Midterm Exam No. 03 (2016 Fall)

PHYS 205B: University Physics

Date: 2016 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 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.**) A proton moving at $4.50 \times 10^6\,\mathrm{m/s}$ through a magnetic field of magnitude $1.76\,\mathrm{T}$ experiences a magnetic force of magnitude $8.00 \times 10^{-13}\,\mathrm{N}$.

   (a) What is the angle between the proton's velocity and the direction of magnetic field?

   (b) Is the answer unique? If not, report all possible angles.

2. (**10 points.**) A loop in the shape of a right triangle of sides $x = 3.00\,\text{cm}$ and $y = 2.00\,\text{cm}$, carrying a current $I = 2.00\,\text{A}$, is placed in a magnetic field $0.300\,\text{T}$. Determine the magnitude and direction of the force on side 3 of the triangle. (Choose $\hat{\mathbf{z}}$ to be out of the page.)

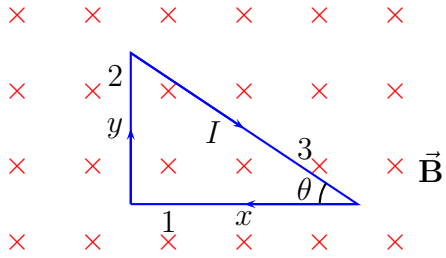

Figure 1: Problem 2.

3. (**10 points.**) A conducting loop in the shape of an equilateral triangle of side $L = 1.00\,\text{cm}$ 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 triangle.

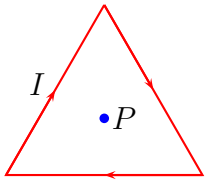

Figure 2: Problem 3.

4. (**10 points.**) Figure 3 shows two, infinitely long, current carrying wires, passing through a plane. The directions of the currents, either going into the page or coming out of the page, are shown in the figure. Determine the magnitude and direction of the magnetic field at the point $\times$, the origin. Let $I_1 = 1.0\,\mathrm{A}$, $I_2 = 2.0\,\mathrm{A}$, $x = 6.0\,\mathrm{cm}$, and $y = 4.0\,\mathrm{cm}$. Find the magnitude and direction of the total magnetic field at the origin.

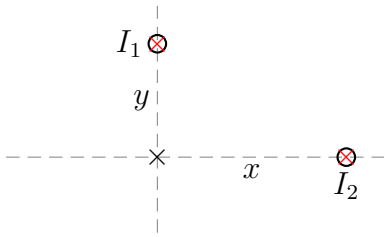

Figure 3: Problem 4.

5. (**10 points.**) Two long, parallel conductors, separated by 14.0 cm, carry currents in the same direction. The first wire carries a current $I_1 = 4.00\,\text{A}$, and the second carries $I_2 = 8.00\,\text{A}$. (Assume the conductors lie in the plane of the page.) What is the force per unit length exerted by wire carrying current I_1 on the wire carrying current I_2?

6. (**10 points.**) A long solenoid that has 1070 turns uniformly distributed over a length of 0.390 m produces a magnetic field of magnitude 1.00×10^{-4} T at its center. What current is required in the windings for that to occur?

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, which is also perpendicular to the same magnetic field. The magnetic flux that passes through the square loop is 3.9×10^{-3} Wb. What is the flux that passes through the circular loop?

8. (**10 points.**) A conducting bar of length l moves to the right on two frictionless rails as shown in the figure below. A uniform magnetic field directed into the page has a magnitude of 0.200 T. Assume $R = 4.0\,\Omega$ and $l = 10.0\,\text{cm}$.

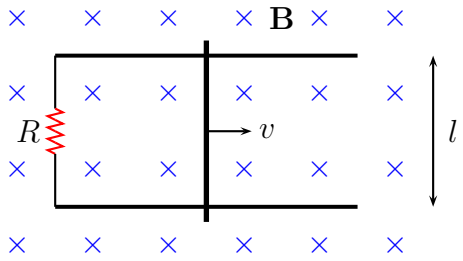

Figure 4: Problem 8.

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

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

(c) What is the current in the resistor if the bar is moving at 5.0 m/s?