

A thin circular wire carrying a current I has a magnetic moment m . The shape of the wire is changed to square and it carries the same current. It will have a magnetic moment equal to: $\frac{m\pi}{4}$

Solution

magnetic moment $m = IA$, A – area

for circular wire $A = \pi r^2 \gg I = \frac{m}{\pi r^2}$, $P(\text{perimeter}) = 2\pi r$

for square wire $A_1 = a^2$, $P_1 = 4a$

$$P_{\text{wire}} = \text{const} \gg P = P_1 \gg 2\pi r = 4a \gg a = \frac{\pi r}{2}$$

$$m_1 = IA_1 = \frac{m}{\pi r^2} \times \left(\frac{\pi r}{2}\right)^2 = \frac{m\pi}{4}$$