SOLUTIONS

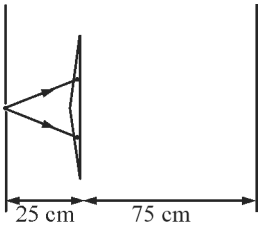
Module - 5 / JEE-2022

IN-CHAPTER EXERCISES	Physics	Wave Optics

EXERCISE

1. $d = 2a\delta = 2a(\mu-1)\alpha = 2(0.25)(1.5-1)\left(\frac{20}{60}\cdot\frac{\pi}{180}\right)$

$\omega = 0.55\ mm, D = 25\,cm + 75cm = 100\ cm,\ \lambda = \frac{\omega d}{D} = 8\times10^{-7} m$



2. $\frac{75}{100} I_{max} = I_{max}\cos^2\frac{\pi x}{\omega} \Rightarrow x = \frac{\omega}{6} = \frac{1}{6}\frac{D\lambda}{d}$ $(D = 120\,cm \text{ and } d = 0.25\,cm)$

3. $\frac{I}{I_{max}} = \cos^2\frac{\pi x}{\omega} = \cos^2\left(\frac{\pi}{\omega}\cdot\frac{\omega}{4}\right) = \frac{1}{2}$

4. $36 = \left(\frac{\sqrt{\frac{I_1}{I_2}}+1}{\sqrt{\frac{I_1}{I_2}}-1}\right)^2 \Rightarrow \frac{I_1}{I_2} = \frac{49}{25} \Rightarrow \frac{A_1}{A_2} = \frac{7}{5}$

5. $\frac{D}{d}(\mu-1)t = 5\omega = \frac{5\lambda D}{d} \Rightarrow \lambda = (\mu-1)\frac{t}{5} = \frac{t}{10} = 6\times10^{-7} m$

6. $\frac{D}{d}(\mu-1)t = 10\omega = 10\frac{D\lambda}{d} \Rightarrow \mu = 10\frac{\lambda}{t}+1 = 1.5$

$(\mu'-1)t' = (\mu-1)t \Rightarrow t' = \left(\frac{\mu-1}{\mu'-1}\right)\cdot t = \frac{t}{3} = 4\times10^{-3}\ mm$

7. $\frac{D}{d}\left[(\mu-1)t-(\mu'-1)t'\right] = \frac{5D\lambda}{d} \Rightarrow (\mu-\mu')t = 5\lambda \Rightarrow t = \frac{5\lambda}{\mu-\mu'} \Rightarrow t = \frac{5\times4800}{0.3}\times10^{-10} m$

MISCELLANEOUS EXERCISE

1.(A) Fringe width $= \frac{D\lambda}{d}$

$\because \quad \theta = \sin^{-1}\frac{\omega}{D}$

angular width $= \theta = \sin^{-1}\left(\frac{D\lambda/d}{D}\right) = \sin^{-1}\left(\frac{\lambda}{d}\right)$

[$\because$ θ is very small $\tan\theta = \sin\theta = \theta$]

2.(A) Missing wavelength occurs at dark fringes.

$$\left[\begin{array}{l} x = \text{odd no.} \times \frac{(\text{fringe width})}{2} \\ x = \frac{d}{2} \end{array}\right]$$

$\Rightarrow \quad \frac{(2m+1)}{2}\frac{D\lambda}{d} = \frac{d}{2} \quad \Rightarrow \quad \lambda = \frac{d^2}{D(2m+1)}$

3.(A) $20\omega_1 = n\omega_2$

$\Rightarrow \quad 20\times\omega_1 = n\omega_2$

$\Rightarrow \quad n = 20\times\left(\frac{480}{600}\right) = 16$

4.(C) $\because \quad \mu_{denser} > \mu_{rarer}$

and $\mu \propto \frac{1}{C} \propto \frac{1}{\lambda}$ and frequency is constant

5.(D) As by using white light you have white colour at the central bright fringe.
But at other position bright or dark fringes of different wavelength of whitelight component may be overlapping. (VIBGYOR)

6.(C) $I = I_0\cos^2\left(\frac{\pi x}{\omega}\right) = I_0\cos^2\left(\frac{\pi x}{\beta}\right)$