Midterm Exam No. 03 (2021 Fall)

PHYS 205B: University Physics

Date: 2021 Nov 2

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 4.
2. Total time = 75 minutes.
3. There are 5 conceptual questions and 5 problems 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. (**5 points.**) What are the dimensions (not to be confused with units) of the ratio of electric field to magnetic field,

$$\frac{E}{B}? \tag{1}$$

2. (**5 points.**) A charged particle initially moving with constant speed v enters a region of magnetic field **B** pointing into the page. It is deflected as shown in Fig. 1. What curve characterizes the path of the deflected particle?

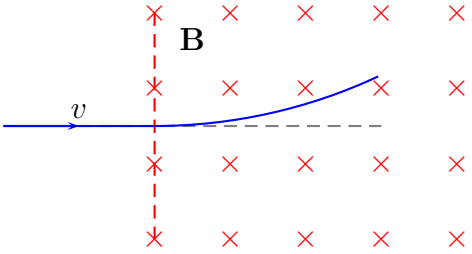

Figure 1: Problem 2

3. (**5 points.**) Briefly describe Hall effect.

4. (**5 points.**) Two infinitely long straight wires parallel to each other carry steady currents I in each of them in the same direction as shown in Figure 2. What is the magnitude and direction of the magnetic field at the point P midway between the wires?

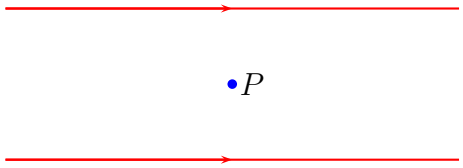

Figure 2: Problem 4

5. (**5 points.**) Figure 3 shows a snapshot of a rectangular coil being pushed through a uniform magnetic field directed into the page. Determine the direction of induced current in the loop at the instance shown in the figure. Given $L = 10.0\,\text{cm}$, $v = 5.0\,\text{m/s}$, and $B = 1.2\,\text{T}$,

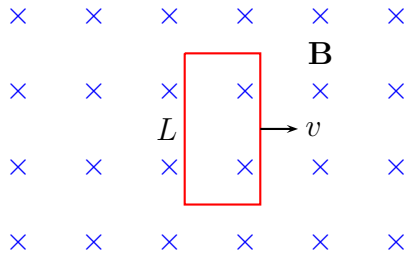

Figure 3: Problem 5.

6. (**10 points.**) A proton and an electron enter a region containing a uniform magnetic field. Determine the ratio of the cyclotron frequency of the electron to the cylcotron frequency of the proton.

7. (**10 points.**) A loop in the shape of a right triangle of sides $a = 3.0\,\text{cm}$ and $b = 2.0\,\text{cm}$, carrying a current $I = 2.0\,\text{A}$, is placed in a magnetic field $0.30\,\text{T}$ as shown in Figure 4. Determine the magnitude and direction of the force on side 3 of the triangle.

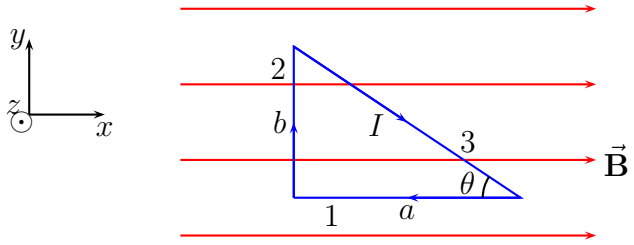

Figure 4: Probelm 7

8. (**10 points.**) A steady current I flows through a wire in the shape of an equilateral triangle of side L shown in Fig. 5. Express the magnitude of the magnetic field at the center of the triangle, P, in the form

$$B = \frac{\mu_0}{4\pi}\frac{I}{L}a. \tag{2}$$

Thus, determine the number a.

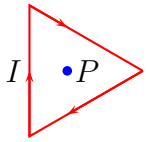

Figure 5: Problem 8

9. (**10 points.**) Figure 6 shows two infinitely long parallel current carrying wires coming out of the plane perpendicular to the wires. 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 force per unit length exrted by the wire carrying I_2 on the wire carrying current I_1. Given $I_1 = 1.0\,\mathrm{A}$, $I_2 = 2.0\,\mathrm{A}$, $x = 12\,\mathrm{cm}$, and $y = 8.0\,\mathrm{cm}$.

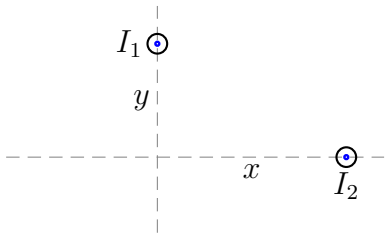

Figure 6: Problem 9

10. (**10 points.**) Figure 7 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. Assume $L = 10.0\,\text{cm}$, $v = 5.0\,\text{m/s}$, $B = 1.2\,\text{T}$, and $R = 0.40\,\Omega$.

(a) What is the rate of change of magnetic flux in the loop?

(b) How is the rate of change of magnetic flux in the loop related to the induced current in the loop?

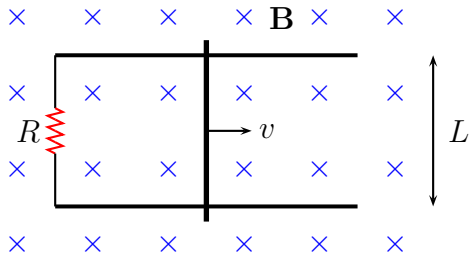

Figure 7: Problem 10