Physics 122

Midterm Examination #1

March 21, 2007

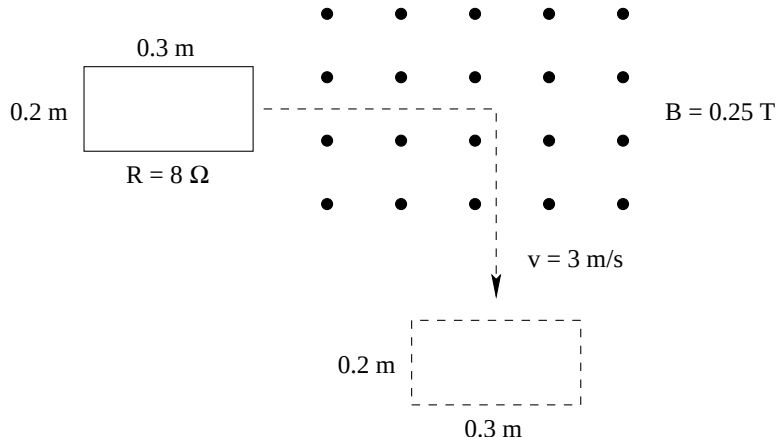
Name: _____

Recitation Section: _____

Lab Section: _____

	Score
Problem 1	
Problem 2	
Problem 3	
Problem 4	
Problem 5	
Total	

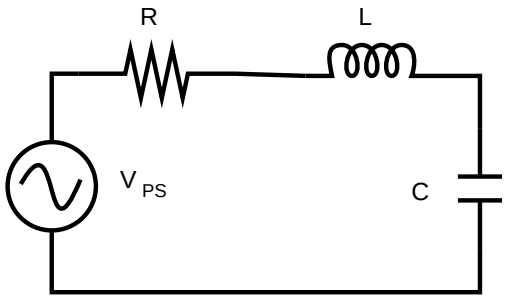
1. Shown in the figure below is a rectangular loop located to the left of a region with a magnetic field ($B = 0.25\ Tesla$) pointed out of the paper. The loop is dragged with a constant speed of $v = 3\ \frac{m}{s}$ along the path shown by the dashed arrow. The resistance of the loop is $R = 8\ \Omega$.



   (a) Determine the magnitude **AND** direction (clockwise or counter-clockwise) of the current in the loop during each of the following three conditions:
      i. The loop is entering the field region.
      ii. The loop is completely inside the field region.
      iii. The loop is leaving the field region.

   (b) Determine the magnitude **AND** direction of the force on the loop as it is exiting the field. Indicate the direction of the force by circling one of the following:
      i. Toward the left of the page.
      ii. Toward the top of the page.
      iii. Toward the right of the page.
      iv. Toward the bottom of the page.
      v. Out of the page.
      vi. Into the page.

2. Shown below is an LRC circuit.



(a) Draw a phaser diagram representing this circuit.

(b) Analyze your phaser diagram to determine the magnitude of the impedance, $|\mathbf{Z}|$.

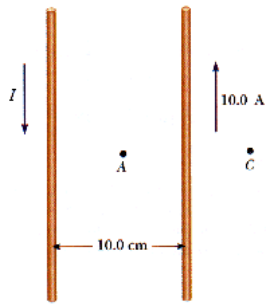
(c) Analyze your phaser diagram to determine the phase of the impedance, ϕ_Z.

(d) Let the resistance be $R = 600\ \Omega$, the inductance be $L = 1.04\ \mu H$ and the capacitance be $C = 3 \times 10^{-12}\ F$. Determine the peak voltage across the resistor if the circuit is driven by an AC power source with $V_{peak} = 10\ V$ and $f = 500\ MHz$.

(e) Clearly, your circuit is not tuned for the $f = 500\ MHz$ signal. Determine the frequency that your circuit **IS** tuned for.

(f) **EXTRA CREDIT (1 point):** What are the call letters of this radio station?

3. Two parallel conductors carry currents in opposite directions, as shown in the Figure below. One conductor carries a current of 10.0 A. Point A is the midpoint between the wires, and point C is 5.00 cm to the right of the 10.0 A current. I is adjusted so that the magnetic field at C is zero.

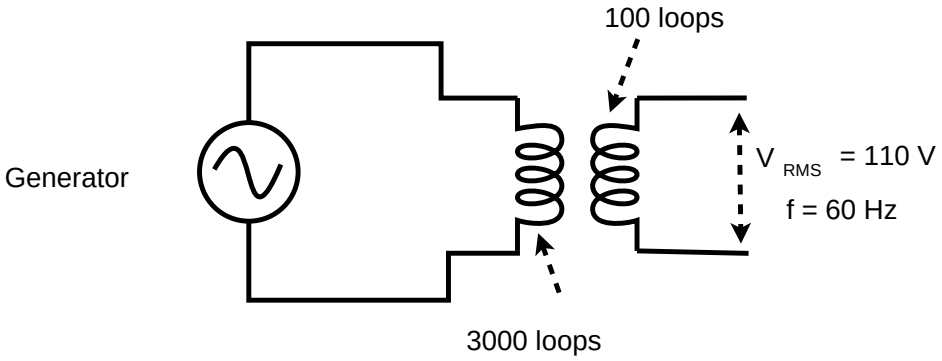


(a) Find the value of the current I.

(b) Find the value of the magnetic field at A.

4. The circuit below shows a generator driving a transformer. The output side of the transformer has an AC voltage whose RMS is $V_{RMS} = 110\ V$ and whose frequency is $f = 60\ Hz$.

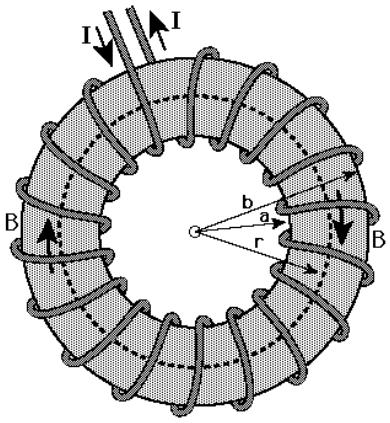
   The generator is made from a circular coil of wire with $N = 400\ turns$ whose radius is $r = 0.2\ m$. The coil is rotated in a uniform magnetic field, B.



   (a) Determine the *peak* voltage applied to the input side of the transformer.

   (b) Determine the magnetic field in the generator.

5. Shown in the figure below is a toroid. The toroid carries a current I and has a total of N turns. Use Ampere's Law to calculate the magnetic field at the radius r shown in the Figure.



HINT: Think of a toroid as a long solenoid bent into a circular shape.