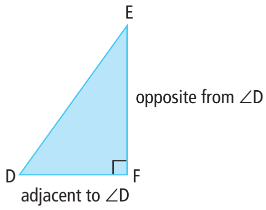
Chapter 3

3.1 The Tangent Ratio, pages 107 to 113

1. a) hypotenuse: XZ; opposite: ZY; adjacent: XY
b) hypotenuse: ST; opposite: SR; adjacent: RT
c) hypotenuse: LM; opposite: MN; adjacent: LN

2. a)

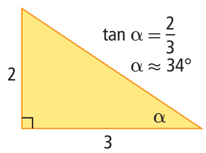


b) $\tan D = \frac{EF}{DF}$

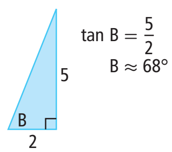
3. a) 3.4874 **b)** 1 **c)** 1.7321
d) 57.2900 **e)** 0.7536 **f)** 0.3249

4. a) 35° **b)** 60° **c)** 29°
d) 49°

5. a)



b)



6. a) $x \approx 19.8$ m **b)** $\theta \approx 3.6°$

7. a) 45° **b)** 17 ft

8. approximately 33.8° and 56.2°

9. a) 29 ft
b) The ratio 1:12 is the tangent of the angle of the ramp. For a safe ramp, the angle of inclination would have to be less than or equal to 4.8°. The ramp shown is not safe.

10. T1: 11.7 km; T2: 37.0 km; T3: 49.2 km

11. approximately 0.5°

12. 1592 ft

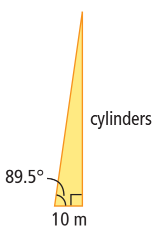
13. a) approximately 35°
b) approximately 260.19 m

14. a) approximately 304.3 m
b) approximately 783.24 m

15. a) approximately 6.11 ft
b) approximately 16.75 ft

16. a) 49.3 m **b)** 50.0 m

17. a)

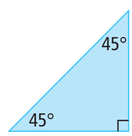


b) 1145.89 m **c)** 11 459 cylinders

18. Example: Ratio: A ratio is the proportion of one number to another. The tangent ratio is the proportion of the length of the side opposite the subject angle in relation to the length of the side (that is not the hypotenuse) adjacent to the subject angle.
$\theta = 63°$: The symbol θ is generally used to indicate the size of an angle. If $\theta = 63°$, the proportion of the lengths of the opposite and adjacent sides is approximately 1.96.
tan 42°: The value of tan 42° is approximately 0.9, so the length of the side opposite the angle measuring 42° is approximately 0.9 times the length of the side that is not the hypotenuse, but that is adjacent to the angle measuring 42°.
$\tan \theta = 1.428$: The value of θ is approximately 55°, so the proportion of the length of a side in a right triangle opposite an angle measuring 55° compared to the length of the side that is not the hypotenuse, but that is adjacent to the angle measuring 55° is approximately 1.428.
$\tan \theta = \frac{3}{4}$: The value of θ is approximately 36.87°.

Opposite Side: You can determine the length of the side opposite the subject angle in a right triangle by using the tangent ratio if the length of the side that is not the hypotenuse, but that is adjacent to the subject angle is known, as well as the size of the subject angle.
Adjacent Side: You can determine the length of the side that is not the hypotenuse, but that is adjacent to the subject angle in a right triangle by using the tangent ratio if the length of the side opposite the subject angle is known, as well as the size of the subject angle.

19.



The triangle is isosceles with both acute angles measuring 45°.

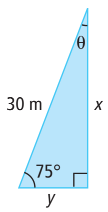
20. In the small triangle, both the lengths of the opposite side of the angle and the side adjacent to the angle are known, so Devin could input $\tan^{-1}(2 \div 1.1)$ into his calculator to find that the angle is approximately 61.2°.

21. **Step 2:** Sight through the straw on the transit to the object. Record the angle the straw makes with the protractor on the transit. Use the tangent ratio with this angle and the baseline distance, AB, to determine the distance from point B to the object.
Step 3: Example:

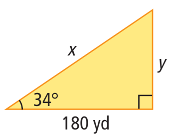
Object	Length of Baseline AB	Measure of ∠A	Distance to the Object (to the nearest tenth of a metre)
Goal posts	30 m	60°	52.0 m
Back stop	25 m	35°	17.5 m

3.2 The Sine and Cosine Ratios, pages 120 to 124

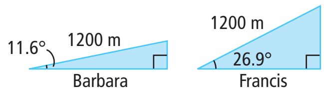
1. a) 0.8290 b) 0.5534 c) 0.8902
   d) 0.3355 e) 1 f) 0.1736
2. a) $\frac{12}{13}$ b) $\frac{5}{13}$ c) $\frac{12}{13}$
   d) $\frac{21}{29}$ e) $\frac{21}{29}$ f) $\frac{20}{29}$
3. a) 62° b) 47°
   c) 34° d) No such angle exists.
   e) 30° f) 41°
4. a) 15.3 b) 22.7
5. a) 33.2° b) 36.9°
6. a) $\theta \approx 44.4°$ b) $x \approx 14.2$ ft
   c) $\theta \approx 40.7°$ d) $x \approx 226.5$ m
7. 10.1 m
8. a)



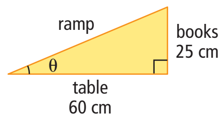
   b) 29.0 m
9. 39.8 m
10. 8485.3 m
11. a)



   b) 217 yd
   c) approximately 84 yd shorter
12. 17°
13. a) Because two sides are known, the Pythagorean relationship could be used to determine the height.
    b) The lengths of the adjacent side and the hypotenuse are known, so the cosine ratio could be used to determine the angle.
14. a)



   Comparing triangles representing the two situations shows that Barbara will cover a greater horizontal distance.
   b) 105.3 m
15. $x \approx 6.01$ m; $y \approx 10.23$ m; $\theta \approx 35.6°$
16. approximately 173.2 cm
17. **Step 1:** Example:



   $\theta \approx 22.6°$
   Step 4:
   a) As the launch angle of the ramp increases, the distance the marble travels increases. This change in distance travelled occurs because at higher angles, the marble will stay in the air longer and travel farther horizontally.
   b) Yes. Making the angle of the ramp larger would increase the speed at which the marble leaves the ramp, so it would increase the horizontal distance travelled when the ramp curves up at the end.

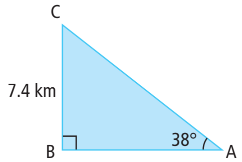
3.3 Solving Right Triangles, pages 131 to 135

1. a) ∠ = 60°; $x \approx 8.7$; $y = 5$
   b) ∠ = 45°; $x = 7$; $y \approx 9.9$
   c) ∠B ≈ 30.3°; ∠C ≈ 59.7°; BC ≈ 13.9
   d) ∠J = 29°; MD ≈ 1.7; MJ ≈ 3.4
2. a) 14.2 cm b) 12.4 cm
3. 75°
4. a) angle of depression b) angle of elevation
   c) angle of depression d) angle of elevation
5. a) approximately 16.17°
   b) approximately 38.66°
   c) approximately 65.06°
   d) approximately 21.80°
   e) approximately 37.95°
6. 1079 m
7. The boat is not safe, because it is approximately 51.2 m from the cliff.
8. 504 ft
9. a) maximum distance: approximately 204.9 m; minimum distance: approximately 192.2 m
   b) maximum angle: approximately 87.6°; minimum angle: approximately 69.5°
10. approximately 165.1 m
11. a) approximately 6.2 mi
    b) approximately 7.9 mi

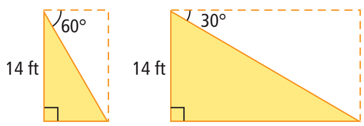
12. a) The boat on the left is closer to the helicopter, because the larger the angle of depression, the closer the object is to the base of where the object is sighted.
b) 1601 m
13. 32.3 m
14. a) 123 m
b) The truck is travelling at approximately 12.3 m/s, which is equivalent to approximately 44 km/h, so the truck driver is speeding.
15. approximately 3524 cm^3
16. a) Richard is incorrect. The angle of depression sighting down will equal the angle of elevation sighting up.
b) Because $\alpha = \theta$, knowing the angle of depression (α) gives the angle of elevation (θ). If we know the height of the window and the horizontal distance, the tangent ratio can be used to determine the value of θ. If we know the height of the window and the length of the line of sight, the sine ratio can be used to determine the value of θ. If we know the length of the line of sight and the horizontal distance, the cosine ratio can be used to determine the value of θ.

Chapter 3 Review, pages 136 to 137

1. BC = 4; AC ≈ 2.6; XZ ≈ 7.9
2. a) $x \approx 17.3$ b) $\theta \approx 54.0°$ c) $y \approx 2.3$
3. 52°
4. a) $x \approx 9.8$ b) $x \approx 11.0$ c) $\theta \approx 56.4°$
5. 41.0°
6. 12.6 ft
7. a)



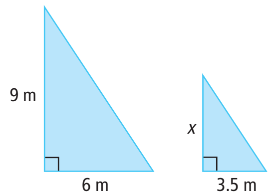
b) ∠C = 52°; AB ≈ 9.5 km; AC ≈ 12.0 km
8. approximately 208.4 m
9. The swimmer is moving away from the lifeguard, because as the angle of depression decreases, the distance from the base of the position of sighting increases.



The swimmer has travelled approximately 16.2 ft.

Chapter 3 Practice Test, pages 138 to 139

1. C
2. B
3. A
4. D
5. 5.3 m



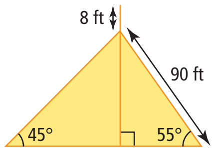
6. a) 0.3057 b) 0.9272 c) 0.9205
7. a) 15° b) 80° c) 42°
8. The second ratio should be cos 18° not sin 18°. The cosine ratio is used in conjunction with the angle's adjacent side and hypotenuse.
9. a) 9.5°
b) No. The puck will be approximately 51 in. high when it reaches the net, which is only 48 in. high.

Unit 1 Review, pages 140 to 143

1. Example: millimetre: thickness of one sheet of Bristo board; centimetre: width of small finger; metre: length of a large step; inch: width of adult male thumb at base of nail; foot: distance from elbow to wrist; yard: length of a large step
2. a) 2.5 cm, because two fingers would total 1 in., which is equal to approximately 2.54 cm.
b) 38.1 cm, because 5 hand widths total 15 in., and (15)(2.54) = 38.1.
c) 6.4 m, because 14 steps total 7 yd, which is equal to 252 in. There are approximately 39.37 in. in 1 m. 252 ÷ 39.37 = 6.4
3. a) 350 cm b) 42 in.
c) 8.723 km d) 1.2954 m
e) approximately 26.4 in.
f) approximately 8.7 mi
4. 19 ft 2 in.
5. 5 ft $1\frac{1}{2}$ in.
6. a) 4.5 m^2 b) 49 561 600 yd^2
7. a) 1728 cm^2 b) 1200 cm^2
8. a) 5 cm
b) approximately 5.89 cm^3
9. approximately 11 879 $in.^3$
10. a) $x \approx 17.7$ cm; $\theta \approx 43°$
b) $x \approx 26.1$ cm; $\theta \approx 32°$

11. 29.7 m

12. a)



b) 82 ft

c) The wire with the unknown length is likely longer than the other wire, because the angle of depression for that wire is less than the angle of depression for the wire that is 90 ft long. The length of the wire is 104.5 ft.

d) 125.5 ft

13. approximately 21.7 m

14. 897.8 m

Unit 1 Test, pages 144 to 145

1. A

2. B

3. C

4. B

5. 8

6. 44

7. 8.0

8. a) 15 cm **b)** 720 cm^3

c) The box must have sides that are at least 12 cm by 12 cm by 15 cm in order for the purse to fit, so the volume needs to be at least 2160 cm^3. The larger size box (2200 cm^3) would fit the purse, providing that the sides are 12 cm by 12 cm by 15 cm.

9. a) Example: $\sin 40° = \dfrac{5}{\text{length of AC}}$

b) 7.8 cm **c)** 4 cm

10. a) approximately 14.0°

b) The angle of depression will decrease because he will not be looking downward as steeply toward the net.