Midterm Exam 02 (2017 Spring)

PHYS 203B-002: College Physics

Date: 2017 Mar 9

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.
2. Total time = 75 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 resistance of a bagel toaster is $20.0\,\Omega$. To prepare a bagel, the toaster is operated for one minute from a $120\,\mathrm{V}$ outlet. How much energy is delivered to the toaster?

2. (**10 points.**) A potential difference $V = 10.0\,\mathrm{V}$ is applied across a capacitor arrangement with two capacitances connected in parallel, $C_1 = 10.0\,\mu\mathrm{F}$ and $C_2 = 20.0\,\mu\mathrm{F}$.

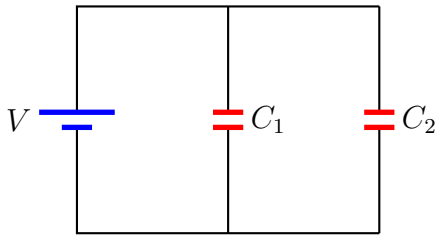

Figure 1: Problem 2

(a) Find the equivalent capacitance.

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

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

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

3. (**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 $R_2 = 200.0\,\Omega$.

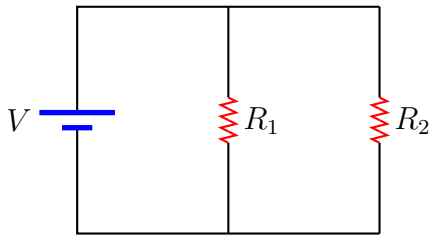

Figure 2: Problem 3

(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?

4. (**10 points.**) A cylindrical copper rod has resistance R. It is reformed to thrice its original length with no change of volume. What is its new resistance in terms of the original resistance R?

5. (**10 points.**) Determine the equivalent resistance in the circuit in Figure 3. Given $R_1 = R_2 = R_3 = R_4 = 100.0\,\Omega$.

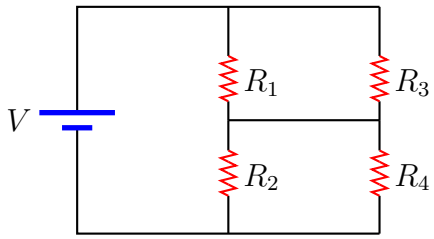

Figure 3: Problem 5

6. (**10 points.**) An alpha particle travels at a velocity $\vec{\mathbf{v}}$ of magnitude 770 m/s through a uniform magnetic field $\vec{\mathbf{B}}$ of magnitude 0.035 T. (An alpha particle has a charge of $+3.2 \times 10^{-19}$ C and a mass of 6.6×10^{-27} kg.) The angle between $\vec{\mathbf{v}}$ and $\vec{\mathbf{B}}$ is 71°.

   (a) What is the magnitude of the force $\vec{\mathbf{F}}_B$ acting on the alpha particle due to the magnetic field?

   (b) What is the direction of $\vec{\mathbf{F}}_B$? (Draw the vectors and describe the direction.)

   (c) What is the resultant (cyclotron) frequency of the rotation of the alpha particle?

7. (**10 points.**) A magnetic field has a magnitude of 1.50 mT and points in the $-\hat{\mathbf{z}}$ direction, and an electric field has a magnitude of 6.00 kN/C pointing in the $\hat{\mathbf{x}}$ direction. A positive 1.0 μC charge moves at a speed of 2.00×10^6 m/s in the direction of $\hat{\mathbf{x}}$. Determine the magnitude of the net force that acts on the charge.

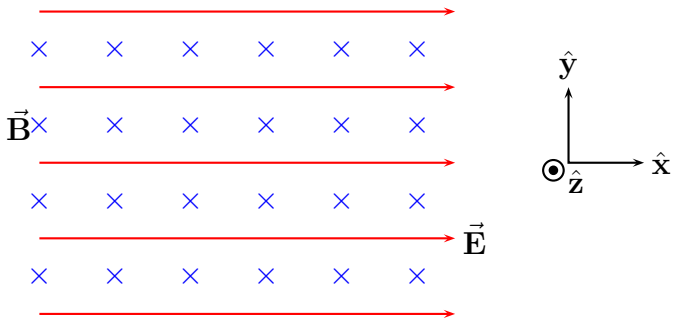

Figure 4: Problem 7.

8. (**10 points.**) A loop in the shape of a right triangle, carrying a current $I = 20.0\,\text{mA}$, is placed in a magnetic field $B = 1.0\,\text{T}$. (Choose $\hat{\mathbf{z}}$ to be out of the page, and $\hat{\mathbf{x}}$ to be along side 1 of the traingle.) Let $x = 3.0\,\text{cm}$, $y = 2.0\,\text{cm}$.

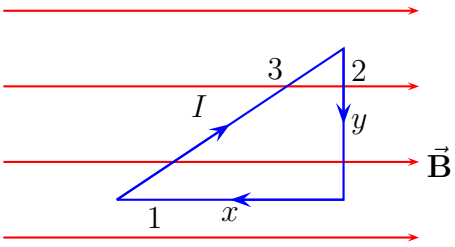

Figure 5: Problem 8.

(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.