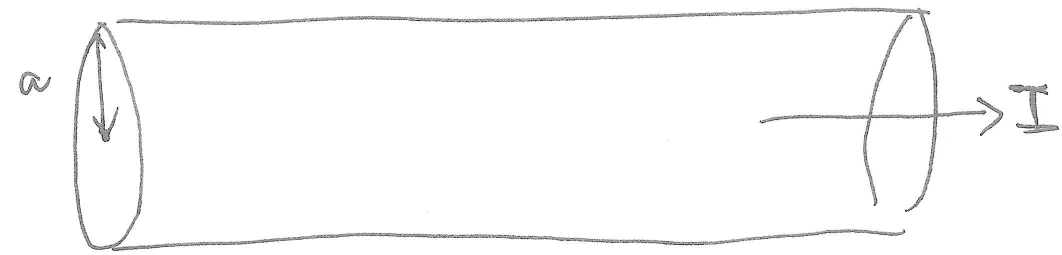
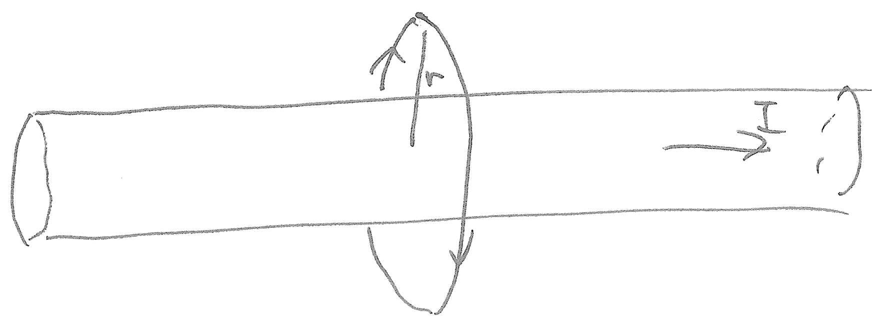


CALCULATE MAGNETIC FIELD FOR $r > a$
FOR $r < a$



OUTSIDE OF WIRE $r > a$

$$\oint \vec{B} \cdot d\vec{s} = |\vec{B}| \underbrace{\int |d\vec{s}|}$$

BECAUSE $|\vec{B}|$ IS CONSTANT

$$= 2\pi r\, |\vec{B}|$$

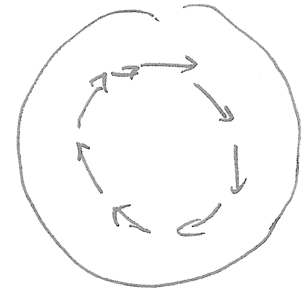
$$\mu_0 I_{THRU} = \mu_0 I$$

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

$$2\pi r\, |\vec{B}| = \mu_0 I$$

$$|\vec{B}| = \frac{\mu_0 I}{2\pi r}$$

$r < a$



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

I: CURRENT IS UNIFORMLY DISTRIBUTED

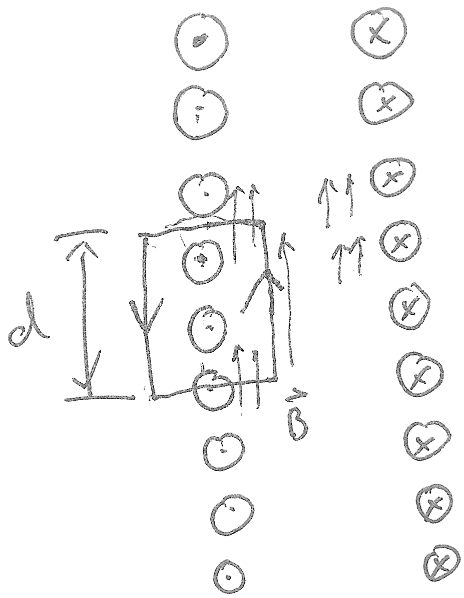
$$I_{THRU} = I \cdot \frac{\pi r^2}{\pi a^2} = I \frac{r^2}{a^2}$$

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

$$|\vec{B}|\, 2\pi r = \mu_0 I \frac{r^2}{a^2}$$

$$|\vec{B}| = \frac{\mu_0 I r}{2\pi a^2}$$

INFINITE SOLENOID



n = COIL DENSITY
(# COIL / m)

$\vec{B} \cdot d\vec{s}$ WHEN $\vec{B}$ AND $d\vec{s}$ ARE $\perp$

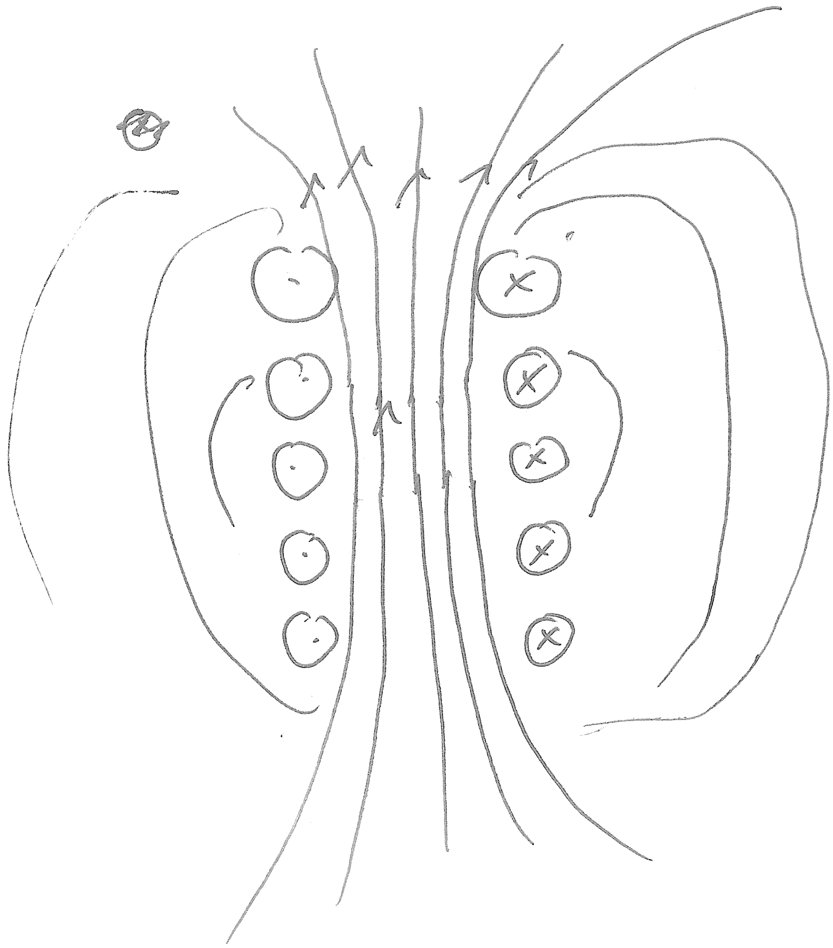
$= 0$

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

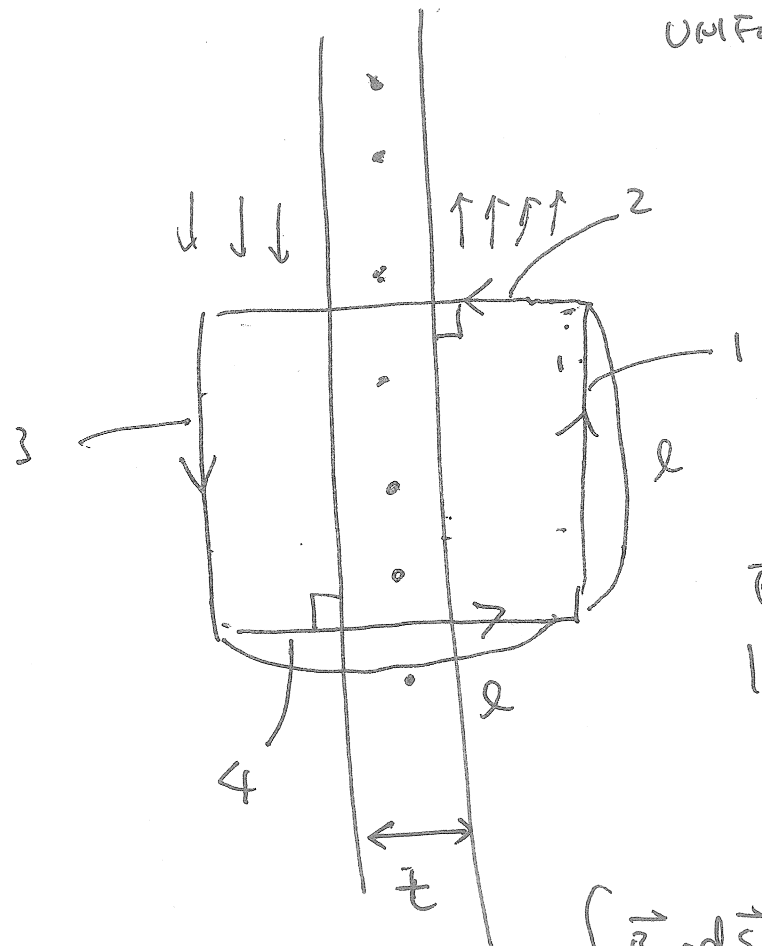
$$= \mu_0 n I d$$

$$B \cdot \cancel{d} = \mu_0 n I \cancel{d}$$

$$B = \mu_0 n I$$



UNIFORM CURRENT DENSITY $\vec{J}$



FOR 2, 4

$\vec{B}\cdot d\vec{s} = 0$

BECAUSE $\vec{B} \perp d\vec{s}$

FOR 1, 3

$|\vec{B}_1| = |\vec{B}_3|$ BECAUSE OF EQUAL DISTANCE FROM THE PLANE

$$\oint \vec{B}\cdot d\vec{s} = |\vec{B}|\cdot \ell + |\vec{B}|\cdot \ell = 2|\vec{B}|\cdot \ell$$

$$I_{THRU} = |\vec{J}|\cdot \ell \cdot t$$

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

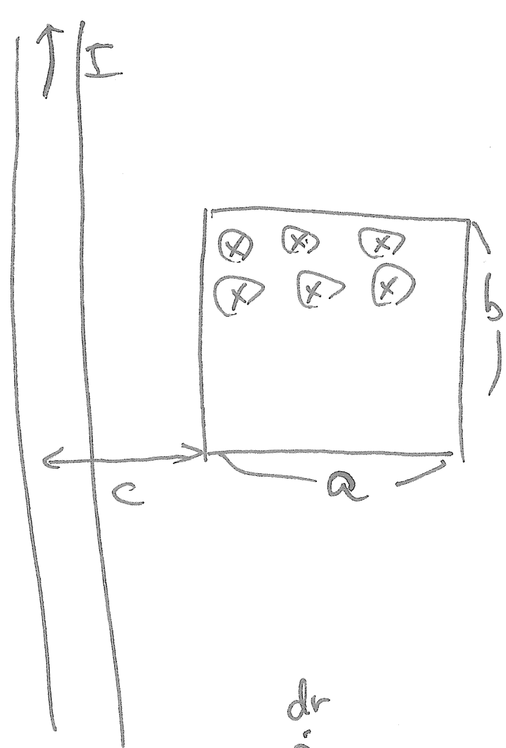
$$2|\vec{B}|\cdot \ell = \mu_0 |\vec{J}|\cdot \ell \cdot t$$

$$|\vec{B}| = \frac{\mu_0 |\vec{J}|\, t}{2}$$ (t: THICKNESS OF THE SHEET)

MAGNET

$$\Phi_B = \int \vec{B} \cdot d\vec{A}$$

EXAMPLE



$$2\pi r B = \mu_0 I$$

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

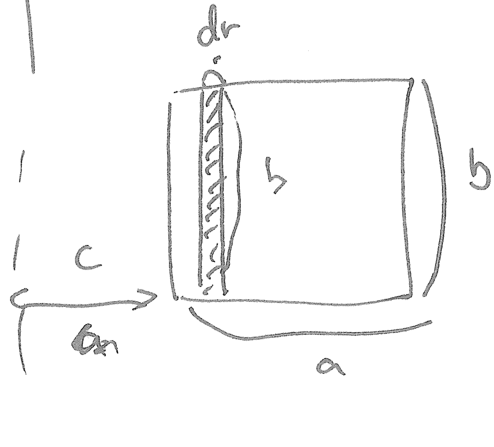
$$d\Phi = \frac{\mu_0 I}{2\pi r}\, dr \cdot b$$

$$d\Phi = \frac{\mu_0 I b}{2\pi r}\, dr$$

$$\Phi = \int d\Phi = \int_c^{a+c} \frac{\mu_0 I b}{2\pi r}\, dr$$

$$= \frac{\mu_0 I b}{2\pi} \ln r \Big]_c^{a+c}$$

$$= \frac{\mu_0 I b}{2\pi} \ln\left[\frac{a+c}{c}\right]$$



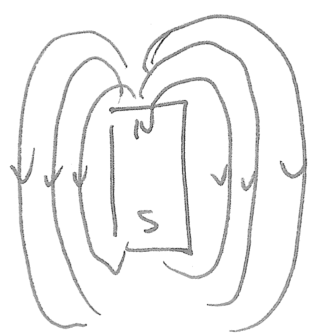
$$\Phi_E = \frac{Q_{ENC}}{\varepsilon_0}$$ GAUSS'S LAW

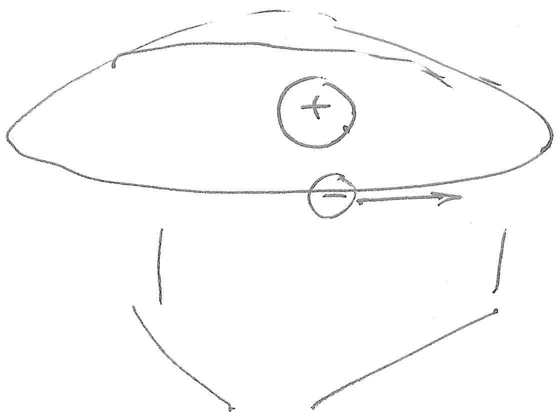
$$\Phi_E = \oint \vec{E} \cdot d\vec{A} = \frac{Q_{ENC}}{\varepsilon_0}$$

$$\oint \vec{B} \cdot d\vec{A} = ?$$

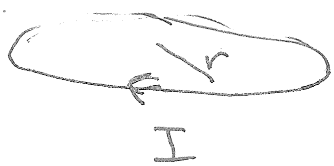
$$\boxed{\oint \vec{B} \cdot d\vec{A} = 0}$$

(A)





$$I = \frac{\text{CHARGE}}{\text{TIME}}$$



$$I = \frac{e}{T}$$

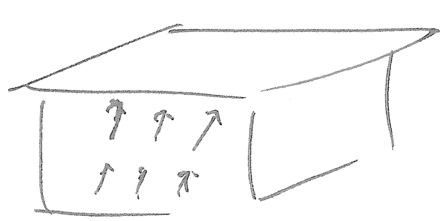
$$T = \frac{2\pi r}{v}$$

$$\mu = I\pi r^2 = \frac{ev}{2\pi r} \cdot \pi r^2$$

$$|\vec{\mu}| = \frac{evr}{2}$$

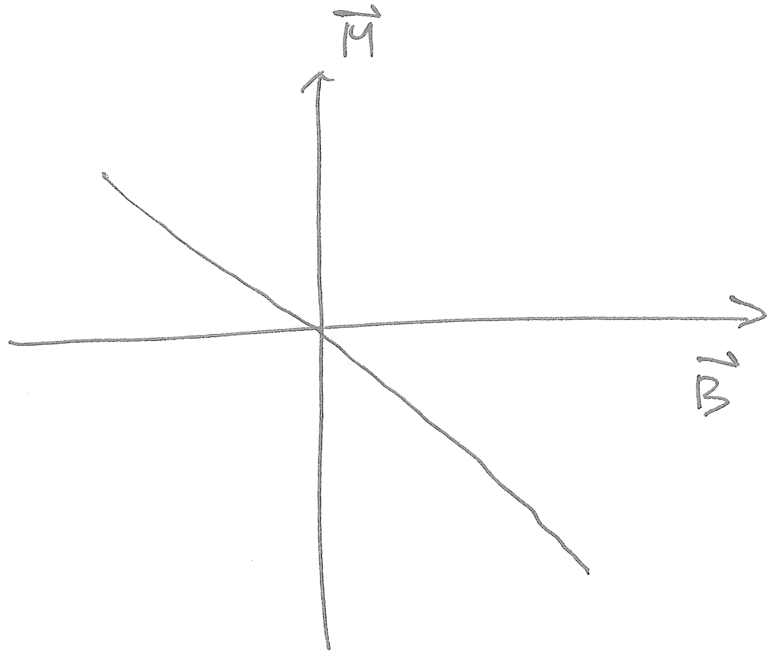
$$|\vec{L}| = mvr \qquad |\vec{\mu}_e| = \frac{e}{2m_e}|\vec{L}|$$

$$|\vec{L}| = \underline{\hbar} \qquad |\mu| = \frac{e\hbar}{2m_e}$$



$$M = |\vec{\mu}|\, V$$

$$\vec{M} = \vec{\mu} \cdot V$$



$\vec{M}$
$\vec{B}$