

King Fahd University Of Petroleum & Minerals  
Physics Department

PHYS201 (Term 071)  
First Major Exam  
(1 November 2007: Time: 7:00-9:00 PM)

Instructor: Dr. M.A. Al-Solami

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*Please show the details of your solutions*

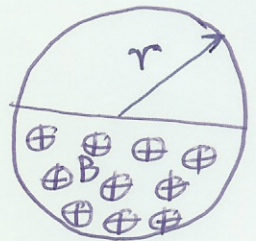
<b>Problem #</b>	<b>Grade / 10</b>
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2	
3	
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10	
11	
12	
Total/120	
Total/15	

### Question # 1

A coil of an unknown inductance is connected in series with  $5.0 \text{ k}\Omega$  resistor. An ideal  $24 \text{ V}$  battery is applied across the two devices, and the current reaches a value of  $2.0 \text{ A}$  after  $2.0 \text{ ms}$ . Find the inductance of the coil.

### Question # 2

The figure below shows a circular wire of radius  $r = 0.20 \text{ cm}$ . the magnetic field exists only on the upper half of the circle and given by  $B = 5t^2 - 2t - 3$ , where  $B$  is in the Tesla and  $t$  is in the second. If the wire has a resistance of  $2.0 \Omega$ , find the magnitude and direction of the current, if the magnetic field points into the page at  $t = 2.0 \text{ sec}$ . of



### Question # 3

An elastic conducting wire is stretched into a circular loop of  $10.0 \text{ cm}$  radius. It is placed with its plane perpendicular to a uniform  $1.0 \text{ T}$  magnetic field. When released, the radius of the loop starts to shrink at an instantaneous rate of  $50 \text{ cm/s}$ , what emf is induced in the loop at that instant?

### Question # 4

An electron is placed in a magnetic field  $\mathbf{B}$  that is directed along  $z$ -axis. The energy difference between parallel and anti-parallel alignments of the  $z$ -component of the electron's spin magnetic moment with  $\mathbf{B}$  is  $8.00 \times 10^{-25} \text{ J}$ . Find the magnitude of  $\mathbf{B}$ .



### Question # 5

A  $1.5 \mu\text{F}$  capacitor is charged to  $50 \text{ V}$  and then connected in series to  $10 \text{ mH}$  coil. Find:

- The maximum current in the coil.
- The potential difference  $V_L(t)$  across the inductor as a function of time.
- The maximum rate  $\left(\frac{di}{dt}\right)_{\text{max}}$  at which the current  $I$  changes in the circuit.

### Question # 6

A Consider an RLC circuit with  $\varepsilon_m = 10 \text{ v}$ ,  $R = 10 \Omega$ ,  $L = 1.0\text{H}$  and  $C = 1.0 \mu\text{F}$ . Find the voltage amplitude across the capacitor at resonance.

### Question # 7

For an RLC ac circuit with  $R = 250 \Omega$ ,  $L = 0.6\text{H}$ ,  $C = 3.5 \mu\text{F}$ ,  $f = 60\text{Hz}$  and  $V = 150\text{v}$ . Find:

- The impedance.
- The rms current.
- The phase angle.
- The voltage across the inductor.

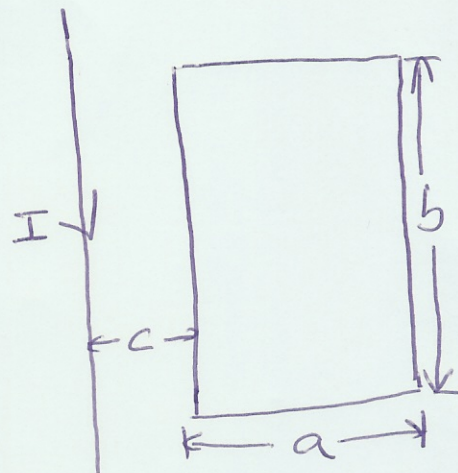
### Question # 8

A uniform electric field is directed into the page with a circular region of radius  $r = 3.0 \text{ cm}$ . The magnitude of the electric field is given by  $E = x \cdot 10^{-3} \left(\frac{\text{V}}{\text{M.S}}\right)t$ , where  $t$  is in second. Find the magnitude of the induced magnetic field at a radial distance of

- $1.5 \text{ cm}$
- $6.0 \text{ cm}$

### Question # 9

A rectangular loop of width  $a$  and length  $b$  is located a distance  $c$  from a long wire carrying a current  $I$  as shown. The wire is parallel to the long side of the loop. Find the magnetic flux through the loop, if  $a = 10\text{ cm}$ ,  $b = 15\text{ cm}$  and  $c = 5\text{ cm}$ .



### Question # 10

A 0.1A current is charging a capacitor with square plates, 5 cm on a side. If the plate separation is 4mm, find

- The rate at which the electric flux between the plates is changing with time.
- The displacement current.

### Question # 11

A ~~plane~~ <sup>plane</sup> electromagnetic sinusoidal wave of frequency 40 MHz travels in free space in the x-direction. The electric field at a given instant has a maximum value of 750 N/C and is along the y-axis. Find:

- The wavelength of the wave
- The magnitude and direction of the magnetic field  $\vec{B}$  when  $\vec{E} = 750 \hat{j} \text{ N/C}$



**Question # 12**

A mirror of area  $2.0 \text{ cm}^2$  intercepts light with intensity of  $10 \text{ W/m}^2$ . What radiation pressure is produced on the mirror?