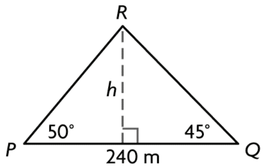
5.



Let h represent the height of the tower.

$$\angle R + \angle P + \angle Q = 180°$$
$$\angle R + 50° + 45° = 180°$$
$$\angle R = 85°$$

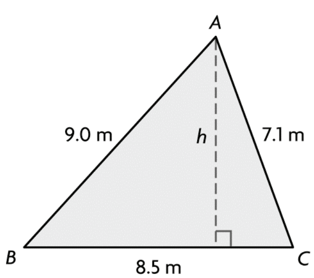
$$\frac{QR}{\sin P} = \frac{PQ}{\sin R}$$
$$\frac{QR}{\sin 50°} = \frac{240}{\sin 85°}$$
$$\sin 50°\left(\frac{QR}{\sin 50°}\right) = \sin 50°\left(\frac{240}{\sin 85°}\right)$$
$$QR = \sin 50°\left(\frac{240}{\sin 85°}\right)$$
$$QR = 184.552...$$

Determine the length of h:

$$\sin Q = \frac{h}{QR}$$
$$\sin 45° = \frac{h}{184.552...}$$
$$184.552\ldots(\sin 45°) = 184.552\ldots\left(\frac{h}{184.552...}\right)$$
$$130.498\ldots = h$$

The height of the tower is 130.5 m.

6.



$$c^2 = a^2 + b^2 - 2ab \cos C$$
$$9.0^2 = 8.5^2 + 7.1^2 - 2(8.5)(7.1) \cos C$$
$$81.0 = 72.25 + 50.41 - 120.7 \cos C$$
$$-41.66 = -120.7 \cos C$$
$$\frac{-41.66}{-120.7} = \cos C$$
$$0.345\ldots = \cos C$$
$$\angle C = \cos^{-1}(0.345\ldots)$$
$$\angle C = 69.808\ldots°$$

Determine the length of h:

$$\sin C = \frac{h}{AC}$$
$$\sin 69.808\ldots° = \frac{h}{7.1}$$
$$7.1(\sin 69.808\ldots°) = 7.1\left(\frac{h}{7.1}\right)$$
$$6.663\ldots = h$$

$$\text{Area} = \frac{1}{2}BC(h)$$
$$\text{Area} = \frac{1}{2}(8.5)(6.663\ldots)$$

Area = 28.320…

The area of the patio is 28.3 cm^2.

7. e.g., If the angle is the contained angle, then use the cosine law. If it is one of the other angles, use the sine law to determine the other non-contained angle, calculate the contained angle by subtracting the two angles you know from 180°, then use either the sine law or the cosine law.

8. e.g., When two angles and a side are given, the sine law must be used to determine side lengths. When two sides and the contained angle are given, the cosine law must be used to determine the third side.

Chapter Review, page 154

1. No. e.g., $\angle C = 90°$, so this will be a right triangle.

2. Part d) is incorrect. It should be the same as part a).

3. a) $\angle X + 67° + 58° = 180°$

$$\angle X = 55°$$
$$\frac{x}{\sin 55°} = \frac{24.5}{\sin 58°}$$
$$\sin 55°\left(\frac{x}{\sin 55°}\right) = \sin 55°\left(\frac{24.5}{\sin 58°}\right)$$
$$x = \sin 55°\left(\frac{24.5}{\sin 58°}\right)$$
$$x = 23.665...$$

The length of x is 23.7 m.

b)
$$\frac{\sin\theta}{35.4} = \frac{\sin 51°}{31.2}$$
$$35.4\left(\frac{\sin\theta}{35.4}\right) = 35.4\left(\frac{\sin 51°}{31.2}\right)$$
$$\sin\theta = 35.4\left(\frac{\sin 51°}{31.2}\right)$$
$$\sin\theta = 0.881...$$
$$\theta = \sin^{-1}(0.881...)$$
$$\theta = 61.855...°$$

The measure of θ is 61.9°.

4. $\angle C + \angle A + \angle B = 180°$

$\angle C + 75° + 50° = 180°$

$\angle C = 55°$

The measure of $\angle C$ is 55.0°.

The length of c is 8.0 cm.

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

$$\frac{a}{\sin 75°} = \frac{8.0}{\sin 55°}$$

$$\sin 75°\left(\frac{a}{\sin 75°}\right) = \sin 75°\left(\frac{8.0}{\sin 55°}\right)$$

$$a = \sin 75°\left(\frac{8.0}{\sin 55°}\right)$$

$$a = 9.433...$$

The length of a is 9.4 cm.

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

$$\frac{b}{\sin 50°} = \frac{8.0}{\sin 55°}$$

$$\sin 50°\left(\frac{b}{\sin 50°}\right) = \sin 50°\left(\frac{8.0}{\sin 55°}\right)$$

$$b = \sin 50°\left(\frac{8.0}{\sin 55°}\right)$$

$$b = 7.481...$$

The length of b is 7.5 cm.

5. Let $\angle C$ be the remaining unknown angle.

$\angle C + \angle A + \angle M = 180°$

$\angle C + 70° + 30° = 180°$

$\angle C = 80°$

$$\frac{c}{\sin C} = \frac{m}{\sin M}$$

$$\frac{c}{\sin 80°} = \frac{150}{\sin 30°}$$

$$\sin 80°\left(\frac{c}{\sin 80°}\right) = \sin 80°\left(\frac{150}{\sin 30°}\right)$$

$$c = \sin 80°\left(\frac{150}{\sin 30°}\right)$$

$$c = 295.442...$$

Alison and Marc are 295.4 m apart.

6. Part a) is not in the form of the cosine law. Cos B should be cos A.

7. a) $x^2 = 5.0^2 + 6.0^2 - 2(5.0)(6.0)\cos 87°$

$x^2 = 25.0 + 36.0 - 60(0.052\ldots)$

$x^2 = 57.859\ldots$

$x = 7.606\ldots$

The length of x is 7.6 m.

b) $14.0^2 = 7.0^2 + 15.0^2 - 2(7.0)(15.0)\cos\theta$

$196.0 = 49.0 + 225.0 - 210.0\cos\theta$

$-78.0 = -210.0\cos\theta$

$$\frac{-78.0}{-210.0} = \cos\theta$$

$0.3714\ldots = \cos\theta$

$\theta = \cos^{-1}(0.371\ldots)$

$\theta = 68.196\ldots°$

The measure of θ is 68.2°.

8. $a^2 = b^2 + c^2 - 2bc\cos A$

$a^2 = 10.0^2 + 14.0^2 - 2(10.0)(14.0)\cos 58°$

$a^2 = 100.0 + 196.0 - 280(0.5299\ldots)$

$a^2 = 147.622\ldots$

$a = 12.150\ldots$

The length of a is 12.2 cm.

$b^2 = a^2 + c^2 - 2bc\cos B$

$10.0^2 = 12.150\ldots^2 + 14.0^2 - 2(12.150\ldots)(14.0)\cos B$

$100.0 = 147.622\ldots + 196.0 - 340.200\ldots\cos B$

$-243.622\ldots = -340.200\ldots\cos B$

$$\frac{-243.622...}{-340.200...} = \cos B$$

$0.716\ldots = \cos B$

$\angle B = \cos^{-1}(0.716\ldots)$

$\angle B = 44.265\ldots°$

The measure of $\angle B$ is 44.3°.

$c^2 = a^2 + b^2 - 2ab\cos C$

$14.0^2 = 12.150\ldots^2 + 10.0^2 - 2(12.150\ldots)(10.0)\cos C$

$196.0 = 147.622\ldots + 100.0 - 243.000\ldots\cos C$

$-51.622\ldots = -243.000\ldots\cos C$

$$\frac{-51.622...}{-243.00...} = \cos C$$

$0.212\ldots = \cos C$

$\angle C = \cos^{-1}(0.212\ldots)$

$\angle C = 77.734\ldots°$

The measure of $\angle C$ is 77.7°.

9. After 2 h, the plane flying at 355 km/h has flown 710 km and the plane flying at 450 km/h has flown 900 km. In a triangle that models the information, the unknown angle θ, is opposite the 800 km side.

$800^2 = 710^2 + 900^2 - 2(710)(900)\cos\theta$

$640\,000 = 504\,100 + 810\,000 - 1\,278\,000\cos\theta$

$-674\,100 = -1\,278\,000\cos\theta$

$$\frac{-674\,100}{-1\,278\,000} = \cos\theta$$

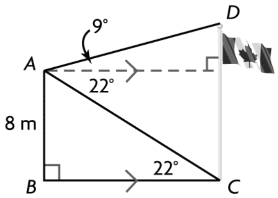
$0.5274\ldots = \cos\theta$

$\theta = \cos^{-1}(0.527\ldots)$

$\theta = 58.165\ldots°$

The angle between the two airplanes is 58°.

10.



In $\triangle ABC$,

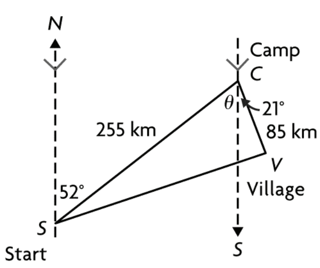
$$\sin C = \frac{AB}{AC}$$
$$\sin 22° = \frac{8}{AC}$$
$$AC(\sin 22°) = AC\left(\frac{8}{AC}\right)$$
$$AC = \frac{8}{\sin 22°}$$
$$AC = 21.355\ldots$$
$$\angle ACD + \angle ACB = 90°$$
$$\angle ACD + 22° = 90°$$
$$\angle ACD = 68°$$

In $\triangle ACD$,

$$\angle D + \angle CAD + \angle ACD = 180°$$
$$\angle D + 31° + 68° = 180°$$
$$\angle D = 81°$$
$$\frac{CD}{\sin CAD} = \frac{AC}{\sin D}$$
$$\frac{CD}{\sin 31°} = \frac{21.355...}{\sin 81°}$$
$$\sin 31°\left(\frac{CD}{\sin 31°}\right) = \sin 31°\left(\frac{21.355...}{\sin 81°}\right)$$
$$CD = \sin 31°\left(\frac{21.355...}{\sin 81°}\right)$$
$$CD = 11.136...$$

The height of the flagpole is 11.1 m.

11.

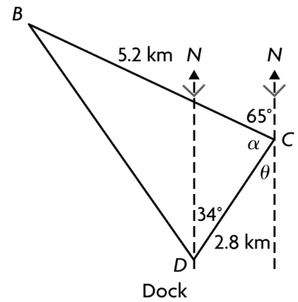


$\theta = 52°$ Alternate interior angles
$\angle C = \theta + 21°$ Property of equality
$\angle C = 52° + 21°$
$\angle C = 73°$

$$c^2 = s^2 + v^2 - 2sv \cos C$$
$$c^2 = 85^2 + 255^2 - 2(85)(255) \cos 73°$$
$$c^2 = 7225 + 65\,025 - 43\,350(0.2923\ldots)$$
$$c^2 = 59\,575.686\ldots$$
$$c = 244.0813\ldots$$

Total distance = $s + v + c$
Total distance = 85 + 255 + 244.0813…
Total distance = 584.081…
The total distance of the trip is 584 km.

12.



$\theta = 34°$ Alternate interior angles
$\alpha + \theta + 65° = 180°$ Supplementary angles
$\alpha + 34° + 65° = 180°$
$\alpha = 81°$

Determine the length of d:

$$c^2 = b^2 + d^2 - 2bd \cos C$$
$$c^2 = 2.8^2 + 5.2^2 - 2(2.8)(5.2) \cos 81°$$
$$c^2 = 7.84 + 27.04 - 29.12(0.1564\ldots)$$
$$c^2 = 30.324\ldots$$
$$c = 5.506\ldots$$

Determine the measure of $\angle D$:

$$d^2 = b^2 + c^2 - 2bc \cos D$$
$$5.2^2 = 2.8^2 + 5.506\ldots^2 - 2(2.8)(5.506\ldots) \cos D$$
$$27.04 = 7.84 + 30.324\ldots - 30.837\ldots \cos D$$
$$-11.124\ldots = -30.837\ldots \cos D$$
$$\frac{-11.124...}{-30.837...} = \cos D$$
$$0.360\ldots = \cos D$$
$$\angle D = \cos^{-1}(0.360\ldots)$$
$$\angle D = 68.854\ldots°$$

Angle of second canoeist = $\angle D - 34°$
Angle of second canoeist = 68.854…° – 34°
Angle of second canoeist = 34.854…°
The second canoeist must travel 5.5 km in the direction N34.9°W.

Chapter Task, page 155

A. Use nine poles to create a tipi that is 3.0 m high at the centre and 4.0 m in diameter when standing.
B. The top view of the tipi shows that the base of the tipi is a nonagon because each pole meets the ground at a vertex of the figure. Since there are nine poles, there are nine vertices and nine sides. The top view of the tipi contains congruent isosceles triangles because the poles are equal in length and form triangles with the ground as their base.
C. The angle at the centre of the nonagon is 360°. Since nine triangles meet at the centre of the nonagon, the measure of each angle at the centre of the nonagon is $\frac{360°}{9} = 40°$. Since the tipi is 4 m across, the side of each triangle is about 2 m.