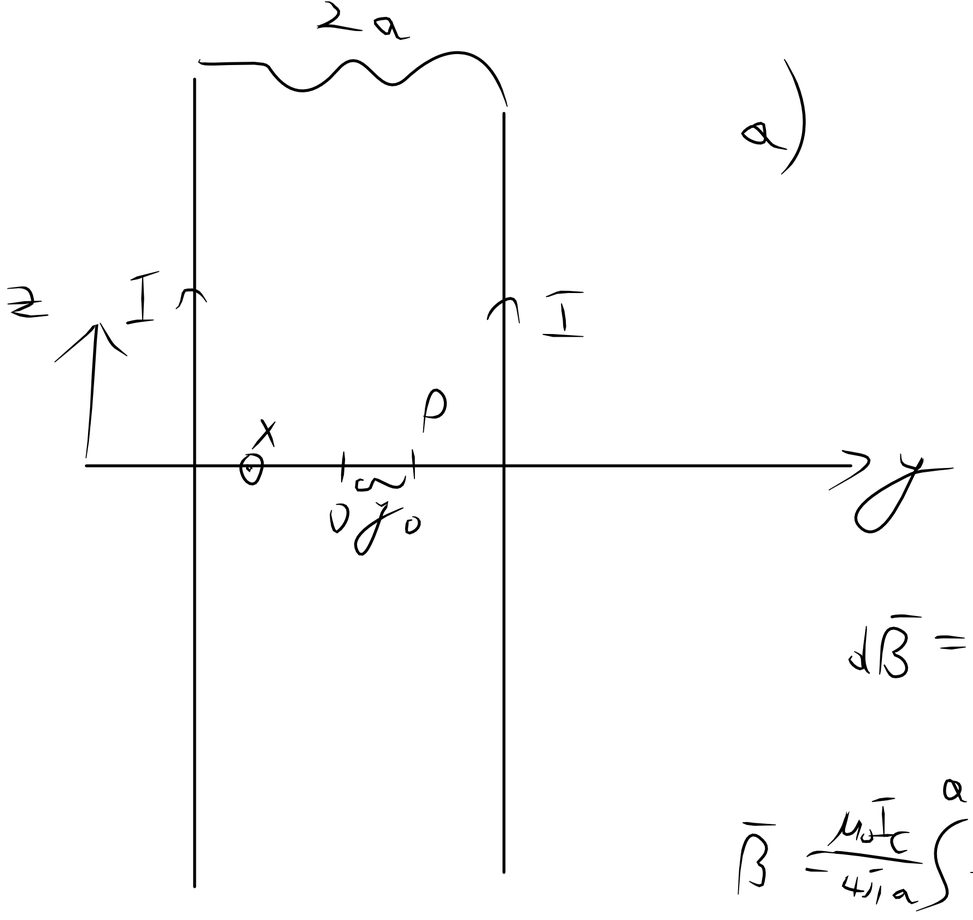


a) $I_c = j \cdot 2a$

$j = \text{const.} \quad dI = j \cdot dy$

$dI = \frac{I_c\, dy}{2a}$

$d\bar{B} = \frac{\mu_0 dI}{2\pi y} = \frac{I_c \mu}{4\pi a} \frac{dy}{y} \hat{e}_x$

$\bar{B} = \frac{\mu_0 I_c}{4\pi a} \int_{-a}^{a} \frac{dy}{y - y_0} = \frac{\mu_0 I_c}{4\pi a} \ln \left| \frac{a - y_0}{-a - y_0} \right| \hat{e}_x$

$B(0) = 0 \qquad B(a) \to \infty$

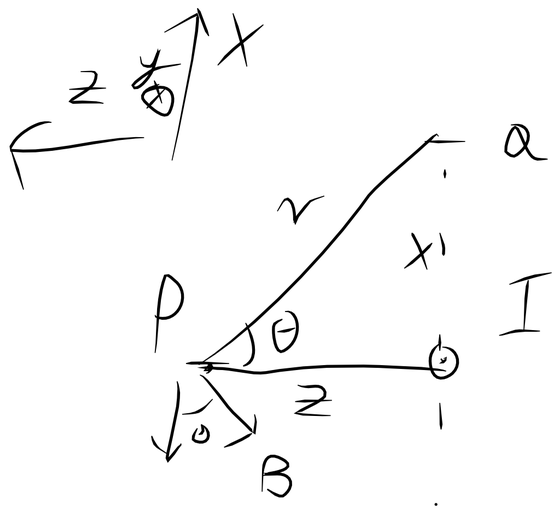
$y >> a$

$\frac{1}{a} \ln \left| \frac{y_0 - a}{a + y_0} \right| = \frac{1}{a} \ln \left(1 - \frac{2a}{a + y_0} \right) = \frac{1}{a} \left(- \frac{2a}{a+y_0} - \frac{4a^2}{2(a+y_0)^2} + \frac{-9a^3}{3(a+y_0)^3} - \dots \right) =$

$\approx \frac{-2}{a + y_0}$

$B(y_0) \approx \frac{-\mu_0 I_c}{2\pi (a + y_0)}$

b)



$dI = \frac{I\, dx}{2a} \qquad \frac{z}{r} = \cos\theta$

$r = z \sec\theta$

$x = z \tan\theta$

$dx = z \sec^2\theta \, d\theta$

$d\bar{B} = \frac{\mu_0 dI}{2\pi r} \begin{bmatrix} -\cos \\ \sin \\ 0 \end{bmatrix} \qquad d\bar{B} = \frac{\frac{I}{2a} z \sec^2\theta}{2\pi z \sec\theta} \begin{bmatrix} -\cos\theta \\ \sin\theta \\ 0 \end{bmatrix} d\theta$

$B = \frac{\mu_0 I}{4\pi a} \int_{-\arctan(\frac{a}{z})}^{\arctan(\frac{a}{z})} \begin{bmatrix} -1 ; \tan\theta ; 0 \end{bmatrix} d\theta$ (0 ↑ symetria)

$= \frac{-\mu_0 I}{2\pi a} \arctan\left(\frac{a}{z}\right) = \frac{-\mu_0 I}{2\pi a} \left(\frac{a}{z} - \frac{a^3}{3z^3} + \frac{a^5}{5z^5} - \dots \right) \approx$

dla $z >> a$

$\approx \frac{-\mu_0 I}{2\pi z}$

jak prosta, zgadza się

dla $a >> z \qquad \arctan\left(\frac{a}{z}\right) \to \frac{\pi}{2}$

$B = \frac{-\mu_0 I}{4 a a}$