Tutorial 2: EM

1. The electric component of a beam of polarized light is $E_y=(5.00\text{V/m})\sin[(1.00*10^6\text{m}^{-1})z+\omega t]$. (a) Write an expression for the magnetic field component of the wave, including a value for ω. What are the (b) wavelength, (c) period and (d) intensity of this light? (e) Parallel to which axis does the magnetic field oscillate? (f) In which region of the electromagnetic spectrum is this wave?

2. On its highest power setting, a certain microwave oven projects 1.00 kW of microwaves onto a 30.0 by 40.0 cm area.

i. **What is the intensity in W/m^2?**
ii. **Calculate the peak electric field strength E_0 in these waves.**
iii. **What is the peak magnetic field strength B_0?**

3. In SI units, the electric field in an electromagnetic wave is described by the following equation.

$$E_y = 118\sin(1.20\times10^{-7}x-\omega t)$$

a. **Find the amplitude of the corresponding magnetic field oscillations.**
b. **Find the wavelength λ**
c. **Find the frequency f.**

4. A monochromatic light source emits 135 W of electromagnetic power uniformly in all directions.

a. Calculate the average electric-field energy density 3.00m from the source.
b. Calculate the average magnetic-field energy density at the same distance from the source.
c. Find the wave intensity at this location.

5. A radio wave transmits 27.0 W/m^2 of power per unit area. A flat surface of area A is perpendicular to the direction of propagation of the wave. Calculate the radiation pressure on it, assuming the surface is a perfect absorber.

6. A 15.0 mW helium-neon laser (λ=632.8 nm) emits a beam of circular cross-section with a diameter of 1.90 mm.

a. Find the maximum electric field in the beam.
b. What total energy is container in a 1.00 m length of the beam?
c. Find the momentum carried by a 1.00 m length of the beam.