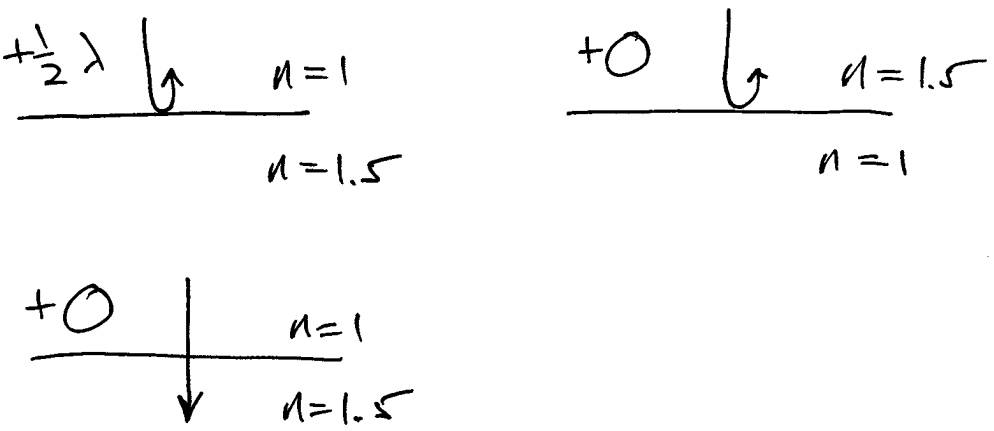
2012 MAR 30

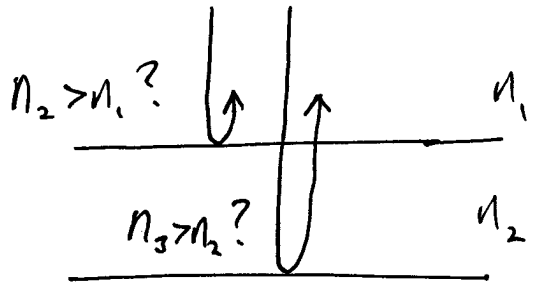
THIN-FILM INTERFERENCE

TWO COMPLICATING FACTORS

(1) $$\lambda_n = \frac{\lambda_0}{n}$$

(2) WHEN LIGHT REFLECTS FROM A MATERIAL WITH A HIGHER INDEX OF REFRACTION, IT EXPERIENCES AN EXTRA $\frac{1}{2}$ WAVELENGTH SHIFT.



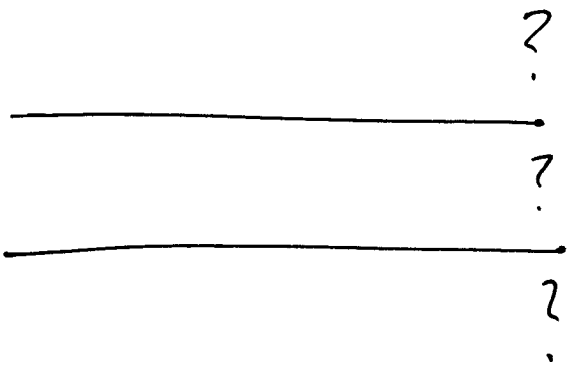


INDEX OF THIN FILM

$$\#\lambda s = \frac{2tn}{\lambda_0} + \begin{Bmatrix} 1/2 \\ 0 \end{Bmatrix} + \begin{Bmatrix} 1/2 \\ 0 \end{Bmatrix}$$

WAVELENGTH RANGE OF VISIBLE LIGHT

400 nm - 700 nm
VIOLET RED



(GG, Ch 24, P 39)

AIR, $n = 1$

SOAP, $n = 1.34$

AIR, $n = 1$

$$\#\lambda_s = \frac{2tn}{\lambda_0} + \{1/2,\ 0\} + \{1/2,\ 0\}$$

TOP SURFACE: $n = 1$ | $n = 1.34$

BOTTOM SURFACE: $n = 1.34$ | $n = 1$

$t = 120\,nm$

$$m = \frac{2(120\,nm)(1.34)}{\lambda_0} + \frac{1}{2} + 0$$

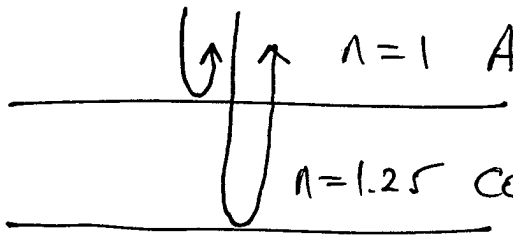
$$\lambda_0 = \frac{2(120\,nm)(1.34)}{m - \frac{1}{2}} = \frac{322\,nm}{m - \frac{1}{2}}$$

$m \leq 0 \Rightarrow$ NEGATIVE WAVELENGTH (NONSENSE)

$m = 1 \Rightarrow \lambda_0 = \boxed{644\,nm}$ ONLY WAVELENGTH IN VISIBLE RANGE.

$m = 2 \Rightarrow \lambda_0 = 214\,nm$

$m > 2 \Rightarrow$ SMALLER λ_0's



$\lambda_0 = 570\text{nm}$

$$\#\lambda_s = \frac{2tn}{\lambda_0} + \{1/2,\ 0\} + \{1/2,\ 0\}$$

$$m = \frac{2t(1.25)}{570\text{nm}} + \frac{1}{2} + \frac{1}{2}$$

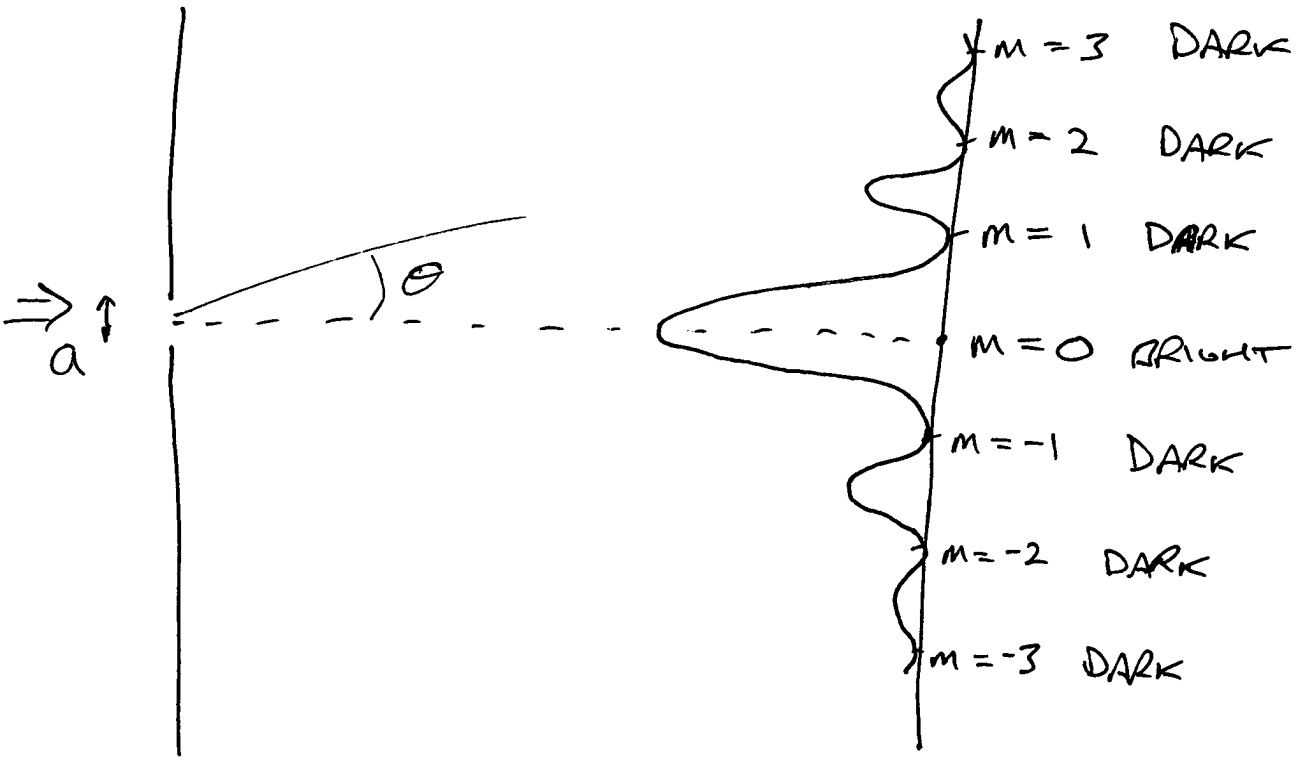
$$t = \frac{(570\text{nm})(m-1)}{2(1.25)} = (228\text{nm})(m-1)$$

$m \leq 1 \Rightarrow$ ZERO OR NEGATIVE THICKNESS (NONSENSE)

$m = 2 \Rightarrow \boxed{t = 228\text{nm}}$ BECAUSE WE WANT THE MINIMUM THICKNESS

$m = 3 \Rightarrow t = 456\text{nm}$

SINGLE-SLIT DIFFRACTION



a = SLIT WIDTH

$$a \sin\theta = m\lambda$$