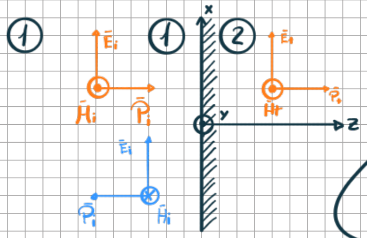
① 

$E_i + E_r = E_t$ $\quad$ $H_i + H_r = H_t$

$2E_i = E_t\left(1+\frac{Z_1}{Z_2}\right)$

$\mu = 4\pi \cdot 10^{-7}$

$\varepsilon = 8{,}85 \cdot 10^{-12}$

$Z_1 = \sqrt{\frac{\mu_1}{\varepsilon_1}}$ $\quad$ $Z_2 = \sqrt{\frac{\mu_2}{\varepsilon_2}}$

$Z_1 = 133\,\Omega$ $\quad$ $Z_2 = 377\,\Omega$

$\frac{2E_i}{1+352{,}8m} = \frac{2 \cdot 1{,}5\frac{mV}{m}}{1{,}3528} = \boxed{2{,}218 \cdot 10^{-3}\frac{V}{m} = E_t}$

Γ_E = Indice de reflexión $_{(E)}$: $\frac{Z_2 - Z_1}{Z_1 + Z_2}$

T_E = Indice de transmisión $_{(E)}$: $\frac{2Z_2}{Z_2 + Z_1}$

$1 + \Gamma_E = T_E$

$E_r = E_t - E_i = 718\mu\frac{V}{m} = E_r$

$|H_i| = \frac{|E_i|}{Z_1}$

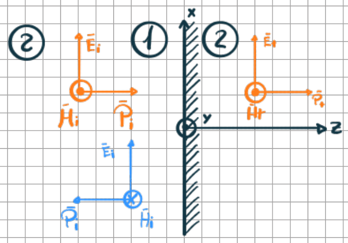
$|H_i| = 11{,}27\mu$

$|H_t| = 5{,}88\mu$

$|H_r| = 5{,}39\mu$

T_H = Coeficiente transmisión H: $\frac{2Z_1}{Z_1 + Z_2}$

Γ_H = Coeficiente reflexión H: $\frac{Z_1 - Z_2}{Z_1 + Z_2}$

② 

$E_i = 1\frac{V}{m}$

$H_r = -1{,}41 \cdot 10^{-3}\frac{A}{m}$

Medio 2: $\sigma_2 = 0$, $\varepsilon_{r2} = 18{,}5$, $\mu_{r2} = ?$

$|E_r| = |H_r| \cdot Z_1$

$|E_r| = 1{,}41m\sqrt{\frac{\mu_{r1}}{\varepsilon_{r1}}} = -531{,}57m\,\frac{V}{m}$

$|H_i| = \frac{|E_i|}{Z_1} = 2{,}65m\,\frac{A}{m}$

$E_i + E_r = E_t = 469m\,\frac{V}{m}$

$H_i + H_r = H_T = 1{,}243m\,\frac{A}{m}$

$|H_t| = \frac{|E_t|}{Z_2} \rightarrow Z_2 =$

$Z = 0 \rightarrow$ NO es el caso

OTRA FORMA

$E_r = \Gamma_E \cdot E_i$

$\frac{E_r}{E_i} = \Gamma_E = \frac{Z_2 - Z_1}{Z_2 + Z_1} = -531m$

$Z_2 - Z_1 = Z_2\,531m - Z_1\,531m$

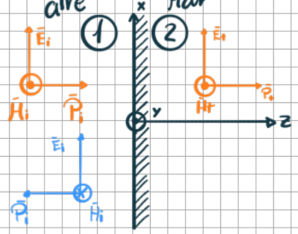
$Z_2 + Z_2 \cdot 531m = -200 + 377$

$Z_2 = \frac{176{,}8}{1+531m} = 115{,}49 = \sqrt{\frac{\mu_2}{\varepsilon_2}} \rightarrow 2{,}184\mu = \mu_2$

$\rightarrow \mu_{r2} = 1{,}737$

③ $E_i = 1\frac{V}{m}$ $\quad$ $\varepsilon_r = 80$

$\sigma_2 = 2{,}5\,S/m$ $\quad$ $f = 30MHz$



$Z_2 = \sqrt{\frac{j\omega \cdot \mu_2}{\sigma + j\omega\varepsilon_2}}$

$Z_2 = \sqrt{\frac{j2\pi f \cdot \mu}{\sigma + j2\pi f \cdot \varepsilon_2}} = \sqrt{5 + 94{,}5j} = \sqrt{94{,}6 \angle 1{,}52} = 9{,}72 \angle 760m = 7{,}045 + 6{,}696j = Z_2 \longrightarrow |Z_2| = 9{,}719$

$\vec{E}_T = \hat{x}\,E_t\,e^{-j\beta_2 z}\,e^{\alpha z}$

$\alpha + j\beta = \sqrt{j\omega\mu(\sigma + j\omega\varepsilon)}$

$|E_t| = |T||E_i| = 50m \cdot 1\frac{V}{m} = |50m\frac{V}{m}| = E_t$

Yo solo quiero el módulo

$\rightarrow |E_t| = \hat{x} \cdot |E_t| \cdot e^{-\alpha z}$

$\alpha + j\beta = \sqrt{j\omega\mu\sigma - \omega^2\mu\varepsilon}$

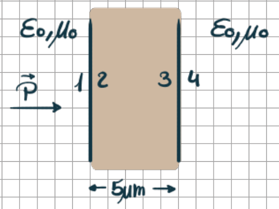
$1m\frac{V}{m} = 50m\frac{V}{m} \cdot e^{-16{,}79 \cdot z}$

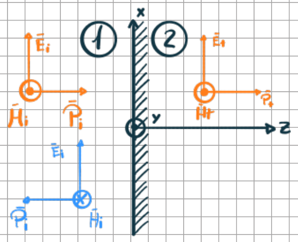
$\alpha =$

$\frac{\ln(20m)}{-16{,}79} = z = 232{,}9\,mm$

$j\beta =$

④ $E_{i0} = 100\ V/m$ $\sigma_2 = 61{,}7 \cdot 10^6\ S/m$ $f = 200M$





Buen conductor? $\frac{\sigma}{\omega\varepsilon} = \frac{61{,}7\cdot10^6}{2\pi\cdot200M\cdot\varepsilon_0} = 5{,}54G \gg 1$ ✓ Buen conductor!

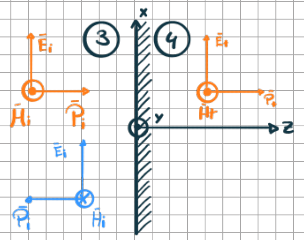
$\left.\begin{array}{l} \Rightarrow \alpha = \beta = \sqrt{\frac{\omega\sigma\mu}{2}} \\ Z = \eta = (1+j)\frac{\alpha}{\sigma} \end{array}\right\}$ Buen conductor

$\alpha = \beta = 220{,}72K$

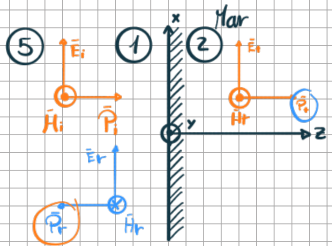
$\eta = 3{,}577m + 3{,}577mj \longrightarrow |\eta| = 5{,}059m\ \Omega$

$E_r = E_r e^{-j\beta z} e^{-\alpha z} \xrightarrow[\text{amplitud}]{\text{solo quiero}} 2{,}684m \cdot e^{-220{,}72K\cdot 5\mu} = E_{T_3} = 890\mu$

$|E_t| = |E_i|\,|T| = E_i \cdot \frac{2\eta_2}{\eta_2+\eta_1} = 2{,}684m = E_{T_2}$



$|E_t| = |T|\,|E_i| = 890\mu \cdot \frac{2\cdot377}{377+5m} = 1{,}78m\frac{V}{m} = E_{T_4}$



$\left.\begin{array}{l} \sigma = 4\ S/m \\ \varepsilon_r = 81 \\ \mu_r = 1 \end{array}\right\}$ Buen conductor? $= \frac{\sigma}{\varepsilon\cdot\omega} = 888$

$\langle \vec{P} \rangle = \frac{E_0 H_0}{2}\cos(\phi_e - \phi_m)\,\hat{z}$

$\angle\eta$

$\alpha = \beta = \sqrt{\frac{\omega\sigma\mu}{2}} = 3{,}97$

$\eta = (1+j)\frac{\alpha}{\sigma} = 0{,}992 + 0{,}992j = 1{,}4\angle\frac{\pi}{4}$

Coef transmisión: $\frac{2\eta_2}{\eta_1+\eta_2} = 5{,}26m + 5{,}2mj \longrightarrow |T| = 7{,}423m$

Coef reflexión: $\frac{\eta_2-\eta_1}{\eta_2+\eta_1} = -0{,}994 + 5{,}2mj \longrightarrow |\Gamma| = 0{,}995$

$E_T = T \cdot E_i$ $E = \frac{H}{\eta}$

$E_r = \Gamma \cdot E_i$

$P_i = \frac{E_i^2}{2\eta_1}\cdot\cos(0) = \frac{E_i^2}{2\eta}$

$P_r = \frac{E_r^2}{2\eta_1}\cdot\cos(0) = \frac{E_r^2}{2\eta}$

$P_T = \frac{E_T^2}{2\eta_2}\cos(\angle\eta_2) = \frac{(E_i T)^2}{2\eta_2}\frac{\sqrt{2}}{2} = \frac{E_i^2 T^2}{2\eta_2}\cdot\frac{\eta_1}{\eta_1}\frac{\sqrt{2}}{2} = P_i\frac{T^2}{\eta_2}\cdot\eta_1\frac{\sqrt{2}}{2} = P_T$

P_i

CHEQUEAR

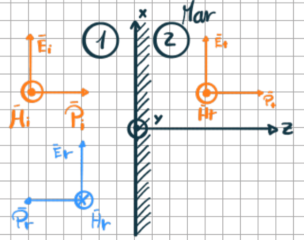
$f = 10GHz$

Tangente de pérdidas: $\frac{\sigma}{\omega\cdot\varepsilon} = 88{,}8m \approx 1$

$\eta = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\varepsilon}} = \sqrt{1{,}746\angle88} = 41{,}79\angle44 = 41{,}79$

Terminar

⑥ $E_{io} = 100\,V/m$ $f = 500M$



Tangente de pérdidas: $\tan(\delta) = \frac{\sigma}{\omega\varepsilon} = 0{,}3 \ll 1$

ⓐ

$0{,}3 \cdot \omega \cdot \varepsilon = \sigma = 18{,}76\,m\,\frac{S}{m}$

$$\Gamma = \frac{Z_2 - Z_1}{Z_2 + Z_1}$$

$$Z_2 = \eta_2 = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\varepsilon}} \sqrt{57{,}9k + 17{,}31\,\cancel{y}\,j} = \sqrt{60{,}5k \angle 0{,}29} = 245{,}886 \angle 0{,}145 = 243{,}3 + 35{,}5j$$

$$\Gamma = -211{,}6m + 69{,}3j = 222{,}6m \angle 2{,}82 \longrightarrow |\Gamma| = 222{,}6m$$

$$T =$$

ⓑ Relación de onda estacionaria: $\frac{|E|max}{|E|min} = \frac{1 + |\Gamma|}{1 - |\Gamma|} = \frac{1{,}2226}{0{,}7774} = 1{,}572 = R_{OE}$

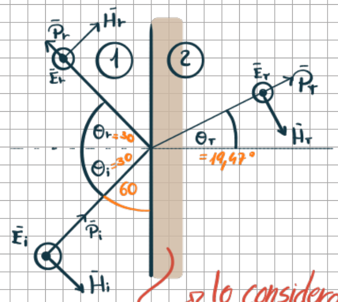
$\Gamma > 0 \begin{cases} \text{Ubicación 1° max: } 2\beta_1 \cdot Z_{MAX} = -2\overset{0}{m}\pi \\ \text{Ubicación 1° mín: } 2\beta_1 Z_{MIN} = -(2\overset{0}{m}+1)\pi \end{cases}$ AL REVES SI $\Gamma < 0$

$\beta = \frac{\omega}{c}$ en medio libre

Falta amplitud

$Z_{MIN} = 0$ $Z_{MAX} = \frac{-\pi}{2\beta} = -0{,}942m$

⑧



¿lo considero dielectrico?

$E_T = 20\,\frac{V}{m}$ ① $\varepsilon_{r_1} = 1$, $\mu_{r_1} = 1$

$f = 100MHz$ ② $\varepsilon_{r_2} = 2{,}25$, $\mu_{r_2} = 1$

$\theta_i = 30°$

$E_T = T \cdot E_i \longrightarrow E_T/E_i = T$

$E_r = \Gamma \cdot E_i \longrightarrow E_r/E_i = \Gamma$

CHEQUEAR DE DONDE SALE!

$$E_r = E_i \cdot \left(\frac{-Z_1 \cos(\theta_t) + Z_2 \cos(\theta_i)}{Z_1 \cos(\theta_t) + Z_2 \cos(\theta_i)} \right)$$

$\beta(\text{Vacío}) = \omega\sqrt{\mu_0\,\varepsilon_0}$

$\beta(\text{generalizado}) = \omega \sqrt{\frac{\mu\varepsilon}{2}\left[\sqrt{1 + \left(\frac{\sigma}{\omega\varepsilon}\right)^2} - 1\right]}$

$\beta(\text{dielectrico}) = \frac{\omega}{c}$

Tangente de pérdidas: $\frac{\overset{0}{\sigma}}{\omega \cdot \varepsilon} = 0$ dielectrico ideal

$\beta_1 \operatorname{sen}(\theta_i) = \beta_2 \operatorname{sen}(\theta_t)$

$\beta_2 = \frac{\omega}{c} = \pi$ $\beta_1 = \frac{2\pi}{3}$

RARO

$\operatorname{sen}^{-1}\left(\frac{\beta_1}{\beta_2}\operatorname{sen}(\theta_i)\right) = \theta_t$

$\theta_t = 19{,}47°$

$\eta_1 = 377\,\Omega$

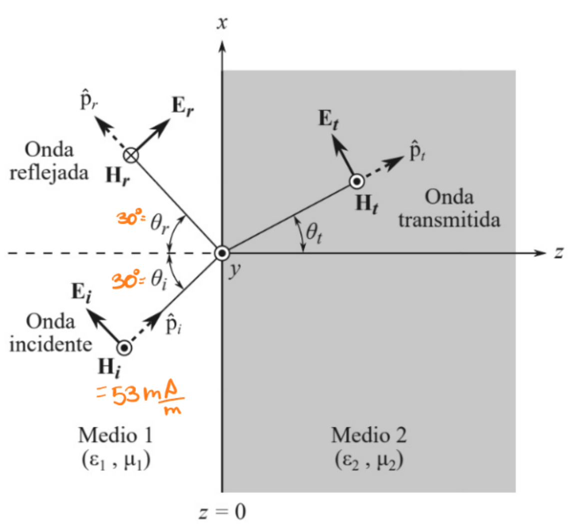
$\eta_2 =$ con generalizada $= 251$
con dielectrico $= \sqrt{\frac{\mu}{\varepsilon}} = 251$

$$E_r = E_i \cdot \left(\frac{-Z_1 \cos(\theta_t) + Z_2 \cos(\theta_i)}{Z_1 \cos(\theta_t) + Z_2 \cos(\theta_i)} \right)$$

$E_r = E_i\,\Gamma = E_i \cdot (-0{,}547) \longrightarrow \Gamma = -0{,}547$

$E_T = E_i \left(\frac{2\eta_2 \cos(\theta_i)}{\eta_2 \cos(\theta_i) + \eta_1 \cos(\theta_t)} \right) = E_i \cdot 0{,}759 \to T = 0{,}759$

⑨ Una onda plana uniforme con polarización paralela incide oblicuamente sobre la superficie de separación entre 2 medios con $\varepsilon_{r1} = 1$, $\varepsilon_{r2} = 2,25$, $\mu_{r1} = \mu_{r2} = 1$, como puede verse en la figura.



Considerando que la amplitud del campo magnético **E** de la onda incidente es de 0,053 A/m, la frecuencia de 100 MHz y el ángulo de incidencia es de 30 °, calcular los coeficientes de reflexión $\Gamma_{\parallel}$ y transmisión $T_{\parallel}$.

$H_i = \frac{E_i}{|\eta_1|}$

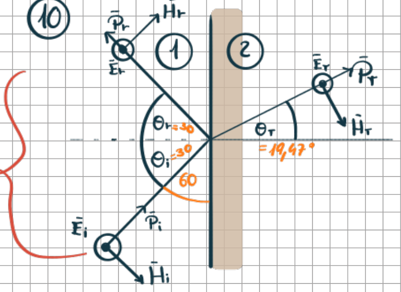
$0{,}053\,\frac{A}{m} \cdot 377\,\Omega = E_i = 19{,}981$

$$\left(\frac{2\eta_2 \cos(\theta_i)}{\eta_2 \cos(\theta_i) + \eta_1 \cos(\theta_t)} \right) = T$$

$$\left(\frac{-Z_1 \cos(\theta_t) + Z_2 \cos(\theta_i)}{Z_1 \cos(\theta_t) + Z_2 \cos(\theta_i)} \right) = \Gamma$$

$\beta_1 = \pi$ $\beta_2 = \frac{2}{3}\pi$

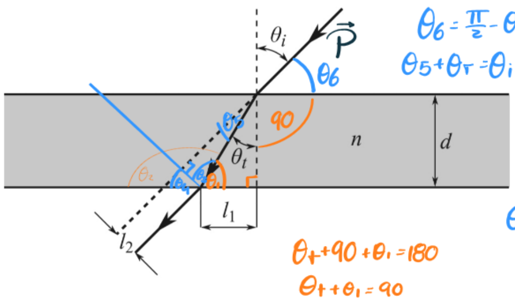
(10)



Potencia TOTAL RADIADA

$$W_T = \int_s \vec{E} \times \vec{H} \, d\vec{s} \quad (W)$$

(12) Un rayo de luz incide oblicuamente desde el aire sobre una lámina transparente de espesor d cuyo índice de refracción es n, como puede verse en la figura.



$\theta_6 = \frac{\pi}{2} - \theta_i$

$\theta_5 + \theta_r = \theta_i \Rightarrow \theta_5 = \theta_i - \theta_t$

$\theta_3 + \theta_4 = \frac{\pi}{2} + \theta_t \Rightarrow \theta_3 = \frac{\pi}{2} + \theta_t - \theta_4$

$\theta_t + 90 + \theta_1 = 180$

$\theta_t + \theta_1 = 90$

$\boxed{\theta_1 = \frac{\pi}{2} - \theta_t}$

$\theta_2 + \theta_1 = 180$

$\theta_2 = \pi - \frac{\pi}{2} + \theta_t$

$\boxed{\theta_2 = \frac{\pi}{2} + \theta_t}$

Para un ángulo de incidencia θ_i, obtener:

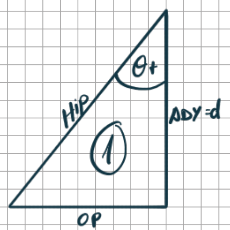
1) El ángulo de transmisión θ_t.
2) La distancia l_1 al punto de salida.
3) El desplazamiento lateral l_2 del rayo emergente.

Supongo polarización perpendicular.

$\beta_1 \cdot sen(\theta_i) = \beta_2 \, sen(\theta_t)$

$\theta_t = arcsen\left(\frac{\beta_1}{\beta_2} \cdot sen(\theta_i)\right)$

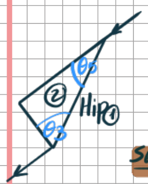
$\left.\begin{array}{l}\beta_1 = \\ \beta_2 = \end{array}\right\}$ Formula gral. $\omega = C$



Soh Cah Toa

$\frac{\tan(\theta_t)}{d} = l_1$

$\frac{\cos(\theta_t)}{d} = \frac{1}{Hip} \Rightarrow Hip = \frac{d}{\cos(\theta_t)}$



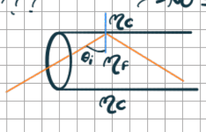
Soh Cah Toa

$\frac{sen(\theta_5)}{Hip_1} = l_2$

$\boxed{\frac{sen(\theta_i - \theta_t) \cdot \cos(\theta_t)}{d} = l_2}$

(13) Incide con ángulo crítico????

→ NO se transmite nada si $\theta_i \leqslant \theta_c$



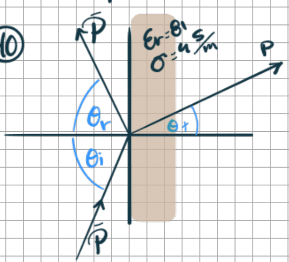
angulo crítico: $sen(\theta_c) = \frac{\eta_c}{\eta_f}$

① $\eta_2 < \eta_1 \rightarrow \eta_f > \eta_c \qquad \theta_i = \theta_c$

Como $\theta_i = \theta_c \Rightarrow$ no se transmite, todo se refleja

? Me pide E_T ...

(10)

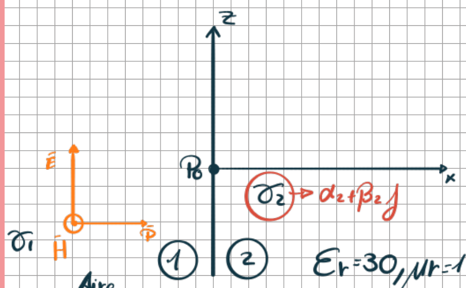


$\frac{\sigma}{\omega \varepsilon} = 0 \ll 1$

$\beta_1 \cdot sen(\theta_i) = \beta_2 \cdot sen(\theta_t)$

Parcial

ⓐ Calcular $\vec{E}_r, \vec{H}_r, \vec{P}_r$



$\varepsilon_r = 30, \mu_r = 1$
$\sigma = 100 \frac{S}{m}$

$\gamma = \sqrt{j\omega\mu(\sigma + j\omega\varepsilon)}$