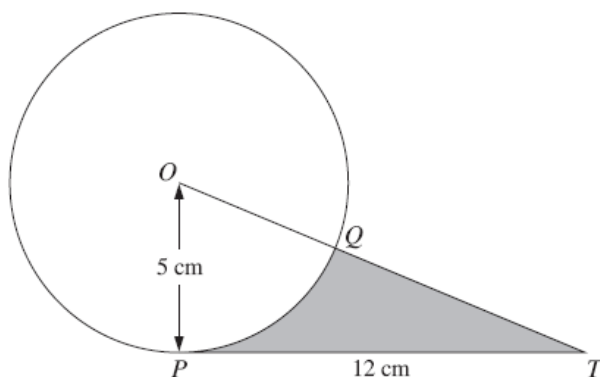


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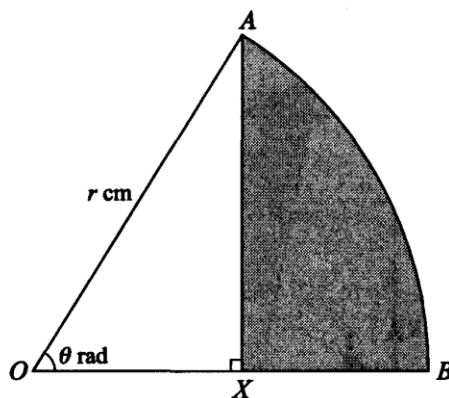


The diagram shows a circle with centre O and radius 5 cm. The point P lies on the circle, PT is a tangent to the circle and $PT = 12$ cm. The line OT cuts the circle at the point Q .

- (i) Find the perimeter of the shaded region. [4]
- (ii) Find the area of the shaded region. [3]

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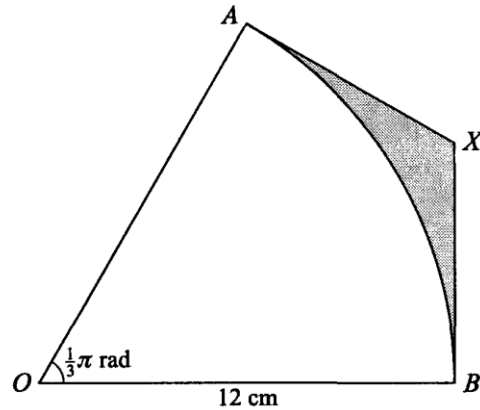


In the diagram, AB is an arc of a circle, centre O and radius r cm, and angle $AOB = \theta$ radians. The point X lies on OB and AX is perpendicular to OB .

- (i) Show that the area, $A \text{ cm}^2$, of the shaded region AXB is given by

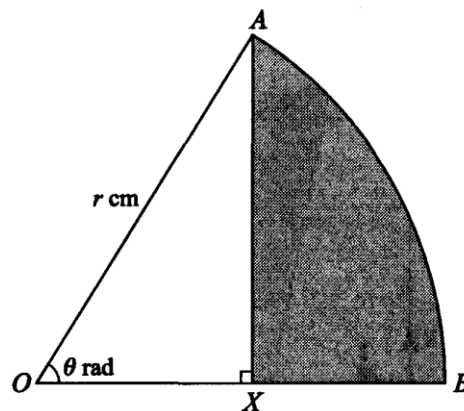
$$A = \frac{1}{2}r^2(\theta - \sin \theta \cos \theta). \quad [3]$$

- (ii) In the case where $r = 12$ and $\theta = \frac{1}{6}\pi$, find the perimeter of the shaded region AXB , leaving your answer in terms of $\sqrt{3}$ and π . [4]



In the diagram, OAB is a sector of a circle with centre O and radius 12 cm. The lines AX and BX are tangents to the circle at A and B respectively. Angle $AOB = \frac{1}{3}\pi$ radians.

- (i) Find the exact length of AX , giving your answer in terms of $\sqrt{3}$. [2]
- (ii) Find the area of the shaded region, giving your answer in terms of π and $\sqrt{3}$. [3]

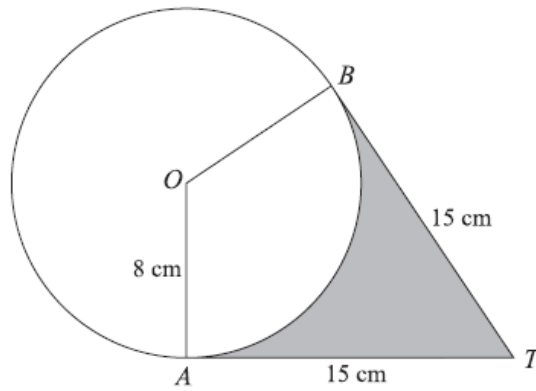


In the diagram, AB is an arc of a circle, centre O and radius r cm, and angle $AOB = \theta$ radians. The point X lies on OB and AX is perpendicular to OB .

- (i) Show that the area, $A \text{ cm}^2$, of the shaded region AXB is given by

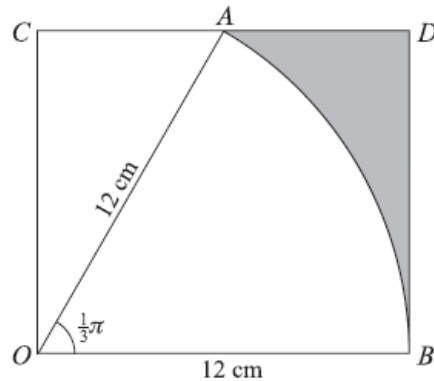
$$A = \frac{1}{2}r^2(\theta - \sin \theta \cos \theta). \quad [3]$$

- (ii) In the case where $r = 12$ and $\theta = \frac{1}{6}\pi$, find the perimeter of the shaded region AXB , leaving your answer in terms of $\sqrt{3}$ and π . [4]

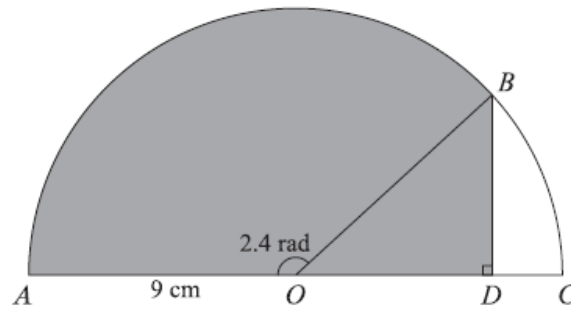


The diagram shows a circle with centre O and radius 8 cm . Points A and B lie on the circle. The tangents at A and B meet at the point T , and $AT = BT = 15\text{ cm}$.

- (i) Show that angle AOB is 2.16 radians, correct to 3 significant figures. [3]
- (ii) Find the perimeter of the shaded region. [2]
- (iii) Find the area of the shaded region. [3]

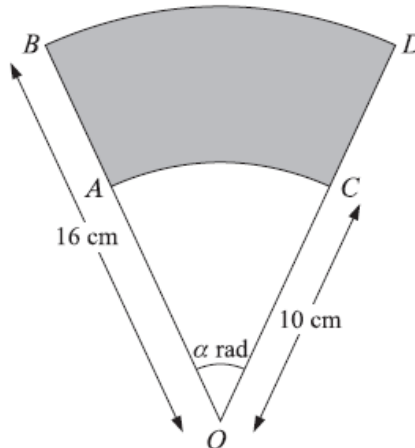


In the diagram, AOB is a sector of a circle with centre O and radius 12 cm . The point A lies on the side CD of the rectangle $OCDB$. Angle $AOB = \frac{1}{3}\pi$ radians. Express the area of the shaded region in the form $a(\sqrt{3}) - b\pi$, stating the values of the integers a and b . [6]



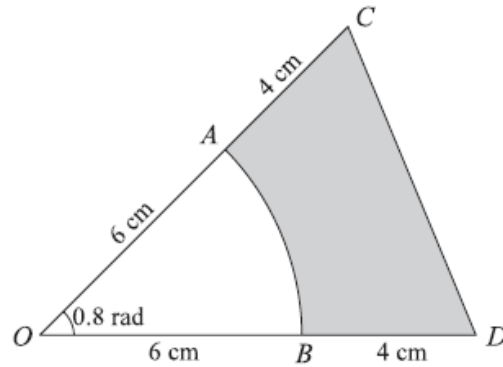
In the diagram, ABC is a semicircle, centre O and radius 9 cm. The line BD is perpendicular to the diameter AC and angle $AOB = 2.4$ radians.

- (i) Show that $BD = 6.08$ cm, correct to 3 significant figures. [2]
- (ii) Find the perimeter of the shaded region. [3]
- (iii) Find the area of the shaded region. [3]



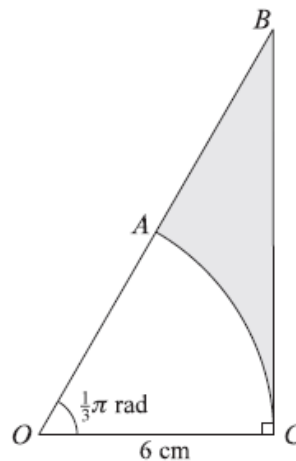
In the diagram, OAB and OCD are radii of a circle, centre O and radius 16 cm. Angle $AOC = \alpha$ radians. AC and BD are arcs of circles, centre O and radii 10 cm and 16 cm respectively.

- (i) In the case where $\alpha = 0.8$, find the area of the shaded region. [2]
- (ii) Find the value of α for which the perimeter of the shaded region is 28.9 cm. [3]



In the diagram, OCD is an isosceles triangle with $OC = OD = 10$ cm and angle $COD = 0.8$ radians. The points A and B , on OC and OD respectively, are joined by an arc of a circle with centre O and radius 6 cm. Find

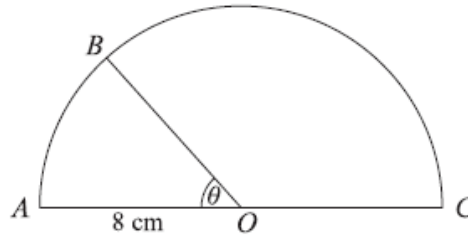
- (i) the area of the shaded region, [3]
- (ii) the perimeter of the shaded region. [4]



In the diagram, AC is an arc of a circle, centre O and radius 6 cm. The line BC is perpendicular to OC and OAB is a straight line. Angle $AOC = \frac{1}{3}\pi$ radians. Find the area of the shaded region, giving your answer in terms of π and $\sqrt{3}$. [5]

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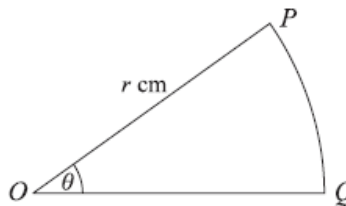


The diagram shows a semicircle ABC with centre O and radius 8 cm . Angle $AOB = \theta$ radians.

- (i) In the case where $\theta = 1$, calculate the area of the sector BOC . [3]
- (ii) Find the value of θ for which the perimeter of sector AOB is one half of the perimeter of sector BOC . [3]
- (iii) In the case where $\theta = \frac{1}{3}\pi$, show that the exact length of the perimeter of triangle ABC is $(24 + 8\sqrt{3})\text{ cm}$. [3]

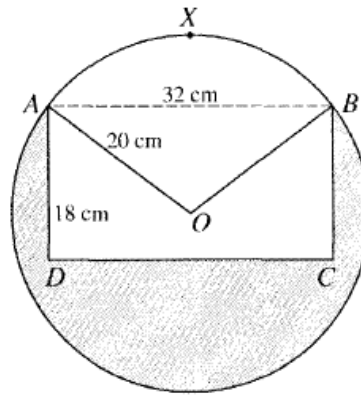
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The diagram shows the sector OPQ of a circle with centre O and radius $r\text{ cm}$. The angle POQ is θ radians and the perimeter of the sector is 20 cm .

- (i) Show that $\theta = \frac{20}{r} - 2$. [2]
- (ii) Hence express the area of the sector in terms of r . [2]
- (iii) In the case where $r = 8$, find the length of the chord PQ . [3]



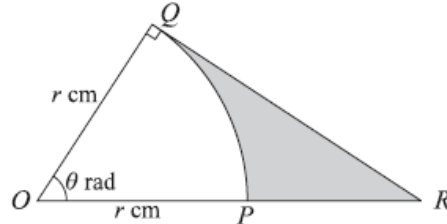
The diagram shows the circular cross-section of a uniform cylindrical log with centre O and radius 20 cm. The points A , X and B lie on the circumference of the cross-section and $AB = 32$ cm.

(i) Show that angle $AOB = 1.855$ radians, correct to 3 decimal places. [2]

(ii) Find the area of the sector $AXBO$. [2]

The section $AXBCD$, where $ABCD$ is a rectangle with $AD = 18$ cm, is removed.

(iii) Find the area of the new cross-section (shown shaded in the diagram). [3]



In the diagram, OPQ is a sector of a circle, centre O and radius r cm. Angle $QOP = \theta$ radians. The tangent to the circle at Q meets OP extended at R .

(i) Show that the area, A cm², of the shaded region is given by $A = \frac{1}{2}r^2(\tan \theta - \theta)$. [2]

(ii) In the case where $\theta = 0.8$ and $r = 15$, evaluate the length of the perimeter of the shaded region. [4]