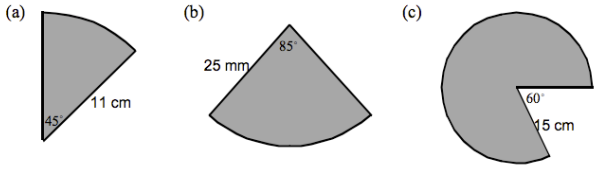
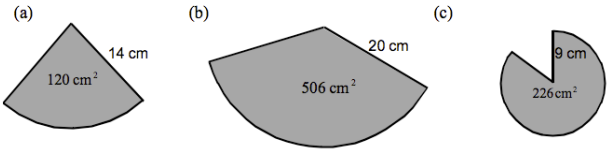
This lesson will be based upon a STUDENT DIRECTED DISCUSSION model ….. in your groups, you should be having DISCUSSIONS about how to think and work through and then present the solutions to the following questions. So, in your group, discuss & prepare solutions to the following questions. Record the key ideas of your discussions/solutions in your notebook. Then, once you have had your discussions, present your solutions on the board. Solutions do NOT necessarily NEED to be correct – they simply form the basis for DISCUSSIONS !!!! If your group has (i) multiple solutions that lead to the same answers OR (ii) same/different solutions that lead to different answers, present them

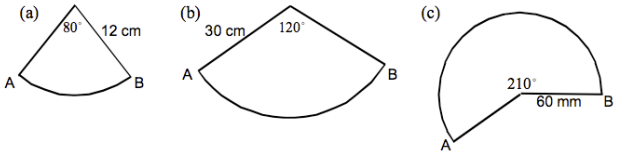
2. Calculate the area of each sector below.



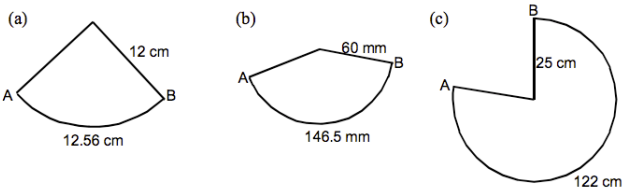
4. In each diagram below the area of the sector is given. Calculate the size of the angle at the centre of the sector.



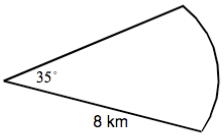
1. Calculate the length of arc AB in each question below



3. In each diagram below the length of arc AB is given. Calculate the size of the angle at the centre of the sector.

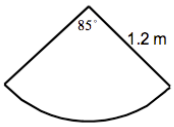


5. The beam from a lighthouse reaches a distance of 8 kilometres and spreads to an angle of 35°.



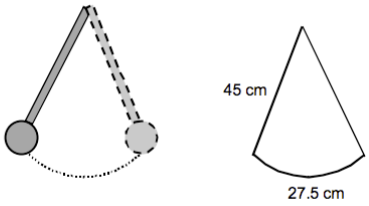
Calculate the area covered by the beam from the lighthouse.

6. The curved part on an anchor is in the shape of an arc of a circle which has radius 1.2 metres.



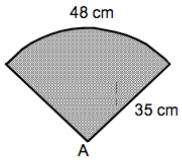
Calculate the length of this arc.

7. A pendulum is 45 centimetres long. When the pendulum swings it travels along the arc of a circle and covers a distance of 27.5 centimetres.



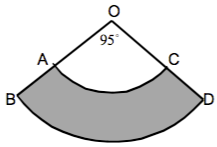
Calculate the size of the angle through which the pendulum travels.

10. A fan is in the shape of an arc of a circle with radius 35 centimetres.



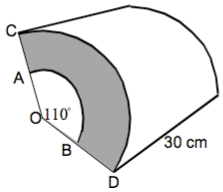
Calculate the size of the angle at A.

13. In the diagram below AC and BD are arcs of circles with centres at O. The radius, OA, is 10 centimetres and the radius, OB, is 16 centimetres.

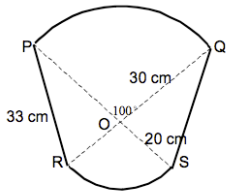


Find the shaded area.

14. The diagram shows a prism whose cross-section is the area between two sectors. One sector has radius OA = 12 centimetres and the other has radius OC = 15 centimetres. Calculate the volume of this prism.

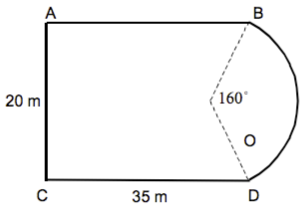


15. In the diagram PQ and RS are arcs of circles with centre O. The radius, OQ, is 30 centimetres long and the radius, OS, is 20 centimetres long.



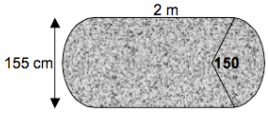
Calculate the perimeter of the shape.

16. The diagram below shows an ornamental garden. The garden is in the shape of a rectangle with a sector of a circle added at one end. The length of the garden is 35 metres and its breadth is 20 metres.



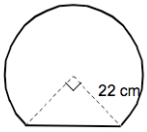
(a) Calculate OB the radius of the sector.
(b) Find the perimeter of the garden.

17. A worktop is in the shape of a rectangle with identical sectors of a circle, centre O, at each end. The width of the tabletop is 155 centimetres and its length is 2 metres.



Calculate the perimeter of the worktop.

18. The diagram below shows a mirror. The mirror is in the shape of the sector of a circle with a straight base. The radius of the sector is 22 centimetres.



Calculate the distance round the outside of the mirror.

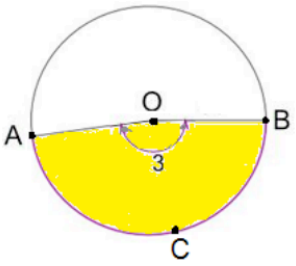
Source: of the following four questions:
http://www.thinkib.net/files/mathhlsl/files/Teaching%20Materials/Trigonometry/4_Qs_circles_arcs_sectors_1_with_answers.pdf

1. A circle of radius 8 cm has a sector whose central angle has radian measure of 3. Find the following **exactly**:

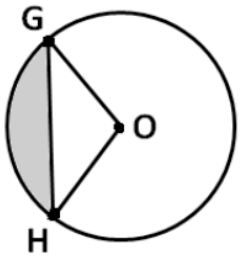
(a) the length of the arc from A to B passing through C.

(b) the area of the shaded sector.

[***no*** *calculator*]



2. O is the centre of a circle with radius 24 cm. Chord $[GH]$ is 36 cm. Find the area of the shaded region. [*calculator allowed*]



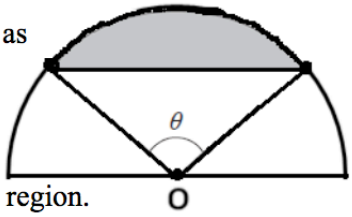
3. The semi-circle with centre O shown at right has an area of exactly 24 cm^2.

(a) Show that the shaded area can be expressed as

$$\frac{24\theta}{\pi} - \frac{24}{\pi}\sin\theta$$

(b) If $\theta = \frac{2\pi}{3}$, find the exact area of the shaded region.

[***no*** *calculator*]

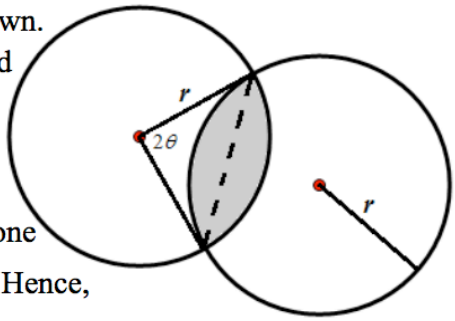


4. Two circles with the same radius r intersect as shown. The angle subtended by the common chord (dashed In diagram) at the centre of each circle is 2θ.

(a) Find an expression in terms of r and θ for the shaded area.

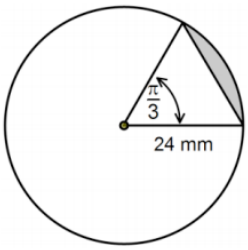
(b) If the shaded area is equal to $\frac{1}{4}$ of the area of one of the two circles show that $8\theta - 4\sin 2\theta = \pi$. Hence, find θ accurate to three significant figures.

[*calculator allowed*]

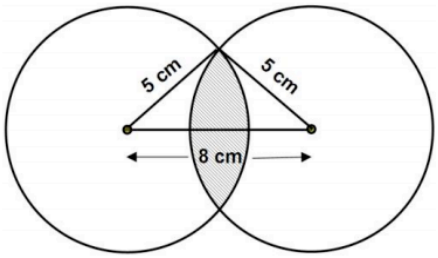


Source of the following 6 questions:
http://www.thinkib.net/files/mathhlsl/files/Teaching%20Materials/Trigonometry/exs_3-1-20v2_slhl_trig_radian_arc_sector.pdf

5. Find the area of the shaded region in the figure.

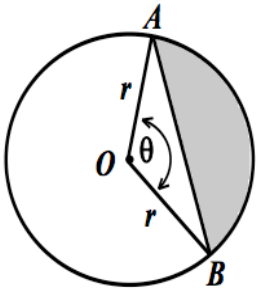


6. Find the area of the overlapping region (shaded below) enclosed by two circles both with radius of 5 cm, positioned such that their centers are 8 cm apart.



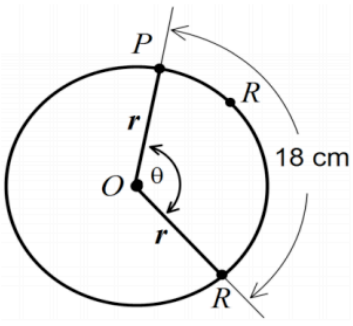
[continues on next page]

7. The diagram shows a circle with centre O and radius r. The central angle AOB has a measure of θ radians. Show that the area of the shaded region is $\frac{1}{2}r^2(\theta - \sin\theta)$.

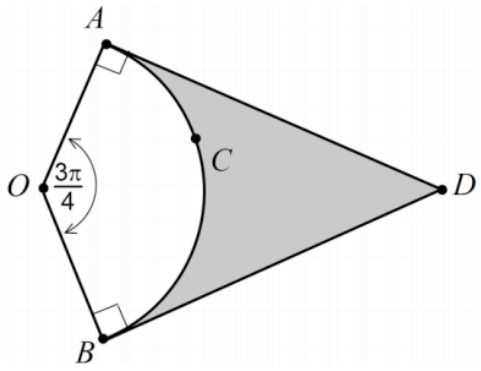


8. The diagram below shows a circle with radius r and centre O. The central angle $POR = \theta$.

The length of the minor arc PR is 18 cm. The area of the sector $OPSR$ is 108 cm^2. Find the value of r and the value of θ.

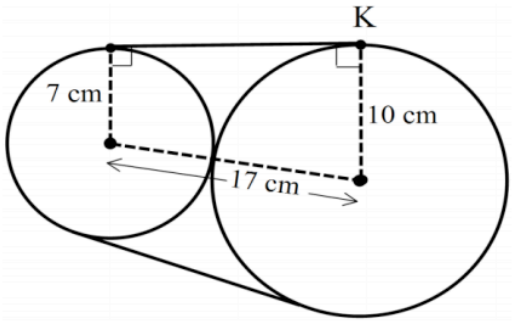


9. ACB is an arc of a circle with centre O and radius 8 cm. AD and BD are tangents to the circle at A and B and angle $AOB = \frac{3\pi}{4}$. Find the area enclosed by arc ACB and line segments AD and BD (region shaded in the diagram below).



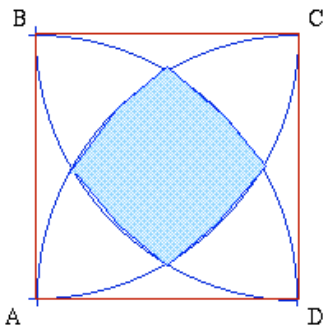
10. Two circles, one of radius 10 cm and one of radius 7 cm, are positioned such that they intersect at a single point as shown in the diagram below. A length of string is wrapped around both circles starting at point K and finishing at point K. Find the length of the string.

[diagram not to scale]



ADVANCED Higher Level Questions

Stage: 4 ★★



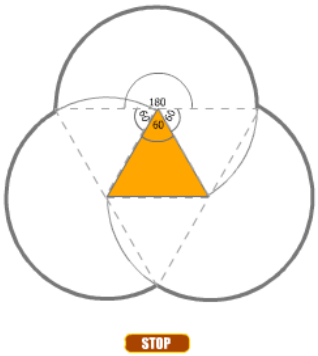
$ABCD$ is a square of side 1 unit. Arc of circles with centres at A, B, C, D are drawn in.

Prove that the area of the central region bounded by the four arcs is:

$(1 + \pi/3 + \sqrt{3})$ square units.

Source: http://nrich.maths.org/1947

Look at the equilateral triangle rotating around the equilateral triangle. It produces a flower with three petals:

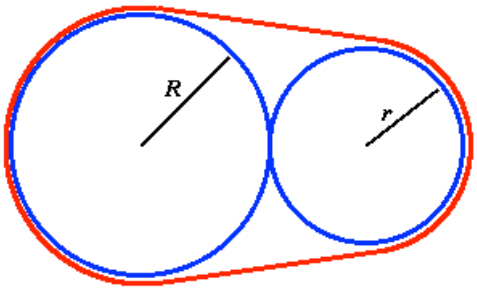


If each equilateral triangle has side length r, can you work out the perimeter of the flower's petals?

Now consider a flower made by the triangle rotating about a square with side length r - what is the perimeter of the petals now?

Source: http://nrich.maths.org/2095

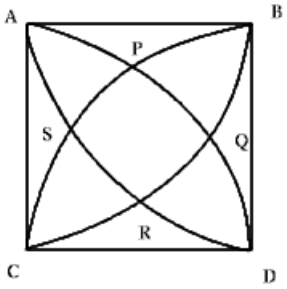
Stage: 5 ★



A length of thin wire (L) binds together two cylindrical welding rods, whose radii are R and r, by passing all the way around them both.

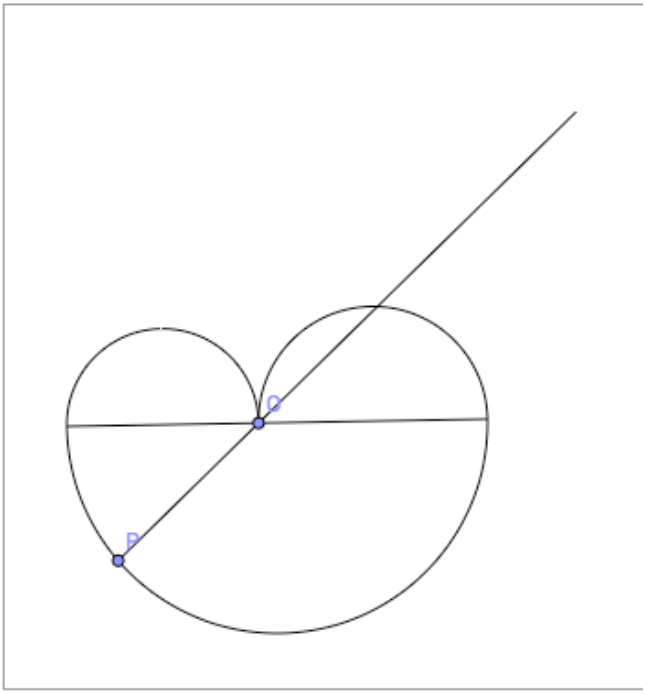
Find L in terms of R and r.

Source: http://nrich.maths.org/1960



Given a square $ABCD$ of sides 10 cm, and using the corners as centres, construct four quadrants with radius 10 cm each inside the square. The four arcs intersect at P, Q, R and S. Find the area enclosed by $PQRS$.

Source: http://nrich.maths.org/372



The figure is made up of three semicircles. The line through O divides the perimeter of this figure into two parts.

What can you say about the lengths of these two parts as you move the points P and O?

Source: http://nrich.maths.org/276

The radius of the Earth is 6367 kilometres.

An observer is on top of a lighthouse which is 25 metres high.

How far from the foot of the lighthouse, measured on the surface of the Earth, is the horizon that the observer can see?

It is 32 kilometres (21 miles) across the Channel between England and France and you can see France from the cliffs of Dover.

How high must the cliffs be for it to be possible to see that distance?

Source: http://nrich.maths.org/2357