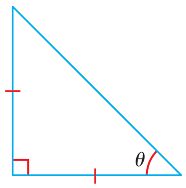
17. **a)** $\sqrt{3}$
b) 2
c) $\sin 30° = \frac{1}{2}$, $\cos 30° = \frac{\sqrt{3}}{2}$, $\tan 30° = \frac{1}{\sqrt{3}}$; $\sin 60° = \frac{\sqrt{3}}{2}$, $\cos 60° = \frac{1}{2}$, $\tan 60° = \frac{\sqrt{3}}{1}$; $\sin 30° = \cos 60°$, $\sin 60° = \cos 30°$, $\tan 30° = \frac{1}{\tan 60°}$

18. **a)** Answers may vary, e.g.,



b) $\sin \theta \doteq \cos \theta \doteq 0.7071$; this makes sense because the opposite side and adjacent side are the same length.

Lesson 7.6, page 412

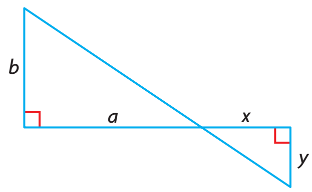
1. 18 m
2. about 2.7 m
3. about 53°
4. about 68°
5. about 31°
6. about 36°
7. 0.5°
8. 130 000 m^2
9. about 42°
10. about 8°
11. about 21 m
12. about 56°
13. about 12.0 m
14. Answers may vary, e.g., I would first draw the height of the triangle from the base to the topmost vertex. Then I would calculate the height using $h = 120 \times \sin 40°$. Next, I would determine the area of the triangle in square metres using $A = 0.5(100)(h)$. Finally, I would multiply the area by the cost of sod per square metre.
15. **a)** 165 m **b)** 297 m
16. about 109.4 m^2
17. about 86°
18. Answers may vary, e.g.,
Draw a diagram.
If two sides are given, use the Pythagorean theorem to determine the third side.
If one acute angle is given, calculate the third angle measure using the fact that the sum of the interior angles is 180°.
To solve for a side, use the appropriate trigonometric ratio.
To solve for an angle, use the appropriate inverse trigonometric ratio.
19. **a)** 36° **b)** 13.3 cm
20. about 37°

Chapter Review, page 416

1. Yes. They are similar. Answers may vary, e.g., all the corresponding pairs of angles are equal: $\frac{9}{4} = \frac{11.25}{5} = \frac{6.75}{3}$. The scale factor is 2.25, which means that the length of each side in the larger triangle is 2.25 times the length of the corresponding side in the smaller triangle.
2. similar; about 3 cm
3. $x \doteq 1.0$ m, $y \doteq 0.6$ m
4. about 29.17 m
5. **a)** $\sin A \doteq \frac{4}{9}$, $\cos A \doteq \frac{8}{9}$, $\tan A = \frac{1}{2}$
b) 27°
6. **a)** 14.7 **b)** 19.8
7. 34°
8. **a)** about 19.9 cm or about 20 cm
b) about 36°
9. $\theta = 72°$, $a \doteq 29$ cm, $b \doteq 28$ cm
10. **a)** about 2.1 m **b)** 2.6 m
11. about 5646 m
12. about 49 m
13. about 10°
14. **a)** about 2°
b) the guard on the first tower, which is 14 m tall; Answers may vary, e.g., the guard on the first tower is about 104 m from the car. The guard on the second tower is about 273 m from the car.
15. $AD = 100 \text{ m} \times \tan 40° \doteq 84$ m; $BD = 100 \text{ m} \times \tan 20° \doteq 36$ m; $AB = AD - BD \doteq 48$ m
16. about 51 m
17. 30°

Chapter Self-Test, page 418

1. $a = 11.80$ units, $b = c = 18.88$ units
2. 9.2 m
3. **a)** 2.3 **b)** 17.8 **c)** 82.0° **d)** 38.9°
4. **a)** about 52 cm **b)** about 67°
5. **a)** $\angle C = 76°$, $a \doteq 21.9$ cm, $c \doteq 21.3$ cm
b) $f \doteq 10.4$ mm, $\angle D \doteq 49°$, $\angle E \doteq 41°$
6. ramp: 14.34 m, run: 14.29 m
7. Answers may vary, e.g., let the width of the river be b. If the surveyors can measure x, y, and a, then they can use similar triangles to calculate b.



8. 39°
9. 5310 m

Chapter 8

Getting Started, page 422

1. **a)** ii **b)** iii **c)** v **d)** iv **e)** vi **f)** i
2. **a)** $a = 80°$, $b = 60°$, $c = 40°$, $d = 120°$, $e = 60°$
b) $i = 80°$, $j = 75°$, $k = 80°$
c) $f = 55°$, $g = 35°$, $h = 55°$
d) $l = 55°$, $m = 125°$, $n = 55°$
3. **a)** longest: AC; shortest: AB
b) longest sides: DE, EF; shortest: DF
4. **a)** greatest: $\angle B$; least $\angle A$ **b)** greatest: $\angle D$; least: $\angle F$
5. **a)** 0.8192 **c)** 0.1392
b) 0.9135 **d)** 0.6018
6. **a)** 20 **b)** 8 **c)** 6 **d)** 50
7. **a)** 30° **b)** 60° **c)** 49° **d)** 51°

8. about 71°

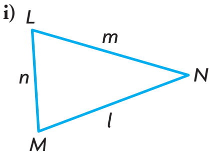
9. a) Yes; $\angle ABG = \angle DCG$, $\angle BAG = \angle CDG$, $\angle AGB = \angle DGC$; all the corresponding angles in the two triangles are equal, because of the properties of angles formed by transversals.

b) $\frac{AG}{DG}, \frac{BG}{CG}$

10. Disagree. This is true for the sine and cosine ratios but not for the tangent ratio. If the opposite side of an angle in a triangle is longer than the adjacent side, then the tangent ratio will be greater than 1, since tangent $= \frac{\text{opposite}}{\text{adjacent}}$.

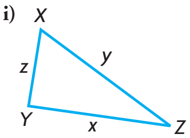
Lesson 8.1, page 427

1. a) i)



ii) $\frac{l}{\sin L} = \frac{m}{\sin M} = \frac{n}{\sin N}$

b) i)



ii) $\frac{x}{\sin X} = \frac{y}{\sin Y} = \frac{z}{\sin Z}$

2. a) 7.1 b) 6.5 c) 34.8° d) 63.2°

3. Agree. Since $\frac{a}{\sin A} = \frac{b}{\sin B}$, rearranging gives $a \sin B = b \sin A$.

4. To calculate the length of an unknown side, you must know the measures of any two angles and the length of any other side. To calculate the measure of an unknown angle, you must know either the measures of the other two angles or the lengths of two sides and the measure of an angle that is opposite one of these sides.

Lesson 8.2, page 432

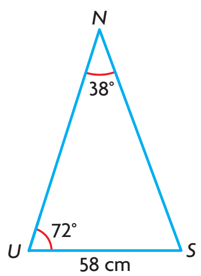
1. $\frac{q}{\sin Q} = \frac{r}{\sin R} = \frac{s}{\sin S}$

2. a) 37.9 cm b) 60.9°

3. a) $d \doteq 21.0$ cm
b) $a \doteq 26.1$ cm, $b \doteq 35.2$ cm
c) $y \doteq 6.5$ cm
d) $\theta \doteq 64°$
e) $\alpha \doteq 85°, \theta \doteq 45°$
f) $\alpha \doteq 75°, \theta \doteq 25°, j \doteq 6.6$ m

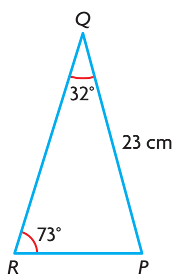
4. about 3275 m

5. a)



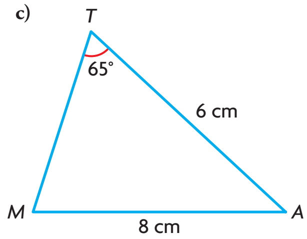
$u \doteq 90$ cm

b)



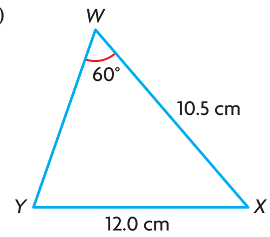
$q \doteq 13$ cm

c)



$\angle M \doteq 43°$

d)



$\angle Y \doteq 49°$

6. $\angle A = 67°$, $a \doteq 41.9$ m, $t \doteq 44.9$ m

7. 15.4 cm

8. about 10.8 m

9. wires: about 12.2 m, about 16.7 m; pole: about 11.8 m

10. Answers may vary, e.g., determine $\angle P$ using $\angle P = \tan^{-1}\left(\frac{p}{r}\right)$. Determine q using the Pythagorean theorem and then $\angle P = \sin^{-1}\left(\frac{p}{q}\right)$.

11. 248 m

12. Answers may vary, e.g.,
a) The sine law can be used to solve a triangle if the measures of any two angles and the length of any side are known, or if the lengths of two sides and the measure of an angle opposite one of these sides are known.
b) The sine law cannot be used to solve a triangle if the lengths of all three sides are known but no angle measures are known, or if the measures of all three angles are known but no side lengths are known, or if the lengths of two sides and the measure of an angle that is not opposite one of these sides are known.

13. Agree. The angle measure known is not opposite any given side, so a complete ratio of the sine law cannot be formed.

14. Calculate $\angle R$ using the fact that the sum of the interior angles in a triangle is 180°. Calculate side lengths q and r using the sine law.

15. 19.7 square units

16. about 10.2 cm

17. a) $\frac{b}{\sin B}$ or $\frac{c}{\sin C}$
b) $\frac{a}{b}$
c) $\frac{\sin A}{\sin C}$
d) $\frac{1}{1}$

Mid-Chapter Review, page 436

1. $\frac{x}{\sin X} = \frac{y}{\sin Y} = \frac{z}{\sin Z}$

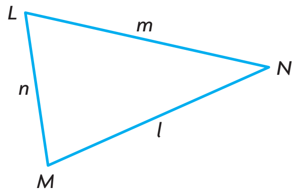
2. Answers may vary, e.g., for right triangles, you can use the primary trigonometric ratios or the Pythagorean theorem. For acute triangles, you can only use the sine law.

3. Disagree. $\frac{d}{\sin D} = \frac{f}{\sin F}$ or $d \sin F = f \sin D$, but neither of these is equivalent to $\frac{d}{\sin F} = \frac{f}{\sin D}$.

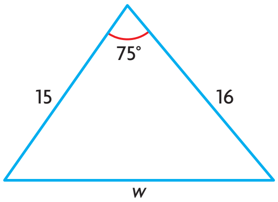
4. a) $\theta \doteq 43°$, $x \doteq 5.9$ cm
   b) $\theta = 62°$, $x \doteq 10.6$ cm, $y \doteq 9.7$ cm
5. $\angle C = 60°$, $b \doteq 12.2$ cm, $c \doteq 13.8$ cm
6. $\angle X$ or $\angle Z$
7. a) the right tower
   b) about 3.1 km
8. about 300 m
9. a) about 84 cm
   b) about 82 cm

Lesson 8.3, page 438

1. a)

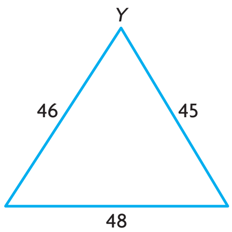


   b) $l^2 = m^2 + n^2 - 2\,mn\cos L$, $m^2 = l^2 + n^2 - 2\,ln\cos M$, $n^2 = l^2 + m^2 - 2\,lm\cos N$
2. Answers may vary, e.g.,
   a)



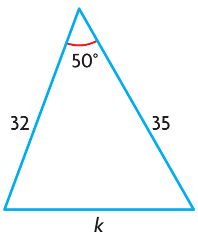
   $w \doteq 19$ units

   c)



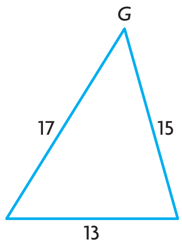
   $\angle Y \doteq 64°$

   b)



   $k \doteq 28$ units

   d)



   $\angle G \doteq 47°$
3. Answers may vary, e.g.,
   a) If an angle measure needs to be determined, the cosine ratio can be determined quickly and the angle measure can be determined using $\cos^{-1}$.
   b) $\dfrac{q^2 + r^2 - p^2}{2\,qr} = \cos P$
   c) $\dfrac{p^2 + r^2 - q^2}{2\,pr} = \cos Q$
4. a) the angle opposite the side with the unknown length and the other two sides
   b) all three side lengths
5. The square of a side length equals the sum of the squares of the other two side lengths minus twice the product of the other two side lengths and the cosine of the angle opposite the first side length.

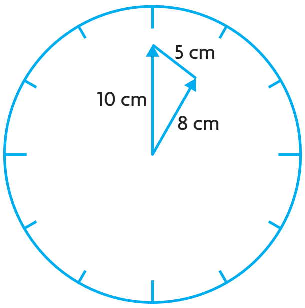
Lesson 8.4, page 443

1. a) No. Another side length, b, is required.
   b) Yes. The lengths of two sides and the measure of the angle between them are given.
2. a) about 13.2 cm
   b) about 72°
3. a) about 6.9 cm
   b) about 14.7 cm
4. a) 34°
   b) 74°
5. a) $\angle D \doteq 46°$, $\angle E \doteq 69°$, $f \doteq 6.3$ cm
   b) $\angle P \doteq 39°$, $\angle Q \doteq 61°$, $r \doteq 10.1$ m
   c) $\angle L \doteq 87°$, $\angle M \doteq 57°$, $\angle N \doteq 37°$
   d) $\angle X \doteq 75°$, $\angle Y \doteq 48°$, $\angle Z \doteq 57°$
6. about 53 cm
7. about 11 cm
8. Use the cosine law: the diagonal, $d^2 = 8^2 + 15^2 - 2(8)(15)\cos 70°$.
9. 5.5°
10. a) i) about 17 cm   ii) about 17 cm
    b) Answers may vary, e.g., the lengths are equal because the triangles formed at 2:00 and at 10:00 are congruent triangles.
11. about 48°
12. No. The angle opposite the 60 cm side would have a negative cosine, which is impossible for an acute angle.
13. about 76.9 km
14. about 423 cm^2
15. Answers will vary, e.g., Problem: Joe and Marie swim away from each other at an angle of 35°. Joe swims at 6 m/s, and Marie swims at 7 m/s. How far apart are they after 5 s? Answer: Joe's distance after 5 s is 30 m, and Marie's distance after 5 s is 35 m. Use the cosine law to determine d, the distance they are apart.
    Problem: During a game of golf, Andrew's ball is 30 m from the hole and Brett's ball is 35 m from the hole. The angle between the two balls, when viewed from the hole, is 35°. How far apart are the two balls? Answer: $d^2 = 30^2 + 35^2 - 2(30)(35)\cos 35°$
16. a) about 67° west of north   b) about 805 km/h
17. perimeter: about 10.9 cm; area: about 8.2 cm^2

Lesson 8.5, page 449

1. a) sine law
   b) tangent ratio or sine law
   c) cosine law
2. a) about 84°   b) about 1.9 cm   c) about 40°
3. a) 64°   b) about 16 cm   c) about 52 cm
4. about 2.5 km
5. about 241 m
6. 8.9 m, 9.5 m
7. a) about 43 m   b) about 13 m
8. *Albacore*: about 61 km; *Bonito*: about 39 km
9. about 276 m
10. about 3.8 km
11. a) about 11 m
    b) about 19 m
12. about 59 cm
13. a) about 879 m
    b) about 40 s
14. a) about 157 km
    b) The airplane that is 100 km away will arrive first.
15. about 85°, about 95°, about 85°, about 95°

16. Answers will vary, e.g., Problem: The minute hand of a clock is pointing at the number 12 and is 10 cm long. The hour hand is 8 cm long. The distance between the tips of the hands is 5 cm. What time could it be? Answer: Use the cosine law to determine the angle formed by the hands, and then determine which number(s) the hour hand could be pointing at, keeping in mind that consecutive numbers on a clock form a 30° angle from the centre. (There are two possible times, depending on whether the hour hand is behind or ahead of the minute hand.)



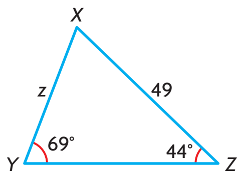
17. about 96 m
18. 50.0 cm^2

Chapter Review, page 453

1. No. e.g., $6^2 + 8^2 = 10^2$, so $\triangle ABC$ is a right triangle.
2. Part d) is not correct for acute triangles.
3. **a)** about 23.7 m **b)** about 62°
4. about 16°
5. $\angle C = 55°$, $a \doteq 9.4$ cm, $b \doteq 7.5$ cm
6. about 295 m
7. **a)** not a form of the cosine law; it should end with cos A
   b) form of the cosine law
   c) form of the cosine law
8. **a)** about 7.6 m **b)** about 68°
9. $\angle B \doteq 44°$, $\angle C \doteq 78°$, $a \doteq 12.2$ cm
10. about 58°
11. about 11 m
12. about 584 km
13. about 5.5 km, about N35°W

Chapter Self-Test, page 454

1. **a)** about 43° **b)** about 2.37 cm
2. $\angle R = 52°$, $p \doteq 25$ cm, $q \doteq 19$ cm
3. **a)** Answers will vary, e.g.,



   b) $z \doteq 36$ units
4. about 117 km
5. about 502.1 m
6. about 11.6 cm
7. about 28.3 m^2
8. about 131 m
9. Answers may vary, e.g., if the angle is formed by the two given sides, use the cosine law. If not, use the sine law to determine a second angle, subtract the two angle measures from 180°, then use the sine or cosine law.

Cumulative Review Chapters 7–8, page 456

1. B	5. D	9. D	13. A	17. A
2. B	6. A	10. D	14. B	18. D
3. D	7. B	11. C	15. B	19. B
4. C	8. C	12. A	16. C	

20. Option B is less costly. For Option A, the cost of cable down the cliff is \$276. The cost of underwater cable is $\frac{23}{\tan 14°}$, which adds up to \$3320.18. For Option B, the change in elevation from the station to the first tower is $\sin^{-1}\left(\frac{8}{39}\right) = 11.84°$, which means 3 extra supports are needed. This costs \$75. The cost of cable from the station to the subdivision is $17(39 + 34 + 33 + 61 + 23) = 3230$. The total cost is \$3305.

21. **a)** 52° **b)** 63°

Appendix A

A-1 Operations with Integers, page 461

1. **a)** 3 **b)** 25 **c)** -24 **d)** -10 **e)** -6 **f)** 6
2. **a)** $<$ **b)** $>$ **c)** $>$ **d)** $=$
3. **a)** 55 **b)** 60 **c)** -7 **d)** 8 **e)** $\frac{15}{7}$ **f)** $\frac{1}{49}$
4. **a)** 5 **b)** 20 **c)** -9 **d)** 76 **e)** -12 **f)** -1
5. **a)** 3 **b)** -1 **c)** -2 **d)** 1 **e)** 8 **f)** $\frac{1}{4}$

A-2 Operations with Rational Numbers, page 462

1. **a)** $-\frac{1}{2}$ **b)** $\frac{7}{6}$ or $1\frac{1}{6}$ **c)** $\frac{2}{15}$ **d)** $\frac{775}{24}$ or $32\frac{7}{24}$ **e)** $\frac{16}{9}$ or $1\frac{7}{9}$ **f)** $\frac{2}{3}$
2. **a)** $\frac{1}{5}$ **b)** $\frac{3}{10}$ **c)** $\frac{1}{15}$ **d)** $-\frac{1}{18}$ **e)** $\frac{36}{5}$ or $7\frac{1}{5}$ **f)** $-\frac{2}{5}$

A-3 Exponent Laws, page 463

1. **a)** 16 **b)** 1 **c)** 9 **d)** -9 **e)** -125 **f)** $\frac{1}{8}$
2. **a)** 2 **b)** 31 **c)** 9 **d)** $\frac{1}{18}$ **e)** -16 **f)** $\frac{13}{36}$
3. **a)** 9 **b)** 50 **c)** 4 194 304 **d)** $\frac{1}{27}$
4. **a)** x^8 **b)** m^9 **c)** y^7 **d)** a^{bc} **e)** x^6 **f)** $\frac{x^{12}}{y^9}$
5. **a)** x^5y^6 **b)** $108m^{12}$ **c)** $25x^4$ **d)** $\frac{4u^2}{v^2}$

Answers