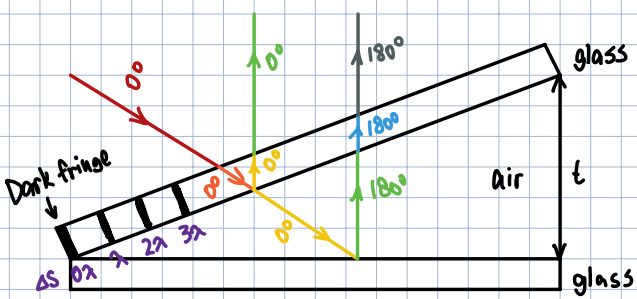
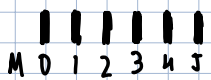
An air wedge is similar to the thin film interference, however with the thickness of the middle layer increasing from one end to the other.



Patterns of Interference



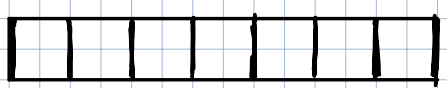
$\Delta S = 2t = 0\lambda, \lambda, 2\lambda$ etc $\quad t = 0, \frac{\lambda}{2}, \lambda, \frac{3\lambda}{2}$, etc

$\Delta S = 2t = (n-1)\lambda$

$t_n = \frac{(n-1)\lambda}{2}$

Ex 1

To determine the thickness of your hair, you place a strand between two plates, at the edge, using 633nm light, you see the 8th dark fringe appears at wider edge



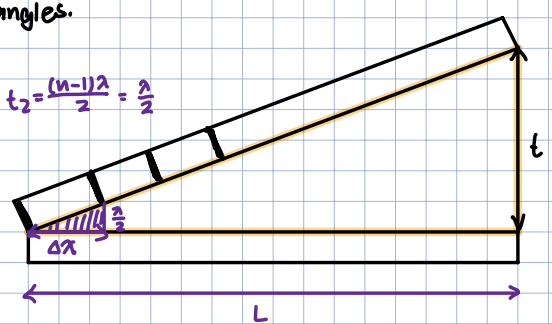
$n = 8$

$\lambda = 633\,nm$ $\quad t_8 = \frac{(8-1)(633)}{2}$

$t_8 = 2.22 \times 10^{-6}\,m$

Another Formula

Another way to find the thickness is by using the distance between nodes and similar triangles.

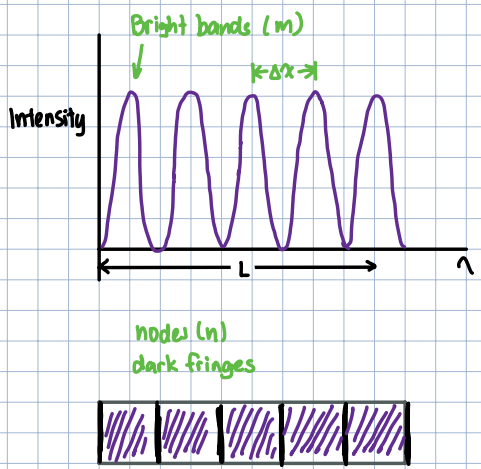


Similar triangles

Base height : $\frac{L}{t}$ $\quad \frac{\Delta x}{\frac{\lambda}{2}}$

$t = \frac{L\lambda}{2\Delta x}$

Let's consider Δx, the distance from node to node, in terms of light intensity as it would appear on the plate:



How many nodes? 6 nodes

How many bright bands? 5 (each has width of Δx)

$L = 5\Delta x$

$L = m\Delta x$

↓

# of maxima

Example 2:

An air wedge with thickness of 257um is struck with a beam of 359nm light. The length of the bottom plate is 15cm. What is the distance between nodes?

$t = 257\,\mu m = 2.57\times10^{-6}\,m$

$\lambda = 359\,nm = 3.59\times10^{-9}\,m$

$L = 15\,cm = 0.15\,m$

$\Delta x = ?$

$$\Delta x = \frac{L\lambda}{2t} = \frac{0.15(359\times10^{-9})}{2(257\times10^{-6})}$$

$\Delta x = 1.05\times10^{-4}\,m$

$= 105\times10^{-6}\,m$

$= 105\,\mu m$

Example 3:

A 7.2cm long air wedge is formed with two glass plates. Light of 640nm is reflected from the wedge showing 65 bright fringes when a piece of paper is inserted between the plates. What is the thickness of the paper?

$L = 0.072\,m$

$\lambda = 640\,nm = 6.4\times10^{-7}\,m$

$m = 65$

$L = m\Delta x$

$$\Delta x = \frac{L}{m} = \frac{0.072\,m}{63}$$

$= 1.11\times10^{-3}\,m$

$$t = \frac{L\lambda}{2\Delta x} = \frac{0.072(640\times10^{-9})}{2(1.11\times10^{-3})}$$

$= 2.08\times10^{-5}\,m$

$= 20.8\times10^{-6}\,m$

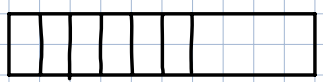
$= 20.8\,\mu m$

Example 4:

A sheet of paper 0.015cm thick separates two glass plates which are 9.3cm long. The distance between center of the first and seventh dark fringe is 1.3cm. What wavelength of light was used?

$t = 0.015 \times 10^{-2} m$

$L = 9.3 \times 10^{-2} m$



$1.3 \times 10^{-2} m$

$\Delta x = \frac{1.3 \times 10^{-2}}{6} = 0.00217 m$

$t = \frac{L\lambda}{2\Delta x}$

$\lambda = \frac{2t\Delta x}{L}$

$= \frac{2(0.015 \times 10^{-2})(0.00217)}{9.3 \times 10^{-2}}$

$= 6.99 \times 10^{-6} m$

$= 6.99 \mu m$