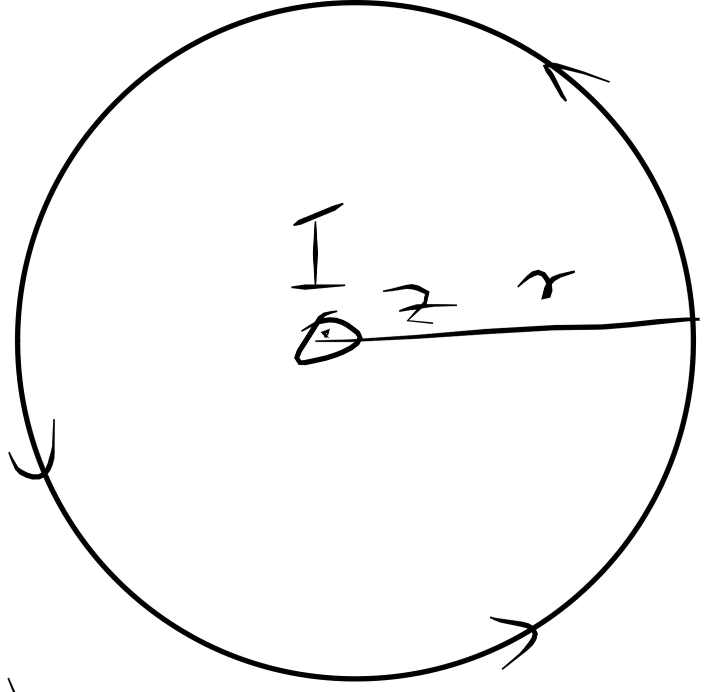
a)



$$\mu_0 I_{in} = 2\pi r B$$

$$I_{in} = \int \bar{j}\, dS = \int_0^r j_0 e^{-a\rho} 2\pi\rho\, d\rho =$$

$$= 2\pi j_0 \int_0^r \rho\, e^{-a\rho} d\rho = 2\pi j_0 \left[-\frac{\rho}{a}e^{-a\rho} - \frac{1}{a^2}e^{-a\rho}\right]_0^r =$$

$$= 2\pi j_0 \left[-\frac{r}{a}e^{-ar} - \frac{1}{a^2}e^{-ar} + \frac{1}{a^2}\right]$$

D	I
$+\ \rho$	$e^{-a\rho}$
$-\ 1$	$-\frac{1}{a}e^{-a\rho}$
$+\ 0$	$\frac{1}{a^2}e^{-a\rho}$

$$B(r) = \frac{\bar{j}_0}{r}\left(\frac{1}{a^2} - \frac{r}{a}e^{-ar} - \frac{1}{a^2}e^{-ar}\right)$$

Dla $a >> r$ $\quad e^{-ar} \longrightarrow 0$

$$B = 0$$

Dla $r >> a$

$$B = \frac{\bar{j}_0}{r}\left(\frac{1}{a^2} - \frac{r}{a}\left(1 - ar + \frac{a^2r^2}{2} \dots\right) - \frac{1}{a^2}\left(1 - ar + \frac{a^2r^2}{2} \dots\right)\right)$$

$$B = \bar{j}_0\left(\cancel{\frac{1}{a^2 r}} - \cancel{\frac{1}{a}} + r - \frac{ar^2}{2} - \cancel{\frac{1}{a^2 r}} + \cancel{\frac{1}{a}} - \frac{r}{2}\right) \approx \bar{j}_0 \frac{r}{2}$$

$$I = \int_0^\infty j_0 e^{-a\rho} 2\pi\rho\, d\rho = \frac{2\pi \bar{j}_0}{a^2} \qquad \bar{j}_0 = \frac{I a^2}{2\pi}$$

b)

$$F_L = q v B = e v B(\rho)$$

$$\bar{j}(\rho) = v \varrho(\rho) = \bar{j}_0 e^{-a\rho}$$

$$F_K = \frac{e \bar{j}_0 e^{-a\rho}}{\varepsilon_0 v a}$$

$$\frac{\varrho(\rho)}{\varepsilon_0} = \frac{\partial E}{\partial \rho}$$

$$\frac{\bar{j}_0}{\varepsilon_0 v} e^{-a\rho} = \frac{\partial E}{\partial \rho}$$

$$E = \frac{\bar{j}_0}{\varepsilon_0 v a} e^{-a\rho}$$

$$\frac{F_L}{F_K} = \frac{\varepsilon_0 v^2 \cancel{a}}{\cancel{\bar{j}_0}\, e^{-a\rho}} \frac{\cancel{\bar{j}_0}}{\rho}\left(\frac{1}{a^2} - \frac{\rho}{\cancel{a}} e^{-a\rho} - \frac{1}{a^2} e^{-a\rho}\right)$$

$$\frac{F_L}{F_K} = \frac{\varepsilon_0 v^2}{\rho}\left(\frac{e^{a\rho}}{a} - \rho - \frac{1}{a}\right)$$