Midterm Exam 02 (2017 Spring)

PHYS 203B-001: College Physics

Date: 2017 Mar 10

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.
2. Total time = 50 minutes.
3. There are 8 questions in this exam.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to show your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. (**10 points.**) The average cost of electricity in the United States, for residential users, is about 0.12 USD/kWh (12 cents per kilo-Watt-hour). At this rate your electricity bill for a month came out to be 50.00 USD. How much electric energy (in Joules) did you use in the month?

2. (**10 points.**) A piece of Nichrome wire of resistivity $1.50 \times 10^{-6}\,\Omega$m has a radius of 6.50×10^{-4} m and a total length of 15 m. It is used in a laboratory to make a heater when connected to a voltage source of 120 V. Ignoring the effect of temperature on resistance, estimate the power output of the heater.

3. (**10 points.**) Determine the equivalent capacitance between points A and B in the circuit in Figure 1. Given $C_1 = 1.0\,\mu\text{F}$, $C_2 = 2.0\,\mu\text{F}$, $C_3 = 3.0\,\mu\text{F}$, and $C_4 = 4.0\,\mu\text{F}$.

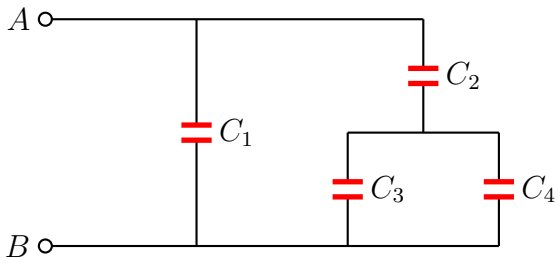

Figure 1: Problem 3

4. (**10 points.**) Figure 2 shows two resistors connected in parallel to a battery. The battery has a voltage of $V = 10.0\,\mathrm{V}$, and the resistors have resistances $R_1 = 100.0\,\Omega$ and $R_2 = 200.0\,\Omega$.

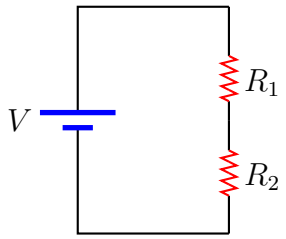

Figure 2: Problem 4

(a) Find the ratio P_1/P_2 of the powers of the resistors.

(b) If the resistors represented electric bulbs, which bulb would glow brighter?

5. (**10 points.**) A potential difference $V = 10.0\,\mathrm{V}$ is applied across a capacitor arrangement with two capacitances connected in series, $C_1 = 10.0\,\mu\mathrm{F}$ and $C_2 = 20.0\,\mu\mathrm{F}$.

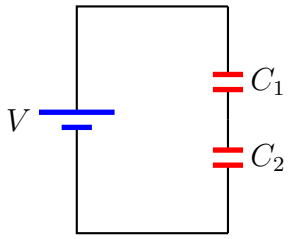

Figure 3: Problem 5

(a) Find the equivalent capacitance.

(b) Find the charges Q_1 and Q_2 on each of the capacitors.

(c) Find the voltages V_1 and V_2 across each of the capacitors.

(d) Find the potential energies U_1 and U_2 stored inside each of the capacitors.

6. (**10 points.**) A charge particle enters a uniform magnetic field and follows the path shown in Fig. 4. What can you conclude about the charge of the particle, that is, is it positive, negative, or neutral?
   Advice: Write a few lines elaborating on the method you used to arrive at the solution. This will help you earn partial credit, if necessary.

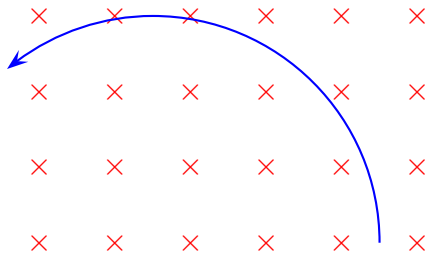

Figure 4: Problem 6

7. (**10 points.**) An electron, is traveling at a velocity of $5.1 \times 10^6\,\mathrm{m/s}$ due East, in a magnetic field that has a magnitude of of 0.10 Tesla along a direction 30° West of North. (Caution: Be careful while interpreting the angle.)

   (a) What is the magnitude of the magnetic force acting on the electron?

   (b) What is the direction of the magnetic force acting on the electron? (Use the notation, $+x$ for East, $-x$ for West, $+y$ for North, $-y$ for South, $+z$ for vertically up, and $-z$ for vertically down.)

8. (**10 points.**) A loop in the shape of a right triangle, carrying a current $I = 2.0\,\text{A}$, is placed in a magnetic field $B = 2.0\,\text{T}$. (Choose $\hat{\mathbf{z}}$ to be out of the page, and $\hat{\mathbf{x}}$ to be along side 1 of the traingle.) Let $x = 3.0\,\text{cm}$, $y = 2.0\,\text{cm}$.

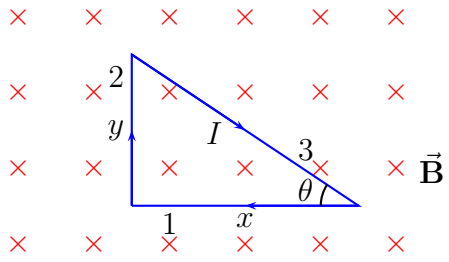

Figure 5: Problem 8.

(a) Determine the magnitude and direction of the magnetic force on side 1 of the traingle.

(b) Determine the magnitude and direction of the magnetic force on side 2 of the traingle.