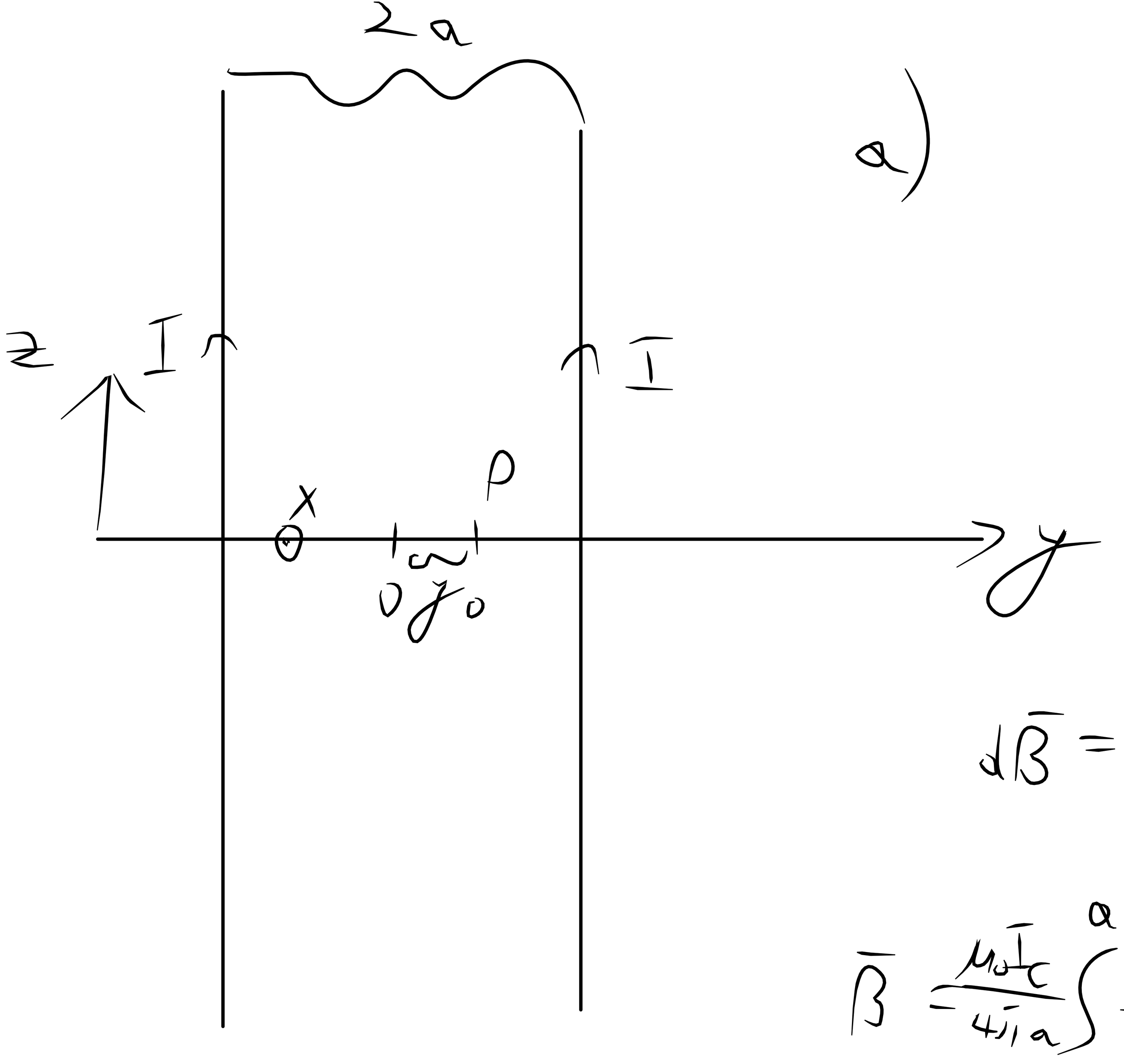


a) $I_c = j L 2a$

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

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

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

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

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

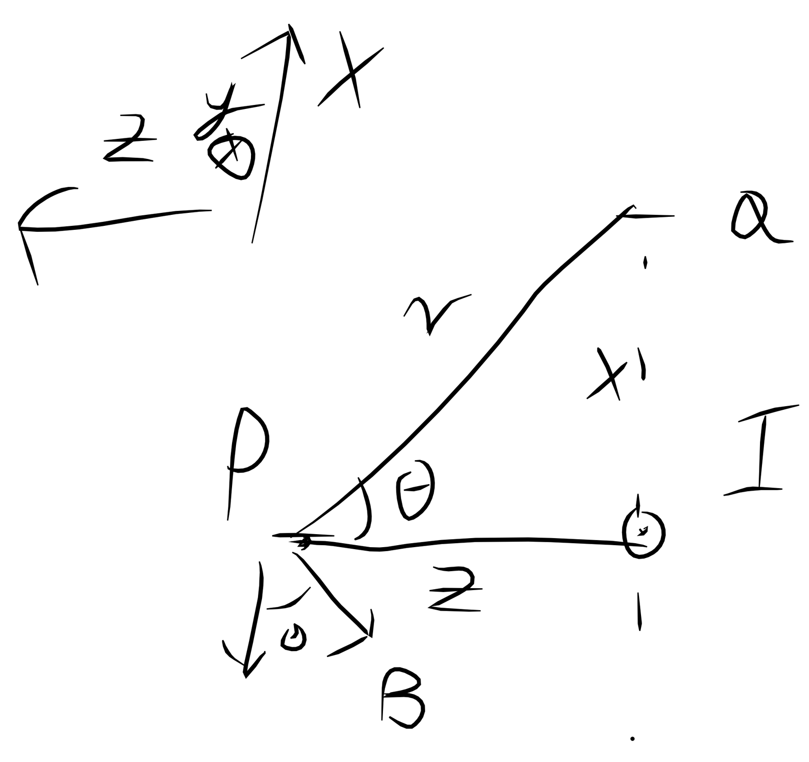
$y \gg a$

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

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

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

b)



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

$$r = z\sec\theta$$

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

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

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

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

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

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

$$\approx \frac{-\mu_0 I}{2\pi z} \qquad B(z) \to 0$$