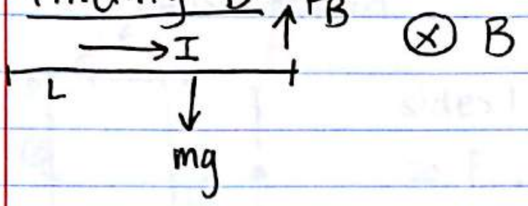
11/5/15

Review

$\vec{F} = q(\vec{v} \times \vec{B})$

$\vec{F} = I(\vec{l} \times \vec{B})$

Finding $\vec{B}$

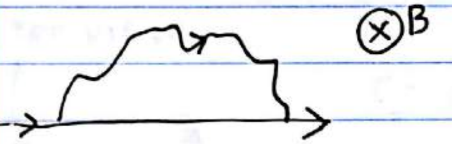


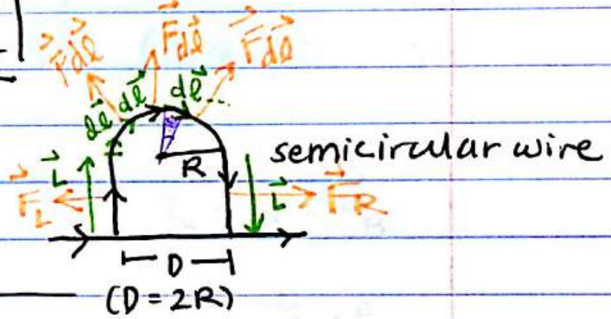
① Run current through wire

② B exerts force

$F_B = mg$

$ILB = mg \rightarrow \boxed{B = \frac{mg}{IL}}$





F(straight sections)

$|\vec{F}_{Left}| = |I(\vec{L} \times \vec{B})| = ILB$

$|\vec{F}_{RIGHT}| = |I(\vec{L} \times \vec{B}| = ILB$

} opposite directions.

$\therefore \vec{F}_{TOTSTRAIGHT} = \vec{F}_L + \vec{F}_R = 0$!

F(circular section) - the x-components cancel out!

$d\vec{F} = Id\vec{l} \times \vec{B}$

$d\vec{F}_{TOT}\ x = 0$

$\int dF_{TOTy} = \int dF \sin\theta$

$F_{TOTy} = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} I dl B \cos\theta$

$= \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} IR d\theta B \cos\theta$

$IRB[\sin\theta]_{-\pi/2}^{\pi/2}$

$= \boxed{2IRB}$

$= \boxed{IDB\ :O!!}$

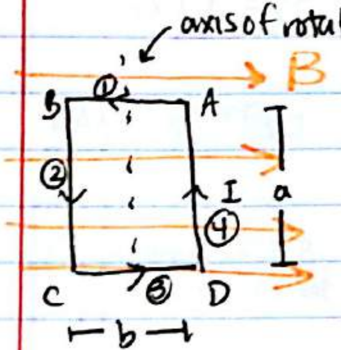
only D matters!

$\vec{F} \to \vec{\tau}$ (Torque)

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

↓

$\vec{\tau} = \vec{d} \times \vec{F}_B$



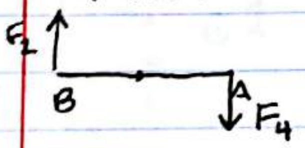
sides 1 and 3 are ∥ $\vec{B}$

so $F_1, F_3 = 0$

$\vec{F}_2 = I(\vec{L}_2 \times \vec{B})$ (force out of page)

$\vec{F}_4 = I(\vec{L}_4 \times \vec{B})$ (force into page)

TOP VIEW



$\tau_2 = \vec{d} \times \vec{F}_B$ $\tau_4 = \vec{d} \times \vec{F}_B$

$= \frac{b}{2} \cdot F_2$ $= \frac{b}{2} \cdot F_4$

$|F_2| = |F_4| = IaB$

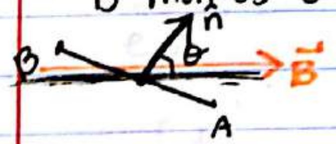
$\tau_{total} = bF_2$

$= \boxed{\underbrace{ab}_{\text{Area}} IB}$ ← maximum torque!

$= AIB$

when rotating

$\vec{B}$ makes θ with vector ⊥ to plane of loop



$\vec{\tau} = \vec{\tau}_2 + \vec{\tau}_4$

$\vec{\tau}_2 = F_2 \frac{b}{2} \sin\theta$

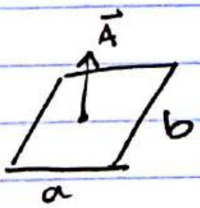
$\vec{\tau}_4 = F_4 \frac{b}{2} \sin\theta$

*a, b = sidelengths
A = area

so $\vec{\tau} = I\overset{ab}{A}B\sin\theta$

Definition

Area vector → $\vec{A}$



$|\vec{A}| = ab$

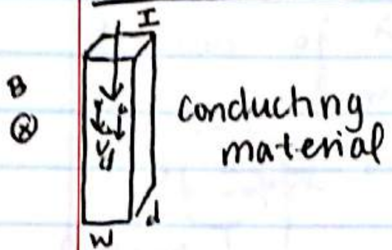
direction dependent on R. Hand Rule (way current flows)

So, $\boxed{\vec{\tau} = I(\vec{A} \times \vec{B})}$ Recall: $\vec{\tau}_E = \vec{p} \times \vec{E}$

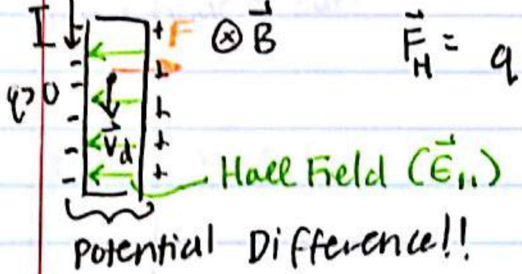
Define $\vec{\mu}$ = magnetic dipole moment ($\vec{p}$'s equivalent)

So $\boxed{\vec{\tau} = \vec{\mu} \times \vec{B}}$

HALL EFFECT



$$\vec{F} = q\vec{v} \times \vec{B}$$
$$= I(\vec{L} \times \vec{B})$$



$\vec{F}_H = q(\vec{v} \times \vec{B})$ ("Hall Force")

@ equilibrium,

$\cancel{q}E_H = \cancel{q}v \times B$

$$\boxed{\vec{v} = \frac{E_H}{\vec{B}}} = \frac{\Delta V_H}{d\vec{B}}$$

$I = nevA$

$n = \frac{I}{evA}$

$$n = \frac{Id\vec{B}}{e\Delta V_H ab} \rightarrow \Delta V_H = \overset{\text{change to } w, d}{\frac{Id\vec{B}}{eabn}} = \boxed{\frac{I\vec{B}}{ewn}}$$