Physics 102: Problem Set 11 (Optional)

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Due date: 5th of January, 2013. For all problems show all work!

1. Young and Freedman(13th Edition) 31.53.
2. Young and Freedman (13th Edition) 31.65.
3. Young and Freedman (13th Edition) 31.67.
4. Young and Freedman (13th Edition) 31.74.
5. **(a)** Suppose that the electric field and magnetic field point in the *y* and *z* directions, respectively their values are constant, and suppose that their value is zero for $x>0$ at time $t=0$. Calculate explicitly the ratios of the two fields. Calculate the *x* value of the boundary after a time *T.* **(b)** Suppose that the fields are propagating in a material with dielectric constant *K.* Repeat the same calculations as in part **(a)**. **(c)** Calculate the energy per unit time flowing through an area *A* in the region in which the fields are finite.
6. **(a)** Starting from Faraday's law and Ampère's law show that the both the electric and magnetic fields satisfy the wave equations. **(b)** Show that $E(x,t) = E_{max}cos(kx-\omega t)$, and $B(x,t) = B_{max}cos(kx-\omega t)$ satisfy the wave equations. **(c)** Are there other functional forms besides $cos(kx-\omega t)$ which satisfy the wave equations?
7. A rectangular loop with sides a and b is placed in a region through which an electromagnetic wave with intensity I and frequency ω is propagating, perpendicular to the direction of propagation. (a) Calculate the energy which passes through the rectangle in time *T.* (b) Suppose the rectangle is now turned by angle θ around the axis which bisects the rectangle along the side of length *a*. Calculate the energy which passes through the rectangle in time *T.*
8. Young and Freedman (13th Edition) 32.44.
9. Young and Freedman (13th Edition) 32.48.
10. Young and Freedman (13th Edition) 32.56.
11. Young and Freedman (13th Edition) 32.57.