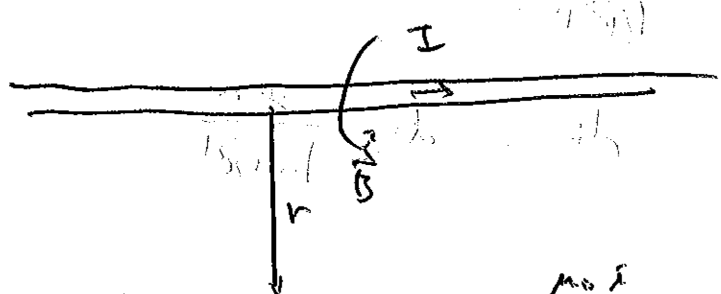
[illegible]

BIOT-SAVART LAW

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

$$\mu_0 = 4\pi\times10^{-7}\ \mathrm{T\cdot m/A}$$

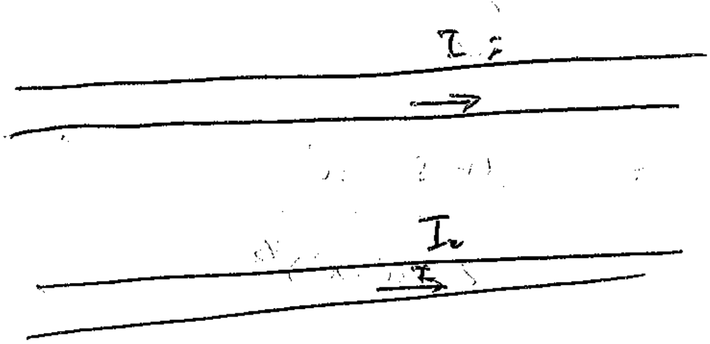


$$|B| = \frac{\mu_0 i}{2\pi d}$$

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

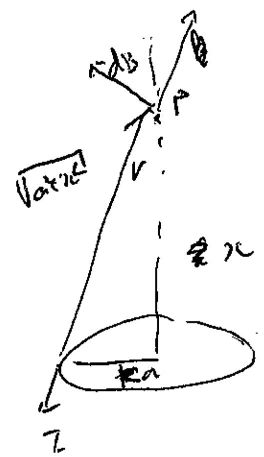
$$\vec{F} = \frac{\mu_0 I_1 I_2}{2\pi d} L$$

[illegible]



PROBABLY AN EXAMPLE YOU'VE SEEN

CIRCULAR CURRENT LOOP



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

$$dB = \frac{\mu_0 I \, ds}{4\pi (a^2+x^2)}$$

~~$|\vec{B}|$ =~~

$$dB_x = dB \frac{a}{\sqrt{a^2+x^2}}$$

$$dB_x = \frac{\mu_0 I}{4\pi} \int \frac{a \, ds}{(a^2+x^2)^{3/2}}$$

$$B_x = \frac{\mu_0 I \; 2\pi a^2}{4\pi (a^2+x^2)^{3/2}}$$

2

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

IF $a << x$

$$B_x \approx \frac{\mu_0 I a^2}{2 x^3}$$

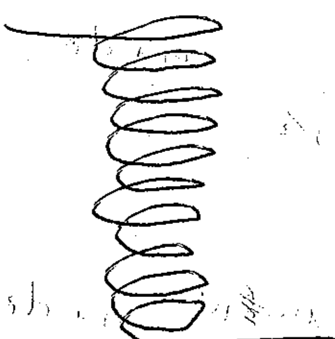
IF $\mu = I(\pi a^2)$

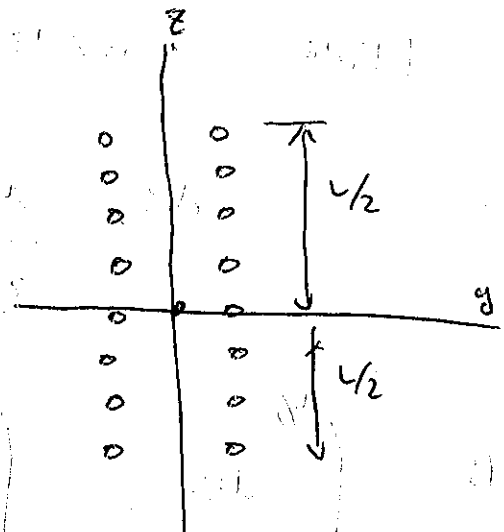
MAGNETIC MOMENT

$$B \sim \frac{\mu_0}{2\pi} \frac{\mu}{x^3}$$

SIMILAR TO ELECTRIC DIPOLE

SOLENOID



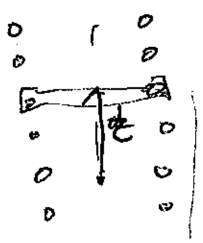


IS IT EQUAL $\vec{B}$ EVERY WHERE?

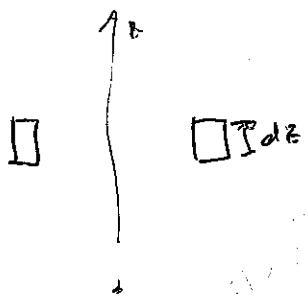
SOLENOID:

R : RADIUS

n : # OF WINDINGS PER UNIT LENGTH



$$dB = \frac{\mu_0 I R^2}{2(R^2+z^2)^{3/2}}$$



$n\,dz$: # OF COILS

$n\,i\,dz$ = TOTAL CURRENT

$$dB = \frac{\mu_0 I R^2}{2(R^2+z^2)^{3/2}} \cdot n\,i\,dz$$

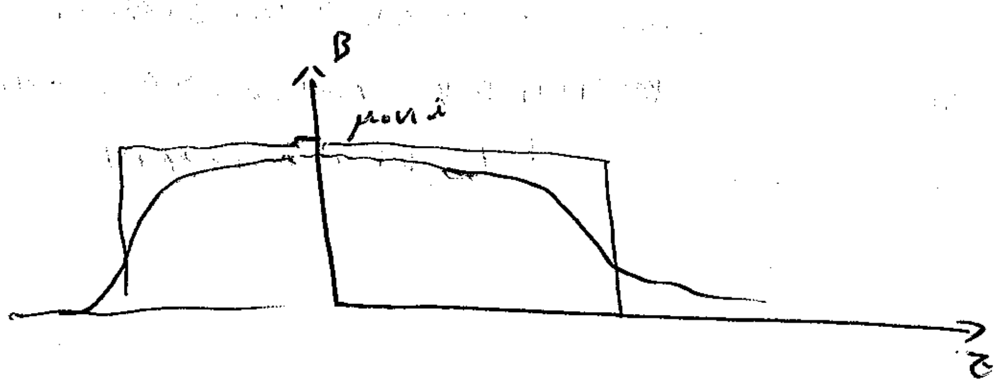
$$B = \int_{-L/2}^{L/2} dB = \int_{-L/2}^{L/2} \frac{\mu_0 R^2}{2(R^2+z^2)^{3/2}}\, n\,i\,dz$$

$$= \frac{\mu_0 n i}{2}\left[\frac{L/2+d}{\sqrt{R^2+(L/2+d)^2}} + \frac{L/2-d}{\sqrt{R^2+(L/2-d)^2}}\right]$$

$L \to \infty$

$$B = \frac{\mu_0 n i}{2}\left[\frac{L/2}{L/2} + \frac{L/2}{L/2}\right]$$

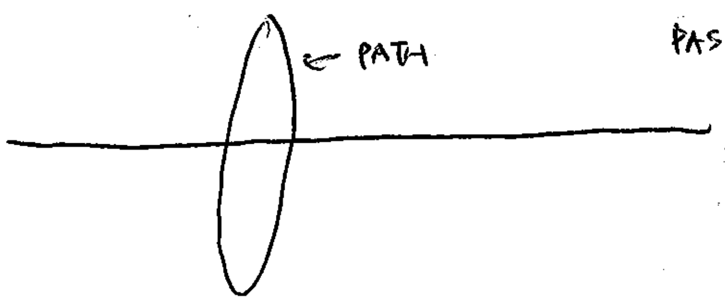
$$= \mu_0 n i$$



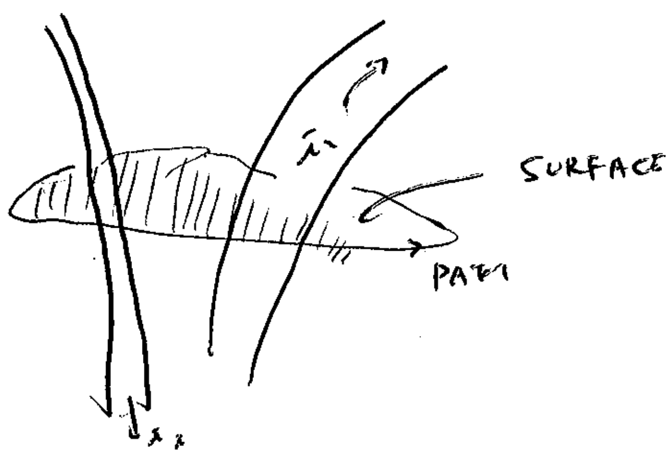
AMPERE'S LAW

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 i$$

EXAMPLE

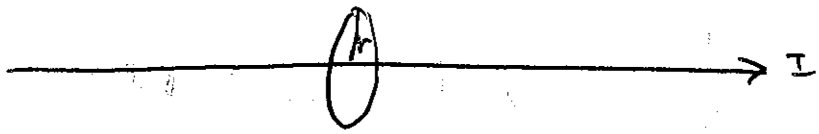


$\vec{B} \cdot d\vec{s}$ AROUND ANY CLOSE PATH WHERE I IS THE TOTAL CURRENT PASSING THRU ANY SURFACE BOUNDED BY THE CLOSED PATH



APPLICATION

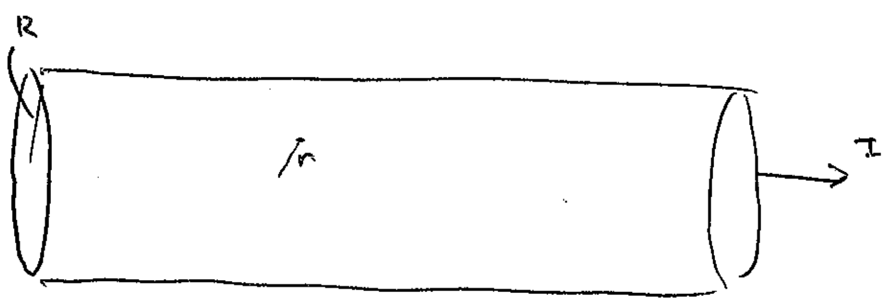
1



$$\oint \vec{B} \cdot d\vec{s} = B \cdot 2\pi r$$

$$= \mu_0 I$$

$$\boxed{B = \frac{\mu_0 I}{2\pi r}}$$ EASY !



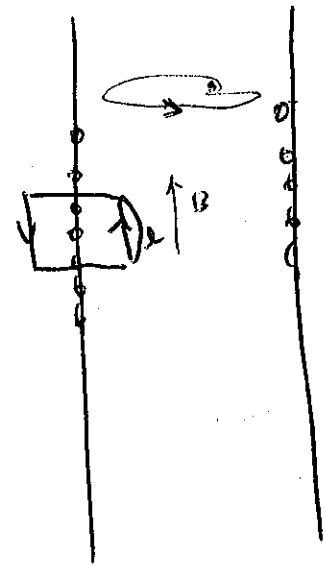
INTERNAL POINTS

$$\oint B \cdot ds = B \cdot 2\pi r$$

$$= \mu_0 I \frac{r^2}{R^2}$$

$$B = \frac{\mu_0 I r}{2\pi R^2}$$

SOLENOID



$$\oint B \cdot ds = Bl$$

$$\mu_0 I_{ENCLOSED} = Bl$$

$$\mu_0 n l I = B l$$

$$\boxed{\mu_0 n I = B}$$