

Applications of Trigonometry 9

Essential GCSE Maths 50.9

GCSE

A Level

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 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.

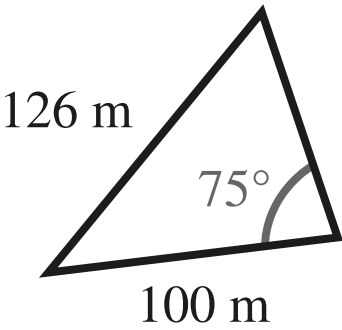


Figure 1: A plan of the piece of land that trees are going to be planted on.

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

A Level

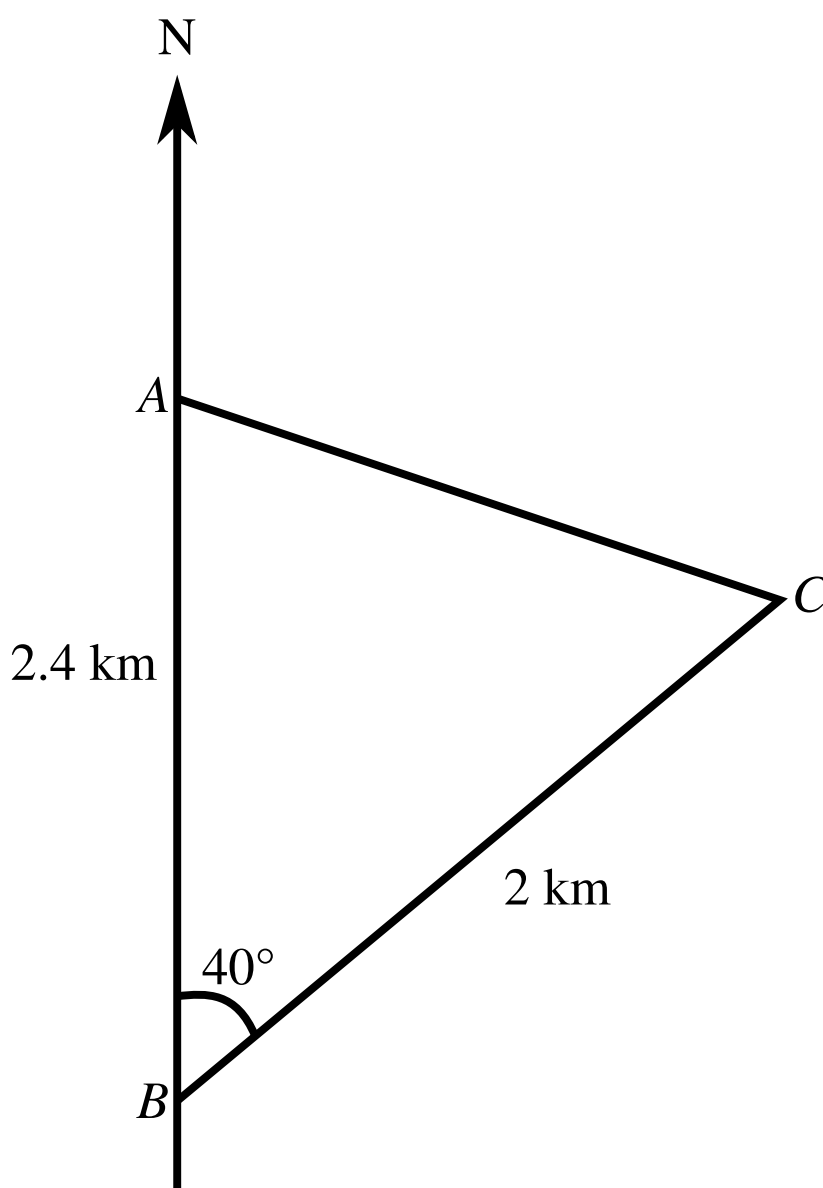


Figure 1: Positions of two points on a coastline, and a nearby ship.

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° 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 θ

The bearing of C from A is θ° . Find the value of θ correct to three significant figures.

Part C Shortest distance

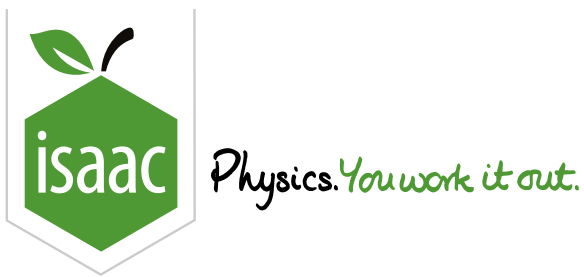
Find the shortest distance from the ship to the coastline, giving your answer in kilometres correct to three significant figures.

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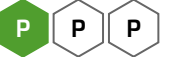
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Trigonometry: Basic Functions 2i

A Level



Part A Trigonometric functions 1

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

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

Part B Trigonometric functions 2

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

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

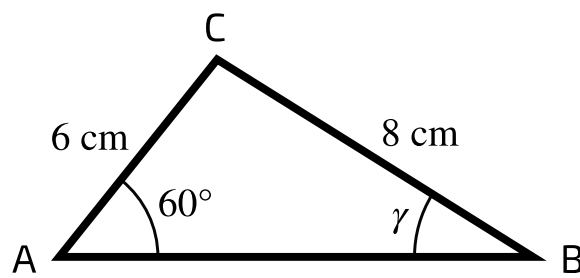
Part C **A triangle****Figure 1:** Triangle ABC.

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

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

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

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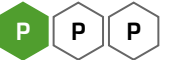
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Trigonometry: Basic Functions 1i

A Level



Part A Sketch a trig function

Sketch the graph of $y = 2 \cos x$ for values of x such that $0^\circ \leq x \leq 360^\circ$, indicating the coordinates of any points where the curve meets the axes. You can check your sketch after giving the correct answer.

Give the value of the smallest root in degrees.

Part B A trig equation

Solve the equation $2 \cos x = 0.8$, giving the highest value of x between 0° and 360° to 3 significant figures.

Part C Equating trig functions

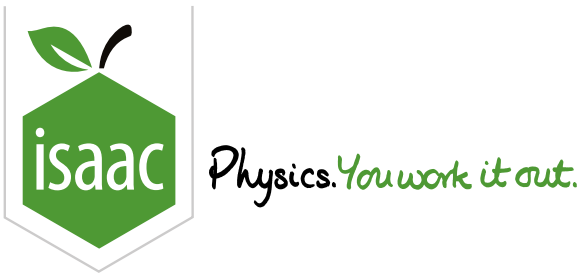
Solve the equation $2 \cos x = \sin x$, giving the value of x between -180° and 180° that has the largest negative value. Give your answer to 3 significant figures.

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Trigonometry: Basic Functions 1ii

A Level

P

P

P

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



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: $\cos()$, $\sin()$, $\tan()$, θ

Part B Solve equation

Solve the equation $15 \cos^2 \theta = 13 + \sin \theta$ giving the second largest value in the range $0^\circ \leq \theta \leq 360^\circ$, in degrees to 4 significant figures.

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Addition of Angles 1

Pre-Uni Maths for Sciences H4.1



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

A Level

P

P

P

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 θ 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 x to highest.

°

(lowest value)

°

(highest value)

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Trigonometry: Combined Angles 3i

A Level
P P P

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.

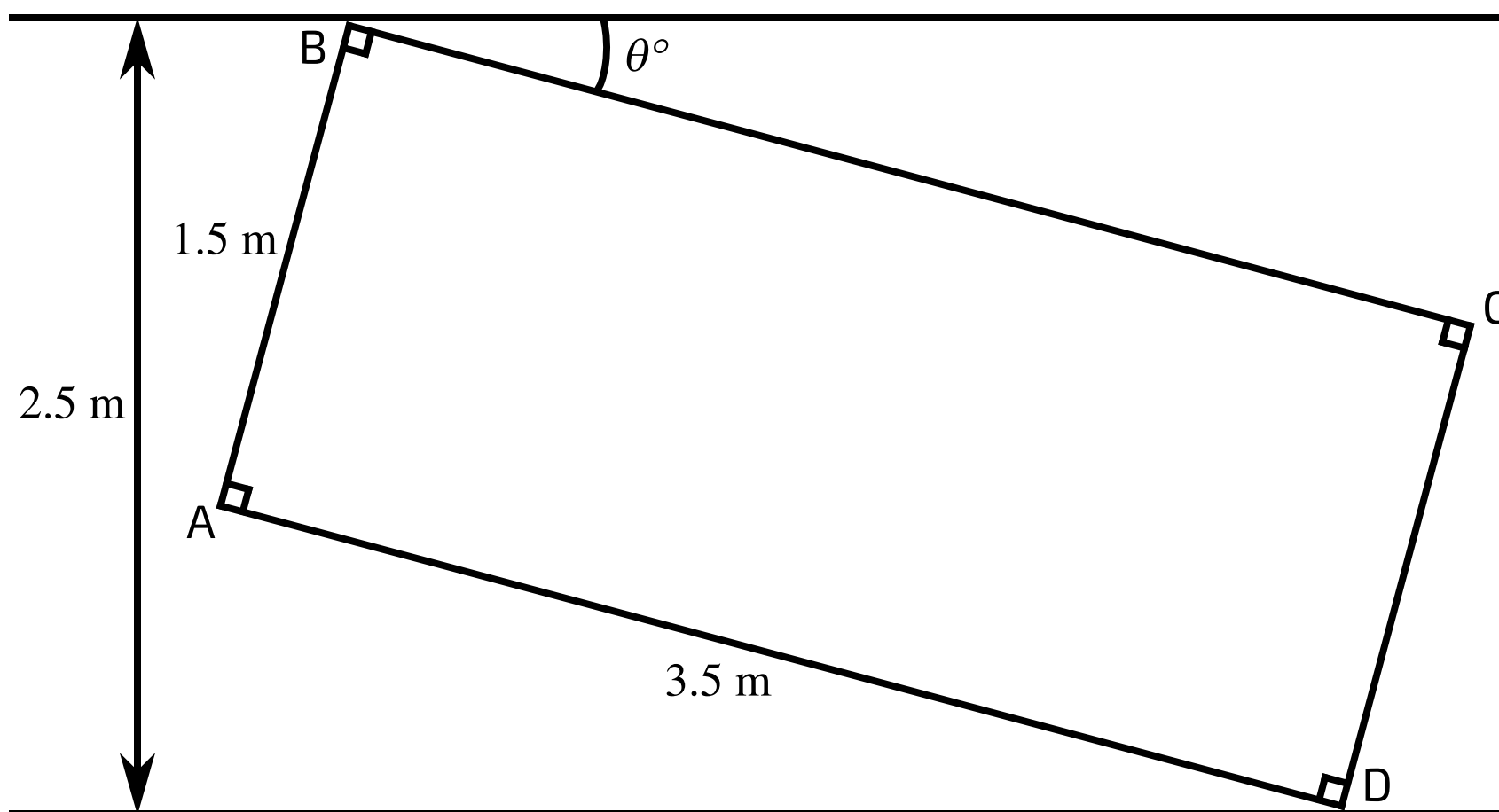


Figure 1: The rectangular table ABCD.

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

Given that θ 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 α to 3 significant figures.

Part C **Find θ**

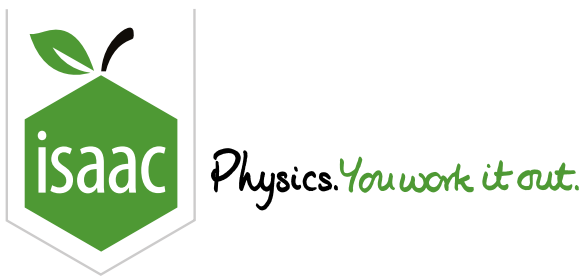
Find θ , to 3 significant figures.

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Wave Interference

Pre-Uni Maths for Sciences H4.10

A Level



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 ψ as the product of two trigonometric functions.

Express ψ as the product of two trigonometric functions.

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

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