(8.1) Find the electric field for an infinitesimal dipole radiator.

$$\mathrm{E} = \frac{1}{i\omega\mu\epsilon}\nabla(\nabla \cdot A) - \frac{\partial A}{\partial t}$$

$$A = \mu\frac{Ide^{ikr}}{4\pi r}\hat{z}$$

$$\mathrm{E} = \frac{1}{i\omega\mu\epsilon}\nabla\left(\nabla \cdot \left(\mu\frac{Ide^{ikr}}{4\pi r}\hat{z}\right)\right) - \frac{\partial\left(\mu\frac{Ide^{ikr}}{4\pi r}\hat{z}\right)}{\partial t}$$

(8.2) What is the magnitude of the Poynting vector at a distance of 1 km from an antenna radiating 1 kW of power, assuming that it is an isotropic radiator with a wavelength much less than 1 km? What is the peak electric field strength at that distance?

$$|P| = W/A = (1000W)/(4\pi 10km^2) \approx 8E^{-5}W/m^2$$

$$8E^{-5}W/m^2 = \frac{E^2}{377\Omega}$$

$$\bar{E} = 173mV/m$$

$$\max E = 346mV/m$$

(8.3) For what value of Rload is the maximum power delivered to the load in Figure 8.3?

$$W_{LOAD} = I^2R_L = \left(\frac{V}{R_{RAD} + R_L}\right)^2 R_L$$

$$dW/dR_{LOAD} = -V^2\frac{R_{LOAD} - R_{RAD}}{(R_{LOAD} + R_{RAD})^3}$$

Inflection point at $R_{LOAD} = R_{RAD}$

(8.4) For an infinitesimal dipole antenna, what are the gain and the area, and what is their ratio?

$$G \stackrel{\text{def}}{=} \max_{\theta\varphi}\frac{P(r = 1, \theta, \varphi)}{\mathrm{W}/4\pi}$$

$$k^2 = \omega^2/c^2$$

$$G = 4\pi \frac{\frac{I^2k^2d^2}{32\pi^2r^2}\sqrt{\mu/\epsilon}\ \sin^2\theta}{\frac{I^2k^2d^2}{12\pi}\sqrt{\mu/\epsilon}}$$

$$G = \frac{\frac{1}{8\pi}}{\frac{1}{12\pi}}$$

$$G = \frac{3}{2}$$

$$A_e = Power/power\ flux$$

$$Power = V^2/R_{antenna} = (|E|d)^2/R = \frac{(W/377)^2}{\frac{2\pi}{3}\sqrt{\mu/\epsilon}\left(\frac{d}{\lambda}\right)^2}$$

$$A_e = \frac{}{\frac{I^2k^2d^2}{32\pi^2r^2}\sqrt{\mu/\epsilon}\ \sin^2\theta}$$