

Solutions

PHYS-205B

(Midterm Exam 03)

Fall 2022

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Problem 1

Using $B = \frac{\mu_0 I}{4\pi a}$ $[\mu_0] = \frac{[B][a]}{[I]} = \frac{[qVB]}{[I]^2} = \frac{[F]}{[I]^2}$

Using $F = \frac{1}{4\pi\epsilon_0} \frac{q^2}{r^2}$ $[\epsilon_0] = \frac{[q]^2}{[F][r]^2}$

Thus, $[\mu_0 \epsilon_0] = \frac{[F]}{[I]^2} \frac{[q]^2}{[F][r]^2} = \frac{T^2}{L^2}$

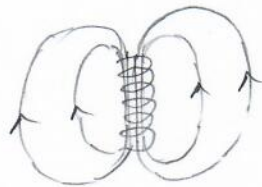
$$\Rightarrow \frac{1}{\sqrt{\mu_0 \epsilon_0}} = \frac{L}{T}$$

Problem 2

$$\vec{F} = q \vec{v} \times \vec{B} = 0$$

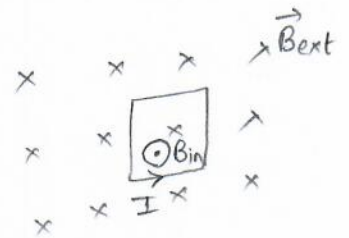
(since angle between \vec{v} and \vec{B} is zero)

Problem 3



Problem 4

- magnetic field is increasing
- flux is increasing
- \vec{B}_{in} is opposite to \vec{B}_{ext}
- I is counterclockwise in the loop.



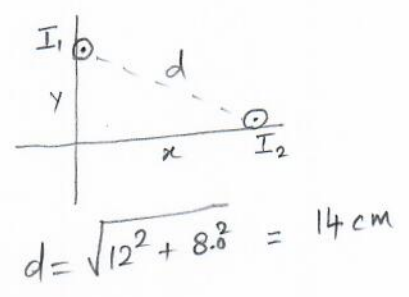
Problem 5

$$\begin{aligned} \vec{\mu} &= \hat{n} N I A \\ &= \hat{n} (1) (1.0) (5.0 \times 10^{-2})^2 \\ &= \hat{n} 2.5 \text{ m A} \end{aligned}$$

\hat{n} - perpendicular to plane of loop.

Problem 6

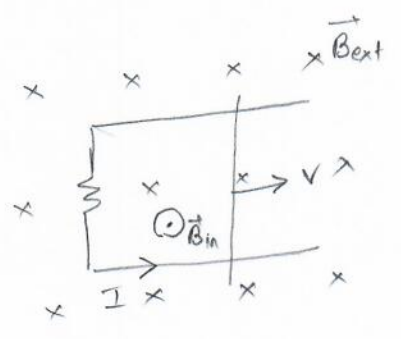
$$\begin{aligned} \frac{F}{L} &= \frac{\mu_0}{4\pi} \frac{2 I_1 I_2}{d} \\ &= \frac{4\pi \times 10^{-7}}{4\pi} \frac{2 (1.0) (2.0)}{0.14} \\ &= 2.9 \times 10^{-6} \frac{\text{N}}{\text{m}} \end{aligned}$$



direction: towards I_2 along the line of length d .

Problem 7

$$\begin{aligned} I &= \frac{B L v}{R} \\ &= \frac{(0.30) (0.050) (10.0)}{3.0} \\ &= 0.050 \text{ A} \end{aligned}$$



- flux is increasing
- \vec{B}_{in} is opposite to \vec{B}_{ext}
- I is counterclockwise.

← direction of I .