\[ E = E_m \sin(bx - wt) \]
\[ B = B_m \sin(bx - wt) \]

Plane wave

direct current

\[ E_m = \frac{C}{B_m} \]

\[ S = \frac{1}{\mu_0} \frac{E \times B}{\text{area}} \]

\[ \mu = \frac{\text{energy}}{\text{volume}} \]

\[ \mu = \mu_E + \mu_B \]

\[ \mu_E = \frac{1}{2} \varepsilon_0 E^2 \]

\[ \mu_B = \frac{B^2}{2\mu_0} \]

\[ \text{Power} \]

\[ \text{Review} \]

\[ \text{p} = \frac{1}{\text{area}} \]

\[ \text{S}_{\text{total}} = I \]
In a medium:

\[ v = v(k) = \frac{\omega_k}{k} = \lambda f = \frac{c}{n} \]

\[ n = \frac{c}{v} \quad \text{and} \quad n(\lambda) = \frac{c}{\nu \lambda} \]

\[ \lambda_0 = \frac{\lambda}{n} = \frac{\lambda_0}{c} \]
\( N = \text{# of wavelengths in length } L \)

\[ N_1 = \frac{L}{\lambda n_1}; \quad N_2 = \frac{L}{\lambda n_2} \]

\[ N_2 - N_1 = \frac{L}{\lambda} (n_2 - n_1) = \Delta N \]

- Constructive:
  \[ \Delta N = m \text{ (integer)} \]
- Destructions:
  \[ \Delta N = m + \frac{1}{2} \]

\[ \Delta \phi = 2\pi \Delta N \]
\[ 2) \quad \Delta N = \frac{\Delta L}{\lambda} \quad \Delta \phi = 2\pi \frac{\Delta L}{\lambda} \]

\[ \sin (kx - \omega t) \quad h = \frac{2\pi}{\lambda} \quad \Delta \phi = hDAx = \frac{2\pi}{\lambda} \Delta x \]

Young
\[ \Delta L = d \sin \theta \]
\[
\begin{align*}
\text{Intensity} & \quad E_1 = E_0 \sin \omega t \\
E_2 & = E_0 \sin (\omega t + \phi) \\
E & = E_1 + E_2 = 2E_0 \frac{\cos \frac{\phi}{2}}{} \sin \left( \frac{\omega t + \phi}{2} \right) \\
I & \propto E^2 \\
1 + e^{i\phi} & = e^{i\phi/2} (e^{-i\phi/2} + e^{i\phi/2}) = 2 \cos \frac{\phi}{2} \quad e^{i\phi/2} \\
I & =
\end{align*}
\]
\[ E_1 = E_0 \sin(\omega t) \]
\[ E_2 = E_0 \sin(\omega t + \phi) \]
\[ E_3 = E_0 \sin(\omega t + 2\phi) \]
\[ E = E_1 + E_2 + E_3 = E_0 \sin (\omega t + \beta) \]
\[ E_n = E_0 (1 + \cos \phi + \cos 2\phi) \]
\[ E_\varphi = E_0 (\sin \phi + \sin 2\phi) \]
\[ E_m = \sqrt{E_n^2 + E_\varphi^2} \]
\[ E = e^{i(\omega t + \beta)} \]
\[ \tan \beta = \frac{E_0}{E_n} \]
\[ 1 + e^{i\phi} + e^{2i\phi} = e^{i\phi} (1 + e^{-i\phi} + e^{i\phi}) = e^{i\phi} (1 + 2\cos \phi) \]
\[ E = E_1 + E_2 = 2 E_0 \cos \phi \sin (\omega t + \phi/2) \]

\[ I = 4 I_0 \cos^2 \phi/2 \]

\[ \text{diagram of a wave pattern} \]

\[ \text{brackets and other markings} \]
When light is incident on a thin transparent film, the light waves reflected from the front and back surfaces interfere. For near-normal incidence, the wavelength conditions for maximum and minimum intensity of the light reflected from a film with air on both sides are

\[
2L = (m + \frac{1}{2}) \frac{\lambda}{n_2}, \quad \text{for } m = 0, 1, 2, \ldots \quad \text{(maxima—bright film in air).}
\]

\[
2L = m \frac{\lambda}{n_2}, \quad \text{for } m = 0, 1, 2, \ldots \quad \text{(minima—dark film in air).}
\]

where \( n_2 \) is the index of refraction of the film, \( L \) is its thickness, and \( \lambda \) is the wavelength of the light in air.

If a film is sandwiched between media other than air, these equations for bright and dark films may be interchanged, depending on the relative indexes of refraction.

If the light incident at an interface between media with different indexes of refraction is initially in the medium with the smaller index of refraction, the reflection causes a phase change of \( \pi \text{ rad} \), or half a wavelength, in the reflected wave. Otherwise, there is no phase change due to the reflection. Refraction causes no phase shift.
When light is incident on a thin transparent film, the light waves reflected from the front and back surfaces interfere. For near-normal incidence, the wavelength conditions for maximum and minimum intensity of the light reflected from a film in air are:

\[ 2L = (m + \frac{1}{2}) \frac{\lambda}{n_2}, \quad \text{for } m = 0, 1, 2, \ldots \quad \text{(maxima—bright film in air)} \]

\[ 2L = m \frac{\lambda}{n_2}, \quad \text{for } m = 0, 1, 2, \ldots \quad \text{(minima—dark film in air)} \]

where \( n_2 \) is the index of refraction of the film, \( L \) is its thickness, and \( \lambda \) is the wavelength of the light in air.

The incident pulse is in the denser string.

The incident pulse in the lighter string. Only here is there a phase change, and only in the reflected wave.
Reflection can cause π phase shift with \( n_1 < n_2 \).

\[ \frac{ZL}{\Delta L} = \text{half integer} \]

\[ \frac{\Delta L}{\lambda n} \]

\[ \frac{\Delta L}{\lambda n} \text{ independent} \]

\[ \lambda_n = \frac{\lambda}{n_2} \]