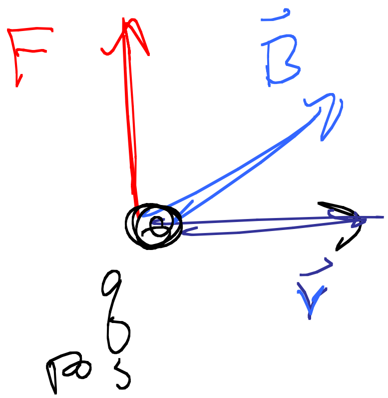
Phys 2120-4   10/5/12

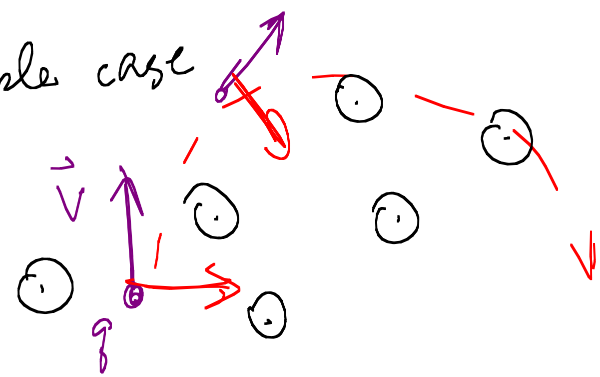
Note Title   10/5/2012

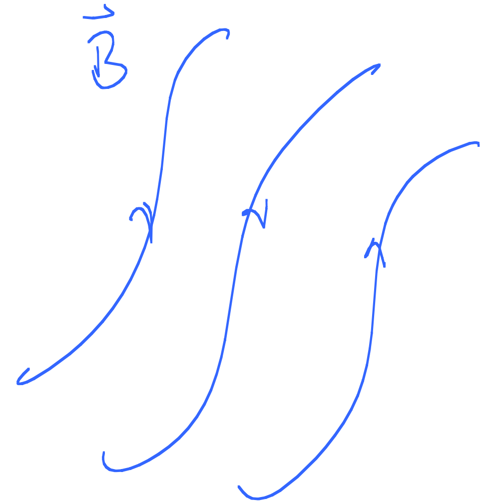
Chap 26 Magnetic forces & fields



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

Simple case





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

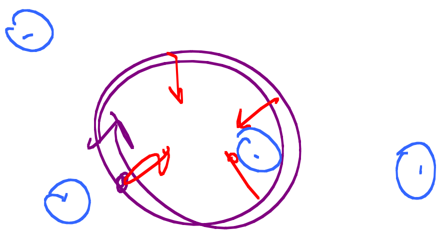
$$f = \frac{qB}{2\pi m}$$

26.20 Find the radius of path described by proton moving at $15 \frac{m}{s}$ in plane perp. to 400 G mag field.

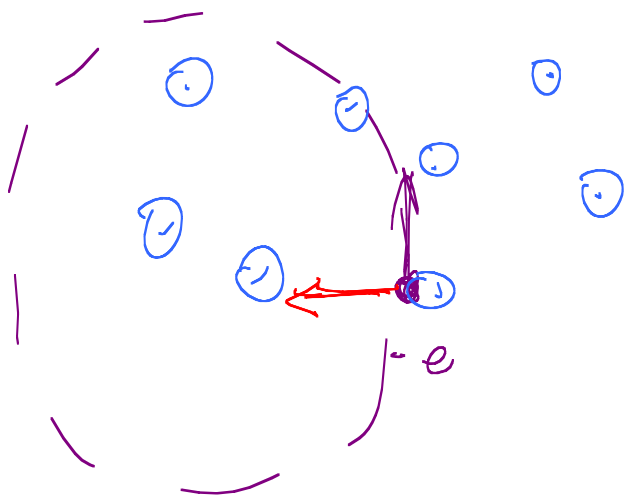
$$1\ G = 10^{-4}\ T$$

$$r = \frac{mv}{qB} = \frac{(1.67\times10^{-27}\ kg)(15\times10^{3}\ \frac{m}{s})}{(1.602\times10^{-19}\ C)(400\times10^{-4}\ T)} = 3.9\times10^{-3}\ m$$

$$= 3.9\ mm$$



26.21 How long does it take electron to complete circ. orbit perp. a 1.0 G magnetic field?



$$T = \frac{1}{f} = \frac{2\pi m}{qB} = \frac{2\pi(9.11\times10^{-31}\,kg)}{(1.602\times10^{-19}\,C)(1\times10^{-4}\,T)}$$

$$= 3.6\times10^{-7}\,s = 360\ ns$$

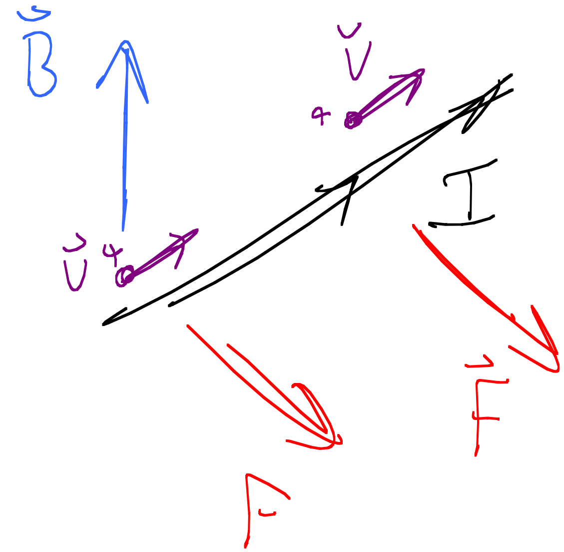
$$F_q = q\vec{v}_d \times \vec{B}$$

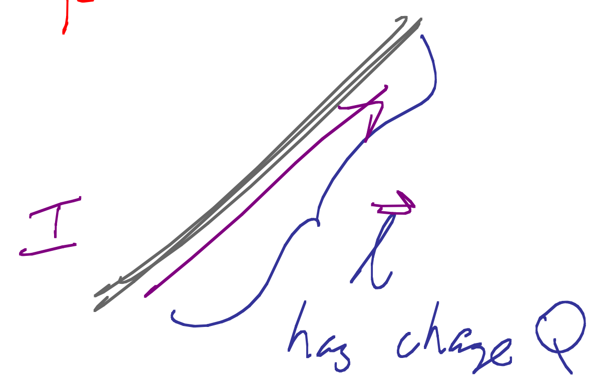
$$Q v_d = n A l \, q \cdot v_d$$

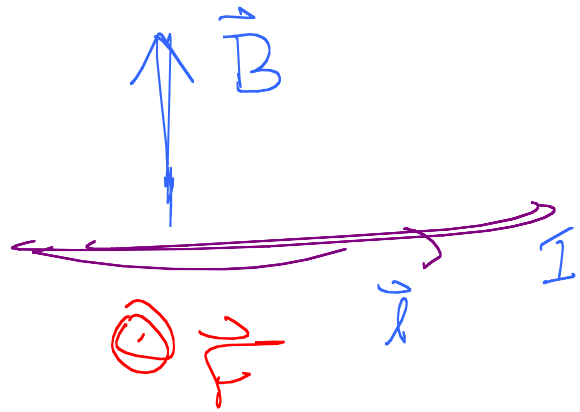
\# density, Volume

$$= (n A q v_d)\, l = I l$$

$$\vec{F}_{\text{length } l \text{ of wire}} = I\vec{l} \times \vec{B}$$







I = mag of current

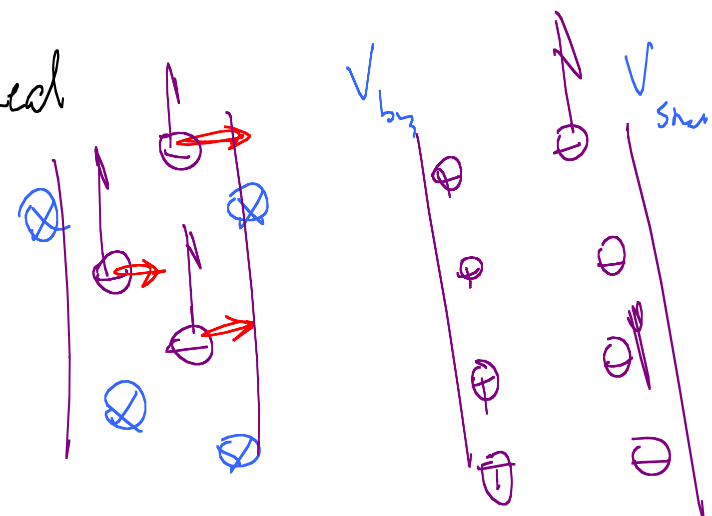
Sign of actual charge carriers doesn't matter

Hall Effect

Measure ΔV across wire. Find sign of carriers.

Phony:

Real

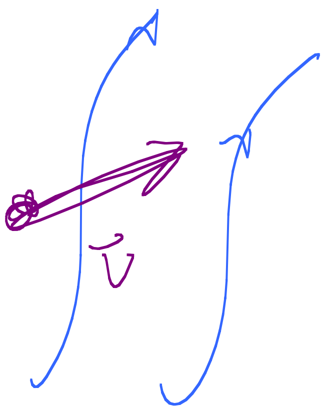


$$V_H = \frac{IB}{nqt}$$

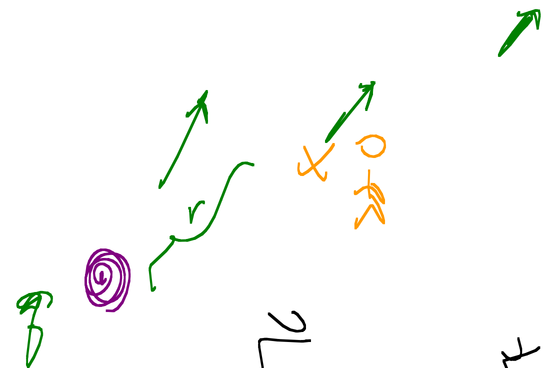
t = Thickness of wire.

n = # dens ch. carriers

q = charge per carrier

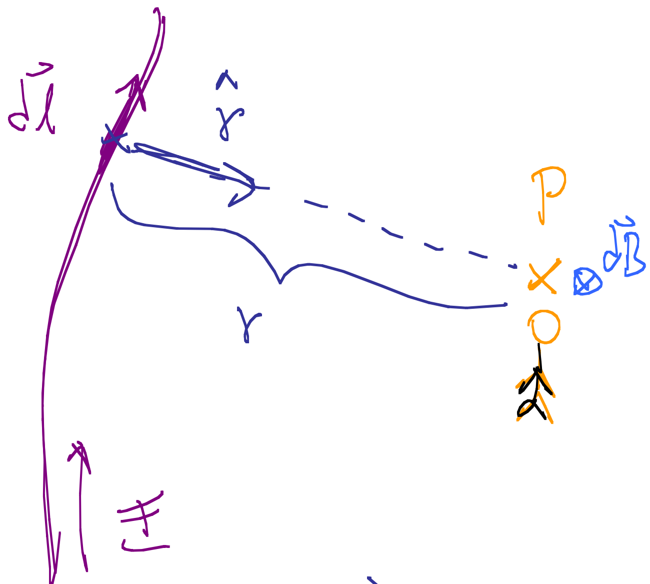


Electric fields



Magnetic Field: Where does it come from.

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



$\vec{r}$ points from bit of wire of interest.

This bit results in a little bit of $\vec{B}$ field at <u>your</u> location

$d\vec{B}$

$$d\vec{B} = \frac{\mu_0}{4\pi} I \frac{d\vec{l} \times \hat{r}}{r^2}$$

ϵ_0

μ_0 = permeability const.

$$= 4\pi \times 10^{-7} \ \frac{N}{A^2}$$

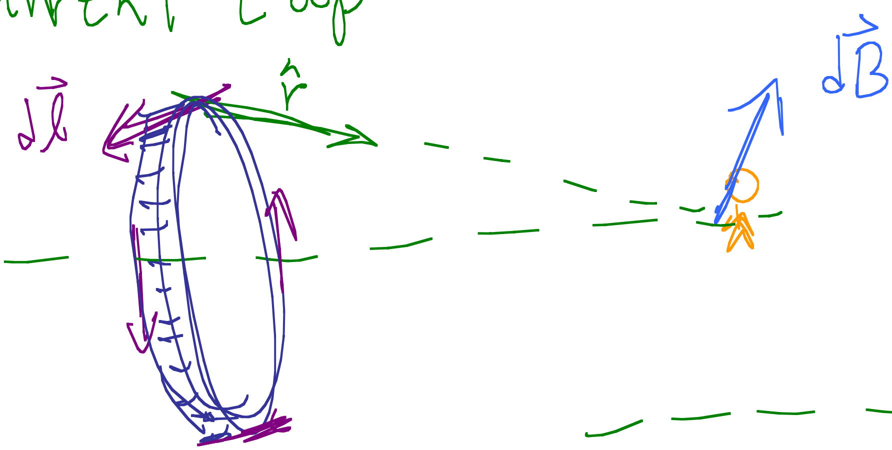
$$\frac{1}{\epsilon_0 \mu_0} = c^2$$

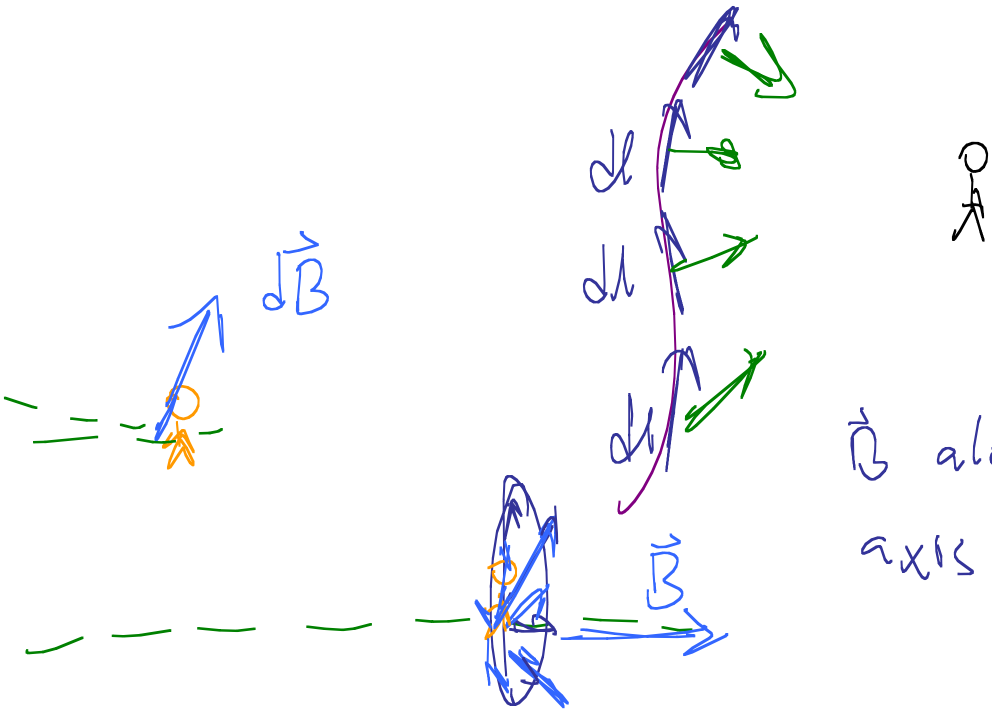
$$\vec{B} = \int d\vec{B} = \frac{\mu_0}{4\pi}\int \frac{I\, d\vec{l} \times \hat{r}}{r^2}$$

Biot-Savart Law

"Simple cases"

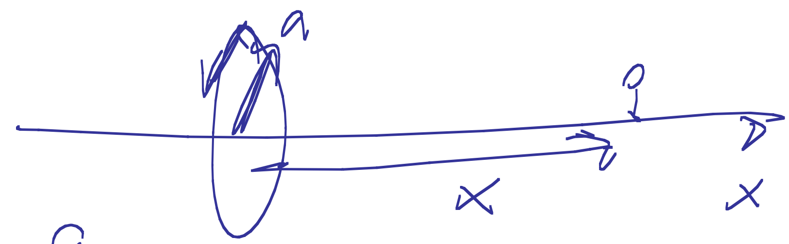
1) Current Loop





$\vec{B}$ along axis

Math gives

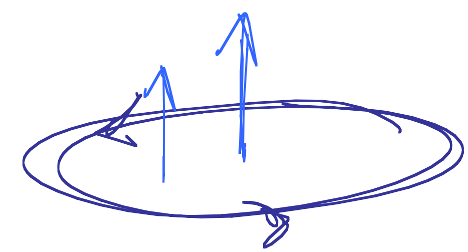


$$B = \int dB_x = \frac{\mu_0 I}{4\pi}\int \frac{dl}{x^2+a^2}\,\frac{a}{\sqrt{x^2+a^2}}$$

$$= \frac{\mu_0 I a^2}{2\,(x^2+a^2)^{3/2}}$$

At middle, $x = 0$

$$B = \frac{\mu_0 I}{2a}$$



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