8.8 a)

$H_{1t} - H_{2t} = K$ (eqn. 8.43)

$\vec{M} = \chi_m \vec{H} \Rightarrow M_t = \chi_m H_t$

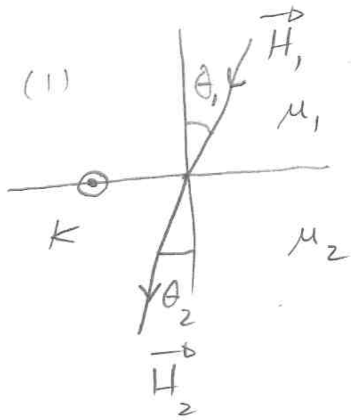
$$\therefore \frac{M_{1t}}{\chi_{m1}} - \frac{M_{2t}}{\chi_{m2}} = K$$

$B_{1n} = B_{2n}$ (8.41)

$\therefore \mu_1 H_{1n} = \mu_2 H_{2n}$

$$\therefore \frac{\mu_1}{\chi_{m1}} M_{1n} = \frac{\mu_2}{\chi_{m2}} M_{2n}$$

b) For a boundary with surface current density K:



$H_{1t} - H_{2t} = K$

$$\frac{B_{1t}}{\mu_1} - \frac{B_{2t}}{\mu_2} = K$$

$$\frac{B_1 \sin\theta_1}{\mu_1} - \frac{B_2 \sin\theta_2}{\mu_2} = K \quad (1)$$

$$B_{1n} = B_{2n} \Rightarrow B_1 \cos\theta_1 = B_2 \cos\theta_2 \quad (2)$$

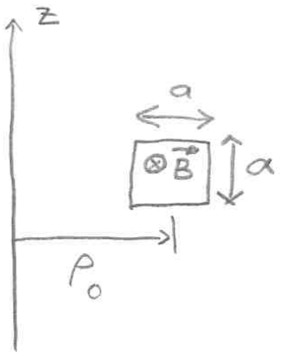
Divide (1) by (2) $\Rightarrow$

$$\frac{\tan\theta_1}{\mu_1} - \frac{\tan\theta_2}{\mu_2} = \frac{K}{B_2 \cos\theta_2} \quad \left(\times \frac{\mu_1}{\tan\theta_2}\right)$$

$$\frac{\tan\theta_1}{\tan\theta_2} - \frac{\mu_1}{\mu_2} = \frac{\mu_1 K}{B_2 \tan\theta_2 \cos\theta_2} = \frac{\mu_1 K}{B_2 \sin\theta_2}$$

$$\therefore \frac{\tan\theta_1}{\tan\theta_2} = \frac{\mu_1}{\mu_2}\left[1 + \frac{\mu_2 K}{B_2 \sin\theta_2}\right]$$

$\underline{\underline{8.9}}$ a) $\oint_l \vec{H} \cdot \vec{dl} = NI$



$\therefore H 2\pi\rho = NI \Rightarrow \vec{H} = \dfrac{NI}{2\pi\rho}\vec{a}_\phi$

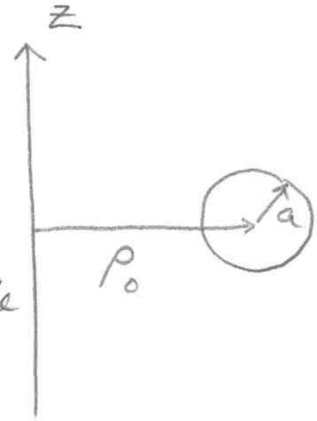
$\therefore \vec{B} = \dfrac{\mu_0 NI}{2\pi\rho}\vec{a}_\phi$ (inside the core)

$$\Psi = \int_S \vec{B} \cdot \vec{ds} = \int_{z=0}^{a}\int_{\rho=\rho_0-\frac{a}{2}}^{\rho_0+\frac{a}{2}} \left(\frac{\mu_0 NI}{2\pi\rho}\vec{a}_\phi\right) \cdot \left(\vec{a}_\phi\, d\rho\, dz\right)$$

$$= \frac{\mu_0 NI}{2\pi}\, a \ln\frac{\rho_0+\frac{a}{2}}{\rho_0-\frac{a}{2}} = \frac{\mu_0 NIa}{2\pi}\ln\left(\frac{2\rho_0+a}{2\rho_0-a}\right)$$

$$L = \frac{\Lambda}{I} = \frac{N\Psi}{I} = \frac{\mu_0 N^2 a}{2\pi}\ln\left(\frac{2\rho_0+a}{2\rho_0-a}\right)$$

b) $\vec{B} = \dfrac{\mu_0 NI}{2\pi\rho}\vec{a}_\phi$ (inside the core).



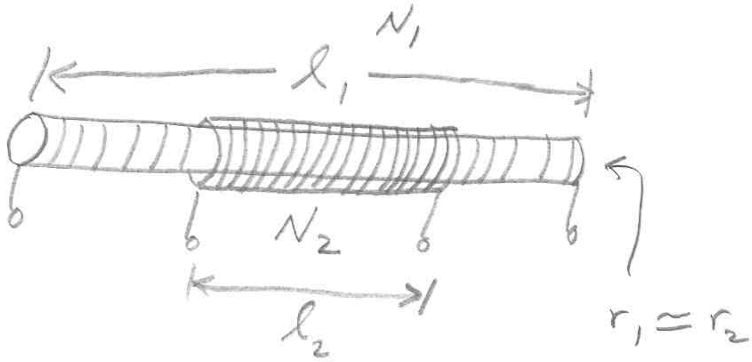
since $\rho_0 >> a$, then:

$\vec{B} \simeq \dfrac{\mu_0 NI}{2\pi\rho_0}\vec{a}_\phi$ (uniform inside the core).

$$\therefore \Psi = BS = \frac{\mu_0 NI}{2\pi\rho_0}\pi a^2 = \frac{\mu_0 NI a^2}{2\rho_0}$$

$$\therefore L = \frac{\Lambda}{I} = \frac{N\Psi}{I} = \frac{\mu_0 N^2 a^2}{2\rho_0}, \quad (\rho_0 >> a)$$

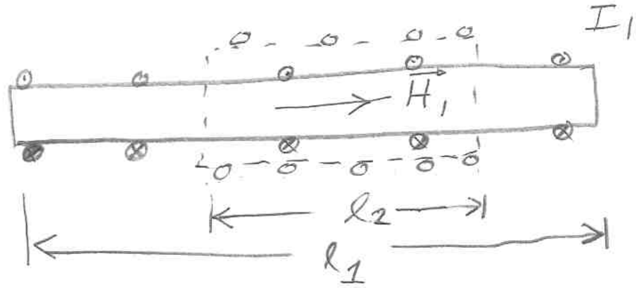
8.10



I_1 passed $\Rightarrow H_1$

$$H_1 \simeq n_1 I_1$$

$$= \frac{N_1}{l_1} I_1$$



$$\therefore B_1 = \frac{\mu N_1}{l_1} I_1$$

$$\Psi_{21} = B_1 S_2 = \frac{\mu N_1 I_1}{l_1} (\pi r_2^2)$$

$$= \frac{\mu N_1 I_1}{l_1} (\pi r_1^2)$$

$$\Lambda_{21} = N_2 \Psi_{21} = \frac{\mu N_1 N_2 I_1 \pi r_1^2}{l_1}$$

$$M_{21} = \frac{\Lambda_{21}}{I_1} = \frac{\mu N_1 N_2 \pi r_1^2}{l_1}$$