KOÇ UNIVERSITY
College of Sciences
PHYS 102 General Physics 2
Spring Semester 2015
Final Exam
June 02, 2015 Tuesday, 15:00-16:30

Please read.

• Count to make sure that there are 5 pages in this question booklet
• Check your name, number, on front page, and student ID on each page.
• This examination is conducted with closed books and notes.
• Put all your personal belongings underneath your seat and make sure that pages of books or notebooks are not open.
• Absolutely no talking or exchanging anything (like rulers, erasers) during the exam.
• You must show all your work to get credit; you will not be given any points unless you show the details of your work (this applies even if your final answer is correct).
• Write neatly and clearly; unreadable answers will not be given any credit.
• If you need more writing space, use the backs of the question pages and put down the appropriate pointer marks.
• Make sure that you include units in your results.
• Make sure that you label the axis and have units in your plots.
• You are not allowed to use calculators during this exam.
• Turn off your mobile phones, and put away.
• You are not allowed to leave the class during the first 15 minutes, and last 15 minutes.
1-(25 Points) Consider a very long straight wire and a short piece of half-square shaped wire that are in close distance with each other as shown in the figure. The short wire is moving with a constant speed $v$ towards the long wire. Here, $L$ is the side-length of the short wire, and $I$ is a time-independent current. Calculate the motional emf induced on the short wire at the instant shown in the figure.
2- (25 Points) In the figure, the switch S has been closed for a long time and it is suddenly opened at time \( t = 0 \).

(a) Find the potential difference, \( V_{ab} = V_a - V_b \), at time \( t = 0 \).

(b) Find the rate of change of the current in the inductor, namely \( \frac{di}{dt} \), at time \( t=0 \).

(c) When does the current in \( R_2 \) become equal to 2.0 A?

(d) The inductor is a solenoid with cross-sectional area \( A=3.2 \times 10^{-4} \text{ m}^2 \) and length \( l=0.40 \text{ m} \). Find the average magnitude of the magnetic field inside the solenoid at time \( t=0 \). \( (\mu_0 = 4\pi \times 10^{-7} \text{Tm/A}) \)
3-(25 Points) Only the answers in the boxes will be graded and NO partial credit will be given. No points will be given to unjustified answers. Incomplete calculations will not be graded.

(i) The reactance of an inductor is 30 Ω at 200 Hz. Find its inductance in units of mH. (You may take π = 3.)

Answer: (5 points)

(ii) An alternating current with a maximum rms value of 10 A is passing through a 20 Ω resistor. Find the average rate of energy dissipated by the resistor in units of kW.

Answer: (5 points)

(iii) A 5 μF capacitor is in series with a 500 Ω resistor. A 120 V voltage with 400 rad/s angular frequency is applied to the combination. Find the phase angle of the circuit.

Answer: (5 points)

(iv) In question (iii), find the maximum rms current through the combination.

Answer: (5 points)

(v) In the antenna circuit of a radio receiver that is tuned to a particular station resistance, inductance and capacitance values are R = 5 Ω, L = 5 mH, and C = 2 pF. Find the frequency of the station (in MHz units) (You may take π = 3)

Answer: (5 points)
4-(25 Points) Helium-Neon lasers are often used in physics demonstrations. Let the laser light have a wavelength of $\lambda$ and a power $P$ that is uniformly spread over a cylindrical beam of diameter $d$. The medium is to be taken as free space.

a) What is the intensity of this laser beam?

b) What are the maximum values of the electric and magnetic fields?

c) What is the average energy density in the laser beam?

*Give your answers in terms of fundamental constants and variables provided in problem.*