7.3 The Tangent Ratio, pages 352–365

1. a) 0.6667 **b)** 0.7292 **c)** 0.4000 **d)** 1.0000 **e)** 0.7500 **f)** 1.8750

2. a) 1.5000 **b)** 1.3714 **c)** 2.5000 **d)** 1.0000 **e)** 1.3333 **f)** 0.5333

3. a) 2.1445 **b)** 0.2679 **c)** 1.8807 **d)** 0.0875 **e)** 0.5938 **f)** 7.4947 **g)** 0.3739 **h)** 1.0000

4. a) 56° **b)** 37° **c)** 31° **d)** 39° **e)** 40° **f)** 41° **g)** 72° **h)** 59°

5. a) $\angle A = 36°$, $\angle C = 54°$ **b)** $\angle M = 51°$, $\angle K = 39°$ **c)** $\angle P = 32°$, $\angle R = 58°$ **d)** $\angle A = 53°$, $\angle C = 37°$

6. a) 6.7 cm **b)** 1.0 m **c)** 10.0 mm **d)** 4.1 cm

7. a) 11.0 m **b)** 6.0 m **c)** 11.2 m **d)** 11.3 m **e)** 5.1 m **f)** 13.1 m

8. a) 5.2 m **b)** 23.6 m

9. $\tan 72° = \frac{w}{12}$; width is 37 m

10. 8.8 m

11. Rocco's height above the ground: 7 m; Biff's height above the ground: 14 m

12. a) 32° **b)** 4.1 min **c)** Answers will vary.

13. 12 m

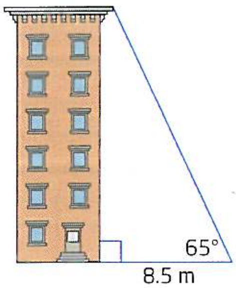
14. 55°

15. 37°

16. $x = 7.0$ m, $y = 6.3$ m

17. $x = 8.9$ cm, $y = 45°$

18. a) Answers may vary.
b) 18.2 m



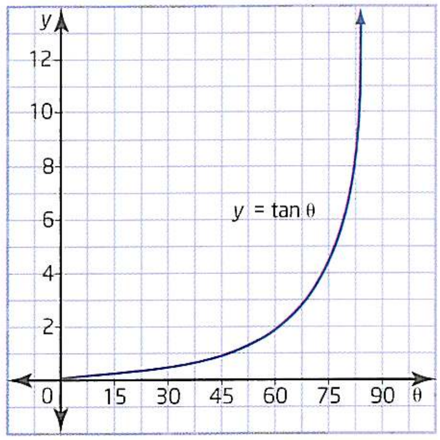
19. a) Tables will vary. **b)** $\tan 45° = 1$ **c)** Answers will vary. **d)** Answers will vary.
e) Tangents of angles less than 45° are between 0 and 1; tangents of angles greater than 45° and less than 90° are greater than 1; tangents of angles very close to, but not equal to, 90° are very large, and approach infinity.
f) Answers may vary. For example: When the angle is less than 45°, the opposite side is shorter than the adjacent side, so the tangent ratio is less than 1. When the angle is greater than 45° but less than 90°, the opposite side is longer than the adjacent side, so the tangent ratio is greater than 1. When the angle gets very close to 90°, the adjacent side gets very small compared to the opposite side, so their quotient becomes very large.

20. a) $\tan 0° = 0$; $\tan 90°$ is undefined.
b) Answers may vary. For example: When the angle is 0°, the opposite side length is zero, so zero divided by any adjacent length equals 0. When the angle is 90°, the adjacent side length is zero, and any opposite side length divided by 0 is undefined.

21. 14°

22. a) Answers may vary. For example: He has a slightly larger angle (14.25° compared to 14.04°) being positioned in the middle, but normally a player slaps the puck predominantly in one direction, so positioning in front of a post might be better.
b) Answers may vary. For example: If he is directly closer to the net, he has a wider angle to work with, so this would be easier. If he is directly farther from the net, he has less of an angle to work with, so this would be more difficult.

23. a) Tables will vary. **b)** Answers will vary.



The relationship is non-linear because the graph is not a straight line.
c) Answers will vary. The graph looks like it increases very quickly as it approaches 90°.

24. 31°

25. 87°

26. a) i) $m = 1$ **ii)** $\tan A = 1$ **iii)** The answers are the same. **iv)** $\angle A = 45°$
b) i) $m = 2$ **ii)** $\tan B = 2$ **iii)** The answers are the same. **iv)** $\angle B = 63°$
c) i) $m = 0.5$ **ii)** $\tan B = 0.5$ **iii)** The answers are the same. **iv)** $\angle C = 27°$

27. C

28. 15°

7.4 The Sine and Cosine Ratios, pages 366–377

1. a) $\sin\theta = \frac{4}{5}$, $\cos\theta = \frac{3}{5}$, $\tan\theta = \frac{4}{3}$
b) $\sin\theta = \frac{12}{13}$, $\cos\theta = \frac{5}{13}$, $\tan\theta = \frac{12}{5}$
c) $\sin\theta = \frac{60}{67}$, $\cos\theta = \frac{30}{67}$, $\tan\theta = 2$
d) $\sin\theta = \frac{89}{120}$, $\cos\theta = \frac{2}{3}$, $\tan\theta = \frac{89}{80}$
e) $\sin\theta = \frac{4}{9}$, $\cos\theta = \frac{8}{9}$, $\tan\theta = \frac{1}{2}$
f) $\sin\theta = \frac{10}{27}$, $\cos\theta = \frac{25}{27}$, $\tan\theta = \frac{2}{5}$
g) $\sin\theta = \frac{25}{54}$, $\cos\theta = \frac{8}{9}$, $\tan\theta = \frac{25}{48}$
h) $\sin\theta = \frac{11}{17}$, $\cos\theta = \frac{13}{17}$, $\tan\theta = \frac{11}{13}$

2. a) sin A = 0.5778, cos A = 0.8111, tan A = 0.7123
b) sin A = 0.5000, cos A = 0.8667, tan A = 0.5769
c) sin A = 0.7895, cos A = 0.6140, tan A = 1.2857
d) sin A = 0.8333, cos A = 0.5500, tan A = 1.5152
e) sin A = 0.7383, cos A = 0.6711, tan A = 1.1000
f) sin A = 0.7469, cos A = 0.6639, tan A = 1.1250

3. a) 0.5736 b) 0.7071 c) 0.8660
d) 0.6018 e) 0.4226 f) 0.0000
g) 0.9998 h) 0.5000

4. a) 0.1702 b) 0.7071 c) 0.8660
d) 0.5000 e) 0.0175 f) 1.0000
g) 0.9962 h) 0.1219

5. Answers may vary. For example: The results are the same for questions 3 h) and 4 d). sin 30° = cos 60° because the sine and cosine ratios of complementary angles are comparing the same side to the hypotenuse.

6. a) 63° b) 30° c) 30° d) 42°
e) 49° f) 72° g) 45° h) 24°
i) 18° j) 86° k) 7° l) 0°

7. a) 63° b) 51° c) 63° d) 70°
e) 27° f) 78° g) 80° h) 52°
i) 20° j) 89° k) 90° l) 60°

8. a) sin T = 0.4545; 27° b) sin T = 0.2; 12°

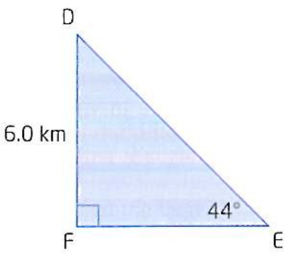
9. a) cos T = 0.5; 60° b) cos T = 0.3; 73°

10. a) 5.5 cm b) 6.1 cm c) 13.1 cm
d) 29.0 cm e) 48.1 cm f) 15.7 cm
g) 18.3 cm h) 27.4 cm

11. a) 37.1 mm b) 8.7 m c) 7.6 cm
d) 13.1 cm e) 8.2 cm f) 12.2 cm
g) 6.3 cm h) 28.6 cm

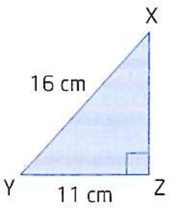
12. a) ∠A = 52°, a = 15.4 cm, b = 19.5 cm
b) ∠D = 75°, d = 15.5 m, f = 4.1 m
c) ∠G = 45°, ∠I = 45°, i = 5.1 mm
d) ∠J = 70°, ∠L = 20°, k = 13.1 cm

13. a)



b) ∠D = 46°, d = 6.2 km, f = 8.6 km

14. a)



b) ∠X = 43°, ∠Y = 47°, y = 11.6 cm

15. a) 38 m b) 12 m

16. a) 0.76°
b) For example: Yes. Explanations may vary. If the rise doubles to 40 m, the angle becomes $\tan^{-1}\left(\frac{40}{1.5}\right) = 1.53°$, and 1.53° is about double 0.76°.

17. 13.1 cm

18. 56°

19. 35 m

20. 3.6 cm

21. 4.1 m

22. 21.8 cm

23. 9.3 m

24. 22 m

25. ∠X = ∠Y = 37°, ∠W = 106°

26. a) 53°
b) 8 min. Explanations may vary. For example: Use the Pythagorean theorem to find the distance along Orchard Avenue, which is 1.6 km. Walking the total distance of 2.8 km at 6 km/h on Rutherford St. and Orchard Ave. would take 28 min, so Enzo saves 8 min by taking the 20-min shortcut. This assumes that Enzo always walks at the same rate.

27. 34 m. Methods may vary. For example: Use the sine ratio to solve for the hypotenuse length.

28. Answers may vary. For example: The sine and cosine ratios of complementary angles are equal. Also, the sum of the square of the sine ratio of a given angle and the square of the cosine ratio of the same angle is one.

29. Answers may vary. For example:
a) No, because both ratios are with respect to the length of the hypotenuse and since the hypotenuse is always the longest side in a right triangle, the denominator in the ratios will always be larger.
b) Yes, because the length of the opposite side to an angle can be greater than the length of the adjacent side.

30. Minneapolis; 2553 km

32. x = 7.2 cm, y = 10.8 cm

33. x = 7.4 m, y = 38°

34. a)

Triangle	△ABC	△DEF
tan x	$\frac{3}{4}$	$\frac{5}{12}$
sin x	$\frac{3}{5}$	$\frac{5}{13}$
cos x	$\frac{4}{5}$	$\frac{12}{13}$
tan (90° − x)	$\frac{4}{3}$	$\frac{12}{5}$
sin (90° − x)	$\frac{4}{5}$	$\frac{12}{13}$
cos (90° − x)	$\frac{3}{5}$	$\frac{5}{13}$

b) Answers may vary. For example: tan x and tan (90° − x) are reciprocals.
c) Answers may vary. For example: sin x = cos (90° − x)
d) Answers may vary. For example: cos x = sin (90° − x)
e) Answers may vary. For example: tan x and tan (90° − x) are reciprocals because when you look at the complementary angle, the opposite sides and adjacent sides switch places. sin x = cos (90° − x) and cos x = sin (90° − x) because in each case the opposite and adjacent sides just switch positions.

35. Answers may vary. For example: Let θ be an acute angle in a right triangle, oriented so that θ is the angle of elevation. Then, the opposite side is the height and the adjacent side is the base of the triangle. Thus,

$\sin \theta = \dfrac{\text{height}}{\text{hypotenuse}}$. The other acute angle will be

$90° - \theta$, and for this angle, the adjacent side will be the height of the triangle. Thus,

$\cos (90° - \theta) = \dfrac{\text{height}}{\text{hypotenuse}}$, which also equals $\sin \theta$.

36. Answers may vary. For example:

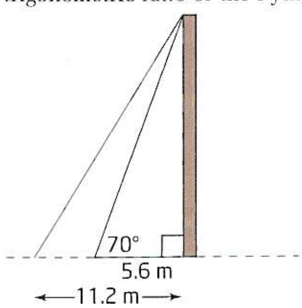
$$\frac{\sin \theta}{\cos \theta} = \frac{\left(\frac{\text{opposite}}{\text{hypotenuse}}\right)}{\left(\frac{\text{adjacent}}{\text{hypotenuse}}\right)}$$
$$= \frac{\text{opposite}}{\text{adjacent}}$$
$$= \tan \theta$$

37. **a)** Examples will vary, but all sums should be 1.
b) Answers may vary. For example:
$(\sin x)^2 + (\cos x)^2 = 1$
c) Answers may vary. For example:
$(\sin x)^2 + \cos x)^2$
$$= \left(\frac{\text{opposite}}{\text{hypotenuse}}\right)^2 + \left(\frac{\text{adjacent}}{\text{hypotenuse}}\right)^2$$
$$= \frac{(\text{opposite})^2 + (\text{adjacent})^2}{(\text{hypotenuse})^2}$$
$$= \frac{(\text{hypotenuse})^2}{(\text{hypotenuse})^2}$$
$$= 1$$

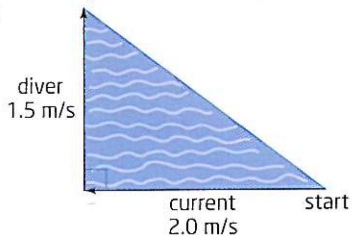
38. **a)** N8°W **b)** 198 km/h
39. D
40. 3 m^2
41. C

7.5 Solve Problems Involving Right Triangles, pages 378–385

1. 15.4 m
2. **a)** 16.4 m
b) Answers may vary. For example: Use a different trigonometric ratio or the Pythagorean theorem.
3. **a)**



b) 19.0 m, 54°
c) 16°
4. 23 cm
5. 22.7 m
6. 9.2 m apart
7. **a)** 68°, 53° **b)** 16 m, 10 m
8. **a)** Answers may vary. For example: Use a different trigonometric ratio or the Pythagorean theorem.
b) 5.2 m
9. Answers may vary. For example: No, because with an angle of 40°, the height of the closest tree is about 25 m tall and Cheryl judges that she can only hit the ball 20 m high. She will hit the tree with the golf ball if she takes this shot.
10. **a)** 49°
b) Answers may vary. For example: In order for the golf ball to land near A, Cheryl needs to hit the golf ball 46.1 m. Since Cheryl on average hits the golf ball a distance of 50 m with the sand wedge, this is the club she should use.
c) 63°
d) Answers may vary. For example: In order for the golf ball to land near the hole, H, Cheryl needs to hit the golf ball 78.3 m. Since Cheryl on average hits the golf ball a distance of 90 m with the pitching wedge, this is the club she should use.
11. **a)** 34.6 m **b)** 115.1 m **c)** 40.0 m, 101.2 m
12. Lucy will escape because the trench is 11.9 m wide but she can leap 12 m, which is just enough!
13. **a)**



b) 450 m
14. 190 m
15. **a)** Theresa should tell Branko to look for the yellow bottle.
b) 84 m
16. Answers may vary. For example: Kim lives on the 9th floor and Yuri lives on the 13th floor. Assume every floor has an equal height.
17. $20\sqrt{2}$ cm
18. **a)** 2.9 km
b) 3.0 km; because the elevation makes the route the hypotenuse of the right triangle with acute angle 15° and adjacent side 2.9 km.
c) 0.8 km
d) 28°
19. **a)** 13 m **b)** 12 m
20. 111 m
21. **a)** 16.6 km **b)** 27°
22. 68 m
23. 42°
24. Watson Lake
25. Answers may vary. For example: length AB = d. In $\triangle$ABC, $\angle$ACB = θ, the hypotenuse is BC, and the opposite side is AB = d. Since $\sin \theta = \dfrac{AB}{BC}$,
$\sin \theta = \dfrac{d}{BC}$.