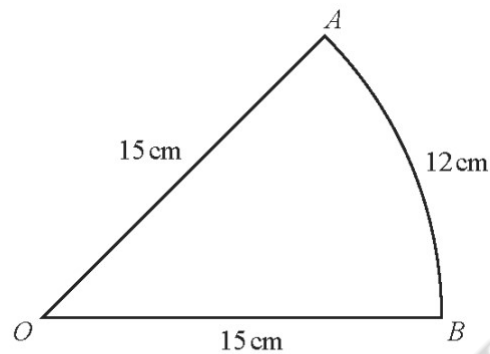


Additional Mathematics- 0606
Circular Measure Questions

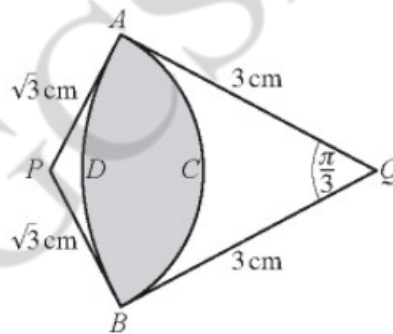
1)



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]

2)

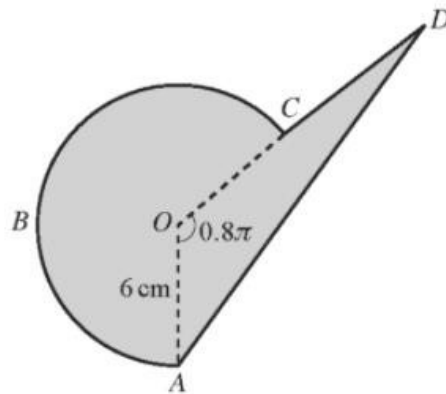


In the diagram, ACB is an arc of a circle with centre P , and ADB is an arc of a circle with centre Q .

Angle $AQB = \frac{\pi}{3}$, $AQ = BQ = 3$ cm and $AP = BP = \sqrt{3}$ cm.

- (i) Show that angle $APB = \frac{2\pi}{3}$. [2]
 (ii) Find the perimeter of the shaded region. [3]
 (iii) Find the area of the shaded region. [5]

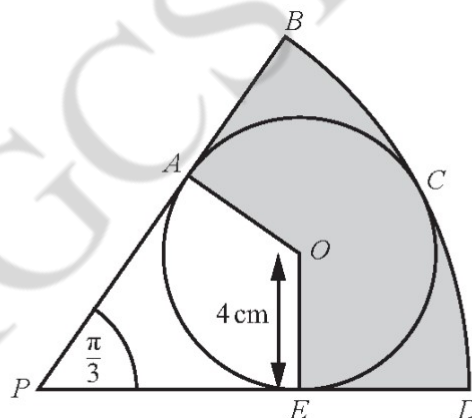
3)



The diagram represents a company logo $ABCD A$, 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]

4)



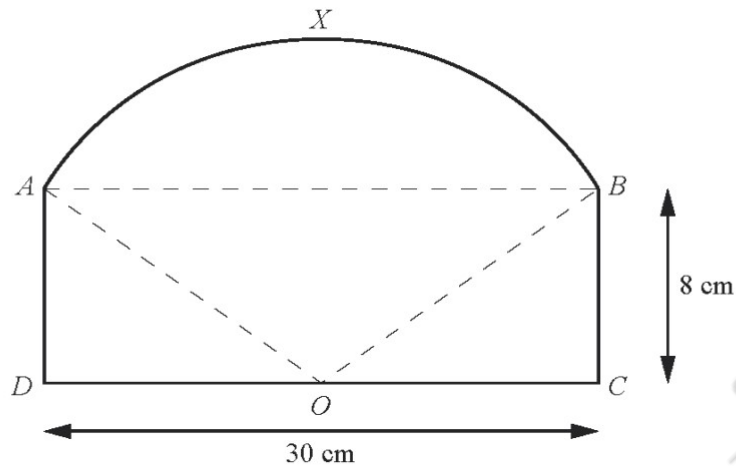
The diagram shows a circle, centre O , radius 4 cm, enclosed within a sector $PBCDP$ of a circle, centre P . The circle centre O touches the sector at points A , C and E . Angle BPD is $\frac{\pi}{3}$ radians.

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

Find, to 1 decimal place,

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

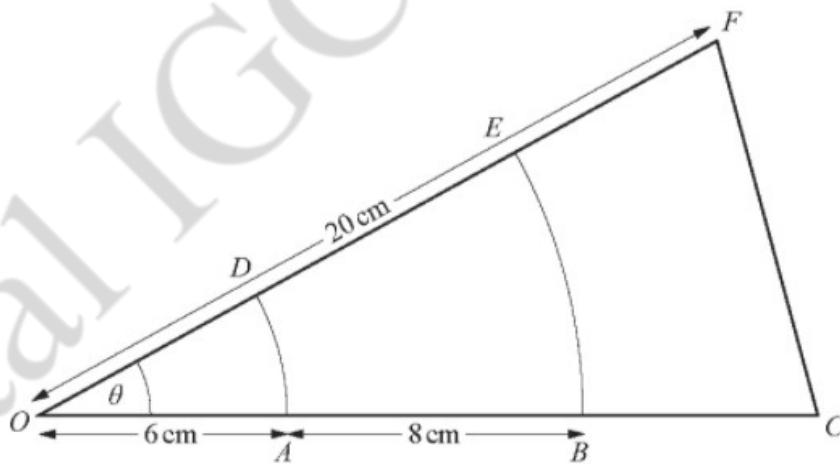
5)



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]

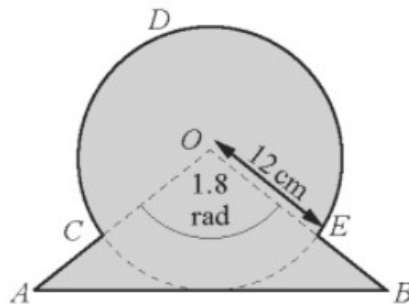
6)



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 cm². 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]

7)

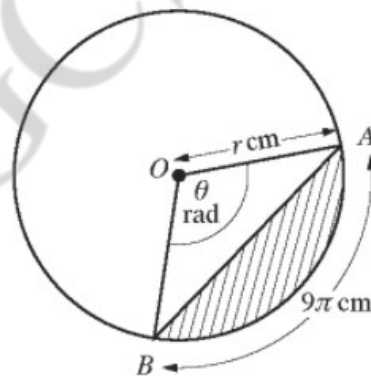


The diagram shows an isosceles triangle AOB and a sector $OCDEO$ of a circle with centre O . The line AB is a tangent to the circle. Angle $AOB = 1.8$ radians and the radius of the circle is 12 cm.

- (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]

8)

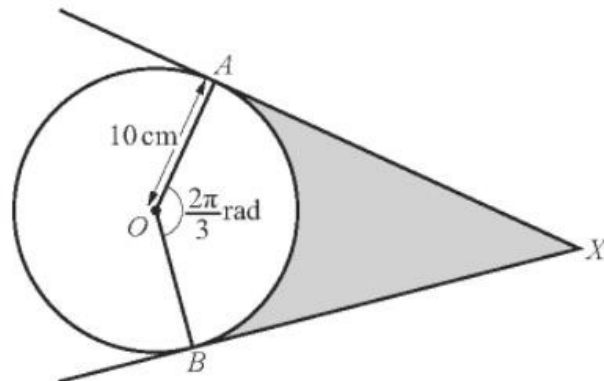
The figure shows a circle, centre O , radius r cm. The length of the arc AB of the circle is 9π cm. Angle AOB is θ radians and is 3 times angle OBA .



- (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]

P.T.O

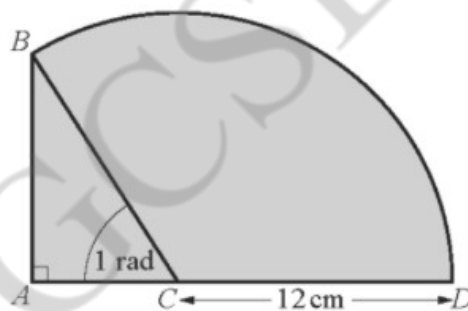
9)



The figure shows a circle, centre O , with radius 10 cm. The lines XA and XB are tangents to the circle at A and B respectively, and angle AOB is $\frac{2\pi}{3}$ radians.

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

10)

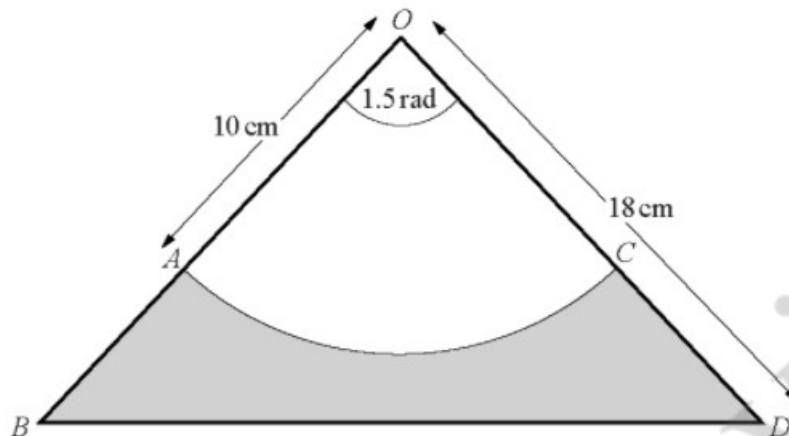


The diagram shows a right-angled triangle ABC and a sector $CBDC$ of a circle with centre C and radius 12 cm. Angle $ACB = 1$ radian and ACD is a straight line.

- (i) Show that the length of AB is approximately 10.1 cm. [1]
 (ii) Find the perimeter of the shaded region. [5]
 (iii) Find the area of the shaded region. [4]

P.T.O

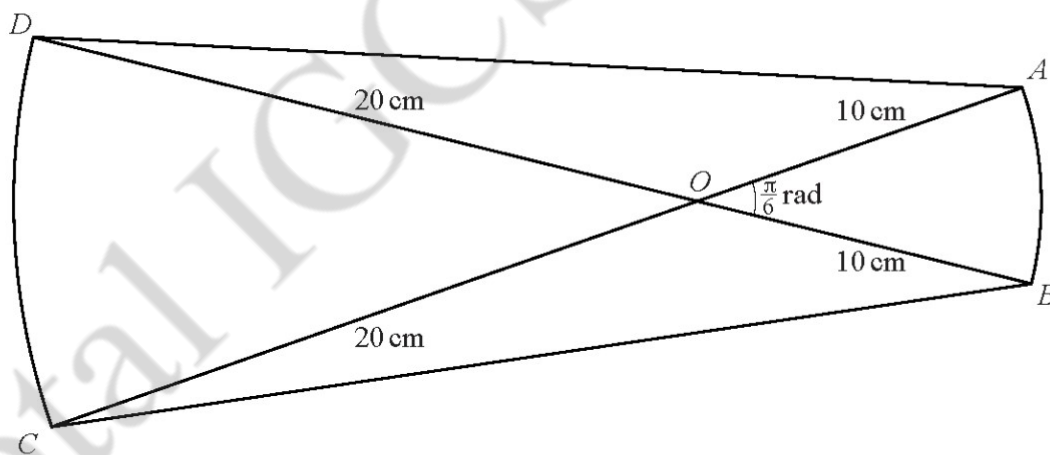
11)



The diagram shows an isosceles triangle OBD in which $OB = OD = 18$ cm and angle $BOD = 1.5$ radians. An arc of the circle, centre O and radius 10 cm, meets OB at A and OD at C .

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

12)

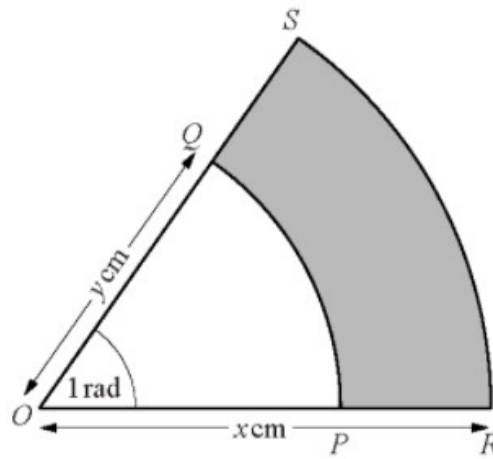


The diagram shows four straight lines, AD , BC , AC and BD . Lines AC and BD intersect at O such that angle AOB is $\frac{\pi}{6}$ radians. AB is an arc of the circle, centre O and radius 10 cm, and CD is an arc of the circle, centre O and radius 20 cm.

- (i) Find the perimeter of $ABCD$. [4]

P.T.O

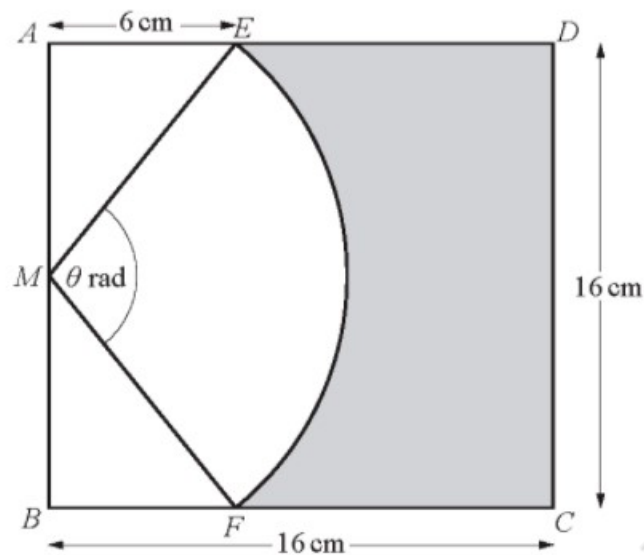
13)



In the diagram PQ and RS are arcs of concentric circles with centre O and angle $POQ = 1$ radian. The radius of the larger circle is x cm and the radius of the smaller circle is y cm.

- (i) Given that the perimeter of the shaded region is 20 cm, express y in terms of x . [2]
- (ii) Given that the area of the shaded region is 16 cm^2 , express y^2 in terms of x^2 . [2]
- (iii) Find the value of x and of y . [4]

14)

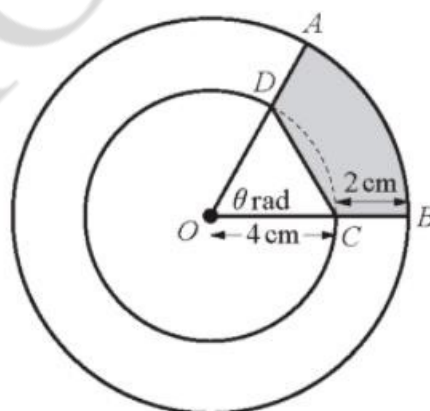


The diagram shows a square $ABCD$ of side 16 cm. M is the mid-point of AB . The points E and F are on AD and BC respectively such that $AE = BF = 6$ cm. EF is an arc of the circle centre M , such that angle EMF is θ radians.

- (i) Show that $\theta = 1.855$ radians, correct to 3 decimal places. [2]
- (ii) Calculate the perimeter of the shaded region. [4]
- (iii) Calculate the area of the shaded region. [3]

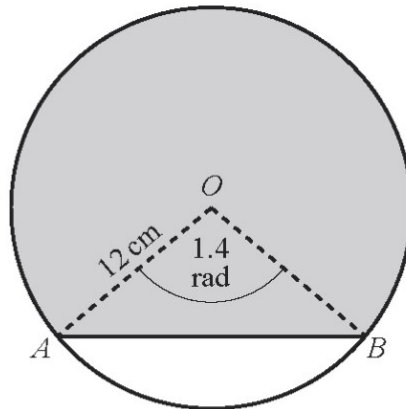
15)

The diagram shows two concentric circles, centre O , radii 4 cm and 6 cm. The points A and B lie on the larger circle and the points C and D lie on the smaller circle such that ODA and OCB are straight lines.



- (i) Given that the area of triangle OCD is 7.5 cm², show that $\theta = 1.215$ radians, to 3 decimal places. [2]
- (ii) Find the perimeter of the shaded region. [4]
- (iii) Find the area of the shaded region. [3]

16)



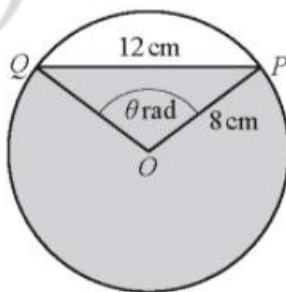
The diagram shows a circle with centre O and a chord AB . The radius of the circle is 12 cm and angle AOB is 1.4 radians.

- (i) Find the perimeter of the shaded region. [5]

P.T.O

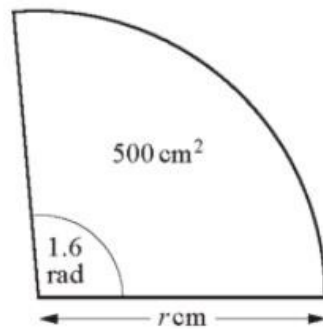
17)

The diagram shows a circle, centre O , radius 8 cm. Points P and Q lie on the circle such that the chord $PQ = 12$ cm and angle $POQ = \theta$ radians.



- (i) Show that $\theta = 1.696$, correct to 3 decimal places. [2]
 (ii) Find the perimeter of the shaded region. [3]
 (iii) Find the area of the shaded region. [3]

18)



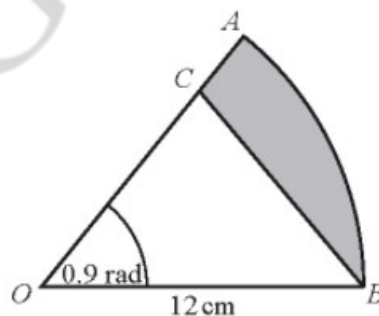
The diagram shows a sector of a circle of radius r cm. The angle of the sector is 1.6 radians and the area of the sector is 500 cm^2 .

- (i) Find the value of r . [2]
 (ii) Hence find the perimeter of the sector. [2]

P.T.O

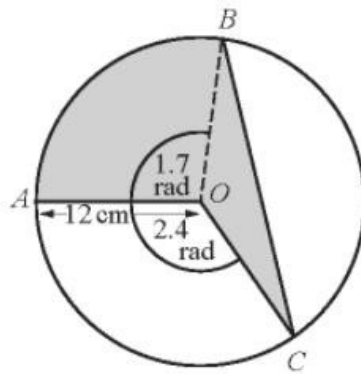
19)

The diagram shows a sector, AOB , of a circle centre O , radius 12 cm. Angle $AOB = 0.9$ radians. The point C lies on OA such that $OC = CB$.



- (i) Show that $OC = 9.65$ 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]

20)

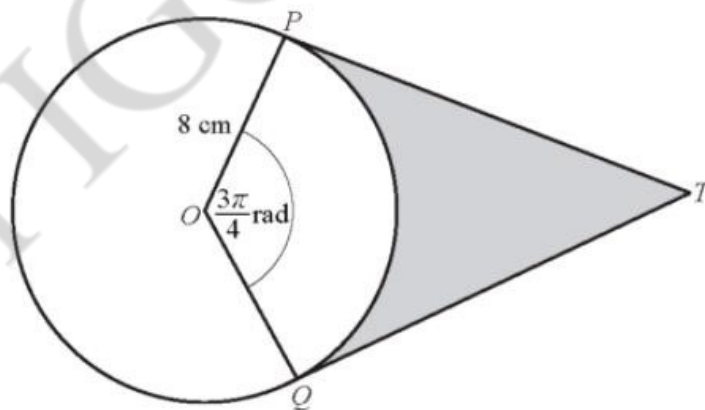


The diagram shows a circle, centre O , radius 12 cm. The points A , B and C lie on the circumference of this circle such that angle AOB is 1.7 radians and angle AOC is 2.4 radians.

- (i) Find the area of the shaded region. [4]
 (ii) Find the perimeter of the shaded region. [5]

P.T.O

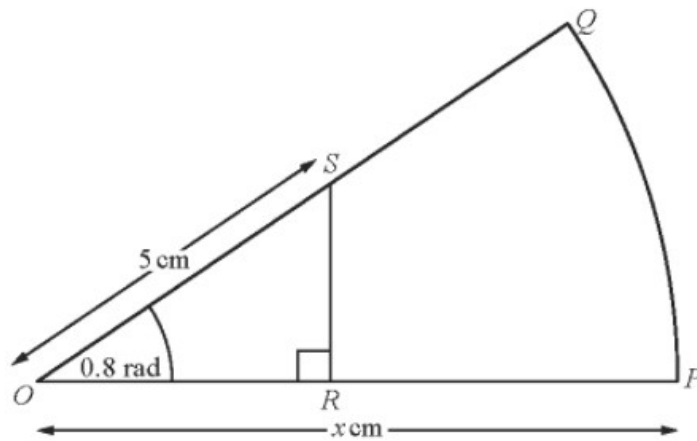
21)



The diagram shows a circle, centre O , radius 8 cm. The points P and Q lie on the circle. The lines PT and QT are tangents to the circle and angle $POQ = \frac{3\pi}{4}$ radians.

- (i) Find the length of PT . [2]
 (ii) Find the area of the shaded region. [3]
 (iii) Find the perimeter of the shaded region. [2]

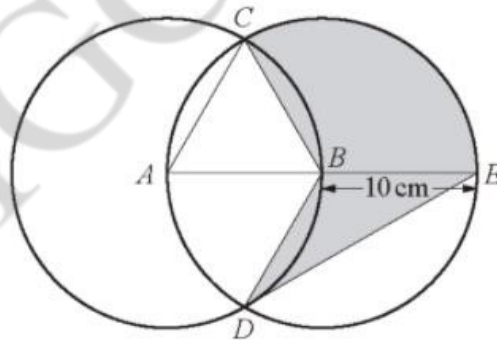
22)



The diagram shows a sector OPQ of a circle with centre O and radius x cm. Angle POQ is 0.8 radians. The point S lies on OQ such that $OS = 5$ cm. The point R lies on OP such that angle ORS is a right angle. Given that the area of triangle ORS is one-fifth of the area of sector OPQ , find

- (i) the area of sector OPQ in terms of x and hence show that the value of x is 8.837 correct to 4 significant figures, [5]
- (ii) the perimeter of $PQSR$, [3]
- (iii) the area of $PQSR$. [2]

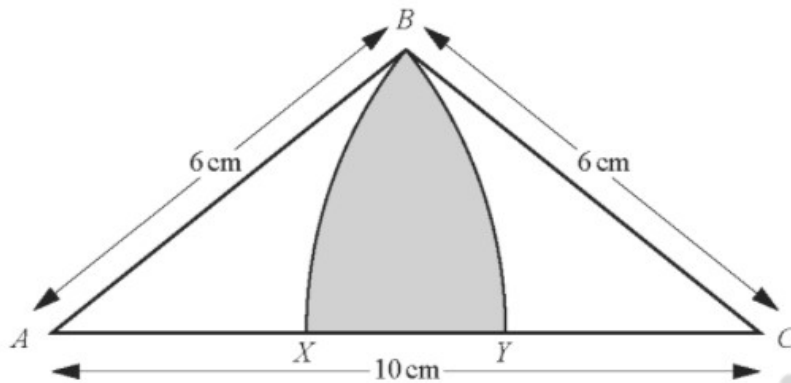
23)



The diagram shows two circles, centres A and B , each of radius 10 cm. The point B lies on the circumference of the circle with centre A . The two circles intersect at the points C and D . The point E lies on the circumference of the circle centre B such that ABE is a diameter.

- (i) Explain why triangle ABC is equilateral. [1]
- (ii) Write down, in terms of π , angle CBE . [1]
- (iii) Find the perimeter of the shaded region. [5]
- (iv) Find the area of the shaded region. [3]

24)

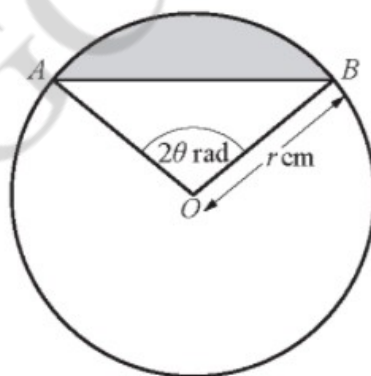


The diagram shows an isosceles triangle ABC such that $AC = 10$ cm and $AB = BC = 6$ cm. BX is an arc of a circle, centre C , and BY is an arc of a circle, centre A .

- (i) Show that angle $ABC = 1.970$ radians, correct to 3 decimal places. [2]
- (ii) Find the perimeter of the shaded region. [4]
- (iii) Find the area of the shaded region. [3]

P.T.O

25)

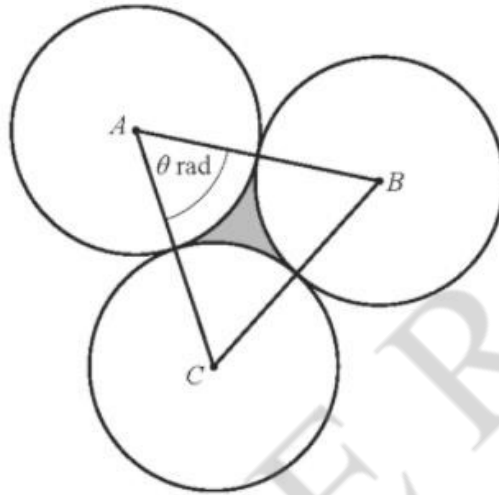


The diagram shows a circle, centre O , radius r cm. The points A and B lie on the circle such that angle $AOB = 2\theta$ radians.

- (i) Find, in terms of r and θ , an expression for the length of the chord AB . [1]

- (ii) Given that the perimeter of the shaded region is 20 cm, show that $r = \frac{10}{\theta + \sin \theta}$. [2]
- (iii) Given that r and θ can vary, find the value of $\frac{dr}{d\theta}$ when $\theta = \frac{\pi}{6}$. [4]
- (iv) Given that r is increasing at the rate of 15 cm s^{-1} , find the corresponding rate of change of θ when $\theta = \frac{\pi}{6}$. [3]

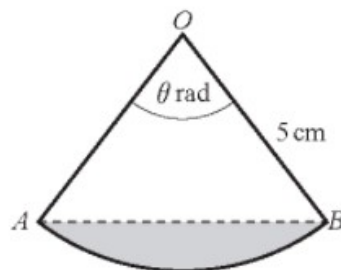
26)



The diagram shows 3 circles with centres A , B and C , each of radius 5 cm. Each circle touches the other two circles. Angle BAC is θ radians.

- (i) Write down the value of θ . [1]
- (ii) Find the area of the shaded region between the circles. [4]

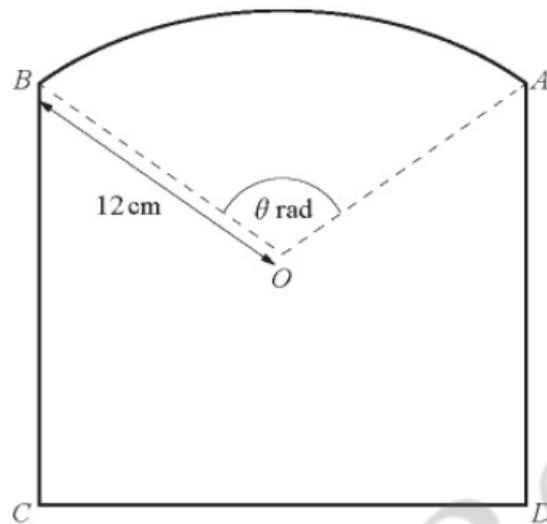
27)



The diagram shows a sector of a circle with centre O and radius 5 cm. The length of the arc AB is 7 cm. Angle AOB is θ radians.

- (i) Explain why θ must be greater than 1 radian. [1]
- (ii) Find the value of θ . [2]
- (iii) Calculate the area of the sector AOB . [2]
- (iv) Calculate the area of the shaded segment. [2]

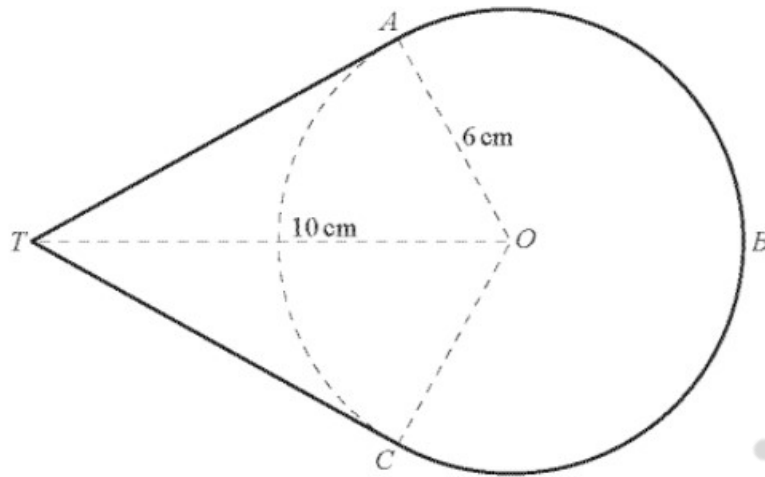
28)



The diagram shows a sector AOB of the circle, centre O , radius 12 cm , together with points C and D such that $ABCD$ is a rectangle. The angle AOB is θ radians and the perimeter of the sector AOB is 47 cm .

- (i) Show that $\theta = 1.92$ radians correct to 2 decimal places. [2]
- (ii) Find the length of CD . [2]
- (iii) Given that the total area of the shape is 425 cm^2 , find the length of AD . [5]

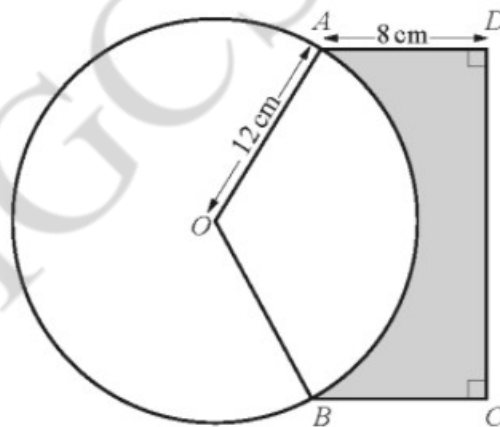
29)



The points A , B and C lie on a circle centre O , radius 6 cm. The tangents to the circle at A and C meet at the point T . The length of OT is 10 cm. Find

- (i) the angle TOA in radians, [2]
- (ii) the area of the region $TABCT$, [6]
- (iii) the perimeter of the region $TABCT$. [2]

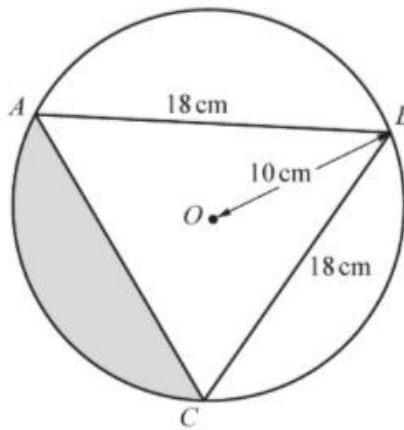
30)



The diagram shows a circle, centre O , radius 12 cm. The points A and B lie on the circumference of the circle and form a rectangle with the points C and D . The length of AD is 8 cm and the area of the minor sector AOB is 150 cm².

- (i) Show that angle AOB is 2.08 radians, correct to 2 decimal places. [2]
- (ii) Find the area of the shaded region $ADCB$. [6]
- (iii) Find the perimeter of the shaded region $ADCB$. [3]

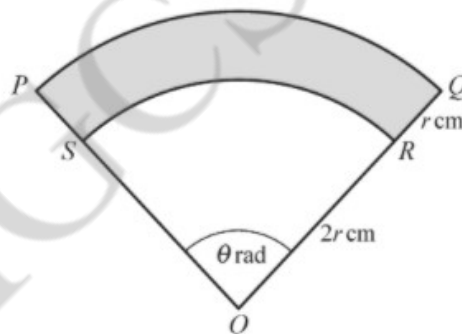
31)



The diagram shows a circle centre O , radius 10 cm. The points A , B and C lie on the circumference of the circle such that $AB = BC = 18$ cm.

- (i) Show that angle $AOB = 2.24$ radians correct to 2 decimal places. [3]
- (ii) Find the perimeter of the shaded region. [5]
- (iii) Find the area of the shaded region. [3]

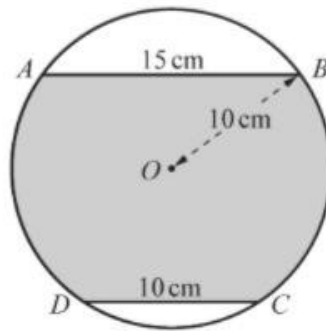
32)



The diagram shows a sector OPQ of the circle centre O , radius $3r$ cm. The points S and R lie on OP and OQ respectively such that ORS is a sector of the circle centre O , radius $2r$ cm. The angle $POQ = \theta$ radians. The perimeter of the shaded region $PQRS$ is 100 cm.

- (i) Find θ in terms of r . [2]
- (ii) Hence show that the area, A cm², of the shaded region $PQRS$ is given by $A = 50r - r^2$. [2]
- (iii) Given that r can vary and that A has a maximum value, find this value of A . [2]
- (iv) Given that A is increasing at the rate of 3 cm²s⁻¹ when $r = 10$, find the corresponding rate of change of r . [3]
- (v) Find the corresponding rate of change of θ when $r = 10$. [3]

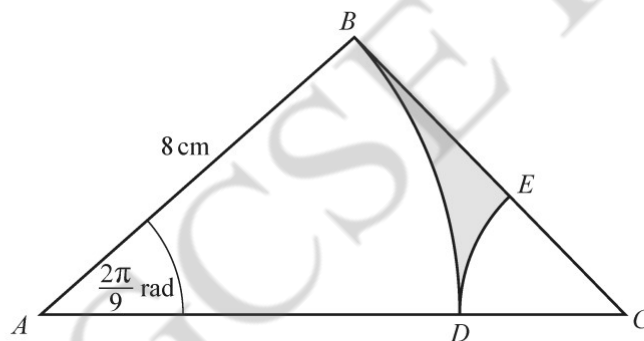
33)



The diagram shows a circle with centre O and radius 10 cm. The points A , B , C and D lie on the circle such that the chord $AB = 15$ cm and the chord $CD = 10$ cm. The chord AB is parallel to the chord DC .

- (i) Show that the angle AOB is 1.70 radians correct to 2 decimal places. [2]
- (ii) Find the perimeter of the shaded region. [4]
- (iii) Find the area of the shaded region. [4]

34)

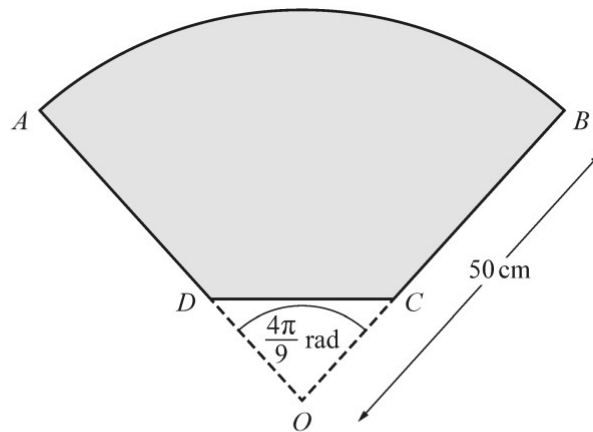


The diagram shows a right-angled triangle ABC with $AB = 8$ cm and angle $ABC = \frac{\pi}{2}$ radians. The points D and E lie on AC and BC respectively. BAD and ECD are sectors of the circles with centres A and C respectively. Angle $BAD = \frac{2\pi}{9}$ radians.

- (i) Find the area of the shaded region. [6]
- (ii) Find the perimeter of the shaded region. [3]

P.T.O

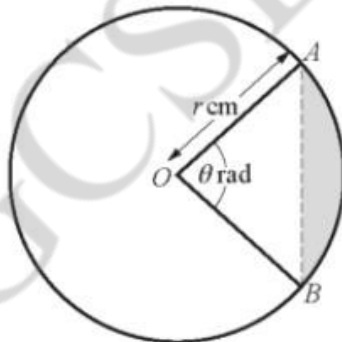
35)



The diagram shows a company logo, $ABCD$. The logo is part of a sector, AOB , of a circle, centre O and radius 50 cm. The points C and D lie on OB and OA respectively. The lengths AD and BC are equal and $AD : AO$ is $7 : 10$. The angle AOB is $\frac{4\pi}{9}$ radians.

- (i) Find the perimeter of $ABCD$. [5]
- (ii) Find the area of $ABCD$. [3]

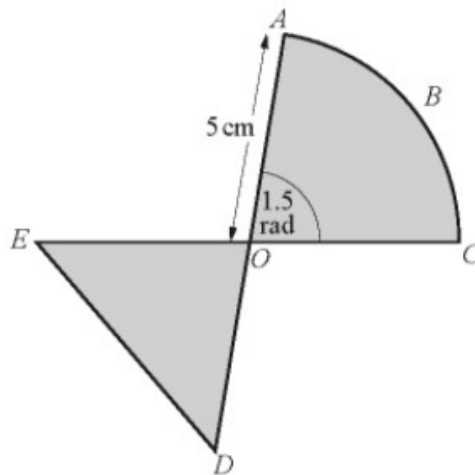
36)



The diagram shows a circle with centre O and radius r cm. The minor arc AB is such that angle AOB is θ radians. The area of the minor sector AOB is 48 cm^2 .

- (i) Show that $\theta = \frac{96}{r^2}$. [2]
- (ii) Given that the minor arc AB has length 12 cm, find the value of r and of θ . [3]
- (iii) Using your values of r and θ , find the area of the shaded region. [2]

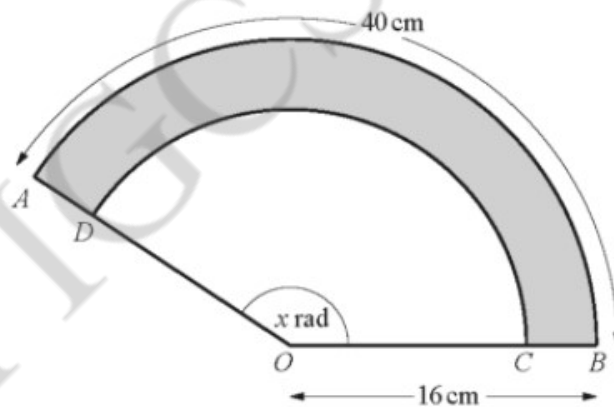
37)



In the diagram, ABC is an arc of the circle centre O , radius 5 cm , and angle AOC is 1.5 radians. AD and CE are diameters of the circle and DE is a straight line.

- (i) Find the total perimeter of the shaded regions. [3]
 (ii) Find the total area of the shaded regions. [3]

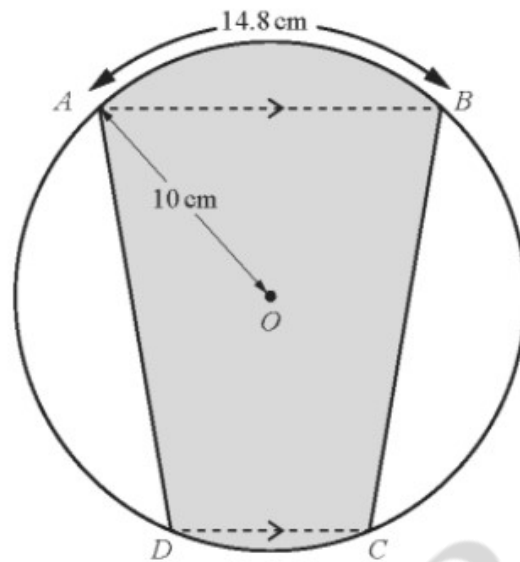
38)



In the diagram AOB and DOC are sectors of a circle centre O . The angle AOB is x radians. The length of the arc AB is 40 cm and the radius OB is 16 cm .

- (i) Find the value of x . [2]
 (ii) Find the area of sector AOB . [2]
 (iii) Given that the area of the shaded region $ABCD$ is 140 cm^2 , find the length of OC . [3]

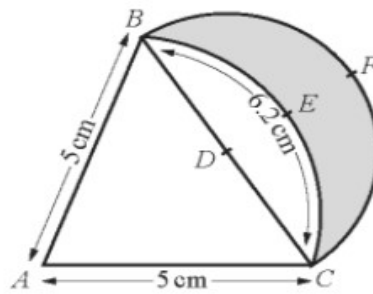
39)



The diagram shows a circle, centre O , radius 10 cm . The points A , B , C and D lie on the circumference of the circle such that AB is parallel to DC . The length of the minor arc AB is 14.8 cm . The area of the minor sector ODC is 21.8 cm^2 .

- (i) Write down, in radians, angle AOB . [1]
- (ii) Find, in radians, angle DOC . [2]
- (iii) Find the perimeter of the shaded region. [4]
- (iv) Find the area of the shaded region. [3]

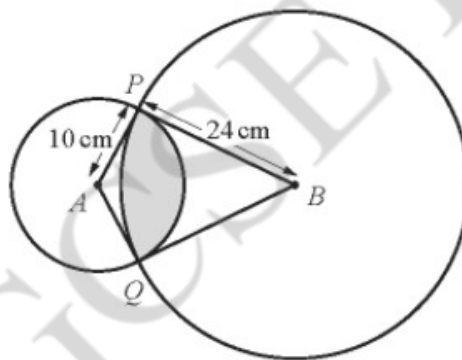
40)



The diagram shows an isosceles triangle ABC , where $AB = AC = 5$ cm. The arc BEC is part of the circle centre A and has length 6.2 cm. The point D is the midpoint of the line BC . The arc BFC is a semi-circle centre D .

- (i) Show that angle BAC is 1.24 radians. [1]
- (ii) Find the perimeter of the shaded region. [3]
- (iii) Find the area of the shaded region. [4]

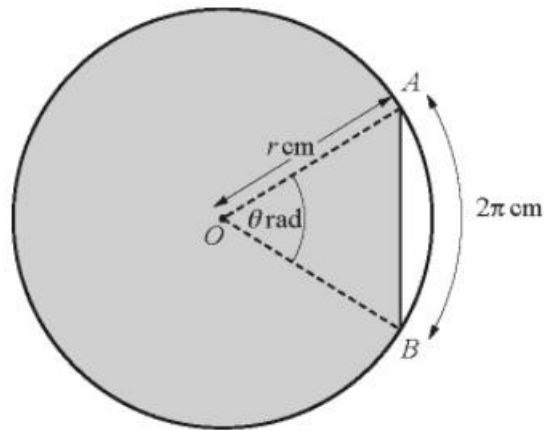
41)



The diagram shows a circle, centre A , radius 10 cm, intersecting a circle, centre B , radius 24 cm. The two circles intersect at the points P and Q . The radii AP and AQ are tangents to the circle with centre B . The radii BP and BQ are tangents to the circle with centre A .

- (i) Show that angle PAQ is 2.35 radians, correct to 3 significant figures. [2]
- (ii) Find angle PBQ in radians. [1]
- (iii) Find the perimeter of the shaded region. [3]
- (iv) Find the area of the shaded region. [4]

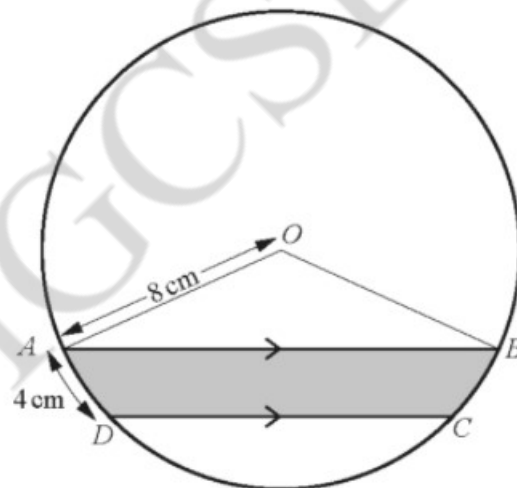
42)



The diagram shows a circle, centre O of radius r cm, and a chord AB . Angle $AOB = \theta$ radians. The length of the major arc AB is 5 times the length of the minor arc AB . The minor arc AB has length 2π cm.

- (i) Find the value of θ and of r . [2]
- (ii) Calculate the exact perimeter of the shaded segment. [2]
- (iii) Calculate the exact area of the shaded segment. [4]

43)



The diagram shows a circle, centre O , radius 8 cm. The points A , B , C and D lie on the circumference of the circle such that AB is parallel to DC . The length of the arc AD is 4 cm and the length of the chord AB is 15 cm.

- (i) Find, in radians, angle AOD . [1]
- (ii) Hence show that angle $DOC = 1.43$ radians, correct to 2 decimal places. [3]
- (iii) Find the perimeter of the shaded region. [3]
- (iv) Find the area of the shaded region. [4]

44)

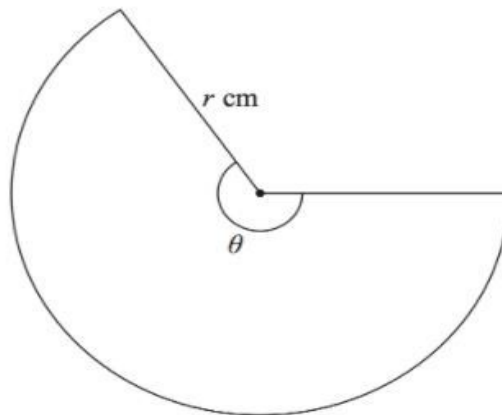
Diagram **NOT**
accurately drawn**Figure 1**

Figure 1 shows a sector of a circle. The circle has radius r cm and the sector has angle θ radians. The sector has an arc length of 18π cm and an area of 126π cm².

Find

- (i) the value of r ,
- (ii) the exact value of θ .

(5)

45) – extra question (test your concept)

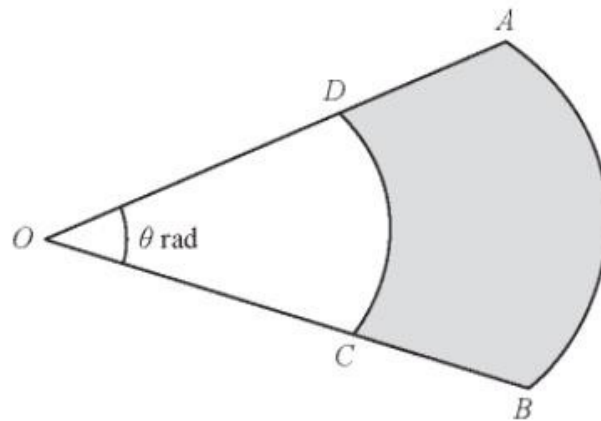


Diagram NOT
accurately drawn

Figure 1

Figure 1 shows a sector OAB of the circle with centre O and radius 10 cm.

The points C and D lie on OB and OA respectively and CD is an arc of the circle with centre O and radius 6 cm. The size of angle AOB is θ radians. The shaded region is bounded by the arcs AB and CD and the lines AD and BC .

The area of the shaded region is S cm².

(a) Show that $S = 32\theta$.

(3)

The size of angle AOB is increasing at a constant rate of 0.2 rad/s.

(b) Find the rate of increase of S .

(2)

When the area of the shaded region is 20 cm²

(c) calculate the perimeter of the shaded region.

(5)