Homework #12 - Phys 273

1) The electric field in a plane wave has the form

$$\vec{E} = E_0 \hat{z} \cos(kx - \omega t) - E_0 \hat{y} \sin(kx - \omega t)$$

This wave is said to have circular polarization.

   a) Show that the magnitude of the electric field is constant at all points in space and at all times. What is the constant?
   b) Consider the point (x,y,z) = (0,0,0). What is the angle between E and the z axis at time t = 0? At time t = $\pi/2\omega$? t = π/ω? t = $3\pi/2\omega$? Draw a diagram showing the y and z axes, and the direction of E at these times. Describe in a few words the behavior of E as a function of time.

2) The electric field in a plane wave has the form

$$\vec{E} = E_0 (\hat{x} + 2\hat{y}) e^{i(kz - \omega t)}$$

   a) What is the direction of propagation of this wave?
   b) What is the direction of polarization? In other words, what angle does the direction of polarization make with the x, y, and z axes?
   c) Write down the formula for the magnetic field of this plane wave as a function of time, assuming that this wave travels in vacuum.

3) A parallel plate capacitor is being charged. The capacitor consists of a pair of identical circular plates that each have a radius (b) and a separation distance (d).

   a) Show that the displacement current term in the modified form of Ampere's Law is equal to the conduction current in the wires which are charging the capacitor.
   b) What is the direction of the Poynting vector in the region between the capacitor plates?
   c) Find an expression for the Poynting vector in this region and show that its flux into the region between the plates is equal to the rate of change of energy stored in the capacitor.