

task_ddjurcpk494go2q1_with_calculation

Student Group

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electric field, magnetic field, exam ee2 SS2024

Exercise E1 Capacitor

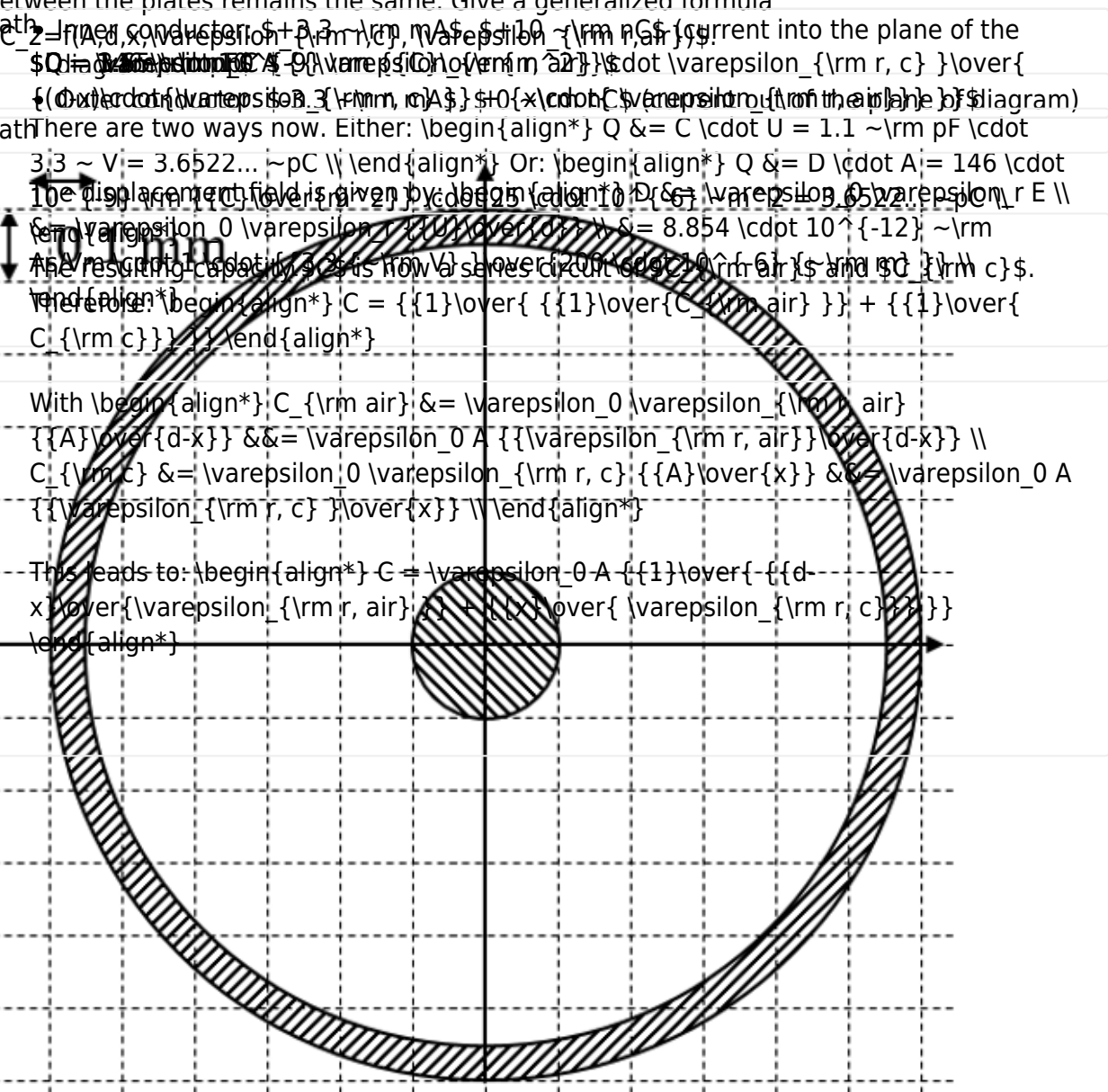
(written test, approx. 12 % of a 120-minute written test, SS2024)

2. On the left, the voltage of the cable is given by the plates of the coaxial cable. The origin is in the center of the coax cable. Due to the given current, the following magnetic field is produced: $\vec{B}(r, \phi) = B(r) \hat{\phi}$, while the distance between the plates remains the same. Give a generalized formula

for the capacitance C of the coaxial cable. The displacement field is given by $\vec{D} = \epsilon(r) \vec{E}$. The result for the capacitance C is $C = \frac{2\pi \epsilon_0 \epsilon_{air}}{\ln(\frac{c}{a})} + \frac{2\pi \epsilon_0 \epsilon_{c}}{\ln(\frac{c}{a})}$.

With $C_{air} = \frac{2\pi \epsilon_0 A}{\ln(\frac{c}{a})}$ and $C_c = \frac{2\pi \epsilon_0 A}{\ln(\frac{c}{a})}$.

This leads to $C = \frac{2\pi A}{\ln(\frac{c}{a})} \left(\frac{1}{\epsilon_{air}} + \frac{1}{\epsilon_c} \right)$.



1. What is the magnitude of the magnetic field strength H at $r = (-0.1 \text{ mm} | 0)$ and $r = (0.55 \text{ mm} | 0)$?
2. Plot the graph of the magnitude of $H(x)$ from $r = (-0.6 \text{ mm} | 0)$ to $r = (0.6 \text{ mm} | 0)$ in one diagram. Use proper dimensions and labels for the diagram!
3. What is the magnitude of the electric displacement field D at $r = (-0.1 \text{ mm} | 0)$ and $r = (0.55 \text{ mm} | 0)$?

4. Plot the graph of the magnitude of $D(x)$ from $x = -0.6 \text{ mm}$ to $x = 0.6 \text{ mm}$ in one diagram. Use proper dimensions and labels for the diagram!

Path

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\begin{align*} C &= \varepsilon_0 \varepsilon_r \frac{A}{d} \quad \&= 8.854 \cdot 10^{-12} \frac{\text{As/Vm} \cdot 1 \cdot \{25 \cdot 10^{-6} \text{ m}\}}{200 \cdot 10^{-6} \text{ m}} \end{align*}
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