5. Outside the capacitor the E field = 0. So the electric flux through the Amperian loop for r > R exist only within the area πR^2

$$\Phi_E = \pi R^2 E$$

$$\oint B \cdot ds = \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$$

$$B(2\pi r) = \mu_0 \varepsilon_0 \pi R^2 \frac{dE}{dt}$$

$$\text{or } B = \frac{\mu_0 \varepsilon_0}{2r} R^2 \frac{dE}{dt}$$

$$\therefore \frac{dE}{dt} = \frac{2rB}{\mu_0 \varepsilon_0 R^2}$$

$$= \frac{2(.006)2 \times 10^{-7}}{(4\pi \times 10^{-7})(9 \times 10^{-12})(.003)^2} = 2.4 \times 10^{13} \frac{V}{m\ sec}$$

14.

$$i_d = \varepsilon_0 \frac{d\phi_E}{dt} = \varepsilon_0 \frac{d}{dt} \oint \vec{E} \circ d\vec{A}$$

If area is such that $\vec{E}$ and $d\vec{A}$ are parallel, then

$$i_d = \varepsilon_0 \frac{d}{dt} \int E dA = \varepsilon_0 \int \frac{dE}{dt} dA$$

$$j_d = \frac{di_d}{dA} = \varepsilon_0 \frac{dE}{dt}$$

15.

$$i_d = \varepsilon_0 \frac{d\phi_E}{dt} = \varepsilon_0 \frac{d(EA)}{dt}$$

$$i_d = \varepsilon_0 A \frac{dE}{dt}, \ V = Ed$$

$$i_d = \varepsilon_0 A \frac{d\left(\frac{V}{d}\right)}{dt} = \frac{\varepsilon_0 A}{d} \frac{dV}{dt}$$

$$C = \frac{\varepsilon_0 A}{d}$$

$$i_d = C \frac{dV}{dt}$$

29. **The displacement current in the gap equals the conduction current in the wires.**

a) $I_{max} = I_d(max) = 7.6\,\mu A$

b) $I_d = \varepsilon_0 \dfrac{d\phi_E}{dt}$

$$\frac{d\phi_E}{dt} = \frac{I_d(max)}{\varepsilon_0} = \frac{7.6\times10^{-6}}{8.85\times10^{-12}} = 859\,\frac{kV\cdot m}{sec}$$

c) $I_d = C\dfrac{dV}{dt} = \dfrac{\varepsilon_0 A}{d}\dfrac{dV}{dt} = \dfrac{\varepsilon_0 A}{d}\dfrac{d\mathcal{E}}{dt}$ see problem #40

$$I_d = \frac{\varepsilon_0 A}{d}\mathcal{E}_{max}\omega\cos(\omega t)$$

Plate seperation d = ?

$$d = \frac{\varepsilon_0 A \mathcal{E}_m \omega}{I_d(max)} = \frac{(8.85\times10^{-12})(.1)(220)(130)}{7.6\times10^{-6}}$$

$d = 3.39\,mm$

d) Ampere's Law: $\int B\circ ds = \mu_0 I_d$

j_d is uniform

$$I_d(max) = j_d(\pi r^2) = I_d\frac{\pi r^2}{\pi R^2}$$

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

$$B_{max} = \frac{\mu_0 I_d(max)}{2\pi r} = \frac{\mu_0}{2\pi r} I_d \frac{\pi r^2}{\pi R^2}$$

$$B_{max} = \frac{\mu_0 I_d r}{2\pi R^2} = \frac{(4\pi\times10^{-7})(7.6\times10^{-6})(.11)}{2\pi(.18)^2}$$

$B_{max} = 5.2\times10^{-12}\,T$