Related Problems

1) A 0.51 mm-diameter hole is illuminated by light of wavelength 510 nm.

What is the width of the central maximum on a screen 2.0 m behind the slit?

Express your answer using two significant figures.

Soln :

Given data

- The diameter of the hole
  is d=0.51 mm=0.51×10−3 md=0.51 mm=0.51×10−3 m
- The wavelength of the light
  is λ=510 nm=510×10−9 mλ=510 nm=510×10−9 m
- The distance of the central maxima behind the slit is D=2.0 mD=2.0 m
- We need to calculate the width of the central maximum on the screen

Using the wavelength of the light and diameter of the hole, the angular seperation is calculated as shown below,

θ=1.22λd=1.22(510×10−9 m)(0.51×10−3 m)θ=1.22λd=1.22(510×10−9 m)(0.51×10−3 m)
Now, using the angular seperation and distance of the central maxima behind the slit the width of the central maximum on the screen is calculated as shown below,

X=2Dθ
=2(2.0 m)[1.22(510×10−9 m)(0.51×10−3 m)]
=(2)(2.0 m)(1.22)(510×10−9 m)(0.51×10−3 m)=0.00488 m
=[(0.00488 m)(1000 mm1 m)]=4.88 mmx=2Dθ
=2(2.0 m)[1.22(510×10−9 m)(0.51×10−3 m)]
=(2)(2.0 m)(1.22)(510×10−9 m)(0.51×10−3 m)
=0.00488 m
=[(0.00488 m)(1000 mm1 m)]
=4.88 mm

Thus, the width of the central maximum on the screen is 4.88 mm.