

15. (a) We use the Rayleigh criteria. Thus, the angular separation (in radians) of the sources must be at least $\theta_R = 1.22\lambda/d$, where λ is the wavelength and d is the diameter of the aperture. For the headlights of this problem,

$$\theta_R = \frac{1.22(550 \times 10^{-9} \text{ m})}{5.0 \times 10^{-3} \text{ m}} = 1.34 \times 10^{-4} \text{ rad} .$$

- (b) If L is the distance from the headlights to the eye when the headlights are just resolvable and D is the separation of the headlights, then $D = L\theta_R$, where the small angle approximation is made. This is valid for θ_R in radians. Thus,

$$L = \frac{D}{\theta_R} = \frac{1.4 \text{ m}}{1.34 \times 10^{-4} \text{ rad}} = 1.0 \times 10^4 \text{ m} = 10 \text{ km} .$$