

45. Assume the wedge-shaped film is in air, so the wave reflected from one surface undergoes a phase change of  $\pi$  rad while the wave reflected from the other surface does not. At a place where the film thickness is  $L$ , the condition for fully constructive interference is  $2nL = (m + \frac{1}{2})\lambda$ , where  $n$  is the index of refraction of the film,  $\lambda$  is the wavelength in vacuum, and  $m$  is an integer. The ends of the film are bright. Suppose the end where the film is narrow has thickness  $L_1$  and the bright fringe there corresponds to  $m = m_1$ . Suppose the end where the film is thick has thickness  $L_2$  and the bright fringe there corresponds to  $m = m_2$ . Since there are ten bright fringes,  $m_2 = m_1 + 9$ . Subtract  $2nL_1 = (m_1 + \frac{1}{2})\lambda$  from  $2nL_2 = (m_1 + 9 + \frac{1}{2})\lambda$  to obtain  $2n\Delta L = 9\lambda$ , where  $\Delta L = L_2 - L_1$  is the change in the film thickness over its length. Thus,

$$\Delta L = \frac{9\lambda}{2n} = \frac{9(630 \times 10^{-9} \text{ m})}{2(1.50)} = 1.89 \times 10^{-6} \text{ m} .$$