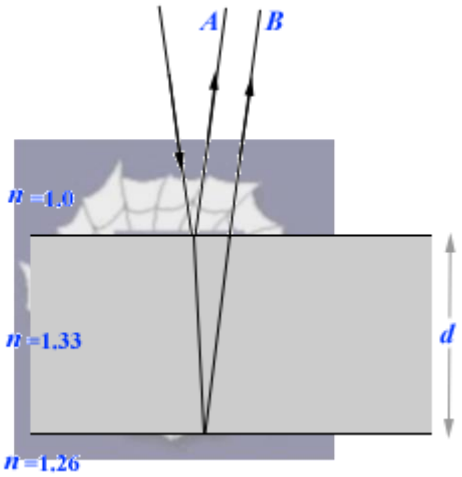
638.

Problem 45.31 (RHK)

If the wavelength of the incident light is $\lambda = 572$ nm, *the rays A and B, as shown in the figure, are out of phase by* 1.50λ. *We have to find the thickness d of the film.*



Solution:

As the ray *A* is reflected from a medium with greater refractive index than that of the medium on the incident side, it undergoes a phase change of π. The transmitted ray on its reflection from the interface of medium of refractive index 1.33 and the medium of refractive index 1.26 does not undergo additional phase change, as reflection is from a medium with lesser refractive index than that of the incident side. If we assume that the

incident ray strikes at near normal angle, between rays *A* and *B* there is an additional phase change of $2\pi \times 2d/\lambda_{n_2}$.

Therefore, the total phase change between waves *A* and *B* is

$$\pi + \frac{4\pi d \times 1.33}{\lambda} \ .$$

We are given that the phase difference between rays *A* and *B* is $1.5\lambda \times 2\pi/\lambda = 3\pi.$

Therefore,

$$\pi + \frac{4\pi d \times 1.33}{\lambda} = 3\pi,$$

or

$$d = \frac{\lambda}{1.33 \times 2}.$$

As

$\lambda = 572$ nm, we find

$$d = \frac{572}{1.33 \times 2} \text{ nm} = 215 \text{ nm}.$$