Question

View this Question Online >

Consider if an unpolarised beam of light with intensity I is incident on two polarizers kept one after another. Now if the angle between two polarizers is θ then the final intensity of light emerging from the second polarizer will be _____.

1. $I \cos^2 \theta$
2. $\left(\frac{I}{2}\right)cos^2\theta$
3. $I \cos^4 \theta$
4. $\left(\frac{I}{2}\right)cos\ \theta$

Answer (Detailed Solution Below)

Option 2 : $\left(\frac{I}{2}\right)cos^2\theta$

Detailed Solution

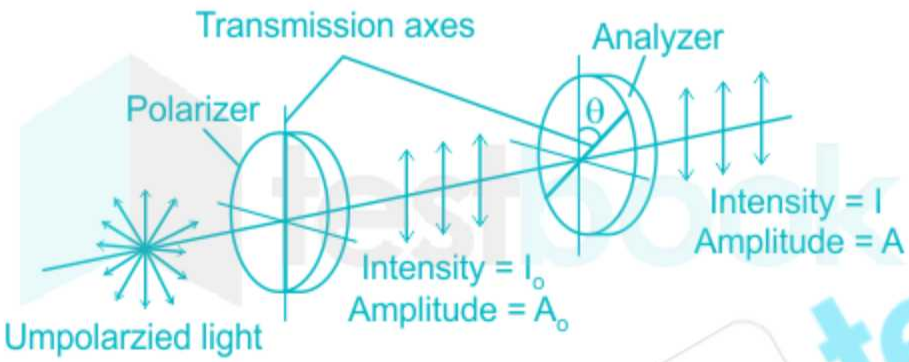
CONCEPT:

Malus' law:

- Malus' law states that the intensity of plane-polarized light that passes through an analyzer varies as the square of the cosine of the angle between the plane of the polarizer and the transmission axes of the analyzer.
- Mathematically it is written as,

$\Rightarrow I = I_o \cos^2\theta$

Where I_o = Intensity of incoming light and I = Intensity light passing through Polaroid



- According to this law:
  - When Unpolarized light is incident on an ideal polarizer the intensity of the transmitted light is exactly half that of the incident unpolarized light no matter how the polarizing axis is oriented.
  - An ideal polarizing filter passes 100% of incident unpolarized light, that is polarized in the direction of the filter's (Polarizer) Polarizing axis.

CALCULATION:

Given I = intensity of an unpolarized beam of light and θ = angle between the axes of the two polarisers

We know that after the first polarisation of an unpolarized beam of light intensity becomes,

$\Rightarrow I_1 = \frac{I}{2}$ -----(1)

After the second polarisation intensity becomes,

$\Rightarrow I_2 = I_1 cos^2\theta$

$\Rightarrow I_2 = \frac{I}{2} cos^2\theta$

- Hence, option 2 is correct.