}$$

$$58. A = 180^\circ - 55.5^\circ - 60.2^\circ = 64.3^\circ$$

$$\frac{b}{\sin 60.2^\circ} = \frac{22.5}{\sin 64.3^\circ}$$

$$19.5247 = 0.90108b$$

$$b = 21.67 \text{ miles}$$

59. Sample answer: Use the law of sines to find the distance from J ún to Amsot, as in Ex. 57. Subtract 55.5° and 60.2° from 180° to find the third angle of the next triangle and then use the law of sines to find the distance from J ún to Rámpúr, as in Ex. 58. Use the law of sines to find the distance from J ún to Dádú.

$$\frac{21.7}{\sin 69.2^\circ} = \frac{c}{\sin 70.4^\circ}$$

$$20.4426 = 0.9348c$$

$$c = 21.87$$

Subtract 78.6° and 47.5° from 180° to find the third angle of the next triangle. Use the law of sines to find the distance from Shi to Dádú.

$$B = 180^\circ - 78.6^\circ - 47.5^\circ = 53.9^\circ$$

$$\frac{d}{\sin 53.9^\circ} = \frac{21.9}{\sin 78.6^\circ}$$

$$17.695 = 0.98027d$$

$$d = 18.1 \text{ miles from Shi to Dádú}$$

$$60. \frac{\sin B}{0.6} = \frac{\sin 145^\circ}{5.7}$$

$$\sin B = \frac{0.6 (\sin 145^\circ)}{5.7}$$

$$\sin B = 0.0604$$

$$B = 3.5^\circ$$

$$A = 180^\circ - 145^\circ - 3.5^\circ$$

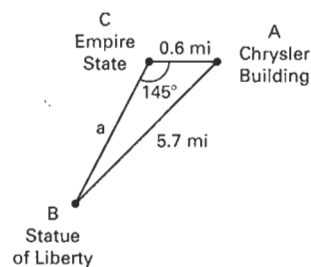
$$= 31.5^\circ$$

$$\frac{a}{\sin 31.5^\circ} = \frac{5.7}{\sin 145^\circ}$$

$$a = \frac{5.7 (\sin 31.5^\circ)}{\sin 145^\circ}$$

$$a = 5.2$$

It is 5.2 miles between the Statue of Liberty and the Empire State Building.



$$61. \frac{48}{\sin 70^\circ} = \frac{50}{\sin B}$$

$$46.9846 = 48 \sin B$$

$$0.97885 = \sin B$$

$$B = 78.2^\circ \text{ or}$$

$$B = 180^\circ - 78.2^\circ = 101.8^\circ$$

$$\theta = 180 - 70 - 78.2 = 31.8^\circ \text{ or}$$

$$\theta = 180 - 70 - 101.8 = 8.2^\circ$$

$$62. \frac{48}{\sin 70^\circ} = \frac{b}{\sin 31.8^\circ}$$

$$25.2939 = 0.93969b$$

$$b = 26.9 \text{ in.}$$

$$\frac{48}{\sin 70^\circ} = \frac{b}{\sin 8.2^\circ}$$

$$6.84619 = 0.93969b$$

$$b = 7.3 \text{ in.}$$

$$63. A = \frac{1}{2}(19.25)(19.25) \sin 123^\circ = 155.4 \text{ ft}^2$$

$$64. \frac{46}{\sin A} = \frac{52}{\sin 65^\circ}$$

$$41.69 = 52 \sin A$$

$$0.801734 = \sin A$$

$$A = 53.3^\circ$$

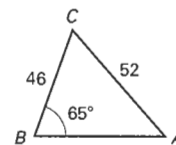
$$C = 180^\circ - 65^\circ - 53.3^\circ$$

$$= 61.7^\circ$$

$$\frac{c}{\sin 61.7^\circ} = \frac{52}{\sin 65^\circ}$$

$$45.78482 = 0.90631c$$

$$c = 50.5 \text{ ft}$$



Chapter 13 continued

65. $A = \frac{1}{2}(46)(52) \sin 61.7^\circ = 1053.1 \text{ ft}^2$

$1053.1 \div 50 = 21$ bags of seed

66. $R = 10(20) = 200$

$200 - 12 - 32 = 156$

$$\frac{20}{\sin 110^\circ} = \frac{n}{\sin 35^\circ}$$

$11.4715 = 0.9397n$

$n = 12.2$

$T = \frac{1}{2}(20)(12.2) \sin 35^\circ = 70$

Total area = $156 + 70 = 226 \text{ ft}^2$

67. $226 \div 400 = 0.565$ gallons so buy 1 can.

68. a. $180^\circ - 65^\circ - 90^\circ = 25^\circ$

$180^\circ - 60^\circ - 90^\circ = 30^\circ$

$30^\circ - 25^\circ = 5^\circ$

$\theta = 5^\circ$

$$\frac{100}{\sin 5^\circ} = \frac{a}{\sin 60^\circ}$$

$86.6025 = 0.08716a$

$a = 993$

$$\frac{993}{\sin 90^\circ} = \frac{h}{\sin 65^\circ}$$

$899.9636 = h$

$h = 900 \text{ ft}$

b. $\tan 25^\circ = \frac{d}{h}$

$0.466 = \frac{d}{h}$

$d = 0.466h$

$\tan 30^\circ = \frac{d + 100}{h}$

$0.577 = \frac{d + 100}{h}$

$d + 100 = 0.577h$

$0.466h + 100 = 0.577h$

$100 = 0.111h$

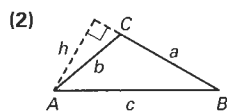
$900.9 = h$

c. The method of Part (a); it was the first one I thought of.

69. area formulas:

(1) Area = $\frac{1}{2}ch$, where $\frac{h}{b} = \sin A$, or $h = b \sin A$.

So, area = $\frac{1}{2}c(b \sin A) = \frac{1}{2}bc \sin A$.



Area = $\frac{1}{2}ah$, where $\frac{h}{b} = \sin (180^\circ - C)$.

Because $\sin (180^\circ - C) = \sin C$, $h = b \sin C$.

So, area = $\frac{1}{2}a(b \sin C) = \frac{1}{2}ab \sin C$.

(3) Area = $\frac{1}{2}ch$, where $\frac{h}{a} = \sin B$, or $h = a \sin B$.

So, area = $\frac{1}{2}c(a \sin B) = \frac{1}{2}ac \sin B$.

law of sines:

(1)

$\frac{1}{2}bc \sin A = \frac{1}{2}ac \sin B$, so $b \sin A = a \sin B$, or $\frac{\sin A}{a} = \frac{\sin B}{b}$.

(2)

$\frac{1}{2}bc \sin A = \frac{1}{2}ab \sin C$, so $c \sin A = a \sin C$, or $\frac{\sin A}{a} = \frac{\sin C}{c}$.

(3)

$\frac{1}{2}ab \sin C = \frac{1}{2}ac \sin B$, so $b \sin C = c \sin B$, or $\frac{\sin C}{c} = \frac{\sin B}{b}$.

13.5 Mixed Review (p. 806)

70. $5\sqrt{11} + \sqrt{11} - 9\sqrt{11} = 6\sqrt{11} - 9\sqrt{11} = -3\sqrt{11}$

71. $2\sqrt{12} + 5\sqrt{12} + 3\sqrt{27}$
 $= 2 \cdot 2\sqrt{3} + 5 \cdot 2\sqrt{3} + 3 \cdot 3\sqrt{3}$
 $= 4\sqrt{3} + 10\sqrt{3} + 9\sqrt{3}$
 $= 23\sqrt{3}$

72. $\sqrt{125} - 7\sqrt{45} + 10\sqrt{40}$
 $= 5\sqrt{5} - 7 \cdot 3\sqrt{5} + 10 \cdot 2\sqrt{10}$
 $= 5\sqrt{5} - 21\sqrt{5} + 20\sqrt{10}$
 $= 20\sqrt{10} - 16\sqrt{5}$

73. $\sqrt{7} + 5\sqrt{63} - 2\sqrt{112}$
 $= \sqrt{7} + 5 \cdot 3\sqrt{7} - 2 \cdot 4\sqrt{7}$
 $= \sqrt{7} + 15\sqrt{7} - 8\sqrt{7}$
 $= 8\sqrt{7}$

74. $2\sqrt{486} - 5\sqrt{54} - 2\sqrt{150}$
 $= 2 \cdot 9\sqrt{6} - 5 \cdot 3\sqrt{6} - 2 \cdot 5\sqrt{6}$
 $= 18\sqrt{6} - 15\sqrt{6} - 10\sqrt{6}$
 $= -7\sqrt{6}$

75. $\sqrt{72} + 6\sqrt{98} - 10\sqrt{8}$
 $= 6\sqrt{2} + 6 \cdot 7\sqrt{2} - 10 \cdot 2\sqrt{2}$
 $= 6\sqrt{2} + 42\sqrt{2} - 20\sqrt{2}$
 $= 28\sqrt{2}$

76. $\cos 52^\circ = 0.6157$ 77. $\cos \frac{12\pi}{5} = 0.3090$

Chapter 13 continued

$$78. \cos \frac{9\pi}{5} = 0.8090 \quad 79. \cos \frac{10\pi}{7} = -0.2225$$

$$80. \cos 20^\circ = 0.9397 \quad 81. \cos 305^\circ = 0.5736$$

$$82. \cos(-200^\circ) = -0.9397 \quad 83. \cos 5^\circ = 0.9962$$

$$84. \tan \theta = \frac{4}{120}$$

$$\theta = \tan^{-1}(0.3333)$$

$$\theta = 1.91^\circ$$

Lesson 13.6

13.6 Guided Practice (p. 810)

1. semiperimeter

2. a. law of cosines b. law of sines

c. law of cosines d. law of sines

e. law of sines

3. an obtuse angle

4. The area of a triangle with sides a , b , and c and semi-perimeter s (one half the perimeter) is the square root of the product s times $(s - a)$ times $(s - b)$ times $(s - c)$.

$$5. b^2 = 120^2 + 100^2 - 2(120)(100)\cos 20^\circ$$

$$b^2 = 14,400 + 10,000 - 24,000 \cos 20^\circ$$

$$b^2 = 24,400 - 22,552.62$$

$$b^2 = 1847.38$$

$$b = 43$$

$$120^2 = 43^2 + 100^2 - 2(43)(100)\cos A$$

$$14,400 = 1849 + 10,000 - 8600 \cos A$$

$$2551 = -8600 \cos A$$

$$-0.29663 = \cos A$$

$$A = 107.3^\circ$$

$$C = 180^\circ - 107.3^\circ - 20^\circ = 52.7^\circ$$

$$A \approx 107.3^\circ, b = 43, C \approx 52.7^\circ$$

$$6. c^2 = 10^2 + 12^2 - 2(10)(12)\cos 95^\circ$$

$$c^2 = 244 - 240 \cos 95^\circ$$

$$c^2 = 244 + 20.9174$$

$$c^2 = 264.92$$

$$c = 16.3$$

$$10^2 = 12^2 + 16.3^2 - 2(12)(16.3)\cos A$$

$$100 = 409.69 - 391.2 \cos A$$

$$-309.69 = -391.2 \cos A$$

$$0.79164 = \cos A$$

$$A = 37.7^\circ$$

$$B = 180^\circ - 37.7^\circ - 95^\circ = 47.3^\circ$$

$$A \approx 37.7^\circ, B \approx 47.3^\circ, c = 16.3$$

$$7. \quad 25^2 = 11^2 + 24^2 - 2(11)(24)\cos A$$

$$625 = 697 - 528 \cos A$$

$$-72 = -528 \cos A$$

$$0.13636 = \cos A$$

$$A = 82.2^\circ$$

$$11^2 = 25^2 + 24^2 - 2(25)(24)\cos B$$

$$121 = 1201 - 1200 \cos B$$

$$-1080 = -1200 \cos B$$

$$0.9 = \cos B$$

$$B = 25.8^\circ$$

$$C = 180^\circ - 82.2^\circ - 25.8^\circ = 72^\circ$$

$$8. \quad 2^2 = 4^2 + 5^2 - 2(4)(5)\cos A$$

$$4 = 16 + 25 - 40 \cos A$$

$$4 = 41 - 40 \cos A$$

$$-37 = -40 \cos A$$

$$0.925 = \cos A$$

$$A = 22.3^\circ$$

$$4^2 = 2^2 + 5^2 - 2(2)(5)\cos B$$

$$16 = 4 + 25 - 20 \cos B$$

$$16 = 29 - 20 \cos B$$

$$-13 = -20 \cos B$$

$$0.65 = \cos B$$

$$B = 49.5^\circ$$

$$C = 180^\circ - 22.3^\circ - 49.5^\circ = 108.2^\circ$$

$$9. \quad s = \frac{1}{2}(25 + 60 + 45) = \frac{1}{2}(130) = 65$$

$$\text{Area} = \sqrt{65(65 - 25)(65 - 60)(65 - 45)}$$

$$= \sqrt{65(40)(5)(20)}$$

$$= \sqrt{260,000}$$

$$= 510 \text{ units}^2$$

$$10. \quad s = \frac{1}{2}(9 + 4 + 11) = 12$$

$$\text{Area} = \sqrt{12(12 - 9)(12 - 4)(12 - 11)}$$

$$= \sqrt{12(3)(8)(1)}$$

$$= \sqrt{288}$$

$$= 17 \text{ units}^2$$

$$11. \quad s = \frac{1}{2}(100 + 55 + 61) = 108$$

$$\text{Area} = \sqrt{108(108 - 100)(108 - 55)(108 - 61)}$$

$$= \sqrt{108(8)(53)(47)}$$

$$= \sqrt{2,152,224}$$

$$= 1467 \text{ units}^2$$

Chapter 13 *continued*

$$12. S = \frac{1}{2}(5 + 27 + 29) = 30.5$$

$$\text{Area} = \sqrt{30.5(30.5 - 5)(30.5 - 27)(30.5 - 29)}$$

$$= \sqrt{30.5(25.5)(3.5)(1.5)}$$

$$= \sqrt{4083.1875}$$

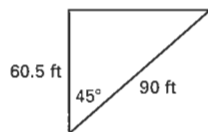
$$= 63.9 \text{ units}^2$$

$$13. a^2 = 60.5^2 + 90^2 - 2(60.5)(90)\cos 45^\circ$$

$$a^2 = 11,760.25 - 10,890 \cos 45^\circ$$

$$a^2 = 4059.86$$

$$a = 63.7 \text{ ft}$$



$$14. S = \frac{1}{2}(63.7 + 60.5 + 90) = 107.1$$

$$\text{Area} = \sqrt{107.1(107.1 - 63.7)(107.1 - 60.5)(107.1 - 90)}$$

$$= \sqrt{107.1(43.4)(46.6)(17.1)}$$

$$= \sqrt{3,703,916.84}$$

$$= 1925 \text{ ft}^2$$

13.6 Practice and Applications (pp. 810–812)

$$15. c^2 = 5^2 + 8^2 - 2(5)(8)\cos 32^\circ$$

$$c^2 = 89 - 80 \cos 32^\circ$$

$$c^2 = 21.1562$$

$$c = 4.6$$

$$5^2 = 8^2 + 4.6^2 - 2(8)(4.6)\cos A$$

$$25 = 85.16 - 73.6 \cos A$$

$$-60.16 = -73.6 \cos A$$

$$0.81739 = \cos A$$

$$A = 35.2^\circ$$

$$B = 180^\circ - 35.2^\circ - 32^\circ = 112.8^\circ$$

$$16. 16^2 = 39^2 + 32^2 - 2(39)(32)\cos C$$

$$256 = 2545 - 2496 \cos C$$

$$-2289 = -2496 \cos C$$

$$0.91707 = \cos C$$

$$C = 23.5^\circ$$

$$39^2 = 16^2 + 32^2 - 2(16)(32)\cos B$$

$$1521 = 1280 - 1024 \cos B$$

$$241 = -1024 \cos B$$

$$-0.23535 = \cos B$$

$$B = 103.6^\circ$$

$$A = 180^\circ - 23.5^\circ - 103.6^\circ = 52.9^\circ$$

$$17. c^2 = 20^2 + 15^2 - 2(20)(15)\cos 40^\circ$$

$$c^2 = 625 - 459.6267$$

$$c^2 = 165.3733$$

$$c = 12.9$$

$$15^2 = 20^2 + 12.9^2 - 2(20)(12.9)\cos A$$

$$225 = 566.41 - 516 \cos A$$

$$-341.41 = -516 \cos A$$

$$0.66165 = \cos A$$

$$A = 48.6^\circ$$

$$B = 180^\circ - 40^\circ - 48.6^\circ = 91.4^\circ$$

$$18. b^2 = 120^2 + 100^2 - 2(120)(100)\cos 20^\circ$$

$$b^2 = 1847.38$$

$$b = 43$$

$$100^2 = 120^2 + 43^2 - 2(120)(43)\cos C$$

$$10,000 = 16249 - 10320 \cos C$$

$$-6249 = -10320 \cos C$$

$$0.6055 = \cos C$$

$$C = 52.7^\circ$$

$$A = 180^\circ - 20^\circ - 52.7^\circ = 107.3^\circ$$

$$19. c^2 = 10^2 + 12^2 - 2(10)(12)\cos 95^\circ$$

$$c^2 = 264.9174$$

$$c = 16.3$$

$$10^2 = 16.3^2 + 12^2 - 2(16.3)(12)\cos A$$

$$100 = 409.69 - 391.2 \cos A$$

$$-309.69 = -391.2 \cos A$$

$$-0.79164 = \cos A$$

$$A = 37.7^\circ$$

$$B = 180^\circ - 37.7^\circ - 95^\circ = 47.3^\circ$$

$$20. 25^2 = 11^2 + 24^2 - 2(11)(24)\cos A$$

$$625 = 697 - 528 \cos A$$

$$0.13636 = \cos A$$

$$A = 82.2^\circ$$

$$\frac{25}{\sin 82.2^\circ} = \frac{11}{\sin B}$$

$$10.89823 = 25 \sin B$$

$$0.43593 = \sin B$$

$$B = 25.8^\circ$$

$$C = 180^\circ - 82.2^\circ - 25.8^\circ = 72^\circ$$

Chapter 13 continued

21. $2^2 = 4^2 + 5^2 - 2(4)(5)\cos A$

$$4 = 41 - 40 \cos A$$

$$-37 = -40 \cos A$$

$$0.925 = \cos A$$

$$A = 22.33^\circ$$

$$\frac{2}{\sin 22.3^\circ} = \frac{4}{\sin B}$$

$$1.51782 = 2 \sin B$$

$$0.7589 = \sin B$$

$$B = 49.4^\circ$$

$$C = 180^\circ - 22.3^\circ - 49.4^\circ = 108.3^\circ$$

22. $a^2 = 2^2 + 4^2 - 2(2)(4)\cos 78^\circ$

$$a^2 = 16.7$$

$$a = 4.08$$

$$2^2 = 4.08^2 + 4^2 - 2(4.08)(4)\cos B$$

$$4 = 32.6464 - 32.64 \cos B$$

$$-28.6464 = -32.64 \cos B$$

$$0.87765 = \cos B$$

$$B = 28.6^\circ$$

$$C = 180^\circ - 78^\circ - 28.6^\circ = 73.4^\circ$$

23. $a^2 = 30^2 + 28^2 - 2(30)(28)\cos 60^\circ$

$$a^2 = 844$$

$$a = 29.1$$

$$\frac{29.1}{\sin 60^\circ} = \frac{30}{\sin B}$$

$$25.9808 = 29.1 \sin B$$

$$0.89281 = \sin B$$

$$B = 63.2^\circ$$

$$C = 180^\circ - 60^\circ - 63.2^\circ = 56.8^\circ$$

24. $b^2 = 11^2 + 22^2 - 2(11)(22)\cos 45^\circ$

$$b^2 = 262.76032$$

$$b = 16.2$$

$$\frac{16.2}{\sin 45^\circ} = \frac{11}{\sin A}$$

$$7.77817 = 16.2 \sin A$$

$$0.48013 = \sin A$$

$$A = 28.7^\circ$$

$$C = 180^\circ - 45^\circ - 28.7^\circ = 106.3^\circ$$

25. $c^2 = 20^2 + 20^2 - 2(20)(20)\cos 30^\circ$

$$c^2 = 107.1797$$

$$c = 10.4$$

$$\frac{10.4}{\sin 30^\circ} = \frac{20}{\sin A}$$

$$10 = 10.4 \sin A$$

$$0.96154 = \sin A$$

$$A = 74^\circ$$

$$B = 180^\circ - 30^\circ - 74^\circ = 76^\circ$$

26. $9^2 = 3^2 + 11^2 - 2(3)(11)\cos A$

$$81 = 130 - 66 \cos A$$

$$-49 = -66 \cos A$$

$$0.7424 = \cos A$$

$$A = 42.1^\circ$$

$$\frac{9}{\sin 42.1^\circ} = \frac{3}{\sin B}$$

$$2.01128 = 9 \sin B$$

$$0.22348 = \sin B$$

$$B = 12.9^\circ$$

$$C = 180^\circ - 42.1^\circ - 12.9^\circ = 125^\circ$$

27. $b^2 = 12^2 + 6^2 - 2(12)(6)\cos 15^\circ$

$$b^2 = 40.9067$$

$$b = 6.4$$

$$\frac{6.4}{\sin 15^\circ} = \frac{12}{\sin A}$$

$$3.10583 = 6.4 \sin A$$

$$0.48529 = \sin A, A = 29^\circ \rightarrow 151^\circ$$

$$C = 180^\circ - 15^\circ - 151^\circ = 14^\circ$$

28. $25^2 = 26^2 + 5^2 - 2(26)(5)\cos A$

$$625 = 701 - 260 \cos A$$

$$-76 = -260 \cos A$$

$$0.29231 = \cos A$$

$$A = 73^\circ$$

$$26^2 = 25^2 + 5^2 - 2(25)(5)\cos B$$

$$676 = 650 - 250 \cos B$$

$$26 = -250 \cos B$$

$$-0.104 = \cos B$$

$$B = 96^\circ$$

$$C = 180^\circ - 96^\circ - 73^\circ = 11^\circ$$

Chapter 13 continued

$$29. \quad 47^2 = 30^2 + 62^2 - 2(30)(62)\cos A$$

$$2209 = 4744 - 3720 \cos A$$

$$-2535 = -3720 \cos A$$

$$0.68145 = \cos A$$

$$A = 47^\circ$$

$$30^2 = 47^2 + 62^2 - 2(47)(62)\cos B$$

$$900 = 6053 - 5828 \cos B$$

$$-5153 = -5828 \cos B$$

$$0.88418 = \cos B$$

$$B = 27.8^\circ$$

$$C = 180^\circ - 47^\circ - 27.8^\circ = 105.2^\circ$$

$$30. \quad \frac{13}{\sin 39^\circ} = \frac{a}{\sin 96^\circ}$$

$$12.9288 = 0.62932a$$

$$20.5 = a$$

$$C = 180^\circ - 96^\circ - 39^\circ$$

$$= 45^\circ$$

$$\frac{13}{\sin 39^\circ} = \frac{c}{\sin 45^\circ}$$

$$9.19239 = 0.62932c$$

$$c = 14.6$$

$$32. \quad a^2 = 17^2 + 48^2 - 2(17)(48)\cos 34^\circ$$

$$a^2 = 1240$$

$$a = 35.2$$

$$\frac{35.2}{\sin 34^\circ} = \frac{17}{\sin B}$$

$$9.50628 = 35.2 \sin B$$

$$0.2701 = \sin B$$

$$B = 15.7^\circ$$

$$C = 180^\circ - 34^\circ - 15.7^\circ = 130.3^\circ$$

$$33. \quad \frac{32}{\sin 104^\circ} = \frac{11}{\sin B}$$

$$10.67325 = 32 \sin B$$

$$0.33354 = \sin B$$

$$B = 19.5^\circ$$

$$A = 180^\circ - 19.5^\circ - 104^\circ$$

$$= 56.5^\circ$$

$$\frac{32}{\sin 104^\circ} = \frac{a}{\sin 56.5^\circ}$$

$$26.68435 = 0.9703a$$

$$27.5 = a$$

$$31. \quad \frac{c}{\sin 30^\circ} = \frac{34}{\sin 80^\circ}$$

$$17 = 0.98481c$$

$$c = 17.3$$

$$A = 180^\circ - 80^\circ - 30^\circ$$

$$= 70^\circ$$

$$\frac{a}{\sin 70^\circ} = \frac{34}{\sin 80^\circ}$$

$$31.9495 = 0.98481a$$

$$a = 32.4$$

$$34. \quad C = 180^\circ - 48^\circ - 51^\circ$$

$$= 81^\circ$$

$$\frac{36}{\sin 81^\circ} = \frac{a}{\sin 48^\circ}$$

$$26.75321 = 0.987688a$$

$$a = 27.1$$

$$\frac{36}{\sin 81^\circ} = \frac{b}{\sin 51^\circ}$$

$$27.9773 = 0.987688b$$

$$b = 28.3$$

$$35. \quad 48^2 = 51^2 + 36^2 - 2(51)(36)\cos A$$

$$2304 = 3897 - 3672 \cos A$$

$$-1593 = -3672 \cos A$$

$$0.43382 = \cos A$$

$$A = 64.3^\circ$$

$$\frac{48}{\sin 64.3^\circ} = \frac{51}{\sin B}$$

$$45.95493 = 48 \sin B$$

$$0.957394 = \sin B$$

$$B = 73.2^\circ$$

$$C = 180^\circ - 64.3^\circ - 73.2^\circ = 42.5^\circ$$

$$36. \quad \frac{5}{\sin 10^\circ} = \frac{25}{\sin C}$$

$$4.3412 = 5 \sin C$$

$$0.86824 = \sin C$$

$$C = 60.3^\circ$$

$$A = 180^\circ - 60.3^\circ - 10^\circ = 109.7^\circ$$

$$\frac{a}{\sin 109.7^\circ} = \frac{5}{\sin 10^\circ}$$

$$4.707353 = 0.173648a$$

$$a = 27.1$$

$$a = 27.1; A = 109.7^\circ; C = 60.3^\circ$$

$$C = 180^\circ - 60.3^\circ = 119.7^\circ$$

$$A = 180^\circ - 119.7^\circ - 10^\circ = 50.3^\circ$$

$$\frac{a}{\sin 50.3^\circ} = \frac{5}{\sin 10^\circ}$$

$$3.846998 = 0.173648a$$

$$a = 22.2$$

$$a = 22.2; A = 50.3^\circ; C = 119.7^\circ$$

$$37. \quad c = \sqrt{4^2 + 11^2}$$

$$c = \sqrt{137}$$

$$c = 11.7$$

$$\tan A = \frac{4}{11}$$

$$A = \tan^{-1}(0.3\overline{6})$$

$$A = 20^\circ$$

$$B = 180^\circ - 90^\circ - 20^\circ = 70^\circ$$

$$38. \quad s = \frac{1}{2}(2 + 3 + 4) = \frac{1}{2}(9) = 4.5$$

$$\text{Area} = \sqrt{4.5(4.5 - 2)(4.5 - 3)(4.5 - 4)}$$

$$= \sqrt{4.5(2.5)(1.5)(0.5)}$$

$$= \sqrt{8.4375}$$

$$= 2.9 \text{ units}^2$$

Chapter 13 continued

39. $s = \frac{1}{2}(8 + 4 + 7) = 9.5$

$$\begin{aligned} \text{Area} &= \sqrt{9.5(9.5 - 8)(9.5 - 4)(9.5 - 7)} \\ &= \sqrt{9.5(1.5)(5.5)(2.5)} \\ &= \sqrt{195.9375} \\ &= 14 \text{ units}^2 \end{aligned}$$

40. $A = \frac{1}{2}(21)(41)\sin 70^\circ = 405 \text{ units}^2$

41. $s = \frac{1}{2}(15 + 20 + 25) = 30$

$$\text{Area} = \sqrt{30(15)(10)(5)} = \sqrt{22,500} = 150 \text{ units}^2$$

42. $s = \frac{1}{2}(13 + 10 + 4) = 13.5$

$$\text{Area} = \sqrt{13.5(0.5)(3.5)(9.5)} = \sqrt{224.4375} = 15.0 \text{ units}^2$$

43. $s = \frac{1}{2}(75 + 68 + 72) = 107.5$

$$\begin{aligned} \text{Area} &= \sqrt{107.5(32.5)(39.5)(35.5)} = \sqrt{4,899,110.938} \\ &= 2210 \text{ units}^2 \end{aligned}$$

44. $s = \frac{1}{2}(3 + 19 + 21) = 21.5$

$$\begin{aligned} \text{Area} &= \sqrt{21.5(18.5)(2.5)(0.5)} = \sqrt{497.1875} \\ &= 22.3 \text{ units}^2 \end{aligned}$$

45. $s = \frac{1}{2}(4 + 2 + 4) = 5$

$$\text{Area} = \sqrt{5(1)(3)(1)} = \sqrt{15} = 3.87 \text{ units}^2$$

46. $s = \frac{1}{2}(20 + 21 + 37) = 39$

$$\text{Area} = \sqrt{39(19)(18)(2)} = \sqrt{26,676} = 163 \text{ units}^2$$

47. $s = \frac{1}{2}(8 + 8 + 8) = 12$

$$\text{Area} = \sqrt{12(4)(4)(4)} = \sqrt{768} = 27.7 \text{ units}^2$$

48. $s = \frac{1}{2}(18 + 15 + 10) = 21.5$

$$\begin{aligned} \text{Area} &= \sqrt{21.5(3.5)(6.5)(11.5)} = \sqrt{5624.9375} \\ &= 75 \text{ units}^2 \end{aligned}$$

49. Suppose $\triangle ABC$ is a right triangle with right angle at C . Then $\cos C = 0$. By the law of cosines, $c^2 = a^2 + b^2 - 2ab \cos C$, so $c^2 = a^2 + b^2 - 2ab \cdot 0$. This gives $c^2 = a^2 + b^2$, which is the Pythagorean Theorem.

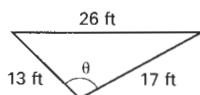
50. $26^2 = 13^2 + 17^2 - 2(13)(17)\cos \theta$

$$676 = 458 - 442 \cos \theta$$

$$218 = -442 \cos \theta$$

$$-0.49321 = \cos \theta$$

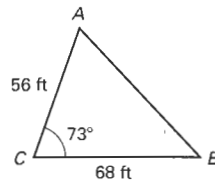
$$\theta = 120^\circ$$



51. $c^2 = 56^2 + 68^2 - 2(56)(68)\cos 73^\circ$

$$c^2 = 5533.2971$$

$$c = 74.4 \text{ ft}$$

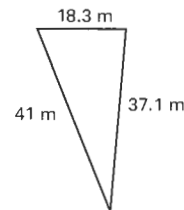


52. $h = 13.2 \text{ m}$

$$s = \frac{1}{2}(18.3 + 37.1 + 41) = 48.2$$

$$\begin{aligned} \text{Area} &= \sqrt{48.2(29.9)(11.1)(7.2)} \\ &= \sqrt{115179.1056} \\ &= 339 \text{ m}^2 \end{aligned}$$

$$V = 339(13.2) = 4475 \text{ m}^3$$



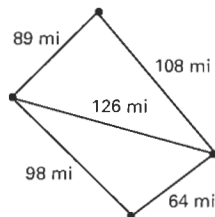
53. $s = \frac{1}{2}(89 + 108 + 126) = 161.5$

$$\begin{aligned} \text{Area} &= \sqrt{161.5(72.5)(53.5)(35.5)} = \sqrt{22,237,843.44} \\ &= 4715.7 \text{ mi}^2 \end{aligned}$$

$$s = \frac{1}{2}(98 + 64 + 126) = 144$$

$$\text{Area} = \sqrt{144(46)(80)(18)} = \sqrt{9,538,560} = 3088.5 \text{ mi}^2$$

$$\text{Total Area} = 4715.7 + 3088.5 = 7804.2 \text{ mi}^2$$



54. $S = \frac{1}{2}(240 + 360 + 300) = 450$

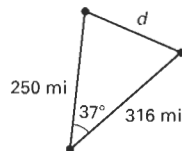
$$\begin{aligned} \text{Area} &= \sqrt{450(210)(90)(150)} = \sqrt{1,275,750,000} \\ &= 35,717.6 \text{ ft}^2 \end{aligned}$$

$$35,717.6 \div 6000 = 6 \text{ bags of fertilizer}$$

55. A

$$d^2 = 250^2 + 316^2 - 2(250)(316)\cos 37^\circ = 36,171.59$$

$$d = 190.2$$



56. D

$$S = \frac{1}{2}(37 + 23 + 42) = 51$$

$$\text{Area} = \sqrt{51(14)(28)(9)} = \sqrt{179,928} = 424 \text{ ft}^2$$

Chapter 13 continued

$$57. a^2 = 4.7^2 + 6^2 - 2(4.7)(6)\cos 25^\circ = \sqrt{6.97424}$$

$$a = 2.64$$

$$\frac{2.64}{\sin 25^\circ} = \frac{4.7}{\sin \alpha}$$

$$0.7521 = \sin \alpha$$

$$49^\circ \approx \alpha$$

$$180^\circ - 25^\circ - 49^\circ = 106^\circ$$

$$\angle OPQ = 106^\circ$$

$$2\theta + m\angle TPQ = 180^\circ$$

$$\theta + m\angle TPQ = 106^\circ$$

$$2\theta + m\angle TPQ = 180^\circ$$

$$-\theta - m\angle TPQ = -106^\circ$$

$$\theta = 74^\circ$$

$$180^\circ - 25^\circ - 74^\circ = 81^\circ$$

$$\angle OTP = 81^\circ$$

$$\frac{4.7}{\sin 81^\circ} = \frac{x}{\sin 25^\circ}$$

$$0.9877x = 1.9863$$

$$x = 2.01$$

13.6 Mixed Review (p. 812)

$$58. \frac{x^2}{4} - \frac{y^2}{45} = 1 \quad 59. \frac{y^2}{9} - \frac{x^2}{112} = 1 \quad 60. \frac{x^2}{25} - \frac{y^2}{56} = 1$$

$$61. y^2 - \frac{x^2}{19} = 1$$

$$62. P(1) = {}_{30}C_1 \left(\frac{1}{6}\right)^1 \left(1 - \frac{1}{6}\right)^{30-1} \\ = 0.02527$$

$$63. P(3) = {}_{30}C_3 \left(\frac{1}{6}\right)^3 \left(1 - \frac{1}{6}\right)^{30-3} \\ = 0.1368$$

$$64. P(5) = {}_{30}C_5 \left(\frac{1}{6}\right)^5 \left(1 - \frac{1}{6}\right)^{30-5} \\ = 0.1921$$

$$65. P(6) = {}_{30}C_6 \left(\frac{1}{6}\right)^6 \left(1 - \frac{1}{6}\right)^{30-6} \\ = 0.16009$$

$$66. P(8) = {}_{30}C_8 \left(\frac{1}{6}\right)^8 \left(1 - \frac{1}{6}\right)^{30-8} \\ = 0.0631$$

$$67. P(10) = {}_{30}C_{10} \left(\frac{1}{6}\right)^{10} \left(1 - \frac{1}{6}\right)^{30-10} \\ = 0.01296$$

$$68. h = -16t^2 + v_0t + h_0$$

$$0 = -16t^2 - 20t + 120$$

$$0 = 4t^2 + 5t - 30$$

$$t = \frac{-5 \pm \sqrt{25 - (4)(4)(-30)}}{8}$$

$$t = \frac{-5 \pm \sqrt{505}}{8}$$

$$t \approx 2.18 \text{ seconds}$$

Lesson 13.7

Developing Concepts Activity (p. 813)

$$1. x = 3t; y = 4t$$

2. $x = 3(5) = 15$ and $y = 4(5) = 20$; the ant reaches the top edge first.

$$4t = 21$$

$$t = 5\frac{1}{4} \text{ sec}$$

13.7 Guided Practice (p. 816)

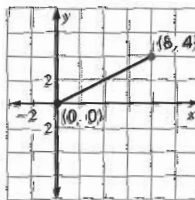
1. parameter

2. The object's starting position and the angle of its motion.

3. The first set is for linear motion at a constant speed, and the second is for the motion of a projectile, where the motion is nonlinear, and varies in velocity because of the effect of gravity.

$$4. x = 2t, y = t, 0 \leq t \leq 4$$

t	0	1	2	3	4
x	0	2	4	6	8
y	0	1	2	3	4



$$5. x = 3t + 4, y = t - 3, 0 \leq t \leq 5$$

t	0	1	2	3	4	5
x	4	7	10	13	16	19
y	-3	-2	-1	0	1	2

