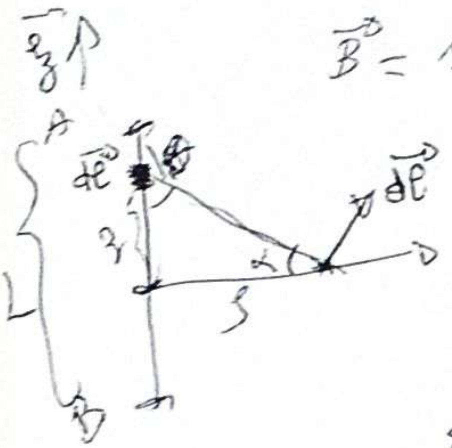
حل النموذجي لمقياس الكهرومغناطيس

ت 01: لدينا (1)



$$\vec{B} = \frac{\mu_0 I}{4\pi}\oint \frac{\vec{dl}\wedge\vec{r}}{r^3}$$ (1P)

$$\vec{dl} = dz\,\vec{e_z}\ ;\quad \cos\alpha = \frac{\rho}{r} \Rightarrow r = \frac{\rho}{\cos\alpha}$$

$$\vec{dl}\wedge\vec{r} = dz\, r\sin\theta\ \vec{e_\theta}$$

ولدينا: $\theta = \frac{\pi}{2}+\alpha \Leftarrow \sin\theta = \cos\alpha$ (2P)

$$\Rightarrow \vec{B} = \frac{\mu_0 I}{4\pi}\int \frac{dz\, r\sin\theta}{r^3} = \frac{\mu_0 I}{4\pi}\int \frac{dz\cos\alpha}{\frac{\rho^2}{\cos^2\alpha}}\vec{e_\theta}$$

و لدينا: $tg\alpha = \frac{z}{\rho} \Rightarrow z = \rho\, tg\alpha$

$$\Rightarrow dz = \frac{\rho\, d\alpha}{\cos^2\alpha}$$ (1P)

$$\Rightarrow \vec{B} = \frac{\mu_0 I}{4\pi}\int \frac{\rho\cos\alpha\, d\alpha}{\frac{\rho^2}{\cos^2\alpha}\cos^2\alpha}\vec{e_\theta} = \frac{\mu_0 I}{4\pi}\int_{\alpha_1}^{\alpha_2}\frac{\cos\alpha\, d\alpha}{\rho}\vec{e_\theta}$$

$$\Rightarrow \boxed{\vec{B}(M) = \frac{\mu_0 I}{4\pi\rho}\left[\sin(\alpha_2) - \sin(\alpha_1)\right]\vec{e_\theta}}$$ (1P)

$$\sin\alpha_1 = \frac{L/2}{\sqrt{\left(\frac{L}{2}\right)^2+\rho^2}}\ ,\quad \sin\alpha_2 = \frac{-L/2}{\sqrt{\left(\frac{L}{2}\right)^2+\rho^2}}$$

2/ لما كان A و B يؤولان للانهاية؛

$$\left.\begin{array}{l} A \to +\infty \Rightarrow \alpha \to \frac{\pi}{2} \\ B \to -\infty \Rightarrow \alpha \to -\frac{\pi}{2}\end{array}\right\} \Rightarrow \vec{B}(M) = \frac{\mu_0 I}{4\pi\rho}\left[(1)-(-1)\right]\vec{e_\theta}$$ (1P)

$$\Rightarrow \boxed{\vec{B}(M) = \frac{\mu_0 I}{2\pi\rho}\vec{e_\theta}}$$ (1P)

3- كتابة عبارة $\vec{B}$ بإستعمال قانون آمبير

لدينا:

(1) $\oint \vec{B} \cdot \vec{dl} = \mu_0 \sum I$

(1) $\Rightarrow B \cdot 2\pi \rho = \mu_0 I$

$\Rightarrow B = \frac{\mu_0 I}{2\pi\rho} \Rightarrow \boxed{\vec{B} = \frac{\mu_0 I}{2\pi\rho} \vec{e_\theta}}$

ت 2:

أ)

$\vec{B} = B_0 \cos(\omega t - ky) \vec{i}$

- اتجاه الإنتشار هو المحور (Oy)
- سرعة الانتشار:

$\boxed{v = \frac{\omega}{k}} \quad k = \frac{\omega}{v}$

- اتجاه الحقل $\vec{B}$ هو المحور (Ox)

ب) عبارة الحقل:

لدينا:

(2p) $\vec{rot}\,\vec{B} = \mu_0 \varepsilon_0 \frac{\partial \vec{E}}{\partial t}$

(1p) $\Rightarrow \vec{E} = \frac{1}{\mu_0\varepsilon_0} \int \vec{rot}\,\vec{B}\, dt$

(2p) $\vec{rot}\,\vec{B} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial_x & \partial_y & \partial_z \\ B_x & 0 & 0 \end{vmatrix} = \frac{\partial B_x}{\partial z} \vec{j} - \frac{\partial B_x}{\partial y} \vec{k}$

$\vec{rot}\,\vec{B} = + B_0 k \sin(\omega t - ky) \vec{k}$ (1p)

$\Rightarrow \vec{E} = \frac{1}{\mu_0\varepsilon_0} \int - B_0 k \sin(\omega t - ky) \vec{k}\, dt$

$\boxed{\vec{E} = \frac{B_0 k}{\mu_0 \varepsilon_0 \omega} \sin(\omega t - ky) \vec{k}}$ (1p)