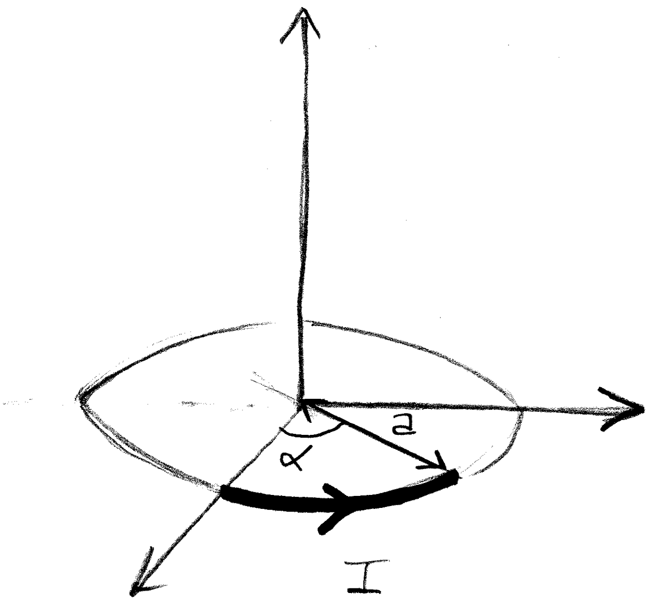
3.9. Calcular el campo magnético creado por un arco de circunferencia de 45° y de 10 cm de radio por el que circula una corriente de 2 A en su centro de curvatura.



$I = 2\,A$

$\alpha = 45^\circ$

$a = 10\ \text{cm}$

$\vec B(\underbrace{0,0,0}_{\vec r})$ ¿?

Usando $\vec B(\vec r) = \frac{\mu_0}{4\pi}\int \frac{I\, d\vec l' \times \vec R}{R^3}$

$\vec r' = (a\cos\phi', a\,\text{sen}\,\phi', 0) \longrightarrow d\vec l' = a\,d\phi'\,\vec u_{\phi'}$

$\vec R = \vec r - \vec r' = (-a\cos\phi', -a\,\text{sen}\,\phi', 0) \rightarrow R = a$

$$\vec{dl}' \times \vec{R} = \overbrace{\begin{vmatrix} \vec{u}_x & \vec{u}_y & \vec{u}_z \\ -\text{sen}\phi' & \cos\phi' & 0 \\ -\cos\phi' & -\text{sen}\phi' & 0 \end{vmatrix}}^{\vec{u}_z} a^2 d\phi'$$

$$\vec{u}_{\phi'} = -\text{sen}\phi' \, \vec{u}_x + \cos\phi' \, \vec{u}_y$$

$$= a^2 d\phi' \, \vec{u}_z$$

$$\vec{B}(0,0,0) = \frac{\mu_0}{4\pi} I a^2 \frac{1}{a^3} \underbrace{\int_0^{\alpha} d\phi'}_{\alpha = \pi/4 \text{ rd } (=45^\circ)} \vec{u}_z$$

$$= \underbrace{\frac{\mu_0}{4\pi}}_{10^{-7} \frac{N}{A^2}} \frac{\overset{2\,A}{I}\,\alpha}{\underset{0.1\,m}{a}} \vec{u}_z$$

$$= \left(5\pi \times 10^{-7} \frac{N}{A \cdot m}\right) \vec{u}_z$$

$$= \left(1.57 \times 10^{-6}\, T\right) \vec{u}_z$$