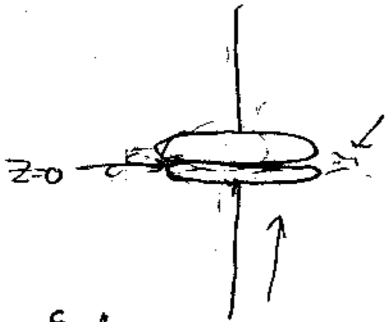
Spring 2002 # 12



$$\oint B \cdot dS = \mu_0 I + \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}$$

a) $C = \frac{\epsilon_0 A}{d}$

$\Phi_E = \text{Flux} = \pi r_c^2 E$

b) $\frac{d\Phi_E}{dt} = \pi r_c^2 \frac{dE}{dt} = \frac{\pi r_c^2}{d} \frac{dV}{dt} = \frac{\pi r_c^2}{\epsilon d} \frac{dQ}{dt} = \frac{\pi r_c^2}{\epsilon_0 A} \frac{dQ}{dt}$

from $V = -\int E \cdot dl$

$C = \frac{Q}{V} = \frac{\epsilon_0 A}{d}$ for parallel plates

$$2\pi r B(r) = \mu_0 \epsilon_0 \frac{\pi r_c^2}{\epsilon_0 A} \frac{dQ}{dt}$$

$$B(r) = \frac{r_c^2 \mu_0}{2 A r} \frac{dQ}{dt} = \frac{\mu_0 r_c^2}{2\pi r_c^2 r} i = \frac{\mu_0 i}{2\pi r} \hat{\phi}$$

c) Now ampere loop far away from capacitor.

$$\oint B \cdot dS = \mu_0 I + \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}^{\,0}$$

$$2\pi r B(r) = \mu_0 i$$

$$B(r) = \frac{\mu_0 i}{2\pi r} \hat{\phi}$$