

Solutions

PHYS-203B

Fall 2016

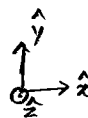
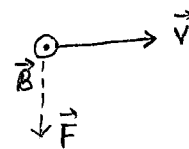
Midterm Exam 03

①

Prob. 1

direction: along $-\hat{y}$

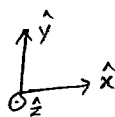
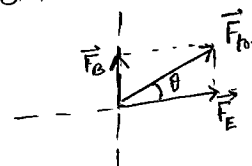
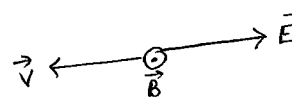
$$\begin{aligned} \text{magnitude: } F &= qvB \sin \theta \\ &= 1.6 \times 10^{-19} \times 2.0 \times 10^6 \times 0.100 \times \sin 90 \\ &= 3.2 \times 10^{-14} \text{ N} \end{aligned}$$



Prob. 2

$$\begin{aligned} |\vec{F}_E| &= qE = 1.0 \times 10^{-6} \text{ C} \times 6.00 \times 10^3 \frac{\text{N}}{\text{C}} \\ &= 6.0 \times 10^{-3} \text{ N} \end{aligned}$$

$$\begin{aligned} |\vec{F}_B| &= qvB \sin \theta = 1.0 \times 10^{-6} \text{ C} \times 2.00 \times 10^6 \frac{\text{m}}{\text{s}} \times 1.50 \times 10^{-3} \text{ T} \sin 90 \\ &= 3.0 \times 10^{-3} \text{ N} \end{aligned}$$



$$\begin{aligned} \vec{F}_{\text{tot}} &= \vec{F}_E + \vec{F}_B \\ &= 6.0 \times 10^{-3} \text{ N } \hat{i} + 3.0 \times 10^{-3} \text{ N } \hat{j} \end{aligned}$$

$$\begin{aligned} \text{magnitude: } |\vec{F}_{\text{tot}}| &= \sqrt{(6.0 \times 10^{-3})^2 + (3.0 \times 10^{-3})^2} = 6.7 \times 10^{-3} \text{ N} \\ \theta &= \tan^{-1}\left(\frac{3.0 \times 10^{-3}}{6.0 \times 10^{-3}}\right) = 26.57^\circ \end{aligned}$$

direction: 26.57° counterclockwise with respect to $\hat{x}$.

Prob. 3

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

$$F = I L B \sin \theta$$

$$\frac{F_2}{F_1} = \frac{I_2}{I_1}$$

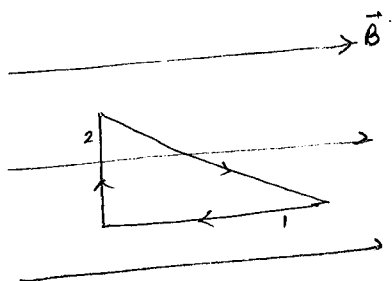
$$I_2 = \frac{F_2}{F_1} I_1 = \frac{0.056 \text{ N}}{0.026 \text{ N}} \times 2.9 \text{ A} = 6.3 \text{ A}$$

Prob. 4

(a) $\vec{F}_1 = 0$ (since angle is 180°)

magnitude = 0

direction : none



(b) $\vec{F}_2 = I \vec{L}_2 \times \vec{B}$

magnitude: $F_2 = I L_2 B \sin \theta$
 $= 2.0 \times 2.0 \times 10^{-2} \times 2.0 \times \sin 90$
 $= 8.0 \times 10^{-2} \text{ N}$

direction: Going into the page. $\otimes$

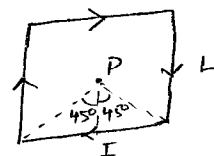
Prob. 5

direction: going into the page $\otimes$

$B_{\text{tot}} = 4 B$ (four sides)

$= 4 \frac{\mu_0 I}{4\pi (\frac{L}{2})} (\sin 45^\circ + \sin 45^\circ)$

$= \frac{\mu_0 I}{\pi L} \frac{2}{\sqrt{2}} = \frac{4\pi \times 10^{-7} \times 2}{\pi \times 1.00 \times 10^{-2} \sqrt{2}} = 5.7 \times 10^{-5} \text{ T}$



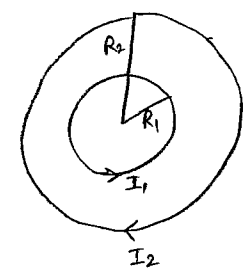
Prob. 6

$$B_1 = B_2$$

$$N_1 \frac{\mu_0 I_1}{2 R_1} = N_2 \frac{\mu_0 I_2}{2 R_2}$$

$$I_2 = \frac{N_1}{N_2} \frac{R_2}{R_1} I_1$$

$$= \frac{120}{160} \frac{0.017 \text{ m}}{0.012 \text{ m}} \times 7.0 \text{ A} = 7.4 \text{ A}$$



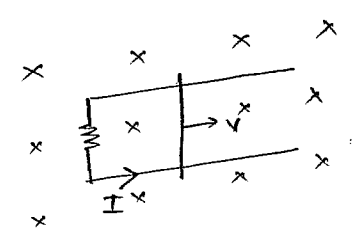
magnitude: 7.4 A

direction: opposite to I_1 (clockwise in figure)

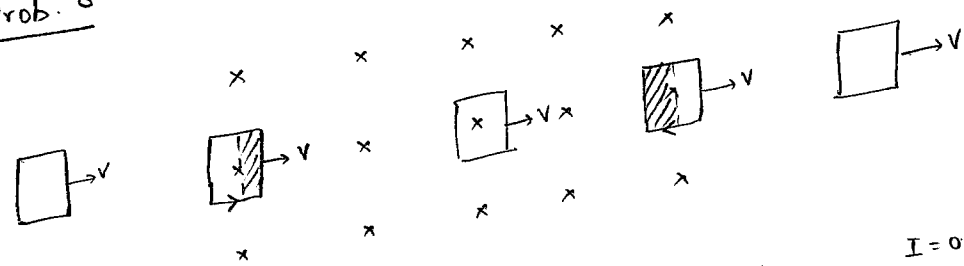
Prob. 7

- (a) increasing
- (b) counterclockwise

$$(c) I = \frac{Blv}{R} = \frac{1.2 \text{ T} \times 10 \times 10^{-2} \text{ m} \times 5.0 \frac{\text{m}}{\text{s}}}{0.40 \Omega} = 1.5 \text{ A}$$



Prob. 8



$I=0$

ϕ increasing
counterclockwise

$I=0$

ϕ decreasing
clockwise

$I=0$