# Chapter 7 Review Problem Solution

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Consider an elliptically polarized electromagnetic wave whose electric component is given by

$$\vec{E}(z,t) = \hat{x}E_0 \sin[\omega(t - z/c)] + \hat{y}E_0 \sin[\omega(t - z/c) - \pi/4] \tag{1}$$

where $\omega$ is the angular frequency and $c$ is the speed of the wave.

(a) Find the magnetic component $\vec{B}(z,t)$ of the wave.

$$\vec{B}(z,t) = -\hat{x}E_0 \sin[\omega(t - z) + \pi/4] + \hat{y}E_0 \sin[\omega(t - z)] \tag{2}$$

(b) Calculate the energy density of the wave propagating in free space.

$$T_{00} = \frac{E_0^2}{4\pi}[\sin^2[\omega(t - z)] + \sin^2[\omega(t - z) + \pi/4]] \tag{3}$$

(c) Find the speed with which the energy is propagating.
The energy travels through the waves which propagate with speed $c$ in a vacuum.

(d) Find the minimum and maximum value of the Poynting vector.

$$\vec{S} = \frac{1}{4\pi}[\vec{E} \times \vec{B}] = T_{00}\hat{z} \tag{4}$$

$$\omega(t - z) = \frac{3\pi}{8} \rightarrow S = 1.7E_0^2 \qquad Maximum \tag{5}$$

$$\omega(t - z) = \frac{7\pi}{8} \rightarrow S = 0.29E_0^2 \qquad Minimum \tag{6}$$