9-22-10

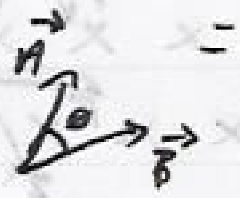
$\times$ $\otimes$ points into the board

$\cdot$ $\odot$ points out of the board

Right hand rule $\vec{A}$ hand $\uparrow \vec{A}$

$|\vec{A} \times \vec{B}| = AB \sin\theta$

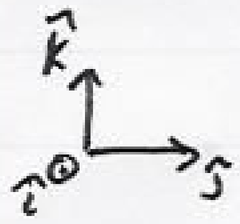
= area of parallelogram



$\vec{B}$ fingers $\leftarrow \vec{B}$

$\vec{A} \times \vec{B}$ thumb $\odot\ \vec{A} \times \vec{B}$

$\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$



$\hat{\imath} \times \hat{\jmath} = \hat{k}$ $\quad \hat{\jmath} \times \hat{\imath} = -\hat{k}$

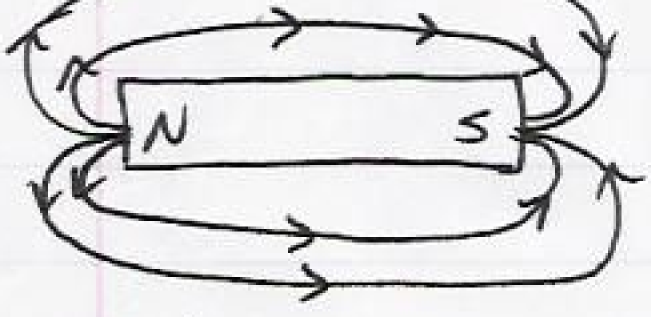
$\hat{\jmath} \times \hat{k} = \hat{\imath}$ $\quad \hat{k} \times \hat{\jmath} = -\hat{\imath}$

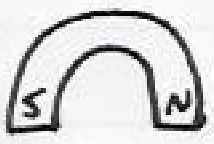
$\hat{k} \times \hat{\imath} = \hat{\jmath}$ $\quad \hat{\imath} \times \hat{k} = -\hat{\jmath}$

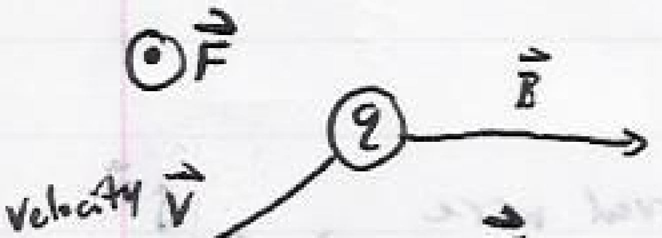
$(3\hat{\imath} + \hat{\jmath}) \times 2\hat{k} = 6\hat{\imath} \times \hat{k} + 2\hat{\jmath} \times \hat{k} = -6\hat{\jmath} + 2\hat{\imath}$

Magnets make $\overbrace{\text{magnetic fields}}^{\vec{B}}$

Magnetic fields accelerate moving charges.







$\vec{v} = \vec{0} \Rightarrow \vec{B} = \vec{0}$

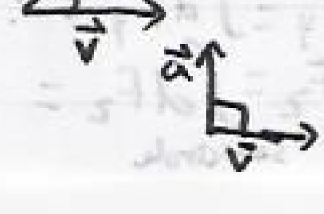
$\vec{F}$ force $= q\vec{v} \times \vec{B}$

For any vectors $\vec{C}, \vec{D}$, $\quad \vec{C} \times \vec{D} \perp \vec{C}$ + $\vec{C} \times \vec{D} \perp \vec{D}$

$\Rightarrow \vec{F} \perp \vec{v}$ + $\vec{F} \perp \vec{B}$

$\vec{F} = \dfrac{m\,d\vec{v}}{dt} \Rightarrow \dfrac{d\vec{v}}{dt} \perp \vec{v} \Rightarrow |\vec{v}|$ constant

$\vec{a} = \dfrac{d\vec{v}}{dt}$



$\theta < 90^\circ \Rightarrow |\vec{v}|$ increasing

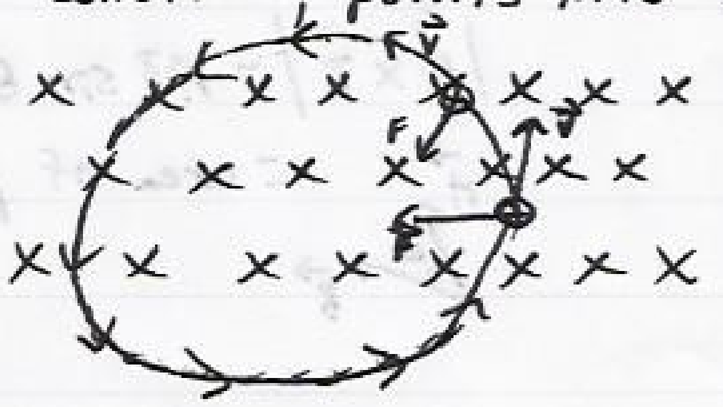
$\theta = 90^\circ \Rightarrow |\vec{v}|$ constant

$\theta > 90^\circ \Rightarrow |\vec{v}|$ decreasing

Magnetic force:

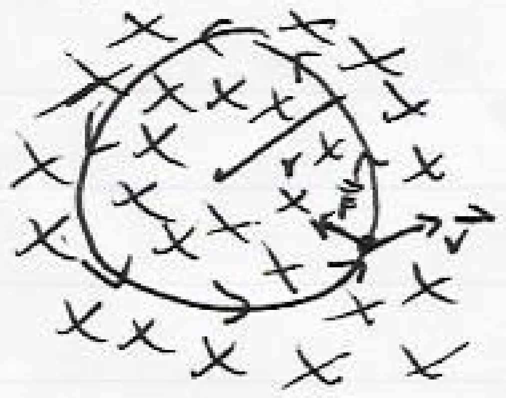
$\frac{d\vec{v}}{dt} = \vec{a} = \frac{\vec{F}}{m} = \frac{q}{m}\vec{v}\times\vec{B} \perp \vec{v} \Rightarrow |\vec{v}|$ constant + circular/helical motion

$\vec{B}$ constant, points into board



⊕ Right hand:
$\vec{v}$: curled fingers
$\vec{B}$: thumb

uniform circular motion
$|\vec{v}|$ constant



$a = \frac{v^2}{r}$

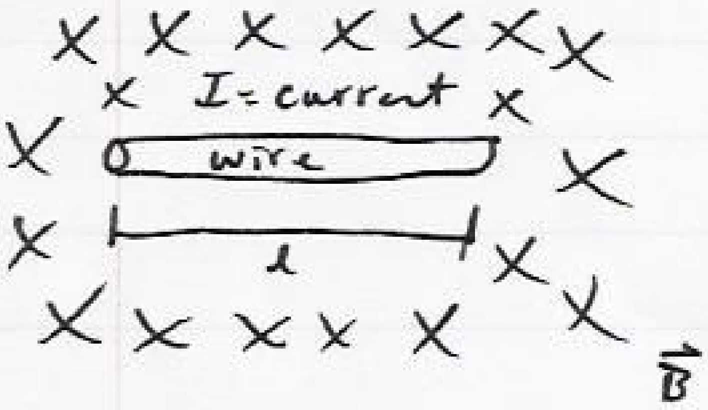
$\vec{B}$ points into board
$|\vec{B}| = B$ constant

$$a = \frac{F}{m} = \frac{|q\vec{v}\times\vec{B}|}{m} = \frac{qvB\sin 90^\circ}{m} = \frac{qvB}{m}$$

$$\frac{v^2}{r} = a = \frac{qvB}{m}$$

$$\frac{v}{r} = \frac{qB}{m}$$

$$\frac{mv}{qB} = r$$



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

$\vec{l}$ = direction of current
Magnitude = length

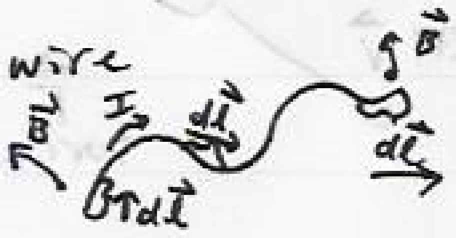
Units:

newton = ampere · meter · tesla

$N = A\cdot m\cdot T$

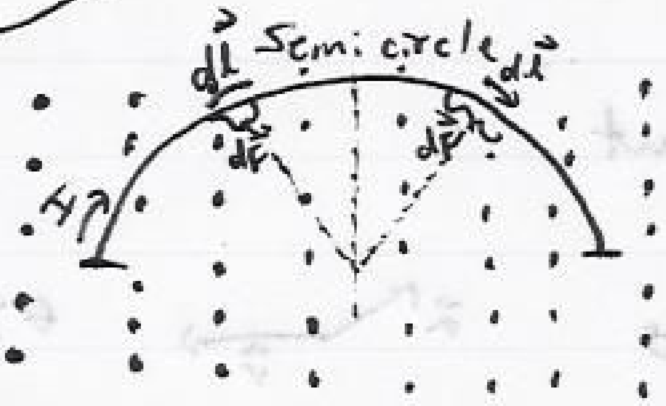
$\frac{N}{A\cdot m} = T$

Curved wire

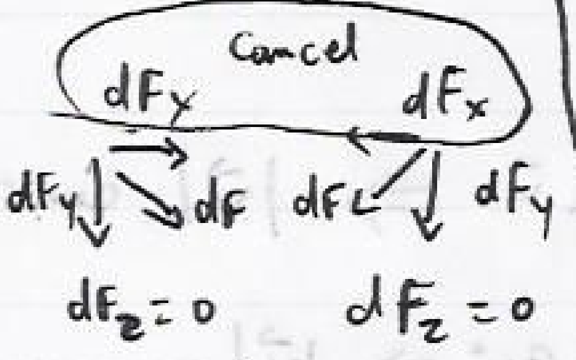


$d\vec{F} = I\,d\vec{l}\times\vec{B}$

$\vec{F} = \int_{wire} I\,d\vec{l}\times\vec{B}$



$\vec{B}$ points out; constant



$dF_z = 0$ $\quad dF_z = 0$

$$F_y = \int_{\theta=0^\circ}^{\theta=180^\circ} (dF)\sin\theta$$

$F_x = \int_{semicircle} dF_x = 0$

$F_y = \int dF_y = ?$

$F_z = \int_{semicircle} dF_z = 0$

$F_y = 2IBr$