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Fresnel's Formulae for perpendicular to the plane of incidence :— Since, the electric vectors are all parallel to the boundary surface.

$$\left.\begin{aligned}(E_i)_t &= E_i\\ (E_R)_t &= E_R\\ (E_T)_t &= E_T\end{aligned}\right\} \text{ and } \begin{aligned}(H_t) &= -H_t \cos\theta_i\\ (H_R) &= H_R \cos\theta_R\\ (H_T)_t &= -H_T \cos\theta_T\end{aligned}$$

So, boundary conditions ③ and ④ reduces to

$$E_i + E_R = E_T \qquad \text{——— ⑤}$$

and $$H_i \cos\theta_t - H_R \cos\theta_R = H_T \cos\theta_T \qquad \text{——— ⑥}$$

Now, $\theta_i = \theta_R$ and $H = E/Z = n(E/Z_0)$

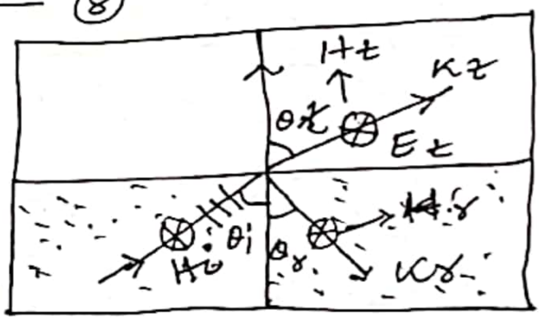
The equation ⑥ reduces as

$$n_1 E_T \cos\theta_i - n_1 E_R \cos\theta_i = n_2 E_t \cos\theta_T \qquad \text{——— ⑦}$$

Now, ~~eliminating E_R &~~ eliminating E_T from eq. (7) ~~and ⑤~~ with the help of eq. ⑤, we get

$$(E_i - E_R)\, n_1 \cos\theta_i = n_2 \cos\theta_T\,(E_i + E_R)$$

or, $$\left(\frac{E_R}{E_t}\right)_\perp = \frac{\cos\theta_t - \frac{n_2}{n_1}\cos\theta_t}{\cos\theta_t + \frac{n_2}{n_1}\cos\theta_T} \qquad \text{——— ⑧}$$



or, $$\left(\frac{E_R}{E_1}\right)_\perp = \frac{\cos\theta_i - \sin\theta_i/\sin\theta_T \times \cos\theta_T}{\cos\theta_i - \sin\theta_i/\sin\theta_T \cos\theta_T}$$

(as $n_1 \sin\theta_1 = n_2 \sin\theta_T$)

or, $$\left(\frac{E_R}{E_t}\right)_\perp = \frac{\sin\theta_T \cos\theta_t - \cos\theta_T \sin\theta_t}{\sin\theta_T \cos\theta_i + \cos\theta_T \sin\theta_i}$$

$$\therefore \left(\frac{E_R}{E_t}\right)_\perp = -\frac{\sin(\theta_i - \theta_T)}{\sin(\theta_i - \theta_T)} \qquad \text{——— ⑨}$$

similarly, eliminating E_R from eq. ⑦ with the help of eq. ⑤ we get

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$$\left(\frac{E_T}{E_i}\right)_\perp = \frac{2\cos\theta_i \sin\theta_T}{\sin(\theta_1 + \theta_T)} \qquad \text{——— ⑩}$$

The above equations ⑧, ⑨, and ⑩ are the desired results. It is known as Fresnel's formulae.