

7.33 A wave traveling in a nonmagnetic medium with $\epsilon_r = 9$ is characterized by an electric field given by

$$\mathbf{E} = [\hat{\mathbf{y}} 3 \cos(\pi \times 10^7 t + kx) - \hat{\mathbf{z}} 2 \cos(\pi \times 10^7 t + kx)] \quad (\text{V/m})$$

Determine the direction of wave travel and average power density carried by the wave.

Solution:

$$\eta \simeq \frac{\eta_0}{\sqrt{\epsilon_r}} = \frac{120\pi}{\sqrt{9}} = 40\pi \quad (\Omega).$$

The wave is traveling in the negative x direction.

$$\mathbf{S}_{\text{av}} = -\hat{\mathbf{x}} \frac{[3^2 + 2^2]}{2\eta} = -\hat{\mathbf{x}} \frac{13}{2 \times 40\pi} = -\hat{\mathbf{x}} 0.05 \quad (\text{W/m}^2).$$
