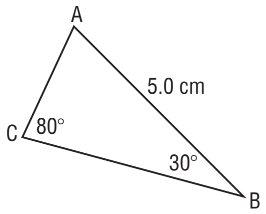
Lesson 6.4 Exercises, pages 478–489

A

3. a) For each triangle, write the Sine Law equation you would use to determine the length of AC.

i)



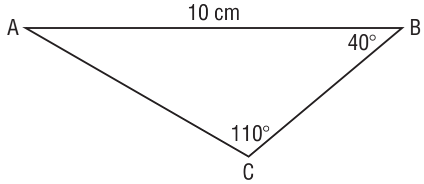
Use: $\frac{b}{\sin B} = \frac{c}{\sin C}$

Substitute:

$\angle B = 30°, \angle C = 80°, c = 5$

$\frac{b}{\sin 30°} = \frac{5}{\sin 80°}$

ii)



Use: $\frac{b}{\sin B} = \frac{c}{\sin C}$

Substitute:

$\angle B = 40°, \angle C = 110°, c = 10$

$\frac{b}{\sin 40°} = \frac{10}{\sin 110°}$

b) For each triangle in part a, determine the length of AC to the nearest tenth of a centimetre.

i) $b = \frac{5 \sin 30^\circ}{\sin 80^\circ}$

$b = 2.5385\ldots$

AC is approximately 2.5 cm.

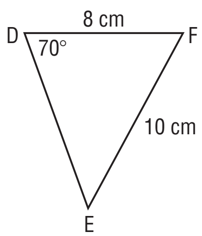
ii) $b = \frac{10 \sin 40^\circ}{\sin 110^\circ}$

$b = 6.8404\ldots$

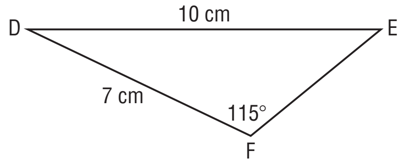
AC is approximately 6.8 cm.

4. a) For each triangle, write the Sine Law equation you would use to determine the measure of ∠E.

i)



ii)



i) Use: $\frac{\sin E}{e} = \frac{\sin D}{d}$

Substitute:

$\angle D = 70^\circ$, $e = 8$, $d = 10$

$\frac{\sin E}{8} = \frac{\sin 70^\circ}{10}$

ii) Use: $\frac{\sin E}{e} = \frac{\sin F}{f}$

Substitute:

$\angle F = 115^\circ$, $e = 7$, $f = 10$

$\frac{\sin E}{7} = \frac{\sin 115^\circ}{10}$

b) For each triangle in part a, determine the measure of ∠E to the nearest degree.

i) $\sin E = \frac{8 \sin 70^\circ}{10}$

Since ∠E is acute:

$\angle E = \sin^{-1}\left(\frac{8 \sin 70^\circ}{10}\right)$

$\angle E = 48.7425\ldots^\circ$

$\angle E \doteq 49^\circ$

ii) $\sin E = \frac{7 \sin 115^\circ}{10}$

Since ∠E is acute:

$\angle E = \sin^{-1}\left(\frac{7 \sin 115^\circ}{10}\right)$

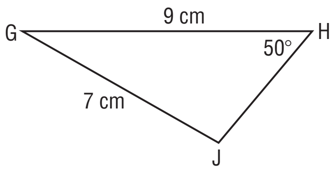
$\angle E = 39.3766\ldots^\circ$

$\angle E \doteq 39^\circ$

B

5. For each triangle, determine the measure of ∠J to the nearest degree.

a)



Use: $\frac{\sin J}{j} = \frac{\sin H}{h}$

Substitute:

$\angle H = 50°, j = 9, h = 7$

$\frac{\sin J}{9} = \frac{\sin 50°}{7}$

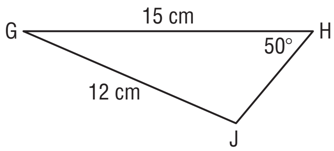
$\sin J = \frac{9 \sin 50°}{7}$

$\sin^{-1}\left(\frac{9 \sin 50°}{7}\right) \doteq 80°$

Since ∠J is obtuse:

$\angle J \doteq 180° - 80°$, or 100°

b)



Use: $\frac{\sin J}{j} = \frac{\sin H}{h}$

Substitute:

$\angle H = 50°, j = 15, h = 12$

$\frac{\sin J}{15} = \frac{\sin 50°}{12}$

$\sin J = \frac{15 \sin 50°}{12}$

$\sin^{-1}\left(\frac{15 \sin 50°}{12}\right) \doteq 73°$

Since ∠J is obtuse:

$\angle J \doteq 180° - 73°$, or 107°

6. Given the following information about each possible ΔABC, determine how many triangles can be constructed.

a) $c = 10$ cm, $a = 12$ cm, $\angle A = 20°$

The ratio of the side opposite the angle to the side adjacent to the angle is: $\frac{a}{c} = \frac{12}{10}$, which is 1.2

Since $\frac{a}{c} > 1$, only 1 triangle can be constructed

b) $c = 18$ cm, $a = 12$ cm, $\angle A = 20°$

The ratio of the side opposite the angle to the side adjacent to the angle is: $\frac{a}{c} = \frac{12}{18}$, which is $0.\bar{6}$

$\sin 20° = 0.3420\ldots$

Since $\sin 20° < 0.\bar{6} < 1$, two triangles can be constructed

c) $c = 18$ cm, $a = 12$ cm, $\angle A = 50°$

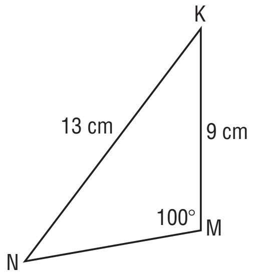
The ratio of the side opposite the angle to the side adjacent to the angle is: $\frac{a}{c} = \frac{12}{18}$, which is $0.\bar{6}$

$\sin 50° = 0.7660\ldots$

Since $\frac{a}{c} < \sin 50°$, no triangle can be constructed

7. a) For each triangle, determine the length of MN to the nearest tenth of a centimetre.

i)



Determine $\angle$N.

Use: $\dfrac{\sin N}{n} = \dfrac{\sin M}{m}$

Substitute: $\angle M = 100°$, $n = 9$, $m = 13$

$\dfrac{\sin N}{9} = \dfrac{\sin 100°}{13}$

$\sin N = \dfrac{9 \sin 100°}{13}$

Since $\angle$N is acute:

$\angle N = \sin^{-1}\left(\dfrac{9 \sin 100°}{13}\right)$

$\angle N = 42.9836...°$

So, $\angle$K

$= 180° - (100° + 42.9836...°)$

$= 37.0163...°$

Use: $\dfrac{k}{\sin K} = \dfrac{m}{\sin M}$

Substitute: $\angle K = 37.0163...°$

$\angle M = 100°$, $m = 13$

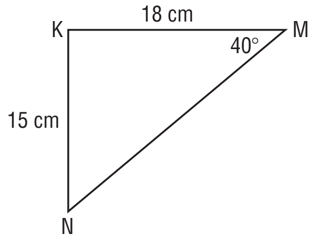
$\dfrac{k}{\sin 37.0163...°} = \dfrac{13}{\sin 100°}$

$k = \dfrac{13 \sin 37.0163...°}{\sin 100°}$

$k = 7.9472...$

MN is approximately 7.9 cm.

ii)



Determine $\angle$N.

Use: $\dfrac{\sin N}{n} = \dfrac{\sin M}{m}$

Substitute: $\angle M = 40°$, $n = 18$, $m = 15$

$\dfrac{\sin N}{18} = \dfrac{\sin 40°}{15}$

$\sin N = \dfrac{18 \sin 40°}{15}$

Since $\angle$N is acute:

$\angle N = \sin^{-1}\left(\dfrac{18 \sin 40°}{15}\right)$

$\angle N \doteq 50.4748...°$

So, $\angle$K

$= 180° - (40° + 50.4748...°)$

$= 89.5251...°$

Use: $\dfrac{k}{\sin K} = \dfrac{m}{\sin M}$

Substitute: $\angle K = 82.5251...°$

$\angle M = 40°$, $m = 15$

$\dfrac{k}{\sin 89.5251...°} = \dfrac{15}{\sin 40°}$

$k = \dfrac{15 \sin 89.5251...°}{\sin 40°}$

$k = 23.3350...$

MN is approximately 23.3 cm.

b) Suppose you had been given the measures for the triangles in part a and not the diagrams. In which triangle would there have been an ambiguous case? Justify your choice.

i) Angle M is obtuse, so there is only 1 triangle

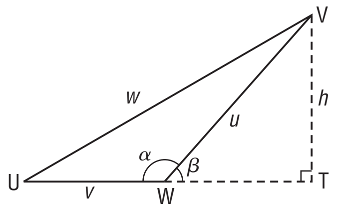
ii) The ratio of the side opposite the angle to the side adjacent to the angle is:

$\dfrac{NK}{KM} = \dfrac{15}{18}$, which is $0.8\overline{3}$

$\sin 40° = 0.6427...$

since $\sin 40° < 0.8\overline{3} < 1$, then there is an ambiguous case

8. Here is a part of a proof of the Sine Law for ΔUVW with obtuse $\angle$W. Explain each step.



In ΔVUT,

$\sin U = \frac{h}{w}$ Using the sine ratio in a right triangle

$h = w \sin U$ Solving for h

In ΔVWT,

$\sin \beta = \frac{h}{u}$ Using the sine ratio in a right triangle

$\beta = 180° - \alpha$ Supplementary angles on a line

$\sin \beta = \sin(180° - \alpha)$ The sine of an angle is equal to

$= \sin \alpha$, or $\sin W$ the sine of its supplement.

So, $\sin W = \frac{h}{u}$ sin UWV = sin VWT

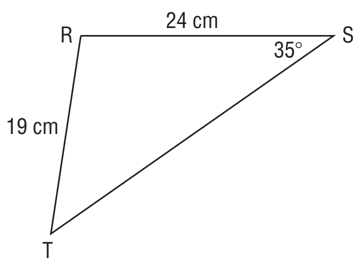
$h = u \sin W$ Solving for h

$u \sin W = w \sin U$ Equating expressions for h

$\frac{u}{\sin U} = \frac{w}{\sin W}$ Dividing each side by sin W sin U

9. Solve each triangle. Give the angle measures to the nearest degree and side lengths to the nearest tenth of a centimetre.

a)



Determine $\angle$T.

Use: $\frac{\sin T}{t} = \frac{\sin S}{s}$

Substitute: $\angle S = 35°$,

$t = 24$, $s = 19$

$\frac{\sin T}{24} = \frac{\sin 35°}{19}$

$\sin T = \frac{24 \sin 35°}{19}$

Since $\angle$T is acute:

$\angle T = \sin^{-1}\left(\frac{24 \sin 35°}{19}\right)$

$\angle T = 46.4287...°$

So, $\angle R = 180° - (35° + 46.4287...°)$

$= 98.5712...°$

Use: $\frac{r}{\sin R} = \frac{s}{\sin S}$

Substitute: $\angle R = 98.5712...°$

$\angle S = 35°$, $s = 19$

$\frac{r}{\sin 98.5712...°} = \frac{19}{\sin 35°}$

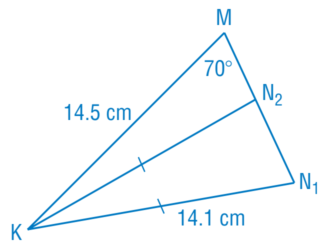
$r = \frac{19 \sin 98.5712...°}{\sin 35°}$

$r = 32.7555...$

$\angle T \doteq 46°$, $\angle R \doteq 99°$,

ST $\doteq$ 32.8 cm

b) In ΔKMN, $\angle M = 70°$, KN = 14.1 cm, and MK = 14.5 cm



This diagram is not drawn to scale.

Check how many triangles can be drawn.
The ratio of the side opposite $\angle M$ to the side adjacent to $\angle M$ is:
$\frac{KN}{KM} = \frac{14.1}{14.5}$, which is 0.9724. . .
$\sin 70° = 0.9396...$
Since $\sin 70° < 0.9724... < 1$,
two triangles can be constructed:
ΔMKN_1 is acute; ΔMKN_2 is obtuse.

In ΔMKN_1
Determine $\angle N_1$.
Use: $\frac{\sin N_1}{n} = \frac{\sin M}{m}$
Substitute: $\angle M = 70°$, $n = 14.5$, $m = 14.1$

$$\frac{\sin N_1}{14.5} = \frac{\sin 70°}{14.1}$$

$$\sin N_1 = \frac{14.5 \sin 70°}{14.1}$$

$$\angle N_1 = \sin^{-1}\left(\frac{14.5 \sin 70°}{14.1}\right)$$

$$\angle N_1 = 75.0943...°$$

So, $\angle K$
$= 180° - (70° + 75.0943...°)$
$= 34.9056...°$

Use: $\frac{k}{\sin K} = \frac{m}{\sin M}$
Substitute: $\angle K = 34.9056...°$
$\angle M = 70°$, $m = 14.1$

$$\frac{k}{\sin 34.9056...°} = \frac{14.1}{\sin 70°}$$

$$k = \frac{14.1 \sin 34.9056...°}{\sin 70°}$$

$k = 8.5862...$
$\angle N_1 \doteq 75°$, $\angle K \doteq 35°$,
$MN_1 \doteq 8.6$ cm

In ΔMKN_2
$\angle N_2 = 180° - 75.0943...°$
$= 104.9056...°$

So, $\angle K$
$= 180° - (70° + 104.9056...°)$
$= 5.0943...°$

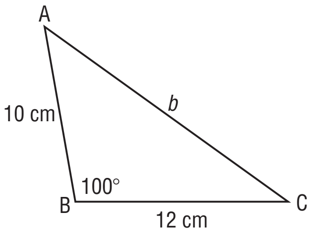
Use: $\frac{k}{\sin K} = \frac{m}{\sin M}$
Substitute: $\angle K = 5.0943...°$
$\angle M = 70°$, $m = 14.1$

$$\frac{k}{\sin 5.0943...°} = \frac{14.1}{\sin 70°}$$

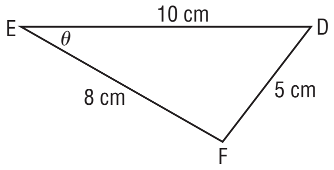
$$k = \frac{14.1 \sin 5.0943...°}{\sin 70°}$$

$k = 1.3323...$
$\angle N_2 \doteq 105°$, $\angle K \doteq 5°$,
$MN_2 \doteq 1.3$ cm

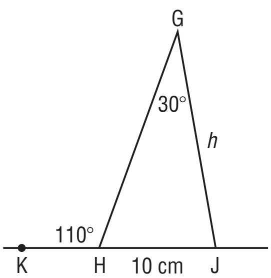
10. For each triangle below, can you use the Sine Law to determine the indicated measure?
If your answer is yes, determine the measure to the nearest tenth of a unit. If your answer is no, explain why.

a) 

No, because only one angle is given and it is a contained angle.

b) 

No, because no angles are given.

c) 

Yes; in $\triangle$GHJ,

$\angle H = 180° - 110°$

$= 70°$

Use: $\dfrac{h}{\sin H} = \dfrac{g}{\sin G}$

Substitute: $\angle H = 70°$,

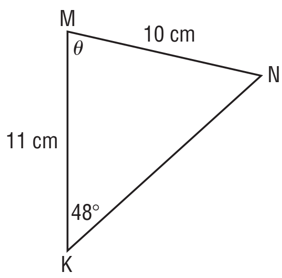
$\angle G = 30°$, $g = 10$

$\dfrac{h}{\sin 70°} = \dfrac{10}{\sin 30°}$

$h = \dfrac{10 \sin 70°}{\sin 30°}$

$h = 18.7938...$

$h \doteq 18.8$ cm

d) 

Yes

Use: $\dfrac{\sin N}{n} = \dfrac{\sin K}{k}$

Substitute: $\angle K = 48°$,

$n = 11$, $k = 10$

$\dfrac{\sin N}{11} = \dfrac{\sin 48°}{10}$

$\sin N = \dfrac{11 \sin 48°}{10}$

Since $\angle N$ is acute:

$\angle N = \sin^{-1}\left(\dfrac{11 \sin 48°}{10}\right)$

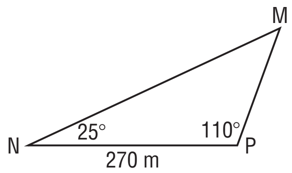
$\angle N = 54.8312...°$

$\theta = 180° - (48° + 54.8312...°)$

$= 77.1687...°$

$\theta \doteq 77.2°$

11. A surveyor constructed this drawing of a triangular lot.



a) Determine the unknown side lengths.

$\angle M = 180° - (25° + 110°)$
$= 45°$

Use: $\dfrac{p}{\sin P} = \dfrac{m}{\sin M}$

Substitute: $\angle P = 110°$, $\angle M = 45°$, $m = 270$

$\dfrac{p}{\sin 110°} = \dfrac{270}{\sin 45°}$

$p = \dfrac{270 \sin 110°}{\sin 45°}$

$p = 358.8100\ldots$

MN is approximately 359 m.

Use: $\dfrac{n}{\sin N} = \dfrac{m}{\sin M}$

Substitute: $\angle N = 25°$, $\angle M = 45°$, $m = 270$

$\dfrac{n}{\sin 25°} = \dfrac{270}{\sin 45°}$

$n = \dfrac{270 \sin 25°}{\sin 45°}$

$n = 161.3715\ldots$

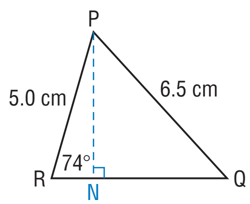
PM is approximately 161 m.

b) Determine the total length of fencing needed to enclose the lot.

Give the answers to the nearest metre.

The total length of fencing is:
359 m + 161 m + 270 m = 790 m

12. a) Solve ΔPQR by drawing a perpendicular from P to QR, then use primary trigonometric ratios in each right triangle formed.
Give the angle measures to the nearest degree and the side lengths to the nearest tenth of a centimetre.



In ΔPRN,

$\cos 74° = \dfrac{RN}{5}$

$RN = 5 \cos 74°$

$RN = 1.3781\ldots$

$\sin 74° = \dfrac{PN}{5}$

$PN = 5 \sin 74°$

$PN = 4.8063\ldots$

In ΔPQN,

$\sin Q = \dfrac{4.8063\ldots}{6.5}$

$\angle Q = 47.6830\ldots°$

$\angle Q \doteq 48°$

$\cos Q = \dfrac{QN}{6.5}$

$QN = 6.5 \cos 47.6830\ldots°$

$QN = 4.3760\ldots$

In ΔPQR,

$\angle P \doteq 180° - (48° + 74°)$
$\doteq 58°$

$RQ = (1.3781\ldots + 4.3760\ldots)$ cm
$RQ \doteq 5.8$ cm

b) Use the Sine Law to solve ΔPQR.

In ΔPQR, use: $\frac{\sin Q}{q} = \frac{\sin R}{r}$

$\frac{\sin Q}{5} = \frac{\sin 74°}{6.5}$

$\sin Q = \frac{5 \sin 74°}{6.5}$

Since ∠Q is acute:

$\angle Q = \sin^{-1}\left(\frac{5 \sin 74°}{6.5}\right)$

$\angle Q = 47.6830...°$

$\angle P = 180° - (47.6830...° + 74°)$

$\angle P = 58.3169...°$

Use: $\frac{p}{\sin P} = \frac{r}{\sin R}$

$\frac{p}{\sin 58.3169...°} = \frac{6.5}{\sin 74°}$

$p = \frac{6.5 \sin 58.3169...°}{\sin 74°}$

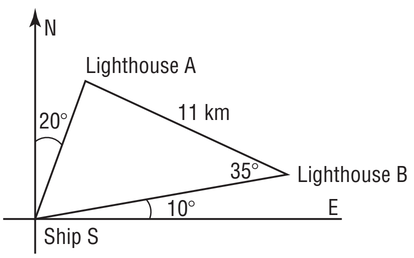
$p = 5.7541...$

$\angle Q \doteq 48°$, $\angle P \doteq 58°$, RQ $\doteq$ 5.8 cm

c) Which strategy for solving ΔPQR was more efficient? Justify your answer.

The Sine Law needed 3 calculations, while the primary trigonometric ratios needed 6 calculations; so the Sine Law is more efficient.

13. A sailor made this sketch on her navigation chart. How much closer is the ship at S to lighthouse A than to lighthouse B?



In ΔSAB,

$\angle ASB = 90° - (10° + 20°)$
$= 60°$

So, $\angle SAB = 180° - (60° + 35°)$
$= 85°$

Use: $\frac{b}{\sin B} = \frac{s}{\sin S}$

Substitute: ∠B = 35°, ∠S = 60°, $s = 11$

$\frac{b}{\sin 35°} = \frac{11}{\sin 60°}$

$b = \frac{11 \sin 35°}{\sin 60°}$

$b = 7.2853...$

Use: $\frac{a}{\sin A} = \frac{11}{\sin 60°}$

Substitute: ∠A = 85°

$\frac{a}{\sin 85°} = \frac{11}{\sin 60°}$

$a = \frac{11 \sin 85°}{\sin 60°}$

$a = 12.6533...$

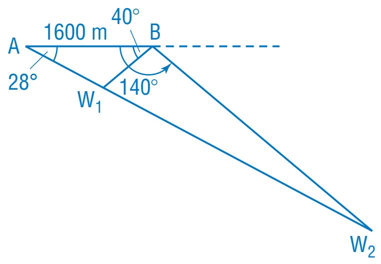
The required distance is: 12.6533... − 7.2853... = 5.3679...

The ship is approximately 5 km closer to lighthouse A.

14. Two ships are 1600 m apart. Each ship detects a wreck on the ocean floor. The wreck is vertically below the line through the ships. From the ships, the angles of depression to the wreck are 40° and 28°.

a) To the nearest metre, how far is the wreck from each ship?

The wreck could be between the ships or on one side of both ships. Sketch a diagram to show both positions.



Case 1 – ΔABW_1

$\angle W_1 = 180° - (28° + 40°)$
$= 112°$

Use: $\dfrac{a}{\sin A} = \dfrac{w}{\sin W_1}$

Substitute: $\angle A = 28°$, $\angle W_1 = 112°$, $w = 1600$

$\dfrac{a}{\sin 28°} = \dfrac{1600}{\sin 112°}$

$a = \dfrac{1600 \sin 28°}{\sin 112°}$

$a = 810.1462...$

Use: $\dfrac{b}{\sin B} = \dfrac{1600}{\sin 112°}$

Substitute: $\angle B = 40°$

$b = \dfrac{1600 \sin 40°}{\sin 112°}$

$b = 1109.2300...$

The wreck is approximately 810 m and 1109 m from the ships.

Case 2 – ΔABW_2

$\angle W_2 = 180° - (28° + 140°)$
$= 12°$

Use: $\dfrac{a}{\sin A} = \dfrac{w}{\sin W_2}$

Substitute: $\angle A = 28°$, $\angle W_2 = 12°$, $w = 1600$

$\dfrac{a}{\sin 28°} = \dfrac{1600}{\sin 12°}$

$a = \dfrac{1600 \sin 28°}{\sin 12°}$

$a = 3612.8535...$

Use: $\dfrac{b}{\sin B} = \dfrac{1600}{\sin 12°}$

Substitute: $\angle B = 140°$

$b = \dfrac{1600 \sin 140°}{\sin 12°}$

$b = 4946.6202...$

The wreck is approximately 3613 m and 4947 m from the ships.

b) To the nearest metre, what is the depth of the wreck?

In ΔABW_1, draw the perpendicular from W_1 to AB at N. Then, W_1N is the depth of the wreck.

In right ΔANW_1:

$\sin 28° = \dfrac{W_1N}{AW_1}$

$W_1N = 1109.2300... (\sin 28°)$

$W_1N = 520.7519...$

In ΔABW_2, draw the perpendicular from W_2 to AB extended to M. Then, W_2M is the depth of the wreck.

In right ΔAMW_2:

$\sin 28° = \dfrac{W_2M}{AW_2}$

$W_2M = 4946.6202... (\sin 28°)$

$W_2M = 2322.2975...$

The wreck is approximately 521 m deep or 2322 m deep.

15. Two people use transits to sight the top of a pole that is on the line through the bases of the transits. The distances to the top of the pole are: 19.8 m at an angle of elevation of 38.0°; and 14.4 m at an angle of elevation of 57.8°. To the nearest tenth of a metre, determine the distance between the people.

Sketch a diagram. There are 2 solutions.

In ΔABC_1,

$\angle A = 180° - (38.0° + 57.8°)$
$= 84.2°$

Use: $\frac{a}{\sin A} = \frac{c}{\sin C_1}$

Substitute: $\angle A = 84.2°$, $\angle C_1 = 57.8°$, $c = 19.8$

$$\frac{a}{\sin 84.2°} = \frac{19.8}{\sin 57.8°}$$

$$a = \frac{19.8 \sin 84.2°}{\sin 57.8°}$$

$$a = 23.2791\ldots$$

In ΔABC_2,

$\angle C_2 = 180° - 57.8°$
$= 122.2°$

So, $\angle A = 180° - (38.0° + 122.2°)$
$= 19.8°$

Use: $\frac{a}{\sin A} = \frac{c}{\sin C_2}$

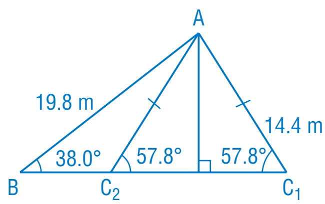
Substitute: $\angle A = 19.8°$, $\angle C_2 = 122.2°$, $c = 19.8$

$$\frac{a}{\sin 19.8°} = \frac{19.8}{\sin 122.2°}$$

$$a = \frac{19.8 \sin 19.8°}{\sin 122.2°}$$

$$a = 7.9260\ldots$$

The people are approximately 23.3 m or 7.9 m apart.



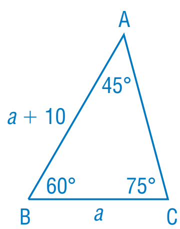
C

16. Two angles in a triangle measure 60° and 45°. The longest side is 10 cm longer than the shortest side. Determine the perimeter of the triangle to the nearest tenth of a centimetre.

Sketch a diagram.

The third angle in the triangle is:
$180° - (45° + 60°) = 75°$

The shortest side is opposite the least angle, so let BC = a.
The longest side is opposite the greatest angle, so AB = $a + 10$.



Use: $\frac{a}{\sin A} = \frac{c}{\sin C}$

Substitute: $\angle A = 45°$, $\angle C = 75°$, $c = a + 10$

$$\frac{a}{\sin 45°} = \frac{a + 10}{\sin 75°}$$

$$a \sin 75° = a \sin 45° + 10 \sin 45°$$

$$a(\sin 75° - \sin 45°) = 10 \sin 45°$$

$$a = \frac{10 \sin 45°}{\sin 75° - \sin 45°}$$

$$a = 27.3205\ldots$$

Use: $\frac{b}{\sin B} = \frac{a}{\sin A}$

Substitute: $\angle B = 60°$, $\angle A = 45°$, $a = 27.3205\ldots$

$$\frac{b}{\sin 60°} = \frac{27.3205\ldots}{\sin 45°}$$

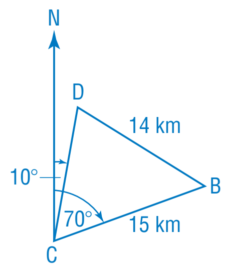
$$b = \frac{27.3205\ldots \sin 60°}{\sin 45°}$$

$$b = 33.4606\ldots$$

The perimeter is:

$(27.3205\ldots + 27.3205\ldots + 10 + 33.4606\ldots)$ cm $\doteq$ 98.1 cm

17. A hiker plans a trip in two sections. Her destination is 15 km away on a bearing of N70°E from her starting position. The first leg of the trip is on a bearing of N10°E. The second leg of the trip is 14 km. How long is the first leg? Give the answer to the nearest tenth of a kilometre.



Sketch a diagram.

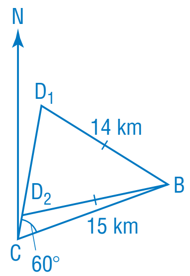
$\angle DCB = 70° - 10°$
$= 60°$

Check how many triangles can be drawn.
The ratio of the side opposite $\angle C$ to the side adjacent to $\angle C$ is:

$\frac{BD}{BC} = \frac{14}{15}$, which is $0.9\overline{3}$

$\sin 60° = 0.8660...$

Since $\sin 60° < 0.9\overline{3} < 1$, two triangles can be constructed:
ΔD_1CB is acute; ΔD_2CB is obtuse



In ΔD_1CB
Determine $\angle D_1$.

Use: $\frac{\sin D_1}{d} = \frac{\sin C}{c}$

Substitute: $\angle C = 60°$, $d = 15$, $c = 14$

$\frac{\sin D_1}{15} = \frac{\sin 60°}{14}$

$\sin D_1 = \frac{15 \sin 60°}{14}$

$\angle D_1 = 68.1073...°$

$\angle B = 180° - (60° + 68.1073...°)$
$= 51.8926...°$

To determine CD_1,
use: $\frac{b}{\sin B} = \frac{c}{\sin C}$

Substitute: $\angle B = 51.8926...°$, $\angle C = 60°$, $c = 14$

$\frac{b}{\sin 51.8926...°} = \frac{14}{\sin 60°}$

$b = \frac{14 \sin 51.8926...°}{\sin 60°}$

$b = 12.7201...$

In ΔD_2CB

$\angle D_2 = 180° - 68.1073...°$
$= 111.8926...°$

So, $\angle B = 180° - (60° + 111.8926...°)$
$= 8.1073...°$

To determine CD_2,
use: $\frac{b}{\sin B} = \frac{14}{\sin 60°}$

Substitute: $\angle B = 8.1073...°$, $\angle C = 60°$, $c = 14$

$\frac{b}{\sin 8.1073...°} = \frac{14}{\sin 60°}$

$b = \frac{14 \sin 8.1073...°}{\sin 60°}$

$b = 2.2798...$

The first leg is approximately 12.7 km or 2.3 km.