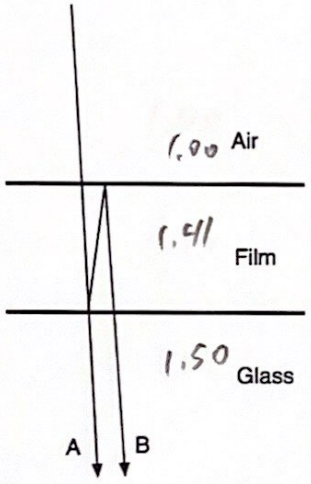
Quiz 27.2A

Light is incident on a 654-nm thick film (n = 1.41) that has been applied to a glass lens (n = 1.50). You may assume that the light is initial in air (n = 1.00) before striking the surface of the film.

We consider two light rays, A and B, that transmit through the film. Ray A passes through the film without reflecting. Ray B reflects twice off the surface of the film before transmitting through, as shown below.

a) What is the phase shift experienced by ray A, in waves?
b) What is the phase shift experienced by ray B, in waves?
c) What wavelengths of light will brightly transmit through the film and into the glass?

Assume visible light ranges from 400 - 700 nm. Answer part c with 3 SF.



$\phi_A = 0$ (no reflection, no extra distance)

$\phi_B = \frac{1}{2} + 0 + \frac{2nt}{\lambda_0}$

$\frac{1}{2} + \frac{2nt}{\lambda_0} = 0 \Rightarrow \frac{2nt}{\lambda_0} = -\frac{1}{2}$ ×

$\frac{1}{2} + \frac{2nt}{\lambda_0} = 1 \Rightarrow \frac{2nt}{\lambda_0} = \frac{1}{2} \Rightarrow \lambda_0 = 4nt = 3689\,nm$ ×

$\frac{1}{2} + \frac{2nt}{\lambda_0} = 2 \Rightarrow \frac{2nt}{\lambda_0} = \frac{3}{2} \Rightarrow \lambda_0 = \frac{4nt}{3} = 1230\,nm$ ×

$\lambda_0 = \frac{4nt}{5} = 738\,nm$ ×

$\lambda_0 = \frac{4nt}{7} = 527\,nm$ ✓

$\lambda_0 = \frac{4nt}{9} = 410\,nm$ ✓

$\lambda_0 = \frac{4nt}{11} = 335\,nm$ ×