

34.25. Solve: (a) The units of cB are

$$\frac{\text{m}}{\text{s}} \times \text{T} = \frac{\text{m}}{\text{s}} \times \frac{\text{N}}{(\text{C})(\text{m}/\text{s})} = \frac{\text{N}}{\text{C}}$$

These are the units for E . In the unit conversion, the units of tesla are taken from the equation $\vec{F} = q\vec{v} \times \vec{B}$.

(b) The magnitude of the Poynting vector is

$$S = \frac{EB}{\mu_0} = \frac{E}{\mu_0} \frac{E}{c} = (c^2 \epsilon_0 \mu_0) \frac{E^2}{\mu_0 c} = c \epsilon_0 E^2$$

The units of S are

$$c \epsilon_0 E^2 \equiv \frac{\text{m}}{\text{s}} \times \frac{\text{C}^2}{\text{N m}^2} \times \frac{\text{N}}{\text{C}} \times \frac{\text{V}}{\text{m}} = \frac{\text{C}}{\text{s}} \times \frac{\text{V}}{\text{m}^2} = \frac{\text{A V}}{\text{m}^2} = \frac{\text{W}}{\text{m}^2}$$

In the unit conversion, we have used both N/C and V/m for the units of the electric field. Since $P = IV$ for circuits, A V = W.