



STEM SMART Double Maths 3 - Trigonometry

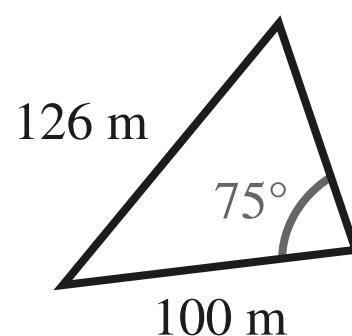
## Applications of Trigonometry 9

Essential GCSE Maths 50.9

Subject &amp; topics: Maths | Geometry | Trigonometry

Stage &amp; difficulty: GCSE C3, A Level P1

A landowner has a triangular piece of land. They are planning to build a path along the boundary of the land, and plant trees in the centre. Each tree will need  $50 \text{ m}^2$  of land when it is mature. The landowner knows that some trees will not survive to maturity. They plant 30% more trees than the maximum suggested by an area calculation.



**Figure 1:** A plan of the piece of land that trees are going to be planted on.

### Part A

#### How long is the path?

How long is the path? Give your answer to 3 sf.

### Part B

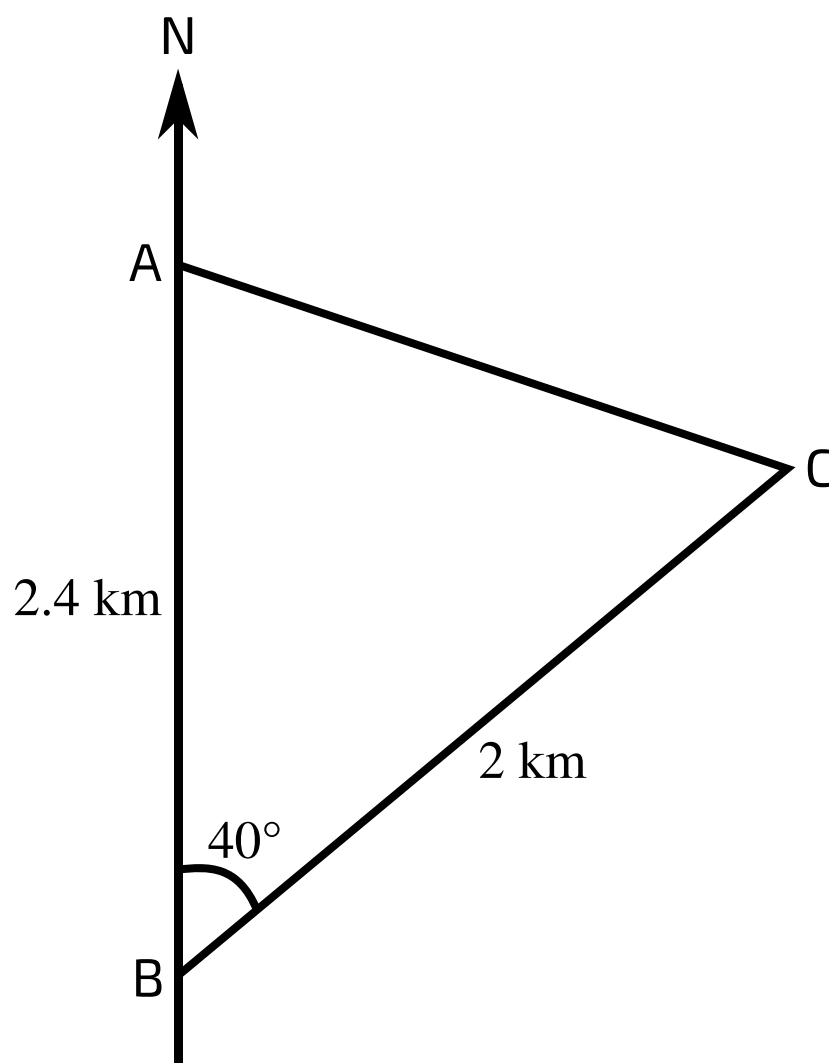
#### How many trees will be planted?

Assuming that the landowner plants as many trees as possible, how many trees will be planted? Round your answer to the nearest whole tree.



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## Sine and Cosine Rules and Area 1i

**Subject & topics:** Maths    **Stage & difficulty:** A Level P1

**Figure 1:** Positions of two points on a coastline, and a nearby ship.

**Figure 1** shows two points A and B on a straight coastline, with A being 2.4 km due north of B. A stationary ship is at a point C, on a bearing of  $040^\circ$  and at a distance of 2 km from B.

**Part A****Find AC**

Find the distance AC in kilometres, giving your answer correct to three significant figures.

Part B  
Find  $\theta$

The bearing of C from A is  $\theta^\circ$ . Find the value of  $\theta$  correct to three significant figures.

Part C  
Shortest distance

Find the shortest distance from the ship to the coastline, giving your answer in kilometres correct to three significant figures.

Used with permission from UCLES, A level, January 2012, Paper 4722, Question 4.

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## Trigonometry: Basic Functions 2i

**Subject & topics:** Maths**Stage & difficulty:** A Level P1**Part A****Find  $\cos \alpha$** 

Given that  $\alpha$  is the acute angle such that  $\tan \alpha = \frac{2}{5}$ , find the exact value of  $\cos \alpha$ .

- ☐  $\frac{5\sqrt{29}}{29}$
- ☐  $\frac{5\sqrt{2}}{8}$
- ☐  $\frac{5}{29}$
- ☐  $\frac{\sqrt{2}}{2}$

**Part B****Find  $\cos \beta$** 

Given that  $\beta$  is the obtuse angle such that  $\sin \beta = \frac{3}{7}$ , find the exact value of  $\cos \beta$ .

- ☐  $-\frac{2\sqrt{10}}{3}$
- ☐  $\frac{2\sqrt{10}}{5}$
- ☐  $-\frac{\sqrt{40}}{7}$
- ☐  $-3\sqrt{10}$

## Part C

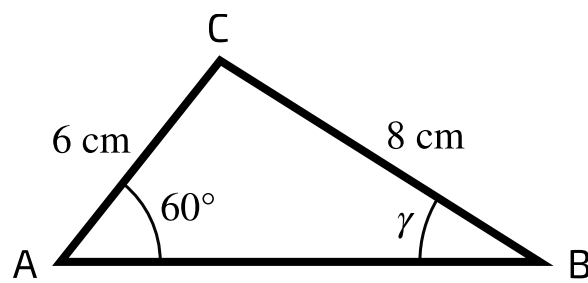
Find  $\sin \gamma$ 

Figure 1: Triangle ABC.

Figure 1 shows a triangle ABC with  $AC = 6 \text{ cm}$ ,  $BC = 8 \text{ cm}$ ,  $\angle BAC = 60^\circ$  and  $\angle ABC = \gamma$ .

Find the exact value of  $\sin \gamma$ , simplifying your answer.

- ☐  $\frac{3}{\sqrt{5}}$
- ☐  $\frac{2\sqrt{5}}{3}$
- ☐  $\frac{3\sqrt{3}}{8}$
- ☐  $2\sqrt{3}$

Used with permission from UCLES, A Level Maths, June 2012, OCR C2, Question 7

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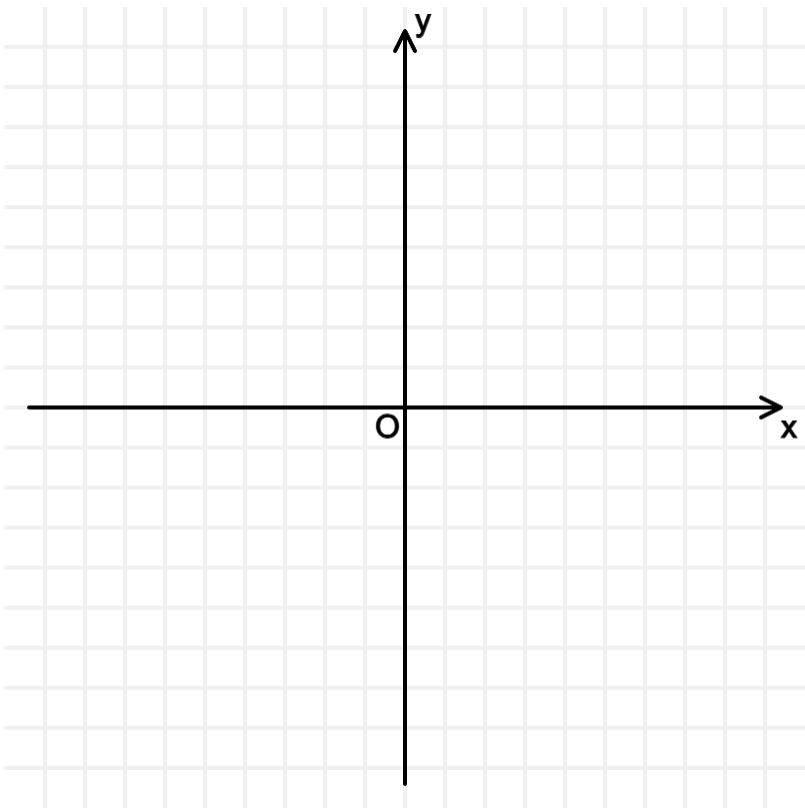
# Trigonometry: Basic Functions 1i

Subject & topics: Maths      Stage & difficulty: A Level P1

Part A

## Sketch a trig function

Sketch the graph of  $y = 2 \cos x$  for  $0^\circ \leq x \leq 360^\circ$ .



Part B

## A trig equation

Solve the equation  $2 \cos x = 0.8$ , in the interval  $0^\circ \leq x \leq 360^\circ$ , to 3 significant figures.

Part C

Equating trig functions

Solve the equation  $2 \cos x = \sin x$ , in the interval  $-180^\circ \leq x \leq 180^\circ$ , to 3 significant figures.

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## Trigonometry: Basic Functions 1ii

Subject &amp; topics: Maths

Stage &amp; difficulty: A Level P1

### Part A

$$\sin\left(\frac{1}{2}x\right) = 0.8$$

Solve  $\sin\left(\frac{1}{2}x\right) = 0.8$ , for  $0^\circ \leq x \leq 360^\circ$ . Give your answer in degrees, to 3 significant figures.

Enter your answers in order from lowest value of  $x$  to highest.

  (lowest value)  (highest value)

### Part B

$$\sin x = 3 \cos x$$

Solve  $\sin x = 3 \cos x$ , for  $0^\circ \leq x \leq 360^\circ$ . Give your answer in degrees, to 3 significant figures.

Enter your answers in order from lowest value of  $x$  to highest.

  (lowest value)  (highest value)

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# Trigonometry: Identities and Equations 3i

Subject & topics: Maths      Stage & difficulty: A Level P1

Part A

Quadratic equation

Write  $15 \cos^2 \theta = 13 + \sin \theta$  as a quadratic equation in  $\sin \theta$ .

The following symbols may be useful: `cos()`, `sin()`, `tan()`, `theta`

Part B

Solve equation

Solve the equation  $15 \cos^2 \theta = 13 + \sin \theta$  in the interval  $0^\circ \leq \theta \leq 360^\circ$ , giving the solutions in degrees to 3 significant figures.

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# Addition of Angles 1

Pre-Uni Maths for Sciences H4.1

**Subject & topics:** Maths | Geometry | Trigonometry     **Stage & difficulty:** A Level P3

Without using a calculator, find exact expressions for the following.

Part A

$\sin 15^\circ$

$\sin 15^\circ$

Part B

$\cos 165^\circ$

$\cos 165^\circ$

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## Trigonometry: Double Angles 1i

Subject &amp; topics: Maths

Stage &amp; difficulty: A Level P2

It is given that  $f(\theta) = \sin(\theta + 30^\circ) + \cos(\theta + 60^\circ)$ .

### Part A

#### Double Angles

Show that  $f(\theta) = \cos \theta$ . Hence find an expression for  $f(4\theta) + 4f(2\theta)$ , in terms of  $\cos \theta$ .

The following symbols may be useful:  $\cos()$ ,  $\sin()$ ,  $\tan()$ ,  $\theta$

### Part B

$$\frac{1}{f(4\theta) + 4f(2\theta) + 7}$$

Hence determine the greatest and least values of  $\frac{1}{f(4\theta) + 4f(2\theta) + 7}$  as  $\theta$  varies.

 (least value)

 (greatest value)

Part C  
Solve

Solve the equation

$$\sin (12\alpha + 30^\circ) + \cos (12\alpha + 60^\circ) + 4 \sin (6\alpha + 30^\circ) + 4 \cos (6\alpha + 60^\circ) = 1$$

for  $0^\circ < \alpha < 60^\circ$ , in degrees, to three significant figures.

Enter your answers in order from lowest value of  $\alpha$  to highest.

(lowest value)

(highest value)

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Question deck:  
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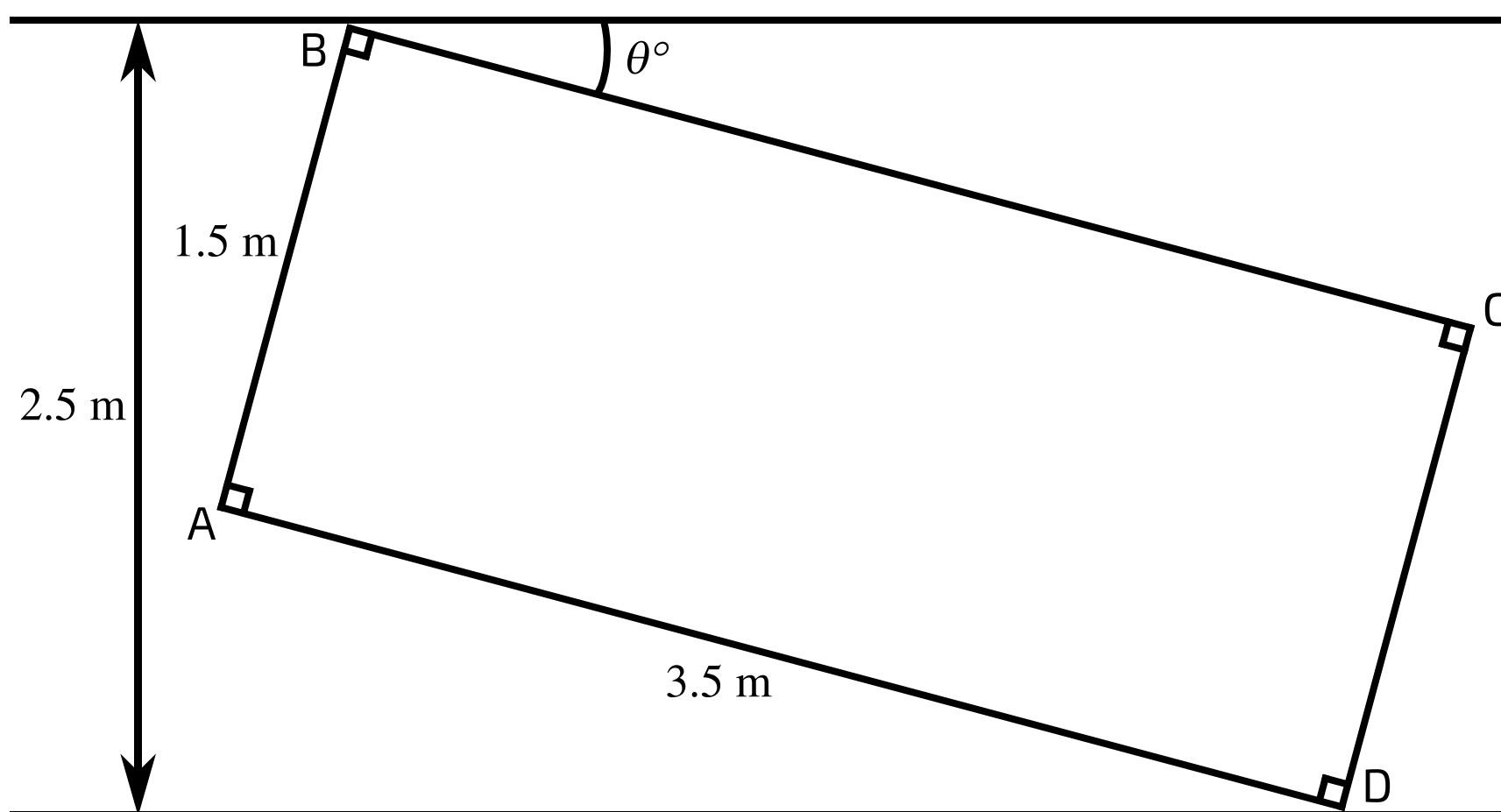


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## Trigonometry: Combined Angles 3i

**Subject & topics:** Maths    **Stage & difficulty:** A Level P2

In **Figure 1**, ABCD represents a rectangular table with sides 3.5 m and 1.5 m. It has been turned so it wedges in a passage of width 2.5 m.



**Figure 1:** The rectangular table ABCD.

### Part A

**Value of  $7 \sin \theta^\circ + 3 \cos \theta^\circ$**

Given that  $\theta$  is the acute angle between the longer side and the passage, as shown in the diagram, find the exact value of  $7 \sin \theta + 3 \cos \theta$ .

The following symbols may be useful:  $\cos()$ ,  $\sin()$ ,  $\tan()$ ,  $\theta$

**Part B****The form  $R \sin (\theta^\circ + \alpha^\circ)$** 

Express  $7 \sin \theta + 3 \cos \theta$  in the form  $R \sin (\theta + \alpha)$ , where  $R > 0$  and  $0^\circ < \alpha < 90^\circ$ .

Give the exact value of  $R$ .

The following symbols may be useful: R

Give the value of  $\alpha$  to 3 significant figures.

**Part C****Find  $\theta$** 

Find  $\theta$ , to 3 significant figures.

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## Wave Interference

Pre-Uni Maths for Sciences H4.10

**Subject & topics:** Maths | Geometry | Trigonometry    **Stage & difficulty:** A Level C3

Two waves

$$\psi_1 = A \cos \left( 2\pi f t - \left( \frac{2\pi}{\lambda} \right) x + \phi \right)$$

and

$$\psi_2 = A \cos \left( 2\pi f t - \left( \frac{2\pi}{\lambda} \right) x - \phi \right)$$

interfere, such that the resultant wave is given by  $\psi = \psi_1 + \psi_2$ . Express  $\psi$  as the product of two trigonometric functions.

Express  $\psi$  as the product of two trigonometric functions.

The following symbols may be useful: A, f, lambda, phi, pi, t, x

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