660.

Problem 46.19 (RHK)

We have to find the separation of two points on the Moon's surface that can just be resolved by the 200-in. (=5.08-m) *telescope at Mount Palomar, assuming that this distance is determined by diffraction effects. We may assume a wavelength of* 565 nm.

Solution:

The mean orbital radius of the Moon from the Earth is

$R_{earth-moon} = 3.82 \times 10^8$ m.

We will use Rayleigh's criterion that two objects must have an angular separation at least θ_R to be resolvable by a lens of aperture *d* using light of wavelength λ .

$$\theta_R = \sin^{-1}\left(\frac{1.22\lambda}{d}\right).$$

Data of the problem are

$d = 5.08$ m,

and

$\lambda = 565$ nm.

Therefore,

$$\theta_R = \sin^{-1}\left(\frac{1.22\lambda}{d}\right) = \sin^{-1}\left(\frac{1.22\times 565\times 10^{-9}}{5.08}\right)$$
$$= 135.7\times 10^{-9} \text{ rad.}$$

The separation of two points on the Moon that can be resolved by the Mount Palomar telescope will therefore be

$$D = \theta_R \times R_{earth-moon} = 135.7\times 10^{-9}\times 3.82\times 10^{8} \text{ m}$$
$$= 51.8 \text{ m.}$$