

task_ddjurcpk494go2q1_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

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electric field, magnetic field, exam ee2 SS2024

Exercise E1 Capacitor

(written test, approx. 12 % of a 120-minute written test, SS2024)

2. With the graph of the magnitude of the magnetic field B as a function of the distance r from the center of the capacitor, the cross-section of the capacitor is shown. The diagram shows the cross-section of the capacitor with the center of the capacitor as the origin and the distance r from the center of the capacitor as the radial coordinate. The diagram appears:

Path

- Inner conductor: $+3.3 \text{ mA}$, $+10 \text{ nC}$ (current into the plane of the diagram)
- Outer conductor: -3.3 mA , 0 nC (current out of the plane of diagram)

Path

- $H_{\text{inner}} = 5.25 \text{ A/m}$
- $H_{\text{outer}} = 0.955 \text{ A/m}$

$C = \frac{\epsilon_0 \epsilon_r A}{d} = 8.854 \cdot 10^{-12} \frac{\text{F}}{\text{m}} \cdot \frac{10^{-6} \text{ m}^2}{200 \cdot 10^{-6} \text{ m}} = 4.427 \cdot 10^{-14} \text{ F}$

In general, the electric field is proportional to $\frac{1}{r}$.

.. What is the magnitude of the magnetic field strength B at $(-0.1 \text{ mm} | 0)$ and $(0.55 \text{ mm} | 0)$?

Path

The magnitude of the magnetic field strength H can be calculated by: $H = \frac{I}{2 \pi \cdot r}$

So:

$$\begin{aligned} H_{\text{in}} &= \frac{I}{2 \pi \cdot r_{\text{in}}} \quad \&= \quad \frac{+3.3 \text{ A}}{2 \pi \cdot \{0.1 \cdot 10^{-3} \text{ m}\}} \quad \& H_{\text{out}} &= \frac{I}{2 \pi \cdot r_{\text{out}}} \quad \&= \quad \frac{+3.3 \text{ A}}{2 \pi \cdot \{0.55 \cdot 10^{-3} \text{ m}\}} \quad \end{aligned}$$

Hint: For the direction, one has to consider the right-hand rule. By this, we get that the H -field on the right side points downwards.

Therefore, the sign of the H -field is negative.

But here, only the magnitude was questioned!

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