

























































$$\vec{B} = -\hat{y} \left( \frac{100 \text{ Vm}^{-1}}{v} \right) \cos(6\pi x - 3\pi \times 10^8 t)$$

or

$$\begin{aligned} \vec{B} &= -\hat{y} \left( \frac{100}{0.5 \times 10^8} \text{ T} \right) \cos(6\pi x - 3\pi \times 10^8 t) \\ &= -\hat{y} (2 \times 10^{-6} \text{ T}) \cos(6\pi x - 3\pi \times 10^8 t) \end{aligned}$$

7. From Eq. (17.53a),  $\vec{S} = \frac{1}{\mu_0} (\vec{E} \times \vec{B})$ . Since the electric field of the electromagnetic wave is directed along the positive  $x$ -axis and its magnetic field along the positive  $y$ -axis at a certain instant of time, from Eq. (17.53a), the direction of the Poynting vector will be along the positive  $z$ -axis at that instant of time. The wave transports energy along the positive  $z$ -axis at that instant of time.
8. We use Eq. (17.53a) again. It is given that the electric field of the electromagnetic wave is directed along the positive  $x$ -axis at a certain instant of time. The wave transports energy in the negative  $y$ -direction. So, the Poynting vector is directed along the negative  $y$ -axis at that instant of time. Hence, from Eq. (17.53a), the direction of the magnetic field at that instant of time is along positive  $z$ -axis.
9. From Eq. (17.53a),

$$\begin{aligned} \vec{S} &= \frac{1}{\mu_0} (\vec{E} \times \vec{B}) = \frac{1}{\mu_0} E_0 B_0 \cos^2(kx - \omega t) (\hat{z} \times \hat{y}) \\ &= -\hat{x} \frac{E_0 B_0}{\mu_0} \cos^2(kx - \omega t) \end{aligned}$$

The magnitude of the Poynting vector for the given plane electromagnetic wave at the given instant of time is  $\frac{E_0 B_0}{\mu_0} \cos^2(kx - \omega t)$ .

Its direction is along the negative  $x$ -axis at that instant of time.

10. From Eq. (17.56), the energy density of the electromagnetic field of Terminal Question 9 is given by

$$\begin{aligned} U_{EB} &= \frac{1}{2} \left( \epsilon_0 E^2 + \frac{1}{\mu_0} B^2 \right) \\ &= \frac{1}{2} \cos^2(kx - \omega t) \left( \epsilon_0 E_0^2 + \frac{1}{\mu_0} B_0^2 \right) \end{aligned}$$