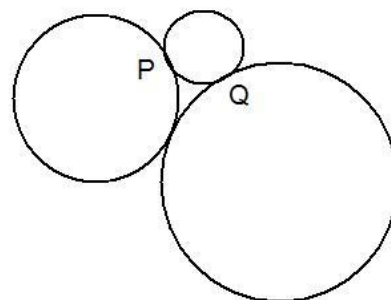




Stage 4 ★★
Mixed Selection 1

1. Circle time

Three circles C_1 , C_2 and C_3 , of radii 1 cm, 2 cm and 3 cm respectively touch as shown. C_1 meets C_2 at P , and meets C_3 at Q .

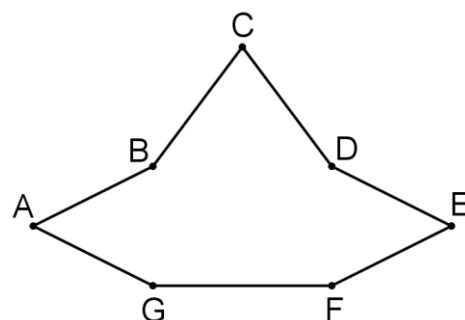


What is the length in cm of the longer arc of circle C_1 between P and Q ?

2. Unusual polygon

The diagram shows a polygon $ABCDEFGG$, in which $FG=6$ and $GA=AB=BC=CD=DE=EF$.

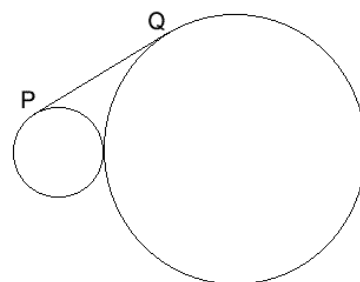
$BDFG$ is a square, and the area of the whole polygon is exactly twice the area of $BDFG$.



What is the perimeter of the polygon?

3. Common tangent

Two circles with radii 1cm and 4cm touch. The point P is on the smaller circle, Q is on the larger circle, and PQ is a tangent to both circles.



What is the length of PQ ?

4. Triangular teaser

The triangle T has sides of length 6, 5, 5. The triangle U has sides of length 8, 5, and 5.

What is the ratio area T : area U ?

These problems are adapted from UKMT Mathematical Challenge problems (ukmt.org.uk).



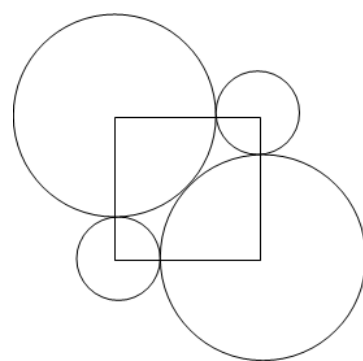
Stage 4 ★★
Mixed Selection 2

1. Centre square

The diagram shows two identical large circles and two identical smaller circles whose centres are at the corners of a square.

The two large circles are touching, and they each touch the two smaller circles. The radius of the small circles is 1cm.

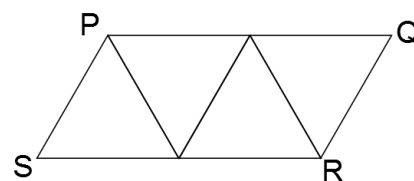
What is the radius of the large circles in centimetres?



2. Crane arm

The parallelogram PQRS is formed by joining together four equilateral triangles of side 2 units, as shown.

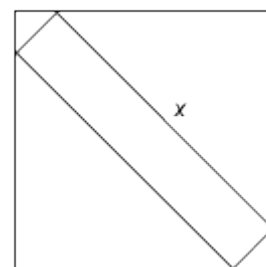
What is the length of the diagonal SQ?



3. Walk the plank

The diagram shows a 1 by x rectangular plank which fits neatly inside a 10×10 square frame.

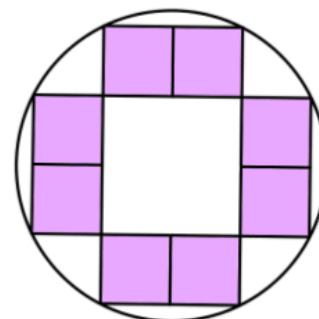
What is the value of x ?



4. Indigo interior

The diagram shows a pattern of eight equal shaded squares inside a circle of area π square units.

What is the area (in square units) of the shaded region?



These problems are adapted from UKMT Mathematical Challenge problems (ukmt.org.uk).