

Name:

Physics 51
Homework #16
November 3, 2016

38-E16, 38-E22, SUP3

SUP3

- (a) Consider an electromagnetic wave in a vacuum with electric field $\vec{E} = E_0 \hat{y} \sin(kx - \omega t)$. What is the propagation direction of this electromagnetic wave?
- (b) Consider an electromagnetic wave with electric field $\vec{E} = E_0 \hat{y} \sin(kx + \omega t)$. What is the propagation direction of this electromagnetic wave?
- (c) Consider the electric field $\vec{E} = E_0 \hat{y} [\sin(kx - \omega t) + \sin(kx + \omega t)]$. Show that the electric field satisfies the wave equation

$$\frac{\partial^2 \vec{E}}{\partial x^2} + \frac{\partial^2 \vec{E}}{\partial y^2} + \frac{\partial^2 \vec{E}}{\partial z^2} = \frac{1}{V^2} \frac{\partial^2 \vec{E}}{\partial t^2},$$

provided the constants k and ω are related as in part (a).

■

38-E16 The electric field associated with a plane electromagnetic wave is given by $E_x = 0$, $E_y = 0$, $E_z = E_0 \sin k(x - ct)$, where $E_0 = 2.34 \times 10^{-4} \text{ V/m}$ and $k = 9.72 \times 10^6 \text{ m}^{-1}$. The wave is propagating in the $+x$ direction.

- (a) Write expressions for the components of the magnetic field of the wave.
- (b) Find the wavelength of the wave.

■

38-E22 A plane electromagnetic wave is traveling in the negative y direction. At a particular position and time, the magnetic field is along the positive z axis and has a magnitude of 28 nT . What are the direction and magnitude of the electric field at that position and at that time?

■