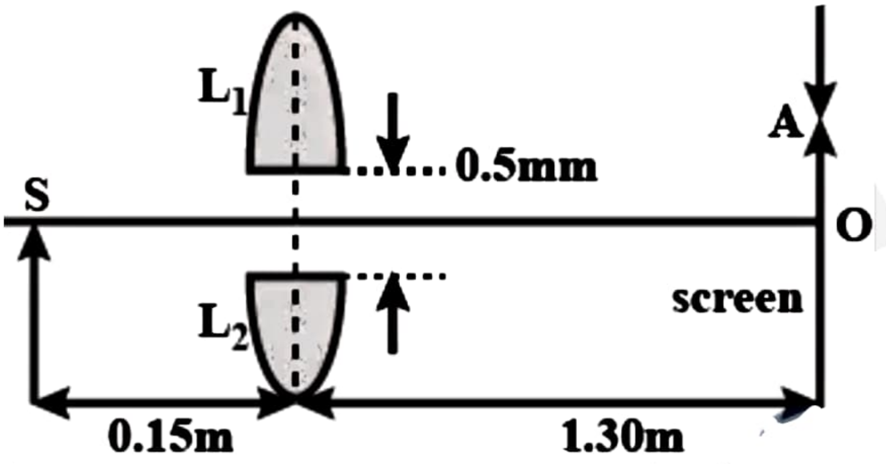
Question

In the figure shown, S is a monochromatic point source emitting light of wavelength $\lambda = 500$ nm. A thin lens of circular shape of focal length 0.10m is cut into two identical halves L_1 and L_2 by a plane passing through a diameter. The two halves are placed symmetrically about the central axis SO with a gap of 0.5 mm. The distance along the axis from S to L_1 and L_2 is 0.15 m, while that from L_1 and L_2 to O is 1.30 m. The screen at O is normal to SO. If the third intensity maximum occurs at point A on the screen, find distance OA in mm.



Solution

Correct option is
A)

Here,

Δ So, O_2 and ΔS S_1 S_2 are similar

Also the placement of O_1 and O_2 are symmetrical to S

$$\therefore \frac{S_1 S_2}{O_1 O_2} = \frac{u+v}{u}$$

$$\Rightarrow S - 1\ S_2 = \frac{(u+v)}{u} \times (O_1\ O_2) =$$

$$\left(\frac{0.15 + 0.3}{0.15}\right) \times 0.5 \times 10^{-3}$$

$$\Rightarrow \boxed{S_1\ S_2 = 1.5 \times 10^{-3} m}$$

d = distance between two slits.

Now,

$$B = \text{fringe width} = \frac{AD}{d}$$

$$B = \frac{500 \times 10^{-9} \times 1}{1.5 \times 10^{-3}} = \frac{1}{3} \times 10^{-3}$$

$$OA = 3B = 3 \times \frac{1}{3} = 10^{-3} m = 1\ mm$$

option A