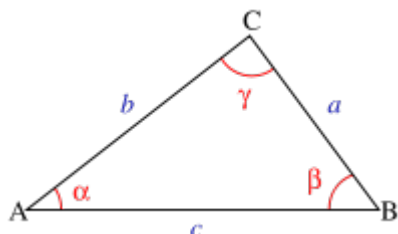


# TR1.3: THE COSINE RULE

If the triangle **does not contain a right angle** we may be able to use the Cosine Rule



Cosine Rule

$$\begin{aligned} a^2 &= b^2 + c^2 - 2bc \cos \alpha, \\ b^2 &= a^2 + c^2 - 2ac \cos \beta, \\ c^2 &= a^2 + b^2 - 2ab \cos \gamma, \end{aligned}$$

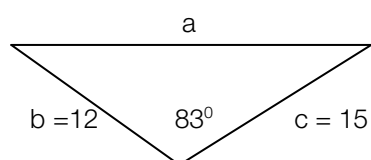
The angles  $\alpha$ ,  $\beta$  and  $\gamma$  are respectively opposite the sides  $a$ ,  $b$ , and  $c$ .

N.B. The side on the left hand side of the equation is opposite the angle listed at the end of the equation.

Use the Cosine Rule when:

- given two sides and the angle between them
- when given three sides

## Examples



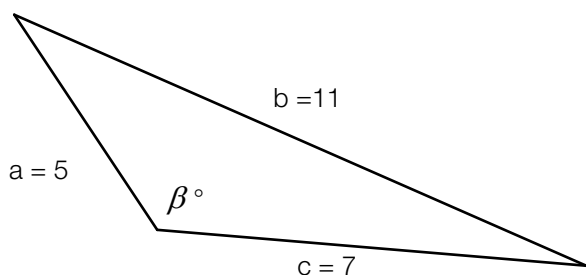
$$a^2 = 12^2 + 15^2 - 2 \times 12 \times 15 \times \cos 83^\circ$$

$$a^2 = 144 + 225 - 360 \times \cos 83^\circ$$

$$a^2 = 369 - 43.87$$

$$a^2 = 325.13$$

$$a = 18.03$$



$$11^2 = 5^2 + 7^2 - 2 \times 5 \times 7 \times \cos \beta^\circ$$

$$121 = 25 + 49 - 70 \cos \beta^\circ$$

$$-70 \cos \beta^\circ = -47$$

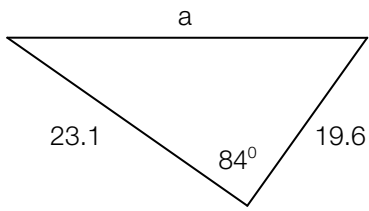
$$\cos \beta^\circ = \frac{47}{-70}$$

$$\beta^\circ = 132^\circ 11'$$

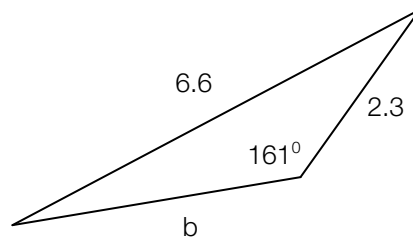
## Exercise

1. Find the pronumeral shown

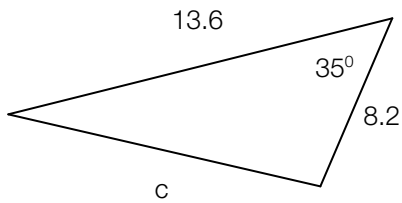
a)



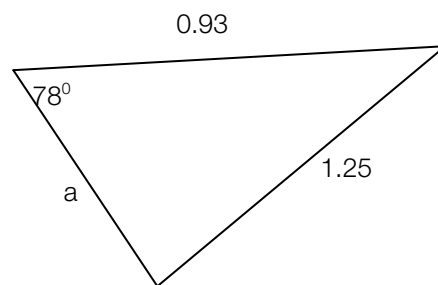
b)



c)

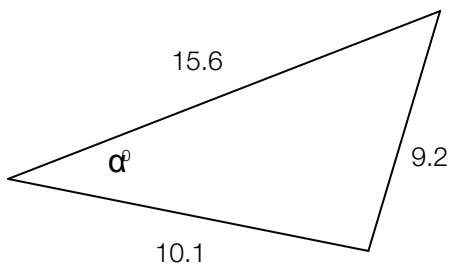


d)

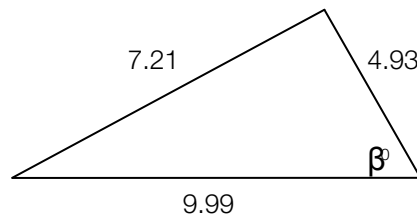


2. Find  $\theta$

a)



b)



3. Verify the Cosine Rule simplifies to Pythagoras' Theorem for Right Angle Triangles

## Answers

1 a) 28.7      b) 4.38      c) 8.33      d) 2.1

2 a)  $34^\circ 10'$       b)  $42^\circ 56'$