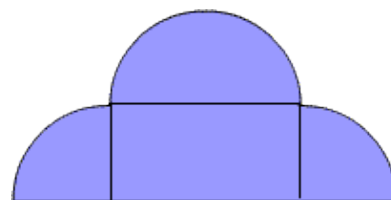**Stage 4 ★**
Mixed Selection 3 - Solutions

1. **Semicircle stack**
   The shaded area may be divided into
   a 2×1 rectangle plus a semicircle plus
   two quarter circles (all of radius 1).
   Hence the total area is that of the
   rectangle plus a circle of radius 1,
   Making $2 + \pi$.

2. **Four leaf clover**
   The radius of each disc in the figure is equal to half of the side-
   length of the square, i.e. $1/\pi$.
   Because the corners of a square are right-angled, the square hides
   exactly one quarter of each disc. So
   three-quarters of the perimeter of each disc lies on the perimeter
   of the figure. Therefore, the length of the perimeter is $4 \times \frac{3}{4} \times 2\pi \times \frac{1}{\pi} = 6$.

3. **Pentagonal area**
   The area of the pentagon is the area of a rectangle of length b and
   breadth a plus that of a triangle of base b and height $(c - a)$.

   Hence the area is $1/2 b(a + c)$.

4. **Semicircular design**
   The shaded area can be seen to be the similar to the overall
   shape. However, it has radii that are half those of the
   corresponding larger shape. This means that the area is multiplied
   by a factor of $\left(\frac{1}{2}\right)^2 = \frac{1}{4}$.

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