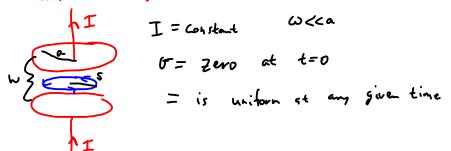


Reading Today: Section 7.3 pgs. 321-332

Tomorrow 8.1 - 8.22 pgs. 345-354

Problem 7.32 pg. 324



$$I = \text{constant} \quad \omega \ll \alpha$$

$$\theta = \text{zero at } t=0$$

θ is uniform at any given time

(a) Find $E(t)$ between the plates

$$E = \frac{\sigma}{\epsilon_0} \hat{z} = \frac{Q(A)}{\pi a^2 \epsilon_0} \hat{z} \quad I = \text{constant}$$

$$\vec{E} = \frac{I t}{\pi a^2 \epsilon_0} \hat{z} \quad \frac{dQ(t)}{dt} = I \Rightarrow Q(t) = It$$

(b) Find I_d using circle shown above. Find B using this surface.

$$\vec{j}_d = \epsilon_0 \frac{\partial \vec{E}}{\partial t} = \frac{I}{\pi a^2} \hat{z} \quad \text{constant & uniform}$$

$$I_d = \int \vec{j}_d \cdot d\vec{a} = \int \frac{I}{\pi a^2} da$$

$$I_d = \frac{I}{\pi a^2} A = I \frac{\pi r^2}{a^2}$$

Ampere Maxwell Law

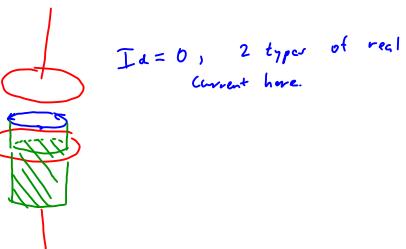
$$\int (\vec{J} \times \vec{B}) \cdot d\vec{a} = \mu_0 \int \vec{j}_d \cdot d\vec{a} + \mu_0 \int \vec{j} \cdot d\vec{a} \quad \text{(no real current)}$$

$$\oint \vec{B} \cdot d\vec{a} = \mu_0 I_d$$

$$B(2\pi S) = \mu_0 I_d$$

$$\vec{B} = \mu_0 \frac{I_d}{2\pi S} = \mu_0 \frac{I}{2\pi a^2} \hat{\phi}$$

Find B using this surface



$I_d = 0$, 2 types of real current here.

If we have monopoles

$$\nabla \cdot \vec{E} = \frac{\rho_m}{\epsilon_0} \quad \nabla \cdot \vec{B} = \mu_0 \rho_m$$

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} - \mu_0 \vec{J}_m \quad \nabla \times \vec{B} = \mu_0 \vec{J}_e + \mu_0 \epsilon_0 \frac{\partial \vec{E}}{\partial t}$$

Contained in 7.36

Integrate Faraday's Law over the area of the loop

$$\oint \vec{E} \cdot d\vec{l} = - \int \frac{\partial \vec{B}}{\partial t} \cdot d\vec{a} - \mu_0 \int \vec{J}_m \cdot d\vec{a}$$

$$-E = -\frac{d \Phi_B}{dt} - \mu_0 I_m$$

Loop has self inductance of L no resistance

$$E = -L \frac{dI}{dt} = -\frac{d \Phi_B}{dt} - \mu_0 \frac{dQ_m}{dt}$$

Integrate everyone wrt. time

$$LI = \Delta \Phi_B + \mu_0 \Delta Q_m$$

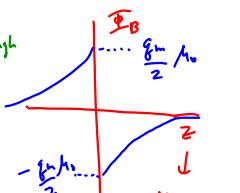
$$I = \frac{\Delta \Phi_B}{L} + \frac{\mu_0}{L} \Delta Q_m$$

$$\Delta Q_m = q_m$$

q_m is just about to go through
 $\Phi_B = -\frac{q_m}{2} \mu_0$

just after

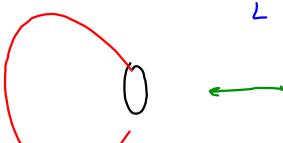
$$\Phi_B = +\frac{q_m}{2} \mu_0$$



distance of monopole to the loop

$$\Delta \Phi_B = 0$$

$$\Rightarrow I = \frac{\mu_0 q_m}{L}$$



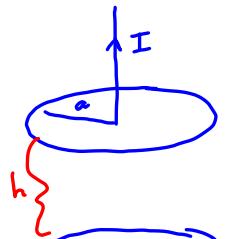
Example

Harmonic time dependence on a capacitor

$$h \ll a$$

In Problem 7.32

$$\vec{E} = \frac{\sigma}{\epsilon_0} \hat{z}$$
 or change with time



$$\vec{B} = \frac{\mu_0 I S}{2\pi a^2} \hat{\varphi}$$
 with I constant

$$\frac{\partial \vec{E}}{\partial t} = \frac{I}{\pi a^2 \epsilon_0} \hat{z}$$

\vec{E} time varying $\rightarrow \vec{B}$ constant
Ampere's Law

$I \sim e^{i\omega t}$ actual current is just the real part

$$\vec{E}_0 = E_0 e^{i\omega t} \hat{z}$$

$$\frac{\partial \vec{E}_0}{\partial t} = i\omega E_0 e^{i\omega t} \hat{z}$$
 but also have

$$\frac{\partial \vec{E}_0}{\partial t} = \frac{I}{\pi a^2 \epsilon_0} \hat{z}$$

$$\Rightarrow i\omega E_0 e^{i\omega t} = \frac{I}{\pi a^2 \epsilon_0}$$

$$\begin{aligned} \vec{B}_1 &= \frac{\mu_0 I S}{2\pi a^2} \hat{\varphi} = \frac{\mu_0 E_0}{2} i\omega E_0 e^{i\omega t} S \hat{\varphi} \\ &= \frac{i E_0}{2c} e^{i\omega t} \left(\frac{S \omega}{c} \right) \hat{\varphi} \end{aligned}$$

$\mu_0 \epsilon_0 = \frac{1}{c}$

Use an iterative solution

$$\vec{E}_0 \rightarrow \vec{B}_1 \quad \text{Ampere's Law}$$

$$\vec{B}_1 \rightarrow \vec{E}_2 \quad \text{Faraday's Law}$$