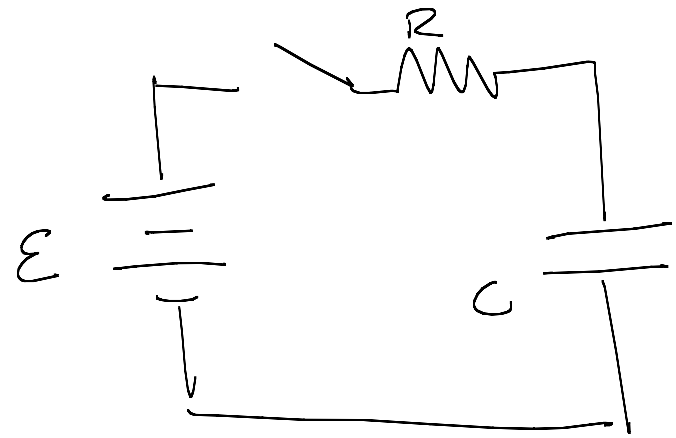
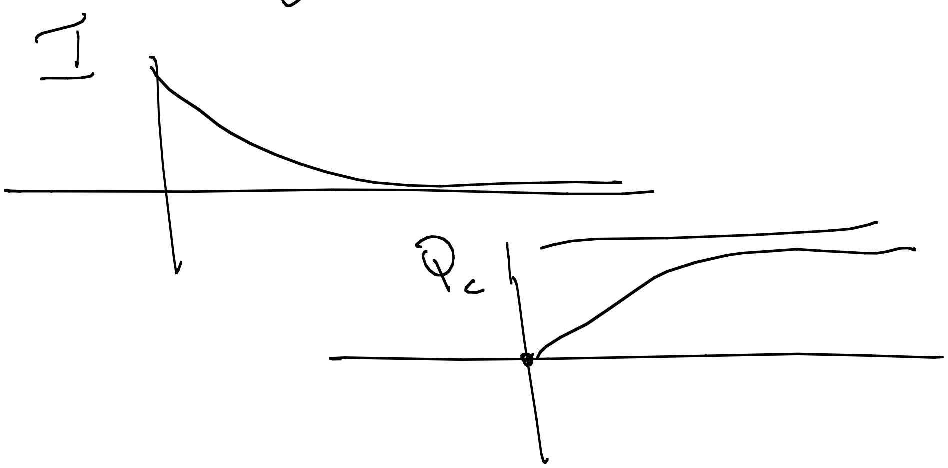
Phys 2120 - 4   10/3/12

Note Title   10/3/2012

RC circuit

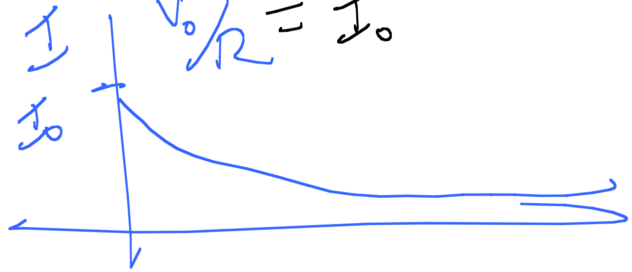


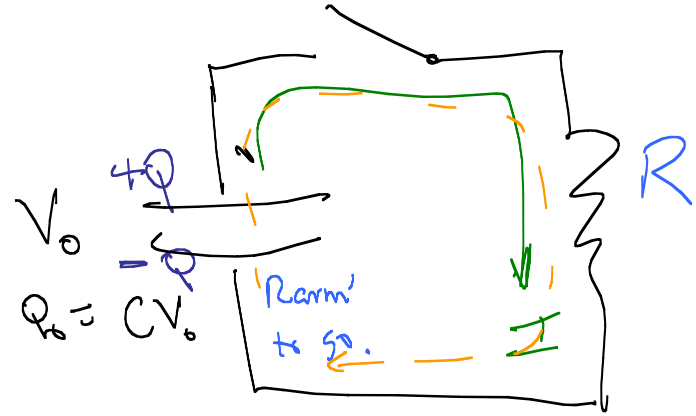
$$\tau = RC$$



Start with charged up capacitor

Expect:





$$I = -\frac{dQ}{dt}$$

$$\frac{dI}{dt} = \frac{-1}{RC} I$$

Loop rules $\quad + \frac{Q}{C} - IR = 0$

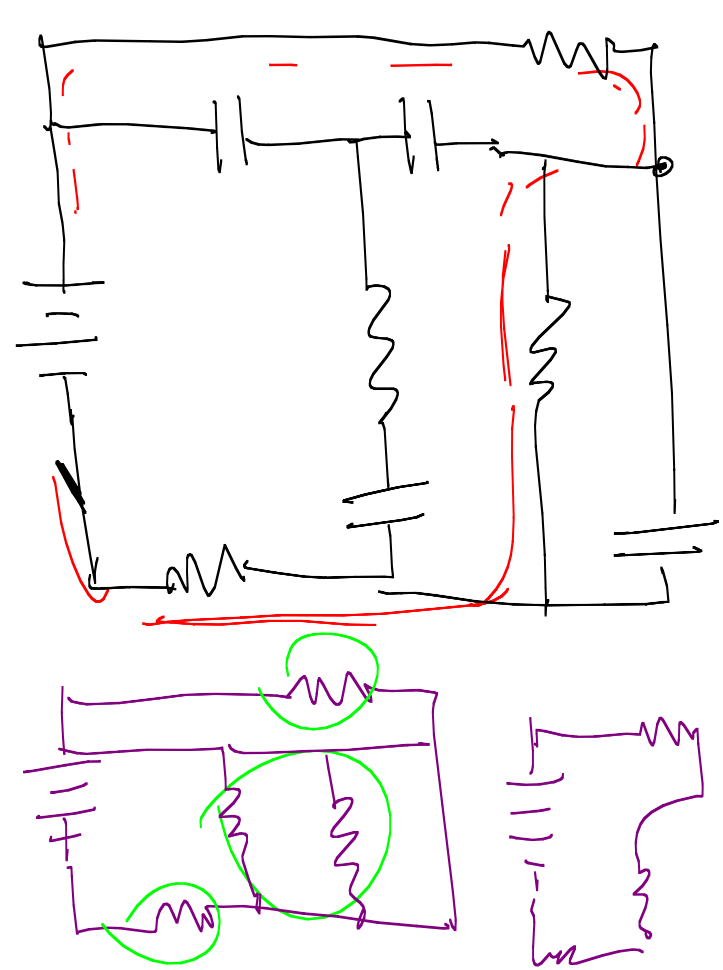
$$I = I_0 e^{-t/RC}$$

Again $\frac{d}{dt}$ $\quad -\frac{1}{C} I - R\frac{dI}{dt} = 0$

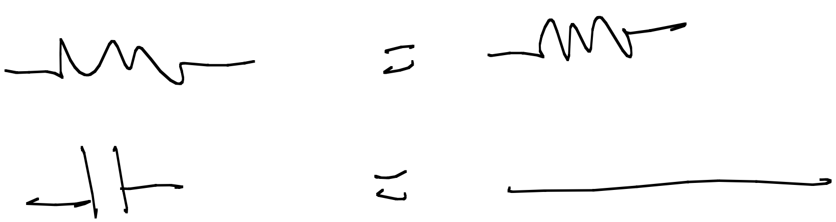
$$RC = \tau$$

$$= \frac{V_0}{R} e^{-t/RC}$$

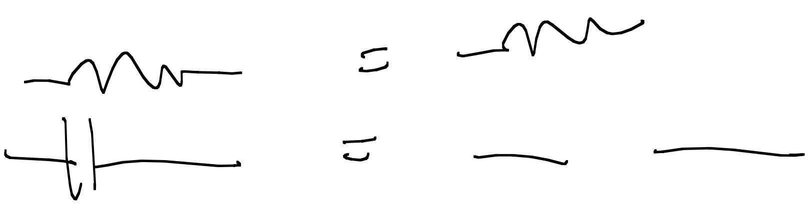
Long & Short Term Behavior



Short (Immediately)



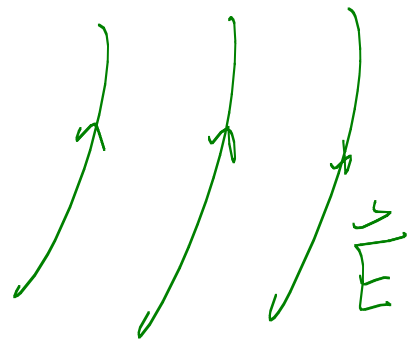
Long term



Chap 26

Magnetism: Force & Field

Electric



$$\boxed{\vec{F} = q\vec{E}}$$

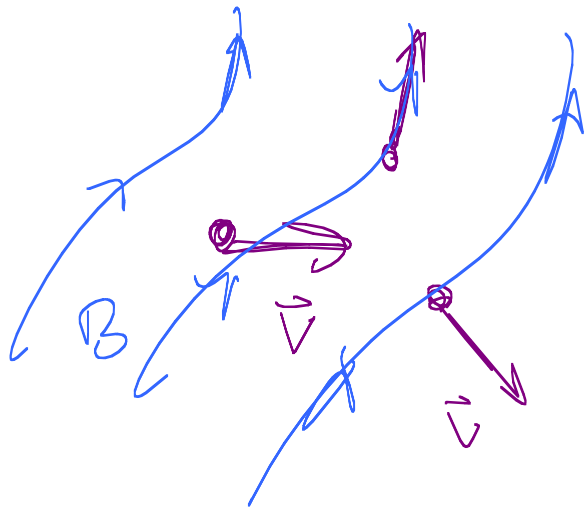
$\Delta U = q\Delta V$

$\vec{B}$

Magnetic Field: Gives force on a charge.

Only on moving charges

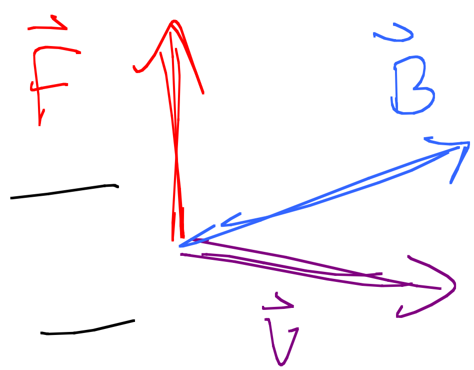
$\vec{B}$ only comes from moving charges.



Vector B

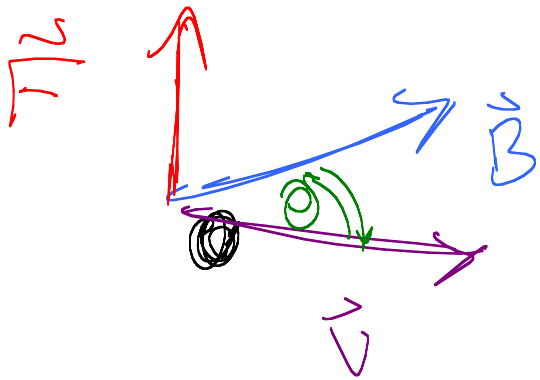
Force is greatest when $\vec{v} \perp \vec{B}$

No force if $\vec{v} \parallel \vec{B}$



Force is perp to both.

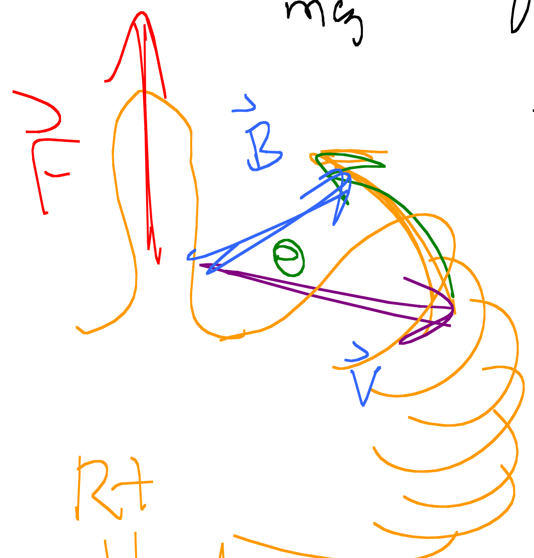
$$\boxed{\vec{F}_m = q\,\vec{v} \times \vec{B}}$$



$$\vec{F}_{mag} = q\vec{v}\times\vec{B}$$

If $\vec{v} \parallel \vec{B}$

$\vec{v} \perp B$ max



Rt Hand

$$\vec{F}_{el} = q\vec{E}$$

$$|\vec{F}| = qvB$$

$$|\vec{F}_m| = |qvB\sin\theta|$$

Units?
Units?

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

$$N = C \cdot \frac{m}{s} \cdot [B]$$

Vector

Units:

$$[B] = \frac{N}{C \cdot \frac{m}{s}}$$

$$= \frac{N \cdot s}{C \cdot m}$$

$$= \text{Tesla}$$

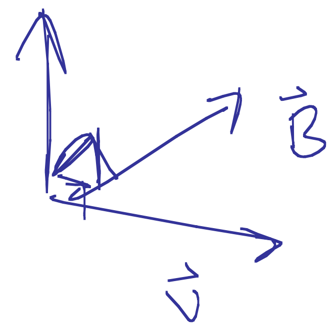
|| crazy years

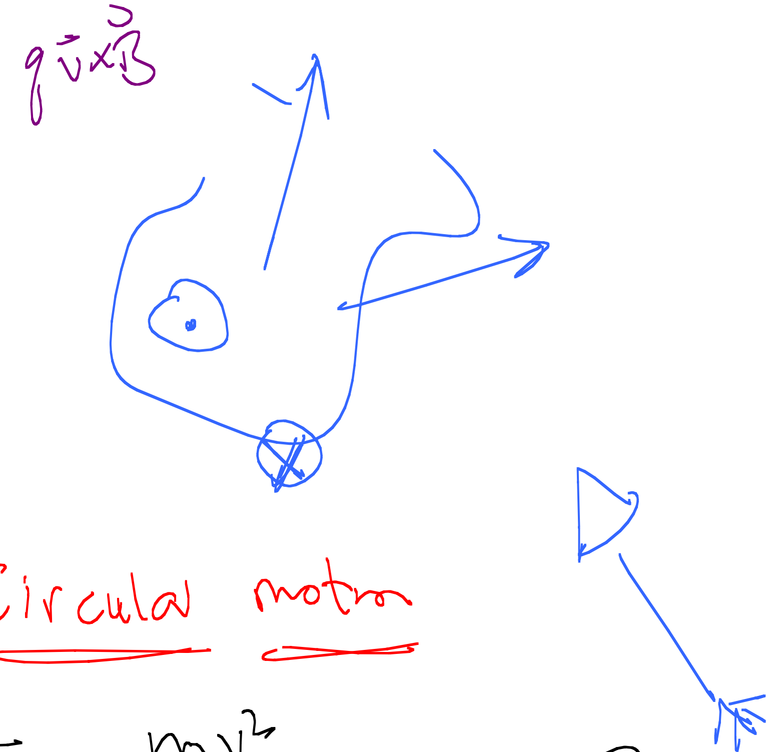
Big mag field

$$1 \text{ gauss} = 10^{-4}\ T$$

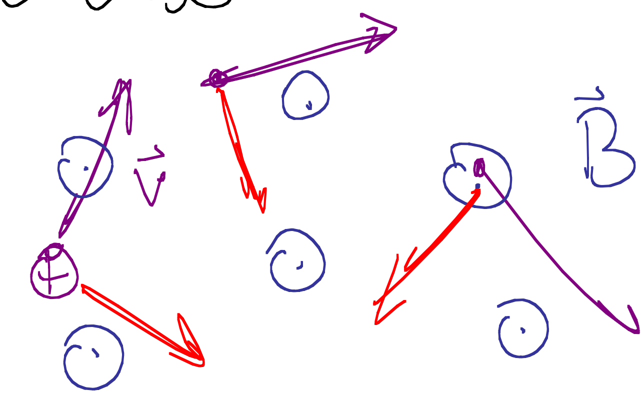
Earth's mag field $\simeq 0.5\ G$

Complicated in general





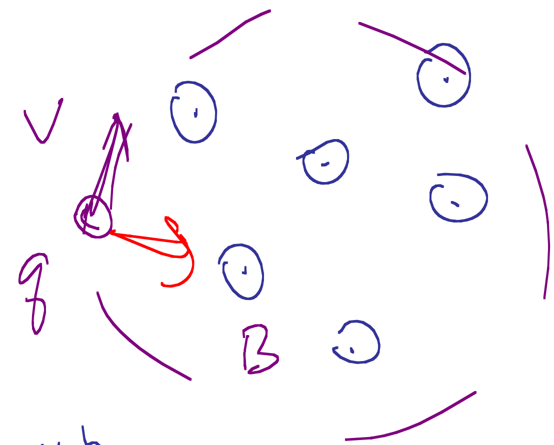
One simple case



Circular motion

$$F_c = \frac{mv^2}{r} = qvB$$

$$\frac{mv^2}{r} = qvB$$



freq. of motion

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

$$f = 1/T = \frac{v}{2\pi r}$$

sub

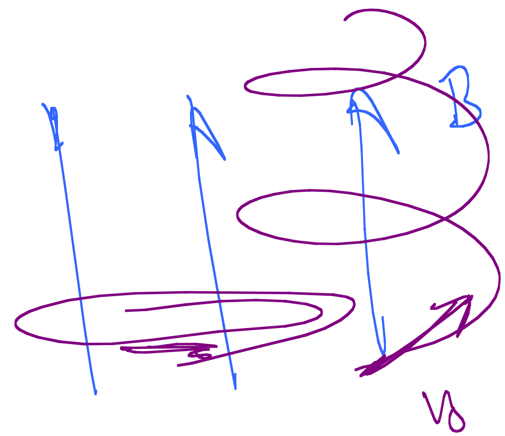
Can show algebra

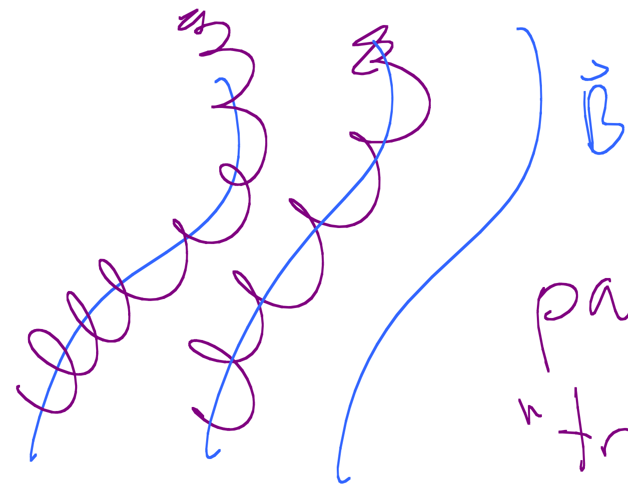
$$T = \frac{2\pi r}{v}$$

$$T = \frac{2\pi r}{v}$$

$$f = \frac{qB}{2\pi m}$$

Cyclotron freq



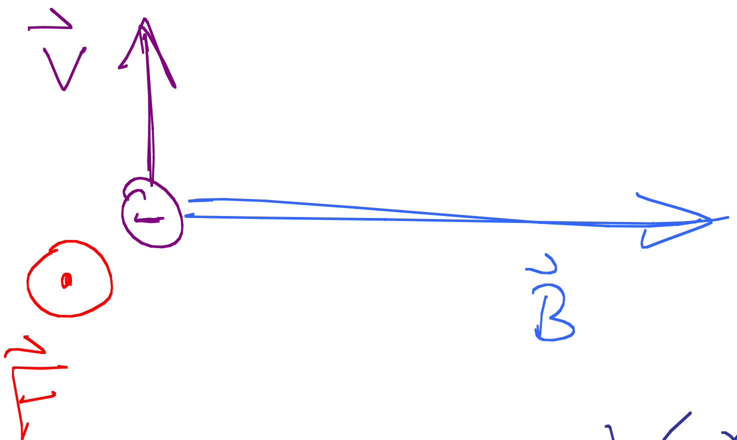


particles "frozen" to field lines

26.18 Magnitude of Earth's field is 0.5 gauss near surface of Earth

Max force on electron, $KE = 1 \text{ keV}$

$= \frac{1}{2} m v^2$



$|F_{max}| = q v B$ $\quad v = 1.88 \times 10^7 \frac{m}{s}$

$= (1.602 \times 10^{-19} C)(1.88 \times 10^7 \frac{m}{s})(0.5 \times 10^{-4} T)$

$= 1.5 \times 10^{-16} N$

$F_{grav} = 8.9 \times 10^{-30} N$ much smaller