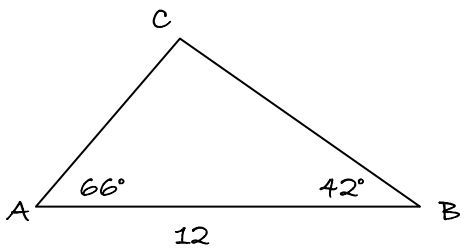
# Section 3: The sine and cosine rules

## Solutions to Exercise level 1

1.




Angle $C = 180° - 66° - 42° = 72°$

Using the sine rule: $\dfrac{a}{\sin A} = \dfrac{c}{\sin C}$

$$\frac{a}{\sin 66°} = \frac{12}{\sin 72°}$$

$$a = \frac{12 \sin 66°}{\sin 72°} = 11.53 \text{ cm}$$

Using the sine rule: $\dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

$$\frac{b}{\sin 42°} = \frac{12}{\sin 72°}$$

$$b = \frac{12 \sin 42°}{\sin 72°} = 8.44 \text{ cm}$$

2. Using the sine rule: $\dfrac{\sin A}{a} = \dfrac{\sin B}{b}$

$$\frac{\sin A}{16} = \frac{\sin 30°}{10}$$

$$\sin A = \frac{16 \sin 30°}{10} = 0.8$$

$$A = 53.1° \text{ or } 126.9°$$

$C = 180° - 30° - A = 96.1°$ or $23.1°$

Using the sine rule: $\dfrac{c}{\sin C} = \dfrac{b}{\sin B}$

$$\frac{c}{\sin C} = \frac{10}{\sin 30°}$$

$$c = \frac{10 \sin C}{\sin 30°} = 19.9 \text{ cm or } 7.9 \text{ cm}$$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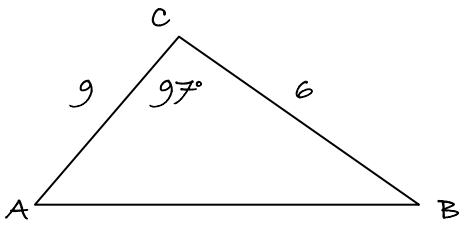
3.




Using the cosine rule: $c^2 = a^2 + b^2 - 2ab\cos C$

$= 9^2 + 6^2 - 2\times 9\times 6\cos 97°$

$c = 11.4$ cm

Using the sine rule: $\dfrac{\sin A}{a} = \dfrac{\sin C}{c}$

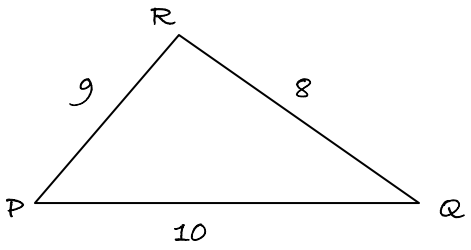
$\dfrac{\sin A}{6} = \dfrac{\sin 97}{11.4}$

$\sin A = \dfrac{6\sin 97}{11.4}$

$A = 31.5°$

$B = 180° - 97° - 31.5° = 51.5°$.

4.




Using the cosine rule: $\cos P = \dfrac{q^2 + r^2 - p^2}{2qr} = \dfrac{9^2 + 10^2 - 8^2}{2\times 9\times 10}$

$P = 49.5°$

Using the cosine rule: $\cos Q = \dfrac{p^2 + r^2 - q^2}{2pr} = \dfrac{8^2 + 10^2 - 9^2}{2\times 8\times 10}$

$Q = 58.8°$

$R = 180° - 49.46° - 58.75° = 71.8°$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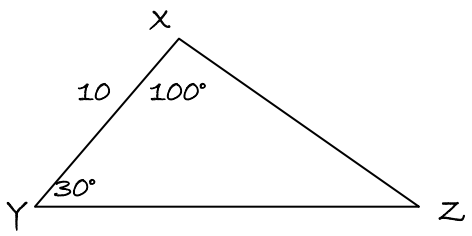
5.




Angle $Z = 180° - 100° - 30° = 50°$

Using the sine rule: $\dfrac{x}{\sin X} = \dfrac{z}{\sin Z}$

$$\frac{x}{\sin 100°} = \frac{10}{\sin 50°}$$

$$x = \frac{10 \sin 100°}{\sin 50°} = 12.86$$

Area of triangle $= \frac{1}{2} xz \sin Y$

$= \frac{1}{2} \times 12.86 \times 10 \sin 30°$

$= 32.1 \text{ cm}^2$

6. Let $a = 6$ and $b = 7$

Area of triangle $= \frac{1}{2} ab \sin C$

$12 = \frac{1}{2} \times 6 \times 7 \sin C$

$C = 34.85°$ or $145.15°$

Using the cosine rule: $c^2 = a^2 + b^2 - 2ab \cos C$

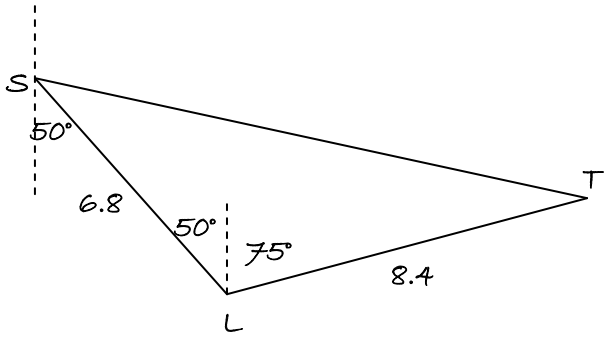
$= 6^2 + 7^2 - 2 \times 6 \times 7 \cos C$

$= 85 - 84 \cos C$

If $C = 34.85°$, $c = 4.01$ cm

If $C = 145.14°$, $c = 12.41$ cm

7.




Using cosine rule: $ST^2 = 6.8^2 + 8.4^2 - 2 \times 6.8 \times 8.4 \cos 125°$

$ST = 13.5$ km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Using sine rule: $\frac{\sin S}{8.4} = \frac{\sin 125^\circ}{13.5}$

$\sin S = \frac{8.4 \sin 125^\circ}{13.5}$

$S = 30.6^\circ$

Bearing of T from S $= 180^\circ - 50^\circ - 30.6^\circ = 099.4^\circ$

8. (i) $\frac{\sin 10}{8} = \frac{\sin \beta}{6}$

$\Rightarrow \sin \beta = 0.13$

$\Rightarrow \beta \approx 7.48^\circ$

$\Rightarrow \alpha = 180^\circ - 10^\circ - 7.48^\circ \approx 162.52^\circ$

$\Rightarrow a^2 = 6^2 + 8^2 - 2(6)(8)\cos 162.52^\circ \approx 191.57$

$\Rightarrow a \approx 13.8$

(ii) $b^2 = 6^2 + 7^2 - 2(6)(7)\cos 50^\circ \approx 31.009$

$\Rightarrow b \approx 5.57$

$\frac{\sin \beta}{7} = \frac{\sin 50^\circ}{5.57} \Rightarrow \sin \beta \approx 0.933$

$\Rightarrow \beta \approx 74.3^\circ$

(iii) $c^2 = 20^2 + 15^2 - 2(15)(20)\cos 20^\circ \approx 61.18$

$\Rightarrow c \approx 7.82$

$d^2 = 20^2 + 10^2 - 2(10)(20)\cos 20^\circ \approx 124.12$

$\Rightarrow d \approx 11.1$

$\frac{\sin \delta}{10} = \frac{\sin 20^\circ}{11.1} \Rightarrow \sin \delta \approx 0.308$

$\Rightarrow \delta \approx 17.9^\circ$

$\Rightarrow \varepsilon \approx 180^\circ - 20^\circ - 17.9^\circ = 142.1^\circ$

$\Rightarrow \eta \approx 180^\circ - 142.1^\circ = 38.9^\circ$

(iv) $\frac{\sin \theta}{5} = \frac{\sin 110^\circ}{10} \Rightarrow \sin \theta \approx 0.470$

$\Rightarrow \theta \approx 28.0^\circ$

$\Rightarrow \phi \approx 42.0^\circ$

$\frac{x}{\sin \phi} = \frac{5}{\sin \theta} \Rightarrow x \approx 7.13$



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