Physics 272. Midterm III

Please write your name at the top of the page. There are 4 problems. Each is assigned 25 points. Show your work.

Problem 1: 25 points

A 80-turn coil has a radius of 5.0 cm and a resistance of 30 Ω. At what rate must a perpendicular magnetic field change to produce a current of 4.0 A in the coil?
Problem 2: 25 points

In the circuit below, the ac generator produces an rms voltage of 115 V when operated at 60 Hz.

(a) What is the rms current in the circuit?

(b) What is the rms voltage between B and C?

(c) What is the rms voltage between C and D?

(d) What is the phase difference between the voltages across the resistor and the inductor?
Problem 3: 25 points

An electromagnetic wave has a frequency of 100 MHz and is traveling in a vacuum. The magnetic field is given by $\vec{B}(z, t) = (10^{-8} \text{T}) \cos(kz - \omega t)\hat{i}$

(a) Find the wavelength and direction of propagation of this wave.

(b) Find the direction and magnitude of the $\vec{E}$ field.

(c) Find the intensity of the wave.
Problem 4: 25 points

(a) What is the frequency of a 300 nm photon? Would such a photon be visible to the human eye?

(b) If the current through an inductor were doubled, how would the energy stored in the inductor and the magnetic energy density in the inductor change?

(c) A parallel plate capacitor has two closely spaced plates. Charge is flowing onto the positive plate and off of the negative plate at a rate \( \frac{dQ}{dt} = 3.0A \). What is the displacement current between the plates? What is the conduction current between the plates?

(d) You are stranded in outer space outside your space ship, but you happen to have a 1 kW laser with you. Explain how you can get back to your space ship?

(e) The figure shows an ac generator. Give a short explanation of how it works.