PHYSICS 211
Final Spring 2010-2011
TIME: 60 minutes

June 3, 2011

DO NOT OPEN THIS EXAM BEFORE YOU ARE TOLD TO BEGIN

NAME_____

ID Number _____

Useful information

$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N.m^2$

$\mu_0 = 4p \times 10^{-7}\ Tm/A$

$q = 1.6 \times 10^{-19}\ C$

$m_e = 9.1 \times 10^{-31}\ kg$

$m_p = 1.67 \times 10^{-27}\ kg$

$k_e = 8.9875 \times 10^{9}\ Nm^2/C^2$

Grading

A	
B	
TOTAL	

Score:_____

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Part A- Problems (20%)

Consider a long conducting wire with radius *a* much smaller than its length *l* and a linear charge density $\lambda = Q/l$.

(a)(6) Using Gauss's law, determine the electric field (*E*) at a distance *r* from the wire center with $r > a$.

We insert a cylinder with radius *b* and the same length *l* around this wire.

(b)(4) Determine the potential difference between the wire and the cylinder.

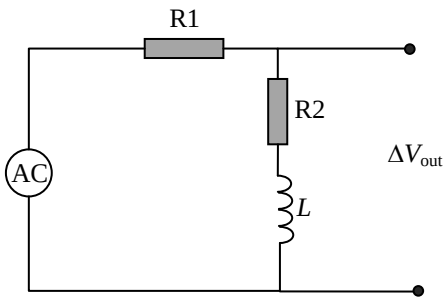
(c)(4) Determine the capacitance of this cylindrical capacitor.

(d)(6) Determine the analytical expression of the energy stored per unit length of this capacitor as a function of λ, *b* and *a*.

Score:_____

☐ Check if solution is continued on the back.

2.(80) Consider the circuit illustrated below, composed of an AC power source, supplying $\Delta V = \Delta V_{max}\sin(\omega t)$, two resistors R1 and R2 and an inductor L. Note that the sides form a square of length a.



(a)(6) Use the phasor diagram to determine the impedance of the circuit.

(b)(4) Determine the expression of the circuit phase.

(c)(4) Determine the expression of the current.

(e)(5) Determine the expression of the maximum potential drop ΔV_{out}

Score:_____

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(c)(10) Discuss the behavior of this circuit of low frequencies ($\omega \to 0$) and for ($\omega \to \infty$)

(d)(10) Determine the expression of the average power dissipated in this circuit.

The expression below gives the magnetic field for a finite wire with a current I flowing in it.

$$B = \frac{\mu_0 I}{4\pi a}\left(\sin\theta_1 - \sin\theta_2\right)$$

(e)(10) Compare the magnetic field obtained from this formula to the one obtained using Ampere's law for an infinite wire.

Score:_____

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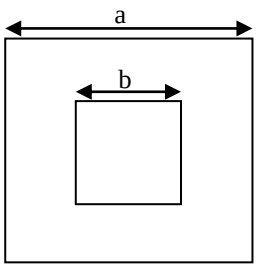
(f) For the AC circuit above, we consider it is a square with length *a*, determine the expression of the total magnetic field at the square center.

(g)(10) We insert another square loop with side *b* (*b*<<*a* so the magnetic field is uniform inside the small rectangle) and resistance R3 as shown in the figure below, determine the FULL expression of the current flowing in the second loop.



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SCRATCH PAPER

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