Homework No. 07 (Spring 2022)

PHYS 203B-001: COLLEGE PHYSICS

Department of Physics, Southern Illinois University–Carbondale
Due date: Monday, 2022 Mar 21, 10:00am, on D2L

Instructions

- To the extent to which you depend on resources to complete this homework is a measure of how much extra work you need to put in to master the related concepts.

- Describe your thought process in detail and organize it clearly. Make sure your answer has the correct units and the right number of significant digits.

- After completion, scan the pages as a single PDF file, and submit the file on D2L (Assessments → Assignments).

Problems

1. (**10 points.**) A steady current I flows through a wire shown in Fig. 1. Determine the magnitude and direction of magnetic field at point P in terms of I and a.
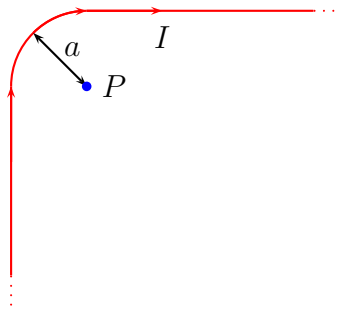

Figure 1: Problem 1

(a) Determine the magnitude and direction of the magnetic field for $I = 1.0\,\text{A}$ and $a = 10.0\,\text{cm}$.

(b) Determine the magnitude and direction of the magnetic force on a proton moving with velocity $v = 2.0 \times 10^6\,\text{m/s}$, to the right, while it is passing the point P.
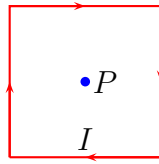
Solution

1

Figure 2: Problem 2

2. (**10 points.**) A steady current I flows through a wire in the shape of a square of side L, shown in Fig. 2. Determine the magnitude and direction of the magnetic field at the center of the square, P.

Solution

3. (**10 points.**) Figure 3 shows two current carrying wires, separated by a distance D. The directions of currents, either going into the page or coming out of the page, are shown in the figure. Determine the point $\times$ where the magnetic field is exactly zero.
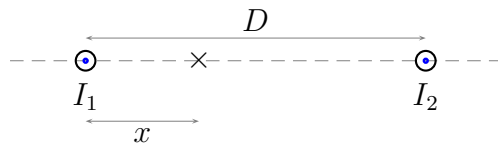

Figure 3: Problem 3

Solution

4. (**10 points.**) Figure 4 shows two current carrying wires, in a plane. The directions of 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 $I_1 = 1.0\,\text{A}$, $I_2 = 2.0\,\text{A}$, $x = 12\,\text{cm}$, and $y = 8.0\,\text{cm}$.
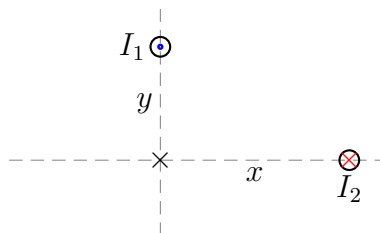

Figure 4: Problem 4

Solution

5. (**10 points.**) A rectangular loop of wire carrying current $I_2 = 2.0\,\text{A}$ is placed near an infinitely long wire carrying current $I_1 = 1.0\,\text{A}$, such that two of the sides of the rectangle are parallel to the current I_1. Let the distances be $a = 5.0\,\text{cm}$, $b = 4.0\,\text{cm}$, and $l = 10.0\,\text{cm}$.
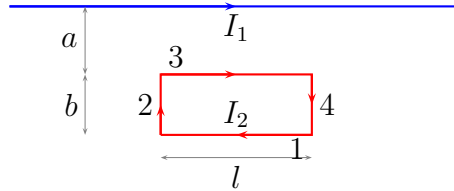

Figure 5: Problem 5

(a) Determine the force on side '1' of the loop.

(b) Determine the force on side '3' of the loop.

(c) Show that the combined force on side '2' and '4' is zero.

(d) Determine the magnitude and direction of the total force on the loop.

Solution