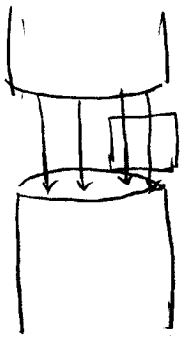
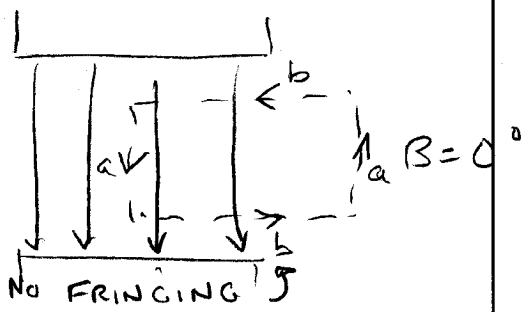
27-47 GIVEN:

AMPERE'S LAW



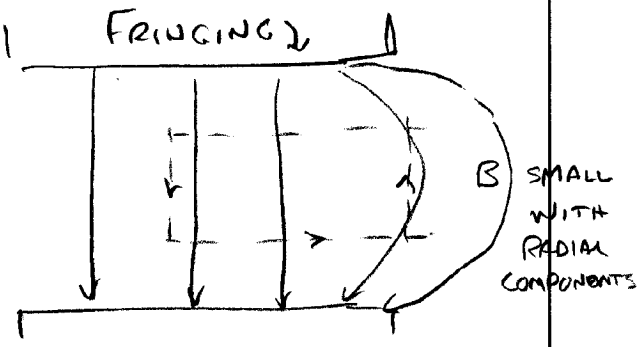
SHOW: NO FRINGING VIOLATES AMPERE'S LAW



$$\oint \vec{B}\cdot d\vec{l} = 0 \quad \left(\text{NO CURRENT}\right)$$

$$Ba = 0$$

$\therefore$ IMPOSSIBLE



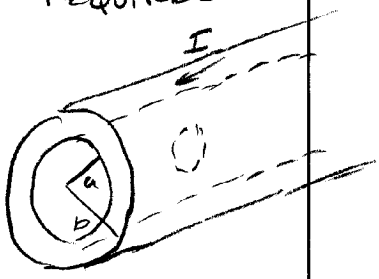
$$\oint B\cdot dl = 0$$

$$Ba - \bar{B}_{fr}\,2b - B_F\,a = 0$$

$\rightarrow$ WITH A RADIAL FRINGING FIELD AND A AXIAL FIELD OUTSIDE THE POLES THE INTEGRAL CAN BE ZERO AS REQUIRED

27-49 GIVEN: CYLINDRICAL SHELL CONDUCTOR

$\vec{J}$ = CONSTANT



FIND B $\quad R < a$

$a < R < b$

$R > b$

$R < a \quad \oint \vec{B}\cdot d\vec{l} = 0 \Rightarrow \boxed{B = 0}$

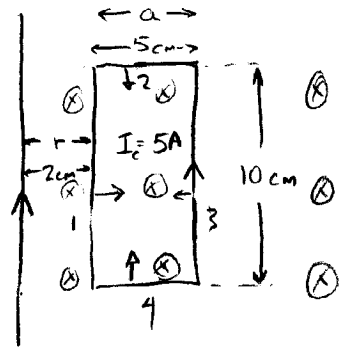
$R > b \quad \oint \vec{B}\cdot d\vec{l} = \mu_0 I_{ENC} \Rightarrow B(2\pi R) = \mu_0 I \Rightarrow \boxed{B = \frac{\mu_0 I}{2\pi R}}$

$a < R < b \quad \oint \vec{B}\cdot d\vec{l} = \mu_0 I_{ENCL} \Rightarrow B(2\pi R) = \mu_0\left(\frac{I}{\pi b^2 - \pi a^2}\right)(\pi R^2 - \pi a^2)$

$$B = \frac{\mu_0 I(\cancel{\pi} R^2 - \cancel{\pi} a^2)}{2\pi R(\cancel{\pi} b^2 - \cancel{\pi} a^2)} = \boxed{\frac{\mu_0 I}{2\pi R}\left(\frac{R^2 - a^2}{b^2 - a^2}\right)}$$

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER
COMET

27-81



$I_w = 20A$

Given: $I_w = 20\ A$

$I_c = 5A$

Find: Force on each segment of coil

Net force on coil

Side 1 $\quad \vec{F} = I\vec{L} \times \vec{B} \Rightarrow |\vec{F}_1| = I_c L \left(\frac{\mu_0 I_w}{2\pi r}\right)$

$$|\vec{F}_1| = (5A)(.1m)\left(2\times10^{-7}\frac{N}{A^2}\right)\left(\frac{20A}{.02m}\right) = \boxed{1.0\times10^{-4}\ N}\ \boxed{\text{Right}}$$

Side 3 $\quad \vec{F} = I\vec{L} \times \vec{B} \Rightarrow |\vec{F}_3| = I_c L \left(\frac{\mu_0 I_w}{2\pi(r+a)}\right)$

$$|\vec{F}_3| = (5A)(.1m)\left(2\times10^{-7}\frac{N}{A^2}\right)\left(\frac{20A}{.07m}\right) = \boxed{2.9\times10^{-5}\ N}\ \boxed{\text{Left}}$$

Side 4 $\quad d\vec{F} = I\,d\vec{l} \times \vec{B}$

$$dF = I_c\,dx\left(\frac{\mu_0 I_w}{2\pi x}\right)$$

$$F = 2k_m I_c I_w \int_r^{r+a} \frac{dx}{x} = 2k_m I_c I_w \ln\left(\frac{r+a}{r}\right)$$

$$= \left(2\times10^{-7}\frac{N}{A^2}\right)(5A)(20A)\ln\left(1+\frac{5}{2}\right)$$

$$= \boxed{2.5\times10^{-5}\ N \mid \text{Up}}$$

Side 2 $\quad F = \boxed{2.5\times10^{-5}\ N \mid \text{Down}}$

$$F_{NET} = 1.0\times10^{-4}\ N - 2.9\times10^{-5}\ N = \boxed{7.1\times10^{-5}\ N\ \text{Right}}$$

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER
COMET