

## Flowers and Petals Problem

**1) For an equilateral triangle rotating around an equilateral triangle, the perimeter of the flower is:**

*Let the equilateral triangle have side length  $r$*

$$\begin{aligned} 2\pi r \times (180 \div 360) \times 3 \\ = 3\pi r \end{aligned}$$

**2) For an equilateral triangle rotating around a square, the perimeter of the flower is:**

*Let the square have side length  $r$*

$$\begin{aligned} 2\pi r \times (150 \div 360) \times 4 \\ = (10 \div 3)\pi r \end{aligned}$$

**3) For an equilateral triangle rotating around a regular pentagon, the perimeter of the flower is:**

*Let the pentagon have side length  $r$*

$$\begin{aligned} 2\pi r \times (132 \div 360) \times 5 \\ = (11 \div 3)\pi r \end{aligned}$$

**Therefore for an equilateral triangle rotating around an  $n$ -sided polygon, the perimeter of the flower is:**

Let the polygon have side length  $r$ , and  $n$  be the number of sides.

The flower's perimeter is made up of the several arcs of a circle.

If the central shape has  $n$  sides, then there are  $n$  arcs.

The length of the arc can be found by  $2\pi r$  (the general formula for the circumference of a circle) multiplied by the fraction of a circle that it is.

The fraction of a circle that the arc is, equals  $120^\circ$  (for the two equilateral triangles' internal angle) + the interior angle of the polygon.

The interior angle of the polygon can be found by the equation  $180 - (360 \div n)$ .

Therefore the fraction of a circle that each arc is:  $(360 - [120 + (180 - (360 \div n))]) \div 360$

Therefore the total perimeter of the flower is:

$$2\pi r n \frac{360 - (120 + (180 - \frac{360}{n}))}{360}$$

$$2\pi r n \frac{60 + \frac{360}{n}}{360}$$

$$\frac{2\pi r n(60n + 360)}{360n}$$

$$\frac{\pi r(60n + 360)}{180}$$

$$\frac{60\pi r n + 360\pi r}{180}$$

$$\frac{\pi r n + 6\pi r}{3}$$

$$\frac{\pi r(n + 6)}{3}$$

As the number of sides of the shape increases, the perimeter of the flower increases, by a third  $\pi r$  for each additional side. This is because as more sides are added, but the length of the sides remains the same, the whole shape just gets bigger.

**For an equilateral triangle rotating around a 100 sided polygon, the perimeter of the flower is:**

$$\begin{aligned} & (\pi r (100 + 6)) \div 3 \\ & = 35\frac{1}{3}\pi r \end{aligned}$$