Ph
TDS

Electromagnétisme
Grandeurs électrocinétique

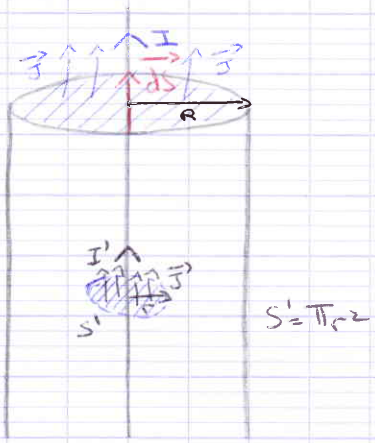
Exercice 1

1a. $\vec{J}$ uniforme $\Rightarrow$ J = cste

$$I_{total} = \iint_S J \times dS \times \cos(0°) = J \times \iint_S dS$$

S totale traversé par I

$$I_{total} = J \times \pi R^2$$



A.N. : $I_{total} = 10^4 \times \pi \times (2 \times 10^{-2})^2$

$= 10^4 \times \pi \times 4 \times 10^{-4}$

$= 4\pi \simeq 12{,}56\ A$

b. I' traverse S' de rayon r

$$I' = J \times \pi r^2 \quad (J \text{ uniforme})$$

2. $J(r) = J_0 \left(1 - \frac{r^2}{R^2}\right)$

a. $$I_{total} = \int_0^{2\pi}\int_0^R J_0 \left(1 - \frac{r^2}{R^2}\right) r\, dr\, d\theta$$

$$= J_0 \int_0^{2\pi} d\theta \int_0^R \left(r - \frac{r^3}{R^2}\right) dr$$

$$= J_0 \times 2\pi \times \left[\frac{r^2}{2} - \frac{r^4}{4R^2}\right]_0^R$$

$$= J_0 \times 2\pi \times \left(\frac{R^2}{2} - \frac{R^4}{4R^2}\right)$$

$$= 2\pi J_0 \times R^2 \left(\frac{1}{2} - \frac{1}{4}\right)$$

$$I_{total} = \frac{2\pi J_0 R^2}{2}$$

A.N. : $I_{total} = 2\pi \simeq 6,28\ A$

b. I' traverse S' de rayon r (on intègre de $0 \to r$ $(r < R)$)

$$I = 2\pi J_0 \left(\frac{r^2}{2} - \frac{r^4}{4R^2} \right)$$

Exercice 2.

1. $\rho = \frac{1}{\sigma} = \frac{1}{2 \times 10^7} = 0,5 \times 10^{-7}\ \Omega m$

$$R = \rho \times \frac{L}{S}$$

$$= \frac{1}{2} \times 10^{-7} \times \frac{1}{2 \times 10^{-6}}$$

$$= \frac{1}{4} \times 10^{-1}$$

$$= 25 \times 10^{-3}\ \Omega = 25\ m\Omega$$

2. $U = R \times I$

$= 25 \times 10^{-3} \times 10$

$= 25 \times 10^{-2}\ V$

$= 0,25\ V$

$U = E \times L \Rightarrow E = \frac{U}{L}$

$E = \frac{0,25}{1} = 0,25\ V.m^{-1}$

3. $\vec{J}$ uniforme $\Rightarrow J = cste$

$\Rightarrow I = J \times S \iff J = \frac{I}{S}$

$$J = \frac{10}{2 \times 10^{-6}} = 5 \times 10^6\ A.m^{-2}$$

4. $J = n\,|q|\,\langle v \rangle \iff n = \frac{J}{|q|\,\langle v \rangle}$

$$n_e = \frac{5 \times 10^6}{1,6 \times 10^{-19} \times 10^{-1}}$$

$$= \frac{5}{1,6} \times 10^6 \times 10^{20} = 3,125 \times 10^{26}\ m^{-3}$$