

**Stage 4 ★**  
**Mixed Selection 1****1. Circle in a semicircle**

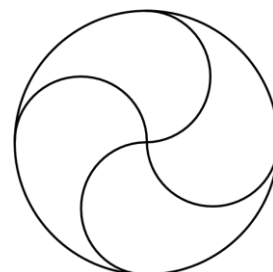
The diagram shows a semicircle containing a circle which touches the circumference of the semicircle and goes through its centre.



What fraction of the semicircle is shaded?

**2. Four parts**

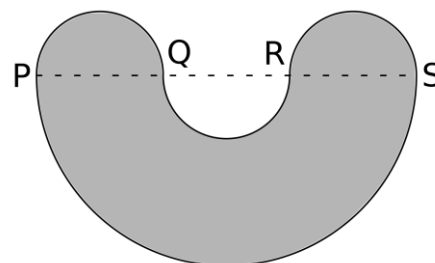
The circle of radius  $4\text{cm}$  is divided into four congruent parts by arcs of radius  $2\text{cm}$  as shown.



What is the length of the perimeter of one of the parts, in cm?

**3. Smile**

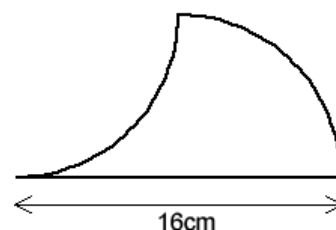
The points  $P, Q, R, S$  lie in order along a straight line, with  $PQ = QR = RS = 2\text{cm}$ . Semicircles with diameters  $PQ, QR, RS$  and  $SP$  join to make the shape shown below.



What is the area of the shape?

**4. Arc area**

This figure is made from a straight line  $16\text{cm}$  long and two quarter circles, one with its centre at the midpoint of the straight line.



What is the area of the figure (in  $\text{cm}^2$ )?

*These problems are adapted from UKMT Mathematical Challenge problems ([ukmt.org.uk](http://ukmt.org.uk))*