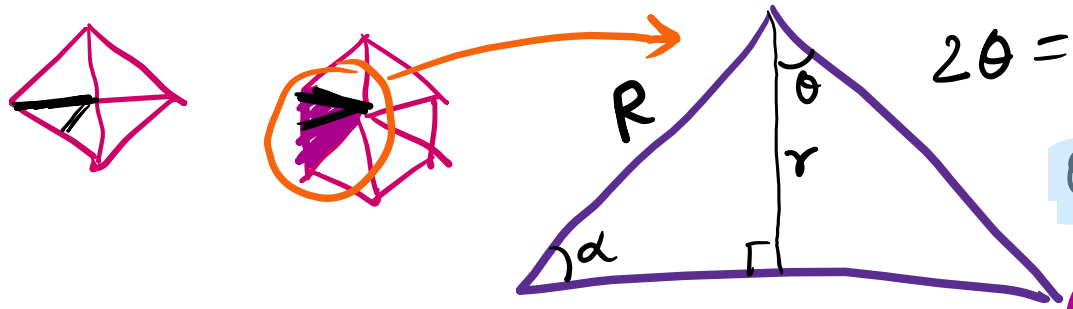
CSIR UGC NET 2019 (June)
PHYSICS (13/55)

Consider a planar wire loop as an n-sided regular polygon, in which R is the distance from the centre to a vertex. If a steady current I flows through the wire, the magnitude of the magnetic field at the centre of the loop is—

(A) $\frac{\mu_0 I}{2R}\sin\left(\frac{2\pi}{n}\right)$ (B) $\frac{\mu_0 nI}{4\pi R}\sin\left(\frac{\pi}{n}\right)$

(C) $\frac{\mu_0 nI}{2\pi R}\tan\frac{2\pi}{n}$ ✓(D) $\frac{\mu_0 nI}{2\pi R}\tan\left(\frac{\pi}{n}\right)$



$2\theta = \frac{2\pi}{n}$

$\theta = \frac{\pi}{n}$

$\alpha = \left(\frac{\pi}{2} - \frac{\pi}{n}\right)$

$B = \frac{\mu_0 I}{4\pi r}(\sin\theta + \sin\theta)$

$\sin\theta = \sin(90-\alpha) = \cos\alpha$

$= \frac{\mu_0 I}{4\pi R\sin\alpha}(2\sin\theta)$

$= \frac{\mu_0 I}{4\pi R\sin\alpha}\, 2\cos\alpha = \frac{\mu_0 I}{4\pi R}\cdot 2\cot\alpha$

$\cot\left(\frac{\pi}{2} - \frac{\pi}{n}\right)$

$= \frac{\mu_0 I}{2\pi R}\tan\frac{\pi}{n}$

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