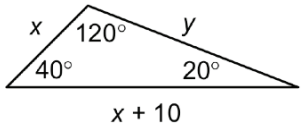
17. Here is the diagram:



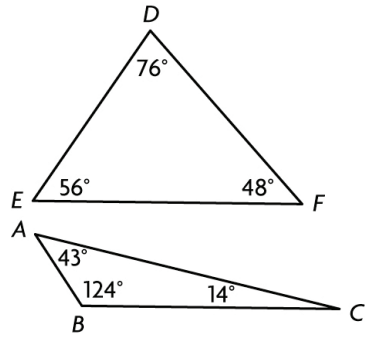
$$\frac{x}{\sin 20°} = \frac{x+10}{\sin 120°}$$
$$\sin 20°\left(\frac{x}{\sin 20°}\right) = \left(\frac{x+10}{\sin 120°}\right)\sin 20°$$
$$x = \left(\frac{x+10}{\sin 120°}\right)\sin 20°$$
$$(\sin 120°)x = \cancel{(\sin 120°)}\left(\frac{x+10}{\cancel{\sin 120°}}\right)(\sin 20°)$$
$$(\sin 120°)x = (x+10)(\sin 20°)$$
$$(\sin 120°)x = x(\sin 20°) + 10\sin 20°$$
$$(\sin 120° - \sin 20°)x = 10\sin 20°$$
$$x = \frac{10\sin 20°}{\sin 120° - \sin 20°}$$
$$x = 6.527\ldots \text{ cm}$$
$$\frac{y}{\sin 40°} = \frac{6.527\ldots}{\sin 20°}$$
$$\sin 40°\left(\frac{y}{\sin 40°}\right) = \left(\frac{6.527\ldots}{\sin 20°}\right)\sin 40°$$
$$y = 12.266\ldots$$

$P = x + (x + 10) + y$
$P = 6.527\ldots + 16.527\ldots + 12.266\ldots$
$P = 35.320\ldots$
The perimeter is 35 cm.

Mid-Chapter Review, page 175

1. a) sin 75° = 0.9659
180° – 75° = 105°
sin 105° = 0.9659
b) cos 100° = –0.1736
180° – 100° = 80°
cos 80° = 0.1736
c) tan 32° = 0.6249
180° – 32° = 148°
tan 148° = –0.6249
d) sin 172° = 0.1392
180° – 172° = 8°
sin 8° = 0.1392
e) cos 38.5° = 0.7826
180° – 38.5° = 141.5°
cos 141.5° = –0.7826
f) tan 122.3° = –1.5818
180° – 122.3° = 57.7°
tan 57.7° = 1.5818

2. e.g., sin 124° = sin 56°



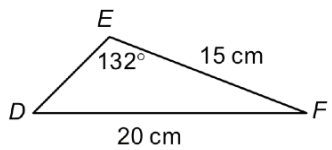
3. a) $\theta = \sin^{-1}(0.362)$
$\theta = 21°$
180° – 21° = 159°
b) $\theta = \cos^{-1}(-0.75)$
$\theta = 139°$
c) $\theta = \tan^{-1}\left(\frac{5}{2}\right)$
$\theta = 68°$
d) $\theta = \sin^{-1}\left(\frac{1}{2}\right)$
$\theta = 30°$
180° – 30° = 150°
e) $\theta = \cos^{-1}(-0.214)$
$\theta = 78°$
f) $\theta = \tan^{-1}(1)$
$\theta = 45°$

4. a)
$$\cos\theta = \frac{11.0^2 + 15.0^2 - 10.7^2}{2(11.0)(15.0)}$$
$$\cos\theta = 0.7015\ldots$$
$$\theta = \cos^{-1}(0.7015\ldots)$$
$$\theta = 45.4488\ldots°$$
To the nearest tenth of a degree, angle θ is 45.4°

b) 180° – 155° = 25°
25° ÷ 2 = 12.5°
$$\frac{y}{\sin 155°} = \frac{2.5}{\sin 12.5°}$$
$$\sin 155°\left(\frac{y}{\sin 155°}\right) = \left(\frac{2.5}{\sin 12.5°}\right)\sin 155°$$
$$y = 4.881\ldots \text{ km}$$
To the nearest tenth of a kilometre, y is 4.9 km.

c)
$$\frac{x}{\sin 55.0°} = \frac{2.0}{\sin 121.0°}$$
$$\sin 55.0°\left(\frac{x}{\sin 55.0°}\right) = \left(\frac{2.0}{\sin 121°}\right)\sin 55.0°$$
$$x = 1.911\ldots \text{ cm}$$
To the nearest tenth of a centimetre, x is 1.9 cm.

5. Here is the diagram:



$$\frac{\sin D}{15} = \frac{\sin 132°}{20}$$
$$15\left(\frac{\sin D}{15}\right) = \left(\frac{\sin 132°}{20}\right)15$$
$$\sin D = 0.5573...$$
$$\angle D = \sin^{-1}(0.5573...)$$
$$\angle D = 33.8692...°$$

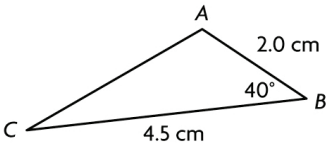
$\angle F$ = 180° – 132°– 33.8692…°
$\angle F$ = 14.1307…°
To the nearest degree, $\angle F$ is 14.1°.

6. a) i)
$$\frac{\sin\theta}{3.0} = \frac{\sin 46°}{2.7}$$
$$3.0\left(\frac{\sin\theta}{3.0}\right) = \left(\frac{\sin 46°}{2.7}\right)3.0$$
$$\sin\theta = 0.7992...$$
$$\theta = \sin^{-1}(0.7992...)$$
$$\theta = 53.0537...°$$

To the nearest tenth, θ is 53.1°, but the angle is obtuse.
θ = 180° – 53.0537°
θ = 126.9462…°
To the nearest tenth, θ is 126.9°.

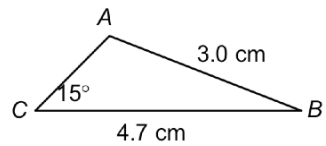
ii)
$$\cos\alpha = \frac{5.0^2 + 2.5^2 - 7.1^2}{2(5.0)(2.5)}$$
$$\cos\alpha = -0.7664\ldots$$
$$\alpha = \cos^{-1}(-0.7664\ldots)$$
$$\alpha = 140.0317\ldots°$$

To the nearest tenth, α is 140.0°.
b) e.g., The diagram is needed for part i), since the acute angle, 53.1°, and the obtuse angle, 126.9°, have the same sine ratio. The diagram shows the angle is obtuse.
7. e.g., **a)** I cannot use the sine law because the measured angle is not across from a measured side.



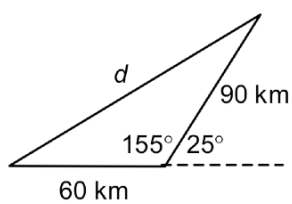
b) $b^2 = 2.0^2 + 4.5^2 - 2(2.0)(4.5)\cos(40°)$
$b = \sqrt{10.461...}$
b = 3.234… cm
$$\frac{\sin A}{4.5} = \frac{\sin 40°}{3.234...}$$
$$4.5\left(\frac{\sin A}{4.5}\right) = \left(\frac{\sin 40°}{3.234...}\right)4.5$$
$$\sin A = 0.8943...$$
$$\angle A = \sin^{-1}(0.8943...)°$$

$\sin^{-1}(0.8943\ldots)$ = 63°, but $\angle A$ is obtuse.
$\angle A$ = 180° – 63°
$\angle A$ = 117°
8. Here is the diagram:



$$\frac{\sin A}{4.7} = \frac{\sin 15°}{3.0}$$
$$4.7\left(\frac{\sin A}{4.7}\right) = \left(\frac{\sin 15°}{3.0}\right)4.7$$
$$\sin A = 0.4054...$$
$$\angle A = \sin^{-1}(0.4054...)$$
$$\angle A = 23.9161...°$$

To the nearest degree, $\angle A$ is 24°, but the angle is obtuse.
$\angle A$ = 180° – 23.9161…°
$\angle A$ = 156.0838…°
To the nearest degree, $\angle A$ is 156°.
9. 180° – 25° = 155°



$d^2 = 60^2 + 90^2 - 2(60)(90)\cos(155°)$
$d = \sqrt{21\,488.124...}$
d = 146.588… km
The boat is 147 km from its initial position.