$$d\bar{B} = \frac{\mu_0 I}{4\pi} \frac{d\bar{l} \times \bar{r}}{r^3}$$

$$\bar{r} = -\left(r_0 + \frac{a}{2\pi}\varphi\right)\bar{e}_r = \begin{bmatrix} -r_0 - \frac{a}{2\pi}\varphi \\ 0 \\ 0 \end{bmatrix}_{r,\varphi,z}$$

$$\bar{l} = \left(r_0 + \frac{a}{2\pi}\varphi\right)\bar{e}_r \qquad \frac{d\bar{e}_r}{d\varphi} = \hat{e}_\varphi$$

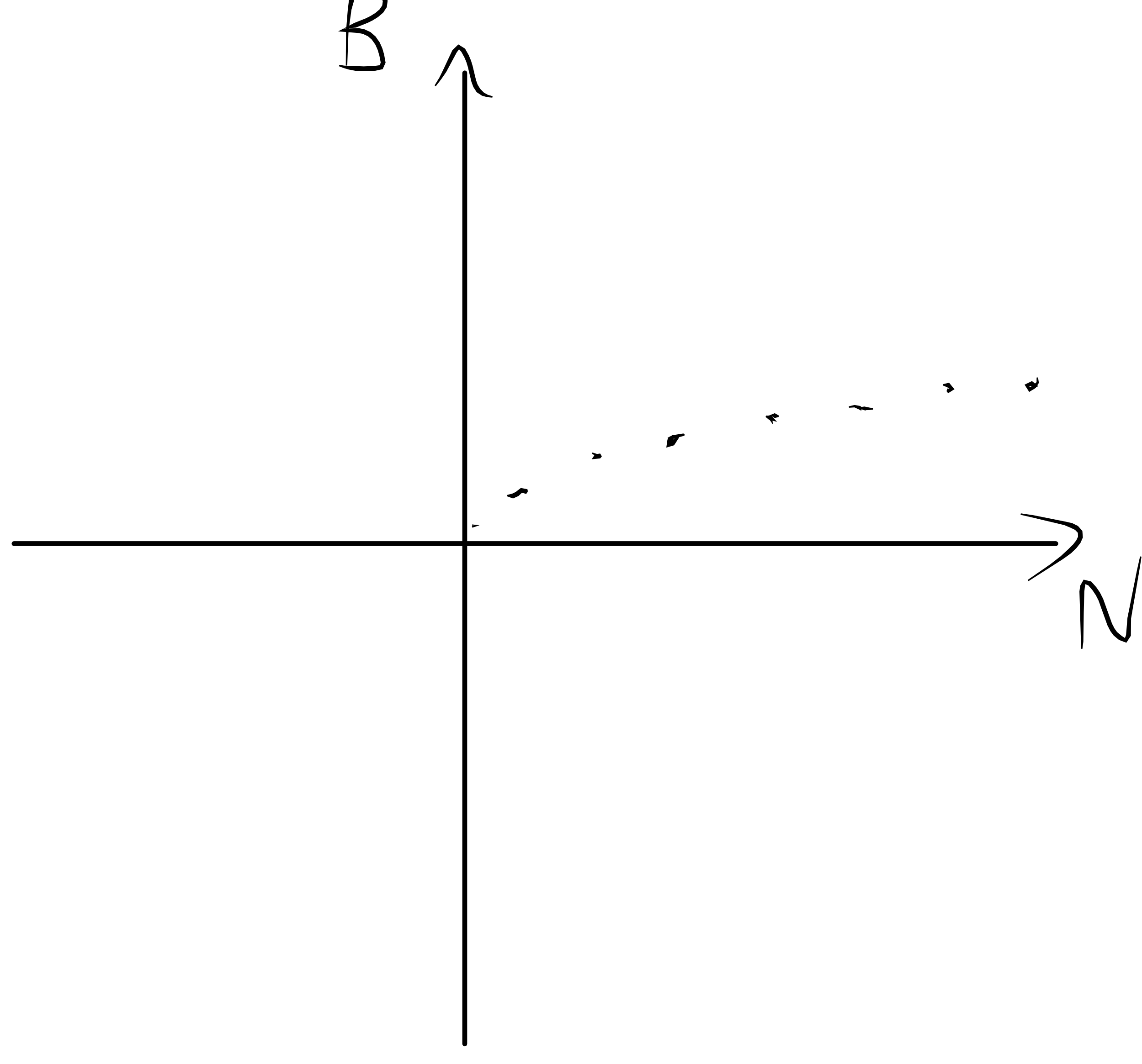
$$d\bar{l} = \left(\left(r_0 + \frac{a}{2\pi}\varphi\right)\hat{e}_\varphi + \frac{a}{2\pi}\bar{e}_r\right)d\varphi = d\varphi \begin{bmatrix} \frac{a}{2\pi} \\ r_0 + \frac{a}{2\pi}\varphi \\ 0 \end{bmatrix}_{r,\varphi,z}$$

$$d\bar{l} \times \bar{r} = d\varphi \begin{bmatrix} \frac{a}{2\pi} \\ r_0 + \frac{a}{2\pi}\varphi \\ 0 \end{bmatrix} \times \begin{bmatrix} -r_0 - \frac{a}{2\pi}\varphi \\ 0 \\ 0 \end{bmatrix} = \left(r_0 + \frac{a}{2\pi}\varphi\right)^2 d\varphi\, \hat{e}_z$$

$$B = \frac{\mu_0 I}{4\pi} \int_0^{2\pi N} \frac{\left(r_0 + \frac{a}{2\pi}\varphi\right)^2 d\varphi}{\left(r_0 + \frac{a}{2\pi}\varphi\right)^3} =$$

$$= \frac{\mu_0 I}{4\pi} \int_0^{2\pi N} \frac{d\varphi}{r_0 + \frac{a}{2\pi}\varphi} = \frac{\mu_0 I}{4\pi} \cdot \frac{2\pi}{a}\left(\ln\left(r_0 + aN\right) - \ln\left(r_0\right)\right) =$$

$$= \frac{\mu_0 I}{2a} \ln\left(1 + \frac{aN}{r_0}\right)$$



Dla danych z zadania:

$B \approx 0{,}29\ mT$