

644.

Problem 45.42 (RHK)

In an air wedge formed by two plane glass plates, touching each other along one edge, there are 4001 dark lines observed when viewed by reflected monochromatic light. When the air between the plates is evacuated, only 4000 such lines are observed. We have to calculate the index of refraction of the air from these data.

Solution:

Let the wavelength of the monochromatic light used in the experiment when measured in vacuum be λ (m). Let the width of the air gap between the plates that corresponds to the 4000th dark line when the air between the plates has been evacuated be d (m). Using the condition for destructive interference of the reflected monochromatic light from the top and the bottom of the wedge formed between two glass plates (air evacuated), we have



$$\frac{2d}{\lambda} \times 2\pi = 3999\pi,$$

or

$$\frac{d}{\lambda} = \frac{3999}{4}.$$

It is given that when the gap between the glass plates contains air, 4001 dark lines are observed. This implies that

$$\frac{2d}{\lambda_{air}} \times 2\pi = 4000 \times \pi,$$

or

$$\frac{4d}{\lambda} \times n = 4000.$$

$$\therefore n = \frac{4000}{3999} = 1.00025.$$

