

7.33 The magnetic field of a plane wave traveling in air is given by $\mathbf{H} = \hat{\mathbf{x}}50\sin(2\pi \times 10^7 t - ky)$ (mA/m). Determine the average power density carried by the wave.

Solution:

$$\mathbf{H} = \hat{\mathbf{x}}50\sin(2\pi \times 10^7 t - ky) \quad (\text{mA/m}),$$

$$\mathbf{E} = -\eta_0 \hat{\mathbf{y}} \times \mathbf{H} = \hat{\mathbf{z}}\eta_0 50\sin(2\pi \times 10^7 t - ky) \quad (\text{mV/m}),$$

$$\mathbf{S}_{\text{av}} = (\hat{\mathbf{z}} \times \hat{\mathbf{x}}) \frac{\eta_0 (50)^2}{2} \times 10^{-6} = \hat{\mathbf{y}} \frac{120\pi}{2} (50)^2 \times 10^{-6} = \hat{\mathbf{y}} 0.48 \quad (\text{W/m}^2).$$
