# Physics
# Theory Part 12

Topics: Waves and Oscillation/ Electrodynamics

Course: B.Sc/ Physics

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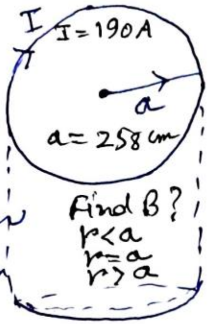
Analogous to Gauss's law in E.F inside the cylinder (hollow) is zero. Analogy is the Ampere's Law if we take Amperian loop inside of




(i) radius $\boxed{r<a}$, then it includes zero current, so

$$\int \vec{B}\cdot d\vec{l} = \mu_0 I_{ence} = 0$$

$\Rightarrow B = 0 \;\forall\; r<a$ i.e for

~~For~~ r = 0 cm, 1.20 cm.

(ii) For $\boxed{r=a}$, $\int \vec{B}\cdot d\vec{l} = \mu_0 I_{ence}$.

or, $B \times 2\pi a = \mu_0 \times I_{ence}$.

or, $B = \dfrac{\mu_0 I_{ence}}{2\pi a} = \dfrac{4\pi \times 10^{-7} \times 190}{2\pi \times 2.58 \times 10^{-2}}$

$= \boxed{147.28 \times 10^{-5}\,T}$

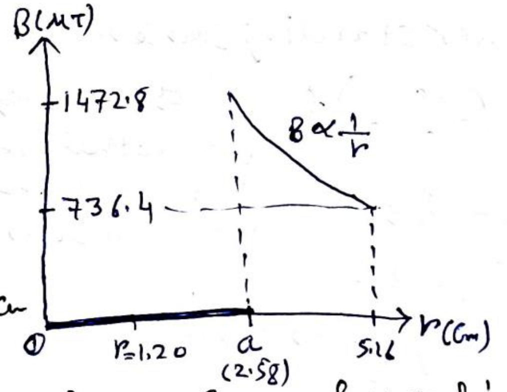
(iii) For $\boxed{r>a}$ also ~~same~~ similar result will be obtained as $I_{ence}$ is same only r changes & r = 5.16 cm

$\therefore B \times 2\pi r = \mu_0 I_{ence}$

$\therefore B = \dfrac{\mu_0 I}{2\pi r} = \dfrac{4\pi \times 10^{-7} \times 190}{2\pi \times 5.16 \times 10^{-2}}$

$= \boxed{73.64 \times 10^{-5}\,T}$

So magnetic field inside the cylinder = 0, as I = 0. and outside, $\boxed{B \propto \frac{1}{r}}$




Plot of B vs. r for cylindrical current carrying conductor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wave eqn in 1D

$$\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2}; \quad v = \frac{\omega}{K}$$

Given $y = A\sin(Kx + \omega t + \phi)$

$$L.H.S = \frac{\partial^2 y}{\partial x^2} = \frac{\partial}{\partial x}\left(\frac{\partial y}{\partial x}\right)$$

$$= \frac{\partial}{\partial x}\left[AK\cos(Kx+\omega t+\phi)\right]$$

$$= -AK^2\sin(Kx+\omega t+\phi) \quad (1)$$

$$R.H.S = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2} = \frac{1}{v^2}\frac{\partial}{\partial t}\left(\frac{\partial y}{\partial t}\right)$$

$$= \frac{1}{v^2}\frac{\partial}{\partial t}\left[A\omega\cos(Kx+\omega t+\phi)\right]$$

$$= \frac{1}{v^2} \times -A\omega^2\sin(Kx+\omega t+\phi)$$

$$= \frac{K^2}{\cancel{\omega^2}} \times -A\cancel{\omega^2}\sin(Kx+\omega t+\phi)$$

$$= -AK^2\sin(Kx+\omega t+\phi) \quad (2)$$

Thus L.H.S = R.H.S from (1) & (2) so it is a solution.

From above it is clear that for the wave eqn.

$$\boxed{\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2}}$$

Solution (general) is

$$\boxed{y = A\sin(Kx+\omega t+\phi) + B\cos(Kx+\omega t+\phi)}$$



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# FOR ANY QUERIES FEEL FREE TO CONTACT ME AT EMAIL: RAJESH.NEOGY@GMAIL.COM



**Thanksss**