Midterm Exam 03 (2017 Spring)

PHYS 203B-001: College Physics

Date: 2017 Apr 14

(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, worth a total of 70 points. One problem will be dropped.
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.**) 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.

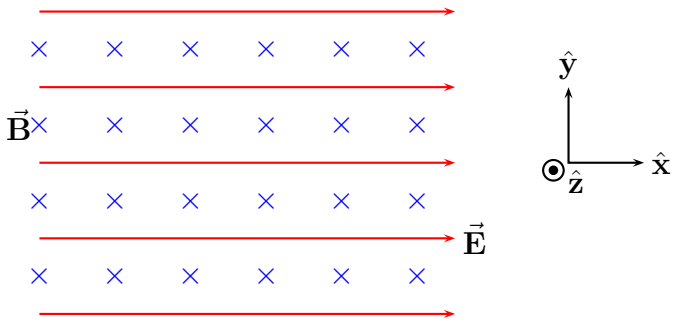

Figure 1: Problem 1.

2. (**10 points.**) A steady current $I = 1.00\,\text{A}$ flows through a wire shown in Fig. 2. Given $a = 5.00\,\text{cm}$. Find the magnitude and direction of the magnetic field at point P.

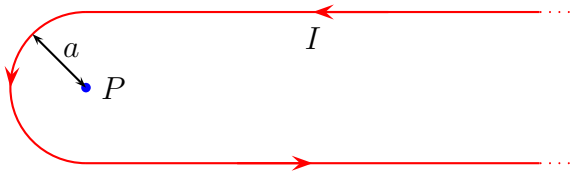

Figure 2: Problem 2

3. (**10 points.**) Figure 3 shows two current carrying wires separated by a distance $D = 10.0\,\text{cm}$. The directions of currents, either going into the page or coming out of the page, are shown in the figure. Determine the distance x of the point $\times$ where the magnetic field is exactly zero. Given $I_1 = 1.0\,\text{A}$ and $I_2 = 4.0\,\text{A}$.

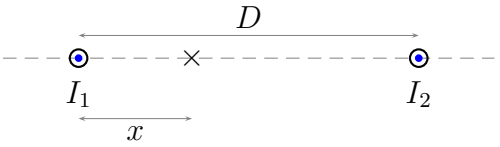

Figure 3: Problem 3.

4. (**10 points.**) Two circular coils are concentric and lie in the same plane. The inner coil contains 120 turns of wire, has a radius of 0.012 m, and carries a current of 5.0 A. The outer coil contains 160 turns and has a radius of 0.016 m. What must be the magnitude and direction (relative to the current in the inner coil) of the current in the outer coil, such that the net magnetic field at the common center of the two coils is zero?

5. (**10 points.**) The drawing shows two surfaces that have the same area of $1.00\,\mathrm{cm}^2$. A uniform magnetic field $\tilde{\mathbf{B}}$ of magnitude $1.0\,\mathrm{T}$ fills the space occupied by these surfaces and is oriented parallel to the yz plane as shown. If $\theta = 30°$, find the magnetic flux Φ_{xz} that passes through the surface xz.

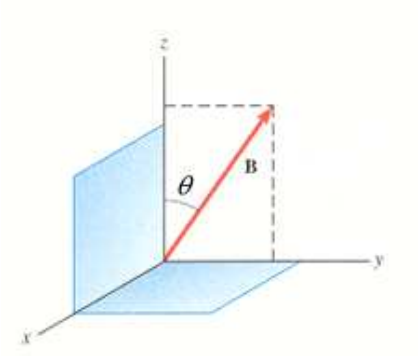

Figure 4: Problem 5

6. (**10 points.**) Figure 5 shows a conducting a rod being pulled along horizontal, frictionless, conducting rails at a constant speed v. A uniform magnetic field $\mathbf{B}$ fills the region in which the rod moves. Assume $L = 10\,\text{cm}$, $v = 5.0\,\text{m/s}$, $B = 1.2\,\text{T}$, and $R = 0.40\,\Omega$.

   (a) Is the magnetic flux in the loop increasing or decreasing?

   (b) What is the direction of the induced current in the loop?

   (c) Determine the magnitude of the induced current in the loop.

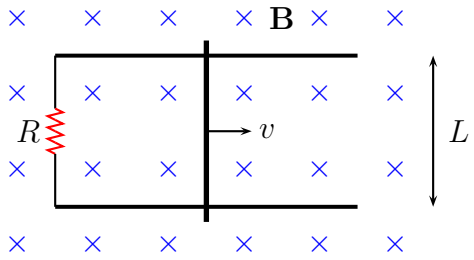

Figure 5: Problem 6

7. (**10 points.**) A square loop of wire consisting of a single turn is perpendicular to a uniform magnetic field. The square loop is then re-formed into a circular loop and is also perpendicular to the same magnetic field. Determine the ratio of the flux through the square loop to the flux through the circular loop.

8. (**10 points.**) A solenoid of infinite extent is constructed by winding 200 turns per centimeter. Determine the energy per unit volume stored in the solenoid when it carries a current of 1.0 A.