ADDITONAL MATHEMATICS

2002 – 2011

CLASSIFIED SECTORS

Compiled & Edited
By

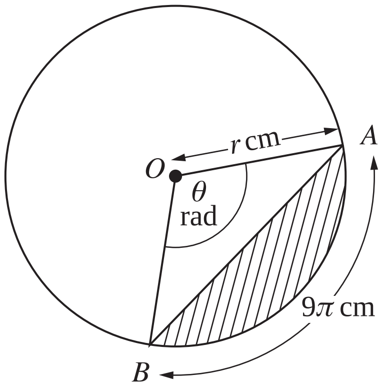
Dr. Eltayeb Abdul Rhman

www.drtayeb.tk

First Edition
2011

9 The figure shows a circle, centre O, radius r cm. The length of the arc AB of the circle is 9π cm. Angle AOB is θ radians and is 3 times angle OBA.

For Examiner's Use

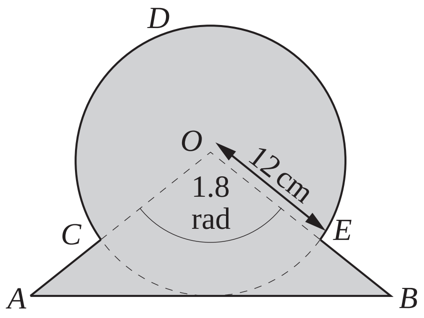


(i) Show that $\theta = \frac{3\pi}{5}$. [2]

(ii) Find the value of r. [2]

(iii) Find the area of the shaded region. [3]

11



The diagram shows an isosceles triangle *AOB* and a sector *OCDEO* of a circle with centre *O*. The line *AB* is a tangent to the circle. Angle *AOB* = 1.8 radians and the radius of the circle is 12 cm.

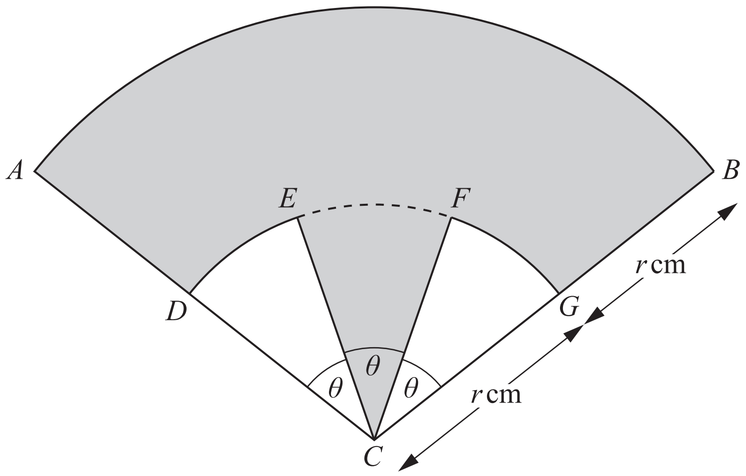
(i) Show that the distance *AC* = 7.3 cm to 1 decimal place. [2]

(ii) Find the perimeter of the shaded region. [6]

(iii) Find the area of the shaded region. [4]

10 Answer only **one** of the following two alternatives.

EITHER



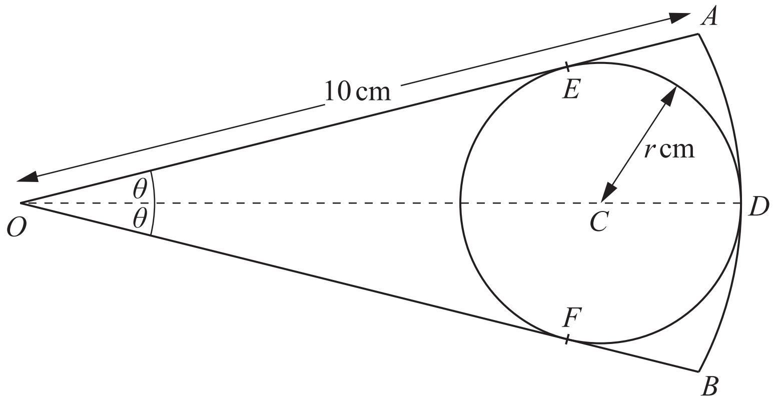
The figure shows a sector ABC of a circle centre C, radius $2r$ cm, where angle ACB is 3θ radians. The points D, E, F and G lie on an arc of a circle centre C, radius r cm. The points D and G are the midpoints of CA and CB respectively. Angles DCE and FCG are each θ radians. The area of the shaded region is $5\,\text{cm}^2$.

(i) By first expressing θ in terms of r, show that the perimeter, P cm, of the shaded region is given by $P = 4r + \dfrac{8}{r}$. [6]

(ii) Given that r can vary, show that the stationary value of P can be written in the form $k\sqrt{2}$, where k is a constant to be found. [4]

(iii) Determine the nature of this stationary value and find the value of θ for which it occurs. [2]

OR



The figure shows a sector OAB of a circle, centre O, radius 10 cm. Angle $AOB = 2\theta$ radians where $0 < \theta < \dfrac{\pi}{2}$. A circle centre C, radius r cm, touches the arc AB at the point D. The lines OA and OB are tangents to the circle at the points E and F respectively.

(i) Write down, in terms of r, the length of OC. [1]

(ii) Hence show that $r = \dfrac{10 \sin \theta}{1 + \sin \theta}$. [2]

(iii) Given that θ can vary, find $\dfrac{dr}{d\theta}$ when $r = \dfrac{10}{3}$. [6]

(iv) Given that r is increasing at $2\,\text{cms}^{-1}$, find the rate at which θ is increasing when $\theta = \dfrac{\pi}{6}$. [3]

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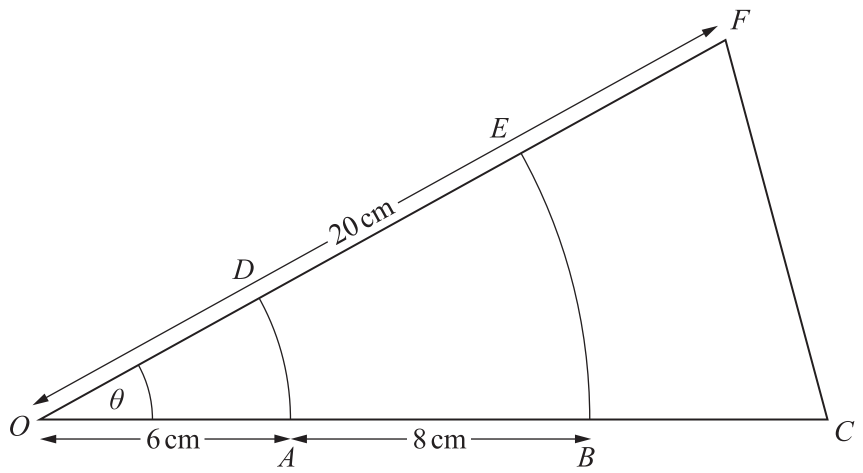


In the diagram *AD* and *BE* are arcs of concentric circles centre *O*, where $OA = 6$ cm and $AB = 8$ cm. The area of the region *ABED* is 32 cm^2. The triangle *OCF* is isosceles with $OC = OF = 20$ cm.

(i) Find the angle θ in radians. [3]

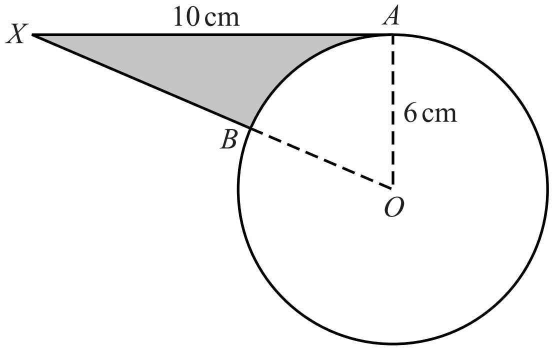
(ii) Find the perimeter of the region *BCFE*. [5]

8 A sector of a circle, of radius r cm, has a perimeter of 200 cm.

(i) Express the area, A cm^2, of the sector in terms of r. [3]

(ii) Given that r can vary, find the stationary value of A. [3]

7

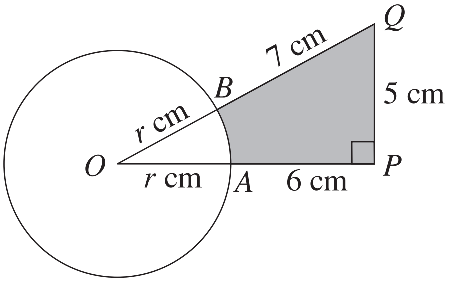


The diagram shows a circle, centre O and radius 6 cm. The tangent from X touches the circle at A and $XA = 10$ cm. The line from X to O cuts the circle at B.

(i) Show that angle AOB is approximately 1.03 radians. [1]

(ii) Find the perimeter of the shaded region. [3]

(iii) Find the area of the shaded region. [3]



The diagram shows a right-angled triangle *OPQ* and a circle, centre *O* and radius *r* cm, which cuts *OP* and *OQ* at *A* and *B* respectively. Given that $AP = 6$ cm, $PQ = 5$ cm, $QB = 7$ cm and angle $OPQ = 90°$, find

(i) the length of the arc *AB*, [6]

(ii) the area of the shaded region. [4]

0606/2/M/J/03

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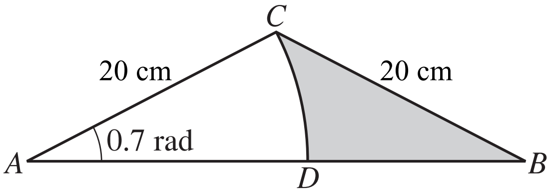


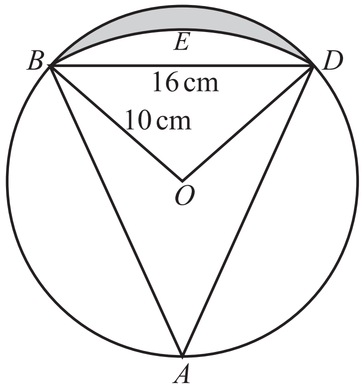
The diagram shows an isosceles triangle *ABC* in which $BC = AC = 20$ cm, and angle $BAC = 0.7$ radians. *DC* is an arc of a circle, centre *A*. Find, correct to 1 decimal place,

(i) the area of the shaded region, [4]

(ii) the perimeter of the shaded region. [4]

0606/1/M/J/04

12



The diagram, which is not drawn to scale, shows a circle *ABCDA*, centre *O* and radius 10 cm. The chord *BD* is 16 cm long. *BED* is an arc of a circle, centre *A*.

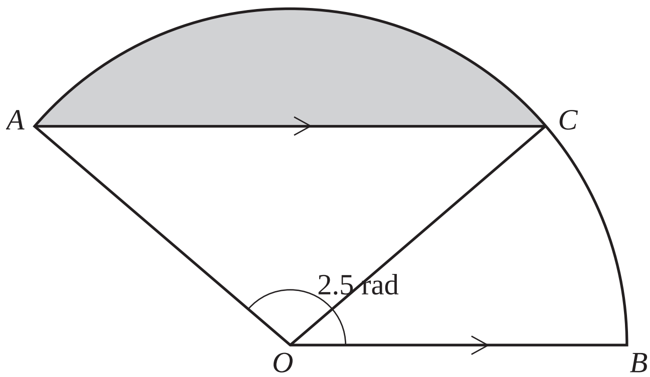
(i) Show that the length of *AB* is approximately 17.9 cm.

For the shaded region enclosed by the arcs *BCD* and *BED*, find

(ii) its perimeter, **(iii)** its area.

[11]

11



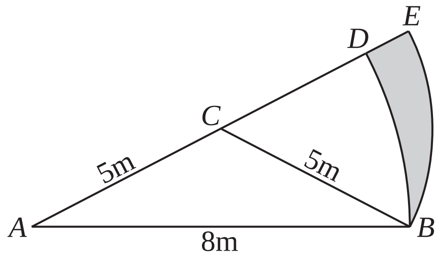
The diagram shows a sector *OACB* of a circle, centre *O*, in which angle *AOB* = 2.5 radians. The line *AC* is parallel to *OB*.

(i) Show that angle *AOC* = $(5 - \pi)$ radians. [3]

Given that the radius of the circle is 12 cm, find

(ii) the area of the shaded region, [3]

(iii) the perimeter of the shaded region. [3]



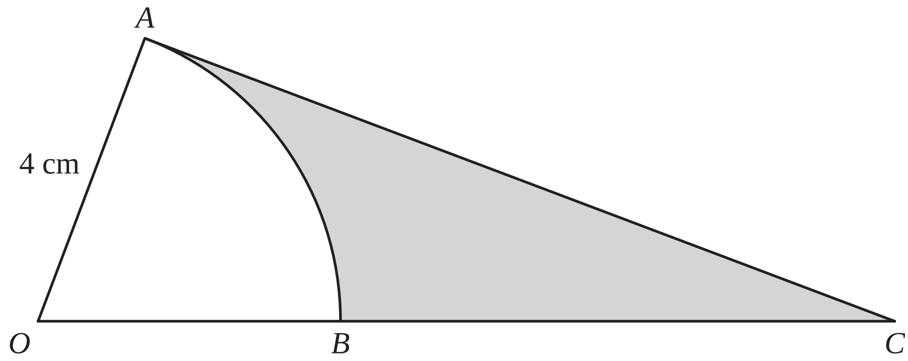
The diagram shows an isosceles triangle *ABC* in which *AB* = 8 m, *BC* = *CA* = 5 m. *ABDA* is a sector of the circle, centre *A* and radius 8 m. *CBEC* is a sector of the circle, centre *C* and radius 5 m.

(i) Show that angle *BCE* is 1.287 radians correct to 3 decimal places. [2]

(ii) Find the perimeter of the shaded region. [4]

(iii) Find the area of the shaded region. [4]

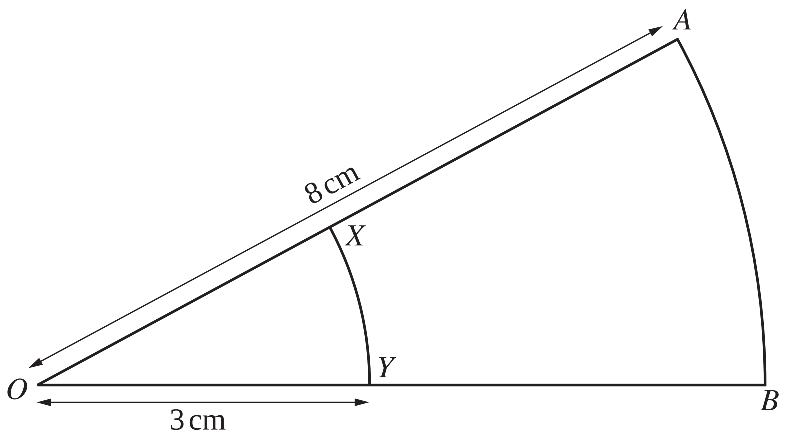
7



The diagram shows a sector *OAB* of a circle, centre *O*, radius 4 cm. The tangent to the circle at *A* meets the line *OB* extended at *C*. Given that the area of the sector *OAB* is 10 cm^2, calculate

(i) the angle *AOB* in radians, [2]

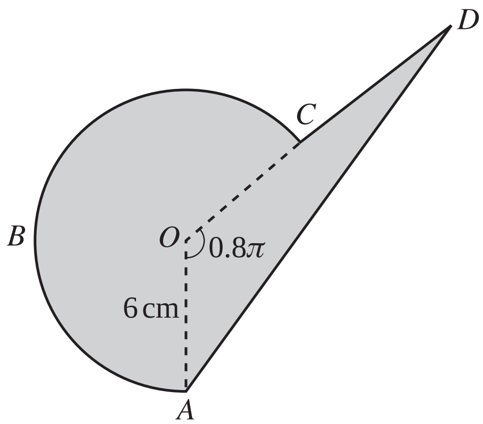
(ii) the perimeter of the shaded region. [4]



The diagram shows a sector OXY of a circle centre O, radius 3 cm and a sector OAB of a circle centre O, radius 8 cm. The point X lies on the line OA and the point Y lies on the line OB. The perimeter of the region $XABYX$ is 15.5 cm. Find

(i) the angle AOB in radians, [3]

(ii) the ratio of the area of the sector OXY to the area of the region $XABYX$ in the form $p : q$, where p and q are integers. [4]



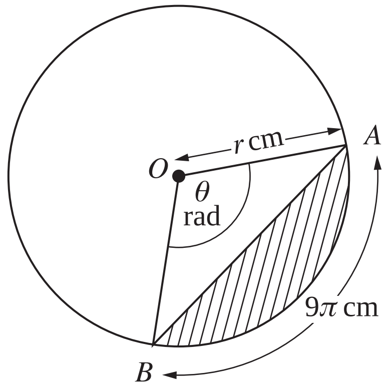
The diagram represents a company logo $ABCDA$, consisting of a sector $OABCO$ of a circle, centre O and radius 6 cm, and a triangle AOD. Angle $AOC = 0.8\pi$ radians and C is the mid-point of OD. Find

(i) the perimeter of the logo, [7]

(ii) the area of the logo. [5]

9 The figure shows a circle, centre O, radius r cm. The length of the arc AB of the circle is 9π cm. Angle AOB is θ radians and is 3 times angle OBA.

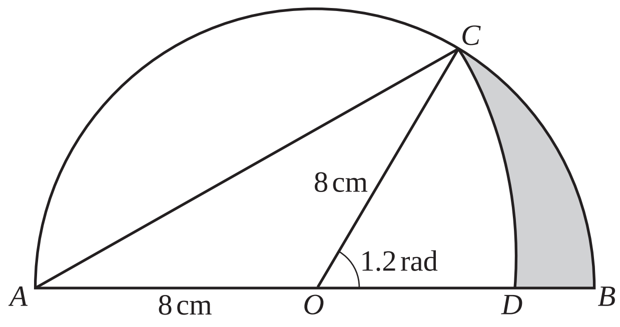
For Examiner's Use



(i) Show that $\theta = \frac{3\pi}{5}$. [2]

(ii) Find the value of r. [2]

(iii) Find the area of the shaded region. [3]



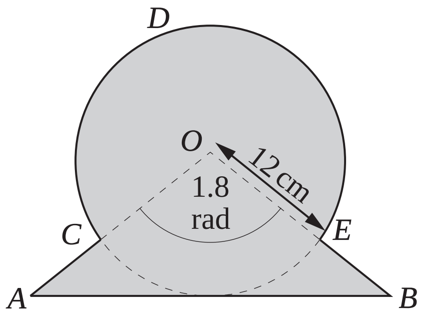
The diagram shows a semicircle, centre O, of radius 8 cm. The radius OC makes an angle of 1.2 radians with the radius OB. The arc CD of a circle has centre A and the point D lies on OB. Find the area of

(i) sector COB, [2]

(ii) sector CAD, [5]

(iii) the shaded region. [3]

11



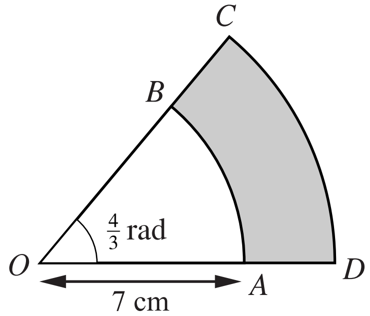
The diagram shows an isosceles triangle *AOB* and a sector *OCDEO* of a circle with centre *O*. The line *AB* is a tangent to the circle. Angle *AOB* = 1.8 radians and the radius of the circle is 12 cm.

(i) Show that the distance *AC* = 7.3 cm to 1 decimal place. [2]

(ii) Find the perimeter of the shaded region. [6]

(iii) Find the area of the shaded region. [4]

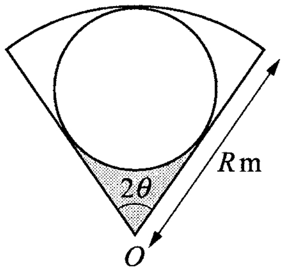
4



The diagram shows a sector *COD* of a circle, centre *O*, in which angle *COD* = $\frac{4}{3}$ radians. The points *A* and *B* lie on *OD* and *OC* respectively, and *AB* is an arc of a circle, centre *O*, of radius 7 cm. Given that the area of the shaded region *ABCD* is 48 cm^2, find the perimeter of this shaded region. [6]

12 Answer only **one** of the following two alternatives.

EITHER



The diagram shows a garden in the form of a sector of a circle, centre O, radius R m and angle 2θ. Within this garden a circular plot of the largest possible size is to be planted with roses. Given that the radius of this plot is r m,

(i) show that $R = r\left(1 + \frac{1}{\sin\theta}\right)$. [4]

Given also that $\theta = 30°$,

(ii) calculate the fraction of the garden that is to be planted with roses. [4]

When the circular plot has been constructed, the remainder of the garden consists of three regions. Given further that $R = 15$,

(iii) calculate, to 1 decimal place, the length of fencing required to fence along the perimeter of the shaded region. [3]

OR

A rectangle of area y m^2 has sides of length x m and $(Ax + B)$ m, where A and B are constants and x and y are variables. Values of x and y are given in the table below.

x	50	100	150	200	250
y	3700	11 000	21 600	36 000	53 500

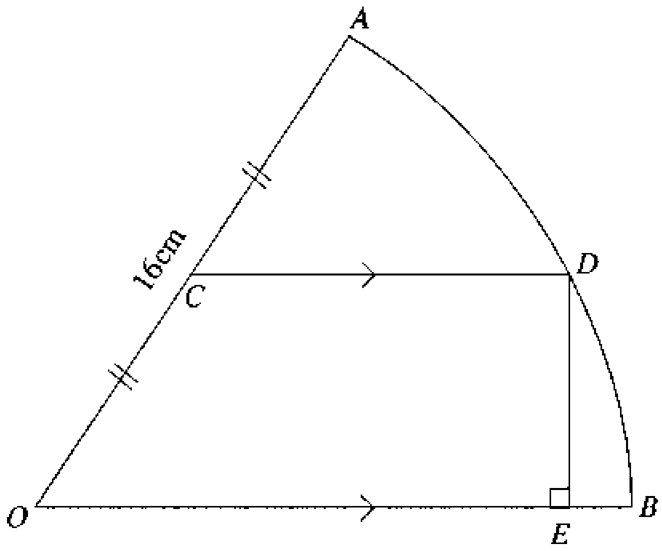
(i) Use the data above in order to draw, on graph paper, the straight line graph of $\frac{y}{x}$ against x. [3]

(ii) Use your graph to estimate the value of A and of B. [4]

(iii) On the same diagram, draw the straight line representing the equation $y = x^2$ and explain the significance of the value of x given by the point of intersection of the two lines. [3]

(iv) State the value approached by the ratio of the two sides of the rectangle as x becomes increasingly large. [1]

10



In the diagram, OAB is a sector of a circle, centre O and radius 16 cm, and the length of the arc AB is 19.2 cm. The mid-point of OA is C and the line through C parallel to OB meets the arc AB at D. The perpendicular from D to OB meets OB at E.

(i) Find angle AOB in radians. [2]

(ii) Find the length of DE. [2]

(iii) Show that angle DOE is approximately 0.485 radians. [2]

(iv) Find the area of the shaded region. [4]

11 A particle, moving in a certain medium with speed $v\ \mathrm{m\,s^{-1}}$, experiences a resistance to motion of R N. It is believed that R and v are related by the equation $R = kv^{\beta}$, where k and β are constants.
The table shows experimental values of the variables v and R.

v	5	10	15	20	25
R	32	96	180	290	410

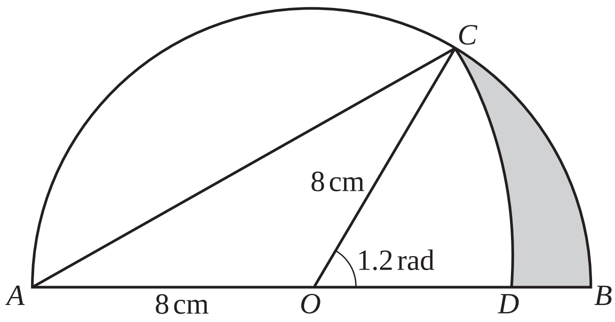
(i) Using graph paper, plot lg R against lg v and draw a straight line graph. [3]

Use your graph to estimate

(ii) the value of k and of β, [5]

(iii) the speed for which the resistance is 75 N. [2]

[Turn over



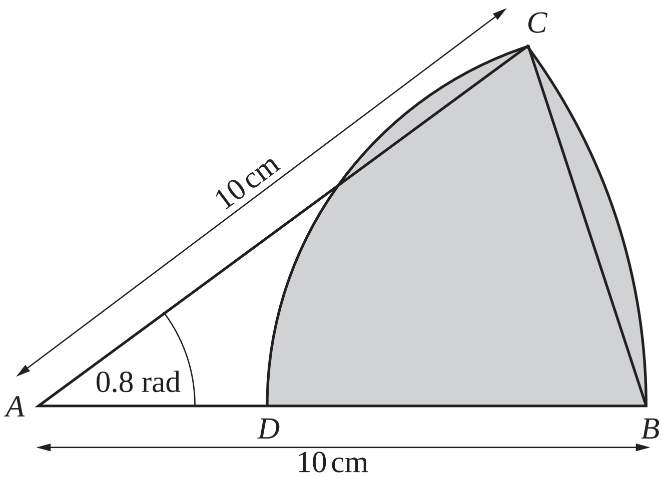
The diagram shows a semicircle, centre *O*, of radius 8 cm. The radius *OC* makes an angle of 1.2 radians with the radius *OB*. The arc *CD* of a circle has centre *A* and the point *D* lies on *OB*. Find the area of

(i) sector *COB*, [2]

(ii) sector *CAD*, [5]

(iii) the shaded region. [3]

0606/01/O/N/05



The diagram shows a sector *ABC* of the circle, centre *A* and radius 10 cm, in which angle *BAC* = 0.8 radians. The arc *CD* of a circle has centre *B* and the point *D* lies on *AB*.

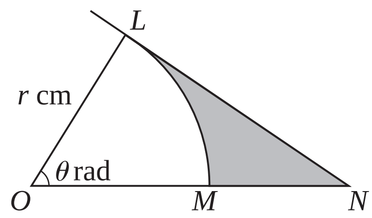
(i) Show that the length of the straight line *BC* is 7.79 cm, correct to 2 decimal places. [2]

(ii) Find the perimeter of the shaded region. [4]

(iii) Find the area of the shaded region. [4]

0606/01/O/N/07

12



The diagram shows a sector of a circle, centre O and radius r cm. Angle LOM is θ radians. The tangent to the circle at L meets the line through O and M at N. The shaded region shown has perimeter P cm and area A cm^2. Obtain an expression, in terms of r and θ, for

(i) P, [4]

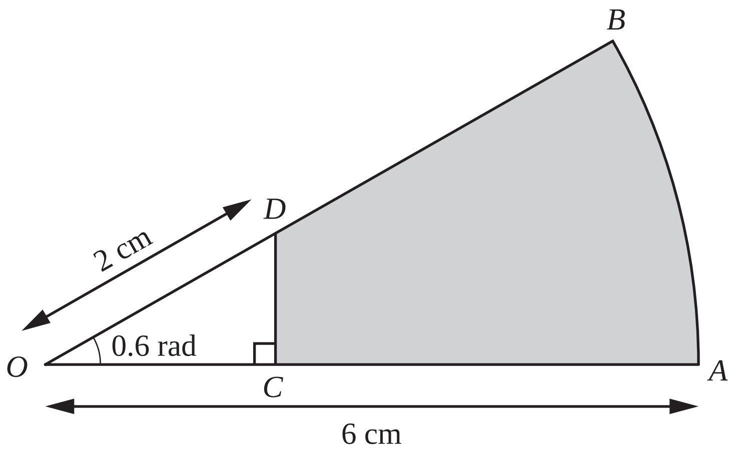
(ii) A. [3]

Given that $\theta = 1.2$ and that $P = 83$, find the value of

(iii) r, [2]

(iv) A. [1]

0606/02/O/N/06



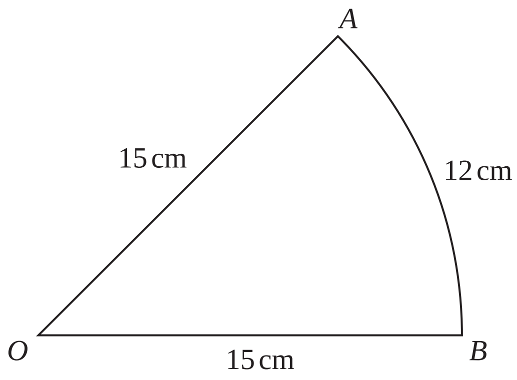
The diagram shows a sector AOB of a circle with centre O and radius 6 cm. Angle AOB = 0.6 radians. The point D lies on OB such that the length of OD is 2 cm. The point C lies on OA such that OCD is a right angle.

Show that the length of OC is approximately 1.65 cm and find the length of CD. [4]

Find the perimeter of the shaded region. [3]

Find the area of the shaded region. [3]

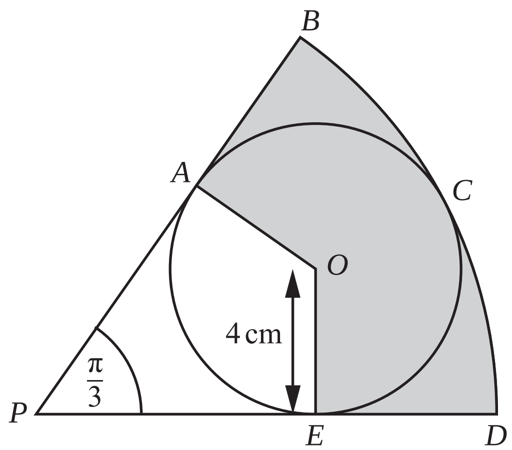
1



The diagram shows a sector *AOB* of a circle, centre *O*, radius 15 cm. The length of the arc *AB* is 12 cm.

(i) Find, in radians, angle *AOB*. [2]

(ii) Find the area of the sector *AOB*. [2]



The diagram shows a circle, centre *O*, radius 4 cm, enclosed within a sector *PBCDP* of a circle, centre *P*. The circle centre *O* touches the sector at points *A*, *C* and *E*. Angle *BPD* is $\frac{\pi}{3}$ radians.

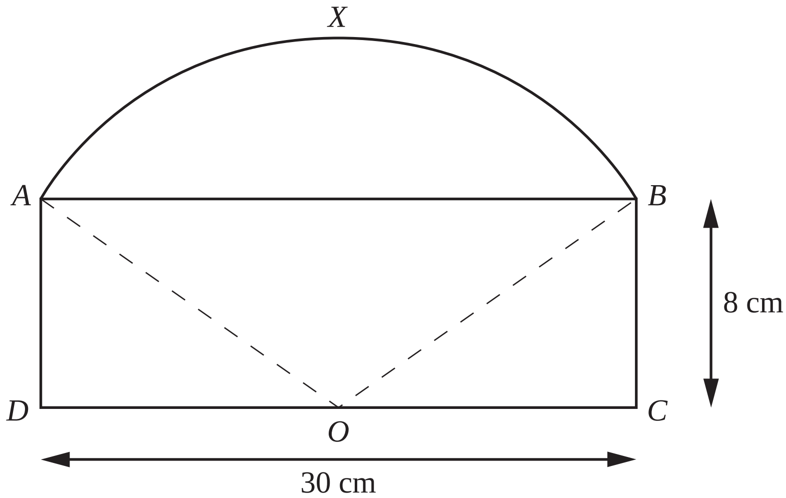
Show that $PA = 4\sqrt{3}$ cm and $PB = 12$ cm. [2]

Find, to 1 decimal place,

the area of the shaded region, [4]

(iii) the perimeter of the shaded region. [4]

9



The diagram shows a rectangle *ABCD* and an arc *AXB* of a circle with centre at *O*, the mid-point of *DC*. The lengths of *DC* and *BC* are 30 cm and 8 cm respectively. Find

(i) the length of *OA*, [2]

(ii) the angle *AOB*, in radians, [2]

(iii) the perimeter of figure *ADOCBXA*, [2]

(iv) the area of figure *ADOCBXA*. [2]

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