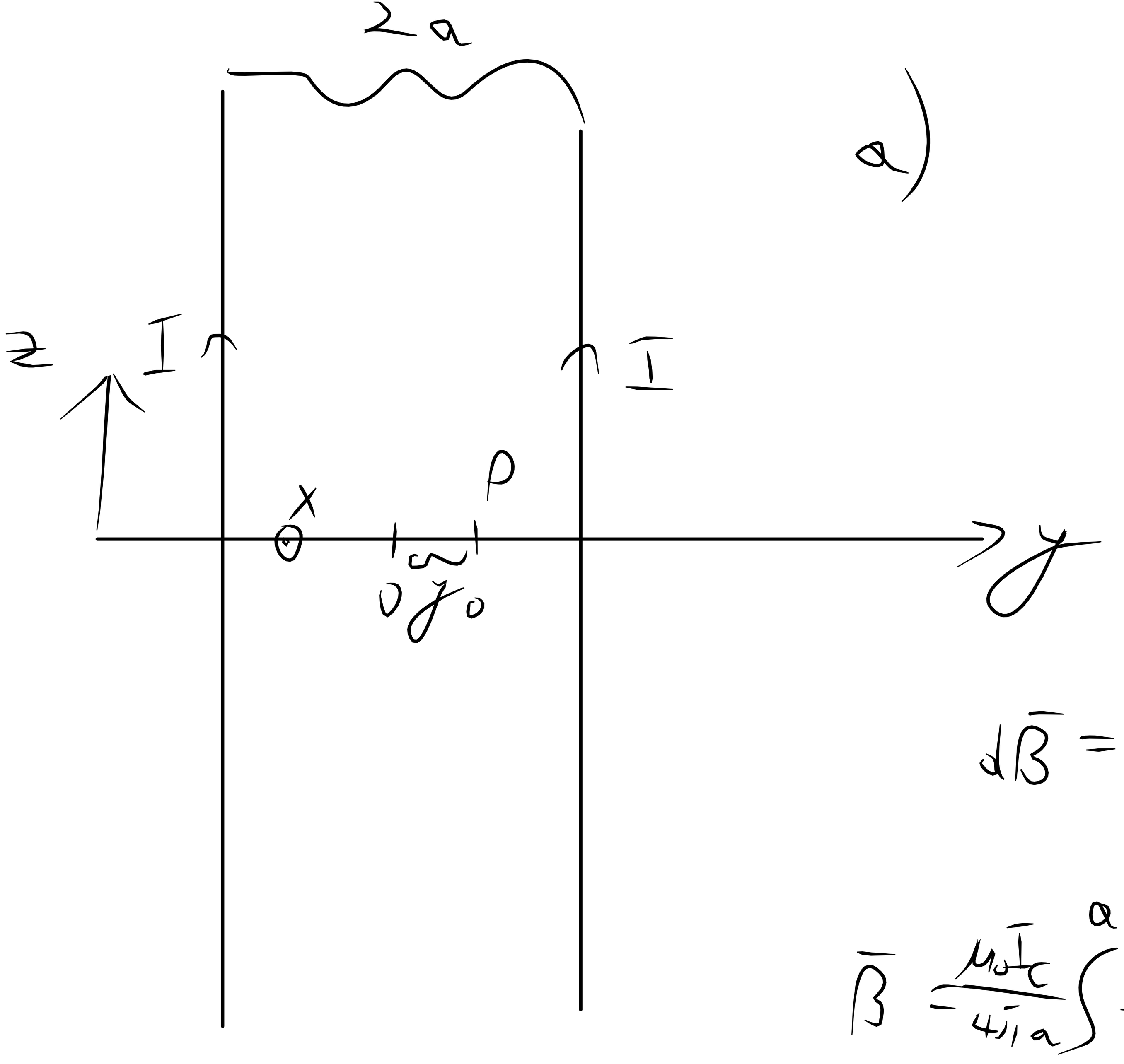


a)

$I_c = j L 2a$

$j = const$ $dI = jL \cdot dy$

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

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

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

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

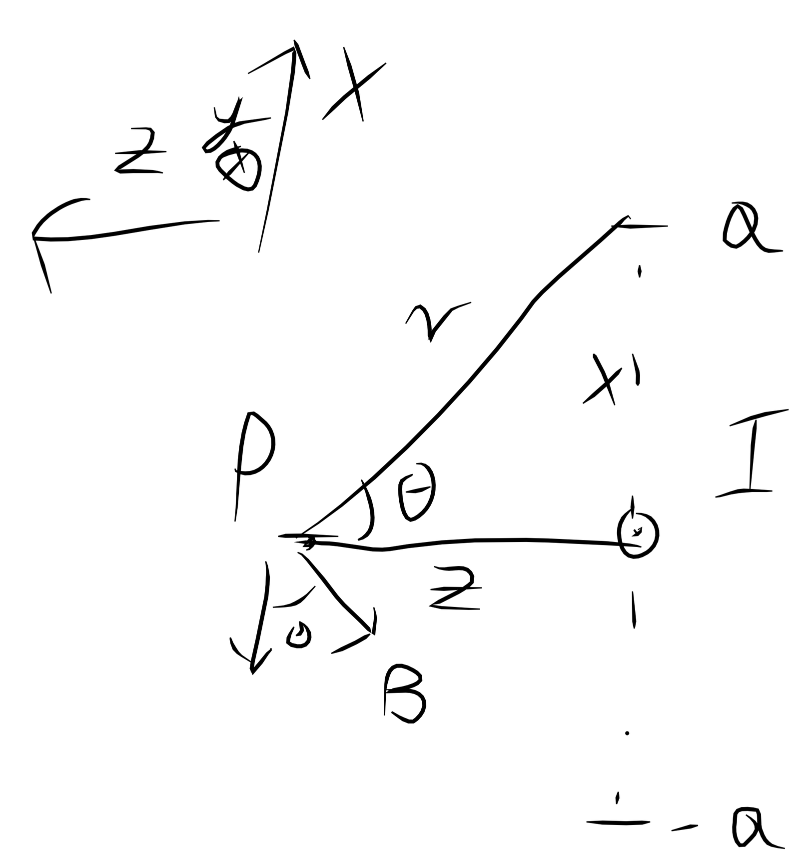
$y >> a$

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

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

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

b)



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

$r = z\sec\theta$

$d\bar{B} = \frac{\mu_0 dI}{2\pi r}\begin{bmatrix}-\cos\\ \sin\\ 0\end{bmatrix}$ $x = z\tan\theta$

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

$dB = \frac{\mu_0 \frac{I}{2a}\cancel{z}\sec^{\cancel{2}}\theta}{2\pi\,\cancel{z\sec\theta}}\begin{bmatrix}-\cos\theta\\ \sin\theta\\ 0\end{bmatrix} d\theta$

$B = \frac{\mu_0 I}{4\pi a}\int_{-\arctan\left(\frac{a}{z}\right)}^{\arctan\left(\frac{a}{z}\right)} \left[-1\ ;\ \overset{0 \text{ bo symetria}}{\tan\theta}\ ;\ 0\right] d\theta$

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

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

$\approx \frac{-\mu_0 I}{2\pi z}$ $B = \frac{-\mu_0 I}{4a}$

jak prosta, zgadza się