

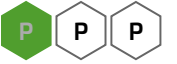


Physics. *You work it out.*

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Circles 4i

A Level



A circle with centre C has the equation $x^2 + y^2 - 10x + 4y + 4 = 0$.

Part A Find the coordinates of C

By completing the square for x and y find the coordinates of C . Enter the x and y coordinates below.

Enter the x coordinate:

The following symbols may be useful: x

Enter the y coordinate:

The following symbols may be useful: y

Part B Find radius

Find the radius of the circle.

Part C Find tangent

Find the equation of the tangent to the circle at the point $P(8, 2)$. Give your answer in the form $ax + by + c = 0$, where a , b , and c are integers.

The following symbols may be useful: x , y

Part D Find area

The circle meets the y axis at Q and the tangent to the circle at P (as in part C) meets the y axis at R . Find the area of triangle PQR .

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Radians 2i

A Level



Figure 1 shows a triangle ABC , and a sector ACD of a circle with centre A . It is given that $AB = 11$ cm, $BC = 8$ cm, angle $ABC = 0.8$ radians and angle $DAC = 1.7$ radians. The shaded segment is bounded by the line DC and the arc DC .

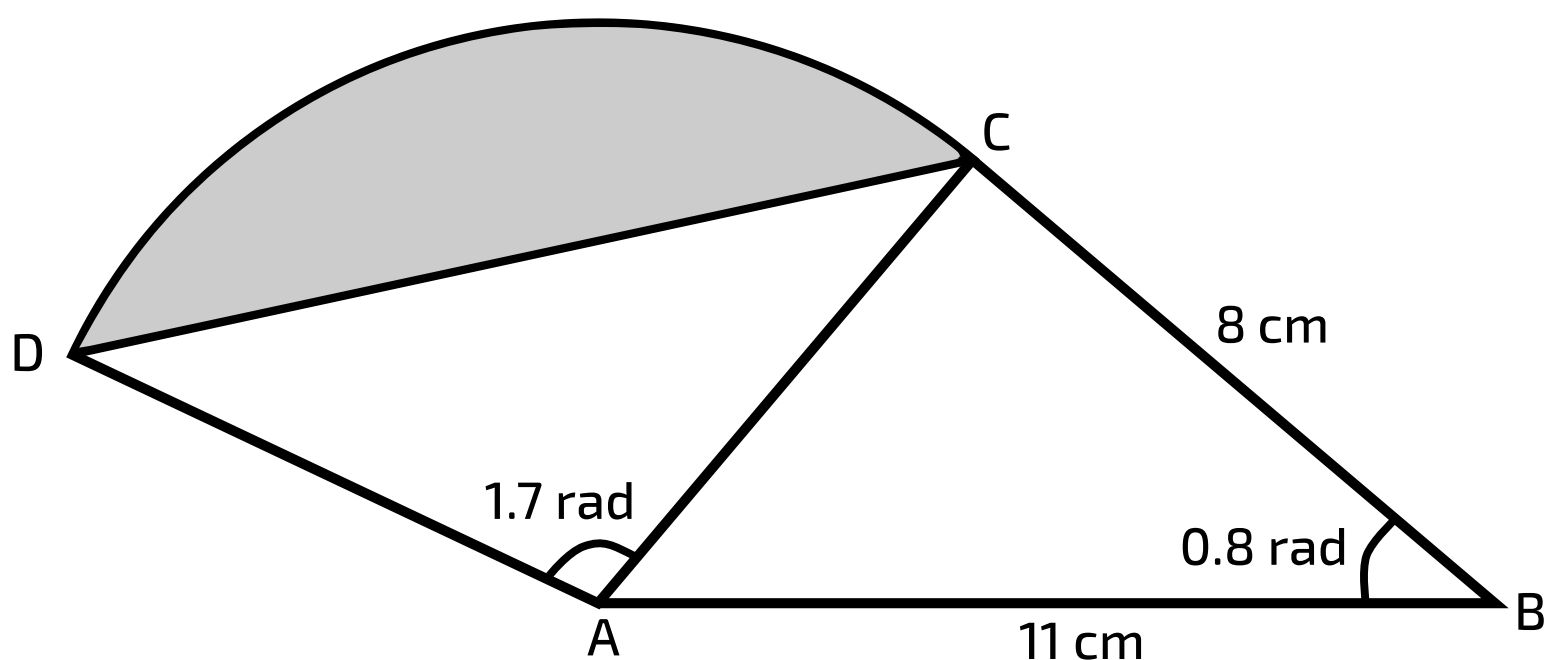


Figure 1: Diagram showing triangle ABC and the sector ACD .

Part A Length AC

Calculate the length of AC correct to 3 significant figures.

Part B Area of segment

Find the area of the shaded segment. Give your answer to 3 significant figures.

Part C Perimeter of segment

Find the perimeter of the shaded segment. Give your answer to 3 significant figures.



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Small Angle Approximations 3ii



Part A Expression

Use the small angle approximation to write an approximate expression for $(\cos \theta + 5)(1 + \sin (2\theta))$ in powers of θ up to θ^2 .

The following symbols may be useful: θ

Part B Approximation

Use your answer from the above part to work out an approximate value for $(\cos \theta + 5)(1 + \sin (2\theta))$ when $\theta = 0.075$. Give your answer to 3 significant figures.

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Functions: Reciprocal Trig 3i

A Level

P

P

P

It is given that θ is the acute angle such that $\sec \theta \sin \theta = 36 \cot \theta$.

Part A Value of $\tan \theta$

Find $\tan \theta$.

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

Part B Value of $\tan \left(\theta - \frac{\pi}{4} \right)$

Hence, using an appropriate formula, find the exact value of $\tan \left(\theta - \frac{\pi}{4} \right)$.

The following symbols may be useful: `pi`, `theta`

Part C Value of $\tan (2\theta)$

Using an appropriate formula, find the exact value of $\tan (2\theta)$.

The following symbols may be useful: `theta`

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Trigonometry: Combined Angles 2i



Part A Proof

Use the identity for $\cos(A + B)$ to write $4 \cos(\theta + 60^\circ) \cos(\theta + 30^\circ)$ in the form $p + q \sin(r\theta)$, where $p, q, r \in \mathbb{R}$.

The following symbols may be useful: θ

Part B $4 \cos 82.5^\circ \cos 52.5^\circ$

Hence find the exact value of $4 \cos 82.5^\circ \cos 52.5^\circ$.

Part C Solve

Solve, for $0^\circ < \theta < 90^\circ$, the equation $4 \cos(\theta + 60^\circ) \cos(\theta + 30^\circ) = 1$.

Give the smallest solution, in degrees, to three significant figures.

Give the largest solution, in degrees, to three significant figures.

Part D **Values of k**

Given that there are no values of θ which satisfy the equation

$$4 \cos (\theta + 60^\circ) \cos (\theta + 30^\circ) = k,$$

determine the set of values of the constant k .

Give one of the bounds, in the form $k < a$, $k \leq a$, $k > a$ or $k \geq a$ where a is an exact value.

The following symbols may be useful: $<$, $<=$, $>$, $>=$, k

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Trigonometry: Double Angles 2i

A Level

P

P

P

Part A Proof

Simplify $\sin (2\theta) (\tan \theta + \cot \theta)$ as far as possible.

The following symbols may be useful: theta

Part B Exact Value

Hence find the exact value of $\tan \frac{\pi}{12} + \tan \frac{\pi}{8} + \cot \frac{\pi}{12} + \cot \frac{\pi}{8}$.

Part C Solve

Using your answer to part A, solve the equation $\sin (4\theta) (\tan \theta + \cot \theta) = 1$ for $0 < \theta < \frac{\pi}{2}$, to three significant figures, giving your answer in **radians**.

Part D $(1 - \cos (2\theta)) \left(\tan \frac{\theta}{2} + \cot \frac{\theta}{2} \right)^3$

Using you answer to part A, express $(1 - \cos (2\theta))^2 \left(\tan \frac{\theta}{2} + \cot \frac{\theta}{2} \right)^3$ in terms of $\sin \theta$.

The following symbols may be useful: θ

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Trigonometry: Combined Angles 4i

A Level



Part A Combined Angles

Express $4 \cos \theta - 2 \sin \theta$ in the form $R \cos (\theta + \alpha)$, 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 three significant figures.

Part B $4 \cos \theta - 2 \sin \theta = 3$

Hence solve the equation $4 \cos \theta - 2 \sin \theta = 3$ for $0^\circ < \theta < 360^\circ$, giving your answers in degrees to three significant figures.

Give the smallest solution.

Give the largest solution.

Part C $25 - (4 \cos \theta - 2 \sin \theta)^2$

Using your answer to part A, determine the greatest and least values of

$$25 - (4 \cos \theta - 2 \sin \theta)^2$$

as θ varies, and, in each case, find the smallest positive value of θ for which that value occurs, giving your answers in degrees, to three significant figures.

Give the smallest value of θ which corresponds to the maximum value.

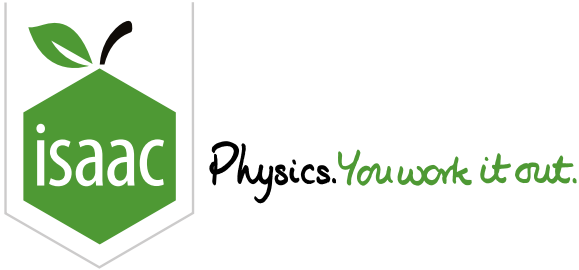
Give the smallest value of θ which corresponds to the minimum value.

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Sketching Inverse Trigonometric Functions

A Level

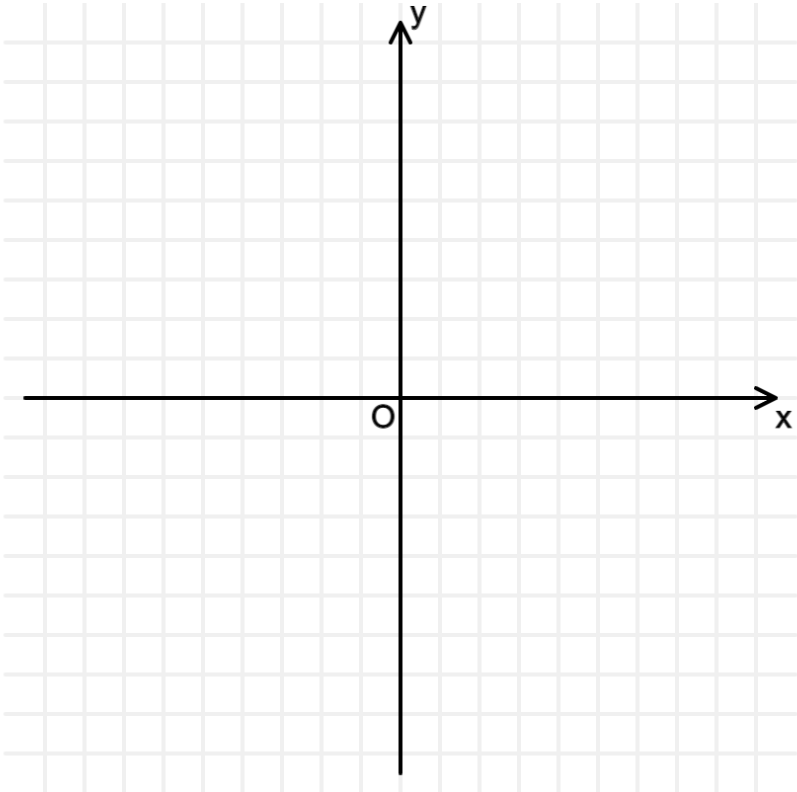
P

P

P

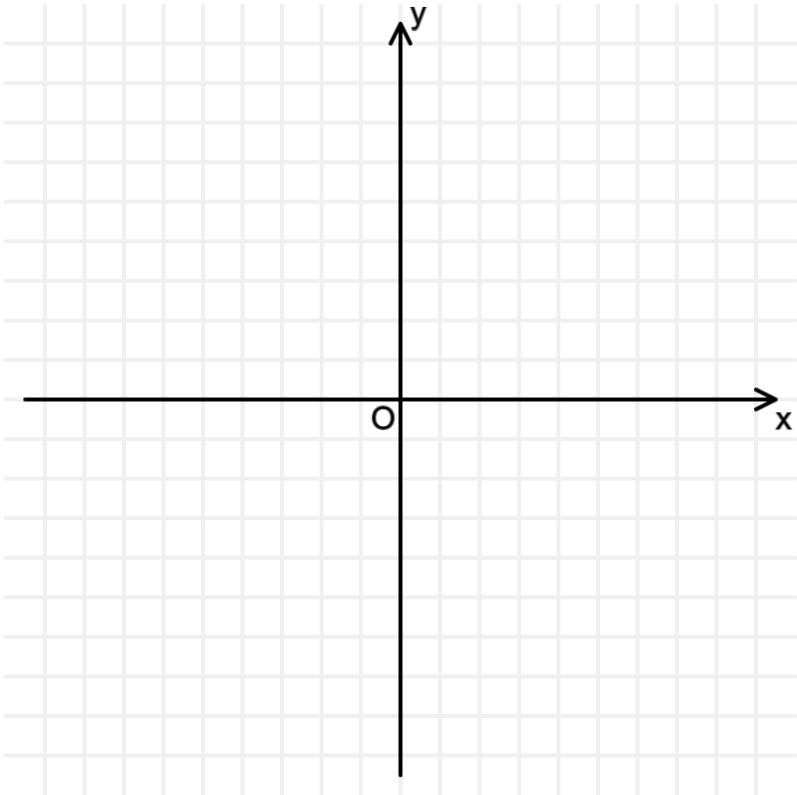
Part A Sketch $\arcsin \frac{x}{3} + \frac{\pi}{2}$

Sketch the graph of $y = \arcsin \frac{x}{3} + \frac{\pi}{2}$.



Part B Sketch $2 \arctan (x - 1)$

Sketch the graph of $y = 2 \arctan (x - 1)$.



Part C Sketch $\arccos \left(-\frac{x}{2} + \frac{1}{2}\right) - \frac{\pi}{3}$

Sketch the graph of $y = \arccos \left(-\frac{x}{2} + \frac{1}{2}\right) - \frac{\pi}{3}$.

