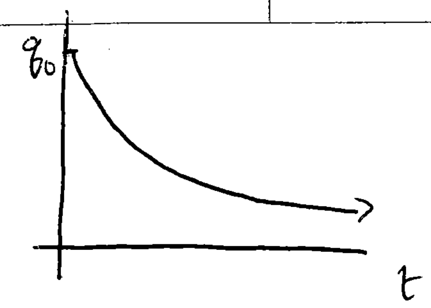


again RC dictates how fast charge drains off

Know $q(t)$ can calculate $i(t)$
$V(t)$ across resistor
$V(t)$ across capacitor
Stored Energy (t) in capacitor
etc.
⋮

Magnetism - Magnetostatics

Put in a good Magnetic field Demo!

There exists a Magnetic field - can effect charged particles

$$\vec{F} = q\vec{V} \times \vec{B}$$

Λ

B units $\quad 1 \text{ Tesla} = 1 \frac{N}{A \cdot M}$ $\quad$ SI

Common unit of cgs system = gauss CGS

$$1 \text{ Gauss} = 10^{-4} \text{ Tesla}$$

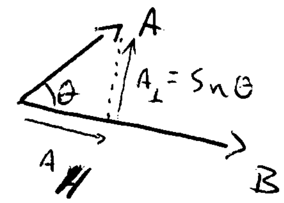
B fields effect Moving charges

You think of Magnets effecting other Magnets or Iron

Well - at a Microscopic level it simplifies to ...

$\vec{F} = q\,\vec{V} \times \vec{B}$

The cross product



$|A \times B| = \underbrace{|A| \sin\theta}_{A_\perp} \; |B|$

Know this

F $\perp$ to plane containing $\vec{A}$ and $\vec{B}$

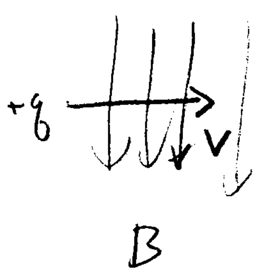
use right-hand rule to get direction

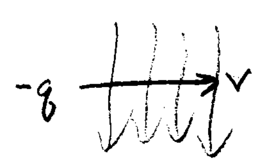
right-hand rule - Put fingers of Right hand along direction of 1st vector and curl them into the 2ND Thumb points along direction of A × B

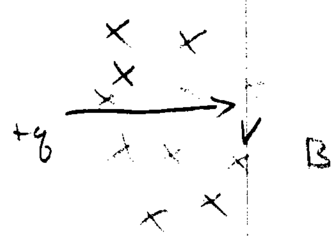
⇒ Ask students to do a couple of Examples

$\vec{F} = q\vec{V} \times \vec{B}$

↑ NOT direction, dependence on Sign of charge





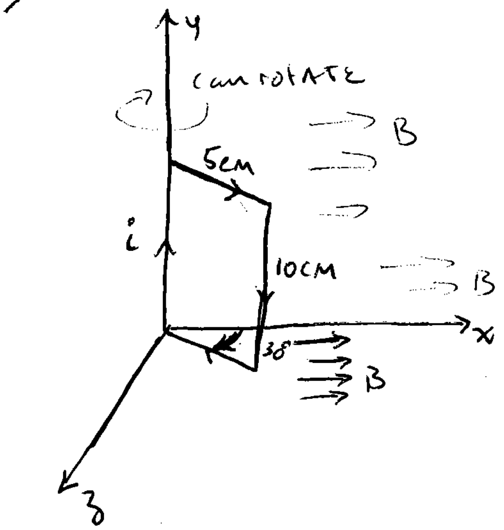


Charged Particles in Magnetic fields

$$\vec{F} = q\vec{E} + q\vec{V} \times \vec{B}$$ Lorentz force law

↑ F on a charge

$$\vec{F} = L\vec{i} \times \vec{B}$$ Force on a wire



$\vec{B}$ uniform and in $\hat{x}$ direction $= (0.5\ \text{Tesla})\hat{x}$

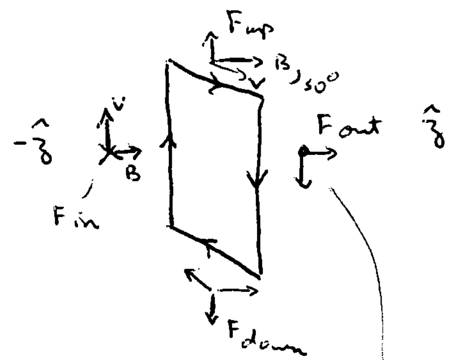
Loop - rectangular cross section

$i = 0.1$ Amp

$B = 0.5$ Tesla

Hinged at y axis

What is Torque on wire loop About y axis?



$$\vec{\tau} = \sum \vec{r}_i \times \vec{F}_i$$

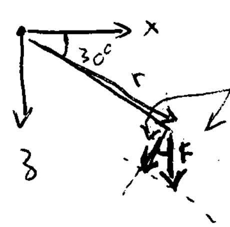
$$\vec{\tau} = F\cos(30)\, r \quad \text{down } (-\hat{y})$$

$$= iLB\cos 30\, r$$

$$\vec{\tau} = (.1\,A)(.1\,m)(.5\,T)(\cos 30)(.05\,m)(-\hat{y})$$

$$\vec{\tau} = \quad NT\,m\ (-\hat{y})$$

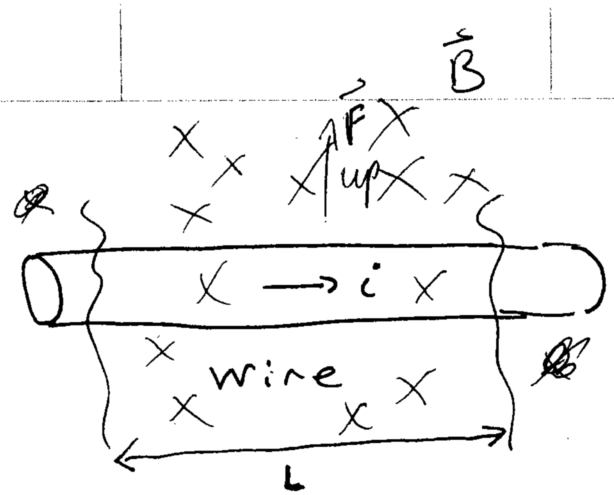
From Top



F component ⊥ to $\vec{r}$ is $F\cos\theta$

$A = \text{Coul}/s$

$$\frac{\text{coul}}{s}\, m\, \frac{N \cdot s}{\text{Coul}\, m}\, m = NT \cdot M$$



$$\vec{F}_{wire} = (q\, V_d \times B)\, n\, A\, L$$

- V_d: drift velocity of charges
- A: x sectional Area of wire
- n: # charges/unit volume

$$i = n\, q\, V_d\, A$$

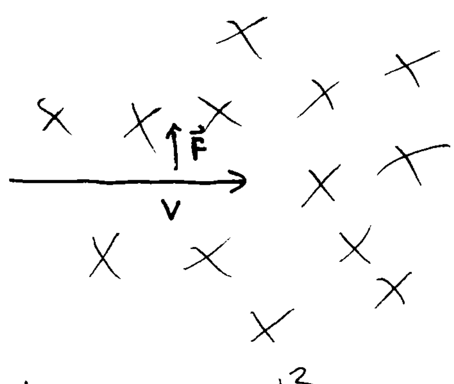
- n: #/vol
- V_d: $\frac{dx}{dt}$

$$\vec{F}_{wire} = L\vec{i} \times \vec{B}$$

Watch signs of charge

Charged particle Moving ⊥ to uniform Magnetic field

$\vec{F} \perp d\vec{s}$ at all Times, No work done (also for nonuniform field or no ⊥)



F always at rt angle to V

$$q\, V B = m \frac{V^2}{R}$$

$$R = \frac{mV}{qB}$$

Know how to think Thru this