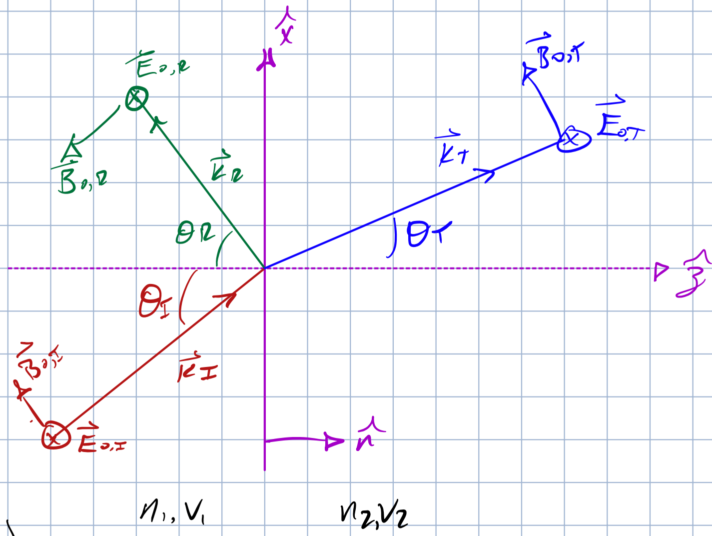
$$k_i = \frac{\omega}{v_i} = \frac{\omega}{c/n_i} = \frac{\omega n_i}{c}$$

$$c\,k_i = \omega n_i$$



$$\frac{1}{\mu_1}\left(\tilde{\vec{B}}_{0,I} + \tilde{\vec{B}}_{0,R}\right)\times\hat{n} = \frac{1}{\mu_2}\left(\tilde{\vec{B}}_{0,T}\right)\times\hat{n}$$

$$\tilde{\vec{B}}_0 = \frac{1}{v}\left(\hat{k}\times\vec{E}_0\right) = \frac{n}{ck}\left(\vec{k}\times\vec{E}_0\right)$$

$$\frac{1}{\mu_1}\left[\frac{n_1}{ck_I}\left(\vec{k}_I\times\vec{E}_{0,I}\right) + \frac{n_1}{ck_I}\left(\vec{k}_R\times\vec{E}_{0,R}\right)\right]\times\hat{n} = \frac{1}{\mu_2}\left[\frac{n_2}{ck_2}\left(\vec{k}_T\times\vec{E}_{0,T}\right)\right]\times\hat{n}$$

$$\frac{1}{\mu_1}\left[\left(\vec{k}_I\times\vec{E}_{0I}\right) + \left(\vec{k}_R\times\vec{E}_{0R}\right)\right]\times\hat{n} = \frac{1}{\mu_2}\left[\vec{k}_T\times\vec{E}_{0T}\right]\times\hat{n}$$

$$(\vec{a}\times\vec{b})\times\vec{c} = (\vec{b}\cdot\vec{a})\cdot\vec{c} - (\vec{b}\cdot\vec{c})\cdot\vec{a}$$

$$\frac{1}{\mu_1}\left[(\hat{n}\cdot\vec{k}_I)\vec{E}_{0I} - \cancel{(\hat{n}\cdot\vec{E}_{0I})}\,\vec{k}_I + (\hat{n}\cdot\vec{k}_R)\cdot\vec{E}_{0R} - \cancel{(\hat{n}\cdot\vec{E}_{0R})}\,\vec{k}_R\right] = \frac{1}{\mu_2}\left[(\hat{n}\cdot\vec{k}_T)\vec{E}_{0T} - \cancel{(\hat{n}\cdot\vec{E}_{0T})}\,\vec{k}\right]$$

$$\frac{1}{\mu_1}\left((\hat{n}\cdot\vec{k}_I)\vec{E}_{0I} + (\hat{n}\cdot\vec{k}_R)\cdot\vec{E}_{0R}\right) = \frac{1}{\mu_2}(\hat{n}\cdot\vec{k}_T)\vec{E}_{0T}$$

$$\frac{1}{\mu_1}\left(k_1\,\tilde{E}_{0,I}\cos\theta_I - k_1\,\tilde{E}_{0R}\cos\theta_R\right) = \frac{k_2}{\mu_2}\,\tilde{E}_{0T}\cos\theta_T$$

$$\left(\tilde{E}_{0I} - \tilde{E}_{0,R}\right)\cos\theta_I = \frac{\mu_1 k_2}{\mu_2 k_1}\,\tilde{E}_{0T}\cos\theta_T$$

snell law

$$\alpha \equiv \frac{\cos\theta_T}{\cos\theta_I} = \frac{\sqrt{1-(\sin\theta_T)^2}}{\cos\theta_I} = \frac{\sqrt{1-\left(\frac{n_1}{n_2}\sin\theta_I\right)^2}}{\cos\theta_I} = \alpha(\theta_I$$

$$\beta \equiv \frac{\mu_1 n_2}{\mu_2 n_1}$$

Fresnell's Eqn's

$$\tilde{E}_{0,R} = \left(\frac{1-\alpha\beta}{1+\alpha\beta}\right)\tilde{E}_{0,I} \qquad \tilde{E}_{0,R} = \left(\frac{\alpha-\beta}{\alpha+\beta}\right)\tilde{E}_{0,I}$$

$$\tilde{E}_{0,T} = \left(\frac{2}{1+\alpha\beta}\right)\tilde{E}_{0,I} \qquad \tilde{E}_{0,T} = \left(\frac{2}{\alpha+\beta}\right)\tilde{E}_{0,I}$$

$\vec{E}\perp$ Plane of Incidence $\qquad$ $\vec{E}\,/\!/$ Plane of incidence limiting cases $\alpha\cdot\beta = \mp 1$ $\quad\quad$ $\alpha = \pm\beta$

Brewster's Angle

$$\alpha=\beta \;\to\; \theta_I=\theta_B$$

$$\alpha^2=\beta^2=\frac{1-\left(\frac{n_1}{n_2}\sin\theta_B\right)^2}{\cos^2\theta_B}$$

$$\sin^2\theta_B = \frac{1-\beta}{\left(\frac{n_1}{n_2}\right)^2-\beta^2} \simeq \frac{\beta^2}{1+\beta^2}$$

for $\mu_1\simeq\mu_2 \to \beta=\frac{n_2}{n_1}$

$$\tilde{E}_{0,R} = \left(\frac{\frac{\cos\theta_T}{\cos\theta_I}-\frac{n_2}{n_1}}{\frac{\cos\theta_T}{\cos\theta_I}+\frac{n_2}{n_1}}\right)\tilde{E}_{0,I}$$

$$= \frac{\tan(\theta_I-\theta_T)\left(1+\tan\theta_I\tan\theta_T\right)}{\tan(\theta_I+\theta_T)\left(1-\tan\theta_I\tan\theta_T\right)}$$

when $\theta_I+\theta_T\approx\pi/2$, $\tilde{E}_{0,R}\to 0$

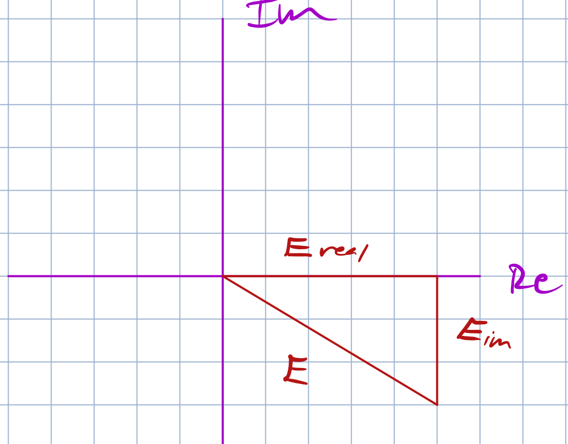
for Snell's law

$$n_1\sin\theta_I = n_2\sin\theta_T$$

$$n_1\sin\theta_B = n_2\sin\theta_T = n_2\sin\left(\frac{\pi}{2}-\theta_B\right)$$

$$n_1\sin\theta_B = n_2\cos\theta_B$$

$$\tan\theta_B = \frac{n_2}{n_1}$$



complex

$\vec{E}_I + \vec{E}_{plate}$

$\omega(n+1)\frac{\Delta z}{c}$