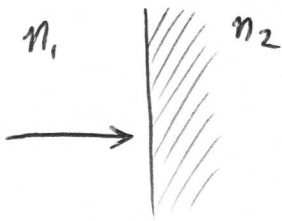


Last time



$$\frac{E_{0,R}}{E_{0,I}} = \frac{n_1 - n_2}{n_1 + n_2}$$

$$\frac{E_{0,T}}{E_{0,I}} = \frac{2n_1}{n_1 + n_2}$$

The intensity of incident, reflected and transmitted waves is

$$I_I = \frac{1}{2} n_1 \epsilon_0 c E_I^2$$

$$I_R = \frac{1}{2} n_1 \epsilon_0 c E_R^2$$

$$I_T = \frac{1}{2} n_2 \epsilon_0 c E_T^2$$

$n_1 = \frac{n_1^2}{n_1}$

← accounts for the higher energy density in a material

← accounts for the slower speed of light in a material

↑ Transmitted wave is in a different material.

The fraction of photons reflected is

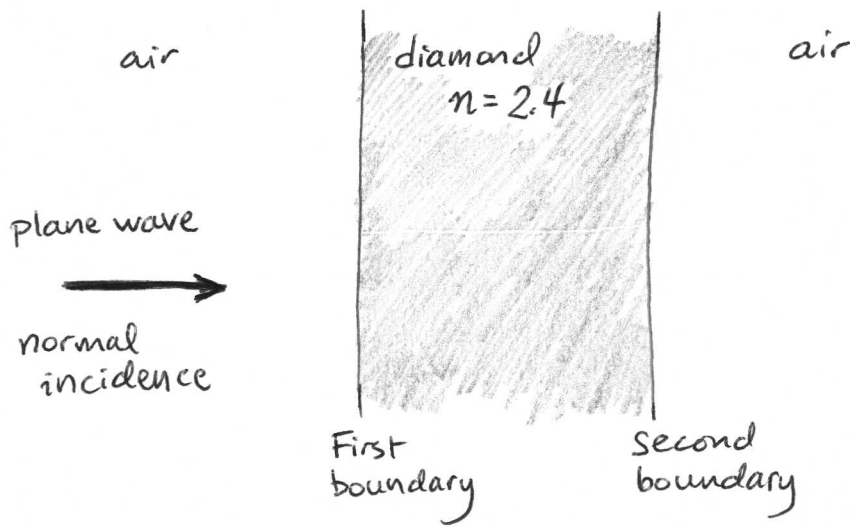
$$R = \frac{I_R}{I_I} = \left| \frac{n_1 - n_2}{n_1 + n_2} \right|^2$$

Known as "reflectance" or "reflectivity"

The fraction of photons transmitted is

$$T = \frac{I_T}{I_I} = \frac{n_2}{n_1} \left| \frac{2n_1}{n_1 + n_2} \right|^2$$

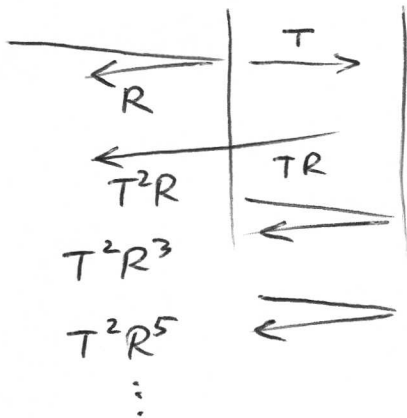
Note $R + T = 1$



- Find R for the first boundary
- Find R for the second boundary
- Find the combined reflectance from the thick slab of diamond assuming that the coherence length of light is short enough that you can neglect interference effects.

③

Answer to pop quiz, part c).



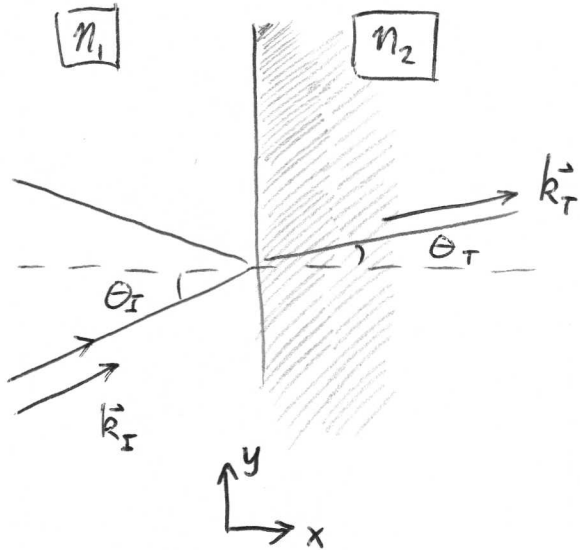
$$\begin{aligned} & R + T^2R + T^2R^3 + T^2R^5 + \dots \\ &= R + T^2R(1 + R^2 + R^4 + R^6 + \dots) \\ &= R + T^2R\left(\frac{1}{1-R^2}\right) \\ &= R\left(1 + \frac{(1-R)^2}{(1-R^2)(1+R)}\right) \\ &= R\left(1 + \frac{1-R}{1+R}\right) \\ &= R\left(\frac{1+R+1-R}{1+R}\right) \\ &= \frac{2R}{1+R} \end{aligned}$$

(4)

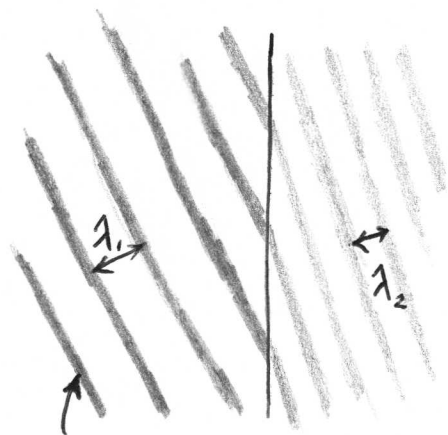
SNELL'S LAW

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

We need this rule when analyzing problems with $\theta_I \neq 0$.



The derivation is based on the concept of "phase matching" at the interface.



λ must change as we cross the interface from n_1 into n_2

$$\frac{2\pi}{\lambda_1} = k_1 = \frac{n_1 \omega}{c}$$

$$\frac{2\pi}{\lambda_2} = k_2 = \frac{n_2 \omega}{c}$$

lines of constant phase,
 $\vec{r} \cdot \vec{k}_I = \text{const}$

The lines of constant phase must match at the interface.

\Rightarrow Propagation direction must change.

The interface is located at $\vec{r} = y \hat{y}$.

$$y \hat{y} \cdot \vec{k}_I = y \hat{y} \cdot \vec{k}_T \quad \text{phase matching condition.}$$