Physics 102

Lecture 29.

Wed. Nov. 17. 2004

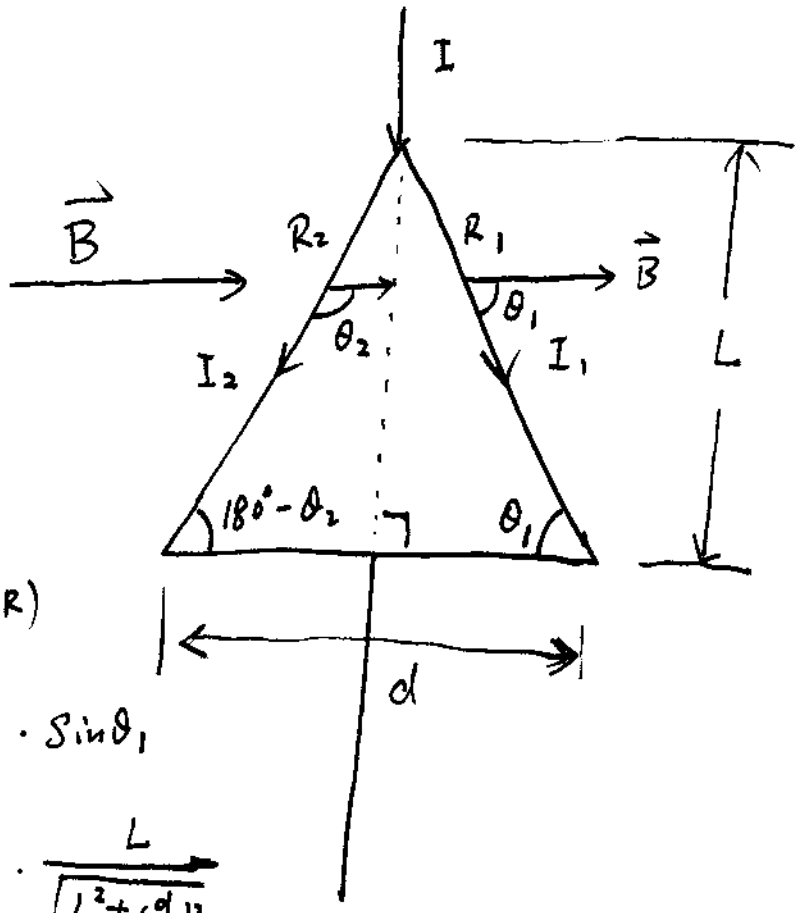
- CAPA set 5. Question #4. (Sample Midterm Q#1).

$I = I_1 + I_2$.

$I_1 R_1 = I_2 R_2$.

$I_1 = I \dfrac{R_2}{R_1 + R_2}$

$I_2 = I \dfrac{R_1}{R_1 + R_2}$.



$\vec{F}_1$: Out of page (RHR)

$F_1 = B I_1 \sqrt{L^2 + \left(\frac{d}{2}\right)^2} \cdot \sin\theta_1$

$= B I_1 \sqrt{L^2 + \left(\frac{d}{2}\right)^2} \cdot \dfrac{L}{\sqrt{L^2 + \left(\frac{d}{2}\right)^2}}$

$= B I_1 L$

$\vec{F}_2$: Out of page too. (RHR)

$F_2 = B I_2 \sqrt{L^2 + \left(\frac{d}{2}\right)^2} \sin\theta_2 = B I_2 \sqrt{L^2 + \left(\frac{d}{2}\right)^2} \sin(180° - \theta_2)$

$= B I_2 L$.

Net torque : $\tau = F_1 \frac{d}{4} - F_2 \frac{d}{4}$.

Why $\frac{d}{4}$? —— centre of force.

$\therefore \quad \tau = \frac{d}{4} \cdot BL(I_1 - I_2)$

$= \frac{d}{4} BLI \frac{R_2 - R_1}{R_1 + R_2}$

For numerical results please see CAPA solutions.

p. 745. # 37. ch. 22.

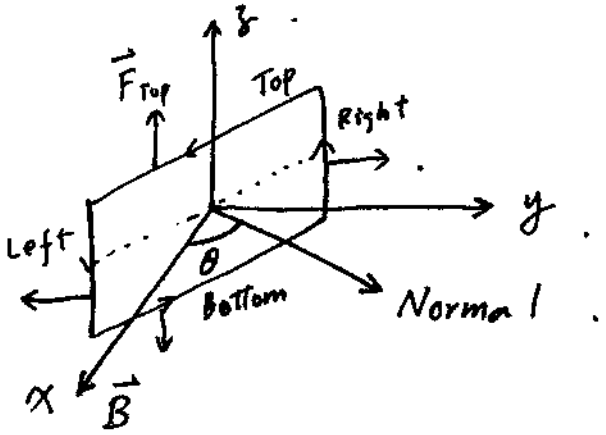
$N = 10$. $I = 0.22\,A$

height $= h = 0.08\,m$.

Width $= W = 0.15\,m$

$B = 0.05\,T$.

$\theta = 65°$.



[Solution] Set up coordinate system

(a). $\vec{F}_{Top}$: along $\hat{z}$, $F_{Top} = NBIW\sin 25°$ $\left[(90° - \theta) = 25°\right]$.

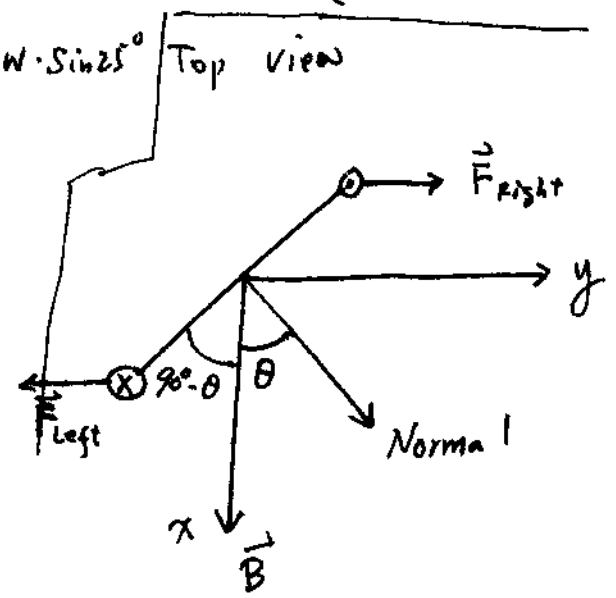
$\vec{F}_{Bottom}$: along $-\hat{z}$, $F_{Bottom} = NBIW\cdot\sin 25°$

$\vec{F}_{Left}$: along $-y$.

$F_{Left} = NBIh$

$\vec{F}_{Right}$: along $\hat{y}$

$F_{Right} = NBIh$.



(b). Net force on Loop :

$$\vec{F}_{net} = \vec{F}_{Top} + \vec{F}_{Bottom} + \vec{F}_{Left} + \vec{F}_{Right} = 0$$

(c). Torque : CW : $\tau = F_{Right}\left(\frac{W}{2}\right)\cdot\sin 65° + F_{Left}\left(\frac{W}{2}\right)\cos 25°$

$$= 2BIh\cdot\frac{W}{2}\cdot\sin 65° = BIA\cdot\sin 65°$$

(d)