PS 250

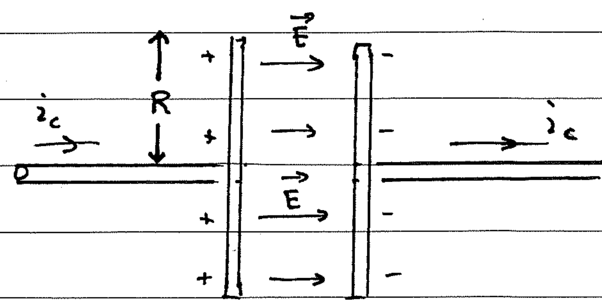
PREPARED BY | DATE

Ch. 29 Exercise 42.

42. A parallel, air-filled capacitor is being charged

$R = 4.00$ cm

$i_c = 0.52$ A



a.) $j_D = \dfrac{i_D}{A} = \dfrac{i_c}{\pi R^2}$

$j_D = \dfrac{0.520\text{ A}}{\pi(0.04\text{ m})^2} = 103\ \dfrac{\text{A}}{\text{m}^2}$

b.) $\dfrac{dE}{dt} = ?$ $\qquad i_D = \varepsilon_0 \dfrac{dE}{dt} A \qquad \dfrac{dE}{dt} = \dfrac{i_D}{A\varepsilon_0} = \dfrac{0.52\text{ A}}{8.85\times10^{-12}\ \pi(0.04\text{ m})^2}$

or $\dfrac{dE}{dt} = \dfrac{j_D}{\varepsilon_0} = \dfrac{103\text{ A/m}^2}{8.85\times10^{-12}} = 1.16\times10^{+13}\ \dfrac{\text{V}}{\text{m}\cdot\text{s}}$

c.) Induced magnetic field at $r = 2.00$ cm

Use Ampère's Law $\qquad \oint_C \vec{B}\cdot d\vec{l} = \mu_0 I_{encl.} = \mu_0 j_D(\pi r^2)$

C = circle whose radius = 2.00 cm

$B \cdot 2\pi r = \mu_0 j_D \pi r^2 \qquad B = \dfrac{\mu_0 j_D \pi r^2}{2\pi r} = \dfrac{\mu_0 j_D r}{2}$

$B = \dfrac{4\pi\times10^{-7}(103)(0.02\text{ m})}{2}$ $\qquad$ **$B = 1.294\times10^{-6}$ T**

$1.29\ \mu$T

d.) Induced magnetic field at $r = 0.01$ m.

$B = \dfrac{4\pi\times10^{-7}(103)(0.01\text{ m})}{2}$ $\qquad$ **$B = 0.65\ \mu$T**