

Physics 201 Electromagnetic Wave Homework One

April 17, 2017

The wave equation for the magnetic field in an electromagnetic wave is: $\frac{d^2}{dx^2} \vec{B} = \frac{1}{c^2} \frac{d^2}{dt^2} \vec{B}$. Note that there are no units here, the speed you get will have no real units, so it will not equal the true speed of light, c .

1. Verify that $B(x, t) = 4 \sin(5x - 6t)$ works, in that it satisfies the equation. What is the wave speed?
2. Verify that $B(x, t) = 5(6x - 8t)^2$ works.
3. Verify the function $B(x, t) = 6x^2 - 8t$ does not work.

In deriving the wave equation, we get equations like: $\frac{d}{dx} E_y = -\frac{d}{dt} B_z$. Here the subscripts indicate the vector components of E and B. (The y-component of E, and the z component of B).

4. If $E_y = A \sin(kx - \omega t)$, find a suitable function for B_z . There are multiple answers. Just find one.
5. The units of electric field, E , are volt per meter or newton per coulomb. If x is in meters, and t in seconds, what are the units of k and ω ? The unit of B is the tesla (T), and verify that the units of your answer in 4 above work. You will need to know what a tesla is in terms of something else. One source of such information is the course equation sheet.