PHY431, Homework 4

1   Waves

1. (4 pts) Determine which of the following functions describe a traveling wave:

   (a)

   $$\psi(y,t) = e^{-(a^2 y^2 + b^2 t^2 - 2abty)}$$

   (b)

   $$\psi(z,t) = A\sin(az^2 - bt^2)$$

   (c)

   $$\psi(x,t) = A\sin\left[2\pi(\frac{x}{a} + \frac{t}{b})\right]$$

   (d)

   $$\psi(x,t) = A\cos^2\left[2\pi(t-x)\right]$$

   The constants A, a and b are positive real numbers. You can use any math software package to assist with math such as http://www.wolframalpha.com.   Show supporting plots.

2. (3 pts) Show explicitly that

   $$\psi(x,t) = A\sin(kx - \omega t)$$

   is solution of the wave equation.

3. (3 pts) Give an order of magnitude estimate of the frequency (in Hz not radians!) and the period of an electromagnetic wave with wavelength equal to

   (a) your height

   (b) the thickness of a sheet of paper

   (c) the size of one carbon atom in a sheet of paper.