

691.

**Problem 48.5 (RHK)**

*Three polarizing sheets are stacked. The first and third are crossed; the one between has its axis at  $45^\circ$  to the axes of the other two. We have to find the fraction of intensity of an unpolarized beam that will be transmitted by the stack.*

**Solution:**

When the incident unpolarized beam passes through the first polarizing sheet its intensity will be halved.

Therefore, after the unpolarized beam of intensity  $I_0$  has passed through the first polarizing sheet, the intensity of the beam will become

$$I_1 = \frac{1}{2} I_0.$$

As the second polarizing sheet has its axis at  $45^\circ$  to the axis of the first polarizing sheet, by the law of Malus, we find that intensity of the beam after it has passed through the second sheet will change to

$$I_2 = I_1 \cos^2 \theta = \frac{1}{2} I_0 \cos^2 45^\circ = \frac{1}{4} I_0.$$

As the axis of the third polarizing sheet is at  $45^\circ$  to the axis of the second polarizing sheet, the intensity of the beam after it has passed through the third sheet will change to

$$I_3 = I_2 \cos^2 \theta = \frac{1}{4} I_0 \cos^2 45^\circ = \frac{1}{8} I_0.$$

$$\therefore \frac{I_3}{I_0} = \frac{1}{8}.$$

