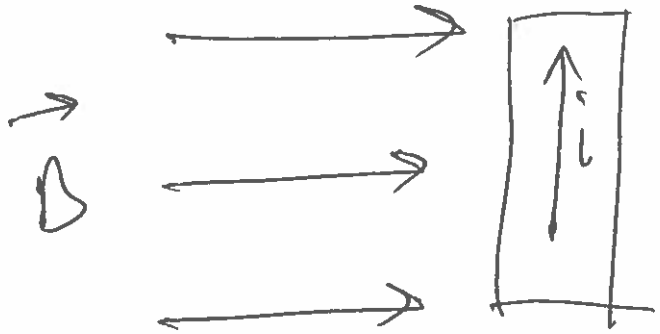
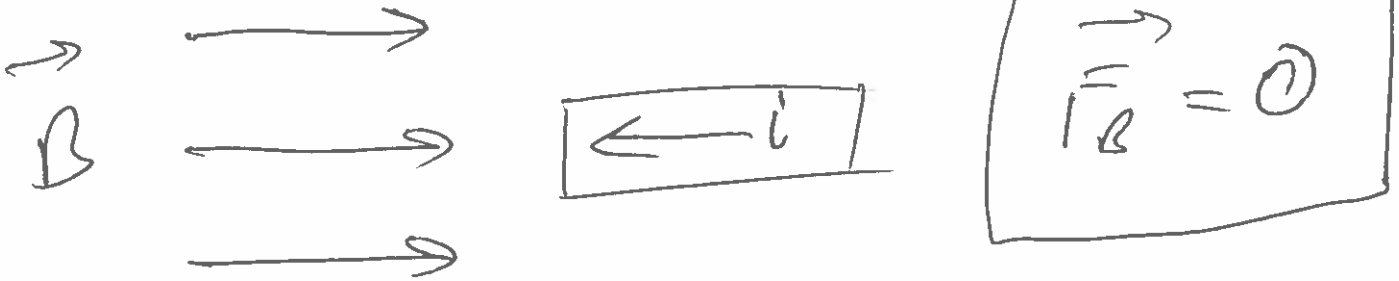
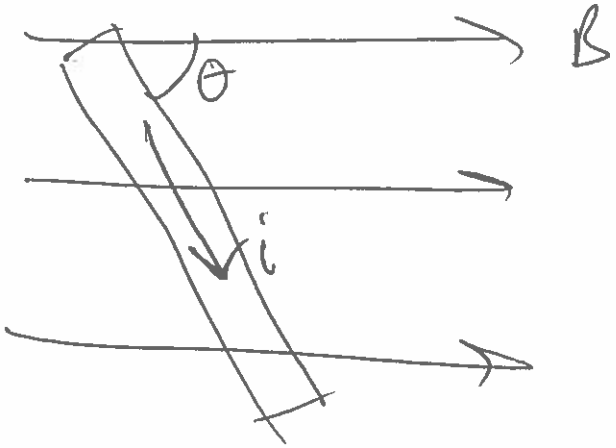
$$\vec{F}_B = q\vec{v} \times \vec{B} = i\vec{L} \times \vec{B}$$



$\vec{F}_B \otimes$ $\quad F_B = iLB$





$\vec{F}_B$ ⊙

$F_B = iLB\sin\theta$

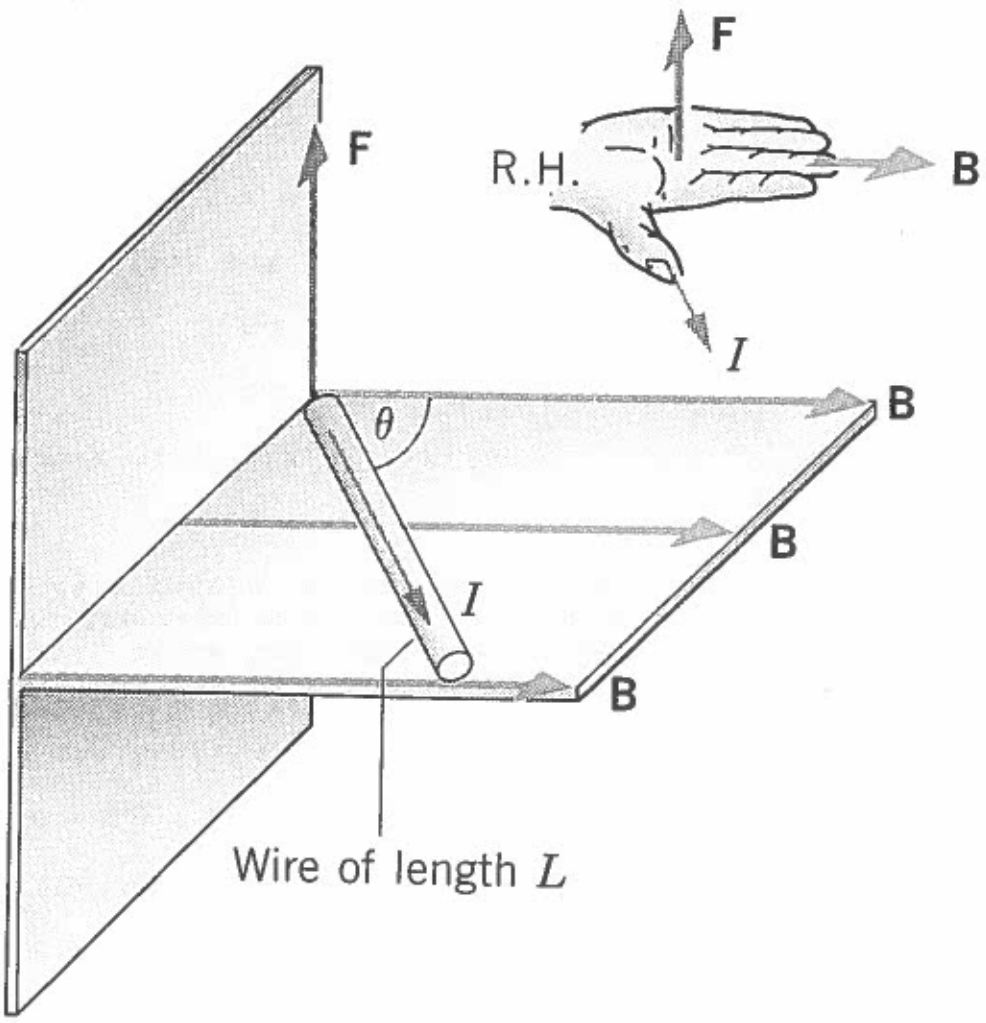
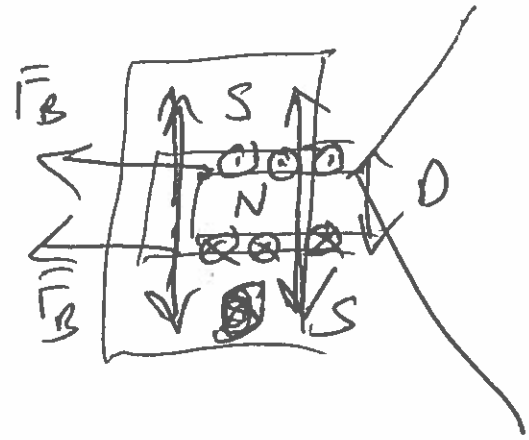


FIGURE 21.14 152

Paper cone Speaker



$D = 0.025\ m \qquad N = 55\ \text{Turns}$

$B = 0.10\ T \qquad i = 2.0\ A \qquad \vec{F}_B = ?$

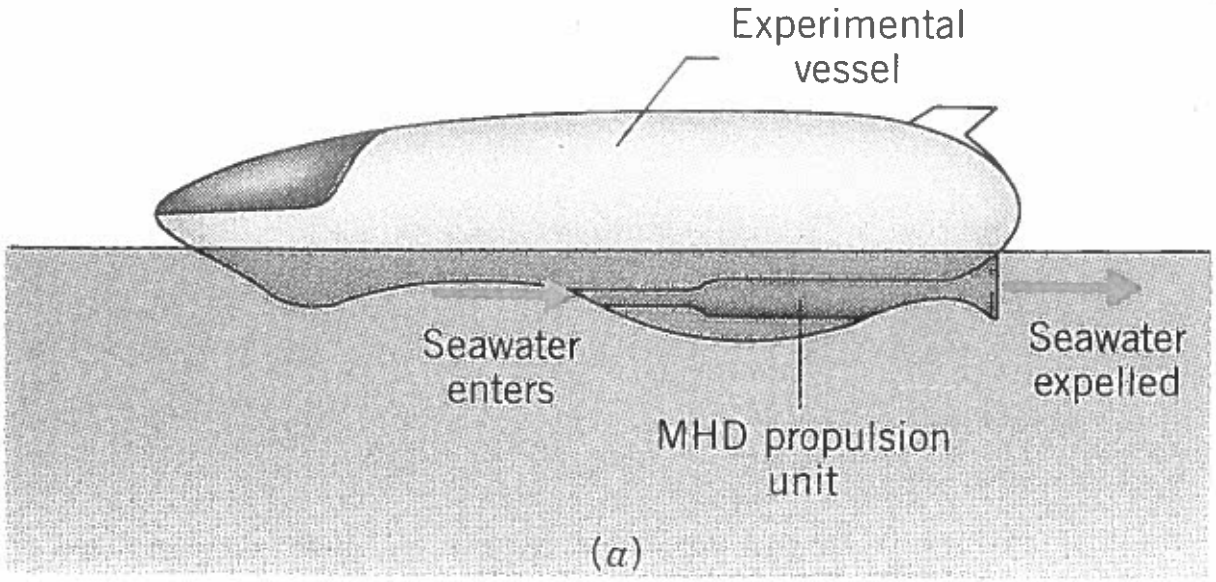
$\vec{F}_B = iLB\sin\theta = iLB\sin(90) = iLB$

$L = N(\text{circumfrence}) = N(\pi D)$

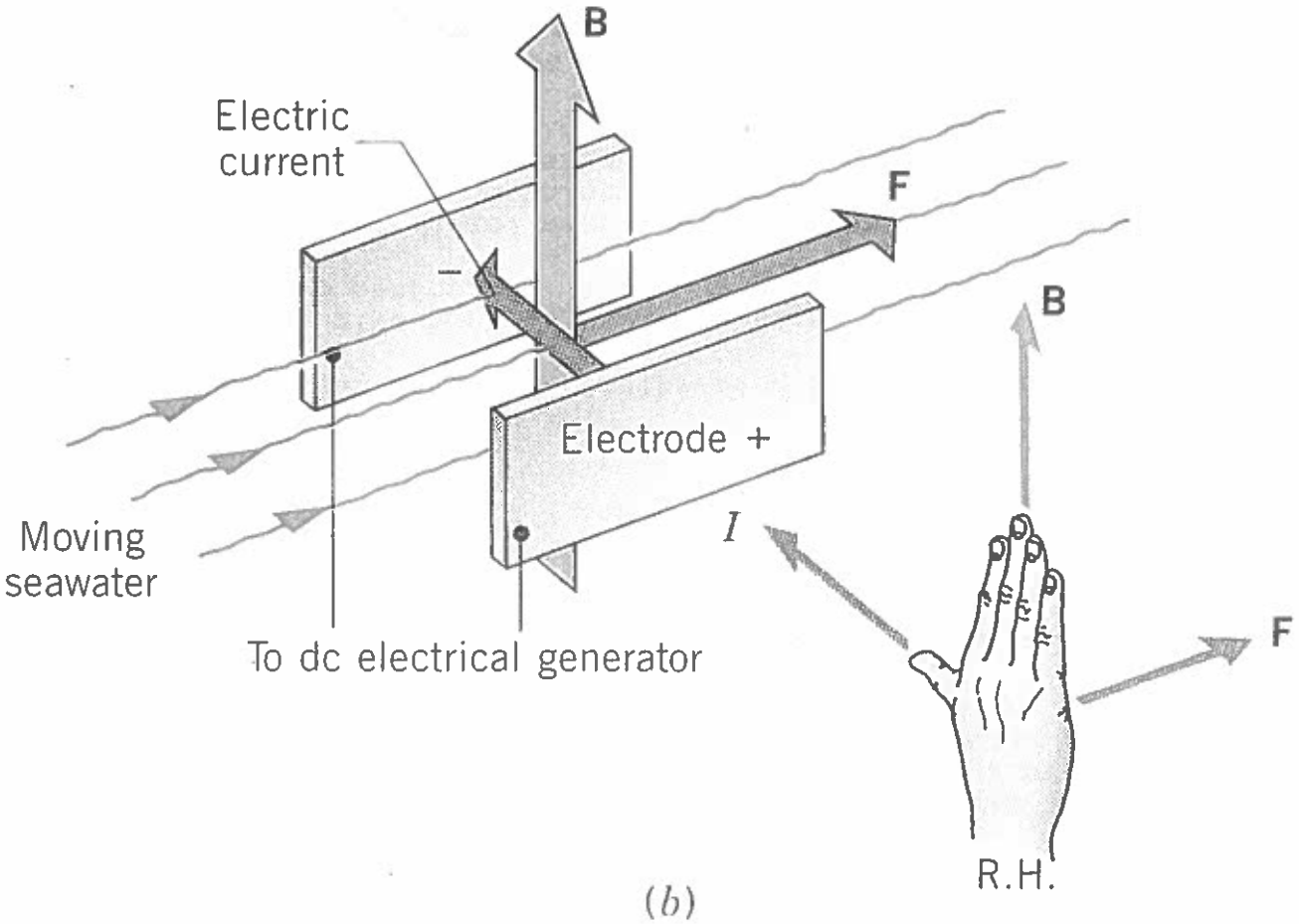
$\vec{F}_B = iN\pi DB$

$= (2.0A)(55\ \text{Turns})\pi(.025m)(0.10\ T)$

$$\boxed{\vec{F}_B = 0.86\ N}$$

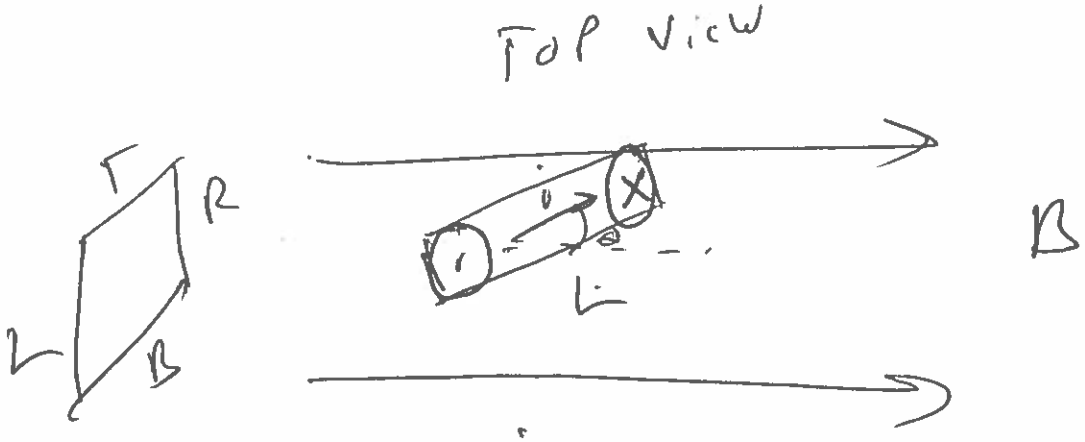


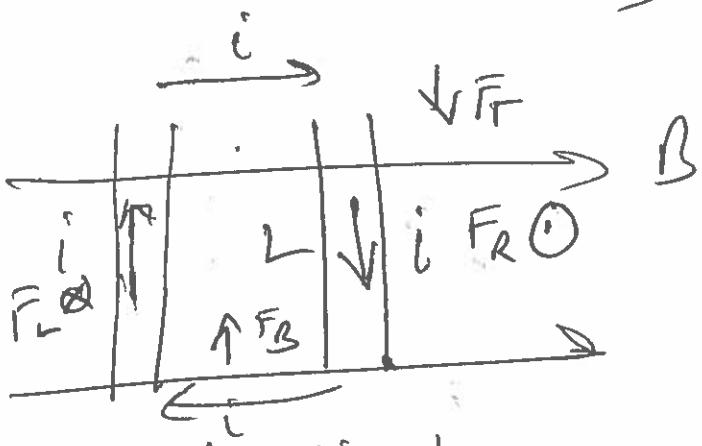
(a)



(b)

FIGURE 21.17 a, b





directions based on side view

$$\vec{F}_T = i_T \vec{L}_T \times \vec{B} = i_T L_T B \sin\theta \ \text{down}$$

$$\vec{F}_T = i L B \sin\theta \ \text{down}$$

$$\vec{F}_R = i L B \ \odot$$

$$\vec{F}_B = i L B \sin\theta \ \text{up}$$

$$\vec{F}_L = i L B \ \otimes$$

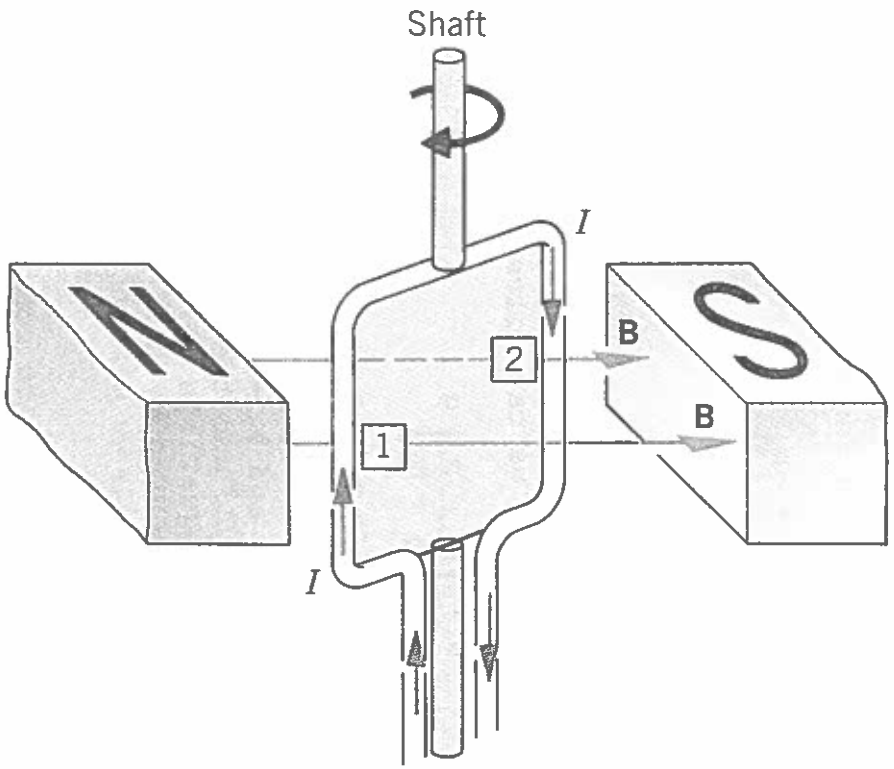
$\vec{F}_T = -\vec{F}_B$

$\vec{F}_L = -\vec{F}_R$

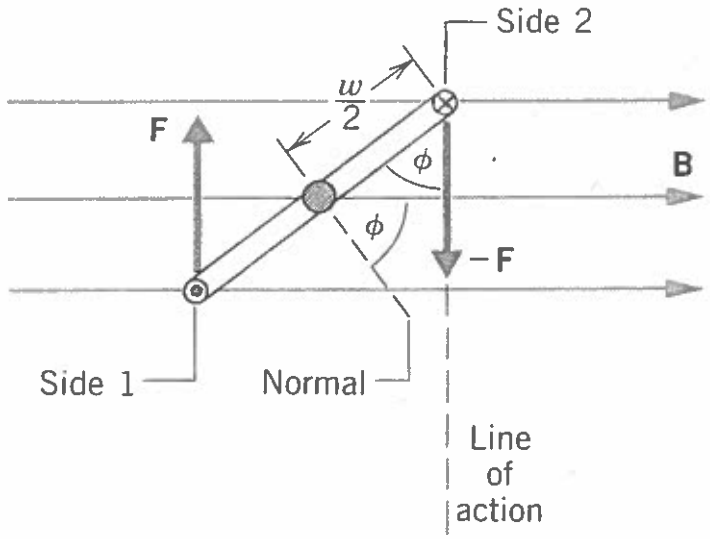
BUT if coil can rotate

$\vec{\tau}_L = \vec{\tau}_R$

$\Rightarrow$ ROTATION!



(a)



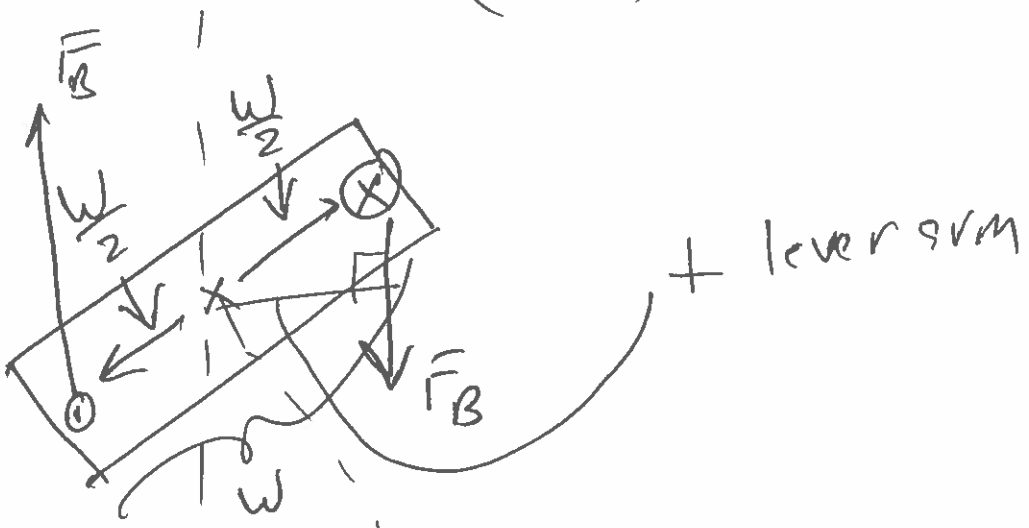
(b)

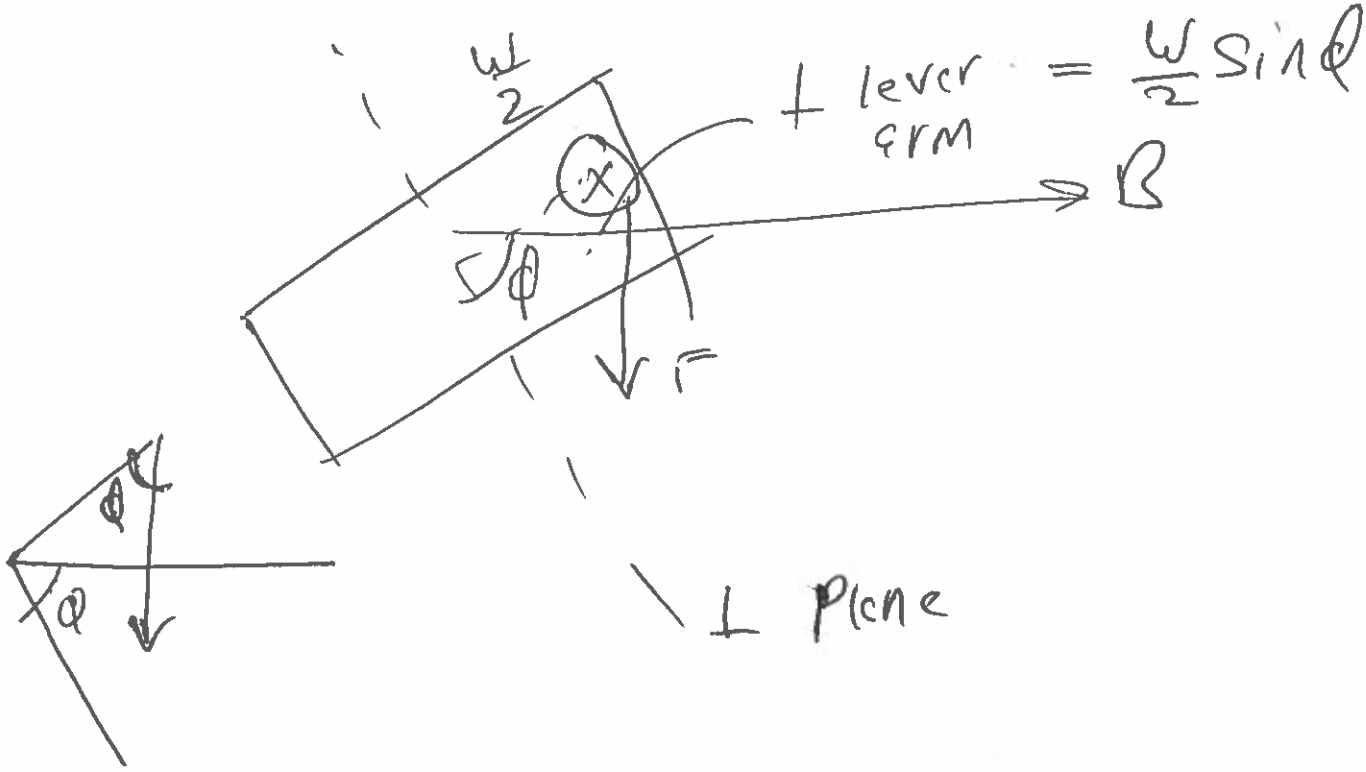
FIGURE 21.18 a, b

$\vec{\tau} = ?$ $\vec{\tau} = \vec{r} \times \vec{F}$

or Torque is $\left(\perp \text{lever arm}\right)$ Force

or $\left(\text{Lever arm}\right)\left(\perp \text{Force}\right)$





$$\tau_{1side} = \left(\frac{w}{2}\sin\theta\right) F_B$$

$$= \left(\frac{w}{2}\sin\theta\right) i L B$$

$$\text{Total Torque} = 2\left(\frac{w}{2}\sin\theta\right) i L B$$

$$\tau = wLiB\sin\theta$$

$$= AiB\sin\theta$$

1 Turn of wire

Coil N Turns

$$\tau = \underbrace{(NiA)}_{\mu} B\sin\theta$$

μ = Magnetic moment $= NiA$

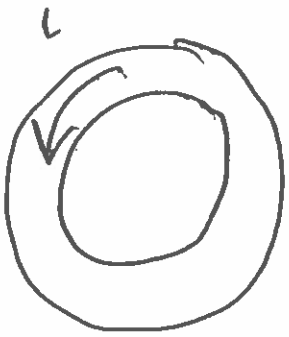
units of $(A\,m^2)$

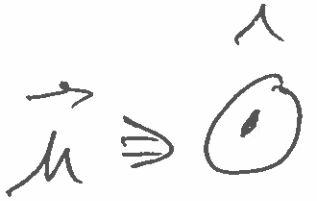
Coil in a Magnetic Field

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

$$|\vec{\tau}| = |\vec{\mu}||\vec{B}| \sin\phi$$

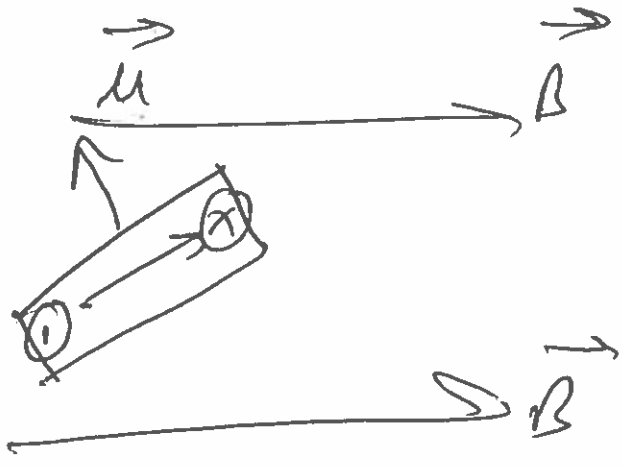
direction of $\vec{\mu}$ is perpendicular to Area and Use Another RT hand rule to Choose sides. Curl fingers in direction of Curren Thumb Points in direction of $\vec{\mu}$



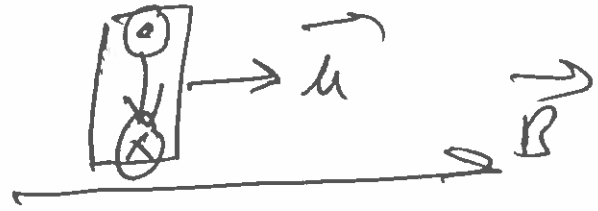


$$\mu = NI\pi R^2$$

$$\vec{\mu} = NI\vec{A}$$



Wants to rotate until



Coil $\Rightarrow$ 50 turns $\quad i = 1.5\,A$

$A = 3.5 \times 10^{-4}\,m^2 \quad \mu = ?$

$$\mu = NiA = (50)(1.5\,A)\left(3.5 \times 10^{-4}\,m^2\right)$$

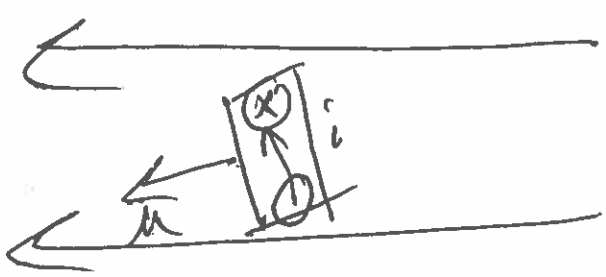
$$\boxed{\mu = 0.026\,A\,m^2}$$

Place this in a magnetic field

$B = 100\,T \quad \phi = 60.0^\circ \quad \tau = ?$

$$\tau = \mu B \sin\theta = (0.026\,A m^2)(100\,T)\sin(60^\circ)$$

$$\boxed{\tau = 2.25\,mN}$$



which way does coil rotate?

clockwise!