Electrodynamics Problems – II

(Due Mar 14 @ 1pm)

① The electric field in a free space is

$$\vec{E}(t) = E_0 (\hat{x} + \hat{y}) \sin\left[\frac{2\pi}{\lambda}(z + ct)\right]$$

What will be the magnetic field $\vec{B}(t)$?

② The power density of the sunlight (at the earth), is about

$$1\ kW/m^2.$$

What is rms of the magnetic field strength?

③ Here is a particular electromagnetic field in free space

$$E_x = 0\ ;\quad E_y = E_0 \sin(kx + \omega t);\quad E_z = 0$$

$$B_x = 0;\quad B_y = 0\ ;\quad B_z = -E_0 \sin(kx + \omega t)$$

(a) show that this fields can satisfy Maxwell's equations, if ω and k are related in a certain way

(b) suppose $\omega = 10^{10}\ s^{-1}$ and $E_0 = 0.05 \frac{V}{cm}$.
What is the wavelength λ in [cm]?
What is the energy density of such a fiel averaged over the region much greater than λ? What is the power density $[\frac{W}{cm^2}]$