Midterm Exam 03 (2017 Spring)

PHYS 203B-002: College Physics

Date: 2017 Apr 13

(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 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 $x = 3.0\,\mathrm{cm}$, $y = 2.0\,\mathrm{cm}$. Determine the magnitude and direction of the magnetic force on side 2 of the traingle.

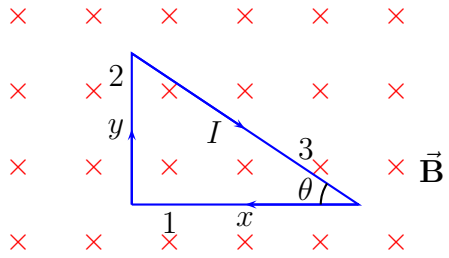

Figure 1: Problem 1.

2. (**10 points.**) A steady current I flows through a wire shown in Fig. 2. Determine the magnitude and direction of the magnetic field at point P for $I = 1.0\,\mathrm{A}$ and $a = 10.0\,\mathrm{cm}$.

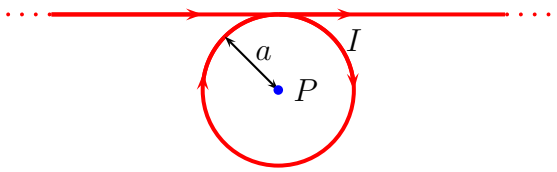

Figure 2: Problem 2.

3. (**10 points.**) Figure 3 shows two (infinitely long) current carrying wires, parallel to each other and crossing the plane that is pictured. The directions of currents, either going into the page or coming out of the page, are shown in the figure. Determine the magnitude of the magnetic field at the point $\times$, the origin. Let $I_1 = 1.0\,\mathrm{A}$, $I_2 = 2.0\,\mathrm{A}$, $x = 12\,\mathrm{cm}$, and $y = 8.0\,\mathrm{cm}$.

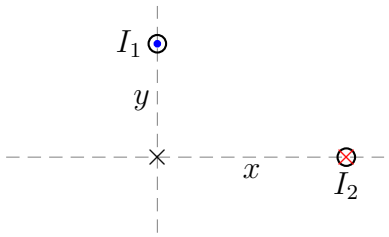

Figure 3: Problem 3

4. (**10 points.**) Two infinitely long parallel wires, carrying currents $I_1 = 1.0\,\mathrm{A}$ and $I_2 = 2.0\,\mathrm{A}$ in the same direction, are separated by a distance $r = 10.0\,\mathrm{cm}$.

   (a) Determine the magnitude and direction of the magnetic field generated by the current carrying wire '1' at the position of current carrying wire '2'.

   (b) Determine the magnitude and direction of the force per unit length exerted by wire '1' on wire '2'.

5. (**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 consists of two turns and 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?
   Caution: Note that the circular loop has two turns.

6. (**10 points.**) A loop of wire having a resistance $R = 100.0\,\Omega$ is placed in a magnetic field whose magnitude is changing in time, as described in Figure 4. The direction of the magnetic field is normal to the plane of the loop. The loop of wire consists of 50 turns and has an area of $A = 25 \times 10^{-4}\,\mathrm{m}^2$. Determine the induced voltage and the induced current in the loop between 0 s to 2 s.

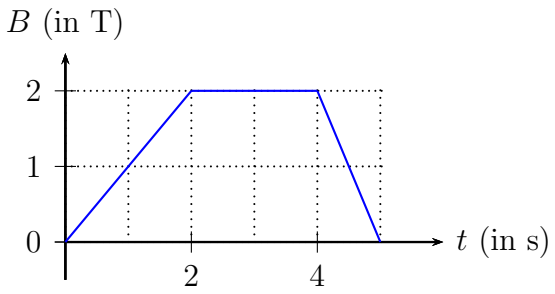

Figure 4: Problem 6.

7. (**10 points.**) Figure 5 shows a conducting 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. Let $l = 10.0\,\text{cm}$, $v = 5.0\,\text{m/s}$, $B = 1.2\,\text{T}$, and $R = 0.40\,\Omega$.

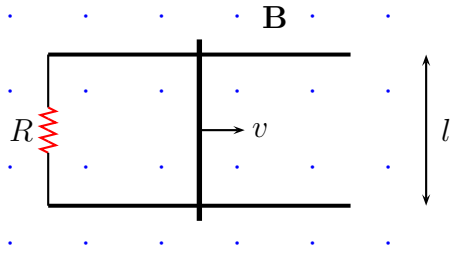

Figure 5: Problem 7.

(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.

8. (**10 points.**) A coil has an inductance of 6.00 mH, and the current in it changes from 0.200 A to 1.50 A in a time interval of 0.350 s. Find the magnitude of the average induced voltage in the coil during this time interval.