26 A uniform conducting wire of length $12a$ and resistance R is wound up as a current carrying coil in the shape of (i) an equilateral triangle of side a, (ii) a square of sides a and, (iii) a regular hexagon of sides a. The coil is connected to a voltage source V_0. Find the magnetic moment of the coils in each case.

K Thinking Process

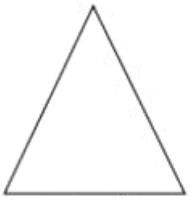
The different shapes forms figures of different area and hence, there magnetic moments varies.

We know that magnetic moment of the coils $m = nIA$.

Since, the same wire is used in three cases with same potentials, therefore, same current flows in three cases.

(i) for an equilateral triangle of side a,

$n = 4$ as the total wire of length $= 12a$



$n = 3$

Magnetic moment of the coils $m = nIA = 4I\left(\frac{\sqrt{3}}{4}a^2\right)$

$\therefore \quad m = Ia^2\sqrt{3}$

(ii) For a square of sides a,

$n = 4$

$A = a^2$

$n = 3$ as the total wire of length $= 12a$

Magnetic moment of the coils $m = nIA = 3\,I\,(a^2) = 3\,I\,a^2$

(iii) For a regular hexagon of sides a,

$n = 2$

$n = 2$ as the total wire of length $= 12a$

Magnetic moment of the coils $m = nIA = 2\,1\left(\frac{6\sqrt{3}}{4}a^2\right)$

$$m = 3\sqrt{3}a^2I$$

m is in a geometric series.