General for Biological Sciences Majors II (171.104)
Midterm Exam #3, Apr 14, 2009, 8:00am-8:50am

- Exams are closed book but each student will be allowed to use a single sheet (8.5 x 11 inches, double-sided) of notes. The page (with your name) must be turned in with your blue book.
- Calculators are allowed. Do not bring laptops, PDAs, cell phones, etc.
- Please write all exams in ink. Exams written in pencil cannot be re-graded.
- All work must be done in the blue book.
- All students must bring their J-card IDs to the exam.

Problem 1. (*40 pts)* Figure 1 shows a cross section through three long wires with a linear mass density of 50 g/m. They each carry equal currents in the directions shown (x: into the paper, ●: out of the paper). The lower two wires are 4.0 cm apart and are attached to a table.

(a) What current I will allow the upper wire to "float" so as to form an equilateral triangle with the lower wires?

(b) What is the magnitude and the direction of the magnetic field at the center of the triangle formed by the three wires?

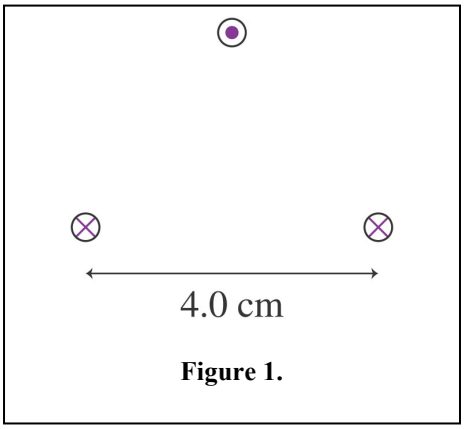

Figure 1.

Problem 2. *(30 pts)* The switch in Figure 2 has been open for a long time. It is closed at t=0. What is the current through the 20Ω resistor

(a) Immediately after the switch is closed?

(b) After the switch has been closed a long time?

(c) After the switch has been closed a long time it is reopened. What is the current through the 20Ω resistor immediately after the switch is reopened?

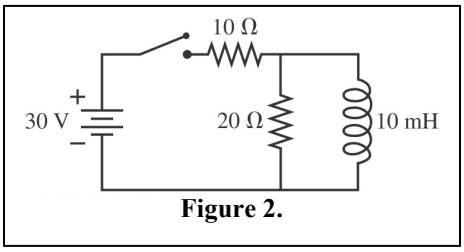

Figure 2.

Problem 3. (30 pts) A proton is fired with a speed of 1.0×10^6 m/s through the parallel-plate capacitor shown of Figure 3. The capacitor's electric field is $\boldsymbol{E} = (1.0 \times 10^5$ V/m, down).

(a) What magnetic field ***B***, both strength and direction, must be applied to allow the proton to pass through the capacitor with no change in speed or direction?

(b) Find the electric and magnetic fields in the proton's reference frame.

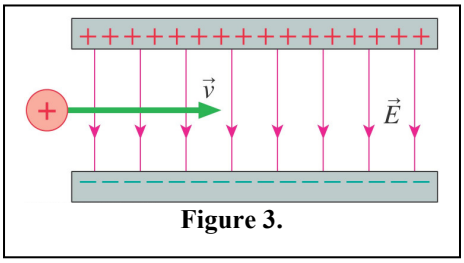

Figure 3.