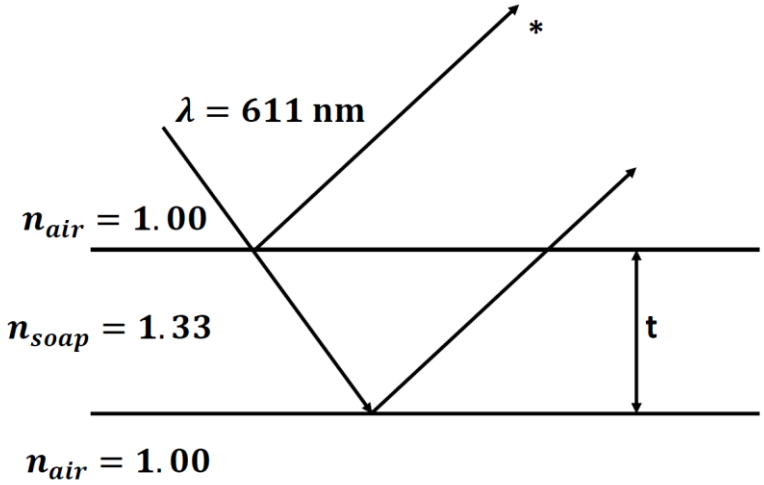
10. Orange light (λ_{vacuum} = 611 nm) shines on a soap film (n = 1.33) that has air on either side of it. The light strikes the film perpendicularly. What is the minimum thickness of the film for which constructive interference causes it to look bright in reflected light?



Now we need to consider constructive interference, so our phase equation is now

$$\boldsymbol{Total\ Phase\ Diff = Optical\ Path\ Diff + Phase\ Shifts = m\lambda}$$

$$\boldsymbol{2n_{soap}t + \frac{\lambda}{2} = m\lambda}$$

$$\boldsymbol{2n_{soap}t = \left(m + \frac{1}{2}\right)\lambda}$$

This is the condition for constructive interference. We do not use (m-1/2), because we do not want negative signs showing up. Now solve for thickness

$$\boldsymbol{t = \frac{\left(m + \frac{1}{2}\right)\lambda}{2n_{soap}} = \frac{\lambda}{4n_{soap}}}$$

For minimum thickness we can make m = 0. Minimum thickness is

$$\boldsymbol{t = \frac{\lambda}{4n_{soap}} = \frac{611\ nm}{4(1.33)} = 114.8\ nm}$$

$$\boxed{\boldsymbol{t = 115\ nm}}$$

Please send any comments or questions about this page to ddonovan@nmu.edu

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