exercice 1

① l'équation de propagation : $\frac{\partial^2 \vec{E}}{\partial z^2} - \frac{1}{c^2}\frac{\partial^2 \vec{E}}{\partial t^2} = 0$

$$\Rightarrow \begin{cases} -E_0 k^2 \cos\alpha \cos(\omega t - kz) + E_0 \frac{\omega^2}{c^2}\cos(\omega t - kz) = 0 \\ -E_0 k^2 \sin\alpha \sin(\omega t - kz + \varphi) + E_0 \frac{\omega^2}{c^2}\sin(\alpha)\sin(\omega t - kz + \varphi) = 0 \\ 0 \end{cases}$$

$$\Rightarrow \begin{cases} k^2 = \frac{\omega^2}{c^2} \\ k^2 = \frac{\omega^2}{c^2} \\ 0 \end{cases} \Rightarrow k^2 = \frac{\omega^2}{c^2} \Rightarrow k = \frac{\omega}{c}$$

La condition necessaire pour que $\vec{E}$ soit une solution de l'équation de propagation d'onde : $k = \frac{\omega}{c}$

② polarisation rectiligne :

α : quelconque

$\cos(\omega t - kz) = \sin(\omega t - kz + \varphi) = \cos(\omega t - kz + \varphi - \frac{\pi}{2})$

$\Rightarrow \varphi - \frac{\pi}{2} = m\pi$ $\quad \varphi = \frac{\pi}{2} + m\pi$

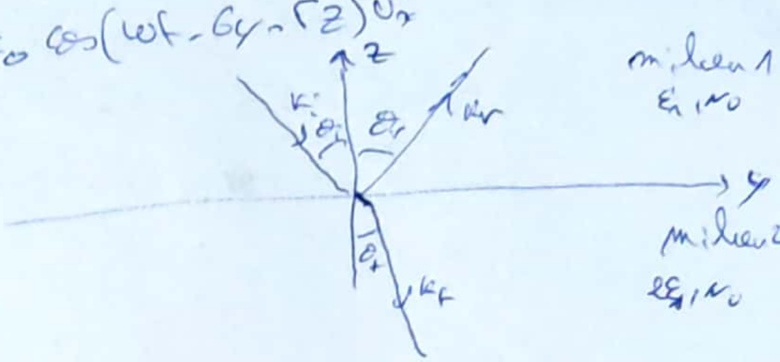
- polarisation circulaire $\Rightarrow$ " $E_{0x} = E_{0y}$ " $\Rightarrow$

$\Rightarrow |E_0 \cos(\alpha)| = |E_0 \sin(\alpha)| \Rightarrow \alpha = \frac{\pi}{4}$

$\varphi - \frac{\pi}{2} = (2m+1)\frac{\pi}{2}$ $\quad \varphi = (m+1)\pi$

Exercice 2 (sujet 1)

onde incidente présentée par $\vec{E} = E_0 \cos(\omega t - 6y - 5z)\vec{u_x}$



$\tan\theta_i = \frac{k_y}{k_z} = \frac{-6}{-5} = 1{,}2$

$\theta_i = 50{,}19°$

$\theta_i = \theta_r = 50{,}19$

$n_1 \sin\theta_i = n_2 \sin\theta_t \Rightarrow \theta_t = \arcsin\left(\frac{n_1}{n_2}\sin\theta_i\right) = \arcsin\left(\frac{1}{\sqrt{2}}\, 0{,}76\right)$

$\varepsilon_{milieu1} = \varepsilon_1 = \varepsilon_{r1}\varepsilon_0 \Rightarrow \varepsilon_{r1} = \frac{\varepsilon_1}{\varepsilon_0} \qquad n_1 = \sqrt{\varepsilon_{r1}} = \sqrt{\frac{\varepsilon_1}{\varepsilon_0}}$

$\varepsilon_{milieu2} = 2\varepsilon_1 = \varepsilon_{r2}\varepsilon_0 \Rightarrow \varepsilon_{r2} = \frac{2\varepsilon_1}{\varepsilon_0} \qquad n_2 = \sqrt{\frac{2\varepsilon_1}{\varepsilon_0}} = \sqrt{2}\sqrt{\frac{\varepsilon_1}{\varepsilon_0}}$

$\theta_t = \arcsin(0{,}53) \Rightarrow \theta_t = 32{,}50°$

coefficient de réflexion

$$r_\perp = \frac{n_1\cos\theta_i - n_2\cos\theta_t}{n_1\cos\theta_i + n_2\cos\theta_t} = \frac{\cos\theta_i - \sqrt{2}\cos\theta_t}{\cos\theta_i + \sqrt{2}\cos\theta_t} = \frac{0{,}64 - \sqrt{2}\; 0{,}84}{0{,}64 + \sqrt{2}\; 0{,}84} = \frac{-0{,}54}{1{,}82}$$

$r_\perp = -0{,}29$

Exo2 sujet 2

onde incidente représentée par: $\vec{E} = E_0 \cos(\omega t - 5y - 2z)\vec{u_x}$

$\tan\theta_i = \frac{k_y}{k_z} = \frac{-5}{-2} = 2{,}5 \Rightarrow \theta_i = \arctan(2{,}5)$ $\quad \theta_i = 68{,}19$

$\theta_r = \theta_i = 68{,}19$

$\theta_t = \arcsin\left(\frac{n_1}{n_2}\sin\theta_i\right) = \arcsin\left(\frac{1}{\sqrt{2}} \cdot 0{,}92\right)$ $\quad \theta_t = 41{,}03$

coefficient de transmission

$$t_\perp = \frac{2n_1\cos\theta_i}{n_1\cos\theta_i + n_2\cos\theta_t} = \frac{2 \times 0{,}37}{0{,}37 + \sqrt{2} \cdot 0{,}75} = \frac{0{,}74}{1{,}43}$$

$t_\perp = 0{,}51$