Midterm Exam 03 (2016 Fall)

PHYS 203B: College Physics

Date: 2015 Nov 15

(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 9 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.**) A proton, traveling with a velocity of 2.0×10^6 m/s in the direction of $\hat{\mathbf{x}}$, passes through a region of magnetic field that has a magnitude of 0.100 T and direction along $\hat{\mathbf{z}}$. What is the magnitude and direction of the magnetic force acting on the proton?

2. (**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.

3. (**10 points.**) A straight wire in a magnetic field experiences a force of 0.026 N when the current in the wire is 2.9 A. The current in the wire is changed, and the wire experiences a force of 0.056 N as a result. What is the new current?

4. (**10 points.**) A loop in the shape of a right triangle, carrying a current $I = 2.0\,\mathrm{A}$, is placed in a magnetic field $B = 2.0\,\mathrm{T}$. (Choose $\hat{\mathbf{z}}$ to be out of the page, and $\hat{\mathbf{x}}$ to be along side 1 of the traingle.) Let $x = 3.0\,\mathrm{cm}$, $y = 2.0\,\mathrm{cm}$.

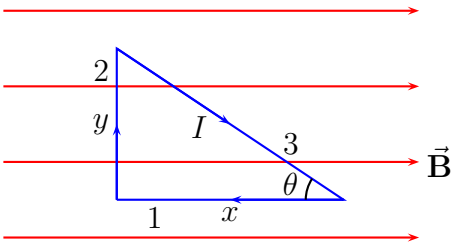

Figure 1: Problem 4.

(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.

5. (**10 points.**) A conducting loop in the shape of a square of edge length $L = 1.00\,\text{cm}$ carries a current $I = 2.00\,\text{A}$ as shown in the figure. Calculate the magnitude and direction of the magnetic field at the center, P, of the square.

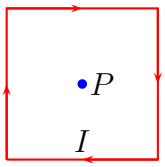

Figure 2: Problem 5.

6. (**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 7.0 A. The outer coil contains 160 turns and has a radius of 0.017 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?

7. (**10 points.**) Figure 3 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.

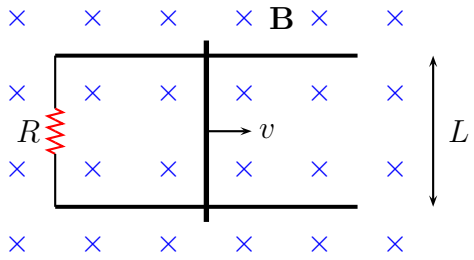

Figure 3: Problem 7.

8. (**10 points.**) Figure 4 shows five snapshots of a rectangular coil being pushed across the dotted region where there is a uniform magnetic field directed into the page. Outside of this region the magnetic field is zero. Determine the direction of induced current in the loop at each of the five instances in the figure.

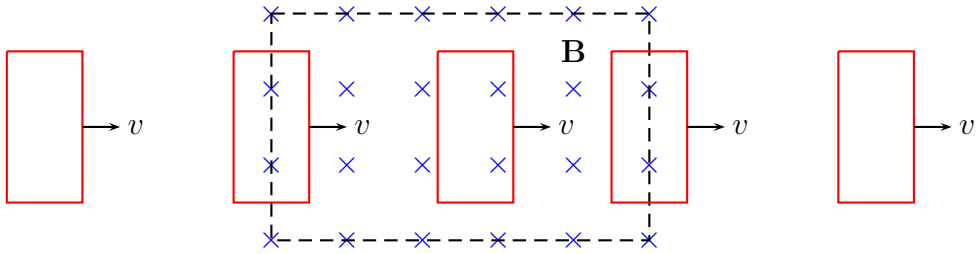

Figure 4: Problem 8.