PHYS 114 - FINAL EXAM
23 May 2006

Name and Surname:
Student ID:
Department:
Signature:

1. Explain the following concepts: (just writing equations will not gain you any point)(4 points each, 20 points total)
   - Displacement Current
   - Electromagnetic Radiation
   - Momentum of and Electromagnetic Wave
   - Self inductance
   - Impedance of a circuit
2. Consider a series of very thin conducting wires placed parallelly one on side of the other forming a sheet. Explain why, an electromagnetic wave incident on this configuration, will be polarized in a direction perpendicular to the wires when it passes to the other side? (20 points)
3. Consider the circuit in the figure. If the alternating power supply delivers an emf given by $\epsilon = \epsilon_0 \cos(\omega t)$, find the current passing through each of the inductor as a function of time. Assume that a sufficient amount of time has passed.(20 points)

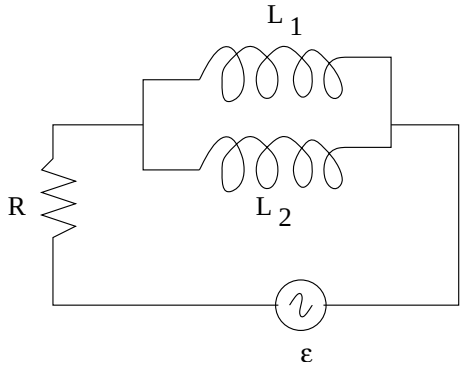

Figure 1: Circuit of Question 2

4. Consider an infinitely long hollow cylinder that carries a uniform charge distribution of σ coulombs per m^2 on its surface. If the cylinder is rotating with an angular frequency of ω around its axis, what is the magnetic field created inside the cylinder? (Take R to be the radius of the cylinder) (20 points)

5. Consider a conducting cylinder of height h and radius R. Suppose that it is moving in a uniform magnetic field $\vec{B} = B_0\hat{x}$ along the z direction. To keep the velocity of the cylinder constant at a value $\vec{v} = v_0\hat{z}$, an external force $\vec{F}$ has to be applied. Find $\vec{F}$. (20 points)

6. BONUS QUESTION (10 points)
   Consider two points: point A in a medium with refractive index n_1 and points B in another medium with refractive index n_2. Assume that the contact area between these two mediums is an infinite plane. Assume that you do not know Snell's law of refraction. Suppose that a light ray passing through point A, goes to a point C in the interface and passes to the second medium, and then goes to the point B. Assume that within a medium, the ray moves along a straight line. Show that the time it takes the light ray to travel from A to B is minimum if and only if the trajectory obeys Snell's law in the interface.

You can use the following relations:

$$(1+x)^n \simeq 1 + nx + \frac{1}{2}n(n-1)x^2 \tag{1}$$