1. An electromagnetic wave has an electric field

\[ E = k \, 1000 \sin(20y + \omega t) \] (1)

(i) What is \( \omega \)? (ii) What is the frequency \( f \)? (iii) What is the direction of travel? (iv) What is \( B \)? (v) What is the average energy density \( \bar{u} \) in \( J/m^3 \) and average intensity \( \bar{S} \) in \( W/m^2 \)?

2. I live 10 km from a 50kW station. What is the peak strength of \( E \) and \( B \) in my house?

3. The smallest wavelength the eye can see is roughly 400nm. What is the frequency?

4. A plane wave traveling along the y-axis has

\[ E = (i + k) \, E_0 \sin(ky - \omega t). \]

Find the corresponding \( B \) (its magnitude, direction, and \( (y, t) \) dependence). You can use the example we did in class (polarized along \( k \)), superposition and rotational symmetry arguments to guess your answer.

5. Imagine a wave in vacuum traveling along the z axis with

\[ E = i \, E_0 \cos(kz - \omega t) \quad B = j \, B_0 \cos(kz - \omega t) \] (2)

(i) Show that the surface integrals of \( E \) and \( B \) obey the Maxwell equations. (ii) Consider the line integrals on three independent planes and write the corresponding equations relating \( \frac{\partial E_x}{\partial z}, \frac{\partial E_y}{\partial t}, \frac{\partial B_y}{\partial z}, \frac{\partial B_z}{\partial t} \). Determine the relation between \( E_0 \) and \( B_0 \) and \( \omega \) and \( k \) that these imply. (Just modify what was done in class. Do not spend too much time on this one.)