Answer on Question#49245 - Physics - Electromagnetism

A wire of length L is bend to form regular hexagon and current I is flowing through it then what is magnetic induction at center of hexagon?

Solution:

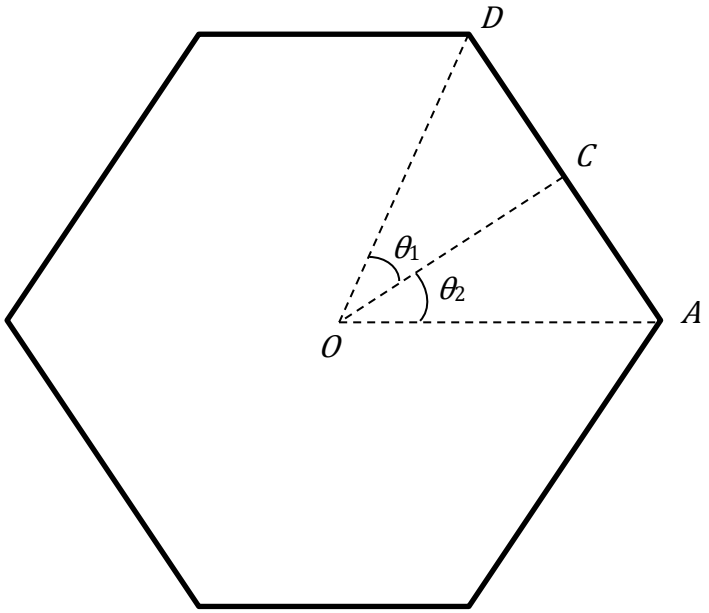

Fig. 1

Since the hexagon is regular each rib gives the same contribution to induction at the center of hexagon (point O in the Fig. 1). Let's find the induction generated by the rib AD. The distance OC from the center of hexagon to the rib AD is given by

$$OC = \frac{AD \cdot \operatorname{ctg} \theta_1}{2}$$

Whereas the AD equals $L/6$ and $\theta_1 = \theta_2 = \frac{\pi}{6}$ (the hexagon is regular) we finally obtain

$$OC = \frac{L \cdot \operatorname{ctg} \frac{\pi}{6}}{12} = \frac{L}{4\sqrt{3}}$$

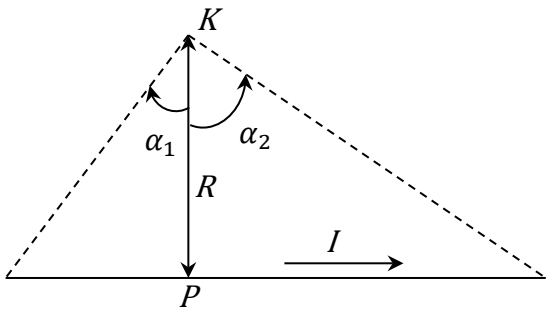

Fig. 2

The magnetic induction of the finite wire is given by

$$B = \frac{\mu_0}{4\pi}\frac{I}{R}(\sin\alpha_2 + \sin\alpha_1)$$

where I is the current, R is the distance to the wire, angles α_1 and α_2 are measured from the KP (see Fig. 2). Using this equation we can obtain the induction generated by the rib of the hexagon:

$$B_{AD} = \frac{\mu_0}{4\pi}\frac{I}{OC}(\sin\theta_2 + \sin\theta_1) = \frac{\sqrt{3}}{\pi}\frac{I}{L}$$

Given that the induction B in the center of the hexagon is six times greater than the induction of the rib, we finally obtain

$$B = 6 \cdot B_{AD} = \frac{6\sqrt{3}}{\pi}\frac{I}{L}$$

Answer: $\frac{6\sqrt{3}}{\pi}\frac{I}{L}$