Question #74548, Physics / Electromagnetism|

A long, straight wire of radius 5.0 mm carries a current of 20A. i) Calculate the magnetic field at the surface of the wire, and ii) calculate the perpendicular distance, from the axis of the wire, at which the magnitude of magnetic field will be half of its value at the wire surface.

Need to calculate:

1) The magnetic field at the surface of the wire; (***H***)

2) Calculate the perpendicular distance, from the axis of the wire, where the magnitude of the magnetic field is equal to half the value of the field on the surface of the wire. (***x***) (pic.2).

r = 5.0 mm = 0.005 m

I = 20 A

Solution:

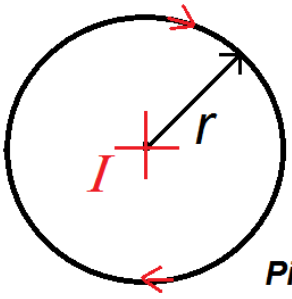
1) - The magnetic field on the wire surface (pic.1) is determined by the law of full current: $\boldsymbol{Hl = \sum I}$, where ***H*** – field, ***l*** - the length of the circuit around the wire equal to - $\boldsymbol{l = 2\pi r}$, and ***I*** – current.

$$\boldsymbol{H = \frac{I}{2\pi r} = \frac{20\ A}{2 \cdot \pi \cdot 0.005\ m} = 636.6\ \frac{A}{m}}$$

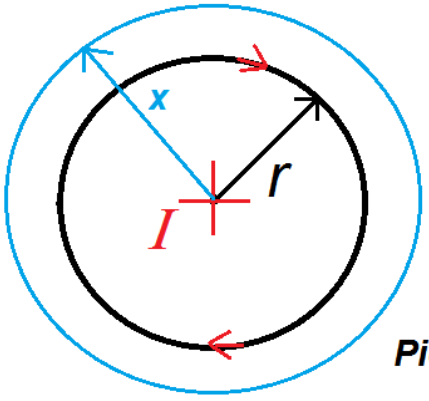
2) $\boldsymbol{\frac{1}{2}H = \frac{I}{2\pi x} \rightarrow x = \frac{I}{\pi H} = \frac{20\ A}{\pi \cdot 636.6} = 0.01\ m = 1\ cm.}$

Answer: The magnetic field ***H*** at the surface of the wire is equal – 636.6 $\frac{A}{m}$;

the perpendicular distance ***x*** is equal – 1 cm.



Pic.1



Pic.2