

# Solutions

PHYS-205B

(Midterm Exam 03)

Fall 2024

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## Problem 1

A solenoid creates a uniform magnetic field inside it.

## Problem 2

Using Ampere's law we have

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{\text{inside}}$$
$$= \mu_0 (+9I - 12I)$$

$$= -3I\mu_0$$

$$= -3(1.0) 4\pi \times 10^{-7} = 3.8 \times 10^{-7} \text{ Tm}$$

$$I = 1.0 \text{ A}$$

## Problem 3

$$\left[ \frac{Q}{C} \right] = \left[ L \frac{dI}{dt} \right]$$

$$\Rightarrow [LC] = T^2$$

T = time

$$V = L \frac{dI}{dt}$$

$$V = \frac{Q}{C}$$

## Problem 4

Yes.

## Problem 5

$$|\vec{B}_1| = |\vec{B}_2|$$

$$\frac{\mu_0 I_1}{2\pi(D+x)} = \frac{\mu_0 I_2}{2\pi x}$$

$$I_1 x = (D+x) I_2$$

$$x = \frac{I_2}{I_1 - I_2} D = \frac{0.50}{1.0 - 0.50} D = D = 5.0 \text{ cm to the right of } I_2$$





Problem 6

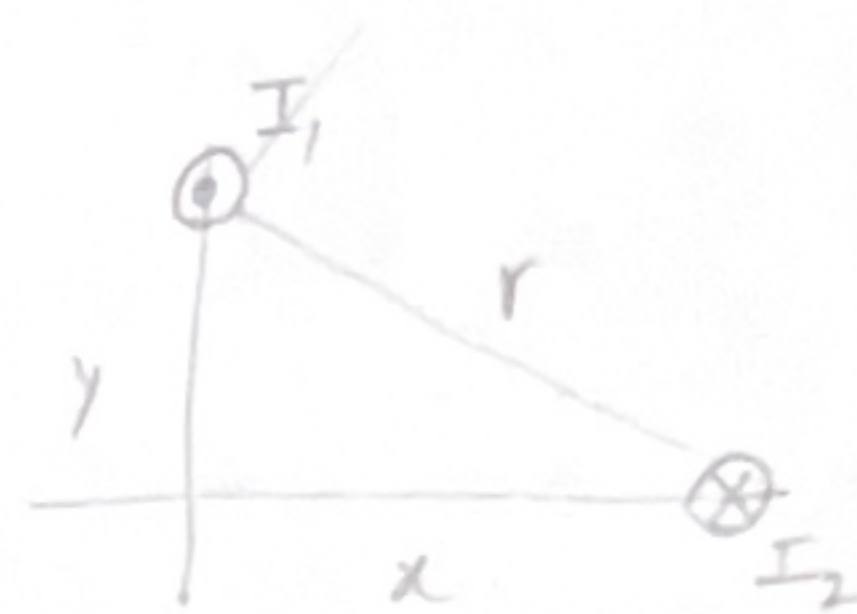
$$r = \sqrt{x^2 + y^2} = 10.0 \text{ cm}$$

$$\vec{F}_{12} = I_1 \vec{L}_1 \times \vec{B}_2$$

$$\left| \frac{\vec{F}_{12}}{L_1} \right| = I_1 \frac{\mu_0}{4\pi} \frac{2I_2}{r}$$

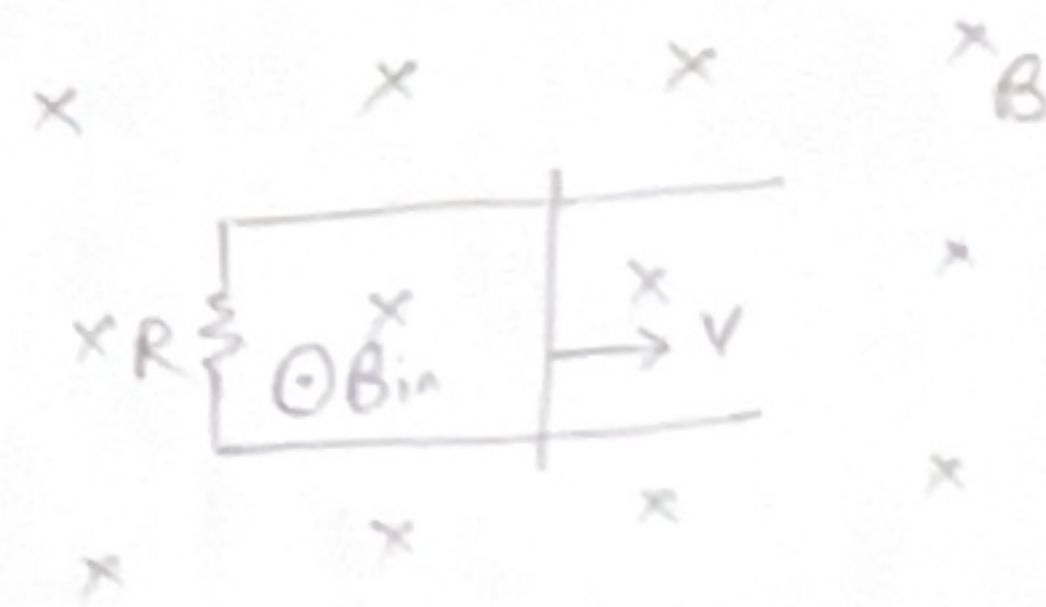
$$= \frac{\mu_0}{4\pi} \frac{I_1 I_2}{r} 2 = \frac{4\pi \times 10^{-7}}{4\pi} \frac{(1.0)(2.0)}{(0.10)} 2 = 4.0 \frac{\mu\text{N}}{\text{m}}$$

direction: along the line 'r' away from current  $I_2$ .



Problem 7

- flux is increasing
- $\vec{B}_{in}$  is opposite to  $\vec{B}$
- current is counter clockwise.



$$I = \frac{Blv}{R}$$

$$= \frac{(1.2)(0.10)(5.0)}{(0.40)} = 1.5 \text{ A}$$