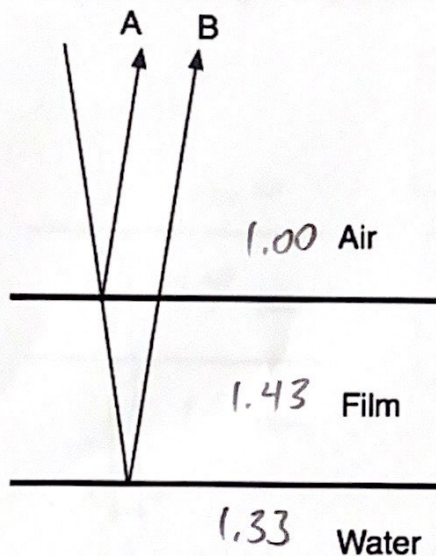


### Quiz 27.2C

Light of wavelength 545 nm is incident on a thin film ( $n = 1.43$ ) that rests on the surface of water ( $n = 1.33$ ). The film has an unknown thickness.

We consider two light rays, A and B, that reflect off of this surface. Ray A reflects off the film, and ray B reflects off the water as shown below.

- What is the phase shift experienced by ray A, in waves?
- What is the phase shift experienced by ray B, in waves?
- What are the possible values for the thickness of the film that would result in this light reflecting brightly? Assume that the maximum possible thickness for the film is 501 nm.



a)  $\phi_A = \frac{1}{2}$

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

c)  $\phi_B - \phi_A = 0, 1, 2, 3, \dots$

$$\frac{2nt}{\lambda_0} - \frac{1}{2} = 0, 1, 2, 3, \dots$$

$$\frac{2nt}{\lambda_0} - \frac{1}{2} = 0 \Rightarrow \frac{2nt}{\lambda_0} = \frac{1}{2} \Rightarrow t = \frac{\lambda_0}{4n} = 95.3 \text{ nm}$$

$$\frac{2nt}{\lambda_0} - \frac{1}{2} = 1 \Rightarrow \frac{2nt}{\lambda_0} = \frac{3}{2} \Rightarrow t = \frac{3\lambda_0}{4n} = 286 \text{ nm}$$

$$\frac{2nt}{\lambda_0} = \frac{5}{2} \Rightarrow t = \frac{5\lambda_0}{4n} = 476 \text{ nm}$$

$$\frac{2nt}{\lambda_0} = \frac{7}{2} \Rightarrow t = \frac{7\lambda_0}{4n} = 667 \text{ nm}$$