task_ti7loik6aurfewkb_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

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Exercise E3 Magnetic Flux Density
(written test, approx. 6 % of a 120-minute written test, SS2021)

A) The inner wire is operated for experiments in the laboratory. A current $B_0 = 100~\rm mT$ with an amplitude of $\hat{I} = 100~\rm A$ is operated.
At what distance to it and the wire about which this value is exceeded? (3 points, independent)
The figure below shows the top view of the laboratory with the supply line between $\rm A$ and $\rm B$.
Path
$B = 42~\rm mT$
$\mu_{0} = 4\pi\cdot 10^{-7} {{\rm Vs}\over{\rm Am}}$, $\mu_{r}=1$

The formula for the magnetic field strength can be rearranged: \begin{align*} H &= {{I}\over{2\pi \cdot r}} \\ r &= {{I}\over{2\pi \cdot H}} \\ \end{align*}

Again, the magnetic flux density B is given as: $B = \mu_0 \mu_r H$
Therefore: \begin{align*} r &= \mu_0 \mu_r {{ I }\over{2\pi \cdot B}} \\ &= 4\pi\cdot 10^{-7} {{\rm Vs}\over{\rm Am}} {{100 ~\rm A}\over{2\pi \cdot 100\cdot 10^{-6} {~\rm T}}} \\ \end{align*}

a) What is the highest magnetic flux density through the line in your body? (3 points)

Path

The magnetic field strength for a conducting wire is given as:

$$\begin{align*} H &= {{I}\over{2\pi \cdot r}} \end{align*}$$

The magnetic flux density B is given as: $B = \mu_0 \mu_r H$

Here, the maximum current is $\hat{I} = 100~\rm A$ and the distance to the cable is $r = \sqrt{(0.1 {~\rm m})^2 + (0.4 {~\rm m})^2}= 0.412... ~\rm m$.

Therefore: $$\begin{align*} B &= 4\pi\cdot 10^{-7} {{\rm Vs}\over{\rm Am}} \cdot 1 \cdot {{100 ~\rm A}\over{2\pi \cdot 0.412... ~\rm m}} \end{align*}$$