Answers for Lesson 8-1, pp. 420–423 Exercises

1. 10 **2.** 7 **3.** 34

4. 12 **5.** 65 **6.** 8

7. No; $4^2 + 5^2 \neq 6^2$.

8. Yes; $10^2 + 24^2 = 26^2$.

9. Yes; $15^2 + 20^2 = 25^2$.

10. $\sqrt{41}$ **11.** $\sqrt{33}$

12. $3\sqrt{11}$ **13.** $2\sqrt{89}$

14. $3\sqrt{2}$ **15.** $5\sqrt{2}$

16. **a.** 14.1 ft

b. about 2.3 ft

17. 17.0 m

18. No; $19^2 + 20^2 \neq 28^2$.

19. No; $8^2 + 24^2 \neq 25^2$. **20.** Yes; $33^2 + 56^2 = 65^2$.

21. acute **22.** obtuse

23. acute **24.** obtuse

25. right **26.** acute

27. 10 **28.** $8\sqrt{5}$

29. $2\sqrt{2}$

30. Answers may vary. Sample: Have three people hold the rope 3 units, 4 units, and 5 units apart in the shape of a triangle.

31. B **32.** 4.2 in.

33. Yes; $7^2 + 24^2 = 25^2$, so $\angle RST$ is a rt. $\angle$.

34. **a.** $|x_2 - x_1|; |y_2 - y_1|$

b. $PQ^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$

c. $PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

35. Answers may vary. Sample: Using 2 segments of length 1, construct the hyp. of the right △ formed by these segments. Using the hyp. found as one leg and a segment of length 1 as the other leg, construct the hyp. of the △ formed by those legs. Continue this process until constructing a hypotenuse of length $\sqrt{n}$.

36. 29 **37.** 50 **38.** 84 **39.** 35

40–47. Answers may vary. Samples are given.

40. 6; 7 **41.** 4; 5

42. 8; 11 **43.** 11; 12

44. 8; 10 **45.** 14; 16

46. 18; 19 **47.** 39; 42

48. $\frac{r}{a} = \frac{a}{c}$ and $\frac{q}{b} = \frac{b}{c}$. So $a^2 = rc$ and $b^2 = qc$. $a^2 + b^2 = rc + qc = (r + q)c = c^2$

49. 2830 km **50.** 12 cm

51. 12.5 cm **52.** 17.9 cm

53. **a.** Answers may vary. Sample: $n = 6$; 12, 35, 37

b. $12^2 + 35^2 = 37^2$

c. $(2n)^2 + (n^2 - 1)^2$
$= 4n^2 + n^4 - 2n^2 + 1$
$= n^4 + 2n^2 + 1$
$= (n^2 + 1)^2$

54. **a.** 5 in.

b. $\sqrt{29}$

c. $d_2 = \sqrt{BD^2 + AC^2 + BC^2}$

d. 34 in.

55. $\sqrt{14}$ **56.** $\sqrt{61}$ **57.** $\sqrt{17}$

58. Draw right $\triangle FDE$ with legs $\overline{DE}$ of length a and $\overline{EF}$ of length b and hyp. of length x. Then $a^2 + b^2 = x^2$ by the Pythagorean Thm. We are given $\triangle ABC$ with sides of length a, b, c and $a^2 + b^2 = c^2$. By subst., $c^2 = x^2$, so $c = x$. Since all side lengths of $\triangle ABC$ and $\triangle FDE$ are the same, $\triangle ABC \cong \triangle FDE$ by SSS. $\angle C \cong \angle E$ by CPCTC, so $m\angle C = 90$. Therefore, $\triangle ABC$ is a right $\triangle$.

Answers for Lesson 8-2, pp. 428–429 Exercises

1. $x = 8; y = 8\sqrt{2}$

2. $x = \sqrt{2}; y = 2$

3. $y = 60\sqrt{2}$

4. $x = 15; y = 15$

5. $4\sqrt{2}$

6. $\sqrt{10}$

7. 14.1 cm

8. 25.5 ft

9. $x = 20; y = 20\sqrt{3}$

10. $x = \sqrt{3}; y = 3$

11. $x = 5; y = 5\sqrt{3}$

12. $x = 24; y = 12\sqrt{3}$

13. $x = 4; y = 2$

14. $x = 9; y = 18$

15. 50 ft

16. 424 ft

17. $a = 7; b = 14; c = 7; d = 7\sqrt{3}$

18. $a = 6; b = 6\sqrt{2}; c = 2\sqrt{3}; d = 6$

19. $a = 10\sqrt{3}; b = 5\sqrt{3}; c = 15; d = 5$

20. $a = 4; b = 4$

21. $a = 3; b = 7$

22. $a = 14; b = 6\sqrt{2}$

23. Rika; Sandra marked the shorter leg as opposite the 60° angle.

24. Answers may vary. Sample: A ramp up to a door is 12 ft long. It has an incline of 30°. How high off the ground is the door? sol.: 6 ft

25. **a.** 28 ft

b. about 0.28 min

26. **a.** 8.5 m

b. 3.1 m

27. **a.** $\sqrt{3}$ units **b.** $2\sqrt{3}$ units **c.** $s\sqrt{3}$ units

28. Explanations may vary. Samples are given.

a. Construct an equilateral triangle with sides twice the length of the given segment. Bisect one of the angles of the triangle (or construct the perpendicular bisector of one side).

b. Construct an equilateral triangle with sides that are the given length. Bisect one of the angles of the triangle and extend the line until it passes through the side opposite the bisected angle.

c. Construct an equilateral triangle with a side length that is roughly 1.25 the length of the given side. Bisect one of the angles of the triangle. Set the compass to the length of the given side, place the point on the vertex of the bisected angle, and mark the length on the angle bisector. Construct a perpendicular to the bisector through that point and extend it until it intersects one of the sides of the equilateral triangle.

Answers for Lesson 8-3, pp. 434–437 Exercises

1. $\frac{1}{2}$; 2
2. $\frac{2}{3}$; $\frac{3}{2}$
3. 1; 1
4. 11.2

5. 12.3
6. 14.4
7. 2.5
8. 1.6

9. 21.4
10. about 50 yd

11. 32
12. 58
13. 48
14. 65

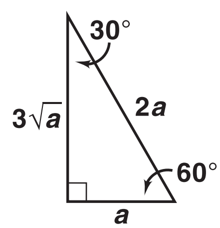
15. 63
16. 58
17. 74.1
18. 13.5

19. 114.5
20. 89.4

21. 44 and 136
22. 52 m

23. D

24. Consider a 30-60-90 △. Let the length of the shorter side be a. Then the length of the longer side, opposite the 60°∠, is $a\sqrt{3}$. Thus, $\tan 60° = \frac{a\sqrt{3}}{a} = \sqrt{3}$.



25. $\frac{\sqrt{2}}{\sqrt{2}} = 1$, so we have to show $\tan^{-1} 1 = 45°$. This is equivalent to showing $1 = \tan 45°$. Consider a 45-45-90 △. Let the lengths of the shorter sides be a. Thus, $\tan 45° = \frac{a}{a} = 1$.

26. 152° and 28°

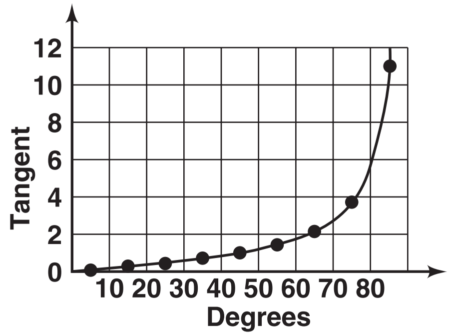
27. $w = 5; x \approx 4.7$

28. $w \approx 6.7; x \approx 8.1$

29. $w \approx 59; x \approx 36$

30. **a.** 0.1; 0.2; 0.3; 0.4; 0.5; 0.6; 0.7; 0.8; 1; 1.2; 1.4; 1.7; 2.1; 2.7; 3.7; 5.7; 11.4

b.



c. approaches 0; increases to infinity

d. Answers may vary. Samples: 82; 2.5; 74

31. about 51°

32. about 701 ft

33. about 296 ft

34. about 58.4%

35. 71.6

36. 60.0

37. 45.0

38. 30.0

39. 22.4

40. 10.4

41. 6.0

42. 3.5

43. 1.6

44. **a.** No; answers may vary. Sample: $\tan 45° + \tan 30° \approx 1 + 0.6 = 1.6$, but $\tan(45 + 30)° = \tan 75° \approx 3.7$

b. No; Assume $\tan A° - \tan B° = \tan(A - B)°$, or $\tan A° = \tan B° + \tan(A - B)°$. Let $A = B + C$, so by subst., $\tan(B + C)° = \tan B° + \tan C°$. This is false by part (a).

45. **a.** 57.290

b. 572.96

c. Answers may vary. Sample: $\tan X° \approx 572{,}958$ for $X° = 89.9999$

d. Answers may vary. Sample: In a rt. △, as an acute ∠ approaches 90°, the opp. side gets longer.

46. a. Every Y_1 value = 1.

b. The graph is that of $Y_1 = 1$.

c. Conjecture: $\tan x° \cdot \tan(90 - x)° = 1$. Proof: Let x be an acute ∠ measure in a rt. △. Then the other acute ∠ measures $(90 - x)$. So $\tan x° = \frac{\text{opp.}}{\text{adj.}}$, and $\tan (90 - x)° = \frac{\text{adj.}}{\text{opp.}}$. Therefore, $\tan x° \cdot \tan(90 - x)° = \frac{\text{opp.}}{\text{adj.}} \cdot \frac{\text{adj.}}{\text{opp.}} = 1$.

47. 42

48. 75

49. 6

50. 50

51. x

52. $m\angle X$

53. 26.6

54. 80.5

55. 78.7

56. 53.1

57. 36.9

58. 33.7

Answers for Lesson 8-4, pp. 441–443 Exercises

1. $\frac{7}{25}; \frac{24}{25}$ **2.** $\frac{4\sqrt{2}}{9}; \frac{7}{9}$ **3.** $\frac{1}{2}; \frac{\sqrt{3}}{2}$

4. 11.5 **5.** 8.3 **6.** 17.9

7. 17.0 **8.** 4.3 **9.** 106.5

10. 1085 ft **11.** 21 **12.** 51

13. 46 **14.** 59 **15.** 24

16. 66 **17.** about 17 ft 8 in.

18. $\sin X \div \cos X = \frac{\text{opp.}}{\text{hyp.}} \div \frac{\text{adj.}}{\text{hyp.}} = \frac{\text{opp.}}{\text{adj.}} = \tan X$

19. $\cos X \cdot \tan X = \frac{\text{adj.}}{\text{hyp.}} \cdot \frac{\text{opp.}}{\text{adj.}} = \frac{\text{opp.}}{\text{hyp.}} = \sin X$

20. $\sin X \div \tan X = \frac{\text{opp.}}{\text{hyp.}} \div \frac{\text{opp.}}{\text{adj.}} = \frac{\text{adj.}}{\text{hyp.}} = \cos X$

21. No; the △s are ~ and the sine ratio for 35° is constant.

22. $w = 3; x \approx 41$

23. $w \approx 37; x \approx 7.5$

24. $w \approx 68.3; x \approx 151.6$

25. **a.** They are equal; yes; the sine and cosine of complementary ∠s are =.

b. $\angle B; \angle A$

c. Answers may vary. Sample: cosine of $\angle A$ = sine of the compl. of $\angle A$.

26. **a.** $\frac{\sqrt{2}}{2}$

b. $\frac{\sqrt{2}}{2}$

c. $\frac{\sqrt{2}}{2}$

d. $\frac{\sqrt{2}}{2}$

e. They are equal.

27. Yes; use any trig. function and the known measures to find one other side. Use the Pythagorean Thm. to find the 3rd side. Subtract the acute ∠ measure from 90 to get the other ∠ measure.

28. **a.** $\frac{\sqrt{3}}{2}$

b. $\frac{1}{2}$

c. $\frac{1}{2}$

d. $\frac{\sqrt{3}}{2}$

e. $\cos 30° = \sqrt{3} \sin 30°$

f. $\sin 60° = \sqrt{3} \cos 60°$

29. Answers may vary. Samples are given.

a. Since $\sin A = \frac{\text{opp.}}{\text{hyp.}}$, if $\sin A \geq 1$, then opp. $\geq$ hyp., which is impossible.

b. Since $\cos A = \frac{\text{adj.}}{\text{hyp.}}$, if $\cos A \geq 1$, then adj. $\geq$ hyp., which is impossible.

30. **a.** 0.99985

b–d. Answers may vary. Samples are given.

b. 1

c. $\sin X = 1$ for $X = 89.9$; no

d. For ∠s that approach 90, the opp. side gets close to the hyp. in length, so $\frac{\text{opp.}}{\text{hyp.}}$ approaches 1.

31. $(\sin A)^2 + (\cos A)^2 = \left(\frac{a}{c}\right)^2 + \left(\frac{b}{c}\right)^2 = \frac{a^2}{c^2} + \frac{b^2}{c^2} = \frac{a^2 + b^2}{c^2} = \frac{c^2}{c^2} = 1$

32. $(\sin B)^2 + (\cos B)^2 = \left(\frac{b}{c}\right)^2 + \left(\frac{a}{c}\right)^2 = \frac{b^2}{c^2} + \frac{a^2}{c^2} = \frac{b^2 + a^2}{c^2} =$
$\frac{c^2}{c^2} = 1$

33. $\frac{1}{(\cos A)^2} - (\tan A)^2 = \left(1 \div \frac{b^2}{c^2}\right) - \frac{a^2}{b^2} = \frac{c^2}{b^2} - \frac{a^2}{b^2} = \frac{c^2 - a^2}{b^2} =$
$\frac{b^2}{b^2} = 1$

34. $\frac{1}{(\sin A)^2} - \frac{1}{(\tan A)^2} = \frac{1}{\left(\frac{a}{c}\right)^2} - \frac{1}{\left(\frac{a}{b}\right)^2} = \frac{c^2}{a^2} - \frac{b^2}{a^2} = \frac{c^2 - b^2}{a^2} =$

$\frac{a^2}{a^2} = 1$

35. $(\tan A)^2 - (\sin A)^2 = \left(\frac{a}{b}\right)^2 - \left(\frac{a}{c}\right)^2 = \frac{a^2}{b^2} - \frac{a^2}{c^2} =$
$\frac{a^2c^2}{b^2c^2} - \frac{a^2b^2}{b^2c^2} = \frac{a^2c^2 - a^2b^2}{b^2c^2} = \frac{a^2(c^2 - b^2)}{b^2c^2} = \frac{a^2 \cdot a^2}{b^2c^2} =$
$\left(\frac{a}{b}\right)^2\left(\frac{a}{c}\right)^2 = (\tan A)^2(\sin A)^2$

36. **a.** about 1.5 AU

b. about 5.2 AU

Answers for Lesson 8-5, pp. 447–449 Exercises

1. ∠ of elevation from sub to boat

2. ∠ of depression from boat to sub

3. ∠ of elevation from boat to lighthouse

4. ∠ of depression from lighthouse to boat

5. ∠ of elevation from Jim to top of waterfall

6. ∠ of elevation from Kelley to top of waterfall

7. ∠ of depression from top of waterfall to Jim

8. ∠ of depression from top of waterfall to Kelley

9. 34.2 ft

10. 502.4 m

11. about 986 m

12. 263.3 yd

13. 0.6 km

14. 769 ft

15. 64°

16. 4.8°

17. about 193 m

18. 3300 m

19. 72, 72

20. 46, 46

21. 27, 27

22. 20, 20

23. B

24. **a.** Length of any guy wire = dist. on the ground from tower to the guy wire div. by the cosine of the ∠ formed by the guy wire and the ground.

b. Height of attachment = dist. on the ground from tower to the guy wire times the tangent of the ∠ formed by the guy wire and the ground.

25. 5

26. about 2.8

27. 0.5; about 84.9

28. 370 m

29. about 28 ft

30. Check students' work.

1. $\langle 602.2, 668.8 \rangle$

2. $\langle -307.3, -54.2 \rangle$

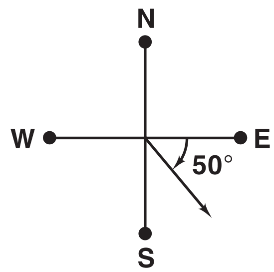
3. $\langle 37.5, -65.0 \rangle$

4. 15° south of west

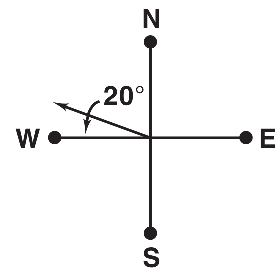
5. 20° west of south

6. 40° east of south

7.



8.



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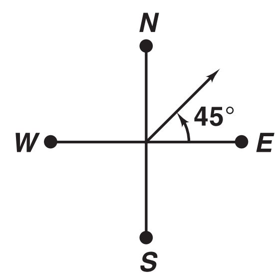

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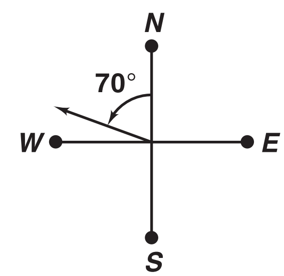

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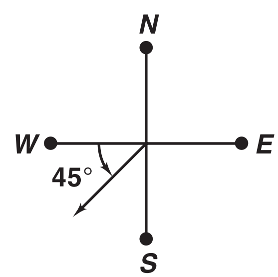

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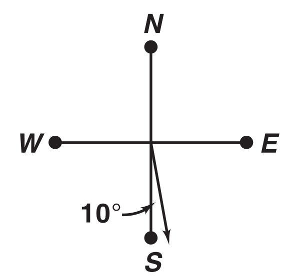


13. about 97 mi at about 41° south of west

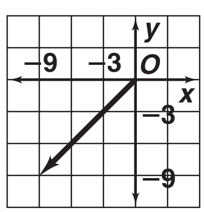
14. about 707 mi; about 65° south of west

15. about 54 mi/h; about 22° north of east

16. about 4805 km; about 12° north of west

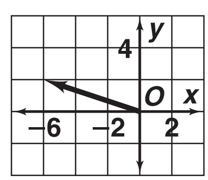
17. a. $\langle -9, -9 \rangle$

b.



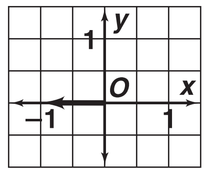
18. a. $\langle -6, 2 \rangle$

b.



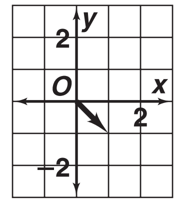
19. a. $\langle -1, 0 \rangle$

b.



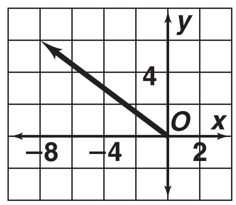
20. a. $\langle 1, -1 \rangle$

b.



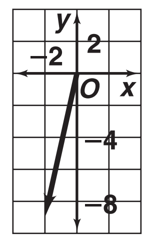
21. a. $\langle -8, 6 \rangle$

b.



22. a. $\langle -2, -9 \rangle$

b.



23. $\langle -1, 3 \rangle$ **24.** $\langle 4, -6 \rangle$ **25.** $\langle -2, 3 \rangle$

26. 35.9 mi/h; 12.9° south of west

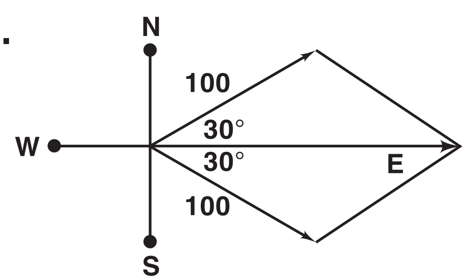
27. about 13.2° north of west

28. 304 mi/h; 9° east of south

29. Yes; both vectors have the same direction, but could have diff. mag.

30. $\langle 6, 1 \rangle$ has mag. $\sqrt{37}$, but $\langle 2, 1 \rangle$ has mag. $\sqrt{5}$.

31. a.



b. about 173 due east

32. Equal vectors have the same mag. and direction.

33. Vectors are $\parallel$ if they have the same or opp. directions.

34. C

35. **a.** $\langle 0, 0\rangle$

b. $\vec{a}$ and $\vec{c}$ have = mag. and opp. direction.

36. about 386 mi/h at 14° south of west

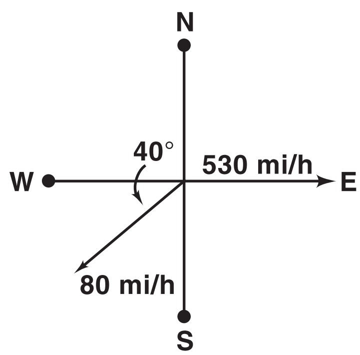
37. $\begin{bmatrix} -1 \\ -2 \end{bmatrix}$ **38.** $\begin{bmatrix} 11 \\ -5 \end{bmatrix}$ **39.** $\begin{bmatrix} -1 \\ 0 \end{bmatrix}$

40. **A.** III

B. II

C. I

41. **a.**

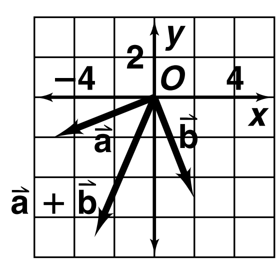


b. $\langle 530, 0\rangle; \langle -61.3, -51.4\rangle$

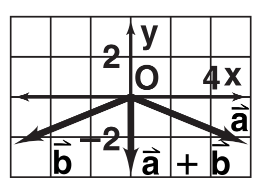
c. $\langle 468.7, -51.4\rangle$

d. 471.5 mi/h at 6.3° south of east

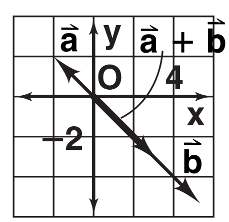
42. $\langle -3, -7\rangle$



43. $\langle 0, -4\rangle$



44. $\langle 3, -3\rangle$



45. The vectors have the same mag.; the vectors have opp. directions.

46. Answers may vary. Sample: $\langle 7, 24\rangle, \langle -7, 24\rangle, \langle 7, -24\rangle, \langle 24, 7\rangle$

47. **a.** about 15° south of west

b. about 6.7 h

48. **a.** about 24.1 mi; about 14.1 mi

b. about 28 mi at about 30° east of north

49. about 2229 ft; about 10°

50. **a.** $\frac{2}{3}$

b. Check students' work.

51. Answers may vary. Sample: zero vector = $\langle 0, 0 \rangle$; it has mag. 0 and no direction.

52. **a.** Yes; when you add integers, which are the coordinates of the vectors, order is not important.

b. yes; if the first two vectors are the same, but in the opp. order