692.

Problem 48.6 (RHK)

A beam of linearly polarized light strikes two polarizing sheets. The characteristic direction of the second is 90^0 *with respect to the incident light. The characteristic direction of the first is at angle* θ *with respect to the incident light. We have to find angle* θ *for a transmitted beam intensity that is* 0.100 *times the incident beam intensity.*

Solution:

Let the intensity of the linearly polarized incident beam be I_0. It is given that the characteristic direction of the first is at angle θ with respect to the incident light. By the law of Malus the intensity of the beam after it has passed through the first polarizing sheet will change to $I_1 = I_0 \cos^2 \theta$.

The characteristic direction of the second polarizing sheet with respect to the first sheet will be $90^0 - \theta$, as the characteristic direction of the second is 90^0 with respect

to the incident polarized light. The intensity of the transmitted beam when it emerges from the second polarizing sheet will be given by

$$I_2 = I_1 \cos^2\left(90^0 - \theta\right) = I_1 \sin^2\theta = I_0 \cos^2\theta \sin^2\theta$$

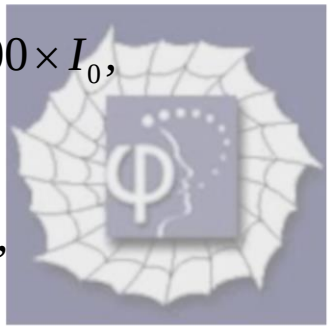
$$= \frac{I_0}{4}\sin^2\left(2\theta\right).$$

It is given that

$$I_2 = 0.100 \times I_0.$$

Therefore,

$$\frac{I_0}{4}\sin^2\left(2\theta\right) = 0.100 \times I_0,$$



or

$$\sin\left(2\theta\right) = \sqrt{0.400},$$

or

$$2\theta = \sin^{-1}\sqrt{0.400} = 0.685 \text{ rad} = 39.2^0,$$

and

$$\theta = 19.6^0.$$