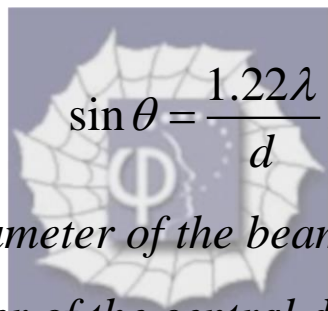


783.

Problem 52.33 (RHK)

A high powered laser beam ($\lambda = 600 \text{ nm}$) with a beam diameter of 11.8 cm is aimed at the Moon, $3.82 \times 10^5 \text{ km}$ distant. The spreading of the beam is caused only by the diffraction effects. The angular location of the edge of the central diffraction disk is given by


$$\sin \theta = \frac{1.22\lambda}{d},$$

where d is the diameter of the beam aperture. We have to find the diameter of the central diffraction disk at the Moon's surface.

Solution:

For the problem the following data has been given:

Diameter of the beam, $d = 12 \text{ cm}$,

Wavelength of the laser beam, $\lambda = 600 \text{ nm}$.

Using the result that the angular location of the edge of the central diffraction disk is given by

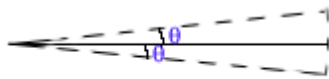
$$\sin \theta = \frac{1.22\lambda}{d},$$

we calculate the angle of the central diffraction disk. We get

$$\begin{aligned} \sin \theta &= \frac{1.22 \times 600 \times 10^{-9} \text{ m}}{12 \times 10^{-2} \text{ m}} \\ &= 61 \times 10^{-7}. \end{aligned}$$

$$\therefore \theta = 61 \times 10^{-7} \text{ rad.}$$

The diameter of the central diffraction disk on the Moon's surface



will be given by

$$\begin{aligned} 2 \times \text{distance to the Moon} \times \theta &= 2 \times 3.8 \times 10^8 \times 61 \times 10^{-7} \text{ m} \\ &= 4.63 \text{ km.} \end{aligned}$$

