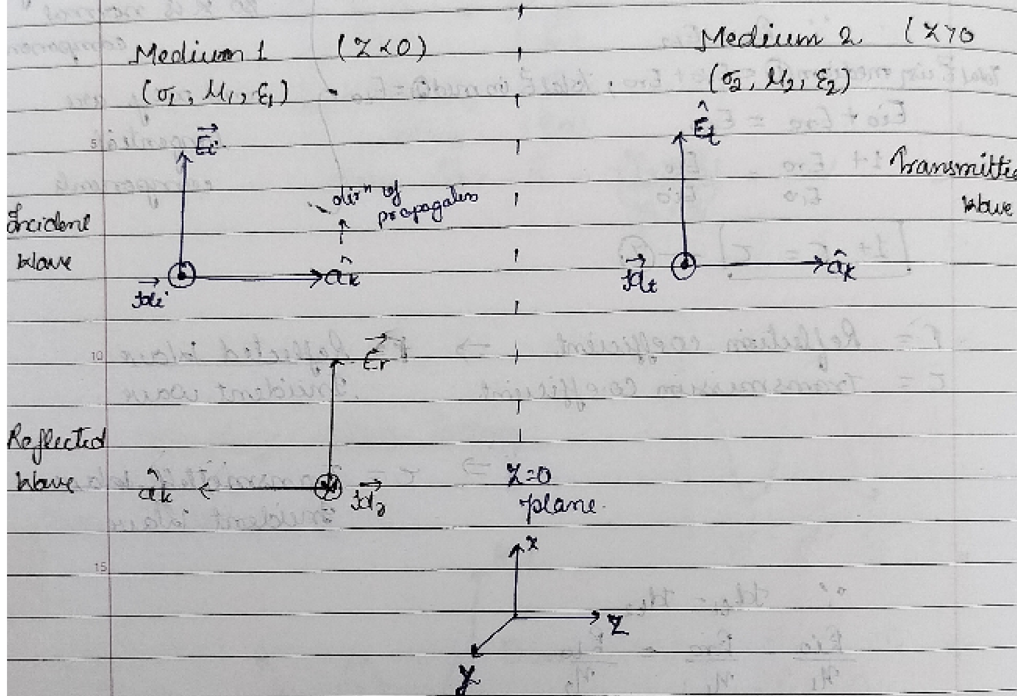
Reflection of Plane Wave at normal incidence:



Incident Wave:

$$\vec{E_{is}} = E_{io}\, e^{-\gamma_1 z}\, \hat{a_x} \quad \text{--- (1)}$$

$$\vec{H_{is}} = H_{io}\, e^{-\gamma_1 z}\, \hat{a_y} = \frac{E_{io}}{\eta_1} e^{-\gamma_1 z} \cdot \hat{a_y} \quad \text{--- (2)}$$

Reflected Wave:

$$\vec{E_{rs}} = E_{ro}\, e^{\gamma_1 z} \cdot \hat{a_x} \quad \text{--- (3)}$$

$$\vec{H_{rs}} = H_{ro} \cdot e^{\gamma_1 z} \cdot (-\hat{a_y}) = \frac{E_{ro}}{\eta_1} \cdot e^{\gamma_1 z} (-\hat{a_y}) \quad \text{--- (4)}$$

Transmitted Wave:

$$\vec{E_{ts}} = E_{to}\, e^{-\gamma_2 z}\, \hat{a_x} \quad \text{--- (5)}$$

$$\vec{H_{ts}} = H_{to} \cdot e^{-\gamma_2 z} \cdot \hat{a_y} = \frac{E_{to}}{\eta_2} \cdot e^{-\gamma_2 z}\, a_y \quad \text{--- (6)}$$

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(2)

Boundary Condition

$\because E_{t1} = E_{t2}$

Total $\vec{E}$ in medium (1) $= E_{i0} + E_{r0}$, Total $\vec{E}$ in med (2) $= E_{t0}$

$E_{i0} + E_{r0} = E_{t0}$

$1 + \frac{E_{r0}}{E_{i0}} = \frac{E_{t0}}{E_{i0}}$

$\boxed{1 + \Gamma = \tau}$ — (7)

$\because x = 0$ boundary so x is normal component and z & y are tangential components

Γ = Reflection coefficient $\Rightarrow \Gamma = \frac{\text{Reflected wave}}{\text{Incident wave}}$

τ = Transmission co-efficient $\Rightarrow \tau = \frac{\text{Transmitted wave}}{\text{Incident wave}}$

$\because H_{t1} = H_{t2}$

$\frac{E_{i0}}{\eta_1} - \frac{E_{r0}}{\eta_1} = \frac{E_{t0}}{\eta_2}$

$\Rightarrow E_{i0} - E_{r0} = \frac{\eta_1}{\eta_2} E_{t0}$

$\Rightarrow 1 - \frac{E_{r0}}{E_{i0}} = \frac{\eta_1}{\eta_2} \frac{E_{t0}}{E_{i0}}$

$\Rightarrow \boxed{1 - \Gamma = \frac{\eta_1}{\eta_2}\tau}$ — (8)

Add (7) and (8) eqn's.

$2 = \tau + \frac{\eta_1}{\eta_2}\tau$

$2 = \tau\left(1 + \frac{\eta_1}{\eta_2}\right)$

$\Rightarrow \boxed{\tau = \frac{2\eta_2}{\eta_2 + \eta_1}}$ (A)

putting eqn (A) in (7)

$1 + \Gamma = \tau$

$1 + \Gamma = \frac{2\eta_2}{\eta_2 + \eta_1}$

$\Gamma = \frac{2\eta_2}{\eta_2 + \eta_1} - 1$

$\boxed{\Gamma = \frac{\eta_2 - \eta_1}{\eta_2 + \eta_1}}$ — (B)

Standing Wave Ratio:

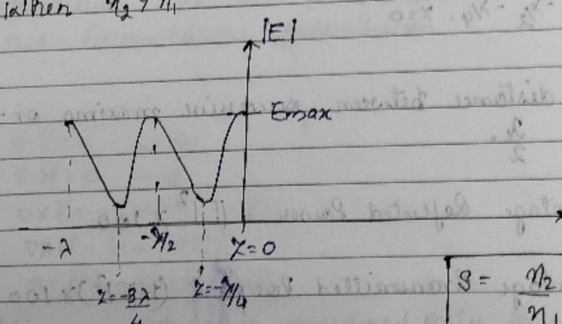
$$S_E = \frac{E_{max}}{E_{min}} = \frac{1+|\Gamma_E|}{1-|\Gamma_E|}$$

$$S_H = \frac{H_{max}}{H_{min}} = \frac{1+|\Gamma_H|}{1-|\Gamma_H|}$$

where $\Gamma_H = -\Gamma_E = -\frac{(\eta_2-\eta_1)}{\eta_2+\eta_1}$

Standing Wave Pattern:

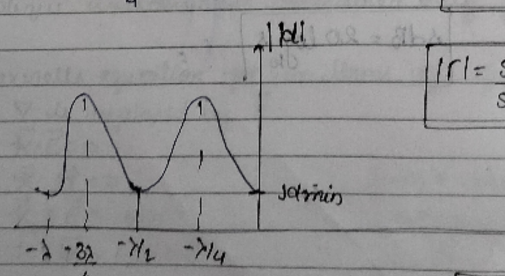
Case I: When $\eta_2 > \eta_1$



$$\boxed{S = \frac{\eta_2}{\eta_1}}$$

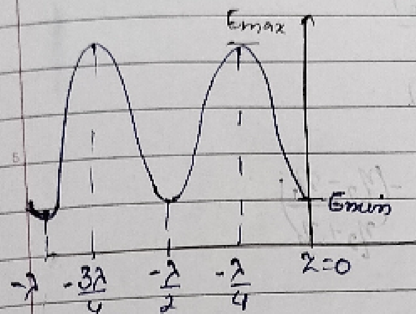
$$\boxed{|\Gamma| = \frac{S-1}{S+1}}$$

when Emax occurs at boundary or Hmin occurs at boundary.

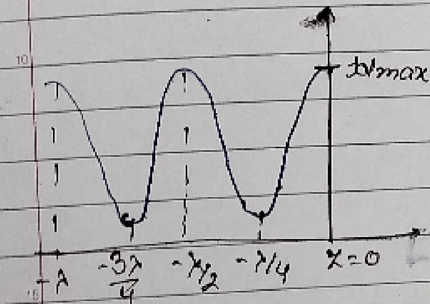


Range → $\boxed{\begin{matrix} -1 \leq \Gamma \leq 1 \\ 1 \leq S \leq \infty \end{matrix}}$

Case 2. $\eta_2 < \eta_1$



$$\boxed{S = \frac{\eta_1}{\eta_2}}$$



- The distance between successive maxima or minima is $\frac{\lambda}{2}$.
- Percentage Reflected Power $= |\Gamma|^2 \times 100$
- Percentage Transmitted Power $= (1-|\Gamma|^2) \times 100$

$$\boxed{S_{dB} = 20 \log_{10} S}$$