

Solution

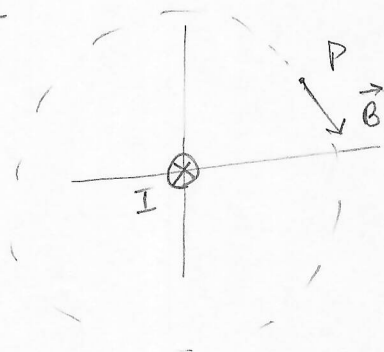
PHYS-205B (Midterm Exam 03) Spring 2025

①

Problem 1

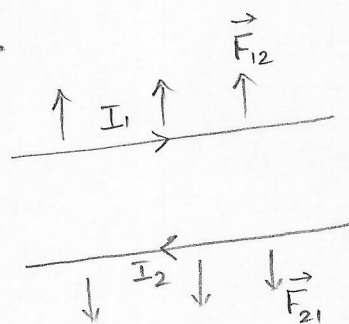
$$\begin{aligned}\vec{F} &= q \vec{v} \times \vec{B} \\ &= (-1.6 \times 10^{-19}) \cdot 2.0 \times 10^6 \cdot \underbrace{\hat{i} \times \hat{k}}_{-\hat{j}} \cdot 0.30 \\ &= +\hat{j} \cdot 9.6 \times 10^{-14} \text{ N}\end{aligned}$$

Problem 2



magnetic field lines due to a wire are circular.

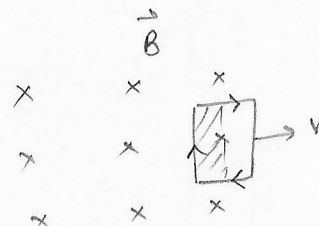
Problem 3



unlike currents repel.

Problem 4

- flux is decreasing $\vec{B}$
- induced $\vec{B}_{in}$ is along $\vec{B}$
- current is clockwise.

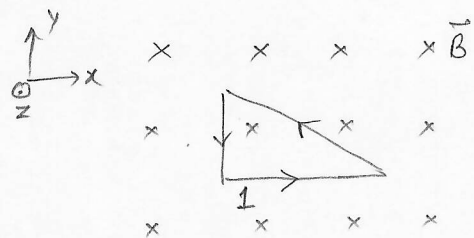


Problem 5

$$\vec{F} = I \vec{L} \times \vec{B}$$

$$= (2.0) (3.0 \times 10^{-2}) (0.30) \sin 90 \hat{j}$$

$$= 1.8 \text{ mN}$$



Problem 6

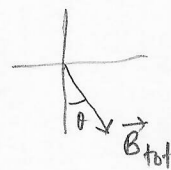
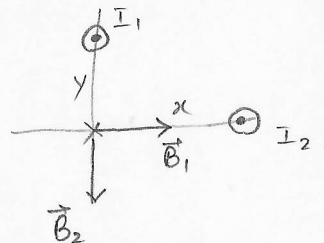
$$\vec{B}_1 = +\hat{i} \frac{\mu_0}{4\pi} \frac{2I_1}{y} = +\hat{i} \frac{4\pi \times 10^{-7}}{4\pi} \frac{2(1.0)}{8.0 \times 10^{-2}} = +\hat{i} 2.5 \mu\text{T}$$

$$\vec{B}_2 = -\hat{j} \frac{\mu_0}{4\pi} \frac{2I_2}{x} = -\hat{j} \frac{4\pi \times 10^{-7}}{4\pi} \frac{2(2.0)}{12 \times 10^{-2}} = -\hat{j} 3.3 \mu\text{T}$$

$$\vec{B}_{\text{tot}} = \vec{B}_1 + \vec{B}_2 = (+\hat{i} 2.5 - \hat{j} 3.3) \mu\text{T}$$

magnitude: $B_{\text{tot}} = \sqrt{2.5^2 + 3.3^2} = 4.1 \mu\text{T}$

direction: $\theta = \tan^{-1} \frac{2.5}{3.3} = 37^\circ \text{ ccw w.r.t. } -\hat{j}$



Problem 7

(a) decreasing

(b) counterclockwise direction

$$(c) \quad I = \frac{BLv}{R} = \frac{(1.2)(0.100)(5.0)}{0.40} = 1.5 \text{ A}$$

