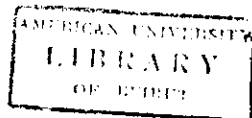# PHYSICS 211

FINAL EXAM

(TIME: TWO HOURS)

FINAL EXAM PAPERS WILL BE SHOWN ON TUESDAY, JUNE 30, ROOM 121 PHYSICS, FROM 2:00 PM TILL 4:00 PM

June 29, 1998

NAME:_____

ID #:_____

12%

1. This problem consists out of four short questions. Give in each case a **short** explanation for your answer.

   (a) Is the Coulomb force that one charge exerts on another changed if other charges are brought near by?

   (b) An electric dipole has its dipole moment $\vec{p}$ aligned with a uniform external electric field $\vec{E}$. Is the equilibrium stable or unstable?

(c) Do electrons tend to go to regions of high potential or low potential?

(d) Is the filament resistance lower or higher in a 500 W light bulb than in a 100 Watt bulb, if both bulbs are designed to operate on 110 Volt?

2. A square coil of 10 turns carries a current of 10 A. The side of the square is 5 cm. The coil is located in the xy- plane with it centers at the origin O. Looking from the positive z – axis down on the loop the current is clockwise.
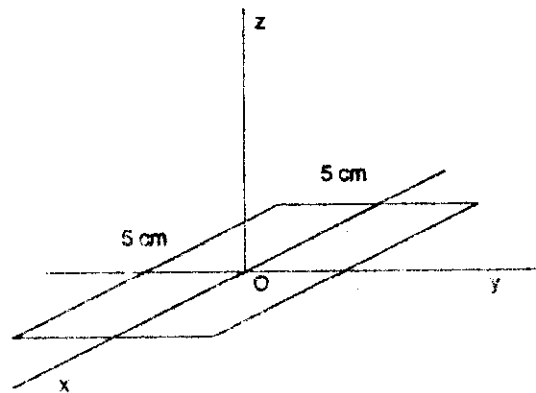
(a) In an external magnetic field B of 2 T, what is the maximum torque exerted by the field on the coil?

(b) If B is in the positive z – axis direction, what is the magnitude and direction of the torque on the loop?

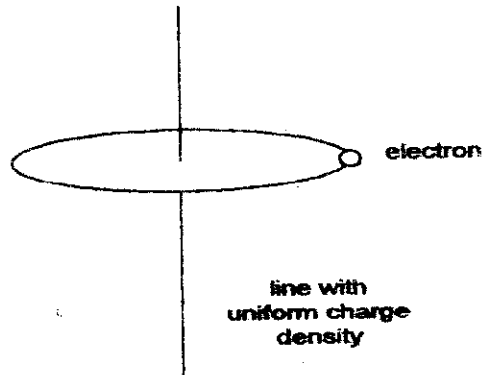(c) If B is in the negative y – axis direction, what is the magnitude and the direction of the torque?

15%

3. An electron moves in an uniform circular motion about an infinitely long, straight wire with uniform charge density λ.

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

$m = 9.0 \times 10^{-31}$ kg

$\varepsilon_0 = 9 \times 10^{-12}$ F/m

(a) Show that the speed of the electron does **not** depend on the distance of the electron from the wire.

(b) If the speed of the electron is 2.0×10^4 m/s, what is the magnitude and sign of the linear charge density λ of the wire?

(c) If the radius r of the circular orbit of the electron is 5×10^{-8} m, what is the orbital magnetic moment μ_L of the electron?

4. Given the circuit in the figure (all resistances in ohms):
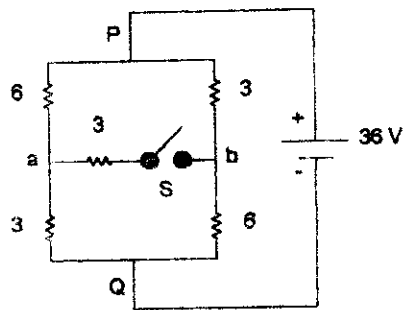
(a) What is the potential difference $V_a - V_b$ when the switch is open?

(b) What is the current through the switch S when it is closed? What is the direction of the current?

(c) What is the equivalent resistance of the circuit between the points P and Q when the switch S is open?

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5. A straight conducting wire is located between the plates of a parallel plate capacitor and carries a current I of 50 A in to the plane of the paper (see figure). The area each plate of the capacitor is 100 cm^2 and their separation is 0.5 m. The charge on each plate is 18 μμC.

$\varepsilon_0 = 9 \times 10^{-12}$ F/m

$\mu_0 = 4\pi \times 10^{-7}$ H/m
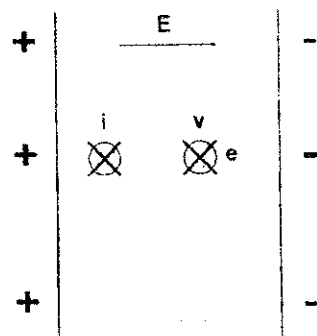
At what speed should an electron be fired parallel to the straight conducting wire at a distance of 5 cm from the wire and in the direction of the current so as to maintain its constant speed in the straight line parallel to the conducting wire?

6.   The capacitor in a LC-circuit has a value of 250 pF.

(a) What should be the value of the inductance L if the resonance frequency of the circuit is 1.0 MHz?

(b) If the total energy stored in the circuit is 5×10^{-7} J, what is the maximum current in the circuit and what is the maximum charge on the capacitor?

(c) If at $t = 0$ the capacitor is fully charged, at what time t_1 will 1/5 of the total energy be stored in the magnetic field of the inductor? (1 degree $= \pi / 180$ radians).

(d) What will be the charge on the capacitor at this time t_1 and what will be the current in the inductor at this time t_1?