Midterm Exam 02 (2015 Summer)

PHYS 203B: College Physics

Date: 2015 Jul 10

(Name) (Signature)

Instructions

1. Total time = 60 minutes.
2. There are 8 questions in this exam.
3. Equation sheet is provided separately.
4. To obtain partial credit for your work you need to show your work in detail and organize it clearly.
5. A simple calculator (with trignometric functions) is allowed.

1. (**10 points.**) A battery pack of a pocket calculator has a voltage of 3.0 V and delivers a current of 0.17 mA. In one hour of operation, how much charge flows in the circuit?

2. (**10 points.**) The average cost of electricity in the United States, for residential users, is about 0.10 USD/kWh (10 cents per kiloWatt-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?

3. (**10 points.**) Figure 1 shows three resistors connected in parallel to a battery. The battery has a voltage of $V = 10.0\,\text{V}$, and the resistors have equal resistances of $R = 300.0\,\Omega$.

   (a) Determine the equivalent resistance across the battery.

   (b) Determine the voltage across each of the resistor.

   (c) Determine the current passing through each resistor.

   (d) Determine the power consumed by each resistor.

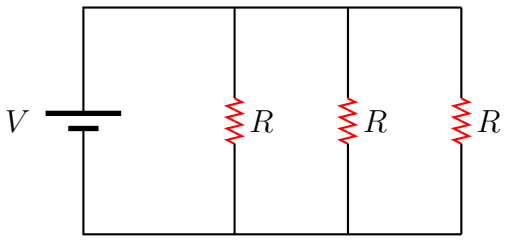

Figure 1: Problem 3

4. (**10 points.**) A potential difference $V = 10\,\mathrm{V}$ is applied across a capacitor arrangement with two capacitances connected in series, $C_1 = 10.0\,\mu\mathrm{F}$ and $C_2 = 20.0\,\mu\mathrm{F}$.

   (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.

5. (**10 points.**) A charged particle initially moving with constant speed v enters a region of magnetic field **B** pointing into the page. It is deflected as shown in Fig. 5.

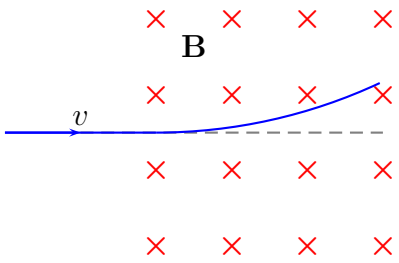

Figure 2: Problem 5

(a) Is the charge on the particle positive or negative?

(b) What curve characterizes the path of the deflected particle?

6. (**10 points.**) In a region, a uniform magnetic field of $1.50 \times 10^{-3}\,\mathrm{T}$ points along the positive z-axis and a uniform electric field of $4.50 \times 10^{3}\,\mathrm{N/C}$ points along the positive x-axis. A positive $1.8\,\mu\mathrm{C}$ charge moves at a speed of $3.00 \times 10^{6}\,\mathrm{m/s}$ along the positive y-axis in the region. Determine the magnitude of the net force that acts on the charge.

7. (**10 points.**) A wire lying along the y axis from $y = 0$ to $y = 0.325\,\mathrm{m}$ carries a current of $2.00\,\mathrm{mA}$ in the negative direction of the axis. The wire fully lies in a uniform magnetic field of magnitude $0.35\,\mathrm{T}$ pointing in the positive x direction.

   (a) What is the magnitude of the magnetic force acting on the wire due to the magnetic field?

   (b) What is the direction of the magnetic force acting on the wire?

8. (**10 points.**) A square coil and a circular coil are each made from the same length of wire. Each contains a single turn. Find the ratio

$$\frac{\tau_{\text{square}}}{\tau_{\text{circle}}} \tag{1}$$

of the maximum torques that these coils experience in the same magnetic field when they contain the same current.