

34.46. Model: Light is an electromagnetic wave. A quick measurement of a light bulb shows that its radius is $r \approx 2.8$ cm.

Solve: 100 W is the energy transported per second by the electromagnetic light wave. This energy is carried in all directions. The light intensity is given by Equation 34.47:

$$I = \frac{P}{A} = \frac{P}{4\pi r^2} = \frac{c\epsilon_0}{2} E_0^2$$
$$\Rightarrow \frac{100 \text{ W}}{4\pi(2.8 \times 10^{-2} \text{ m})^2} = \frac{(3 \times 10^8 \text{ m/s})(8.85 \times 10^{-12} \text{ C}^2 / \text{N m}^2)}{2} E_0^2 \Rightarrow E_0 \approx 2800 \frac{\text{V}}{\text{m}}$$
$$\Rightarrow B_0 = \frac{E_0}{c} = \left(\frac{2800 \text{ V/m}}{3.0 \times 10^8 \text{ m/s}} \right) \approx 9.3 \times 10^{-6} \text{ T}$$