PHYS 408 2010/11 term2

Homework problem set #2, problems 1-3
Assigned: 14/01/2011
Written Solution due 21/01/2011 5 PM in Hennings 328
If you collaborated with anyone, please write their name at the top of your HW

Problem 1 (20 marks) TAKE THIS PROBLEM SERIOUSLY IT!!!

Look at the homework solutions I posted for the previous homework (HW#1 in this case) and pick a problem that you may have gotten wrong. Describe in words what you may have done wrong and what your misconceptions were. And explain what you didn't understand and what techniques you needed to know in order to solve the problem. Explain in words what you have learned from this.

If you feel you solved all of the problems correctly, then pick a problem and try to find and explain three misconceptions that might lead a person to answer wrongly. To be an expert, you must learn to identify the possible conceptual difficulties that a person may have in order to communicate with them effectively

Problem 2 (40 marks)

In this class (and physics in general) it is extremely important to be able to visualize what is represented by mathematical expressions. Consider the following plane wave traveling in vacuum

$$\vec{E} = 3\hat{z}e^{i(-6x+2y)*10^6+i\pi/6}$$

a) What is the direction of travel for this wave?
b) The wavefronts (or surfaces of constant phase) of this wave are planes (hence it is called a plane wave). Give a mathematical expression that defines this plane and also give a more qualitative description of this plane. *Hint: it is easiest to define a plane in terms of a vector normal to that plane.*
c) Find and mathematically define the surfaces of constant amplitude. Draw the Electric vector field that appears in this surface.
d) Sketch (to scale) the wavefronts on a piece of paper along with the direction of travel. Take the wavefronts to be surfaces of constant phase in multiples of 2 pi *n, n=0,1,2,3…
e) On your sketch, identify the wavelength of this field along with the wavelength compenents along the x and y directions. In the latter two, I mean how far do I need to walk along the x (or y) axis to go from crest to crest. Relate this distance to k_x and k_y
f) Find the intensity and total power carried by this wave
g) What is the wavelength of this ware?

Problem 3 (40 marks)

Now consider a scalar wave emitted from a point source again traveling in vacuum with wavelength of 600 nm where

$$U = \frac{A_o}{r}e^{i(\vec{k}\cdot\vec{r})} = \frac{4}{r}e^{ikr}$$

a) What is the direction of travel for this wave?
b) Give a mathematical expression that defines the wavefronts for this wave and also give a more qualitative description of the wavefronts.
c) Does this wave have surfaces where the amplitude does not change. If so, what are they. If not, why? Prove your answer in either case.
d) At a distance of 10 meters from the point source, sketch to scale the wavefronts projected onto a plane that is perpendicular to the direction of the wave's travel.
e) U is normalized such that one half of the magnitude squared of U is intensity [W/m^2]. Is U the electric field? If not, how is U related to the electric field? What are the units of A_o ?
f) Find the intensity and total power carried by this wave