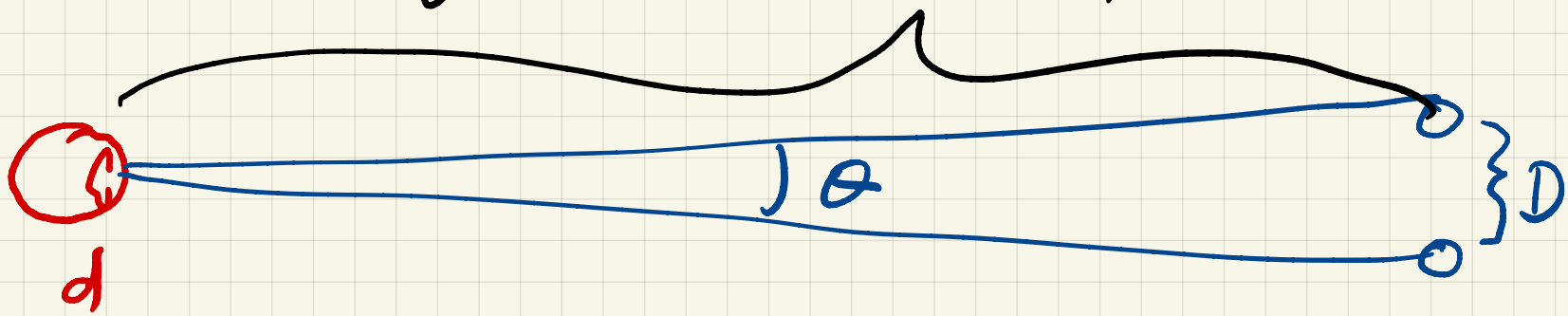
Example resolution problem

9/30/21

Assume a pair of blue lights moving toward your eye. If they are seperated by a distance D, at what distance L can you (your eye) resolve the 2 seperate lights. [assume pupil diameter of 3mm and n=1 for eye & air] [D = 2.44m]



small angle $\theta = \sin\theta = \tan\theta \approx \frac{D}{L}$

$\theta_R = \theta_{min} = 1.22 \frac{\lambda}{d}$

So $\frac{D}{L_{max}} = 1.22 \frac{\lambda}{d} \Rightarrow L_{max} = \frac{D\,d}{1.22\,\lambda}$

If $D = 2.44\ m$, $d = 3 \times 10^{-3}\ m$, $\lambda_{blue} = 450\ nm$

$$\Rightarrow L_{max} = \frac{2.44 \times 3 \times 10^{-3}}{1.22 \times 450 \times 10^{-9}} = \frac{2}{1.5} \times 10^{4} = 1.33 \times 10^{4}\ m$$

this is $\sim 13\ Km$

If light was red instead of blue

$\lambda_{Red} \sim 2\lambda_{blue}$ so $L_{max_{red}} \sim L_{max_{blue}}/2 \cong 6\ Km$